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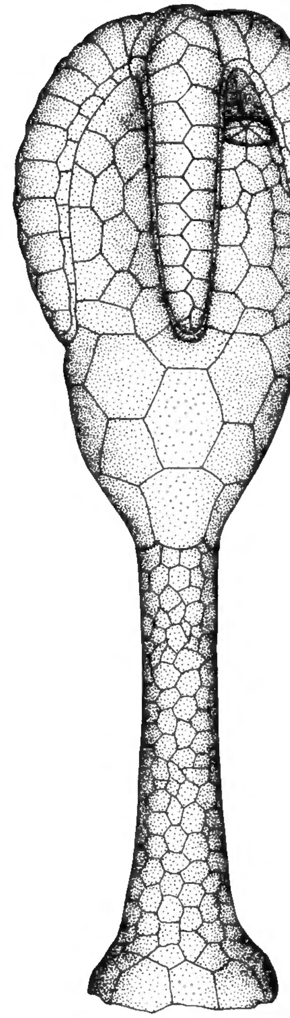

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MEMOIRS
OF THE
QUEENSLAND MUSEUM

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ANOPLOGNATHUS HILLERI SP. NOV. (COLEOPTERA: SCARABAEIDAE: RUTELINAE) FROM SOUTHEASTERN QUEENSLAND AND NOTES ON *A. FLINDERSENSIS* CARNE

P.G. ALLSOPP

Allsopp, P.G. 1990 08 31: *Anoplognathus hilleri* sp. nov. (Coleoptera: Scarabaeidae: Rutelinae) from southeastern Queensland and notes on *A. flindersensis* Carne. *Memoirs of the Queensland Museum* 28(2): 377-381. Brisbane. ISSN 0079-8835.

Anoplognathus hilleri is described from both sexes collected in Cooloola National Park, SEQ. The adpressed white setae on the dorsal surface, the general shape of the clypeus of both sexes and of the aedeagus, and the black spots on the elytra clearly place *A. hilleri* with the *A. velutinus* species-group. *A. hilleri* differs from both *A. velutinus* and *A. flindersensis* in the detailed shape of the aedeagus and in colour. A further specimen of *A. flindersensis* Carne is also noted. ☐ *Anoplognathus hilleri, Rutelinae, Scarabaeidae, Coleoptera.*

P.G. Allsopp, Bureau of Sugar Experiment Stations, PO Box 651, Bundaberg, Queensland 4670, Australia; 18 October, 1989.

Anoplognathus Leach was last revised by Carne (1957) who recognised 32 species. *A. antiquus* Arrow has since been transferred to *Trioplognathus* Ohaus (junior synonym of *T. griseopilosus* (Ohaus)) (Carne, 1958) and four further species have been described (Carne, 1981; Allsopp and Carne, 1986). Additional distribution records for *Anoplognathus* spp. were given by Carne (1958, 1981), Carne and Monteith (1971), Allsopp (1975, 1987), Monteith (1986), Allsopp and Lloyd (1987), and De Baar and Hockey (1987). The majority of species occur in coastal and subcoastal eastern Australia with only four species recorded from the arid interior. One species is known also from Papua New Guinea.

This paper describes a previously unknown species collected in southeastern Queensland and gives notes on a further specimen of *A. flindersensis* Carne. The following abbreviations are used for collections: AH = A. Hiller collection, Mt Glorious; ANIC = Australian National Insect Collection, Canberra; PGA = P.G. Allsopp collection, Bundaberg; QDPI = Queensland Department of Primary Industries, Brisbane; QM = Queensland Museum, Brisbane; RIS = R.I. Storey collection, Mareeba.

Anoplognathus Leach

Anoplognathus Leach, 1815, p. 43; Carne, 1957, p. 88, 1958, p. 181, 1981, p. 289; Allsopp and Carne, 1986, p. 99. Type species *Melolontha viridiaeneus* Donovan, 1805; designated by Carne, 1957, p. 93.

Paranonca Castelnau, 1840, p. 143; Lansberge, 1873, p. 86.

Anoplognathus hilleri sp. nov.
(Figs 4-8)

MATERIAL EXAMINED

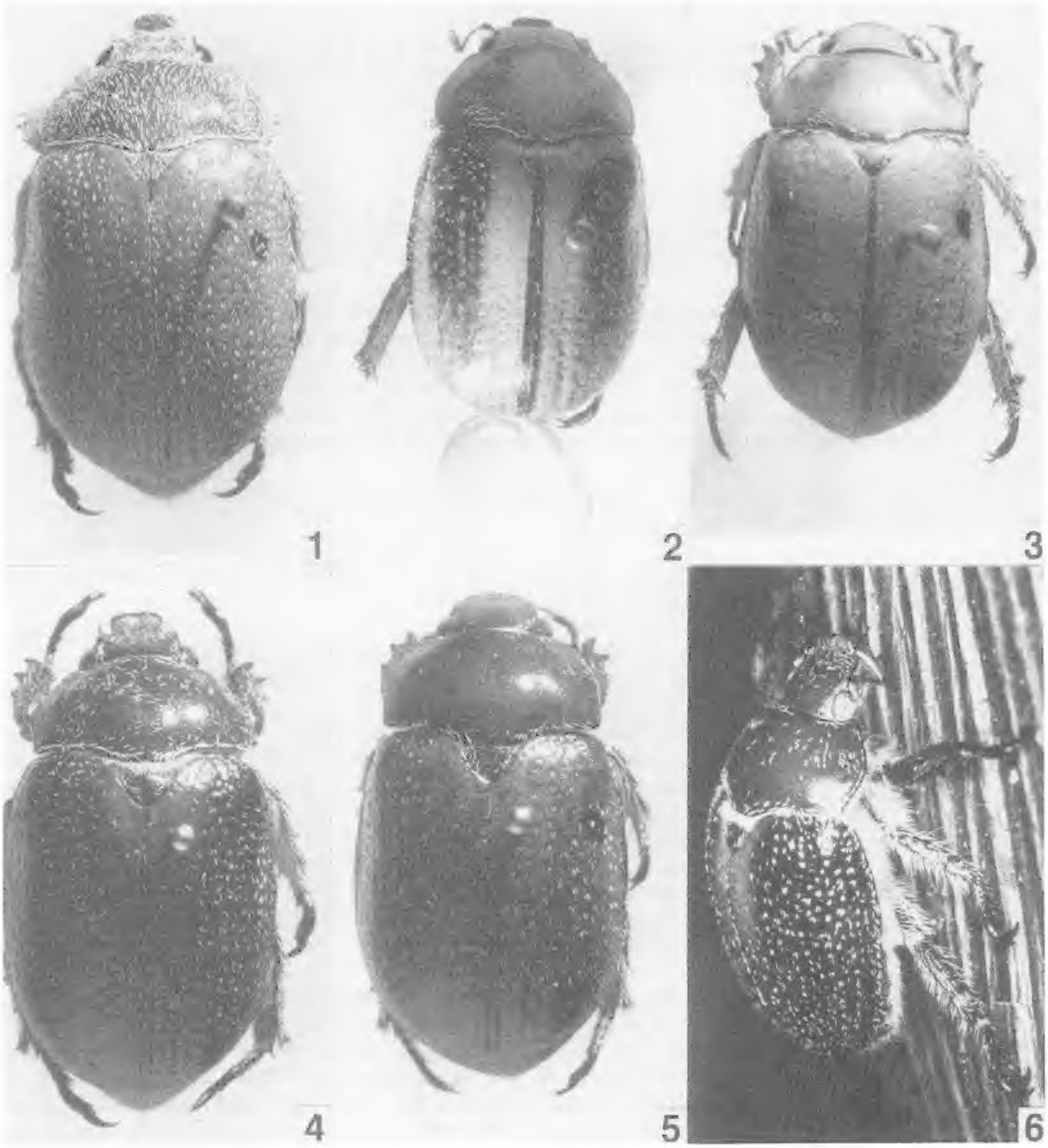
HOLOTYPE: QM T11289 ♂, Cooloola National Park, Queensland (153°5'E, 26°10'S), 15.ix.1988, A. and K. Hiller, to UV light.

PARATYPES: 2 ♂♂, same data as holotype; 14 ♂♂, 1 ♀, same data as holotype except 28.ix-1.x.1988; 1 ♂, Cooloola, 21.ix.1987, K. and T. Thomas; in AH, ANIC, PGA, QDPI, QM, RIS.

DESCRIPTION

Male: Total length 23.5-26.5 mm.

Head, pronotum, scutellum, pydigium, legs and ventral surface red-brown; elytra red-brown to nearly black with broad longitudinal band of yellow-brown either side of sutural interval but narrower and less defined towards apex (Figs 4,6), elytra in paler specimens red-brown; all adpressed setae white. Labrum triangular, apex rounded, surface densely punctate with long setae except scattered short setae on smoother apex. Clypeus with surface of anterior face with micropunctures and scattered long setae arising from larger punctures, anterior face 2.4 times as wide as deep; dorsal surface rugulose with flattened adpressed setae, anterior margin slightly convex, lateral margins parallel near base then sharply curved and tapering to reflexed anterior margin, 1.7 times as wide across base as mid length; clypeofrontal suture posteriorly sinuate

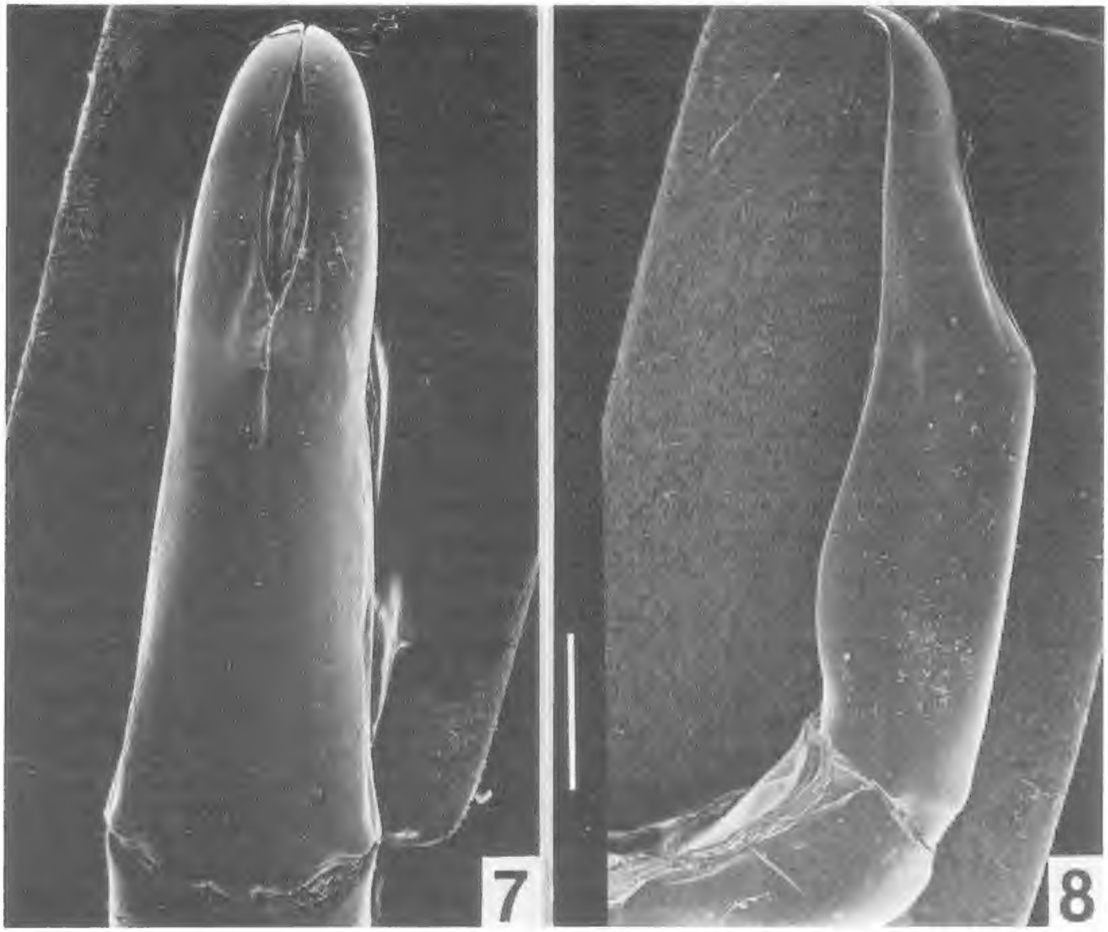


FIGS 1-6. Dorsal view of *Anoplognathus* spp. 1 - *A. velutinus*, ♂; 2 - *A. flindersensis*, holotype ♂; 3 - *A. flindersensis*, paratype ♀; 4 - *A. hilleri*, holotype ♂; 5 - *A. hilleri*, paratype ♀; 6 - *A. hilleri*, living ♂ (photo, A. Hiller).

in middle. Frons with large punctures becoming smaller posteriorly, some punctures with single flattened adpressed seta; ocular canthi with dense erect setae. Maxillary palps conspicuous, segment 3 longer than segments 1 and 2 combined, segment 3 with large longitudinal concavity on upper side. Antennae 10-segmented; club 3-segmented, 2.6 mm long and about as long as segments 2-7 combined. Labium with long dense setae near base, apex glabrous. Pronotum punctate with sparse irregularly-distributed adpressed setae, with faintly rugose impunctate median stripe; 1.6 times as long as wide; anterior and lateral margins defined by obvious ridges, posterior margin weakly bilobed in median third where ridge absent; anterior angles slightly obtuse, posterior angles distinctly obtuse; long setae arising from beneath posterior margin, denser and longer opposite scutellum. Scutellum with flattened adpressed setae, denser on lateral edges. Elytra with surface conspicuously punctate, coarsely rugose near apices, almost glabrous along sutural interval, elsewhere punctures with 1-7 adpressed setae (average 4 to 6); apices contiguous, sutures slightly produced with series of short sharp spinules; epipleurae only visible on posterior half, glabrous. Ventral surface with dense long erect white setae. Postcoxal prosternal process absent. Mesosternal process acute, slightly depressed away from body anteriorly, apex almost glabrous and level with hind margin of fore coxae. Fore tibiae broad, evenly tridentate with teeth at less than right angles to major axis, with white scales dorsally and fine reddish-brown setae on inner margins; mid and hind tibiae with mixture of scattered long reddish or white setae; hind tibial spurs separated by 2 large and 1 smaller ciliae. Ventrites 1-5 with dense white setae and scattered longer white setae; sternite 6 with reduced vestiture, almost bare in middle, slender pale yellow setae across median third of posterior margin. Pygidium finely rugulose, with uniform coating of white setae, longer erect pale yellow setae near posterior margin; posterior margin with continuous ridge, slightly truncated in middle. Aedeagus similar to that of *A. velutinus* Boisduval and *A. flindersensis* Carne but with a more rounded nodule about halfway along outer edge (Figs 7-8).

Female (Fig. 5): Total length 26 mm.

Head, pronotum, scutellum, pygidium, legs



FIGS 7-8. *Anoplognathus hilleri* ♂, parameres. Scale line = 1 mm.

and ventral surface red-brown, pronotum with faint dark spot near mid lateral margin; elytra dark yellow-brown with black spot posterior to humerus. Dorsal surface of clypeus more finely punctate, glabrous, anterior margin almost straight, only very slightly reflexed, lateral margins convex, 2.1 times as wide across base as mid length. Frons more finely punctate, glabrous except for few adpressed setae across base. Antennal club 2.0 mm long. Pronotum with few adpressed setae, mainly on posterior margin. Otherwise as male.

COMMENTS

The species is named after Anthony Hiller of Mt Glorious who went to great lengths to obtain the two series.

The adpressed white setae on the dorsal surface, the general shape of the clypeus of both sexes and of the aedeagus, and the black spots on the elytra clearly place *A. hilleri* with the *A. velutinus* species-group (Carne, 1957). *A. hilleri* differs from both *A. velutinus* and *A. flindersensis* in the detailed shape of the aedeagus (Figs 7-8) and in colour (Figs 1-6).

A. hilleri keys to *A. velutinus* in Carne's (1957) key. It and *A. flindersensis* can be incorporated into the key by deleting couplet 2 and inserting the following:

2(1). Dorsal surface of body with adpressed white scales (*velutinus* species-group)................2a

Dorsal surface of body lacking adpressed white scales..3

2a(2). Head and pronotum red-brown, pronotum of males without black spots near lateral margins; elytra of males red-brown to nearly black with broad longitudinal band of yellow-brown either side of sutural interval, in pale specimens no indication of black humeral spot; southeastern Queensland...............................*hilleri* Allsopp

Head and pronotum yellowish-brown, pronotum with black spot near each lateral margin; elytra of males with black humeral spot or longitudinal brownish-black streak extending from anterior margins and becoming progressively paler...2b

2b(2a). Elytral punctures with 1-12 scales (average 5-6); elytra of both sexes with black humeral spot; southeastern Australia........................ ....*velutinus* Boisduval

Elytral punctures with 0-3 scales; elytra of males with longitudinal brownish-black streak extending from anterior margins and becoming progressively paler; Flinders Ranges, South Australia..........................*flindersensis* Carne

The two series were taken in a sandy, dry area with low shrubs and 3-4 *Eucalyptus* spp. and *Casuarina* sp. as overstorey but bordering a *Gahnia* (swordgrass) swamp of at least 0.5 ha. The surrounding eucalypts were searched during the day following the capture of each of the series in an attempt to locate feeding trees but no beetles or evidence of feeding were seen. When collected all specimens had no food in their guts and the female had apparently laid all her eggs. This indicates that the species flies in early September. This early flight period appears characteristic of the *velutinus* species-group; *A. velutinus* is known from September in south Queensland (Carne, 1957) and *A. flindersensis* from mid-October in South Australia (Carne, 1981). Most other *Anoplognathus* spp. fly during summer.

The three species of the *velutinus* species-group have allopatric distributions (*A. hilleri* occurs north of the known northern limit of *A. velutinus* at Caloundra (Carne, 1957)).

Anoplognathus flindersensis Carne

(Figs 2-3)

Anoplognathus flindersensis Carne, 1981, p. 290.

ADDITIONAL MATERIAL EXAMINED

South Australia: 1♂, Angorichina Hostel, 7 km E of Parachilna, 23.x.1978, E.B. Britton, in ANIC.

COMMENTS

A. flindersensis was described from Wilpena Pound in the Flinders Ranges. This new specimen comes from the western edge of the Flinders Ranges, *c.* 50 km NNW of the type locality. The black elytral streak is not as well defined as in males of the type series, but there is a well-defined black humeral spot.

ACKNOWLEDGEMENTS

I thank Anthony Hiller for access to the specimens and for the photograph of a living specimen (Fig. 6); Phil Campbell for the SEM illustration; and Geoff Monteith for assistance with the layout of the figure.

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TWO NEW SPECIES OF *TRICHOTICHNUS* MORAWITZ FROM NORTH QUEENSLAND (COLEOPTERA: CARABIDAE: HARPALINAE)

MARTIN BAEHR

Baehr, M. 1990 08 31: Two new species of *Trichotichnus* Morawitz from north Queensland (Coleoptera: Carabidae: Harpalinae). *Memoirs of the Queensland Museum* **28**(2): 383-388. Brisbane. ISSN 0079-8835.

Two new species of *Trichotichnus* are described from north Queensland: *T. storeyi* sp. nov. and *T. tolgae* sp. nov. Also new records of *T. straneoi* (Louwerens) from north Queensland are communicated. A key is given to all known Australian *Trichotichnus*.
Zwei neue *Trichotichnus*-Arten aus Nordqueensland werden beschrieben: *T. storeyi* sp. nov. und *T. tolgae* sp. nov. Außerdem werden weitere Funde von *T. straneoi* (Louwerens) mitgeteilt. Für alle australischen *Trichotichnus*-Arten wird ein Bestimmungsschlüssel gegeben. ☐*Coleoptera, Carabidae, Harpalinae, Trichotichnus, new species, Queensland.*

Martin Baehr, Zoologische Staatssammlung, Münchhausenstraße. 21, D-8000, München 60, West Germany; 14 January, 1989.

Trichotichnus is a genus of Holarctic-Oriental ground beetles that are especially common in the eastern Palearctic Region but also rather numerous as far south as New Guinea (Darlington, 1968). Till recently this genus was unrecorded from Australia (Darlington, 1968; Noonan, 1985) but it has since been discovered in northeastern Queensland (Baehr, 1983, 1985) where a widespread Oriental and an endemic Australian species are now known.

In Australia, as well as in New Guinea, *Trichotichnus* are mainly collected at light traps. Single specimens have been found in rain forest litter, which is presumably the true habitat of most Indoaustralian *Trichotichnus*.

The two new species described in this paper were taken at light traps, together with three further specimens of *T. straneoi* (Louwerens). They were received courtesy of Mr R.I. Storey (Mareeba). They were collected at different localities on the Atherton Tableland and the Windsor Tableland between Mossman and Cooktown. These are areas of upland rainforest.

Neither of the new species match any of the described New Guinean or Australian forms. However, both are vaguely associated with different species-groups or subgenera of Noonan (1985).

Abbreviations for collections are CBM, Collection of M. Baehr, München; DPIM, Department of Primary Industries, Mareeba; and QMB, Queensland Museum, Brisbane. Measurements were made using an ocular micrometer. Length was measured from apex of labrum to apex of elytra. Hence measurements can slightly differ

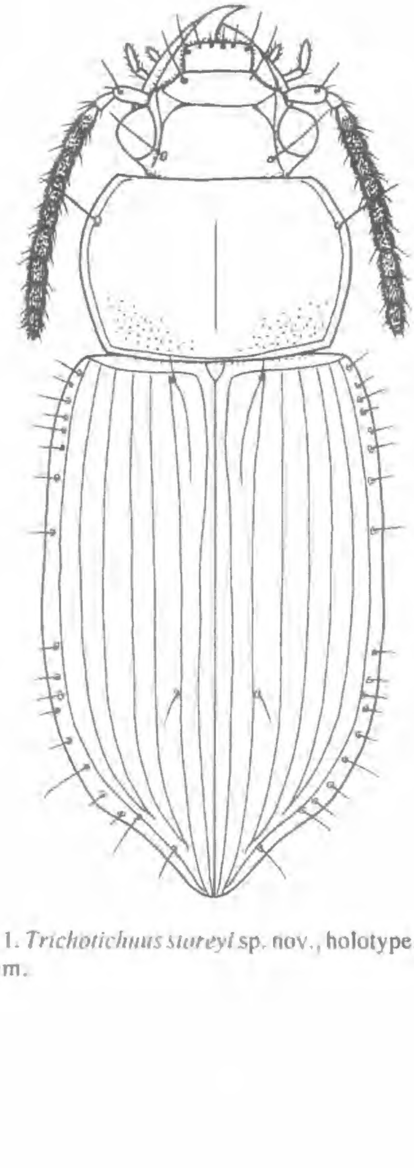


FIG. 1. *Trichotichnus storeyi* sp. nov., holotype. Scale: 5mm.

from those of other authors, especially Darlington (1968).

Trichotichnus straneoi (Louwerens)
(Fig.8)

Carbanus straneoi Louwerens, 1962, p. 142, fig. 7.
Trichotichnus straneoi Darlington 1968, p. 50; Noonan 1985, p. 67; Baehr 1985, p. 21.

MATERIAL EXAMINED

NEW RECORDS: 1♂, Windsor Tableland, Qld, 29-30.XII.1984, at light, R.I. Storey (DPIM); 1♀, Tolga, Qld, 22.VIII.1986, light trap, J.D. Brown (CBM); 1♀, Tully Falls, SF 730m, 18km SSW Ravenshoe, Qld, 18.I.1988, light, Storey and Dickinson (DPIM).

REMARKS

This species was recently included in the subgenus *Trichotichnus s. str.* by Noonan (1985). It is known from Amboina, New Guinea, New Britain, and New Ireland (Darlington, 1968) and was recently recorded from north Queensland (Baehr, 1985). The new records indicate that this species is rather widely distributed and common in the tablelands of northeastern Queensland. It lives in leaf litter in rainforest (Baehr, 1985). However, the best collecting method seems to be lighting; all three of the records are from light traps.

Trichotichnus storeyi sp. nov.
(Figs 1,3,5,7,8)

MATERIAL EXAMINED

HOLOTYPE: ♂, Australia, NQ, Tully Falls SF 730m, 18km SSW Ravenshoe, 18.I.1988, light, Storey and Dickinson (QMB T.11327).

PARATYPES: 1♂, 1♀, same data, ♀ labelled: *Trichotichnus demarzi* Baehr, det. R.I. Storey 1988 (DPIM, CBM).

TYPE LOCALITY

Tully Falls, Atherton Tableland, NQ.

DIAGNOSIS

Easily recognised by yellow border of pronotum, elytra, and abdomen and by wide posterior angles of pronotum.

DESCRIPTION

Measurements: Length: 7.9-8.2mm, width: 3.3-3.4mm. Width of head/pronotum: 0.78-0.8. Width/length of pronotum: 1.49-1.53. Width of base/apex of pronotum: 1.18-1.2. Width of pronotum/elytra: 0.76-0.78. Length/width of elytra: 1.55-1.58.

Colour: Black with slight metallic lustre. Lateral border of pronotum narrowly yellow. Two outer intervals of elytra yellow, this yellow border widened at apex almost to suture. Lower surface black, lateral parts of thorax brown with scattered yellow spots, abdominal segments with a lateral and a sublateral yellow spot each, brown between, apex of last segment yellow. Labrum brownish, antennae dark yellow, with 2nd and 3rd segments piceous and terminal segments becoming gradually lighter. Each segment with a distinct dark median stripe on inner and outer

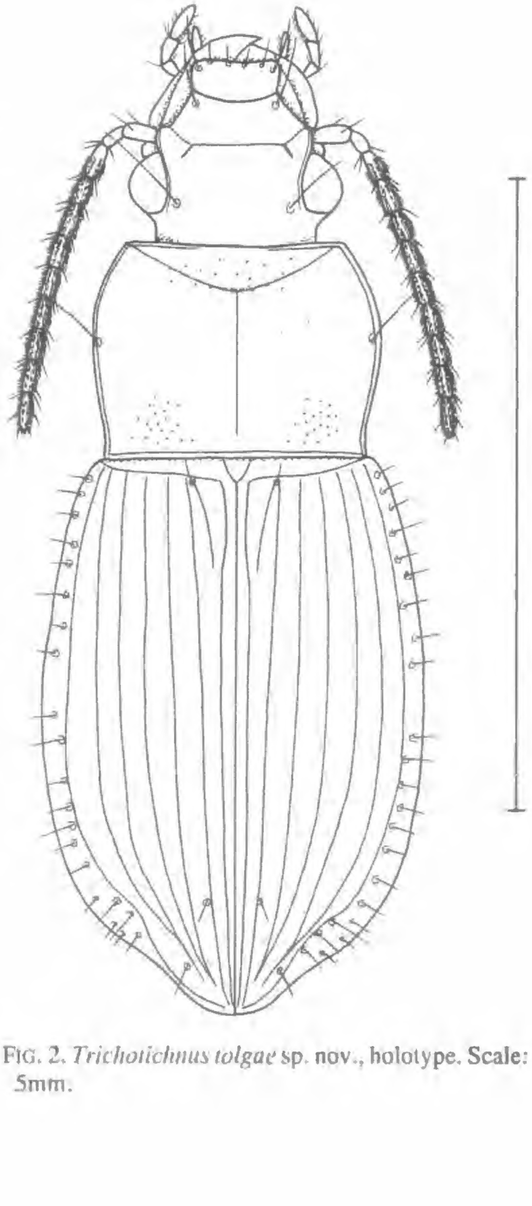
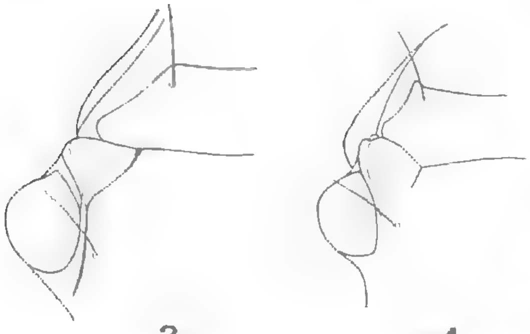


FIG. 2. *Trichotichnus tolgae* sp. nov., holotype. Scale: 5mm.



FIGS 3,4. Clypeo-ocular sulcus. 3. *Trichotichnus storeyi* sp. nov.; 4. *Trichotichnus tolgae* sp. nov.

surface. Palpi lighter brown. Femora yellow, tibia yellow at base, infuscate to apex, considerably darker than femora. Tarsi infuscate.

Head: Large, with large, rather protruding eyes. Orbits short. Eyes separated from mouth by *c*.1/6 of eye diameter. Clypeal suture deep. Clypeo-orbital sulcus distinct, elongate, almost attaining eye, though not prolonged inside eye. Clypeus with one seta each, labrum 6-setose. Antennae short, barely surpassing base of pronotum. Median segments wide, square, almost as wide as long. 3rd segment pilose from middle. Last and fore-last segments of palpi finely setose. Labium with elongate, unidentate tooth. Microsculpture of upper surface inconspicuous.

Pronotum: Considerably wider than head, *c*.1.5 times wide as long, widest shortly behind position of lateral seta. Apex very lightly excised, anterior angles rounded off, not projecting. Lateral borders anteriorly convex, behind middle almost straight. Posterior angles wide, obtuse, base laterally rather oblique. Base distinctly bordered laterally, medially smooth. Median line well impressed, neither attaining apex nor base. Basal grooves shallow, slightly linear. Base laterally punctate, rather smooth in middle. Microsculpture indistinct, rather irregular.

Elytra: Rather parallel, short, lateral borders well sinuate in front of apex. Shoulder rounded off. Striae fine, impunctate, intervals slightly convex, especially near apex. Setiferous puncture adjacent to 2nd stria, approximately at posterior 2/3 of elytra. Microsculpture of intervals consisting of very indistinct transverse lines. Intervals also with fine punctures, rather glossy, winged.

Lower surface: Prosternum, metasternum, and base of abdomen with fine, rather dense pilosity. Pilosity on 4th-6th abdominal sternites extremely short and fine, difficult to see. Lower surface shagreened. Last abdominal sternite laterally slightly excised. ♂ and ♀ with 4 setae at apex of last sternite.

Legs: Anterior tibia not much widened at apex. ♂ anterior and median tarsi biseriately squamose beneath. 1st segment of metatarsus rather short, considerably shorter than 2nd and 3rd segments together.

Male genitalia: Aedeagus elongate, narrow, basally strongly curved. Apex with minute upturned denticle. Internal sac and parameres see Fig. 7.

Variation: There is little variation among the few specimens available.

DISTRIBUTION

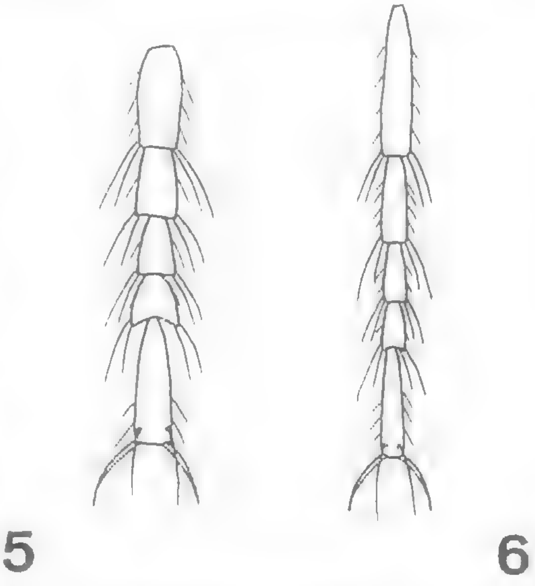
Known only from type locality in southern Atherton Tableland, NEQ.

HABITAT

Not known, but perhaps lives in rainforest litter. This is apparently an upland rainforest species.

RELATIONSHIPS

It is difficult to assign *T. storeyi* to any of the currently distinguished subgenera of Noonan (1985), because it is somewhat intermediate be-



FIGS 5,6. Posterior tarsus. 5. *Trichotichnus storeyi* sp. nov.; 6. *Trichotichnus tolgae* sp. nov.

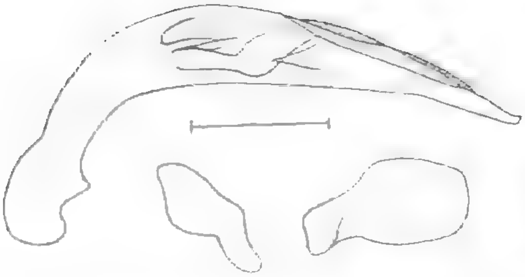


FIG. 7. ♂ genitalia of *Trichotichnus storeyi* sp. nov. Scale: 0.5mm.

tween *Trichotichnus s. str.* and *Harpaloxenus* Schauberger. It has the apex of anterior tibia not conspicuously widened, but has at the same time the lower surface of the thorax and abdomen strongly mottled, which is only ascribed to members of subgenus *Harpaloxenus* (Noonan, 1985). From descriptions, *T. storeyi* seems next to *T. brandti* Darlington and *T. obscurus* Darlington, respectively, both from New Guinea. However, it is slightly smaller than both species and is further distinguished by slightly wider pronotum with lateral borders not at all sinuose, and by wide, conspicuous, yellow, lateral border of elytra.

Trichotichnus tolgae sp. nov.
(Figs 2,4,6,8)

MATERIAL EXAMINED

HOLOTYPE: ♀, Australia, NQ, Tolga, 3.XI.1985, J.D. Brown, light trap (QMB T.11326).

TYPE LOCALITY

Tolga, 5km N Atherton, Atherton Tableland, NEQ.

DIAGNOSIS

Distinguished by lack of dorsal and ventral pattern and by convex pronotum with short, but accentuate prebasal sinuosity.

DESCRIPTION

Measurements: Length: *c*.7.5mm, width: *c*.3.2mm. Width of head/pronotum: 0.7. Width/length or pronotum: 1.39. Width of base/apex of pronotum: 1.27. Width of pronotum/elytra: 0.76. Length/width of elytra: *c*.1.45.

Colour: Piceous, rather glossy. 1st antennal segment dark yellow, following segments slightly darker, terminal segments yellow again. Median segments with inconspicuous dark stripe on inner and outer surface. Palpi dirty yellow. Legs reddish, apex of tibia and tarsi slightly darker. Ventral surface piceous.

Head: Almost as wide as apex of pronotum. Eyes large, protruding. Orbits distinct, oblique. Eyes separated from mouth by *c*.1/5 of diameter of eye. Clypeal suture deep. Clypeo-orbital sulcus deep, rather short, almost punctiform, not attaining eye, not prolonged inside median border of eye. Clypeus with one seta each, labrum 6-setose. Antennae medium-sized, attaining base of pronotum. Median segments almost twice as long as wide. 3rd segment pilose from middle. Last and fore-last segments of palpi sparsely setose. Labium with a short, triangular tooth. Microsculpture of upper surface fine, though distinct, consisting of rather regular, slightly transverse meshes.

Pronotum: Convex, rather narrow, with wide base. Apex straight, but anterior angles slightly produced. Lateral borders convex throughout, though with a short, distinct sinuation just in front of the rectangular posterior angles. Base almost straight. Pronotum widest at position of lateral setae, slightly in front of middle. Median line superficial, neither reaching apex nor base. Base strongly bordered, also in middle. Basal grooves shallow, circular. Base with very scattered punctures, laterally of basal grooves rather smooth. Medially behind apex also with some punctures. Surface glossy, but with fine, regular, slightly transverse microsculpture.

Elytra: Rather short and wide, slightly widened behind middle. Shoulders rounded. Lateral borders well sinuate in front of apex. Striae smooth, quite deep. Intervals convex throughout, near apex strongly convex. Setiferous puncture in middle of 3rd interval, though nearer to 2nd stria, far down on apical declivity, at approximately last 1/6 of elytra. Microsculpture distinct, composed of slightly transverse, regular meshes. No additional punctures visible. Winged.

Lower surface: Prosternum, metasternum, and basal abdominal segment medially with short pubescence. Other abdominal segments virtually smooth. Lower surface finely microreticulate. Last abdominal sternite laterally not excised, in ♀ 4-setose.

Legs: Anterior tibia not widened at apex. Clothure of anterior and median tarsi of ♂ unknown. 1st segment of metatarsus elongate, approximately as long as 2nd and 3rd segments together.

Male genitalia: Unknown.

DISTRIBUTION

Known only from type locality in Atherton Tableland, NEQ.

HABITAT

Unknown. The type was collected at light. It probably lives in rainforest litter.

RELATIONSHIPS

Unknown. *T. tolgae* belongs to subgenus *Trichotichnus* s. str., though it is a rather atypical species. There is no obvious relationship to anyone of the New Guinean species included in Darlington's (1968) key. Using this key, *T. tolgae* comes to *T. medius* Darlington which is, however, not closely related to *T. tolgae*. As long as the ♂ genitalia and tarsal vestiture is unknown, the relationships will be obscure.

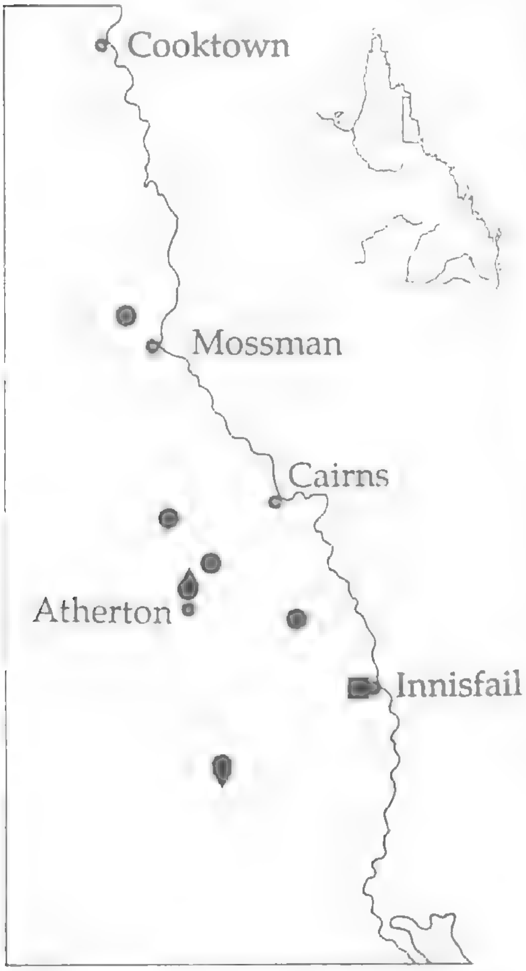


FIG. 8. Distribution of the Australian *Trichotichnus*-species: ●*Trichotichnus straneoi* (Louwerens); ■*Trichotichnus demarzi* Baehr; ▼*Trichotichnus storeyi* sp. nov.; ▲*Trichotichnus tolgae* sp. nov.

DISCUSSION

With the two species described here, four *Trichotichnus* species are now known to occur in northeastern Queensland, all in or near the uplands of Atherton Tableland and Windsor Tableland. All species seem to live in leaf litter of mountain rainforest (Baehr, 1983, 1985) which is the same mode of life that several of the New Guinean species apparently have (Darlington, 1968). The four Australian species belong to different species groups and they are perhaps more closely related to certain New Guinean species than one to another. As was to be expected from the high species diversity in New Guinea, northeastern Australia also has quite a diverse *Trichotichnus* fauna. Certainly the four species are outliers of the northern, Oriental fauna from which many members have dispersed to northern Queensland, mainly via New Guinea and Cape York Peninsula (Darlington, 1961, 1971; Kikkawa, Monteith and Ingram 1981). This means that north Queensland was subject to several independent invasions of different *Trichotichnus* stocks, the most recent apparently being that of *T. straneoi* which has conspecific populations in Australia, New Guinea and much of Melanesia. It is to be expected that future collecting in the upland rainforests of northern Queensland will result in the discovery of yet more *Trichotichnus*.

KEY TO THE AUSTRALIAN SPECIES OF *TRICHOTICHNUS*

1. Prothorax wide with strongly convex sides, head only 2/3 as wide as prothorax. Surface of elytra strongly iridescent. Small species, less than 6.5mm long .... *T. straneoi* (Louwerens)

Prothorax less wide, sides posteriorly rather straight or even sinuate, head almost 3/4 as wide as prothorax. Elytra not or only slightly iridescent. Larger species, always over 7mm long.. 2

2. Pronotum and elytra distinctly bordered with yellow. Abdomen with lateral yellow border and sublateral yellow spots. Sides of pronotum near

base convex, posterior angles wide, because lateral parts of base clearly oblique .... *T. storeyi* sp. nov.

Pronotum at most inconspicuously bordered with yellow. Abdomen with lateral yellow border or spots or not, but without sublateral spots. Sides of pronotum posteriorly straight or even slightly concave. Posterior angles less wide, base straight 3

3. Larger species, 9mm long or longer. Clypeo-ocular sulcus prolonged as a furrow inside eyes. Abdominal segments with large, yellow, lateral spots. Femora conspicuously lighter than tibiae. Pronotum heart-shaped, widest well in front of middle, sides near base straight .... *T. demarzi* Baehr

Smaller species. *c.*7.5mm long. Clypeo-ocular sulcus not prolonged inside eye. Abdomen without yellow spots. Femora not conspicuously lighter than tibiae. Pronotum widest approximately at middle, sides posteriorly convex, but shortly sinuate just in front of posterior angles .... *T. tolgae* sp. nov.

ACKNOWLEDGEMENTS

I want to express my thanks to Mr R.I. Storey (DPIM, Mareeba) who kindly offered the specimens for examination.

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HYSTEROTHYLACIUM WARD AND MAGATH, 1917, AND *ICHTHYASCARIS* WU, 1949, ASCARIDOID NEMATODES FROM AUSTRALIAN DEMERSAL FISHES

NIEL L. BRUCE

Bruce, N.L. 1990 08 31: *Hysterothylacium* Ward and Magath, 1917 ,and *Ichthyascaris* Wu, 1949, ascaridoid nematodes from Australian demersal fishes. *Memoirs of the Queensland Museum* 28(2): 389-426.Brisbane. ISSN 0079-8835.

Genera and species of ascaridoid nematodes are recorded from Australian demersal marine fishes. *Ichthyascaris* Wu is redefined with two new species and the following new combinations: *I. fisheri* (Hooper), *I. vicentei* (Santos), *I. lutjani* (Olsen), *I. mediterraneus* (Lèbre and Petter), *I. chirocentri* (Yamaguti) and *I. biwakoensis* (Fujita). *Ichthyascaris* lacks flanged lips, any trace of interlabia and intestinal caecum; the excretory system is posteriorly unilateral and filamentar. Descriptions are given for the following species: *Hysterothylacium leptaspi* n. sp., *Hysterothylacium chrysostomi* n. sp., *H. sebae* n. sp., *H. tasmaniense* (Johnston and Mawson), *H. thalassini* n. sp., *H. zenis* (Baylis), *Ichthyascaris gymnocraniae* n. sp. and *I. sillagoides* n. sp. Notes are given on an unidentified species of *Goezia* from *Arius thalassinus*. ☐ *Nematoda, Ascaridoidea, taxonomy, fish parasites, Indo-West Pacific.*

Niel L. Bruce, Queensland Museum, PO Box 300, South Brisbane, Queensland 4101, Australia; 27 June, 1989.

A brief review of ascaridoid nematodes from Australian marine fishes was given by Bruce and Cannon (1989) recording ascaridoids from Australian pelagic marine fishes. This present work records ascaridoids from demersal and euryhaline fishes. The species treated here include only those species that were represented by adult specimens in good or reasonable condition. Material examined prior to preparation of this work included species of *Hysterothylacium* and *Ichthyascaris* from a further 10 host species. Clearly the number of species presently recorded from Australia is but a fraction of the potential total.

MATERIAL AND METHODS

The following demersal fish (or fish stomachs) were examined and, except for those reported in the species description, proved negative for adult ascaridoids. The number in parentheses is the total number of specimens examined. Fish totals of less than 4 are not represented individually.

From the Rockhampton coast and central section Great Barrier Reef, 7 species in total. Serranidae: *Plectropoma leopardus* (13); Lutjanidae: *Lutjanus malabaricus* (10) and *L. sebae* (10).

From Heron Island and Wistari Reefs, Capricorn Group, southern Great Barrier Reef, 22 species. Serranidae, 7 species including *Plectropomus leopardus* (16), *Epinephilus fasciatus* (6) and *E. merra* (5); Lutjanidae, 3 species including *Lutjanus carponotatus* (9); Lethrinidae, *Lethrinus chrysostomus* (30), *L. nebulosus* (4) and *Gymnocranius bitorquatus* (34); Labridae, *Choerodon venustus* (26) and *C. albigena* (6).

From southeastern Queensland (Moreton Bay region) *Platycephalus fuscus* (28), *Sillago maculata* (60), *Pomatomus saltator* (34) and *Acanthopagrus australis* (20).

Names are from Grant (1987) and Hutchins and Swainston (1986).

Materials and methods are the same as used and detailed by Bruce and Cannon (1989). Measurements are given in micrometres except where otherwise indicated. Measurements in millimetres were made under binocular microscope, those in micrometres under a compound microscope.

Abbreviations used in the text: AHC - Australian Helminth Collection, at the South Australian Museum; BL - Body length; BM(NH) - -British Museum (Natural History), London; CSIRO - Commonwealth Scientific and Industrial Research Organisation; ED - Ejaculatory duct; QM - Queensland Museum; SAM - South Australian Museum, Adelaide.

Goezia Zeder

The genus *Goezia* has been rediagnosed by Sprent (1978a) and more recently by Deardorff and Overstreet (1980). In both diagnoses the lack of interlabia is a character, among others, of generic significance. To date no species of this genus that has been illustrated has shown any trace of interlabia or semi-interlabia (see 'Remarks' for *Raphidascaroides* for discussion of interlabial structures). The lack of interlabia is clearly illustrated by the SEM's of Sprent (1978a) and Lèbre and Petter (1983).

It is of some interest, therefore, to record a species of *Goezia* (or an undescribed genus closely allied to *Goezia*) from *Arius thalassinus* trawled by CSIRO in the Gulf of Carpentaria at Weipa. These samples include one that has a large mature male (31.7 mm long by 1.5 mm wide) and 2 large females (the largest measuring 50.0 mm long by 2.7 mm wide). These specimens (QM G10286) are in very poor condition and cannot be used for description. The remaining two samples (QM GL10250, GL10285) contain immature specimens (10.7-18.0 mm). All have distinct pseudo- or sessile interlabia (Fig. 1). Additionally the serrations (or cuticular spine rows) fade away completely towards the tail in 2 specimens, and are very weak in the caudal region of the third. These are large worms compared to others of the genus, which measure as adults from under 3 mm to about 25 mm.

Hysterothylacium Ward and Magath

Bruce and Cannon (1989) described those species of the genus to be found is Australian pelagic and oceanic fishes. A further 5 species are recorded here, all from demersal or estuarine hosts. The diagnosis given by Deardorff and

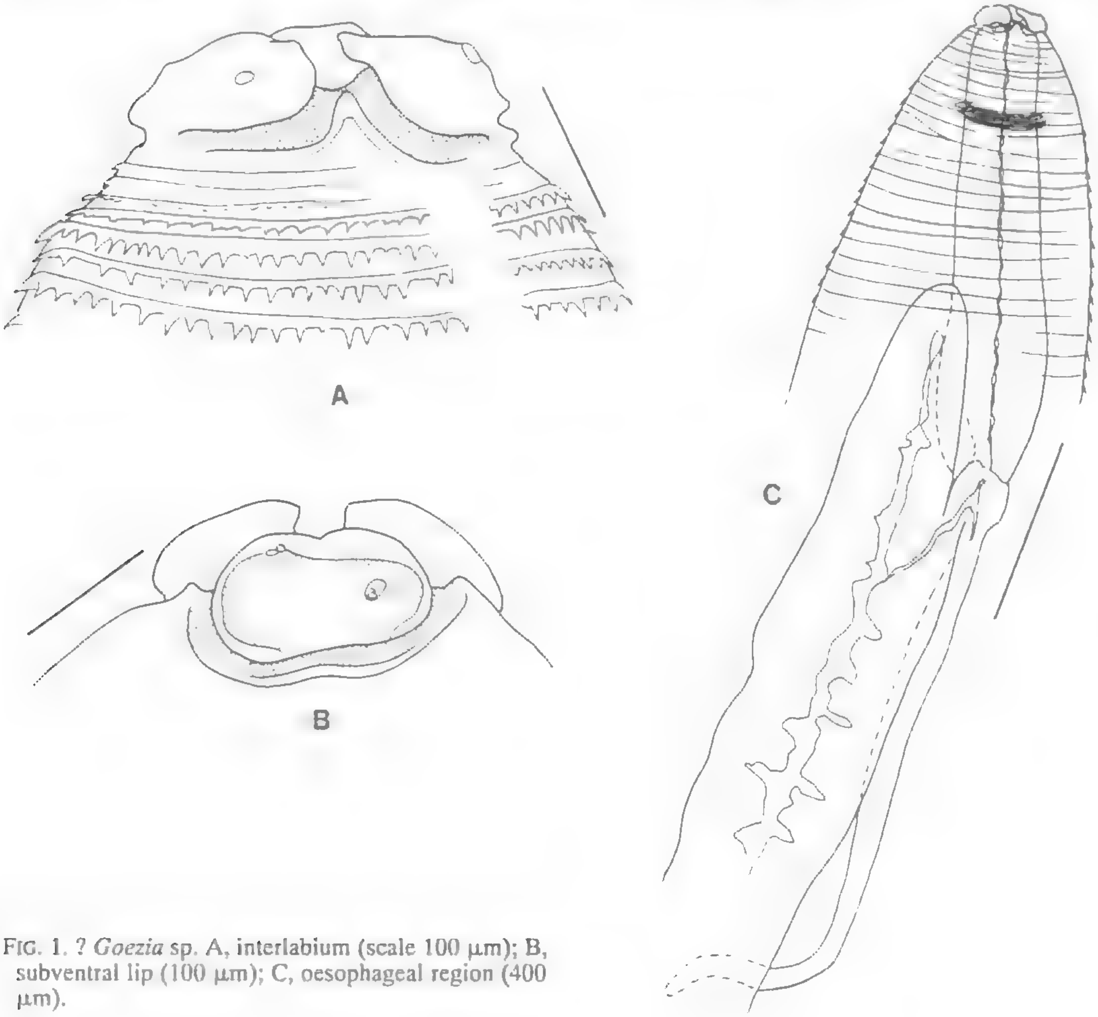


FIG. 1. ? *Goezia* sp. A, interlabium (scale 100 μm); B, subventral lip (100 μm); C, oesophageal region (400 μm).

Overstreet (1981) is not in need of modification at present. *Hysterothylacium* is the largest of the ascaridoid genera, and considerable variation is present with regard to tail morphology, the excretory system, and presence or absence of alae. It is still necessary that further species be described and that a detailed description of the type species be available before a critical analysis of the genus can be given.

Hysterothylacium leptaspi n. sp.
(Figs 2-4)

MATERIAL EXAMINED

All from Embley Estuary, Weipa, Gulf of Carpentaria, Q., from stomachs of *Arius leptaspis*, coll. CSIRO. 10 males, 11 females, Heinemann's Creek, middle reaches of Embley Estuary, 20 Feb. 1987 (male HOLOTYPE QM GL10244, PARATYPES QM GL10245). 18 males, 7 females, same data as above (QM GL10246, QM GL10247, AHC 18813).

Also examined: 2 females, lower reaches of estuary, 15 and 23 Feb. 1987, *Arius thalassinus*, coll. CSIRO (QM GL10248, GL 10249).

TYPE LOCALITY

Embley Estuary, Weipa, Q., ca 12°13.5'S. 144°57.0'E.

TYPE HOST

Arius leptaspis (Bleeker), Ariidae.

DIAGNOSIS

Cuticle finely annulated, appearing smooth under light microscopy; posteriorly with transverse folds. Lips with length to width ratio 1: 0.93-1.45 (mean = 1.02, n = 15) with deep postlabial grooves; constricted about one third length from anterior. Alae absent. Caudal papillae pairs: precloacal 40-58 in an irregular row; paracloacal 2 pairs; postcloacal 4-5 pairs, usually without doubled papillae; medioventral precloacal organ present. Spicules approximately equal in length, 1:1.03-1.10, 3.64-5.74% BL. Tail short, with finely nodulose conical lip.

DESCRIPTION

Based on 6 mature males and 8 mature females.

General. Body reaching greatest width about mid-body. Dorsal lip slightly smaller than subventrals, about as long as wide; flanges positioned about half way along lip, small and triangular, lateral constriction weakly developed. Interlabia prominent, extending anterior to oesophagus; about half-length of lip, medially expanded. Oesophagus 7.63-10.59% BL. Ventriculus usually narrower than widest level of oesophagus, longer than wide; posteriorly narrowing gradually to ventricular appendix. Ventricular appendix very slender, (difficult to observe without dissection) 104.3-261.0% length of oesophagus. Cervical papillae conspicuous, near nerve ring. Nerve ring lying between anterior 15.0-18.3% of oesophagus. Excretory system H-shaped, anteriorly and posteriorly bilateral, with excretory nucleus about half way between nerve ring and ventriculus; excretory pore immediately posterior to nerve ring.

Male. Body 27.5-54.2 mm long, 517-1109 maximum width; width at oesophageo-intestinal junction 414-790; ratio of greatest width to length 1: 45.9-60.7 (mean = 50.51). Dorsal lip 174-202 long, 179-188 wide (2 specimens); subventral lips 221-244 long, 216-273 wide (3 specimens). Nerve ring 498-846 from anterior. Excretory pore 611-893 from anterior (3 specimens). Oesophagus 2914-4418 long by 150-244 wide. Ventriculus 141-259 long by 89-165 wide; ventricular appendix 3948-10058 long by 47-108 wide. Intestinal caecum 1692-2914 long by 169-188 wide; 58.1-75.6% (mean = 65.7%) oesophageal length (3 specimens). Ejaculatory duct 1880-2350 long, 3.6-5.0% BL. Spicules 1222-2820 long, 112.1-150.0% ED (3 specimens). Caudal papillae pairs 49-66, changing from button to mamillate at about 6th anterior to cloaca. Post cloacal pad absent. Tail 118-188 long, ventrally flexed.

Female. Body 48.3-66.8 mm long, 1034-1410 maximum width; width at oesophageo-intestinal junction 470-931; ratio of greatest width to length 1: 45.0-54.7 (mean = 41.22). Dorsal lip 221-230 long by 216-273 wide (3 specimens); subventral lips 226-244 long by 212-282 wide. Nerve ring 658-846 from anterior. Excretory pore 952-912 from anterior. Oesophagus 3666-5640 long by 216-310 wide. Ventriculus 188-376 long by 197-329 wide (3 specimens); ventricular appendix 5734-8930 long by 113-179 wide (3 specimens). Intestinal caecum 1974-3666 long by 235-282 wide; 51.9-65.0% (mean = 57.5) oesophageal length. Vulva opening 21.7- 30.0 mm or 32.4-48.0% BL from anterior; vulva area not swollen. Vagina 5.60-8.84 mm (3 specimens); uterus undivided for 5.84-10.0 mm, divided for further 6.18-7.10 mm. Tail 335-536 long.

Variation. Several minor variations were

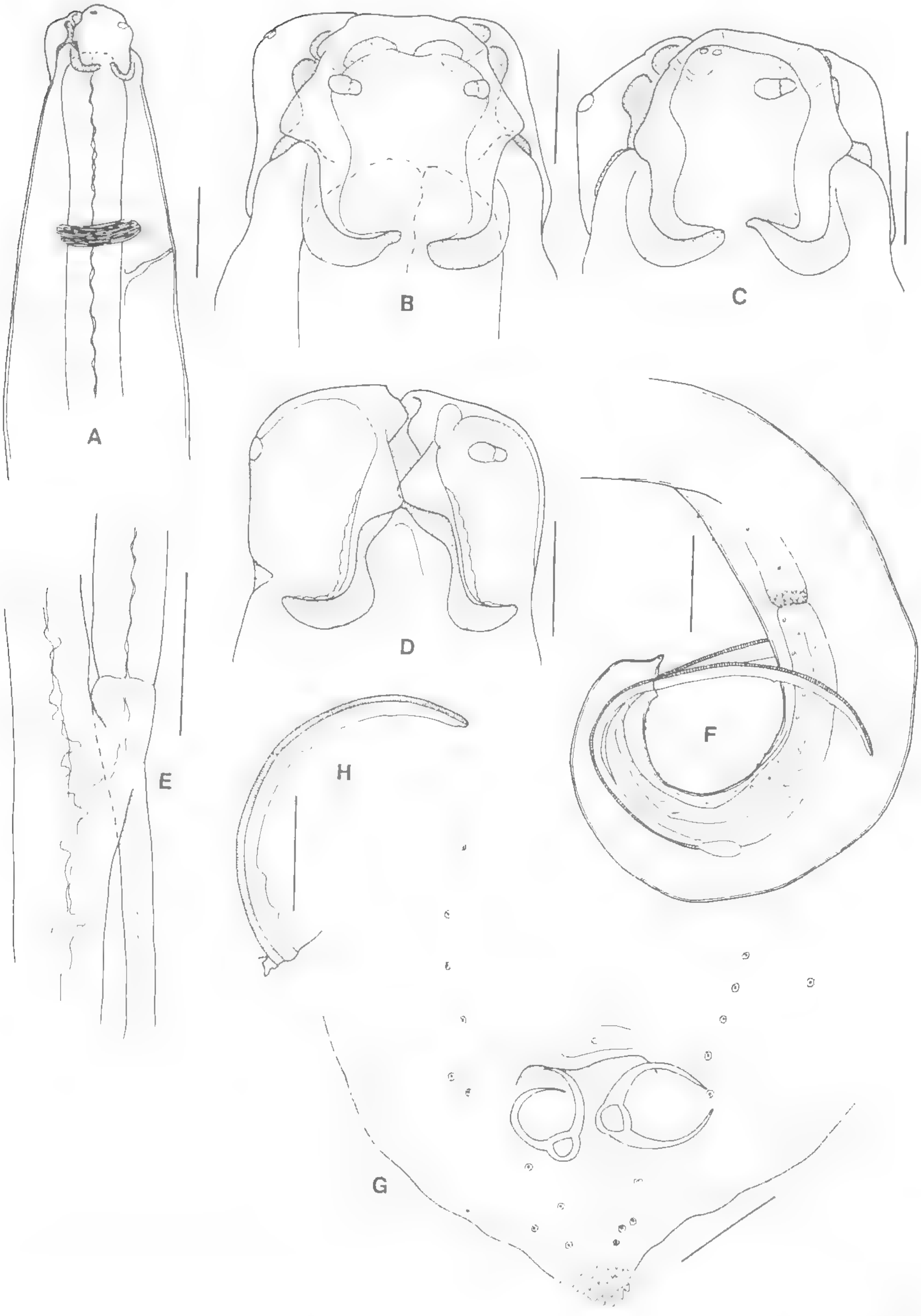


FIG. 2. *Hysterothylacium leptaspi* n. sp. All figs. ♂ #3 except where indicated. A, anterior end (scale 200 μm); B, dorsal lip (100 μm); C, subventral lip (100 μm); D, subventral interlabium (100 μm); E, ventriculus and ventricular appendix (0.50 mm); F, caudal area, ♂ #8 (0.5 mm); G, tail, ventral view, ♂ #3 (100 μm); H, emergent spicule, ♂ #1 (200 μm).

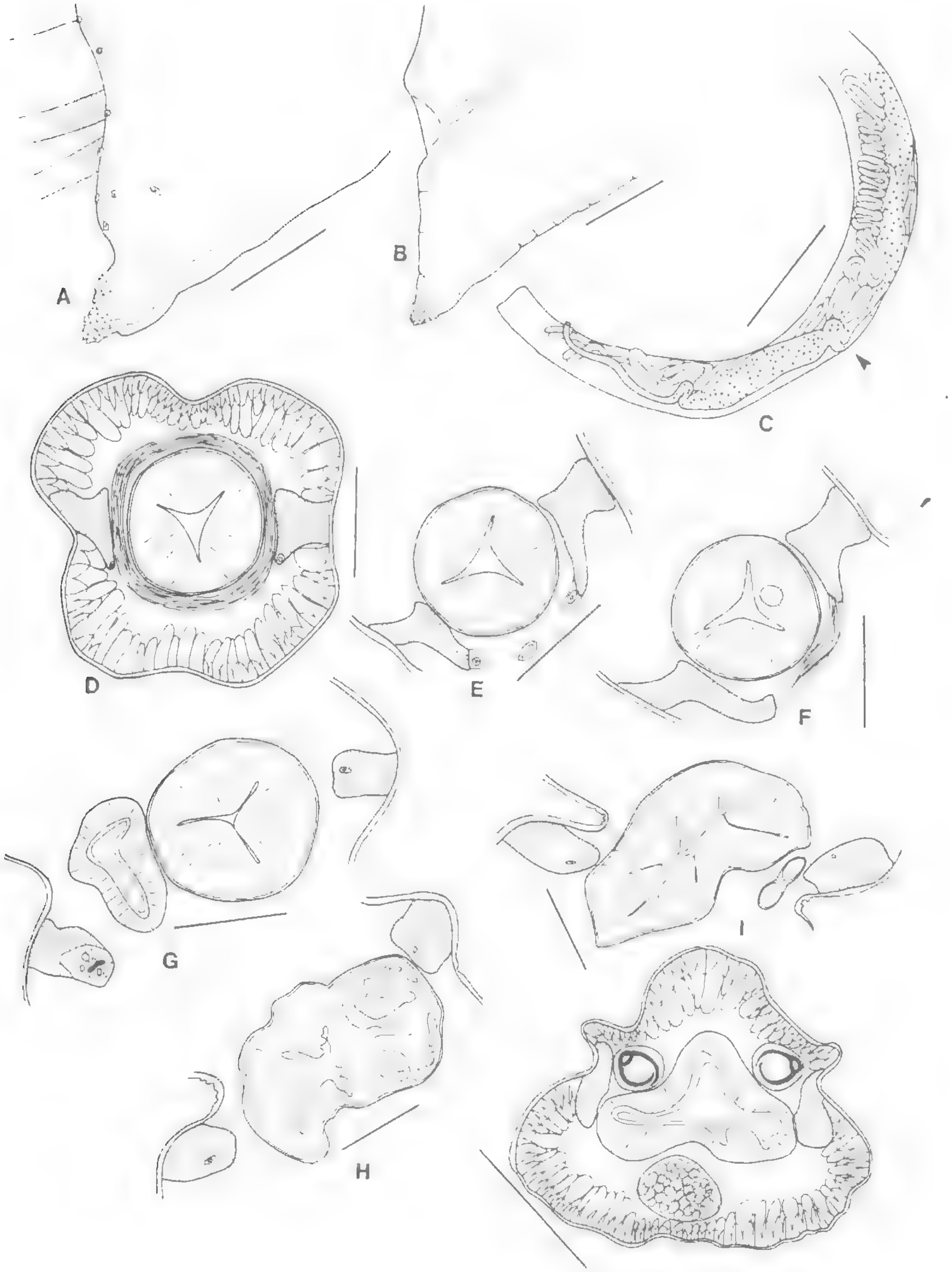


FIG. 3. *Hysterothylacium leptaspi* n. sp. A, tail, lateral view, holotype (scale 100 µm); B, tail, lateral view, ♀ #7 (200 µm); C, vagina and uterus, ♀ #6 (3.0 mm), arrow indicates point of division of uterus. Sections (all male): D, nerve ring (100 µm); E, excretory duct (100 µm); F, excretory commissure (100 µm); G, excretory nucleus (100 µm); H, ventriculus (100 µm); I, ventricular appendix (100 µm); J, tail (0.5 mm).

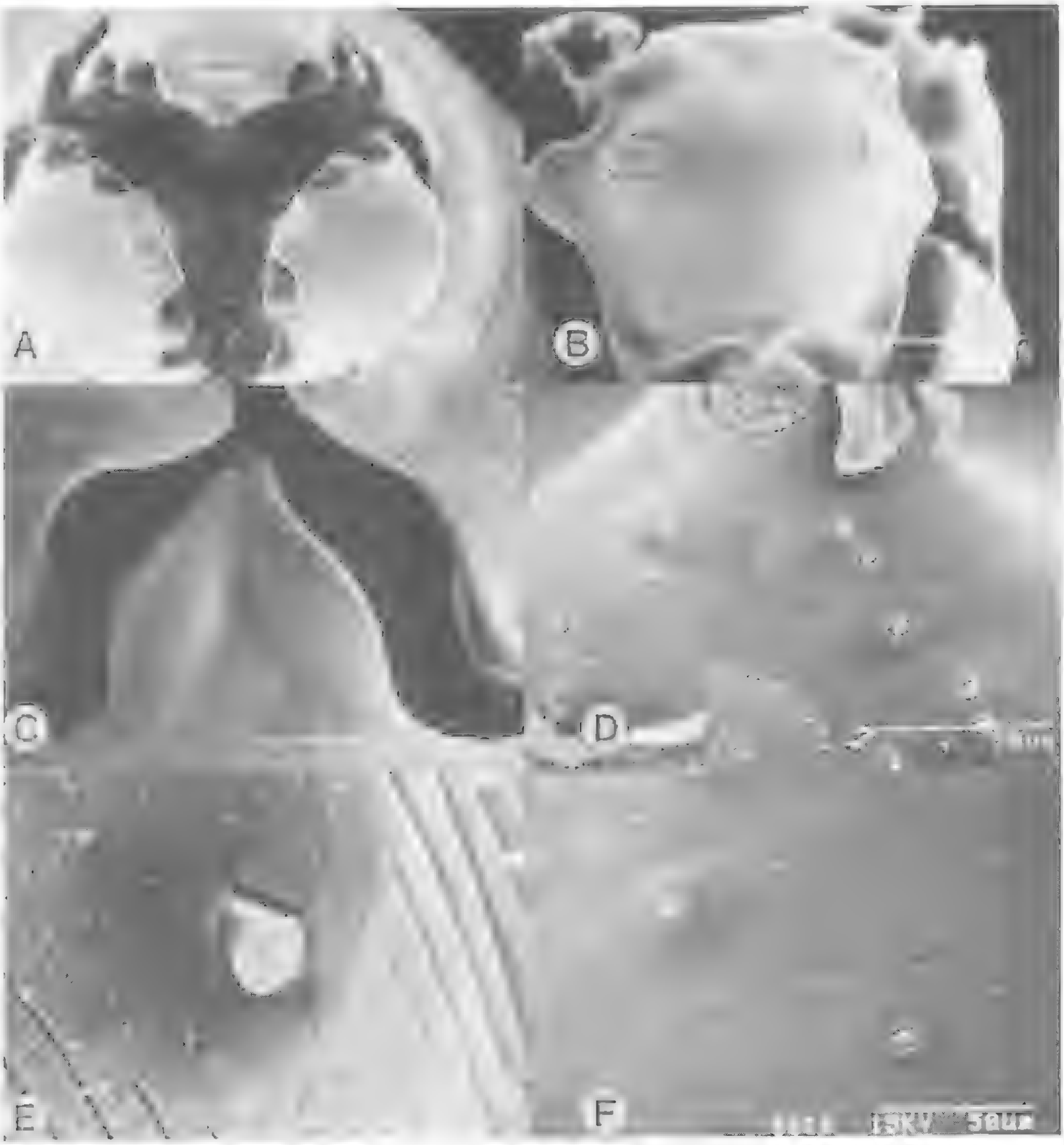


FIG. 4. *Hysterothylacium leptaspi* n. sp. Scanning electron micrographs. A, en face; B, dorsal lip; C, interlabium; D, postcloacal papillae; E, precloacal papilla, #6; F, precloacal papillae, *c.* #20.

noted. The ventricular appendage is extremely long, and it is likely that the shorter lengths quoted here may be underestimated due to breakage. Lip width varied between being slightly wider and slightly shorter than long; this variation is entirely due to perspective when measured as the lateral flanges curve away from the point of view. The smallest male worm (27.5 mm) had the largest number of papillae pairs (66). The largest male was proportionally the most slender. One male had a single double postcloacal papilla (Fig. 4D).

HOSTS

Presently recorded from *Arius leptaspis* and two single specimens only from *Arius thalassinus* (Rüppell).

DISTRIBUTION

At present known only from Embley Estuary, Weipa, Queensland, but see 'Remarks.'

REMARKS

At a species level there are problems posed in the determination of this species. *Hysterothylacium arii* (Yamaguti, 1954) was taken from an unidentified species of *Arius* from Sulawesi. There are several points of agreement with Yamaguti's (1954) description: long caecum, very long ventricular appendage; postlabial grooves; lip shape; tail apex. There are equally several points of distinction, Yamaguti's species being described as having alae, longer spicules, and fewer caudal papillae. Without access to Yamaguti's type material (see Bruce and Cannon, 1989), the recorded differences force the conclusion that the two species are distinct.

Amplicaecum indica Srivastava and Gupta, 1975, is a more recently described species from *Arius venosus* from India. The description consists largely of family characters, and the figures do not illustrate in detail the characters needed to assess the correct generic position of the species, or to compare with *C. leptaspis*. Srivastava and Gupta (1975) state clearly that their single male specimen was 'without posterior bulb' and therefore also without a ventricular appendage. These authors did not state the disposition of their material and further comparisons between these apparently similar species cannot be made. In view of the stated difference (lack of ventriculus), the two species cannot be considered congeneric.

Australia has over 18 species in the catfish family Ariidae (Kailola and Pierce, 1988) and a further 130 species are known world wide (Sands, 1985). With little data on host specificity it is not possible to assume that worms from congeneric hosts are the same species or belong to the same genus. In Australia at least four species of ascaridoid have been recorded from *Arius* species.

It should be noted that the ventriculus and ventricular appendage in this species is difficult to observe, and in all cases dissection was necessary. The ventriculus is small and clear, and merges gradually into the ventricular appendage. The ventricular appendage is very flat (Fig. 31) and transparent (in section it appears hollow), and appears to adhere closely to the lateral cord, being only clearly visible where gently separated away.

Hysterothylacium leptaspi is readily distinguished from all other species of the genus by complete lack of alae, and from those species for which the excretory system has been described by having an distinctly H-shaped excretory system. *Hysterothylacium* most commonly have a purely unilateral system, sometimes retaining traces of the left posterior filament. The excretory system of the type species *H. brachyurum* Ward and Magath, 1917 remains undescribed.

Hysterothylacium chrysostomi n. sp.

(Fig. 5)

MATERIAL EXAMINED

Male HOLOTYPE (QM GL10251), female PARATYPE (QM GL10252) off Dongara, Western Australia, 10 Dec. 1987, stomach of *Lethrinus chrysostomus*, coll. A. Williams.

TYPE LOCALITY

Dongara, Western Australia

TYPE HOST

Lethrinus chrysostomus Richardson, Lethrinidae.

DIAGNOSIS

Cuticle annulated. Lips with length to width ratio 1: 1.2-1.7, with deep postlabial grooves; laterally constricted at about 0.3 length from anterior. Alae present, not expanded, originate just posterior to base of subventral lips. Spicules 4.3-4.5% BL; ratio of 1: 1.02. Caudal papillae pairs: precloacal 30-32, paracloacal 2, postcloacal 9-10.

DESCRIPTION

Based on male holotype and female paratype.

General. Body reaching greatest width anterior to mid-body. Dorsal lip smaller than subventrals, shorter than wide (0.63); flanges widest at posterior third of lip. Interlabia large, lateral margin weakly convex, basally wider than long. Oesophagus 8.9-10.8% BL. Ventriculus slightly narrower than widest level of oesophagus, longer than wide. Ventricular appendix 33.9-38.8% length of oesophagus. Nerve ring lying between anterior 21.4-22.5% of oesophagus. Excretory system with pore to just posterior to nerve ring.

Male. Body 21.4 mm long, 470 maximum width; width at oesophageo-intestinal junction 282. Ratio of greatest width to length 1: 45.6. Subventral lip 78 long by 91 wide. Nerve ring 517 from anterior; excretory pore 696 from anterior. Oesophagus 2303 long by 188 wide.

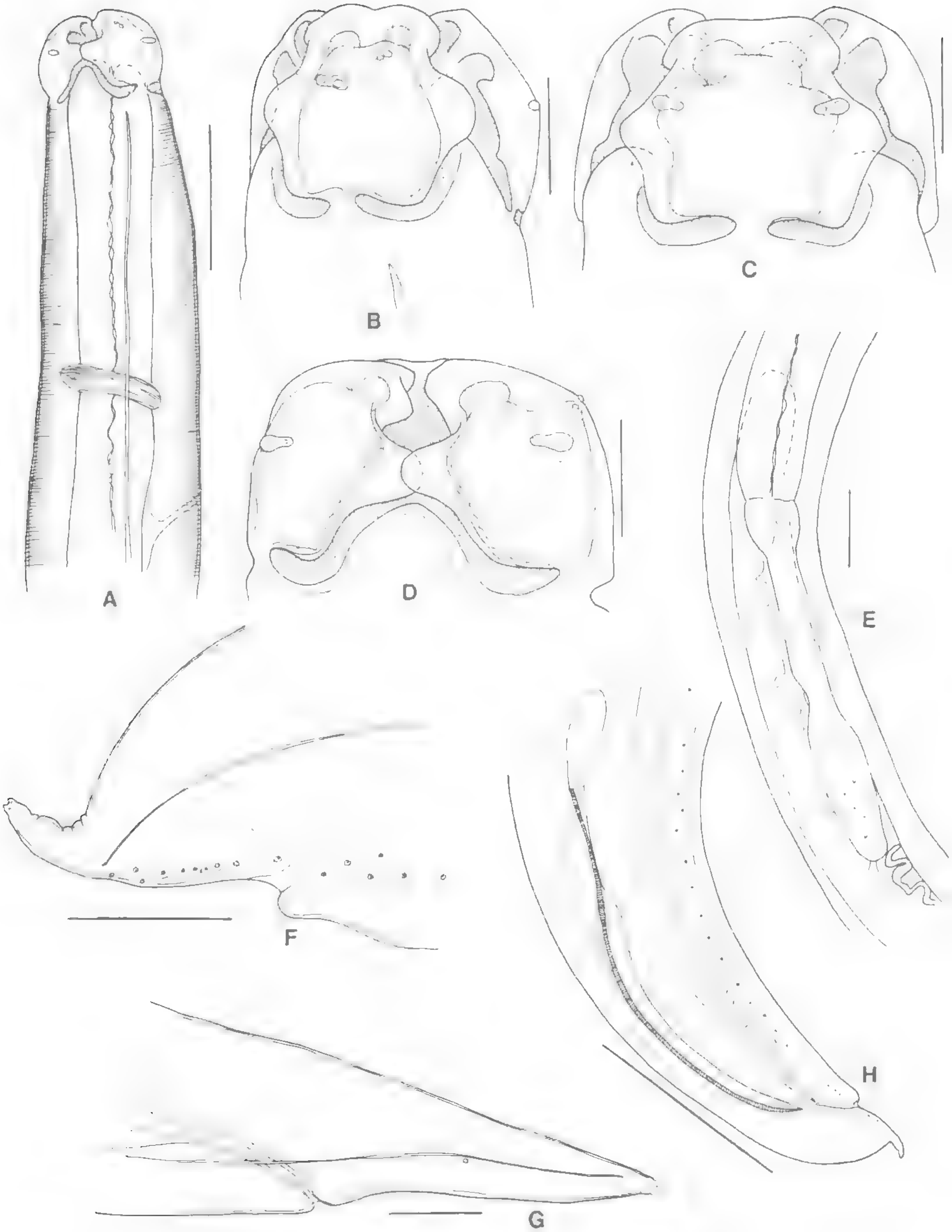


FIG. 5. *Hysterothylacium chrysostomi* n. sp. All figs of male holotype except where indicated. A, anterior (scale 200 μm); B, subventral lip (50 μm); C, dorsal lip, ♀ (50 μm); D, interlabium, ♀ (50 μm); E, ventricular region (200 μm); F, tail, lateral view (100 μm); G, tail, ♀ (100 μm); H, caudal region (0.50 mm).

Ventriculus 165 long by 188 wide; ventricular appendix 893 long by 85 wide, posterior half wider than anterior. Intestinal caecum 348 long by 141 wide; 15.1% oesophageal length. Ejaculatory duct 2350 mm long, 11.0% BL. Spicules 940-959 long, 40.0-40.8% ED. Caudal papillae pairs 42-45, becoming mamillate at about 6th or 7th anterior to cloaca. No double papillae discerned in lateral view. Tail 165 long, with weakly nodulose truncated mucron.

Female. Body 29.7 mm long, 517 maximum width; width at oesophageo-intestinal junction 385; ratio of greatest width to length 1: 57.4. Dorsal lip 94 long by 150 wide; subventral lip 127 long by 160 wide. Nerve ring 564 from anterior. Excretory pore 658 from anterior. Oesophagus 2632 long by 188 wide. Ventriculus 169 long by 160 wide; ventricular appendix 893 long by 86 wide. Intestinal caecum 423 long by 179 wide; 33.9% oesophageal length. Vulva opening 11.0 mm from anterior or 37.0% BL from anterior extremity; vulva area not swollen. Vagina about (estimated) 940 long. Tail 400 long, with rounded minutely nodulose tip.

Hosts

Known only from the type host.

Remarks

There are numerous species of *Hysterothylacium* and related genera described from the Indian and Pacific Oceans that are inadequately described (see Bruce and Cannon, 1989, for discussion). Of those that can reasonably be inferred as belonging to *Hysterothylacium* only two seem close to the present species. *Hysterothylacium epinepheli* (Yamaguti, 1941) has a similarly shaped subventral lip, but differs by having more numerous precloacal papillae, fewer postcloacal papillae, a longer ventricular appendage and a less strongly constricted lip. Similar differences also separate *H. pagrosomi* (Yamaguti, 1935) from *H. chrysostomi*.

Etymology

The epithet is taken from the host species epithet.

Hysterothylacium sebae n. sp.
(Figs 6-8)

Material Examined

Male, Holotype, Bundaberg, eastern Queensland, 14 Jun. 1976, intestine of *Lutjanus sebae* (QM GL10253). Paratypes 2 males, 2 females, same data as holotype (QM GL10254).

Type Locality

Off Bundaberg, Queensland; no more precise locality data was available.

Type Host

Lutjanus sebae (Cuvier), Lutjanidae.

Diagnosis

Cuticle distinctly annulated. Lips with length to width ratio of 1: 0.72-0.80, with indistinct postlabial groove. Anterior half of lip approximately rectangular; flanges approximately triangular, anterior margin thickened. Cervical alae not evident; posteriorly alae distinct. Caudal papillae pairs: precloacal 19-20, paracloacal 1 double, postcloacal 2. Medioventral precloacal papilla present. Postcloacal pad absent. Spicules approximately equal in length, 1.8-2.9% BL. Tail apex acute, unornamented.

Description

Based on 2 mature males and 2 mature females.

General. Body thickest in middle half, anteriorly and posteriorly slender. Dorsal lip slightly shorter than subventrals, shorter than wide (0.72 width); flanges widest at posterior 0.28-0.30 of lips; lateral constriction not strongly developed. Interlabia sessile, short. Oesophagus 9.6-14.9% BL. Ventriculus narrower than widest level of oesophagus, narrower than long. Ventricular appendix 15.5-17.3% oesophageal length. Nerve ring lying between anterior 14.9-17.3% of oesophagus. Excretory system with pore opening posterior to nerve ring, otherwise unobserved.

Male. Body 38.5-39.2 mm, 771-799 maximum width; width at oesophageo-intestinal junction 508-470; ratio of greatest width to length 1: 49-50. Dorsal lip not measured. Subventral lips 146- 188 long by 189-235 wide. Nerve ring 658 from anterior. Excretory pore 752 from anterior (one specimen). Oesophagus 3807-4277 long by 301-348 maximum width. Ventriculus 282-301 long by 244-273 wide; ventricular appendix 658-733 long by 56 wide. Intestinal caecum 226-282 long by 197-207 wide, 5.3-7.4% oesophagus length. Ejaculatory duct 2256-2444 long, 5.9-6.2% BL. Spicules 658-1128 long, 29.2-45.3% ED. Caudal papillae pairs 22-23, changing to mamillate at about 5th anterior to cloaca. Tail 207-226 long, apex acute, unornamented.

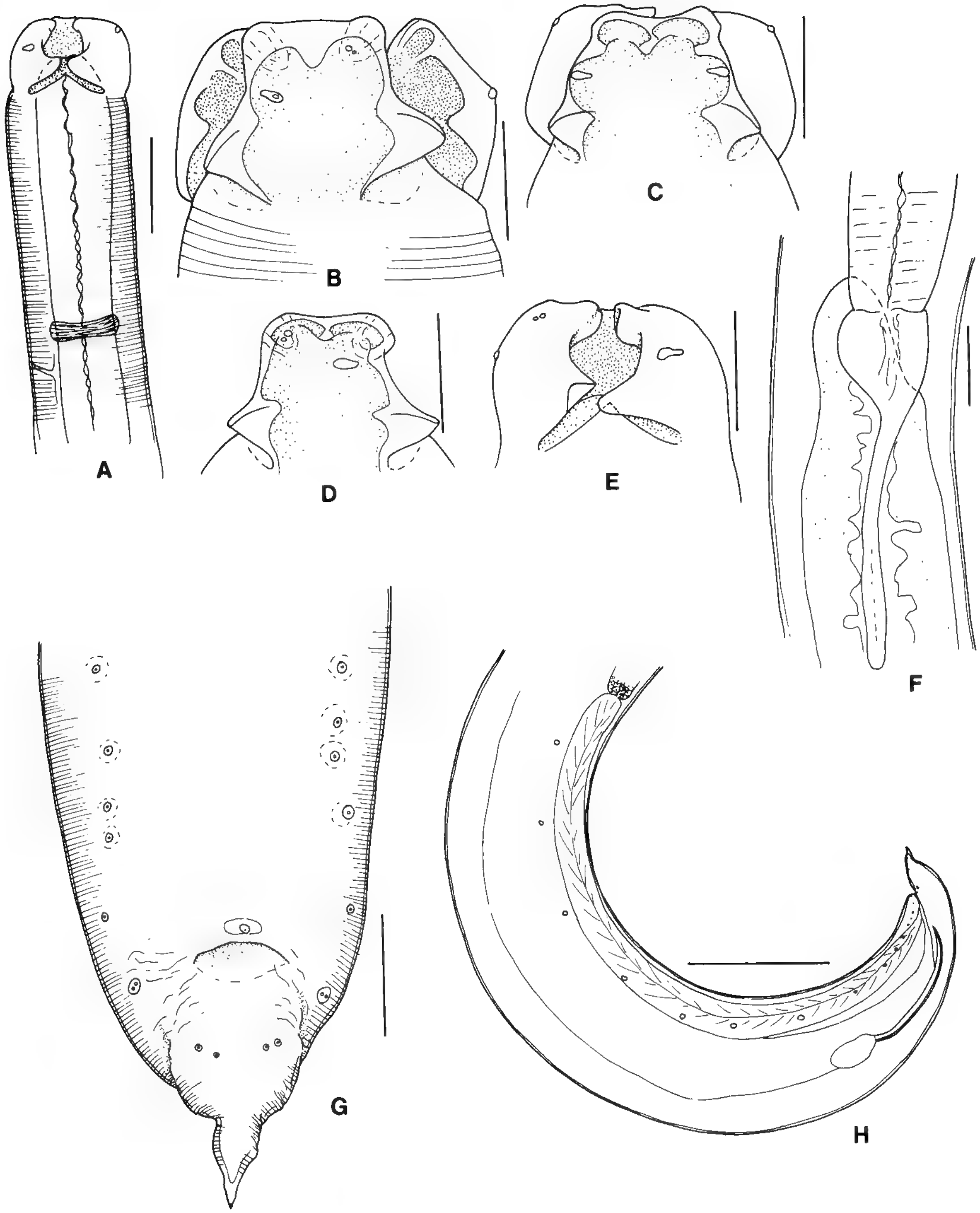


FIG. 6. *Hysterothylacium sebae* n. sp. A, anterior, holotype (scale 200 μm); B, subventral lip, holotype (100 μm); C, dorsal lip, ♀ #1 (100 μm); D, subventral lip, ♀ #1 (100 μm); E, subventral interlabium, ♀ #1 (100 μm); F, ventricular region, holotype (200 μm); G, tail, ventral view, ♂ #2 (100 μm); H, caudal region (0.50 mm).

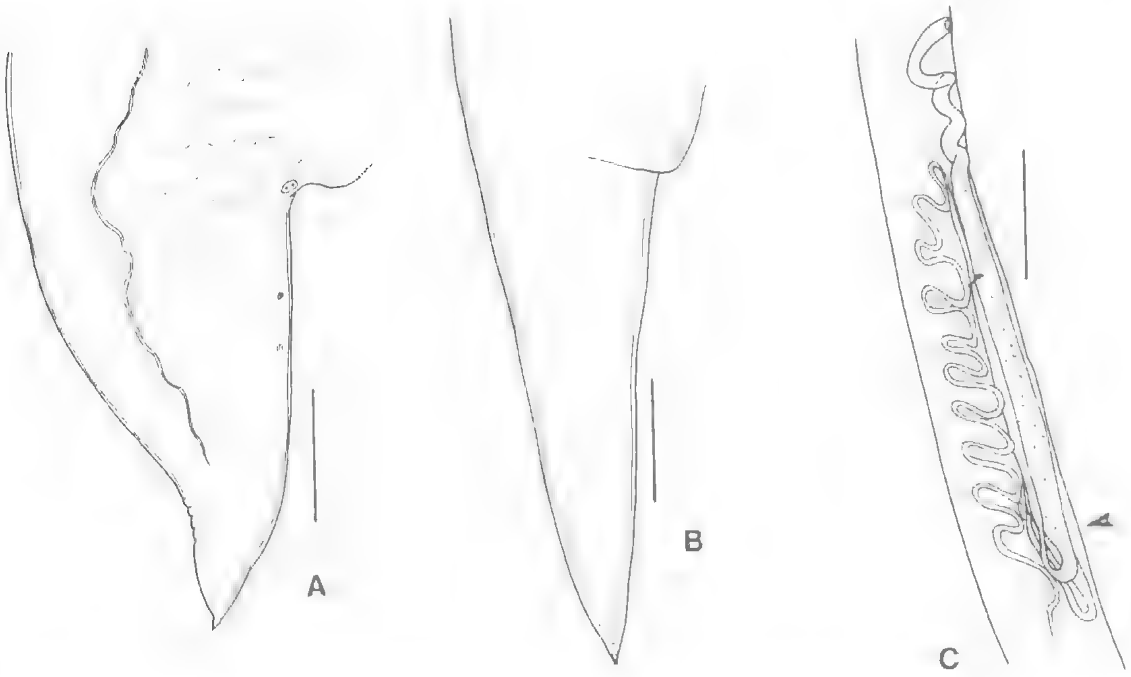


FIG. 7. *Hysterothylacium sebae* n. sp. A, tail, lateral view, holotype (scale 50 µm); B, tail, lateral view, ♀ #2 (100 µm); C, vagina and uterus, ♀ #1 (1.0 mm), arrow indicates point of division of uterus.

Female. Body 42.5-45.2 mm long, 752-818 maximum width; width at oesophageo-intestinal junction 564-658; ratio of greatest width to length 1:60.0. Dorsal lip 160 long by 221 wide (one specimen). Subventral lips 165-174 long by 211-226 wide. Nerve ring 658-667 from anterior. Excretory pore not located. Oesophagus 4234-4418 long by 320-404 maximum width. Ventriculus 329-376 wide by 282- 338 long; ventricular appendix 658-752 long by 66-69 wide. Intestinal caecum 226-329 long by 179-216 wide, 5.1-7.8% oesophagus length. Vulva opening 13.5-14.8 mm or 31.8-32.8% BL from anterior. Vagina 1320-1500 mm long; uterus 3,67-4.51 mm long, dividing 4.98-6.02 mm from vulva. Eggs not seen. Tail 376- 409 long, apex acute, unornamented.

HOSTS

Known only from type host.

DISTRIBUTION

Known only from the type locality.

REMARKS

Distinctive characters shown by this species are the shape of the dorsal lip, lack of obvious cervical alae, and the distinctive tail shape with an unornamented apex. Recent work (Bruce and Cannon, 1989) indicate that the morphology of alae is constant within a species of a sibling complex, such as the species of *Maricostula*, once the species have been discriminated. At present there is no species of *Hysterothylacium* that shows any degree of close similarity to this species. To my knowledge no species of *Hysterothylacium* has been specifically recorded from Lutjanidae.

Scanning electron micrographs show cuticular features not observed by light microscopy. The tail, while having a simple tip has a nodular patch on the ventral side (Fig. 8B). Immediately posterior to this terminal 'cone' or 'cactus' is an area in which striae form ridges; the dorsal surface of the cuticle anterior to cloaca has fine ridges, but these do not constitute crests in the sense of Bruce and Cannon (1989). Unfortunately the material examined was in only adequate condition and it was not possible to examine the anterior of the specimen. Similarly the fixation was not of a standard that would have allowed interpretable sections.

ETYMOLOGY

Named after the host species.

Hysterothylacium tasmaniense
(Johnston and Mawson) n. comb.
(Figs 9-11)

Contracaecum (Thynnascaris) tasmaniense Johnston and Mawson, 1945: 134, Figs 24-27.- Korotaeva and Leont'eva, 1972: 404; Deardorff and Overstreet, 1981: 1044.
Contracaecum tasmaniense.- Mozgovoi, 1953: 229; Yamaguti, 1961b: 30.
Thynnascaris tasmaniense.- Beumer *et al.*, 1982: 22.

MATERIAL EXAMINED

8 males, 5 females, one 4th, from Tamar River (estuary presumably), Tasmania, 30 Nov. 1983, from

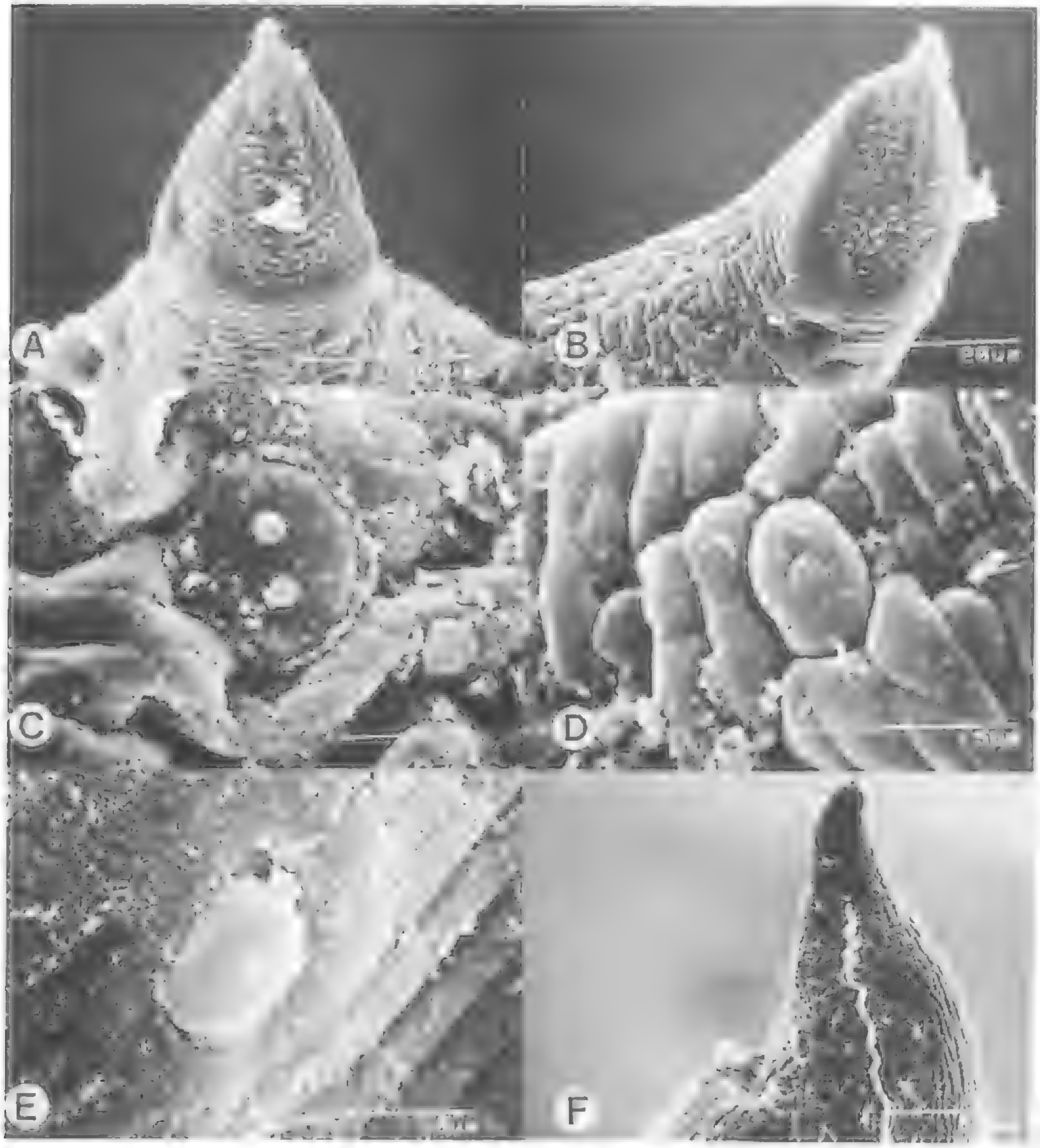


FIG. 8. *Hysterothylacium sebae* n. sp. Scanning electron micrographs. A, tail apex, cactus; B, cactus lateral view; C, double papilla; D, amphid (positioned dorsal to ala); E, precloacal papilla, #6; F, tail, lateral.

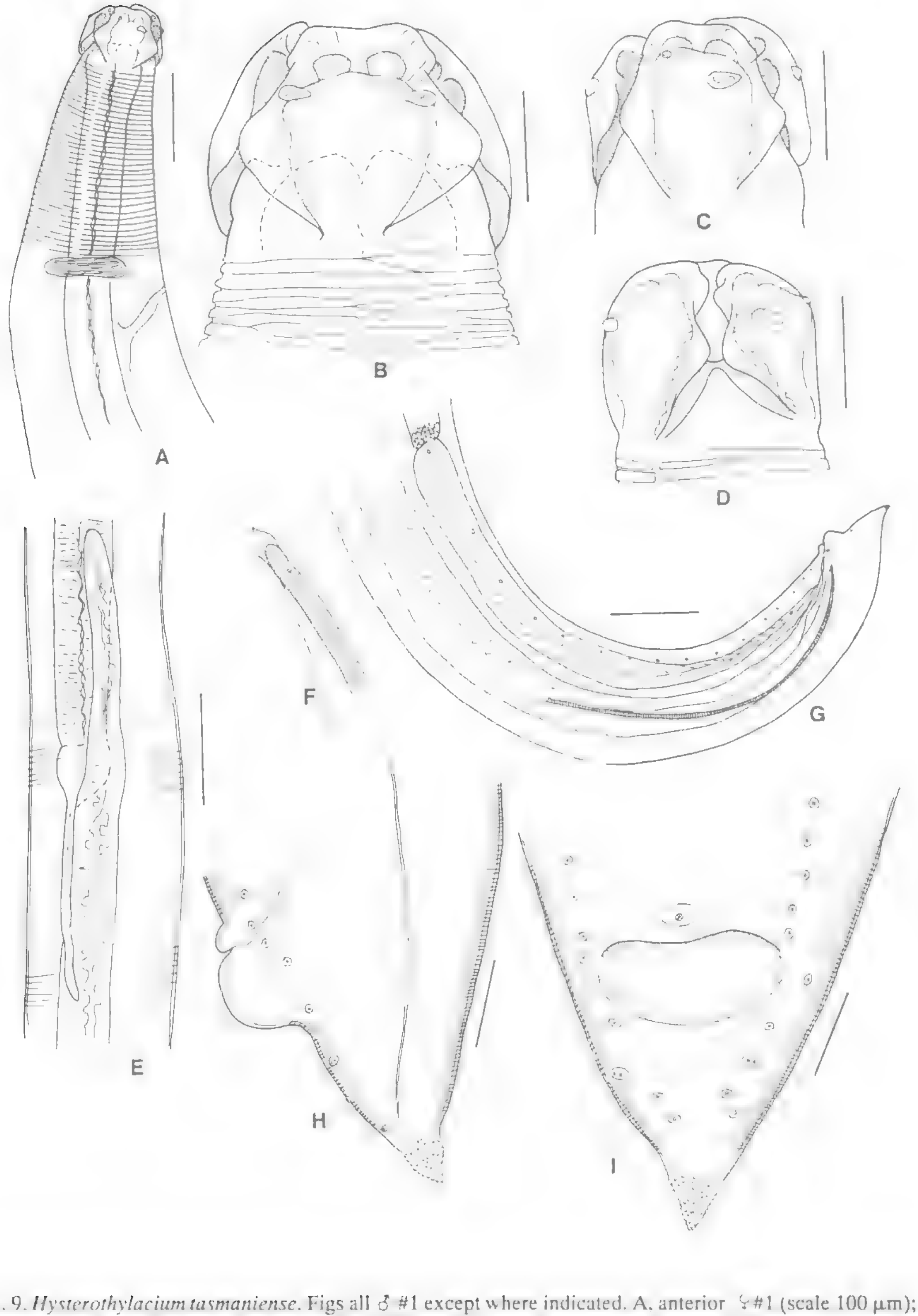


FIG. 9. *Hysterothylacium tasmaniense*. Figs all ♂ #1 except where indicated. A, anterior ♀#1 (scale 100 μm); B, dorsal lip, ♂#2 (75 μm); C, subventral lip (100 μm); D, ventral interlabium (100 μm); E, ventricular region (200 μm); F, spicule apex, ♂ #4; G, caudal region (300 μm); H, tail, lateral view (100 μm); I, tail, ventral view, ♂#2 (100 μm).

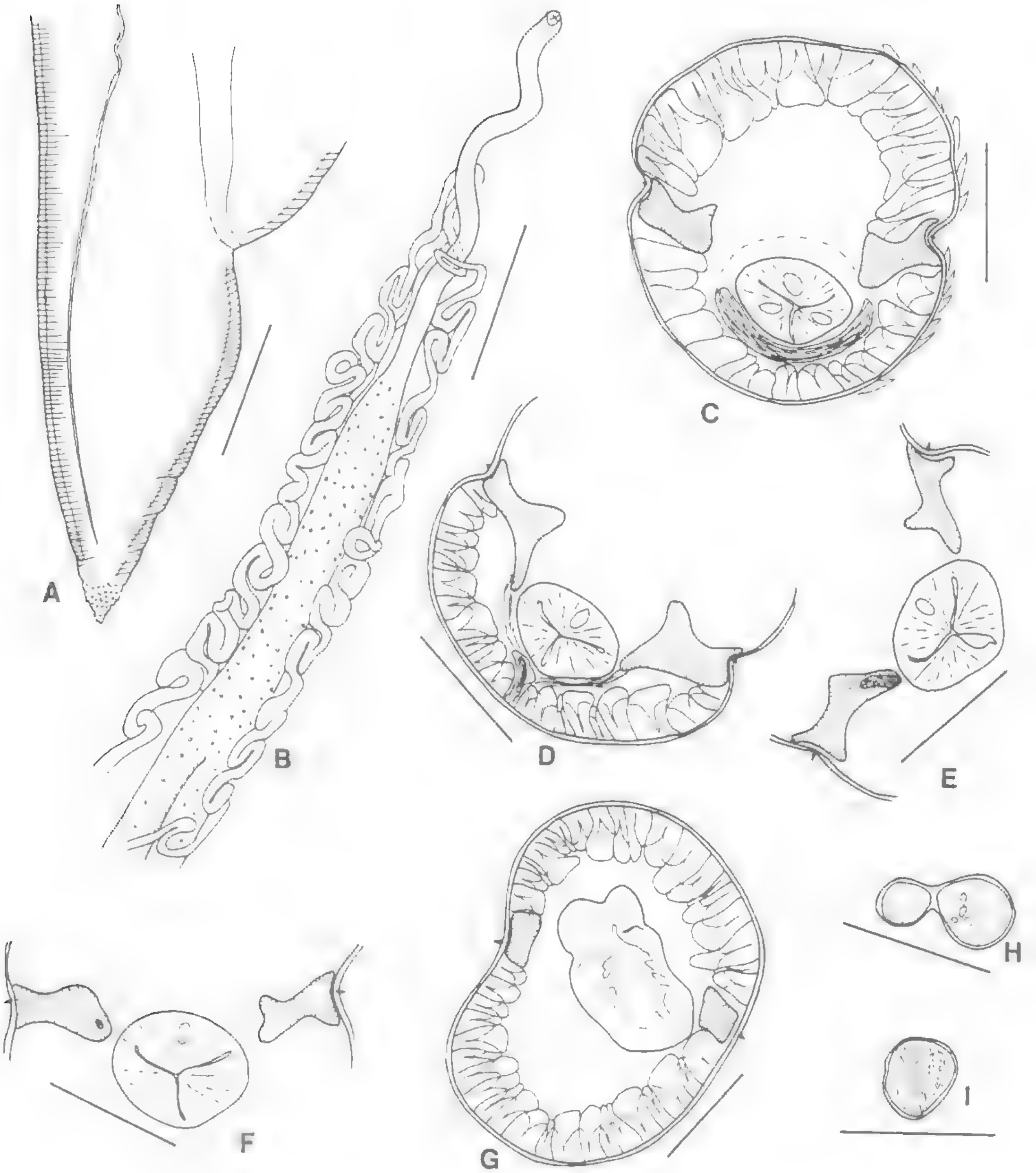
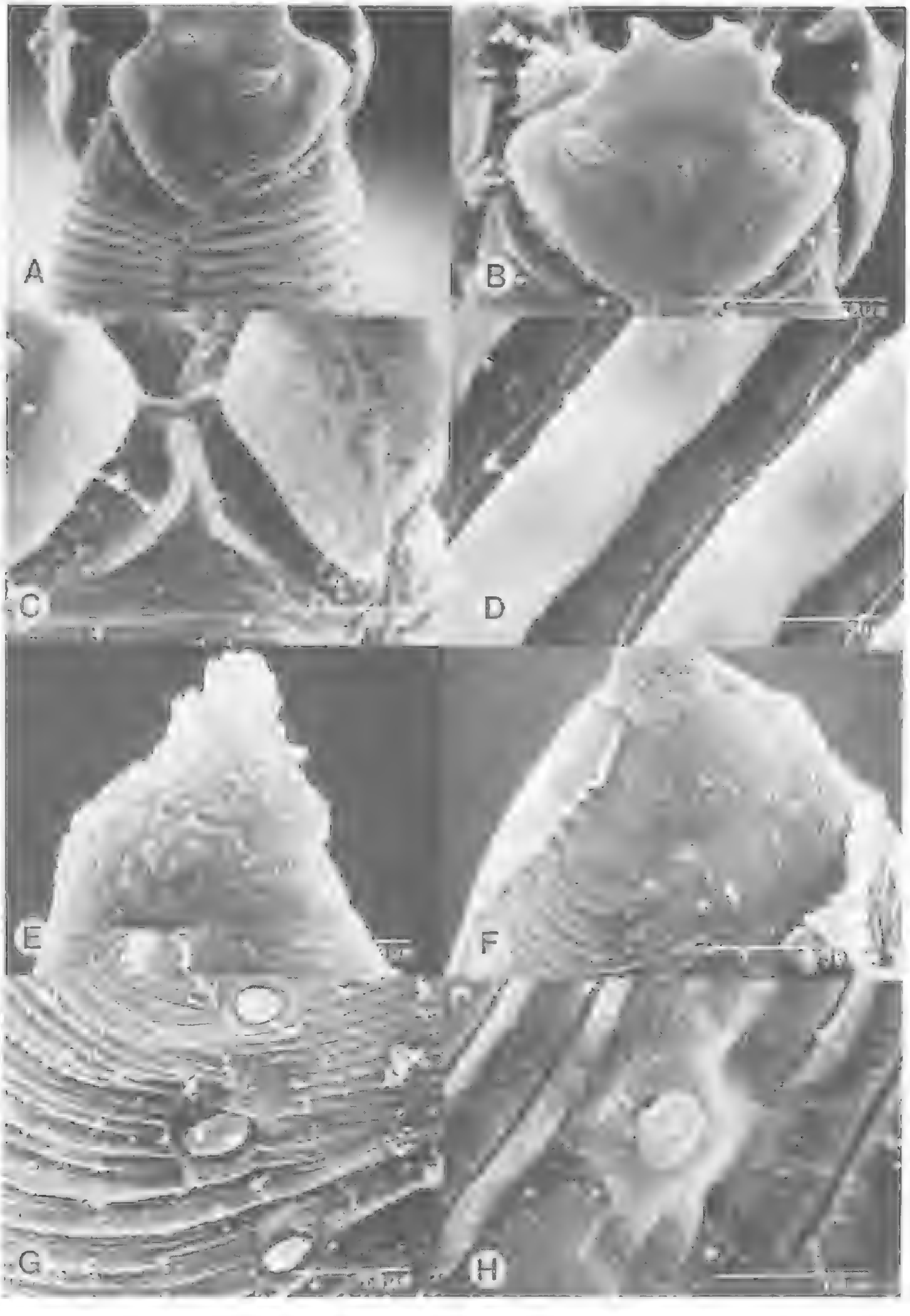


FIG. 10. *Hysterothylacium tasmaniense*. A, tail, lateral view, ♀ #1 (scale 100 μm); B, vagina and uterus, ♀ #3 (0.50 m). Sections (scales all 100 μm): C, nerve ring; D, excretory duct; E, excretory nucleus; F, mid oesophagus; G, ventriculus; H, anterior ventricular appendix; I, posterior ventricular appendix.

FIG. 11. *Hysterothylacium tasmaniense*. Scanning electron micrographs. A, anterior and subventral lip; B, dorsal lip; C, interlabium; D, cuticular rings, detail; E, cactus; F, tail; G, postcloacal papillae; H, precloacal papilla #12.


A
B
C
D
E
F
G
H

Pseudophycis barbata (AHC 16494, one pair and 4th QM GL10255).

TYPES

Johnston and Mawson (1945) did not specify types. Their syntype material was reported to be held at the South Australian Museum, Adelaide, but could not be located.

TYPE LOCALITY

The material examined by Johnston and Mawson was all from one station. This then is the type locality with the co- ordinates 42°40.0'S, 148°27.5'E.

TYPE HOST

The original description was based on material from two species of host, and neither was designated as type host.

DIAGNOSIS

Cuticle with prominent cervical rings. Lips with length to width ratio 1: 1.0-1.3 (mean = 1.10), posteriorly pedunculate; without postlabial grooves; weakly constricted about 0.3 length from anterior; flanges forming broadly rounded points. Alae not evident anteriorly; alal grooves run from base of each subventral lip, become evident as alae towards posterior. Caudal papillae pairs: precloacal 18-25, paracloacal 1, postcloacal 4-5 with 2nd doubled. Spicules approximately equal in length, ratio of 1: 1.03-1.08; 4.9-6.4% BL. Tail narrowing evenly, apex covered with fine nodules.

DESCRIPTION

Based on 6 mature males and 3 mature females.

General. Body reaching greatest width about midbody. Dorsal lip slightly smaller than subventrals, usually slightly shorter than wide (0.75-0.83, 2 specimens); flanges widest at posterior 0.3 of lip; lips laterally constricted about anterior 0.3 of lip. Interlabia triangular, sessile, about twice as wide basally as long. Oesophagus 7.88-11.4% BL. Ventriculus narrower than widest level of oesophagus, slightly longer than wide. Ventricular appendix 21.3-47.1% length of oesophagus. Nerve ring lying between anterior 18.3-21.7% of oesophagus. Excretory system with pore immediately posterior to nerve ring, posteriorly unilateral, without anterior filament; excretory nucleus immediately posterior to commissure.

Male. Body 18.2-40.0 mm long, 376-799 maximum width; width at oesophageo-intestinal junction 282-461; ratio of greatest width to length 1: 48-79 (mean = 1: 60). Dorsal lip 132 long, 165 wide (1 specimen); subventral lips 103-150 long by 103-165 wide. Oesophagus 2068-3243 long by 122-235 wide. Ventriculus 103-141 long by 103-165 side; ventricular appendix 555-1269 long, 28-103 wide; 21.3-29.5% (mean = 26.8%) oesophageal length. Intestinal caecum 611-799 long, 75-113 wide, 23.7-33.1% (mean = 26.4%) oesophageal length. Ejaculatory duct 5.9-7.9% BL (mean = 6.5%). Spicules 1504-2350 long, 63.3-97.4% ED. Caudal papillae pairs 26-31, changing from button to mamillate at about 9th anterior to cloaca. Tail 127-188 long, narrowing evenly, terminating in minutely nodulose apex. Medioventral papillated precloacal organ present; posterior of anus elevated.

Female. Body 22.0-35.0 mm long, 376-611 maximum width; width at oesophageo-intestinal junction 282-517; ratio of greatest width to length 1: 55.4-62.1 (mean = 59.4). Dorsal lip 89 long by 118 wide (one specimen); subventral lips 99-141 long by 103-160 wide. Nerve ring 446-634 from anterior. Excretory pore 517-658 from anterior. Oesophagus 2162-2914 long by 141-207 wide. Ventriculus 89-235 long by 99-179 wide; ventricular appendix 611-799 long by 28-66 wide; 22.5-28.3% (mean = 26.1%) oesophageal length. Intestinal caecum 630-893 long by 75-132 wide; 26.5-30.6% (mean = 28.9%) oesophageal length. Vulva opening 8.8-11.7 mm or 31.5-38.6% BL from anterior extremity; vulva area not swollen. Vagina short, 1-2 mm in length, ovaries not extending beyond vulva; uterus divides 2.7 mm from vulva (smallest specimen). Eggs about 56 in diameter. Tail 282-846 long, tapering gradually, apex minutely nodulose.

Variation. All but one male had the spicules shorter than the ejaculatory duct. In the differing male both spicules were about 130% the length of the ejaculatory duct. This male also had an abruptly narrower head than neck. In one specimen the ventricular appendage was markedly longer, 47% oesophageal length. The ventricular appendage and intestinal caecum are of about equal length, with the caecum usually (5 of 9) slightly longer than the ventricular appendage.

HOSTS

Present material is from *Pseudophycis barbata* Günther (Moridae, Gadiformes). Johnston and Mawson's (1945) record was from *Coelorhynchus australis* (Richardson) (Macrouridae, also Gadiformes) and *Notopogon lillei* Regan (Macrorhamphoridae, Syngnathiformes). Korotaeva and Leont'eva (1972) recorded *Macruronus novaezelandiae*.

DISTRIBUTION

Type locality, New Zealand (Korotaeva and Leont'eva, 1972) and now from the Tamar River, Tasmania.

REMARKS

Johnston and Mawson (1945) described *Hysterothylacium tasmaniense* from immature females. Their illustrations were few, but there are several points of correspondence between present material and the original description. Lip shape, lack of distinct postlabial grooves, interlabium shape, the relative proportions of the intestinal caecum and ventricular appendage and the prominent cuticular rings all serve to identify this species.

The most similar species to *Hysterothylacium tasmaniense* appears to be *Hysterothylacium aduncum*. Descriptive accounts and figures for this species are given by Punt (1941), Petter (1969), Petter and Maillard (1988). Berland (1961) give a detailed account of that species. Points in common that suggest that the two species are closely related are the lip shape, relative proportions of the intestinal caecum and ventricular appendage, papillae details, shape and ornamentation of the tail. Although there are inconsistencies in descriptions of material previously recorded as *H. aduncum*, *H. tasmaniense* can consistently be separated by the lack of cervical alae, wider interlabia, conspicuous cervical rings, lack of postlabial grooves and more obviously constricted lips.

The prominent cuticular rings give this species a superficial resemblance to the monotypic genus *Iheringascaris* Peirera. In addition to the generic characters, the cuticular rings are themselves different between the two species, those of *Iheringascaris* overlapping posteriorly.

Hysterothylacium thalassini n. sp.

(Fig. 12)

MATERIAL EXAMINED

All specimens from Albatross Bay, Weipa, Q., Gulf of Carpentaria, March 1987, from stomachs of *Arius thalassinus* trawled at depth of 36m, coll. CSIRO. Male HOLOTYPE, (QM GL10256), 6 females, PARATYPES QM GL10257, GL10258).

TYPE LOCALITY

Albatross Bay, Weipa, Queensland. Gulf of Carpentaria, 1240'S, 14142'E.

TYPE HOST

Arius thalassinus (Rüppell), Ariidae.

DIAGNOSIS

Cuticle distinctly annulated; lips with length to width ratio 1:1.05-1.23, with postlabial grooves, constricted a little less than one third (0.29) length from anterior. Alae originate just posterior to subventral lips. Ventricular appendage about 70% length of oesophagus, nearly as wide as oesophagus. Caudal papillae: precloacal 16, paracloacal 1, postcloacal 2. Spicules approximately equal in length, ratio of 1:1.11, 5.48-4.96% BL. Tail with conical nodulose apex.

DESCRIPTION

Based on one mature male and 4 mature females.

General. Body slender, about greatest width mid-body. Dorsal lip slightly smaller and basally manifestly wider than subventrals, about as long as wide; flanges widest about half way along length of lip, weakly developed. Interlabia sessile, less than half as long as lips. Oesophagus 10.6-15.6% BL. Ventriculus slightly wider than widest level of oesphagus, about as wide as long. Ventricular appendix 67.1-90.0% length of oesophagus. Nerve ring lying between anterior 11.9-16.4% length of oesophagus. Excretory system unilateral, with pore opening distinctly posterior to nerve ring.

Male. Body 18.0 mm long, 282 maximum width; width at oesophageo-intestinal junction 212; ratio of greatest width to length 1: 63.8. Dorsal lip 75 long by 71 wide. Subventral lips not measured. Nerve ring 400 from anterior. Excretory pore 494 from anterior. Oesophagus 2444 long by 112 wide. Ventriculus 118 long by 85 wide; ventricular appendix 2115 long by 103 wide. Caecum 1788 long by 94 wide, 73.1% oesophageal length. Ejaculatory duct 1128 long, 6.27% BL. Spicules 893-987 long, 79.2-87.5% ED. Caudal papillae 16-19. Tail 106 long.

Female. Body 19.4-27.1 mm long 320-470 maximum width; width at oesophageo-intestinal junction 216-348; ratio of greatest width to length 1: 44.2-72.1 (mean = 1: 58.3). Dorsal lip 66-99 long by 71-94 wide (2 specimens). Subventral lips 85-116 long by 71-94 wide (2 specimens). Nerve ring 329-447 from anterior. Excretory pore 353-517 from anterior.

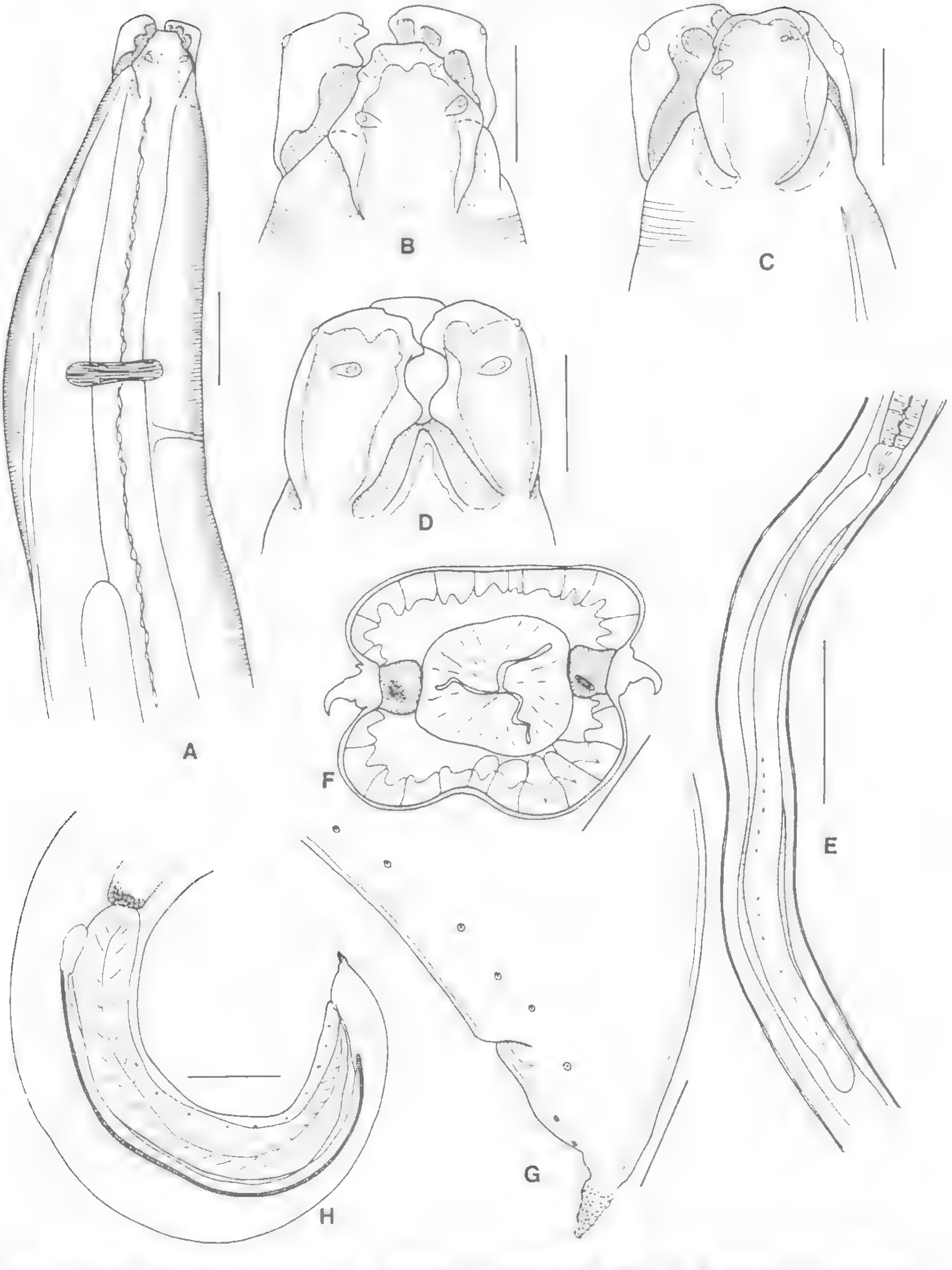


FIG. 12. *Hysterothylacium thalassini* n. sp. A, anterior, holotype (scale 100 μm); B, dorsal lip, holotype (50 μm); C, subventral lip, ♀ #3 (50 μm); D, ventral interlabium, ♀ #2 (50 μm); E, ventricular region holotype (0.5 mm); F, section, posterior to nerve ring (100 μm); G, tail, lateral view, holotype (50 μm); H, caudal region, holotype (200 μm).

Oesophagus 2350-3290 long by 103-132 wide. Ventriculus 94-141 long by 194-146 wide; ventricular appendix 1598-2538 long by 85-113 wide. Caecum 1739-2632 long by 94-169 wide; 74.0-80.0% BL (mean = 76.3%). Vulva opening 7.51-11.84 mm or 37.6-43.7% BL from anterior; vulva area not swollen. Vagina not measured accurately, approximately 1.3-2.2 mm long. Uterus didelphic, opisthodidelphic. Oviducts not extending anterior to vagina. Tail 235-282 long.

Variation. There was notable variation in the length to width ratio, with one specimen being distinctly more slender (1: 71.2) than the others (1:44.2-60.5). One specimen had a subventral lip length to width ratio of 1:0.93. With the limited material at hand no other particular variations were noted.

HOSTS

Known only from the type host. One female specimen from *Nemipterus hexodon* (Quoy and Gaimard) (Family Nemipteridae) was examined, and although similar, a positive determination could not be made.

REMARKS

This small species shows no particular affinity with any other member of the genus. The long and, compared to other species, wide ventricular appendage is a noteworthy character which, in combination with lip shape and caecal length, should ensure easy identification.

The state of preservation of these specimens was such that detailed histology was not successful therefore the position of the excretory nucleus remains undescribed. Similarly it was not possible to get accurate measurements of the female reproductive system nor obtain successful SEMs.

ETYMOLOGY

The epithet is taken from the species name of the type host.

Hysterothylacium zenis (Baylis)
(Figs 13-15)

Contracaecum zenis Baylis, 1929: 547, Fig. 4.- Yamaguti, 1961b: 30.

Contracaecum (*Contracaecum*) *zenis*.- Mozgovoi, 1953: 168, Fig. 102.

Contracaecum zenopsis Yamaguti, 1941: 366, Fig. 24, plate V. Figs. 27-30.- 1961b: 30.

Contracaecum (*Contracaecum*) *zenopsis*.- Mozgovoi, 1953: 168, Fig. 103.

Hysterothylacium zenis.- Deardorff and Overstreet, 1981: 1042.

Hysterothylacium zenopsis.- Deardorff and Overstreet, 1981: 1042.

MATERIAL EXAMINED

8 males, 4 females, 3 fourths, off Townsville, Q., no date (but catalogue number implies circa 1982), from *Zenopsis nebulosus*, coll. J. Stevens, CSIRO (AHC 16332, one pair QM GL10259). Also examined: 4 syntypes.

TYPES

The syntypes of *H. zenis*, all female, are held at the BM(NH) 1934.9.29.51-54. The types of *H. zenopsis* are believed to be at the Meguro Parasitological Museum, Tokyo, where Yamaguti's nematode types were deposited (see Bruce and Cannon, 1989).

TYPE LOCALITY

Baylis cited only 'off South-west Africa, July 8, 1927'.

TYPE HOST

Zeus capensis, Zeidae (Baylis, 1929).

DIAGNOSIS

Cuticle finely annulated, lips with length to width ratio 1:0.72-0.90; with deep postlabial grooves; constricted about 0.3 length from anterior; dorsal lip flange approximately rectangular. Alae originate from and are united with subventral interlabia; expanded to about position of ventricular appendage. Caudal papillae pairs: precloacal: 24-29, paracloacal 1, postcloacal 6-7 of which 4th or 5th from cloaca is doubled. Spicules subequal in length, ratio of 1: 1.05-1.17; 4.67-7.08% BL. Tail narrowing evenly to bluntly rounded apex, provided with small finely nodulose nipple like process.

DESCRIPTION

Based on 4 mature males and 2 mature females.

General. Body reaching greatest width about mid-body. Dorsal lip slightly larger than subventrals, usually slightly shorter than wide (0.72-0.81); flanges widest at posterior two thirds of lip; lips laterally constricted about anterior 0.34-0.37 of lip. Ventral interlabium about 1.3-1.5 long as basal width. Oesophagus 12.1-16.5% BL. Ventriculus narrower than widest level of oesophagus, wider than long. Ventricular appendix 25.0-34.3% length of oesophagus. Nerve ring lying between anterior 7.66-10.18% of

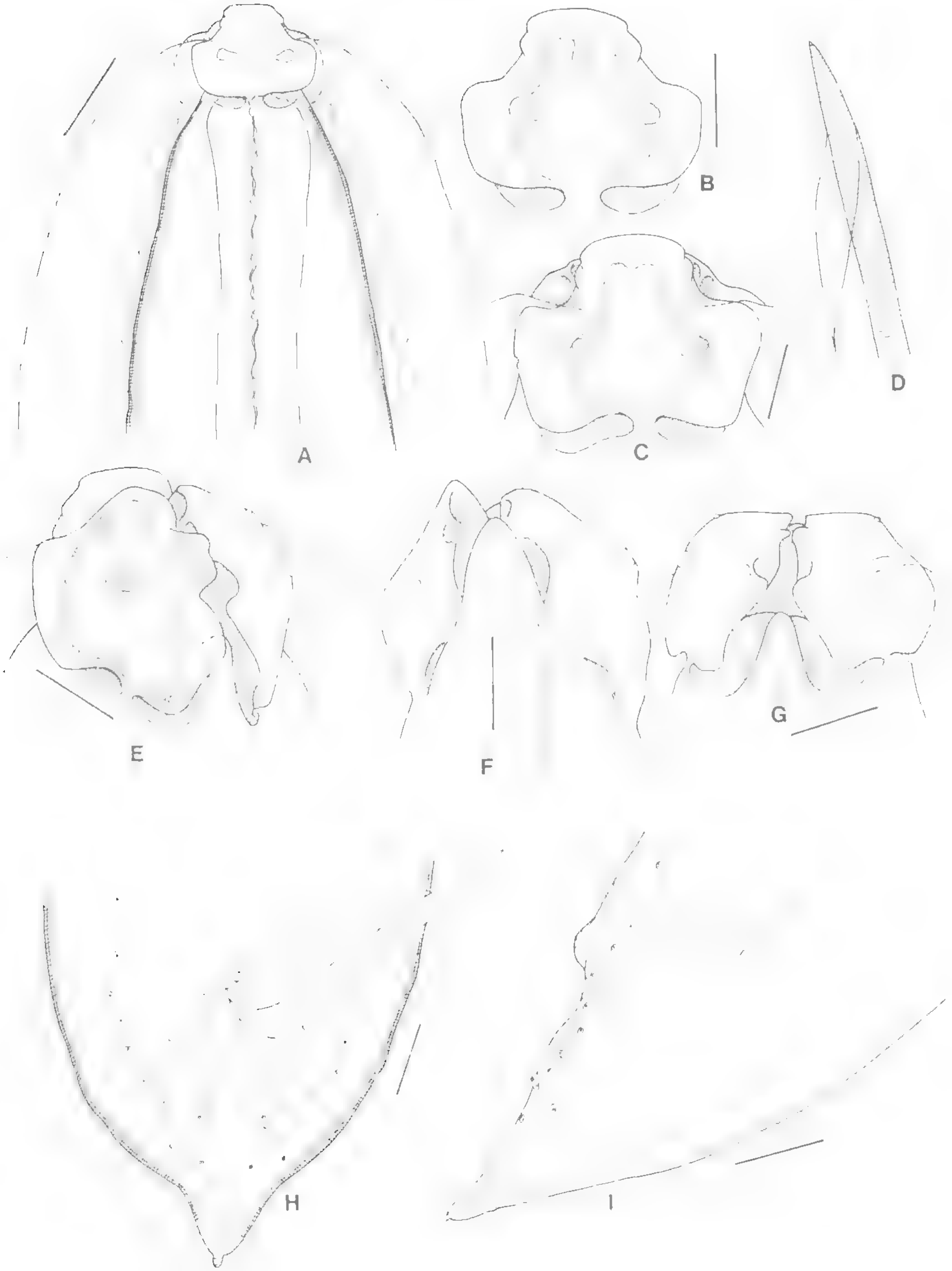


FIG. 13. *Hysterothylacium zenis*. A, anterior, ♂ #1 (scale 100 µm); B, dorsal lip, ♂ #1 (50 µm); C, dorsal lip, ♀ #1 (50 µm); D, spicule apex, ♂ #2; E, subventral lip, ♂ #1 (50 µm); F, subventral interlabium/ala, ♂ #1 (50 µm); G, ventral interlabium, ♂ #2 (50 µm); H, tail, ventral view, ♂ #2 (50 µm); I, tail, lateral view, ♂ #3 (50 µm).

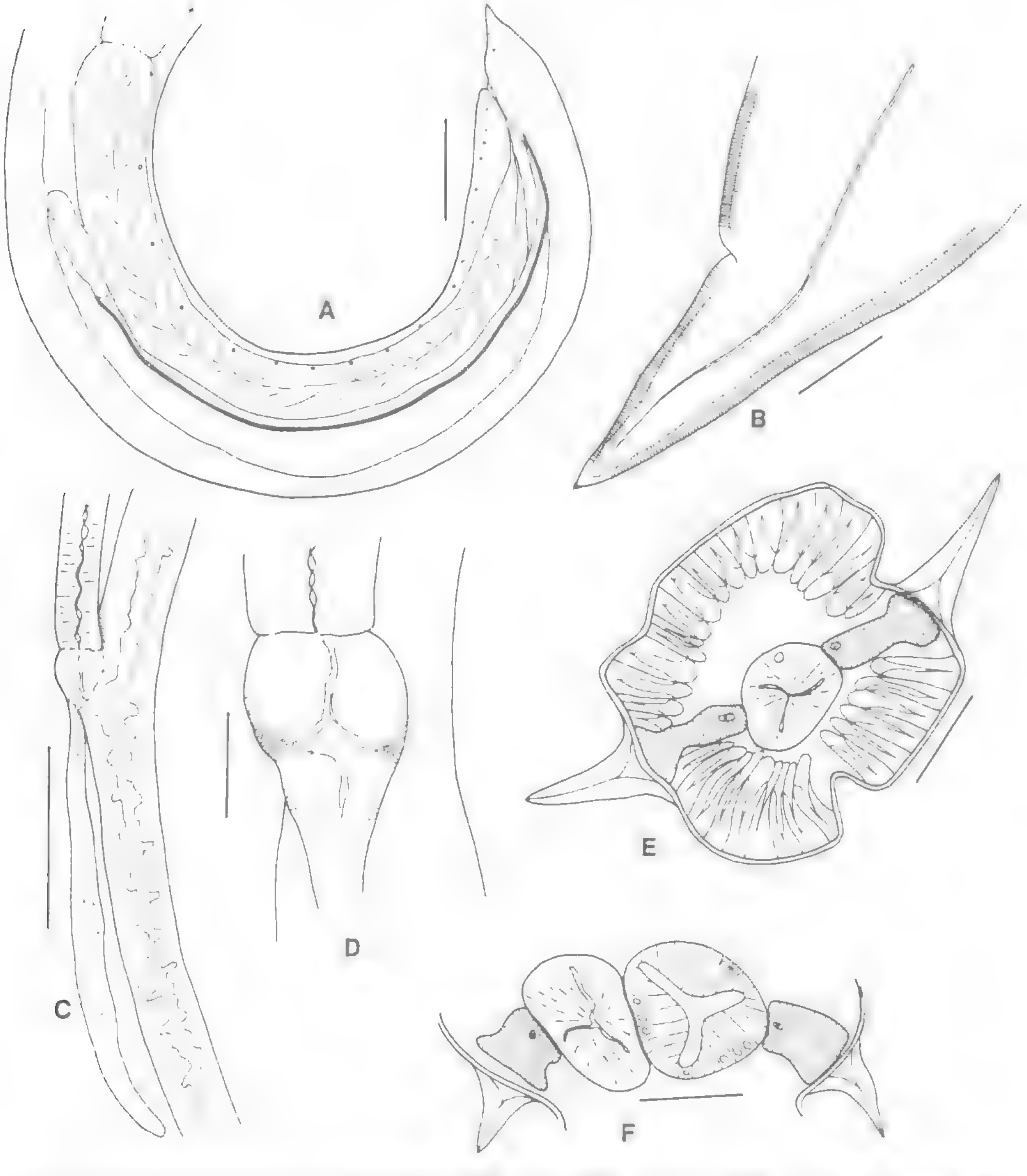
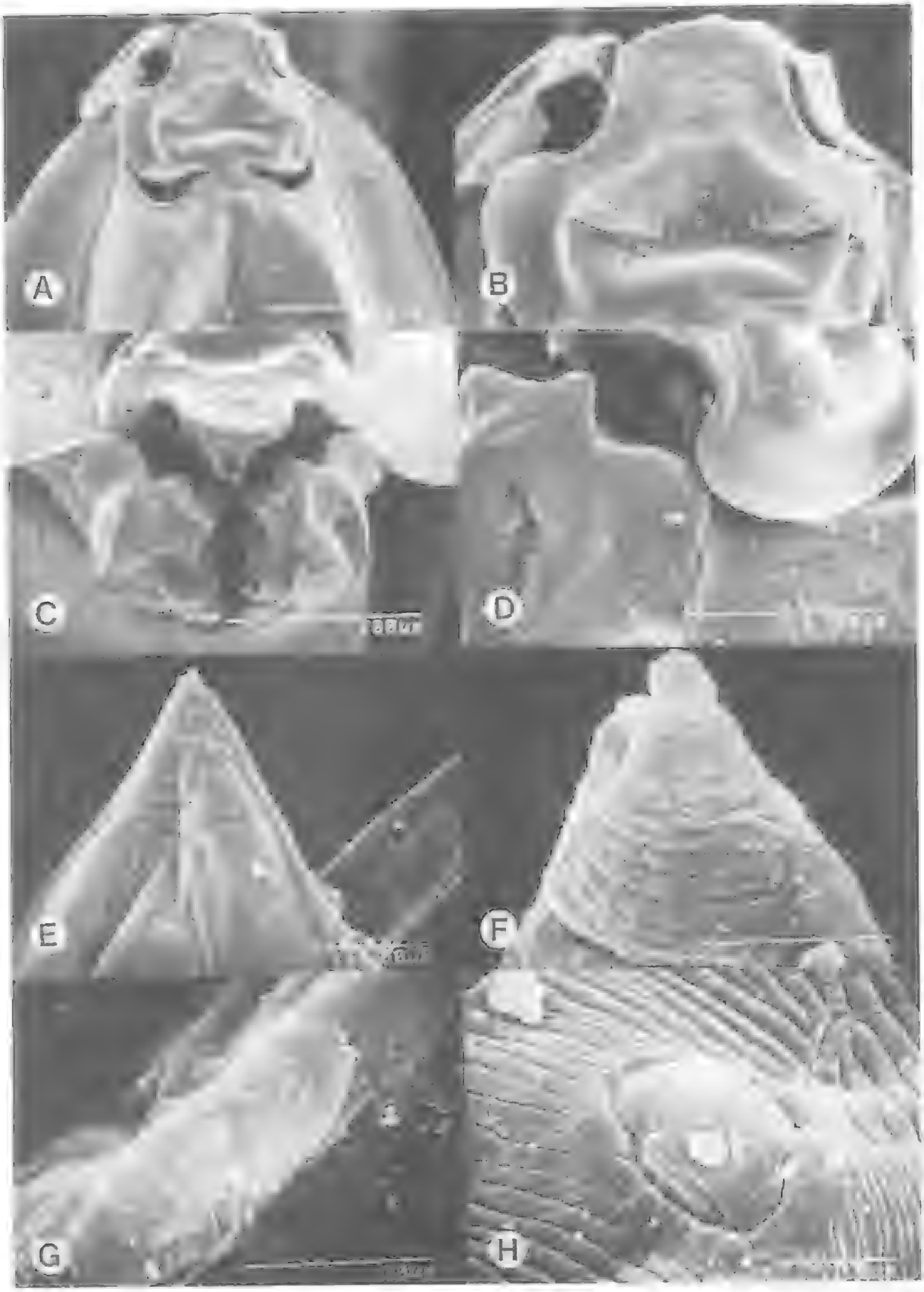


FIG. 14. *Hysterothylacium zenis*. A, caudal region, ♂ #3 (scale 200 µm); B, tail, ♀ #1 (100 µm); C, ventricular area, ♂ #1 (0.5 mm); D, ventriculus, ♀ #2 (100 µm); Sections: E, posterior to nerve ring (100 µm); F, mid oesophagus (100 µm).

oesophagus. Excretory system initially posteriorly bilateral with right canal terminating anterior to ventriculus, left canal persisting beyond ventriculus; pore opening immediately posterior to nerve ring (one specimen observed).

Male. Body 21.5-32.5 mm long, 329 maximum width; width at oesophageo-intestinal junction 251-517; ratio of greatest width to length 1: 44.3-65.4 (mean = 1: 56.12). Dorsal lip 113-122 long, 146-169 wide (two specimens); subventral lip 103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long by 115 wide (one specimen). Oesophagus 4606-5076 long, 160-188 wide. Ventriculus 116-166 long by 141-188 wide; ventricular appendix 1269-1316 long, 75-94 wide, 25.00-26.17% (2 specimens) oesophageal length. Intestinal caecum 3008-3572 long, 188-216 wide; 62.0-71.0% (mean = 66.1%) oesophageal length. Ejaculatory duct 5.70-8.74% BL (mean = 7.52%). Spicules 1222-2115 long; 65.0- 87.6% ED (mean = 76.21%). Caudal papillae pairs 24-32, changing from button to mamillate at about 7th anterior to cloaca. Tail 150-188 long.

Female. Body 41.8-43.6 mm long, 743-846 maximum width; width at oesophageo-intestinal junction 470-536; ratio of greatest width to length 49.4-57.9. Dorsal lip 132 long by 165 wide; subventral lip 141 long by 160 wide. Nerve ring 494-517 from anterior. Excretory pore not sighted. Oesophagus 5075-5452 long by 141-207 wide. Ventriculus 136-165 long by 141-207 wide; ventricular appendix 1410-1739 long by 66-94 wide; 25.9-34.3% oesophageal length. Intestinal caecum 3572-3854 long by 141-255 wide; 70.4- 70.7% oesophageal length. Vulva opening 21.34-21.76 mm or 49.6-52.1% BL form anterior extremity, vulva area not swollen. Vagina 1974-3729 long; uterus divides 4068 from vulva. Eggs 56-85 in diameter. Tail 282-320 long, apex with small, minutely nodulose nipple like process.

Variation. One male had two double papillae on the right side of the tail, all others had only one. The lower figures given for the precloacal papillae may be too low as most specimens were tightly coiled and papillae obscured from view. The lengths for the vagina given for two females of similar body lengths appears disparate. Examination of further specimens is necessary to place more confidence on the range given.

HOSTS

Recorded only from the Family Zeidae. Present material is from *Zenopsis nebulosus* (Temminck and Schlegel). Previous records are from *Zeus capensis* Valenciennes (type host, Baylis, 1929), and *Zenopsis nebulosus* from Japan (Yamaguti, 1941, 1961b).

DISTRIBUTION.

Japan (Yamaguti, 1941), South Africa (Baylis, 1929), and now eastern Australia. The unpublished record of Brunsdon (1956) is not of this species.

REMARKS

Comparison of the present material to the syntypes of Baylis (1929) reveal no points of contradiction. The shape of the dorsal lip in both cases corresponds exactly. There are two other inadequately characterised species of *Hysterothylacium* that have been recorded only from zeids. *Hysterothylacium baylisi* (Yamaguti, 1941) can be separated by having only two postcloacal papillae pairs, fewer precloacal papillae, longer spicules (potentially 9.8-13.8% BL) and the vulva positioned at the anterior one third of the body. *Hysterothylacium zenopsis* (Yamaguti, 1941), the second species, is here placed in synonymy with *H. zenis*. Yamaguti's (1941) description agrees in most respects (papillae pairs, spicules, position of vulva, tail apex, ventricular appendage and intestinal caecum proportions), but does not have good lip details, and does not mention alae. Yamaguti routinely neglected to mention alae in his descriptions, and while I have not been able to obtain his material, lack of mention in Yamaguti's description cannot be taken to indicate absence.

Several other congeneric species have also been recorded from zeids. These are *Hysterothylacium aduncum* (Rudolphi), *H. clavatum* (Rudolphi) and *H. fabri* (Rudolphi). All of these species lack the long expanded alae and massive subventral interlabia which characterise *H. zenis*, and all have prominently nodulose tail apices.

Brunsdon (1956 unpublished) recorded this species from *Zenopsis nebulosus* in New Zealand waters. This record is a misidentification and differs in several respects, most notably in the proportions of the intestinal caecum and ventricular appendage (about equal, versus ventricular appendage 25-40% caecal length) and in lacking prominent alae.

Ichthyascaris Wu, 1949

Ichthyascaris Wu, 1949: 53.

DIAGNOSIS

Male. Body elongate, reaching greatest width

FIG. 15. *Hysterothylacium zenis*. Scanning electron micrographs. A, anterior; B, dorsal lip; C, en face; D, lateral interlabium; E, tail, lateral view; F, tail apex; G, precloacal papilla #10; H, postcloacal double papilla.

at about anterior one third of body length. Cuticle finely annulated. Alae run entire length of body, anteriorly united forming flange running posterior to subventral lips; forming cordons on tail. Lips with rounded lateral margins, posteriorly not defined; not pedunculate, without teeth and not laterally constricted; anterolateral angles each with deep socket; pulp anteriorly bilobed. Dorsal lip with 2 lateral double papillae; subventral lips with lateral double papilla and anterolateral papilla with adjacent amphid. Interlabia entirely absent. Ventriculus shorter than wide, with triradiate lumen; ventriculus in line with oesophagus. Ventricular appendage originates from middle of ventriculus, short (24.6-41.3% oesophageal length for the species described herein), sac like, with longitudinal septum. Intestinal caecum absent. Excretory system unilateral, filamentar, with excretory nucleus immediately posterior to excretory commissure; excretory pore opens posterior to nerve ring. Gubernaculum absent. Spicules short (2.2-2.9% BL), alate. Medioventral precloacal papilla present. Tail narrows evenly, apex recurved and provided with fine nodules.

Female reproductive system. Vulva at about anterior one quarter to one third of body. Vagina not distinctly demarcated from uterus. Uterus didelphic, opisthodidelphic, oviducts extending anteriorly to, but not beyond vagina.

TYPE SPECIES

Ichthyascaris lophii Wu, 1949, by monotypy. Wu (1949) did not state where the material he examined was held or to be deposited.

COMPOSITION

Ichthyascaris biwakoensis (Fujita, 1928) n. comb., *I. chirocentri* (Yamaguti, 1935) n. comb., *I. fisheri* (Hooper, 1983) n. comb., *I. gymnocraniae* n. sp., *I. lutjani* (Olsen, 1952) n comb., *I. meditteraneus* (Lèbre and Petter, 1983) n. comb., *I. sillagoides* n. sp., and *I. vicentei* (Santos, 1970) n. comb. All except *I. biwakoensis* are from marine hosts.

REMARKS

The genus *Ichthyascaris* Wu, 1949, has received little attention since its inception. The major compilations of Mozgovoi (1953), and later Yamaguti (1961b) did not include the genus. Hartwich (1957) placed the genus in synonymy with *Raphidascaris*, remarking that the two characters Wu (1949) used to distinguish the genus were probably artefacts. Chabaud (1965) followed Hartwich(1957), but Hartwich (1975) later did not include *Ichthyascaris* in the synonymy for *Raphidascaris*. Although the genus has been overlooked it is distinctive, and differs from *Raphidascaris* in detail of the lip morphology, a character not considered by Hartwich (1957). Removal of the misplaced species from *Raphidascaris* to *Ichthyascaris* will allow for a clearer concept of both genera.

This genus is readily characterised by the simple lips, as long as wide, with rounded lateral margins. This is in great contrast to the lip morphology shown by the genera *Hysterothylacium*, *Raphidascaroides* and *Raphidascaris*, all of which have flanged lips with a clearly defined posterior border. The lack of an intestinal caecum, short ventriculus, short sac like ventricular appendage, caudal cordons and anterior alal form all serve to further distinguish this genus. Wu (1949) established the genus *Ichthyascaris* with a brief illustrated diagnosis. Nonetheless, several critical diagnostic characters are figured or mentioned. These are: 1, the ventriculus and ventricular appendage; 2, lack of interlabia; 3, alae uniting forming a ventral flange; 4, lack of intestinal caecum; and 5, lips without flanges. While there is little doubt that the genus is valid and clearly distinct from *Raphidascaris* (with which it had been synonymised by Hartwich, 1957), the description of the type species is insufficient in detail to allow recognition or clear separation from other species now being placed in *Ichthyascaris*.

The anterior alal morphology, with the alae uniting close the subventral lips is a character unique to this genus. It is primarily on the basis of this character that *Ichthyascaris chirocentri* is transferred from *Raphidascaris*.

Additional species of *Ichthyascaris* for which there was insufficient material for description were obtained from *Macquaria colonorum* (Günther), *Solea* sp., and *Atherinomorus ogilbyi* (Whitley). These worm specimens are held in the collections of the Queensland Museum.

RELATIONSHIPS

The genus most similar to *Ichthyascaris* is *Paraheterotyphlum* Johnston and Mawson, 1948 (see Sprent, 1978b for a detailed description). It differs from *Ichthyascaris* in possessing an intestinal caecum, lacking the distinct united anterior alae and lacking caudal cordons. Both genera share the characteristic lip shape, lack of interlabia and ventricular morphology. *Heterotyphlum* Spaul, 1927 (and see Deardorff and

Overstreet, 1981) is also very similar, but has lips that are much shorter, lacking the characteristic rectangular shape of *Ichthyascaris* or *Paraheterotyphlum*.

The previously named species now assigned to *Ichthyascaris* had all (except *Raphidascaroides fisheri*) been placed in the genus *Raphidascaris* Railliet and Henry, 1915. Smith (1984) gave an excellent redescription of *Raphidascaris acus* (Bloch) the type species for the genus. In comparing the lip morphology of *R. acus* to that of the species now transferred to *Ichthyascaris* it is evident that the species in question are generically incompatible. This is further supported by differences in alal morphology, excretory system and caudal cordons.

There are several other genera that show an affinity to *Ichthyascaris*. Most of these genera would have been placed in the Heterocheilinae (sensu Sprent, 1983) or the Goeziinae (sensu Gibson, 1983). Within these groups they appear to form a group apart from the other genera, characterised by the unique morphology of the ventriculus and ventricular appendage. The ventriculus of these genera is about as wide as the preceding oesophagus and in line with the oesophagus. In those genera for which there are appropriate figures, the ventriculus still maintains the triradiate symmetry of the oesophagus. The ventricular appendage originates from the middle of the ventriculus, in contrast to that of *Hysterothylacium* where the bulb like ventriculus gradually narrows to form the posterior ventricular appendage. The genera forming this group are *Raphidascaris*, *Heterotyphlum*, *Paraheterotyphlum*, *Ichthyascaris*, *Sprentascaris* Petter and Cassone, 1984 and probably also *Alibagascaris* Kalyankar, 1970.

None of these genera have interlabia or teeth with dentigerous ridges. *Sprentascaris* and *Raphidascaris* have flanged lips. It is unclear from Yamaguti's diagnoses (1935, 1961b), or the species contained within the genus, quite where *Raphidascaroides* should be placed.

Most of the genera mentioned above have not been rediagnosed since their inception. In order to facilitate their clear discrimination from *Ichthyascaris* it is necessary to attempt a redefinition that allows comparison to that given for *Ichthyascaris*. To this end the genera *Raphidascaris*, *Raphidascaroides*, *Heterotyphlum* and *Paraheterotyphlum* are rediagnosed with remarks at the end of the text.

Ichthyascaris fisheri (Hooper) n. comb.

Raphidascaroides fisheri Hooper, 1983: 8, Fig. 4.

MATERIAL EXAMINED

Holotype (AM W15713) and allotype (AM W16039).

REMARKS

Examination of the type material showed that discrepancies exist between the material and the figures and description given by Hooper (1983). Hooper (1983) described the species as 'with interlabia ⅓ the length of lips' and 'Lips with dentigerous ridges'. The figures show distinct interlabia, and also what appear to be narrow lateral flanges on the lips. These character states are not present in the holotype and allotype. The lips are simple, without flanges, dentigerous ridges or interlabia, and conform entirely to the diagnosis given here for *Ichthyascaris*. The tail is typical of the shape shown by the genus with the apex turned up and with the alae forming cordons. The alae are united anteriorly forming a flange just posterior to the subventral lips. Accordingly the species is here transferred to *Ichthyascaris*.

Ichthyascaris fisheri, recorded only from flathead (Platycephalidae), is easily separated from other Australian species of the genus by the lateral margins of the lips having a small bulge posterior to the anterolateral sockets and by the very short intestinal caecum.

Ichthyascaris gymnocraniae n. sp.

(Figs 16, 17)

MATERIAL EXAMINED

All taken from the northwestern side of Wistari Reef, Capricorn Group, Queensland, coll. N.L. Bruce and S. Cook. 2 males, 1 female, 21 Apr. 1988, intestine of *Gymnocranius bitorquatus* (HOLOTYPE male, QM GL10260, PARATYPES QM GL10261). Female, 22 Apr. 1988, intestine of *G. bitorquatus* (PARATYPE QM GL10262). Female, 21 Apr. 1988, intestine of *Lethrinus chrysostomus* (sectioned, QM GL10263).

TYPE LOCALITY

Wistari Reef, Capricorn Group, Queensland, 23°26.5'S, 151°54.0'E.

TYPE HOST

Gymnocranius bitorquatus Cockerell, Lethrinidae.

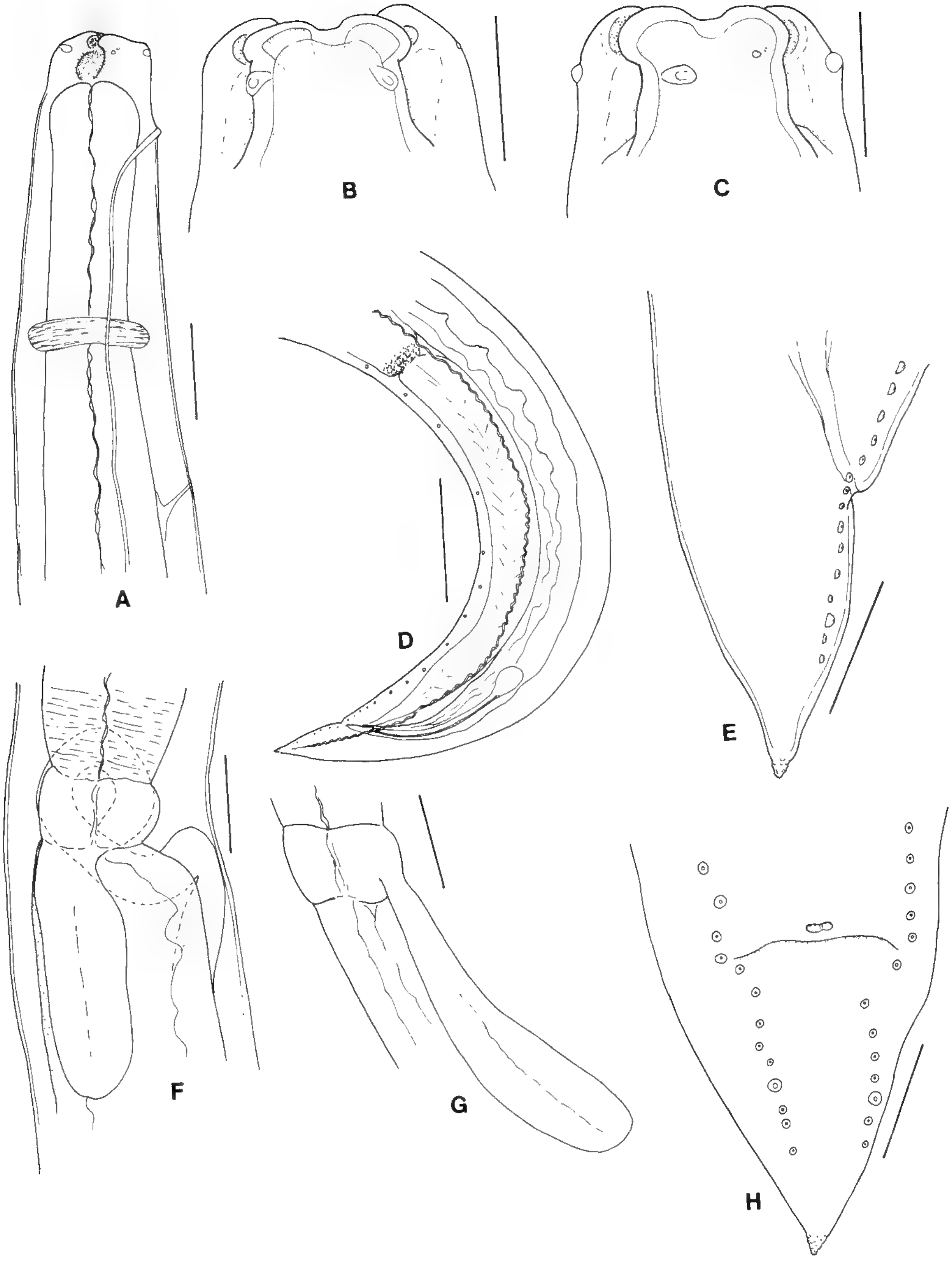

FIG. 16. *Ichthyascaris gymnocraniae* n. sp. Figs. of holotype except where indicated. A, anterior (scale 100 μm); B, dorsal lip ♂ #1 (50 μm); C, subventral lip, ♂ #1 (50 μm); D, caudal region (200 μm); E, tail, lateral view (100 μm); F, ventricular region. ♂ #1 (100 μm); G, ventriculus and appendix (100 μm); H, tail, ventral view, ♂ #1 (50 μm).

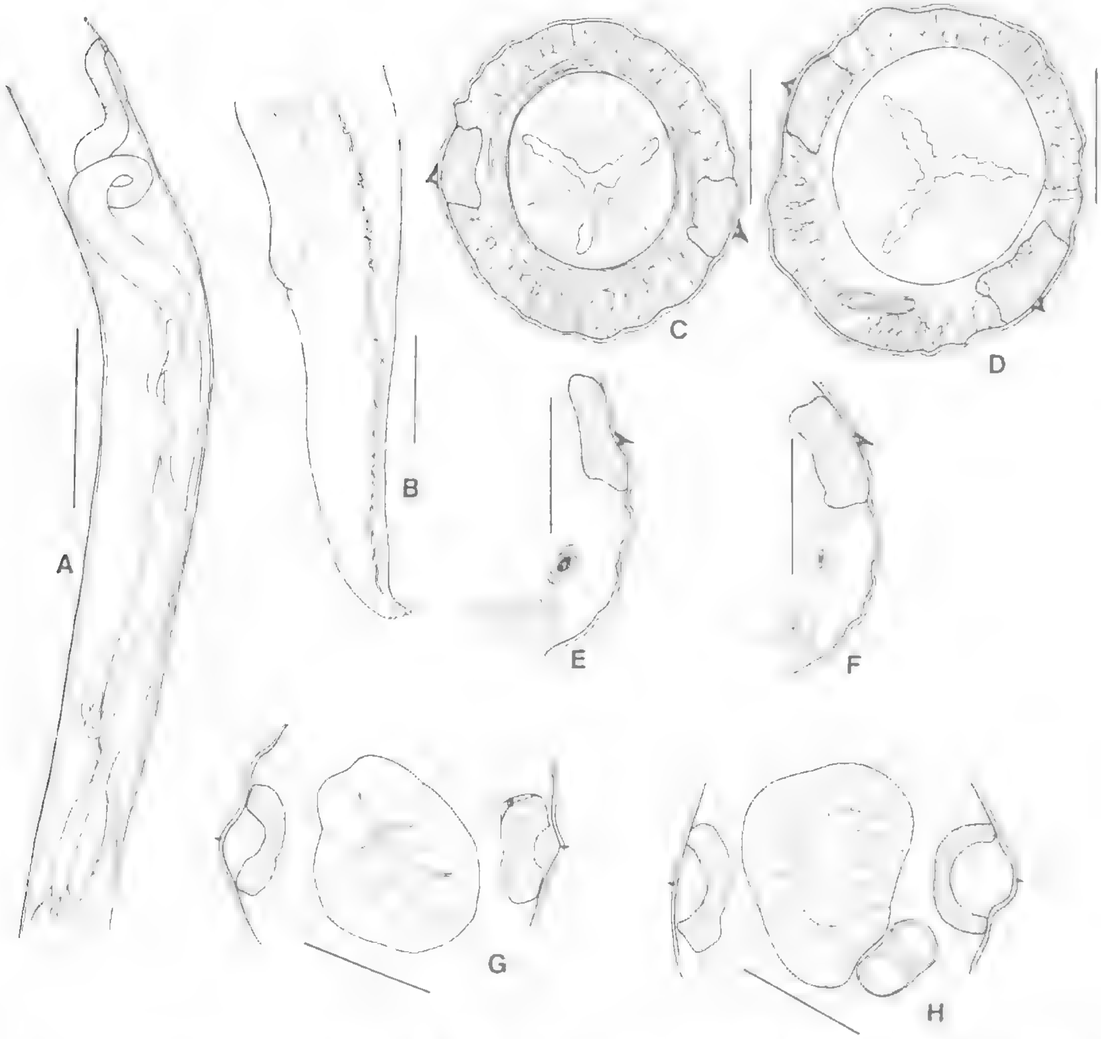

FIG. 17. *Ichthyascaris gymnocraniae* n. sp. A, vagina and uteri, ♀ #1 (scale 200 μm); B, tail, lateral view, ♀ #1 (100 μm); Sections (scales all 100 μm): C, nerve ring; D, excretory duct; E, excretory nucleus; F, posterior to excretory nucleus; G, ventriculus; H, mid ventricular appendix.

DIAGNOSIS

Cuticle finely annulated. Lips as long as, or slightly longer than wide, widest anteriorly. Alae run entire length of body. Caudal papillae pairs: precloacal 24-28; paracloacal 2; postcloacal 7-9, 3rd or 4th from posterior larger than adjacent papillae. Weakly developed medioventral precloacal organ present. Spicules subequal in length, ratio of 1: 1.07-1.08, 2.19-2.91% BL. Tail converging evenly to minutely nodulose apex.

DESCRIPTION

Based on 2 mature males and 2 mature females.

General. Body reaching greatest width at anterior one third to one half of length, of moderately even width. Dorsal lip slightly wider than subventrals. Oesophagus 7.69-9.32% BL. Ventriculus narrower than greatest width of oesophagus, about one half to one third as long as wide (0.45-0.66). Ventricular appendix 24.59-41.27% length of oesophagus. Nerve ring lying between anterior 25.2-29.9% of oesophagus. Excretory system with pore opening distinctly posterior to nerve ring.

Male. Body 11.3-15.0 mm long by 188-291 maximum width; width at oesophageo-intestinal junction 118-249, ratio of greatest width to length 1: 51.6-60.1. Dorsal lip 61-70 long, 66 wide; subventral lips 66-67 long, 56-67 wide. Nerve ring 241-249 from anterior. Excretory pore 353-494 from anterior. Oesophagus widest at posterior one third, 1053-1194 long by 122-160 wide. Ventriculus 80-85 long, 127-150 wide; ventricular appendix 259-385 long, 71 wide, 24.59-32.25% oesophageal length. Ejaculatory duct 799-1175 long, 5.33-10.4% BL. Spicules 306-353 long, 26.04-44.18% ED (mean = 34.85%). Caudal papillae pairs 33-38, changing from button to mamillate at 9th anterior to cloaca. Tail 127-160 long, apex minutely nodulose.

Female. Body 11.6-18.0 mm long by 226-409 maximum width; width at oesophageo-intestinal junction 179-306; ratio of greatest width to length 1: 44.0-51.3. Dorsal lip not measured; subventral lips 56-80 long, 56-80 wide. Nerve ring 249-320 from anterior. Excretory pore 353-470 from anterior. Oesophagus 865-1222 long by 132-216 wide. Ventriculus 71-85 long by 108-188 wide. Ventricular appendix 306-357 long by 75 wide. Vulva opening 2.12-3.57 mm or 18.23-19.84% BL from anterior extremity; vulva area not swollen. Vagina 235-893 long, uterus divides 1834-2538 from vulva, divided branches short, 271-423 long. Oviducts not extending anterior to vulva. Eggs 38-47 in diameter. Tail 390-423 long, apex minutely nodulose.

Variation. The most notable variation is that of the absolute and relative lengths of the ventricular appendage ranging from 24.5%-41.3% oesophageal length.

HOSTS

Presently recorded only from the family Lethrinidae: *Gymnocranius bitorquatus* and *Lethrinus chrysostomus* Richardson.

DISTRIBUTION

At present known only from the type locality.

REMARKS

This species is readily separated from most others of the genus by the lips being abruptly wider anteriorly. *Ichthyascaris lutjani* has similar lips, but has a slender ventricular appendage, is much larger in size, has fewer precloacal papillae (9-11 pairs *vs* 24-28 pairs) and fewer postcloacal papillae (3 pairs vs 7-9 pairs). The remaining species have the lips illustrated as anteriorly rounded, except that the shape of the lips is not known for *I. chirocentri* (Yamaguti). In *I. chirocentri* the number of papillae (60) clearly separates it from *I. gymnocraniae* (33-38).

For details on how to distinguish *I. gymnocraniae* from *I. sillagoides* see the 'Remarks' for the latter species.

ETYMOLOGY

The epithet is taken from the genus name of the type host.

Ichthyascaris sillagoides n. sp.
(Figs 18-20)

MATERIAL EXAMINED

All from *Sillago maculata*, Moreton Bay, southeastern Queensland, coll. G. Berry. Male, HOLOTYPE, 17 Feb. 1981, Deception Bay (QM GL9260). PARATYPES: Female (sectioned), 17 June 1978, Deception Bay (QM GL18776); male, 29 Aug. 1982, (QM GL 9448); 2 females (one for SEM), 23 Apr. 1978, Deception Bay (QM GL8768); female, 23 Apr. 1978, Deception Bay (QM GL8769); female, 17 Jun. 1978, Deception Bay (QM GL9106); female, 29 Aug. 1982, (QM GL9447); female, 29 Aug. 1982, (QM GL9450); female, 29 Aug. 1982, (QM GL9451). Two immature specimens (QM GL9449, AHC 18814).

TYPE LOCALITY

Deception Bay, Moreton Bay, southeastern Queensland.

TYPE HOST

Sillago maculata Quoy and Gaimard, Sillaganidae.

DIAGNOSIS

Cuticle distinctly annulated. Lips with length to width ratio of 1.07-1.18, widest anteriorly. Caudal papillae pairs: precloacal 22-26; paracloacal 1; postcloacal 8-10; medioventral precloacal papilla not discerned; no double papillae. Spicules of approximately equal length, ratio of 1: 1.09; 2.27-2.47% BL. Tail with recurved minutely nodulose apex.

DESCRIPTION

Based on 2 males and 5 females.

General. Body of fairly even thickness. Dorsal lip slightly larger than subventrals; widest at

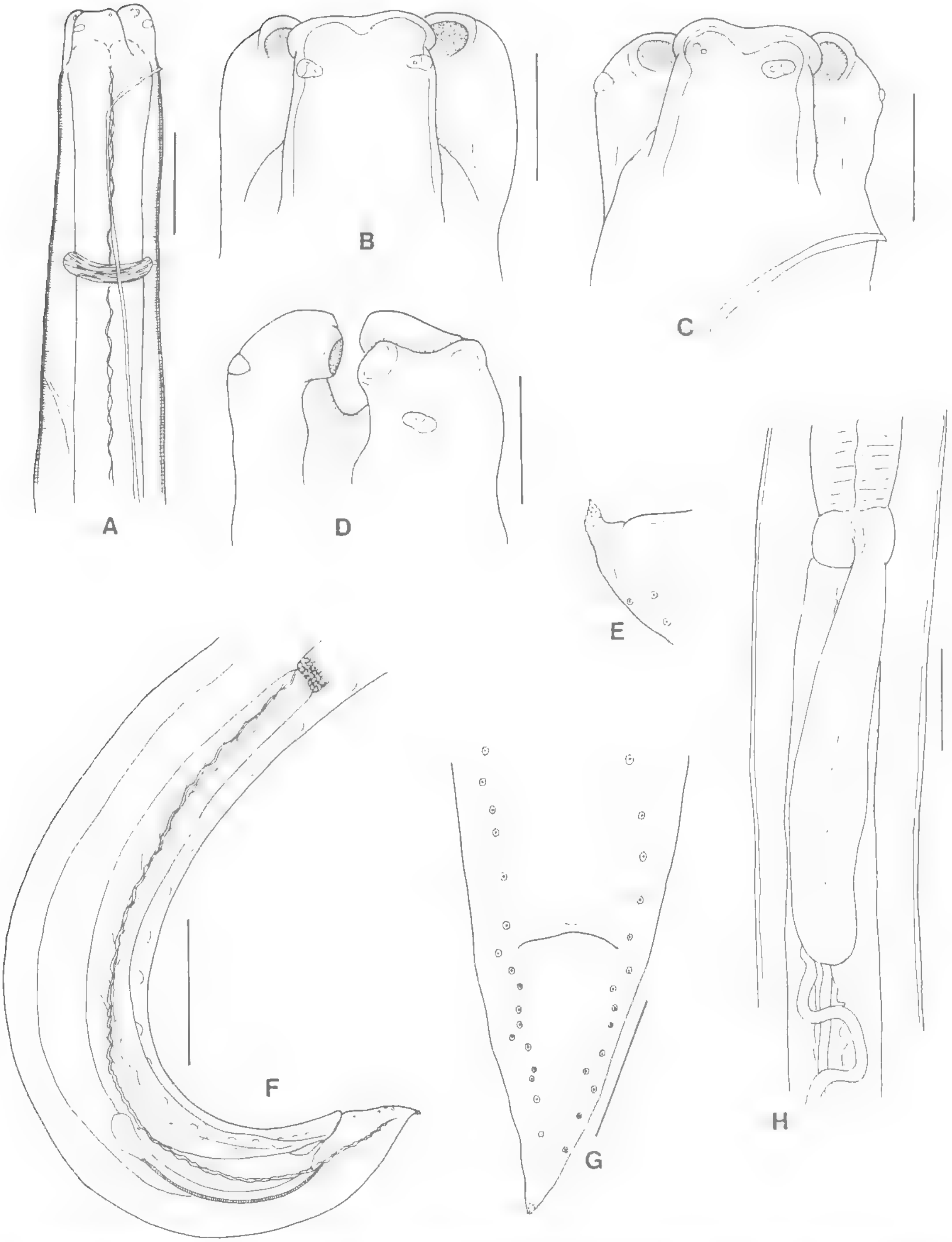

FIG. 18. *Ichthyascaris sillagoides* n. sp. Figs of holotype except where indicated. A, anterior (scale 100 µm); B, dorsal lip, ♀ #21 (50 µm); C, subventral lip, ♀ #2 (50 µm); D, between lips, ♀ #2 (50 µm); E, tail apex; F, caudal region (200 µm); G, tail, ventral view, ♂ #2 (50 µm); H, ventricular area (100 µm).

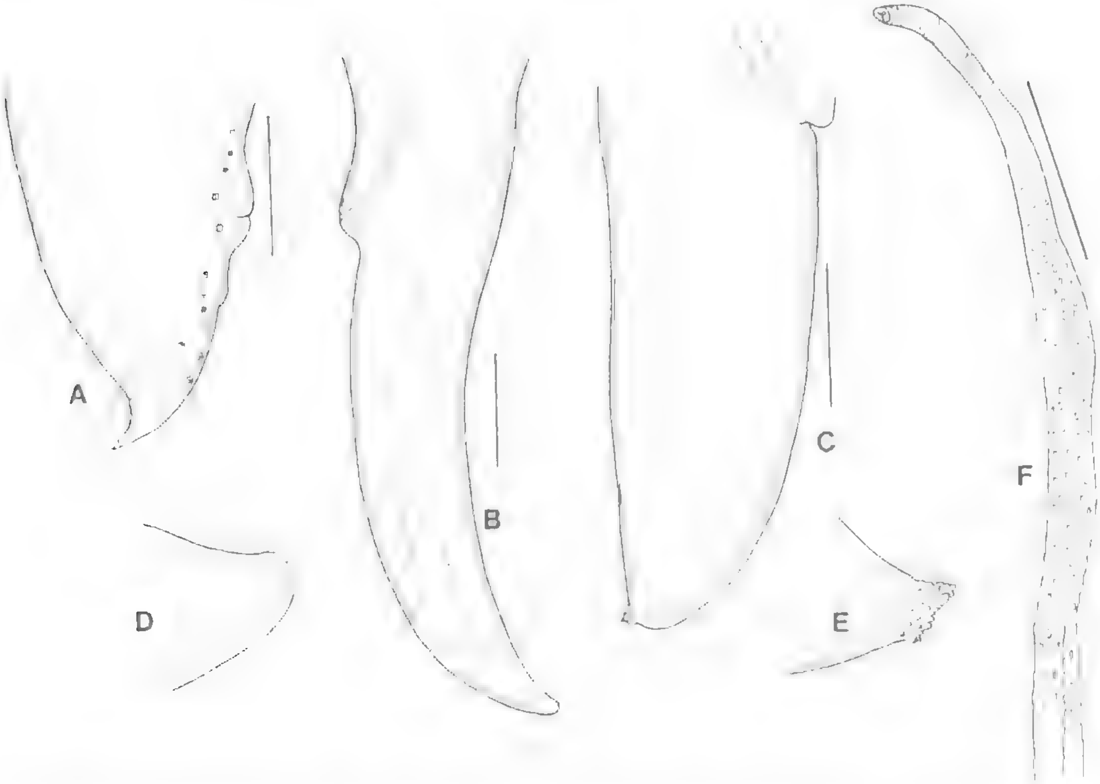

FIG. 19. *Ichthyascaris sillagoides* n. sp. A, tail, lateral view, holotype (scale 50 μm); B, tail, lateral view, ♀ #1 (100 μm), C, tail, lateral view, ♀ #3 (100 μm); D, tail apex, ♀ #1; E, tail apex, ♀ #2; F, vagina and uterus, ♀ #1 (0.5 mm).

anterior margin. Oesophagus 5.91-8.16% BL. Ventriculus slightly narrower than widest level of oesophagus, shorter than long. Ventricular appendix 27.59-38.60% length of oesophagus. Nerve ring lying between anterior 24.83- 31.70% of oesophagus. Excretory system with pore opening distinctly posterior to nerve ring.

Male. Body 9.5-14.2 mm long, 188-212 maximum width; width at oesophageo-intestinal junction 155-165; ratio of greatest width to length 1: 51.0-67.0. Dorsal lip not measured. Subventral lips 47-71 long by 42-71 wide. Nerve ring 230-282 from anterior. Excretory pore 352-376 from anterior. Oesophagus 729-1128 long by 94-113 wide. Ventriculus 52-61 long by 85-94 wide; ventricular appendix 282-447 long by 42-80 wide. Testes extend anteriorly to vicinity of ventricular appendix. Ejaculatory duct 8.82-12.89% BL. Caudal papillae pairs 31-37, changing from button to mamillate at about 8th anterior to cloaca. Spicules 282-306 long 17.7-19.1% ED (one specimen). Tail 103-118 long, apex recurved.

Female. Body 13.6-30.2 mm long, 216-498 maximum width; width at oesophageo-intestinal junction 179-320; ratio of greatest width to length 1: 48.4-67.8 (mean = 1: 59.7). Dorsal lip 94 long by 80 wide (one specimen); subventral lips 66-108 long by 66-94 wide. Nerve ring 291-470 from anterior. Excretory pore 611-423 from anterior (3 specimens). Oesophagus 1109-1833 long by 80-188 wide. Ventriculus 66-103 long by 80-174 wide; ventricular appendage 306-611 long by 66-118 wide. Vulva opening 3.50-9.34 mm or 22.8- 29.0% BL from anterior extremity, vulva area not swollen, ovaries extending to vicinity of vulva. Vagina short 329-517, not abruptly differentiated from uterus. Uterus divides 1192-2350 posterior to vagina, branches 658-1880 long (2 specimens). Eggs 19-47 in diameter. Tail 301-479 long, posteriorly recurved, apex minutely nodulose.

Variation. The two largest female specimens had noticeably thicker tails, while the degree of nodule development on the tail apex also varied. Lip shape varied with regard to degree of indentation of the anterior margin (e.g. comparing Fig. 18B to Fig. 18C) but this may be attributable to angle of observation.

HOSTS

Known only from the type host.

DISTRIBUTION

Known only from localities in Moreton Bay, southeastern Queensland.

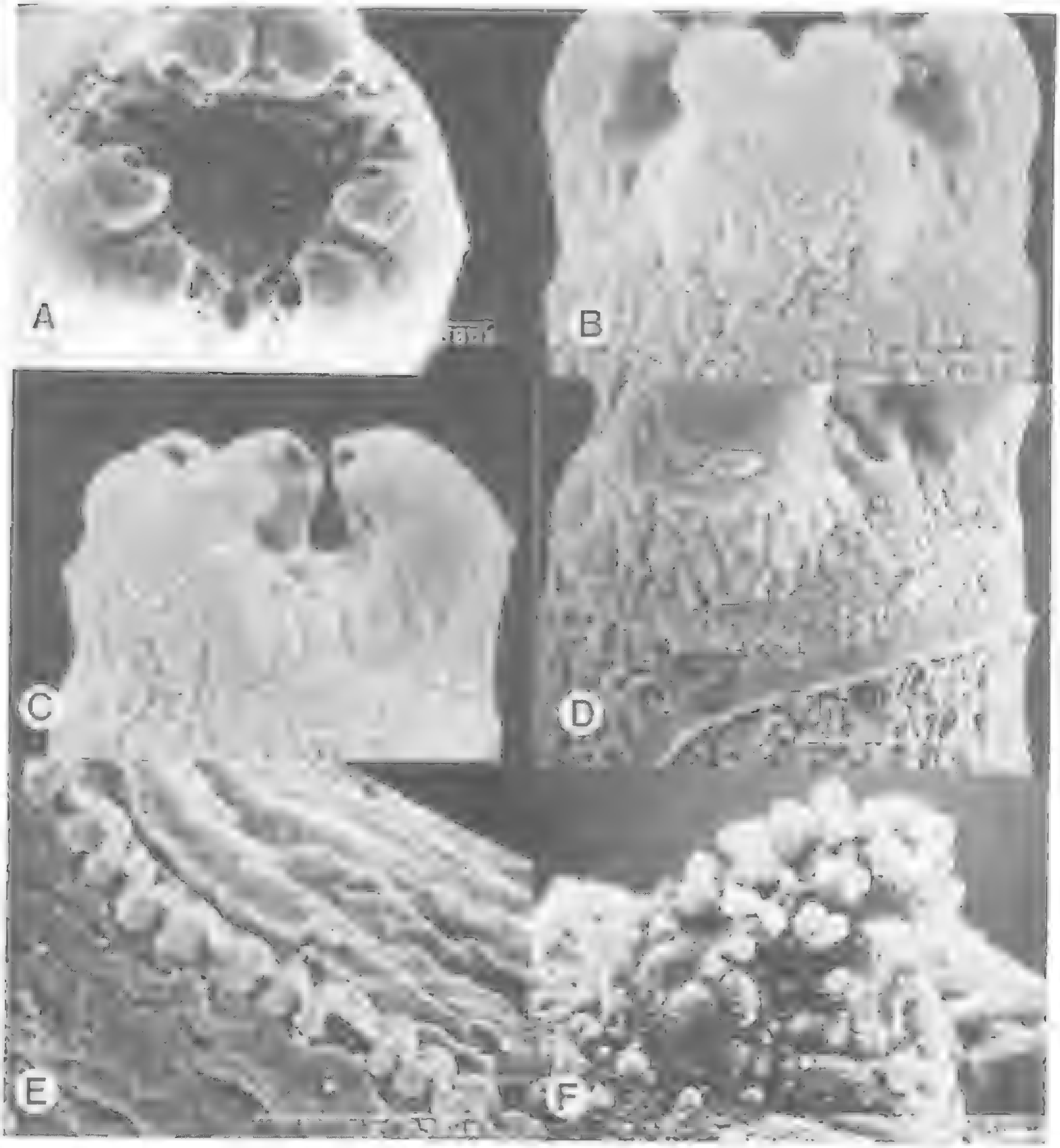

FIG. 20. *Ichthyascaris sillagoides* n. sp. Scanning electron micrographs. A, en face; B, dorsal lip; C, between lips; D, subventral ala; E, caudal cordon; F, cactus.

REMARKS

Ichthyascaris gymnocraniae and *I. sillagoides* are superficially very similar. There are however numerous differences, especially sexual characters, and these are sufficient to consider the two species as distinct. These differences are in *I. sillagoides*: spicules 17.7-19.1% ED (vs 26.1-44.2% ED in *I. gymnocraniae*); ejaculatory duct 8.8-12.9% BL (vs 5.3-10.4% BL); precloacal papillae 22-26 pairs (vs 24-28 pairs); vulva 22.8-29.0% BL from anterior (vs 18.2-19.0% BL); and uterine branches long, 658-1180 (vs short 270-423).

Ichthyascaris sillagoides can be distinguished from other species by the lesser number of precloacal papillae, except for *L. vicentei* and *L. mediterraneus* from which it differs by having more postcloacal papillae.

Khan and Yaseen (1969) described a worm from *Sillaginopsis panijus* using the combination *Raphidascaris panijii* Khan and Yaseen. Smith (1984) considered this species as *species inquirenda*. While the description is not detailed, and the species cannot be reliably assigned to any genus, the very long ventricular appendage suggests that it is not conspecific with the material from *Sillago maculata* described here.

ETYMOLOGY

The epithet is derived from that of the host genus.

REDIAGNOSED GENERA

In order to enable comparisons to be made between *Ichthyascaris* and related genera it is necessary to rediagnose the following genera in as much detail as possible. Without recourse to fresh material, type material, or in some cases a good description, the information contained within these diagnoses is inevitably uneven in detail. Nonetheless these diagnoses are here attempted to allow the clear separation of *Ichthyascaris* from related genera. A second purpose is to draw attention to these genera and highlight the need for additional descriptive data. In this regard it is *Raphidascaroides* that is most deficient in detail, and will remain so until the types or fresh specimens of the type species are redescribed.

Heterotyphlum Spaul

Heterotyphlum Spaul, 1927: 634.- Mozgovoi, 1953; Hartwich, 1957: 238; Yamaguti, 1961b: 31; Deardorff and Overstreet, 1981: 431.

DIAGNOSIS

Body elongate, anterior half manifestly narrower than posterior half; cuticle finely annulated, male with fine crests anterior to cloaca. Alae narrow, originate close to subventral lips, run entire length of body. Lips about half as long as wide, anterior rounded, without anterolateral sockets or dentigerous ridges; without lateral flanges and constrictions, posteriorly not defined. Interlabia entirely absent. Dorsal lip with two lateral double papillae; subventral lips with one double papilla and anterolateral single papilla with adjacent amphid. Ventriculus shorter than wide, in line with oesophagus. Ventricular appendage long (*c.* 62-72% length of oesophagus) anterior half slender, posterior half expanded, sac like. Intestinal caecum present. Excretory pore opens near to nerve ring (excretory system otherwise not described). Gubernaculum absent. Spicules short (*c.* 2.2% BL), alate. Tail broadly rounded, with simple mucron.

Female reproductive system. Vulva situated in anterior half of body (38% BL from anterior), didelphic, opisthodidelphic. Oviducts not extending anteriorly to vagina.

TYPE SPECIES

Heterotyphlum himantolophi Spaul, 1927, by monotypy [BM(NH) 1927.7.22 31-38].

REMARKS

The type species of this genus is still known only from the original material. Of the other species placed in the genus only one has been adequately described and that species has been placed in *Hysterothylacium* by Deardorff and Overstreet (1981). As indicated by Deardorff and Overstreet (1981) the remaining species are in need of redescription before their generic position can be accurately determined.

The morphology of the ventriculus and lips indicates that *Heterotyphlum* is most closely related to *Paraheterotyphlum* and *Ichthyascaris*. *Ichthyascaris* can be distinguished by the longer lips and lack of an intestinal caecum. *Paraheterotyphlum* by having long rectangular lips and a body of even width.

The syntypes of *H. himantolophi* were examined for purposes of the generic diagnosis, and it was noticed that the male tail is provided with fine transverse crests anterior to the cloaca. These are not prominent as in the species of *Maricostula* figured by Bruce and Cannon (1989).

Species placed in the genus (Yamaguti 1961b), all of which should be regarded as *species inquirendae* and *incertae sedis* are: *H. cheni* Hsu, 1957; *H. multipapillosum* (Skrjabin, 1916); and *H. obtuscaudatum* (Zeder, 1800).

Paraheterotyphlum Johnston and Mawson

Paraheterotyphlum Johnston and Mawson, 1948: 102.- Hartwich, 1957: 242; Yamaguti, 1961b: 169; Schmidt and Kunz, 1973: 483; Sprent, 1978b: 164.

DIAGNOSIS

Body elongate, of even thickness. Cuticular annules not evident. Alae not cervically expanded; run entire length of body, originating posterior to subventral lips. Lips longer than wide, rectangular, not pedunculate, posteriorly not defined; without dentigerous ridges and lateral flanges, not laterally constricted; anterolateral corner each with socket. Dorsal lip with 2 lateral double papillae; subventral lips each with double papilla and mediolateral single papilla and adjacent amphid. Interlabia entirely absent. Ventriculus shorter than wide, with triradiate lumen; in line with oesophagus. Ventricular appendage long (35-58% oesophageal length). Intestinal caecum present. Excretory system filamentar, unilateral, nucleus near nerve ring; excretory pore opening immediately posterior to nerve ring. Gubernaculum absent. Spicules short (*c.* 2% BL), alate. Tail straight, narrowly rounded, apex minutely nodulose.

Female reproductive system. Vulva in anterior one third of body, didelphic, opisthodidelphic; oviducts not extending anterior to vagina.

TYPE SPECIES

Paraheterotyphlum australe Johnston and Mawson, 1948, by monotypy.

REMARKS

The genus and its constituent species have been discussed in detail by Sprent (1978b). The most closely allied genus is *Ichthyascaris* which has a near identical lip morphology. *Paraheterotyphlum* differs in having shallower lip sockets and an intestinal caecum. A further difference is that the two species of *Paraheterotyphlum* are far larger (61-158 mm) than most *Ichthyascaris* (up to 30 mm) although size is not regarded as a character of generic significance. However *I. lutjani* is recorded 32-72 mm which overlaps with that for *Paraheterotyphlum*. *Heterotyphlum* is distinguished by its very much shorter lips. Two species from sea snakes are known, the type species and P. ophiophagos Schmidt and Kunz, 1973.

Raphidascaris Railliet and Henry

Raphidascaris Railliet and Henry, 1915.- Mozgovoi, 1953: 402; Hartwich, 1957: 237; 1974: 9; 1975: 101; Yamaguti, 1961b: 35; Yorke and Maplestone, 1926: 274; Chabaud, 1965: 904.
Neogoezia Kreis, 1937: 129.

DIAGNOSIS

Male (from Smith, 1984). Body elongate, finely annulated. Alae originate from between bases of subventral lips and run to middle of tail; cervically expanded, without caudal cordons. Lips with lateral flanges, medially constricted; with postlabial grooves; pulp anteriorly bilobed. Dorsal lip with two lateral double papillae; subventral lips with double papilla and anterolateral papilla with adjacent amphid. Interlabia absent. Ventriculus shorter than long, in line (= cylindrical) with oesophagus. Ventricular appendage with septum. Intestinal caecum absent. Excretory system filamentar, posteriorly bilateral, with reduced right canal. Excretory nucleus distinctly posterior to commissure (Gibson, 1983, fig. 1, C1). Excretory pore opening posterior to nerve ring. Gubernaculum absent. Spicules short, subequal, alate. Precloacal medioventral papilla present. Tail curving ventrally, apex narrowed, unornamented.

Female reproductive system. Vulva opening between anterior one quarter and one third of body. Uterus didelphic, opisthodidelphic; oviducts not extending anterior to vulva.

TYPE SPECIES.

Ascaris acus Bloch, 1779, by original designation.

REMARKS

Smith (1984) redescribed *Raphidascaris acus* in excellent detail with a full synonymy and also listed the species then placed in the genus. Of a total of 10 species that Smith considered potentially valid, he regarded five as *species inquirendae*. All of the remaining species, for which there were adequate figures, are here transferred to *Ichthyascaris*.

As discussed for *Raphidascaroides* the interpretation of interlabia is of great importance in discriminating these two genera. Two species of *Raphidascaroides* (*R. bishaii* and *R. chilomycteri*) differ from *Raphidascaris* only by having distinct (as figured) interlabia. Yet, examining the SEM's of Smith (1984) one sees a rudimentary interlabial knob (cf. Soleim, 1984) or what is formed by united postlabial grooves. Redescription and reassessment of interlabial morphology is necessary before generic reassignment of those species can be undertaken.

At present the type species is the only identifiable species of the genus. Species of doubtful status are listed by Smith 1984.

Raphidascaroides Yamaguti

Raphidascaroides Yamaguti, 1941: 355.- 1961b: 36; Mozgovoi, 1953: 418; Chabaud, 1965: 995; Hartwich, 1957: 239; 1974: 9.

Ryjikovascaris Mozgovoi, 1950.- 1953: 419.

DIAGNOSIS (adapted and expanded from Yamaguti, 1941, 1961b).

Body elongate, finely annulated. (Alae not described). Lips with lateral flanges, medially constricted, with dentigerous ridges; pulp anteriorly bilobed. Dorsal lip with two lateral double papillae; subventral lips with double papilla and anterolateral single papilla with adjacent amphid. Distinct interlabia present. Ventriculus shorter than long, with ventricular appendage. Intestinal caecum absent. Excretory pore opens posterior to nerve ring (excretory system otherwise undescribed). Gubernaculum absent. Spicules subequal in length, alate. Tail weakly curved ventrally, apex minutely nodulose.

Female reproductive system. Vulva situated about one third of body length from anterior; oviducts not extending anterior to vulva.

TYPE SPECIES

Raphidascaroides nipponensis Yamaguti, 1941, by original designation.

REMARKS

Yamaguti (1941) established the genus for one species and a subspecies of the nominate type species. Later (Yamaguti, 1961a) he described a second species, not mentioning the presence of dentigerous ridges. When redefining the genus (Yamaguti, 1961b), the diagnosis was modified by adding in a footnote '[dentigerous ridges] Absent occasionally'. Species were slowly added to the genus, and by 1988 eleven species had been assigned to the genus. Two characters are critical in the discussion of *Raphidascaroides*: dentigerous ridges on the lips and interlabial morphology. Lip shape is a further character that is of significance.

Of the species currently placed in the genus only those that Yamaguti (1941) originally placed in the genus and *R. fisheri* Hooper, 1983 have been described as having dentigerous ridges. No species have had the dentigerous ridges figured. Examination of the type material of *R. fisheri* failed to reveal dentigerous ridges, and the species has been transferred to *Ichthyascaris* (see the species account and 'Remarks' for that genus). Presence of a dentigerous ridge is a character that is consistent within genera, and it would seem unacceptable to have both states within a single genus. Therefore those species without dentigerous ridges should be reassigned.

Yamaguti's (1941, 1961a, 1961b) descriptions clearly indicate that substantial interlabia were present in the species he examined, describing them as 'conical' (Yamaguti, 1941) and 'nearly half as long as lips' (Yamaguti, 1961a). In at least one species currently placed in the genus, *R. africanus* Khalil and Oyetayo, 1988, the SEMs show that interlabia, in the sense of Yamaguti (1941, 1961a) or as shown by *Hysterothylacium* and *Maricostula*, are absent.

There is a problem here of intergradation of characters and of interpretation. Interlabial morphology has been discussed by Soleim (1984), who reiterated Berland's (1961) distinction between interlabia and semi-interlabia. In the genera here under discussion all interlabia are of the latter category. This interlabial form is not clearly defined, and when reduced causes problems in interpretation. In the genus *Ichthyascaris*, totally lacking postlabial grooves, the lack of interlabia is unambiguous. In species with defined postlabial grooves, the continuation of the groove clearly gives the impression of an interlabium. This is clearly shown by *Hysterothylacium tasmaniense* where the interlabial structure is sessile and in great contrast to the form shown by *Hysterothylacium zenis* (Fig. 13G) or species of *Maricostula* Bruce and Cannon, 1989 (SEM's). While it is pertinent therefore to attempt differentiate between postlabial grooves, sessile interlabia and semi-interlabia, it is immediately obvious that these first two states will intergrade, whereas the free standing ('non-sessile') form is distinct.

Of the species currently placed in *Raphidascaroides* four are of uncertain status and those are regarded here as *species inquirendae*: *Raphidascaroides armatusi* Gupta and Srivastava, 1984; *Raphidascaroides blochii* Bilqees and Khanum, 1974; *Raphidascaroides jagganathai* Gupta and Srivastava, 1984; *Raphidascaroides trachinocephalausi* Rajya Lakshmi *et al.*, 1985. No detailed figures have been given for lip shape, and the species descriptions are not in sufficient detail to allow specific determination or generic placement.

Both *Raphidascaroides diadonis* (Thwaite, 1927) and *R. africanus* have a similar lip morphology. That is flanged lips which are posteriorly narrowed (or angled) with a medial constriction, and lip papillae positioned anterior to the constriction. The recently described species *Sprentascaris hypostomi* Petter and Cassone, 1984 has a cephalic morphology entirely similar to that of *R. africanus* and, contrary to generic diagnosis given for the genus (Petter and Cassone, 1984), is clearly figured with rudimentary interlabia (Petter and Cassone, 1984, fig. 6D). While not questioning the validity of *Sprentascaris* it seems probably that the species mentioned above should be placed within a separate genus, defined by their distinctive lip morphology. *Ryjikovascaris* Mozgovoi, currently placed in synonymy with *Raphidascaroides*, is an available name but redescription of the type species *R. diadonis* is necessary before the validity of the genus can be reassessed.

Both *Raphidascaroides chilomycteri* and *R. bishaii* are figured with prominent interlabia, and it is this character alone which separates them from *Raphidascaris*. The labial and interlabial morphology of these two species also needs to be reassessed.

At present the species are retained within their current combinations and other than those species listed in the preceeding as *species inquirendae* the genus consists of: *R. nipponensis*, the type species and *R. nipponensis lophii* Yamaguti 1941. Also within the genus, but here regarded as *incertae sedis* are: *Raphidascaroides bishaii* Khalil, 1961, *Raphidascaroides chilomycteri* Yamaguti, 1961b, *Raphidascaroides africanus* Khalil and Oyetayo, 1988 and *Raphidascaroides diadonis* (Thwaite, 1927).

Resolution of the generic concept of *Raphidascaroides*, which at present is very loose, and its constituent species can only come about with a detailed redescription of the type species coupled with re-examination of the type specimens. Unfortunately the types are not available for loan, and it is not possible to add further to the descriptions of the type species.

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REDESCRIPTION OF THE ASCARIDOID NEMATODE *HYSTEROTHYLACIUM SCOMBEROMORI* (YAMAGUTI) FROM AUSTRALIAN SPANISH MACKEREL *SCOMBEROMORUS COMMERSON* (LACEPÈDE)

NIEL L. BRUCE

Bruce, N.L. 1990 08 31: Redescription of the ascaridoid nematode *Hysterothylacium scomberomori* (Yamaguti) from Australian spanish mackerel *Scomberomorus commerson* (Lacepède). *Memoirs of the Queensland Museum* 28(2): 427-434 Brisbane. ISSN 0079-8835.

Stomachs of 5 species of mackerel were examined. *Hysterothylacium* were obtained only from *Scomberomorus commerson. Hysterothylacium scomberomori* is redescribed, together with comments on another undescribed species. *Goezia aspinulosa* Arya is placed in synonymy with *H. scomberomori*. The other ascaridoids recorded from mackerels are discussed. Notes are included on *Hysterothylacium* sp. which occurs concurrently with *H. scomberomori* in stomachs of *Scomberomorus commerson*. ☐*Ascarididoid nematode, Hysterothylacium, mackerel, Scomberomorus commerson.*

Niel L. Bruce, Queensland Museum, PO Box 300, South Brisbane, Queensland 4101, Australia; 31 January, 1989.

Ascaridoid nematodes from Australian pelagic marine fishes were reviewed by Bruce and Cannon (1989). Since the completion of that work a small number of specimens has been collected from *Scomberomorus commerson* (Lacepède) from Queensland waters. The specimens proved to belong to two species of *Hysterothylacium* Ward and Magath: *H. scomberomori* (Yamaguti, 1941) and an undescribed species. The undescribed species is represented by four mature females, but no males. This record of *H. scomberomori* brings the total number of adult marine species of the genus recorded from Australia (Bruce,1990; Bruce and Cannon, 1989) to nine.

Five species of mackerel were examined for worms. With the exception of one worm from the Solomon Islands, all were collected from eastern Queensland. The species examined were: *Scomberomorus commerson* (Lacepède), Lizard Island (northern Great Barrier Reef) (19 examined), Heron Island (southern Great Barrier Reef) (14), southeastern Queensland (10); *Scomberomorus munroi* Collette and Russo, southeastern Queensland (35); *Scomberomorus queenslandicus* (Munro), Heron Island (1), southeastern Queensland (34); *Scomberomorus semifasciatus* (Lacepède), Lizard Island (5); *Grammatorcynus bicarinatus* (Quoy and Gaimard), Lizard Island (7). Nomenclature for the hosts follows Collette and Russo (1984).

All material is housed in the Lower Invertebrates collections of the Queensland Museum (QM). Abbreviations used are BL - body length; ED - ejaculatory duct. All measurements are in microns (μm) unless otherwise indicated and were obtained using a calibrated micrometer eyepiece. Numbers in the figure caption refer to specimens numbered in the collection.

SYSTEMATICS OF ASCARIDOIDS FROM MACKERELS

Mackerels of the genera *Scomber* and *Scomberomorus* are important food fishes in many parts of the world. Larval ascaridoids, commonly of the genera *Anisakis* Dujardin, *Contracaecum* Railliet and Henry, *Hysterothylacium* Ward and Magath and *Terranova* Leiper and Atkinson, have been widely reported in mackerel hosts (e.g., Beumer *et al.*, 1982; Cannon, 1977; Korotaeva, 1974; Oshima, 1972). Not surprisingly there are many nominal species. Most of these are unidentifiable by contemporary standards, with brief and sometimes unillustrated descriptions. For many of these species there is no information on the whereabouts of the type material or, indeed, if there was any. A survey of the literature revealed 9 names which have been established for ascaridoids with species of *Scomber* or *Scomberomorus* as type host. Of these names I regard four as valid. It is important to recognize that although some of these names are here regarded as *nomina dubia* and are unlikely ever to be resolved, they still remain available. The species involved are listed in Table 1 together with remarks on their status. All names based on larval stages are here regarded as *nomina dubia*.

SPECIES	HOST	REFERENCE	TYPES	REMARKS
Goezia aspinulosa Arya, 1980	*S. guttatus*	present work	Jodhpur Univ.	Synonym of *H. scomberomori*
Dujardinascaris cybii Arya and Johnston, 1978	*S. guttatus*		?	larva of *Terranova* ?
Hysterothylacium fortalazae (Klein, 1973)	*S. brasiliensis* and spp.	Deardorff and Overstreet, 1981	OCI	valid
Porrocaecum paivai Silva Motta and Gomes, 1968	*S. cavalla*		OCI	valid, *incerta cedis*
Ascaris papilligerum Creplin, 1846	*Scomber scomber*	Stossich, 1896	?	valid, *nomen dubium*
Ascaris pedum Deslongschamps, 1824	*Scomber scomber*	Stossich, 1896	?	*nomen dubium*
Hysterothylacium saba (Yamaguti, 1941)	*Scomber japonicus* and spp.		MPM	valid
Hysterothylacium scomberomori (Yamaguti, 1941)	*S. sinensis*, *S. commerson*	present work	MPM	valid
Ascaris scombromorum Stossich, 1892	*Scomber colias*	Stossich, 1896	?	larva, *nomen dubium*
Hysterothylacium sp.	*S. commerson*	present work		known only from females

TABLE 1. Ascaridoid species described from type hosts of the genera *Scomber* and *Scomberomorus* (*S.* = *Scomberomorus;* OCI = Oslwaldo Cruz Institute; MPM = Meguro Parasitological Museum).

There are several other species, such as *Hysterothylacium fabri* (Rudolphi), *H. aduncum* (Rudolphi) and *H. incurvum* (Rudolphi) (see Mozgovoi, 1953; Yamaguti, 1961; Zhukov, 1960), that have been widely recorded from a variety of hosts including scombroid fishes. These species were not established on the basis of type material from *Scomber* or *Scomberomorus* hosts. In many cases the identities of these species are uncertain or, when reassessed, are shown to be misidentifications. Examples of such misidentifications include records of *Maricostula incurva* (in various combinations) from hosts other than *Xiphias* and records of *Hysterothylacium cornutum* (Stossich) from hosts other than tunas (Bruce and Cannon, 1989). Without examination of the material on which the decisions were made, it is not possible to corroborate or refute many of the older determinations. To tabulate the numerous unsubstaniated records of ascaridoids from scombroid hosts is a task beyond the scope of this work and such records are not included in Table 1.

Hysterothylacium scomberomori
(Yamaguti) (Figs 1, 2)

Contracaecum scomberomori Yamaguti, 1941: 362, pl.V, figs 21, 22, text figures 18, 19.—1962: 30.
Contracaecum (*Erschovicaecum*) *scomberomori*—Mozgovoi, 1953: 208, fig. 127.
Goezia aspinulosa Arya, 1980: 96, fig. 1.
Hysterothylacium scomberomori.—Deardorff and Overstreet, 1981: 1042.

MATERIAL EXAMINED

All from stomachs of *Scomberomorus commerson* (Lacepède). Male, Lizard Island, 5.xi.1988, coll. L.R.G. Cannon and N.L. Bruce. (QM GL10264). Male, 10 females, Heron Island Reef, 26.iv.1988, coll. N.L. Bruce and S. Cook (QM GL10147). 2 females, several immature, northern side of Wistari Reef, 21.iv.1988, coll. N.L. Bruce and S. Cook (QM GL10148). 2 damaged females, 2 immature, Heron Island Reef, 25.iv.1988, coll. N.L. Bruce and S. Cook (QM GL10146). 2 females (frozen sample), off Moreton Island, iv.1988, coll. S. Watson and N.L. Bruce (QM GL10265). 2 males, Moreton Bay, 12.ii.1989, coll. T.H. Cribb (QM GL10343). Female, Vana Vana, Solomon Islands, viii.1988, coll. CSIRO (QM GL10266).

Types

Believed to be held at the Meguro Parasitological Museum, Tokyo, Japan. S. Kamegai (*in litt.*) informs me that the collection was received in poor condition, uncatalogued, and therefore type specimens cannot be identified.

Type Locality

Yamaguti (1941) merely stated 'Pacific'. Collette and Russo (1984) give the distribution of the type host from Japan to Cambodia and Vietnam. The probable type locality can therefore be restricted to north western Pacific.

Type Host

Yamaguti (1941) gave *Scomberomorus chinensis* as the host for his material. The currently accepted name and spelling (Collette and Russo, 1984) is *Scomberomus sinensis* (Lacepède).

Diagnosis

Cuticle with distinct cuticular rings. Lips with length to width ratio 1: 1.08-1.33 (mean = 1.14, n=5), with deep postlabial grooves; lateral constriction wide, positioned slightly less than one third length from anterior. Alae commence posterior to ventral postlabial groove of subventral lips. Caudal papillae pairs: precloacal 28-33; paracloacal 2-3; postcloacal 7-11, without doubled papillae; medioventral precloacal organ present. Postcloacal pad present. Spicules approximately equal in length, 1: 1.02-1.09, 3.01-4.60% BL. Tail apex with 5-7 small acute spines.

Description

Based on 3 mature males, 1 mature female and 4 immature females.

General. Body reaching greatest width about midbody. Dorsal lip slightly shorter than subventrals, flanges moderately developed, triangular. Interlabia prominent, not extending beyond anterior of oesophagus, less than half length of lips. Oesophagus 6.97-7.83% BL. Ventriculus narrower than widest level of oesophagus, longer than wide. Ventricular appendage 27.9- 37.5% length of oesophagus. Intestinal caecum 18.2-25.0% length of oesophagus. Nerve ring lying between anterior 25.6-29.4% of oesophagus. Excretory system filamentar, unilateral, with canal extending slightly anterior to commissure, posteriorly beyond ventriculus.

Male. Body 19.2-43.8 mm long, 353-818 maximum width; width at intestinal/oesophageal junction 273-395, ratio of greatest width to length 1: 42.1-54.4. Dorsal lip 71 long by 94 wide (one specimen); subventral lips 85-141 long by 94-150 wide. Nerve ring 442-630 from anterior. Excretory pore 470-705 from anterior. Oesophagus 1504-2632 long by 118-179 wide. Ventriculus 71-118 long by 82-141 wide; ventricular appendage 564-799 long by 47-66 maximum width. Intestinal caecum 273-658 long by 108-188 wide. Ejaculatory duct 1,692-3,854 long, 8.8- 10.6% BL. Spicules 884-1,363 long, 37.9-52.2% ED. Caudal papillae pairs 40-43, changing from button to mamillate at about 8th anterior to cloaca. Tail tapering evenly, 155-329 long.

Female. Body 28.3 mm long, 705 maximum width; width at oesophageal/intestinal junction not observed; ratio of maximum width to length 1: 40.1. Dorsal lip 118 long by 127 wide. Subventral lip 122 long by 136 wide. Nerve ring and excretory pore not observed. Oesophagus 1974 long by 188 wide. Ventriculus 235 long by 160 wide; ventricular appendage lost in dissection. Intestinal caecum 432 long by 235 wide. Vulva opening 10.0mm or 35.3% BL from anterior, vulva area not swollen. Vagina 3290 long; uterus undivided for 846, divided part 3478. Eggs about 47. Tail 564 long.

Immature females. Body length 12.5-22.5 mm. Oesophagus 1105-1739 long by 84-122 wide; 7.73-9.30% BL. Ventricular appendage 376-564 long by 33-71 wide; 31.85-39.29 length of oesophagus. Intestinal caecum 165-371 long by 66-118 wide; 14.57-21.33% length of oesophagus. Vulva 4.57-8.34 mm or 28.90-37.04% BL from anterior.

Variation. The largest males (QM GL10342) have the tail more abruptly narrowed than shorter males and also have a greater number of postcloacal papillae (11) than the smaller males (7-8).

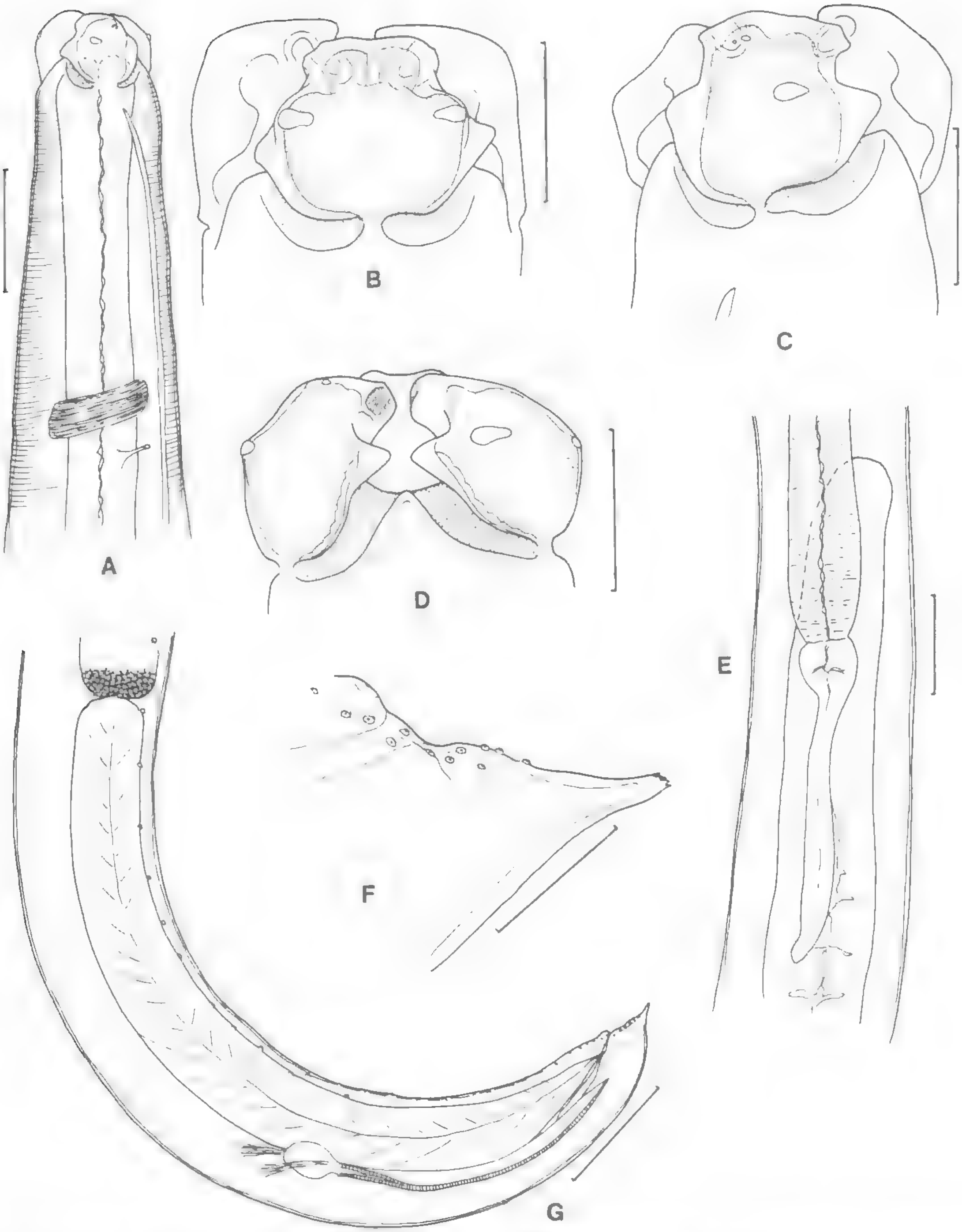

FIG. 1. *Hysterothylacium scomberomori*. A, anterior end, ♂#1 (scale bar 200μm); B, dorsal lip, ♀#5 (100μm); C, subventral lip, ♂#2 (100μm); D, interlabium, ♂ #2 (100μm); E, ventricular region, ♂#2 (200μm); F, tail, lateral view, ♂#2 (100μm); G, caudal area, ♂#2 (400μm).

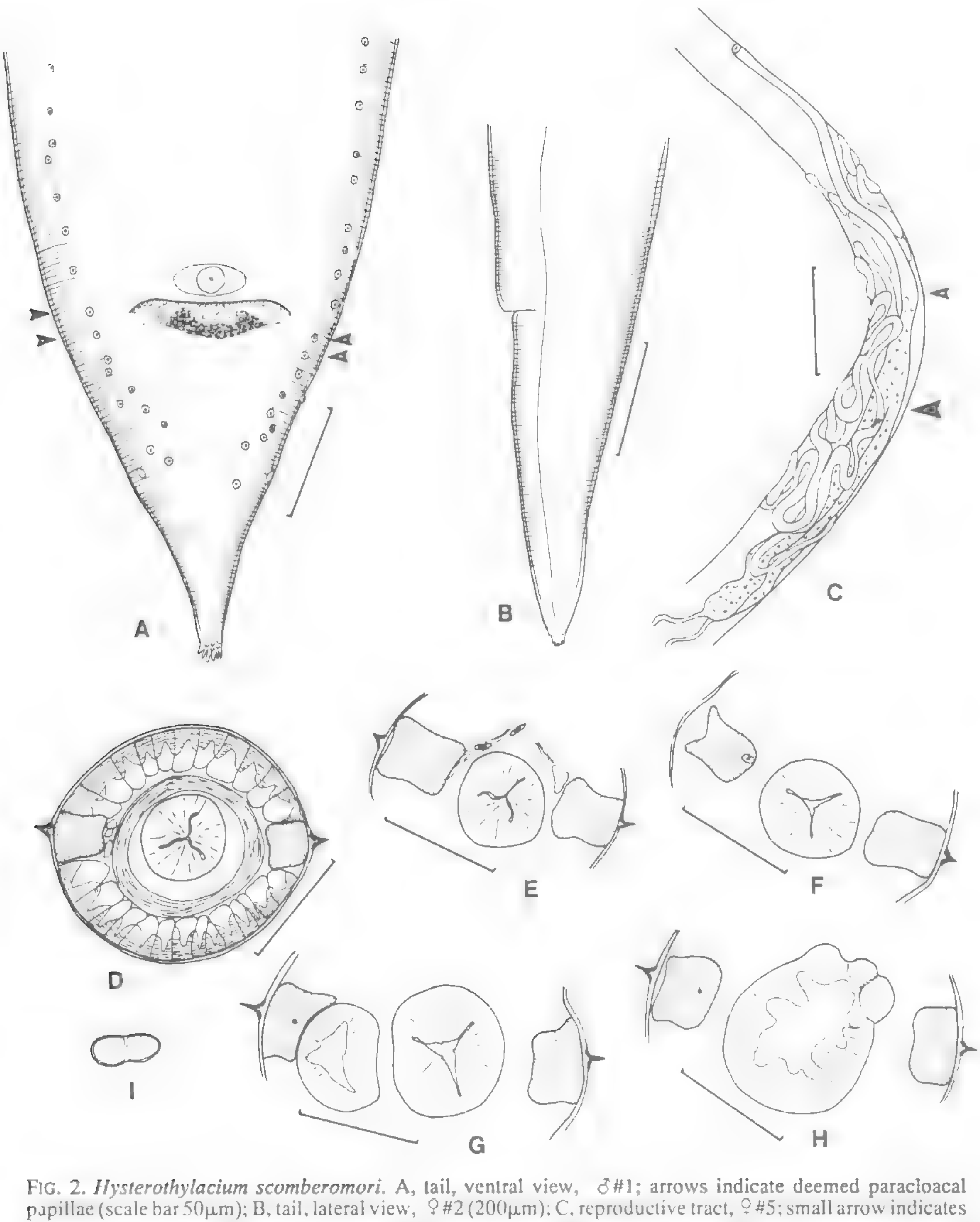

FIG. 2. *Hysterothylacium scomberomori*. A, tail, ventral view, ♂#1; arrows indicate deemed paracloacal papillae (scale bar 50μm); B, tail, lateral view, ♀#2 (200μm); C, reproductive tract, ♀#5; small arrow indicates end of vagina, large arrow indicates point of division of uterus (1.0mm). Sections (from immature female, scale bars all 50μm): D, through nerve ring; E, excretory commissure; F, about 80μm posterior to nerve ring; G, anterior of intestinal caecum; H, posterior of ventriculus; I, mid-ventricular appendage.

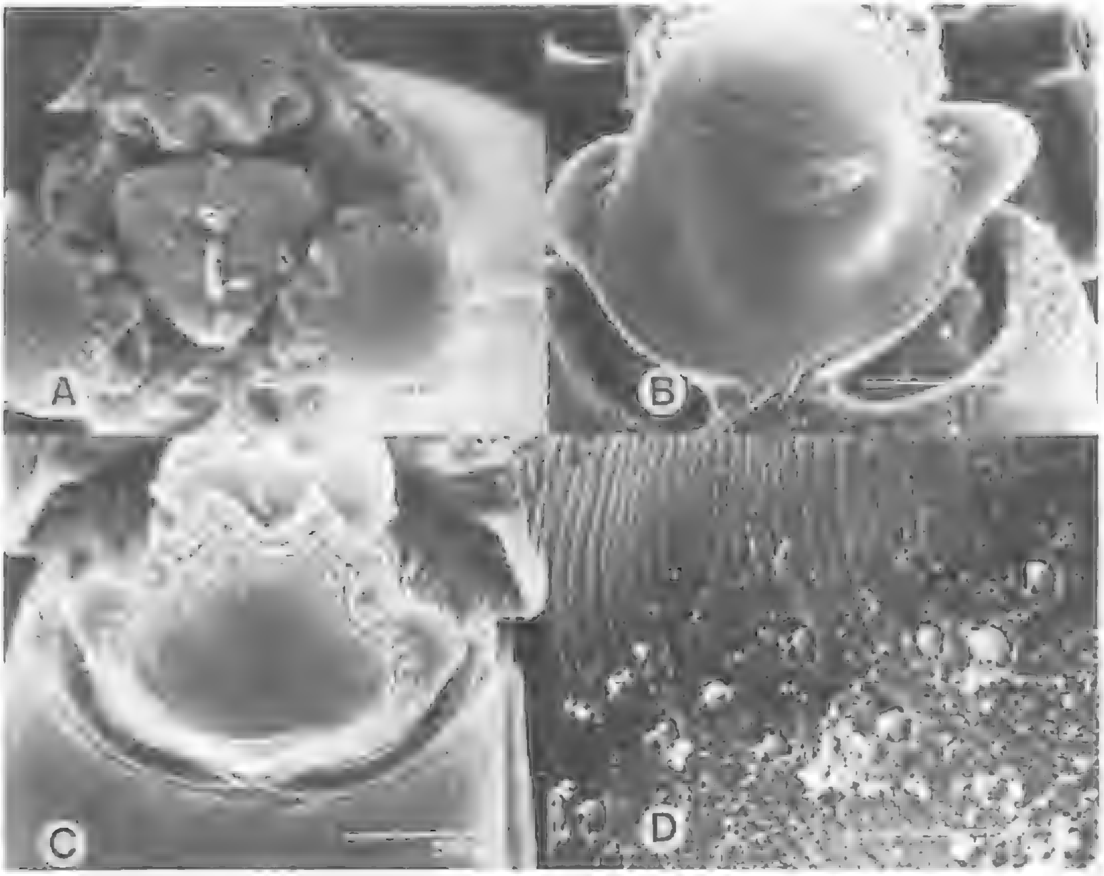

FIG. 3. *Hysterothylacium scomberomori*. Scanning electron micrographs. A, en face; B, subventral lip; C, dorsal lip; D, postcloacal papillae.

HOSTS

Australian material recorded only from *Scomberomorus commerson*; also *Scomberomorus sinensis* (type host) and *Scomberomorus guttatus* (Bloch and Schneider) by Arya (1980, see synonymy).

DISTRIBUTION

In Australia, at least in Queensland, presumably throughout the range of *Scomberomorus commerson*. One specimen recorded from Solomon Islands. Also India (Arya, 1980) and within the range of *Scomberomorus sinensis*, that is, southeast Asia to Japan (Collette and Russo, 1984) if the type host was correctly identified.

REMARKS

The adult male material at hand agrees well with the brief description and figures of Yamaguti (1941). Particular points of correspondence include the proportions of the oesophagus, intestinal caecum and ventriculus, the caudal papillae and spicule details and the description of the tail. Other ascaridoid species described from *Scomberomorus* hosts are *Hysterothylacium fortalazae* (Klein) (Deardorff and Overstreet, 1981), *Porrocaecum* (*P.*) *paivai* Silva Motta and Gomes, 1968, *Dujardinascaris cybii* Arya and Johnston, 1978 and *Goezia aspinulosa* Arya, 1980.

Hysterothylacium fortalazae is easily distinguished by the prominent cervical alae, more spinose tail apex and fewer precloacal papillae. Of the remaining species, *Porrocaecum* (*P.*) *paivai* should be treated as *incertae sedis* until more fully described. However, it differs from *H. scomberomori* in having wider alae and, most notably, in lacking a ventricular appendage. From the brief description and rudimentary figures, *Dujardinascaris cybii* cannot be assigned to a genus. It was listed as *incertae cedis* by Soota (1983)

Goezia aspinulosa is obviously not a species of *Goezia* and, as figured, has the characteristics of an *Hysterothylacium*. Soota (1983) commented that the species lacked cuticular spines. The description and figures given by Arya (1978), consisting largely of family or generic characters, are not adequate to allow absolute resolution of the identity of the species. The general correspondence of lip size, prominent cuticular rings, tail ornamentation, spicule size, and morphology of the ventricular appendage and intestinal caecum strongly suggests that *G. aspinulosa* is a junior synonym of *H. scomberomori* and is so included in the synonymy.

Data taken from immature females are included to illustrate the constancy of proportions of the characters listed.

Hysterothylacium sp.

A second species of *Hysterothylacium* (represented by four mature females QM GL10267) was collected from the stomach of one specimen of *Scomberomorus commerson* from Heron Island together with immature specimens of *H. scomberomori*. This worm is easily distinguished from *H. scomberomori* (including synonyms and related species) by the following: alae starting immediately posterior to postlabial groove; long intestinal caecum (75.7-78.4% length of oesophagus), longer ventricular appendix (52.7-58.1% length of oesophagus), a bluntly rounded tail with conical nodulose apex, oviducts extending 1.5- 2.5mm anterior to the vagina and the uterus with the undivided portion (3854) approximately equal in length (93.2%) to the undivided portion (4136) in the dissected female. This latter character is very different in *H. scomberomori*, which has the undivided part 24.3% the length of the divided part.

Without adult males, it is not possible to give a full and diagnostic description of this species or to be sure if it has previously been described. The specimens are recorded here to draw attention to the presence of two species of *Hysterothylacium* that can be found in *Scomberomorus* hosts in Australia and that can occur together within the single host stomach.

Additionally two immature specimens from *Scomberomorus queenslandicus* were tentatively identified as belong to this species rather than *H. scomberomori*.

ACKNOWLEDGEMENTS

This study was generously funded by the Australian Research Council. The staff of Heron Island Research Station and Lizard Island Research Station are thanked for their assistance. I also thank the following for assistance with field work: Dr L.R.G. Cannon, Dr T. Cribb, Mr S. Cook and Mr R.T. Springthorpe. I also thank Mr D. Steel, Mr S. Watson (Brisbane Sportsfishing Club) and Mr J. Smith (CSIRO - Cleveland) for their efforts in continuing to supply me with host stomachs. Mrs Christine Lee is thanked for her careful preparation of sections.

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APIDIOPLANA APLUDA N. SP., A TURBELLARIAN SYMBIOTE OF GORGONIAN CORALS FROM THE GREAT BARRIER REEF, WITH A REVIEW OF THE FAMILY APIDIOPLANIDAE (POLYCLADIDA:ACOTYLEA)

L.R.G. CANNON

Cannon, L.R.G. 1990 08 31: *Apidioplana apluda* n. sp., a turbellarian symbiote of gorgonian corals from the Great Barrrier Reef, with a review of the family Apidioplanidae (Polycladida: Acotylea). *Memoirs of the Queensland Museum* 28(2): 435-442. Brisbane. ISSN 0079-8835.

Apidioplana apluda n. sp. is from gorgonian corals, *Melithea* sp., from the Great Barrier Reef. The worms are small, red like their host, and live closely applied to it. The worms are characterized by a slender, tapering penis with a fine, terminal sclerotic tube, which may be recurved. The genus has been found only with gorgonians of the genus *Melithea* and is known from Fiji and Japan. This is the first report from Australia. ☐*Apidioplana, Polycladida, Turbellarian, Symbiote, Gorgonian, Coral, Great Barrier Reef.*

L.R.G. Cannon, Queensland Museum, PO Box 300, South Brisbane, Queensland 4101, Australia; 20 March, 1989

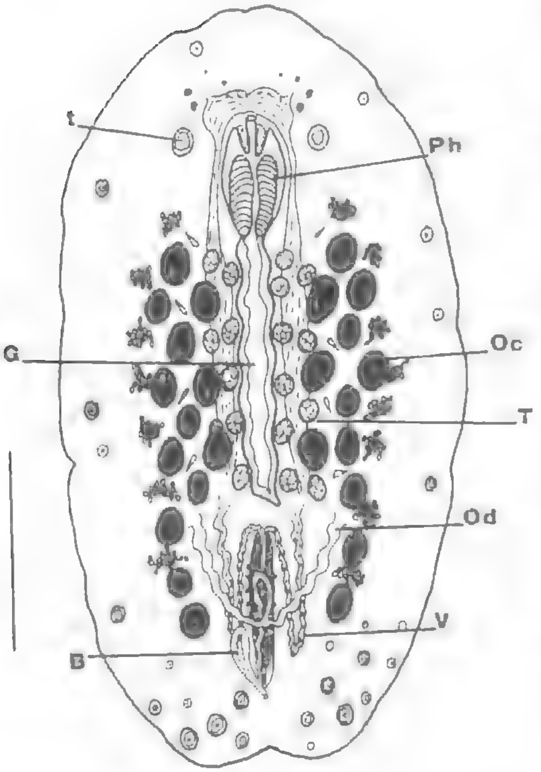

FIG. 1. *Apidioplana apluda* n. sp. whole worm (Scale: = 500µm) (B = bursa, G = gut, Od = oviduct, Oc = oocyte, Ph = pharynx, T = tesis, t = tentacle, V = vas deferens)

During his expedition to the South Pacific in 1917-18, Dr Sixten Bock recovered some small polyclad turbellarians from gorgonians taken from the surf zone from reefs in Fiji. Their orange to red colour matched well that of their host, *Melithea* (=*Melitodes*). Furthermore, he found they had numerous pyriform, glandular structures on the ventral surface, each with a hard, conical or tubular mouthpiece. Bock (1926) called these organs apioids and created a new genus, species and family within the Acotylea for the worms: *Apidioplana mira*, Apidioplanidae.

Subsequently Bock (1927) published a much fuller account of these animals and erected a second species, *A. similis*, which he had earlier overlooked among the specimens. Kato (1944) described a third species, *A. okadai*, found on *Melithea (=Melitodes) flabellifera* at Simoda, Izu Japan. Although briefly mentioned by Bresslau (1928-33), Stummer-Traunfels (1933), Hyman (1951), Faubel (1983), Prudhoe (1985) and Cannon (1986), *Apidioplana* has been unrecorded for nearly 50 years. The discovery of a new species of the genus prompts my review of the family.

Polycladida: ACOTYLEA
Superfamily PLANOCEROIDEA Poche, 1926
Family APIDIOPLANIDAE Bock, 1926
Genus **Apidioplana** Bock, 1926

Apidioplana apluda n. sp.

(Figs 1,2,3a-e)

MATERIAL EXAMINED

HOLOTYPE: ex *Melithea* sp. 3m on Milln Reef, GBR,

P. Alderslade, March 1978, GL10337 (whole mount: stained with Mayer's Haemalum, mounted in Canada Balsam).

PARATYPES: data as for Holotype, GL10338 (whole mount: treated as for holotype) and GL10339-10342 (sections: serial sections cut at 7µm and prepared as follows - longitudinal sagital sections stained with Haematoxylin and eosin GL10340 and GL10342, longitudinal facial sections stained with Papanicolou's GL10339 and transverse sections stained with Heidenhain's iron haematoxylin GL10341).

All material is in the Queensland Museum.

DESCRIPTION

The whole worms are about 2 by 1mm, quite russet red dorsally and grey ventrally, with a short, tubular pharynx opening via a mid-ventral mouth about one third from the anterior margin. They have a bilobed brain and four anterior-lateral eyes of unequal dimensions. The largest (about 15µm in diam.) and most posterior pair abut the ventral basal membrane, slightly anterior and in the midbody are the next largest pair. The two smaller, more median pairs of eyes are closer to the dorsal surface. A rudimentary pair of tentacles are found on either side of the anterior just lateral to the brain. They are represented in fixed material by a pair of low bosses (Fig. 3a).

The dorsal and ventral epithelia are weakly ciliated, and the dorsal epithelium (but not the ventral) is filled with prominant rhabdoid bundles, often appearing to be arranged in small rings anterior to the pharynx, but more irregularly in the posterior. In section, small blisters from the basal membrane of the dorsal epithelium can be seen and may account for this arrangement.

Subepidermal muscles consist of outer longitudinal fibres underlain by transverse then diagonal layers. All three muscle layers are more strongly developed ventrally than dorsally. Strong dorso-ventral muscles run through the parenchyma. Unicellular basiphilic glands are scattered through the mid-body. Larger, granular cells lie in the parenchyma more dorsally. The brain is bilobed, with a scattering of anterior nuclei. Thick lateral cords run posteriorly lateral to the pharynx and form a ventral plexus.

The mouth opens on the ventral surface about 300 - 350µm from the anterior margin. The anterior buccal region has a ciliated pouch (about 100µm long by 60-70µm wide) extending into the pharyngeal chamber in which lies the short, tubular and strongly muscled pharynx (3b). The gut opens behind the pharynx and proceeds posteriorly as a more or less tubular canal: the gut is virtually saccate (3c).

The male reproductive system consists of numerous testes (about 40-50µm in diam.) scattered laterally to the centrally placed gut and stretching from the region of the phanynx posteriorly to just in front of the penis. They lie predominantly ventrally or ventro-laterally. From the posterior of this field on each side a

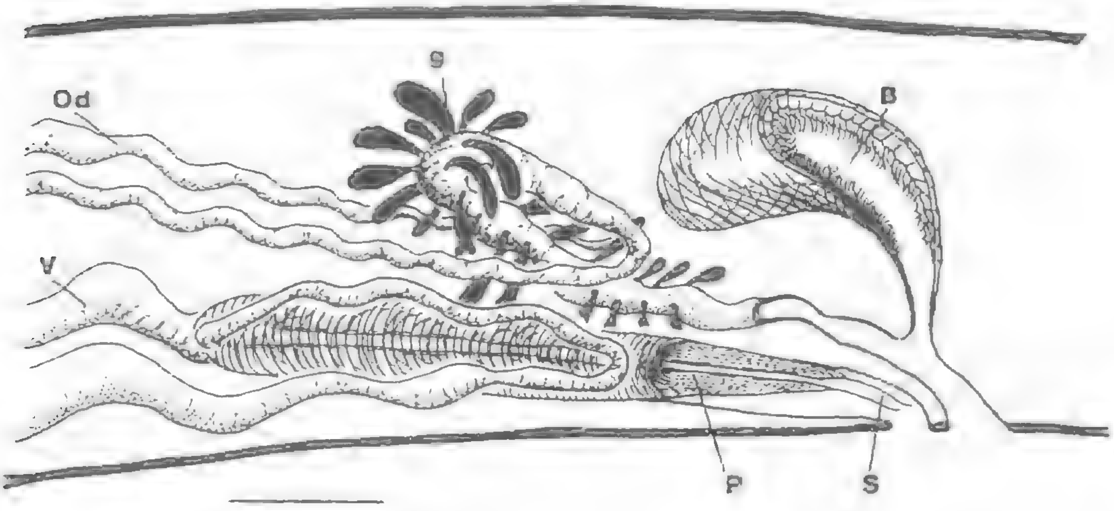

FIG. 2. *Apidioplana apluda* n. sp. reconstruction of copulatory structures (Scale: = 100µm) (B = bursa, g = accessory glands of the *vagina media*, Od = oviduct, p = penis, S = stylet, V = vas deferens)

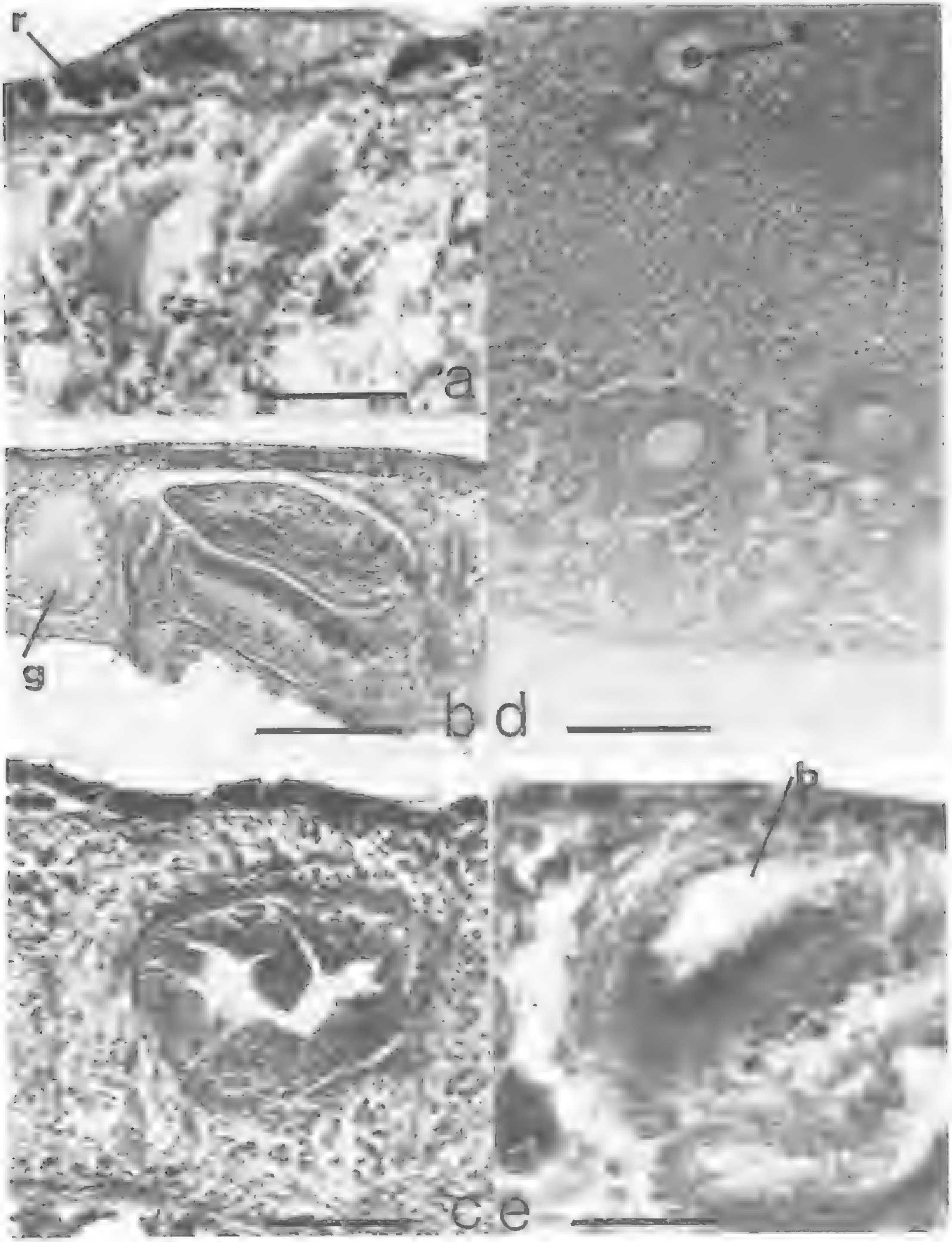

FIG. 3. *Apidioplana apluda* n. sp. (a) tentacle (r = rhabdoids), (b) pharynx and buccal pouch (g = brain ganglion), (c) section through intestine, (d) tangential section through gonopores and revealing the penis stylet (s), (e) bursa (b) without hook (Scales: a = 25μm, b = 100μm, c-e = 50μm)

weak-walled and much coiled duct, the vas deferens, runs posteriorly to near the gonopore then bends and runs forward along the penis to curve again and enter the penis stem. There is no evidence of a distinct seminal vesicle or of prostate tissue. The penis is a long, tapering muscular organ 400 - 500μm long within a penis cavity. Internally there is a narrow ejaculatory duct. The penis ends in a very fine tip covered with a thin, tubular, sclerotic stylet (Fig. 3d). This fine tip may be strongly reflexed within the antrum. The male gonopore opens separately to the ventral surface immediately anterior to the female pore (Fig. 3d) i.e., 100 - 200μm from the posterior margin which is somewhat indented in the mid-posterior region.

The female system consists of numerous ovaries (about 60 - 100μm in diam.) developing laterally and slightly more dorsal to the testes. There is a tendency for gonads to interdigitate. Dorsally on each side oviducts run sinuously posteriorly from the hind most quarter of the ovaries. In the region of the stem of the penis the ducts curve medially, join and a common duct (*vagina media*) then runs anteriorly for a short distance. Numerous acidophilic glands discharge into it. The duct loops ventrally and then runs posteriorly above the penis. At the level of the gonopores it joins the duct running from the bursa copulatrix and this short common duct opens into a female antrum and then to the female gonopore. The bursa (about 150 by 40μm) lies medially and is a short blind sac running forward over the top of the penis. It has smooth walls lined with tall cilia and is without evidence of any sclerotic boss or hook (Fig. 3e).

Characteristic of the worms is the presence, on the ventral surface, of numerous 'apioid' organs or prostatoids (Fig. 3d). These range from 15 - 60μm in diameter and are scattered around the lateral regions of the body, being smaller and less numerous (or absent?) anteriorly than posteriorly. The organs are prominent in the posterior lateral body. Each organ consists of a strong muscular capsule through which the necks of glands pass. Inside the organ there are several large cells filled with a granular secretion. Each organ opens to the exterior via a short, strong sclerotic cone which projects from a small depression of the ventral epithelium. Within the organ the secretion granules failed to stain with the stains used, but become increasingly basiphilic towards the exterior of the cone.

ETYMOLOGY

The specific name *apluda* L. = scale, chaff. It pertains to the habit of these animals to be closely applied to their host.

REMARKS

The presence of only one type of apioid, those with conical mouthpieces, and their presence scattered about the body, place the new species close to *A. mira* with which it also shares an unarmed bursa. The gonopores are well separated in *A. mira* and the penis armature is quite different. *A. mira* has a short, wide, sclerotic ring with scalloped distal rim, like a coronet, but *A. apluda* has a long, finely tapering stylet that may be reflexed. Further, *A. mira* has a large, thin-walled seminal vesicle which passes via a small pore into a voluminous penis cavity with a well developed interpolated prostate.

Apidioplana mira Bock, 1926
(Figs 4a-b, 5a and c)

Bock (1926) 133, 3 figs.; (1927) 6, 17 figs.; Bresslau (1928-33) 89, fig.; Hyman (1951) 116, fig., Faubel (1983) 96; Prudhoe (1985) 118, fig.; Cannon (1986) 72, fig.; on *Melithea (=Melitodes)* surf zone Mbau, Fiji Islands.

MATERIAL EXAMINED

13 slides of serial sections from Fiji of Sixten Bock's material from the collections of the Natural History Museum, Stockholm.

REMARKS

Bock (1927) gave a thorough but discursive account of *A. mira*. Although the prostatoids (apioids) (Fig. 5e) can be found anteriorly in some cases, their number can be small. The gonopores are well separated by about 100μm. The bursa copulatrix is strongly muscled with a thick homogenous lining (Fig. 5a). The male copulatory apparatus (Fig. 4a) has a seminal vesicle with a thin muscular wall about 10μm

FIG. 4. Male copulatory organs: (a) *Apidioplana mira* - longitudinal section showing seminal vesicle and commodious interpolated prostate (v = vagina and s = stylet). (b) same section as (a) but at greater magnification showing the ring like sclerotic stylet, (c) *A. similis* - longitudinal section showing heavy musculature of seminal vesicle and penis (p) which lacks a sclerotic stylet (v = vagina) (Scales: a and c = 100μm, b = 25μm).


v
a
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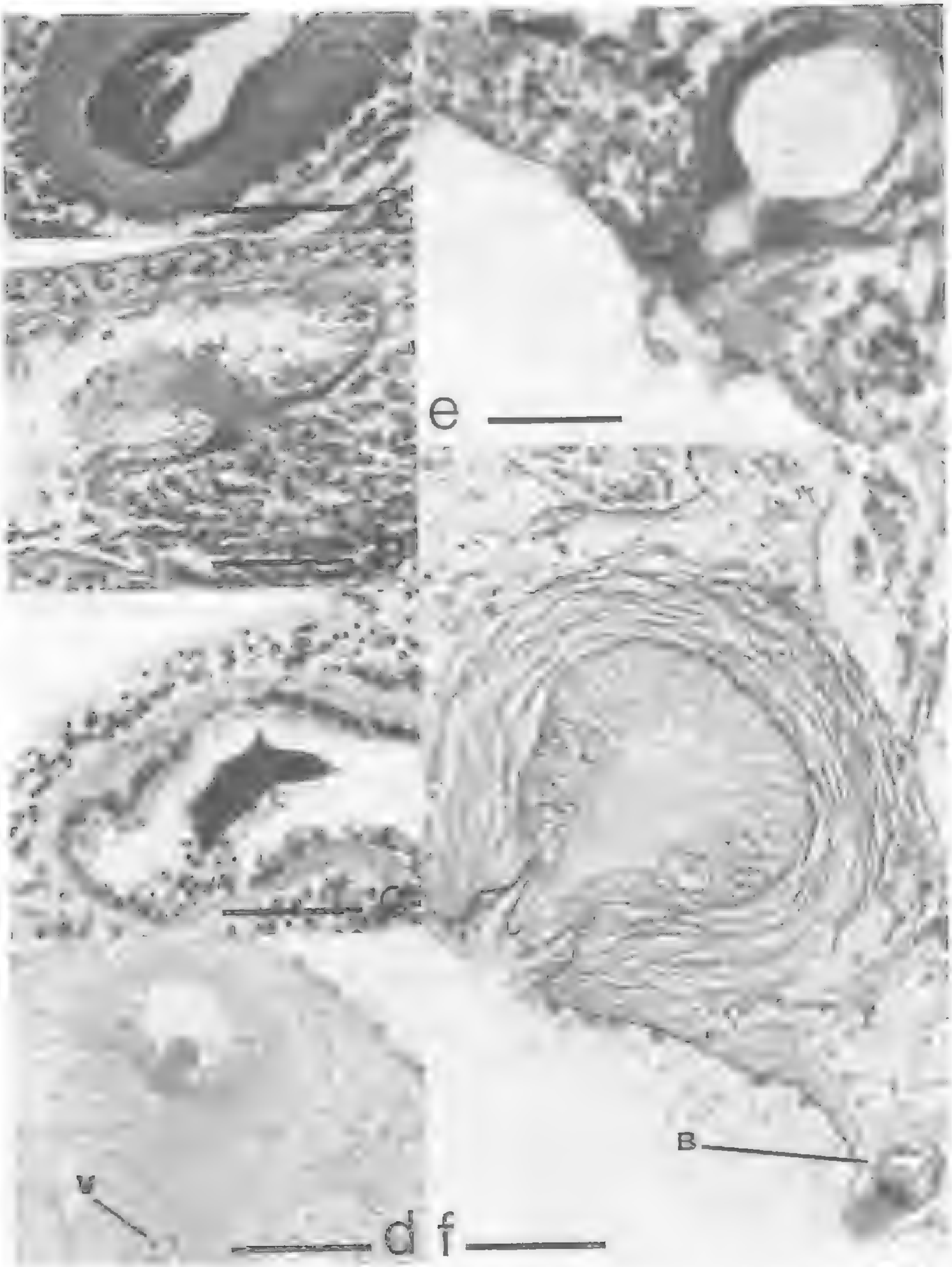

FIG. 5. Bursae and prostatoids: (a) *A. mira* - longitudinal section of bursa showing thick wall, but no hook, (b) *A. similis* - longitudinal section of bursa as figured by (Bock, 1927) showing a blunt hook, (c) *A. similis* - longitudinal section of bursa showing spinous hook, (d) *A. simils* - transverse section showing tubular hook (v = vagina), (e) *A. mira* - postatoid, (f) *A. simils* - a large Type-A prostatoid and a small Type-B prostatoid (B) (Scales: a,c and e = 50µm, d = 100µm, f = 25µm)

thick, 'sehr stark muskulös' according to Bock; the interpolated prostate is extensive and the terminal armature (Manschette) is a small sclerotic ring bearing distal scalloping like a coronet (Fig. 4b). The mouth opens into a short buccal pouch (Mundrohr) which is provided with a high ciliated epithelium and is protrusible. The gut is virtually saccate.

Apidioplana similis Bock, 1927

Bock (1927) 87, 97, 2 figs.

MATERIAL EXAMINED
8 slides of serial sections; details as for *A. mira*

REMARKS
Bock's (1927) description of *A. similis* is very much less detailed than that of *A. mira*. He highlighted the major differences he perceived between the species. He recognized a second, much smaller prostatoid (apioid type B) (Fig. 5f) without a sclerotic mouthpiece. In some of Bock's sections these small prostatoids are strongly stained and readily seen. In other sections, however, they stain weakly and easily could be overlooked. Many of the type A apioids (Fig. 5f) are larger and more strongly muscled than those of *A. mira*. The gut is similar to that of *A. mira* in having both the buccal pouch and little lateral branching. The seminal vesicle is extremely muscular with walls about 25µm or more thick. A narrow strongly muscled sphincter leads into the ejaculatory duct with only moderate prostate development (Fig. 4c). The penis is muscular, but completely unarmed. Bock described the bursa (his fig. 19) with a rounded sclerotic boss (Zapfen) (Fig. 5b). From his material, this structure is quite variable being also with spinous projections (Fig. 5c) or merely a long thin spine (Fig. 5d). The gonopores are well separated.

Apidioplana okadai Kato, 1944

Kato (1944) 287, figs.

REMARKS
Kato's material was lost during the allied bombing of Japan during the World War II (Kawakatsu, pers. comm.).

This species was characterized by having a single large apioid with a very muscular wall immediately posterior to a common gonopore, having a muscular copulatory organ containing a seminal vesicle with a narrow duct leading to an ejaculatory duct with moderate prostate development and an unarmed penis. Also there is a long fine sclerotic spine in the bursa. Kato made no mention of a buccal pouch and described the gut as 'provided with numerous lateral branches which form a network'.

DISCUSSION

Bock (1927) gave a thorough account of the 'apioid' organs and of the many terms used to describe them. Since then, similar organs have been recorded several times most notably within the triclads where they are known as adenodactyls. Hyman (1951) suggested the term 'prostatoid' be adopted as a convenient term for all of them. Within the polyclads, prostatoids are found in the Discocelididae, Polyposthiidae as well as the Apidioplanidae within the Acotylea and also in the Boniniidae (Cotylea). They may be clustered about the male antrum and open into it (*Coronadena, Adenoplana, Cryptocelides* (Discocelididae) and *Boninia* (Boniniidae)), be on the walls of the penis (*Discocelis* (Discocelididae)) or open onto the ventral surface either clustered around and radiating from the gonopore (*Paraboninia* (Boniniidae), *Polyposthia, Polyphalloplana, Metaposthia* (Polyposthiidae)), forming a line of mid-ventral rosettes but also scattered about the ventral periphery (*Polyposthides* (Polyposthiidae)), simply scattered ventrally about the periphery, mainly posteriorly *Apidioplana mira*, restricted to the posterior *A. similis* or reduced to one large organ opening ventrally just posterior to the gonopores in *A. okadai* as well as *Traunfelsia* (Boniniidae).

In most cases the organ is as described above, i.e., a pyriform muscular capsule filled with secretion and extracapsular glands feeding into it. There is a short conical or tubular sclerotic mouthpiece opening to the exterior. Sometimes the organ is not armed and sometimes vasa deferentia, or just reminant ducts, lead to the organs. Marcus and Marcus (1968) state regarding *Boninia antillarum* (p.63) 'The prostatoids of the original worm have no stylets, because the animal is growing'. Bock (1927) described *Apidioplana similis* with small, unarmed prostatoids as well as the larger armed type. He discounted the possibilty of these being from young individuals since he found the prostatoids (8 in all) in one quite juvenile individual.

The function of these glands is unclear, but some stimulatory role in facilitating copulation and/or fertilization is possible. All species of *Apidioplana* are reported from gorgonians of the genus *Melithea* (=*Melitodes*). *Boninia mirabilis* was recorded also from the same coral. It may be tempting to speculate that these glands in some cases have been modified to assist with adhesion to the host. Gorgonians live in turbulent waters and Bock (1926) collected his specimens from the surf zone. Similar glands are found, however, in several species, both Acotylean and Cotylean, not known to be associated with hosts nor known to live in areas of exceptional turbulence.

A comparison of the principal characters of the species in the genus is given in Table 1. Re-examination of Bock's original material suggests little change in details for *A. mira*, the type species of the type genus of the family. However, the details of the bursal hook in *A. similis* reveal it to be more variable than Bock indicated. The presence of a specimen with a long fine bursal spine, together with the unarmed penis indicates *A. similis* is quite close to *A. okadai*. It is regrettable that the type material of the latter species is lost.

A. okadai is reported to have a common gonopore, in the other species the pores are separate, though in *A. apluda* they are close together. *A. okadai* has only one large posterior apioid, and while *A. similis* has both large and small prostatoids, these are all confined to the posterior. Further, the large apioids of *A. similis* are more prominent than those in *A. mira*. The small (Type B) ones are quite tiny and may be easily overlooked if the staining does not highlight them. Insufficient is known of the development of these organs or of the variability of their occurrence: in both *A. mira* and *A. apluda* anterior prostatoids may not be common.

Characters	*A. apluda*	*A. mira*	*A. similis*	*A. okadai*
Prostatoids				
armed	+	+	+	+
unarmed			+	
number	many	many	many	1 only
arrangement	all round	all round	posterior only	posterior
Penis				
fine stylet	+			
sclerotic ring		+		
unarmed			+	+
Genital Pores	separate	separate	separate	common
Bursa	unadorned	unadorned	sclerotic boss or spine	sclerotic spine
Gut	tubular	tubular	tubular	ramifying

TABLE 1. Comparison of the Species of *Apidioplana*

The two species *A. similis* and *A. okadai* also share a similar internal arrangement of the penis with a long muscular duct between seminal vesicle and ejaculatory duct. While these two species must remain distinct, suffice to say they appear closely related. Kato's (1944) report of the gut anatomy of *A. okadai* is at variance with the other species in the genus. *Apidioplana mira* and *A. apluda* appear close, but the differences in the penis and its armature make them distinct.

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ROCK PAINTINGS OF THE YINGALARRI REGION: PRELIMINARY RESULTS AND IMPLICATIONS FOR AN ARCHAEOLOGY OF INTER-REGIONAL RELATIONS IN NORTHERN AUSTRALIA

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Recent research in Wardaman country, Northern Territory, has revealed an extremely varied body of cave paintings. Preliminary investigations of painting techniques from 48 sites located around the Yingalarri waterhole has failed to identify any significant changes in the distribution of rock paintings from the region through time. Given that intensive interactions between Wardaman people and their westerly and southerly neighbours have been repeatedly documented in the anthropological literature for the recent past, and that the distribution of rock art does not indicate any significant changes in the pattern of inter-regional relations, we conclude that these contacts have considerable antiquity. ☐*Rock art, cave paintings, Wardaman, Northern Territory, intensification, Australian prehistory.*

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It was once customary to view the Australian Aboriginal past as consisting of a series of distinct *episodes* of prehistory, each observable archaeologically as made up of a distinct and relatively discrete set of material artefacts. For example, the early 'Core Tool and Scraper Tradition' has been seen to consist of large artefacts often characterised by steep edges and percussion flaking, and followed by the 'Small Tool Tradition' which, amongst other things, saw the beginnings of pressure flaking and blade technologies. Each Tradition was seen as an internally coherent system of artefactual production (and use), and each implied a system in steady-state equilibrium (cf. McCarthy, 1967; Mulvaney, 1975).

In the late 1970s and early 1980s a dissatisfaction with culture-historical approaches to Aboriginal prehistory began to appear in the literature (e.g. Lourandos, 1983). These dissatisfactions stemmed from the failure of such approaches to address issues which concern social *processes*. For this reason, archaeology has been, until recently, more concerned with *documenting* material aspects of Aboriginal life, and *ordering* the resultant classifications in structural-functionalist terms, than in trying to understand how these structures came to be. Cultures were seen as made up of interacting parts, each part at once functionally and structurally contributing to the formation of an *integrated* whole. This is the case not only for the archaeological 'traditions' which investigators claimed to have identified, but also for the alliance and trading systems documented ethnographically (and which by implication operated in the past) (e.g. McCarthy, 1939). This, to a large extent, is testimony to the influence of Radcliffe-Brown's work on Australian archaeology (and Australian anthropology in general). It also highlights a tendency which has prevailed amongst archaeologists to treat prehistoric Aboriginal systems as ecologically adaptive ones, whilst ignoring the role that socio-cultural relations have played in socio-cultural change and stability. Humans interact with each other, create and re-create social and individual identities (creations of a symbolised self *in relation to 'the other'*) observe and break social rules, and in the process create the *dynamic* environments which we study. It is not just in 'the norm', in people frozen in time and space, that we can hope to understand the past, but by inquiring into the social forces which influence people's behaviour, and consequently structure social change. It is only thus that we may arrive at an understanding of those forces which have shaped the prehistoric past (and, consequently, the present). Yet it is the very dynamism of Aboriginal peoples which for a long time has been neglected, even denied, in early works.

In this paper we therefore wish to argue that, in spite of the difficulties involved in addressing questions of social relations and *social* change in archaeology, such issues should not only be addressed, but should be central in our inquiries of the past. We illustrate this issue by reference to our own research in *Wardaman* country, Northern Territory, by looking at the rock paintings of the Yingalarri region. Here, a rich and varied body of rock art is analysed with respect to the information it can supply on inter-group relations, both past and present. It is concluded that not only have extensive alliance networks been established in the region, but also that such networks have probably been operating for a very long time, although the particular configuration of alliances may or may not have changed significantly during this time.

WARDAMAN COUNTRY

The Yingalarri waterhole is located towards the heart of Wardaman country, approximately 130km southwest of Katherine, Northern Territory. Wardaman country currently extends from the Victoria River to the west, the southern Flora River to the northwest, Scott Creek in the northeast, and Romula Knob in the east (Merlan, 1988, p.3). Their country is made up of a configuration of territories to which people are affiliated in numerous ways, but where patri- and cognatic affiliation are of primary importance. It is in relation to the Dreaming that these affiliations to the land are given meaning and identity.

Although identified with the region delimited above, Wardaman people have wide-ranging associations with peoples sometimes hundreds of kilometres from their homelands. For instance, Stanner (1959-63) reports seeing a Wardaman man visiting the Port Keats region, 250km from Wardaman country, early this century. In this meeting, he records a Wardaman version of the Rainbow Serpent story, and shows its great similarity to versions recorded west-northwest of Wardaman country. In effect the story itself links Wardaman places with regions all the way to Port Keats, incorporating places such as Garnawala (Mt Hogarth), Murning and Nimji (both near the Yingalarri waterhole) into the story line. Some of the actors in the Rainbow Serpent story go on to participate in other Dreaming stories, and although some stories appear unrelated to others, it is in the Dreaming itself that the whole landscape is linked into a broad configuration of sites each expressing a broader ideological system. It is this organising of the landscape, via the identification of localised Dreaming beings and events, which articulates the relation of people to the land. As a result, the landscape cannot just be seen as comprising autonomous units in space, but must be understood also as expressing a broader ideological system in continuous social space.

Extensive interactions of Wardaman with peoples to the west and south have been documented by Merlan (1988), Davidson (1935) and Spencer (1914). Davidson has noted recent trading relations with people to the west, whilst Merlan (1988) notes that there is much evidence for extensive inter-marriage between Wardaman, Mudburra, Bilinara and Garranga peoples to the south, and Ngariynman, Ngaliwurru, Jaminjung and Nungali peoples to the west and southwest (see Fig. 1). These inter-regional links echo favourably the patterning of

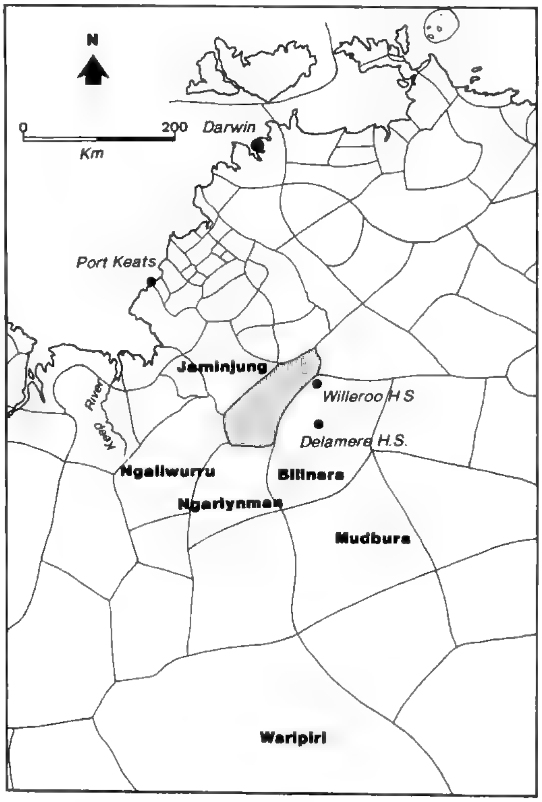

FIG. 1. Distribution of linguistic groups mentioned in text. After Tindale (1974).

linked Dreaming places, such as the Rainbow Serpent and Lightning Brothers stories, which show an extensive network of relatedness between Wardaman country and places to the west and south. In the case of the Lightning Brothers, although the main participants in the story, Jabirringgi and Yagjagbula, are said to be from Yiwarlarlay itself (and not to have come from anywhere else), the frogs and rain (*wiyan*) associated with the story are said to have come from the south, watching the brothers fight. In this case, the Yiwarlarlay site and its associated story are extremely significant to both Mudburra and Warlpiri peoples of the south (Walsh, 1988). Further links with the south are implied in that Warlpiri, Mudburra and Wardaman peoples, amongst others, all share a similar 8-class kinship system (along with a similar terminology), as well as the practice of subincision. The patterning of both the 8-class system and subincision not only links Wardaman social practice with peoples to the south and west, but also sets them apart from peoples to the north and northeast, where both subincision and the 8-class system are not practised.

With respect to trade, little information is available. It is assumed that given the widespread interactions between Wardaman people and those to the south and west, both material goods and ideas, and with them stylistic conventions, have been extensively shared (see below). Items traded include reed/bamboo spear shafts from the Daly River to the northwest of Wardaman country, in return for stone spear points (Riley Birdun, Wardaman man, pers. comm., 1989). Ground stone axes made from greenstone have been located on the surface of Wardaman sites. Visual inspection of these axes points to an original Western Australian source, although more detailed petrological analysis, planned for the near future, may pinpoint the source more precisely. In short, the available evidence,as limited as it is, points to widespread contacts with peoples to the west and south.

As will be argued below, these interactions have resulted in the diversification of rock art styles in specific locations, whilst at the same time standardising artistic conventions within the broader interacting sphere. The region is set apart in terms of rock art from northern regions, where other forms of rock art (especially x-ray art) are common, and we believe that this geographical separation of artistic conventions reflects broader issues centring upon the structure of alliance networks and patterns of interregional interaction.

YINGALARRI ROCK PAINTINGS

The rock art of the Yingalarri region analysed below was recorded in 1988 during the first season of the Lightning Brothers Earthwatch Project. In the field, the rock art was extensively photographed and sketched with annotated drawings of each picture being undertaken. The ensuing preliminary classification presented in this paper was constructed by allocating each picture a *technique* category (Y-axis) and a *formal* category (X-axis) (Fig. 2). The current paper is concerned purely with a preliminary examination of the *technique* characteristics of the rock *paintings* from the region.

The formal characteristics of the paintings of the Yingalarri region are extremely varied. By far the most numerous are anthropomorphs (43.2%), with zoomorphs (28.9%), abstract designs (23.9%), boomerang-forms (0.5%), track-forms (0.7%), and images of contact (European) objects (0.8%) also present. In this preliminary analysis, 45 motif forms have been identified (see Appendix 1), 33 of these consisting of biomorphic forms (anthropomorphs and zoomorphs). These can be divided into eleven painting *technique types* (Fig. 2):

A: *linear*. These include 'stick figures' and other, non-area paintings. These are rare and very different from the 'stick figures' documented from the Hammersley Ranges to the south-west (Walsh, 1988) and those of the earlier periods of the Arnhem Land regions to the north (Chaloupka, 1984; Lewis, 1988; Brandl, 1973) (Fig. 3);

B: *enclosed linear*, defined as linear motifs (Type A) enclosed by an outline. Extremely rare and not known from elsewhere (Fig. 4);

C: *outlined*; very common and widespread throughout Wardaman country and beyond, especially to the west and south, including the Victoria River region all the way to Keep River and further west in Western Australia (Lewis and Rose, 1988);

D: *infilled*; very common, and found commonly throughout most of Australia, and especially the northern half of Queensland, the Northern Territory and Western Australia. Chaloupka (1984) has argued that similar paintings as some infilled biomorphs from the Yingalarri region have been found in late Pleistocene rock art in the Alligator Rivers region (but see Lewis, 1988) (Figs 5 and 6).

E: *striped*. These include a range of longitudinally

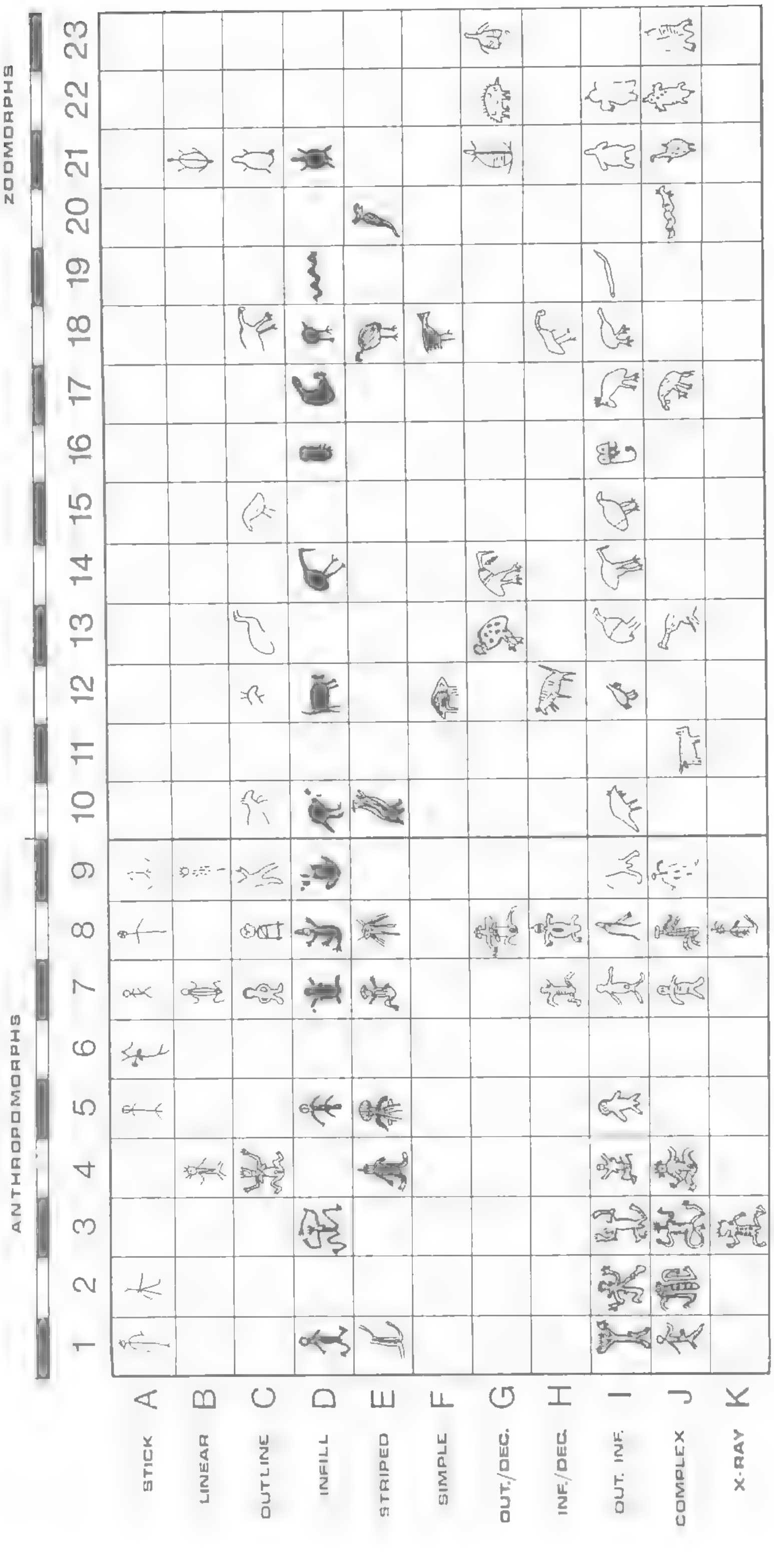

FIG. 2. Preliminary classification of all non-indeterminate paintings from Yingalarri sites 2-49. X axis are *motif forms*. Y axis are *technique types*.

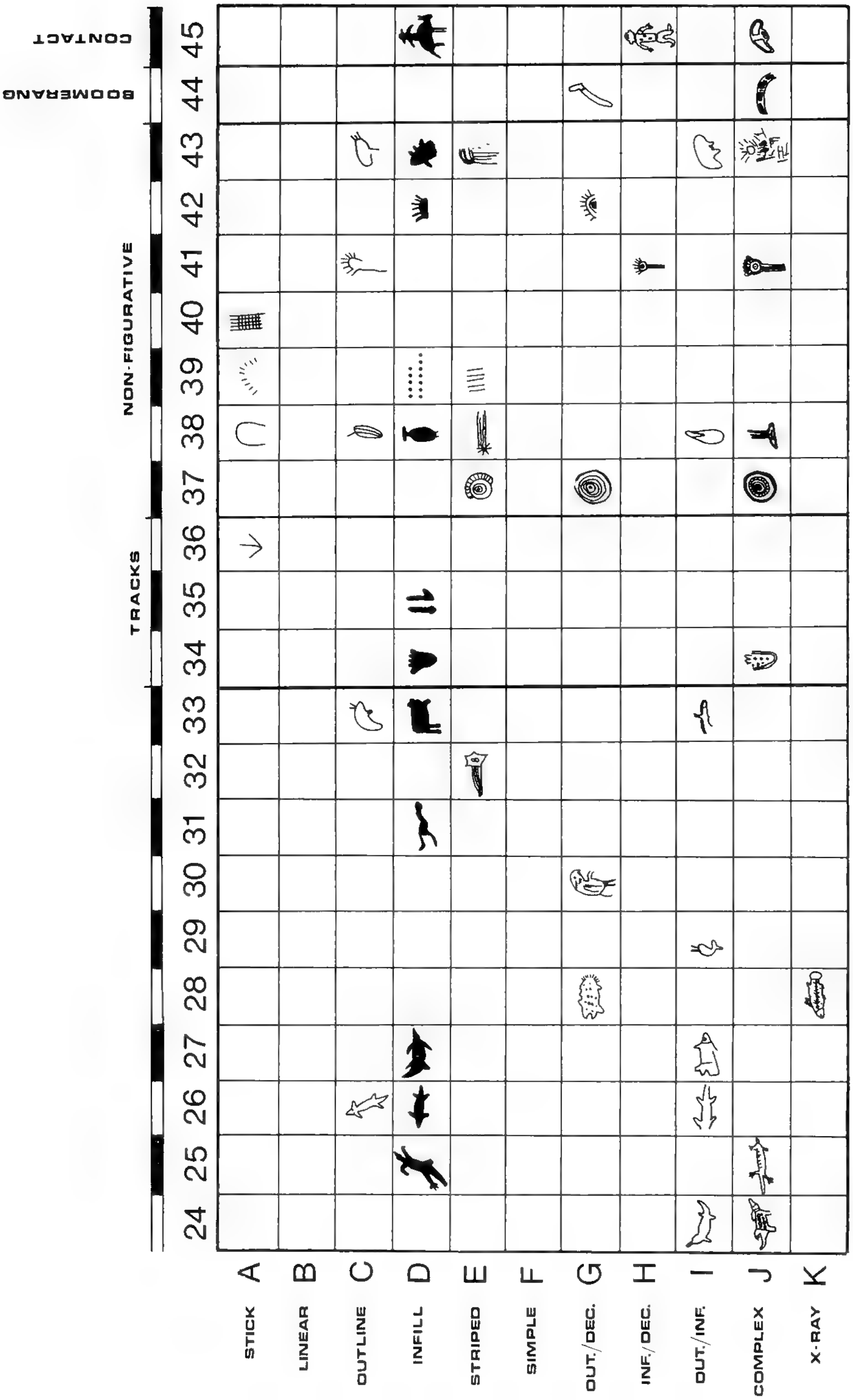

FIG. 2. cont. Preliminary classification of all non-indeterminate paintings from Yingalarri sites 2-49. X axis are *motif forms*. Y axis are *technique types*.

striped forms; again, these are extremely common throughout Wardaman country, and continue to appear further west along the Victoria River, Katherine River headwaters, Keep River, and into Western Australia (Walsh, 1988; Lewis and Rose, 1988). To the south, similar forms of striping are found at Emily Gap. Although present, they are uncommon in Katherine Gorge (Jawoyn country). They do not appear to occur further north (Fig. 7).

F: *sectioned*. These are paintings where sections of the image have been painted in different colours. All paintings in this category are zoomorphs, and features have been abstracted into angular forms (such as ears, tails, heads); These paintings have not been observed anywhere else, and they are rare even in the Yingalarri region, and could be the work of a single artist (Fig. 8).

G: *outlined/internally decorated*. These do not possess solid infilling, and occur repeatedly but in low numbers throughout Wardaman country (Fig. 6).

H: *infilled/internally decorated*; again, such paintings have been noted repeatedly but in low numbers throughout Wardaman country (Fig. 9). Infilled/internally decorated paintings have also been noted to the west along the Victoria River and at Keep River, where they extend further west into Western Australia (Walsh, 1988; Lewis and Rose, 1988).

I: *outlined/infilled*; extremely common both in Wardaman country and beyond, especially to the west (pers. obs., 1988);

J: *outlined/infilled/internally decorated*; these paintings are often large and very elaborate. Internal decoration most commonly occurs as spots or dashes. They are commonly found to the west, including in country surrounding the Victoria River (Lewis and Rose, 1988), Daly River (Walsh, 1988, p. 196; pers. obs.), Fitzmaurice River (Walsh, 1988, p. 176) and beyond the Western Australian border (e.g. Walsh, 1988, p. 190-192). Unlike outlined/infilled/internally decorated designs from the Laura region of northern Queensland, however, the Yingalarri paintings do not include sectioned and short-striped figures (cf. Huchet, 1988) (Figs 9 and 10);

K: *x-ray*; such paintings are extremely rare in Wardaman country and to the west. Very similar x-ray paintings occur to the north, especially in Arnhem Land, where they are extremely common (Fig. 5).

FIG. 3. Type A: linear painting.

FIG. 4. Type B: enclosed linear painting.

FIG. 5. Type D (infilled) anthorpomorphic and Type K (x-ray) fish- form paintings.

In Table 1 the distribution of paintings from 48 sites is presented in terms of the A-K technique types.

The rock paintings from Yingalarri sites 2-49 are extremely varied both in terms of painting techniques (A-K above) and motif forms (Forms 1-45, see Appendix 1). Many of these techniques and forms are also found beyond Wardaman country, and this is especially so of all motif forms undertaken in techniques A to J (the non-x-ray pictures). More specifically, the most common painting techniques (techniques C, D, E, I and J) found in the Yingalarri region are commonly found to the west of Wardaman country, as far as Keep River, and for a considerable distance beyond. Walsh (1988) has even suggested that the Wandjina art of the Kimberleys is closely related to the art of the Victoria River region, including Wardaman rock art, implying significant cultural interactions between peoples of these regions in the past (see also Mulvaney, 1975, p. 261). Such interactions may have taken place through trade and/or extensive ceremonial networks, directly involving peoples from distant regions, but it is more likely that ideas were passed on from area to area through continued interactions between Wardaman peoples and their immediate westerly neighbours. In their turn, these neighbours passed on dominant cultural conventions further west in a chain of connections which, through time, served to standardise artistic conventions through space.

If this is so, it may be possible to identify painting styles which were used during specific periods of time in the past, and thereby identify specific episodes of inter-regional interaction in the past. We therefore pose the question:

Are there particular sites or groups of sites which are significantly different, on the basis of their rock art content (analysed here in reference to painting technique types)? If this is so, can we identify these differences as being due to a changing configuration of site use through time (changes in use of space)?

To help resolve these questions, two tests were undertaken in addition to an analysis of superimpositions. Firstly, an average linkage Cluster Analysis was undertaken to explore the way sites 2-49 compare to each other with respect to their rock art contents. The data set was transformed using Wright's VORTRANS program (R. Wright, pers. comm., 1989) option 14, then 1 and 2. Option 14 gives equal weight by producing percentage frequencies. Option 1 centres the variables by subtracting the mean from each object value (thus the variable results as a standard mean and is given equal weighting to all other variables). Option 2 transforms the matrix by dividing the variable by the standard deviation. This produces a variable with a *variance* (and a standard deviation of 1). This results in the variable having equal scatter. Options 1 and 2 combined produced a table of standard scores.

A hierarchical Cluster Analysis was performed using a Group Average clustering algorithm. The algorithm operates upon mean euclidean distance. The results of the Cluster Analysis show that Yingalarri sites 2-49 cannot be separated into *distinct* groups of sites on the basis of their rock paintings, although three loosely defined groups could be defined (Fig. 11). As the selective variables are unknown, however, a Principal Components Analysis was undertaken, firstly to try to isolate any *individual* sites (rather than groups of sites) which may show significant differences in their contents of rock art types, and to identify the techniques which contribute most to the isolation of sites as characterised by distinct configurations of rock art.

The results of the PCA on the variables show that all variables are loaded highly on the first component (first component accounts for 60.61% variability, second component for 15.42%). The distribution on the second component showed clustering of techniques G (outlined/internally decorated) and K (x-ray) together. Types A-E and H-J also occur together, whereas type F (sectioned) is isolated. General abundance cannot be attributable to this distribution as it is eliminated at the commencement of the program (as with the Cluster Analyses).

The sites tend to cluster around the centroid and, by virtue of this statistical insignificance, reveal little information. At a 0.5 significance level, only sites 2, 3, 21 and 22 show separation from the other sites (Fig. 12) (with site 4 being significantly different at a 0.49 level of significance). Such a patterning is particularly interesting in that these five sites contain more rock paintings than any other site in the sample (but this is not so of engravings). Techniques G and K (outlined/internally decorated and x-ray paintings) contribute most to this patterning.

Because the objects were so tightly clustered around the centroid, the orthogonal axes was rotated (Varimax rotation) to illuminate the possible structure further. The results of the rotation for the variable plot show that variables cluster in the same fashion as for the straight PCA. The only difference is that technique K becomes negatively loaded, although relative to the rest of the plot this variable retains its original significance. Rotation served to further differentiate the distribution of the objects although the majority retained their original proximity to the centroid thus reflecting their failure to differentiate.

INTERPRETATION OF PCA

The PCA results are particularly interesting for a number of reasons. Firstly, the separation of sites 2, 3, 21 and 22 may be interpreted in a number of ways:

SITE	PAINTING TECHNIQUE											
	A	B	C	D	E	F	G	H	I	J	K	ENGRAVED
2	8	1	3	8	5	1	1		1	2		1082
3	3		3	18			5	2	9	8	2	703
4	3		5	11	5			3	13	4	2	2
5	2			2				2	1	1		17
6									1			
7				3								25
8												5
9												15
10												40
11										1		1
12				1								
13				1	2							4
14					2							1
15					1							2
16												1
17			1	1								19
18	1			5								
19												4
20	1	1	5	6	4		1		9	2		288
21	9	2	13	39	8		1	8	27	12		2152
22	5	2	13	29	11	1		1	30	9		1422
23	2		3	4	6				5			62
24												7
25		1	2	3						1		3
26												51
27	1			5					1	1		2
28												5
29				6	1							67
30												26
31	4											
32	1		6	5	2		2		3	2		712
33				1								
34				1					1			
35				1								7
36			2	3	2							
37	1											
38	1		7	1	7							
39				4	5				2	1		
40	1	1	1	9	4		3		7	1		37
41				1								
42				1								5
43			2	6			2		9	1		25
44				1								
45				1								
46				5								
47				1								
48				1								1
49				1								2
TOTAL	43	8	66	185	65	2	15	16	119	46	4	6838

TABLE 1. Number of pictures in Yingalarri sites 2-49.

1] these sites are functionally different from the other sites, but roughly contemporaneous.

2] each or some of the painting techniques (A to K) used in the analysis pertains to a different point in time, and hence operates as a temporal marker. In containing more paintings and a broader range of techniques than any other site in the sample (except for site 4), sites 2, 3, 21 and 22 have therefore been painted upon during different points in time than the other sites.

3] a combination of 1] and 2] above.

4] the statistical separation of sites 2, 3, 21 and 22 is due to differences in the stability of rock surfaces (preservation of paintings). This point can be discounted as many of the sites included in this analysis are located in the same rock outcrops, facing the same directions, with similar configurations of the rock walls, location of driplines etc., but contain very different amounts of rock art.

For point 2] above to hold strength, we must be able to show that there has been a change in painting techniques through time. To investigate this issue, an analysis of the superimpositioning of different technique types were undertaken (Table 2). Whilst not particularly numerous, painting techniques G and K appear to be preferentially superimposed over other paintings, and this may imply that in recent times there has been a shift in art styles, although this pattern may be a result of small sample size (and therefore needs to be further explored). Patterns of superimposition do not show significant changes in superimpositions of the most common painting techniques (A,C,D,E,I,J), although striped

		OVER										
		A	B	C	D	E	F	G	H	I	J	K
UNDER	A	1			1					5	3	
	B					1						
	C	1		1	1	2				2		
	D	3		10	5	3		2		6	4	1
	E	3		1	7	7				8	2	1
	F											
	G										1	
	H					2				1		
	I	2	1	6	11			2	1	10	8	1
	J				1	2		2	2	2	1	1
	K									1		

TABLE 2. Superimpositions by painting techniques.

FIG. 6. Type D (infilled) contact image and Type G (outlined and internally decorated) zoomorphic painting.

FIG. 7. Type E (striped) paintings.

figures (type E) appear much more commonly *under* other paintings (especially outline/infilled ones) than *over* them (Table 2). These results, however, should be further explored by increasing the sample size, a project planned by the authors for the near future.

In short, four sites, Yingalarri 2, 3, 21 and 22 separate out as significantly different from the other Yingalarri sites on the basis of their paintings. These differences can be best explained by the fact that these sites contain more paintings than the other sites (with the exception of site 4), although sample size itself is not a contributing factor as all variables from each site were given equal weight. An examination of superimpositions in these sites has failed to locate any clear change in painting technique through time, although it is possible that longitudinally striped biomorphs are earlier depictions, whilst the x-ray and outlined-infilled paintings are relatively recent. The recent beginnings of x-ray paintings is supported by their fresh appearance, and this may reflect recent interactions with peoples from the north, where very similar x-ray (fish) representations are common. Such paintings are not found to the south or west of Wardaman country.

In summary, we emphasise 5 points:

1) the Yingalarri paintings are dominated by biomorphic paintings, undertaken in outline, infill, outline/infill, outline/infill/internal decoration, or striped longitudinally. The latter in particular are found only in Wardaman country and to the south and west, with some very rare examples found in Jawoyn country. All other painting techniques are mostly found to the west, with the exception of some extremely rare x-ray paintings (mainly fish), which are characteristically northern influences.

2) Yingalarri sites 2-49 cannot be divided into distinct groups on the basis of the techniques used to make the paintings which decorate these sites.

3) Four sites separate-out as significantly different. These differences can be best explained by reference to site size: a) the four sites, having more paintings than any other site in the sample, may have witnessed more painting episodes than the other sites, and as such a more heterogeneous painting assemblage has resulted in these sites,

FIG. 8. Type F (sectioned) painting.

or b) this may purely be attributable to significant differences in site function.

4) The surviving paintings do not show any conclusive evidence of changing techniques through time. All techniques are roughly contemporaneous, although some techniques *may* indicate recent influences from the north (x-ray paintings) (see also Mulvaney, 1975, p.273).

5) From 4) above, we suggest that the paintings observed reflect largely contemporaneous influences from numerous sources by local populations. The art may reflect more the particular painting styles of *individuals* who's styles have differentially developed via influences from numerous places, rather than representing a strict cultural convention that can be specifically identified as 'The' Wardaman rock painting style (as distinct from neighbouring 'styles').

In a later paper, these issues will be further addressed by us in a more detailed analysis of the paintings. This analysis includes both an investigation of the distribution of *motif forms* (see Appendix 1) and particular stylistic elements (e.g. type of internal decoration). We present below a preliminary discussion of the above points in relation to documented Wardaman inter- regional relations.

DISCUSSION

Perhaps the most influential debate in the history of Australian prehistory has fallen under the guise of the 'Intensification Debate' (Lourandos, 1983; Beaton, 1983). It has recently been the subject of focused attention, and represents a critical stage in Australian prehistory as it has addressed a number of questions which have re-oriented the nature of archaeological enquiry in this country. It has not only brought the issue of intensification, for long a major source of discourse in international circles, to Australia, but more importantly, it has brought it out of its traditional 'hunter-gatherer to farmer' frame of reference to one addressing hunter-gatherers as capable of 'intensifying' without venturing out of the hunter-gatherer mode of production. In

FIG. 9. Type H (infilled and internally decorated) zoomorphic painting (uppermost painting) and Type J (outlined, infilled and internally decorated) zoomorph (lowermost painting).

FIG. 10. Type J (outlined, infilled and internally decorated painting).

other words Aboriginal society is not seen as a static socio-economic network, but rather is referred to as a *dynamic* socio-ideological system, subject to the same kinds of influences characterising farming or agricultural societies. The questions asked of prehistoric Aboriginal life are now more directed at understanding the nature of inter-personal relations (i.e. at the power structures which mediate the maintenance of social traits and changes there-in), questions which traditionally have been the realm of archaeologists studying more complex (structurally differentiated) societies.

It is in questioning the nature of inter-personal relations that we may best attain information on the social forces which serve to both re-direct and maintain trajectories of change.

Lourandos (1983, 1984) has recently taken up these issues with reference to Australian prehistory. He has argued that in many parts of Australia, and in the Victorian southwest in particular, the very *structure* of alliance networks has witnessed a fundamental shift during mid- to late-Holocene times. These shifts, he believes, are visible archaeologically in the following ways:

1] there is an increase in use of individual sites;
2] there is an increase in the rate of establishment of new sites;
3] there is a diversification and increase in the complexity of resource management strategies;
4] there is an increase in the use of marginal environments (see also Flood *et al.*, 1987; David, 1987; Walters, 1989);
5] the development of widespread trading networks takes place.

Together, Lourandos sees these changes as reflecting an *intensification* of socio-economic variables, where these can refer to 'economic as well as social variables which may themselves bear directly or indirectly upon economy' (Lourandos, 1983,p. 81).

Yet in spite of the far-reaching implications of

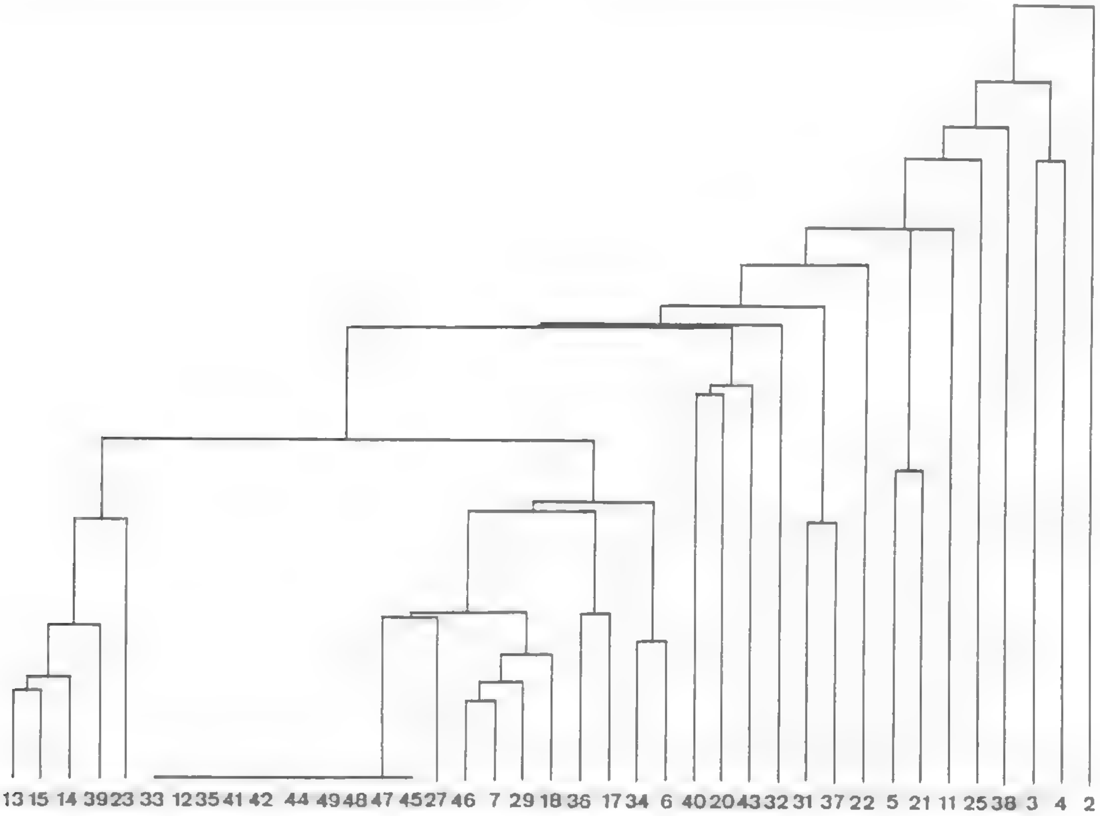

FIG. 11. Average Linkeage Cluster Analysis, showing site numbers.

Lourandos's work, it is surprising that little attempt has yet been made to investigate the distribution of, and changes in, particular stylistic conventions, and this is especially so of rock art. One notable exception has been Lewis (1988), who has argued that during the height of the last glaciation, an extensive interaction network existed throughout the Bonaparte catchment, which extended from the Kimberleys to the Victoria River, Arnhem Land and beyond (including Wardaman country). In relation to climatic changes (especially the development of wetlands) and population increases during the late Holocene, Lewis (1988) sees the rock art of northern Australia becoming more regionalised during the last 2000 years or so. Although we agree with the directions of Lewis' (1988) work, we have argued in this paper that the patterning of stylistic conventions in Wardaman rock paintings does not reflect any significant changes in this region, and we therefore argue that there have been no *major* changes in inter-regional alliance networks for the period documented by the region's surviving rock paintings. We briefly discuss the probable antiquity of this body of rock art below, situating it in a broader temporal sequence. We conclude below with some implications for the Intensification question.

CONCLUSION

A number of factors lead us to believe that most, if not all, of the *surviving* rock paintings from the Yingalarri region are of relatively recent age (late Holocene):

1) The sandstones of the region are soft and friable, unlike those of the Kombolgie Formation to the north (where much of the Kakadu rock art is located). Chaloupka (1984, p. 53) notes, for instance, that sandstones found on the Arnhem Land Plateau are far more stable than those found in Wardaman country. The conditions for preservation of long-standing paintings are not widespread in Wardaman country.

2) Despite the elaborate, figurative nature of Wardaman rock paintings, no evidence of extinct fauna has yet been found in the region. This is so despite the fact that 109 sites and 3379 paintings have so far been systematically recorded. This is in direct contrast to the situation to the north, where numerous examples of extinct fauna (i.e. Thylacines) have been found (Lewis, 1977).

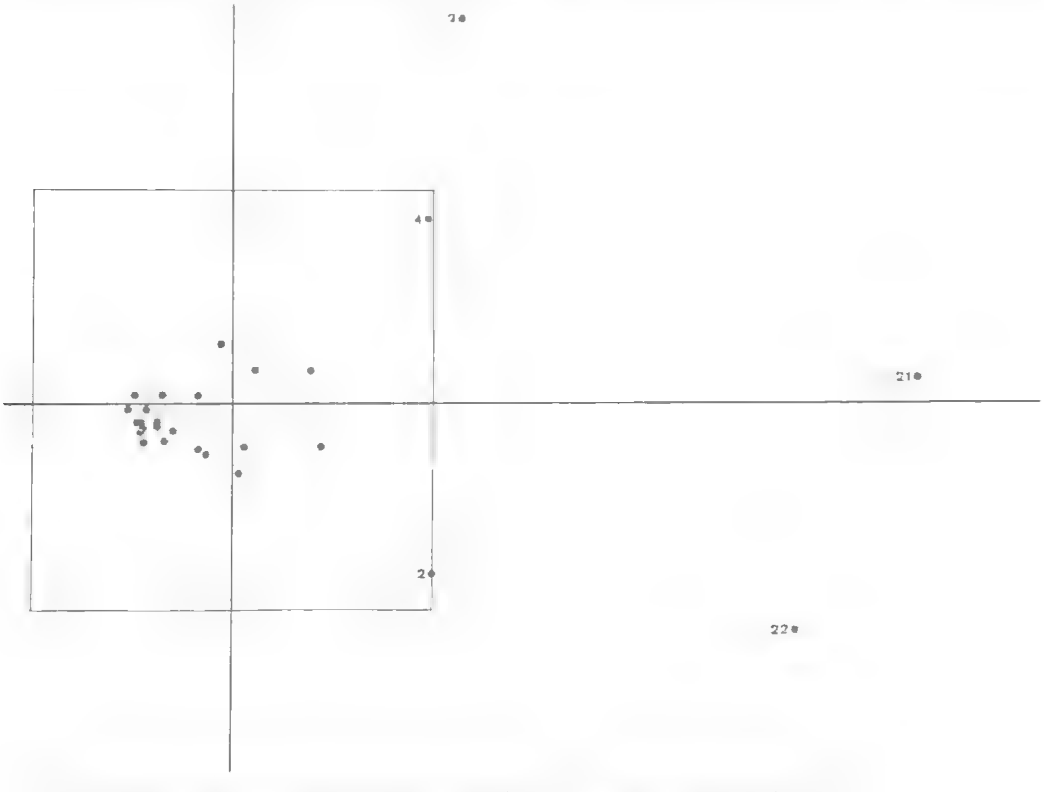

FIG. 12. PCA on sites Yingalarri 2-49, showing 0.5 level of significance (boxed area).

3) Compounding 1) above, dramatic increases in precipitation, and increases in conditions promoting exfoliation of rock surfaces, before 3000 years ago, would mitigate against the stabilisation of rock surfaces in friable sandstone outcrops.

4) Excavations of two sites at Yiwarlarlay have shown:

a] dramatic increases in occupational intensity, along with presence of ochre, in late Holocene levels;

b] the presence of exfoliated, painted wall cortex *only* in very recent times.

5) Excavations at Mennge-ya (near Yingalarri) have revealed dramatic increases in occupational intensity and in amounts of ochre in late Holocene layers.

6) Paintings *always* overlie patinated peckings when superimpositions occur. No example of peckings over paintings are known to us despite the fact that 18,354 pictures (engravings, paintings, stencils, prints) have been recorded from Wardaman country.

7) The creation of engravings have been dated stratigraphically to over 5000 years by Mulvaney (1975) at the Yingalarri 1 (Ingaladdi) site. However, it is likely that some of these (abraded grooves especially) have been created continuously for long periods of time, as both Merlan (1988) and Flood *et al.* (in press) document the recent making of abraded grooves by Wardaman people. No examples of paintings underlying abraded art have been observed.

8) The fragility and therefore instability of paintings is re-enforced by the fact that numerous clear paintings from Yingalarri which were photographed in the 1960s have since disappeared to the point of total disintegration (mainly fading).

As a result of these observations, we suggest that the paintings from the Yingalarri region are mostly, if not entirely, relatively recent (late Holocene). Furthermore, as is shown in the distribution of superimpositions (Table 2), no major temporal changes in painting techniques have been noted for sites 2-49. As a result of these observations, we suggest that there is no evidence for any major shift in the distribution of painting conventions in the Yingalarri region during the late Holocene. By implication the alliance networks observed ethnohistorically from the broader region (which have been central to the dispersal of painting conventions throughout the broader region) have been operating perhaps throughout the late Holocene period (and, as previously argued by Lewis [1988], linked the Wardaman region with the Victoria River and western areas). In effect, we suggest also that the seeds to the alliance networks documented during ethnohistoric times were already in place during or before the *mid*-Holocene. We say this as a result of the great similarities between the patinated engravings of what is today Wardaman country (some of which have been dated stratigraphically at Yingalarri 1 to over 5000 years BP), and those to the south and to the west. The similarities in the early engravings may even document a system of alliance networks far broader than that documented ethnohistorically, as the 'early' engravings are stylistically similar to those of Keep River and beyond to the west, and to those of numerous parts of South Australia (e.g. Meadow's Bluff) to the south. Engravings are considerably rarer in the north and, contra Lewis (1988), this may imply considerable antiquity for an Arnhem Land-Victoria River cultural discontinuity. Although these issues will form the subject of a separate study, we suggest that early Holocene socio-organisational systems were more open than those observed ethnohistorically, perhaps stressing the maintenance of social relatedness, a feature of arid and semi-arid life which Myers (1986, p. 164) has argued is central to survival and everyday life in central Australia. Further assessment of these questions will, however, have to await a more detailed analysis of the rock art found in both what is today Wardaman country and beyond.

ACKNOWLEDGEMENTS

We would first and foremostly like to thank the many Wardaman people who showed us and allowed us to record their sites. Special thanks go to Ruby Alison, Riley Birdun, July Blutcher, June Blutcher, Daisy Gimin, Lily Gingina, Queenie Ngabijiji, Tarpot Ngamunagami, Elsie Raymond, Oliver Raymond, Barbara Raymond, Michael Raymond, Lindsay Raymond and Tilley Raymond.

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APPENDIX 1

Description of the 45 Motif Forms identified from sites Yingalarri 2-49 in this preliminary classification system (see Fig. 2). In the descriptions below, the number corresponds to the Motif Form number as is shown on Fig. 2, and this is followed by a key word description (e.g. 1] *elongated anthropomorph*).

1] *elongated anthropomorph*, where length of painting is at least twice its width.

2] *split anthropomorph*, where the image is either split along the entire length of the body, or at its junction with the arms (giving the impression of an absence of torso).

3] *elongated limbed anthropomorph*, where arms/legs are elongated, often showing presence of joints (elbows, knees).

4] *detailed anthropomorph*, where facial and body features are detailed (e.g. eyes and mouth especially).

5] *split face anthropomorph*, where the face is split into two halves.

6] *dynamic anthropomorph*, where body features are standardised into geometric elements (e.g. square head, oval breasts, circular elbows), and there is a total absence of any detail of internal features (such as eyes, mouths, etc.).

7] *generalised anthropomorph*, where only the basic body shapes are shown.

8] *other anthropomorph*. This category refers to one-off anthropomorphs that do not conform to 1]-8] above. Further surveys will, hopefully, increase the sample sizes of these pictures, and each form will be treated separately and further described in our final report.

9] *indeterminate anthropomorph*, where the picture can be identified as an anthropomorph but is too faded or damaged to further identify.

10] *macropod*, where the picture has the formal characteristics of a mammalian quadruped, and where the fore-limbs are noticeably shorter than the hind-limbs.

11] *canid*, where the picture has the formal characteristics of a mammalian quadruped, where the limbs are all of approximately equal size, and where ears and tail resemble those of dogs.

12] *other quadruped*, where the picture does not conform to either 10] or 11] above.

13] *emu*, where the body is extremely large relative to the head, and where the formal characteristics of the image resemble those of birds.

14] *long-beaked bird*, where the beak-length is pronounced, and the image has the formal characteristics of a bird.

15] *generalised bird*, where the image has the formal characteristics of a bird, but where no other distinct feature can be identified.

16] *owl*, where the picture consists of a generalised oval body with the head above it, and where the head is divided into two equal halves.

17] *short bird*, where the image is of a biped whose length is approximately equal to its width, where the picture is relatively small (50cm or less in length), and where the legs emanate from the side of the body (rather than from underneath it).

18] *other bird*, one-off pictures where the image resembles a bird, and where specific features distinguish it from 13] to 17] above.

19] *snake*, being elongated images with identifiable heads and/or tails.

20] *eared snake*. As with 19] above, with the addition of one or two ears above the head.

21] *turtle*, being four-limbed zoomorphs with head and sometimes tail emanating from a circular body.

22] *echidna*, having the formal characteristics of echidnas. There is a linear extension protruding from a roundish head when in plan view, whilst the linear extension emanated from the body when in profile.

23] *indeterminate echidna/turtle*, being pictures which are too faded or damaged to determine whether they belong to category 21] or 22].

24] *crocodile*, having the formal characteristics of crocodiles, and where head is pictured as relatively circular and followed by an elongated 'snout'.

25] *lizard*, similar to 24] above, but where the head is elongated.

26] *indeterminate crocodile/lizard*, where the picture resembles 24] and 25] above, but where it cannot be identified as either one or the other.

27] *indeterminate crocodile/lizard/fish*, where the image cannot be differentiated between 23], 24] above or 28] below.

28] *fish*, where the picture resembles a fish (presence of fins, tail and head).

29] *bat*, where image resembles a bat/flying fox. These are either upright or up-side down. These are small, generalised bipedal bodies with heads and relatively large ears.

30] *unidentified quadruped*, being a four-legged and tailed zoomorph whose formal characteristics do not resemble those of any known animal.

31] *unidentified biped*, being a two-legged biped whose formal characteristics do not resemble those of any known animal.

32] *star zoomorph*, being a tailed-image with a star-shape in head position, and where two circles occur in the position of the eyes.

33] *indeterminate zoomorph*, where degree of fading and/or damage precludes it from further identification.

34] *foot*, being a toed track-form resembling the shape of a human foot.

35] *macropod track*, being a track-form which resembles (either singly or in pairs) the tracks of macropods. Side toe(s) must be present.

36] *bird track*, being three- or four-pronged pictures resembling the shape of bird tracks, and where the meeting point of the prongs must be angular.

37] *concentric circles*, including single circles.

38] *geometric non-figurative*, these being one-off geometric non- figurative pictures which do not conform to 39], 40, 41] or 42] below.

39] *tally-forms*, being series of dots or parallel lines.

40] *grids*.

41] *matchsticks*, being geometric linear shapes with circular 'head' above them. These sometimes have radiating lines emanating from the 'heads'.

42] *half-suns*, being geometric semi-circles with radiating lines.

43] *other non-figurative*, being amorphous non-figurative designs.

44] *boomerang-shapes*, being curvilinear pictures resembling boomerangs, or hooked curvilinear pictures.

45] *contact images*, being pictures having formal characteristics of post-contact items (e.g. guns, person on horse).

NEW AND RARE CRABS OF THE SUBFAMILY DOTILLINAE (CRUSTACEA: OCYPODIDAE) FROM NORTHERN AUSTRALIA AND PAPUA NEW GUINEA

P.J.F. DAVIE

Davie, P.J.F. 1988 08 31: New and rare crabs of the subfamily Dotillinae (Crustacea : Ocypodidae) from northern Australia and Papua New Guinea. *Memoirs of the Queensland Museum* 28(2):463-473. Brisbane. ISSN 0079-8835.

Two new species of the previously monotypic genus *Tmethypocoelis*, *T. koelbeli* and *T. odontodactylus*, are described. They are separated from each other and from *T. ceratophora* (Koelbel) by their distinctive male pleopods, and cheliped characters. *Ilyoplax strigicarpus* is also described, and is separated from its closest ally, *I. orientalis*, by the shape of the lower orbit and the male first pleopod. *Ilyoplax dentatus* is discussed and the male and female abdomens and male pleopod are figured. ☐ *Crustacea, Ocypodidae, Dotillinae, Tmethypocoelis, Ilyoplax, new species, Australia, Papua New Guinea.*

P.J.F. Davie, Queensland Museum, PO Box 300, South Brisbane, Queensland 4101, Australia; 14 August, 1989.

The ocypodid subfamily Dotillinae has long been referred to as the Scopimerinae, but Manning and Holthuis (1981: 192) point out that Dotillidae Stimpson, 1858, is older than Scopimerinae Alcock, 1900, and therefore has priority. The dotillines are poorly represented in Australia; only *Scopimera inflata* A. Milne Edwards and *Ilyoplax dentatus* Ward have been previously recorded. This paper records two new species bringing the total number to four. All appear to be endemic. Only *Scopimera kochi* Roux, 1927, has been previously recorded from New Guinea. All specimens examined are in the collections of the Queensland Museum (QM), the Australian Museum (AM), or the Western Australian Museum (WAM).

Genus **Tmethypocoelis** Koelbel, 1897

Tmethypocoelis Koelbel, 1897, p. 715.* (Type species: *Dioxippe* (*Tmethypocoelis*) *ceratophora* Koelbel, 1897, by original designation, subsequently elevated by Shen, 1935).

DIAGNOSIS

Scopimerinae with ocular peduncle prolonged beyond the cornea as a long styliform projection. Sub-orbital margin cut into two parts by a deep groove which runs obliquely and medially downwards; the inner part has two transverse granular ridges separated by a groove. The endopod of the second maxilliped has an ovate palp. Chelipeds subequal. Second maxilliped with the penultimate segment not expanded and with the ultimate segment attached terminally. Carapace with upper surface and lateral walls not conspicuously sculptured. Ambulatory legs with large tympana.

REMARKS

Within the Dotillinae, *Tmethypocoelis* shows closest affinities with the genus *Ilyoplax* and, indeed, it was originally considered a subgenus of *Ilyoplax* (then referred to by the preoccupied name *Dioxippe* de Man). *Tmethypocoelis* shares in common with *Ilyoplax*: subequal chelipeds; a similar type of second maxilliped that does not have the penultimate segment expanded, and has the ultimate segment attached terminally; and, the upper surface and lateral walls of the carapace are not conspicuously sculptured.

The most unusual character of *Tmethypocoelis* is the long styliform projection on the cornea. This character is not unique to *Tmethypocoelis* as it also occurs in a number of species of *Ocypode* and *Uca* (see Barnes, 1968; Hagen, 1970).

In itself the ocular projection would not be sufficient to delimit the genus, however, combined with the grooves of the sub-orbital margin and the extremely consistent overall appearance of the chelae and carapace, the three species now described must be considered generically distinct. Shen's (1935) diagnosis gave eight characters to separate *Tmethypocoelis* from *Ilyoplax*. My diagnosis is somewhat shorter because, in the light of the new species described here, I decided that several of his characters were useful only at the specific and not the generic level.

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* Not seen, pagination follows Shen (1935) and others, although Tesch (1918) gives p. 573.

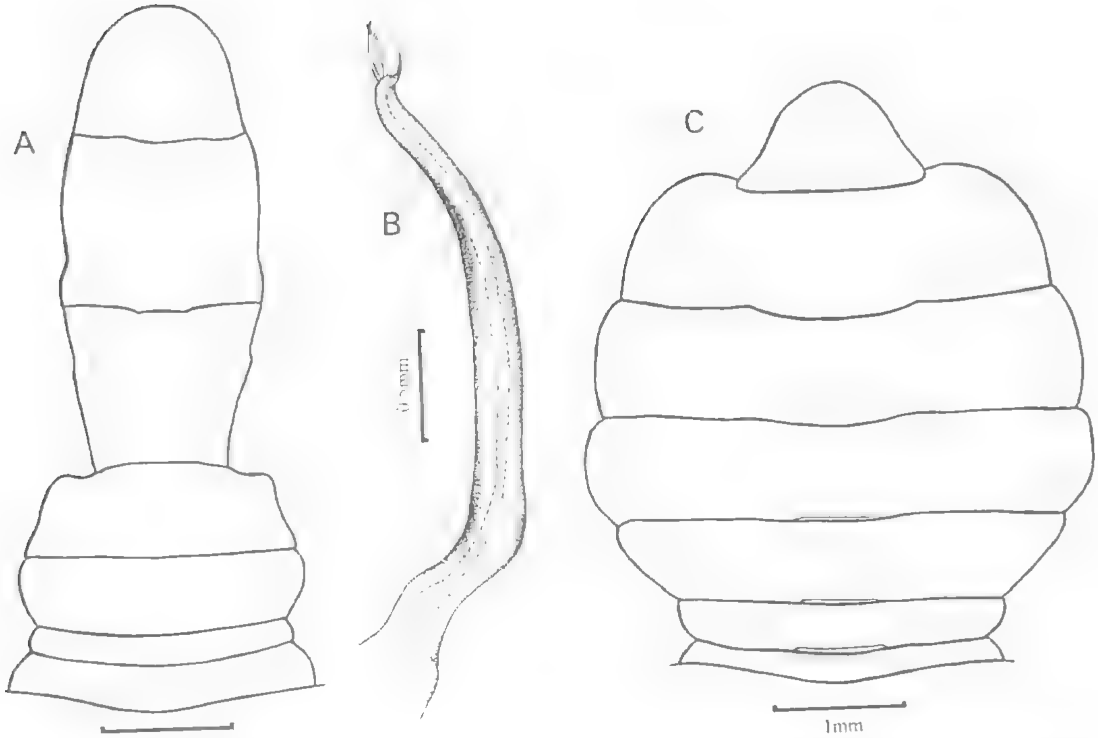

FIG. 1. *Tmethypocoelis koelbeli* sp. nov. A, male abdomen (paratype, QM W7982); B, male first pleopod (paratype, QM W7982); C, female abdomen (paratype, QM W7983).

Tmethypocoelis koelbeli sp. nov.
(Figs 1,2,6A)

MATERIAL EXAMINED

HOLOTYPE: QM W7981, ♂ (6.9 mm), South Alligator R., Northern Territory, P. Davie, 11.5.1979.

PARATYPES: QM W7982, 6♂♂ (7.3, 7.1, 7.0, 6.8, 5.9, 5.7 mm), same data as Holotype. QM W7983, 1♂ (5.5 mm), 3♀♀ (6.0, 5.8, 4.6 mm), East Alligator R., Northern Territory, P. Davie, 30.4.1979. QM W15085, 22♂♂ (5.3–8.2 mm), 1♀ (6.7 mm), Magela Ck, East Alligator River, Kakadu National Park, Northern Territory, 13.vi.1981, P. Davie.

DESCRIPTION

Carapace: Approximately pentagonal, somewhat flattened. Convex along mid-dorsal line, slightly convex laterally. About 0.6 as long as broad. Regions semi-defined; epigastric lobes slightly swollen, joined in a depressed arc behind front but separated behind. Ovoid mesogastric region prolonged anteriorly between epigastric lobes; cervical groove dividing gastric and cardiac regions, short and distinct, narrow medially, widening laterally. Cardiac region with a slight central depression. Orbital, hepatic and branchial regions not distinctly separated; with undulating surface. Branchial region sloping, with irregular small setiferous tubercles. Sub-branchial region bulging, regularly hairy, separated from branchial region by sinuous lateral border which is hairy and minutely granular in its anterior half and with closely spaced short hairs posteriorly.

Front at base about one-fifth distance between external orbital angles. Side borders slightly convex, converging; frontal angles rounded. Anterior borders with sides oblique and shallowly concave; a central blunt prominence. Supraorbital borders sinuous, sloping backward, microscopically beaded particularly towards external orbital angles. External orbital angle, with edges more or less serrulate; posteriorly followed by a broad U-shaped sinus which continues as a depressed oblique channel onto dorsal surface behind supra-orbital margin. Epibranchial angle capped by small tubercle.

FIG. 2. *Tmethypocoelis koelbeli* sp. nov. S.E.M. photographs of apex of male first pleopod (paratype, QM W7982). Scale line = 0.1 mm.

Distance between epibranchial angles subequal or slightly less than between external orbital angles. Hind margin slightly concave and about two-thirds distance between external orbital angles; a fine ridge parallel with the hind margin forms a broad rim.

Infra-orbital border projects beyond supra-orbital, and is of two parts separated by a notch, from which on the pterygostome, runs an inwardly directed oblique channel. This channel forms a tilted Z-shape and terminates above the base of the chela. Inner part of infra-orbital border about equal in length to outer part and consists of two rows of large granules separated by a concavity. Anterior row follows the arc of the orbit, posterior row is slightly irregular, almost straight, and converges on but does not intercept the anterior row at the notch. Just behind this second row is a line of closely spaced long feathery hairs which extend from the base of the eyestalk and are longest behind the notch. Outer part of infra-orbital border also granular; terminates just below external orbital angle such that a broad notch is formed. Undersurface of the external orbital angle with a brush of feathery hairs. Side walls perpendicular anteriorly but sloping outwards at the sub-branchials; regions not separated; setiferous tubercles over whole area.

Eyestalks: Widen distally; cornea bulging; medial thickening gives twisted appearance; usually reach level of external orbital angle. Eyestalk projects beyond the cornea in the form of a long style, which in adult males is equal to, or longer than cornea, but shorter in younger specimens. Female style short and fine, almost like a stout hair. Tip with two or three stiff hairs disposed in single file. Always a long stout hair placed just before cornea and projecting upwards.

External maxillipeds: Do not close buccal cavern, slightly vaulted. Ischium subquadrate, although antero-internal angle produced as an obtuse lobe. Dense fine hair longest on postero-internal curve and extending dorsally up inner side. Anterior margins slightly concave. A line of fine hair runs obliquely from anterior margin near antero-internal angle and then down outer margin, increasing in length so that are longest at the outer margin. Merus slightly larger than ischium. Lateral margins converge distally; inner margin straight with long feathered hairs, outer margin slightly convex with short pile. Merus and ischium covered with very short scattered hairs. Carpus occupies the narrow anterior margin of merus as with *T. ceratophora*. Dactylus slender and twice length of propodus. Long feathered hairs apically.

Abdomen: Terminal segment rounded. Penultimate segment slightly longer than fifth segment, and with slightly concave, parallel sides. Fifth segment with straight sides, narrowest at base. Fourth segment expanded. Female abdomen as figured.

Chelipeds: Massive; long but not remarkably; subequal. Merus is sharply three faced with serulate borders; tympanum on inner surface, broadly oval; feathery hairs on whole inner surface including tympanum. Outer face granulate distally and with tympanum smaller and elongate. Carpus a little elongated in large males, but not so in smaller males and in females; distal internal angle is extended to form tooth-like articulation point with the palm; unarmed except for fine serrulation of inner and outer borders; inner face in large males with scattered, pointed granules proximo-dorsally and a short near vertical ridge of large rounded granules ventrally. Palm bulky, length approximately three-quarters distance between outer orbital angles; height about half length, and about equal to length of immovable finger; outer surface granulate dorsally, granules largest distally; smooth ventrally. Large granules down edge of gape between fingers, on both outer and inner surfaces. Inner surface evenly and finely granulate on upper half. These granules extend over the dorsal curve to the sharply cut superior border of the outer surface. Both upper and lower borders finely granulate. Lower border extends onto, and is obvious, for about half length of immovable finger. Small group of long hairs on upper surface just behind the articulation joint of dactylus. Fingers gaping at base. Both fingers curved inwards, expanded distally to form spooned tip. Cutting margins with even rows of teeth, however on moveable finger of smaller males, a raised platform of teeth is differentiated in proximal half and some trace of this is usually evident in fully mature chelae. Inside surface of moveable finger with short irregular line of large tubercles just above cutting margin near base. Band of fine granules on dorsal surface takes the same form as palm. Superior border straight, extending three-quarters length of finger; terminates in an overhanging 'shelf' because of sharp inward turning of tip. Outer surface with two subregular lines of granules originating at base; development of granules and length of line variable. Superior one may extend three-quarters of length to tip, lower one a little less. Inner margin at tip of both fingers with a short row of 6–10 stout hairs. Spooned tips with corneous edge. Chelipeds of females of small and simple 'ocypodid' type.

Ambulatory legs: Meri approximately two and a half times as long as broad, as long as the next two joints together. Upper and lower margins convex. Upper margin slightly crenulate distally, otherwise smooth. Provided both sides with oval tympana. Tympana large and of same relative size on anterior surface of all meri; on posterior surface, become progressively smaller from 1st to 4th legs. Second pair of legs the longest, second and third pairs both longer than first; fourth pair the shortest. First pair a little longer than distance between external orbital angles. Carpo- and propodites with fine bristles. Dactyli nearly straight, flattened dorso-ventrally, pointed, shorter than propodites. Closely spaced fine hairs laterally, not extending to tip. Length of hairs tapering distally.

Hairy edged pouch present between bases of first and second, and second and third walking legs. Hair tufts are long, thick, and conspicuous and extend to bases of meri.

First male pleopod: As figured.

Colour: Chestnut brown to grey with white chelae.

HABITAT

Burrow in soft moist mud banks in upper estuary, low salinity, mangrove situations.

REMARKS

This species is only known from the Alligator Rivers System, Northern Territory. It differs most conspicuously from *T. ceratophora*, by being not quite as broad (c. 0.6 as long as broad, as opposed to *c.* 0.5 in *T. ceratophora*); having a distinctive first male pleopod; and having the carpus of cheliped not as elongated in adult males. It differs from *T. odontodactylus* by the shape of the first male pleopod and the form of the chelae.

Tmethypocoelis odontodactylus sp. nov.
(Figs 3,6B)

MATERIAL EXAMINED

HOLOTYPE: WAM 953-88, ♂ (7.7 x 4.5mm), Mouth of Gogol River, South of Madang, Papua New Guinea, sand, intertidal, 1.vii.1987, G.J. Morgan.

PARATYPES: WAM 218-88, 8♂♂ (6.1–9.3mm), 5♀♀ (5.6–7.6mm), data as for holotype, QM W15385, 2♂♂ (6.2, 8.6mm), 1♀ (6.6mm), data as for holotype.

DESCRIPTION

Carapace: Approximately pentagonal, evenly convex longitudinally, slightly convex laterally; about 0.6 (0.57–0.61) times as long as broad; regions semi-defined. Frontal region furrowed; epigastric lobes small, not joined anteriorly; mesogastric region ovoid and slightly swollen; cervical groove separating gastric and cardiac regions is quite wide and widens into depressed areas laterally bordering the cardiac region; intestinal region separated by a shallow furrow. Orbital, hepatic, and branchial regions not distinctly separated from each other, marked by several short lateral, setiferous ridges and the whole area laterally with short strong setae. Subbranchial region bulging, regularly hairy, separated from branchial region by a sinuous lateral border of short stout setae.

Front at base about one-fifth distance between

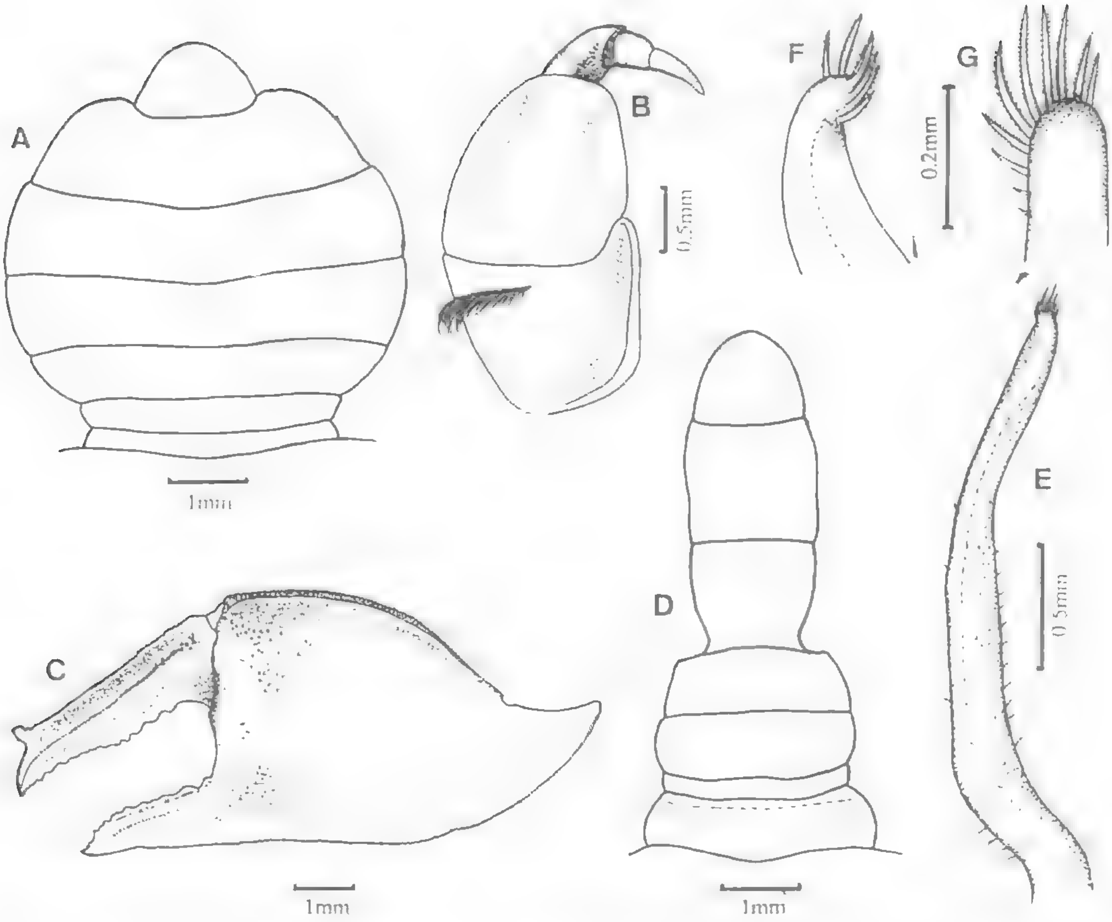

FIG. 3. *Tmethypocoelis odontodactylus* sp. nov. A, paratype WAM 218-88 (7.6 mm), female abdomen; B-D, paratype male, WAM 218-88 (9.1 mm); B, third maxilliped (denuded); C, left chela; D, abdomen; E-G, holotype male, WAM 953-88 (7.7 mm), first pleopod, and magnifications of apex.

external orbital angles; lateral borders slightly convex, converging; anteriorly concave either side of a central blunt point. Supra-orbital borders sinuous, sloping backward, microscopically beaded. External orbital angle bluntly pointed, granulate; followed by U- shaped sinus which forms a depressed oblique furrow onto dorsal surface behind outer half of orbit. Epibranchial angle blunt and at the same level as external orbital angle although may be slightly more protruding on small specimens. Hind margin slightly concave, about two-thirds of the distance between the external orbital angles; with a broad smooth rim.

Infra-orbital border projects beyond supra-orbital and consists of outer and inner sections of about equal length, and separated by a notch; inner part consists of two rows of granules separated by a deep furrow, outer part with small granules on border, terminating below the external orbital angle such that a broad notch is formed; ventral margin of external orbital angle with a brush of feathery hairs. Side walls perpendicular anteriorly but sloping outwards at the sub-branchials; covered in short stout setae.

Eyestalks: Widen distally; slight medial thickening, cornea bulging; usually reach level of external orbital angle. Style projects beyond cornea in males; length variable but usually slightly more than length of cornea; tipped with two or three long bristles. A stout hair usually placed on stalk just before the cornea, and projecting upwards.

External maxillipeds: Do not close buccal cavern; slightly vaulted; internal margins and palp with thick lining of fine setae; outer margins with short sparse setae. Ischium subquadrate, a little broader than long, and with the internal superior angle produced as an obtuse lobe. Merus distinctly larger than ischium, lateral margins convergent distally; palp occupies the narrow anterior margin.

Abdomen: Telson rounded, about the same length as fifth segment; sixth segment longest; fifth segment basally constricted; fourth segment expanded; second segment a thin strip. Female abdomen a wide flap as figured.

Chelipeds: Massive in males, subequal; merus trihedral with serrulate borders; broadly oval tympanum on proximal two-thirds of inner face; outer face with a smaller elongate tympanum near lower border. Carpus elongated (length c. 1.5 times breadth), sub-rectangular, granulate borders. Palm bulky, height about half total length, and equal to length of moveable finger; outer surface finely granulate mid-dorsally, granules largest distally, smooth ventrally, larger granules along edge of gape. Lower border granulate except for distal portion of immovable finger. Upper half of inner surface evenly and finely granulate, granules extending over the dorsal curve to the sharply defined superior border of the outer face. Both fingers curved inwards distally, and expanded distally to form spooned corneous tips; cutting margins are evenly toothed although on the proximal half of the moveable finger the teeth are a little more elevated. Moveable finger with a medial granulate ridge running the whole length and another granulate crest on the superior margin which terminates subdistally in a strong upturned tooth. Chelipeds of females of small and simple 'ocypodid' type.

Ambulatory legs: Similar to *T. koelbeli*; tympana on anterior surface of meri are large and of similar relative size, on posterior surface becoming progressively smaller from first to fourth legs. Second pair of legs longest. Hairy edged pouch present between bases of first and second, and second and third walking legs.

Colour: Chestnut brown, with lighter chelae becoming white on the fingers. Some specimens have large lateral cream patches extending over the orbital floor, and the hepatic and anterior branchial regions but not onto the frontal and protogastric regions.

First male pleopod: As figured.

HABITAT

Found on intertidal sand at the mouth of the Gogol River and so would appear to be more tolerant of high salinity than *T. koelbeli.*

REMARKS

This species is only known from the type locality. It is distinguished from both the other species by the remarkable subdistal tooth on the anterior margin of the moveable finger of the chela, and by the distinctive tip of the first male pleopod. Both *T. odontodactylus* and *T. koelbeli* differ from *T. ceratophora* in having the carpus of the cheliped rather short and not remarkably elongated.

Ilyoplax strigicarpus sp. nov.

(Figs 4,6D)

MATERIAL EXAMINED

HOLOTYPE: QM W14944, ♂ (7.1 mm), near the Australian Institute of Marine Science, Cape Ferguson, Townsville, NEQ, Nov. 1980, N. Zucker.

PARATYPES: QM W11258, 2♂♂ (6.4, 6.4 mm), data as for Holotype. QM W2996, 2♂♂ (4.9, 5.0 mm), Pioneer River, Mackay, MEQ, B. Campbell, 4.ii.1965. QM W4584, 2♂♂ (5.0, 5.3 mm), 2♀♀ (4.9, 5.9 mm), Redbank Ck, Trinity Inlet, Cairns, NEQ, R. Timmins, 11.xii.1974. QM W4625, 1♂ (4.2 mm), Bogimbah Ck, Fraser Island, SEQ, Australian Littoral Society, 3.i.1973. QM W4776, 3♂♂ (4.6, 5.9, 6.5 mm), Bogimbah Ck, Fraser Island, SEQ, Australian Littoral Society, 1.i.1974. QM W5383, 1♂ (5.2 mm), Pulgul Ck, Hervey Bay, SEQ, P. Davie, 19.vii.1975. QM W15083, 1♂ (4.7 mm), 3♀♀ (3.8, 4.1, 5.3 mm), Point Farewell, East Alligator River, Kakadu National Park, Northern Territory, 11.vi.1981, P. Davie. WAM 185-80, 1♂ (5.8 mm), Main Channel, Broome, N.W. Australia, between Broome Pearls Ck and Roebuck Hotel Ck, 25.ix.1980, D.S.Jones and R.W. George. WAM 219-80, 1♂ (6.0 mm) 1♀ (5.4 mm), Main Channel, Broome, N.W.A., 2.x.1980, D.S. Jones and R.W. George.

OTHER MATERIAL: AM Unreg. 1♂ (5.3 mm), mouth of Nungbalgari Ck, NT, mudflat burrows, 22.viii.1975, D. Grace (Messel). AM Unreg. 1♂ (4.2 mm), Hutchinson Strait, 10 km W/B, mudfloor, *Rhizophora* forest, 25.ix.1975, D. Grace/Green. AM Unreg. 3♂♂ (5.5, 5.9, 5.0 mm) Wurugois Ck, NT, 19.viii.75, mudbank, burrow, D. Grace.

DESCRIPTION

Carapace: Sub-rectangular, regions poorly defined; smooth or microscopically granular, with sparsely scattered small hairs. Front relatively broad (approx. 0.29 × distance between external orbital angles), slightly deflexed; lateral borders converging, angular; a blunt median prominence; distinctly concave dorsally. Gastro-cardiac groove well defined; cardiac region with a low swelling either side of the mid-line; branchial regions with three short, low, horizontal crests posterolaterally above the articulation of the last walking leg, each with a row of short hairs. Posterior border slightly concave, and with a very broad rim. Side walls divergent; greatest carapace width at about the first walking leg.

Supra-orbital borders, sinuous, sloping backward, minutely granular on central convexity otherwise smooth. External orbital angles pointed although not sharply, posteriorly followed by broad U-shaped notch. Lateral borders slightly divergent, straight or slightly concave, sharp and clearly defined in anterior half then becoming indistinct.

Infra-orbital border projects beyond supra-orbital; smooth; slightly sinuous, and is continuous with the lower edge of the external orbital angle laterally; the anterolateral edge has a tooth capped by a molar-like pectination and from this tooth a ridge extends almost to the outer lobe of the epistome so forming a horizontal, triangular, concave shelf anterior to the orbit.

Eyestalks; c. 0.36 × distance between external orbital angles, cornea bulging.

External maxillipeds: Merus longer than ischium (*c.* 1.3×). Antero-internal angle of ishium produced along edge of merus. Anterior half of ishium with a line of microscopic granules slanting down toward external border and equipped with feathery hairs longest near external border.

Maxilliped slightly bulging and completely closing the buccal cavity.

Abdomen: Terminal segment rounded triangular, slightly shorter than penultimate. Penultimate with sub-parallel margins. Fifth segment subequal in length to penultimate, characteristically constricted near base. Fourth and third segments divergent, fourth longer than

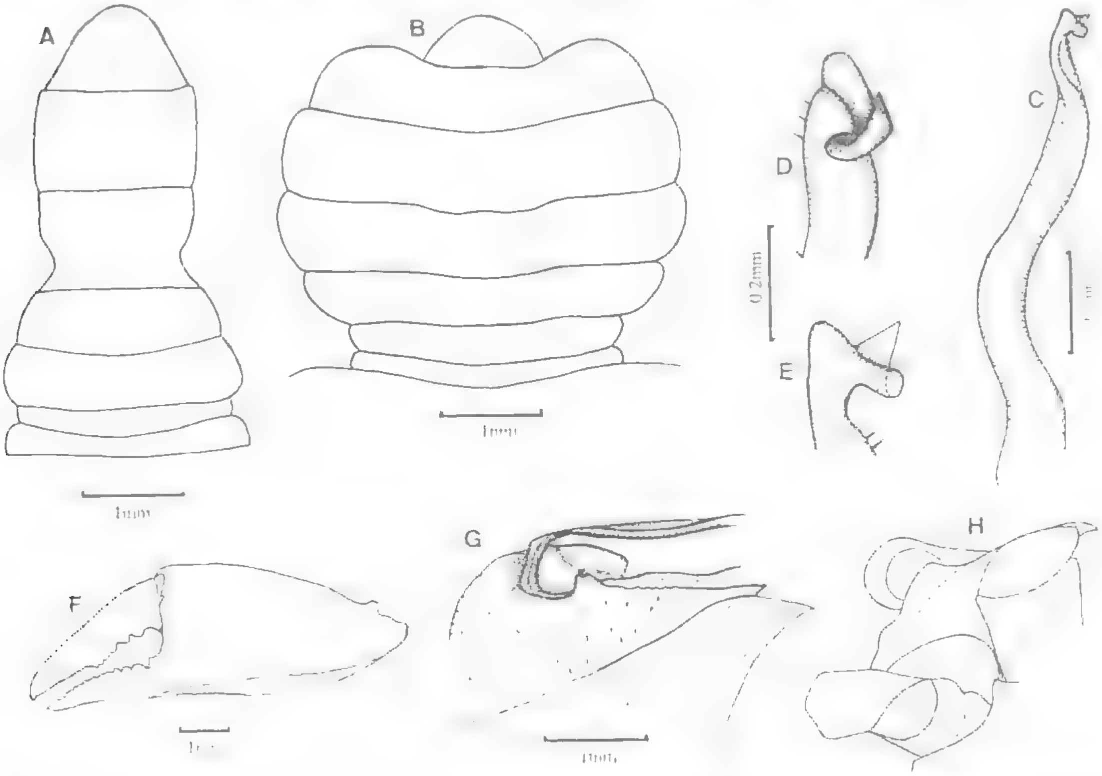

FIG. 4. *Ilyoplax strigicarpus* sp. nov. A,C–G, holotype male; A, male abdomen, B, female abdomen, paratype (QM W4564: 5.9 mm c.b.); C, male first pleopod; D,E, magnifications of apex; F, left chela; G, suborbital border showing chitinous peg on tip of outer orbital tooth; H, suborbital margin of *Ilyoplax orientalis* (Zool. Ref. Coll., University of Singapore; Cat. No. 1965.7.19.192–196; ♂ (4.2 mm c.b.), Pandan Forest Reserve Singapore, coll. Sept. 1934).

third. Second segment constricted. First with horizontal keel subparallel to anterior margin. Female abdomen as figured.

Chelipeds: Massive, very long (*c.* 3× distance between external orbital angles); equal; merus trihedral, inner margin granulate, outer margin serrated; posterior border rounded. Posterior face with squamiform markings except for a smooth band down outer edge. Carpus greatly elongated (*c.* 2× as long as wide); and about as long as length of carapace; widest proximally, tapering distally. This elongation is typical in males over 6 mm carapace breadth however length is variable with age being not nearly so long in smaller males; in females it is short and quadrate. The internal proximal angle possessess an obtuse tooth which on its inner edge bears a series of ridges which extend in a band along the proximal lower edge of the carpus. These ridges, in association with the tooth on the inferior orbital border would appear to be a stridulatory apparatus. Above the stridulatory ridges is a row of fine hairs, longest distally.

Chela considerably elongated (length *c.* 2.6× height). Dorsal margin of palm rounded, marked by a line of fine granules which continue down about two-thirds of the inside face. Upper surface of outside face slightly roughened by a series of low wrinkles, ridges or flattened tubercles, otherwise outer face is smooth. Ventral margin formed by a fine granulate line arising from the tip of the immovable finger and extending *c.* two-thirds distance toward articulation. An accessory line of granules also arises from the tip of the finger and extends the whole length of the lower outer face. The lower surface of the immovable finger between these two lines is also finely granulate. A granulate ridge also arises near the tip on the inside of the finger and curves upwards behind the gape for about one-third the length of the palm. This forms one side of an approximately triangular smooth area directly behind the gape.

Fingers hollowed but with a brush of hairs on inside edge near tip; pointed; immovable finger slightly down-turned; cutting margin convex, armed with an even row of teeth that range from large and rounded proximally to tiny points distally.

Upper margin of movable finger granulate; cutting margin with similar dentition to fixed finger except for the differentiation of a medial protruberance.

Walking legs: Meri *c.* 4× as long as wide; about as long as the last three segments. There appear to be faint signs of large oval tympana on both sides of the meri but these are not as distinct as are those of other members of this genus.

The second leg slightly the longest. Dense hair is present on the carpi and propodi of the first and second pairs of walking legs however the extent of coverage is variable. The propodi may be completely covered except for a small bare area on the postero-ventral edge behind the dactylar joint, and the carpi similarly, may be well covered except for the dorsal proximal third and the ventral surface. There does not appear to be any relationship between extent of coverage and size or sex.

First male pleopod: As figured.

REMARKS

In overall appearance *I. strigicarpus* is almost identical with *Ilyoplax orientalis* and cannot be distinguished from the type description and illustration. The differences are: the presence of a pectinate tooth on the projecting lobe of the outer orbital border; the stridulatory ridges on the proximal inner tooth of the carpus; and the form of the first male pleopod. It falls into the Group 1 species of Serène and Lundoer (1974), which includes *I. orientalis*, *I. tansuiensis*, *I. gangeticus* and *I. longicarpus*. The species of this group have long ambulatory legs without obvious tympana. *I. orientalis* and *I. longicarpus* share with *I. strigicarpus* a similarly formed first male pleopod characterised by an apex distally divided into several short lobes. The gonopods of the other two species are still unknown.

HABITAT

Common on very soft mud flats at the mouths of estuaries, and sheltered bays.

DISTRIBUTION

Northern Australia from Hervey Bay in Queensland, north and westwards to Broome in NW Australia.

Ilyoplax dentatus Ward, 1933

(Figs 5,6C)

Ilyoplax dentata Ward, 1933, p. 391, pl. xxii, figs 5, 6. Tweedie, 1935, p. 53; 1937, p. 148 (in key).
Ilyoplax dentatus: Serène and Lundoer, 1974, pp. 4,5.

MATERIAL EXAMINED

HOLOTYPE: AM P10638, ♂ (6.0 mm), Port Curtis, Queensland, M. Ward, June 1929.

OTHER MATERIAL QM W7428, 1♂ (5.1 mm), Trinity

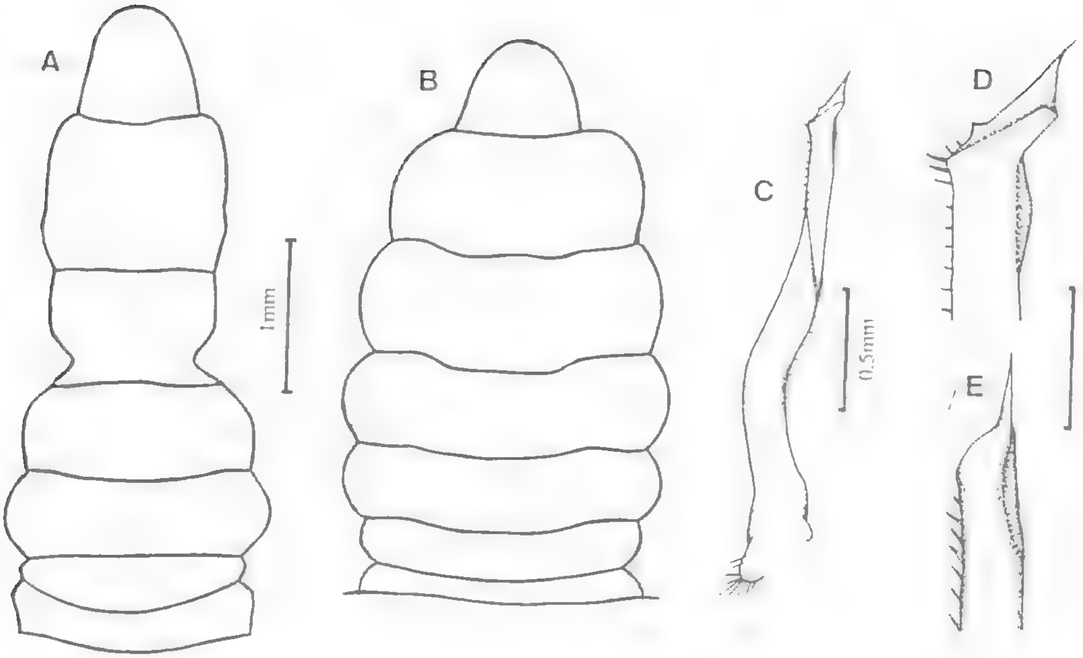

FIG. 5. *Ilyoplax dentatus* Ward; A, male abdomen (QM W7428); B, female abdomen (QM W8565); C, male first pleopod (QM W12964); D,E, magnifications of tip.

Inlet, Cairns, NEQ, R. Timmins, 14.xii.1975. QM W8565, 1♀ (5.2 mm), Murray River, north of Cardwell, NEQ, P. Davie, 19.v.1978. QM W8566, 1♀ (3.8 mm), same data as QM W8565. QM W12964, 18♂♂ (3.4–4.8 mm), 8♀♀ (3.8–4.7 mm), Murray River, NEQ, upstream of Tates Landing, exposed bank, P. Davie and J. Short, 19.iii.1987. QM W8567, 3♀♀ (3.9, 4.5, 6.5 mm), 1♂ (4.1 mm), Calliope R., Gladstone, SEQ, P. Saenger, July 1979. QM W8570, 1♂ (3.4 mm), same data as QM W8567. QM W8568, 1♀ (5.8 mm), Oct. 1975, same data as QM W8567. QM W8569, 1♀ (4.5 mm), 2 juveniles (2.6, 2.8 mm), May 1977, same data as QM W8567.

REMARKS

Although Ward's description is short, this species is quite distinctive; the large spine on the inner angle of the carpus of the chela is diagnostic. Some further description and notes on variability are warranted.

Lateral margins of carapace sinuous, bifid anteriorly such that a straight edge continues to the base of the third ambulatory leg and clearly separates the sub-branchial region. External orbital angles rounded, the distance between them less than between epibranchial angles, which are also rounded. The margin between these angles continuous, depressed and shallowly concave. The underside of the external orbital angle forms a sub-acute tooth produced into the orbit laterally.

A supplementary row of granules is present on the lower portion of the chela. This is not mentioned by Ward but is vaguely indicated as a ridge on the right chela in his figure. It arises about midway along the outer surface of the immovable finger and is prominent for only a short distance (about one-quarter length of chela) before fading to an indistinct ridge proximally. This, however, is variable as the granulate row may extend the full length of the smaller chelae of females and juvenile males.

The first two pairs of walking legs may have a thick short fur on the dorsal anterior surfaces of the carpi and propodi. When present this fur extends from the joint but varies in extent of cover.

In well preserved specimens the tympana are large and obvious on both the inner and anterior surface of the merus of the cheliped, and although not as distinctive on the other legs nevertheless occupy most of the width and about

FIG. 6. A, *Tmethypocoelis koelbeli* sp. nov., paratype male (QM W15085); B, *Tmethypocoelis odontodactylus* sp. nov. paratype male (WAM 218-88); C, *Ilyoplax dentatus* Ward, male (QM W7428); D, *Ilyoplax strigicarpus* sp. nov., holotype male (QM W14944). Scale line in mm.

two-thirds the length on both sides of the meri of the first to third pairs of legs and about a half the width and length of the last pair.

Ilyoplax dentatus is a little difficult to place into one of the groups of Serène and Lundoer (1974). The presence of the tympana on the legs must place it in their 'Group III' but the form of the first male pleopod is not particularly like those so far figured for other species in this group, except perhaps for that of *I. formosensis*. According to Serène and Lundoer (1974), 'Group III' species have a male first pleopod characterised by a narrow tongue-like apex, and a stem with a longitudinal row of setae on one side, and a subdistal lobe with long setae on the other side. *I. dentatus* does not have an obvious subdistal lobe.

HABITAT

Most common on firm mud banks of mid- to upper-estuary.

DISTRIBUTION

Eastern Australia between Port Curtis and Cairns.

ACKNOWLEDGEMENTS

I wish to thank the Australian Littoral Society, particularly its Director, Mr Ed Hegerl, for inviting me to take part in the Alligator Rivers Field Survey, and also the Australian National Parks and Wildlife Service who allocated the money for this survey to be done. Dr Gary Morgan of the Western Australian Museum kindly loaned me the specimens of *Tmethypocoelis odontodactylus* that he collected in Papua New Guinea while in receipt of a Christiansen Fellowship, and allowed me to describe it. Dr Michael Türkay of the Forschungsinstitut Senckenberg kindly gave me comparative material of *T. ceratophora* and he is especially thanked. Mrs Yang Chang Man of the Zoological Reference Collection, University of Singapore also kindly loaned me comparative material of *I. orientalis*. Mr Bruce Campbell of the Queensland Museum is thanked for his valuable comments which have improved the manuscript. Mrs Peta Woodgate typed the manuscript, and Mr J. Short photographed the specimens, and to both I am grateful.

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LITORIA ELECTRICA: A NEW TREEFROG FROM WESTERN QUEENSLAND

GLEN INGRAM AND CHRIS CORBEN

Ingram, G. and Corben, C. 1990 08 31: *Litoria electrica*: a new treefrog from western Queensland. *Memoirs of the Queensland Museum* 28(2): 475-478. Brisbane. ISSN 0079-8835.

Litoria electrica sp. nov. is a member of the *L. rubella* complex. Morphologically, it is very similar to *L. rubella* but readily distinguished by its distinctive colour-pattern and mating call. *L. electrica* inhabits semi-arid country in northwest and west central Queensland. It is sympatric with *L. rubella*. A lectotype for *Hyla rubella* Gray, 1842, is designated. ☐ *Litoria electrica, Litoria rubella, Hylidae, Queensland.*

Glen Ingram, Queensland Museum, P.O. Box 100, South Brisbane, Queensland 4101, Australia; Chris Corben, Queensland Forest Service, 80 Meiers Rd, Indooroopilly, Queensland 4068, Australia; 12 October, 1989.

In 1975, at Polygammon Creek, west central Queensland (WCQ), one of us (CC) heard a frog's call with which he was unfamiliar. When the frog was located and captured, he was convinced it was an undescribed species. The frog was very similar in morphology to *Litoria rubella*, which was also common at the locality. In 1981, Ingram found the frog again near Cloncurry, WCQ. Like Corben, he was impressed with the differences between the calls of the frog and nearby *Litoria rubella*.

In this paper, we describe the frog as a new species. Although it is generally very similar to *L. rubella*, we consider that the differences in the mating calls indicate the presence of specific-mate recognition systems (*sensu* Paterson, 1985) maintaining the genetic isolation of two species in sympatry. In addition, the new species differs consistently, though subtly, in colouration and body form.

To check which taxon the name '*rubella*' designated, we examined two of the three syntypes of *Hyla rubella* Gray, 1942 (British Museum (Natural History) numbers 1947.2.24.7 and 1947.2.24.9: we select the latter as lectotype) from Port Essington, Northern Territory. The syntypes are typical frogs of the taxon traditionally called *Litoria rubella* (*sensu* Copland, 1957), hence the name has been correctly applied. Despite fading, they lack the brown dorsal bars and the brown blotching on the posterior of the thighs of the new taxon.

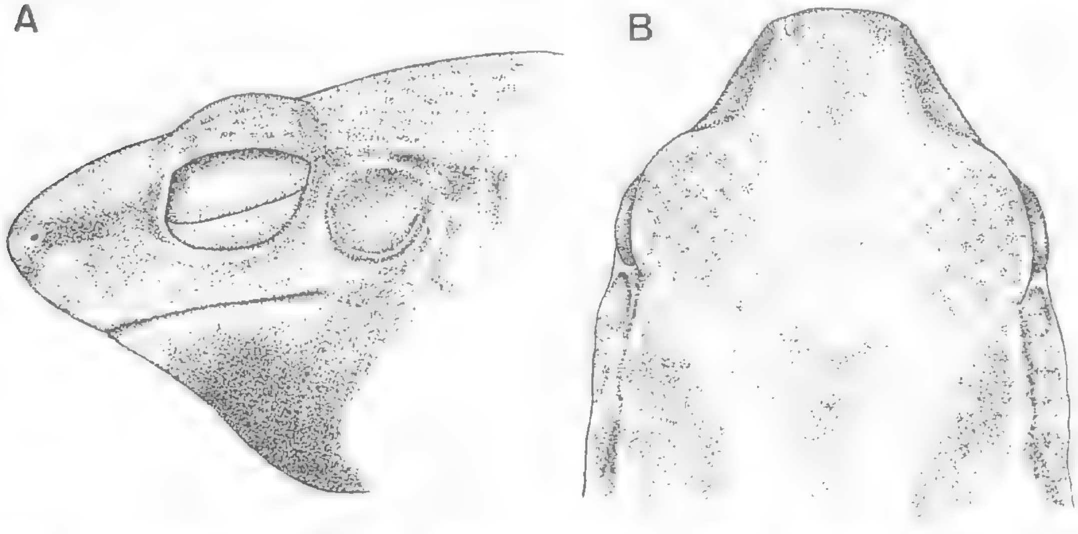

FIG. 1. *Litoria electrica* sp. nov., holotype, J38963. A. Lateral view of head. B. Dorsal view of head.

The following abbreviations are used in the text: SV - snout-vent length; TL - tibial length; HW - width of head at broadest part; ED - diameter of eye opening between anterior and posterior borders; EN - distance between the external nostril and anterior border of eye opening; IN - distance between the two external nostrils. Specimens with registration numbers prefixed by 'J' and 'R' are housed in the Queensland and Australian Museums respectively. Measurements are in millimetres and ratios are expressed as percentages. The sonograms were made on a Kay Sonograph.

Litoria electrica sp. nov.

(Figs 1-4)

MATERIAL EXAMINED

HOLOTYPE: Adult ♂, J38963, 25.1km E of Cloncurry on Julia Creek-Cloncurry road, WCQ (20°43'S, 140°39'E). Collected by G.J. Ingram and G.V. Czechura on 21 January, 1981.

PARATYPES: Floraville, NWQ (R129391); Floraville Crossing, NWQ (R129393-396, 129407-16); Lawn Hill Station, NWQ (J49227-8); 13.7km E of Cloncurry on Julia Creek-Cloncurry road, WCQ (J38964); 20km E of Cloncurry on Julia Creek-Cloncurry road, WCQ (J38973-4); 25.1km E of Cloncurry on Julia Creek-Cloncurry road, WCQ (J38976-7); Polygammon Creek, on Middleton-Hamilton Hotel road, WCQ (J27240-3).

DESCRIPTION OF HOLOTYPE

SV 38, TL 11, TL/SV 28.9, HW 9, HW/SV 23.7, HW/TL 81.8, ED 2.5, ED/HW 27.8, EN 3.0, IN 2.0, EN/IN 150.

Eye small. Snout pointed in lateral view; blunt in dorsal view. Canthus rostralis poorly defined, curving in then out to the nostril. Loreal region concave. Tympanic annulus prominent. Supratympanic fold present, poorly defined. Neck slightly elongate.

Subarticular tubercles on hand rounded, one each on first and second fingers and two each on third and fourth fingers; one outer metacarpal tubercle. Subarticular tubercles on feet rounded, one each on first and second toes, two each on third and fifth toes, three on fourth toe; two metatarsal tubercles, outer small, inner elongated. Hands and toes poorly webbed. Finger disks large, bigger than toe disks. Nuptial pads present, covering three-quarters of dorsal and lateral surfaces of first finger.

Dorsal surface of skin finely granular, ventral surfaces coarsely granular. Vocal sac distended.

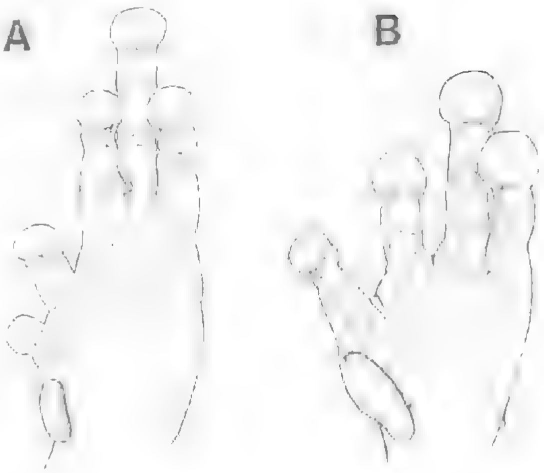

FIG. 2. *Litoria electrica* sp. nov., holotype, J38963. A. Underside of foot. B. Underside of hand.

Ground colour of dorsum yellow-brown, with an indistinct chocolate mark across the upper back; a chocolate forward- pointing chevron across the lower back; also a chocolate blotch above the cloaca. Sides speckled and blotched with chocolate markings that tend to coalesce above and form a distinct dark line running from nostril to eye, beginning again behind eye and continuing to hind leg. Back of thighs with brown and yellow (white in preservative) blotching. Skin of vocal sac dark grey. Nuptial pads purple-brown.

VARIATION IN THE PARATYPES

There are 26 paratypes. SV 26-38 (mean 31.1), TL 9-12 (mean 10.2), TL/SV 30-35 (mean 33.1), HW 7-10 (mean 8.6), HW/SV 26-31 (mean 27.9), HW/TL 78-91 (mean 84.4), ED 2.4-3.4 (mean 2.77), ED/HW 28-35 (mean 32.1), EN 2.6-3.4 (mean 3.14), IN 2.0-2.9 (mean 2.47), EN/IN 100-149 (mean 127.9).

The two bars across the dorsum can vary from bold and well- defined to indistinct. The brown blotching on the back of the thighs can be faint.

DIAGNOSIS

L. electrica closely resembles *L. rubella*. It can be readily distinguished by the banded dorsal markings and the pattern on the posterior surface of the thigh. In *L. rubella*, this area is unicolourous or finely dusted with brown, whereas in *L. electrica* the area is patterned with well-defined dark blotches. In life, *L. electrica*

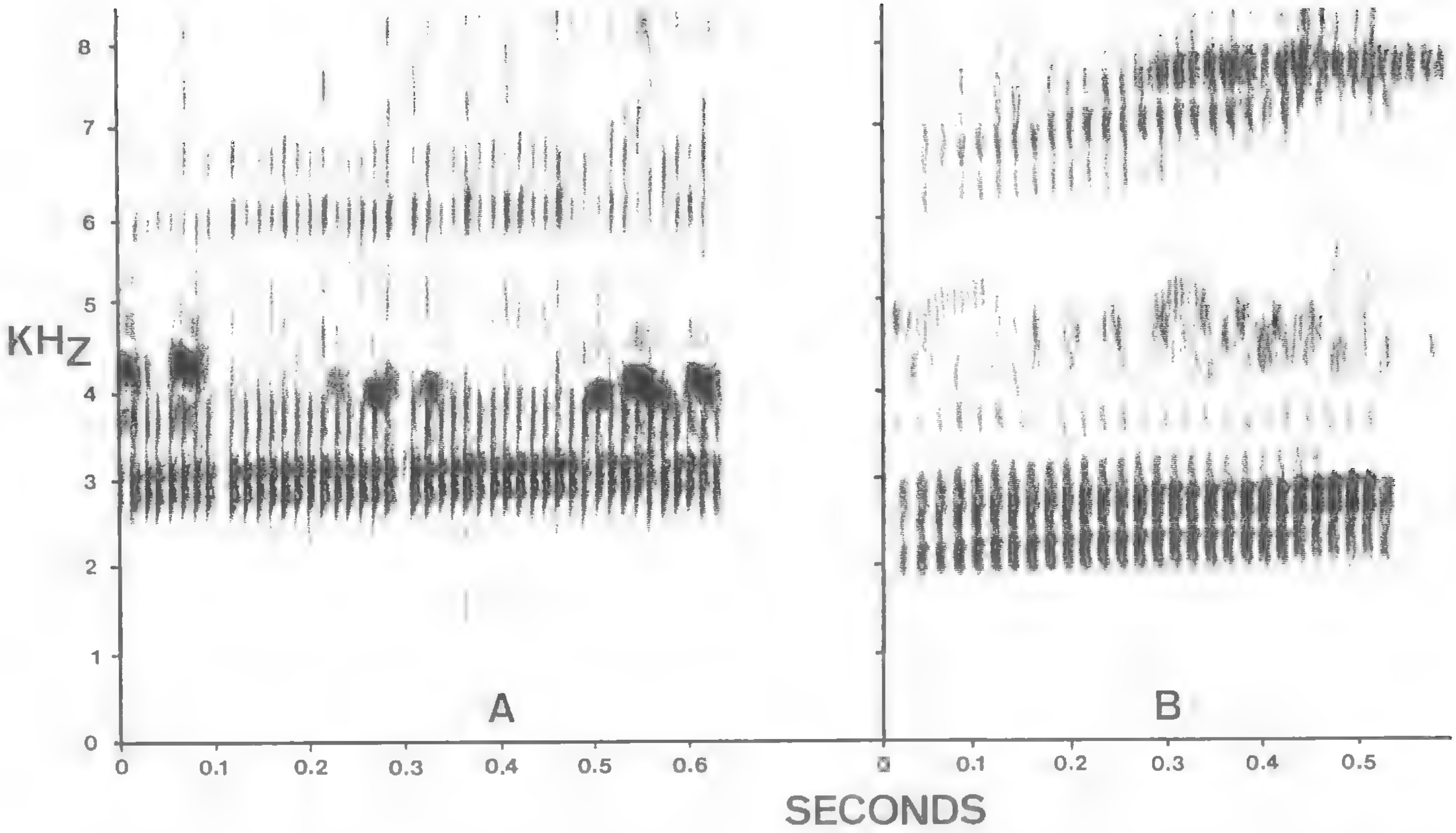

FIG 3. Sonograms of calls. A. *L. electrica* sp. nov., recorded at Polygammon Creek, on Middleton-Hamilton Hotel road, WCQ, 27 October, 1975; the large dark patches at *c.* 4.5KHz are representations of the call of *Ranidella deserticola*. B. *L. rubella*, recorded at 8km E of Toowoomba, SEQ, 22

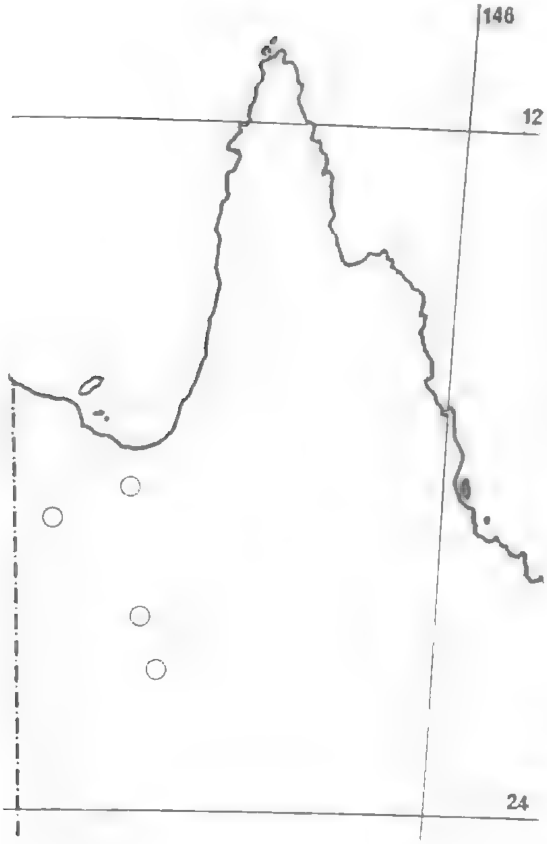

FIG. 4. Distribution of *L. electrica* sp. nov.

further differs from *L. rubella* by its longer necked appearance, darker irides, yellower colouration and distinctive mating call.

CALL

The call of *L. electrica* has a wavering quality that suggests the sound of a high voltage, long duration, electric arc. This appears to be due to irregular variations in amplitude between pulses of a call. Moreover, some pulses may be left out altogether (Fig. 3A)

L. electrica has a higher pitched call compared with that of *L. rubella* (3.1 *vs* 2.0-2.7KHz respectively. See Fig. 3). As well, the pitch remains much the same throughout the call while that of *L. rubella* rises. The pulse repetition rate is higher than in *L. rubella* (70 *vs* 55Hz respectively) and the duration is longer (585 *vs* 510 milliseconds respectively). Thus, the number of pulses per call is much greater in *L. electrica* (40+ *vs* 30).

DISTRIBUTION

Known only from the semi-arid northwest and central west of Queensland (Fig. 4) in the Gulf drainage: Gregory, Leichardt and Flinders Rivers; and in the Lake Eyre drainage : Hamilton River.

REMARKS

During breeding, *L. electrica* is usually found calling from the ground next to, or from low emergent vegetation in, temporary water.

ACKNOWLEDGEMENTS

We thank Ester Lawless and Clare Bremner for their assistance and Kate Couper for the drawings. We also thank Anita Smyth, Gregory Czechura and Gregory Roberts for their help with field work. For specimens, we thank Ross Sadlier, Australian Museum, and Keith McDonald, Queensland National Parks and Wildlife Service. Finally, we thank Jeanette Covacevich and Steve Donnellan.

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'YES, I WELL REMEMBER THAT MRS W.C.C. WRIGHT....' THE ELSIE WRIGHT NEEDLEWORK COLLECTION

KERRY KLEINSCHMIDT

Kleinschmidt, K. 1990 08 31: 'Yes, I well remember that Mrs W.C.C. Wright....' The Elsie Wright Needlework Collection. *Memoirs of the Queensland Museum* 28(2): 479-497. Brisbane. ISSN 0079-8835.

Mrs Elsie Wright (1898-1986) of Nambour, Queensland, exhibited needlework and handicrafts from the 1920s to the 1970s at agricultural shows and Country Women's Association competitions throughout Australia. In 1980, she donated a collection of her work to the Queensland Museum. The Elsie Wright Collection consists of 129 pieces of her needlework and handicrafts. As well, it has valuable documentation such as prize certificates and sashes, her embroidery needles, a needlework encyclopaedia and photocopies of her scrapbook of undated press clippings.
Elsie Wright was no ordinary embroiderer, but a significant figure in the history of women's needlework in Queensland. Throughout her successful exhibiting career, Elsie achieved a national reputation and won some 10,363 prizes and awards. ☐*Elsie Wright, Mrs W.C.C. Wright, needlework, embroidery, handicrafts, Queensland.*

Kerry Kleinschmidt, 31 Jacaranda Street, East Ipswich, Queensland 4305, Australia; 15 February, 1989.

The Elsie Wright Collection was donated to the Queensland Museum in 1980 by Mrs Elsie Wright (1898-1986) of Nambour. The collection comprises 129 pieces of needlework and handicrafts. These were worked by her during the fifty years in which she actively exhibited at agricultural shows and Country Women's Association competitions throughout Australia from the 1920s to the 1970s. The collection also has valuable documentation in the form of prize certificates and sashes, her embroidery needles, a needlework encyclopaedia and photocopies of her scrapbook of undated press clippings (see Appendix).

Elsie Wright (Fig. 1)was no ordinary embroiderer. She was a significant figure in the history of women's needlework in Queensland. Throughout her successful exhibiting career, she achieved a national reputation and won some 10,363 prizes and awards. Sadly, fame for Elsie was fleeting. After a brief return to the spotlight in 1976 with a one-woman fund-raising exhibition at Nambour, Maroochydore and Buderim, she returned to anonmynity. The achievements of women in the domestic and decorative arts have been largely overlooked by mainstream art history. However, with the emergence of feminist art history and the revival of interest in traditional handicrafts, women like Elsie Wright are being rediscovered.

The Elsie Wright Collection is significant as a document of high quality Australian needlework from the mid-1920s to the mid- 1970s. It provides much information about embroidery styles, techniques and design. For example, the fine hand-made and hand-embroidered garments of the 1920s and 1930s, are of a standard of technical virtuosity that can not be reproduced in modern domestic needlework; the materials needed to produce them are no longer commercially available. The Collection is an important source of historical needlework. In it, the trends and changing styles in embroidery, from Victorian white work to the cruder, more interpretive crafts of the 1960s and 1970s, can be traced in the production of one woman.

In addition to its artistic and technical significance, the Collection has social significance as the work of a woman whose life experiences were typical of many Australian women of her time. She had an isolated country childhood and a limited public education. She experienced the strictures of social expectations for women in the early decades of this century. She was a war-bride in the First World War. She 'made do' during the Depression. She coped with the rapidly changing technology and mores of post World War Two society. And, finally, there were illness, ageing and death. In the following, I discuss Elsie Wright's Collection and her career (1). My major sources of evidence include interviews with her family and friends, show catalogues and newspaper reports.

FROM CHILDHOOD TO MOTHERHOOD

On 17 February 1898, Elsie Sallaway was born on her parents' dairy farm at Alstonville in the Richmond River area of New South Wales. She was the fifth child and first daughter of Ada May and Edward Sallaway. Needlework was an important part of Elsie's life from the age of four (2). Her first sewing lessons were taken at her mother's knee. There followed some formal instruction in needlework during her schooling at the Rous Public School (3). In New South Wales, the Public Instructions Act of 1880 made elementary education compulsory for children between the ages of six to fourteen years of age. Needlework probably dominated Elsie's school life, from plain sewing with coloured threads in her first year as an infant to fancy needlework as a teenager, as prescribed in the school curriculum for girls (4). Unlike countless Australian schoolgirls, Elsie loved needlework. Through it, Elsie expressed an artistic creativity, which was shared by all of her six siblings. Her brother Arthur took up painting. Her sister Ethel in later life won numerous awards in the needlework section at the Brisbane, Sydney and Melbourne Royal Shows. Their mother Ada continued sewing and doing fancywork into her seventies (5).

Elsie was still a young girl when her family left New South Wales and took up a farming property near Pomona in Queensland. During the succeeding years Elsie's needlework became 'her preoccupation, her means of self-expression and her recreation' (13). As a teenager she travelled long distances to country shows and to 'the big one' in Brisbane, primarily to visit the embroidery exhibits.

'I used to study closely any piece that took my eye to work out how it was done... then I would pay a penny to go into the ladies' toilet and sit in there reproducing the different stitches on the top of my stockings. This way I could carry the new stitches home with me and put them into my embroidery' (7).

In this way Elsie taught herself new stitches and techniques, developing her skills by observation and trial and error.

Life for Elsie entered a new phase when, in 1916 at the age of eighteen, she married William Charles Cecil Wright at Cooroy in Queensland. At twenty-five, William had spent a number of years in the Sunshine Coast area of Queensland. He was a good-looking young man with an eye for the ladies and a great sense of humour. Soon after the marriage William enlisted for active service in the Great War and Elsie returned to her parents' property near Pomona. In 1917 she gave birth to their first and only child, Edward Charles.

FIG. 1. Elsie Wright nee Sallaway (1891-1986), c.1940s. Elsie Wright designed and executed the punched hole decoration on her hat. Photo courtesy Mr E. Wright.

AFTER THE GREAT WAR

Although the sequence and details of events are sometimes unclear, and the memories of those times have a timeless quality of family legend, the story of Elsie's life in the decades following the war emerges vividly from her published reminiscences and from the recollections of Edward. Upon William's return from the war, probably late in 1919 or early the following year, the young family moved to Tweed Heads on the northern coast of New South Wales, where they stayed for at least twelve months. They then moved to the hinterland of the Sunshine Coast to their first farm in White's Road, near Landsborough. As a returned soldier, William received a government subsidised loan to buy the property. Life was not easy. The homestead was little more than a slab hut. Amenities were primitive: lighting was by kerosene lamp and there was neither running water, nor a hand- pump at the back of the house.

Both Elsie and William worked long and hard. During the day William worked three miles away on another man's farm at Bald Knob Mountain, while Elsie did the housework and her share of the farm work. During the season, William cut bananas in the evening and Elsie packed them. He then took them the ten to twelve kilometres into Landsborough, returning home again at 2.30am. At seven o'clock that morning it was time to leave again for his day-time job. Elsie's experience in 'making do' as a farmer's daughter stood her in good stead. She coped with the physical labour of farm work and keeping house in primitive conditions. She met the challenge of providing for her family's comfort and well-being on limited resources in the isolation of their bush farm. Elsie's son, Edward, recalls that she was an excellent cook and a good shot with a rifle. She shot parrots and made them into parrot pies. She also made her own bread and grew vegetables. Their household furniture was also

FIG. 2. Diamond Jubilee medal, Brisbane Exhibition, 1935. Awarded to Mrs W.C.C. (Elsie) Wright for the best piece of needlework in the show. Scale in mm. Photo courtesy Mrs J. Fawke.

improvised. Edward's first bed was two corn sacks suspended on poles.

In the following years, William and Elsie owned several properties in the Landsborough district. After some twelve months of share-farming and dairying at Maleny, they moved to Caboolture. William found work on a farm at Mount Mellum, a soldier settlement near Landsborough. Elsie looked after her home and family, ran a fruit stall on the Caboolture railway station and still found time to do her needlework. In those days Caboolture was an important railway junction with big refreshment rooms (8). Elsie held the franchise on the fruit stall for twelve months.

THE BEGINNING OF A PRIZE-WINNING CAREER

During this period, Elsie's national show career was launched. Prior to 1927, she had exhibited successfully at small local shows like Woombye and Landsborough (9). In 1926, she also exhibited eight articles, in the open classes of the needlework section at the Brisbane Show, but without success (10). In 1927, Mrs Maude Egan, herself an exhibitor and needlework judge at country shows, saw some of Elsie's work and persuaded her to enter it in the next important show on the calendar - at Toowoomba. Mrs Egan provided Elsie with a prospectus and entry form and she entered twelve pieces of needlework (11).

Maude Egan's confidence in Elsie's skill was well founded. Elsie did extremely well against stiff competition from some of the best Queensland and interstate needlewomen. She won one first and four second prizes. The first prize was awarded for an example of fibrone embroidery. Hers was the sole entry in that class but this did not diminish her achievement. The judge was not obliged to issue the prize (12). Her white table centre, hand-embroidered pillow sham, article of lazy daisy work and guest towel attracted the second prizes. In some of these classes she was beaten into second place only by veteran prize-winners of national standing, such as Miss Roma Field of Sydney and Mrs A. M. Price. Encouraged by this success, Elsie later the same year entered seven pieces in the Brisbane Show. On her second attempt at cracking 'the big one', Elsie was more successful than in the previous year. She won second prizes in the classes for Oriental embroidery and white applique (13).

MOUNT MELLUM

In late 1927 or early 1928, William and Elsie purchased the farm at Mount Mellum on which William had worked for the last twelve months. Elsie recalled:

'I can still remember seeing the farm for the first time. I saw this small slab hut and asked my husband if that was the packing shed. He told me it was where we would be living.

Well it was pretty rough I can tell you. Two rooms and a dirt floor' (14).

They grew bananas and small crops on the farm, Elsie working alongside her husband. Only when the house and farm work were done did Elsie have time to indulge her passion for needlework. At night, she worked by kerosene lamp to complete a collection for the show circuit. William recounted in a newspaper interview:

'She slashed bananas with those hands you know, she hoed and dug and even picked vegetables. But even when she was getting up at 2.00am in the morning to milk the cows she'd often be doing her needlework until midnight sometimes. I'd be lying there in bed and the needle would be coming backwards and forwards in front of my nose' (15).

Hardwork took its toll on Elsie's hands. Clean hands were important to a needlewoman because washed needlework was disqualified at shows and a soiled piece had no chance of winning a prize (16). Rough hands could also snag fine fabrics, like lawn and silk crepe de Chine, which she used for handkerchiefs, lingerie and baby's clothes. Elsie's remedy for ingrained dirt and work-roughened hands was a home-made cold cream of equal parts of glycerine, lemon juice and methylated spirits.

Towards the end of 1928, Elsie and William felt secure enough to take on the expense of building a homestead to replace the slab hut. Elsie designed the new weatherboard bungalow and took the measurements herself. Her sketch was passed onto an architect who drew up the plans late in October that year. William and Elsie ordered pre-cut materials from Toowoomba at a cost of 450 pounds.

Then, when they were heavily committed financially, disaster struck. In the 1928 season, the market for bananas and small crops collapsed. Terrible years followed as the Depression approached. Along with countless other Australians, Elsie and William were badly affected. During the day they laboured on the farm. After dark, Elsie worked on her embroidery which had suddenly achieved a new importance. Edward recalls that it was only Elsie's prize money that pulled them through the Depression years and spared them from selling the farm. One year she made 500 pounds, a huge addition to the family's income (17).

THE UPS AND DOWNS OF EXHIBITING (1930S TO 1940S)

During the 1930s, Elsie's exhibiting career flourished. From 1926-40 she exhibited annually at the Brisbane Show, and at the Toowoomba Show from 1927-41, and at scores of smaller shows from Cairns to Wagga Wagga. She was on the mailing lists of many show societies. When she discovered a show new to her, she wrote asking to be added to their mailing list. Catalogues and entry forms were constantly arriving at their home. William looked after the clerical side of exhibiting. He wrote the entry forms and dispatched the precious boxes of embroidery by train. If the exhibits were for local shows such as Nambour, he took them in person. Elsie herself rarely went to the country shows, although she liked to visit the Brisbane Exhibition (18).

Elsie's growing reputation can be traced through award lists and newspaper articles. These give fascinating glimpses of the fierce competition that raged beneath the refined and lady-like face of the needlework section. In 1928, Elsie made her media debut, when her collection of white fancywork at the Brisbane Show was among those complimented in *The Queenslander* (19). From then on, throughout the 1930s, glowing reports of Elsie's latest achievements at the Brisbane Show were rarely missing from the women's pages of *The Queenslander* and *The Courier-Mail*. For example in 1932 in 'Needlework at the Show', it was reported enthusiastically, if slightly inaccurately:

'Mrs W.C.C. Wright ... another needlewoman who has had many successes in previous Shows, was again represented by some beautiful work, and five first, seven second, and one third prize tickets bore her name' (20).

Elsie reached the peak of her success at the Brisbane Show in 1935, when she won twenty first prizes and three second prizes out of a total of twenty-five entries. She also was awarded the Jubilee Medal (Fig. 2) for the best piece of needlework in the show, for a 'three-piece trousseau set in pink silk, which is adorned with exquisite French embroidery and tiny bars of hand veining, and also has a dainty edging' (21).

In 1933 Elsie felt confident enough to enter her work against the best Australian needlewomen in the Melbourne Show. She did very well, gaining two first prizes for her buttonholes on linen and on tweed (22). She continued to exhibit at Melbourne throughout the 1930s, winning the prize for the most successful exhibitor (that is, the exhibitor with the highest aggregate points) in the fancy needlework section in 1935, 1936 and from 1938 to 1940. Her exhibits were often singled out for praise in *The Age's* columns adding to her growing national reputation. For example in 1936, it was reported:

'Another veteran who retains her title is Mrs W.C.C. Wright, who has once again scored the highest aggregate of points in the fancy needle work. Mrs Wright submitted 25 entries, and took 8 firsts, 7 seconds, a third and 4 high commendation certificates. Her work is amazing in its delicacy and her hand-made trousseau set of white crepe de Chine with its minute scalloping and hemstitching, its exquisite eyelet and satin stitch embroidery, is as dainty and charming as it is expertly worked, while the child's frock that won her the prize for plain hand sewing is the perfection of fine stitchery' (23).

In 1939, a Women's Industries section was reintroduced at the Royal Easter Show, Sydney, following a long suspension because of World War I. Elsie submitted twenty-three entries, and won ten first prizes, four seconds, and the prestigious award for champion piece of needlework (24).

Elsie's successes in the big metropolitan shows were reflected by her results in the smaller Queensland, New South Wales and Victorian country shows. At Toowoomba, she won the points prize for the highest aggregate of points in the needlework section in 1930, 1931, 1935, 1936, 1938 and 1941. At Wagga Wagga, New South Wales, she won the champion prize for best piece of hand made underwear in the shows in 1934, 1936, 1938 and 1939. In 1934 and 1939, she also won a champion prize for the best piece of a fancywork, and in 1934 and 1939 won the grand championship for 'champion piece of work in Class C, needlework'. Many of her surviving prize certificates and sashes in the Queensland Museum's collection were awarded for Champion piece of fancy needlework at rural shows, such as Cairns (1937-1941), Dalby (1939-1941) and Killarney (1937-1938, 1941). There were many more awards for which prize certificates have not survived.

With this propensity to 'scoop the pool', a number of country show societies politely requested that she abstain from exhibiting with them in future years. Few other women cared to compete against such a formidable opponent, in the classes that she monopolised. Many competitors must have shared the feeling of frustration and admiration, expressed recently by Mrs Lyn McKay (*née* Skerman), formerly of Millmerran, in a letter to her daughter.

'Yes, I well remember that Mrs W.C.C. Wright. She used to win all the needlework prizes at country shows- as well as city shows. I would have had several first prizes at Millmerran shows, only for her! -She used to "scoop the pool" in every section- absolutely perfect work' (25).

Early in the 1940s, World War Two halted Elsie's winning streak. Many shows, including the large metropolitan ones, were curtailed and eventually suspended during the later years of the war. During those years, Elsie, like many other Australian women, directed her energies to the war effort.

When agricultural shows resumed after the war, so did Elsie's prize winning career. In the Toowoomba Show of 1946, she won sixteen first and twenty-two second prizes out of forty-four entries. At the Melbourne Show in the same year, she won special prizes for the best piece of fancy needlework and for the most successful exhibitor in the fancywork section (26). She exhibited annually in the Toowoomba Show until 1950, but restricted her participation in the shows in Brisbane (1946) and Melbourne (1946,1947 and 1950).

Elsie was not unchallenged throughout those years. Stiff competition was provided by a number of expert needlewomen, including Miss Roma Field, Mrs C.J. Dwyer, Miss Isla McConachie and Mrs J.A. Anlezark. Of these, the competitor who matched Elsie most closely in skill and techniques was Mrs Dwyer of Toowoomba, who also came to the fore in the late 1920s (27). Edward recalls that his mother hated Mrs Dwyer with a passion, although they had never met. The day after judging at the Brisbane Show, Elsie waited impatiently for her father to ring from Brisbane to read the prize list from the newspaper. When Mrs Dwyer beat Elsie there would be frowns, but when Elsie won over her rival, then... the delight!

Elsie would go to great lengths to beat Mrs

Dwyer. One day, frustrated by her rival's consistent victories in the coloured afternoon tea or supper cloth class, Elsie broke with her normal rule of not visiting country shows. She went to see what gave Mrs Dwyer's work the winning edge. On her return home, she announced with much satisfaction to her family, 'I've got it!', and then set to work embroidering. Needless to say, at the next show it was Elsie's supper cloth which carried off first prize (28). Her show career gave her other high moments, such as the time when a Melbourne bank manager sent a telegram seeking to buy all her articles at the Royal Melbourne Show for his fiancee. There were sad incidents too, such as the time in the 1930s when a fire at the Toowoomba Show pavilion destroyed an entire collection of thirty-two pieces of needlework (29).

'PREMIER NEEDLEWOMAN'

In the 1950s, Elsie continued to enjoy her national reputation. She exhibited successfully at metropolitan and country shows in Queensland, New South wales and Victoria: at Brisbane (1955), Townsville (1951-52), Ayr (1950, 1952-54); Sydney (1953), Wagga Wagga (1951-52); Melbourne (1950-53), Bairnsdale (1951-52); and Mirboo North (1951, 1954). In 1953, she won the Central Agency (Aust.) Ltd's special trophy for best exhibit in the needlework section at the Royal Easter Show in Sydney (30). By 1951, a national women's magazine is said to have run a story on the 'mysterious Queensland needlewoman' from the 'backwoods', revealing the personality behind the awards (31). Elsie did not welcome such exposure. She preferred her long periods of seclusion on the farm.

After many years of struggle, the early 1950s also brought material comfort to Elsie and William. In *c.*1952, their Mount Mellum home was described as 'a comfortable weatherboard cottage overlooking the sea and surrounded by the 140-acre plantation of bananas, oranges, bush nuts, paw paws and other tropical fruits' (32). In 1953, they sold the farm to Edward, and moved to Perwillowen Road, Nambour. Here for the first time they had the luxury of electricity , although William held it in deep distrust and Elsie continued to cook on an internal combustion stove for the rest of her life. As their prosperity increased, Elsie began to suffer the legacy of those early years of heavy work. She was constantly in and out of hospital during the latter half of her life. However, she continued to pursue her love of needlework. Moreover, her contacts at the local hospital proved a valuable source of materials for her growing interest in handicrafts. The celluloid of X-ray film, when soaked to remove the light-sensitive coating, was perfect for making decorative containers, such as work boxes and waste-paper baskets (33).

Elsie joined the local branch of the Country Women's Association, when she moved to Nambour in 1953. Soon she participated in both their state and national handicraft competitions. Local CWA members urged Elsie to enter a special piece of work in the Association's national needlework competition for the Clifton Joseph Rose Bowl. Elsie won it with a waffle-ette stitched article she designed herself. She went on to win this prestigious award for five successive years, each time for a different type of embroidery: binca work, huckaback, drawn thread work, counted thread work and Richelieu embroidery (34).

In 1955, at the urging of her grandchildren, Elsie entered the 2000 pound Embroidery Contest, run by *The Australian Women's Weekly*. It attracted over 4000 entries from Australasia. Elsie entered an article in Section Two: 'Best hand-embroidered tray-cloth, runner,tablecentre, duchess set,or set of 4 d'oyleys'. She won the third prize of 35 pounds with a blue table centre. Together with the other prize-winning entries it was exhibited at the Farmer department store's Blaxland Gallery in Sydney in February 1956, and later in stores throughout Australia (35).

LATER LIFE

Despite illness and deteriorating eye-sight and co-ordination, Elsie continued to design and embroider well into her seventies. But instead of the fine needlework of her earlier years, Elsie now executed the coarser types of counted thread work, such as Swedish darning and blackwork (36) which were in vogue in the 1960s and early 1970s.

Elsie exhibited at the Brisbane Show from 1963 to 1969, and from 1974 to 1975. Her new interest in handicrafts is reflected in entries in the classes for artificial flowers and in one year, in bark painting (37). Her beautifully hand-tinted bouquets of fabric fuchias and nasturtiums, are now in the possession of her family. Throughout the sixties and seventies, Elsie participated in CWA competitions, winning first prize for a Swedish darning pillow cover in the Queensland

CWA handicraft contest in 1971, at the age of seventy-three (38). Sadly, in the mid 1970s, a stroke put an end to Elsie's needlework. Thereafter her creativity was expressed through a wide variety of handicrafts. As part of her recuperation therapy in hospital, she learnt to decorate ceramic plaques and to make poker flowers. She also made scratched pictures on painted metal foil and decorative pot-plant holders from large tins.

In 1976, Elsie was asked to display her work to raise money to aid the Sundale appeal to build a new wing on the Sundale Nursing Home at Nambour. Throughout her life, Elsie had used her talents for charity, donating many of her trophies to aid worthy causes.

On the 29th February, accompanied by considerable publicity in the local press, a one-woman exhibition of Elsie's work was held in the CWA Hall at Nambour. A local newspaper reported that:

'hundreds of people came to see it. The organisers were amazed at the interest the exhibition created and at the wide cross section of people who came to admire and marvel' (39).

On this occasion, $300 was raised for the Sundale appeal, and the success of the exhibition was such that it was later shown at Maroochydore and at Buderim, on the Sunshine Coast.

Apparently, at this time the Queensland Museum was offered its choice of Elsie's work (40). However, it was not until November 1980, that the Museum took custody of the collection, just prior to her admission to the James Grimes Nursing Home, Sundale Garden Village at Nambour on New Years Day 1981. Sadly, Elsie was never to see her work displayed in its new home. She died on 20th May, 1986 at the age of eighty-eight. The end of a remarkable life of courage and creativity.

ELSIE: NEEDLEWOMAN AND 'DESIGN ARTIST'

Elsie Wright's achievement is remarkable. Apart from needlework instruction at school, she was entirely self-taught. Unlike more privileged women, who had access to art classes and technical education, Elsie had to rely on her own natural abilities, on observation and on trial and error. An indication of her lack of basic needlework training was her inability to knit or crochet (41). She made up for this deficiency with inventive and painstaking needlelace edging. Some time in the 1930s or 1940s, she bought herself an encyclopaedia of needlework. It is difficult to trace the influence of this manual on Elsie's work. In one instance she copied a monogram from the book and used it on a handkerchief (42).

Elsie usually designed her own work for exhibition. She gained inspiration from many sources, such as shows and shop displays, memorising what she saw and adapting it in her own work. Occasionally, she used commercially produced designs. She won prizes in a section at the Toowoomba Show for a coloured afternoon tea or supper cloth traced with 'Semco' designs only (43).

The output and range of Elsie's creative activity throughout her life was enormous and varied. She had to continually produce new pieces. Prize-winning exhibits often could not be re-entered in the same show in following years. In addition to her embroidery which included calceolaria work, punch work, richelieu work, lace stitch, binca work, fibrone embroidery, broderie anglaise, and Mount Mellick work, she produced a wide variety of handicrafts. These crafts included, artificial flowers, shell work, bark painting, decorations of painted and threaded pine cones and gum nuts and cut, rolled and painted jam-tin dahlias. She made her own hats (Fig. 1), even out of hessian bags (44).

The best of Elsie's needlework is remarkable for its exquisite fineness, achieved by using very fine No. 12 embroidery needles, made by H. Milward and Sons. For her most delicate work, she would unravel the finest cotton she could buy into three strands. All her sewing supplies, such as needles, cotton and silk thread and fine Irish linen came from McWhirters in Brisbane, where she bought them by the dozen (45).

ACKNOWLEDGEMENTS

The following gave generous assistance with my research: Elsie Wright's family, Mr Edward and Mrs Vera Wright and Mrs Joan Fawke; the staff of the Queensland Museum, especially Judith McKay; Mrs Joan Selnes of the Embroiderers' Guild of Queensland; Mrs Mary Nipperess; the Royal National Agricultural and Industrial Association of Queensland and the Royal Agricultural Society of Queensland.

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APPENDIX

CATALOGUE OF THE ELSIE WRIGHT COLLECTION

Because Elsie Wright died before the Collection was accessioned in 1988, it was not possible to assign specific dates and awards to individual items. Approximate dates were assigned on stylistic grounds by Mrs Joan Selnes of The Embroiderers' Guild of Queensland. She also provided valuable assistance in identifying and describing embroidery techniques and stitches. The following sections in this catalogue are arranged in approximate chronological sequence, based on when the particular needlework techniques were popular in Australia. Within each section, the items are arranged by accession number. The descriptive information is taken from the Queensland Museum Accession Register for the History and Technology collections.

MOUNT MELLICK WORK (45)

H.19718 Table Centre, white linen, poppies of fine Mount Mellick embroidery with detached buttonhole lace fillings, commercial lace edging, circular shape 52.0cm diameter. *c.*1920s. (Fig.3)

H.19720 Doyley, white linen, flowers of fine Mount Mellick embroidery, with detached buttonhole lace fillings, scalloped edge, buttonhole lace edging with details in scallops, 36.1 x 53.9cm. c.1920s.

The examples of Mount Mellick work in the Elsie Wright Collection are fairly typical in colour and design. However, they are much finer in texture than usual. Elsie Wright has used some unusual stitches, such as fly stitch, seeding stitch and detached buttonhole lace fillings. The edgings of buttonhole stitch and buttonhole lace details are typical of her work. These pieces probably date to the 1920s.

BRODERIE ANGLAISE (46)

Fine Scale

H.19709 Handkerchief, yellow lawn, with broderie anglaise, floral design, with stem stitch stems and satin stitch leaves, buttonholed edging. *c.*1930s.

H.19710 Handkerchief, yellow lawn, with broderie anglaise, floral design with stem stitch stems and satin stitch leaves, buttonholed edging. *c.*1930s.

H.19711 Handkerchief, white lawn, with broderie anglaise and running stitches in yellow thread, floral design with stem stitch stems and satin stitch leaves, hemmed edges. *c.*1930s.

H.19712 Doyley, white linen, with broderie anglaise, floral design with satin stitch surface embroidery, buttonholed lace edging, circular shape 14.6cm diameter. *c.*1930s.

H.19714 Handkerchief, white lawn, with broderie anglaise, floral design with stem stitch stems and satin stitch leaves, buttonholed edging with eyelets. *c.*1930s.

Large Scale

H.19715 Doyley, white linen, with large scale broderie anglaise, clustered vine design with satin stitch surface embroidery, scalloped edge, buttonhole lace edging with details in scallops, oval shape 36.2 x 53.6cm. *c.*1920s.

H.19716 Doyley, white linen, with large scale broderie anglaise, floral design with satin stitch and seed stitch surface embroidery, buttonhole lace edging, oval shape 34.3 x 50.0cm. *c.*1920s.

Broderie Anglaise with Cut Work

H.19713 Handkerchief, white lawn, with broderie anglaise, and cutwork diamonds with buttonholed lace fillings at each corner, floral design with satin stitch and stem stitch surface embroidery, buttonhole edging. *c.*1930s.

H.19768 Woman's Apron, pink organdie broderie anglaise with cutwork, commercial lace edging. *c.*late 1930s.

Broderie Anglaise with Drawn Thread Work

H.19767/1, H.19767/2 Baby's Dress and Matching Bonnet, white lawn, broderie anglaise and drawn thread work, commercial lace edging. H.19767/1 - dress. H.19767/2 - Bonnet, broderie anglaise with drawn thread work, underlaid with cream net, commercial lace edging and medallion. *c.*1940s.

Of the examples of broderie anglaise in the Collection, most are on a very fine scale with tiny punched and overcast eyelets. Two doyleys, however, are done in large scale broderie anglaise. Elsie Wright used this form of embroidery on doyleys, lady's handkerchiefs, baby's garments and lingerie. Sometimes it appears with other forms of embroidery, such as cut work and drawn thread work Scalloped buttonholed edges are typical of these pieces, as is buttonhole lace edging and details. They date to *c.*1920s-1930s.

SHADOW WORK (47)

H.19729 Duchess Doyley, white organdie, with 3-colour (yellow, green and pink) embroidery including shadow work, buttonhole lace edging, oval shape 42.1 x 63.4cm. *c.*1930s-1940s.

H.19730/1, H.19730/2, H.19730/3 Duchess Set, white organdie, with 4-colour (yellow, green, pink and blue) embroidery including shadow work, scalloped, with buttonhole lace edging. H.19730/1 - centre, diamond shape 45.7 x 61.1cm. H.19730/2-3 - side mats, circular shape 17.3cm diameter. *c.*1930s-1940s.

Elsie Wright's duchess set and doyley in this technique appear to be typical of coloured shadow work in fabric, design and stitchery. The buttonhole lace edging is typical of her work. These pieces probably date to the 1930s-1940s.

APPLIQUE (48)

H.19727 Child's Apron, unbleached linen; applique embroidery with buttonhole stitch; toadstools, rabbits and elf design, pocket with buttonhole lace edge; buttonholed edging with needle lace details in scallops. *c.*1953.

Won a first prize in the Melbourne Show, 1953.

H.19728 Child's Apron, unbleached linen; applique embroidery with buttonhole stitch; ducks and flowers

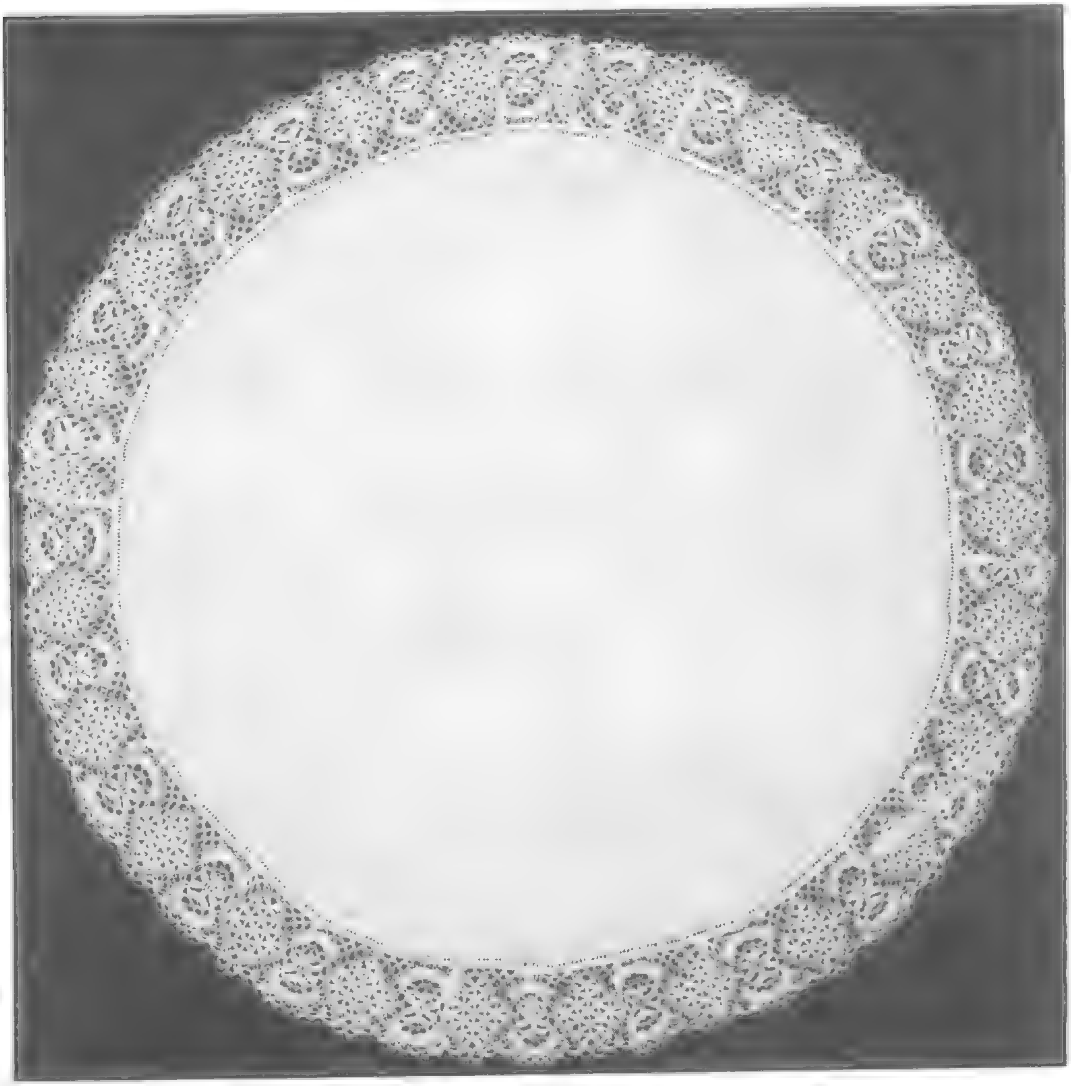

FIG. 3. White linen table centre in Mount Mellick work, *c.*1920s. (H.19718)

design; duck pocket, buttonholed edging with needle lace details in scallops. *c.*1950s.

H.19755 Tea Cosy, cream organdie, with applique flowers (?hollyhocks) and fence; yellow organdie inner cosy, padded; buttonhole lace edging. *c.*1930s.

APPLIQUE WITH CUT WORK

H.19725 Doyley, cream linen, border of applique flowers and leaves and cutwork loops, satin stitch, stem stitch, french knots and feather stitch surface embroidery, oval shape 27.2 x 41.6cm. *c.*1940s.

H.19726 Doyley, cream linen, border of applique flowers and leaves and cutwork loops, oval shaped 32.8 x 46cm. *c.*1940s.

Elsie Wright used applique on a wide range of articles from delicate objects such as organdie baby's bonnets and rayon lingerie to sturdy unbleached linen child's aprons. All her applique work is characterised by the use of buttonhole stitch to apply the design to the ground fabric, and by added interior and exterior details in satin stitch, stem stitch and running stitch. Elsie Wright's individual touch can be seen in details, such as the unusual filling of feather stitch within the cut work loops in H.19725, and the interior details of the appliqued flowers in H.19726, where on one flower they are dark, on the next they are light coloured and on the third one they alternate light and dark, petal by petal. The completely buttonholed edges on the aprons are typical of Elsie Wright's edging and are a marathon feat of embroidery.

In addition to surface embroidery. Elsie Wright also used applique in combination with other types of embroidery, such as cut work; cut work and net insertion; cut work and drawn thread work; cut work, applique, net insertion and drawn thread work; and richelieu work and drawn thread work.

SIMPLE CUT WORK (49)

In Elsie Wright's work, cut work (50) is often found combined with other techniques such as broderie anglaise, applique, or applique and net insertion. Other combinations are cut work with applique and drawn thread work; cut work with applique, drawn thread work and net insertion; cut work with drawn thread work; cut work with net insertion and drawn thread work; cut work with net/lace insertion; and cut work and embroidery.

H.19691 is the only piece in the Collection with a design based on Australian flora or fauna (Fig.4). The design of H.19692, which uses the traditional English daffodil motif, has a strong feel of William Morris and the Arts and Crafts Movement, and it is possible that Elsie adapted it from an illustration. These pieces are dated to *c.*1930s.

H.19691 Doyley, white linen, cut work embroidery, padded satin stitch details, flannel flowers design, 28.1 x 43.4cm. *c.*1930s. (Fig. 4)

H.19692 Doyley, white linen, cut work embroidery, padded satin stitch details, daffodils design, oval shape 33.6 x 49.6cm. *c.*1930s.

H.19693 Doyley, white linen, cut work embroidery, ivy design, buttonhole lace edging, circular 16.1cm diameter. *c.*1930s.

H.19706 Handkerchief, white handkerchief linen, cut work embroidery, ivy design, embroidered monogram, buttonholed edging. *c.*1930s.

The design for the monogram was taken from the new revised and enlarged edition of 'The Encyclopedia of Needlework' by Therese De Dillmont.

CUT WORK WITH APPLIQUE AND NET INSERTION

H.19722 Handkerchief, white lawn, flowers in cut work with applique, net insertion with satin stitch and stem stitch embroidery, scalloped buttonholed edging with buttonhole lace details in the scallops. *c.*1930s.

H.19723 Handkerchief, white lawn, flowers and leaves in cut work with applique and net insertion at corners, stem stitch and satin stitch surface embroidery, scalloped buttonholed edging with needle lace details in the scallops. *c.*1930s.

H.19724 Doyley, yellow organdie, poinsettia flowers and leaves in cut work with applique and net insertion, satin stitch, stem stitch and buttonholed eyelets, oval shape 36.5 x 51.2cm. *c.*1930s.

H.19773 Baby's Bonnet, pink organdie, cut work with applique, lace insertion and drawn thread work, buttonhole lace edging. *c.*1930s.

CUT WORK WITH APPLIQUE AND DRAWN THREAD WORK

H.19769 Woman's Apron, yellow organdie, cut work and applique, with drawn thread work, vine leaf and grape design, edging buttonhole lace details in scallops. *c.* late 1930s.

CUT WORK WITH APPLIQUE, NET INSERTION AND DRAWN THREAD WORK

H.19772 Baby's Bonnet, pink organdie, cut work, net insertion and applique with drawn thread work, buttonhole edging, ribbon work rosettes. *c.*1930s.

CUT WORK WITH DRAWN THREAD WORK

H.19770 Baby's Bonnet, yellow crepe de Chine, cut work, with drawn thread work buttonhole edge with buttonhole lace details, vine leaf design, ribbon work rosette trim. *c.*1930s.

CUT WORK WITH NET INSERTION AND DRAWN THREAD WORK

H.19771 Baby's Bonnet, pink crepe de Chine, cut work with net insertions with drawn thread work, floral and heart design, ribbon work trim. *c.*1930s.

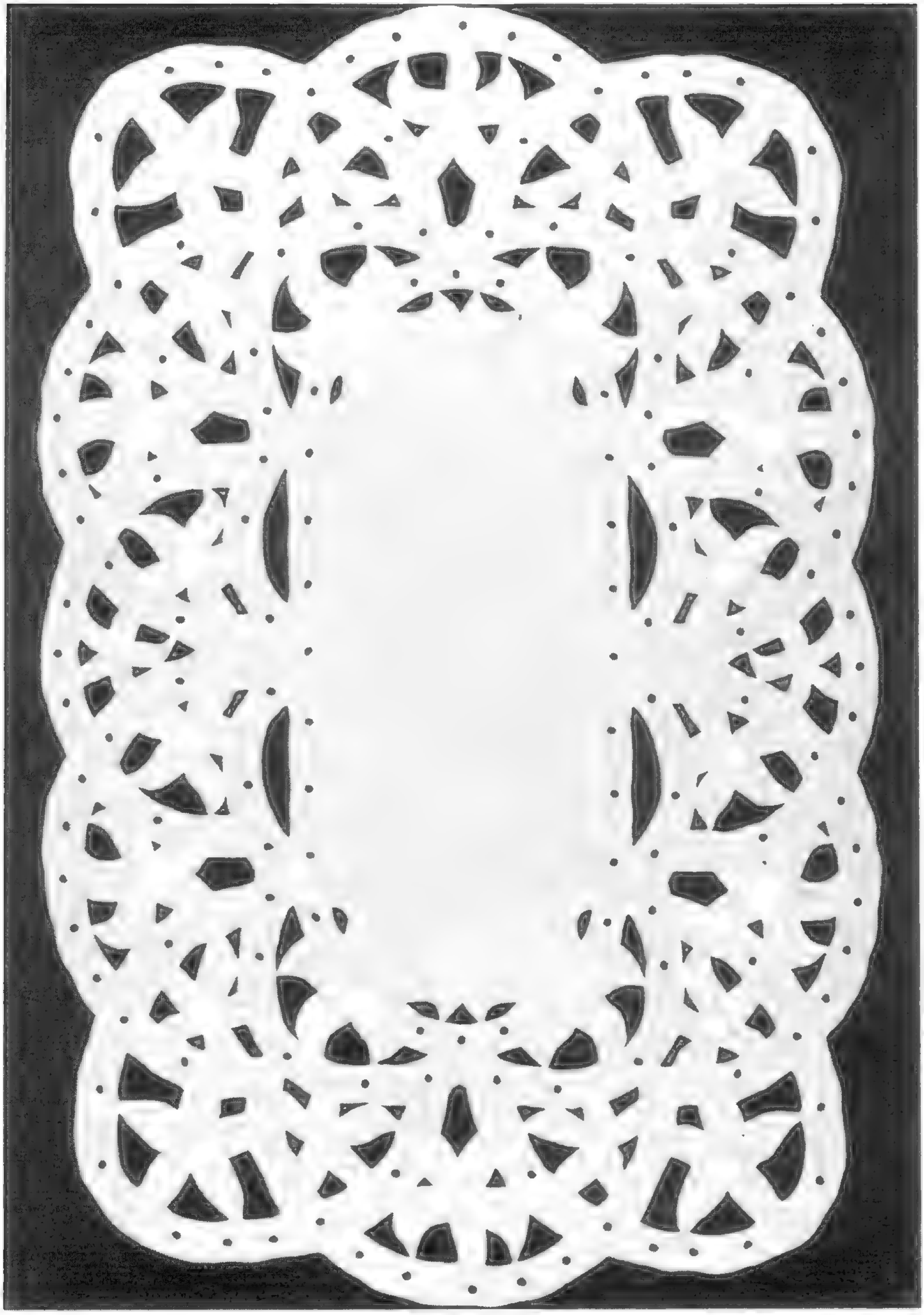

FIG. 4. White linen cut work doyley with a design of flannel flowers, *c.*1930s. (H.19691)

CUT WORK WITH NET/LACE INSERTION

H.19717 Doyley, white linen, border of cut work flowers and leaves with lace insertion, buttonhole lace edging, circular shape 44.5cm diameter. c.1930s.

H.19719 Tray Cloth, white linen, centre medallion of cut work deer and leaves with lace insertion, satin stitch berries, commercial lace edging, 45.3 x 60cm. *c.*1930s.

CUT WORK WITH EMBROIDERY

H.19694/1, H.19694/2, H.19694/3 Duchess Set, cream linen; cut work and satin and seed stitch embroidery; floral and scroll design, cream and green threads. H.19694/1 - centre, oval shape 27.6 x 41.1cm. H.19694/2-3 - side mats, circular shape approx. 19.6cm diameter. *c.*1950s.

VENETIAN CUT WORK (51)

H.19689 Doyley, white linen, Venetian cut work, floral design, buttonholed edge, oval shape 31.1 x 46.4cm. *c.*1930s.

H.19690 Doyley, white linen, Venetian cut work, border of roses design, circular 17.0cm diameter. *c.*1930s.

ROMAN CUT WORK (52)

Roman cut work occurs in the Elsie Wright Collection on garments, in combination with some other embroidery technique. For instance, with embroidery; with smocking; and with drawn thread work.

ROMAN CUT WORK WITH EMBROIDERY

H.19754 Cushion Cover, unbleached linen with lining of yellow satin, Roman cut work with padded satin stitch, deer and foliage design in medallion. *c.*1950s.

ROMAN CUT WORK WITH SMOCKING

H.19766 Child's Dress, yellow crepe de Chine, Roman cut work with smocked front, buttonhole edge with edging of buttonhole lace details. *c.*1930s.

ROMAN CUT WORK WITH DRAWN THREAD WORK

H.19679 Guest Towel, white textured linen, composite embroidery (including Roman cut work, drawn thread work, padded satin stitch), butterflies and floral design. *c.*1930s.

H.19680/1, H.19680/2, H.19680/3 Duchess Set, white linen, Roman cut work, drawn thread and padded satin stitch, floral design, buttonhole lace edging. H.19680/1 - centre 32.3 x 46.5cm. H.19680/2-3 - side mats 20.5 x 20.5cm. *c.*1950s.

H.19758 Woman's Nightdress, pink crepe de Chine, Roman cut work with drawn thread work, buttonhole edge with buttonhole lace details in scallops, tie belt with overcast eylets. *c.*1930s?

H.19765 Child's Dress, pink crepe de Chine, Roman cut work and drawn thread work, ruching, edging in plain buttonhole with buttonhole lace edging. *c.*1930s.

H.19761/1, H.19761/2, H.19761/3 Woman's Lingerie ('Trousseau') Set, pink crepe de Chine, Roman cut work with drawn thread work. H.19761/1 - nightdress, ruched waist and self tie. H.19761/2 - petticoat. H.19761/3 - scanties.

? Prize-winner at Brisbane R.N.A. Exhibition of 1935.

RICHELIEU EMBROIDERY (53)

The Collection contains traditional white richelieu, as well as self-colour and coloured richelieu pieces. The traditional white pieces probably date to *c.*1930s and 1940s, while the coloured work has been dated to *c.*1940s. In a number of pieces, richelieu embroidery is combined with surface embroidery. These were probably produced *c.*1930s to 1940s.

Again there is extensive use of buttonhole edgings, both simple buttonhole and buttonhole lace. Sometimes, as in H.19696, the use of buttonhole lace edging and details is excessive and mars the design qualities of the article.

Richelieu embroidery often appears on articles combined with other forms of embroidery, for example, applique and drawn thread work, drawn thread work or with net insertion.

WHITE OR ECRU RICHELIEU

H.19698 Doyley, white linen, richelieu embroidery, floral design, buttonhole lace edging, square shape 14.7cm sides. *c.*1930s- 1940s.

H.19699 Doyley, white linen, richelieu embroidery, star shape 50.5cm diameter. *c.*1930s-1940s.

H.19700 Doyley, white linen, richelieu embroidery floral and scroll design, buttonhole lace edging, circular shape 17cm diameter. *c.*1930s-1940s.

H.19701 Doyley, white linen, richelieu embroidery floral and scroll design, square shape 14.5 x 13.5cm. *c.*1930s-1940s.

H.19703 Handkerchief, white lawn, richelieu embroidery, floral and ribbon design, scalloped buttonhole edging with buttonhole lace details in scallops. c.1930s.

H.19704 Handkerchief, white lawn, richelieu embroidery, floral (?blossom) design, buttonhole edging. *c.*1930s.

H.19705 Doyley, white linen, border of richelieu embroidery, floral design, buttonhole lace edging, circular shape 16.0cm diameter. *c.*1930s-1940s.

H.19707 Doyley, white linen, richelieu embroidery, art nouveau floral (?lily) design, star shape 48.7cm diameter. *c.*1930s- 1940s.

H.19708 Doyley, white linen, richelieu embroidery, floral design, oval shape 29.9 x 43.9cm. *c.*1930s-1940s.

COLOURED RICHELIEU

H.19695 Doyley, cream linen; coloured richelieu embroidery with needle lace flowers in brown, orange and yellow threads; buttonhole lace edging with details, square shape 42.1cm sides. *c.*1940s.

H.19696 Doyley, cream linen, coloured richelieu embroidery with needle lace flowers in brown, orange and yellow threads, oval shape 33.8 x 50.3cm. *c.*1940s.

H.19702 Doyley, cream linen, coloured richelieu embroidery, in brown, orange, green and yellow threads, floral design, diamond shape 40 x 42.9cm *c.*1940s.

H.19756 Tea Cosy, cream linen, coloured richelieu embroidery in blues, blue taffeta and net lining; cream net inner cosy, padded. *c.*late 1930s-1940s.

H.19757 Tea Cosy, cream linen, coloured richelieu embroidery in blues, blue net lining; cream satin cotton inner cosy, padded. *c.*late 1930s-1940s.

RICHELIEU EMBROIDERY WITH SURFACE EMBROIDERY

H.19686 Doyley, cream linen, composite embroidery (including richelieu and padded satin stitch); in brown thread, buttonhole lace edging with many details, square shape 42.0cm sides. *c.*1950s.

H.19687 Doyley, cream linen, richelieu embroidery and some hedebo filling, with coloured padded buttonhole stitch flowers, in yellow thread, oval shape 30.7 x 45.6cm. *c.*1940s.

H.19688 Doyley, cream linen; coloured richelieu, padded satin stitch and seed stitch embroidery, in blue threads, 30.5 x 41.1cm. *c.*1950s.

RICHELIEU EMBROIDERY WITH APPLIQUE AND DRAWN THREAD WORK

H.19759 Woman's Nightdress, pink rayon, satin applique, richelieu and drawn thread work, ruched shoulders, buttonhole edge with buttonhole lace details in scallops, tie belt. *c.*1930s?

RICHELIEU EMBROIDERY WITH DRAWN THREAD WORK

H.19671 Lady's Apron, cream linen, composite embroidery (with coloured richelieu, drawn thread work, padded satin stitch), floral design in blue threads, buttonhole edging with buttonhole lace details in scallops, two pockets. *c.*1940s.

H.19672 Tablecloth, cream linen, composite embroidery (with coloured richelieu, drawn thread work, padded satin stitch), floral and ribbon design in blue threads, buttonhole lace edging, 84.2 x 85.5cm. *c.*1940s-1950s.

H.19673 Tablecloth, cream linen, composite embroidery (with coloured richelieu, drawn thread work, padded satin stitch), floral design in blue threads, buttonhole lace edging, 85.6 x 87.3cm. *c.*1940s-1950s.

H.19674 Tablecloth, cream linen, composite embroidery (with coloured richelieu, drawn thread work, padded satin stitch and buttonhole), floral and ribbon design in orange and brown threads, buttonhole lace edging, 86.8 x 84.7cm. *c.*1940s-1950s.

H.19675 Doyley, cream linen, composite embroidery (including richelieu, drawn thread work, padded satin stitch), in red, brown and black threads, buttonhole lace edging, circular shape, 49cm diameter. *c.*1950s. (Fig.5)

H.19676 Guest Towel, white textured linen, composite embroidery (with richelieu, drawn thread work, padded satin stitch), scroll design with monogram. *c.*1930s.

H.19677 Guest Towel, white textured linen, composite embroidery (with richelieu, drawn thread work, padded satin stitch), floral design. *c.*1930s.

H.19678 Guest Towel, pink textured linen, composite embroidery (with richelieu, padded satin stitch, drawn thread work), butterflies and floral design, fringed ends. *c.*1930s.

H.19685 Doyley, cream linen, composite embroidery (including richelieu and drawn thread work); in yellow, green and brown threads; buttonhole lace edging with many details, 34.1 x 49cm. *c.*1950s.

H.19760 Woman's Bed Jacket, pink crepe de Chine, richelieu embroidery with drawn thread work, ruching on shoulders, edging buttonhole lace details in scallops ribbon work rosettes. *c.*1930s?

H.19762 Child's Dress, yellow crepe de Chine, richelieu embroidery and drawn thread work edging of buttonhole and buttonhole lace details. *c.*1930s.

H.19763/1, H.19763/2 Child's Dress and Matching Jacket, cream silk, richelieu embroidery with drawn thread work, applied waist band, buttonhole edge. H.19763/1 - dress. H.19763/2 - Jacket. *c.*1930s.

RICHELIEU EMBROIDERY WITH NET INSERTION

H.19764 Child's Dress, pink crepe de Chine, richelieu embroidery with net insertion, buttonhole lace edgings of details, ruching. *c.*1930s.

PLAIN SEWING

Elsie Wright was very expert in the art of plain sewing.

H.19753 Series of five samples of buttonholes: two of linen; three of woollen fabric. no date

SURFACE EMBROIDERY (54)

WHITE WORK

H.19666 Handkerchief, white linen, hemmed on all sides, embroidered monogram. *c.*1930s.

H.19667 Handkerchief, white linen, hemmed on all sides, embroidered monogram. *c.*1930s.

This monogram appears to be a modified version of the one illustrated in Elsie's 'Encyclopedia of Needlework' by Therese De Dillmont which was also used in H.19706.

H.19668 Handkerchief, white linen, hemmed on all sides, embroidered monogram. *c.*1930's.

COLOURED EMBROIDERY

H.19681 Child's Apron, unbleached linen with green bias binding, transfer design of birds and flowers, coloured embroidery. *c.*1950s.

H.19682/1, H.19682/2, H.19682/3 Duchess Set, white linen, coloured embroidery with birds, possibly worked from a transfer design, buttonhole lace edging. H.19682/1 - centre 30.8 x 48.9cm. H.19682/2-3 - side mats, circular shape 17.5cm diameter. *c.*1950s.

The black and red birds in H.19681 and H.19682 are fanciful, no known species.

H.19683/1, H.19683/2, H.19683/3 Duchess Set,

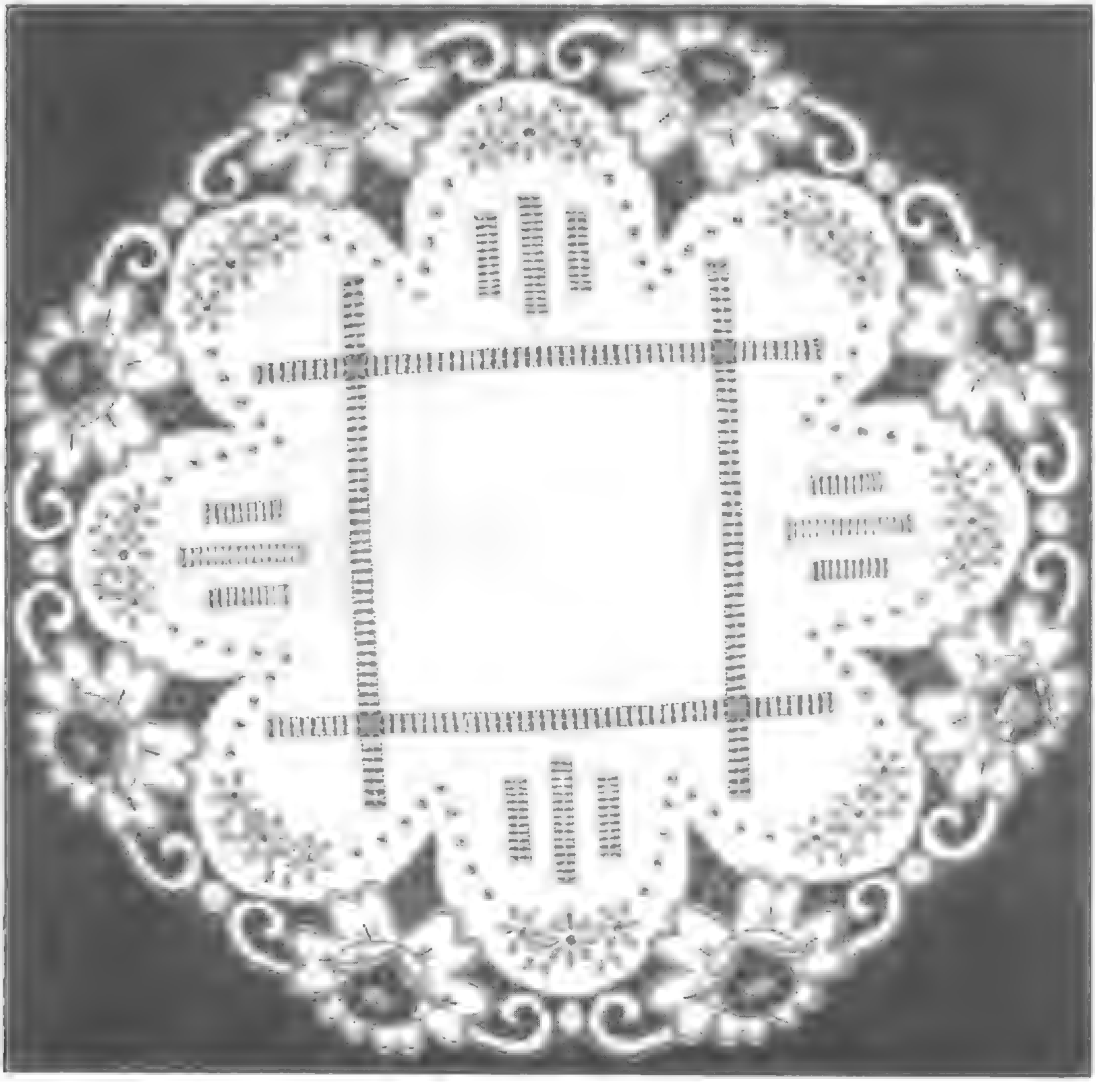

FIG. 5. Cream linen doyley combining richelieu embroidery, drawn thread work and padded satin stitch, *c.*1950s. (H.19675)

white linen, composite coloured embroidery, with blue birds and flowers, buttonhole lace edging. H.19683/1 - centre 39.3 x 59.6cm. H.19683/2-3 - side mats, circular shape 21.7cm diameter. *c.*1950s.

H.19684 Doyley, fawn cotton, coloured embroidery with parrots and flowering creeper on trellis, commercially prepared edging with buttonhole lace, worked from a transfer design, 37.9 x 53.7cm. *c.*1940s.

Elsie Wright usually used her own designs for her exhibition pieces. However, there are a number of pieces in the Collection whose designs are very different from her usual style. Their motifs, in fact, are strongly suggestive of commercial transfer designs. On some pieces, such as H.19681, the printed design can still be seen under the embroidery threads, while other pieces (H.19682 and H.19684) have a commer-

FIG. 6. Cream linen mat in Dorset feather stitchery in pink, orange and browns, *c.*1960s. (H.19697)

cially made spoke stitch edging. These pieces were probably produced in *c.*1940s and 1950s.

HUCKABACK DARNING (55)

The Collection, contains a number of guest towels decorated by Elsie Wright in this technique. They have been dated to c.1940s and 1950s. Generally, Elsie has used fairly typical geometric designs, with some (H.19740 and H.19744) displaying particularly careful shading. H.19741, however, has a most unusual design (56)

H.19740 Guest Towel, white huckaback cotton, huckaback darning in red, yellow and orange threads, hemmed sides, fringed ends. *c.*1940s-1950s.

H.19741 Guest Towel, white huckaback cotton with huckaback darning in yellow and orange threads, hemmed sides and fringed ends. *c.*1940s-1950s.

H.19742 Guest Towel, white huckaback cotton with huckaback darning in yellow and orange threads, hemmed sides and fringed ends. *c.*1940s-1950s.

H.19743 Guest Towel, white huckaback cotton with huckaback darning in yellow and orange threads, hemmed sides and fringed ends. *c.*1940s-1950s.

H.19744 Guest Towel, white huckaback cotton with huckaback darning in yellow and orange threads, hemmed sides and fringed ends *c.*1940s-1950s.

DORSET FEATHER STITCHERY (57)

The one example (Fig. 6) of Dorset feather stitchery in the Collection seems to be typical of this technique. In addition to feather stitch, it includes satin stitch, plain and whipped buttonhole stitch and wheat ear stitch. It was probably produced in *c.*1960s

H.19697 Mat, cream linen, with Dorset feather stitchery, in orange, browns and pink threads, border of ric rac braid attached with buttonhole stitch; buttonhole lace edging, 39.3 x 45.7cm. *c.*1960s. (Fig.6)

DRAWN THREAD WORK (58)

Of counted thread work (59). There are two examples of pure drawn thread work in the Collection. The appearance of a pattern in her exercise book (H.19792), indicates that Elsie counted and sketched at least the more complex drawn thread work designs. The coarseness of the work and lack of precision in technique indicates a date of *c.*1960s-1970s for this work. A bonnet of drawn thread work with some broderie anglaise (H.19774) is a much earlier and finer piece.

Drawn thread work often appears in Elsie Wright's embroidery as a subsidiary decoration, for example with broderie anglaise on children's garments; cut work and applique; cut work, applique and net insertion; cut work; cut work and net insertion; richelieu embroidery and applique; richelieu embroidery; or roman cut work.

H.19669 Mat, cream even weave cotton, drawn thread work, in ecru thread, hemmed on all sides, 46.5 x 48cm. *c.*1960s-1970s.

H.19670 Mat, cream even weave cotton, drawn thread work, in ecru thread, hemmed on all sides, 31.8 x 85.5cm. *c.*1960s-1970s.

Drawn Thread Work with Broderie anglaise

H.19774 Baby's Bonnet, pink organdie, drawn thread work and broderie anglaise, commercial braid edging, ribbon work. *c.*1930s.

CONTEMPORARY COUNTED THREAD WORK

The Collection contains a number of pieces of counted thread work in a style that I have not been able to identify. This style of contemporary embroidery has a peasant feel to its designs. They were designed by Elsie and seem to utilise several motifs, which reoccur with variations. Elsie appears to have worked up these motifs, first sketching them on graph paper and then reproducing them on aida cloth using a basic repertory of stitches. These stitches include herringbone stitch, satin stitch, fly stitch, detached chain stitch, back stitch, chevron stitch, feather stitch, sheaf stitch and stem stitch (60). In some cases (H.19731 to H.19733), counted thread work has been combined with free stitchery. Occasionally, as on H.19732, a buttonhole lace edging has been added that does not marry happily with the coarse fabric and stitchery or the geometric design. The technique is sometimes lacking in precision, which, together with the modern style of the fabric and embroidery, would seem to indicate a date later in her life, *c.*1960s.

H.19731 Mat, blue aida cloth, contemporary counted thread embroidery in red thread, hemmed on all sides, buttonhole lace edging, 39.5 x 37cm. *c.*1960s.

H.19732 Mat, blue aida cloth, contemporary counted thread embroidery in red thread, hemmed on all sides, buttonhole lace edging, 43.4 x 38.7cm. *c.*1960s

H.19733 Mat, blue aida cloth, contemporary counted thread embroidery in red thread, hemmed on all sides, buttonhole lace edging, 39.4 x 38.8cm. *c.*1960s.

H.19734 Mat, ochre aida cloth, counted thread embroidery, in brown, green and red threads, fringed on all sides, 36 x 35.1cm. *c.*1960s.

H.19735 Mat, ochre aida cloth, counted thread embroidery, in brown, green and orange threads, hemmed on all sides, 69 x 34.4cm. *c.*1960s.

H.19736 Mat, ochre aida cloth, counted thread embroidery, in blue and red threads, hemmed on all sides, buttonhole lace edging, 44.8 x 34.8cm. *c.*1960s.

H.19737 Mat, lemon aida cloth, counted thread embroidery, in red and blue threads, hemmed on all sides, 45 x 35.2cm. *c.*1960s.

H.19738 Mat, lemon aida cloth, counted thread embroidery, in brown and purple threads, hemmed on all sides, 91.8 x 37.2cm. *c.*1960s.

H.19739 Tablecloth, yellow aida cloth, counted thread embroidery, in brown, green and orange threads, hemmed on all sides, 88.7 x 87.5cm. *c*.1960s.

CROSS STITCH (61)

H.19745 Mat, ecru even weave cotton cloth, cross stitch embroidery in brown, orange and green threads; hem-stitched and fringed borders, 41.2 x 39.7cm. *c*.1950s-1960s.

H.19746 Mat, ecru even weave cotton cloth, cross stitch embroidery in brown, orange and green threads; hem stitched and fringed borders, 43.4 x 41.5cm. *c*.1950s-1960s.

H.19747 Tablecloth, black and white gingham, cross stitched in white, border of white ric rac braid and buttonhole lace, 87 x 85.3cm. *c*.1960s-1970s.

H.19748 Woman's Apron, black and white gingham, cross stitched in white, border of white ric rac braid. *c*.1960s-1970s.

H.19749 Woman's Apron, black and white gingham, cross stitched in red and white, border of white ric rac braid. *c*.1960s- 1970s.

H.19750 Tablecloth, red and white gingham, cross stitched in black, border of red ric rac braid, 87.8 x 85.3cm. *c*.1960s- 1970s.

H.19751 Tablecloth, black and white gingham, cross stitched in yellow, brown and orange, border of yellow ric rac braid, 87 x 83.5cm. *c*.1960s-1970s.

H.19752 Tablecloth, green and white gingham, cross stitched in black, border of black ric rac braid, 89.2 x 83.2cm. *c*.1960s-1970s.

Cross stitched pieces in the Elsie Wright Collection range from quite fine stitchery on linen to coarse work on gingham tablecloths and aprons. The finer cross stitched pieces (H.19745, H.19746) have a multicolored floral design, and a drawn thread work border. Elsie designed these, sketching the design first on graph paper. The coarse work on gingham uses geometric designs and applied ric rac braid. They are dated to *c*.1950s to 1960s, and *c*.1960s to 1970s, respectively.

BLACKWORK (62)

H.19721 Mat, cream even weave cotton, with blackwork embroidery, fringed on all sides, 45.8 x 40.5cm. 1960s-70s.

Only one piece of blackwork is found in the Collection. In it, blackwork is combined with a border of drawn thread work. Elsie designed this piece and the pattern, counted out and sketched on graph paper, survives. Lack of precision in the stitching suggests that this piece was executed by Elsie Wright later in life. It has therefore been dated to *c*.1960s to 1970s.

CANVAS WORK: SWEDISH DARNING (63)

H.19775 Cushion Cover, top of yellow canvas stitched in Swedish darning in red raffia, back of red satin. *c*.early 1970s

A reference and photograph in *The Courier-Mail* (64) identifies the cushion cover (H.19775) with this technique with a fair degree of certainty. Another cushion cover in the same technique remains with the family.

SMOCKING (65)

There are two examples of this technique. One is applied to a child's dress (H.19766) with Roman cut work, which dates to *c*.1930s; the other is a gingham cushion cover (H.19776) smocked in snow-flake smocking, which was popular in *c*.1960s.

H.19776 Cushion cover, brown and white gingham, top is snow-flake smocked. *c*.1960s.

HANDICRAFTS

The Elsie Wright Collection contains a wide variety of handicrafts made by Elsie from the 1950s to the 1970s.

H.19777 Waste Paper Basket, made of cardboard; celluloid and wallpaper sides and base; joined by green blanket stitch, sides decorated with a collage of floral wrapping paper, plastic ferns and ribbon bows; 18.0cm high. *c*.1950s

H.19778 Posy of flowers made with painted shells, buttons and wire; plastic ferns. undated.

H.19779 Lady's Bag, nylon embroidery on plastic, lined with taffeta, metal clasp. undated.

H.19785 Lady's Hat, made from a hessian sugar bag, machine stitched brim, band of petals of the same hessian. undated.

H.19786 Posy of French flowers, hand-made, synthetic fabric, rose, bud and leaves, one white, one pink, carnation flower, bud and leaves, shades of pink. *c*.1960s.

H.19787 Lady's Brooch, comprising a pink imitation pearl button mounted in a commercial imitation gold setting, decorated with sequins, imitation pearls and beads threaded onto sewing pins. undated.

H.19788 Lady's Brooch, comprising a cream imitation pearl button mounted as above. undated.

H.19791 Work Box, made of cardboard, celluloid and paper sides and base; joined by green blanket stitch with buttonhole lace edging. *c*.1950s.

TOOLS OF THE TRADE

H.19782 Sewing needles, made by H. Milward and Sons of Redditch, England, steel, sharps no.12, 2 packets.

H.19789 'Encyclopedia of Needlework' by Therese De Dillmont, new edition, Mulhouse, France, not dated.

H.19792 Exercise book, 'The Shell Geometry Book', containing pencil drawn patterns for counted thread work. undated.

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A REVIEW OF THE *POLYRHACHIS VIEHMEYERI* SPECIES-GROUP (HYMENOPTERA: FORMICIDAE: FORMICINAE)

RUDOLF J. KOHOUT

Kohout, R.J. 1990 08 31: A review of the *Polyrhachis viehmeyeri* species-group (Hymenoptera: Formicidae: Formicinae). *Memoirs of the Queensland Museum* 28(2): 499-508. Brisbane. ISSN 0079-8835.

Nine species of the *Polyrhachis viehmeyeri* species-group are recognised, including *P. davydovi* Karawajew, *P. hirta* Viehmeyer and *P. viehmeyeri* Emery and six new species: *P. bamaga*, *P. eremita*, *P. greensladei*, *P. loweryi*, *P. rustica* and *P. stigmatifera*. Lectotypes are designated for *P. davydovi* and *P. hirta*. A key to the species-group is provided. ☐*Formicidae, Polyrhachis, viehmeyeri species-group, systematics, distribution.*

Rudolf J. Kohout, Queensland Museum, PO Box 300, South Brisbane, Queensland 4101, Australia; 20 June, 1989.

The *Polyrhachis viehmeyeri* species-group was delimited by Emery (1925) within the subgenus *Myrmhopla* Forel for two of its more unusual constituents: *P. hirta* Viehmeyer and *P. viehmeyeri* Emery. A third species, *P. davydovi*, was added by Karawajew in 1927 and, since then, the composition of the species-group has remained unchanged. Subsequent systematic work has been hampered by the scarcity of research material because specimens of this rather distinct group are seldom collected and only a few have been taken in addition to the types.

My study has been possible because of recent collections, particularly those gathered by Dr P.J.M. Greenslade in the Solomon Islands, and Rev. B.B. Lowery in Australia and Papua New Guinea. Their collections are lodged in the Australian National Insect Collection and provided three of the new species, namely *P. greensladei*, *P. loweryi* and *P. rustica*. The material collected by Rev. Lowery also included the only known specimens of *P. viehmeyeri* apart from the holotype. My collecting in northern Australia and Papua New Guinea has produced two more new species, *P. bamaga* and *P. eremita*, together with additional specimens of *P. greensladei* and *P. hirta*. Finally, two specimens located by Barry Bolton in the collections of the British Museum (Natural History) provided the unique holotype of *P. stigmatifera* sp.nov. and an additional paratype of *P. rustica* sp.nov.

The *P. viehmeyeri* species-group ranges from Moluccas and Papua New Guinea to Guadalcanal in the Solomon Islands (09/159) and northern Australia, south to southern Queensland (lat. 26°). In the following, Australian and some Melanesian records are given using 1-degree coordinates as initiated by Taylor (1987). The illustrations were prepared using a Zeiss (Oberkochen) SR Stereomicroscope with *camera lucida*. All figures depict the primary types. The measurements (in mm) and indices follow those of Kohout (1988): HL - maximum head length, measured from the anterior clypeal border to the occipital margin; HW - width of the head, measured immediately in front of the eyes; CI - cephalic index (HW x 100/HL); SL - length of the antennal scape, excluding the condyla; SI - scape index (SL x 100/HW); PW - width of the pronotal dorsum, measured at the bases of the pronotal spines; and MTL - maximum measurable length of the tibia of the hind leg.

Acronyms for museums and depositories are: ANIC - Australian National Insect Collection, CSIRO Division of Entomology, Canberra; BMNH - British Museum (Natural History), London, U.K.; BPBM - Bernice P. Bishop Museum, Honolulu, Hawaii, U.S.A.; IZAS - Institute of Zoology, Academy of Sciences, Kiev, U.S.S.R.; MCSN - Museo Civico di Storia Naturale 'Giacomo Doria', Genoa, Italy; MCZC - Museum of Comparative Zoology, Harvard University, Cambridge, Mass., U.S.A.; MHNG - Muséum d'Histoire Naturelle, Geneva, Switzerland; MNHU - Museum für Naturkunde, Humboldt-Universität, Berlin, D.D.R.; NMNH - National Museum of Natural History, Smithsonian Institution, Washington, D.C., U.S.A.; QMBA - Queensland Museum, South Brisbane; RJK - Rudolf J. Kohout, Brisbane (author's accessions and private collection data).

CHARACTERS OF THE *P. VIEHMEYERI* SPECIES-GROUP

The *P. viehmeyeri* species-group can be characterised within the genus *Polyrhachis* by the following combination of characters:

1. All dorsal surfaces of the body with bristle-like hairs, which are distinctly shorter than the maximum diameter of the eye.
2. Dorsa of head, mesosoma and petiole with characteristic vermiculate-rugose sculpturation.
3. Mesosomal dorsum bluntly marginate on each side along its entire length.
4. Pronotum and propodeum each armed with a pair of spines.
5. Pronotal spines flattened dorsally, with anterior and lateral margins acute; their length, direction and degree of elevation usually highly variable within species.
6. Pronotal and propodeal dorsa almost flat, mesonotal dorsum transversely convex with rounded lateral margins.
7. Node of petiole with more or less flat dorsum, bearing a pair of widely separated, diverging spines, and without intercalary spines or teeth.
8. Eyes strongly convex, almost hemispherical, with numerous short, erect hairs.
9. Mandibles very finely longitudinally striate.
10. Clypeus with anterior margin medially truncated; posterior margin usually deeply impressed.
11. Antennal carinae rather flat, widely separated.

KEY TO MEMBERS OF THE *P. VIEHMEYERI* SPECIES-GROUP BASED ON WORKER CASTE

1. Australian species with base of first gastral tergite finely micro-reticulate and more or less shiny; mandibles with 4 distinct teeth 2

Indonesian, Melanesian or Australian species with base of first gastral tergite more or less closely, transversely striate and opaque; mandibles with 5 teeth, of which the basal tooth is often vestigial 4

2. Larger species (HL>1.87); median ocellus well developed, distinct 3

Smaller species (HL<1.78); median ocellus rather small, indistinct .... *P. rustica*

3. Body bicoloured, medium reddish-brown with most of the head, pronotal collar and antero-median patch on mesosomal dorsum light yellowish-brown; antennal scapes shorter (SI<144) .... *P. eremita*

Body more or less uniformly coloured, dark reddish-brown with only the mandibles, spines and subpetiolar process slightly lighter; antennal scapes longer (SI>146) .... *P. loweryi*

4. Inner surfaces of hind femora without erect hairs, or with only a few hairs at their proximal and distal ends; body dark reddish-brown 5

All surfaces of hind femora with numerous erect hairs; body light to medium reddish-brown 7

5. Metathoracic spiracles prominent, situated on laterally projecting tubercles .. *P. stigmatifera*

Metathoracic spiracles not prominent, more or less flat 6

6. Sides of head between eyes and mandibular bases with numerous projecting short hairs .... *P. greensladei*

Sides of head between eyes and mandibular bases without projecting short hairs (Fig. 4) .... *P. bamaga*

7. Smaller species (HL 1.93); antennal scapes relatively short (SI 130).......................... *P. davydovi*

Larger species (HL >2.00); antennal scapes longer (SI >135) 8

8. Pronotal, propodeal and petiolar spines well elevated (Fig. 7); truncated median portion of anterior clypeal margin distinctly dentate laterally (Fig. 3)........................ *P. viehmeyeri*

Pronotal, propodeal and petiolar spines scarcely elevated (Fig. 5); truncated median portion of anterior clypeal margin bluntly angulate laterally (Fig. 1) .... *P. hirta*

Polyrhachis bamaga sp.nov.
(Fig. 4)

MATERIAL EXAMINED

HOLOTYPE: AUSTRALIA: Queensland, Cape York Peninsula, Bamaga, 10°53'S,142°23'E, 18 March 1987, RJK acc. 87.4 (worker). PARATYPES: data as for holotype (10 workers). Type deposition: Holotype in QMBA (type no. T 11123); 2 paratypes each in ANIC and RJK; 1 paratype each in BMNH, BPBM, MHNG, MCSN, MCZC and NMNH.

WORKER

Dimensions (holotype cited first): TL 7.41, 7.11-8.01; HL 1.90, 1.84-1.96; HW 1.53, 1.50-1.62; CI 81, 79-83; SL 2.12, 2.03-2.25; SI 139, 134-142; PW 0.75, 0.72-0.81; MTL 2.74, 2.62-2.90 (11 measured).

Clypeus in profile distinctly sinuate, with the base deeply impressed; median carina feebly marked anteriorly, indistinct posteriorly; truncated median portion of anterior margin dentate laterally. Ocelli lacking. Pronotum with anteriorly converging lateral margins, bearing a pair of antero-lateral, more or less horizontal spines. Propodeal spines well elevated, moderately divergent, slightly sinuate in lateral view. Dorsum of petiole flat, anterior and posterior margins well defined, spines well elevated, widely divergent.

Clypeus with fine, V-shaped rugae, extending to the frontal area of head; sculptural intensity increasing posteriorly, so that dorsa of head and mesosoma are coarsely vermiculate-rugose; propodeal declivity and dorsum of petiole transversely rugose. Sculptural intensity distinctly less coarse laterally, with sides of mesosoma and petiole only weakly rugose. Propodeal spines smooth and shiny, with only microscopic reticulation. Basal half of first gastral tergite very finely and regularly, transversely striate, opaque.

Brown, bristle-like hairs longest and most dense on gaster, only slightly shorter and more dilute on dorsa of head and mesosoma. Hairs almost completely absent from sides of head between eyes and mandibular bases, dorsal surfaces of front and middle femora and tibiae, and dorsal and inner surfaces of hind femora. Golden, relatively short, appressed pubescence very sporadic on dorsum of body except gaster, where it is rather abundant.

Very dark reddish-brown; sides of mesosoma and petiole, spines and appendages a shade lighter.

Sexuals and immature stages unknown.

REMARKS

The eleven specimens of the *P. bamaga* type-series were collected on the edge of riverine lowland rainforest at Bamaga (Grid cell 10/142), near the tip of Cape York Peninsula. This species shares characteristic features with *P. viehmeyeri*-group species from the Solomons, New Guinea and Indonesia, including 5-dentate mandibles and an opaque first gastral tergite. In contrast, the more southern Australian members of the group (*P. eremita*, *P. loweryi* and *P. rustica*) possess 4-dentate mandibles and have more or less shiny gasters.

At the time of collection the site was inundated following torrential rain and the ants were running in disarray over low vegetation and flood debris in company with *Polyrhachis paxilla* Fr. Smith, a species of similar appearance and with almost identical vermiculate-rugose sculpturation. Despite repeated visits over following days no other *P. bamaga* specimens could be found.

Polyrhachis davydovi Karawajew, 1927
(Figs 2, 6)

Polyrhachis (Myrmhopla) davydovi Karawajew, 1927:24. Syntype workers. Type locality: INDONESIA, Aru Is., Wammar (= Wamar I., Kepulauan Aru) (05/134), 19 iii 1913, Karawajew, Nr.2746, IZAS (1 syntype examined).

LECTOTYPE DESIGNATION

I have examined one of two syntypes comprising the *P. davydovi* type series, kindly loaned by Dr A.G. Radchenko of the Zoological Institute, Ukrainian Academy of Sciences, Kiev. The specimen is in good condition and, besides the orange tag reading *davidovi* (sic), which is glued directly to the card triangle with the specimen, it bears three additional labels of which two are apparently in Karawajew's handwriting and read as follows: 'Wammar, Aru. 2746. Karavaiev'; '*Polyrhachis (Myrmhopla) davydovi* Karav. Typus'. The third label (on a red tag) reads: 'Holotypus ☿ *Polyrhachis (Myrmhopla) davydovi* Karawajew'. Despite the specimen being labelled 'Holotype', Karawajew's original description clearly indicates that both specimens are of equal value and thus syntypes. I designate the specimen I have examined as lectotype and, consequently, the second specimen is a paralectotype.

Dimensions of lectotype: TL 7.91; HL 1.93; HW 1.56; CI 81; SL 2.03; SI 130; PW 0.81; MTL 2.90.

WORKER

Clypeus in profile almost straight, with moderately impressed basal margin; median carina vague; truncated median portion of anterior margin obtuse laterally. Ocelli lacking (a shallow depression in the cephalic sculpturation indicates the relative position of the median ocellus). Pronotum with anteriorly converging lateral margins, bearing a pair of antero-laterally projecting, well elevated spines. Propodeal spines well elevated, subparallel, almost straight in lateral view. Dorsum of petiole convex, anterior and posterior margins ill defined; spines moderately elevated, widely divergent.

Fine, mostly V-shaped rugae, on clypeus and frontal area of head. Sculptural intensity increasing dorsally and posteriorly, with dorsum of head and mesosoma vermiculate-rugose; the pattern tends to be less coarse laterally, with sides of mesosoma only weakly rugose. Dorsum of petiole with rather fine, somewhat transverse, but mostly irregular rugulations. Base of first gastral tergite very finely, mostly transversely striate, opaque.

Yellow and reddish-brown, bristle-like hairs dense on head and gaster, but rather sporadic on dorsa of mesosoma and petiole. Mostly silvery, appressed pubescence fairly sparse everywhere, except the gastral dorsum, where it is longer and golden-yellow, with a distinct reddish-tint.

Medium reddish-brown; dorsum of mesosoma and sides of mesonotum and propodeum a shade darker. Mandibles, clypeus, antennal carinae and posterior margins of gastral tergites bordered dark brown.

Sexuals and immature stages unknown.

REMARKS

P. davydovi closely resembles *P. hirta* and *P. viehmeyeri*, and is undoubtedly closely related to both. Besides the characters given in the key, it differs from *viehmeyeri* in having the truncated portion of the anterior clypeal margin bluntly terminated laterally, and the propodeal and petiolar spines distinctly shorter. From *hirta* it differs in having the propodeal spines distinctly shorter and well elevated, and the petiolar spines more widely divergent. The anterior margin of the petiolar dorsum in *davydovi* is blunt and indistinct (Fig. 6), while it is clearly defined or even dorsally produced in the other two species (Figs 5, 7). Also, the bristle-like hairs in *P. davydovi* are much shorter and more dilute than in *P. hirta* and *P. viehmeyeri*.

Polyrhachis eremita sp.nov.

MATERIAL EXAMINED

HOLOTYPE. AUSTRALIA. Queensland, c. 4-10 km N of Marlborough, 22°45'S,149°54'E, 9 April 1981, RJK acc. 81.51 (worker). PARATYPES data as for holotype (8 workers). Type deposition: Holotype in QMBA (type no. T 11124); 2 paratypes each in ANIC and RJK, 1 paratype each in BMNH, MHNG, MCSN and MCZC.

WORKER

Dimensions (holotype cited first): TL 7.66, 7.66-8.72; HL 1.92, 1.87-2.03; HW 1.61, 1.56-1.70; CI 84, 82-85; SL 2.28, 2.21-2.43; SI 142, 141-144; PW 0.87, 0.81-0.91; MTL 3.00, 2.97-3.22 (9 measured).

Clypeus in profile almost straight, with posterior margin moderately impressed; median carina rather smooth and shiny for most of its length; truncated median portion of anterior margin obtuse laterally. Median ocellus distinct; lateral ocelli lacking (their relative location marked by shallow depressions in cephalic sculpturation). Pronotal dorsum narrowed anteriorly, bearing a pair of slender, well elevated, short to medium long, often asymmetrical spines (see below under remarks on *P. rustica*). Propodeum flat, bearing a pair of straight, well elevated, moderately divergent spines. Petiole with posteriorly sloping dorsum, which is more or less concave between divergent, well elevated spines.

Clypeus and front of head with fine, more or less longitudinal rugae; sculptural intensity increasing posteriorly to vermiculate-rugose on dorsum of head and occipital border. Dorsa of mesosoma and petiole vermiculate-rugose; sculptural intensity decreasing laterally to weakly rugose. Propodeal spines, besides a few piliferous pits at their bases, highly polished. First gastral tergite finely, microscopically reticulate, more or less shiny.

Short, yellowish to reddish-brown, bristle-like hairs most dense on head and gaster, rather dilute on dorsa of mesosoma and petiole. Short, appressed pubescence very sporadic everywhere, save for the gaster, where it is rather abundant, ranging from reddish- golden dorsally to silvery on lateral and ventral surfaces

Distinctly bicoloured; head mostly light reddish-brown with mandibles, clypeus, antennal carinae, median ocellus and the lateral ocellar depressions, narrowly bordered very dark brown; occipital border dark brown. Dorsa of mesosoma and petiole dark reddish-brown, except the pronotal collar, antero-median patch on mesonotal dorsum, propodeal spines, and sides of mesosoma and petiole, which are yellowish to light reddish-brown. Gaster reddish-brown, its base widely diffused yellowish-brown. Posterior margins of tergites and sternites widely bordered very dark brown. Appendages reddish-brown.

Sexuals and immature stages unknown.

Remarks

The type-series of *P. eremita* was collected in open sclerophyll forest at the base of Pine Mountain, near Marlborough, CQ (Grid cell 22/149). The ground had been disturbed, possibly by recent logging activities, and the immediate surface of the forest floor was badly ravaged. A few ants were observed running in disarray, together with a similarly coloured unidentified species of *Rhytidoponera* Mayr (Ponerinae). Some specimens were found dead and damaged. Subsequent visits to the area in following years failed to produce further specimens of *P. eremita*.

Polyrhachis greensladei sp.nov.

Material Examined

Holotype: Solomon Is.: Guadalcanal Prov., Mt Austen, 10 v - 28 vi 1965, P.J.M. Greenslade (worker). Paratypes: data as for holotype, 5 x 1965, P.J.M. Greenslade (1 dealate female); data as for holotype, 5 vii 1984, RJK acc. 84 1 (1 worker); Central Prov., Savo I., 5 viii 1963, P.J.M. Greenslade (1 worker). Papua New Guinea (PNG): New Ireland Prov., Lelet Plateau, 800-1000 m, *c.* 03°20'S,151°56'E, 19-24 vii 1984, RJK acc. 84.93 (worker). Type deposition: Holotype in ANIC (type no. 7732); 1 paratype (dealate female) in ANIC; 1 paratype (worker) in BMNH; 2 paratypes (workers) in RJK.

Worker

Dimensions (holotype cited first): TL 7.86, 7.81-8.77; HL 2.00, 1.96-2.15; HW 1.61, 1.59-1.73; CI 81, 80-82; SL 2.15, 2.15-2.34; SI 134, 133-135; PW 0.84, 0.87-0.94; MTL 2.97, 2.97-3.28 (4 measured).

Clypeus of holotype in profile almost straight, but rather distinctly sinuate in some paratypes, with posterior margin deeply impressed; median longitudinal carina feebly marked anteriorly, indistinct posteriorly; truncated median portion of anterior margin distinctly dentate laterally. Ocelli lacking. Pronotal dorsum with sides subparallel; spines moderately long, scarcely elevated. Propodeal suture more or less marked by a shallow transverse depression. Dorsum of propodeum straight in profile, spines well elevated, moderately divergent, with tips gently turned outwards in dorsal view. Dorsum of petiole flat, sloping posteriorly, with distinct anterior margin; spines relatively long, well elevated, widely divergent.

Clypeus, front and sides of head with irregular, mostly longitudinal rugae; sculptural intensity increasing posteriorly, so that the dorsum of head is rather coarsely vermiculate-rugose. Dorsa of mesosoma and petiole vermiculate-rugose; sculpturation markedly more fine laterally. Propodeal spines smooth and polished, petiolar spines with a few longitudinal rugae. First gastral tergite basally with more or less regular transverse striations, opaque.

Brown, bristle-like hairs abundant on head and gaster, only slightly less dense on dorsa of mesosoma and petiole. The rather dilute, whitish pubescence has a somewhat reddish tint on the dorsal aspect of gaster.

Very dark brown; clypeus, sides of head, mesosoma, petiole and appendages a shade lighter. Mandibles reddish-brown, bordered very dark brown.

Female

Dimensions: TL 9.17; HL 2.03; HW 1.62; CI 80; SL 2.28; SI 141; PW 1.71; MTL 2.97 (1 measured).

The female differs from the worker in the usual characters identifying full sexuality, including three ocelli, complete thoracic structure and wings. The sculpturation, pilosity and colour is essentially that of the worker, and only the configuration of spines is different. The pronotal spines are reduced to pair of minute denticles; the propodeal spines are distinctly shorter than in the worker, almost horizontal in lateral view, and divergent. The petiolar spines are similar to those of worker, but markedly shorter.

Male and immature stages unknown.

Remarks

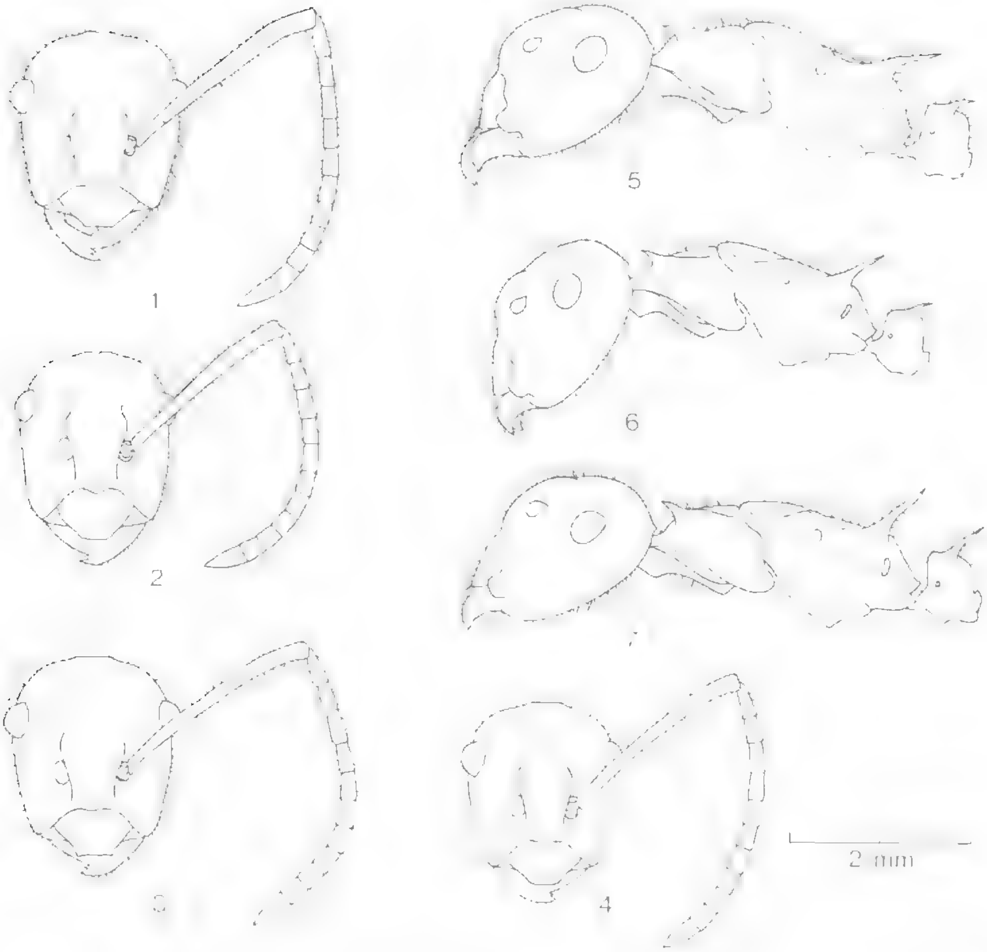
The known distribution of *P. greensladei* is from the Bismarck Archipelago in Papua New Guinea to Guadalcanal in the Solomon Islands (Grid cells 3/151, 9/159, 9/160). The locality data label under the holotype states that the specimen was taken in a carrion trap. The single specimen from New Ireland was collected dead on a narrow path winding through low dense fern thicket, which is typical of parts of the Lelet Plateau.

Polyrhachis hirta Viehmeyer, 1913
(Figs 1, 5)

Polyrhachis hirta Viehmeyer, 1913:59. Syntype workers. Type locality: New Guinea, Wareo (Madang Prov., PNG) (06/147), MNHU (1 syntype examined).

Lectotype Designation

I have examined one syntype of *P. hirta*, kindly loaned by Dr Frank Koch of the Museum für



FIGS 1 - 4. Head in full face view (right antenna omitted): 1 - *P. hirta*; 2 - *davydovi*; 3 - *viehmeyeri*; 4 - *bamaga*. FIGS 5 - 7. Lateral view (antennae, legs and gaster omitted): 5 - *P. hirta*; 6 - *davydovi*; 7 - *viehmeyeri*.

Naturkunde, Humboldt-Universität, Berlin. The specimen is in a fair condition and bears six labels as follows: 'Wareo, D. Neuguinea', 'Typus' (on red tag), 'Coll. Viehm.', 'Zool. Mus. Berlin', 'Syntype' (round label) and '*hirta* Viehm., det. B. Bolton, 1973'. This specimen is here designated lectotype of *P. hirta*, and has been so labelled.

Dimensions of lectotype: TL 8.16; HL 2.03; HW 1.65; CI 81; SL 2.28; SI 138; PW 0.87; MTL 3.22.

ADDITIONAL MATERIAL EXAMINED

PAPUA NEW GUINEA: Northern Prov., Managalese Plateau, *c.* 09°05'S, 148°26'E, S of Popondetta, July 1964, R. Pullen (1 worker); Pongani Riv., *c.* 500 m, Boikiki Plantation, *c.* 8 km NNE Afore, 09°06'S, 148°25'E, 29- 30 viii 1984, RJK acc. 84.386 (4 workers); Morobe Prov., Bulolo (07/146), 2300 ft, 3 January 1968, B.B. Lowery (7 workers, 1 dealate female).

WORKER

Dimensions: TL 7.76-8.92; HL 1.96-2.18; HW 1.59-1.75; CI 78-81; SL 2.15-2.43; SI 135-139; PW 0.79-0.90; MTL 3.02-3.38 (12 measured).

Clypeus in profile almost straight, with basal margin deeply impressed; median longitudinal carina vague; truncated median portion of anterior margin bluntly angulate laterally. Ocelli lacking. Pronotal dorsum with lateral margins subparallel, bearing a pair of barely elevated, often asymmetrical spines (including those of lectotype). Propodeal spines only weakly elevated, somewhat divergent. Petiolar dorsum sloping posteriorly, almost flat, with anterior margin distinct or even dorsally produced in some specimens; spines only weakly elevated, divergent.

Clypeus with fine, mostly V-shaped rugae, extending to sides and frontal areas of head; sculptural intensity increasing dorsally and posteriorly, with dorsa of head and mesosoma vermiculate- rugose, and decreasing laterally, with sides of mesosoma and petiole less coarsely, somewhat irregularly, rugose. Base of first gastral tergite finely, mostly transversely, striate, opaque.

Short, reddish-brown or yellowish, bristle-like hairs on all dorsal surfaces of body, most dense on head and gaster. White to silvery, appressed pubescence very sparse, except on gastral dorsum, where it is more abundant and yellow, with a distinct reddish tint.

Medium reddish-brown, mandibles, propodeal and petiolar spines a shade lighter. Mandibles, antennal carinae and lateral margins of mesosoma narrowly and posterior margins of gastral tergites more widely, bordered dark brown. Appendages reddish-brown.

Female

Dimensions: TL 9.22; HL 2.03; HW 1.57; CI 77; SL 2.28; SI 145; PW 1.72; MTL 3.17 (1 measured).

The single available female closely resembles the worker and, besides the usual characters identifying full sexuality, differs only in the configuration of the spines. The pronotal spines are reduced to minute denticles. The propodeal spines are relatively short with tips curved gently outwards; in lateral view the spines are horizontal at their bases and then gently downturned. Petiolar spines are rather short, widely divergent.

Male and immature stages unknown.

Remarks

I have directly compared the lectotype of *P. hirta* Viehmeyer with the holotype of *P. viehmeyeri* Emery and other available material. Despite certain similarities of the specimens, I am confident that each name designates separate and valid species.

Polyrhachis loweryi sp.nov.

Material Examined

Holotype: Australia: Queensland, Miles, 20 viii 1975, B.B. Lowery (worker).

Paratypes: data as for holotype (4 workers). Type deposition: Holotype in ANIC (type no. 7733); 1 paratype each in BMNH, MCZC, QMBA and RJK.

Worker

Dimensions (holotype cited first): TL 8.26, 8.26-8.77; HL 2.03, 1.93-2.00; HW 1.65, 1.56-1.65; CI 81, 81-84; SL 2.46, 2.31-2.46; SI 149, 145-152; PW 0.94, 0.87-0.94; MTL 3.28, 3.12-3.33 (5 measured).

Clypeus in profile almost straight with the base moderately impressed; median carina rather blunt, frequently interrupted throughout its length; truncated median portion of anterior margin obtuse laterally. Median ocellus distinct, lateral ocelli lacking (their relative position marked by shallow depressions in the cephalic sculpturation). Pronotal dorsum with sides converging anteriorly; spines well elevated, long and slender. Propodeal suture marked by a shallow transverse depression. Propodeal spines only moderately elevated, subparallel. Dorsum of petiole widely concave between well elevated, relatively long, divergent spines.

Clypeus and front of head finely, mostly longitudinally, striate-rugose; sides irregularly rugose. Dorsa of head, mesosoma and petiole vermiculate-rugose, with sides distinctly less rugose than dorsum; propodeal declivity transversely rugose. First gastral tergite very shallowly micro-reticulate, more or less shiny.

Light to dark brown, bristle-like hairs, most dense on head and gaster, rather dilute on dorsa of mesosoma and petiole. Silvery, appressed pubescence, very scarce everywhere except on gaster, where it is abundant with distinctly reddish tint dorsally.

Very dark reddish-brown, with only mandibles (except their masticatory borders), spines and petiole below spiracles, a shade lighter.

Sexuals and immature stages unknown.

Remarks

The type-series was collected in dry sandy sclerophyll forest with *Callitris*, near Miles in southern Queensland (Grid cell 26/150). Lowery's original data label states that the specimens were 'found only in galleries of common large species of *Rhytidoponera*'.

Polyrhachis rustica sp.nov.

Material Examined

Holotype: Australia: Queensland, 4 km N of Collinsville (20/147), savannah woodland, 24 v 1981, B.B. Lowery (worker)

PARATYPES: data as for holotype (1 dealate female). AUSTRALIA. Queensland, Mareeba, Chico(?) Rd. (17/145), 17 vi 1961, L.H. Weatherill (B.M 1966-163) (worker). Type deposition: Holotype (type no. 7735) and 1 paratype (dealate female) in ANIC; 1 paratype (worker) in BMNH.

WORKER

Dimensions (holotype cited first): TL 7.16, 7.00; HL 1.78, 1.75; HW 1.47, 1.43; CI 83, 82; SL 2.15, 2.00; SI 146, 140; PW 0.81, 0.80; MTL 2.84, 2.68 (2 measured).

Clypeus in profile almost straight with rather shallowly impressed posterior margin; median longitudinal carina poorly marked, except for a short, clearly defined anterior section; truncated median portion of anterior margin obtuse laterally. Median ocellus vestigial; lateral ocelli lacking. Pronotal dorsum narrowed anteriorly, bearing a pair of well elevated spines, which are rather short and triangular in the holotype, and distinctly longer and more slender in the paratype. Propodeal suture distinct laterally, rather obsolete medially. Propodeal spines scarcely elevated, subparallel. Dorsum of petiole with more or less distinct anterior margin, bearing a pair of somewhat divergent, gently curved spines.

Clypeus and front of head with fine, more or less longitudinal rugosity. Sculptural intensity increasing dorsally and posteriorly, so that the dorsa of head, mesosoma and petiole are mostly vermiculate-rugose. Sculpturation distinctly less intense laterally, with sides of mesosoma and petiole somewhat reticulate-rugose. Dorsum of first gastral tergite very finely, microscopically reticulate, shiny.

Very short brown to yellowish bristle-like hairs rather scarce on dorsa of mesosoma and petiole, more numerous on head and gaster. Short, appressed, silvery pubescence sporadic over most of the body, except the gastral dorsum, where it is more abundant, with a distinct, reddish-golden tint.

Dark reddish-brown with dorsum and sides of mesosoma and petiole infuscated medium reddish-brown. Dorsum of gaster medium reddish-brown with posterior margins of tergites widely bordered dark brown.

FEMALE

Dimensions: TL 8.97; HL 1.90; HW 1.56; CI 82; SL 2.37; SI 152; PW 1.76; MTL 3.22 (1 measured).

Very similar to worker and, besides the obvious characters identifying full sexuality, with the following differences: pronotal spines reduced to triangular, somewhat dorso-ventrally flattened teeth which, in direct comparison to those in other known *viehmeyeri* species-group females, are distinctly longer; propodeal spines relatively short, their length equal to about half the distance between their bases; petiolar dorsum concave between short, widely divergent, well elevated spines, the anterior petiolar margin rather blunt, posterior margin indistinct. Colour brownish-black; mandibles medium reddish-brown with masticatory borders narrowly bordered very dark brown. Sides of head at mandibular bases, sides of mesosoma, petiole and gastral tergites and sternites infuscated medium reddish-brown. Appendages medium reddish-brown, tarsi a shade lighter.

Male and immature stages unknown.

REMARKS

P. rustica is similar to *P. eremita*. It shares with that species a number of characteristics, including an almost identical clypeal outline, with distinct median carina. The colour scheme of the mesosoma and gaster is similar. Besides the characters given in the key, it differs from *eremita* in the colour of the head which is uniformly dark reddish-brown in *P. rustica*, but conspicuously bicoloured in *P. eremita*. Also, the petiole in lateral view is distinctly higher and more slender in *P. rustica*.

The holotype and paratype worker of *P. rustica* were collected from relatively distant localities but, besides the marked differences in the length of pronotal spines, they are closely comparable and undoubtedly conspecific. The variability in the length, elevation and orientation of the pronotal spines is a peculiar character exhibited to some degree by all known *viehmeyeri*-group species. I examined many individuals (including types) with the pronotal spines asymmetrical. Although morphologically interesting, this variability seems to be random, and is apparently of no taxonomic value.

Like some other species of the group (*eremita*, *loweryi* and *viehmeyeri*), *P. rustica* seems to be closely associated in the field with ants of the genus *Rhytidoponera*. Lowery's original label states that the specimens (holotype and paratype female) were collected 'under same rock as large *Rhytidoponera*'. Also the specimen sent by Barry Bolton was apparently collected in association with ants of that genus, since the BMNH register for 1966-163 states '315 *Rhytidoponera* Australia...'.

Polyrhachis stigmatifera sp.nov.

MATERIAL EXAMINED

HOLOTYPE: INDONESIA: Seram, Solea, viii 1987, M.C. Day (worker). Type deposition: Unique holotype in BMNH.

WORKER

Dimensions: TL 8.06; HL 2.00; HW 1.59; CI 79; SL 2.25; SI 141; PW 0.78; MTL 2.96.

Clypeus in profile straight, with basal margin deeply impressed; medial longitudinal carina rather acute anteriorly, somewhat less distinct posteriorly; truncated median portion of anterior margin dentate laterally. Ocelli lacking. Pronotal dorsum narrowed anteriorly, bearing a pair of weakly elevated, asymmetrical spines (right spine on the unique holotype is long and slender, while the left spine is distinctly shorter and more triangular). Metathoracic spiracles situated on prominent, laterally projecting tubercles. Propodeum bearing a pair of moderately elevated spines. Petiolar spines scarcely elevated, widely divergent.

Clypeus with fine, more or less V-shaped rugae, continuous over frontal area of head. Sculptural intensity increasing posteriorly, with dorsa of head, mesosoma and petiole vermiculate-rugose, and decreasing laterally with sides only irregularly rugose. Propodeal and petiolar spines smooth and shiny, save for a few transverse rugae at their bases. First gastral tergite opaque; the base somewhat striate-rugose laterally, with sculpturation distinctly less regular dorsally and posteriorly.

Rather short yellow to reddish-brown, bristle-like hairs very sparse everywhere, save on the gaster, where they are longer and more abundant. Short silvery to golden appressed pubescence very dilute over most of body, except gaster, where the hairs are longer, with a distinct reddish tint on the dorsal aspect.

Dark reddish-brown, lateral portions of head a shade lighter. Mandibles reddish-brown, with masticatory borders narrowly bordered dark brown. Appendages and tips of spines medium reddish-brown.

Sexuals and immature stages unknown.

REMARKS

P. stigmatifera is only the second species of the *P. viehmeyeri* species-group known from Indonesia (the other is *P. davydovi*). Besides the prominent metathoracic spiracles, it is easily separable from *davydovi* by the anterior section of the median clypeal carina which forms rather acute ridge; the petiolar dorsum with well defined anterior margin; and the generally dark colour of the body. In contrast, the clypeus in *P. davydovi* is almost flat with the median carina vague; the anterior margin of the petiolar dorsum is ill defined; and general coloration distinctly lighter.

Polyrhachis viehmeyeri Emery, 1921
(Figs 3, 7)

Polyrhachis (Myrmhopla) viehmeyeri Emery, 1921:19. Holotype worker. NE NEW GUINEA, MCSN (Examined).

Dimensions of holotype: TL 8.77; HL 2.06; HW 1.65; CI 80; SL 2.31; SI 140; PW 0.86; MTL 3.22.

ADDITIONAL MATERIAL EXAMINED

PAPUA NEW GUINEA: Morobe Prov., Bupu Riv., Lae (06/146), 6 January 1968, B.B. Lowery (47 workers, 2 alate females, 4 males); Northern Prov., Kokoda (08/147), 1100', 17 January 1971, B.B. Lowery (1 worker).

WORKER

Dimensions: TL 7.46-8.52; HL 1.90-2.15; HW 1.57-1.78; CI 81-84; SL 2.18-2.34; SI 130-141; PW 0.75-0.94; MTL 2.92-3.28 (21 measured).

Clypeus in profile almost straight, with well impressed posterior margin; median longitudinal carina vague; truncated median portion of anterior margin distinctly dentate laterally. Ocelli generally lacking, but in some specimens a vestigial median ocellus is evident. Pronotal dorsum narrowed anteriorly, bearing a pair of well elevated, long, slender spines. Propodeal spines well elevated, subparallel, somewhat divergent in some specimens. Dorsum of petiole with clearly defined anterior margin and well elevated, long, slender spines.

Clypeus with fine, somewhat longitudinal rugae, extending to the frontal areas and sides of head. Sculptural intensity increasing dorsally and posteriorly, so that the dorsa of head, mesosoma and petiole are vermiculate-rugose. Sculpturation is more fine laterally, with the sides of the mesosoma and petiole only reticulate-rugose. Base of first gastral tergite finely, more or less transversely striate, opaque.

Mostly reddish-brown, bristle-like hairs abundant over most of body. Silvery appressed pubescence very sparse, save for the gastral dorsum, where it is more abundant and somewhat yellow with a reddish tint.

Light to medium reddish-brown, dorsa of head and mesosoma a shade darker. Mandibles, anterior clypeal margin and antennal carinae narrowly bordered dark brown.

FEMALE

Dimensions: TL 8.47-8.87; HL 1.93-2.06; HW 1.53-1.62; CI 79; SL 2.06-2.15; SI 133-135; PW 1.75-1.81; MTL 2.72-2.92 (2 measured).

The female is very similar to the worker, with almost identical sculpturation and colour. Besides the characters identifying full sexuality it differs only in the length of the mesosomal spines: pronotal spines reduced to minute denticles; propodeals short, subparallel, and almost horizontal in lateral view. The petiolar spines are similar to those of the worker, except shorter. The female of *P. viehmeyeri* is distinguishable from that of the closely related *P. hirta*, and from other known females of the *viehmeyeri* species-group, by its relatively wide mesoscutum, which is as wide, or even wider than long. In comparison, the mesoscutum of *hirta*, *greensladei* and *rustica* is distinctly more narrow, being longer than wide. The mesoscutum in *P. viehmeyeri* is also somewhat concave posteriorly, when viewed from the side; it is almost straight in all other species.

Males and immature stages in ANIC.

REMARKS

I have examined and directly compared the unique holotype of *P. viehmeyeri* with numerous specimens collected by Rev. Lowery. They matched the holotype closely. The main characters separating this species from the closely related *P. hirta* and other species of the group are given in the key and in the discussion under *P. davydovi* and *P. hirta*.

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NOTES ON AUSTRALIAN ANTS OF THE GENUS *POLYRHACHIS* FR.SMITH, WITH A SYNONYMIC LIST OF THE SPECIES (HYMENOPTERA: FORMICIDAE: FORMICINAE)

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The named Australian species of the ant genus *Polyrhachis* are reviewed. Eleven subspecies are raised to species: *P. guerini lata* Emery, *P. hookeri lownei* Forel, *P. hookeri obscura* Forel, *P. aurea obtusa* Emery, *P. guerini pallescens* Mayr, *P. rastellata pilosa* Donisthorpe, *P. sexspinosa reclinata* Emery, *P. appendiculata schoopae* Forel, *P. guerini vermiculosa* Mayr, *P. lombokensis yarrabahensis* Forel and *P. rastellata yorkana* Forel. *P. australis* Mayr, formerly a junior synonym of *P. levior* Roger, is declared a valid species. Nine new synonyms are proposed (senior names cited first): *P. australis* Mayr = *P. nox* Donisthorpe, *P. creusa* Emery = *P. creusa chlorizans* Forel = *P. hecuba* Forel, *P. heinlethii* Forel = *P. heinlethii sophiae* Forel, *P. hookeri* Lowne = *P. hookeri aerea* Forel, *P. lata* Emery = *P. gab aegra* Forel, *P. pallescens* Mayr = *P. aurea depilis* Emery, *P. phryne* Forel = *P. sidnica perthensis* Crawley, *P. sexspinosa* (Latreille) = *P. barnardi* Clark. Seven Papuasian species are recorded for the first time from Australia: *P. argenteosignata* Emery, *P. atropos* Fr.Smith, *P. denticulata* Karawajew, *P. mucronata* Fr.Smith, *P. obtusa* Emery, *P. reclinata* Emery and *P. semiobscura* Donisthorpe. *P. guerini* Roger, *P. levior* Roger and *P. lombokensis* Emery, which were previously reported from Australia, apparently do not occur there. *P. guerini* is known only from New Caledonia and is apparently endemic there. A current synonymic list of the 114 valid named Australian *Polyrhachis* species is provided, and the position of all names in the traditional subgeneric arrangement is indicated. □ *Formicidae, Polyrhachis, Australia, synonymy, distribution, checklist.*

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This study culminates a series to which both authors have contributed (Kohout, 1988a, 1988b, 1988c, 1989, 1990; Taylor, 1989). With these studies, we have aimed to review the identities and nomenclature of all described Australian species of the large and diverse formicine ant genus *Polyrhachis* Fr.Smith. In this paper, a number of species-group taxa are discussed in detail. They are the last remaining for consideration in this project.

During the 210 years preceding 1985, 20 authors generated a nomenclature comprising 137 available specific and subspecific names for Australian *Polyrhachis*. As well, several infrasubspecific names, which have no formal status in zoological nomenclature (Taylor, 1986), were proposed. The arrangement of species that resulted was summarised by Taylor and Brown (1985) and Taylor (1987). Because no comprehensive revision of the genus was available, these lists ranked the available names according to the their then most recent taxonomic assignment. In Taylor's checklist (1987), for example, 86 names were ranked as species, and 33 as subspecies. At that time, only 5 names had previously been assigned to junior synonymy and 3 to junior homonymy. However, because this arrangement was assembled piecemeal and neither subjected to critical review nor revision, any impression of systematic comprehensiveness in the resulting nomenclature is illusory.

Following our studies, we are now able to recognise 114 validly named species of *Polyrhachis* from Australia, and 33 junior synonyms or homonyms. We find no justification for continued nomenclatural recognition of subspecies. In our recent papers, 20 of the subspecies listed by Taylor (1987) have been elevated to specific rank, and 13 consigned to junior synonymy. Of the latter, 5 are treated as junior synonyms of their species, 2 as junior synonyms of an elevated name that was previously treated as a subspecies of the same species, and 6 as junior synonyms of species with which they were not previously associated.

Six of the 28 names cited below as senior synonyms were originally proposed for Papuasian species. Four of these (*P. creusa* Emery, *P. dives* Fr.Smith, *P. fervens* Fr.Smith, and *P. insularis* Emery) have not been used before for Australian ants. Five names of Southeast Asian or Melanesian taxa (*P. guerini* Roger, *P. ithona* Fr.Smith, *P. levior* Roger, *P. lombokensis* Emery and *P. relucens* (Latreille)), which were previously treated as senior synonyms of Australian names or were considered to be nominotypical subspecies of Australian taxa, no longer apply to the Australian fauna. Finally, the first Australian records are noted of 10 species originally described from lands to the north (*P. argenteosignata* Emery, *P. atropos* Fr.Smith, *P. consimilis* Fr.Smith, *P. denticulata* Karawajew, *P. mucronata* Fr.Smith, *P. obtusa* Emery, *P. paxilla* Fr.Smith, *P. reclinata* Emery, *P. rufofemorata* Fr.Smith and *P. semiobscura* Donisthorpe).

Some of the species listed below have not been discussed in detail in our papers. Nonetheless, the species have been studied, found to be valid, and do not require further comment at present. We envisage that few changes will be required in the nomenclature proposed below. However, there is the possibility that we may have overlooked sibling species concealed by variability that we have interpreted here as infraspecific (a problem always prominent in taxonomic work on Australian ants).

All of the species listed are represented in the Australian National Insect Collection (ANIC), Canberra, and most are in the Queensland Museum (QMBA), Brisbane. The ANIC has type material of a number of taxa, including syntypes or paralectotypes of several of the species or subspecies described by Auguste Forel. These were generously donated in 1968 by the Muséum d'Histoire Naturelle, Geneva, Switzerland. In addition the ANIC contains many specifically labelled voucher specimens identified by one of us following direct comparison with type material on loan from foreign or other Australian collections. Between us, we have seen types of every relevant available name for which types are known to exist. We also believe that any specimen bearing one of our determination labels written during or since 1987 can be considered to have been identified with confidence. We have also designated and used a few particular ANIC vouchers as nomenclatural paradigms for species of which the types are deemed to have been lost (see *P. guerini*). As a result, we believe that Australian workers using our published notes, and the resources of either collection should have little difficulty in identifying material of named *Polyrhachis* species or in recognising specimens representing undescribed species. The undescribed species known to us will at least double the Australian species tally. The next phase of our project will attend to their description and ultimately to the provision of keys enabling the ready identification of all relevant species.

Although we do not make formal use of the *Polyrhachis* subgenera of the Emery/Wheeler classification (Wheeler, 1922; Emery, 1925), we consider that they do provide useful foci for the sorting of species. The collections in our care are arranged following this system, generally as simplified by Hung (1967). For this reason a second list of species is given below, arranged in subgeneric groups. We do not support the direct use of species-group names to replace those of the subgenera. It seems unlikely that all of these subgenera are monophyletic. As well, a number of apparently monophyletic species-groups, which do not correlate with the present subgenera, can be discerned. We expect the present subgenera to be replaced by a larger set of informally-named species-groups but, prior to an overall formal taxonomic analysis, we will not initiate such a classification. No apology is made for this apparent ambivalence; the categorical subvision of *Polyrhachis* cannot be resolved until all of the species now known are nomenclaturally and taxonomically accessible, and have been subjected to classificatory analysis. We trust that this paper will contribute meaningfully to the achievement of such a classification.

Abbreviations for institutions (with the names of co-operating curators) are: ANIC, Australian National Insect Collection, Canberra; BMNH, British Museum (Natural History), London (Barry Bolton); BPBM, Bernice P. Bishop Museum, Honolulu, Hawai'i, U.S.A. (Dr G. Nishida); HNHM, Hungarian Natural History Museum, Budapest (Dr J. Papp); IZAS, Institute of Zoology, Academy of Sciences, Kiev, U.S.S.R. (Dr A.G. Radchenko); MCSN, Museo Civico di Storia Naturale 'Giacomo Doria', Genoa, Italy (Drs R. Poggi and V. Raineri); MCZC, Museum of Comparative Zoology, Harvard University, Cambridge, Mass., U.S.A. (Dr A.F. Newton, Jr); MHNG, Muséum d'Histoire

Naturelle, Geneva, Switzerland (Dr C. Besuchet); MVMA, Museum of Victoria, Melbourne (Dr A. Neboiss and K. Walker); NHMW, Naturhistorisches Museum, Vienna, Austria (Dr M. Fischer); NHRS, Naturhistoriska Riksmuseet, Stockholm, Sweden (Dr K-J. Hedquist); OXUM, University Museum, Oxford, U.K. (Drs G. McGavin and C. O'Toole); QMBA, Queensland Museum, Brisbane (E.C. Dahms and Dr G.B. Monteith).

SYNONYMIC LIST OF AUSTRALIAN POLYRHACHIS SPECIES

The following list includes all described Australian *Polyrhachis* species known to the authors. Non-Australian junior synonyms are excluded. Names of the unresolved *P. (sidnica)* complex (Taylor, 1989) - comprising *P. sidnica*, *P. cedarensis*, *P. leae*, and *P. tambourinensis* - are listed as species. For publication details see Taylor and Brown (1985) or Taylor (1987), and Emery (1925). Synonyms are in italics.

- **ammon** (Fabricius, 1775)
  - *ammon angustata* Forel, 1902
- **ammonoeides** Roger, 1863
- **andromache** Roger, 1863
  - *connectens australiae* Emery, 1887
- **angusta** Forel, 1902
- **appendiculata** Emery, 1893
- **arcuata** (Le Guillou, 1841)
- **argentosa** Forel, 1902
- **argenteosignata** Emery, 1900
- **atropos** Fr.Smith, 1860
- **aurea** Mayr, 1876
- **australis** Mayr, 1870
  - *nox* Donisthorpe, 1938 syn.nov.
- **bamaga** Kohout, 1990
- **barretti** Clark, 1928
- **bedoti** Forel, 1902
- **bellicosa** Fr.Smith, 1859
- **bicolor** Fr.Smith, 1858
- **cataulacoidea** Stitz, 1911
- **cedarensis** Forel, 1915
- **chalchas** Forel, 1907
- **cleopatra** Forel, 1902
- **clio** Forel, 1902
- **clotho** Forel, 1902
- **constricta** Emery, 1897
- **consimilis** Fr.Smith, 1858
- **contemta** Mayr, 1876
- **crawleyi** Forel, 1916
- **creusa** Emery, 1897
  - *hecuba* Forel, 1902 syn.nov.
- **cupreata** Emery, 1895
  - *daemeli exlex* Forel, 1915
- **daemeli** Mayr, 1876
- **denticulata** Karawajew, 1927
- **dives** Fr.Smith, 1857
  - *exulans* Clark, 1941
- **doddi** Donisthorpe, 1938
- **erato** Forel, 1902
  - *aeschyle* Forel, 1915
- **eremita** Kohout, 1990
- **euterpe** Forel, 1902
- **femorata** Fr.Smith, 1858
  - *emeryi* (Forel, 1880)
- **fervens** Fr.Smith, 1860
  - *kershawi* Clark, 1930
- **flavibasis** Clark, 1930
- **foreli** Kohout, 1989
- **fuscipes** Mayr, 1862
  - *semipolita hestia* Forel, 1911
- **gab** Forel, 1880
- **glabrinota** Clark, 1930
- **gravis** Clark, 1930
- **heinlethii** Forel, 1895
  - *heinlethii sophiae* Forel, 1902 syn.nov.
- **hermione** Emery, 1895
- **hexacantha** (Erichson, 1842)
  - *froggatti* Forel, 1910
- **hirsuta** Mayr, 1876
  - *hirsuta quinquedentata* Viehmeyer, 1925
- **hookeri** Lowne, 1865
  - *hookeri aerea* Forel, 1902 syn.nov.
- **inconspicua** Emery, 1887
  - *thalia* Forel, 1902
- **insularis** Emery, 1887
  - *inconspicua subnitens* Emery, 1895
- **inusitata** Kohout, 1989
- **io** Forel, 1915
- **jacksoniana** Roger, 1863
- **lachesis** Forel, in Emery 1897
- **lata** Emery, 1895 stat.nov.
  - *gab aegra* Forel, 1915 syn.nov.
- **latreillii** (Guérin-Méneville, 1838)
- **leae** Forel, 1913
- **loweryi** Kohout, 1990
- **lownei** Forel, 1895 stat.nov.
- **lydiae** Forel, 1902
- **lysistrata** Santschi, 1920
- **machaon** Santschi, 1920
- **mackayi** Donisthorpe, 1938
- **macropus** Wheeler, 1916
  - *longipes* Wheeler, 1915
- **maculata** Forel, 1915
- **micans** Mayr, 1876
- **mjobergi** Forel, 1915
  - *anguliceps* Viehmeyer, 1925
- **mucronata** Fr.Smith, 1859
- **obscura** Forel, 1895 stat.nov.
- **obtusa** Emery, 1897 stat.nov.

- **ops** Forel, 1907
- **ornata** Mayr, 1876
  - *humerosa* Emery, 1921
  - *chrysothorax* Viehmeyer, 1925
- **pallescens** Mayr, 1876 stat.nov.
  - *aurea depilis* Emery, 1897 syn.nov.
- **patiens** Santschi, 1920
- **paxilla** Fr.Smith, 1863
- **penelope** Forel, 1895
- **phryne** Forel, 1907
  - *sempronia* Forel, 1907
  - *perthensis* Crawley, 1922 syn.nov.
- **pilosa** Donisthorpe, 1938 stat.nov.
- **polymnia** Forel, 1902
- **prometheus** Santschi, 1920
- **pseudothrinax** Hung, 1967
- **punctiventris** Mayr, 1876
- **pyrrhus** Forel, 1910
- **queenslandica** Emery, 1895
  - *delicata* Crawley, 1915
- **rastellata** (Latreille, 1802)
- **reclinata** Emery, 1887 stat.nov.
- **rowlandi** Forel, 1910
- **rufifemur** Forel, 1907
  - *terpsichore elegans* Forel, 1910
- **rufofemorata** Fr.Smith, 1859
- **rustica** Kohout, 1990
- **schenkii** Forel, 1886
- **schoopae** Forel, 1902 stat.nov.
- **schwiedlandi** Forel, 1902
- **semiaurata** Mayr, 1876
- **semiobscura** Donisthorpe, 1944
- **semipolita** André, 1896
- **senilis** Forel, 1902
  - *gab tripellis* Forel, 1915
  - *comata* Crawley, 1915
  - *crawleyella* Santschi, 1916
- **sexspinosa** (Latreille, 1802)
  - *barnardi* Clark, 1928 syn.nov.
- **sidnica** Mayr, 1866
  - *quadricuspis* Mayr, 1870
- **sokolova** Forel, 1902
  - *sokolova degener* Forel, 1910
- **tambourinensis** Forel, 1915
- **templi** Forel, 1902
- **terpsichore** Forel, 1893
- **thais** Forel, 1910
- **thusnelda** Forel, 1902
- **townsvillei** Donisthorpe, 1938
- **trapezoidea** Mayr, 1876
- **tubifera** Forel, 1902
- **turneri** Forel, 1895
- **urania** Forel, 1902
- **vermiculosa** Mayr, 1876 stat.nov.
- **yarrabahensis** Forel, 1915 stat.nov.
- **yorkana** Forel, 1915 stat.nov.
- **zimmerae** Clark, 1941

SUBGENERIC ARRANGEMENT OF THE SPECIES

The following list, which basically follows the subgeneric arrangement of the Emery/Wheeler classification, is presented with the qualifications previously mentioned.

Polyrhachis (Campomyrma): *cedarensis, creusa, femorata, flavibasis, fuscipes, gravis, hexacantha, hirsuta, inconspicua, insularis, io, jacksoniana, leae, macropus, maculata, micans, ops, patiens, phryne, polymnia, prometheus, pseudothrinax, pyrrhus, schwiedlandi, semipolita, sidnica, tambourinensis, templi, zimmerae.*

P. (Chariomyrma): *appendiculata, arcuata, argenteosignata, aurea, bedoti, cataulacoidea, constricta, contemta, gab, heinlethii, hookeri, lata, latreillii, lownei, obscura, obtusa, pallescens, punctiventris, rowlandi, schoopae, senilis, urania, vermiculosa.*

P. (Cyrtomyrma): *australis, doddi, mackayi, pilosa, rastellata, townsvillei, yorkana.*

P. (Hagiomyrma): *ammon, ammonoeides, angusta, chalchas, crawleyi, denticulata, lachesis, lydiae, paxilla, penelope, schenkii, semiaurata, semiobscura, sokolova, thusnelda, trapezoidea, tubifera.*

P. (Hedomyrma): *argentosa, atropos, barretti, cleopatra, clio, clotho, consimilis, cupreata, daemeli, erato, euterpe, fervens, hermione, machaon, mjobergi, ornata, rufifemur, terpsichore, thais, turneri.*

P. (Myrma): *andromache, foreli, inusitata, rufofemorata.*

P. (Myrmatopa): *yarrabahensis.*

P. (Myrmhopla): *bamaga, bicolor, dives, eremita, glabrinota, loweryi, mucronata, reclinata, rustica, sexspinosa.*

P. (Myrmothrinax): *lysistrata, queenslandica.*

P. (Polyrhachis): *bellicosa.*

NOMENCLATURAL NOTES ON SOME RECENT POLYRHACHIS RECORDS

Voucher specimens supplied by Dr A.N. Andersen enable the following allocation of the names he used in his ecological papers (Andersen, 1986a, 1986b, 1988). Specimens of: (1) *P. femorata* were variously identified as '*femorata*','*femorata* sp A' or '*femorata* sp B'; (2) *P. fuscipes* as '*hexacantha*' or '*hexacantha* sp A'; (3) *P. patiens* as '*micans*', '*micans* sp B' or '*micans* sp C'; and (4) *P. (sidnica)* as '*hexacantha* sp B'.

Specimens identified by Imai, Crozier and Taylor (1977) using the voucher designation '*Polyrhachis* sp no 1 (ANIC)' represent an unnamed '*Campomyrma*' species, which will be described elsewhere.

DISCUSSION OF INDIVIDUAL SPECIES

In the following, distributions are summarised using 'short' coordinates to specify 1-degree mapping grid-cells; all latitudes are for the southern hemisphere. Unless otherwise indicated, all specimens discussed are workers and all nomenclatural changes have been based on direct comparison of relevant type specimens.

Polyrhachis atropos Fr.Smith, 1860

Polyrhachis atropos Fr.Smith, 1860:100, pl.1,fig.22. Type locality: New Guinea, Dory (= Manokwari, Irian Jaya), (holotype examined, OXUM).

Polyrhachis (Hedomyrma) eucharis Karawajew, 1927:22, fig.12. Type locality: Aru, Wammar I., Dobo (= Kepulauan Aru, Indonesia) (syntype examined, IZAS). syn.nov.

P. atropos has not previously been recorded from Australia. Specimens from Maer (= Murray) Island (09/144) in Torres Strait (29.vii.1974, H. Heatwole and E. Cameron) and Bamaga (10/142) on Cape York Peninsula (18,24.iii.1987, R.J. Kohout (RJK)) are in the ANIC and QMBA. The species is known from the Moluccas through West Irian to Papua New Guinea and northern Cape York Peninsula, Queensland (Qld). Recent New Guinean records are from Oransbari, S of Manokwari (01/134), Aitape (03/142), Lumi (03/142), Umboi I. (05/147), Wampit nr Lae (06/146), Kokoda (08/147), Rouna (09/147) and Pongani R. (09/148). This species nests in small hollow twigs on standing low trees and shrubs.

Polyrhachis argenteosignata Emery, 1900

Polyrhachis argenteosignata Emery, 1900:335. Type locality: New Guinea (syntype examined, MCSN).

This New Guinean species is recorded for the first time from Australia where it is known only from lowland rainforests on northern Cape York Peninsula, at Lockerbie Scrub (10/142), Bamaga (10/142) and Iron Range (12/143). New Guinean records are from at or near the following localities: Oransbari, S of Manokwari (01/134); Kar Kar I., Kurum (04/145); and Wampit, nr Lae (06/146). *P. argenteosignata* inhabits lowland and gallery rainforests where it mostly frequents the edges, rather than deeper in the forest or in the surrounding savannah woodland.

Polyrhachis australis Mayr, 1870

Polyrhachis australis Mayr, 1870:945. Type locality: Port Mackay, Ostaustralien (= Mackay, Qld) (type presumed lost).

Polyrhachis levior Roger, 1863; Mayr, 1876:71. (spurious synonymy of *australis* under *P. levior*).

Polyrhachis (Cyrtomyrma) nox Donisthorpe, 1938:249. Type locality: Mackay, Queensland (2 syntypes examined, BMNH). syn.nov.

The holotype of *P. australis* cannot be found in the Mayr collection and appears to have been lost. However, details given in the original description, and stated in support of the subsequent inappropriate (see below) synonymy of *australis* under *P. levior* Roger (= *laevissimus* Fr.Smith, 1859) (Mayr, 1876:71), enabled us to identify *P. australis* with reasonable confidence. In this species the pronotal humeri are angulate and the propodeum is armed with a pair of spines. The same characters were used by Donisthorpe to characterise his *P. nox*, the types of which were evidently collected at Mackay (Qld), as were those of *P. australis*. We are confident that these names apply to a single species and that *nox* is thus a junior synonym of *australis*. On the other hand, examination of the holotype of *P. levior* shows it clearly to be representative of another species. Its head is missing, but the mesosomal structure is very distinctive. The pronotal humeri are distinctly bilobed, and the propodeal spines relatively long and thick, somewhat dorsoventrally flattened and rather bluntly terminated. In contrast, the pronotal humeri of *P. australis* (as represented by the *P. nox* syntypes and other available material) are only bluntly angulate, and the propodeal spines distinctly shorter, more slender and more acute than in *levior*. We have not seen confidently identified Australian specimens of *P. levior*, and thus consider it no longer to be referable to the Australian fauna.

P. australis is known from just north of Mackay (20/148), south to Rundle Range (23/150). It is an arboreal species that builds its nests by joining the leaves of various trees and shrubs with silk.

Polyrhachis creusa Emery, 1897

Polyrhachis creusa Emery, 1897:577. Type locality: New Guinea, Ighibirei (holotype examined, MCSN).

Polyrhachis creusa var. *chlorizans* Forel, 1901:30. Type locality: Bismarck Archipelago, Ralum (04/152) (Papua New Guinea (PNG), East New Britain Prov.) (4 syntypes examined, MHNG). syn.nov.

Polyrhachis hecuba Forel, 1902:527. Type locality: Qld, Mackay (21/149) (2 syntypes examined, ANIC). syn.nov.

The *creusa* holotype has somewhat less clearly expressed gastral shagreening than the *chlorizans* syntypes. This difference is slight, however, and does not justify separate specific status.

When describing *P. creusa* Emery noted its similarity to the then unpublished *P. hecuba* Forel (of which Forel had sent him specimens). Comparison of the types shows that these names are synonyms. In fact, were it not for modern material collected in both New Guinea and Australia, we would suspect that one of the type series had been mislabelled, so closely do they match. It is historically of interest to note that Forel had evidently distributed identified specimens of *P. hecuba* by 1897, five years before he formally published the name.

Modern type-compared ANIC vouchers are from Mingende (05/144), Papua New Guinea (collected in grassland at 5000ft elevation, B.B. Lowery, 13.i.1968), and Finch Hatton Gorge, Eungella Nat. Park (21/148), Qld (7-13 April 1975, RJK). The *creusa chlorizans* types were taken 'im Graslande und am Strande' (Forel, 1901). This species is widely distributed both geographically and altitudinally and, like other species discussed here that are found both in Australia and New Guinea, it was probably vicariantly isolated when the two lands were last separated.

Polyrhachis denticulata Karawajew, 1927

Polyrhachis (Hagiomyrma) denticulata Karawajew, 1927:13. Type locality: Amboina (= Ambon), Indonesia)(syntype examined IZAS).

P. denticulata has been reported previously only from the Moluccas and New Guinea. The first Australian record is based on a single worker collected on Mabuiag Island (09/142), Torres Strait (1974, H. Heatwole and E.Cameron; ANIC).

Recent Papua New Guinea records are from at or near Lae (06/147), Buna (08/148), Oro Bay (08/148), and Milne Bay (10/150).

Polyrhachis guerini Roger, 1863

Although its holotype cannot be located in any relevant European collection and appears to have been lost, *P. guerini* may be recognised as the only *Polyrhachis* species known from New Caledonia, where it has been abundantly collected. In lieu of the type we recognise several ANIC voucher specimens from Mt Panié (20°34'S, 164°46'E) (*Melaleuca* scrub, 120m, 15 February 1977, P.S. Ward acc. 2218) as the nomenclatural paradigms of the name *guerini*. Designation of a neotype would not be appropriate here.

The Australian species *P. lata, P. pallescens* and *P. vermiculosa* were first described as subspecies of *P. guerini* (see below). We have seen no Australian specimens that are conspecific with the New Caledonian species and consider *P. guerini* to be endemic to New Caledonia. It was originally described from 'Neuholland', but this citation seems to have been an error (Emery, 1897:588-589; Emery, 1914:428).

Polyrhachis heinlethii Forel, 1895

Polyrhachis heinlethii Forel, 1895:47. Type locality: Qld, Mackay (21/149) (6 syntypes examined, MHNG, ANIC).

Polyrhachis heinlethii var. *sophiae* Forel, 1902:521. Type locality: Qld, Mackay (21/149) (5 syntypes examined, MHNG, ANIC). syn.nov.

P. heinlethii sophiae was putatively distinguished from the nominotypical subspecies by its smaller size, the shape and length of its pronotal and propodeal spines, and its more regularly striate pronotal dorsum. These characters are now known to vary infraspecifically. Examination of numerous specimens from throughout the range of *P. heinlethii* has revealed no other taxonomically significant variation. This is a ground nesting species which inhabits open forests and woodlands. It is known from Mt Ossa, NQ, south to Campbelltown, New South Wales(NSW). (Grid cells 20/148, 20/149, 25/153, 26/153, 27/152, 27/153, 28/153, 34/150).

Polyrhachis hookeri Lowne, 1865

Polyrhachis hookeri Lowne, 1865:334. Type locality: NSW, vicinity of Sydney (as Sidney) (33/151) (types presumed lost).

Polyrhachis hookeri var. *aerea* Forel, 1902:521. Type locality: Qld, Mackay (21/149) (2 syntype workers, 1 alate queen examined, MHNG). syn.nov.

Lowne's type material of *P. hookeri* cannot be found in the collections of the BMNH or OXUM and must be presumed to have been lost (Bolton, pers. comm.). The original description, however, enables reasonably confident identification of this species. In lieu of a type we recognise a topotypical worker (ANIC) from Manly Reservoir, Sydney (33/151), NSW (sandstone scrub, 250ft, 19.v.1960, B.B. Lowery) as the nomenclatural paradigm of the name *hookeri*. Designation of a neotype would not be appropriate here, because the type(s) might still be extant. Comparison of syntypes of *P. hookeri aerea* with this paradigm, and with other specimens collected near Sydney, shows them to be conspecific.

P. hookeri is a common ground-nesting ant which inhabits open forests and woodlands. It ranges from NQ to central coastal NSW (Grid cells 19/146, 20/148, 20/149, 21/148, 21/149, 22/149, 23/149, 23/150, 25/153, 27/150, 27/152, 27/153, 28/151, 28/152, 33/151). Specimens from N and CQ tend generally to be relatively large, with more acute pronotal spines than those of other series, and with the colour of the mesosomal dorsum ranging from bright metallic green to various shades of blue and purple. Southern specimens are generally somewhat smaller, with the pronotal spines less strongly projecting and the mesosomal dorsum more uniformly green. These forms, however, intergrade, and we perceive a single, somewhat variable, species.

Polyrhachis lata Emery, 1895 stat.nov.

Polyrhachis guerini ssp. *lata* Emery, 1895:357. Type locality: Qld, Somerset (10/142) (syntype examined, MHNG).

Polyrhachis (Chariomyrma) gab var. *aegra* Forel, 1915:109. Type locality: Qld, Atherton (17/145) (6 syntypes examined, MHNG) (Raised to species by Kohout, 1988:49). syn.nov.

Comparison of the *P. guerini lata* syntype with the ANIC nomenclatural paradigms of *P. guerini* (see above) and consideration of other Australian and New Caledonian material shows *P. guerini* and *P. lata* to be separate species. Comparison of the *lata* and *aegra* syntypes shows that they are conspecific. *P. lata* is known from the Torres Strait (Horn I.) and Cape York Peninsula, south to Rundle Range near Gladstone, Qld (Grid cells 10/142, 16/146, 17/145, 17/146, 19/147, 20/148, 21/148, 23/150). It is an inhabitant of open sclerophyll forests and savannah woodlands.

Polyrhachis lownei Forel, 1895 stat.nov.

Polyrhachis hookeri r. *lownei* Forel, 1895:44. Type locality: Qld, Mackay (21/149) (10 syntype workers, 1 alate queen examined, MHNG, ANIC).

The most obvious difference between syntypes of *P. hookeri lownei* and specimens considered here to be conspecific with the ANIC nomenclatural paradigm of *P. hookeri* (see above) is the colour of the mesosomal dorsum. In *hookeri* this ranges from metallic green to blue and purple, while in *lownei* it is uniformly very dark brown, at times almost black. Also, the propodeal spines in *hookeri* are relatively short (distinctly shorter than the distance between their bases), straight and divergent, while in *lownei* they are longer (with length equal to or exceeding the distance between their bases), and are gently curved, so that the extreme apices project posteriorly. We consider these types to represent separate species. *P. lownei* appears to be uncommon, and is perhaps confined to the higher altitude sclerophyll forests of NQ, from Kuranda south to Eungella, inland from the type locality (Grid cells 16/145, 18/145, 18/146, 21/148).

Polyrhachis mucronata Fr.Smith, 1859

Polyrhachis mucronatus Fr.Smith, 1859:140. Type locality: Indonesia, Aru (= Kepulauan Aru, 06/134) (holotype examined, OXUM).

P. mucronata has been reported previously only from Kepulauan Aru (Moluccas) and New Guinea. It has recently been taken at a number of localities on or adjacent to Cape York Peninsula. Examination of the holotype and of all available Australian and New Guinean specimens shows *mucronata* to be somewhat variable. However, the observed differences between specimens seem not to be taxonomically significant. They include relatively 'soft' characteristics, such as the degree of elevation of the propodeal spines and the colour of the appendages.

In Australia *mucronata* ranges from Lockerbie Scrub, south to Hinchinbrook Island, Qld (Grid cells 10/142, 12/143, 16/145, 17/145, 17/146, 18/146). Moluccan and New Guinean records are from Vogelkop, Sururai (01/133); Biak I. (01/136); Lumi, Torricelli Mts (03/142); Naru, SW of Madang (05/145); Wampit, nr Lae (06/146); and nr Sogeri (09/147). This species builds arboreal nests by joining leaves with silk, or by constructing small, pocket-like structures of silk and assorted plant fragments against the underside of living leaves on low trees and shrubs. It inhabits lowland tropical rainforest.

Polyrhachis obscura Forel, 1895 stat.nov.

Polyrhachis hookeri r. *obscura* Forel, 1895:44. Type locality: Qld, Mackay (21/149) (8 syntype workers, 2 alate queens examined, MHNG, ANIC).

Comparison of *P. hookeri obscura* syntypes with the ANIC nomenclatural paradigm of *P. hookeri* (see above), and consideration of other material, demonstrates that *obscura* almost certainly constitutes a species separate from *P. hookeri*. The most obvious differences involve the colour of the mesosomal dorsum, which in *hookeri* is mostly metallic green, blue or purple, but dark brown in *obscura*, with a faint but distinct coppery metallescence. Also, the gaster in *hookeri* is brownish-black, usually with a metallic green sheen, and has a dark brownish-maroon coloured median longitudinal dorsal patch. The gaster in *P. obscura* is reddish-brown (lighter and more reddish than the mesosoma), with an equivalent dorsal patch much less distinctly visible. The propodeal spines of *P. obscura* are relatively short, dorso-ventrally flattened and unusually wide at the base; each has a conspicuous, brightly reflective smooth dorsal patch near its base; the petiolar spines are relatively short compared to those of *hookeri*. *P. obscura* is apparently rare; the only specimens known to us are the types.

Polyrhachis obtusa Emery, 1897 stat.nov.

Polyrhachis aurea var. *obtusa* Emery, 1897: 589. Original localities: New Guinea: Haveri (09/147), Kapa Kapa (09/147), Humboldt Bay (02/140) (syntype from Haveri examined, MNHG).

The syntypes of *P. aurea* (original localities: Qld, Rockhampton (23/150) and Gayndah (25/151), workers, NHMW, MHNG) and *P. aurea obtusa* clearly represent separate species. The pronotal humeri of *aurea* are distinctly spinose, while those of *obtusa* are at most obtusely angulate or subdentate. The head in *aurea* is relatively narrow, and the Scape Index (SI = Scape Length x 100/Head Width, measured immediately in front of the eyes) relatively high (>125). SI in *P. obtusa* is <117. Available specimens of *P. obtusa* are generally smaller than those of *P. aurea*; Head Length (HL) of the *obtusa* syntype is 1.65 mm; other New Guinean worker specimens are consistently smaller; the smallest examples we have seen are from the Torres Strait Islands, where HL ranges from 1.37 to 1.53 mm. HL in available *P. aurea* specimens exceeds 1.70 mm.

The first Australian records of *P. obtusa* are from the Torres Strait Islands: Boigu (09/142), Darnley (09/143), Moa (= Banks, 10/142), and Prince of Wales (10/142)(all 1974, H. Heatwole and E. Cameron; ANIC).

Recent West Irian and Papua New Guinea records are from Nabire, S of Geelvink Bay (03/135); Lumi, Torricelli Mountains (03/142); Madang, Amele (05/145); near Lae (06/147); and Obo, Fly River (07/141) (ANIC, BPBM, QMBA).

Polyrhachis pallescens Mayr, 1876 stat.nov.

Polyrhachis guerini var. *pallescens* Mayr, 1876:74. Type locality: Qld, Rockhampton (23/150) (type presumed lost).

Polyrhachis aurea var. *pallescens* Mayr; Emery, 1897:584.

Polyrhachis aurea var. *depilis* Emery, 1897:589 (footnote). Type locality: Queensland (syntype examined, MHNG). syn.nov.

The unique holotype of *P. guerini pallescens* cannot be located in the Mayr collection (NHMW) and must be presumed to have been lost.

Syntypes of *P. aurea* (see above under *P. obtusa*) and *P. aurea depilis*, have been compared and matched against the ANIC nomenclatural paradigms of *P. guerini* (established above), and other material. We conclude that *P. aurea*, *P. guerini* and *P. depilis* are almost certainly separate species.

The mesosomal dorsum of *P. aurea* is covered with dense, golden pubescence and abundant, long, somewhat undulating hairs. The pubescence of the gaster is very dense and golden, often with a distinct reddish tint mid-dorsally. The mesosomal dorsum of *P. depilis* has relatively sparse, whitish appressed pubescence, with fewer scattered hairs than in *aurea* (these are lacking in some of the specimens examined, apparently due to wear in life). The relatively long, appressed pubescence on the gaster is silvery-white, with at most only a very slight yellowish tint.

The original descriptions of *depilis* and *pallescens* show these taxa to be closely similar, and we conclude with reasonable confidence that they are conspecific. *P. pallescens* is evidently not common. It is known from the types, collected in central coastal Qld, and from a single additional series taken further south, from wallum community (a coastal heathland formation with dominant *Banksia aemula*, which extends from the Tropic of Capricorn south to northern NSW) at Lake Cootharaba (26/153) (near Boreen Point, SEQ, 13.xi.1976, RJK acc. 76.86).

Polyrhachis phryne Forel, 1907

Polyrhachis phryne Forel, 1907:41. Type locality: NSW, Mt Victoria (33/150).

Polyrhachis sidnica var. *perthensis* Crawley, 1922:36. Type locality: WA, Perth (31/115). syn.nov

Taylor (1989) discussed affinities between the eastern Australian *P. phryne* (= *P. sempronia* Forel) and the southwestern *P. sidnica perthensis*, and raised *perthensis* to species rank. Subsequent examination of ANIC material from bulk spirit storage, and consideration of previously unstudied QMBA, Western Australian Museum and South Australian Museum specimens, along with the ecological voucher material of Dr P.J.M. Greenslade (CSIRO Division of Soils and ANIC), shows that these taxa should now be considered conspecific.

P. phryne is one of the most widespread of all southern Australian ants. It is known from *c.* 100 km N of Geraldton (28/114), Western Australia, southeastwards to the Great Australian Bight, across the southern part of the continent to southeastern South Australia and Victoria, thence northwards along the Great Dividing range and its eastern flanks to the Mackay district (21/148,149), NQ. An apparently outlying population is present further north at Forty Mile Scrub (18/144), where the species has been taken in deciduous monsoon rainforest. *P. phryne* is unrepresented in available collections from Tasmania, though its presence there seems likely.

P. phryne is generally collected from nests in the soil under stones, or taken abroad at night, usually in dry sclerophyll forests or woodlands, including mallee and subalpine woodland. It is commonly encountered foraging nocturnally on tree trunks in tall mallee near Poochera (32/134), SA, at well studied sites where *Nothomyrmecia macrops* Clark is present; it has only rarely been seen abroad there during daytime; nests are excavated in very fine calcareous soil, often without covering stones.

P. phryne is not a particularly variable species when compared to some others in '*Campomyrma*'. Detailed examination of scores of mounted specimens from all parts of the known range has not revealed characters implying the presence of more than a single species, and there is no clear evidence of consistent geographical variation.

Relevant specimens have been examined from at or near the following localities:

QUEENSLAND: Forty Mile Scrub (18/144); Britton Range, Eungella Nat Pk, Finch Hatton Gorge (21/148); Blackdown Tableland (23/149); Cammoo Caves (23/150); Rundle Range (23/151); Biloela (24/150); Kroombit Tops (24/151); Bunya Mountains (26/151); D'Aguilar Range, Mt Coot-tha (27/152); Cedar Creek Nat Pk, North Tamborine, Tamborine Mountain, Thunderbird Park (27/153); Goondiwindi (28/150); Fletcher (28/151); Mt Devlin (28/152); Binna Burra Lodge, Lamington Nat Pk (28/153). NEW SOUTH WALES: Lismore, Mt Nullum (28/153); Armidale, Ben Lomond Hill, Moonbi Range (30/151); Wauchope (31/152); Bulga, Fassifern, Heaton State Forest (32/151); Bulahdelah (32/152); Hillston (33/145); Grenfell (33/148); Blaxland, Kanangra Creek, Mount Victoria (33/150); Bucketty, Lane Cove, Swansea (33/151); Griffith (34/142); Euston (34/143); Tabbita (34/145); Boorowa, Cootamundra, Yass (34/148); Gunning, Wombeyan Caves (34/149); Mt Flora (34/150); Como (34/151); Finley (35/145); Tumut (35/148); Bungendore, Jerrabomberra Hill, Queanbeyan (35/149); Rosedale Beach (35/150); Khancoban (36/148); Tathra (36/149). AUSTRALIAN CAPITAL TERRITORY: Cotter Dam, Gibraltar Falls, Orroral Crossing, Uriarra Forest (35/148); Black Mountain, Mt Ainslie, Mt Majura, Mt Pleasant, Stirling Park, Tharwa, Yarralumla (35/149). VICTORIA: Linga (35/141); Nyah (35/143); Kiata (36/141); Heathcote (36/144); Ovens Valley (36/146); Chewton, Elphinstone (37/144). SOUTH AUSTRALIA: Nullarbor (31/130), 100 mi W of Penong (31/132); Wilpena Pound (31/138); Candada, Poochera, Streaky Bay

(32/134); Alligator Creek (32/138); Koonamore (32/139); Flinders Island (33/134); Arno Bay, Curtinye Hill, Kimba (33/136); Blyth, Jamestown, Leighton, Sevenhill (33/138); Worlds End (33/139), Boston Bay, Port Lincoln (34/135); Warooka (34/137); Port Parham (34/138); Cambrai, Morgan (34/139); Cape Borda, Sandy Creek Bay, West Bay (35/136); D'Estrees Bay, Marion Bay (35/137); Belair (35/138); Murray Bridge (35/139). WESTERN AUSTRALIA: Billabong Roadhouse (26/114); Mullewa (28/115); Dongara (29/114); 160km S of Eneabba (30/115); Bungalbin Hill (30/119); Karonie (30/122); Perth (31/115); Coomalling (31/116); Merredin (31/118); Madura (31/127); Eucla (31/128); Armadale (32/116); Narrogin (32/117); 120km W of Balladonia (32/122); Booyana Rock (32/123); Cocklebiddy (32/126); Ongerup, Pingrup (33/118); Newdegate (33/119); Esperance; Telegraph Hill (33/121); Goora Rock, Junana Rock, Mt Ragged, Thomas River (33/123); Mt Barker (34/117); Mt Trio (34/118); Salisbury Island (34/123).

Polyrhachis pilosa Donisthorpe, 1938 stat.nov.

Polyrhachis rastellata r. levior var. *pilosa* Forel, 1902:527, workers from author's study series examined, MHNG, NHRS, ANIC (an inadmissible infrasubspecific name).

Polyrhachis rastellata var. *pilosa* Donisthorpe, 1938:256.

The epithet *pilosa* was introduced by Forel (1902) as the fourth name in a quadrinomen. It was later excluded, as an infrasubspecific name (Taylor, 1986), from the catalogues of Taylor and Brown (1985) and Taylor (1987). These actions overlooked Donisthorpe's 1938 nomenclatural act, in which '*pilosa*' was used in a trinominal context for a subspecies, with clear reference to the earlier Forel name. As a result, authorship of the available species-group name *pilosa* in *Polyrhachis* must be formally attributed to Donisthorpe, under the *International Code of Zoological Nomenclature*, and the year of publication for purposes of priority is 1938. We take existing specimens from Forel's 1902 series to be the types of *P. rastellata pilosa* Donisthorpe, 1938.

The subgenus *Cyrtomyrma*, to which this taxon is assigned, has a number of Australian and New Guinean species, and the differences separating them can be subtle. Nonetheless, we recognise *P. pilosa* as a good species, in consideration of its very distinctive habitus. It uniquely possesses the following combination of characters: pronotal humeri evenly rounded in dorsal view, lacking projections; propodeum without spines or other armament; and (most distinctively) entire dorsal surfaces of mesosoma and gaster with numerous long, erect hairs. The only other known (apparently undescribed) Australian species with long gastral hairs occurs in coastal areas centred on Cairns (16/145), NQ, but it has distinct, relatively long propodeal spines.

We have seen *P. pilosa* in Qld from Mt Ossa, NW of Mackay (20/148); Rundle Range, nr Gladstone (23/150); several sites near Bundaberg (24/152); Scary Scrub, Cooloola (25/153); Blackall Range (26/152); Peregian Beach (26/153); and in NSW from near Lismore (28/153) and Taree (31/152). It has been collected most frequently towards the southern limits of this range. It is a relatively common ant in parks and suburban gardens in Brisbane (27/153). The types are putatively from Wollongbar (28/153) and Richmond River (29/153), NSW (Forel, 1902), and this accords with the known distribution. However, two syntypes (ANIC, donated by MHNG) on a single pin labelled 'COTYPUS' carry a Forel autograph label reading '*levior* var *pilosa*, Mackay, Turner, no 7'.

Polyrhachis reclinata Emery, 1887 stat.nov.

Polyrhachis sexspinosa var. *reclinata* Emery, 1887:236. Type locality: New Guinea, Fly River (07/141) (3 syntypes examined, MCSN).

Polyrhachis sexspinosa (Latreille, 1802); Bolton, 1975:12 (in part).

P. sexspinosa reclinata syntypes have been compared with specimens identified by Bolton (1975) as *P. sexspinosa*, and with the ANIC nomenclatural paradigm of *sexspinosa* (see below). We consider *reclinata* to represent a species separate from *sexspinosa*. The head in *sexspinosa* is strongly tapered immediately behind the eyes, and the somewhat flange-like occipital margin forms prominent, well developed lateral lobes, which are usually clearly visible in full face view. In addition, the front of the head behind the eyes is coarsely rugose, with rather dilute, mostly white or silvery pubescence. In the *P. reclinata* types the head is generally shorter behind the eyes and less strongly tapered, and the lateral occipital lobes are relatively weakly developed and barely visible in full face view; the sculpturing on the back of the frons is a very faint, somewhat polished, fine puncturation, which is usually largely masked by rich, brassy, appressed pubescence. The propodeal spines in *sexspinosa* are generally vertical relative to the main axis of the body, or even inclined forwards when viewed from the side. In *reclinata* they are posteriorly inclined, more curved in side view, and somewhat more divergent in dorsal view.

P. sexspinosa is relatively common and widespread on the mainland of New Guinea (Grid cells 03/135, 03/142, 05/145, 07/146, 08/147), but *P. reclinata* is known only from the savannas of the Port Moresby area, and from the Fly River delta in the south of the island, in areas generally opposite the tip of Cape York Peninsula (Grid cells 08/143, 09/143, 09/147). In Australia both species are known only from northern Cape York Peninsula, where *sexspinosa* ranges from Lockerbie Scrub south to Rocky River, ENE of Coen (Grid cells 10/142, 12/143, 13/143), and *reclinata* has been taken only at Iron Range (12/143) (RJK accs 81.185, 209, 210), where it nests in the hollow internodes of the bamboo *Bambusa forbesii*. Bamboo-internode nesting is common to most Australian species of the *sexspinosa*-group. The exceptions are *P. sexspinosa* itself, which builds camouflaged pocket nests of silk and bark fragments attached to the trunks of rainforest trees, and *P. glabrinota*, which uses silk to build nests by joining the leaves of various rainforest trees and shrubs. There are, incidentally, 5 species of the *sexspinosa*-group present on N Cape York Peninsula (*P. reclinata, P. sexspinosa, P. glabrinota* and 2 species yet to be described).

Polyrhachis schoopae Forel, 1902 stat.nov.

Polyrhachis appendiculata r. *schoopae* Forel, 1902:520. Type locality: Qld, Mackay (21/149) (8 syntypes examined, MHNG, ANIC).

The *P. appendiculata* and *P. appendiculata schoopae* syntypes, and specimens considered conspecific with each, are consistently separable. We consider them to represent separate species. *P. appendiculata* is generally smaller than *P. schoopae*, with the relatively fine sculpturing of the promesonotal dorsum partly to largely obscured by silvery pubescence. The pronotal dorsum in profile is more strongly convex than in *schoopae*, and the mesonotal and propodeal dorsa almost straight. *P. schoopae* is relatively large, with the promesonotal dorsum mostly longitudinally striate and shining, with appressed pubescence virtually lacking. The entire mesosomal dorsum in profile forms a single, strongly convex, almost semicircular arc.

The known range of *P. schoopae* is from Cape Tribulation, Qld, south to Mackay (Grid cells 16/145, 20/148, 20/149, 21/148, 21/149). *P. appendiculata* is known only from the Torres Strait islands (Yam I., Stephens I., Murray I.) (Grid cells 09/142, 09/143, 09/144), except for a single record from mid Cape York Peninsula (Jane Table Hill, Princess Charlotte Bay, 28 June 1980, RJK acc. 80.47) (Grid cell 14/144).

Polyrhachis semiobscura Donisthorpe, 1944

Polyrhachis (Hagiomyrma) semiobscura Donisthorpe, 1944:65. Type locality: New Ireland, Kavieng (02/150) (holotype examined, BMNH).

P. semiobscura has been previously reported only from mainland PNG, and adjacent islands. It was recently collected for the first time in Australia, on Cape York Peninsula, Qld, at Bamaga (10/142) (RJK acc. 87.76) and Iron Range (12/143) (RJK accs 81.176, 179, 203). A colony at Iron Range occupied two adjacent woody galls attached to the thin branch of a low shrub in open forest. Melanesian records are from at or near the following localities: Bubia, nr Lae (06/146); Bulolo (07/146); and nr Sogeri (09/147). This is an open forest and savannah-inhabiting species.

Polyrhachis sexspinosa (Latreille, 1802)

Formica sexspinosa Latreille, 1802:126, pl.4,fig.21. Type locality: East Indies (type presumed lost).

Polyrhachis (Myrmhopla) barnardi Clark, 1928:39, pl.1,figs 37,38. Type locality: Qld, Cape York (10/142) (syntypes examined, MVMA, ANIC, MCZC). syn.nov.

Five nominal specimens (all labelled 'Type', one on a red tag, the others on blue tags) of *P. barnardi* have been examined, and the series is considered to include 2 distinct species. Three specimens match Clark's original description and illustrations, and these we take authentically to represent *P. barnardi*. A lectotype (the specimen bearing a red tag, MVMA) has been selected, and the other 2 specimens (MVMA) are designated paralectotypes. Further comparison of these specimens with others identified as *P. sexspinosa* by Bolton (1975), shows *sexspinosa* and *barnardi* (as restricted here) to be conspecific. The 2 remaining original *barnardi* syntypes (ANIC, MCZC, the last examined by Bolton, 1975) are to be included in the type series of a new species for description by RJK. *P. sexspinosa* was originally described from a queen collected in the 'East Indies'. Like Bolton (1975) we have been unable to locate the type. In lieu we recognise a specimen in the ANIC from a long series collected at Pes Mission nr Aitape (03/142), West Sepik Province, PNG (RJK acc. 84.207) as the nomenclatural paradigm of *P. sexspinosa*. Designation of a neotype would not be appropriate here. Other details are given above under *P. reclinata*.

Polyrhachis vermiculosa Mayr, 1876 stat.nov.

Polyrhachis guerini var. *vermiculosa* Mayr, 1876:74. Original localities: Qld, Rockhampton (23/150) and Peak Downs (22/148); NSW, Sydney (as Sidney) (33/151), (3 syntype workers, 1 alate queen examined, NHMW, MHNG).

Polyrhachis aurea var. *vermiculosa* Mayr; Emery, 1897:584.

The compared syntypes of *P. guerini vermiculosa* and *P. aurea* (specimen details given under *P. pallescens*) are similar but, following examination of other relevant specimens, we consider them to represent separate species. *P. aurea* has the mesosoma strongly narrowed posteriorly, with the dorsum of the propodeum distinctly indented across the bases of the propodeal spines; the sculpturing of its pronotal dorsum consists of fine, more or less generally longitudinal, fragmented rugulation. *P. vermiculosa* is more stoutly built, with the propodeal dorsum at the base of the spines relatively wide, and the pronotal dorsum irregularly and rather vermiculosely rugose. The antennal scapes are relatively long in *aurea*, with Scape Index (see above under *P. obtusa*) >125, versus <115 in *vermiculosa*.

We have seen P. vermiculosa specimens from many localities, ranging from Lakefield on Cape York Peninsula, Qld, to just south of Brisbane (Grid cells 14/144, 20/148, 21/148, 22/149, 23/150, 26/153, 27/152, 27/153, 28/152). This species inhabits open forest and woodland, and nests mostly in the soil between grass roots, or under suitable covering objects, such as stones or logs.

Polyrhachis yarrabahensis Forel, 1915
stat.nov.

Polyrhachis (Myrmatopa) lombokensis var. *yarrabahensis* Forel, 1915:115. Type locality: Qld, Malanda (17/145) (for the queen), Yarrabah (16/145) (for the worker) (syntype workers examined, ANIC).

Worker syntypes of *P. lombokensis yarrabahensis* have been compared to a syntype of *P. lombokensis* (Emery, 1898: 239; worker (MCSN); Indonesia, Lombok). With some hesitation we consider them to represent separate species. We are hesitant to synonymize the names because of the great distance separating the known ranges of these taxa and because no material is known from areas in between. One syntype was unfortunately the only specimen of *P. lombokensis* available to us, and we have been unable to match it with any of the numerous Indonesian and Melanesian '*Myrmatopa*' specimens we have seen. The characters differentiating these taxa are relatively slight, but consistent in the material available.

The eyes of *P. yarrabahensis* are rather strongly convex, extending prominently beyond the outline of the head in frontal view. In *P. lombokensis* the eyes are less strongly convex, and exceed the outline of the head less strongly. The humeral margins of the pronotal dorsum in *yarrabahensis* are slightly angled in dorsal view, and the propodeal declivity descends from the dorsum as a relatively gentle slope (the accurately goniometer-measured angle between the basal and declivitous propodeal faces in side view ranges from 37 to 45° in 10 *yarrabahensis* specimens examined). The humeri in *lombokensis* are broadly and smoothly rounded in dorsal view, and the propodeal declivity descends more abruptly in the available syntype, at an angle of 50°.

P. yarrabahensis is an arboreal species which uses silk to build complex, often polydomous nests by joining together the leaves of various lowland rainforest trees, shrubs and vines. Known records (NQ) are from Massy Spur Creek, near Silver Plains (13/143) and from Kamerunga and Yarrabah, in the Cairns area (16/145). We would expect that this species is limited to altitudes below about 350 m in the coastal strip of the Base-of-Peninsula area (as are many ant species of Papuasian affinity, including the prominent green weaver ant *Oecophylla* *smaragdina* (Fabricius)), and that the alate type-queen from Malanda had probably flown to elevations beyond the usual nesting range.

Polyrhachis yorkana Forel, 1915 stat.nov.

Polyrhachis (Cyrtomyrma) rastellata var. *yorkana* Forel, 1915:110. Type locality: Qld, Cape York Peninsula (syntypes examined, ANIC).

P. yorkana is the oldest available name based on Australian type-material that is applicable to a widespread species (or complex of species) represented throughout the range of the subgenus '*Cyrtomyrma*' in eastern Australia (i.e. from Cape York south to near 30°S in coastal eastern NSW). These ants are relatively nondescript, lacking any of the features discriminating more easily characterised *Cyrtomyrma* species (such as propodeal spines, abundant gastral or mesosomal/gastral pilosity, dense body pubescence), except for a tuft of fewer than 10 long hairs on the summit of the strongly arched mesosoma. Similar ants are present in SE Asia and New Guinea, so that senior names based on foreign specimens could be applicable to the Australian species.

All available names of the species-group have identical status in nomenclature regardless of their rank, and the assigning of species rank to the names of unresolved taxa of the species-group seems the best course to follow. For these reasons we here attribute full specific rank to *P. yorkana*. We suspect that it will survive as a good species following revision of *Polyrhachis*.

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We thank Philip S. Ward and Kazuo Ogata for useful comments, and the institutions and curators listed in the introduction for the loan of types and other material in their care. Sound taxonomic work would not be possible in Australia without such collaboration, and we are deeply appreciative of their help. Much of the material pertinent to the project of which this paper is a part was collected by Rev. B.B. Lowery SJ, or Geoff B. Monteith. We take this opportunity especially to acknowledge their merits as ant collectors.

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A NEW *CYRTOMAIA*, *C. GRIFFINI*, FROM AUSTRALIA (CRUSTACEA: DECAPODA: BRACHYURA)

BERTRAND RICHER DE FORGES AND DANIÈLE GUINOT

Richer de Forges, B. and Guinot, D. 1990 08 31: A new *Cyrtomaia, C. griffini*, from Australia (Crustacea: Decapoda: Brachyura). *Memoirs of the Queensland Museum* **28**(2): 523-530. Brisbane. ISSN 0079-8835.

A new species of crab of the genus *Cyrtomaia* is described from deepwater off the eastern coast of Australia: *C. griffini* sp. nov. This species is compared with its closest relatives, *C. suhmii* and *C. curviceros*, and remarks on the geographic distribution of the six species in this genus with large protogastric spines are given.

Une nouvelle espèce de crabe de profondeur du genre *Cyrtomaia* est décrite de la côte est de l'Australie: *C. griffini* sp. nov. Après la description de l'espèce et une comparaison avec les espèce proches, *C. suhmii* et *C. curviceros*, des remarques sur la distribution géographique des six espèces de ce genre à grandes épines protogastriques sont faites.

☐*Crustacea, Decapoda, Brachyura, Cyrtomaia, new species.*

Bertrand Richer de Forges, Australian Institute of Marine Science, PMB No.3, Townsville M.C., Queensland 4810, Australia; Danièle Guinot, Muséum National d'Histoire Naturelle, 61 rue de Buffon, Paris cedex 05, France; 14 August,1989.

In earlier works (Guinot and Richer de Forges, 1982a: 1097, under *Cyrtomaia gaillardi*; 1982b: 24, under *C. suhmi*; 1986: 119, under *C. suhmi*), we raised the question of the identity of some Australian material that was attributed to *Cyrtomaia suhmii*[1] Miers, 1886 (p. 18, pl. 3, fig. 2, 2a-2c) by Griffin and Brown (1976: 252, fig. 6). All the specimens from the East Australian coast have a strong intercalated orbital spine but on the holotype of *C. suhmii* Miers (from the Tulur islands to the north of the Molucca Sea) the supra-orbital edge bears only a small granule. The holotype was examined and this feature figured by Guinot and Richer de Forges (1982b, fig. 10, 11a-b). Another species, *Cyrtomaia curviceros* Bouvier, 1915 (pp. 9-15, pl. 1), originally described from Japan and similar to *C. suhmii* (cf. Guinot and Richer de Forges, 1986: 118, fig. 11a, under *C. suhmi*) is typified by a completely smooth, inermous supra-orbital edge. In their important work on the Majidae gathered by the *Siboga*, Griffin and Tranter (1986a: 30, 31) put *C. curviceros* Bouvier in synonymy with *C. suhmii* and questioned the taxonomic value of the intercalated orbital spine: 'The spine in the orbit of *Cyrtomaia* and similarly *Platymaia* doesn't constitute a more useful distinguishing feature than the other small carapace spines'. When they wrote this, the two Australians were not aware of our work, published the same year (Guinot and Richer de Forges, 1986), in which we reported the discovery of the Philippines topotypical *Cyrtomaia suhmii*. In all our material, juvenile and adult at various stages, from the Philippines, the supra-orbital edge uniformly bears a small, but distinct, intercalated granule.

The fine fresh material collected during the Cidaris I cruise and also found by the vessels *Soela*, *Southern Intruder* and *Iron Summer* on the east Australian coasts, does not belong either to *C. suhmii* or to *C. curviceros*, and the description of a new species, *C. griffini* sp. nov., is therefore required.

List of abreviations: MP, Museum national d'Histoire naturelle, Paris (B - Brachyoures); QM, Queensland Museum. Length measurements exclude pseudorostral spines.

Cyrtomaia griffini sp. nov.
(Figs 1, 2, 3,4)

Cyrtomaia suhmi: Griffin and Brown (not Miers, 1886), 1976: 252, fig. 6. Griffin and Tranter, 1986a: 30, fig. 91g.

not *Cyrtomaia suhmi*: Griffin and Tranter, 1986b: 351, fig. 1.

Cyrtomaia suhmii: Davie and Short, 1989: 27.

MATERIAL EXAMINED

HOLOTYPE: QM W15362, ♂ (78.8 x 83.3mm), *Soela*

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[1] The specific spelling of Miers' species should in fact be *C. suhmii* to respect the original formulation, as Davie and Short (1989) have pointed out.

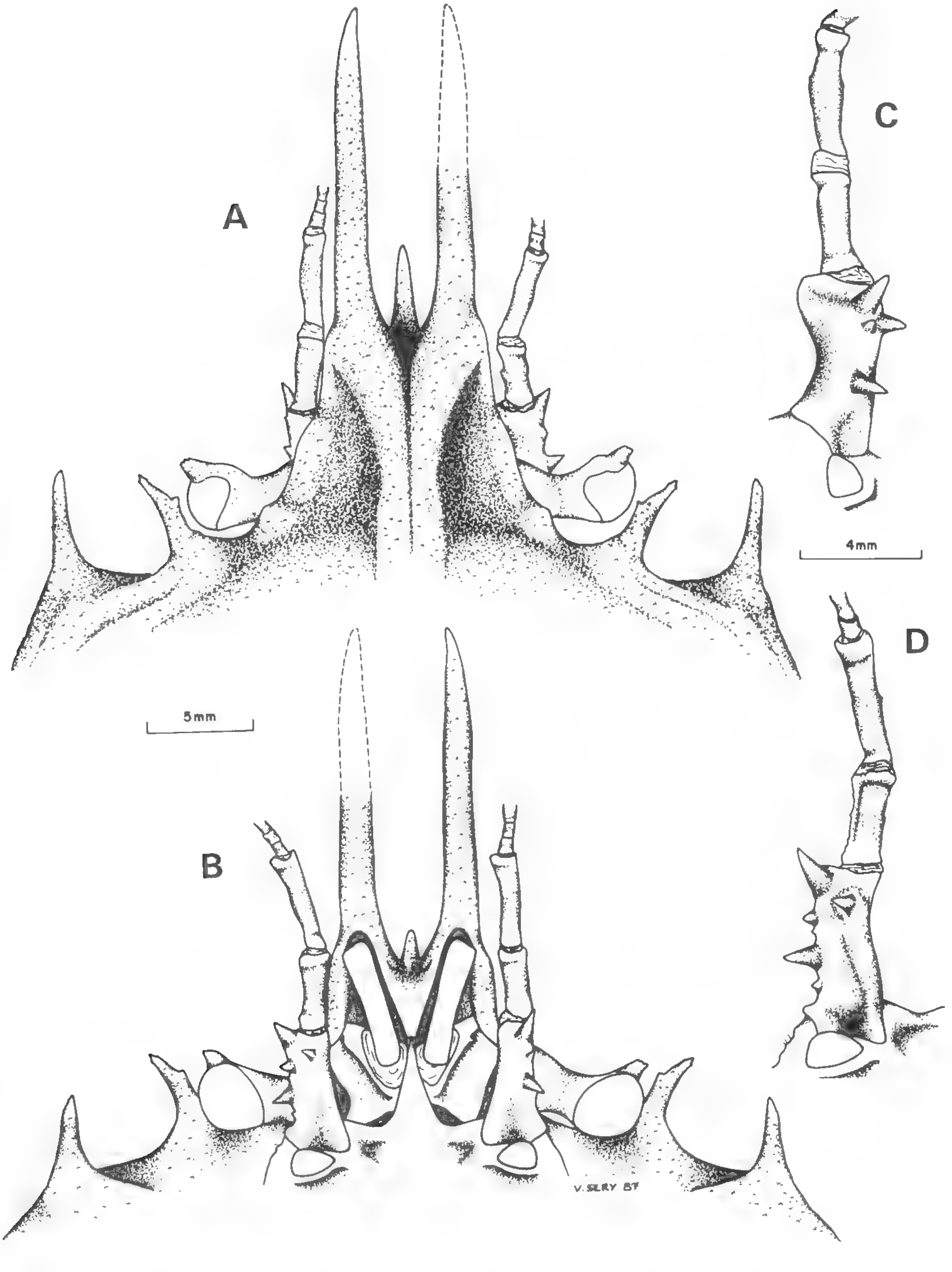

FIG. 1. *Cyrtomaia griffini* sp. nov., paratype ♀ (55 x 60.6mm), R.V. *Franklin*, Cidaris I, Stn 47-3, 505m, 17°51.35′S–143°07.83′E, 17.v.1986, beam trawl (QM W16067). A, dorsal view of fronto-orbital region. B, ventral view. C, D, detail of the antenna from two different angles.

Cr6, stn. 79, 6.xii 1985, 800m, 17°01'S, 151°20'E, P. Davie.

PARATYPES: MP-B 20555, ♀ (58 x 65mm), *Soela* Cr6, stn. 78, 6.xii.1985, 880m, 16°55'S- 151°34'E, P. Davie. QM W15360, 6♀ (57.4 x 62, 58.8 x 65.6, 61.9 x 65.7, 55.5 x 58.6, 60.5 x 65.7, 56.1 x 60.6), 5♂ (75.9 x 81.8, 46.1 x 50.1, 47.8 x 52.6, 47.9 x 52.2, 48.5 x 50.7mm), Cr6, Stn 78, 6.xii.1985, 880m, 16°55'S, 151°34'E, P. Davie. QM W16067, ♀ (55 x 60.6mm), *Cidaris I*, Stn 47-3, 15.v.1986, 17°51.35'S, 143°07.83'E, 505m. QM W16068, ovig. ♀ (50.5 x 63mm), *Cidaris I*, Stn 48-3, 17.v.1986, 17°52.00'S, 147°08.00'E, 740-680m. QM W16069, ♀ (43.8 x 49.5mm), *Cidaris I*, Stn 1-4, 6.v.1986, 18°08.69'S, 147°33.97'E, 966m.

OTHER MATERIAL: R.V. *Soela*: QM W15373, 6 ♀ (40.2 x 42.2, 40.6 x 43, 25.5 x 27.4, 24.4 x 25.7, 26.8 x 28.2, 24.4 x 24.6mm), 1 juv. ♂ (20 x 20.8mm), Cr6, Stn 78, 6.v.1985, 880m, 16°55'S, 151°14'E, P. Davie. QM W15375, 3♂ (27.2 x 27, 20.3 x 20.9, 17.3 x 17.9mm), Cr6, Stn 79, 6.xii.1985, 800m, 17°01'S, 151°20'E. QM W15361, 1♂ (74.2 x 78.9mm), 1 crushed specimen (74mm width), Cr6, Stn 80, 6.xii.1985, 700m, 17°02'S, 151°03'E, P. Davie. QM W15932, crushed juv. ♂ (20.8 x 21.5mm), Cr6, Stn 59, 2.xii.1985, 900-908m, 17°30'S, 149°00'E, P. Davie.

M.V. *Iron Summer*: QM W14908, 2♂ (60.2 x 62.7, 58.1 x 62.1mm), Shot 2, 10.v.1983, 600m, 28°19.91'S, 153°53.47'E. QM W10611, 1♀ (64.9 x 72.5mm), Shot 1, 3.x.1982, 500-540m, 27°22'S, 153°E, M. Holmes. QM W10612, 1♂ (61.3 x 66.3mm), Shot 6, 25.iii.1983, 520m, 27°13'S, 153°22'E, R. Morton. QM W10609, 1♂ (68.4 x 73.2mm), Shot 5, 13.viii.1982, 540m, 27°18'S, 153°54'E, G. Smith and J. Burke. QM W14909, 1♂ (63.2 x 61.9mm), Shot 1, 10.v.1983, 590m, 27°13.00'S, 153°52.53'E, R. Morton. QM W14916, 1♀ (63.5 x 72.7mm), Shot 3, 10.v.1983, 555m, 27°12.83'S, 153°52.87'E, R. Morton. QM W10610, 1♀ (67 x 75mm), 1♂ (62.3 x 66.9mm), Shot 4, 10.v.1983, 540m, 27°34'S, 153°56'E, R. Morton.

M.V. *Southern Intruder*: QM W11233, 1♀ (64.4 x 53.8mm), Shot 40, 30.xii.1983, 460m, 23°17'S, 153°56'E, P. Davie. QM W11232, 1♀ (60.6 x 66.2mm), Shot 37, 29.xii.1983, 550m, 23°45'S, 153°07'E, P. Davie.

DESCRIPTION

A large species, that may measure as much as 80mm across the cephalothorax. Carapace is smooth and shiny, with a few bristles in front of the protogastric spines. Protogastric spines distinctly longer than the others, in the form of parallel horns, pointing forward and very slightly incurved; the spines appear smooth to the naked eye and to the touch, but in fact are very finely granular. A single, pointed gastric spine with a very slight granule in front. Two pointed and raised cardiac spines.

Very sharp, slanting anterior branchial spine, similar in size to the single gastric spine. A very short, but also sharp, posterior branchial spine, with a tubercle behind it. A branchial spine, pointed, but shorter than the abovementioned. On the latero-posterior edge of the branchial area is a line of five spinules. The intestinal area is almost imperceptible. Long pointed pseudorostral spines, subparallel on the paratype (Fig. 1A) but diverging on other specimens (Fig. 4A); the pointed rostral spine extends from the front; there is a broad supraocular hood with smooth edges. A very distinct intercalated orbital spine, fine and sharp, pointing obliquely towards the postocular spine. Strong postocular spine, pointing forwards (Fig. 4B).

Dorsal facet with marked relief; clear branchio-cardiac grooves (Fig. 4A), very fine and diffuse granulation, visible only under a binocular microscope.

Short ocular peduncle with a single horn, (Fig. 1A). Antennal basal article with three large spines, plus a small one on the lower facet (Fig. 1C).

The meri of P4 and P5 are smooth, as are the carpi and propodi; in the female, the P2 merus is distinctly longer than that on P1; in the male, on the other hand, the P2 merus is much shorter than that of P1, and the P1 propodus is broader.

The live animal is orange-pink all over; the eggs of the ovigerous female are navy blue.

DISCUSSION

The differences between *Cyrtomaia griffini* sp. nov. and *C. suhmii* Miers, 1886 are as follows: an intercalated orbital spine is not found in *C. suhmii* but is found in *C. griffini*, both in males and in females, whatever their size; the number of spines on the antennal basal article is 3 in *C. griffini* and 4 or 5 in *C. suhmii*.

The study of numerous species of the genus *Cyrtomaia* shows a stability in the shape and spinulation of the supra-orbital edge. The presence of an intercalated orbital spine constitutes a constant character whatever the size or sex. Guinot and Richer de Forges (1986: 117-19, fig. 11a) reported on many specimens of *C. suhmii* from the Philippines Islands and confirmed that, as on the holotype, the supra-orbital edge was always smooth. *Cyrtomaia curviceros* Bouvier, 1915, is another large species with very

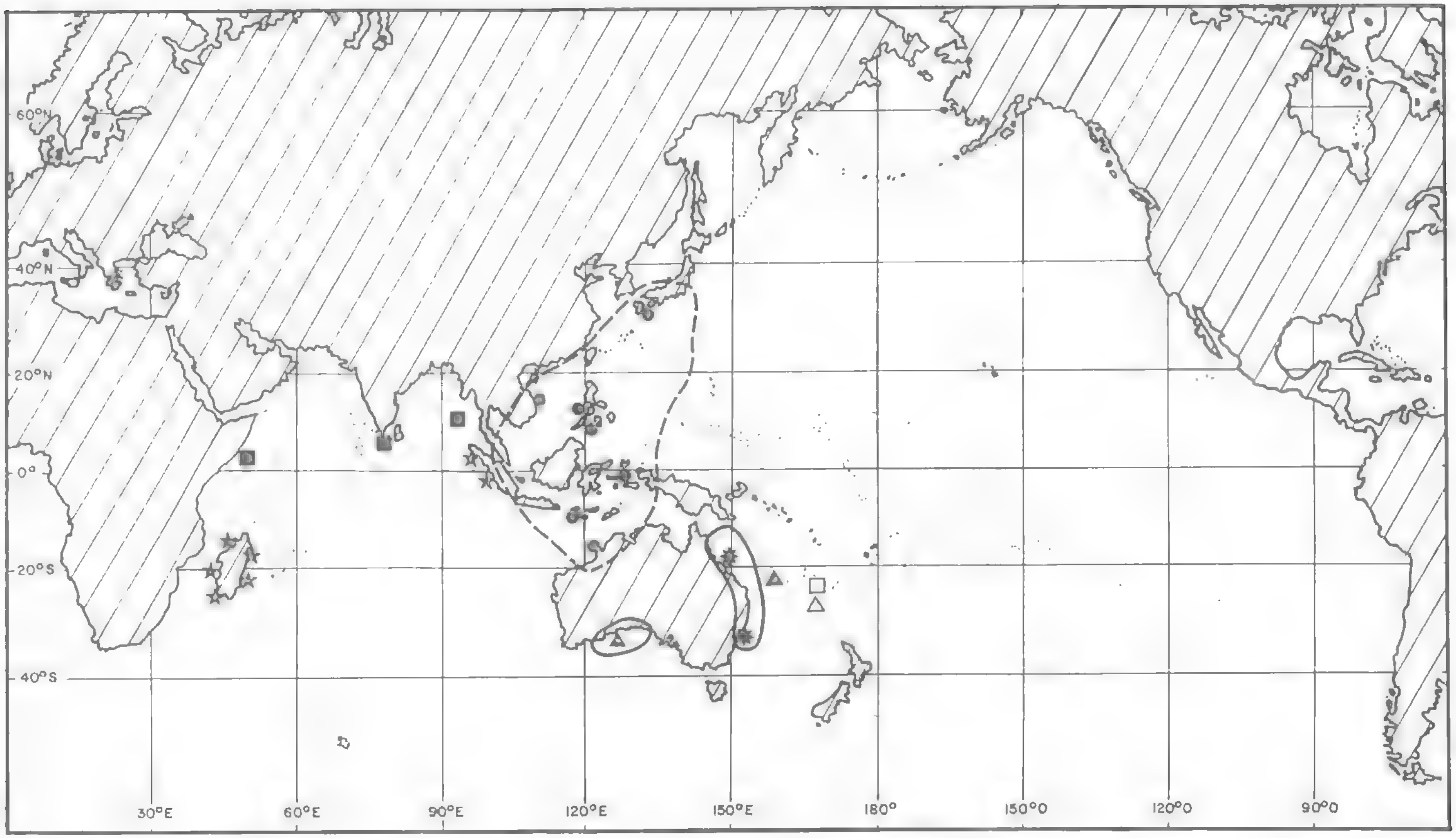

FIG. 2. Distribution of the group of species of *Cyrtomaia* related to *C. suhmii* Miers, 1886. ● *C. suhmii* and *C. curviceros*; ▲ *C. maccullochi*; ✱ *C. griffini*; ★ *C. gaillardi*; ■ *C. goodridgei*; △ *C. coriolisi*; □ *C. cornuta*.

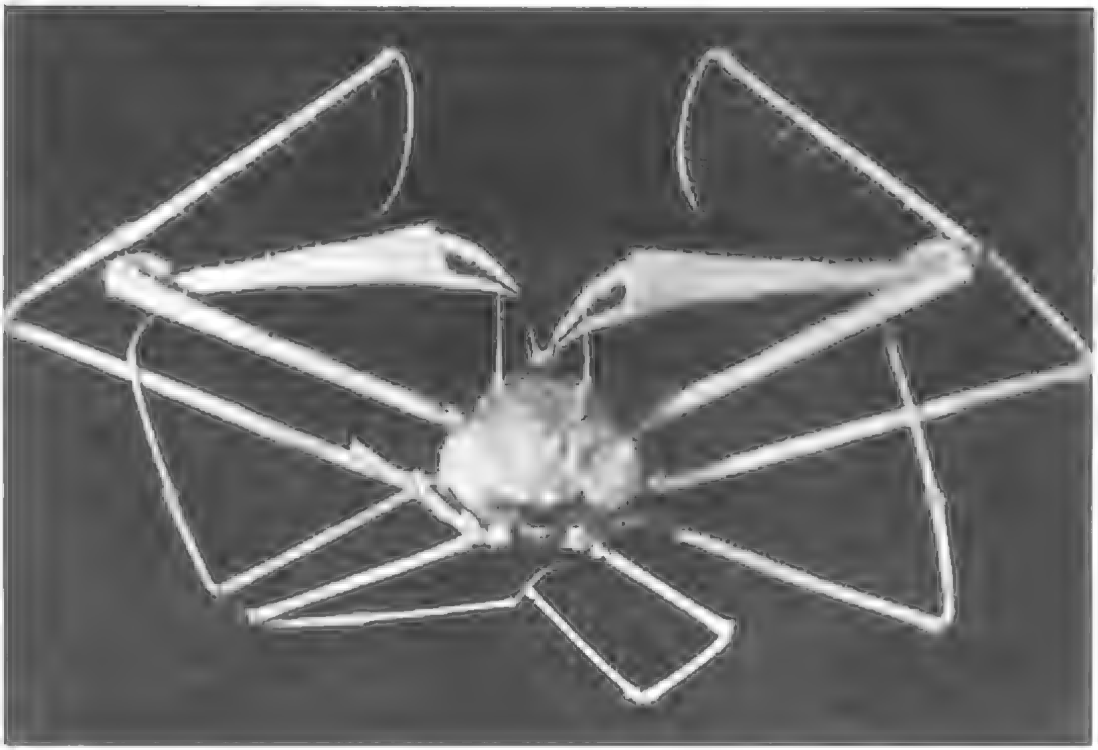

FIG. 3. *Cyrtomaia griffini* sp. nov., holotype ♂ (78.8 x 83.3mm), Queensland, *Soela*, Cr.6, Stn 79, 800m, 6.xii.1985, P. Davie (QM W15362), dorsal view.

well-developed protogastric spines but is known only from the holotype, a very large specimen from Japan. It also has a smooth supra-orbital edge and this is the reason why some authors think it is a synonym of *C. suhmii*. It will be necessary to examine topotypical material of *C. curviceros* before this problem can be finally resolved. *C. curviceros* (see Guinot and Richer de Forges, 1982b: 24, fig. 12) like *C. suhmii* is different from *C. griffini* by having the supra-orbital edge smooth and the basal antennular article with five spines.

C. gaillardi Guinot and Richer de Forges, 1982, found in the waters of Madagascar can easily be distinguished from *C. griffini* by its divergent pseudorostral spines, the granular carapace (in *C. griffini* it is smooth), and the possession of a small intercalated orbital spine (in *C. griffini* this is large and pointed).

The other Australian species, *C. maccullochi* Rathbun, 1918, from the Great Australian Bight in southern Australia, is smaller than *C. griffini*. It also has long protogastric spines but has no intercalated orbital spine and its carapace is granular.

It would appear that the specimens of *C. suhmii* reported by Griffin and Tranter (1986b), from the Molucca Passage and from the continental slope of northwestern Australia (Port Hedland) are very different from those of the eastern coast. Indeed, the excellent photographs illustrating this work show that the supra- orbital edge is smooth, with no spine or granule; this species should therefore be related to the *C. suhmii* - *C. curviceros* group of species.

It seems, therefore, that of the species that have very long protogastric spines, there are three that inhabit the Australian coasts, *C. maccullochi* in the south, *C. suhmii* in the northwest and *C. griffini* in the east (Fig. 2). One other species of *Cyrtomaia*, *C. horrida* also occurs off the east coast.

Richer de Forges and Guinot (1988) have just described three new species of the genus *Cyrtomaia*, gathered in New Caledonia and in the Chesterfield Islands. Two of them, *C. cornuta* and *C. coriolisi*, are relatively large in size and

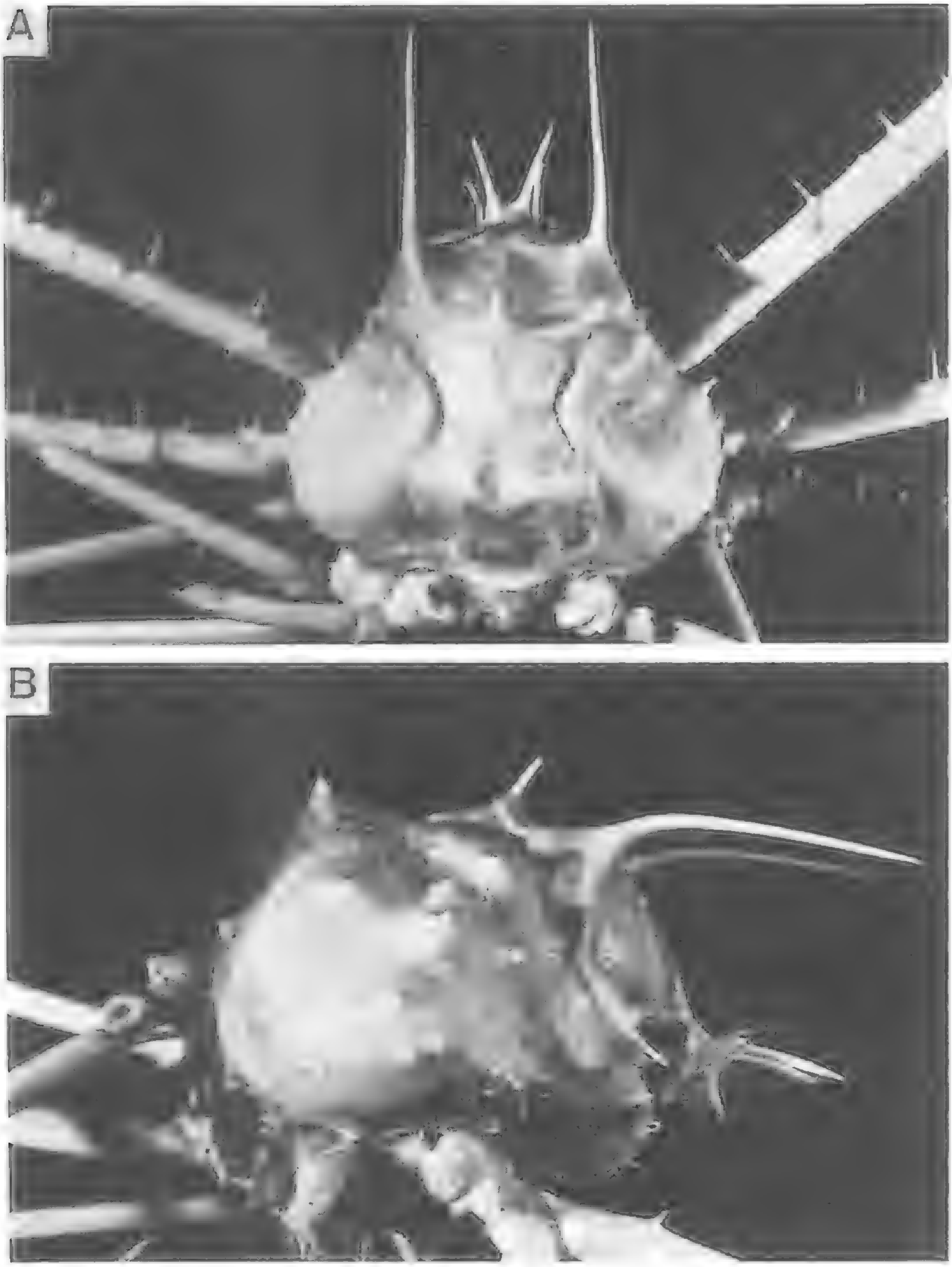

FIG. 4. *Cyrtomaia griffini* sp. nov., holotype ♂ (78.8 x 83.3mm), Queensland, *Soela*, Cr.6, Stn 79, 800m, 6.xii.1985, P. Davie (QM W15362). A, enlargement of the carapace; B, lateral view.

the fact that their longest spines are the protogastric spines places them in the same group of species as *C. griffini*.

C. coriolisi, taken at a depth of 650m in the Chesterfield Islands and on the Norfolk Ridge, is very similar to *C. griffini*, but it is smaller in size; its carapace is finely granular (it is smooth in *C. griffini*); and its protogastric spines are longer.

C. cornuta, found in the south of New Caledonia (at depths of 270 to 535m), has granular legs and carapace, and very long, curved protogastric spines.

DISTRIBUTION

Northeastern coast of Australia between 35°S and 17°S, on sandy-mud bottoms situated at depths of 360 to 980m. The present geographical distribution of the large species of *Cyrtomaia* with long protogastric spines (*C. suhmii, C. curviceros, C. maccullochi, C. griffini, C. gaillardi, C. goodridgei*) indicates that they are quite distinct entities (Fig. 2).

It appears that the group *C. suhmii/C. curviceros* is limited to the western Pacific and East Indian Ocean zone between Japan and the northwest of Australia, with several spots in the Philippines and the Sunda Islands; it would be impossible for these bathyal species to pass through the Torres Strait on account of the very shallow shelf between Papua New Guinea and northern Australia. These species have not been reported from the Marianas despite all the trap fishing that has been done in this area by L. Eldredge. It would be most interesting to obtain some *Cyrtomaia* from the Solomon Islands to see if there is a relationship between them and *C. suhmii* or *C. griffini*.

The species *C. maccullochi* has been found only in southern Australia, at a very low latitude (33°S). Griffin and Tranter (1986a) quote a fine male in the South China Sea, which they relate, with reservations, to *C. maccullochi*.

The distribution of the species *C. goodridgei* and *C. gaillardi* in the Indian Ocean appears very scattered (Guinot, 1985); this is probably because there has been so little sampling. To understand the distribution of these species, it would be necessary to collect them from the different types of sea- bed relief (e.g. sea mounts, ridges) which have served as bridges during the geological eras.

The genus *Cyrtomaia* Miers is typically bathyal (200-2000m), and the geographical spread of the species seems to be limited by the immense abyssal zones; their distribution is thus naturally discontinuous.

ETYMOLOGY

We dedicate this species to Dr D.J.G. Griffin, who has done a great deal of work on the Majidae and especially on bathyal fauna.

ACKNOWLEDGEMENTS

Dr D.J.G. Griffin received one of us (Richer de Forges) at the Australian Museum in Sydney and it gives us much pleasure to pay him a tribute in dedicating this species to him. We extend sincere thanks to Mr P. Davie who placed his *C. suhmii* material at our disposal at the Queensland Museum and who also suggested we describe *Cyrtomaia griffini* sp. nov. in the *Memoirs of the Queensland Museum*.

We also thank Ms V. Sery for the drawings, J. Rebière for the photographs and J. Semblat for preparing the manuscript.

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A REVISION OF THE AUSTRALIAN PARCOBLATTINI (BLATTARIA: BLATTELLIDAE: BLATTELLINAE)

LOUIS M. ROTH

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Diagnostic characters and descriptions of species belonging to 4 genera of Australian Blattellinae, tribe Parcoblattini are presented. *Gislenia* Princis is synonymised with *Neotemnopteryx* Princis. *Shawella* Princis and *Franwalkeria* Princis are synonymised with *Paratemnopteryx* Saussure. *Neotemnopteryx ferruginea* (Tepper), *Gislenia apicalis* (Walker), and *Gislenia australica* (Brunner) are synonymised with *Neotemnopteryx fulva* (Saussure). *Paratemnopteryx blattoides* Tepper is synonymised with *P. couloniana* (Saussure). *P. zeitzi* Tepper is synonymised with *P. rufa* (Tepper). *Symploce centralensis* Roth, previously known only from New Guinea, occurs in Australia, and is transferred to *Paratemnopteryx*.
There are 10 species of *Neotemnopteryx*, 3 of which are new combinations: *fulva* (Saussure), *australis* (Saussure), and *douglasi* (Princis); the remaining 7 are new taxa: *gloriosa*, *bifurcata*, *glossa*, *concava*, *elliptica*, *nana* and *styliparedra*. A neotype is designated for *Neotemnopteryx fulva* (Saussure). *Paratemnopteryx* contains 10 taxa of which 3 were correctly placed; *australis* (Saussure), *rufa* (Tepper), and *atra* Princis; 3 are new combinations: *couloniana* (Saussure), *glauerti* (Princis), *centralensis* (Roth); 4 are new taxa: *stonei*, *howarthi*, *broomehillensis* and *suffuscula*. One species of *Neotemnopteryx* and 3 species of *Paratemnopteryx* are cavernicolous. *Trogloblattella* Mackerras contains 1 Australian cavernicolous species, *nullarborensis*. The new genus *Keyella* contains 2 new taxa, *gayi* and *armidalensis*. Keys are provided to separate the genera and to distinguish between males of the species. ☐*Blattaria, Blattellidae, Parcoblattini, Australia, cockroaches, cave insects.*

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According to Rentz and Cameron (1983) the Blattellidae of Australia are among the poorest known cockroaches found on that continent. They suggest that the species belonging to this family may be twice the number actually recorded. From my studies thus far, they may be too conservative in their estimate of undescribed taxa.

This paper includes the following 7 closely related blattellid genera belonging to the tribe Parcoblattini: *Neotemnopteryx* (including *Gislenia*), *Trogloblattella*, *Paratemnopteryx* (including *Shawella* and *Franwalkeria*) and *Keyella*. The specimens were loaned to me by the following museums and their curators or collection managers: ANIC - Australian National Insect Collection, CSIRO, Canberra, ACT, Australia; Dr D.C.F. Rentz and Mr John Balderson; ANSP - Academy of Natural Sciences of Philadelphia, Philadelphia, USA, Mr Donald Azuma; BMNH - British Museum (Natural History), London, England, Mrs Judith Marshall; BPBM - Bernice P. Bishop Museum, Honolulu, Hawaii, Mr Gordon M. Nishida; DARA - Biological and Chemical Research Institute, Rydalmere, New South Wales, Australia, Dr G.R. Brown; MCZH - Museum of Comparative Zoology, Harvard University, Cambridge, MA, USA; MHGN - Musée d'Histoire Naturelle, Neuchâtel, Switzerland, Dr Jean-Paul Haenni; MHNG - Museum d'Histoire Naturelle, Geneva, Switzerland, Dr V. Aellen and Dr B. Hauser, NMVM - Museum of Victoria, Melbourne, Victoria, Australia, Dr A. Neboiss; NMWA - Naturhistorisches Museum Wien, Vienna, Austria, Dr A. Kaltenbach; QMBA - Queensland Museum, Brisbane, Queensland, Australia, Dr G.B. Monteith; SAMA - South Australian Museum, Adelaide, South Australia, Dr G.F. Gross; WAMP - Western Australian Museum, Perth, Western Australia; Dr T.F. Houston, ZILS - Zoological Institute, Lund, Sweden, Dr Roy Danielsson.

I have examined some of Saussure's specimens borrowed from the Geneva and Neuchâtel museums. According to Dr Bernd Hauser (pers. comm., 1986), Saussure was an independent scientist and his private collection was transferred to the Geneva Museum after his death. He did not designate types, some specimens had no labels on them, and he never indicated how many specimens he used in his descriptions. A minimum of 2 specimens was certain only if he described, or gave measurements of both sexes of a species. He made many exchanges with friends and colleagues so that his syntypes, if any, may be widespread in major world collections. The fact that Saussure indicated 'Mus. Neuchâtel' in his publications does not mean that he did not have specimens of the same species in his private collection. Dr Hauser believes that Saussure's specimens in the Geneva Museum are syntypes, even though he listed only Neuchâtel as the location of the specimens, in his publications.

DIAGNOSTIC CHARACTERS

The characters that have been used to distinguish between the genera discussed in this paper are shown in Table 1. A diagnostic character is one that is useful in distinguishing a species or genus from its relatives, but as Key (1970, p.144) points out the 'difficulty here is to know which characters may prove to be needed when all related species have been discovered.' In this paper I attempt to evaluate the generic importance of the characters shown in Table 1, and redefine those genera which I believe to be valid. My conclusions are based for the most part on examination of the type species (including type specimens wherever possible) as well as the known and new taxa.

Wings. 'The fully developed, reduced or absent organs of flight, in one or both sexes, is often specific and sometimes attributable to nothing more than mere individual variation. Such differences may occasionally be given generic recognition, but only in conjunction with other differential characters of much greater usual stability.' (Hebard, 1929, p.4). Regarding Australian cockroaches, Hebard (1943, p.4, footnote 6) stated 'Different degrees of reduction in the organs of flight have obviously been used as major generic factors, although it is now well known that such characteristics rarely have any generic significance whatever, and indeed such dissimilarity between the sexes is now recognised as characteristics of many species.'

The wing venation of those species with fully developed flight organs (*Neotemnopteryx* and *Paratemnopteryx*) are essentially similar. Whether or not the tegmina and wings are reduced may be intraspecifically variable in some species of a genus, and is of questionable generic value. Princis (1954, p.35) claimed that *Shawella* (=*Paratemnopteryx*) differed from *Gislenia* (=*Neotemnopteryx*) and *Franwalkeria* (=*Paratemnopteryx*) by its reduced wings which do not reach beyond the first abdominal tergum. *Paratemnopteryx couloniana* (Saussure) has brachypterous tegmina and micropterous wings, but the degree of reduction varies, and there are males whose flight organs are fully developed and extend beyond the end of the abdomen. *Neotemnopteryx fulva* (Saussure) males are macropterous and the females may be macropterous or brachypterous.

Male tergal specialisations. 'In males the dorsal surface of the abdomen may always be un-

Genus	Tegmina	Hind Wings	Front Femur Type	Pulvilli	Arolia	Tergal Gland on T1	T7
Gislenia [1]	Fully Developed	Fully Developed	A_3	Present	Present	Present	Present
Neotemnopteryx [2]	Reduced	Reduced	A_3	Present	Present		
Shawella [1]	Reduced	Reduced	A_3	Present	Present	Present	Absent
Franwalkeria [1]	Fully Developed	Fully Developed	A_3	Present	Absent	Present	Absent
Paratemnopteryx [1]	Reduced	Reduced	A_3	Absent	Absent		
Keyella [3]	Fully Developed	Fully Developed	B_1	Present or Absent	Present	Present	Present or Absent
Trogloblattella [4]	Reduced	Reduced	B_3	Absent	Absent	Present or Absent	Present

[1]From Princis (1954). [2]From Princis (1951), based on female only. [3]This paper. [4]From Mackerras (1967).

TABLE 1. Characters that have been used to distinguish between 7 genera of Parcoblatinni.

specialised in certain genera and show a distinctive type of specialisation in others, but various differences in specialisation or rarely both types may be found to exist in species of the same genus.' (Hebard, 1929, p.5).

According to Princis, *Gislenia* males have a gland on T1 and T7, as compared to *Shawella* and *Franwalkeria* that have only T1 modified. The abdominal tergum(a) on which the sexual gland(s) is/are located may be a good generic character (Roth, 1969). But as pointed out by Hebard, the number of modified segments, and their position and morphology may vary in the same genus. Some examples of this are: in *Blattella* spp., the tergal glands may occur on T7 only, or on T7 and T8, and their morphology differs between different species-groups (Roth, 1985a). The Australian species discussed here belong in the Parcoblattini, and of special interest is the American genus *Parcoblatta* Hebard whose males have glands on T1 only (6 spp.), T1 and T2 (4 spp.), or they are absent (2 spp.) (Hebard, 1917). A striking example of uniformity in position and morphology of male tergal glands on T7 and T8 is found among species of *Ischnoptera* Burmeister (Roth, 1969, figs 47-53).

The degree of development and morphology of the gland may differ between species and may be diagnostic (i.e., deep or shallow fossae, with or without associated setae, or whether setal patches are dense or sparse). *Neotemnopteryx* spp. males always have T1 modified, but based on new taxa, T7 may or may not be modified. In *Neotemnopteryx fulva* the first abdominal tergum has relatively few setae along the anteromedial margin of T1, and sometimes these are difficult to see because they are hidden by the hind margin of the metanotum. In his original redescription of *Shawella couloniana* (=*N. fulva*) Princis (1951, p.61) stated that the male's abdomen is unspecialised, but later (1954, p.35) he corrected this. A similar tergal gland is found on T1 of *Paratemnopteryx*. The gland on T1 of *Neotemnopteryx* often covers a larger area, and the group of setae is denser, exposed, and located in about the middle of the segment.

Legs. Hebard (1917) defined 2 kinds of spines on the anteroventral margin of the front femur: those armed with a row of spines which decrease gradually in size and length distad (Type A) (p.12) and those armed with a row of heavy proximal spines, succeeded by a row of more slender, shorter distal spines (Type B) (p.11). Later (Hebard, 1929, p.5) stated that the margin may have an elongate row of minute piliform spines ('type A') or a row of heavy spines which decrease gradually in size distad ('type B'), two or three apical spines furnishing an additional feature of high importance. These definitions are not consistent with his earlier ones. I follow his (1917) original definitions as do recent workers (e.g. Bruijning, 1948, p.33; Bey-Bienko, 1950, pp.15-17, fig. 5) and recognise the following types of front femurs (numerals denote the number of terminal spines, exclusive of the genicular spines); hairlike setae are not considered in the classification:

1. Types A_2, A_3, A_4: long, robust spines which gradually or sometimes suddenly become shorter towards the apex of the femur, the 2 to 4 terminal spines of unequal length, the most distad longest; the first of the terminal spines may be very short and not much longer than the one preceding it.

2. Types B_2, B_3: one or more large proximal spines succeeded by a row of minute piliform spinules, terminating in 2 or 3 large spines.

In some instances the row of spines may be uniform in length and the size of but stouter than piliform spinules; or there may be a few piliform spinules among the small heavy spines. These forms may be intermediate between Types A and B, but usually are considered Type A.

3. Types C_2, C_3: row of piliform spinules only.

4. Types D_1, D_2: robust spines and piliform spinules absent.

Sometimes a genus may have 2 types of front femurs. *Balta* spp. have Type B or C (Hebard, 1943). The Parcoblattini discussed here have Types A or B. Type D femurs are found in *Choristima* Tepper, *Choristimodes* Hebard, *Ectoneura* Shelford, and *Stenectoneura* Hebard.

'The number and type of pulvilli, armament of the ventral surface of the tarsi and development of the arolium has proved to be useful in many ways, while the symmetry or specialisation of the tarsal claws are features of importance.' (Hebard, 1920, p.3). Princis (1974, p.518) quoted this sentence and so strongly believed in the importance of the presence or absence of pulvilli and arolia that he used them as a principal diagnostic character for certain genera. Bruijning (1948, p.33) also stated that whether or not the arolia are well developed has 'high generic value.' This may well be true for some genera, but apparently is of less significance in a number of taxa, including some closely related to *Paratemnopteryx* Saussure, discussed in this paper.

Shelford (1908a, p.34), and Rehn (1922, p.65) indicated that in *Tivia* spp. (Polyphagidae), the presence or absence of tarsal arolia varies, and does not have as much taxonomic importance in the polyphagids as in the Blattidae. But even species of *Tryonicus* Shaw (Roth, 1987a, p.152) and *Neostylopyga* Shelford (Roth, 1988, p.316), both Blattidae, have some species without arolia, and with some or all pulvilli absent, whereas most of the species in these genera have the structures.

There are several closely related Australian genera in the Blattellinae (Parcoblattini) in which the presence or absence of pulvilli and arolia has been used as an important character to distinguish between them. Pulvilli and arolia are present in *Neotemnopteryx* and absent in *Paratemnopteryx* (original diagnosis) and *Trogloblattella*. In *Shawella* (=*Paratemnopteryx*) pulvilli are present or absent, and in *Franwalkeria* (=*Paratemnopteryx*) pulvilli are present, arolia absent. In his original diagnosis of *Shawella* (based only on *couloniana*), Princis (1951, p.61) stated that small pulvilli are present on the 4 proximal tarsomeres. However, pulvilli are absent in *Shawella douglasi* Princis (=*Neotemnopteryx douglasi*) (Princis, 1963, p.11). Sometimes it is difficult to determine if pulvilli are absent. In *Trogloblattella* the pulvillar regions on most tarsal segments are heavily sclerotised and bear small spines, but some spines form a line limiting a clear apical area of the tarsomere. A 'normal' pulvillus is convex and generally is not completely surrounded by short stout spines. Princis and Mackerras probably considered pulvilli absent if, in lateral view, the apex of the tarsomeres do not show small, colourless convex swellings that protrude beyond the margins of the segments. Perhaps the presence of clear, non-protruding structures at the apex of the tarsomeres (viewed in ventral view) should be considered as subobsolete pulvilli; probably these are nonfunctional and cannot be used in climbing.

Mackerras (1967, p.43) stated 'Why the tarsi should lack pulvilli and arolia is not obvious, but they are so frequently lost in cavernicolous cockroaches that they must be disadvantageous in some way; possibly mud adheres to them and retards progress. Among their relatives living on the surface neither *Shawella couloniana* nor *Gislenia australica* (Brunner), nor *G. fulva* (Saussure) have pulvilli in the nymphal stages. These structures are only acquired at the last ecdysis. It is noticeable that nymphs cannot run up the sides of a glass container in the way that adults can, so that *T.*[*rogloblattella*] *nullarborensis* would not be able to negotiate a smooth vertical surface. *Shawella douglasi* which has so far only been found in caves, lacks pulvilli in nymphs and adults, but small arolia are present in both. In another related genus, *Paratemnopteryx*, lack of pulvilli and arolia is cited as a generic character.' Although she didn't say so, Mackerras may have been questioning the generic importance of the presence or absence of pulvilli and arolia in this group of cockroaches. Although absence of pulvilli and arolia may be associated with strictly cave species, these characteristics may occur in truly epigean species as well.

During climbing, the tarsal claws function on rough surfaces whereas the arolia and pulvilli are important in climbing smooth surfaces (Roth and Willis, 1952; Arnold, 1974). Christiansen (1965) found that the more elongated tarsal claws in cave collembola reduced adhesion by the surface tension of water in moist caves, and this facilitated locomotion on wet surfaces. In a study of some domiciliary pest cockroaches, Roth and Willis (1952, p.499) found that at least two species, *Blatta orientalis* Linn. and *Periplaneta australasiae* (Fab.) have great difficulty walking on a smooth horizontal surface like glass, because their first and sometimes second pulvilli (euplantulae) adhere to the substrate. The insect walks readily if its body is raised high above the surface. But if the body is held close to the substrate and its legs are extended so that the first pulvilli of the mid and/or hind legs touch the surface the cockroaches have difficulty pulling or lifting the tarsi away from the smooth substrate. In some instances the insect will actually pull itself free leaving the tarsi adhering to the glass (Roth and Willis, 1952, fig. 5).

Whether or not the presence or absence of pulvilli and arolia influences the locomotor ability of cockroaches on different cave surfaces remains to be determined. Pulvilli and arolia are adaptive characters (Arnold, 1974), although their loss is not restricted to cave habitats, and they are insufficiently stable to be used as a principal diagnostic generic character in the genera discussed here. *Ischnoptera peckorum* Roth (Blattellidae) and *Neostylopyga jambusanensis* Roth (Blattidae), both cavernicolous species, differ principally from other epigean members of their respective genera, by the absence or reduction of eyes, absence of some or all pulvilli, and absence of arolia. There is no need to erect new genera based on these differences alone (Roth, 1988).

Hebard (1917, p.9) stated that 'It must be remembered that until the Blattidae of the world are monographed, the relative values of all diagnostic features can not be fully determined.' Mackerras (1967, p.39) stated that *Trogloblattella* has the characters of *Gislenia* but is modified for a cave existence. In *Franwalkeria*, *Shawella* and *Paratemnopteryx*, we find intermediate stages towards a complete loss of pulvilli and arolia, and the species in these genera generally have reduced eyes. My study of these three genera indicates that they are congeneric. Except for specific determinations, Princis tended to ignore similarities in male characters (if males were known) when he diagnosed genera. I believe that male styles, genital phallomeres, tergal glands, which tend to link the Parcoblattini together, are more important than the presence or absence of pulvilli and/or arolia, although in some instances the latter may be used for species differences.

Size. The Parcoblattini contains some of the largest species of Blattellidae (e.g. *Neotemnopteryx gloriousa* n. sp., *Paratemnopteryx broomehillensis* n. sp., *Trogloblattella nullarborensis* Mackerras). Considerable size variation occurs in some species and the difference between the smallest and largest specimens is so great that they appear to be different species (e.g. *Paratemnopteryx centralensis* (Roth)). However, if all important male characters (supraanal and subgenital plates, styles, and genitalia) are similar between the different sized specimens, I have considered them to be one taxon. Measurements are given in millimetres.

Colouration. The Parcoblattini are more or less unicolourous and for the most part yellowish brown (*Neotemnopteryx*), or dark-, reddish- or blackish-brown (*Paratemnopteryx*). Head, pronotum, and tegmina do not have distinctive markings.

KEY TO AUSTRALIAN GENERA OF PARCOBLATTINI
based mainly on male characters

1. Anteroventral margin of front femur Type A 2

   Anteroventral margin of front femur Type B 3

2. Epigean species: Eyes extending below level of antennal sockets (Figs 2B,5C,13C). Tegmina and wings fully developed. Styles usually asymmetrically placed on hind margin of subgenital plate (Fig. 2F), rarely close together near mid-line (Fig. 13E). Intercercal ridge usually present on undersurface of supraanal plate (Figs 1D,13B), rarely subobsolete (Fig. 12B), or absent. Pulvilli present on 4 proximal tarsomeres, arolia present. First abdominal tergum specialised, the setae located in a group medially; seventh abdominal tergum with or without a setal specialisation. Cavernicolous species: Eyes reduced, not extending below level of antennal sockets (Fig. 14B-D). Tegmina reduced, width normal (Fig. 14A), hind wings vestigial. Pulvilli absent from all tarsomeres, or with a subobsolete pulvillus on the fourth segment only .... *Neotemnopteryx*

   Epigean and cavernicolous species: Eyes reduced, usually not extending below level of antennal sockets (Figs 16B,20D,22B), rarely well below level of sockets (Figs 29A,31A). Tegmina often reduced in length, rarely fully developed (Figs 16C,E,24A). Hind wings usually reduced or vestigial (Figs 16C,E,25A). Styles usually symmetrically placed, wide apart on hind margin of subgenital plate (Figs 17D,E,18D,24D). Intercercal ridge absent. First abdominal tergum specialised, the setae arranged or dispersed along the anterior region of segment (Figs 17B,20C,27C), or with a small group of setae located anteromedially partly or sometimes completely hidden under hind margin of metanotum; seventh abdominal tergum usually unspecialised, rarely with a large, dense, medial group of setae (Figs 18B,27A). Pulvilli present, subobsolete, or absent, arolia small or absent .... *Paratemnopteryx*

3. Eyes present. Tegmina and wings fully developed. First abdominal tergum with a pair of medial setal tufts (Figs 32A,33A) .... *Keyella*

   Eyes absent. Tegmina and wings reduced to small, coriaceous, lateral pads (Fig. 15A). First abdominal tergum with an elliptical depression without any or only a few minute setae (Fig. 15D) .... *Trogloblattella*

Neotemnopteryx Princis

Neotemnopteryx Princis, 1951, p. 61. Type species: *Temnopteryx ferruginea* Tepper, by monotypy.
Gislenia Princis, 1954, p. 33. Type species: *Ischnoptera fulva* Saussure, by selection. N. Syn.

REMARKS

It is impossible to separate *Neotemnopteryx* from *Gislenia* using Princis' characters. The holotype of *ferruginea* is an unusually small female of *Gislenia fulva* with reduced tegmina that do not reach to hind margin of T7, and wings only slightly smaller; in spite of wing reduction the cubitus has 6 complete and 4 incomplete branches, similar to specimens from a colony established under the name *Gislenia australica* at CSIRO, Canberra. I have not seen the type of *Ischnoptera fulva* but I have examined specimens which Princis determined as *Gislenia fulva* and which I find is conspecific with *Gislenia australica* and *Neotemnopteryx ferruginea* both of which I consider synonyms of *fulva*.

Princis (1969, p.732) listed 1 species of *Neotemnopteryx* and 6 species of *Gislenia* (1969, p.729). The former (*ferruginea*) and 3 Australian species of *Gislenia* belong in *Neotemnopteryx*

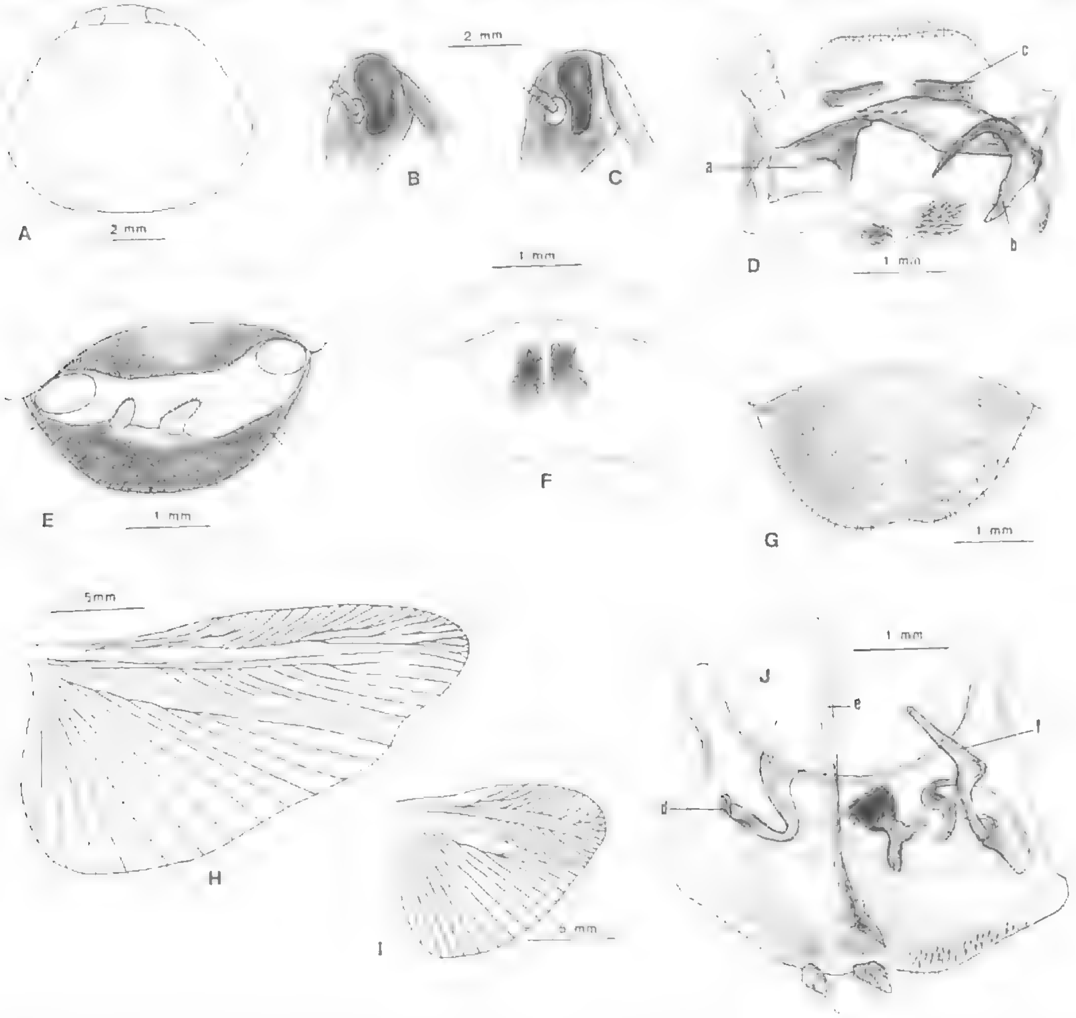


FIG. 1. *Neoteninopteryx fulva* (Saussure). A, B, D-H, J, ♂♂: A, Pronotum; B, Eye (lateral view); C, ♀, eye; D, Supraanal plate and paraprocts (ventral view); E, Supraanal and subgenital plates, styles (rear view); F, Setal gland on seventh abdominal tergum; G, Subgenital plate (ventral view; styles reflexed dorsad and not visible); H, Hind wing; I, ♀, hind wing; J, Subgenital plate and genitalia (dorsal view). Abbreviations: a, left paraproct; b, right paraproct; c, intercercal ridge; d, left hooklike genital phallomere; e, median phallomere; f, right phallomere. Localities: A, D, J, lectotype of *Ischnoptera australica* Brunner, Tarangower, N.S.W.; B, C, H, I, Canberra, A.C.T.; E-G, Black Mt., A.C.T.

which is restricted to that continent. The two Indian species, *Gislenia brevipes* (Walker) and *G. himalayaca* (Brunner), are species of *Episymploce* (Roth, 1987b). *Gislenia indica* (Brunner) from Malacca, West Malaysia is a *Symploce* (Roth, 1986). I recognise 10 species of *Neotemnopteryx* of which 6 are new and 3 are new combinations. One species is cavernicolous, the others epigean.

The distribution of species of *Neotemnopteryx* is shown in Fig 34.

Diagnosis

Epigean species. Eyes well developed usually

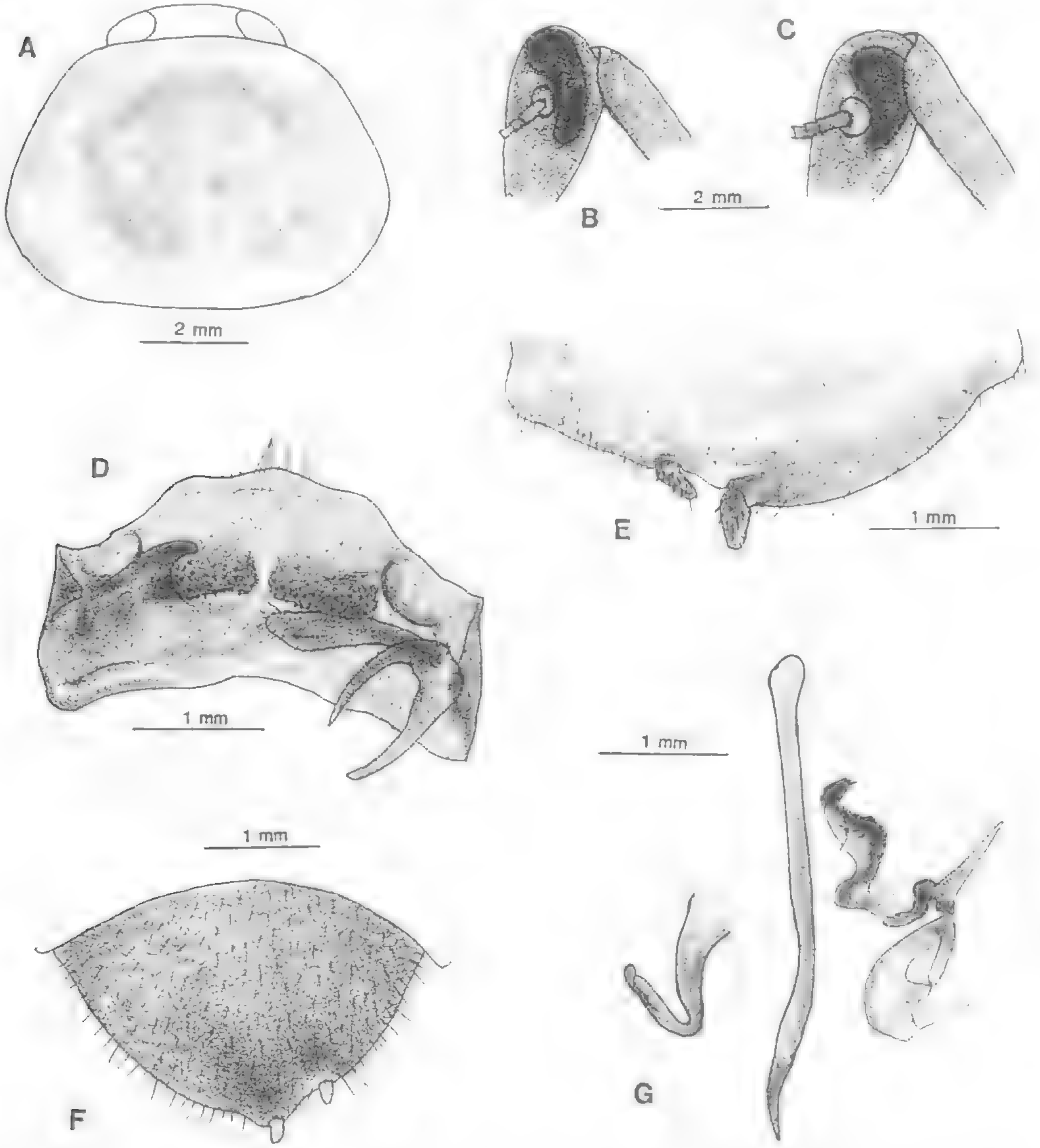


FIG. 2. *Neotemnopteryx fulva* (Saussure). ♂♂: A, Pronotum; B, C, eye (lateral view); D, Supraanal plate and paraprocts (ventral view); E, Distal region of subgenital plate, and styles (dorsal view); F, Subgenital plate and styles (ventral view); G, Genital phallomeres (dorsal view). Localities: A, D, E, G, Australia (no exact locality), holotype of *Periplaneta apicalis* Walker; B, Perth, W.A.; C, D, Margaret River, W.A.

extending below level of antennal sockets (Figs 1B,5C,6D). Tegmina and wings usually fully developed extending beyond end of abdomen; in one species (*fulva*) some females have reduced tegmina not reaching end of abdomen, hind wings only slightly smaller, their veins distinct. Cubitus vein of hind wing with 2-6 (usually 4-6) complete and 2-7 (usually 3 or more) incomplete branches, apical triangle absent or subobsolete (Fig. 1H,I). Anteroventral margin of front femur Type A3; pulvilli present on 4 proximal tarsomeres, tarsal claws simple, symmetrical, arolia present. *Male.* First abdominal tergum specialised, the dense group of setae exposed medially on segment. Seventh abdominal tergum with or without specialisation; if present may vary from dense to sparse (Fig. 3D-G). Supraanal plate usually with ridge or shelf on ventral surface between cerci (intercercal ridge); this may be darkly sclerotised extending ventrad into genital chamber (Figs 5B,8C) but sometimes is reduced (Fig. 1D), subobsolete (Fig. 12B), or absent (Fig. 6B). Paraprocts dissimilar, right one larger, often with spinelike processes (Figs 1D,8D-F). Styles present, partially covered by small dark spines, usually asymmetrically placed, right one at or near apex of plate, the other to its left (Fig. 2E,F), rarely both symmetrically located at apex (Fig. 13E). Genital hooklike phallomere on left side. Ootheca rotated 90° prior to deposition.

Cavernicolous species. In the one cave-dwelling taxon (*douglasi*) eyes are reduced and do not extend below level of antennal sockets (Fig. 14B-D). Pulvilli are lacking from all tarsomeres or a subobsolete pulvillus occurs on fourth tarsomere only.

KEY TO MALES OF *NEOTEMNOPTERYX*

Neotemnopteryx fulva appears twice in the key because its tergal gland on T7 is variable and some individuals apparently lack this specialisation.

1. Eyes reduced, not extending below level of antennal sockets (Fig. 14B-D). Tegmina reduced reaching to T5 or T7 (Fig. 14A). Hind wings vestigial. (cavernicolous) .... *douglasi*

Eyes well developed, extending below level of antennal sockets (Figs 2B,5C). Tegmina and wings fully developed reaching beyond end of abdomen. (epigean) 2

2. Styles close together at or near apex of subgenital plate (Fig. 13E) .... *styliparedra*

Styles not as above 3

3. Posterior halves of lateral margins of pronotum, straight, weakly oblique (Figs 6A,7A) 4

Posterior halves of lateral margins of pronotum not straight 5

4. Supraanal plate subtrapezoidal (Fig. 6B). Right style decidedly more robust than the left one (Fig. 6E) .... *australis*

Supraanal plate produced, tongue-shaped (Fig. 7C). Right and left styles about same size (Fig. 7B,D) .... *glossa*

5. Hind margin of supraanal plate distinctly concavely excavated (Fig. 10A) .... *concava*

Hind margin of supraanal plate not concavely excavated 6

6. Abdominal terga 1 and 7 with setal specialisation 7

Abdominal tergum 1 specialised, T7 unspecialised 8

7. Right style distinctly more robust than left one (Fig. 5F,G). Paraprocts as in Fig. 5B. Median genital phallomere with square-shaped preapical extension (Fig. 5E) .... *gloriousa*

Right and left styles similar (Figs 1J,2E). Paraprocts as in Figs 1D,2D. Median genital phallomere without preapical extension (Figs 1J,2G) .... *fulva*

8. Pronotum subelliptical, greatest width at about middle (Fig. 11A) .... *elliptica*

Pronotum with greatest width below middle 9

9. Median genital phallomere apically bifurcate (Fig. 8G) .... *bifurcata*

Median genital phallomere not apically bifurcate 10

10. Pronotum subparabolic (Fig. 12A). Intercercal

ridge subobsolete (Fig. 12B). Genital phallomeres as in Fig. 12E .... *nana*

Pronotum suboval (Figs 1A,2A). Intercercal ridge distinct (Fig. 2D). Genital phallomeres as in Fig. 1J .... *fulva*

Neotemnopteryx fulva (Saussure) n.comb.(Figs 1A-J,2A-G,34)

Ischnoptera fulva Saussure, 1863, p. 156, pl. 1, fig. 18 (♂); Walker, 1868, p. 119; Saussure, 1869, p. 251; 1872, p. 102; Tepper, 1893, p. 55; 1894, p. 172; Kirby, 1904, p. 81; Shelford, 1908b, p. 7.

Gislenia fulva (Saussure): Princis, 1954, p. 33, fig. 31 (♂ and ♀); 1959, p. 125. N. Comb.

Ischnoptera australica Brunner, 1865, p. 131 (♂); 1862, p. 95 (*Ischnoptera australica* sp. nov., nom. nud. till 1865); Walker, 1869, p. 145; 1871, p. 31; Tepper, 1893, p. 50; Kirby, 1904, p. 81 (incorrectly synonymised under *Ischnoptera australis* Saussure).

Gislenia australica (Brunner): Richards, 1967, pp. 37-39; Roth, 1968, pp. 84, 110, fig. 111 (ootheca); Princis, 1969, p. 730.

Periplaneta apicalis Walker, 1868, p. 129 (♂); Tepper, 1893, p. 105; Kirby, 1904, p. 81 (incorrectly synonymised under *Ischnoptera australis* Saussure).

Gislenia apicalis (Walker): Princis, 1959, p. 125 (synonymised under *Gislenia fulva*); 1969, p. 730. N. Syn.

Temnopteryx ferruginea Tepper, 1895b, p. 148 (♀).

Ceratinoptera ferruginea (Tepper): Shelford, 1908b, p. 20.

Neotemnopteryx ferruginea (Tepper): Princis, 1951, p. 61. N. Syn.

HOLOTYPE (not examined)

♂, Australia. (According to Saussure, the specimen was in the Mus. Neuchâtel. However, Jean-Paul Haenni (pers. comm., 1986) informed me that it is not there. It is not in the Geneva Museum (Dr B. Hauser, pers. comm., 1986)).

MATERIAL EXAMINED

NEOTYPE (here designated): ♂, Canberra, ACT, Australia, light trap, 7.xiii.1950, P.B. Carne; in ANIC.

NEW SOUTH WALES. NMWA: ♂ (terminalia slide 45) lectotype (selected by Princis in 1965), of *Ischnoptera australica* Brunner, Tarangower; a ♀ 'paratype', from Qld, 'Boucard ded.' also was selected by Princis, but it is not conspecific with *fulva* and is *Neotemnopteryx gloriosa* n. sp. This specimen does not have type status because Brunner did not describe the female of *australica* and did not indicate Queensland as one of the localities, listing only Tarangower, and Sydney. ANIC: Armidale, 1♀, 26.i.1960, A. Stock, 1♂, 12.xi.1959, 1♂ (terminalia slide 59), 26.xii.1959, 1♂, 5.i.1960, C.W. Frazier; NE National Park, Pt Lookout, 5200ft. 1♂, 7.xii.1962, A. Stock; Armidale (U.N.E. Campus), 670m, 1♀, 30.xii.1978, S. Harrington; Yass, F.C.T., 1♀ (carrying partially rotated ootheca), 10.ii.1929, K. English; Jervis Bay, 1♂ (reared), 19.ix.1951, H.M. Cane. ANIC: Arrawarra, north coast, at light, 1♂ (terminalia slide 75) 7.xii.1961, 1♂, 9.x.1961, 1♀, 5.xii.1961, C.W. Frazier; Armidale, 1♀, at light, 27.i.1963, C.W. Frazier.

SOUTH AUSTRALIA. MHNG: 1♀ paralectotype (here designated) of *Ischnoptera australis* Saussure (misidentification). This female is not *australis* because the posterior halves of the lateral margin of the pronotum are rounded, not straight (see Fig. 4A). Its tegmina and wings are fully developed and extend beyond end of abdomen; cubitus of hind wing with 6 complete and 5 incomplete branches. Based on Dr. Hauser's comments that Saussure did not indicate 'syntypes' (see introduction) I have designated this specimen a paralectotype, but I believe it is *fulva*. The male lectotype of *australis* is in the Neuchâtel Museum (MHGN). ANIC: 25km E by N of Kimba, 33.05S 136.41E, 2♀♀, 3.ix.1981, D.C.F. Rentz.

VICTORIA. NMVM: Fernshaw, ♀ holotype of *Temnopteryx ferruginea* Tepper, iii.1958, type no. 4446; same data as holotype of *T. ferruginea*, 1 (abdomen missing). ANIC: 8km SW of Moyston, 1♂, 16.xi.1959, E.F. Riek.

AUSTRALIAN CAPITAL TERRITORY. ANIC: Canberra, in house, 1♀, 16.ii.1963 (killed 8.iv.1963, 'progeny in jar 33', 2♂♂, 1♀ nymph (det. *Gislenia fulva* (Saussure) by Mackerras); Canberra, C.S.I.R.O., colony 146 (started from 1♀), 20♂♂ (1 with terminalia slide 43), 17♀♀ (1 with genitalia slide 44), 14♂♂ and 9♀♀ nymphs (det. as *G. fulva* by Mackerras); Canberra, 1♀, 18.ii.1965, 1♀ (carrying partially rotated ootheca), iii.1952, D.F. Waterhouse; Canberra, light trap, C.S.I.R.O., 3♂♂, 4.ii.1953, 5♂♂, 23.xii.1953, 1♂, 14.xii.1950, I.F.B. Common, 2♂♂, 25.i.1954, P.J. Sinclair, 1♂, 29.xi.1950, 2♂♂, 18.xii.1950, P.B. Carne; Canberra (Turner), 1♂ (terminalia slide 72), 22.i.1969, R.W. Kerr; Black Mt. (some taken in light trap), 1♂ (terminalia slide 46), 23.xii.1966, 1♂ (terminalia slide 71), 14.i.1963, 1♂, 29.xii.1961, 3♂♂, 17.ii.1962, 1♂, 18.xii.1962, 1♂, 5-6.xi.1966, 1♂, 9.xii.1968, 1♂, 7.i.1969, I.F.B. Common, 1♂, 7.xii.1950, 2♂♂, 18.xii.1950, 1♂, 28.xii.1950, 2♂♂, 13.i.1951, 1♂, 13.i.1953, P.B. Carne, 1♂, 1.xii.1948, R.W. Kerr.

WESTERN AUSTRALIA. ANIC: Denmark, 1♂, 23.i.1935, K.R. Norris; Dandalup, 1♂ (terminalia slide 74), 19.i.1948, D. Nicholson; Augusta, 1♀, ii.1968, R.F. and E.M. Watson; Victoria Park, 1♂, 18.iii.1950, J.A. Mahon; Perth, ex colony 179 (CSIRO), 6♂♂, 4♀♀ (all with oothecae), 3♂♂ and 3♀♀ nymphs, xii.1964, BPBM; 5km W of 'Lake Cave', 1-40m, 1♂ (terminalia slide 454), 7-8.xi.1963, J. Sedlacek. MCZH: The following were collected by P.J. Darlington or W.M. Wheeler, on the Harvard Australian Expedition 1931. Pemberton, 2♂♂, 1♀, 10.xi., 1♀, 13.xi.; Margaret River, 3♂♂ (1 with terminalia slide 239), 2♀♀, 3.xi., 1♂, 30.x. ZILS: The following were collected by T. Gislén and reported as *Gislenia fulva* (Sauss.) by Princis (1954, p.33): Margaret River, Mammoth Cave, 8♂♂, 5♀♀, 10 xii.1951; S Karridale, Hamelin Bay, 2♂♂, 11.xii.1951; C. Naturaliste, Bunker's Bay, 3♂♂, 1♀, 9.xii.1951; Nornalup, 1♀, 20.i.1952; Denmark, Karri forest, 1♀, 26.i.1952. WAMP: Manjimup, 1♂; Yallingup, 1♂, 1♀ (labelled *Gislenia fulva* by Princis, 1954); Cottesloe, 1♂, iv.1916; Apple Cross, 1♂, 1.xii.1963, G.M. Riley; Margaret River, 2♀♀; Kalamunda, 1♂, 15.i.1971, P. Shaw; Rottnest, 1♂, i.1931 (labelled *G. fulva* by Princis, 1954); Mandurah, 1♂, 23.i.1979, R. Easton; Highbury, 1♀, 6.ii.1965, W.H. Butler; nr Devils Lair Cave, 3 miles from sea, 1♀, 20.iii.1973, A. Baynes; Denmark, 1♀, 27.i.1979, R.P. McMillan.

AUSTRALIA (no exact locality). BMNH: ♂ (not ♀ as indicated) (terminalia slide 250) holotype of *Periplaneta apicalis* Walker, presented by C.G. Grey

DESCRIPTION

Male. Eyes well developed extending slightly below antennal sockets (Figs 1B,2B,C). Interocular space about same or slightly greater than space between antennal sockets. Pronotum widest below middle (Figs 1A,2A). Tegmina and wings fully developed extending beyond end of abdomen; cubitus vein of hind wing with 3-6 complete and 2-6 incomplete branches, apical triangle absent (Fig. 1H). Front femur Type A_3; pulvilli on 4 proximal tarsomeres, tarsal claws symmetrical, simple, arolia small. First abdominal tergum specialised, setae dense and numerous. Seventh abdominal tergum specialised, with setae as dense as on T1 (Fig. 1F), or sometimes sparse and difficult to see. Supraanal plate with hind margin (when flattened) with small median protrusion (Fig. 2D), truncate (Fig. 1D), or rounded; intercercal ridge present but variably developed (Figs 1D,2D); paraprocts dissimilar, right one with U-shaped sclerotization (Figs 1D,2D). Subgenital plate weakly asymmetrical, styles small located to left of midline, right one slightly more robust (Fig. 1E,J); in pinned specimens hind margin may be reflexed dorsad (Fig. 1E) so that styles are not visible in ventral view; if margin is not reflexed, styles are visible from below (Fig. 2F). Genitalia as in Figs 1J,2G: hook on left side, with a subapical incision, median phallomere rodlike, apically acute.

Colouration. Yellowish to reddish brown. Hind wings with anterior field weakly yellowish, sometimes darker apically. Terminal abdominal segments sometimes darkly infuscated.

Measurements. Length, 17.0-23.0; pronotum length x width, 4.5-5.8 x 5.9-7.5; tegmen length, 16.5-24.0.

Female. Tegmina fully developed extending beyond end of abdomen, or reduced reaching to about T5-T8, rounded apically; in brachypterous individuals, wing venation is distinct (Fig. 1I), and eyes (Fig. 1B) are similar to those of males and macropterous females. Supraanal plate trigonal, reaching to hind margin of subgenital plate or slightly beyond.

Ootheca. Dark reddish brown, 4.1-4.3mm high, 6.4-10.6mm long, with 20-33 small keel serrations and 20-30 egg chambers; oothecal wall not covered by a removable membrane.

Measurements. Length, 16.4-22.8; pronotum length x width, 4.9-6.0 x 6.1-7.7; tegmen length, 11.0-14.2 (brachypterous), 16.5-21.5 (macropterous).

?VARIANTS (Figs 3A-H,4A-D,34)

MATERIAL EXAMINED

QUEENSLAND. QMBA: Braemar, S.F., via Kogan, SE Qld, 1♂, 15-19.x.1979, G.B. Monteith and QM; Hinchinbrook Is., NE Qld, Gayundah Ck, 10m, 1♂, 1♀, 7-15.xi.1984, Monteith, Cook and Thompson; 'Morney', 120km W of Windorah, 2♂♂, 24.ix.1983, G.B. Monteith. ANIC: The Boulders, 5km W of Babinda, 17.21S 145.52E, 1♂ (terminalia slide 65), 14-15.xi.1981, J. Balderson; 24 miles SW by W of Kingaroy, at light, 1♂ (terminalia slide 66), 21.xi.1968, Britton and Misko; Eidsvold, 1♂.

NEW SOUTH WALES. ANIC: 31km WNW of Tenterfield, 28.58S 15.43E [*sic*: probably 151.43E], 1♂, 23.xi.1983, Stop 64; Lake Cowal, 1♂ (terminalia slide 62), 16.xii.1971, W. Vestjens; Willandra Bridge, 11km N of Mossgiel, dry swamp, at light, 33.16S 144.34E, 1♂ (terminalia slide 68), 21.xii.1970, Britton, Misko, and Pullen; Arrawarra, north coast, 1♂ (terminalia slide 75), at light, 7.xii.1961, C.W. Frazier.

SOUTH AUSTRALIA. ANIC: 2km SW of Mt Barr, SSE of Abminga, 26.20S 134.56E, at light, 1♂ (terminalia

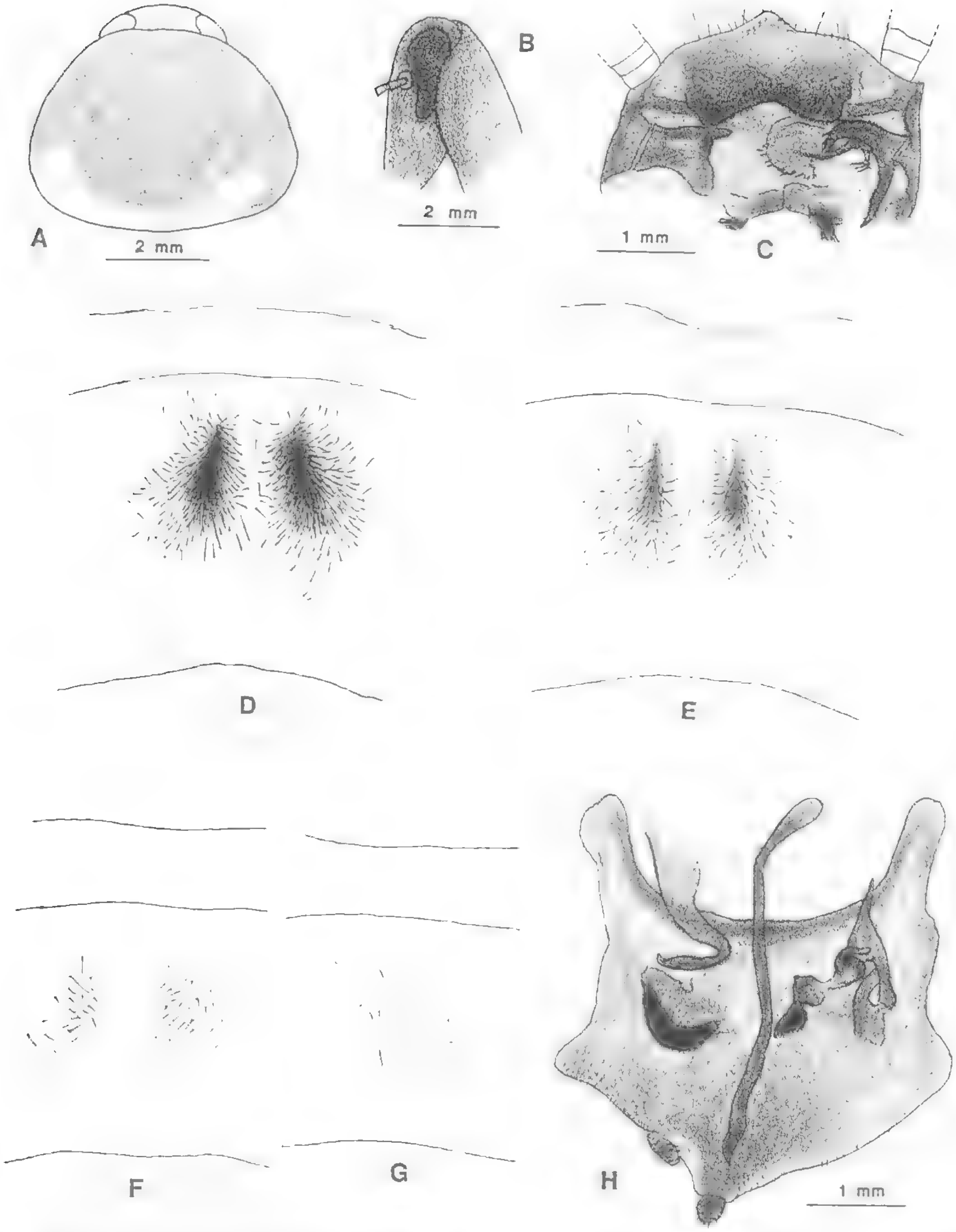


FIG. 3. *Neotemnopteryx ?fulva* (Saussure), variant. ♂♂: A, Pronotum; B, Eye (lateral view); C, Supraanal plate and paraprocts (ventral view); D-G, Setal glandular area on seventh abdominal tergum; H, Subgenital plate and genitalia (dorsal view). Localities: A, B, Tenterfield, N.S.W.; C, H, Lake Cowal, N.S.W.; D, The Boulders, Qld; E, 24 miles SW. by W. of Kingaroy, Qld; F, G, exact localities unknown.

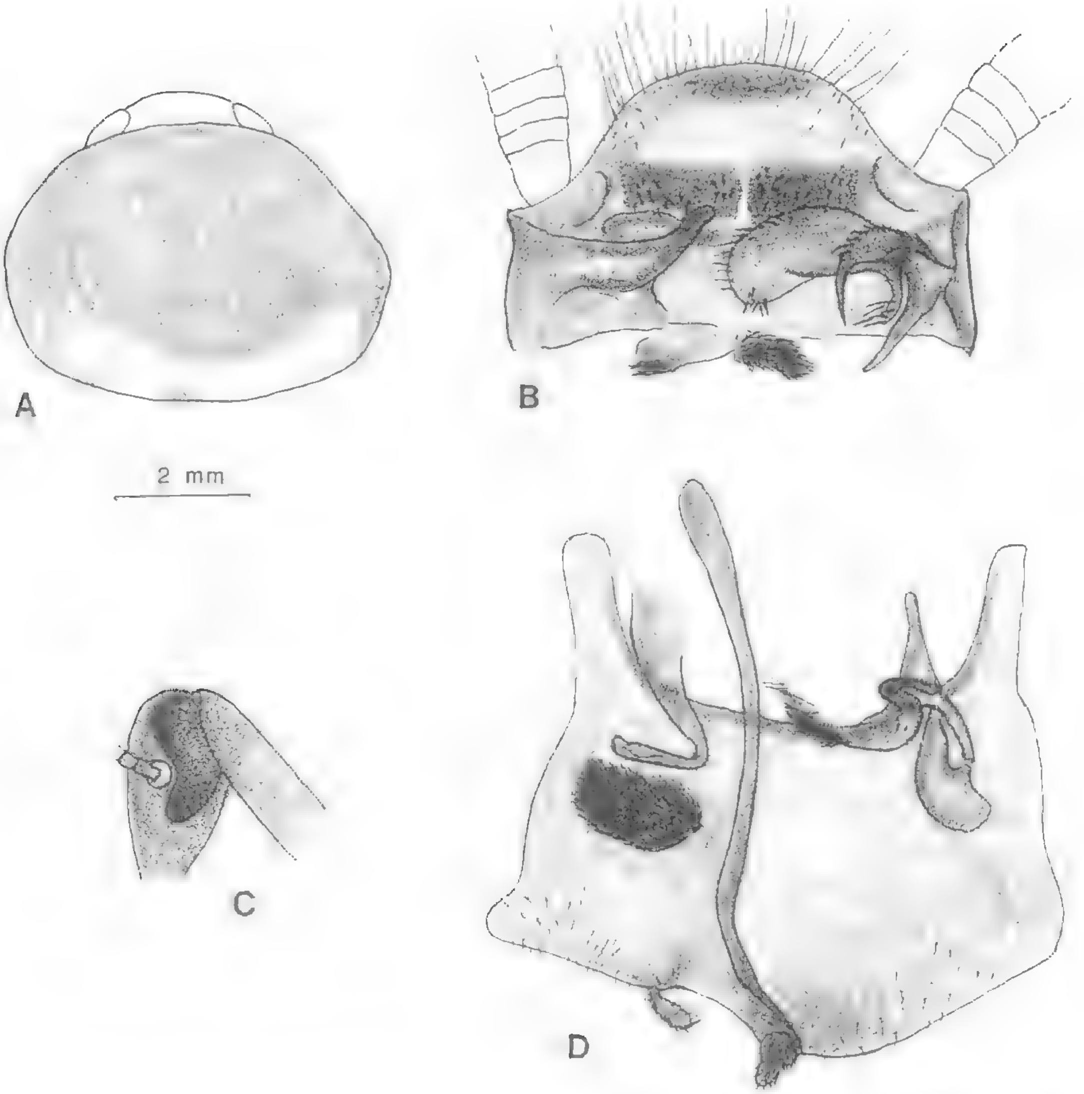


FIG. 4. *Neotemnopteryx ?fulva* (Saussure), variant. ♂♂: A, Pronotum; B, Supraanal plate and paraprocts (dorsal view); C, Eye (lateral view); D, Subgenital plate and genitalia (dorsal view). Localities: A, C, Braemer, Qld; B, D, The Boulders, Qld.

slide 69), 25.ix.1972, K.H.L. Key *et al.* WAMP: Etadunna Stn, 1♂, x.1972, K. and B. Oldfield.

DESCRIPTION

A number of small specimens appear to be different from *fulva*, but in spite of their size I am provisionally considering them to be variants because their paraprocts and genital phallomeres are similar to what I believe to be that species. The hind margin of the supraanal plate may have a small medial protuberance (Fig. 3C, cp. Fig. 2D), or is rounded (Fig. 4B). The intercercal ridge may be divided (Fig. 4B, cp. Fig. 2D), or undivided and concave (Fig. 3C). The tergal gland on T7 varies from dense and distinct to sparse and subobsolete (Fig. 3D-G), or apparently absent. Because characters such as shape of hind margin of supraanal plate, intercercal ridge, and presence or absence of a gland on T7, which in some species are diagnostic, but here are so variable in the large number of specimens I have examined, I do not feel it advisable to describe a new species. However, biological studies might show that more than one taxon is present among this material.

Measurements (♂♂). Length, 13.5-18.4; pronotum length x width, 3.4-4.7 x 4.7-6.0; tegmen length, 15.0-19.7.

REMARKS

Neotemnopteryx apicalis was synonymised by Kirby under *australis*, and by Princis under *fulva*. It is clearly not *australis*, as indicated by Princis (1969, p.730). Princis (1969) gave only Western Australia as the locality for *fulva*, and all his records (Princis, 1954, p.33) are from that state. Both Saussure and Walker simply indicated that their species, *fulva* and *apicalis*, came from Australia. The differences between the types of *apicalis* and *australica* (cp. Figs 1,2) are small and, based on examination of a large number of individuals, I consider them synonyms of *fulva*. As pointed out under remarks of the generic diagnosis, *Neotemnopteryx ferruginea* is based on a brachypterous specimen of *N. fulva*.

Collection data indicates that this is a common and widespread species occurring in ACT, NSW, Vict., SA, and WA.

Neotemnopteryx gloriousa n. sp.

(Figs 5A-G,34)

MATERIAL EXAMINED

HOLOTYPE: ♂, Mt Glorious, southeast Queensland, 2.i.1974, A. Hiller; in QMBA.

PARATYPES: QUEENSLAND. QMBA: Mt Glorious. 2♂♂, 2.i.1974, 1♂, 1♀, 3.xii.1973, A. Hiller; Mt Misery, Shiptons Flat, via Cooktown, 1♂, 2♀♀, 1982, L.Roberts; Mt Chinghee, 12km southeast of Rathdowney, 1 ♀, 17.xii.1982 (Rf, 720m), Monteith, Yeates and Thompson; Kroombit Tops (Upper Kroombit Ck), SSW Calliope, 1♀, open forest, 9-19.xii.1983, G. Monteith and G. Thompson; Blackdown Tableland via Duaringa, C. Qld, 1♀, 28-29.x.1980, G.B. Monteith; Mt Cannon summit via West Burleigh, SE Qld, rainforest, 1♂, 1♀, 18.i.1987, G. Monteith and D. Cook; Mt Moffat, N.P., Top shelter shed, 1000m, 1♂, 10-12.x.1987, Top Moffat Camp, 1♂, 13-15.xii.1987, Monteith, Thompson, Yeates. BPBM: Mt Glorious, 1♀ terminalia slide 453), 29.xi 1968, R. Rice. The following were collected by J.L. and M. Gressitt: Mt Glorious, Malaise trap, 6♂♂ (1 with terminalia slide 452), 3♀♀, 5-8.ii.1961, 1♂, 3♀♀, 13.ii.1961, sclerophyll forest, 1♂, 13-16.ii.1961, rain forest, 1♀, 24-28 ii.1961 (1♂, 1♀, retained at MCZH). ANIC: Brisbane, 1♂, 13.ii.1960, C.F. Ashby; 2km NW of Mt Mowbullan, Bunya Mtns, light trap in *Nothofagus* forest, 3♂♂, 6.i.1970, Britton, Holloway, and Misko; Binna Burra, Lamington Nat. Park, 1♂ (terminalia slide 86), 1♀, 12.ii.1964.

NEW SOUTH WALES. BPBM: Ourimbah, 1♀, i.1904. ANIC: Armidale, 1♂, 26.xii.1959, 1♀, at light, 1.ii.1960, C.W. Frazier; Allyn River, Chichester, S.F., 32.08S 151.27E, 1♂, 10-11.xi.1981, T. Weir; Iluka N. Res., 4km N of Iluka, 1♀, 21.xi.1982, J.T. Doyen; Plot Forest Road, 3km NNE of Minyon Falls, Whian Whian State Forest, NNE of Lismore, 28.35S 153.23E, 2♂♂ (1 with terminalia slide 52), 17.xi.1982, D.C.F. Rentz and C.D. MacNeill. The following were collected by D.C.F. Rentz and M.S. Harvey: Sawpit Ck, 23km E of Woodenbong, 28.22S 152.51E, 5♂♂, 22.xi.1983; Condong Falls, Whian Whian State Forest, NNE of Lismore 28.37S 153.23E, 1♂, 1♀, 18.xi.1983; Big Bend Flora Reserve, Gibbergunyah Rd, Whian Whian State Forest NNE of Lismore, 28.37S 153.19E, 1♂, 19.xi.1983; Moore Park, Richmond R., 27km E by S of Woodenbong, 28.27S 152.54E, 1♂, 21.xi.1983; The Bird Tree, Middle Brother State Forest, near Kendall, 31.41S 152.41E, 1♂, 1♀, 16.xi.1983. The following were collected by J.T. Doyen: Lake Cathie, 1♂, 10-11.xi.1982; Cobcroft Camp, Werrikimbe Nat. Park, 1♂, 12.xi.1982. The following were collected by H.M. Cameron: Mt Warning Nat. Park, near Murwillumbah, 1♂, 10.viii.1979; Victoria Park near Alstonville, 1♂, 6.vii.1981, 1♀ (with ootheca, reared from nymph, Feb. 1981). The following were collected by A. Calder: Gloucester R, Barrington Tops Nat. Pk, 32.04S 151.41E, 2♂♂, 1♀, 12-14.xi.1981; Wiangaree S.F., 28.22S 153.05E, 1050m, 1♂, 10- 12.ii.1983 (coll. with T. Weir). DARA: Lane Cove, 5♀♀, 14.xii.1977, G.R. Brown.

AUSTRALIAN CAPITAL TERRITORY. ANIC: Canberra, CSIRO light trap, 1♂, 4.ii.1953, I.F.B. Common.

DESCRIPTION

Male. Eyes extending below level of antennal sockets (Fig. 5C); interocular and interocellar distances similar; last palpal segment elongate. Pronotum as in Fig. 5A. Cubitus vein of hind wing with 5-6 complete and 4-7 incomplete branches, apical triangle subobsolete. Front femur Type A_3; pulvilli present on 4 proximal tarsomeres, tarsal claws symmetrical, simple, arolia present. First, and seventh (Fig. 5D) abdominal terga specialised. Supraanal plate with posteromedial region deflexed, hind margin with small mesal convexity (Fig. 5B), or broadly, smoothly convex; intercercal ridge on ventral surface large, darkly sclerotised, divided, covered with minute setae; right and left paraprocts with elongated spinelike processes, right one covered with small setae (Fig. 5B).

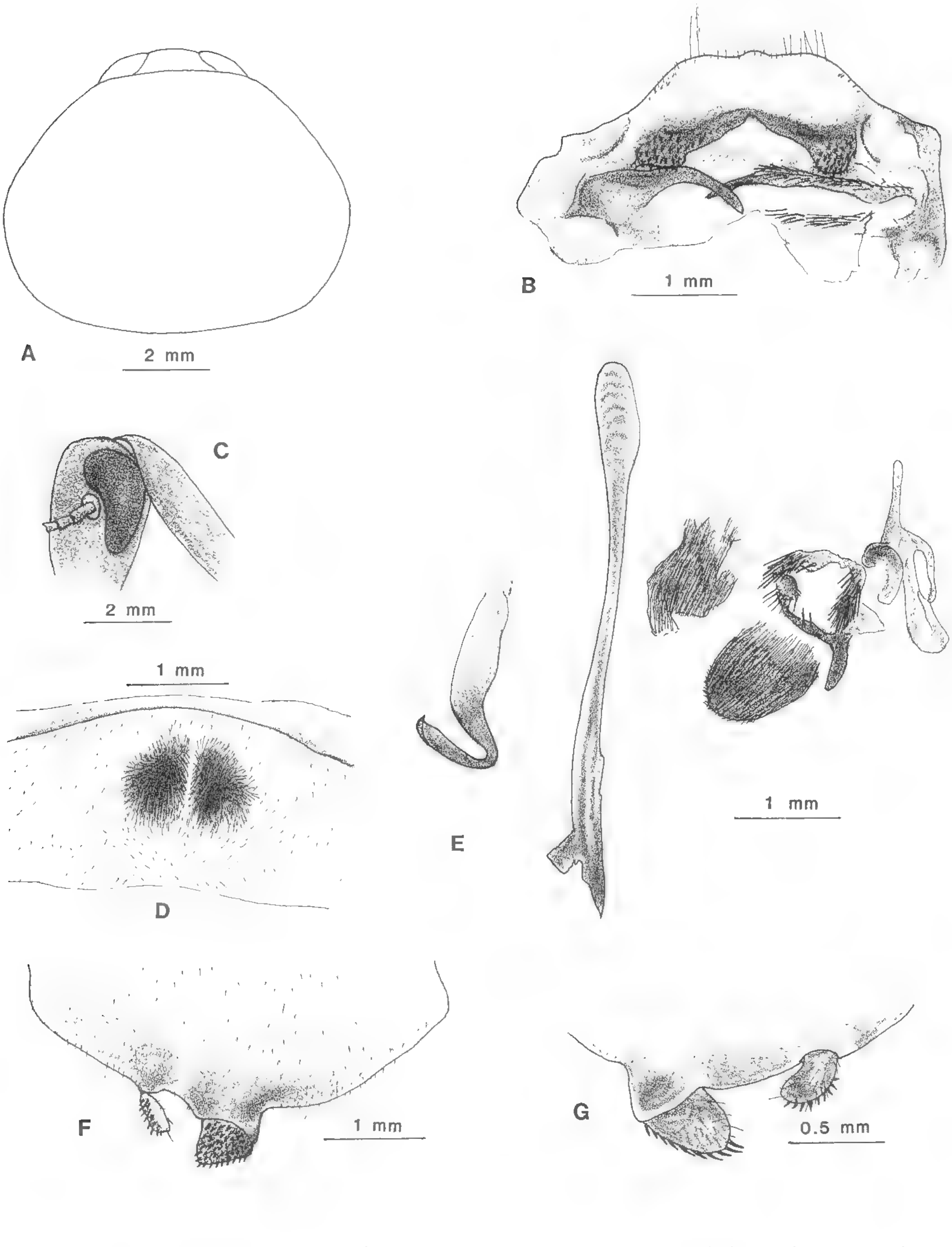


FIG. 5. *Neotemnopteryx gloriousa*, n. sp. ♂ paratypes: A, Pronotum; B, Supraanal plate and paraprocts (ventral view); C, Eye (lateral view); D, Setal gland on seventh abdominal tergum; E, Genitalia (dorsal view) F, Distal region of subgenital plate showing styles (dorsal view); G, Styles (ventral view). Localities: A-F, Mt Glorious, Qld; G, Condong Falls, N.S.W.

Right style at apex of subgenital plate, much more robust than left cylindrical one, both covered with small spines (Fig. 5F,G). Genitalia as in Fig. 5E: hook on left side with subapical incision, median phallomere, apically acute, with preapical square-shaped extension on one side.

Colouration. Chestnut brown. Antennae uniformly pale or first two segments light, remainder dark brown. Pronotum with posterolateral and hind border regions ranging from practically opaque to variably translucent. Supraanal plate with dark brown medial region on posterior half. Cerci dark brown. Hind wing yellowish brown, distal region may be darker. Specimens from New South Wales may have broad dark brown lateral border on venter, with a dark subgenital plate.

Female. Supraanal plate broadly trigonal, apex acute or subacute. Supraanal plate may be darkly infuscated in New South Wales specimens; dark brown lateral borders of abdominal sterna, and dark subgenital plate are more extensive and intense than in males.

Measurements (♀ in parentheses). Length, 19.0-25.5 (19.0-26.2); pronotum length x width, 5.0-6.3 x 6.3-8.3 (5.1-6.4 x 6.0-8.2); tegmen length, 22.3-27.8 (19.0-26.6).

Remarks

There is considerable variation in size in this species. Specimens from Mt Glorious tend to be larger than those from New South Wales.

Neotemnopteryx australis (Saussure)
n. comb. (Figs 6A-E,34)

Ischnoptera australis Saussure, 1863, p. 155, pl. 1, fig. 17 (♂)

Symploce fulva (*nec* Saussure, 1863): Princis, 1951, p. 59, pl. 6, figs 61, 62 (♂ and ♀)(misidentification).

Gislenia australis (Saussure): Princis, 1954, p. 34; 1969, p. 730

Material Examined

Lectotype (here designated): ♂, Australia; in MHGN. (I received 4 specimens, supposedly of *Ischnoptera australis* Saussure, from the Neuchâtel Museum. These were Saussure's specimens but were not individually labelled and were arranged in the collection under the above name. One was '*Ischnoptera*' *australis* which I am designating the lectotype of *Neotemnopteryx australis*. Of the other 3 specimens, one is a male of an *Ischnoptera*, having the typical specialisations on abdominal terga 7 and 8; the other 2 specimens are females and probably belong in *Ischnoptera* based on their wing venation and Type B_3 front femurs. *Ischnoptera* is found principally in South America and does not occur in Australia. Saussure described several species from South America, and the 3 specimens probably were incorrectly arranged in the Museum collection).

Australian Capital Territory. ANIC: Canberra, CSIRO light trap, 2♂♂, 12.iv.1953, P.J. Sinclair; Black Mt., light trap, 1♂ (terminalia slide 51), 15.xii.1968, 1♂, 8.i.1969, I.F.B. Common.

New South Wales. ANIC: 16 miles E of Bungendore, 1♂, 18.xii.1951, H.M. Cane; 13km ENE of Kyogle, 28.35S 153.08E, 1♀, 20.xi.1983, D.C.F. Rentz and M.S. Harvey; Durras North, nr Batemans Bay, 1♀ (with detached ootheca), 16.i.1985, H.M. Cameron.

Description

Male. Eyes extending below level of antennal sockets (Fig. 6D), interocular width about same as distance between ocellar spots, less than space between antennal sockets. Pronotum with pair of shallow oblique impressions on distal half, lateral margins truncate, oblique, on posterior half, hind margin weakly convex, posterior region mostly hyaline (Fig. 6A). Abdominal terga 1 and 7 with large dense medial tufts of setae, those on the latter segment (Fig. 6C) partly hidden by T6. Supraanal plate subtrapezoidal (Fig. 6B); intercercal ridge absent, represented by few, robust, minute spines; some small to minute spicules along hind margin and posterior halves of lateral margins of plate; left paraproct with slender surface setae, posterodistal corner prolonged into robust sclerotised spine, right paraproct with large, single,curved, spine-like process, robust and slender setae on other regions of sclerite (Fig. 6B). Subgenital plate with exposed region trigonal, convex, large right style at its apex, the smaller left style separated from it by more than its length, both with surface spines (Fig. 6E). Genital phallomeres as in Fig. 6E: genital hook on left side, hardly any neck between hook portion and broad basal arm, former uniformly slender, apex slightly enlarged without subapical incision; median phallomere rodlike, apex acute, right phallomere with cleft sclerite.

Colouration. Yellowish brown.

Female. Supraanal plate trigonal, sides not concave, apex rounded, reaching about hind margin of subgenital plate. Pronotum as in male. Ootheca black, microscopically roughened, individual egg cells not discernible, keel with 24

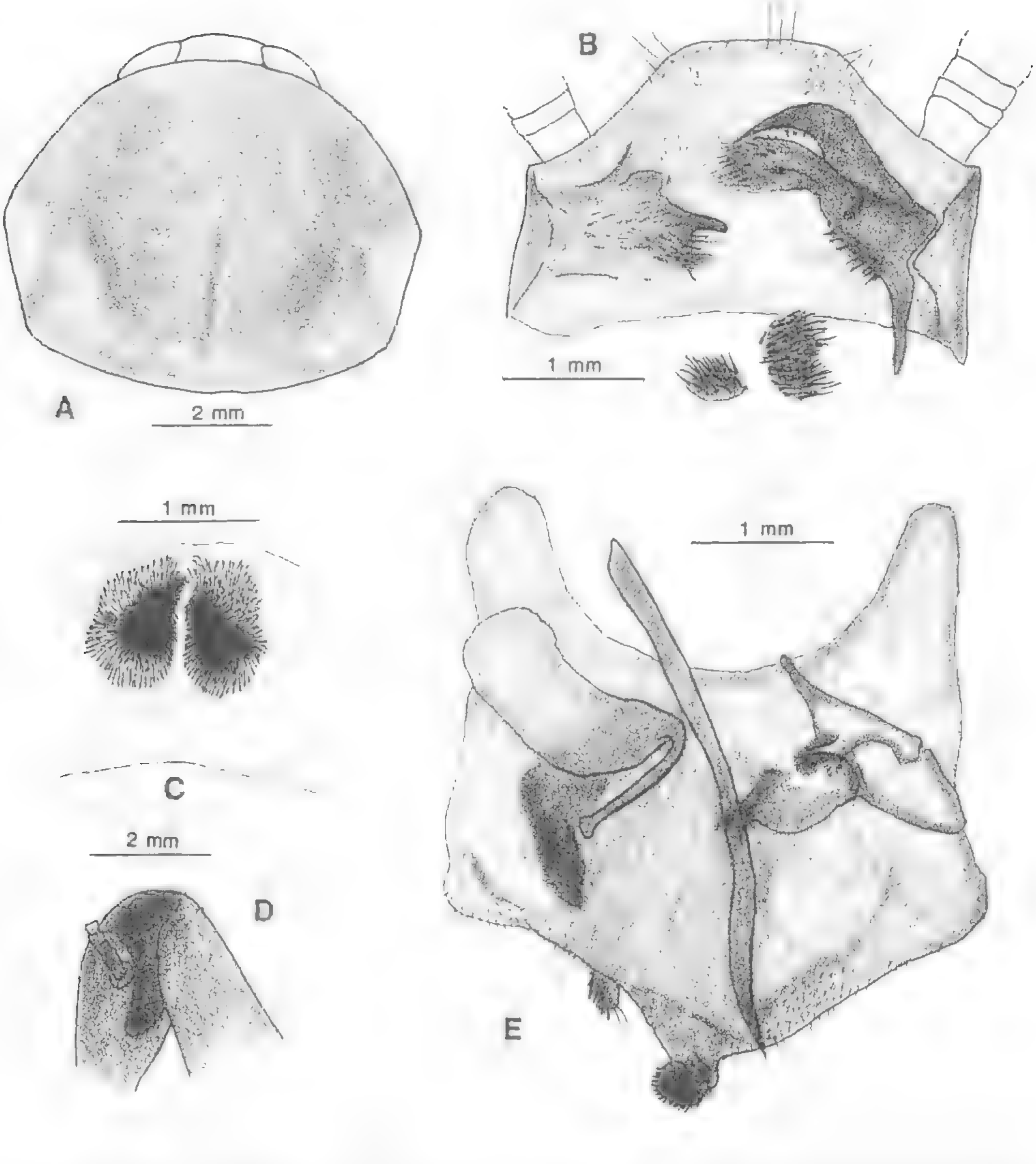
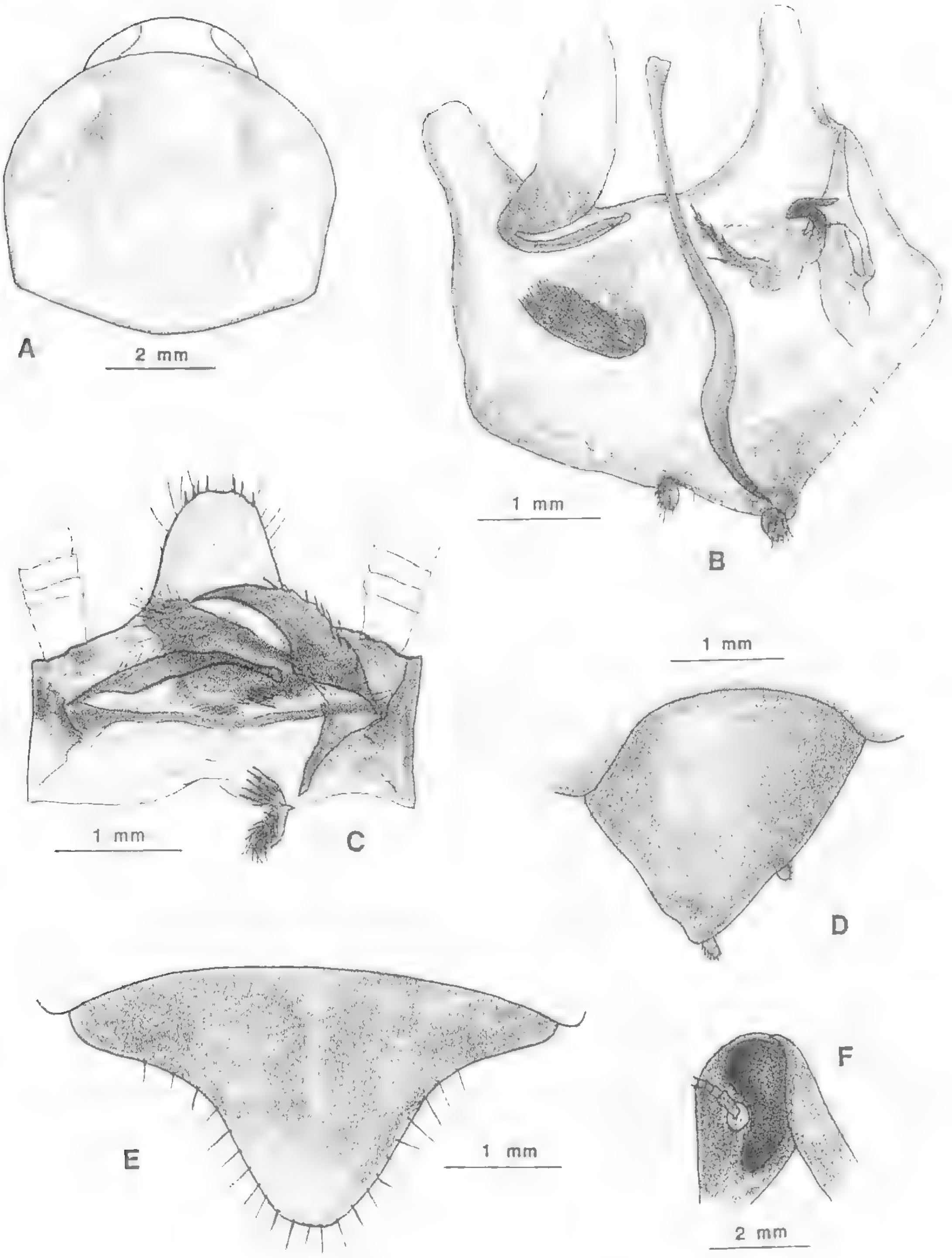


FIG. 6. *Neotemnopteryx australis* (Saussure). ♂♂: A, Pronotum; B, Supraanal plate and paraprocts (ventral view); C, Setal gland on seventh abdominal tergum; D, Eye (lateral view); E, Subgenital plate and genitalia (dorsal view). Localities: A- C, E, Black Mt., A.C.T.; D, Canberra, A.C.T.

FIG. 7. *Neotemnopteryx glossa*, n. sp. A-D, F, ♂ Holotype: A, Pronotum; B, Subgenital plate and genitalia (dorsal view); C, Supraanal plate and paraprocts (ventral view); D, Subgenital plate and styles (ventral view); E, Female paratypefrom 'Baren Grounds', southeast of Robertson, N.S.W., supraanal plate (dorsal view); F, Eye (lateral view).


A
2 mm
B
1 mm
C
1 mm
D
1 mm
E
1 mm
F
2 mm

shallow, undulate teeth; 4.0mm high, 7.6mm long.

Measurements (♀ in parentheses): Length, 20.5-23.0 (19.6-21.4); pronotum length x width, 4.8-5.6 x 6.3-7.2 (5.2-6.1 x 6.7-7.3); tegmen length, 24.0-25.0 (22.4).

Neotemnopteryx glossa n. sp.
(Figs 7A-F,34)

MATERIAL EXAMINED

HOLOTYPE: ♂ (terminalia slide 61), Jolly Flora Res., 17km N of Dorrigo, New South Wales, 15.xi.1982, J.T. Doyen; in ANIC.

PARATYPES: NEW SOUTH WALES. ANIC: 'Barren grounds', SE of Robertson, 1♀, 29.xii.1974, K.H.L. Key; Armidale, at light, 1♀, 27.i.1963, C.W. Frazier; Durras North, near Batemans Bay, 1♀ (with ootheca), 16.i.1985, H.M. Cameron.

ADDITIONAL MATERIAL

QUEENSLAND. QMBA: Mt Moffat N.P., C. Qld, Mahogany Forest, 1000m, 1♀, 11-12.xii.1987, Monteith, Thompson, Yeates.

ETYMOLOGY

The specific name refers to the male's tongue-shaped supraanal plate.

DESCRIPTION

Male. Eyes extending well below antennal sockets (Fig. 7F), interocular distance about same as interocellar space, less than space between antennal sockets. Pronotum with posterior half of lateral margins straight, weakly oblique, margin of anterior half convexly rounded, disk with pair of shallow oblique grooves on posterior half (Fig. 7A). First and seventh abdominal terga with large, dense, groups of setal tufts. Supraanal plate with concave sides, produced, tongue-shaped, margins incrassate with small dark spines apically on each side of midline; paraprocts dissimilar, right one larger, spinelike; intercercal ridge present as a pair of pale plates hidden under paraprocts (Fig. 7C). Subgenital plate trigonal, convex, styles small, right one slightly more robust, located at apex of plate (Fig. 7B,D). Genitalia as in Fig. 7B: hook on left side, distal portion slender with subapical incision, basal arm portion broad, neck region absent; median phallomere rodlike, enlarged distally, tapering to weakly divided, acute apex; right phallomere with cleft.

Colouration. Yellowish brown.

Female. Supraanal plate less concave than in male, apex rounded (Fig.7E). Cubitus vein of hind wing with 5 complete and 3-5 (1 bifurcate) incomplete branches, apical triangle subobsolete. Hind wing with anterior field infuscated. The ootheca is blackish, surface microscopically roughened, keel undulate with 26 shallow rounded teeth; 4mm high, 7.8mm long.

Measurements (♀ in parentheses). Length, 21.0 (21.5); pronotum length x width, 5.3 x 6.4 (5.9 x 7.1); tegmen length, 24.7 (25.0).

REMARKS

The shape of the pronotum is similar in *glossa* and *australis* and the differences in the male genitalia are small. The males are easily separated by the shapes of the supraanal plate, and styles. The supraanal plate of female *australis* is more triangular than that of *glossa*. The female record of *glossa* from Mt Moffat, Qld, should be confirmed by examining males.

Neotemnopteryx bifurcata n. sp.
(Figs 8A-G,34)

MATERIAL EXAMINED

HOLOTYPE: ♂, Emu Ck, 27km of SW of Dimbulah, Queensland, 17.20S 144.57E, 25-26.xi.1981, J. Balderson; in ANIC.

PARATYPES: QUEENSLAND. QMBA: Bellenden Ker Range, Cableway Base Stn, 100m, Malaise trap in rainforest, 1♂ (terminalia slide 52), 25-31.x.1981, Earthwatch/QM. ANIC: Crystal Ck, 23 miles SSE of Ingham, 18.58S 146.16E, 1♂ (terminalia slide 63), 9.xii.1968, Britton and Misko; 6km SE of Chillagoe, 17.12S 144.33E, 1♂, 26.xi.1981, J. Balderson; Ewan Road, 3-14 miles W of Paluma, 1♂, 4-6.i.1966, J.G. Brooks; Mt Spec, Paluma Ra., 1♂, 5- 7.i.1965, J.G. Brooks; Cunningham's Gap, McPherson Ra., Qld, 1♂ (terminalia slide 177), 3-4.xii.1982, G. Theischinger.

AUSTRALIAN CAPITAL TERRITORY. ANIC: Black Mt. light trap, 1♂, (terminalia slide 58), 25.i.1966, 1♂, 24.xii.1962, I.F.B. Common.

ETYMOLOGY

The specific name refers to the bifurcated apex of the male's median genital phallomere.

DESCRIPTION

Male. Eyes extending below antennal sockets (Fig. 8B), interocular width greater than distance between ocellar spots. Pronotum suboval (Fig. 8A), lateral and posterior regions transparent. Cubitus vein of hind wing with 4-5 complete and 2-3 incomplete branches, apical triangle small or

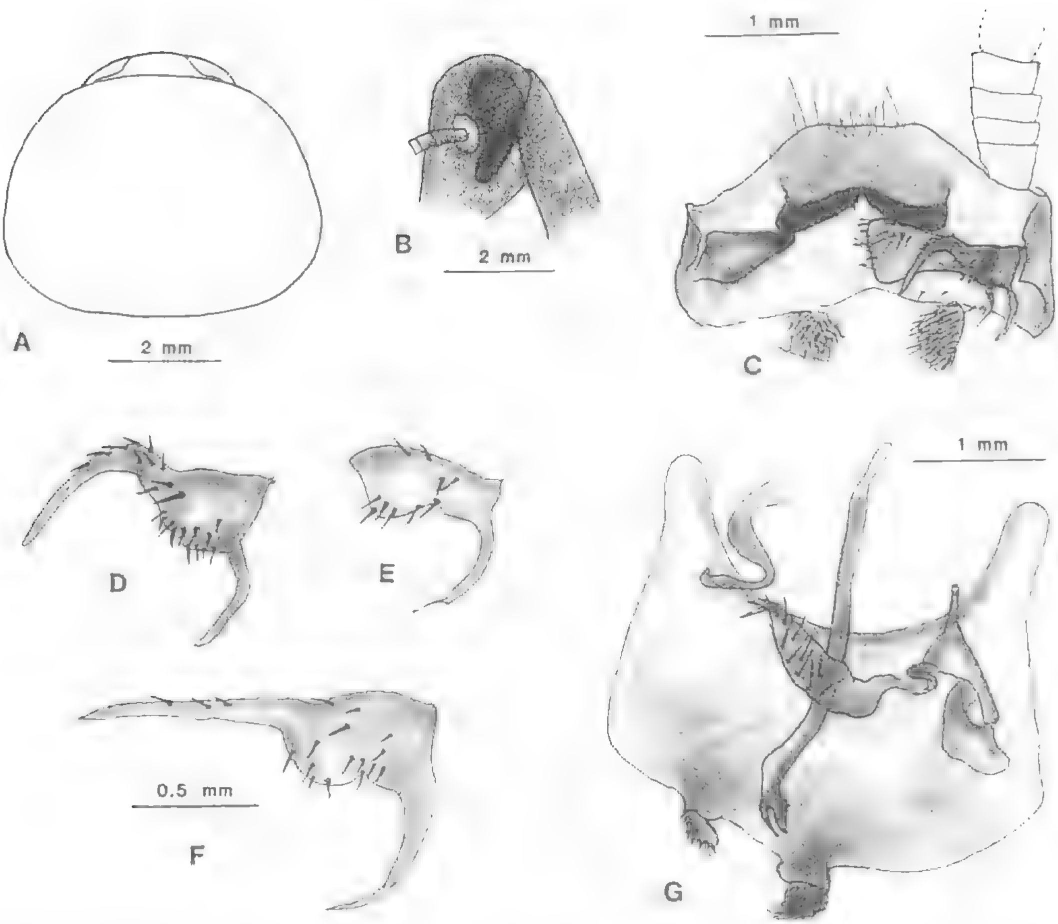


FIG. 8. *Neotemnopteryx bifurcata*, n. sp. ♂♂. A, B, Holotype, pronotum, and eye (lateral view); C-G, Paratypes: C, Supraanal plate and paraprocts (ventral view); D-F, Variation in right paraprocts (ventral views); G, Subgenital plate and genitalia (dorsal view). Localities: A, B, Emu Ck, Qld; C, D, Crystal Ck, Qld; E, Bellenden Ker Range, Qld; F, Black Mt., A.C.T.; G, Crystal Ck, Qld.

subobsolete. Front femur Type A$_3$; pulvilli present on 4 proximal tarsomeres, tarsal claws simple, symmetrical, arolia very small. First abdominal tergum with a pair of dense setal tufts anteromedially. Seventh abdominal tergum unspecialised. Supraanal plate transverse, trapezoidal, midposterior region weakly depressed so margin appears undulate or concave in pinned specimen; intercercal ridge darkly sclerotised and spined on free border; paraprocts dissimilar, right one variable, with or without a straight, or curved spinelike process (Fig. 8C-F). Subgenital plate with dissimilar styles, right one more robust, at apex of plate, both with small dark spines, interstylar region membranous, less sclerotised (Fig. 8G). Genitalia as in Fig. 8G: hook on left side, with a subapical incision; median phallomere rodlike, apex divided (the bifurcation is visible in pinned specimens if the supraanal and subgenital plates are separated).

Colouration. Light brown. Hind wing with distal region of anterior field darker.

Female. See variant.

Measurements (ACT specimens in parentheses). Length, 15.0- 18.1 (20.0-23.0); pronotum length x width, 4.1-5.0 x 5.1-6.0 (5.1-5.4 x 6.3-6.7); tegmen length, 17.3-19.0 (23.3-24.0).

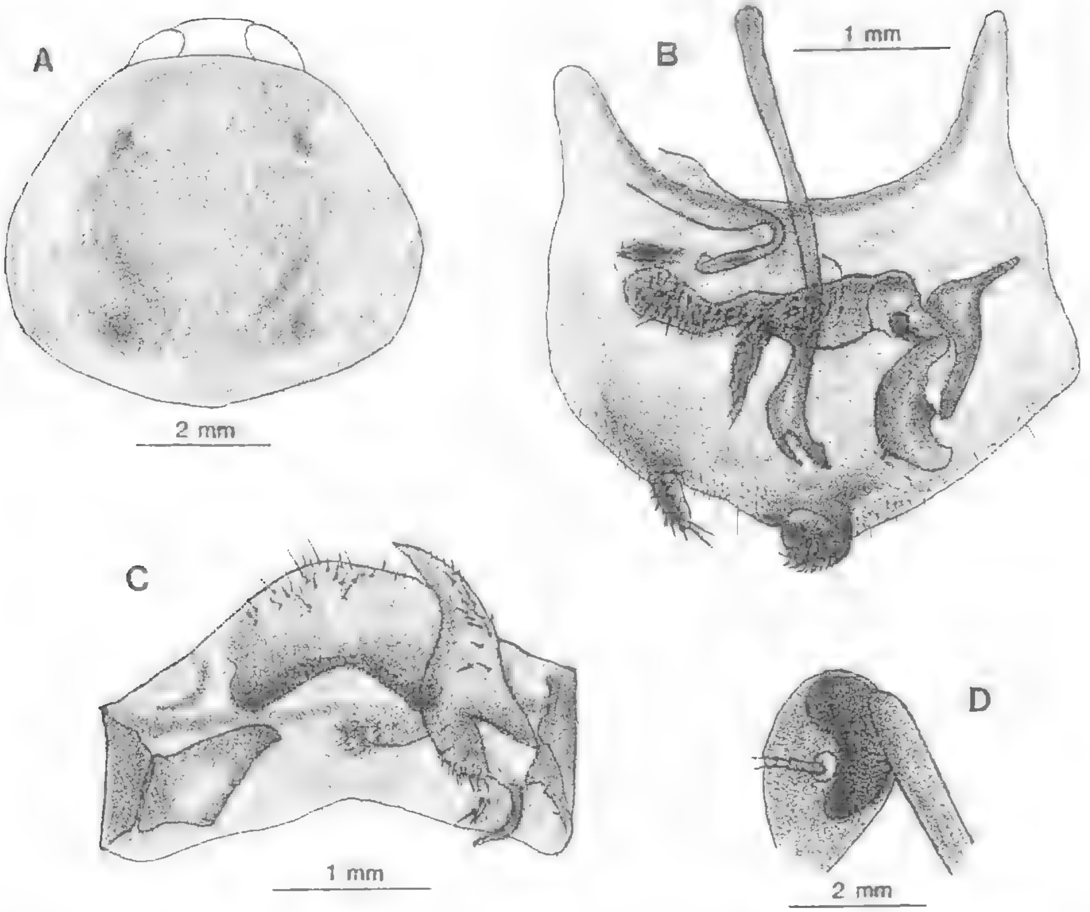


Fig. 9. *Neotemnopteryx bifurcata*, n. sp., ♂ variant from Broken River, Qld, 50 miles west of Mackay: A, Pronotum; B, Subgenital plate and genitalia (dorsal view); C, Supraanal plate and paraprocts (ventral view); d, Eye (lateral view).

VARIANT (Figs 9A-D,34)

MATERIAL EXAMINED

QUEENSLAND. ANIC: Broken River, 50 miles west of Mackay, 1♂ (terminalia slide 67), 1♀, at light, rain forest, 29.xi.1968,. Britton and Misko; Coominglah St. For., 22km NW of Monto, 1♂ (terminalia slide 73), 23.xii.1982. J.T. Doyen.

DESCRIPTION

Male. Eyes extending below level of antennal sockets (Fig. 9D); interocular and interocellar distances similar. Pronotum (Fig. 9A) with lateral portions opaque or hyaline. Cubitus vein of hind wing with 4-5 complete (1 bifurcate), and 4 incomplete branches, apical triangle subobsolete. Front femur Type A_3; pulvilli on 4 proximal tarsomeres, tarsal claws symmetrical. simple, arolia small. First abdominal tergum with a pair of dense setal tufts anteromedially. Seventh abdominal tergum unspecialised. Supraanal plate with hind margin convexly rounded, intercercal ridge on ventral surface deeply concave, minute spines on free border; right paraproct large, broad, robust (Fig. 9C). Subgenital plate with robust right style at apex, left style more slender, cylindrical, both covered with small spines (Fig. 9B). Genitalia as in Fig. 9B.

Colouration. Light brown. Anterior field of hind wing light brown, darker distally.

Female. Cubitus vein of hind wing with 6 complete and 5 (1 bifurcate) incomplete

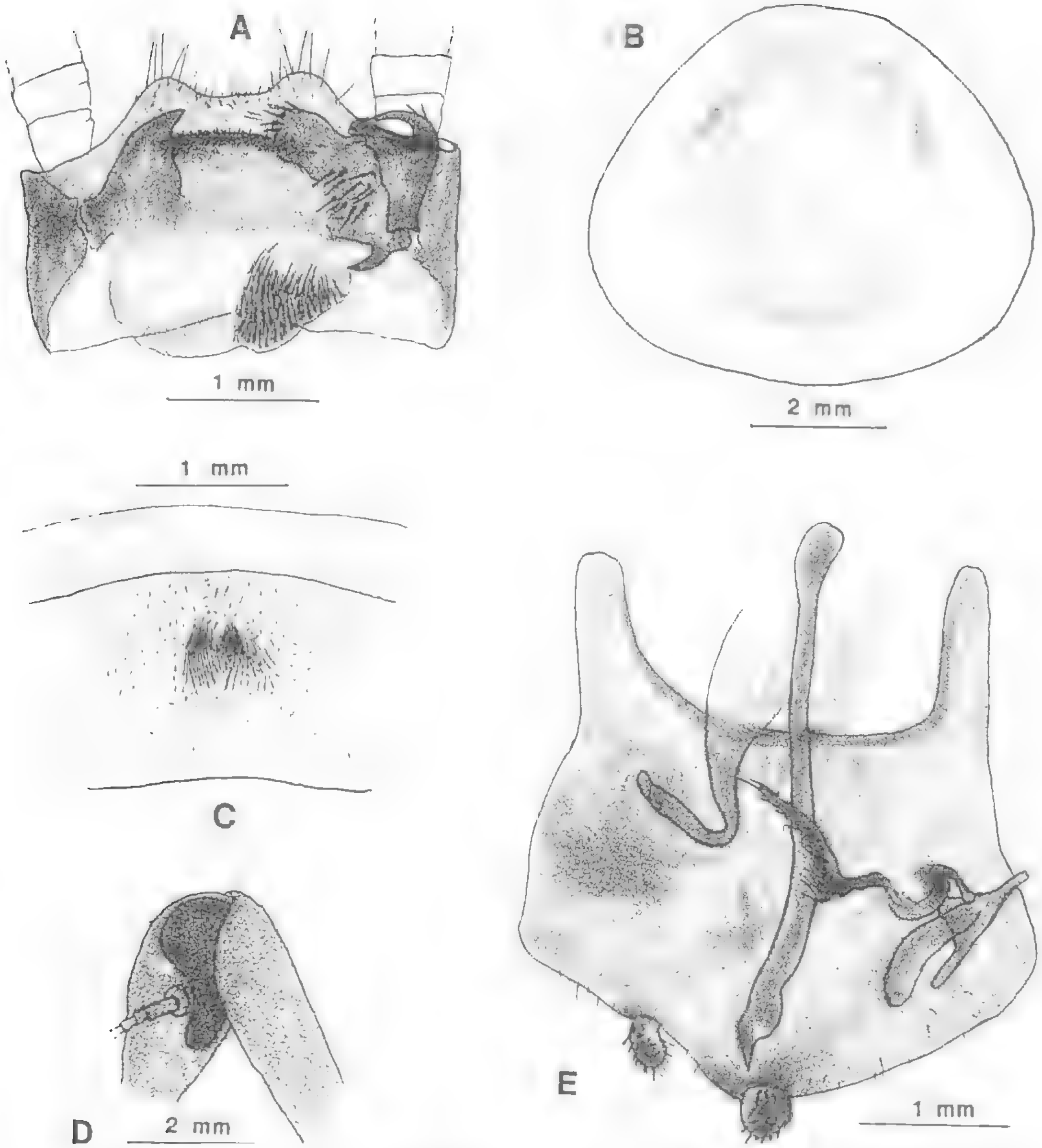


FIG. 10. *Neotemnopteryx concava*, n. sp., ♂ paratype from same locality as holotype: A, Supraanal plate and paraprocts (ventral view); B, Pronotum; C, Setal gland on seventh abdominal tergum; D, Eye (lateral view); E, Subgenital plate and genitalia (dorsal view).

branches. Supraanal plate trigonal, apex extending slightly beyond hind margin of subgenital plate.

Measurements (♀ in parentheses). Length, 18.7-19.2 (23.0); pronotum length x width, 5.0-5.2 x 6.0-6.5 (5.6 x 6.9); tegmen length, 21.4-22.8 (24.7).

REMARKS

There are some differences between the variant and the typical specimens in shape of pronotum, hind margin of supraanal plate, and intercercal ridge. The most striking difference is in the shape of the male's right paraproct. However, the right paraproct of the typical morph is variable (Fig. 8D-F). Slenderization of the more robust right

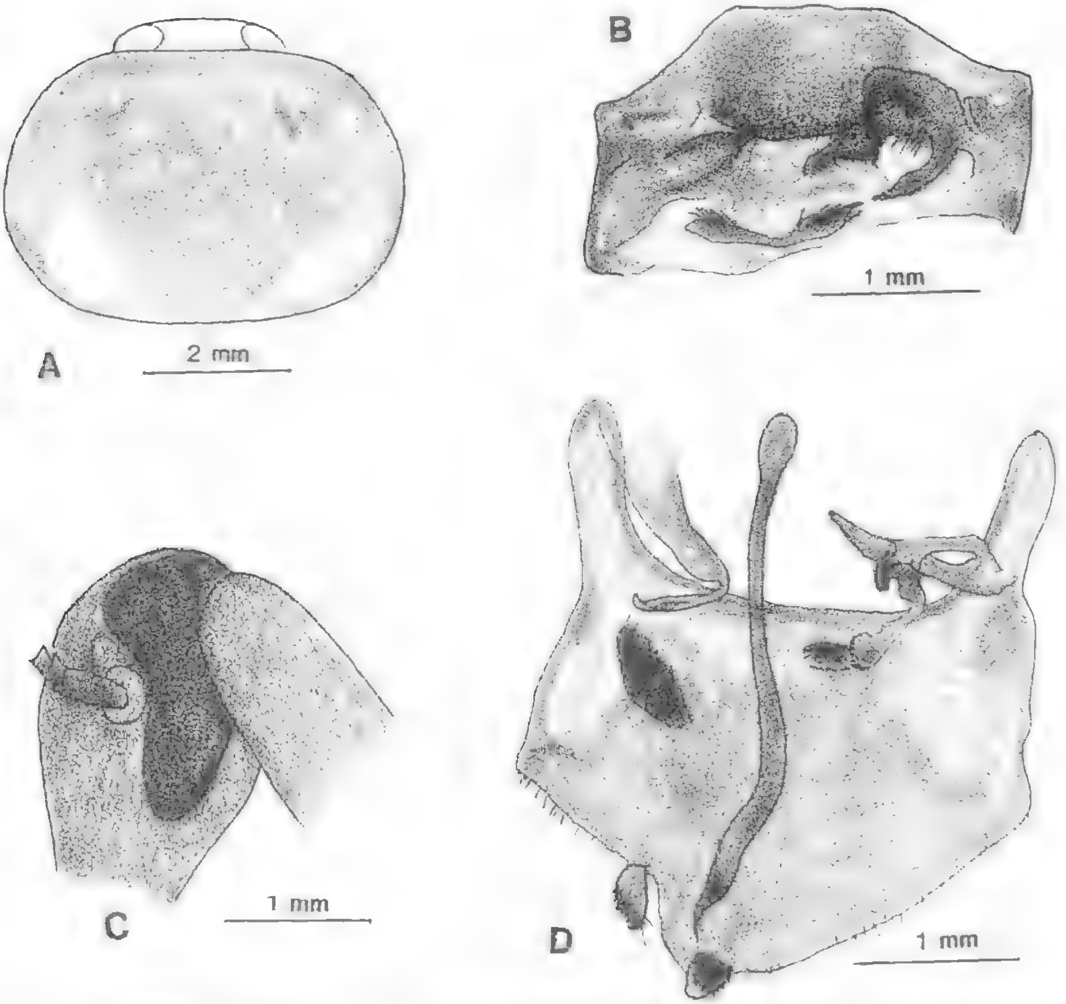


FIG. 11. *Neotemnopteryx elliptica*, n. sp.♂♂: A, Pronotum; B, Supraanal plate and paraprocts (ventral view); C, Eye (lateral view); D, Subgenital plate and genitalia (dorsal view). C, from holotype, A, B, D, paratype from same locality as holotype.

paraproct of the variant (Fig. 9C) could result in a structure similar to that shown in Fig. 8D or F. If additional collecting and study shows no intermediate forms between the variant and typical morphs then the former may prove to be a distinct taxon.

Neotemnopteryx concava n. sp.
(Figs 10A-E,34)

MATERIAL EXAMINED

HOLOTYPE: ♂, Plot Forest Road, 3km NNE of Minyon Falls, Whian Whian State Forest, NNE of Lismore, New South Wales, 28.35S 153.23E, Stop 93, 17.xi.1982, D.C.F. Rentz and C.D. MacNeill; in ANIC.

PARATYPES: NEW SOUTH WALES. ANIC: same data as holotype, 1♂ (terminalia slide 64); Federal, near Dorrigo, 1♂, 26.xi.-8.xii.1985, H.M. Cameron. DARA: Baulkham Hills, 1♂, 5.xi.1977, B.E. Wallbank. BPBM: Harwood Island, 1♂, 28.i.1967, C. Ryan. MCZH: Wentworth Falls, 2800ft, 1♂, 23.xii.1931, P.J. Darlington, Harvard Australian Exp. QUEENSLAND. BPBM: Brisbane, 1♂, 30.ix.1967, B. Bonnie.

WESTERN AUSTRALIA. WAMP: Buningonia Spring (well), 31.26S, 123.33E, 1♂, light trap, 18-25.xi.1978, T.F. Houston *et al.*

ADDITIONAL MATERIAL

NEW SOUTH WALES. ANIC: Willoughby, 1♀, 8.i.1950, K.G. Campbell.

QUEENSLAND. BPBM: Mt Glorious, 1♀, 13.ii.1961, L. and M. Gressitt.

ETYMOLOGY

The specific name refers to the concave excavation of the hind margin of the male's supraanal plate.

DESCRIPTION

Male. Eyes extending below level of antennal sockets (Fig. 10D), interocular and interocellar distances about same, less than space between antennal sockets. Pronotum suboval (Fig. 10B), posterolateral and hind border regions transparent. Cubitus vein of hind wing with 5 complete and 3-4 incomplete branches. Front femur Type A3; pulvilli on 4 proximal tarsomeres, tarsal claws simple, symmetrical, arolia small. First and seventh abdominal terga specialised, setae on T1 numerous, dense, dark, those on T7 (which is hardly depressed medially) pale, fewer, less dense and difficult to see (Fig. 10C). Supraanal plate with hind margin broadly concavely excavated, corners rounded; right and left paraprocts dissimilar, former with a spinelike process and setal plate; intercercal ridge present, free margin convex, with small spines (Fig. 10A). Subgenital plate broadly trigonal, right style at its apex, more robust than the left one (Fig. 10E). Genitalia as in Fig. 10E: hook on left side with a subapical incision, rodlike median phallomere apically acute, right phallomere with visible cleft.

Colouration. Yellowish brown. Hind wings with veins and distal region of anterior field, yellowish.

Measurements. Length, 16.3-22.0; pronotum length x width, 4.2-5.2 x 5.0-6.5; tegmen length, 18.5-23.3.

Female. I am provisionally placing 2 females listed above, here, pending finding males in the same localities (Willoughby, NSW, and Mt Glorious, Qld). The supraanal plate is trigonal and its apex is shallowly, but distinctly excavated.

Measurements. Length, 16.7-18.0; pronotum length x width, 4.8-5.2 x 5.9-6.3; tegmen length, 17.7-18.5.

REMARKS

The shape of the hind margin of the male's supraanal plate is distinctive, as is the apically indented apex of the female's plate. The smallest male came from Harwood Island.

Neotemnopteryx elliptica n. sp.

(Figs 11A-D,34)

MATERIAL EXAMINED

HOLOTYPE: ♂, at light, 3 miles N of Eromanga, Queensland, 3.xi.1967, R.C. Lewis; in ANIC.

PARATYPES. QUEENSLAND. ANIC: same data as holotype, 1♂ (terminalia slide 60); 62km W by S of Boulia, 23.02S 139.18E, 1♂, 16.x.1978, M.S. Upton.

NORTHERN TERRITORY. ANIC: 'Newcastle Waters', 1♂, 1.vi.1929, T.G. Campbell.

ETYMOLOGY

The specific name refers to the shape of the pronotum.

DESCRIPTION

Male. Eyes very well developed extending well below level of antennal sockets (Fig. 11C), interocular space slightly greater than interocellar width, about same as distance between antennal sockets. Pronotum essentially elliptical, greatest width at about middle (Fig. 11A). Hind wing with median vein bifurcate distad; cubitus vein with 3-4 complete and 3-4 incomplete branches, apical triangle absent. Front femur Type A3; pulvilli present on 4 proximal tarsomeres, tarsal claws symmetrical, simple, arolia present. First abdominal tergum with a dense, medial, setal tuft. Seventh abdominal tergum unspecialised. Supraanal plate trapezoidal (Fig 11B), hind margin deflexed medially, not extending beyond hind margin of subgenital plate; intercercal ridge large, pale or darkly sclerotised, with or without a medial indentation, and with dense group of small spines on rounded free margin; paraprocts dissimilar, right one with a robust, curved, apically acute process (Fig. 11B). Subgenital plate trigonal, apex bearing a small knoblike right style, left style slightly longer, both with some small dark spines (Fig. 11D). Genitalia as in Fig. 11D: hook on left side with a subapical incision, basal arm slightly wider than hook portion; median phallomere with an acute, darkly sclerotised apex; right phallomere with a reduced cleft sclerite.

Colouration. Light brown.

Female. Unknown.

Measurements. Length, 15.6-16.4; pronotum length x width, 3.8-4.0 x 5.1-6.0; tegmen length, 16.5-18.3.

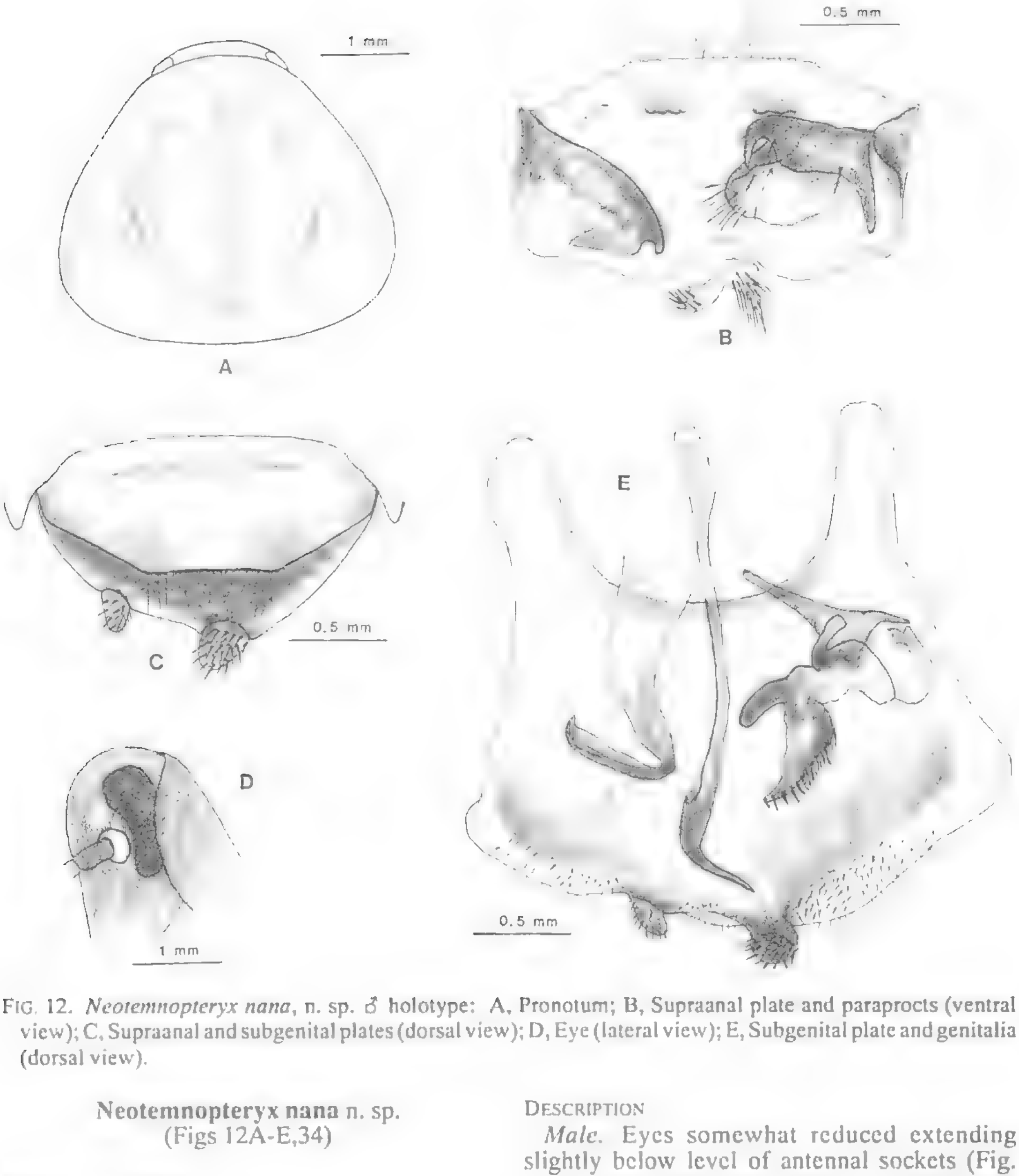


FIG. 12. *Neotemnopteryx nana*, n. sp. ♂ holotype: A, Pronotum; B, Supraanal plate and paraprocts (ventral view); C, Supraanal and subgenital plates (dorsal view); D, Eye (lateral view); E, Subgenital plate and genitalia (dorsal view).

Neotemnopteryx nana n. sp.
(Figs 12A-E,34)

MATERIAL EXAMINED

HOLOTYPE: ♂ (terminalia slide 51), Braemar S.F., via Kogan, SE Queensland, 15-19.x.1979, G.B. Monteith and QM; in QMBA.

ETYMOLOGY

The specific name refers to the small size of the species.

DESCRIPTION

Male. Eyes somewhat reduced extending slightly below level of antennal sockets (Fig. 12D), interocular space distinctly greater than interocellar space. Pronotum subparabolic (Fig. 12A), sides deflexed, posterolateral and hind border regions transparent. Cubitus vein of hind wing with 2 (1 bifurcate) or 3 complete, and 3 incomplete branches. Front femur Type A3; pulvilli on 4 proximal tarsomeres, tarsal claws symmetrical, simple, arolia present. First abdominal tergum with large setal specialisation. Seventh

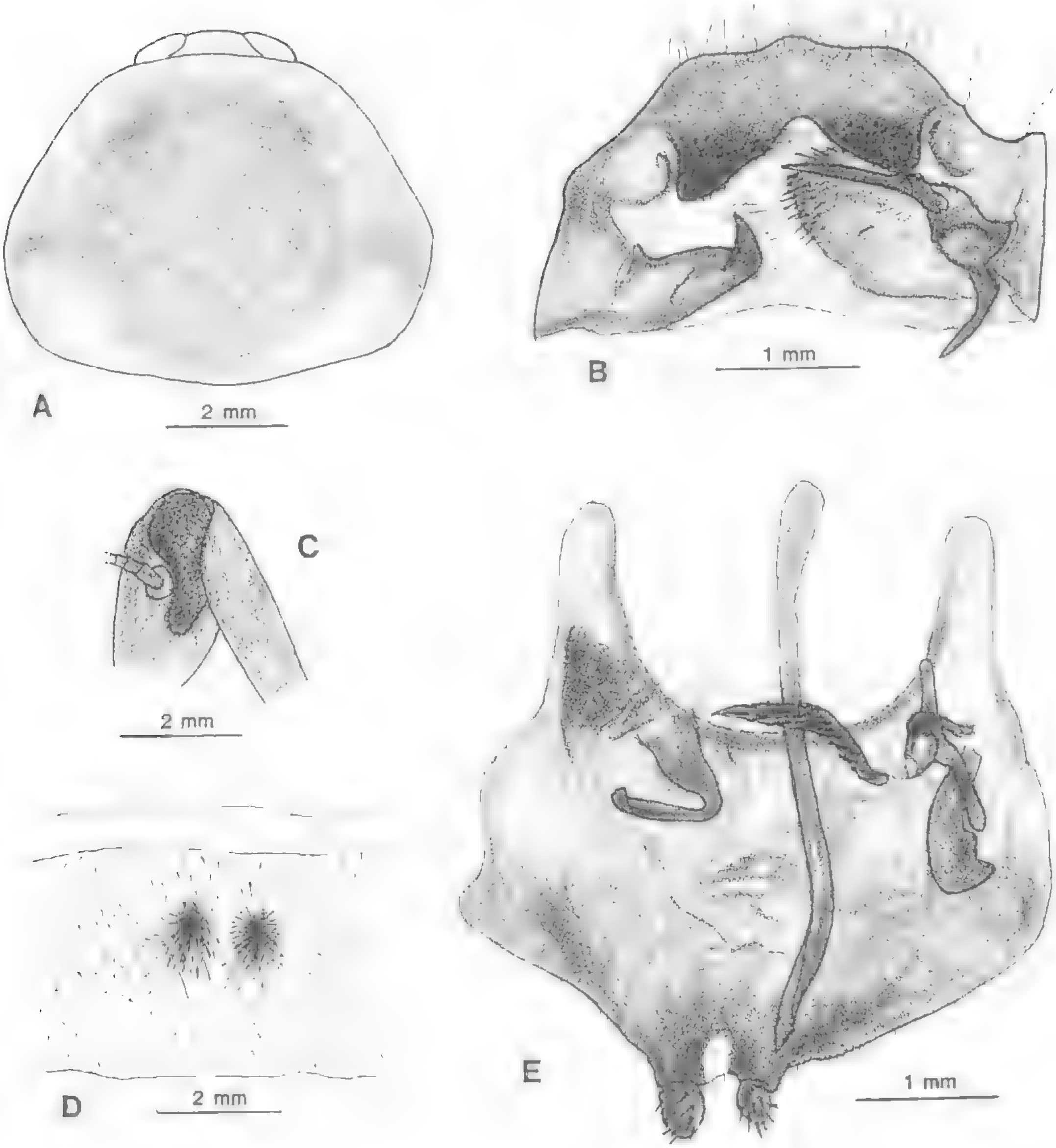


FIG. 13. *Neotemnopteryx stylipareda*, n. sp. ♂♂: A, Pronotum; B, Supraanal plate and paraprocts (ventral view); C, Eye (lateral view); D, Setal gland on seventh abdominal tergum; E, Subgenital plate and genitalia. Localities: A, C, Holotype, Wongabel State Forest, Qld; B, D, E, Paratype, 21 km south of Atherton, Qld.

abdominal tergum unspecialised. Supraanal plate transverse, trapezoidal, with horizontal groove on anterior half, hind margin not reaching hind margin of subgenital plate (Fig. 12C); intercercal ridge practically obsolete, represented by pair of thin, lightly sclerotised plates with only a few minute spicules; right and left paraprocts are dissimilar (Fig. 12B). Subgenital plate broadly asymmetrically rounded, right style stouter than left one (Fig. 12C,E). Genitalia as in Fig. 12E: hook on left side; median phallomere with curved, darkly sclerotised acute apex; right phallomere with cleft sclerite.

Colouration. Head brownish between eyes and medially on face, cheeks pale. Pronotum yellowish brown. Tegmina and wings dark brown.

Female. Unknown.

Measurements. Length, 12.5; pronotum length x width, 3.4 x 3.8; tegmen length, 14.7.

REMARKS

This is the smallest known species of *Neotemnopteryx*.

Neotemnopteryx styliparedra n. sp.
(Figs 13A-E,34)

MATERIAL EXAMINED

HOLOTYPE ♂, Wongabel State Forest, near Atherton, Queensland, 17.20S 145.31E, 18.xi.1981, J. Balderson; in ANIC.

PARATYPES: QUEENSLAND. QMBA: 21km S of Atherton, 1040-1100m, 1♂ (terminalia slide 50), D.K. Yeates and G.I. Thompson; Bellenden Ker Range, Cable Tower 5, 500m, NE Queensland, 1♀, x.-xii.1982, S. Montague; Kroombit Tops (Upper TA 47 Ck), 45km SSW Calliope, rain forest, 1♀, 9-19.xii.1983, G. Monteith and G. Thompson.

ETYMOLOGY

The specific name refers to the closeness of the styles.

DESCRIPTION

Male. Eyes extending below antennal sockets (Fig. 13C), interocular space less than distance between ocelli and antennal sockets. Pronotum subparabolic (Fig. 13A). Hind wing with 6 complete and 4 (1 bifurcate) incomplete branches. Front femur Type A_3; pulvilli on 4 proximal tarsomeres, tarsal claws simple, symmetrical, arolia present. Abdominal terga 1 and 7 with medial setal specialisations, the latter (Fig. 13D) smaller and less dense than former. Supraanal plate transverse, hind margin subtruncate with small medial projection, long slender setae along dorsal surface, and medioventrally; ventral surface with pair of large, dark, triangular, intercercal ridges, each densely covered with small spines or spicules; right paraproct with long, slender, spinelike process, left one with wider, shorter, apically upturned acute process (Fig. 13B). Subgenital plate with pair of closely spaced styles at apex, left one slightly more robust than right (Fig. 13E). Genitalia as in Fig. 13E: hook on left side with subapical incision; median phallomere rodlike, apex unmodified; right phallomere with reduced cleft sclerite.

Colouration. Chestnut brown. Subgenital plate and part of supraanal plate may be darkly infuscated. Hind wing with distal region of anterior field and most of costal vein area infuscated.

Female. Eyes wide apart, interocular space greater than distance between ocellar spots. Supraanal plate trigonal, apex rounded. Hind wing infuscated as in male.

Measurements (♀ in parentheses). Length, 20.8-21.0 (20.0-21.0); pronotum length x width, 5.4-5.7 x 6.6-7.0 (5.6-6.1 x 7.3-7.4); tegmen length, 23.5-27.0 (24.5-26.0).

REMARKS

The hind margin of the supraanal plate of *styliparedra* (Fig. 13B) is similar to those of *gloriousa* (Fig. 3B) and some specimens of *fulva* (Fig. 2D). The right paraproct (Fig. 13B) is like that of *bifurcata* (Fig. 6F), and the intercercal ridge (Fig. 13B) resembles that of *gloriousa* (Fig. 3B). The position and closeness of the styles at the apex of the subgenital plate distinguishes *styliparedra* from other species in the genus.

Neotemnopteryx douglasi (Princis) n. comb.
(Figs 14A-J,34)

Shawella douglasi Princis, 1963, p. 11, fig. 1 (♂); Richards, 1967, pp. 37, 38, 41.

MATERIAL EXAMINED

HOLOTYPE ♂, Jurien Bay, Western Australia, Limestone Caves, 30.17S 115.00E, ix.1958, associated with droppings of small cave dwelling bats, *Epicecus pumilus*, A.M. Douglas; Type no. 63-354, in WAMP.

WESTERN AUSTRALIA. WAMP: same data as holotype, 2 nymphs (det. as *Shawella douglasi* by Princis in 1961). ANIC: Smithies Cave, Jurien Bay, on guano, 1♂ (terminalia slide 40), 1♀ nymph, 14.xi.1964, B. Muir (det. as *Shawella douglasi* Princis by Mackerras).

DESCRIPTION

Male. Eyes variably reduced not reaching below level of antennal sockets (Fig. 14B,D), interocular space greater than distance between antennal sockets (Fig. 14C). Tegmina reduced in length, meeting along midline of body, tapering posteriorly to rounded apex which reaches to T5 or T7 (Fig. 14A). Hind wings vestigial, lateral, narrow, reaching T2 or hind margin of T3. Front femur Type A_3; pulvilli absent or with subobsolete pulvillus on fourth tarsomere; tarsal claws simple, symmetrical, arolia small. First abdominal tergum with large, dense group of setae medially (Fig. 14J). Seventh abdominal tergum unspecialised. Supraanal plate transverse, corners rounded, hind margin shallowly in-

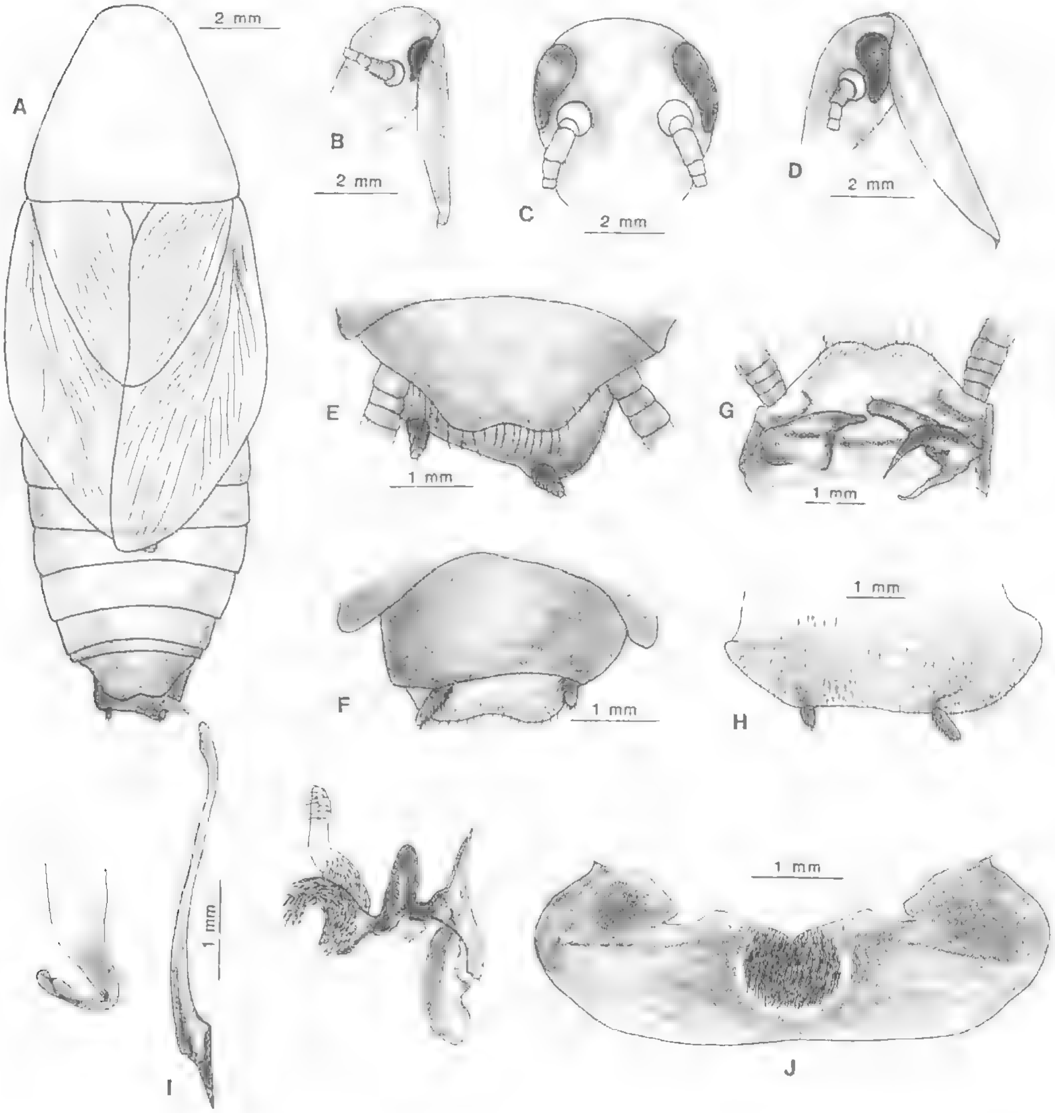


FIG. 14. *Neotemnopteryx douglasi* (Princis). ♂♂: A, Habitus; B-D, Eyes (lateral and frontal views); E, Supraanal and subgenital plates (dorsal view); F, The same (ventral view); G, Supraanal plate and paraprocts (ventral view); H, Distral region of subgenital plate, and styles (dorsal view); I, Genitalia (dorsal view); J, First abdominal tergum and setal gland. Localities: A, D, Holotype, Jurien Bay, W.A.; B, C, E-J, Smithies Cave, Jurien Bay, W.A.

dented, fringed with setae along edge, a dense group of small dark spines on distal ventral surface (Fig. 14E,F,G); right paraproct with pair of spinelike processes, intercercal ridge absent (Fig. 14G). Subgenital plate weakly asymmetrical, styles widely separated, right one slightly larger, both covered with small dark spines dorsally, interstylar margin straight (Fig. 14E,F,H). Genitalia as in Fig. 14I: hook on left side, with subapical incision; median phallomere apically acute; right phallomere with large setose sclerite.

Colouration. Light brown.

Female. Unknown.

Measurements (holotype in parentheses). Length, (17.5); pronotum length x width, (4.0 x 5.1) 6.2 x 6.4; tegmen length, (9.2) 13.0.

REMARKS

The eyes of the holotype are smaller than those of the large male from Smithies Cave (Fig. 14B,D). According to Princis, *douglasi* lacks pulvilli. This seems true for the holotype, but in the other specimen the fourth tarsomere appears to have a subobsolete pulvillus. As pointed out earlier, it is sometimes difficult to decide if pulvilli are completely absent. In *douglasi* the pulvilli regions, especially on the fourth tarsomeres, are lined on either side by a row of heavy spines, and in lateral view pulvilli appear to be absent. When viewed on their ventral surfaces, the apices of these segments are clear and colourless, and somewhat depressed (due to drying?). I have seen only 2 males, but it is possible that both eye reduction and loss of pulvilli could vary between populations of the same species, established in different caves. Individuals established longer in a particular cave might show greater loss of these structures (see races under *Paratemnopteryx stonei*).

The well developed specialisation on T1 and the shapes of the right paraproct and median and right phallomeres (cp. Figs 1D,J and 14G,I) indicate that *douglasi* evolved from a *Neotemnopteryx*- like ancestor.

Trogloblattella Mackerras

Trogloblattella Mackerras, 1967, p.39. Type species: *Trogloblattella nullarborensis* Mackerras, by monotypy.

DIAGNOSIS

Eyes greatly reduced or absent. Antennae very long. Tegmina and wings reduced. ♂: first abdominal tergum weakly specialised. Front femur with several large proximal spines followed by row of small piliform spinules, terminating in 3 large distal spines (Type B_3); pulvilli and arolia absent, tarsal claws simple, symmetrical. Male genitalia, subgenital plate and styles, paraprocts, and male and female supraanal plates similar to these structures in *Neotemnopteryx*.

REMARKS

Mackerras (1967, p.39) was correct in stating that *Trogloblattella* is related to surface dwelling *Neotemnopteryx* (*Gislenia*) and *Paratemnopteryx* (*Shawella*). However, its male genitalia, subgenital plate, styles, and paraprocts are closer to *Neotemnopteryx* than to *Paratemnopteryx*. In the only other known species, *Trogloblattella chapmani* Roth from Sarawak (Roth, 1980, p.97), the male subgenital plate and styles differ distinctly from those of *T. nullarborensis* and clearly did not evolve from a *Neotemnopteryx*-like ancestor.

Distribution of *T. nullarborensis* is shown in Fig. 35.

Trogloblattella nullarborensis Mackerras
(Figs 15A-I,35)

Trogloblattella nullarborensis Mackerras, 1967, p. 39, pl. 1A-D, figs 1-6 (♂ and ♀); Norris, 1970, p. 110, fig. 5.6.

HOLOTYPE (not examined)

♂, Western Australia, Abrakurrie Cave, about 24 miles WNW of Eucla, 27.ix.1966, D.C. and J. Lowry.

MATERIAL EXAMINED

WESTERN AUSTRALIA. ANIC: The following were determined by Mackerras, and most of them were reported in her paper under distribution but were not indicated as paratypes: Mullamullang Cave, Nullarbor, 1♀ (found dead about 1 mile in), 6.i.1966, J. Lowry, 1♀, Jan.1966, B. Robinson, 1♂, W Crowle, 1♀, 8.i.1965, E.G. Anderson; Abrakurrie Cave, about 24 miles WNW of Eucla, 1 nymph, 27.ix.1966, D.C. Lowry and J. Lowry; Thylacine Hole, 1♀, 12.viii.1966, 1 nymph, 23.x.1966, J. Lowry; Easter Extension, Mullamullang Cave, 1♂ (terminalia slide 80), 1.ix.1966, J. Lowry; Roaches Rest Cave, about 27 miles NE of Madura, 1♂, 29.viii.1966, D.C. and J. Lowry, and G. Hunt; Weebubbie Cave, 1 nymph, 3.x.1966, J. Lowry.

SOUTH AUSTRALIA. ANIC: Koonalda Cave, 31.24S 129.50E, 1♀, 11.x.1970, M.S. Upton and J.E. Feehan.

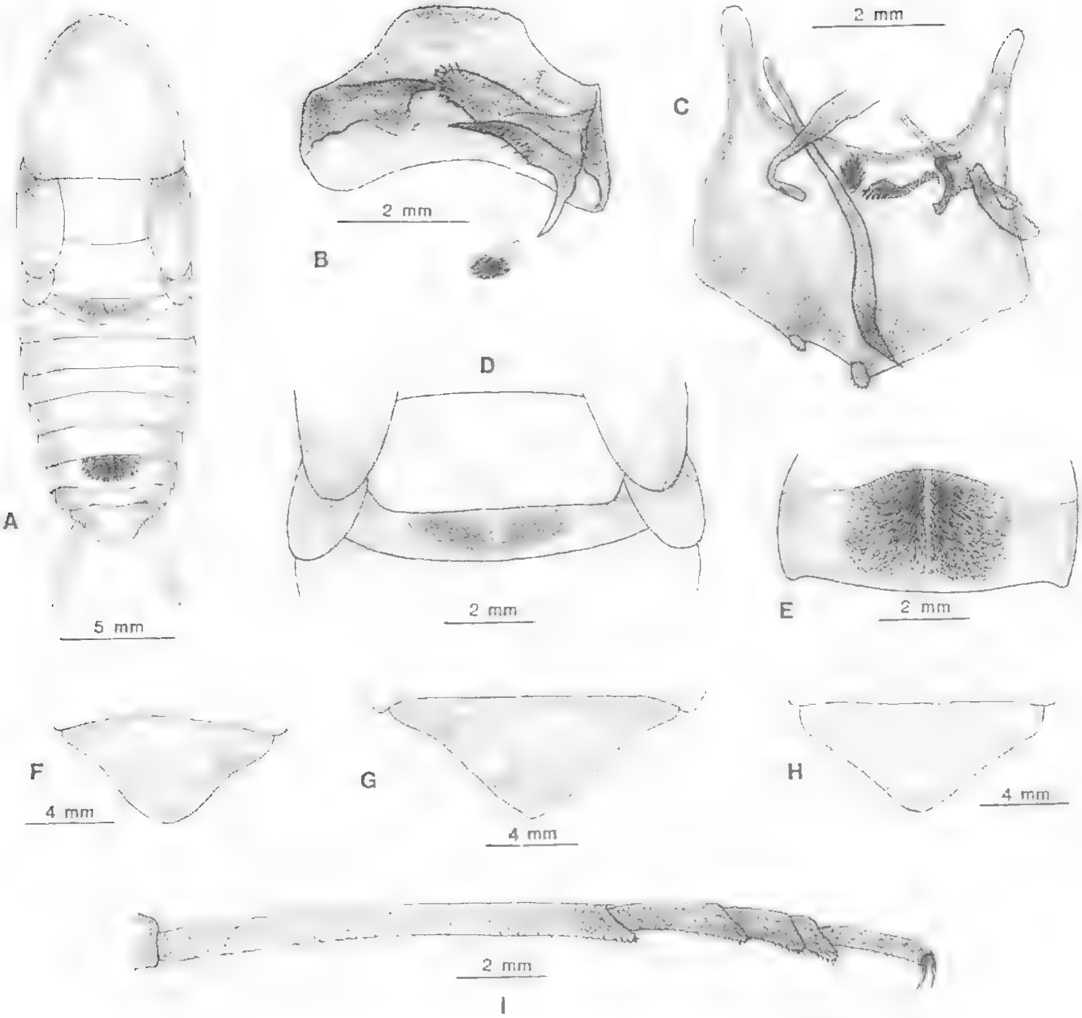


FIG. 15. *Trogloblattella nullarborensis* Mackerras. A-E, ♂♂ : A, Habitus; B, Supraanal plate and paraprocts (ventral view); C, Subgenital plate and genitalia (dorsal view); D, Hind wing region showing reduced tegmina (in part) and hind wings, and glandular region on first abdominal tergum; E, Gland on seventh abdominal tergum; F-I, ♀♀: F-H, Supraanal plates (dorsal views); I, Tarsus. Localities: A, Roaches Rest Cave, W.A.; B-E, H, I, Mullamulang Cave, W.A.; F, Koonalda Cave, S.A.; G, Thylacine Hole, W.A.

DESCRIPTION

Male. Eyes and ocelliform spots absent. Antennae considerably longer than abdomen. Tegmina narrow, leaf-like, almost reaching hind margin of metanotum, venation obsolete; hind wings resemble tegmina in colour and texture, smaller, reaching to about middle of T1 or T2 (Fig. 15A). Front femur Type B$_3$; pulvilli and arolia absent (Fig. 15I). First abdominal tergum weakly specialised with a medial elliptical shallow depression divided medially by low, rounded, tapering, longitudinal ridge, which may or may not have a few setae anteriorly (Fig. 15D). Seventh abdominal tergum with a huge, round, medial depression filled with setae, and occupying most of segment (Fig. 15A,E). Supraanal plate subtrapezoidal, hind margin slightly deflexed (Fig. 15B); paraprocts as in Fig. 15B.

Subgenital plate weakly asymmetrical, styles dorsally spined, small, right one slightly larger and located in middle of hind margin (Fig. 15C). Genitalia as in Fig. 15C: hook on left side; median phallomere apically acute; right phallomere with a small setose plate and subobsolete cleft sclerite.

Colouration. Yellowish brown to brown.

Measurements (Mackerras's measurements in parentheses). Length, 22.0 (24.0-27.5); pronotum length x width, 7.0-8.0 x 7.3- 8.4 (9.0 x 10.0), tegmen length, 5.1-5.8 x 2.4-2.9 (7.0 x 4.0).

Female. Much larger than male. Supraanal plate broad basally, sides tapering to a subacute or rounded apex (Fig. 15F- H).

Measurements (Mackerras's measurements in parentheses). Length, 32.5-38.5 (34.0-38.5); pronotum length x width, 10.0-12.0 x 10.1-12.5 (13.0 x 13.0); tegmen length x width, 8.2-9.5 x 3.7- 5.0 (11.0 x 5.5).

Paratemnopteryx Saussure

Paratemnopteryx Saussure, 1869, p. 273; Kirby, 1904, p. 106; Shelford, 1908b, p. 9; Princis, 1954, p. 35. Type species: *Paratemnopteryx australis* Saussure, by monotypy.

Shawella Princis, 1951, p. 61; 1954, p. 35. Type species: *Blatta couloniana* Saussure, Princis, 1951, p. 61). N. Syn.

Franwalkeria Princis, 1954, p. 34. Type species: *Franwalkeria glauerti* Princis, by monotypy. N. Syn.

REMARKS

The armament on the front femur, and hind wing venation in fully winged forms of *Paratemnopteryx*, *Shawella*, and *Franwalkeria* are similar. Male characters such as style morphology and their placement on the subgenital plate, morphology and position of the setal gland on T1, and the genital phallomeres also show basic similarities. The principal characters used by Princis to distinguish these 3 nominal genera are the degree of reduction of the tegmina and wings, and the presence or absence of pulvilli and arolia. I have discussed, under diagnostic characters, why these characteristics cannot be used as distinguishing characters in these taxa, and therefore I am synonymising them.

Princis (1969, p.732) listed 5 species of *Paratemnopteryx*, one with a query. Two of these species are synonyms. I recognise 10 species of which 4 are new and 3 are new combinations. Three of the taxa are cavernicolous. Some of the epigean species have reduced eyes and lack pulvilli and or arolia, and apparently are preadapted for cave dwelling. Based on front femur type, hind wing venation, male genital phallomeres and style morphology, *Paratemnopteryx* is closely related to *Neotemnopteryx*. Distribution of *Paratemnopteryx* species is shown in Fig 35; *Paratemnopteryx centralensis* also occurs in New Guinea.

DIAGNOSIS

Eyes usually somewhat reduced, not extending below level of antennal sockets (Figs 16D,18A,24B), sometimes well developed extending below level of antennal sockets (Figs 29A,30A,31A). Tegmina reduced with hind wings smaller or vestigial (Fig. 16E,G), or both completely developed reaching beyond end of abdomen (Fig. 31B); in fully developed tegmina and wings, discoidal sectors of former oblique (Fig. 31E); hind wing with discoidal, median and cubitus veins straight, latter with 2-4 complete and 0 (rarely) to 4 incomplete branches, apical triangle absent (Figs 16A,20F,30F). Anteroventral margin of front femur usually Type A_3, rarely Type A_2; pulvilli present on 4 proximal tarsomeres (Fig. 18H), or absent from some or all segments (Fig. 18G), arolia present (Fig. 16I), or absent. ♂: First abdominal tergum usually modified, rarely unspecialised; when present, gland area consisting of setae arranged along anterior border of tergum, sometimes partly hidden by overlapping hind margin of metanotum (Figs 17B,27C), or grouped anteromedially (Fig. 30D). Seventh abdominal tergum usually unspecialised, rarely with large dense group of setae, medially (Figs 18B,27A). Supraanal plate symmetrical without intercercal ridge on ventral surface; paraprocts dissimilar (e.g. Fig. 17C). Right and left styles usually similar, or almost so, widely separated, symmetrically placed on hind margin of subgenital plate (e.g. Fig. 17D,E). Hooklike genital phallomere on left side. Ootheca rotated prior to deposition.

Based on male characters, species of *Paratemnopteryx* can be arranged in the following species-groups:

1. *couloniana* species-group. Right and left styles similar in size, covered in part with short dark spines.

A) Supraanal plate with hind margin truncate, rounded, or with a shallow indentation. Right paraproct similar to that shown in Fig. 17A.

a) Seventh abdominal tergum specialised. Pulvilli present or absent, arolia present. Species: *stonei*.

The following lack a specialisation on T7

b) Pulvilli and arolia present. Species: *couloniana*.

c) Pulvilli present, arolia absent. Species: *glauerti*.

d) Pulvilli and arolia absent. Species: *atra, australis, rufa*.

B) Supraanal plate with hind margin deeply excavated, right paraproct as in Fig. 28A. Right genital phallomere as in Fig. 28B. Seventh abdominal tergum specialised. Pulvilli and arolia present. Species: *broomehillensis*.

2. *centralensis* species-group. Styles very small, similar, cylindrical (Fig. 31D), or dissimilar, right one bearing long, curved setae, left one minute, cylindrical, without long setae (Fig. 30E). Right genital phallomere as in Figs 29B,30G,31D. First abdominal tergum with or without specialisation. Species: *centralensis, howarthi, suffuscula*.

This group, originally containing only *centralensis*, was in the genus *Symploce* (Roth, 1985b, p.300).

KEY TO MALES OF *PARATEMNOPTERYX*

1. Styles large, similar in shape, partially covered with short, dark spines (e.g. Figs 17E,23D) 2

Styles small, cylindrical, similar (Fig. 31D), or dissimilar (Fig. 30E) 8

2. Seventh abdominal tergum with large, dense, setal specialisation (Figs 18B,27A) 3

Seventh abdominal tergum unspecialised 4

3. Hind margin of supraanal plate shallowly concave (Fig. 18C). (cavernicolous) .... *stonei*

Hind margin of supraanal plate with U-shaped excavation (Fig. 27B)(epigean) .... *broomehillensis*

4. Arolia present. Supraanal plate with apex of hind margin narrow, concavely excavated (Fig. 17B). (epigean) .... *couloniana*

Arolia absent. Supraanal plate not as above .. 5

5. Pulvilli present. Tegmina and wings fully developed. (epigean) .... *glauerti*

Pulvilli absent or subobsolete 6

6. Supraanal plate broadly rounded (Fig. 22D). Tegmina not quite reaching tip of abdomen, tapering towards rounded apex (Fig. 22A). (cavernicolous) .... *atra*

Hind margin of supraanal plate not as above. Tegmina shorter, reaching hind margin of T2 or T3 (Fig. 24A) 7

7. Hind margin of supraanal plate almost truncate, corners rounded (Fig. 24E). (epigean) .... *rufa*

Hind margin of supraanal plate shallowly concave (Fig. 23C). (epigean) .... *australis*

8. Styles similar, cylindrical (Fig. 31D). First abdominal tergum unspecialised. (epigean) .... *suffuscula*

Styles dissimilar, right one with curved setae, left one smaller, sometimes subobsolete, without curved setae (Fig. 30E). First abdominal tergum specialised (Fig. 30D) 9

9. Supraanal plate broadly rounded (Roth, 1984: figs 18A,19F). Pulvilli present on 4 proximal tarsomeres. (epigean) .... *centralensis*

Supraanal plate trigonal (Fig. 30H). Pulvilli absent. (cavernicolous) .... *howarthi*

Paratemnopteryx couloniana (Saussure) n. comb. (Figs 16A-H,17A-H,35)

Blatta couloniana Saussure, 1863, p. 150, pl. 1 fig. 14 (♂ and ♀); Walker, 1868, p. 87.

Periplaneta concinna (*nec* Haan, 1842): Brunner, 1865, p. 229 (♂); Princis, 1969, p. 731.

Temnopteryx couloniana (Saussure), 1869, p. 240; Walker, 1871, p. 18; Tepper, 1894, p. 170; Kirby, 1904, p. 104.

Blatta brunneri Kirby, 1903, p. 375; 1904, p. 139; Princis, 1954, p. 35.

Ceratinoptera couloniana (Saussure): Shelford, 1908b, p. 19.

Shawella couloniana (Saussure): Princis, 1951, p. 62 (♂); 1954, p. 35; McKittrick, 1964; Roth, 1968, p. 110, fig. 106 (ootheca); Johns, 1966, pp. 95, 96, 134.

Paratemnopteryx blattoides Tepper, 1895b, p. 150. N. Syn.

Paratemnopteryx australis (*nec* Saussure): Tepper, 1895b, p. 149 (♂) (misidentification).

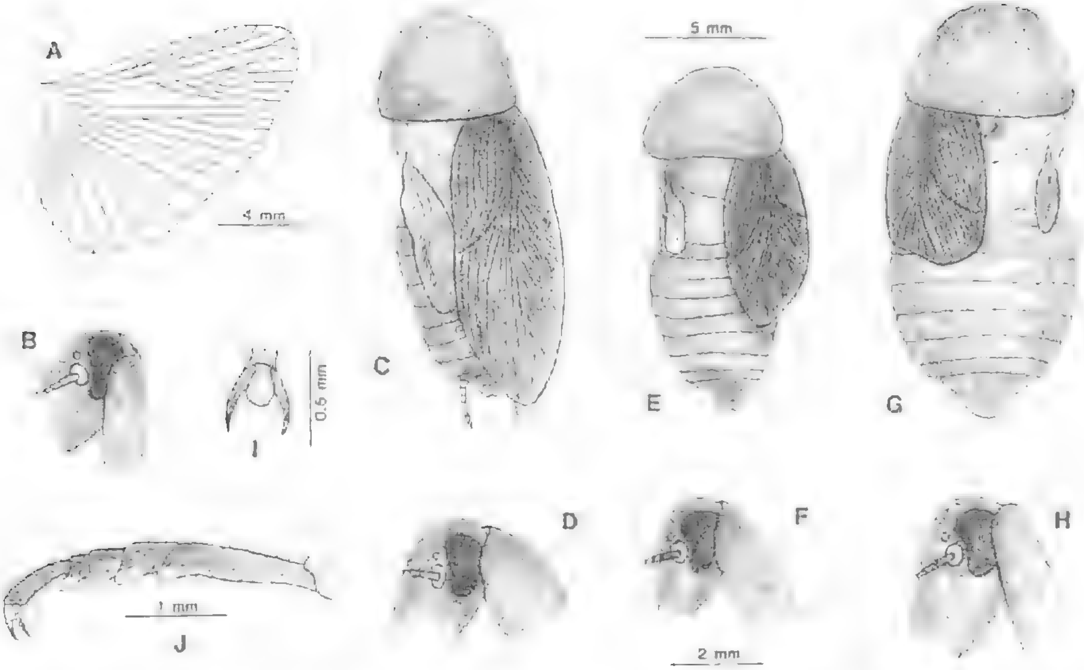


FIG. 16. *Paratemnopteryx couloniana* (Saussure). A-F, ♂♂: A, Fully developed hind wing; B, Eye (lateral view) from ♂ with fully developed hind wings; C, D, Habitus (left tegmen removed) and eye (lateral view); E, F, The same; G, H, ♀, habitus (right tegmen removed), and eye (lateral view); I, Tarsal claws and arolium (frontal view); J, Tarsus (lateral view). Localities: A, B, 31 km west northwest of Tenterfield, N.S.W.; C, D, Canberra, A.C.T.; E, F, Black Mt., A.C.T.; G, H, Eildon, Victoria; I, J, Same as A, B.

Methana sp., May, 1963, p. 44, fig. 3 (misidentification); Johns, 1966, p. 134.

REMARKS

Shelford examined Tepper's syntypes of *Paratemnopteryx blattoides* and correctly concluded that one of the adults was a male of '*Ceratinoptera*' *couloniana* (Saussure). However, he incorrectly believed that the other male, which Tepper described as a female, was a valid specimen of *blattoides*. Actually this specimen also is *couloniana*. Shelford apparently was misled by the fact that the lectotype has fully developed tegmina and wings, whereas the paralectotype is brachypterous. Also the characteristic concavely excavated apex of the supraanal plate, typical of *couloniana*, and distinct in the paralectotype of *blattoides*, is not clear in the lectotype because the edges of the plate are curled upwards and the weakly concave apex looks slightly different. The third syntype of *blattoides* is a nymph with the same locality as the adults; it is badly damaged and labelled *Paratemnopteryx ?blattoides*. It is not a *Paratemnopteryx*; there are no spines on the posteroventral margins of front and mid femurs (hind legs missing), and the anteroventral margin of the front femur has piliform spinules only and one large distal spine (Type C_1).

MATERIAL EXAMINED

All specimens are brachypterous unless indicated as macropterous (macr.): AUSTRALIA. MHGN: ♂ lectotype (here designated) and 1♀ paralectotype of *Blatta couloniana* Saussure.

VICTORIA. NMVM: Narre Warren, ♂ (macr.) lectotype (here designated), and 1♂ (incorrectly labelled ♀) paralectotype of *Paratemnopteryx blattoides* Tepper (the lectotype has a handwritten label 'copy from above', i.e., copy from the label on the paralectotype which states '*Ceratinoptera couloniana*' Sauss.; Tepper describes 2♂♂ as opposite sexes of *blattoides*. His ♀ = '*Cerat. couloniana* Sauss., det. by Shelford, sent xii.1907'. The paralectotype also has a label 'sent to Shelford, xii.1907; see other specimen of Tepper with note by Shelford.'). ANIC: 2 MacAlistair Crt, Surrey Hills, 1♂, inside house, 2.xi.1981, M.R. Harvey; Snobs Creek Fish Hatchery near Eilden, 1♀, inside building, 13.ii.1979, M.R. Harvey; Swift's Crk, 1♀, 10.x.1949, T.G. Campbell; Glen Wills, 20km E of Falls Creek, 1♂, 13.ix.1972, M. Schwartz. The following were collected by H.M. Cane: 28 miles NNE of Cavendish, 1♂, 1♀, 11.iv.1951; Mangalore, 1♀, 9.iv.1951. SAMA: Victoria, 1♀, C. French (incorrectly reported as *Paratemnopteryx australis Sauss.* by Tepper, 1895, p.150). MCZH: Melbourne, 1♂ (macr.), H. Edwards.

New South Wales. ANIC: Dorrigo, 1♂ nymph, 21.iii.1954, E.F. Riek; Armidale, 1♂ (macr.), 1.i.1960, C.W. Frazier; Avalon, 1♂, 1♀, 7.xii.1951, M.F. Day; Bankstown, 1♂, 1♀, xi.1953, Holmes; Coolamon, 1♂ (macr.), to light, 8.i.1954, A.L. Dyce; 65km NW of Nyngan, 1♂ (macr.), 21.x.1949, E.F. Riek; 31km WNW of Tenterfield, 1♂ (macr.), 23.xi.1983, D.C.F. Rentz and M.S. Harvey; Nullo Mt., 20 miles NE of Rylstone, 1♂, 11.xi.1950, T.G. Campbell; 16 miles E of Bungendore, 1♀, 18.xii.1951, H.M. Cane; Hearne Bay, Georges River, 1♀, 6.i.1941, Mrs Day; Sydney, 2♀♀ nymphs, 20.v.1925, W.W. Froggatt; Sutherland, 1♂ nymph, xi.1927, M. Fuller; Braidwood, 1♀ nymph, 3.viii.1949, F.J. Gay; Nelligen, 1♀ nymph, 13.viii.1949, 2♀♀ nymphs, 16.iv.1949, K.H.L. Key, 1♀ nymph, 3.xi.1949, Cane and Gemmell. The following were collected by H.M. Cane: 4 miles SE of Braidwood, 1♀ nymph, 4.iii.1953; Gundy, 1♂ and 1♀ nymphs, 5.iv.1949; Towamba, 2♀♀ nymphs, 27.iv.1949; 3 miles SSW of Bega, 3♂♂ and 3♀♀ nymphs, 27.iv.1949. DARA: Bass Hill, 1♂ (macr.), 1♀, 2.xii.1953; Roseville, 1♂ (macr.), infesting house, 30.xii.1952; Dapto, 2♀♀, 2.ii.1956; Sydney, 1♀, ii.1961; Gladesville, 1♀ (with ootheca), infesting house, 14.i.1953, R. Wilson; Herne Bay, 1♀, 7.ix.1952; Waratah, 1♀, 1 nymph, infesting house, 5.xi.1952, R. Golledge; Belfield, 1♀ (with ootheca), in house, 29.i.1954; Seven Hills, 1♀, 3.xii.1953, Mrs E. Grudnoff; Bankstown, 1♂, 26.xi.1953; Eastwood, 1♂, 2.xii.1953; East Hills, 4 nymphs, 6.iii.1953, 1 nymph in house, 11.iii.1954; 'Gilbula', 16km S of Campbelltown, 1 nymph, 1.vii.1984, S.G. Hunter; Berridale, 1♂, 20.xi.1961; Bankstown, 2♂♂, 16.xi.1954; Wollongong; 1♂, eating papers in cardboard, 9.xii.1960; Nundle, 1♀, 13.xi.1958; Punchbowl, 1♂, indoors, infesting linen cupboards, also noticed outside underneath wood, etc., 9.xii.1954, Caller; Seven Hills, 1♂, in house, 7.i.1961; Wahroonga, 1♂, 7.xi.1952, H.M. Bungham; Cammeray, 1♀, 21.x.1957; Clovelly, 1♂, 25.xi.1959, W.E. Wright; Northbridge, 1♂, x.1950, 1♂, 14.v.1951; Groman, 1♂, 6.xi.1958, T.V. Bourke; Springwood, 1♀, 19.xi.1954; Beverly Hills, 1♂, 1♀ nymph, 24.i.1955; Blacktown, 1♂ nymph, 22.iii.1964; Forestville, 3♂♂ and 1♀ nymphs, indoors, 16.iv.1962, Mrs Holder; Rydalmere, 1♀ nymph, attacking dried insects in collection, 5.ix.1962, M.J. Nikitin; Blacktown, 1♂ and 1♀ nymphs, under bricks, 8.vi.1975, J.A. Longley; Lalor Park, 2♂♂ nymphs, 2.v.1961; Narwee, 1♂ nymph, infesting house and believed to be damaging articles of clothing, 8.iv.1954, A.R. Wood. The following were collected by C.E. Chadwick: Dapto, 2♀♀, in house at night, 22.xi.1957; Wollongong, 1♂, under bark of *Eucalyptus*, 15.x.1950; Beverley Hills, 2♂♂, 1♀ nymph, in house, iv.1951; Lismore, 1♂, in garage, 10.x.1965; North Ryde, 1♀, 28.iii.1975, 1♀, 20.ii.1975. SAMA: Sydney, 1 nymph, labelled *Paratemnopteryx australis* Sauss., by Tepper, 19.ix.1894, Froggatt, 1♀, Lea.

South Australia. ANIC: Ardrossan (Browns Scrub), 1♂, 1♀ (with ootheca), 1♀ (genitalia slide 45), 1♂, 24.vii.1979, H.M. Cameron; Ardrossan, 1♀ nymph, 31.viii.1949, 1♀, i.1950, 1♀, 5.i.1951, H.M. Cane; no exact locality, 2♂♂, 2-12.i.1952, H.M. Cane. SAMA: Adelaide, public library, 1♂ (macr.) (incorrectly reported as *Paratemnopteryx australis* Sauss, by Tepper, 1895b, p.149. DARA: Gawler, 1♂, under bark of *Eucalyptus* sp., 24.xii.1967, C.E. Chadwick.

Queensland. ANIC: 15km S by W of Charleville, 26.32S 146.12E, 1♂ (macr.), 21.x.1975, M.S. Upton.

Australian Capital Territory. ANIC: Canberra, 1♂ (macr.), 21.xii.1951, 1♂ (terminalia slide 41), 4♀♀ (1 with genitalia slide 42), E.F. Riek, 1♂, xii.1949, 1♀, 2♀♀ nymphs, 14.vii.1949, H.M. Cane, 2♀♀, iii.1944, D.F. Waterhouse, 1♀, 15.xi.1954, H.M Cameron, 1♀, 8.i.1950, 1♀, 19.ii.1950, K.H.L. Key, 1♂, xii.1931, 1♀ nymph, in house, ii.1964; Canberra (Downer), 1♂, 2♀♀, 14.i.1968, K.H.L. Key; Canberra (Farrer), 35.22S 149.05E, 1♀, 2.ii.1984, 1♀, 21.ii.1984, D.C.F. Rentz; Canberra (Turner), 1♀, 8.iv.1984, A.M. Hastings; Tinbinbilla, 1♀, 17.ix.1950, H.M. Cane; Black Mt., in glass house, CSIRO, 1♂, 1♀, viii.1948, R.W. Kerr, 1♂, 21.x.1949, 1♂, x.1949, 'culture parent adults from Black Mt. and CSIRO Labs, ACT, killed 20.xi.1950', 11♂, 2♀♀, 5♂♂ and 3♀♀ nymphs, 24.vii.1949, 2♂♂ and 1♀ nymphs, 7.x.1949, 1♀ nymph, 21.x.1949, H.M. Cane, 1♂ nymph, 13.ix.1949, I.F.B. Common; Cotter R., 2♀♀ nymphs, 16.xi.1949, H.M. Cane; Tinbinbilla Ck, 2♀♀ nymphs, 17.vii.1949, E.F. Riek; Canberra (Deakin), 18♂♂, 4 nymphs, 2.xi.1983, E.B. Britton.

Description

Male. Eyes extend to about level of antennal sockets in macropterous and brachypterous morphs (Fig. 16B,D,F). Tegmina normal width, usually reduced in length reaching hind margin T5, wings more reduced, narrow, reaching T1 (Fig. 16E); rarely, reduced tegmina are longer

TABLE 2. Measurements of *Paratemnopterex couloniana.*

	Length	Pronotum length x width	Tegmen length
macropterous (♂)	13.2-15.5	3.7-4.7 x 5.0-5.8	12.0-15.5
brachypterous (♂)	12.8-17.8	3.6-4.8 x 5.3-6.8	6.7-11.0
brachypterous (♀)	15.8-20.9	4.5-5.7 x 6.8-7.6	5.4-7.5

reaching T7 or supraanal plate, in which case hind wings longer and wider, reaching T2, or between T3 and T4 respectively; some individuals have fully developed tegmina and the wings reach about middle of abdomen (Fig. 16C) or end of abdomen, if latter, median vein is simple or bifurcate apically, cubitus vein with 3-4 complete and 0-1 incomplete branches, apical triangle absent (Fig. 16A). Front femur Type A3; pulvilli distinct on 4 proximal tarsomeres (Fig. 16J), arolia present (Fig. 16I,J). First abdominal tergum with setae grouped transversely along thickened anterior margin of segment, partly hidden by overlapping edge of metanotum (Fig. 17B). Seventh abdominal tergum unspecialised. Supraanal plate shallowly convex, raised portion delineated from flattened border by shallow groove paralleling tapering margins of plate, hind margin apex shallowly concave (Fig. 17A), sometimes almost rounded. Dissimilar paraprocts as in Fig. 17C. Subgenital plate symmetrical, transverse, styles similar, symmetrically placed, widely separated on either side of midline, suberect, or usually curved, apices lateral, interstylar margin straight (Fig. 17D,E). Genital phallomeres as in Fig. 17F: hook on left side with subapical incision; median phallomere rodlike, apex blunt, unmodified; right phallomere with cleft and spined sclerite.

Colouration. Dark brown or dark reddish brown.

Female. Eyes reduced reaching to about level of antennal sockets (Fig. 16H). Tegmina reaching to middle of T2 or T3; hind wings narrow, vestigial (Fig. 16G). I have seen no macropterous females. Supraanal plate trigonal, apex rounded (Fig. 17G). Genitalia as in Fig. 17G: right paratergite with an enlarged sclerotised plate (arrow). Ootheca rotated prior to deposition; dark reddish brown, 18 small, rounded teeth in keel, 17 egg cells, 3.5mm high, 5.6mm long (Fig. 17H).

Nymph. Resembles adult but lacks pulvilli, arolia and tegmina and wings.

Measurements. See Table 2.

REMARKS

Brachypterous morphs of *P. couloniana* are more common than macropterous forms. All macropterous morphs are males, and the hind wings of brachypterous individuals in both sexes are smaller, usually rudimentary, than the reduced tegmina. Collection data suggest that this species may be domiciliary, and is the most common and widespread member of the genus. Outside of Australia, the species was introduced and is established in New Zealand (Johns, 1966, p.134).

Paratemnopteryx stonei n. sp.
(Figs 18A-H,19A,B,35)

MATERIAL EXAMINED

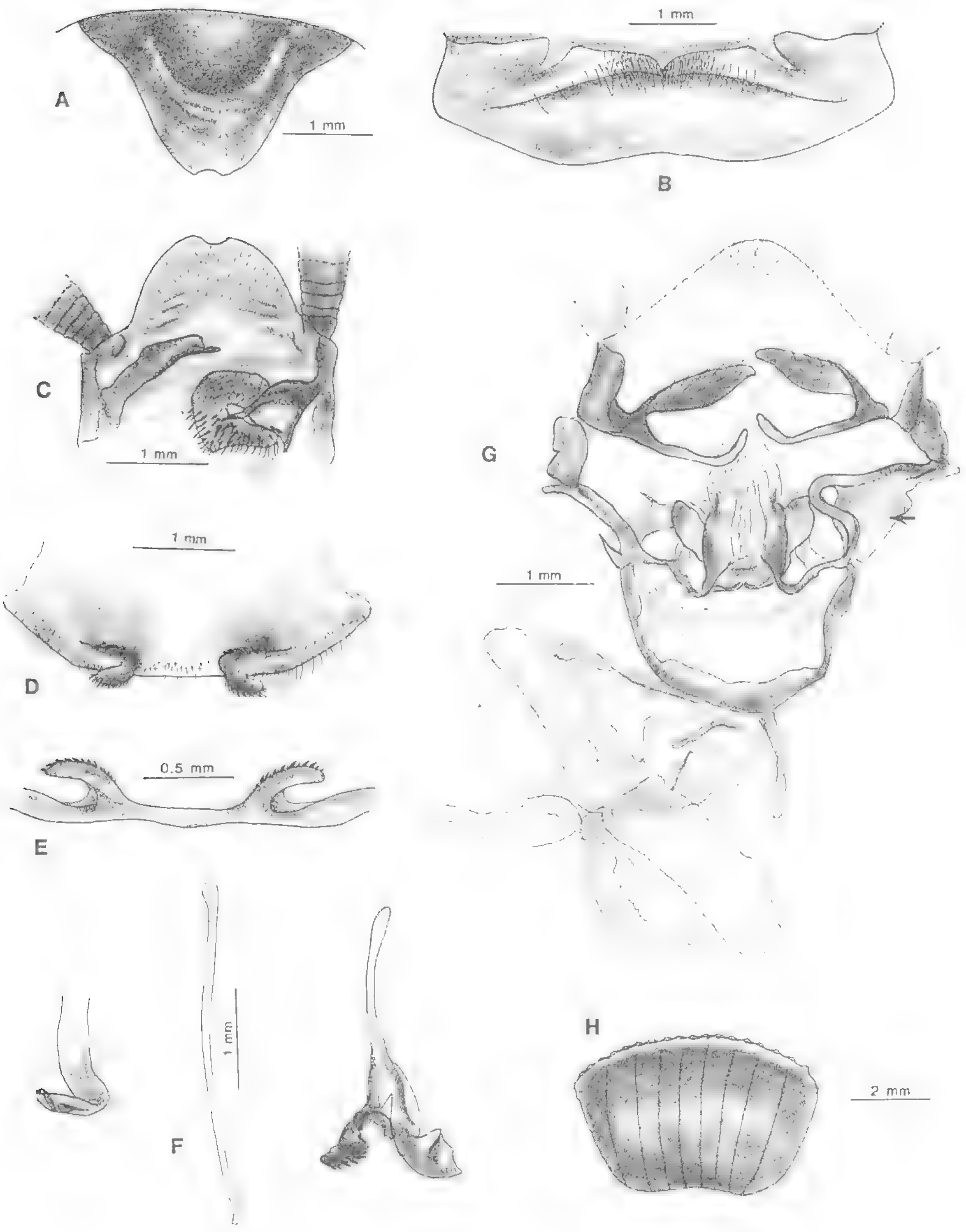
HOLOTYPE: ♂, Chillagoe Caves National Park, Royal Arch Cave, RA-117, NE Queensland, Australia, 6.vi.1985, F.D. Stone; in QMBA.

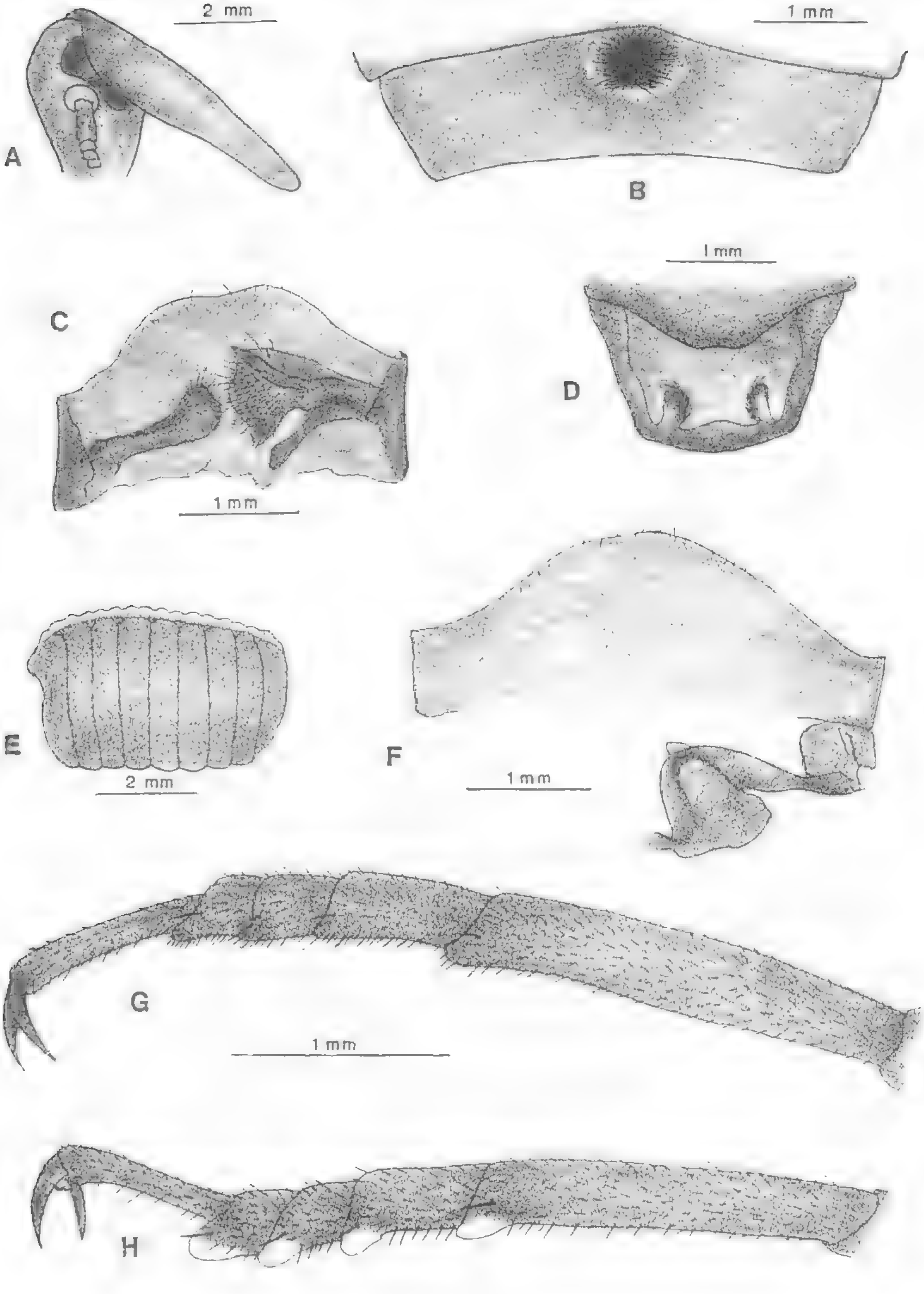
PARATYPES: QUEENSLAND. QMBA: same data as holotype, 3♂♂, 5♀♀ (1♂, 1♀, retained at MCZH); Royal Arch Cave, 1♀, 7 nymphs, 2.viii.1984, F.D. Stone, T. Connery, and N. Sullivan, 2♀♀, 1 nymph, 2.vii.1984, F.D. Stone, 1♂ (terminalia slide 46), 4♀♀ (1 with genitalia slide 47), 2♂♂ and 4♀♀ nymphs, 19.vii.1982, Explorers Club, 3♀♀, 1♂ and 2♀♀ nymphs, 29.v.1985, F.D. Stone, F.G. Howarth, and K. Eipel.

ETYMOLOGY

The species is dedicated to Dr F.D. Stone of

FIG. 17. *Paratemnopteryx couloniana* (Saussure). A-F, ♂♂: A, Supraanal plate (dorsal view); B, First abdominal tergum and setal specialization; C, Supraanal plate and paraprocts (ventral view); D, Distal region of subgenital plate, and styles (dorsal view); E, Styles (rear view); F, Genitalia (dorsal view); G, ♀, supraanal plate and genitalia (ventral view; arrow indicates enlarged region of right paratergite; H, Ootheca. Localities: A, B, E, Bankstown, N.S.W.; C, D, F, Canberra, A.C.T.; G, Ardrossan (Browns Scrub), S.A.; H, Belfield, N.S.W.


A
1 mm
1 mm
B
C
1 mm
G
1 mm
D
0.5 mm
E
1 mm
F
H
2 mm


2 mm
A
1 mm
B
1 mm
C
1 mm
D
E
2 mm
F
1 mm
G
1 mm
H

the University of Hawaii, who collected some of the specimens.

DESCRIPTION

Male. Eyes developed, not reaching below level of antennal sockets (Fig. 18A), interocular space about same as distance between antennal sockets. Tegmina reduced reaching to about hind margin of T6 (see variants), hind wings vestigial extending to about T1 or T2, lateral, narrow, membranous, with a few visible veins. Anteroventral margin of front femur Type A_3; pulvilli essentially absent from all tarsomeres (Fig. 18G) (see variants), tarsal claws long, simple, symmetrical, arolia small. First abdominal tergum weakly specialised with a few setae along anteromedial border, often completely covered by hind margin of metanotum. Seventh abdominal tergum with a large dense group of setae in an anteromedial depression (Fig. 18B), partly hidden by T6. Supraanal plate transverse, hind margin broadly rounded, convex or weakly concave; paraprocts dissimilar, right one with a large setose lobe and sclerotised spinelike process, left one with or without a short, stout, fingerlike process (Figs 18C,19A). Subgenital plate essentially symmetrical, sides upturned, styles erect (Fig. 18D) or deflexed ventrad, symmetrically placed, widely separated, spines on dorsal surface, interstylar margin weakly convex or straight, with a dense group of short spines along margin of plate at base of styles (Figs 18D,19B). Genitalia as in Fig. 19B: genital hook on left side, robust, median phallomere rodlike, broader on basal half, right phallomere with a cleft and setose plate.

Colouration. Reddish brown.

Female. Supraanal plate with hind margin rounded or with a shallow apical indentation; right paratergite with an enlarged sclerotization (Fig. 18F). Tegmina slightly longer than in male. Pulvilli essentially absent, but in some specimens they are weakly indicated on tarsomeres 3 and 4 of the mid legs.

Measurements (♀ in parentheses): Length, 16.0-18.7 (16.8-20.0); pronotum length x width, 4.2-5.0 x 6.5-6.8 (5.1-6.1 x 6.9-7.7); tegmen length, 10.3-11.7 (10.5-12.0).

Nymph. Resembles adult except for absence of tegmina and wings. Eyes present, pulvilli and arolia absent.

REMARKS

Mackerras (*in* Richards 1967, p.40) may have recorded this species as ?*Gislenia* sp. from 21 nymphs which could not be placed with certainty to genus. Some of her specimens came from Royal Arch Cave, Chillagoe Caves, and probably these are the same as *stonei* collected in the same cave. Richards stated that 'They have been collected from nine caves ranging in distribution from Northern Queensland to Central New South Wales, and also just across the South Australian border. Many are guanobites. Specimens from Ashford Cave in northern New South Wales, and Riverton and Viator Caves just across the Queensland border, all show loss of pigmentation. The nymphs from Alexandra Cave, Naracoorte, are troglophiles. No bats occur in this cave. Cockroaches are present in large numbers breeding in the cave, but show no sign of cave adaptation.' Specimens of *stonei*, including its variants, show no loss of pigmentation.

VARIANTS

Specimens taken in different caves may vary from the typical material from Royal Arch Cave, in size, length of tegmina (hind wings are very small in all morphs) (Table 3), and presence or absence of pulvilli (all have small arolia). The important male characters such as genital phallomeres, subgenital plate, styles, supraanal plate and paraprocts, and tergal glands are so similar in all the forms that I consider them to be races of the same taxon (not paratypes).

RACE A

MATERIAL EXAMINED

QUEENSLAND. QMBA: Chillagoe Caves: Clam Cave, 2♂♂, 3♀♀, 21.vi.1984, F.G. Howarth and F.D. Stone (1♀ retained at MCZH), 1♂ (terminalia slide 58), 3♀♀, 6 nymphs, 21.vi.1984, 1♂, 2♀♀ (1 with ootheca), 27.vi.1984, F.G. Howarth and F.D. Stone; Rhino Cave, 2♂♂, 1 nymph, 22.vi.1984, F.D. Stone; Spatial Cave, 1♂, 22.vi.1984, F.D. Stone.

FIG. 18. *Paratemnopteryx stonei*, n. sp., paratypes and races. A-D, ♂♂: A, Eye (lateral view); B, Setal gland on seventh abdominal tergum; C, Supraanal plate and paraprocts (ventral view); D, Supraanal and subgenital plates and styles (rear view); E, Ootheca; F-H, ♀♀: F, Supraanal plate and enlarged right paraproct (ventral); G, H, Front tarsi (lateral views). Races and Qld localities: A, E, H, Race A, Clam Cave; B, D, Race C, Barkers Cave, Yarramulla Station; C, F, G, Typical morph, Royal Arch Cave.

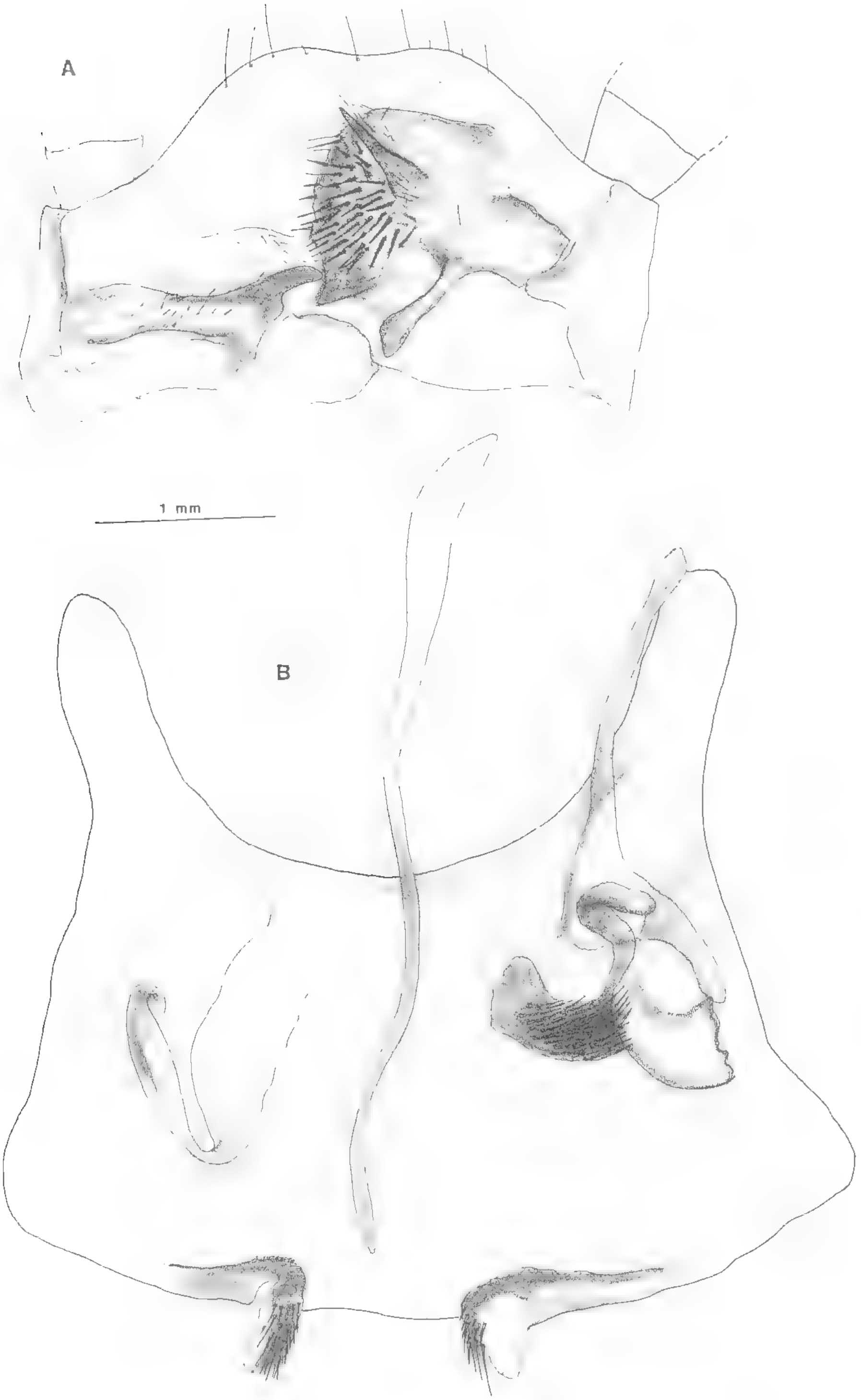


FIG. 19. *Paratemnopteryx stonei*, n. sp. ♂, Race C, Undarra, Qld, Barkers Cave: A, Supraanal plate and paraprocts (ventral view); B, Subgenital plate and genitalia (dorsal view).

TABLE 3. Variation in pronotum length and width and tegmen length in races of *Paratemnopteryx stonei*.

	Typical	Race A	Race B	Race C	Significance between morphs (*significant at P≤0.05)
Pronotum (mm) Length (♂) Mean ± S.D.	4.8± 0.4	5.0± 0.2	4.6± 0.2	4.2 ±0.2	T & A = 0.42; T & B = 0.23; T & C =).00*; A & B = 0.01;* A & C = 0.00*; B & C = 0.00*
Width (♂) Mean ± S.D.	6.6± 0.1	6.7 ±0.3	6.4 ±0.1	5.8 ±0.3	T & A = 0.61; T & B = 0.01*; T & C = 0.00*; A & B = 0.02*; A & C = 0.00*; B & C = 0.00*
N	5	5	8	24	
Length (♀) Mean ± S.D.	5.6±0.3	5.5±0.3	5.5±0.1	5.1±0.3	T & A = 0.63; T & B = 0.57; T & C = 0.00*; A & B = 0.83; A & C = 0.01*; B & C = 0.05*
Width (♀) Mean ± S.D.	7.4±0.3	7.3±0.3	7.6±0.2	6.7±0.4	T & A = 0.60; T & B = 0.15 T & C = 0.00*; A & B = 0.13; A & C = 0.00*; B & C =0.00*
N	13	10	4	11	
Tegmen Length (mm) Mean ± S.D. (♂)	10.7±0.6	10.9±0.8	6.8±0.2	6.8±0.6	T & A = 0.58; T & B = 0.00* T & C = 0.00*; A & B = 0.00*; A & C = 0.00*; B & C = 0.73
N	5	5	8	24	
Mean S.D. (♀)	11.2±0.4	10.4±0.4	7.4±0.7	7.5±0.5	T & A = 0.00*; T & B = 0.00*; T & C = 0.00*; A & B = 0.00*; A & C = 0.00*; B & C = 0.90
N	13	10	4	11	

DESCRIPTION

In the male, pulvilli occur on the 4 proximal tarsomeres of front and mid legs, and on tarsomeres 3 and 4, or only on 4, of hind tarsus. In the female, pulvilli are present on tarsomeres 1 to 4 of front tarsi (Fig. 18H), 1-4 (rarely 3 and 4) of mid tarsi, and 1-4, 2-4, or 3 and 4 of hind tarsi. Two oothecae are dark reddish brown, surface smooth, keel undulating, with 14 and 17 egg chambers and 16 and 18 keel serrations (Fig. 18E); they measure (height x length), 3.7 x 5.2, and 3.7 x 5.8.

Measurements (♀ in parentheses). Length, 15.1-17.6 (15.6-18.5); pronotum length x width, 4.7-5.3 x 6.5-7.2 (5.1-5.9 x 6.6-7.6); tegmen length, 10.0-12.2 (9.6-11.0).

RACE B

MATERIAL EXAMINED

QUEENSLAND. QMBA: Undarra, Bayliss Cave, 1♀ (on floor, halfway in), 22.v.1985, D. Irwin, 1♂, 1 ootheca, 22.v.1985, F.D. Stone, 1 ootheca, 15.vi.1985, Howarth, Stone, and J. Bresnan. The following were collected by Howarth, Stone, and Irwin in Bayliss Cave: 1♀, 21.v.1985, 2♂♂, 1♀ (on floor near low ceiling), 23.v.1985, 1♀, 1♀ nymph (roots, just before D.U.), 21.v.1985, 5♂♂ (1 retained at MCZH), 1♀ nymph, 14.vi.1985.

DESCRIPTION

Tegmina further reduced reaching only to middle or hind margin of T3, significantly shorter than the typical morph and Race A (Table 3). Pulvilli present on tarsomeres 1-4 of front and mid tarsi; on hind tarsi pulvilli may be present on 4 proximal tarsomeres, or absent from the first and subobsolete on tarsomeres 2-4.

Measurements (♀ in parentheses): Length, 15.5-17.4 (19.5); pronotum length x width, 4.4-4.8 x 6.2-6.5 (5.4-5.7 x 7.4-7.8); tegmen length, 6.4-7.0 (7.0-8.0).

RACE C

MATERIAL EXAMINED

QUEENSLAND. QMBA: Undarra, Pinwill Cave, 17♂♂ (1 with terminalia slide 56), 4♀♀, 4♂♂ and 7♀♀

nymphs, 1 ootheca (1♂, 1♀ retained at MCZH), 20.v.1985, F.G. Howarth, D. Irwin, and F.D. Stone; 1km SE of Yarramulla, E of Mt Surprise, Pinwill Cave, 1♂, 1♀, 11.vii.1984, D. Irwin; Mt Garnet, Yarramulla Sta., Pinwill Cave, on floor, 1♂, 1♀ nymph, 18.5.1985, F.G. Howarth; Undarra, Barkers Cave, 4♂♂ (1 with terminalia slide 54), 23.v.1985, 6♀♀, 21.v.1985, Howarth, Irwin and Stone, 1♂, 1♀, 1 ootheca, 15.vi.1985, FGH, FDS, JB. 1♂, 12.vii 1984, D. Irwin.

DESCRIPTION

Tegmina reduced as in *Race B* reaching only to T3 or rarely as far as middle of T5. Pulvilli present on tarsomeres 1-4 of all tarsi. Pinwill Cave specimens are the smallest of all the variants. *Race C* females from Barkers Cave are somewhat larger than those in Pinwill Cave, and their measurements are listed separately (male size is similar in both caves). The ootheca has 14 egg chambers and measures 3.5mm high and 4.8mm long.

Measurements (♀ in parentheses): Pinwill Cave: Length, 12.2-16.6 (15.0-18.0); pronotum length x width, 3.6-4.7 x 5.0-6.1 (4.7-5.0 x 6.0-6.6); tegmen length, 5.8-7.9 (7.0-8.3). Barkers Cave: Length, 14.5-16.6 (18.2-19.7); pronotum length x width, 4.2-4.7 x 5.3-6.1 (5.2-5.6 x 6.7-7.3); tegmen length, 6.2-7.6 (7.0-8.0).

REMARKS

This species is interesting from an evolutionary view of cavernicolous species because of its various races. Whatever the cause for the loss of pulvilli (see earlier discussion), their presence or absence varies in different cave populations. It may well be that the type of cave surface on which the insects walk influences the eventual loss of pulvilli, i.e., certain surfaces may be detrimental for a species with pulvilli and arolia, even though the loss of pulvilli is not necessarily correlated with a cave habitat. There are epigean species, like *Paratemnopteryx rufa* (Tepper) which essentially lack pulvilli. Loss of arolia also isn't dependent on cave living; the epigean *Paratemnopteryx glauerti* (Princis) (=*Franwalkeria glauerti*) lacks arolia but has pulvilli.

The variation in pulvilli and arolia negates using them in generic diagnoses in this tribe (Parcoblattini) of cockroaches. In the case of *stonei*, they cannot even be used to separate species. However, *Paratemnopteryx howarthi*, which is cavernicolous, lacks pulvilli and clearly evolved from epigean *Paratemnopteryx centralensis* (Roth) which has them (see below). The parent species of *P. stonei* probably had pulvilli on all 4 proximal tarsomeres of all legs, and *Race C* with pulvilli on all its tarsomeres may be closest to the original stock. The differences in the degree of loss of the pulvilli in the various races may be due to the lengths of time the morphs have been isolated in their respective caves. The typical morphs, which lack pulvilli on all tarsomeres, may have been established in their caves the longest.

There is a marked difference in the size of typical morphs of *stonei* from Royal Arch Cave, and those of *Race C* from Pinwill Cave. Perhaps differences in the kind of available food in the 2 caves account for this variation.

Paratemnopteryx glauerti (Princis) n. comb.

(Figs 20A-F,21A,B,35)

Franwalkeria glauerti Princis, 1954, p. 34, fig. 32 (♂).
Paratemnopteryx australis (*nec* Saussure): Tepper, 1896, p. 358 (misidentification).

MATERIAL EXAMINED

HOLOTYPE: ♂ (terminalia slide 8), Merredin, Western Australia; in WAMP

WESTERN AUSTRALIA. ZILS: Norsemen, 1♂ (reported by Princis, 1954, p.34).

NORTHERN TERRITORY. ANIC: 9km N of Kulgera, 25.46S 133.18E, 1♂ (terminalia slide 82), 2.x.1972, K.H.L. Key *et al.* SAMA: Alice Springs, 1♀, Horn Exped., 1894 (incorrectly reported as *Paratemnopteryx australis* Sauss., by Tepper, 1896, p.358 (label reads *Paratemnopteryx australis* Sauss. var.?).

QUEENSLAND. SAMA: Cunnamulla, 1♂, 1♀, H. Hardcastle. QMBA: 'Morney', 120km W of Windorah, 1♂, 24.ix.1983, G.B. Monteith.

DESCRIPTION

Male. Eyes extending slightly or not at all below level of antennal sockets, ocellar spots well developed (Fig. 20D). Tegmina and wings fully developed, extending beyond end of abdomen; cubitus vein of hind wing with 3-4 complete and 1-2 incomplete branches, apical triangle absent (Fig. 20F). Front femur Type A_3; pulvilli present on 4 proximal tarsomeres, tarsal claws symmetrical, simple, arolia absent. First abdominal tergum with setae along a ridge near anteromedial margin, those in middle partly covered by hind margin of metanotum (Fig. 20C). Seventh abdominal tergum unspecialised. Supraanal plate transverse, hind margin broadly rounded (Fig. 20A); right paraproct with a setose lobe (Fig. 20B). Subgenital plate symmetrical,

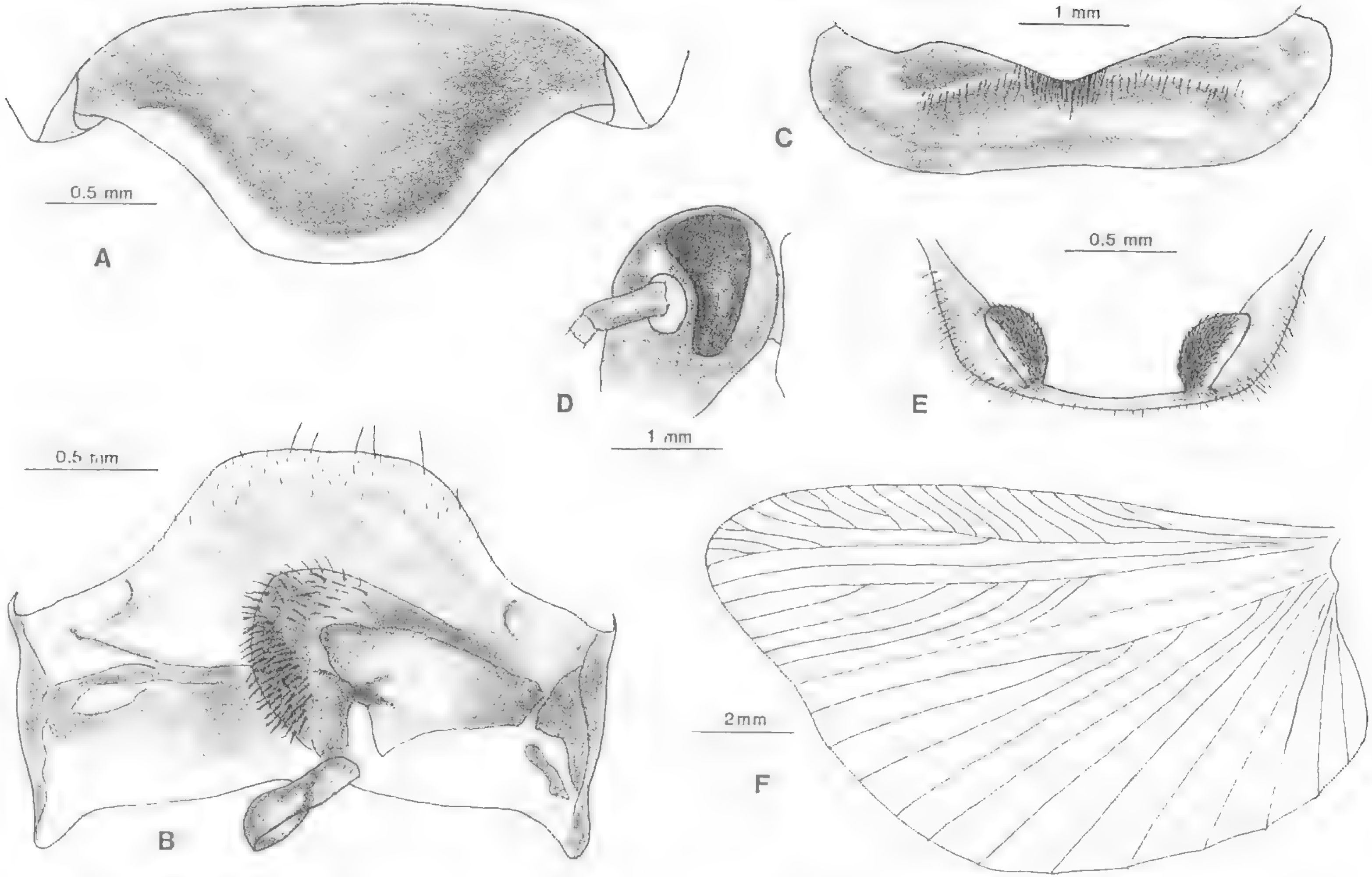


FIG. 20. *Paratemnopteryx glauerti* (Princis). ♂ holotype; A, Supraanal plate (dorsal view); B, Supraanal plate and paraprocts (ventral view); C, First abdominal tergum; D, Eye (lateral view); E, Styles (rear view); F, Hind wing.

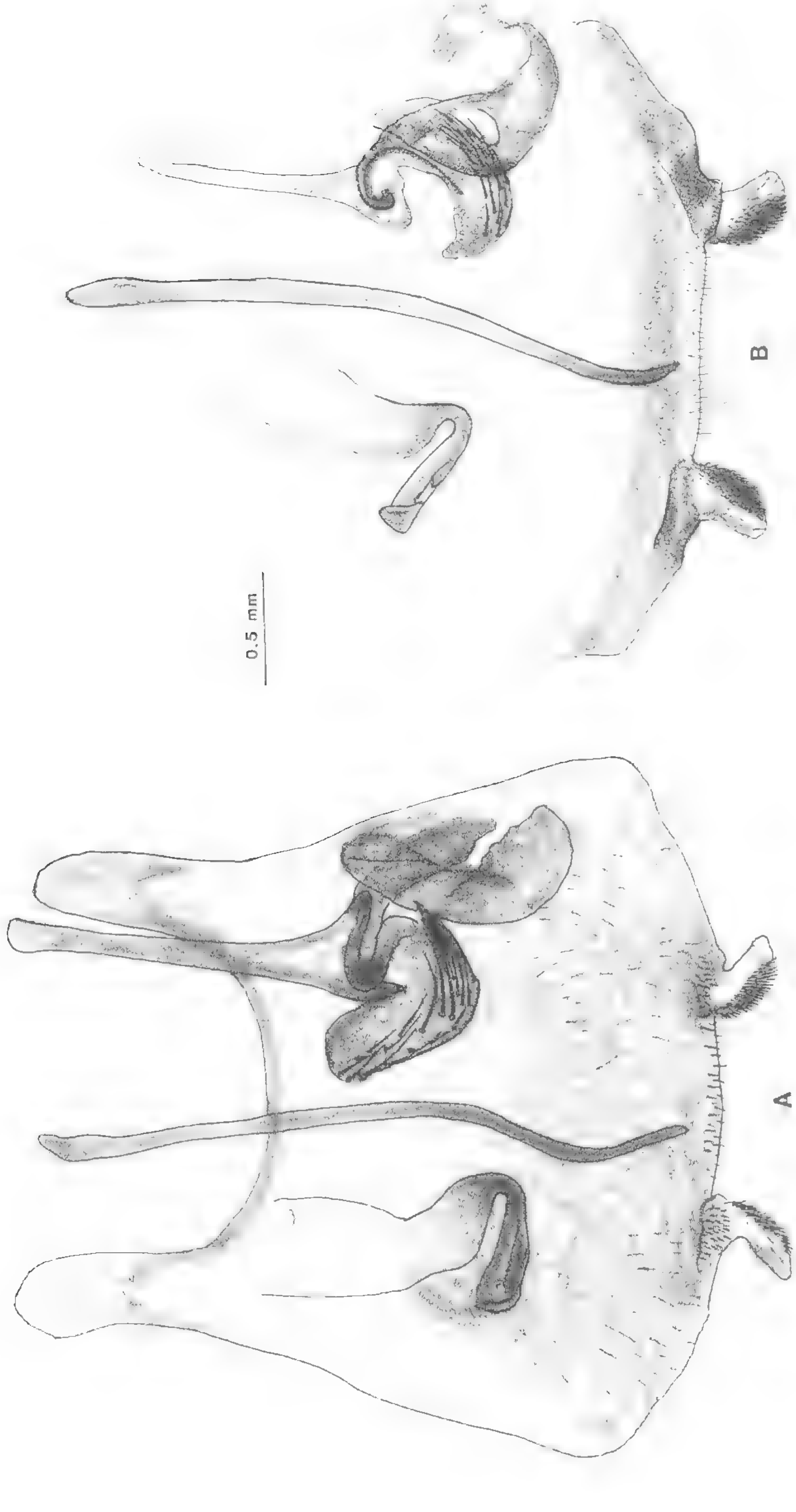


FIG. 21 *Paratemnopteryx glauerti* (Princis). A, ♂ holotype, subgenital plate and genitalia (dorsal view); B, ♂, ?variant, Murchison River, W.A., subgenital plate and genitalia (dorsal view).

pilose, styles similar, erect, robust, wide apart (Fig. 20E). Genitalia as in Fig. 21A: hook on left side, with a subapical incision; median phallomere rodlike, unmodified; right phallomere with cleft and spined sclerites.

Colouration. Brown. Head with face darker brown than vertex. Terminal abdominal terga darker, supraanal plate with flattened hind border region yellowish brown (Fig. 20A). Coxae with basal regions dark brown, remaining parts of legs lighter. The male from Northern Territory is darker than the holotype, its head is uniformly dark brown, pronotal disk with light brown mark, posterior border zones darker than lateral regions.

Female. Habitus essentially similar to females of *couloniana*, but somewhat larger. Tegmina reduced reaching only to T2; hind wings much smaller. Genitalia similar to that of *couloniana*, with right paratergite enlarged (as in Fig. 17G).

Measurements (♀ in parentheses). Length, 14.0-19.0 (19.5-20.5); pronotum length x width, 3.9-5.1 x 5.4-7.3 (5.5-5.7 x 7.7-8.5); tegmen length, 13.5-18.0 (8.2).

?VARIANT

Material Examined

Western Australia. ANIC: Murchison River, 27.49S 114.41E, 1♂ (terminalia slide 81), 28.iii.1971, E.F. Riek.

Description

Male. This specimen appears to be a very small *glauerti*. It is dark reddish brown, head uniformly dark except for pale clypeus, supraanal plate unicolourous its hind border not yellowish. Styles and genital phallomeres similar to those of the type, the right phallomere showing minor differences (cp. Fig. 21A,B).

Measurements. Length, 13.2; pronotum length x width 3.6 x 5.1; tegmen length, 12.2.

Remarks

Paratemnopteryx glauerti is very close to *P. couloniana* and can be distinguished from it by the shape of the supraanal plate. However, it is essentially a *couloniana* that has lost its arolia. The absence of arolia also separates the females of the two taxa. It is possible that the 2 females with reduced tegmina which I have determined as *glauerti* are female *couloniana* that apparently lack arolia.

Paratemnopteryx atra Princis

(Figs 22A-H,35)

Paratemnopteryx atra Princis, 1963, p. 11, fig. 2 (♂ and ♀); Richards, 1967, pp. 37, 38, 41.

Material Examined

Holotype. ♂ (terminalia slide 6), Marble Bar, Western Australia, 21.07S 119.41E, 10.x.1957, collected deep in mines on piles of dung of the bat *Macroderma gigas*, A.M. Douglas; in WAMP.

Paratypes. Western Australia. WAMP: same data as holotype, 4♂♂ (1 incorrectly labelled ♀), 1♀ (genitalia slide 7).

Additional Material: Western Australia. WAMP: same data as holotype, 1♀, 1♀ nymph.

Description

Male. Eyes reduced, not extending below level of antennal sockets (Fig. 22B), ocellar spots present. Pronotum flat, parabolic (Fig. 22A). Tegmina slightly reduced, width normal, tapering towards rounded apex, not reaching end of abdomen (Fig. 22A); hind wings vestigial, lateral, membranous, reaching between T1 and T2. Front femur Type A_3, pulvilli and arolia absent, tarsal claws symmetrical, simple. First abdominal tergum with a medial group of setae along anterior margin, completely or incompletely covered by metanotum (Princis incorrectly stated that all terga are unspecialised). Seventh abdominal tergum unspecialised. Supraanal plate trigonal, hind margin broadly rounded (Fig. 22D); paraprocts dissimilar, right one with large setose lobe, left one with spinelike process (Fig. 22E). Subgenital plate symmetrical, convex, styles similar, symmetrically placed, wide apart (Fig. 22C). Genitalia as in Fig. 22F: hook on left side with subapical incision; median phallomere rodlike, apex unmodified; right phallomere with spined sclerite.

Colouration. Black or black with reddish tinge.

Female. Supraanal plate with hind margin concavely excavated (Fig. 22G). Genitalia as in Fig. 22H: right paratergite with an enlarged swelling (arrow).

Measurements (♀ in parentheses). Length, 19.0-25.5 (23.5-26.5); pronotum length x width, 7.3-7.7 x 10.0- 10.4 (8.1-8.8 x 11.7-12.5); tegmen length, 16.4-18.0 (17.2-17.3).

Remarks

This, a true guanobe, is the largest species of cavernicolous *Paratemnopteryx*. It is closely related to *P. couloniana*.

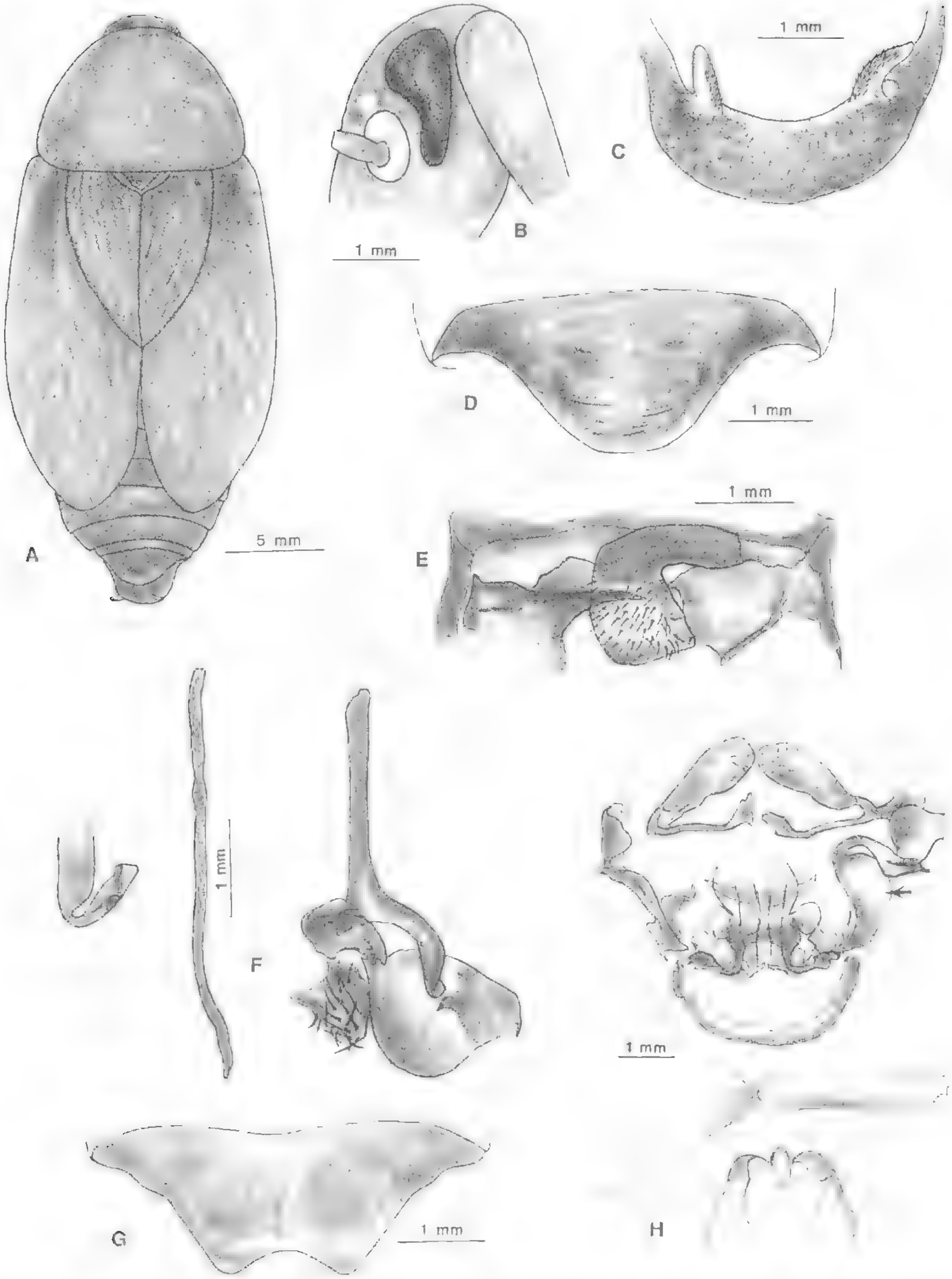


FIG. 22. *Paratemnopteryx atra* Princis from Marble Bar, W.A.: A-F, ♂♂: A, habitus; B, Eye (lateral view); C, subgenital plate and styles (rear-oblique view); D, Suptraanal plate (dorsal view); E, Paraprocts (ventral view); F, Genitalia (dorsal view); G, H, Females: G, Supraanal plate (dorsal view); H, Genitalia (ventral view; arrow indicates expanded region of right paratergite), E, F, holotype, others paratypes.

Paratemnopteryx australis Saussure
(Figs 23A-D,35)

Paratemnopteryx australis Saussure, 1869, p. 273, pl. 3, fig. 22 (♀); Walker, 1871, p. 18; Tepper, 1894, p. 170; Kirby, 1904, p. 106; Shelford, 1908b, p. 9; Alexander, 1917, p. 98; Princis, 1954, p. 35; Roth, 1968, pp. 84, 110, fig. 141 (ootheca).

HOLOTYPE (not examined)
♀, Melbourne (Victoria), Australia; the type apparently is not in the MHNG; I received only 1♀ specimen from the Geneva Museum, supposedly of this species, but it was from Peak Downs, Queensland.

MATERIAL EXAMINED
WESTERN AUSTRALIA. WAMP: 11km SSE of Banjiwarn HS., 27.42S 121.37E, 1♀ (carrying rotated ootheca), ex pitfall trap, 22-28.ii.1980, T.F. Houston *et al.*, Biol. Survey Site BWRI; 6.8km NNW of Mt Linden, 29.19S 122.25E (with detached ootheca), 1♀, 17-23.iii.1979, T.F. Houston *et al.*, Biol. Survey Site YMR2; Yandil, 1♀, 1928 (reported by Princis, 1954, p.35); Kathleen Valley, 1♀, 1963, T. Moriarty; Barrow Island, ex *Nasutitermes triodiae* nest, 1♂ (terminalia slide 11), 12.v.1982, C.N. Smithers and W.H Butler, 1♀ nymph, 16.ii.1982, C.N. Smithers.

DESCRIPTION
Male. Eyes reduced, not extending below antennal sockets, interocular space less than distance between antennal sockets. Tegmina reduced in length reaching to about hind margin of T2, width normal, touching at midline, distal margin truncate, corners rounded; hind wings vestigial, narrow, lateral, reaching to about hind margin of T1. Front femur Type A_3; tarsal claws simple, symmetrical, pulvilli and arolia absent. First abdominal tergum with a few setae medially on anterior margin, mostly hidden by overlapping hind margin of metanotum, only their tips visible. Seventh abdominal tergum unspecialised. Supraanal plate with sides concave, tapering, hind margin shallowly concave, corners rounded, a distinct transverse groove near basal margin (Fig. 23A); right paraproct much larger than left, composed of 3 sclerites one of them roundly bulbous and partially spined (Fig. 23C). Subgenital plate symmetrical, sides upturned, styles elongate, similar, upright (Fig. 23B), each located in posterolateral corners of plate, interstylar margin straight (Fig. 23D). Genitalia as in Fig. 23D: hook on left side with subapical incision; median phallomere slender, apex slightly enlarged, rounded; right phallomere with a cleft sclerite and small number of spines or setae.

Colouration. Dark reddish brown.

Female. Supraanal plate trigonal, apex rounded. Tegmina, hind wings, legs, and colouration as in male.

Measurements (♀ in parentheses). Length, ? (16.9-20.5); pronotum length x width, ? (4.7-5.8 x 6.3-8.4); tegmen length, 6.5 (4.5-6.0).

The following is Saussure's description of the female of *P. australis*. Head smooth. Pronotum semicircular, slightly convex, with traces of grooves, lateral borders deflexed, posterior angles slightly rounded, hind border weakly arched, slightly projecting medially. Tegmina terminating on second abdominal tergum and touch or cross each other along their inner borders, apex attenuated, rounded, nearly semicircular at apex; veins visible, anal field elongated reaching to four fifths of sutural border showing 6-7 axillary veins; anal groove strongly sinuate. Wings rudimentary. Legs greatly compressed, tarsi elongated and spined over their lengths. Arolia absent. Hind borders of abdominal terga straight, lateral borders weakly serrated. Supraanal plate triangular, apex slightly prolonged and rounded. Cerci large, flattened, fusiform.

Colouration. Brownish black. Antennae brownish black provided with gray hairs. Head with mouth, ocellar spots, antennal sockets, brownish yellow. Tegmina chestnut brown. Legs and abdomen basally brown to brownish yellow, tibiae darker brown.

Measurements. Length, 16.0; pronotum length x width, 5.0 x 7.0; tegmen length, 6.5.

The female from the Geneva Museum which was sent to me as *Paratemnopteryx australis*, from Peak Downs, Queensland, is smaller than Saussure's specimen from Melbourne, or the material from Western Australia and is as follows:

Eyes reduced, reaching level of antennal sockets, interocular space slightly greater than distance between ocellar spots. Front femur Type A_3; pulvilli and arolia absent. Tegmina reduced, width normal; hind wings vestigial, reaching hind margin of metanotum. Supraanal plate trigonal, apex rounded. Head dark brown, clypeus and labrum lighter brown. Pronotum reddish brown. Tegmina lighter reddish brown. Abdominal terga and cerci blackish, with metallic sheen. Legs reddish brown, cerci darker.

Measurements. Length, 11.5; pronotum length x width, 3.5 x 5.0; tegmen length 4.3.

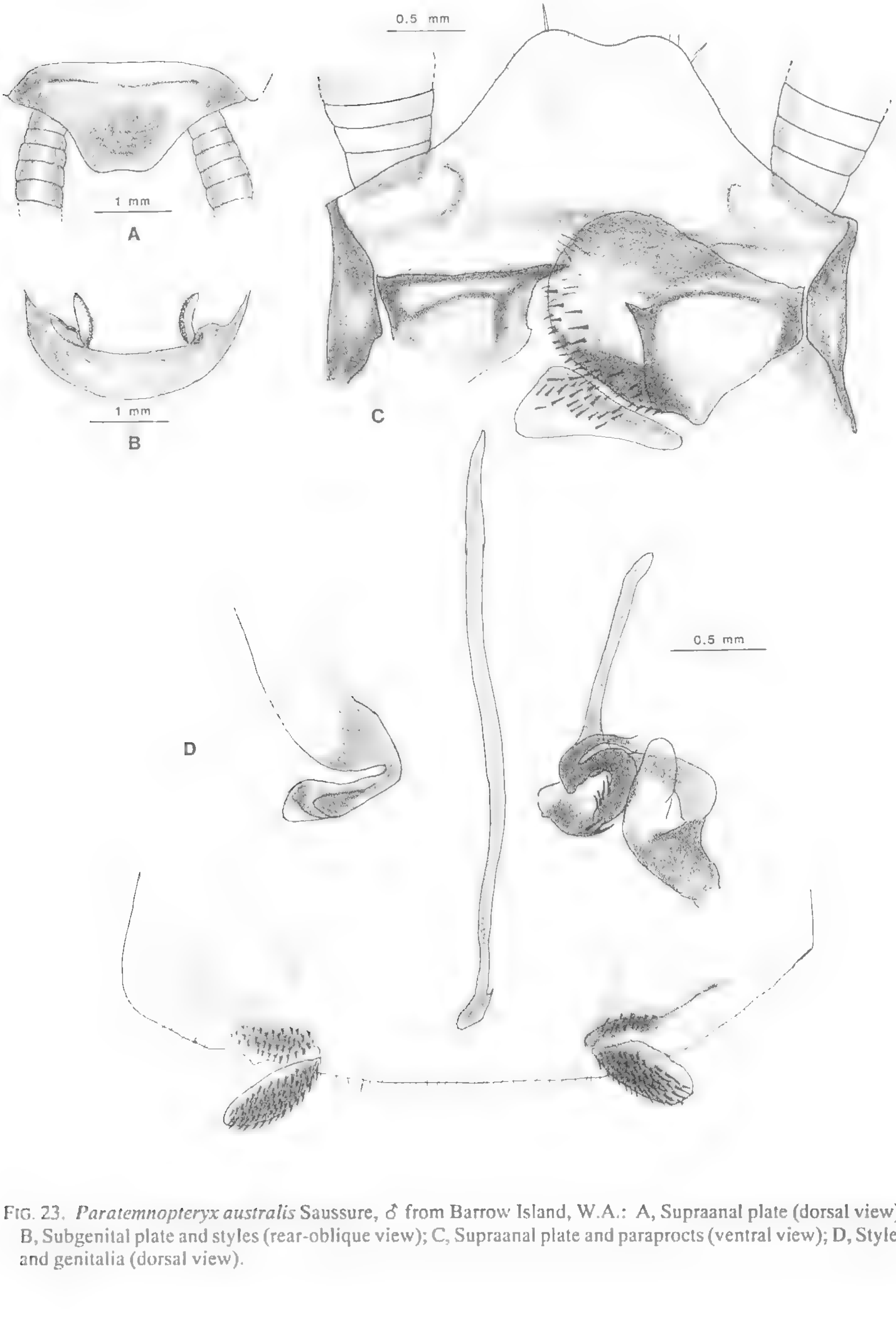


FIG. 23. *Paratemnopteryx australis* Saussure, ♂ from Barrow Island, W.A.: A, Supraanal plate (dorsal view); B, Subgenital plate and styles (rear-oblique view); C, Supraanal plate and paraprocts (ventral view); D, Styles and genitalia (dorsal view).

REMARKS

The male from Western Australia which Princis determined as *Paratemnopteryx australis*, and which I have described here as that species, differs from the male of *Paratemnopteryx rufa*, principally in the shape of the supraanal plate, paraprocts, and in the apex of the median genital phallomere. The females are similar and I doubt if they can be distinguished, unless collected with males. Colour is of little significance because it can be so variable. In general the specimens which I have described as rufa are larger than those of *australis*, but here too size in this group of cockroaches can be extremely varible.

It is possible that *australis* and *rufa* are conspecific. They clearly are very close taxonomically. Establishing cultures of specimens from different localities, especially topotypic material, and studying their biology, would help in deciding whether *rufa* is a valid species.

Paratemnopteryx rufa (Tepper)

(Figs 24A-G,25A-F,35)

Periplaneta rufa Tepper, 1893, p. 101 (♂); *in* Horn, 1896, p. 363.

Blatta rufa (Tepper): Kirby, 1904, p. 139; Shelford, 1910, p. 16.

Blatta tepperana Gurney, 1942, p. 24 (footnote); Princis, 1969, p. 733.

Paratemnopteryx rufa (Tepper): Princis, 1954, p. 35 (♀).

Paratemnopteryx zeitzi Tepper, 1895a, p. 20 (♂). N. Syn.

?*Paratemnopteryx zeitzi* Tepper: Princis, 1969, p. 733.

MATERIAL EXAMINED

HOLOTYPE: ♂ (terminalia slide 49), Oodnadatta, Central Australia (=South Australia), F. Juncken; in SAMA.

SOUTH AUSTRALIA. SAMA: ♂ (terminalia slide 50) lectotype (here designated) of *Paratemnopteryx zeitzi* Tepper, L.(ake) Callabonna, far north South Australia, A. Zeitz, 1893.

NEW SOUTH WALES. ANIC: near Milparinka, 1♀, 5.i.1967, collected as nymph, xi.1966, under rock in 7" rainfall country, M.F. Day.

QUEENSLAND. QMBA: 30km east of Betoota, SW Qld, 3♂♂, 3♀♀, 25.ix. 1983, G.B. Monteith.

DESCRIPTION

Male. Eyes reduced not extending below antennal sockets, interocular distance greater than space between small ocelliform spots and antennal sockets (Figs 24B,25B). Pronotum smooth, parabolic, weakly convex (Figs 24A,25A). Tegmina normal in width, reduced in length reaching to about hind margin of T2, distal margin obliquely truncate or subtruncate, veins visible; hind wings vestigial, lateral, membranous, not reaching hind margin of T1 (Fig. 25A). Front femur Type A3; pulvilli absent or subobsolete (in ventral view pulvilli may be represented by lightly sclerotised areas bordered by several large spines, at the apices of 4 proximal tarsomeres), tarsal claws simple, arolia absent. First abdominal tergum with few short setae arranged in longitudinal row near anterior margin of segment, hidden by hind margin of metanotum. Seventh abdominal tergum unspecialised. Supraanal plate transverse, hind margin subtruncate (Figs 24E,25C), or weakly convexly rounded: paraprocts dissimilar as in Fig. 24E. Subgenital plate almost symmetrical, styles, elongate, upright, partially covered by dense, dark setae, interstylar margin almost straight (Figs 24C,D,F,25D,E). Genitalia as in Fig. 24G,25F: hook on left side with a subapical incision; median phallomere slender, apically unmodified; right phallomere with a cleft and setose sclerite.

Colouration. Shiny, reddish brown or dark brown to blackish brown.

Female. Supraanal plate trigonal, apex broadly rounded. The specimen from near Milparinka, NSW is light chestnut brown.

Measurements. See Table 4.

		Length	Pronotum		Tegmen	
			length	width	length	width
♂ holotype *rufa*		22.0?	6.0	9.4	8.0	6.0
♂ lectotype *zeitzi*		21.0	5.8	7.9	6.1	5.4
Queensland	♂♂	23.0-24.0	6.5-7.4	10.3-10.8	8.0-8.3	6.4-6.5
	♀♀	29.-30.0	7.4-7.5	10.2-11.0	7.7-9.0	6.1-6.7
New South Wales	♀	26.0	7.3	10.2	8.0	6.3

TABLE 4. Comparative measurements of *Paratemnopteryx rufa*.

REMARKS

According to Tepper (1893, p.102), 'Mr. F. Juncken, ... mentioned in one of his letters that cockroaches proved rather annoying.' At Tepper's request he sent him a single male on which the description of *rufa* was based. Presumably if these cockroaches were annoying, they are found in houses. But it is doubtful that

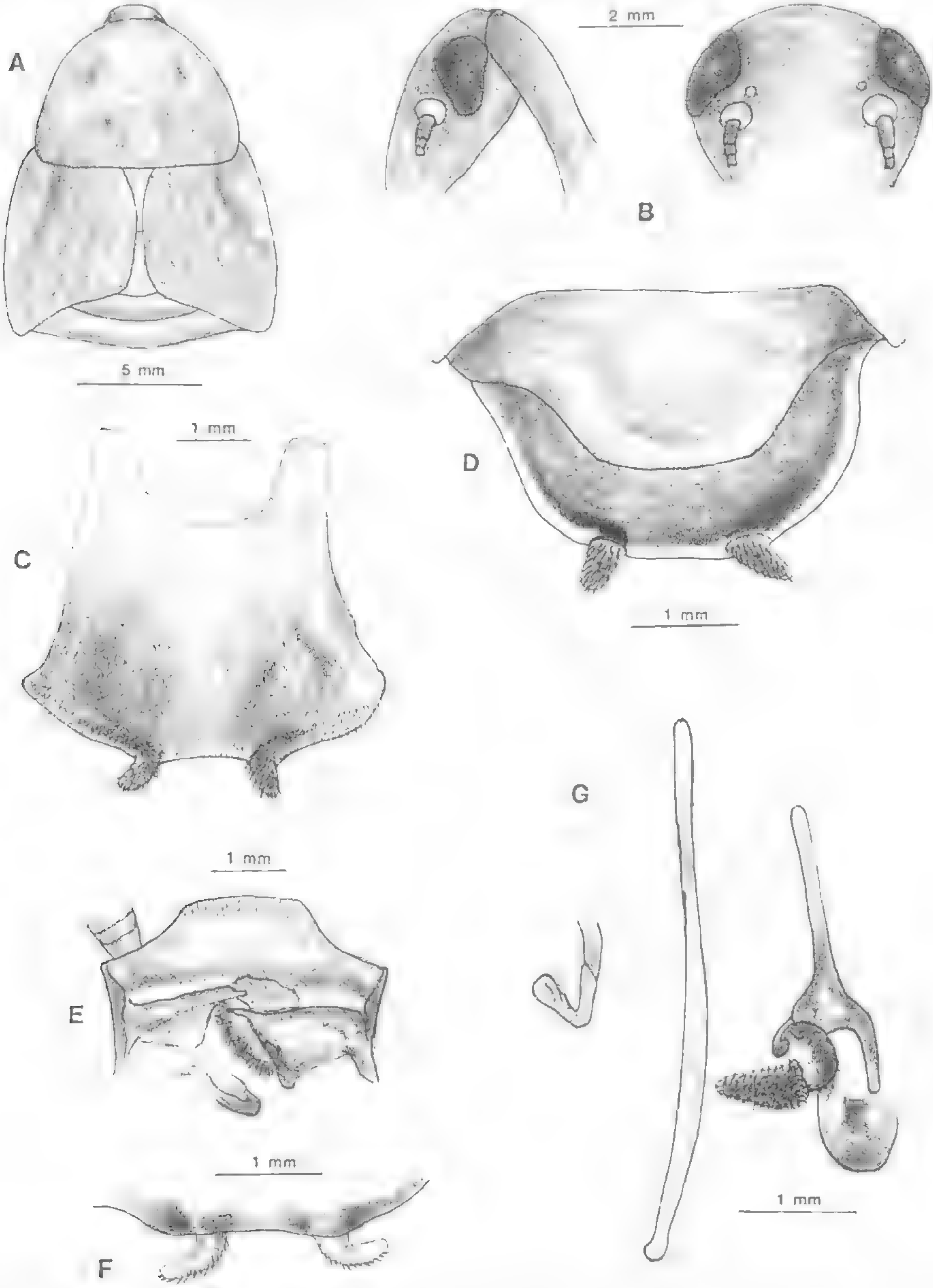


FIG. 24. *Paratemnopteryx rufa* (Tepper), ♂ holotype: A, Pronotum and tegmina; B, Eyes (lateral and frontal views); C, Subgenital plate and styles (dorsal view); D, Supraanal and subgenital plates (dorsal view); E, Supraanal plate and paraprocts (ventral view); F, Styles (ventral view); G, Genitalia (dorsal view).

the 'annoying' cockroaches were *Paratemnopteryx*. A second specimen (in SAMA), from New Hebrides, which Tepper identified as *Periplaneta rufa*, actually is a male nymph of *Periplaneta americana* which is an annoying domiciliary pest. Superficially nymphs of *P. americana* resemble *Paratemnopteryx rufa*, but they have well developed pulvilli and arolia, and the male subgenital plate and styles are typical of a *Periplaneta*.

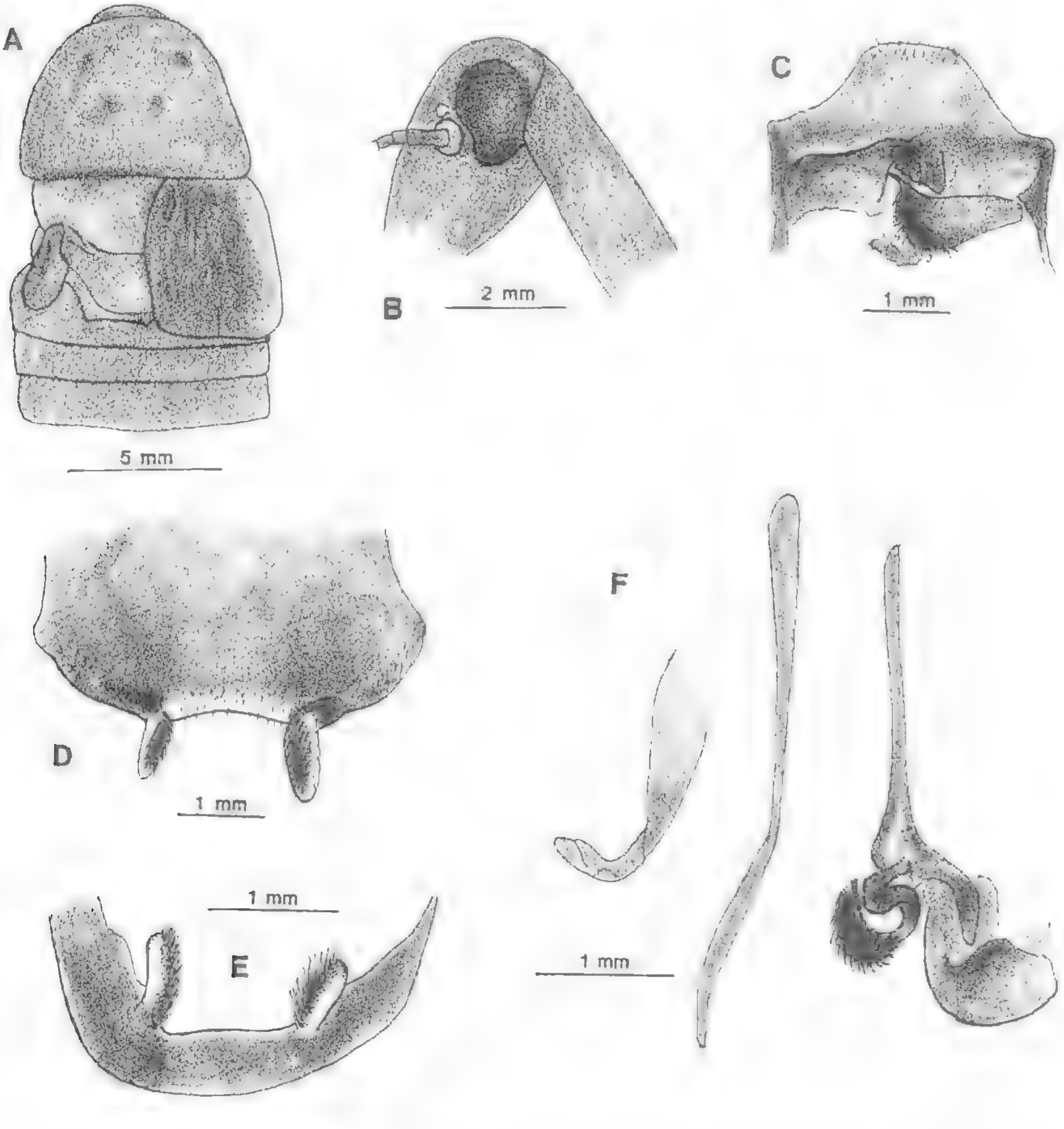


FIG. 25. *Paratemnopteryx rufa* (Tepper), ♂ lectotype of *Paratemnopteryx zeitzi* Tepper: A, Thorax, tegmina (left one removed to show vestigial hind wing), and first 3 abdominal terga; B, Eye (lateral view); C, Supraanal plate and paraprocts (ventral view); D, Distal part of subgenital plate and styles (dorsal view); E, Styles (rear view); F, Genitalia (dorsal view).

Paratemnopteryx sp. 1
(Fig. 26A-C)

MATERIAL EXAMINED

QUEENSLAND. ANIC: The following were collected by S.R. Morton: 10km north of Sandringham Stn Homestead, at seed bait, Sandridge, 2♂♂ (1 with terminalia slide 49), 20.ii.1980, 1♂, 1♀, 21.ii.1980; 10km west of Sandringham, 1♀, 12.i.1979; Sandringham Stn, 1♀ nymph, 24.i.1979. QMBA: Birdsville, SW Qld, ex pitfall trap 2♂♂, 1 nymph, 11-17.xi.1976, D. McGreedy; Canterbury, 90km W of Windorah, southwest Qld, 1♀, 27.ix.1983, G.B. Monteith.

NORTHERN TERRITORY. ANIC: 15km south of Alice Springs, bat caves, pitfall trap 60m from entrance, 1♀, 2 nymphs, 15.vi.1976, G. Griffin; 26km WSW of Mulga Park H.S., 26.00S 131.25E, 1♀ (genitalia slide 83), 18.i.1982; D.C.F. Rentz, B.G.F. Rentz, and R. Honeycutt, Stop 10.

DESCRIPTION

Male. Eyes reduced not reaching below level of antennal sockets, interocular space slightly greater than that between sockets. Pronotum subparabolic. Tegmina reaching to T2, width normal, veins distinct. Hind wings vestigial

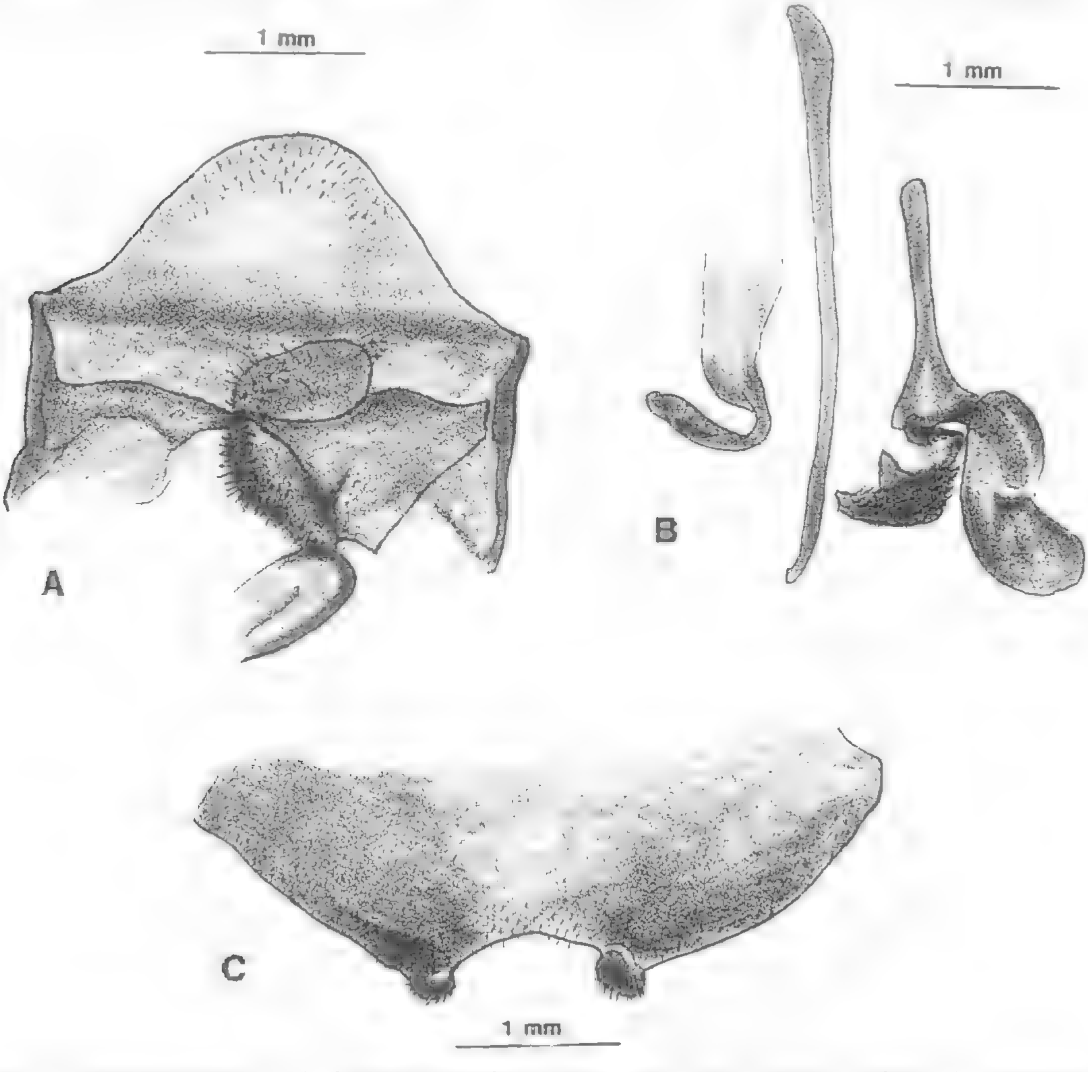


FIG. 26. *Paratemnopteryx* sp. 1, ♂ from 26 km WSW of Mulga Park H.S., Northern Territory: A, Supraanal plate and paraprocts (ventral view); B, Distal part of subgenital plate, and styles (dorsal view); C, Genitalia (dorsal view).

reaching T1. Front femur Type A3 (rarely A4); arolia absent, pulvilli variable, absent or subobsolete on tarsomeres 2 to 4. First abdominal tergum with row of short setae along anterior margin medially, covered by hind margin of metanotum. Seventh abdominal tergum unspecialised. Supraanal plate broadly rounded, right paraproct with setose plate (Fig. 26A). Subgenital plate symmetrical, styles short, widely spaced, erect or curved ventrad around hind margin of plate, interstylar margin weakly concave or straight (Fig. 26C). Genitalia as in Fig. 26C.

Colouration. Light reddish brown.

Female. Supraanal plate trigonal, broadly rounded. Females may be much darker than males. The female from Canterbury is the darkest with head black except for yellowish brown clypeus, brown labrum; pronotum black; tegmina dark reddish brown; abdominal terga and cerci black, abdominal sterna and legs reddish brown.

Measurements (♀ in parentheses). Length, 18.0-19.7 (18.0-22.0); pronotum length x width, 4.8-5.8 x 6.5-8.0 (5.2-6.1 x 7.2-8.5); tegmen length x width, 5.7-6.3 x 4.3-5.2 (5.1-8.3 x 4.4-5.5).

REMARKS

This species appears to combine characters of *australis* and *rufa*. Its size, and shape of male supraanal plate are more like those of *australis* (Fig. 23C) although it is not indented medially. The right paraproct and median and right genital phallomeres are similar to *rufa* (Fig. 24E,G). This may prove to be a distinct taxon. However, I have not seen the type of *australis* and, at least, topotypic specimens (Melbourne) should be examined before deciding this question.

Paratemnopteryx broomehillensis n. sp.
(Figs 27A-G,28A,B,35)

MATERIAL EXAMINED

HOLOTYPE: ♂, Broomehill, Western Australia, 33.51S 117.38E, MV light trap, 9.ii.1985, R.P. McMillan; in WAMP.

PARATYPE: WESTERN AUSTRALIA. ANIC: Wanneroo, 1♂, (terminalia slide 136), 1.i.1964, G.S. McCutcheon.

DESCRIPTION

Male. Eyes fully developed extending below level of antennal sockets; interocular space less than distance between antennal sockets. Pronotum with lateral margins posterior to middle weakly oblique (Fig. 27G). Tegmina and wings fully developed extending well beyond end of abdomen; cubitus vein of hind wing with 3-4 complete and 4 incomplete branches, apical triangle absent. Front femur Type A3; pulvilli present on 4 proximal tarsomeres, tarsal claws simple, symmetrical, arolia present. First abdominal tergum with large anteromedial transverse depression bordered by rounded elevation bearing very small spaced setae, these also present on either side of depression (setae not in dense group) (Fig. 27C,D). Seventh abdominal tergum with large group of dense, black setae in shallow depression medially on anterior half of segment, partially covered by T6 (Fig. 27A,B). Supraanal plate produced, sides concave, hind margin with deep U-shaped excavation forming pair of apically rounded lobes bearing long slender setae dorsally, densely covered with small dark spines ventrally (Figs 27B,28A); ventral intercercal ridge absent, or at most represented by transverse, unpigmented, shallow elevation; right paraproct with very large spinelike process (Fig. 28A). Subgenital plate symmetrical, styles similar, elongated, tapering, upright, bearing small, densely packed dark spines on one surface, each style located in posterior corners of plate, below cerci, interstylar margin convex (Figs 27B,E,F,28B). Genitalia as in Fig. 28B: hooklike phallomere on left side, with subapical incision; median phallomere rodlike, apex acute; right phallomere with cleft-like sclerite.

Colouration. Light brown. Pronotum hyaline on posterior half lateral to disk, and along hind border.

Female. Unknown.

Measurements. Length, 21.0-23.9; pronotum length x width, 5.7-6.0 x 7.2-7.6; tegmen length, 22.1-23.8.

REMARKS

The general appearance of *broomehillensis* is that of a *Neotemnopteryx*, but the shape and position of the styles are typical of most species of *Paratemnopteryx*. The apex of the median genital phallomere resembles that found in *P. centralensis* (Fig. 29B). The shape of the supraanal plate of *broomehillensis* readily distinguishes it from all other species of *Paratemnopteryx*, or of *Neotemnopteryx*.

Paratemnopteryx sp. 2

MATERIAL EXAMINED

NEW SOUTH WALES. Lord Howe Island, Ned's Beach, 1♀ (genitalia slide 84), xii.1972, Z. Liepa.

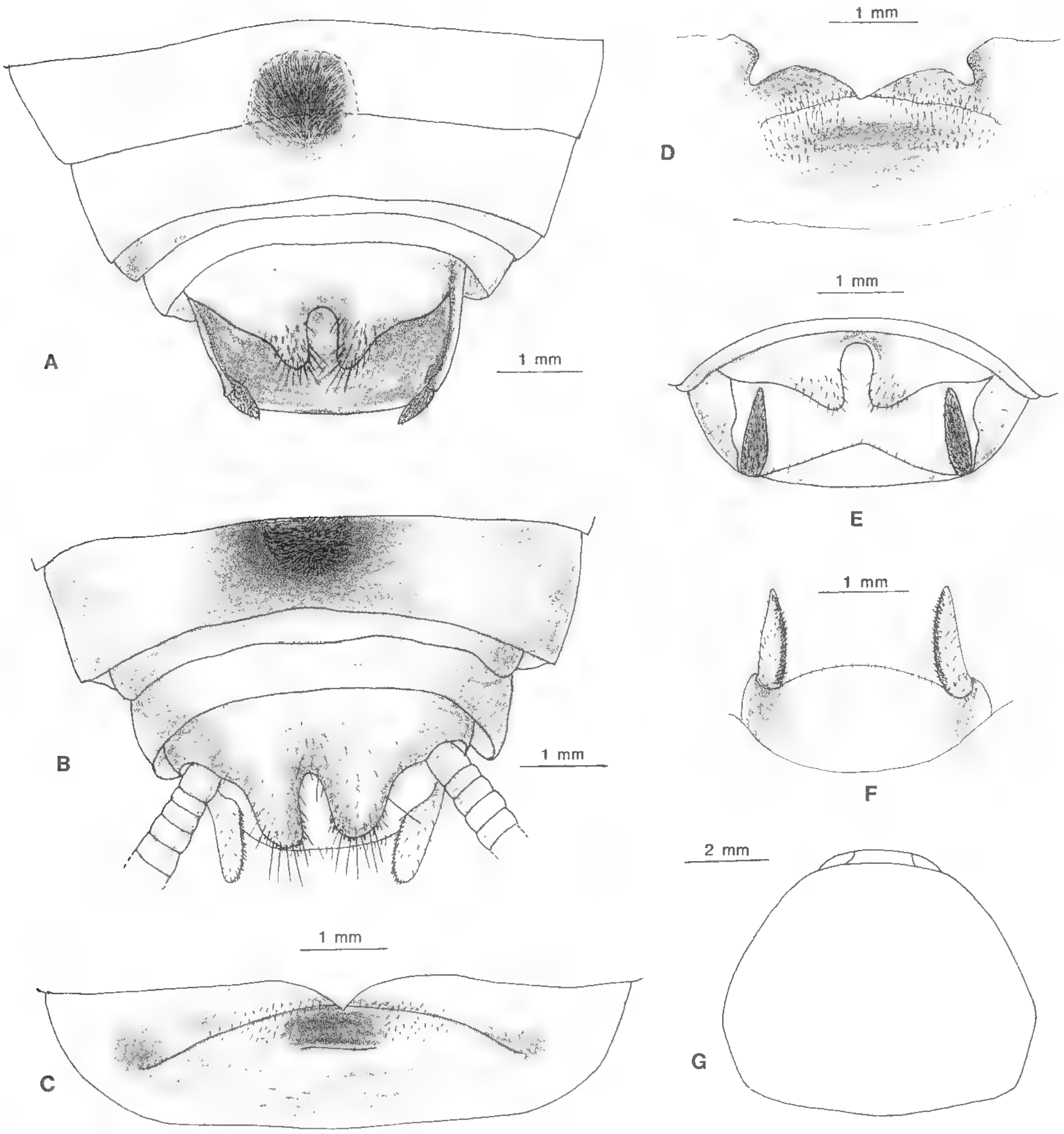


FIG. 27. *Paratemnopteryx broomehillensis*, n. sp. ,♂♂: A, Abdominal terga 6 to 10 (supraanal plate), and subgenital plate (part of T6 removed to show setal gland on T7); B, Abdominal terga 7 to supraanal plate; C, First abdominal tergum; D, Glandular region on T1; E, Supraanal and subgenital plates (rear view); F, Subgenital plate and styles (ventral view); G, Pronotum. Localities: A, C, E, G, paratype from Wanneru, W.A.; B, D, F, holotype from Broomehill, W.A.

DESCRIPTION

Female. Eyes reduced, interocular space greater than distance between small, distinct ocellar spots, and antennal sockets. Tegmina reduced in length, width normal, reaching to T7, tapering to a rounded apex. Hind wings slightly smaller, reaching to T6, cubitus vein with 4 complete and 2 incomplete branches, apical triangle absent. Front femur Type A3; tarsal claws simple, symmetrical, pulvilli absent, arolia very small.

FIG. 28. *Paratemnopteryx broomehillensis*, n. sp. ♂ paratype from Wanneroo, W.A.; A, Supraanal plate and paraprocts (ventral view); B, Styles and genitalia (dorsal view).

Colouration. Head reddish brown, lighter on vertex and clypeal region. Pronotum and tegmina light reddish brown. Wing with yellowish tinge. Abdominal terga and sterna dark brown. Legs light brown.

Measurements. Length, 13.2; pronotum length x width, 4.8 x 6.8; tegmen length, 9.0.

Paratemnopteryx sp. 3

MATERIAL EXAMINED

QUEENSLAND. ANIC: Noccundra, 1 ♀, 8.xi.1949, E.F. Riek.

DESCRIPTION

Female. Interocular space less than distance between ocellar spots, about same as space between antennal sockets. Pronotum transverse, anterior margin straight, hind margin weakly convex, lateral margins obliquely convex. Tegmina reduced in length reaching T2, width normal, apex rounded, veins distinct. Hind wings vestigial, lateral, reaching hind margin of T1. Front femur Type A3; pulvilli present on fourth tarsomere only, tarsal claws symmetrical, simple, arolia absent. Supraanal plate trigonal, broadly rounded.

Colouration. Head dark reddish brown, ocellar spots distinct, yellowish white, clypeus yellowish, labrum light brown. Pronotum reddish brown, disk lighter. Tegmina light reddish brown. Abdominal terga with basal 2 segments light reddish brown, remainder blackish. Abdominal sterna reddish brown becoming darker on posterior segments. Cerci blackish. Legs light brown.

Measurements. Length, 16.0; pronotum length x width, 4.5 x 6.8; tegmen length, 6.5.

Paratemnopteryx sp. 4

MATERIAL EXAMINED

QUEENSLAND. QMBA: Undarra, Bayliss Cave, on floor beyond Duckunder, 1 ♀, 1 ♀ nymph, 23.v.1985, F.G. Howarth, D. Irwin, and F.D. Stone.

DESCRIPTION

Female. Ocelli and eyes absent. Tegmina reduced in length, width normal, reaching to about hind margin of T3, anterior margin strongly convex, apex rounded. Hind wings vestigial, narrow, lateral, reaching to hind margin of T2, some venation visible. Femur Type A3; pulvilli and arolia absent. Supraanal plate trigonal, lateral margins shallowly concave, apex rounded.

Colouration. Pale yellowish brown.

Measurements. Length, 21.5; pronotum length x width, 6.7 x 7.5; tegmen length, 9.3.

Nymph. Resembles female except for size (length, 16.5mm), and absence of tegmina and wings.

REMARKS

The habitus of this female resembles that of *Neotemnopteryx douglasi*, but that species (known only from the male) has eyes (variably reduced), and small arolia, pulvilli essentially absent. The absence of eyes indicates it is restricted to a cave habitat. *Paratemnopteryx stonei* also has been found in Bayliss Cave, but this specimen clearly is not that species.

Paratemnopteryx centralensis (Roth) n. comb. (Figs 29A,B,35)

Symploce centralensis Roth, 1985b, p. 322, figs 18A-18G, 19A-19I (♂ and ♀).

Material Examined

Holotype and paratypes from Irian Jaya and Papua New Guinea listed in Roth (1985b).

Additional Material from Australia. Queensland. ANIC: Danbulla Forestry Reserve, 13km NE by N of Yungaburra, 17.10S 145.39E, 1♂ (terminalia slide 106), 16.xi.1981, J. Balderson; 3km NE of Mt Webb, near Cooktown, 2♂♂, 3.x.1980, T.A. Weir and R.A. Barrett. The following were collected by I.F.B. Common and M.S. Upton: 1 mile N of Kuranda, 1200ft, 1♂, 23.iv.1969; 3 miles W of Mossman, 1♂, 14.iii.1964, 1♂, 13.iii.1964; 9 miles N of Kuranda, 1♂, 12.iii.1964; 9 miles E of El Arish, 1♂, 7.iii.1964. BPBM: Cairns, 3♂♂, J.F. Illingworth. QMBA: Flying Fish Pt, 2♂♂, 21.i.1965, E.C. Dahms. The following were collected by G.B. Monteith: 3km E of Lockerbie, C. York, 1♂, at MV Light, 30.i.-4.ii.1975; Lockerbie Area, Cape York, 1♂, 13-27.iv.1973.

Northern Territory. BPBM: Darwin, 1♂ (terminalia slide 459), M.V. Light Trap, 1-7.i.1964, J. Sedlacek.

Remarks

Previously known only from the island of New Guinea, this species was fully described by Roth (1985b, p.322). The epigean species varies greatly in size and colour. Specimens from Australia are generally smaller, and some are darker brown than New Guinea specimens and very dark brown individuals may have a metallic sheen. The eyes are very large (Fig. 29A) and close together. Pronotum and tegmina usually are covered with spaced upright hairs. Male supraanal plate, paraprocts, subgenital plate and minute styles, and genital phallomeres (Fig. 29B) are similar in Australian and New Guinea specimens (Roth, 1985b, figs. 18,19). As indicated below, *centralensis* probably was the species from which the cavernicolous *howarthi* arose.

Measurements (♂♂ only; New Guinea specimens in parentheses from Roth 1985b): length, 9.5-14.4 (12.3-16.0); pronotum length x width, 2.6-3.2 x 3.4-4.2 (3.0-3.7 x 3.9-4.9); tegmen length, 10.8-16.0 (14.2-20.0).

Paratemnopteryx howarthi n. sp. (Figs 30A-J,35)

Material Examined

Holotype: ♂, Chillagoe, Queensland, Christmas Pot Cave, 29.vi.1984, F.D. Stone and D. Irvine, Explorers Club Expedition; in QMBA.

Paratypes: Queensland. QMBA: All specimens were collected on the Explorers Club Expedition in 1984 to the Chillagoe Caves, Queensland. The following are all brachypterous morphs unless indicated as macropterous (macr.): Tea Tree Cave, 1♂ (macr.), 1♂ (entire insect mounted on slides 48a and 48b), 1♀ (genitalia slide 49), 2.vii., 1♂, 24.vi., F.G. Howarth, 1♀, 1 ootheca, 2 nymphs, 24.vi., 1♂, 3 nymphs, 29.vi., F.G. Howarth, and F.D. Stone, 1♂, 24.vi., F.D.Stone et al.; Christmas Pot, 1♂, 2♀♀, 2 nymphs (swiftlet guano), 5 nymphs, 29.vi., F.D. Stone and D. Irvine. (1♂ (terminalia slide 240) and 1♀, brachypterous paratypes retained in MCZH).

Etymology

The species is dedicated to Dr Francis G. Howarth of the Bernice P. Bishop Museum.

Description

Male. Eyes well developed in macropterous morphs extending well below level of antennal sockets (Fig. 30A), but somewhat reduced in brachypterous forms (Fig. 30B), ocellar spots absent; interocular space less (macr.) or greater (brachypterous) than distance between antennal sockets. Tegmina and wings fully developed extending well beyond end of abdomen, or tegmina reduced in length (normal width), reaching to about middle of T5 or its hind margin. Hind wings smaller, membranous, reaching to about hind margin of T2 or T3; in fully developed wings, discoidal, median and cubitus veins straight, the former with 2-3 complete and 2-3 incomplete branches, apical triangle absent (Fig. 30F). Anteroventral margin of front femur Type A_3; pulvilli absent, tarsal claws simple, symmetrical, arolia very small. First abdominal tergum with large, dense group of setae near anteromedial half of segment (Fig. 30D). Seventh abdominal tergum unmodified. Supraanal plate transverse, trigonal, right and left paraprocts dissimilar (Fig. 30C). Subgenital plate almost symmetrical, styles minute, the right somewhat larger with long curved setae, the left one cylindrical, each located near posterior

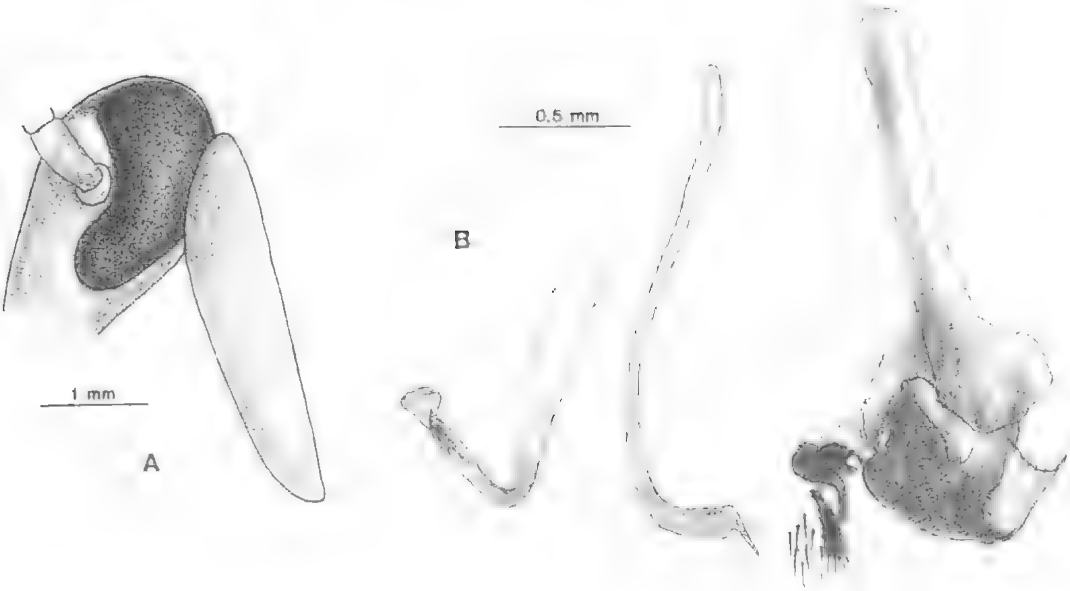


FIG. 29. *Paratemnopteryx centralensis* (Roth), ♂ from Danbulla Forestry Reserve, Qld, A, Eye (lateral view); B, Genitalia (dorsal view).

corners of plate, interstylar margin straight (Fig. 30E). Genitalia as in Fig. 30G: hook on left side, median phallomere a slender curved rod with acute apex, right phallomere with an associated setal brush.

Colouration. Light to dark brown. Lateral regions of pronotum hyaline. In dark morphs, the head may be much darker than abdomen, although the pronotum also may be relatively dark. Tegmina hyaline even in darkest forms.

Measurements. Macropterous morphs in brackets, all others including holotype (in parentheses), are brachypterous: Length, 9.5-11.0 (10.5) [10.0-10.5]; pronotum length x width, 2.6-2.8 x 3.0-3.5 (2.9 x 3.1) [2.8-2.9 x 3.1-3.2]; tegmen length, 4.5-5.7 (5.6) [11.0-11.2].

Female. Eyes narrower and slightly smaller than in brachypterous males, usually not extending below level of antennal sockets. Tegmina and wings reduced reaching to T3 or hind margin of T4, wings smaller extending to about middle of T1 or T2. No macropterous females were seen. Supraanal plate distinctly triangular (Fig. 30H). Right genital paratergite with a small basal swelling (Fig. 30I). An empty ootheca (Fig. 30J) is brown with 12 egg cells, 12 shallow keel serrations, and measures 2.5mm high and 3.5mm long.

Measurements. Length, 8.5-12.3; pronotum length x width, 2.7-3.1 x 3.1-3.5; tegmen length, 3.9-6.1.

Nymph. The eyes of small individuals are greatly reduced and are represented by a narrow strip of dark ommatidia. These increase in number in large nymphs where the eyes almost reach adult size. Arolia and pulvilli absent.

REMARKS

Paratemnopteryx howarthi is very close to, and probably arose from the epigean species *Paratemnopteryx centralensis* (Roth) (=*Symploce centralensis* Roth) from Irian Jaya, Papua New Guinea (Roth, 1985b, p.322) and Australia. The shapes of the styles and their position on the subgenital plate are similar in both species. Some differences are seen in the shapes of the supraanal plate (in both sexes), and in the apex of the hooklike genital phallomere in the males. The male paraprocts and right genital phallomere appear to have some small differences, but this may be due in part to their orientation on the slides. *Paratemnopteryx centralensis*

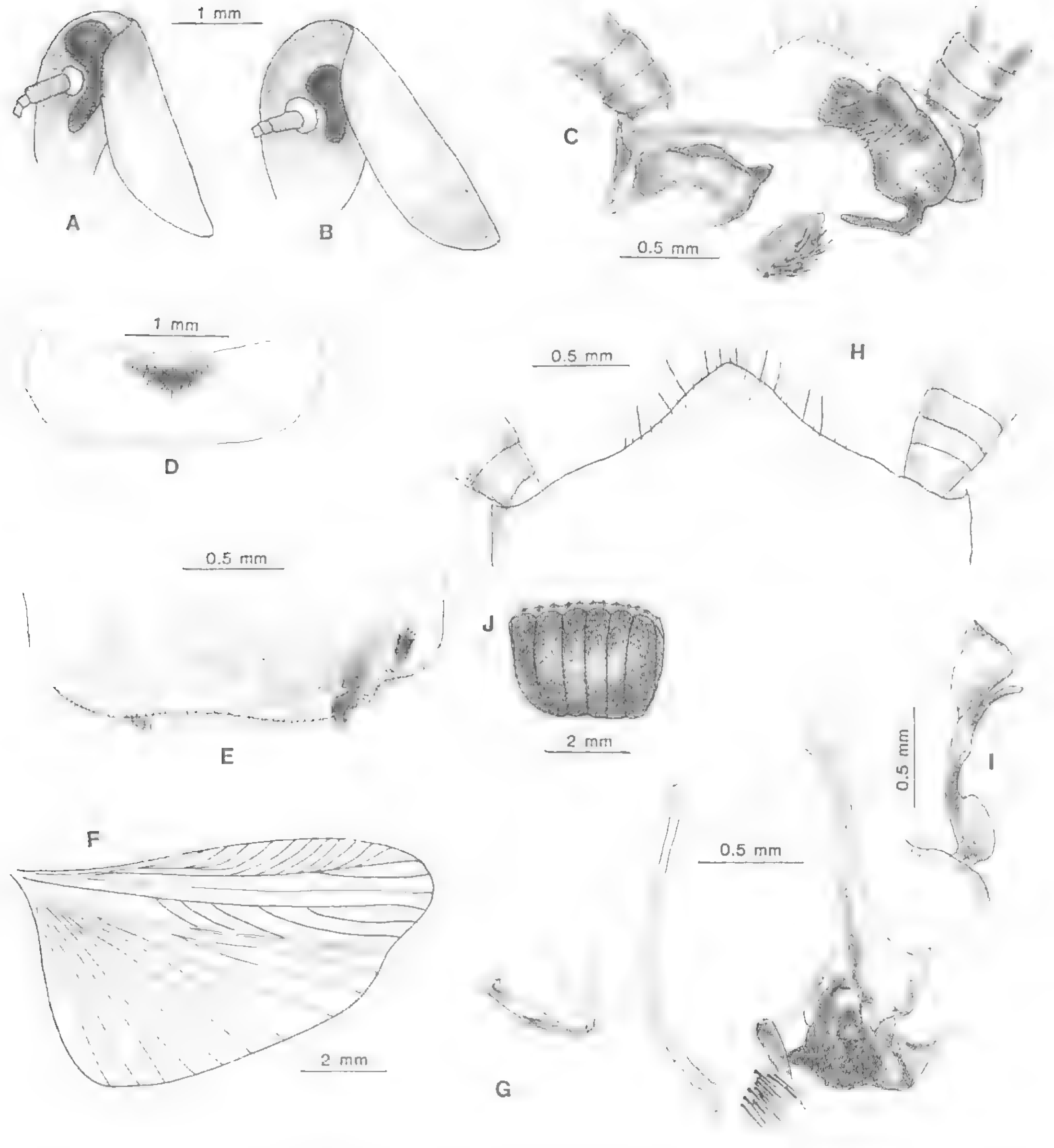
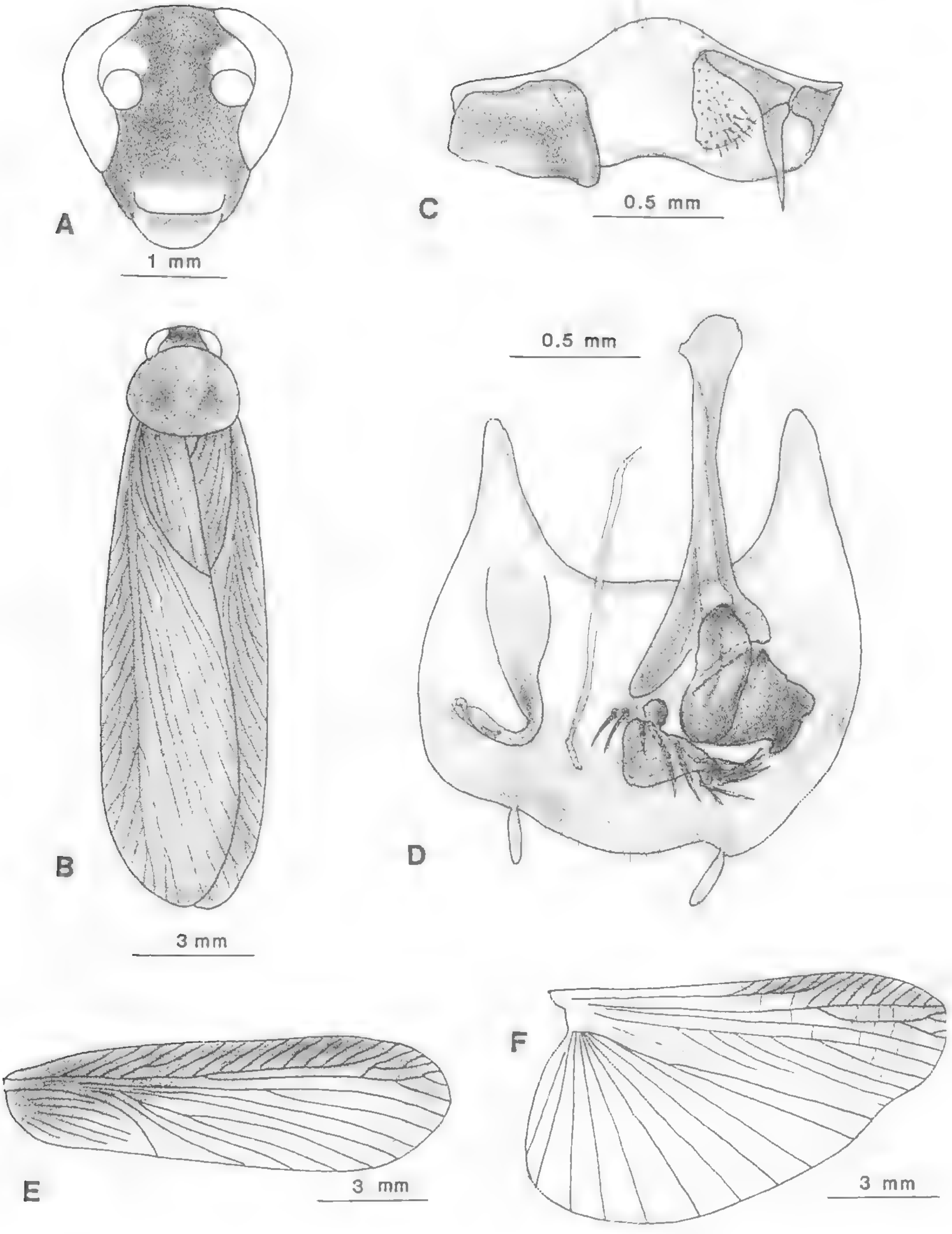


FIG. 30. *Paratemnopteryx howarthi*, n. sp., paratypes. A- G, ♂♂: A, Eyes (lateral views) of macropterous and brachypterousu specimens respectively; C, Supraanal plate and paraprocts (ventral view); D, Setal specialization on first abdominal tergum; E, Distal region of subgenital plate, and styles (dorsal view); F, Hind wing; G, Genitalia (dorsal view); H, I, Females: H, Supraanal plate (dorsal view); I, Right paratergite; J, Ootheca. Localities: F, Christmas Pot Cave, all others, Tea Tree Cave, Chillagoe, Qld.

FIG. 31. *Paratemnopteryx suffuscula* n. sp., ♂♂. A, Paratype from Mt Boppy, N.S.W., head; B, Holotype, habitus; C, D, Paratype from Mt Arthur, N.S.W., supraanal plate and paraprocts (ventral), and subgenital plate and genitalia (dorsal); E, F, Paratype from same locality as holotype, right tegmen and hind wing.


A
1 mm
C
0.5 mm
0.5 mm
B
D
3 mm
F
E
3 mm
3 mm

varies considerably in size, but generally it is larger than *howarthi*.

The presence of both brachypterous and macropterous morphs of *P. howarthi* in the same cave is of interest. Macropterous individuals have larger eyes than brachypterous morphs, but both forms lack ocelli and pulvilli. The correlation of normal sized eyes with macropterous morphs, and their reduction in brachypterous forms has been shown in another cavernicolous cockroach, *Alluaudellina cavernicola* (Shelford) (Chopard, 1932). This species is found both inside and outside of caves and Chopard arranged individuals in the following categories: 1) macropterous and macropthalmic; 2) macropterous and micropthalmic; 3) micropterous and micropthalmic. Chopard concluded that in *Alluaudellina*, ocular reduction precedes wing reduction.

The eye and wing reduction in *P. howarthi* does not reach the extreme losses found in *Alluaudellina*, at least in the specimens I have seen. I have seen one male specimen which I am provisionally referring to *P. howarthi*, and which was not taken in a cave [24km N by W of Mareeba, Queensland, 16.47S 145.22E (terminalia slide 141, 24-25.xi.1981, J. Balderson (ANIC)]. It has fully developed tegmina and wings but its eyes are reduced and widely separated and has larger ocellar spots. There are small pulvilli on the 4 proximal tarsomeres and the arolia are small. Its pronotum measures 2.4 x 3.0mm, and the tegmen length is 10.2mm. If this specimen is *howarthi* it may be an epigean form of the taxon.

Paratemnopteryx suffuscula n. sp.
(Figs 31A-F,35)

MATERIAL EXAMINED

HOLOTYPE. ♂, 11 miles S by W of Cocklebiddy, Western Australia, 32.12S 126.03E, 2.xi.1969, Key and Upton. In ANIC.

PARATYPES. WESTERN AUSTRALIA. ANIC: same data as holotype, 1♂ (tegmen and wing slide 214) (Key's field notes, trip 163, Stop 18683.6); Bullsbrook, 1♂, at light, 4.xii.1978, K. and E. Carnaby; Python Pool, nr Mt Herbert, S of Roebourne, 2♂♂, 28.viii.1964, P.B. and L.C. Carne. The following were collected by M.S. Upton and J.E. Feehan: 1km SSW of Millstream H.S., 21,35S 117.04E, 1♂, 30.x.1970; 15km E of Millstream H.S., 21.35S 117.12E, 1♂ (terminalia slide 190), 20.x.1970. WAMP: 70-75km ENE of Norseman, 1♂, 10-16.xi.1978, T.F. Houston *et al.*

SOUTH AUSTRALIA. ANIC: Buckaringa Gorge, Flinders Range, c. 20km NNW of Quorn, 1♂, 19.xii.1985, C. Reid, P.W. Gullan, M. Lewis.

NEW SOUTH WALES. ANIC: Mount Boppy, 3♂♂, 25.xi.1949, E.F. Riek; Mt Arthur, nr Wellington, 1♂ (terminalia slide 142), E.F. Riek.

DESCRIPTION

Male. Head exposed, eyes large, extending well below antennal sockets, interocular distance about same as space between antennal sockets (Fig. 31A); third and fifth palpal segments longer than fourth. Pronotum suboval with a pair of depressions on distal half (Fig. 31B). Tegmina and wings fully developed extending well beyond end of abdomen, discoidal sectors of former, oblique (Fig. 31B,E), veins with short, upright hairs. Hind wing with subcosta reaching beyond middle, discoidal and median veins straight, cubitus vein straight with 2-3 complete and 2-3 incomplete branches, apical triangle absent (Fig. 31F). Front femur Type A_2; pulvilli subobsolete or absent on proximal tarsomeres 1-3, present on fourth tarsomere, tarsal claws symmetrical, simple, arolia small. Supraanal plate with hind margin convexly rounded, not reaching hind margin of subgenital plate; right and left paraprocts dissimilar, right one with a plate bearing spines, and a long spinelike process (Fig. 31C). Subgenital plate with pair of widely separated similar, cylindrical styles, interstylar margin weakly convex (Fig. 31D). Genitalia as in Fig. 31D: hook on left side with preapical incision; median phallomere uniformly slender, apex unmodified; right phallomere very large, one of the plates bearing a row of large, stout, setae.

Colouration. Brown. Head dark reddish brown, large ocellar spots white, clypeus yellowish white, labrum reddish brown, distal part lighter (Fig. 31A); last palpal segment light brown, other segments mostly pale. Pronotum with disk yellowish brown or dark brown, surrounding area hyaline or subhyaline. Tegmina reddish brown, hyaline (Fig. 31E). Hind wing with subcosta and costal vein regions and distal half of anterior field infuscated (Fig. 31F). Abdominal terga brown, lateral regions and terminal segments darker. Abdominal sterna brown, segment on distal half, darker. Cerci blackish brown dorsally and ventrally. Coxae with basal halves or more dark brown, remainder pale; femurs mostly pale sometimes infuscated, tibiae and tarsi darker.

Female. Unknown.

Measurements. Length, 9.0-11.5; pronotum length x width, 1.9-2.3 x 2.5-2.8; tegmen length, 9.9-11.8.

REMARKS

The habitus of *P. suffuscula* resembles that of some species of *Dyakinodes*.

Keyella n. gen.

TYPE SPECIES

Keyella gayi n. sp.

ETYMOLOGY

The genus is dedicated to Dr K.H.L. Key of CSIRO.

DIAGNOSIS

Eyes well developed or somewhat reduced. Tegmina and wings fully developed in both sexes, sometimes reduced in the female; cubitus vein of hind wing with complete and incomplete branches, apical triangle absent. Anteroventral margin of front femur with some large proximal spines followed by a row of piliform spinules and terminating in 3 large spines (Type B_3); pulvilli on 4 proximal tarsomeres of front and mid tarsi only, and only on fourth tarsomere of hind tarsus, or pulvilli on all tarsal segments; tarsal claws simple, symmetrical, arolia present. ♂: first abdominal tergum specialised. Seventh abdominal tergum with or without a specialisation. Intercercal ridge on ventral surface of supraanal plate absent. Subgenital plate symmetrical or nearly so. Two styles, weakly dissimilar. Hooklike genital phallomere on left side.

REMARKS

This genus is closely related to *Neotemnopteryx* and *Paratemnopteryx* and belongs in the Blattellidae: Blattellinae, tribe Parcoblattini. It is readily separated from the above 2 genera by Type B_3 front femur (vs. Type A_3). The morphology of the male setal gland on T1 also differs distinctly from those found in the related 2 genera. *Keyella* appears to be a link between *Neotemnopteryx* and *Paratemnopteryx*; one of the two species is closer to the former and the other is closer to the latter.

Distribution of the 2 species of *Keyella* is shown in Fig. 35.

KEY TO MALES OF *KEYELLA* SPP.

1. Supraanal plate trigonal (Fig. 32B). Seventh abdominal tergum unspecialised. Styles short, stocky, rounded (Fig. 32E) .... *gayi*

Supraanal plate subtrapezoidal (Fig. 33B,D). Seventh abdominal tergum with a pair of large medial depressions containing a large dense group of setae (Fig. 33B). Styles elongate, tapering (Fig. 33E) .... *armidalensis*

Keyella gayi n. sp.
(Figs 32A-E,35)

MATERIAL EXAMINED

HOLOTYPE: ♂, 'dried out of spirit', near Cairns, Queensland, Australia, viii.1966, H.M. Cameron; in ANIC.

PARATYPES: QUEENSLAND. ANIC: Lake Barrine, 1♂ (terminalia slide 134), 15.vii.1933, H.A. Gay; Davies Ck, 20km east by south of Mareeba, 17.02S 145.37E, 1♀, 19.xi.1981, J. Balderson. QMBA: Shiptons Flat, 35km S of Cooktown, 250m, 1♂, 22.iv.1982, Monteith, Yeates, and Cook.

ETYMOLOGY

The species is dedicated to H.A. Gay who collected one of the paratypes.

DESCRIPTION

Male. Eyes not extending below antennal sockets, interocular space greater than distance between ocelli or antennal sockets. Tegmina and wings fully developed the former with unbranched discoidal vein, branches of median and cubitus rami longitudinal. Hind wing with discoidal vein branched or unbranched (may differ on the right and left wings), median and cubitus veins straight, the former simple, the latter with 2 or 3 complete (some may be bifurcate) and 1 or 2 incomplete branches, apical triangle absent. Anteroventral margin of front femur with 6 large spines on proximal half followed by row of piliform spinules and 3 stout terminal spines (the first of these is only slightly longer, but stouter, than the spinules preceding it); pulvilli large on 4 proximal tarsomeres of front and mid tarsi, present only on segment 4 of hind tarsi; arolia very small. Modification on first abdominal tergum consisting of a pair of exposed, small, dense yellowish setal tufts, with a distinct space between them, and on either side an elevation bearing long slender setae (Fig. 32A). Seventh abdominal tergum unspecialised. Supraanal plate trigonal (Fig. 32B), reaching hind margin of subgenital plate; right and left paraprocts weakly dissimilar (Fig. 32D). Subgenital plate symmetrical, convexly rounded, hind margin pale, membranous, upturned (Fig. 32C). Styles, short, stocky, right one larger, pale ventrally (a continuation of pale margin of subgenital plate), dorsal surface densely covered with small appressed dark spines (Fig. 32E). Genitalia as in Fig. 32E: hook on left side; median phallomere uniformly slender, rodlike, right phallomere well developed with cleft.

Colouration. Dark reddish brown. Portion of right tegmen covered by left, hyaline, colourless. Hind wing with anterior margin darkly infuscated, veins brown.

Female. Tegmina and wings fully developed. Hind margin of supraanal plate less trigonal than male, convexly rounded. Pulvilli present on 4 proximal tarsomeres of all tarsi but small on first and second segments on hind tarsus, arolia very small.

Measurements (♀ in parentheses): Length, 17.3-17.7 (25.0 flattened); pronotum length x width, 5.0-5.1 x 5.7 (sides strongly deflexed) - 6.8 (5.1 x 6.9); tegmen length, 15.8-17.4 (17.0).

REMARKS

The widely spaced styles tend to resemble those of some *Paratemnopteryx* spp.

Keyella armidalensis n. sp

(Figs 33A-E,35)

MATERIAL EXAMINED

HOLOTYPE: ♂, at light, Armidale, New South Wales, Australia, 14.i.1963, C.W. Frazier, donated by University of New England; in ANIC.

PARATYPES: NEW SOUTH WALES. ANIC: same data as holotype except for collection dates: 1♂ (terminalia slide 135), 13.xii.1959, 2♂♂, 2.i.1960. MCZH: Salisbury Ct., 1♂, xi., Wheeler.

DESCRIPTION

Male. Eyes well developed extending below level of antennal sockets; interocular space same as distance between antennal sockets. Pronotum with sides rounded, hind margin weakly convex. Tegmina and wings fully developed. Tegmina discoidal vein with an apically forked branch near middle, branches of median vein longitudinal, those of the cubitus vein longitudinal and weakly slanted. Hind wing discoidal vein straight, with an apically forked branch beyond middle, median and cubitus veins straight, the former simple, the latter with 3-4 complete and 2-4 incomplete branches, apical triangle absent. Anteroventral margin of front femur Type B_3 with 4 large proximal spines; pulvilli present on 4 proximal tarsomeres of all legs; arolia present. First abdominal tergum with a pair of small separated tufts of setae and longer setae along a ridge anterior to them (Fig. 33A). Seventh abdominal tergum with a pair of depressions medially, in which is a large dense group of setae (Fig. 33B). Supraanal plate with hind margin truncate, right and left paraprocts dissimilar (Fig. 33B,D). Subgenital plate almost symmetrical, convex, hind margin upturned. Styles very close together near midline of plate, elongated, somewhat triangular, dorsal surface densely covered with small spines; right style slightly shorter and more robust than the left one (particularly in the pinned specimen, (Fig. 33C), but appears less so in the slide preparation (Fig. 33E). Genitalia as in Fig. 33E: genital hook of left side, with a subapical incision; median phallomere slightly enlarged and acute apically, right phallomere reduced.

Colouration. Light to dark brown.

Female. Unknown.

Measurements. Length, 9.5-12.2; pronotum length x width, 2.5-2.8 x 3.7-3.8; tegmen length, 10.5-13.2.

REMARKS

The closeness of the male styles resembles those found in *Neotemnopteryx styliparedra* (Fig. 13E).

Keyella sp.

MATERIAL EXAMINED

NEW SOUTH WALES. ANIC: Durras North, near Batemans Bay, 1♀, 23.xii.1984, H.M. Cameron

DESCRIPTION

Female. Eyes reaching slightly below level of antennal sockets; fifth palpal segment swollen, distinctly larger than the fourth. Tegmina reduced in length, width normal, tapering apically rounded reaching to hind margin of T3. Hind wings smaller reaching slightly beyond hind margin of T2, folded longitudinally down middle, veins present. Supraanal plate trigonal, apex rounded. Front femur Type B_3, pulvilli present on 4 proximal tarsomeres of all tarsi, arolia present, tarsal claws simple, symmetrical.

Colouration. Pronotum and abdominal terga dark reddish brown. Head, hyaline tegmina, cerci and legs light brown. Hind wings infuscated. Abdominal sterna light brown, its sides and subgenital plate darker.

FIG. 32. *Keyella gayi*, n. sp., ♂ paratype from Lake Barrine, Qld: First abdominal tergum and setal specialization; B, Supraanal plate (dorsal view); C, Subgenital plate and styles (rear view); D, Supraanal plate and paraprocts (ventral view); E, Subgential plate, genitalia, and styles (dorsal view).

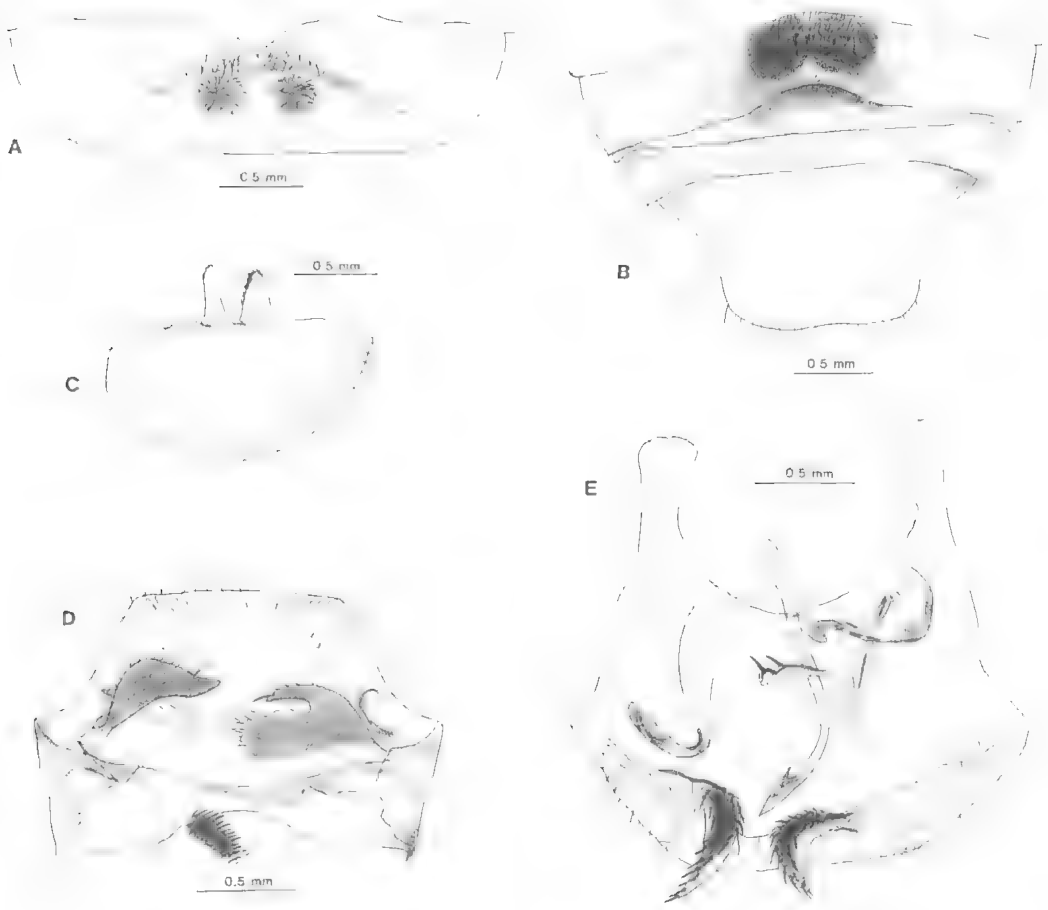


FIG. 33. *Keyella armidalensis*, n. sp., ♂♂. A-C, Holotype: A, First abdominal tergum and setal specialization; B, Abdominal tergum 7 (with setal gland) to supraanal plate; C, Subgenital plae and styles (rear view); D-E, Paratype from Armidale, N.S.W.: D, Supraanal plate and paraprocts (ventral view); E, Subgenital plate, genitalia, and styles (dorsal view).

Measurements. Length, 10.0; pronotum length x width, 2.5 x 3.6; tegmen length, 4.2.

REMARKS

The supraanal plate of this specimen resembles that of male *K. gayi* and it may be a brachypterous female of that species. Males from Batemans Bay are needed for specific determination. The unnamed female looks like a very small specimen of *Paratemnopteryx couloniana* (Princis) but its Type B3 front femur distinguishes it from that species (and genus) which has Type A3.

ACKNOWLEDGEMENTS

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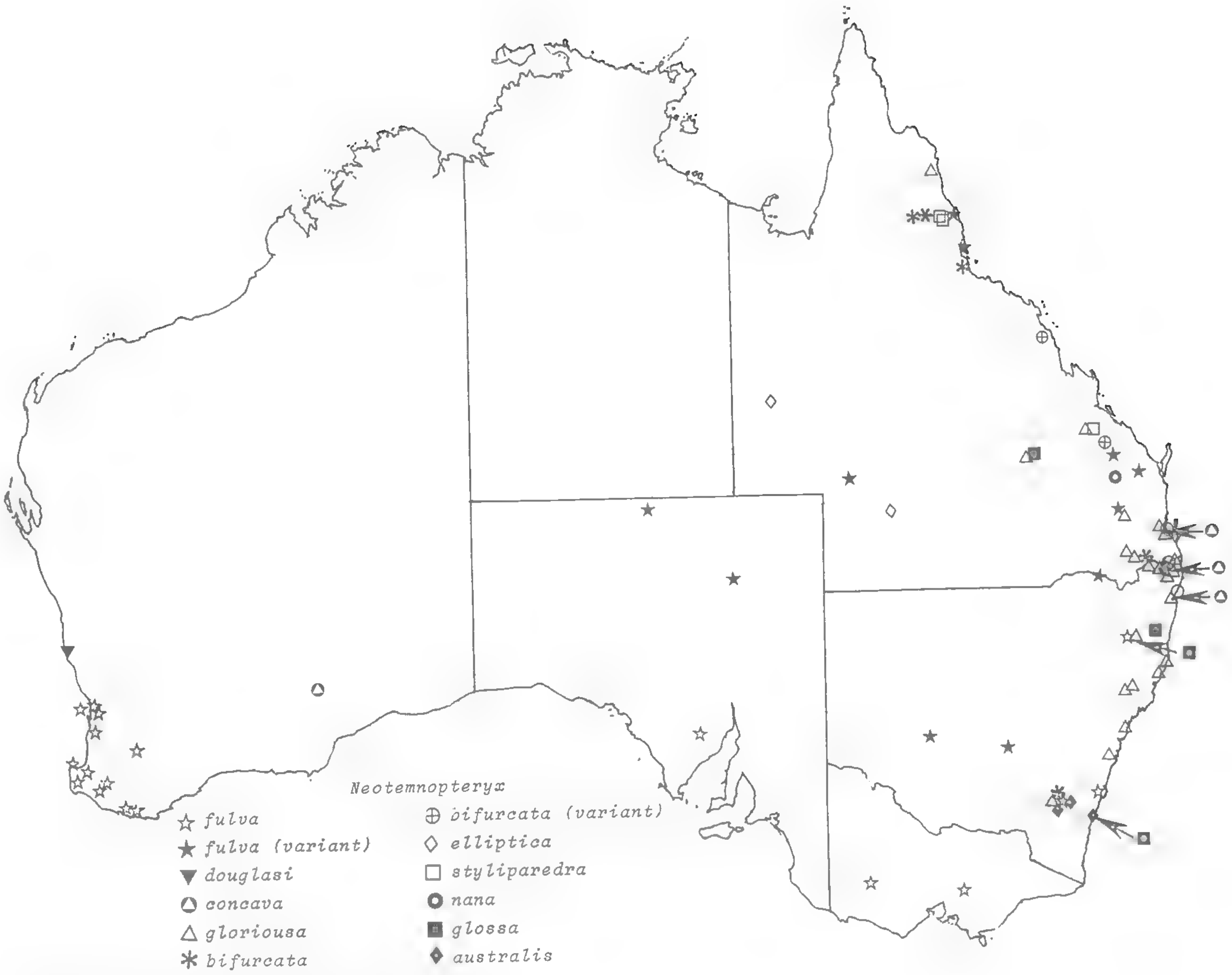

FIG. 34. Distribution of *Neotemnopteryx* spp. in Australia.

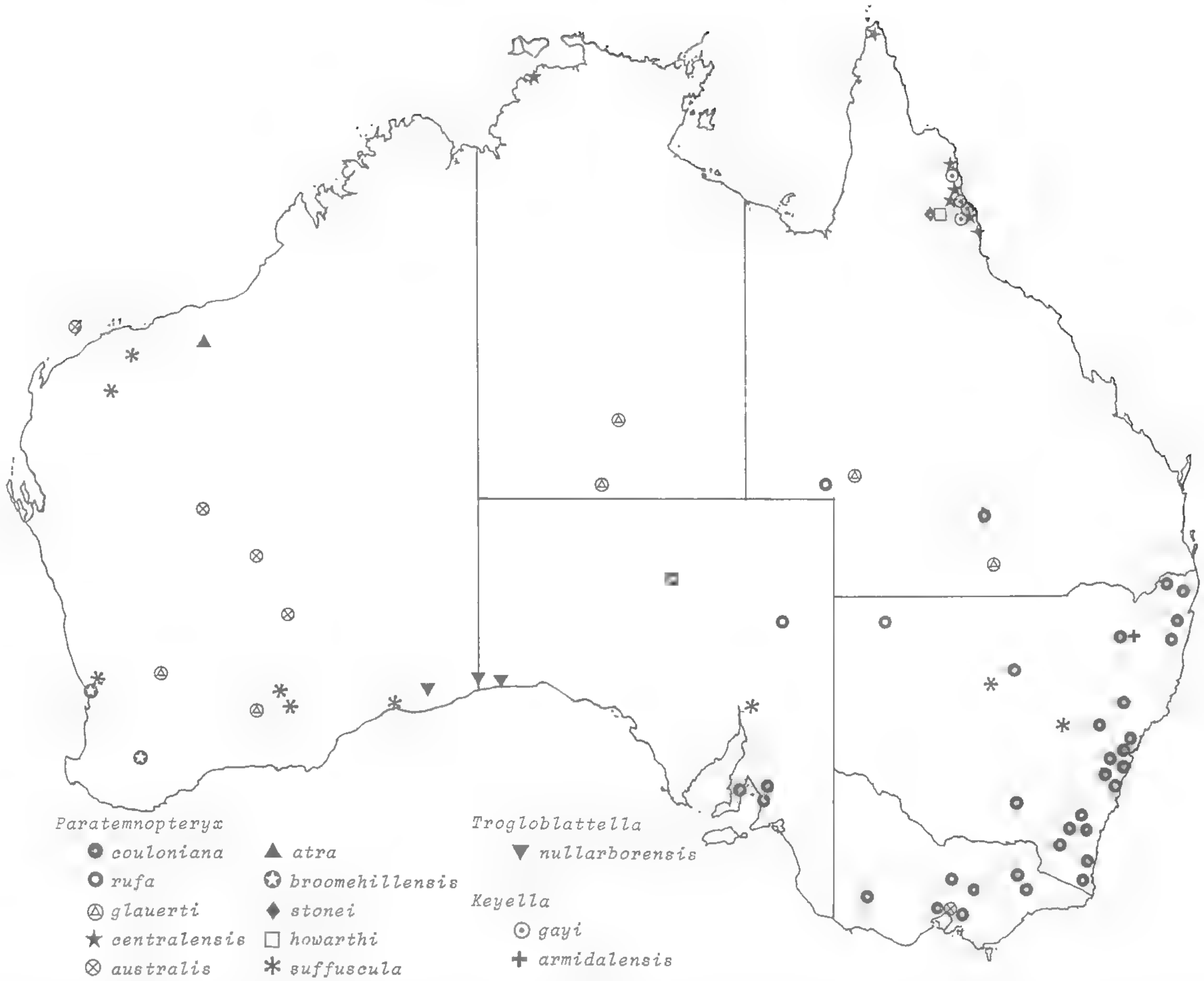

FIG. 35. Distribution of species of *Paratemnopteryx*, *Trogloblattella*, and *Keyella* in Australia. New Guinea records for *Paratemnopteryx centralensis* are shown for Papua only; those for Irian Jaya are not included.

for partial support, and Dr D.C. Rentz for his aid with the maps.

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REVISIONARY STUDIES ON BLATTELLIDAE (BLATTARIA) FROM THE INDO-AUSTRALIAN REGION

LOUIS M. ROTH

Roth, L.M. 1990 08 31: Revisionary studies on Blattellidae (Blattaria) from the Indo-Australian Region. *Memoirs of the Queensland Museum* **28**(2): 597-663. Brisbane. ISSN 0079-8835.

The genus *Shelfordina* Hebard is reviewed and the following 10 species are redescribed: *digitata* (Hanitsch); *fuscocastanea* (Hanitsch); *jarakae* Hebard; *latimarginata* (Hanitsch), n. comb.; *minor* (Hanitsch); *orchidae* (Asahina), n. comb.; *panamae* (Hebard), n. comb.; *spinistylifera* (Roth), n. comb.; *terminalis* (Brunner); *uniformis* (Hanitsch). The following 7 new species of *Shelfordina* are described: *cooki*; *philippinensis*; *robertsi*; *sumatrensis*; *tozerensis*; *wailimensis*; *yeatesi*. Five species are found in Australia, one is from Panama and the others are mostly Indonesian. The type species of the related genus *Imblattella* Bruijning, *Imblattella impar* (Hebard), is redescribed. The Australian genus *Dyakinodes* Princis is reviewed. One species, *centralis* (Walker) is redescribed and the following 6 new taxa are described: *bispinulifera*; *fraserensis*; *kurandensis*; *penibifida*; *waterhousei*; *uptoni*. Keys for identifying males of *Shelfordina* and *Dyakinodes* are given. Three species of *Anaplecta* Burmeister are recognised in Australia, namely, *A. calosoma* Shelford from Queensland (previously known from Papua New Guinea), *A. australiensis* n.sp. from Queensland and Northern Territory, and *A. brachyptera* n.sp. from Queensland. The banded tegmina of *calosoma* are similar to those of *A. vittata* Hanitsch (Singapore, Sumatra, West Malaysia, and Indonesia), but based on male genitalia both taxa are distinct.
Parectoneura bivittata n.gen., n.sp. from Northern Territory and Western Australia is described. *Pseudectoneura* Princis (New Caledonia) and *Pseudectobia* Saussure (India) are redescribed. *Pseudectobia insularis* (Saussure) (Mauritius) is transferred to *Chorisoblatta* Saussure and Zehntner. The subfamily placement of the last four genera is discussed. *Parectoneura* and *Pseudectoneura* are placed in the Blattellinae and *Pseudectobia* and *Chorisoblatta* are assigned to the Pseudophyllodromiinae. ☐*Insecta, Blattaria, Blattellidae, taxonomic revisions, Indo-Australian.*

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In this paper I review several blattellid genera, one of which, *Dyakinodes* with 7 species, occurs only in Australia. The Second, *Shelfordina*, has 17 species, 5 of which occur in Australia and the others are mainly Indonesian. In 1986 Dr David Rentz of CSIRO sent me some cockroaches that were found feeding on orchids in a greenhouse in Canberra. I decided the species was *Imblattella panamae* Hebard (*in* Rentz, 1987a) basing my determination on Asahina's (1973) description of what he believed to be that species found on orchids in a Tokyo greenhouse. I was unaware that Asahina (1985) decided that the Tokyo species was not *panamae* and described it as *Imblattella orchidae*. After examining a paratype of *I. panamae* I concluded that it belonged in the genus *Shelfordina* Hebard, as did *orchidae*.

One of the diagnostic characters of *Shelfordina* is the presence of a stylelike structure near the base of each style so that the male seems to have 4 styles rather than 2. I have examined the type species of *Imblattella* [*I. impar* (Hebard)] and find that it is not congeneric with *Shelfordina*. Other species now in *Imblattella* should be reexamined, as should those species that appear to have 4 styles. Some species of *Margattea* Shelford [e.g., *contingens* (Walker), and *longealata* (Brunner)] have accessory styles similar to those in *Shelfordina*, but they have Type B front femurs (Roth, 1989), rather than Type A.

In this paper I also describe 2 new species of *Anaplecta*, and redescribe *Anaplecta calosoma*, all from Australia, the latter also occurring in Papua New Guinea. I also describe *Parectoneura bivittata* n.gen., n.sp., from Northern Territory and Western Australia. Superficially this species resembles some species of *Ectoneura*, an Australian genus which Hebard (1943) placed in the Ectobiinae, and Princis (1969) included in the Chorisoneuridae. I redescribe *Pseudectoneura*

Princis, and *Pseudectobia* Saussure because the diagnosis of the former was similar to that of *Parectoneura*, and the latter name suggested a relationship to *Ectobius*.

The specimens used in this study were loaned to me by the following museums and their curators or collection managers: AMSA - Australian Museum, Sydney, New South Wales; Dr M.R. Gray and Mr B.J. Day; ANIC - Australian National Insect Collection, CSIRO, Canberra, Australian Capital Territory, Australia, Dr D.C.F. Rentz and Mr John Balderson; ANSP - Academy of Natural Sciences of Philadelphia, PA, U.S.A., Mr Donald Azuma; BMNH - British Museum (Natural History), London, England, Mrs Judith Marshall; BPBM - Bernice P. Bishop Museum, Honolulu, Hawaii, U.S.A., Mr Gordon Azuma and Mr J. Strazanac; DARA - Biological and Chemical Research Institute, Rydalmere, New South Wales, Australia, Dr G.R. Brown; HDEO - Hope Entomololgical Collections, University Museum, Oxford University, Oxford, England, Dr G.C. McGavin; ISNB - Institut Royal des Sciences Naturelle de Belgique, Brussels, Belgium, Dr P. Grootaert; MCZH - Museum of Comparative Zoology, Harvard University, Cambridge, MA, U.S.A.; MHNB - Naturhistorisches Museum, Basel, Switzerland, Dr M. Brancucci; MNHG - Museum d'Histoire Naturelle, Geneva, Switzerland, Dr Bernd Hauser; NMVM - National Museum of Victoria, Melbourne, Victoria, Australia, Dr A. Neboiss; NMWA - Naturhistorisches Museum Wien, Vienna, Austria, Dr U. Aspöck; QMBA - Queensland Museum, Brisbane, Queensland, Australia, Dr G.B. Monteith; SAMA - South Australian Museum, Adelaide, South Australia, Dr G.F. Gross; UZMC - Universitets Zoologiske Museum, Copenhagen, Denmark, Dr H. Enghoff. [The United States National Museum, Washington, D.C. (USNM) has a type specimen which was not borrowed. Dr Syoziro Asahina sent me a paratype of '*Imblattella*' *orchidae* Asahina which I have deposited in ANIC.]

Measurements are given in millimetres.

Imblattella impar (Hebard) (Figs 1A-D)

Neoblattella impar Hebard, 1920, p.58, pl.3, fig. 13 (♂ and ♀): 1921a, p.163; 1933, p.115.

Imblattella impar (Hebard): Bruijning, 1959, p.65; Princis, 1969, p.797.

HOLOTYPE (not examined)♂, Tabernilla, Canal Zone, Panama, A.H. Jennings; in USNM.

MATERIAL EXAMINED

PARATYPES: PANAMA. ANSP: Porto Bello, 1♂ (terminalia slide 410), 15.ii.1911, E.A. Schwarz; Alhajuelo, 1♂, 17.iv.1911, 2♂♂, 9.iv.1911, A. Busck; Bejuco Riv., 1♂, Wm. Schaus.

DESCRIPTION

Male. Interocular space less than distance between antennal sockets. Tegmina and wings fully developed, former with discoidal sectors longitudinal. Hind wings with proximal costal veins distinctly clubbed; discoidal, median, and cubitus veins straight, latter with 4-5 complete and 0 incomplete branches, apical triangle small (Fig. 1B). Front femur Type A_2; pulvilli present on 4 proximal tarsomeres, tarsal claws symmetrical, minutely serrated, arolia present. Abdominal terga unspecialised. Supraanal plate with medial portion broadly produced (Fig. 1A). Subgenital plate strongly asymmetrical, styles small, cylindrical, located on and near left posterior corner of plate; left style slightly larger, bearing some small, dark, robust spines, these absent from right one, interstylar margin an elongated oblique process bearing couple of rows of dark robust spines on proximal half (Figs 1C,D). Genitalia as in Fig. 1C; hook on right side.

Colouration. Brown. Heads of the specimens are discoloured. According to Hebard, there are '... 4 vertical lines on occiput, a moderately broad band between eyes, a moderately broad band, convex ventrad, between ocelli and face maculate with blackish brown'. Pronotal disk light brown with picturing and dots of dark brown. Tegmina transparent, light brown. Wings with non-uniform brownish tinge. Abdominal terga light brown with dark suffusions on distal segments. Abdominal sterna with shiny black maculation mesad on proximal segments.

Measurements. Length, 9.0-11.1; pronotum length x width, 2.6-2.9 x 3.3-3.6; tegmen length, 10.8-11.8.

REMARKS

Neoblattella Shelford is a large South and Central American genus of Blattellidae, and the males show a great diversity of subgenital plate and style morphology. Hebard described many species and separated them into species-groups, but did not provide diagnostic characters for these groups. Bruijning (1959) raised some of Hebard's species-groups to genera, and selected

Neoblattella impar as the type species of *Imblattella* and included *Neoblattella litosoma* Hebard as a second species with a general statement that the species included Hebard's *impar*-species group. Princis (1969, pp.796-798) listed 14 species in *Imblattella*, most of them transferred from *Neoblattella*, and included *Neoblattella panamae* as a new combination.

Hebard (1920, p.58) pointed out that the male subgenital plate of *impar* is '... of a type in no way comparable to that found in any of the species ...' of *Neoblattella*, or '... in any of the forms of Blattellites'. I consider the subgenital plate and style morphology important generic characters in this group of cockroaches. *Imblattella panamae* agrees with all the diagnostic characters of *Shelfordina* and I am transferring the species to that genus. The subgenital plate and styles of *Imblattella impar* are so unique that it may represent a monotypic genus.

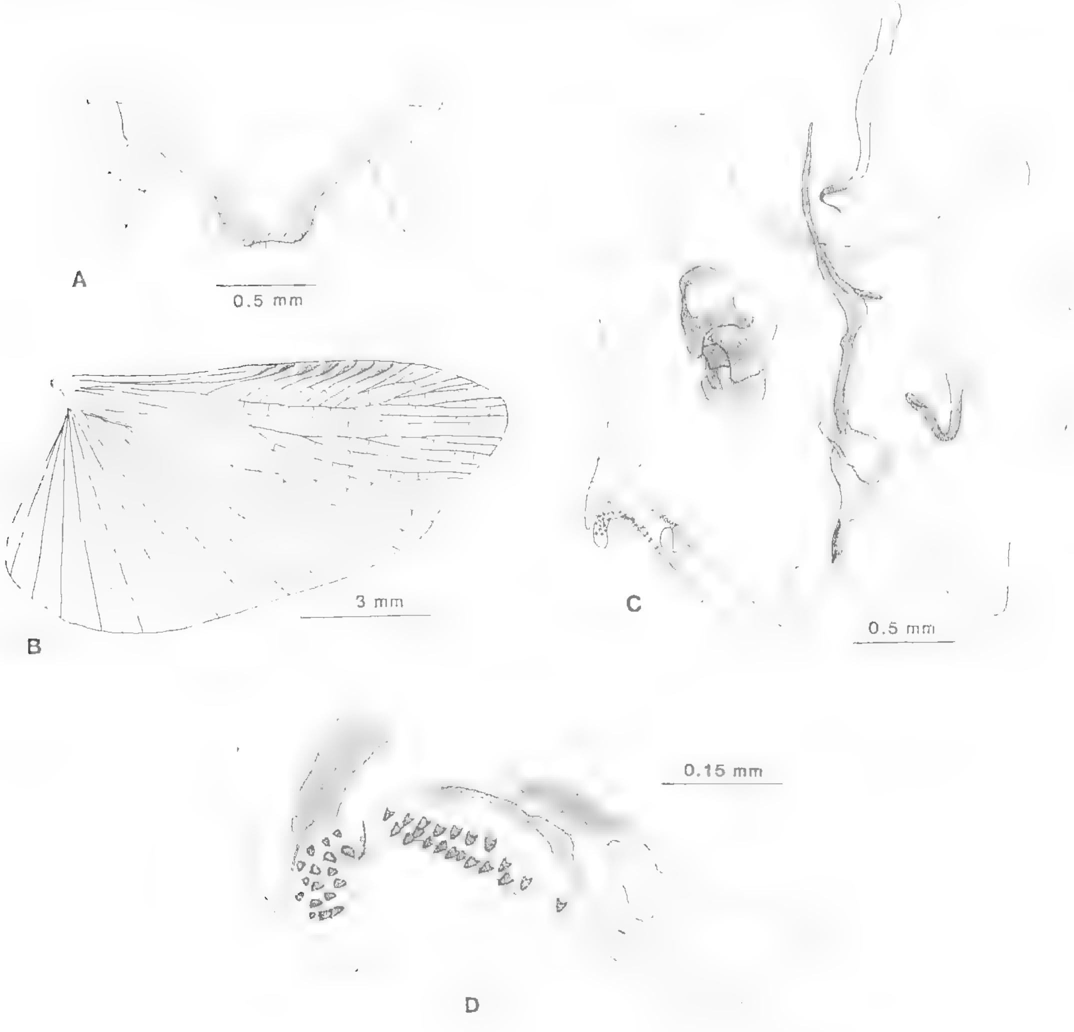

FIG. 1. *Imblattella impar* (Hebard), ♂ paratype from Alhajuelo, Panama: A, Supraanal plate (dorsal); B, Hind wing; C, Subgenital plate and genitalia (dorsal); D, Left corner of subgenital plate (dorsal).

Shelfordina Hebard

Shelfordina Hebard, 1929, p.46; Princis, 1969, p.871.
Shelfordella (*nec* Adelung): Hanitsch, 1933, p.126; Princis, 1951, p.57.
Possoina Strand, 1934, p.275; Bruijning, 1947, p.218; Princis, 1951, p.57.
Ebnerella Hanitsch, 1935, p.14; Princis, 1951, p.57.

TYPE SPECIES

Shelfordina fuscocastanea (Hanitsch), here selected [= *Phyllodromia terminalis* (*nec* Brunner), Hebard, 1929, p.46]. Hebard had 3 specimens when he selected *terminalis* as the type species of *Shelfordina*. One is a male of *fuscocastanea* and the other 2 are females of *Shelfordina terminalis minor* (Hanitsch) which I am raising to specific rank. Since Hebard misidentified the type species I intend to apply to the commission to designate *fuscocastanea* as the type species because there is no question as to the identification of Hebard's male specimen. A male specimen of *terminalis* from Borneo, the type locality, is unknown; I have seen a male from Sumatra which I have provisionally determined as that species.

One of Hebard's diagnostic characters of *Shelfordina* was '... sexes dissimilar, female with reduced organs of flight reaching apex of abdomen only.' Hanitsch (1933, p.126) found that Hebard had misidentified the specimens he used for his description of the genus and the above 'diagnostic' character was invalid. Hanitsch renamed the genus *Shelfordella*. However, *Shelfordella* was preoccupied and Strand (1934, p.275) replaced it with *Possoina*. In the interim, learning that *Shelfordella* was preoccupied, Hanitsch (1935, p.14), renamed it *Ebnerella*. Hanitsch had no valid reason for discarding Hebard's original name and Princis (1951, p.57, footnote 2) synonymised the 3 invalid names.

DIAGNOSIS

Tegmina and wings usually fully developed, sometimes reaching only to end of abdomen; hind wings may be shorter than tegmina, sometimes almost vestigial (Fig. 10J). Discoidal sectors of tegmina longitudinal or sublongitudinal (Figs 6E,7G,8F). Hind wing with some costal veins (usually the unbranched ones) clubbed (Fig. 11F), or thickened (Fig. 19D); discoidal vein straight, simple; median vein straight, usually simple, rarely with small apical branch; cubitus vein usually straight, rarely weakly concave, with 0 (rarely) to 5 complete branches, incomplete rami almost invariably absent, apical triangle present (except in greatly reduced wings). Front femur Type A_2, or A_3 (if latter, first terminal spine only slightly longer than preceding one); pulvilli present on 4 proximal tarsomeres, tarsal claws symmetrical, specialised (ventral margins serrated) (Fig. 11E; teeth may vary from distinct to sub-obsolete), arolia present. ♂: Abdominal terga unspecialised (in 2 species eighth segment enlarged, bearing spaced setae: Fig. 19E). Exposed portion of subgenital plate symmetrical. Styles widely separated, usually with a stylelike structure arising near their bases (hereafter called accessory styles) giving appearance of 4 styles rather than 2 (cp. Fig. 11C,c, Fig. 2G). Supraanal plate transverse, symmetrical, right and left paraprocts similar plates, without spinelike processes (Fig. 11A). Genital hook on right side (Fig. 13B,e).

REMARKS

Princis (1969, p.871) listed 7 species of *Shelfordina* from Malacca, Sumatra, Mentawai Islands, Celebes, and Japan. Of these *S. japonica* (Shelford) is a *Symploce* (Asahina, 1974) and *S. erythrocephala* (Hanitsch) is an *Episymploce* (Roth, 1985a, p.211; 1986, p.180). In this paper I describe, redescribe, or discuss 17 species of *Shelfordina* of which 7 are new and 4 are new combinations.

The male genital hook on the right side places *Shelfordina* in the Pseudophyllodromiinae (= Plectopterinae of McKittrick, 1964). The females in this subfamily usually do not rotate the ootheca prior to depositing it. A female of *Shelfordina digitata* (Fig. 2F), and one of *S. orchidae* were carrying oothecae in the vertical position, and they probably deposit the egg case from this position.

SPECIES-GROUPS OF *SHELFORDINA*

Based on the male subgenital plate and accessory styles I place species of *Shelfordina* in 3 species-groups as follows:

1. *digitata* species-group: Accessory styles absent; interstylar margin unmodified. Species: *digitata*.
2. *latimarginata* species-group: Accessory styles present, right and left ones similar in shape; interstylar margin strongly modified, bearing a pair of large, lobelike structures. Species: *jarakae*, *latimarginata*, *sumatrensis*.
3. *fuscocastanea* species-group: Accessory

styles present, right and left ones similar or distinctly different in shape; interstylar region not strongly modified, without setose lobes. Species: *cooki*; *fuscocastanea*; *minor*; *orchidae*; *panamae*; *philippinensis*; *robertsi*; *spinistylifera*; *terminalis*; *tozerensis*; *uniformis*; *yeatesi*; *wailimensis*.

Before receiving the type of *Shelfordina uniformis*, I considered erecting a fourth group in which the right and left accessory styles are strongly dissimilar; 2 species, *spinistylifera* and *wailimensis* would have been assigned to this group. However, *S. uniformis* has similar right and left accessory styles (placing it in the *fuscocastanea* group), but its median genital phallomere and eighth abdominal tergum are so similar to those of *spinistylifera* that I consider them to be more closely related than *spinistylifera* is to *wailimensis*.

KEY TO MALES OF *SHELFORDINA*

The male of *S. minor* is not known, but if its tegmina are similar to the female's (clear apical region), it will key to *terminalis*.

1\. Accessory styles absent (Fig. 2G) (*digitata* species-group). (Mentawai Islands) .... *digitata*

Accessory styles present, giving the appearance of 4 styles (e.g., Fig. 11C,e) 2

2\. Right and left accessory styles similar, or almost similar in shape (e.g., Figs 6G,14C) 3

Right and left accessory styles strongly dissimilar in shape, left one larger than right one (Fig. 20G) 15

3\. Interstylar region strongly modified with 2 large lobes densely covered in part with setae (Figs 3H,4E,5F). (*latimarginata* species-group) 4

Interstylar region not as above (*fuscocastanea* species group) 6

4\. Pronotal disk light brown without distinct markings (Fig. 5C). Region between interstylar lobes roundly raised, setose (Fig. 5F). (Sumatra) .... *sumatrensis*

Pronotal disk with large light or dark reddish brown macula (Figs 3A,B,4A). Region between interstylar lobes not as above (Figs 3H,4E) 5

5\. Apex of median genital phallomere hardly enlarged (Fig. 3H). (Mentawai Islands) ...*latimarginata*

Apex of median genital phallomere greatly enlarged, rounded (Fig. 4E). (Pulo Jarak) .... *jarakae*

6\. Tegmina reddish brown except for transparent colourless apical zone (Fig. 6E). (Borneo, Sumatra) .... *terminalis*

Tegmina not as above 7

7\. Head with broad, brownish, transverse band on vertex, face very pale, immaculate (Fig. 12A). (Japan, Australia) .... *orchidae*

Head not as above 8

8\. Accessory styles with 3 or 4 dark spines on inner lateral margins (Fig. 9C). (Panama) ... *panamae*

Accessory styles not as above 9

9\. Apical margins of accessory styles with small setae; ventral surface of subgenital plate with small mound bearing group of dark setae anterior to each accessory style (Fig. 8D). (Sumatra) .... *fuscocastanea*

Accessory styles not as above. Mound-bearing setae anterior to accessory styles absent 10

10\. Accessory styles short, bulbous, apically bifid (Fig. 16F). Tegmina and wings reaching to about end of abdomen. (Australia). .... *cooki*

Accessory styles not bulbous. Tegmina and wings extending beyond end of abdomen 11

11\. Head with a pair of transverse bands between ocellar spots and antennal sockets (Fig. 10C). Pronotum as in Fig. 10A. Interstylar margin convexly rounded (Fig. 10D). (Philippines) .... *philippinensis*

Head, pronotum, and interstylar margin not as above 12

12\. Cubitus vein of hind wing with 3-5 complete branches (Figs 14D,19D) 13

Cubitus vein of hind wing with 1 or 2 complete branches (Figs 17B,18D) 14

13. Accessory styles with 2 or 3 small apical spines (Figs 14C, 15A). Eighth abdominal tergum not enlarged, without scattered setae. (Australia) . . . . *tozerensis*

Accessory styles spinelike, without apical spines or setae (Fig. 19G). Eighth abdominal tergum enlarged bearing numerous spaced setae (Fig. 19E). (Celebes) .... *uniformis*

14. Interstylar margin undulate with pair of widely separated setal brushes (Fig. 17E). (Australia) ....*yeatesi*

Interstylar margin trigonal, without setal brushes (Fig. 18E). (Australia) .... *robertsi*

15. Eighth abdominal tergum enlarged, bearing scattered spaced setae (as in Fig. 19E; also see Roth, 1985b: Fig. 12G). (Sabah) .... *spinistylifera*

Eighth abdominal tergum not enlarged, without scattered setae (Sumatra) .... *wailimensis*

Shelfordina digitata (Hanitsch) (Figs 2A-G)

Neoblattella digitata Hanitsch, 1928, p.18, pl.1, fig.7 (♂ and ♀).
Shelfordella digitata (Hanitsch): Hanitsch, 1933, p.126.
Ebnerella digitata (Hanitsch): Hanitsch, 1935, p.14.
Shelfordina digitata (Hanitsch): Princis, 1969, p.872.

HOLOTYPE (not examined)

Mentawai Islands; in HDEO.

MATERIAL EXAMINED

PARATYPES: Mentawai Islands, HDEO: Siberut, 1♂ (terminalia slide 232), 26.ix.1924, H.H. Karny, Type Orth. $329^3/6$; Sipora, 1♀ (with attached ootheca), 31.x.1924, H.H. Karny, Type Orth. $329^2/6$.

DESCRIPTION

Male. Interocular space less than distance between antennal sockets (Fig. 2C); palpal segments 3 and 4 each longer than segment 5. Pronotum subelliptical (Fig. 2B). Tegmina and wings fully developed extending beyond end of abdomen, former with discoidal sectors longitudinal or almost so. Hind wing with subcosta and unbranched costal veins thickened on distal halves, discoidal, median and cubitus veins straight, latter with 5 complete and 0 incomplete branches, apical triangle small (Fig. 2E). Front femur Type A3; pulvilli on 4 proximal tarsomeres, tarsal claws symmetrical, ventral margins minutely toothed, arolia present. Abdominal terga unspecialised. Supraanal plate transverse, trigonal, apex weakly indented; right and left paraprocts similar, weakly defined plates (Fig. 2D). Subgenital plate symmetrical, styles similar, cylindrical, widely separated, accessory styles absent, interstylar margin straight, unmodified (Fig. 2G). Genitalia as in Fig. 2G; hook on right side, apex acute without apical spine or preapical incision; median phallomere slender, terminating in threadlike filament, sclerotised plate and 2 groups of setal brushes.

Colouration. Head reddish brown, clypeus and labrum pale (Fig. 2C). Pronotum with reddish brown maculae on anterior half, blackish brown on posterior region, background colour at centre of disk yellowish, broad lateral regions hyaline (Fig. 2B); the dark pattern apparently varies (cp. Hanitsch, 1928, pl.1, fig.7). Tegmina with mediastinal area subhyaline, pale yellowish, remainder dark amber to light yellowish brown. Hind wing clouded on distal half of costal vein region and anterior field, and behind apical triangle (Fig. 2E). Abdominal terga light brown, darkly infuscated laterally, round spots sublaterally. Abdominal sterna light brown with lateral stripes and sublateral dots. Cerci yellowish brown, basal 2 segments dark brown.

Female. Cubitus vein hind wing with 3 complete branches (1 bifurcate). Supraanal plate strongly transverse, hind margin shallowly convex. Pronotal pattern as in Fig. 2A. Abdominal terga extensively infuscated. Abdominal sterna with large medial zone and most of subgenital plate dark brown.

Ootheca. The female is carrying an ootheca in vertical position, keel dorsal (Fig. 2F). The egg case is black with very narrow keel, respiratory serrations very small; surface covered with transverse striae, longitudinal cell divisions absent; height, 2.6mm, length, 5.4mm, width, 2.0mm.

Measurements (♀ in parentheses). Length, 12.5 (12.8, contracted); pronotum length x width, 4.0 x 5.2 (4.5 x 5.7); tegmen length, 15.0 (14.5).

REMARKS

Were it not for having Type A front femur, this species could be mistaken for a member of the *ceylanica* species-group of *Margattea* (front femur Type B).

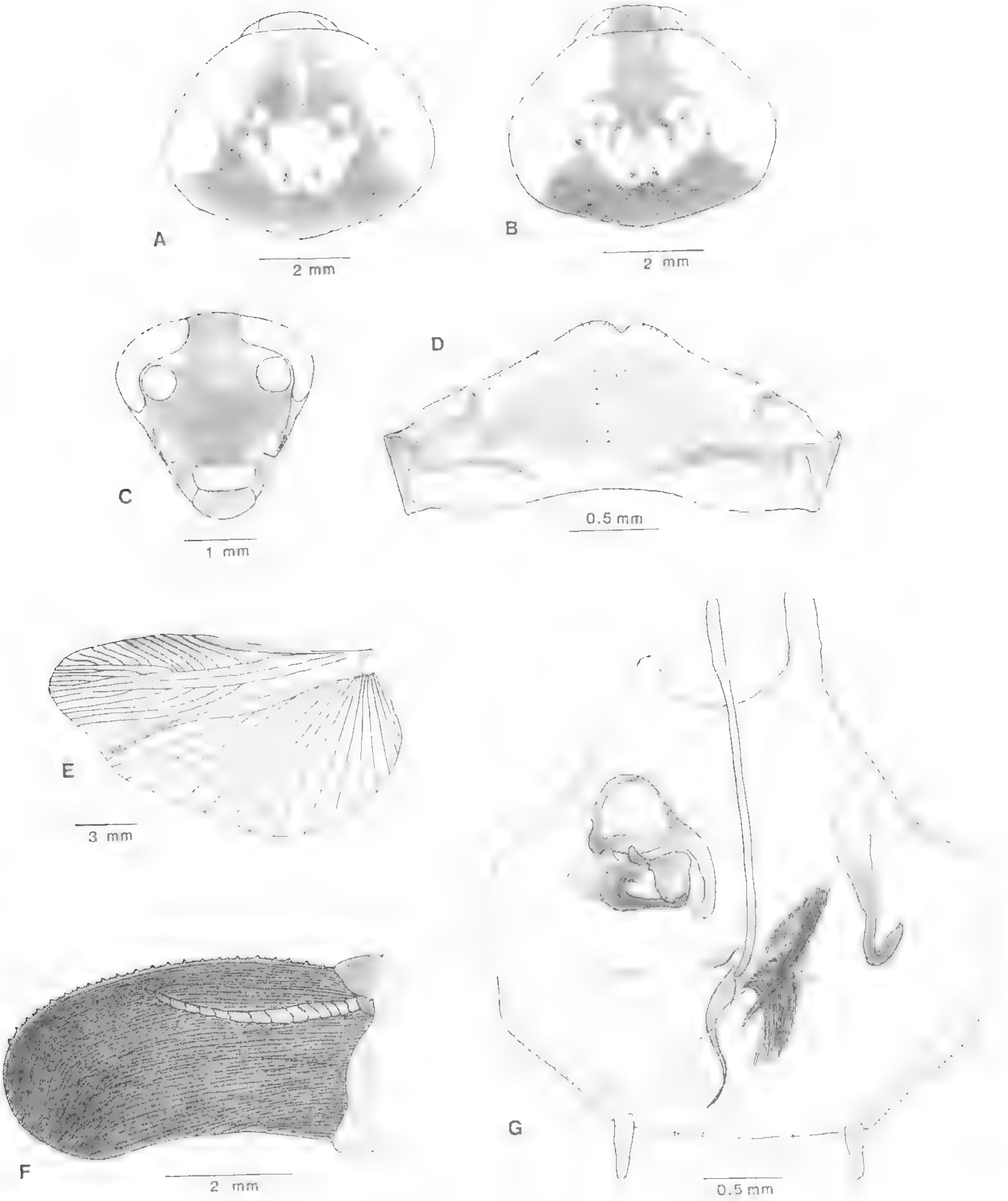

FIG. 2. *Shelfordina digitata* (Hanitsch), paratypes form Mentawai Islands: A, ♀ from Sipora, pronotum; B-E, G, ♂ from Siberut: B, Pronotum; C, Head; D, Supraanal plate and paraprocts (ventral); E, Hind wing; F, Ootheca attached to abdomen (lateral; from ♀ shown in Fig. A); G, Subgenital plate and genitalia (dorsal).

Shelfordina latimarginata (Hanitsch) n.comb. (Figs 3A-H)

Neoblattella latimarginata Hanitsch, 1928, p.19 (♂ and ♀).
?*Shelfordina latimarginata* (Hanitsch): Hebard, 1929, p.9.
Shelfordella latimarginata (Hanitsch): Hanitsch, 1933, p.126.
Ebnerella latimarginata (Hanitsch): Hanitsch, 1935, p.14.
Possoina latimarginata (Hanitsch): Bruijning, 1948, p.88.
Shelfordella jarakae (Hebard): Hanitsch, 1933, p.126 (incorrectly synonymised with *latimarginata*; Princis, 1969, p.872 (listed as a synonym of *latimarginata*).

HOLOTYPE (not examined)
♂, Mentawai Islands; in HDEO.

MATERIAL EXAMINED

PARATYPES. MENTAWAI ISLANDS. HDEO: Sipora, 1♂ (terminalia slide 231), 22.x.1924, H.H. Karny, Type Orth. 330^{3}/5.

WEST SUMATRA. HDEO: Siberut Island, 1♂, ix.1924, C.B.K. and N.S.. Type Orth. 330^{4}/5.

DESCRIPTION

Male. Interocular space less than distance between antennal sockets (Fig. 3C); palpal segments 3 and 4 each longer than segment 5. Pronotum subelliptical (Figs 3A,B). Tegmina and wings extending beyond end of abdomen, discoidal sectors of former longitudinal (Fig. 3F). Hind wing with unbranched costal veins thickened on distal halves, discoidal, median and cubitus veins straight, median with a small apical bifurcation, cubitus vein with 5 complete (1 with 2 small branches) and 0 incomplete branches, apical triangle distinct (Fig. 3G). Front femur Type A_3; pulvilli on 4 proximal tarsomeres, tarsal claws symmetrical, minutely toothed, arolia present. Abdominal terga unspecialised. Supraanal plate transverse, trigonal, apex of hind margin narrowly truncate, right and left paraprocts similar plates (Fig. 3D). Subgenital plate symmetrical, distal region directed dorsad (Fig. 3E); styles slender, cylindrical, similar, widely separated with accessory styles beneath them; interstylar lobe with pair of large structures their distodorsal surfaces covered with small dark spines (Figs 3E,H). Genitalia as in Fig. 3H; hook on right side with small apical spine, entire structure covered by sclerotised plate; median phallomere, slender, curved, rodlike, apically modified as rounded membrane; below phallomeres a large membrane, distal margin bearing huge brush composed of densely packed dark curved setae (in pinned male from Siberut Island this brush, which is normally hidden in the genital chamber, was extruded and exposed).

Colouration. Head with reddish brown occiput and vertex, transverse whitish band above antennal sockets, then a large reddish brown macula with pale areas within it, region below dark pattern, yellowish brown (Fig. 3C). Pronotum with broad reddish brown macula, pale areas within it, oblique lateral margins outlined opaque whitish, regions surrounding coloured area hyaline (Fig. 3B); pattern varies, disk may be light with dark oblique sides, whitish margins absent (Fig. 3A). Tegmina with mediastinal and costal vein area pale brownish yellow, remainder reddish brown, darker in anal area (Fig. 3F). Wings pale fuscous, darker in costal vein region and distal part of anterior field, and behind apical triangle which is pale (Fig. 3G). Abdominal terga yellowish brown, mottled with dark brown and lateral dots. Abdominal sterna yellowish brown, segments on basal half darker; subgenital plate dark brown on distal upturned portion below paired stylelike structures. Legs yellowish brown. Cerci dorsally light yellowish brown, basal segments darker.

Female. Not seen.

Measurements. Length, 13.0; pronotum length x width, 3.8-4.1 x 4.8-5.3; tegmen length, 15.0-16.8.

REMARKS

Differences in male genitalia and interstylar margin of subgenital plate clearly show that *latimarginata* and *jarakae* are valid taxa and not conspecific as claimed by Hanitsch. The brushlike membrane underlying the genital phallomeres is much larger in *latimarginata* than in *jarakae* or *sumatrensis*, the other two members in the species-group.

Shelfordina jarakae Hebard (Figs 4A-E)

Shelfordina jarakae Hebard, 1929, p.48, pl.3, figs 3,4 (♂): Princis, 1969, p.872 [listed as a synonym of *S. latimarginata* (Hanitsch)].
Shelfordella jarakae (Hebard): Hanitsch, 1933, p.126 [incorrectly synonymised with *S. latimarginata* (Hanitsch)].

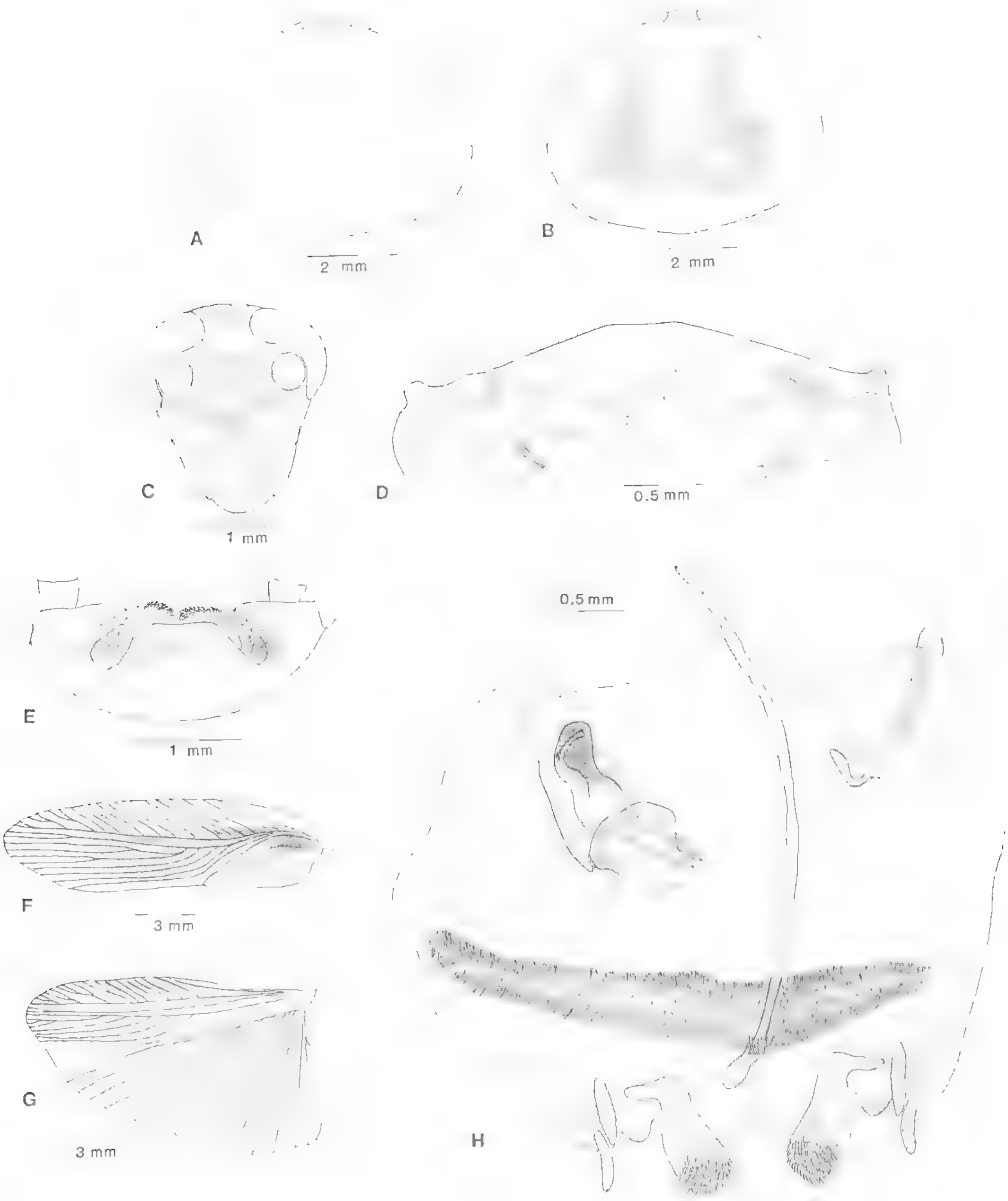

FIG. 3. *Shelfordina latimarginata* (Hanitsch), ♂ paratypes: A, from Siberut Island, West Sumatra, pronotum; B-H, from Sipora, Mentawai Islands; B, Pronotum; C, Head; D, Supraanal plate and paraprocts (ventral); E, Subgenital plate (rear-oblique view); F, Left tegmen; G, Left hind wing; H, Subgenital plate and genitalia (dorsal).

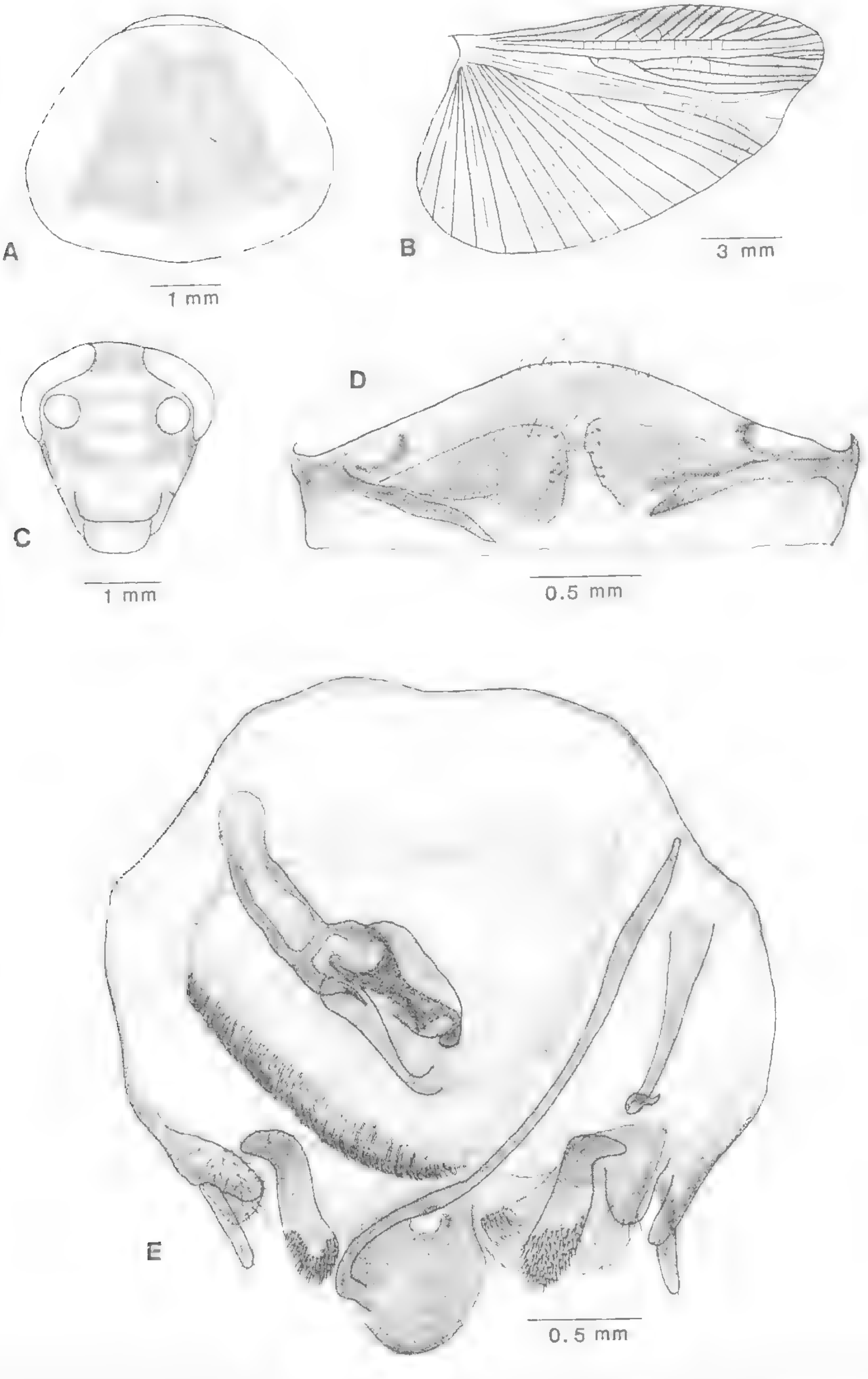

FIG. 4. *Shelfordina jarakae* Hebard, ♂ holotype: A, Pronotum; B, Hind wing; C, Head; D, Supraanal plate and paraprocts (ventral); E, Subgenital plate and genitalia (dorsal).

MATERIAL EXAMINED

HOLOTYPE: HDEO: ♂ (terminalia slide 230), Pulo Jarak, 14.iv.1921, V. Knight (with a Hanitsch label, *Neoblattella latimarginata* Han.).

DESCRIPTION

Male. Interocular space less than distance between antennal sockets (Fig. 4C). Pronotum subelliptical (Fig. 4A). Tegmina and wings fully developed reaching beyond end of abdomen. Hind wing with several costal veins clubbed, discoidal, median, and cubitus veins straight, latter with 4 complete (2 of them bifurcate) and 0 incomplete veins, apical triangle distinct (Fig. 4B). Front femur Type A_3; pulvilli present on 4 proximal tarsomeres, tarsal claws symmetrical their inner margins minutely toothed, arolia present. Abdominal terga unspecialised. Supraanal plate transverse, hind margin weakly trigonal, apex rounded, paraprocts similar plates (Fig. 4D). Subgenital plate symmetrical; styles slender, cylindrical, similar, each located near posterolateral corner of plate with stouter accessory style near its base; interstylar region with pair of large lobes densely covered with small spines on distal halves of dorsal surface; between these structures a large, round plate that seems to be the apex of the median genital phallomere (Fig. 4E). Genitalia as in Fig. 4E: hook on right side without apical or subapical spine or incision (in the drawing the hook is oriented with its apex directed upwards); median phallomere apparently expanded apically as a rounded plate; membrane beneath phallomeres with long row of dark setae.

Colouration. Head reddish brown, occiput darker with 3 light transverse bands on face (Fig. 4C). Pronotum with large subtrigonal reddish brown macula, its lateral margins outlined brownish yellow, lateral regions hyaline (Fig. 4A). Tegmina brownish yellow, hyaline in mediastine area and greater part of marginal field, then reddish brown becoming paler distad (see Hebard, 1929: pl.3, fig.3). Wings tinged with brown, apical triangle clear (Fig. 4B). Abdominal terga brownish yellow, each segment infuscated on distal half, with brown mesolateral dot. Abdominal sterna yellowish brown, darker brown lateral dots and in large proximal area and bilobate portion of subgenital plate. Legs brownish yellow, small flecks of darker brown at bases of most spines, ventral surfaces of hind femurs washed with that colour.

Female. Unknown.

Measurements. Length, 12.6; pronotum length x width, 3.5 x 4.5; tegmen length, 14.0.

REMARKS

Hanitsch considered *jarakae* a synonym of *latimarginata* undoubtedly because of the similarities in colour patterns and male terminal abdominal segments. However, differences in the median and left genital phallomeres and interstylar margins leave no doubt the 2 taxa are distinct.

Shelfordina sumatrensis n.sp. (Figs 5A-F)

MATERIAL EXAMINED

HOLOTYPE: ♂, Wai Lima, Z. Sumatra, Lampongs, no. 178, xi-xii.1921, Karny and Siebers; in HDEO.

PARATYPE: SUMATRA, HDEO: same data as holotype, 1♂, no. 86 (terminalia slide 233), 2♂♂, nos.197 and 394, 1♀, no.190 (labelled *Ebnerella* sp. by Hanitsch); Pedada-B, Lampongs, 1♂, i. 1922.

DESCRIPTION

Male. Interocular space less than distance between antennal sockets (Fig. 5A); palpal segments 3 and 4 each longer than segment 5. Pronotum subparabolic (Fig. 5C). Tegmina and wings fully developed extending beyond end of abdomen. Tegmina with discoidal sectors weakly oblique or longitudinal. Hind wing with subcosta and unbranched costal veins thickened distad; discoidal, median, and cubitus veins straight, the median usually simple (rarely with a small apical bifurcation), cubitus with 4-5 complete (one of the branches may be forked) and 0 incomplete branches, apical triangle small (Fig. 5E). Front femur Type A_2 or A_3 (if latter, first 'large' terminal spine only slightly longer than one preceding it). Abdominal terga unspecialised. Supraanal plate transverse, hind margin convex, right and left paraprocts similar plates (Fig. 5B). Subgenital plate symmetrical, distal half bent upwards at right angle (Fig. 5D); styles, slender, cylindrical widely spaced, at base of each a stouter accessory style; interstylar region strongly modified forming large rounded plate bearing pair of densely spined structures, floor between them longitudinally raised, setose (Fig. 5F). Genitalia as in Fig. 5F: hook on right side, slender, without subapical incision or spine, with sclerotised plate at basal end; median phallomere slender rod, apex unmodified; membrane beneath phallomeres greatly reduced, roughly anchor-shaped, distal area covered by small spines, the setae relatively light compared to those in *jarakae* and *latimarginata*.

Colouration. Head light brown, sometimes partially hyaline, without distinct markings (Fig. 5A); some specimens have faint indications of couple of transverse reddish brown bands. Pronotum with disk yellowish brown, without markings, surrounding region hyaline (Fig. 5C). Tegmina hyaline, light brown without markings. Hind wing with thickened region of costal veins dark, remainder with yellowish tinge, apical triangle clear (Fig. 5E). Abdominal terga and sterna light brown, former laterally infuscated, latter with large dark macula medially on anterior segments. Cerci light brown dorsally, apical segment dark. Male from Pedada has more extensive infuscation on abdominal segments, and head has more distinct reddish bands.

Female. Front femur Type A_2. Hind wing with 1 of 4 cubitus vein branches, bifurcate. Supraanal plate transverse, narrow, hind margin convex.

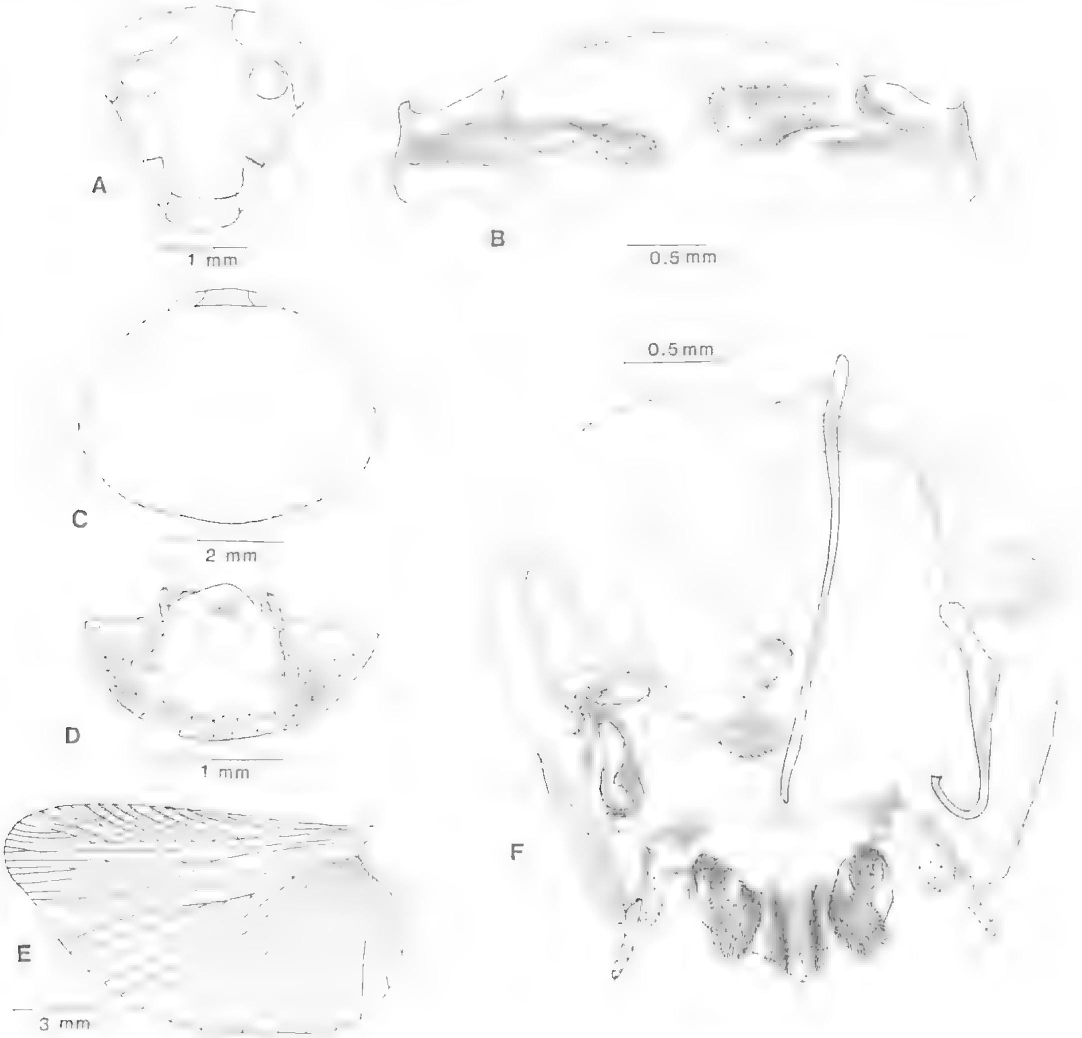

FIG. 5. *Shelfordina sumatrensis* n.sp., ♂♂. A,C,D, From holotype; B,E,F, from paratype, same locality as holotype: A, Head; B, Supraanal plate and paraprocts (ventral); C, Pronotum; D, Upturned region of subgenital plate (rear view); E, Hind wing; F, Subgenital plate and genitalia (dorsal).

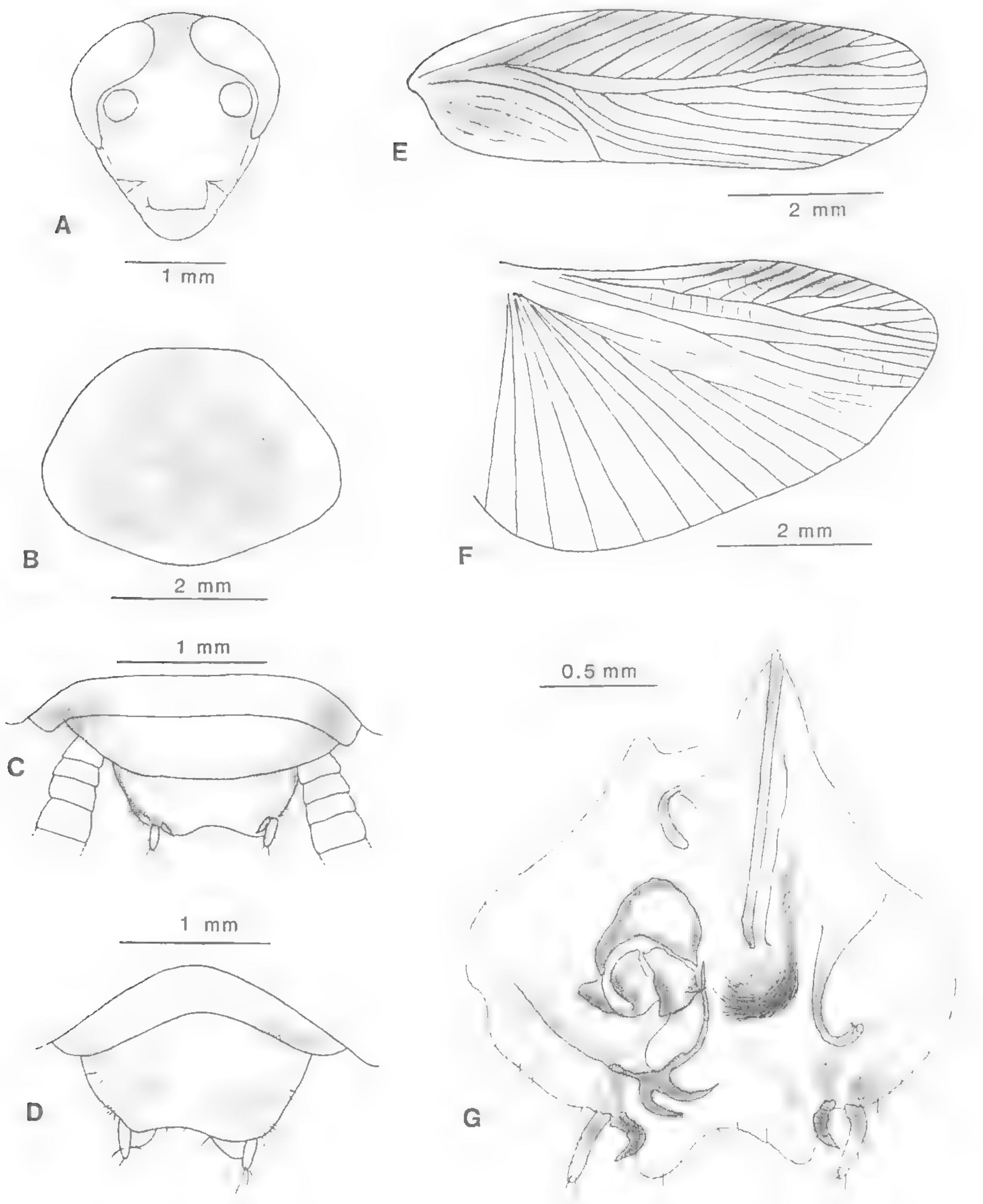

FIG. 6. *Shelfordina terminalis* (Brunner), ♂ from Wai Lima, Sumatra: A, Head; B, Pronotum; C, Supraanal and subgenital plates (dorsal); D, Subgenital plate (ventral); E, Tegmen; F, Hind wing; G, Subgenital plate and genitalia (dorsal).

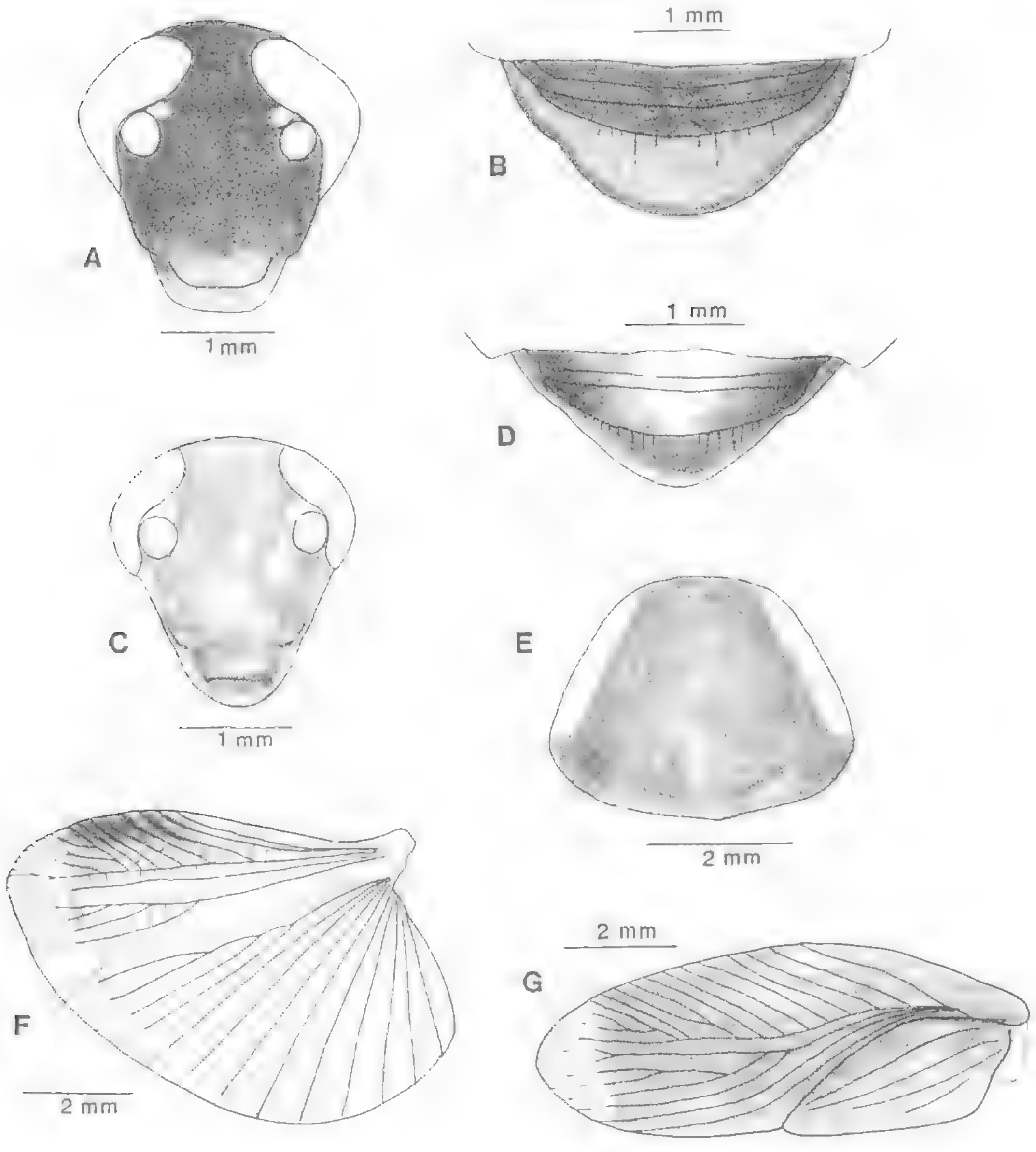

FIG. 7. *Shelfordina* spp. A,B, *S. terminalis* (Brunner), head, and terminal abdominal segments (dorsal) of ♀ holotype; C-G, *S. minor* (Hanitsch), ♀ from Fort de Kock, Sumatra: C, Head; D, Terminal abdominal segments (dorsal); E, Pronotum; F, Hind wing; G, Tegmen.

Subgenital plate with large dark reddish brown macula.

Measurements (♀ in parentheses). Length, 11.0-12.7 (13.5); pronotum length x width, 3.5-4.0 x 4.5-4.8 (3.8 x 5.1); tegmen length, 14.5-15.5 (13.4).

REMARKS

The subgenital plate, styles and their associated structures places *sumatrensis* close to *latimarginata* and *jarakae*. The median phallomere with its unmodified apex is more like that of *latimarginata*. The left genital phallomere is closer to that of *jarakae*. The greatly reduced membrane beneath the phallomeres, and the shape of the interstylar lobe and spination of the brushes, are distinctly different in *sumatrensis*. Superficially *sumatrensis* can be distinguished from its 2 close relatives by the absence of markings on pronotum and tegmina.

Shelfordina terminalis (Brunner)
(Figs 6A-G, 7A-B)

Phyllodromia terminalis Brunner, 1898, p.206, pl. 16, fig. 11 (♀); Kirby, 1904, p.93; Shelford 1908, p.13; Hanitsch, 1923, p.414.

Shelfordina terminalis (*nec* Brunner): Hebard, 1929, p.47 [♀ = *Shelfordina minor* (Hanitsch); ♂ = *Shelfordina fuscocastanea* (Hanitsch), pl. 3, figs 1, 2]; Princis, 1969, p.871.

Shelfordella terminalis (Brunner): Hanitsch, 1933, p.126 (♂).

Possoina terminalis (Brunner): Strand, 1934, p.275; Bruijning, 1948, p.88

Ebnerella terminalis (Brunner); Hanitsch, 1935, p.14.

MATERIAL EXAMINED

HOLOTYPE: ♀, Borneo; in NMWA.

ADDITIONAL MATERIAL. SUMATRA. HDEO: Wai Lima, Z. Sumatra, Lampongs, 1♂ (terminalia slide 228), xi.xii.1921, Karny (with following labels in Hanitsch's handwriting '*Neoblattella terminalis* Brunner, ♂; *Shelfordella*).

DESCRIPTION

Male. Eyes very close together, space between them distinctly less than distance between antennal sockets (Fig. 6A). Pronotum subelliptical (Fig. 6B). Tegmina and wings extending well beyond end of abdomen, discoidal sectors of former longitudinal or sublongitudinal (Fig. 6E). Hind wing with costal veins thickened distad, discoidal, median, and cubitus veins straight, latter with 3 complete and 0 incomplete branches, apical triangle poorly defined (Fig. 6F). Front femurs and all tarsal claws missing (see ♀ description). Abdominal terga unspecialised. Supraanal plate strongly transverse, hind margin convex, not reaching hind margin of subgenital plate (Fig. 6C). Exposed portion of subgenital plate symmetrical, styles similar, cylindrical widely separated (Figs. 6C,D); near base of each style a shorter, curved dark articulated accessory style, interstylar margin concavely excavated (Fig. 6G). Genitalia as in Fig. 6G: genital hook on right side with preapical spine; median phallomere straight rod, apex unmodified; left phallomere with pair of sclerotised, curved, spinelike processes.

Colouration. Head reddish brown, darker on occiput and vertex (Fig. 6A). Pronotum with broad reddish brown area that extends from anterior margin almost to convex hind margin, most of lateral regions hyaline (Fig. 6B). Tegmina reddish brown except for transparent, colourless apical zone (Fig. 6E). Hind wing infuscated, thickened costal vein region somewhat darker, small area posterior to apical triangle also darker, apical region practically colourless (Fig. 6F). Abdominal terga light brown, laterally infuscated. Abdominal sterna brown, terminal segments darker. Cerci dorsally with segments 1-3, 9, 10, and 12 (apex) dark brown, others pale, ventrally segments darker but those in middle somewhat lighter than basal and apical ones.

Female (holotype). Interocular space considerably less than distance between ocellar spots and antennal sockets (Fig. 7A). Tegmina and wings extending well beyond end of abdomen, cubitus vein of latter with 4 complete branches. Supraanal plate strongly transverse, convex, not reaching hind margin of subgenital plate (Fig. 7B). Front femur Type A_2; pulvilli on 4 proximal tarsomeres, tarsal claws symmetrical, ventral margins with subobsolete teeth, arolia present.

Colouration. Head blackish with reddish tinge, clypeus and labrum yellowish brown (Fig. 7A). Pronotal disk dark reddish brown, lateral borders lighter reddish brown. Tegmina dark reddish brown, large apical region transparent, colourless. Hind wing with thickened costal vein region yellowish, distal borders of anterior and posterior fields almost colourless, remainder weakly infuscated. Abdominal terga light brown, lateral borders slightly darker, terminal segments blackish brown. Abdominal sterna reddish brown, subgenital plate blackish with reddish tinge. Cerci and legs reddish brown.

Measurements (♀ holotype in parentheses). Length, 8.3 (11.4); pronotum length x width, 2.6 x 3.7 (3.6 x 4.7); tegmen length, 11.5 (12.6).

REMARKS

Hebard (1929, p.46) had 2 females from Fort de Kock, Sumatra, which he determined as *terminalis* because their tegmina were '...suddenly transparent and whitish like ground glass, the other portions being dark.' He also identified a male from the same locality as the same species even though its tegmina lacked the transparent, colourless apical region. Hanitsch (1933, p.126) pointed out that this male was not *terminalis* and

Princis (1969, p.872) correctly listed it under *S. fuscocastanea*, whose type I have seen. Hanitsch had a male from Mt Poi, Sarawak, and Wai Lima, Lampong, Sumatra, which had tegminal markings like those of *terminalis* and he considered them that species. The male which I am describing here as *terminalis* is Hanitsch's Wai Lima specimen; I have not seen his Mt Poi male. The females from Fort de Kock were named by Hanitsch *terminalis minor*, but I have raised this subspecies to specific rank (see below).

Shelfordina minor (Hanitsch)
(Figs 7C-G)

Neoblattella terminalis Brunner, *minor* Hanitsch, 1929b, p.273 (♀).

Shelfordina terminalis (*nec* Brunner): Princis, 1969, 872 [♀ only; ♂ = *S. fuscocastanea* (Hanitsch)].

Shelfordina terminalis minor (Hanitsch): Princis, 1969, p.872.

MATERIAL EXAMINED

HOLOTYPE: ♀, Fort de Kock, Sumatra, 920m, 1925, E. Jacobson; type Orth. 354^1/3 in HDEO.

PARATYPE: Pulo Tioman, HDEO: 1♀, vi.1915, V. Knight, Type Orth.354^2/3. Additional material. Sumatra. ANSP: Fort de Kock, 1♀ (genitalia slide 415), 19.xi.1913. 1♀, 920m, xii.1921, E. Jacobson (both reported as *S. terminalis* by Hebard, 1929, p.47).

DESCRIPTION

Male. Unknown (see remarks).

Female. Eyes wide apart, interocular space slightly less than distance between antennal sockets (Figs 7C). Pronotum subparabolic (Fig. 7E). Tegmina and wings somewhat reduced reaching only slightly beyond end of abdomen, discoidal sectors of former, sublongitudinal (Fig. 7G). Hind wings with costal veins thickened distad, discoidal and median veins straight, simple; cubitus vein weakly concave with 4 complete and 0 incomplete branches, apical triangle present (Fig. 7F). Front femur Type A$_3$ (first of 3 terminal spines may be only slightly longer than preceding one); pulvilli present on 4 proximal tarsomeres, tarsal claws symmetrical with few subobsolete teeth, arolia present. Terminal abdominal segments as in Fig. 7D.

Colouration. Head reddish brown (Fig. 7C). Pronotum with lateral borders yellowish, remainder dark reddish brown (Fig. 7E). Tegmina reddish brown, apical region transparent, appearing whitish (Fig. 7G). Hind wing with broad distal region practically colourless, remainder infuscated, thickened costal vein region somewhat darker, veins dark except in pale apical zone (Fig. 7F). Abdominal terga of terminal segments with broad lateral borders blackish, or dark brown, remainder light brown which extends medially to hind margin of supraanal plate. Abdominal sterna reddish or blackish brown. Cerci dark blackish brown with 2 pale preterminal segments. Coxae infuscated, remaining parts of legs reddish brown.

Measurements. Length, 9.0-10.6; pronotum length x width, 3.1-3.3 x 4.0-4.6; tegmen length, 8.9-9.2.

REMARKS

Because the apical region of the tegmina are transparent in Sumatran specimens, as they are in Brunner's Bornean *terminalis*, Hanitsch (1929b, p.273) described it as a subspecies, *minor*, stating that it differed from the nominate form in being smaller and in colour of the pronotum. There are other colour differences, but more importantly, the interocular space is distinctly greater (Fig. 7C) in *minor*, than it is in the holotype of *terminalis* (Fig. 7A), and for this reason I am raising Hanitsch's subspecies to specific rank. Because the eyes of the male from Wai Lima, Sumatra, are even closer together than are those of the female *terminalis*, I am provisionally identifying it as that species. It is not uncommon to find the interocular space somewhat different between the sexes of conspecific species, but the difference usually is less than that seen between Figs 6A and 7C, and more like that between Figs 6A and 7A. However, my interpretation of these 2 taxa should be confirmed by examining males from 'Borneo' and Fort de Kock, and females from Wai Lima.

Shelfordina fuscocastanea (Hanitsch)
(Figs 8A-G)

Neoblattella fusco-castanea Hanitsch, 1929b, p.274 (♂).

Ebernella fuscocastanea (Hanitsch), 1935, p.14.

Possolna fuscocastanea (Hanitsch): Bruijning, 1948, p.88.

Shelfordina terminalis (*nec* Brunner, 1898): Hebard, 1929, p.47, pl. 3, figs 1,2 [♂ only; ♀ = *Shelfordina minor* (Hanitsch), not *S. terminalis* (Brunner) as stated by Princis, 1969, p.872].

Shelfordina fuscocastanea (Hanitsch): Princis, 1969, p.872.

MATERIAL EXAMINED

HOLOTYPE: ♂, Fort de Kock, Sumatra, 920m, 1926, E. Jacobson; Type Orth. 355; in HDEO.

ADDITIONAL MATERIAL. SUMATRA. ANSP: same data as holotype, 1♂ (terminalia slide 416), i.1921 (misidentified as *S. terminalis* by Hebard, 1929).

DESCRIPTION

Male. (see Hebard, 1929, pl. 3, fig. 1, for habitus). Head slightly exposed beyond pronotum; interocular space less than distance between antennal sockets (Fig. 8A). Pronotum as in Fig. 8B. Tegmina and wings extending well

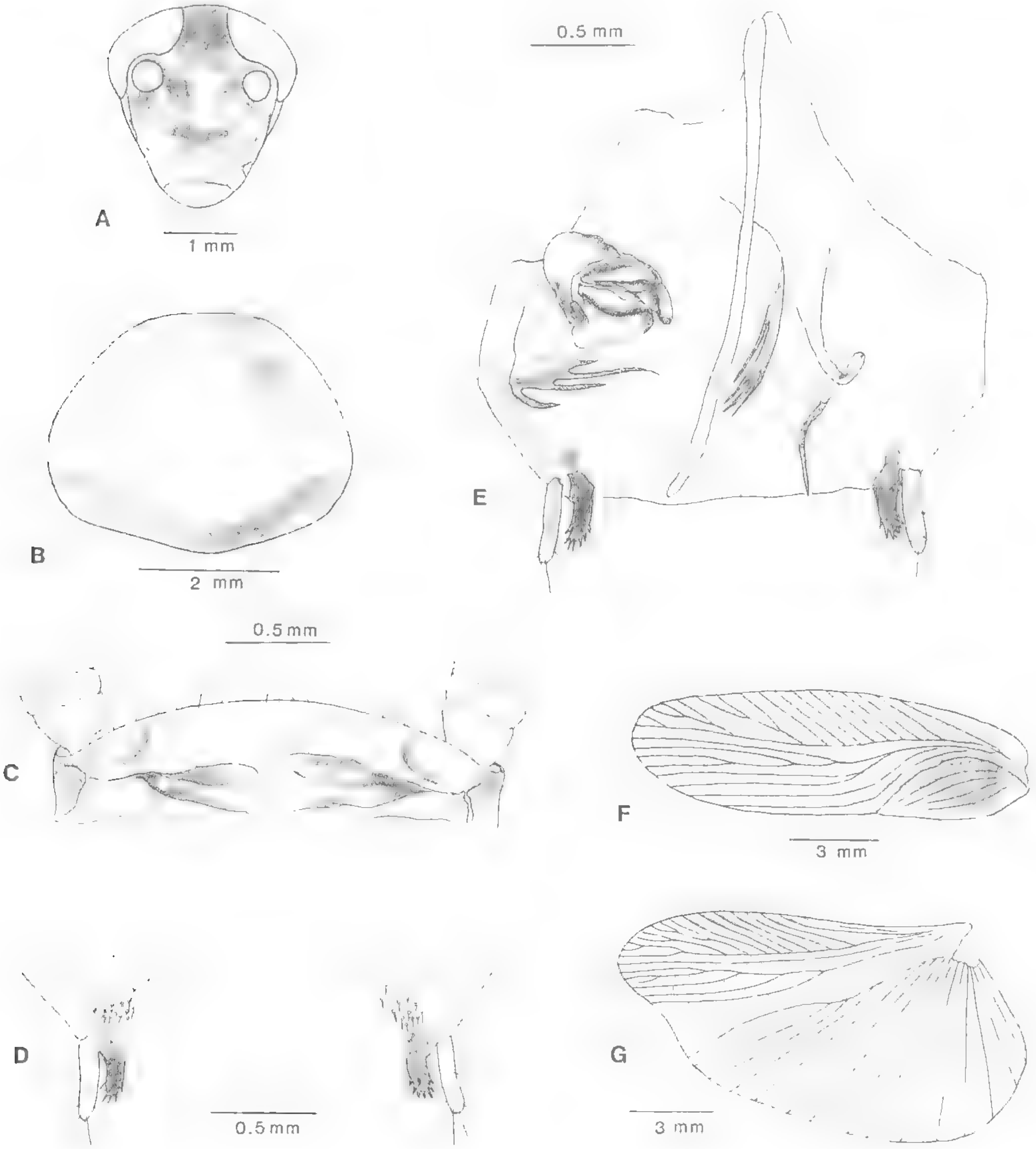

FIG. 8. *Shelfordina fuscocastanea* (Hanitsch), ♂♂ from Fort de Kock, Sumatra. A,B,F,G, From holotype: A, Head; B, Pronotum; C, Supraanal plate and paraprocts (ventral); D, Distal region of subgenital plate showing styles and accessory styles (ventral); E, Subgenital plate and genitalia (dorsal); F, Tegmen; G, Hind wing.

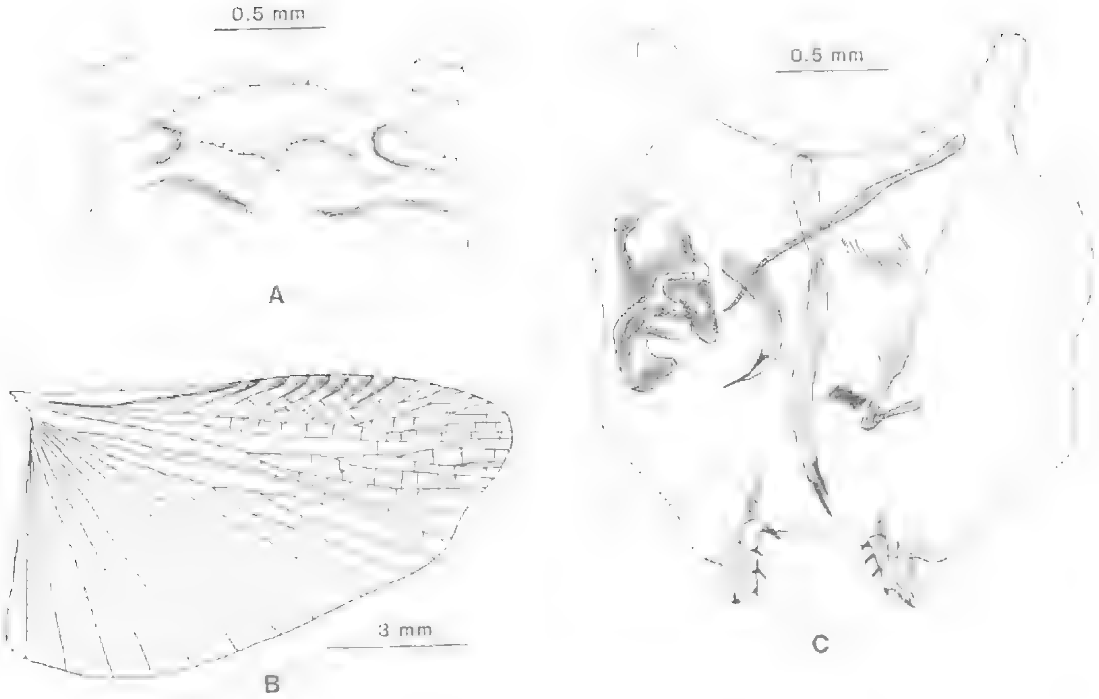

FIG. 9. *Shelfordina panamae* (Hebard), ♂ paratype from Rio Trinidad, Panama: A, Supraanal plate and paraprocts (ventral); B, Hind wing; C, Subgenital plate and genitalia (dorsal).

beyond end of abdomen, discoidal sectors of former longitudinal (Fig. 8F). Hind wing with unbranched costal veins slightly thickened on distal halves, discoidal, median, and cubitus veins almost straight, latter with 3-4 complete and 0 incomplete rami, apical triangle distinct (Fig. 8G). Front femur Type A_3; pulvilli present on 4 proximal tarsomeres, tarsal claws with subobsolete teeth on ventral margins, arolia present. Abdominal terga unspecialised. Supraanal plate strongly transverse, hind margin convex, reaching hind margin of subgenital plate, right and left paraprocts similar (Fig. 8C). Subgenital plate with exposed portion symmetrical, styles widely separated arising from posterolateral corners of plate, each with slightly shorter accessory style near base, interstylar margin straight, upturned, unmodified (Fig. 8E); ventrally, anterior to base of each accessory style, a small mound bearing group of small dark setae (Fig. 8D). Genitalia as in Fig. 8E: hook on right side with small apical spine; median phallomere, slender, rodlike, apex unmodified.

Colouration. Head reddish brown, labral and clypeal regions pale, face with light areas near each antennal socket and on frons (Fig. 8A). Pronotum with disk deep reddish brown, oblique margins of macula yellow, lateral regions semi-hyaline, posterior area very dark brown or blackish (Fig. 8B). Tegmina reddish brown, yellow spot near base of axillary vein (Fig. 8F). Hind wing with subcostal and thickened costal vein areas pale, region posterior to thickened veins up to discoidal vein weakly infuscated, darkened region extending to apical margin, small area behind apical triangle weakly infuscated. Abdominal terga light brown, lateral borders infuscated, supraanal plate with pale longitudinal macula medially. Abdominal sterna reddish brown, upturned interstylar region pale. Legs reddish brown. Cerci dark brown dorsally and ventrally, preapical segment pale.

Female. Unknown.

Measurements. Length, 10.0-11.5; pronotum length x width, 3.0 x 4.0-4.2; tegmen length, 12.5-13.6.

Shelfordina panamae (Hebard) n.comb.
(Figs 9A-C)

Neoblattella panamae Hebard, 1920, p.56, pl. 3, fig. 12 (♂ and ♀).

Imblattella panamae (Hebard): Princis, 1969, p.796.

Holotype (not examined)
♂, Rio Trinidad, Panama, 19.iii.1912, A. Busck; in United States National Museum.

Material Examined
Paratype: ANSP: same locality as holotype, ♂ (terminalia slide 409), 7.x.1911, A. Busck.

Description

Male. Interocular space slightly less than distance between antennal sockets. Pronotum with anterior and posterior margins truncate, latter broader, lateral margins convex. Tegmina and wings fully developed, discoidal sectors of former, longitudinal. Hind wing with most costal veins distinctly clubbed, discoidal, median and cubitus veins straight, latter with 3-4 complete and 0 incomplete branches, apical triangle small (Fig. 9B). Front femur Type A_3 (first terminal spine may be only slightly longer than one preceding it); pulvilli present on 4 proximal tarsomeres, tarsal claws with flange on inner margins and with 2 or 3 distinct but microscopic teeth distad. Abdominal terga unspecialised. Supraanal plate transverse, hind margin convex, right and left paraprocts similar, simple plates (Fig. 9A). Subgenital plate almost symmetrical; styles similar, widely spaced, adjacent to each style basally, an accessory style about as long as styles, with 3 or 4 dark spines on inner margins; interstylar margin almost straight (Fig. 9C). Genitalia as in Fig. 9C: hook on right side without a terminal spine or subapical incision; median phallomere with apical and preapical spines.

Colouration. General colour brown. Head with subobsolete broad brown interocular band. Pronotal disk brown with dark lines and blotches. Tegmina light brown, hyaline. Hind wing weakly infuscated, axillary vein area lighter (Fig. 9B).

Measurements. (Hebard's measurements in parentheses). Length, 9.6 (10.0-11.5); pronotum length x width, 2.4 x 3.4 (2.5-2.7 x 3.6), tegmen length, 10.6 (11.1-11.8).

Shelfordina philippinensis n. sp.
(Figs 10A-J)

Material Examined
Holotype: ♂ (terminalia slide 470), Camarines Sur Prov., Mt Iriga, Luzon Island, Philippines, 500-600m, light trap, 3-4.iv.1962, H.M. Torrevillas; in BPBM.
Paratypes: Philippine Islands, BPBM: Negros Or., Mt Talinas, 900-1200m, rain forest, 1♀, 9.vi.1958, H. E. Milliron, Luzon, Mt Prov., Ifugao Mayoyao, 1000-1500m, 1♀, 29.vi.1966, H. M. Torrevillas.

Description

Male. Eyes close together, interocular distance distinctly less than space between ocellar spots and antennal sockets (Fig. 10C). Pronotum subelliptical (Fig. 10A). Tegmina and wings fully developed extending well beyond end of abdomen. Tegmina with discoidal sectors longitudinal (Fig. 10E). Hind wing with subcosta and unbranched costal veins clubbed, discoidal and median veins straight, simple; cubitus vein practically straight with 2 or 3 complete and 0 incomplete branches, apical triangle well developed (Fig. 10F). Front femur Type A_2; pulvilli present on 4 proximal tarsomeres, tarsal claws symmetrical, ventral margins distinctly toothed, arolia present. Abdominal terga unspecialised. Supraanal plate transverse, hind margin convexly rounded; right and left paraprocts, similar simple plates (Fig. 10B). Subgenital plate symmetrical, styles widely separated, accessory styles present, similar, interstylar margin convexly rounded (Fig. 10D). Genitalia as in Fig. 10D: hook on right side, hook portion short, apically rounded with a small preapical spine; distal end of median phallomere obliquely bent, with preapical setose modification.

Colouration. Yellowish brown. Head yellowish with vertex brown becoming lighter on occiput, transverse brown bands between ocellar spots and antennal sockets (Fig. 10C). Pronotum with symmetrical pattern of dark maculae, lateral regions hyaline (Fig. 10A). Tegmina pale hyaline, mediastine vein weakly darkened for part of its length. Hind wing with clubbed region of costal veins dark, remainder with yellowish tinge (Fig. 10F). Abdominal terga yellowish brown. Abdominal sterna yellowish brown, basal half of subgenital plate with pair of large brownish black maculae on distal half of segment. Legs yellowish brown.

Female. Interocular space about same as interocellar distance greater than space between antennal sockets. Tegmina reduced (Figs 10G,I), reaching to about T7; hind wings shorter than tegmina, cubitus vein with 1 or no complete branches, apical triangle absent (Figs 10H,J). Supraanal plate with hind margin convexly rounded (as in ♂, Fig. 10B). Head and pronotal markings less intense than in male. Tegmina with mediastine vein weakly darkened, anal vein pale

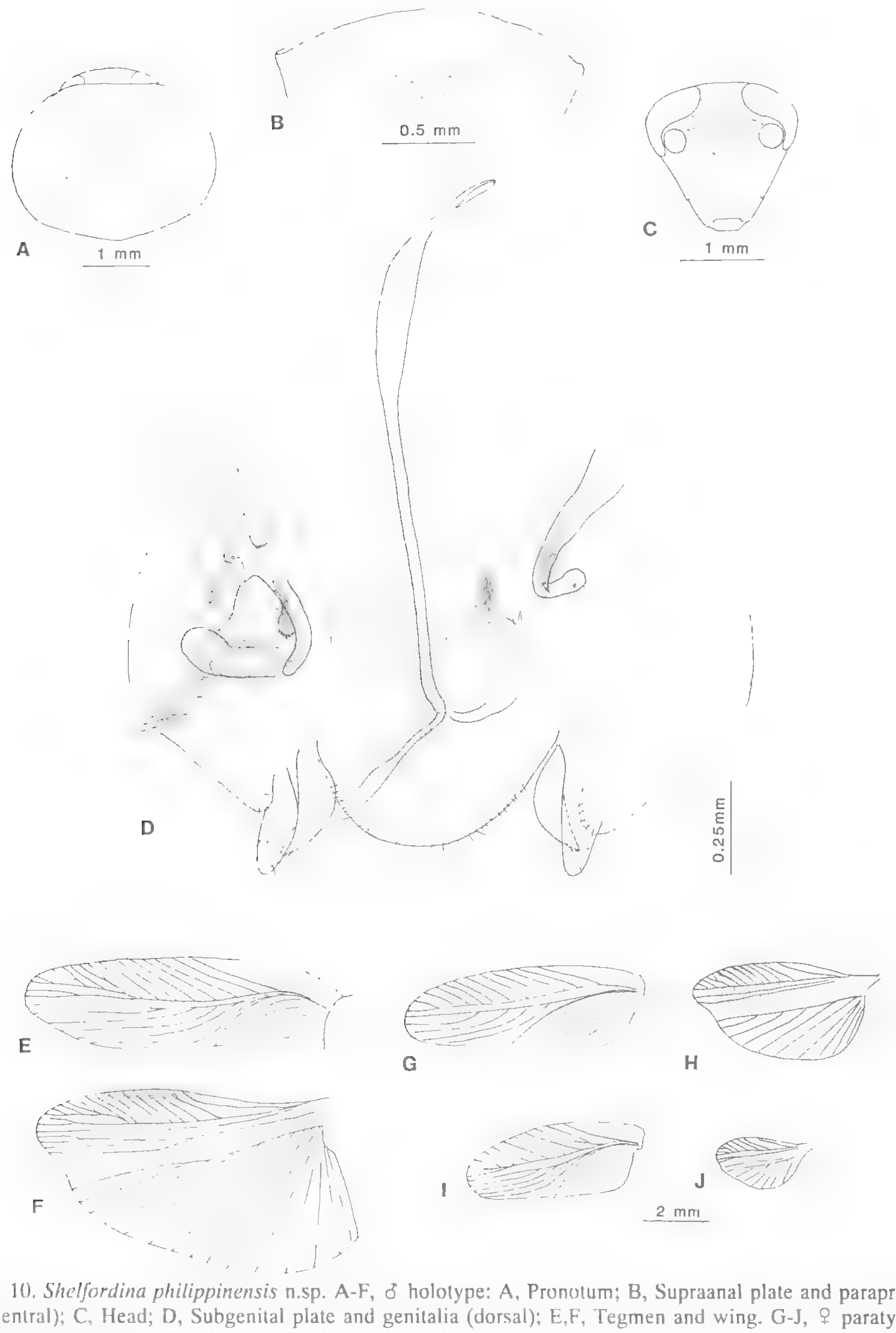

FIG. 10. *Shelfordina philippinensis* n.sp. A-F, ♂ holotype: A, Pronotum; B, Supraanal plate and paraprocts (ventral); C, Head; D, Subgenital plate and genitalia (dorsal); E,F, Tegmen and wing. G-J, ♀ paratypes, tegmina and wings: G,H, From Mt Talinas, Negros Or.;.I,J, From Ifugao, Mayoyao, Luzon. All tegmina and wings to same scale.

FIG. 11. *Shelfordina orchidae* (Asahina), ♂ from Black Mt., ACT., Australia: A, Supraanal plate and paraprocts (ventral); B, Terminal abdominal segments (ventral); C, Subgenital plate (dorsal); D, Pronotum; E, tarsal claws and arolium; F, Hind wing. Abbreviations: a, supraanal plate; b, right paraproct; c, subgenital plate; d, style; e, accessory style.

or weakly darkened. Abdominal terga and sterna reddish brown, with interspersed light areas.

Measurements. (♀ in parentheses). Length, 8.7 (7.7-9.6); pronotum length x width, 2.3 x 3.0 (2.3-2.6 x 3.1-3.5); tegmen length, 9.5 (5.6-6.7).

REMARKS

This is the first record of the genus in the Philippines.

Shelfordina orchidae (Asahina) n. comb.
(Figs 11A-F,12A-D,13A-B,29)

Imblattella panamae (*nec* Hebard), Asahina, 1973, p.126, figs 9-12, 19-22; Rentz, 1987b, p.3, figs 1-8.
Imblattella orchidae Asahina, 1985, p.6, figs 9-18, 20, 21, 23, 24(♂ and ♀); Rentz, 1987a, p.44, figs 1-8; 1987c, p.14, figs.1-8.

MATERIAL EXAMINED

JAPAN. ANIC: 1♂ (terminalia slide 181), paratype of *Imblattella orchidae* Asahina, Totsuka, 5.ii.1973, S. Asahina.

AUSTRALIAN CAPITAL TERRITORY. ANIC: Canberra (Spence), 1♂, 1 nymph, 25.ix.1987, J. and S. Rickard. The following were collected by D.C.F. Rentz: Black Mt., 35.17S 149.06E, Botanical Gardens, in orchids or orchid house, 1♂, 3♀♀ (1 carrying ootheca; 1 genitalia slide 176), reared from nymphs, 27.iii.1986, 1♂ (terminalia slide 175), 24.xi.1986, 1♀ 22.vii.1985 (coll. as nymph, matured 10.x.1985), 1♀, 27.iii.1986 (coll. as nymph, matured 4.vi.1986), 1♀, 23.vii.1985

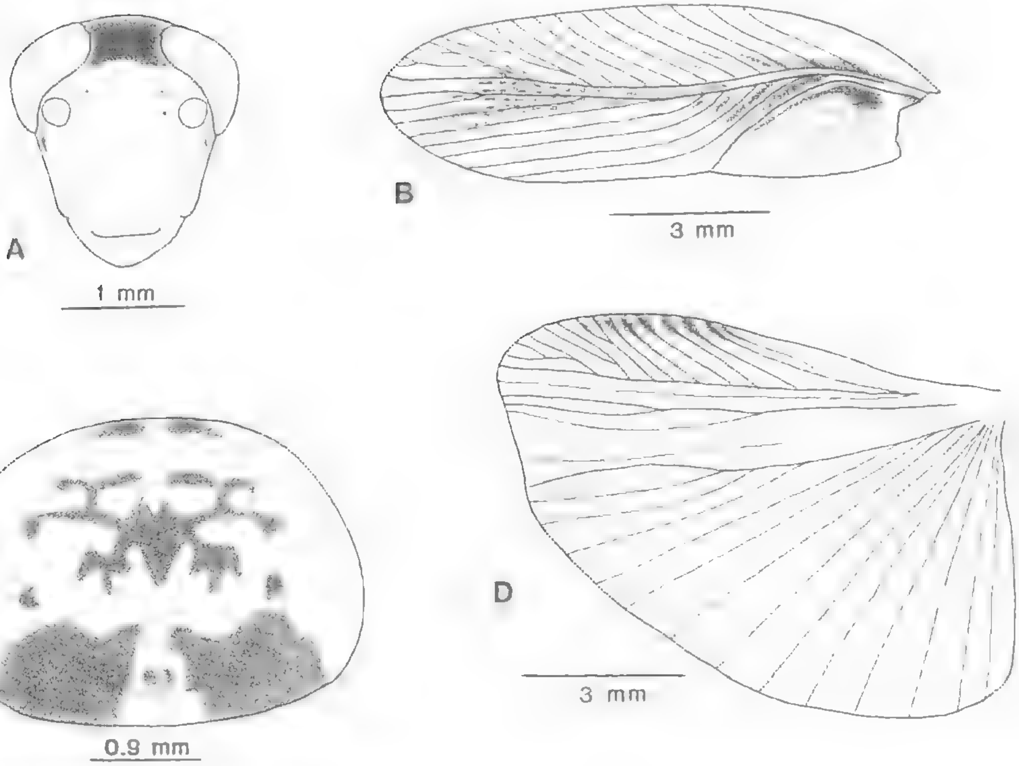

FIG. 12. *Shelfordina orchidae* (Asahina), ♀ from Lake Barrine, Qld: A, Head; B, Tegmen; C, Pronotum; D, Hind wing.

(coll. as nymph, matured, 17.ix.1985), 1♀, 10.iii.1987; Canberra (Farrar), 35.22S 149.05E, 2♂♂, 5.ii.1987, 1♂, 12.i.1987.

NEW SOUTH WALES. DARA: Hamilton, 2♂♂, 5♀♀, 'eating orchid leaves', 23.ii.1955.

QUEENSLAND. ANIC: Pialba (orchid nursery), x.1988, G. Cook (pers. comm. D. Rentz); Dunk Island, 1♀, 8.viii.1950, R. Dobson. QMBA: Lake Barrine, Atherton Tableland, 17.15S 145.38E, rainforest, by torch, 1♀, 7.xii.1950, J. Balderson; Curtain Fig, 2km SSW of Yungaburra, Atherton Tableland, 17.17S 145.34E, 1♀, 14.xii.1985, J. Balderson.

DESCRIPTION

Male. Interocular space distinctly less than distance between antennal sockets (Fig. 12A). Pronotum suboval (Fig. 11D). Tegmina and wings fully developed, discoidal sectors of former sublongitudinal (Fig. 12B). Hind wing with proximal costal veins clubbed, discoidal, median, and cubitus veins straight, latter with 2-4 complete and 0 incomplete branches, apical triangle small (Figs 11F,12D). Front femur Type A3; pulvilli present on 4 proximal tarsomeres, tarsal claws symmetrical, ventral margins distinctly serrated, arolia present (Fig. 11E). Abdominal terga unspecialised. Supraanal plate transverse, hind margin convexly rounded, paraprocts similar, plates partially sclerotised (Fig. 11A). Subgenital plate symmetrical, styles short, cylindrical, apically rounded, located in posterolateral corners of plate, each with short contiguous, articulated accessory style terminating in pair of minute spines (Fig. 11B); between styles and accessory styles an upturned (in pinned specimens) plate (seen flattened in Fig. 11C). Genitalia as in Fig. 13B: hook small, on right side with small apical spine; apex of median phallomere terminating in pair of spinelike processes; accessory median phallomere with several large terminal setae; beneath median and accessory median phallomeres, a densely setose wrinkled membrane (this and dark brushlike structure visible through transparent subgenital plate); left phallomere much larger than right genital hook and is drawn further to the left of its

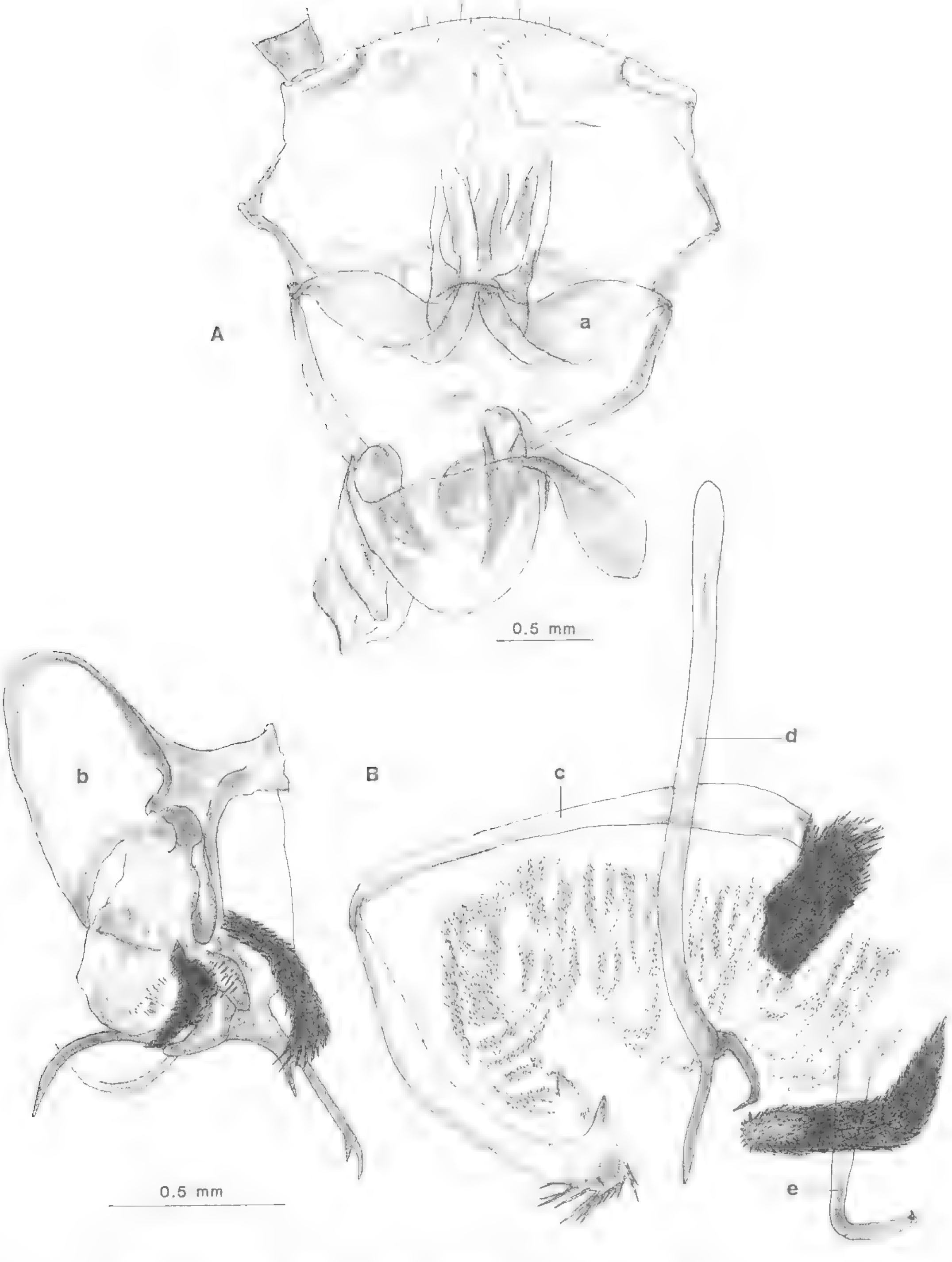

FIG. 13. *Shelfordina orchidae* (Asahina), from Black Mt., ACT., Australia: A, ♀, genitalia (ventral); B, ♂, genitalia (dorsal). Abbreviations: a, first valvifer; b, left phallomere; c, accessory median phallomere; d, median phallomere; e, hooklike right phallomere.

normal position in order to show left side of accessory median phallomere.

Colouration. Head with occiput yellowish brown, broad brownish band on vertex, face very pale, immaculate (Fig. 12A). Pronotum hyaline, including disk which has symmetrical brown markings (Fig. 11D). Tegmina transparent, very light brown, with some small dark brown spots basally along mediastinal and anal veins. Hind wings pale, translucent, veins dark. Abdominal terga very pale, translucent, narrowly suffused with brown along lateral margins, supraanal plate with pair of dark maculae near hind margin. Abdominal sterna pale, brownish dot and suffusion near lateral borders. Cerci yellowish, basal segments, apex, and couple of preapical segments dark brown and separated from tip by pale segment.

Female. Supraanal plate transverse, hind margin convex (Fig. 13A) not reaching hind margin of subgenital plate. Colouration as in male but a female from Lake Barrine, Queensland, has very dark markings on pronotum (Fig. 12C) and maculae on tegmina are more extensive (Fig. 12B). Subgenital plate has pair of dark spots or single large macula near hind margin. Genitalia as in Fig. 13A; base of first valvifer greatly enlarged, femur-shaped. The ootheca is illustrated in Asahina (1985, Fig. 21).

Nymph. The nymph is illustrated in Asahina (1973, fig.21; 1985, fig. 20) (these were also reproduced by Rentz (1987a-c).

Measurements (♀ in parentheses). Length, 8.6- 10.8 (9.6-11.0); pronotum length x width, 2.4-2.7 x 3.2-3.7 (2.5- 2.9 x 3.4-3.8); tegmen length, 10.4-11.8 (9.5-10.5)

REMARKS

This species apparently is well established in Australia. The earliest specimens were collected in 1955 in Hamilton, New South Wales., feeding on orchid leaves. Although most of the specimens were taken associated with orchids (including the type specimens from Japan), the species has been collected outside of greenhouses. Dr Asahina confirmed my determination of the Australian specimens

According to Rentz (1987a-c), *Shelfordina orchidae* is nocturnal, lives among roots of epiphytic orchids, and may feed on the growing root tips and damage flower buds and developing shoots of vegetative parts of the plants. They also live amongst pinebark and other planting material used in pot grown orchids. Oothecae are secured to tangles of roots. The insects hide among the roots or planting media and emerge and feed at night. Lepschi (1989) determined that *orchidae* is predominantly herbivorous, feeding on a variety of plant material including pollen, fungal hyphae and plant tissue. It has been collected on ferns and apparently is not restricted to feeding on orchids.

Shelfordina tozerensis n.sp.

(Figs 14A-E, 15A-C, 29)

MATERIAL EXAMINED

HOLOTYPE: ♂, 9km ENE of Mt Tozer, Iron Range Nat. Park, 12.43S 143.17E, mixed low open forest, 10.xii 1986, D.C.F. Rentz; in ANIC.

PARATYPES: QUEENSLAND. QMBA: Bellenden Ker Range, 1/2km S. Cable Tower No. 7, 500m, 2♂♂ (1 with missing abdomen), 2♀♀, 17-24.x.1981, Earthwatch/Qld Mus.; Iron Range, NQ, 1♂ (pyrethrum knockdown/RF), 1♂, 1♀, 50m, in rainforest, 3-10.xii.1985, G. Monteith and D. Cook; Iron Range, Cape York Pen., NQ, 1♀, 30.vi.-4.vii.1977, G.B. Monteith. ANIC: 6km ENE of Mt Tozer, 12.44S 143.16E, 1♀, 30.vi.1986, T. Weir and A. Calder. The following were collected by D.C.F. Rentz, in or near Iron Range National Park: 2km NE by E of Mt Tozer, 12.44S 143.13E, 1♂, 1♀, 1.vii.1986; 3km ENE of Mt Tozer, 12.44S 143.14E, rainforest margin 1♂ (terminalia slide 183); 3♀♀ (1 with ootheca; 1 with terminalia slide 184), 28.vi.-4.vii.1986, [1♀, same data ex pan trap, J.C. Cardale]; 8km E by N of Mt Tozer, 12.44S 143.17E, 1♂, 1♀, rainforest, 7.vii.1986, same data as holotype, 2♂♂ (1 with terminalia slide 180), 1♀, 1 nymph, 10.vii.1986; 11km ENE of Mt Tozer, 12.43S 143.18E, rainforest margin, 1♂, 1♀, 1♀ (at light), 11.vii.1986.

DESCRIPTION

Male. Eyes very close together, interocular space less than length of first antennal segment (Fig. 14B). Pronotum suboval (Fig. 14A). Tegmina and wings fully developed extending beyond end of abdomen. Hind wing with subcosta and 5 or 6 costal veins clubbed, discoidal and median veins straight, simple, cubitus vein straight with 3-4 complete and no incomplete branches, apical triangle small (Fig. 14D). Front femur Type A_2, or A_3 (first terminal spine only slightly longer than preceding ones), pulvilli present on 4 proximal tarsomeres, tarsal claws minutely serrated, arolia present. Abdominal terga unspecialised. Supraanal plate transverse, hind margin convexly rounded, reaching to about hind margin of subgenital plate, right and left

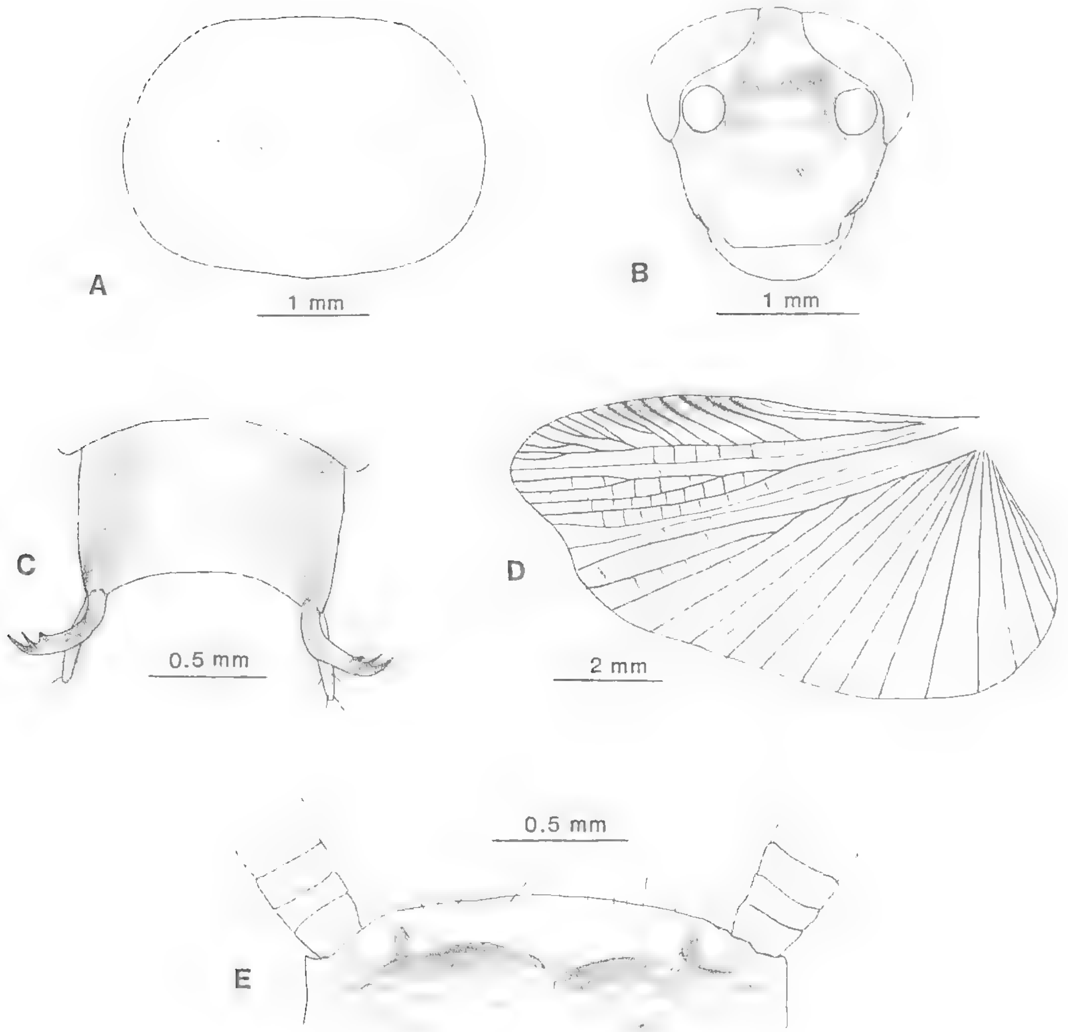

FIG. 14. *Shelfordina tozerensis* n.sp., ♂ paratypes from near Mt Tozer, Qld, Australia: A, Pronotum; B, Head; C, Subgenital plate (ventral); D, Hind wing; E, Supraanal plate and paraprocts (ventral).

paraprocts similar, simple plates (Fig. 14E). Subgenital plate symmetrical, styles similar, cylindrical located in posterolateral corners, each with an accessory style terminating with one or 2 small spines, arising ventrally on the plate (Fig. 14C, 15A); styles and accessory styles extend beyond supraanal plate and are visible in dorsal view; interstylar margin straight or weakly curved, generally reflexed dorsad. Genitalia as in Fig. 15A; hook on right side; median phallomere strongly curved distally.

Colouration. Head with occiput and vertex dark brown, dark brown interocellar band, narrow concave band between antennal sockets, more narrow maculae on frons (Fig. 14B). Pronotal disk with brown markings, lateral and posterior borders hyaline or semihyaline (Fig. 14A). Tegmina light brown, hyaline, basal part of humeral and anal veins darkly infuscated. Hind wing dark, not uniformly infuscated, anterior field lighter than posterior field, its apical region yellowish, region of axillary veins near apical triangle darker than rest of posterior field (amount of infuscation varies with some

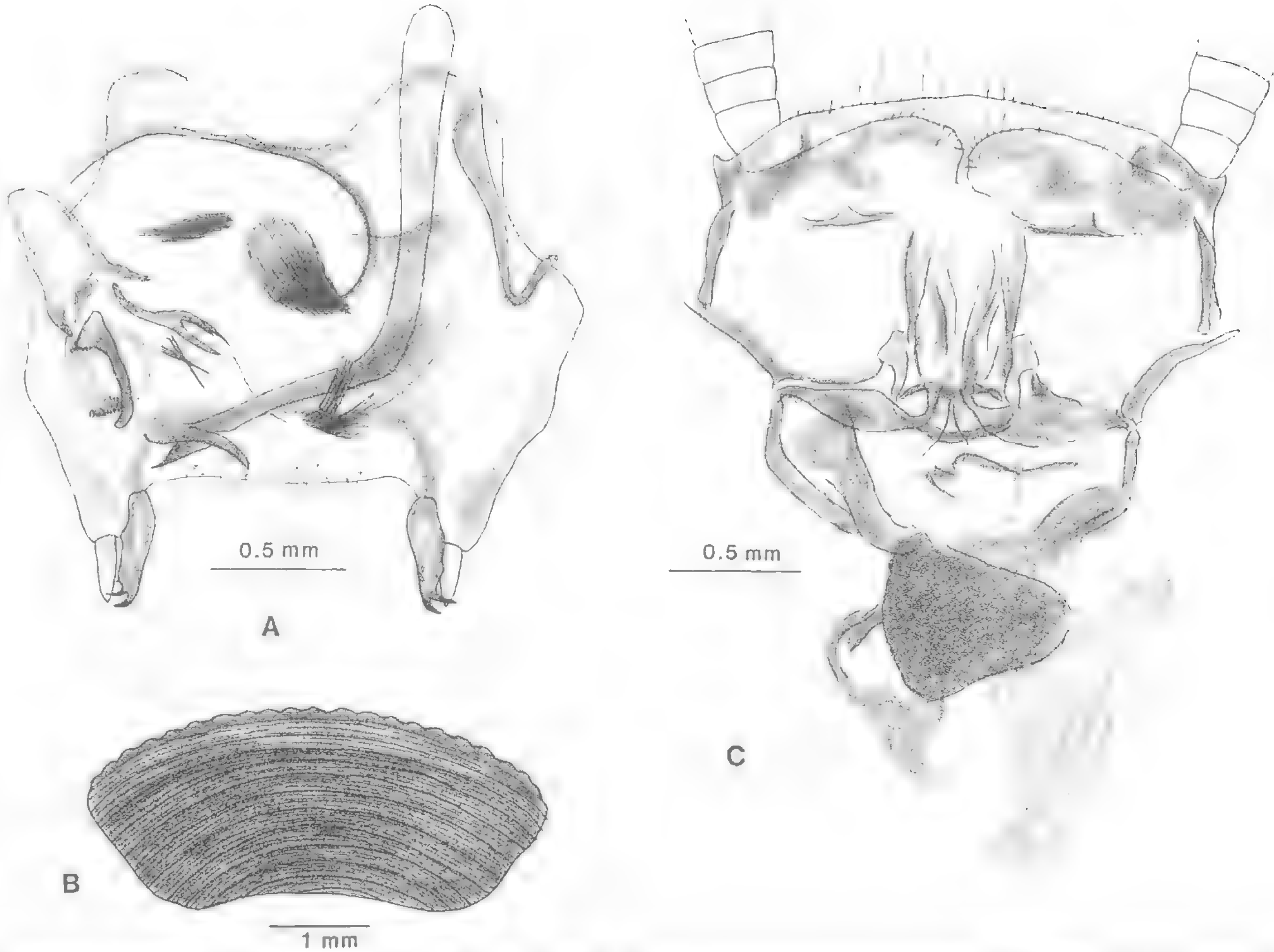

FIG. 15. *Shelfordina tozerensis* n.sp., paratypes from near Mt Tozer, Qld: A, ♂, subgenital plate and genitalia (dorsal); B, Ootheca; C, ♀, genitalia (ventral).

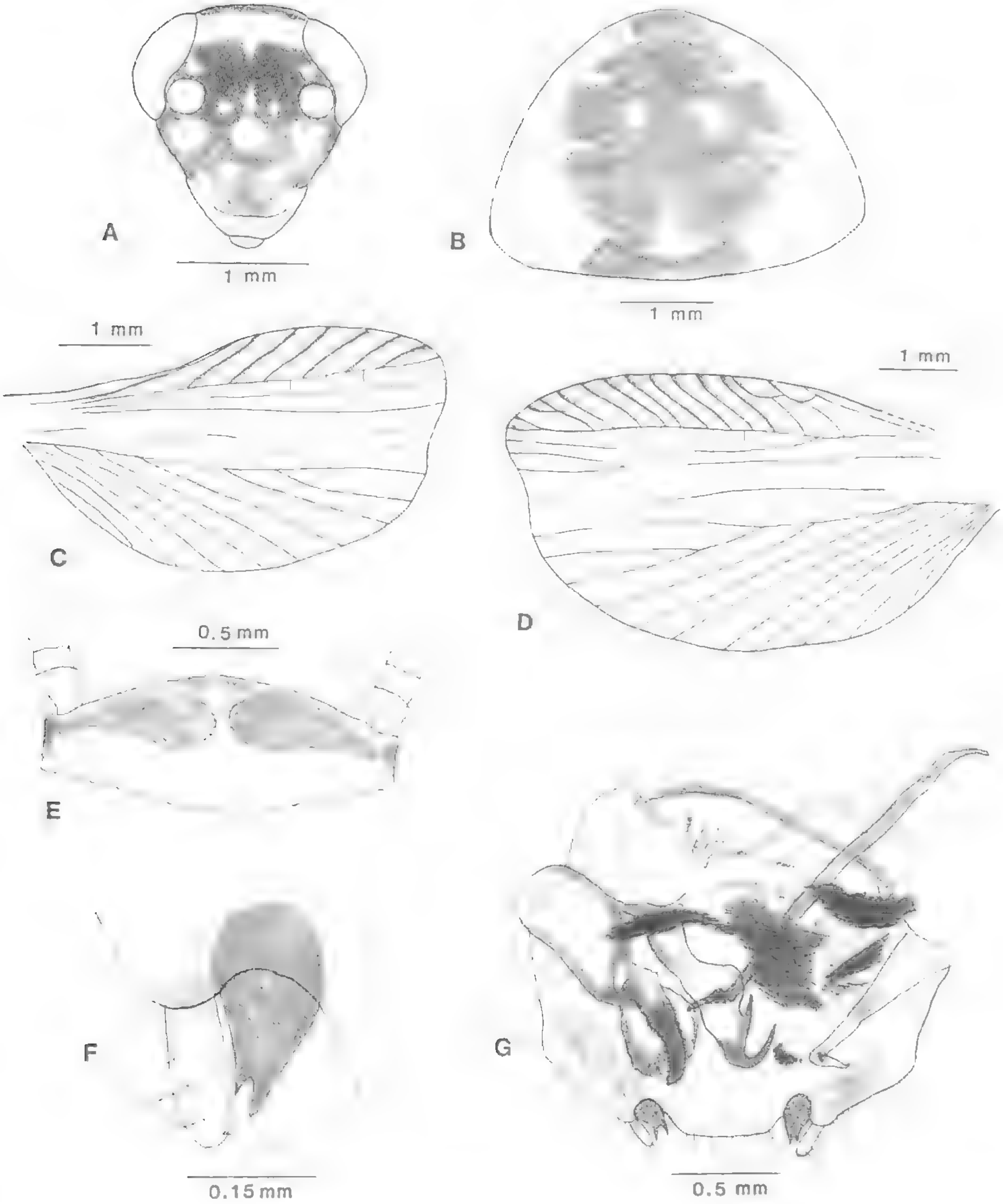

FIG. 16. *Shelfordina cooki* n.sp., ♂♂. A,C,E- G, paratype; B,D, holotype: A, Head; B, Pronotum; C,D, Hind wings; E, Supraanal plate and paraprocts (ventral); F, Right corner of subgenital plate showing style and accessory style (ventral); F, subgenital plate and genitalia (dorsal).

specimens much paler than others) (Fig. 14D). Abdominal terga light brown, terminal segments darker. Abdominal sterna light brown medially, darker laterally, pale spots near each border. Cerci dorsally pale with blackish basal and preapical segments, ventrally mostly brown.

Female. Interocular space about same as length of first antennal segment. Supraanal plate strongly transverse, subrectangular, corners rounded, (Fig. 15C), hind margin not reaching hind margin of subgenital plate. Subgenital plate convex, produced, sides obliquely concave, apex rounded. Genitalia as in Fig. 15C. Abdominal sterna pale with narrow dark brown lateral borders and small prelateral round dots.

Ootheca. Brownish black, keel shallowly undulate with 21 small apically rounded teeth, with about 12 transverse, curved heavy ridges, finer ridges between them, longitudinal cell divisions absent. Length, 4.4 mm, height, 1.8 mm (Fig. 15B).

Measurements (♀ in parentheses). Length, 8.7- 9.3 (8.7-10.3); pronotum length x width, 2.2-2.3 x 3.0-3.3 (2.2- 2.4 x 3.1-3.3); tegmen length, 9.9-10.3 (9.8-10.3).

Shelfordina cooki n.sp.
(Figs 16A-G, 29)

MATERIAL EXAMINED

HOLOTYPE: ♂, Upper Boulder Ck, 11km NNW of Tully, NQ, 850m, 16-19.xi.1984, Cook, Monteith, and Thompson; in QMBA (Reg. No. T11280).

PARATYPES: QUEENSLAND. QMBA: same data as holotype, 1♂ (terminalia slide 64); Mt Bartle Frere, NQ, NW/Centre Peak ridge, 1400-1500m, 1♂ (abdomen missing), 7-8.xi.1981.

ETYMOLOGY

The species is dedicated to Mr D.J. Cook who has participated in many Queensland Museum collecting trips (Monteith, pers. comm.).

DESCRIPTION

Male. Head slightly protruding beyond prothorax; interocular space about same as distance between antennal sockets (Fig. 16A). Pronotum subparabolic (Fig. 16B). Tegmina slightly reduced reaching end of or slightly beyond end of abdomen. Hind wings smaller, costal veins weakly thickened, their number variable, fewer in more reduced wings; discoidal and median veins simple, straight, latter may arise from and look like branch of former, cubitus vein straight, simple or with 1 complete and no incomplete branches, apical triangle essentially absent (Figs 16C,D). Front femur Type A_3, first of 3 terminal spines may be only slightly longer than preceding spines which may include couple of piliform spinules; pulvilli on 4 proximal tarsomeres, tarsal claws distinctly serrated, arolia present. Abdominal terga unspecialised. Supraanal plate transverse, hind margin broadly, shallowly convex; paraprocts similar dark plates (Fig. 16E). Subgenital plate convex, symmetrical, distal half reflexed dorsad; styles small, cylindrical, similar, each arising in posterolateral corners of plate; associated with each style, arising from dorsal surface of plate, a bulbous, apically divided accessory style (Figs 16F,G). Genitalia as in Fig. 16G; hook on right side without subapical incision.

Colouration. Head with occiput dark brown, broad pale transverse band on vertex, then a shiny blackish macula between eyes and antennal sockets, dull brownish macula on frons (Fig. 16A; dark markings in holotype are more intense and extensive than in paratype). Pronotal disk dark reddish brown with small yellowish spots, lateral borders yellowish on anterior half, remainder hyaline (Fig. 16B). Tegmina reddish brown, hyaline with suffused dark areas. Anterior abdominal terga brown with dark infuscations, terminal segments dull black. Abdominal sterna mostly blackish brown, distal segments pale medially, subgenital plate dark except for narrow medial zone. Cerci dorsally with segments 1-3, 6, 7 and 10 blackish (segment 7 may be pale), other segments yellowish, ventrally brown. Legs with coxae largely infuscated, femurs with narrow dark brown bands distad on anterior surfaces.

Female. Unknown.

Measurements. Length, 7.2-8.0; pronotum length x width, 2.2-2.5 x 3.4-3.7; tegmen length, 5.6-6.5.

Shelfordina yeatesi n.sp.
(Figs 17A-F, 29)

MATERIAL EXAMINED

HOLOTYPE: ♂ (terminalia slide 63), Thornton Peak via Daintree, NQ, 1100-1300m, 24-27.ix.1984, G.B. and S.R. Monteith; in QMBA (Reg. No. T11187).

PARATYPES: QUEENSLAND. QMBA: Thornton Peak, 11km NE of Daintree, 1100-1200m, 1♀, 30.x.-1.xi.1983, Monteith, Yeates, and Thompson; Thornton Peak via Daintree, 1000-1300m, 1♀ (with ootheca: genitalia slide 66), 20-22.ix.1981, G. Monteith and D. Cook; Bellenden Ker Range, Cable Tower 3, 1054 m, 1♀ (genitalia slide 67), 25-31.x.1981, Earthwatch/Qld Mus.

ETYMOLOGY

The species is dedicated to Dr D.K. Yeates who has done survey work in north Queensland (Monteith, pers. comm.).

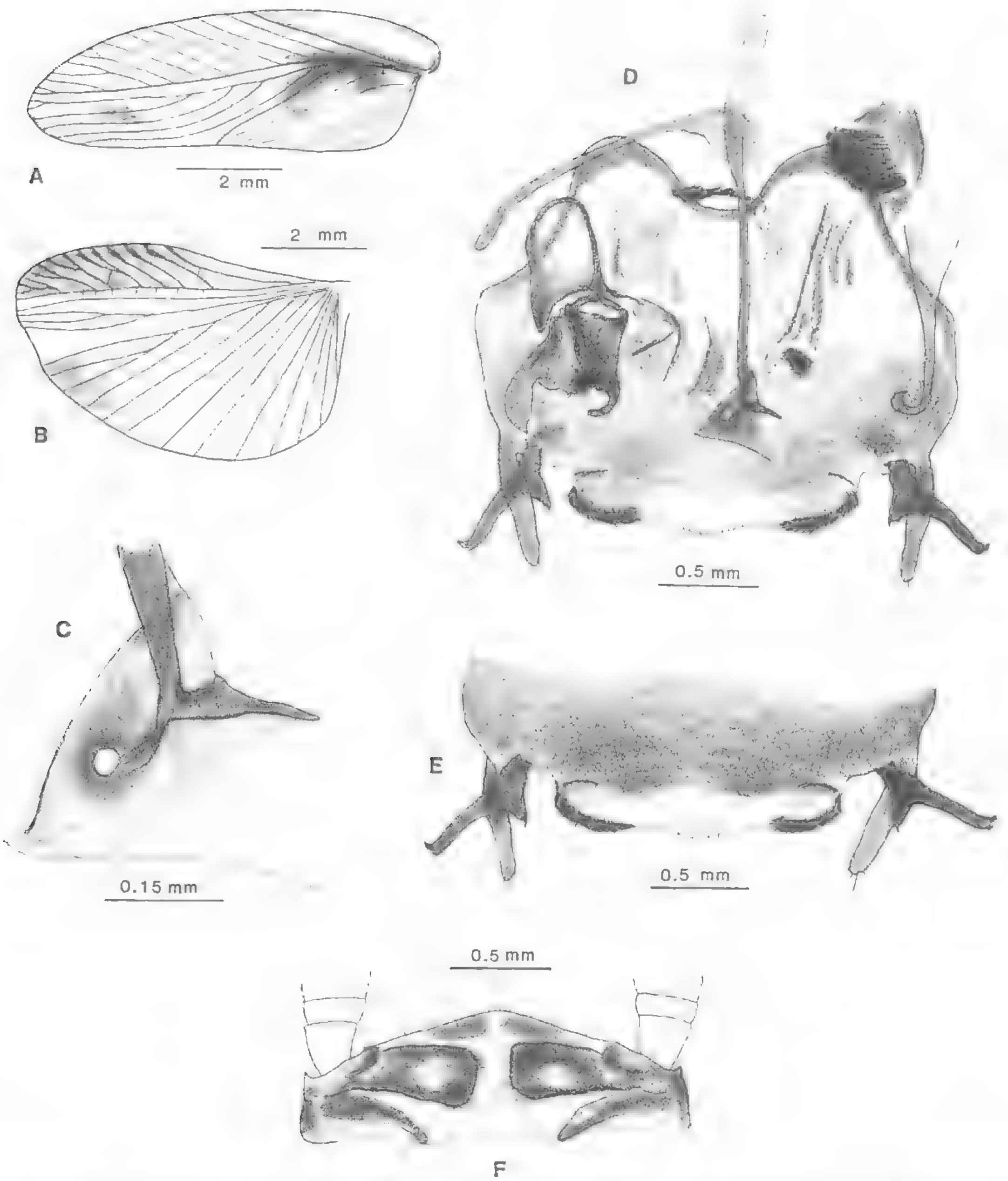

FIG. 17. *Shelfordina yeatesi* n.sp., ♂ holotype: A, Tegmen. B, Hind wing; C, Apex of median genital phallomere (dorsal); D, Subgenital plate and genitalia (dorsal); E, Hind margin of subgenital plate (ventral). F, Supraanal plate and paraprocts (ventral).

DESCRIPTION

Male. Head hidden under pronotum; interocular space less than distance between antennal sockets. Pronotum subparabolic. Tegmina and wings fully developed but reaching only slightly beyond end of abdomen. Hind wing with costal veins distinctly clubbed, discoidal and median veins simple, cubitus vein straight with 2 complete and 0 incomplete branches, apical triangle small (Fig. 17B). Front femur Type A3 (first terminal spine only slightly longer than preceding ones); pulvilli on 4 proximal tarsomeres, tarsal claws distinctly toothed, arolia present. Abdominal terga unspecialised. Supraanal plate strongly transverse, hind margin shallowly trigonal; right and left paraprocts similar dark plates with pale round central zones (Fig. 17F). Subgenital plate symmetrical with long cylindrical, similar styles in posterolateral corners, below them accessory styles with a small basal branch; interstylar border membranous, upturned, with dense lateral setal brushes (Figs 17D,E). Genitalia as in Fig. 17D: hook on right side, distal region short, curved, without subapical incision; apex of median phallomere modified as in Fig. 17C.

Colouration. Reddish brown. Head with dark brown maculae similar to those of *cooki* (Fig. 16A). Pronotal disk reddish brown with indistinct pale spots. Tegmina reddish brown, hyaline, with large dark basal spot in anal vein region (Fig. 17A). Hind wing with costal vein region (except yellowish apex), and plical fold area darkly infuscated, area between discoidal and cubitus veins unpigmented, posterior field lightly infuscated.

Female. Supraanal plate transverse, hind margin convexly rounded. Cubitus vein of hind wing with 1-2 complete and 0-1 incomplete branches (branching may differ on right and left wings of same female).

Ootheca. Similar to that of *S. tozerensis* (Fig. 15B) except there are fewer heavy longitudinal ridges, most of them being very fine.

Measurements (♀ in parentheses). Length, 8.5 (9.0-9.6); pronotum length x width, 2.5 x 3.9 (2.7 x 3.8-4.1); tegmen length, 7.3 (6.7-7.6).

Shelfordina robertsi n.sp. (Figs 18A-F, 29)

MATERIAL EXAMINED

HOLOTYPE: ♂, Mt Finnigan [15.49S 145.17E], 37km S of Cooktown, NQ, 1100m, Pyrethrum knockdown, 20.xii.1982, L. Roberts; in QMBA (Reg. no. T.11178). PARATYPES: QUEENSLAND. QMBA: same data as holotype, 2♂♂ (1 with terminalia slide 61), 2♀♀ (1 with genitalia slide 62); same locality and collection method as above, 3♀♀, 850-1100m, 19-22.iv.1982, RF, Monteith, Yeates, and Cook; Mt Finnigan summit via Helenvale, NQ, 1100m, 1♂ (terminalia slide 65), 1♀, 28-30.xi.1985, Monteith, Cook, and Roberts, 1♀, pitfall trap, rainforest, 28-30.xi.1985, G. Monteith and D. Cook.

ETYMOLOGY

The species is dedicated to Mr Lewis Roberts who collected the holotype. He is a self-taught naturalist who lives at the foot of Mt Finnigan and who has guided many biologists to the summit of this remote mountain (Monteith, pers. comm.).

DESCRIPTION

Male. Head almost completely hidden under pronotum; eyes wide apart, the space between them about same as distance between antennal sockets (Fig. 18A). Tegmina and wings reaching only slightly beyond end of abdomen. Hind wing with costal veins clubbed, discoidal and median veins straight, simple, cubitus vein straight with 1-2 complete and 0 incomplete branches, apical triangle small (Fig. 18D). Front femur Type A3 (first terminal spine only slightly longer than those preceding it); pulvilli present on 4 proximal tarsomeres, tarsal claws distinctly serrated, arolia present. Abdominal terga unspecialised. Supraanal plate transverse, broadly trigonal, apex rounded; paraprocts similar plates, darkly sclerotised around the borders forming a clear, circular, central zone (Fig. 18F). Subgenital plate symmetrical, sides upturned, distal half membranous, reflexed dorsad under supraanal plate; styles similar, cylindrical, non-articulated, located in posterolateral corners of plate, below them large dark accessory styles, the right and left ones weakly dissimilar, interstylar margin trigonal (Figs 18C,E; in pinned specimens interstylar membrane is collapsed and margin appears straight). Genitalia as in Fig. 18C: hook on right side, with small preapical spine; apex of median phallomere modified (Fig. 18B).

Colouration. Brown. Head with pale vertex, occiput darker, large shiny, brown macula extending from between eyes to level of antennal sockets, below this a symmetrical macula (Fig. 18A). Pronotal disk weakly mottled brown. Tegmina hyaline, brown, slightly darker along part of anal vein. Hind wing weakly infuscated, subcostal vein region slightly darker than rest of wing. Abdominal terga light brown, darkly infuscated laterally and on 3 terminal segments. Cerci pale dorsally, segment 6 and apical segment dark. Legs pale, weak distal spots on anterior femoral surfaces.

Female. Supraanal plate transverse, broadly rounded, hind margin entire, not reaching hind margin of subgenital plate. Colour markings may be more intense than in male. Abdominal sterna with large dark brown medial spots, and pair of

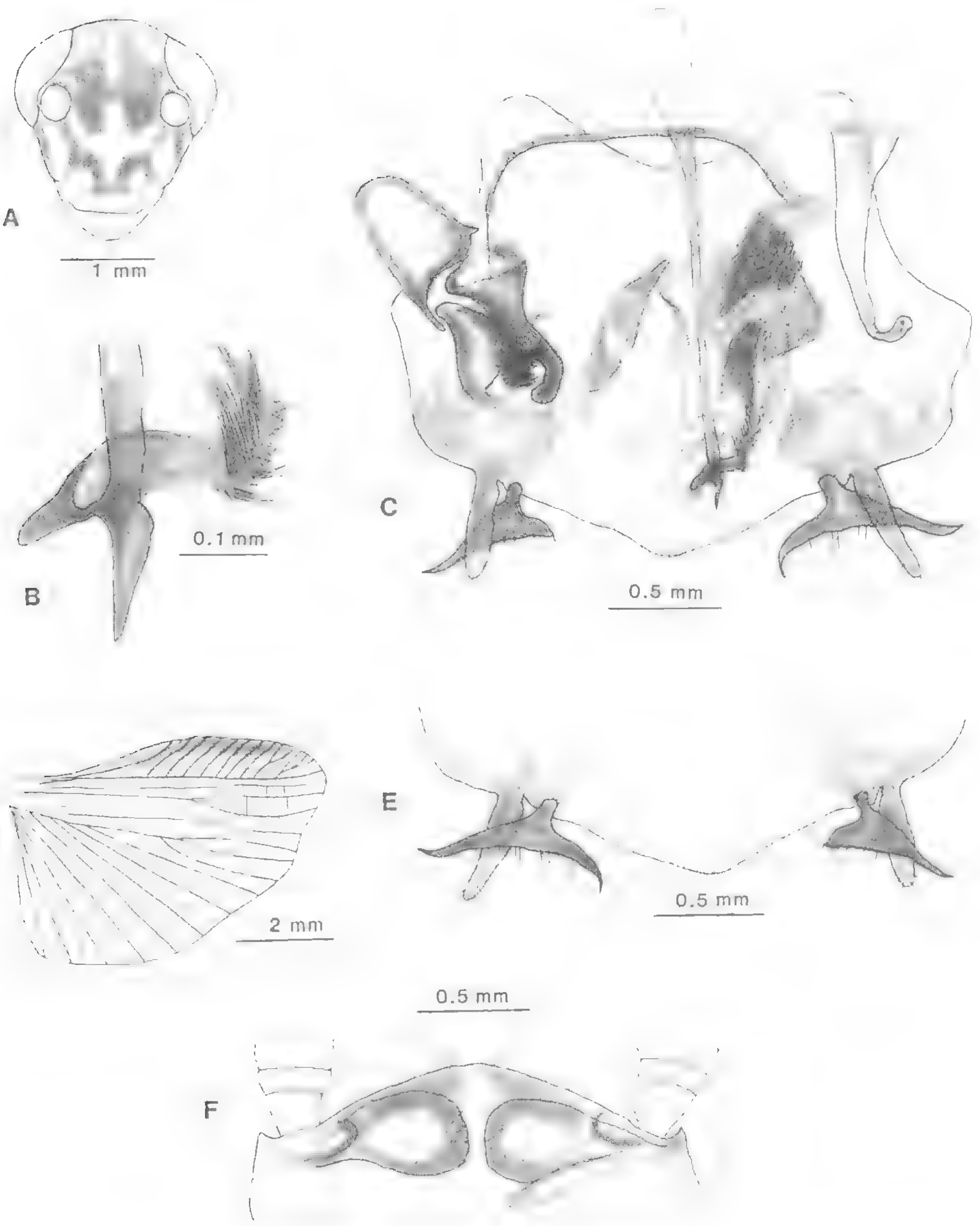

FIG. 18. *Shelfordina robertsi* n.sp., from Mt Finnigan, Qld. D, From holotype, all others from paratypes: A, ♀, head; B-F, ♂♂: B, Apex of median genital phallomere (dorsal); C, Subgenital plate and genitalia (dorsal); D, Hind wing; E, Hind margin of subgenital plate showing styles and accessory styles (ventral); F, Supraanal plate and paraprocts (ventral).

large, narrowly separated maculae in middle of subgenital plate.

Measurements (♀ in parentheses). Length, 7.9- 8.3 (7.9-8.5); pronotum length x width, 2.4-2.6 x 3.5-3.9 (2.4- 2.7 x 3.6-3.9); tegmen length, 7.0-7.4 (6.5-7.5).

Shelfordina uniformis (Hanitsch)
(Figs 19A-G)

Shelfordella uniformis Hanitsch, 1933, p.127, fig.1 (♂).

Ebnerella uniformis (Hanitsch): 1935, p.14.

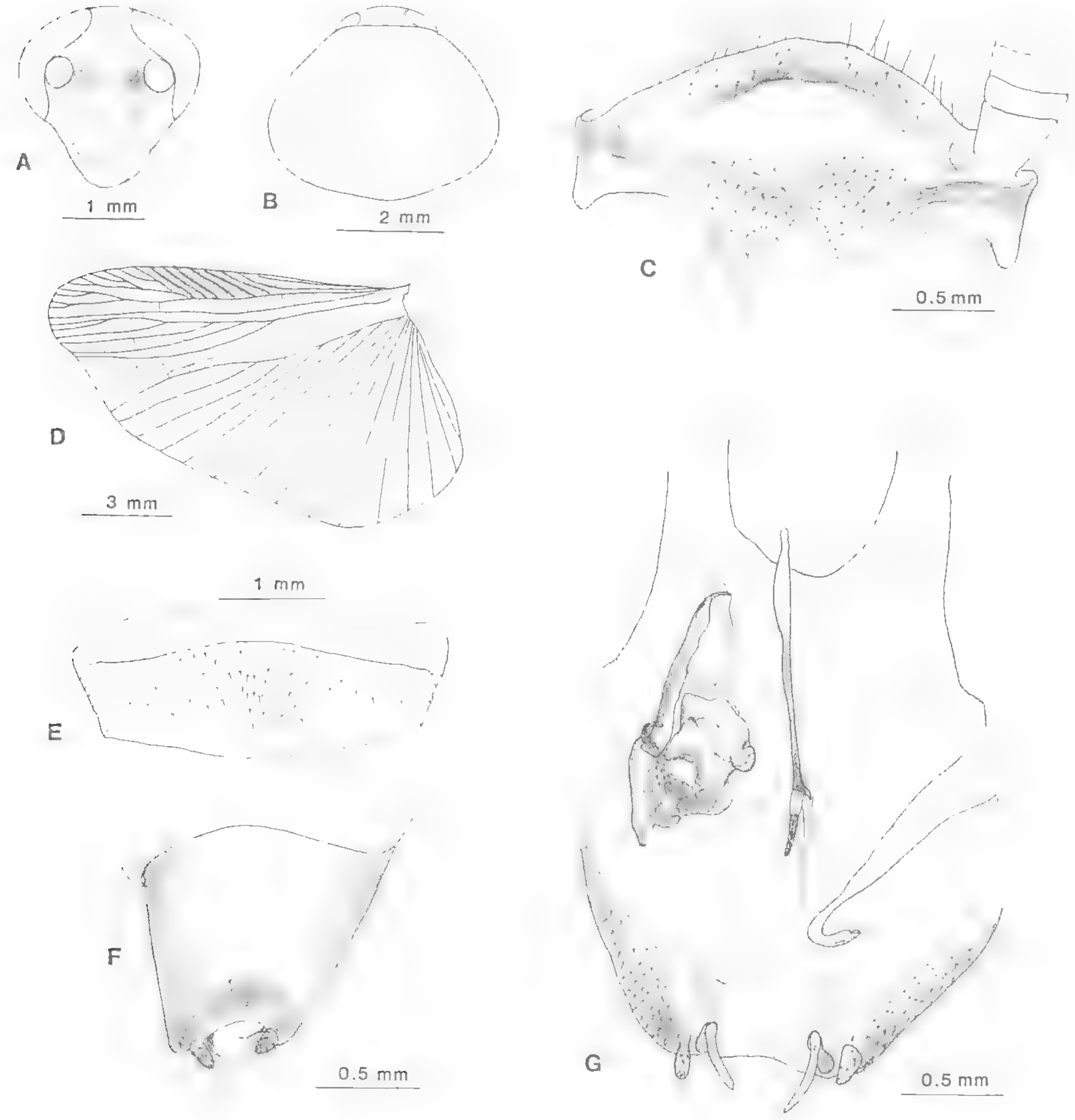

FIG. 19. *Shelfordina uniformis* (Hanitsch), ♂ holotype: A, Head; B, Pronotum; C, Supraanal plate and paraprocts (ventral); D, Hind wing; E, Seventh abdominal tergum; F, subgenital plate (ventral); G, Subgenital plate and genitalia (dorsal).

Possoina uniformis (Hanitsch): Bruijning, 1947, p.218.
Shelfordina uniformis (Hanitsch): Princis, 1969, p.872.

MATERIAL EXAMINED

HOLOTYPE: ♂ (terminalia slide 27), Lake Posso and neighbourhood, Central Celebes, ii.1895, Sarasin (labelled *Shelfordella uniformis* n.gen., n.sp.,♂, R. Hanitsch, 7.vii.1933); in MHNB.

DESCRIPTION

Male. Interocular space distinctly less than distance between antennal sockets (Fig. 19A); fifth palpal segment slightly smaller than fourth. Pronotum subparabolic (Fig. 19B). Tegmina and wings fully developed, former with longitudinal discoidal sectors. Hind wing with unbranched costal veins uniformly thick throughout, not clubbed, discoidal and median veins unbranched, straight, cubitus vein with 5 complete and 0 incomplete branches, apical triangle well developed (Fig. 19D). Front femur Type A_3; 4 proximal tarsomeres with pulvilli, tarsal claws symmetrical, ventral margins minutely toothed, arolia present. Seventh abdominal tergum unspecialised. Eighth abdominal tergum enlarged, surface with spaced setae (Fig. 19E). Ninth tergum completely hidden under T8. Supraanal plate with hind margin thickened, convexly rounded not reaching hind margin of subgenital plate; right and left paraprocts similar darkly sclerotised (in part) setose plates (Fig. 19C). Subgenital plate elongate, sides broadly upturned, distal region reflexed dorsad, concave; small styles flat, located in posterolateral corners, near base of each a large, curved, accessory style, interstylar margin weakly concave (Figs 19F,G). [Hanitsch, 1933, fig. 1, did not show the accessory styles in the illustration of the subgenital plate, nor did he mention them in his description]. Genitalia as in Fig. 19G: hook on right side; distal half of median phallomere modified with a slender filament and a short dark sclerite connected to anterior half by a colourless membrane.

Colouration. Head reddish brown, labrum yellowish brown, facial region darker (Fig. 19A). Pronotum dark reddish brown without markings, region outside disk somewhat hyaline. Tegmina light reddish brown, hyaline. Hind wing lightly infuscated, costal vein region darker (Fig. 19D). Abdominal terga light brown. Abdominal sterna reddish brown, subgenital plate darker. Cerci dark brown. Legs reddish brown.

Female. Unknown.

Measurements. Length, 10.0; pronotum length x width, 3.3 x 4.3; tegmen length, 12.0.

REMARKS

The enlarged and setose eighth abdominal tergum, and the unusual median genital phallomere so similar to these structures in *S. spinistylifera*, clearly show that these two taxa are very closely related (see earlier discussion of species-groups).

Shelfordina spinistylifera (Roth) n.comb.

Symploce spinistylifera Roth, 1985b, p.154, figs 12A-G (♂).

MATERIAL EXAMINED

SABAH. BPBM: Tawau Residency, Kalibakan R., 48km west of Tawau, primary forest,♂ holotype of *Symploce spinistylifera* Roth, 9-18.xi.1958, T.C. Maa (terminalia slide 381; tegmen and wing on 2 slides no. 382).

REMARKS

The subgenital plate and styles of *spinistylifera* are similar to those of *wailimensis*, but the accessory styles are much larger and differ in shape (Roth, 1985b; fig. 12C). The eighth abdominal tergum is greatly enlarged and has well spaced setae (Roth, 1985b; fig. 12G). I stated that this was a specialisation, and if it is, then *spinistylifera* and *uniformis* are the only two species of *Shelfordina* with a tergal gland. In my description of *spinistylifera* I stated that the male's genital hook was on the left side. I re- examined my slide but I had separated the 3 main phallomeres and it was impossible to tell the original position of the hook. However, based on its position in *uniformis* and *wailimensis*, it probably is on the right side.

Because of the similarity of T8 and median genital phallomere, I consider *spinistylifera* and *uniformis* more closely related than the former is to *wailimensis*.

Shelfordina wailimensis n.sp.
(Figs 20A-G)

MATERIAL EXAMINED

HOLOTYPE: ♂ (terminalia slide 234), Wai Lima, Z. Sum.[atra]., Lampongs, xi.xii.1921, Karny and Siebers (no. 221); in HDEO.

DESCRIPTION

Male. Interocular space less than distance between antennal sockets (Fig. 20A); palpal segment 5 slightly smaller than segment 4. Tegmina and wings extending beyond end of abdomen, former with longitudinal discoidal sectors. Hind

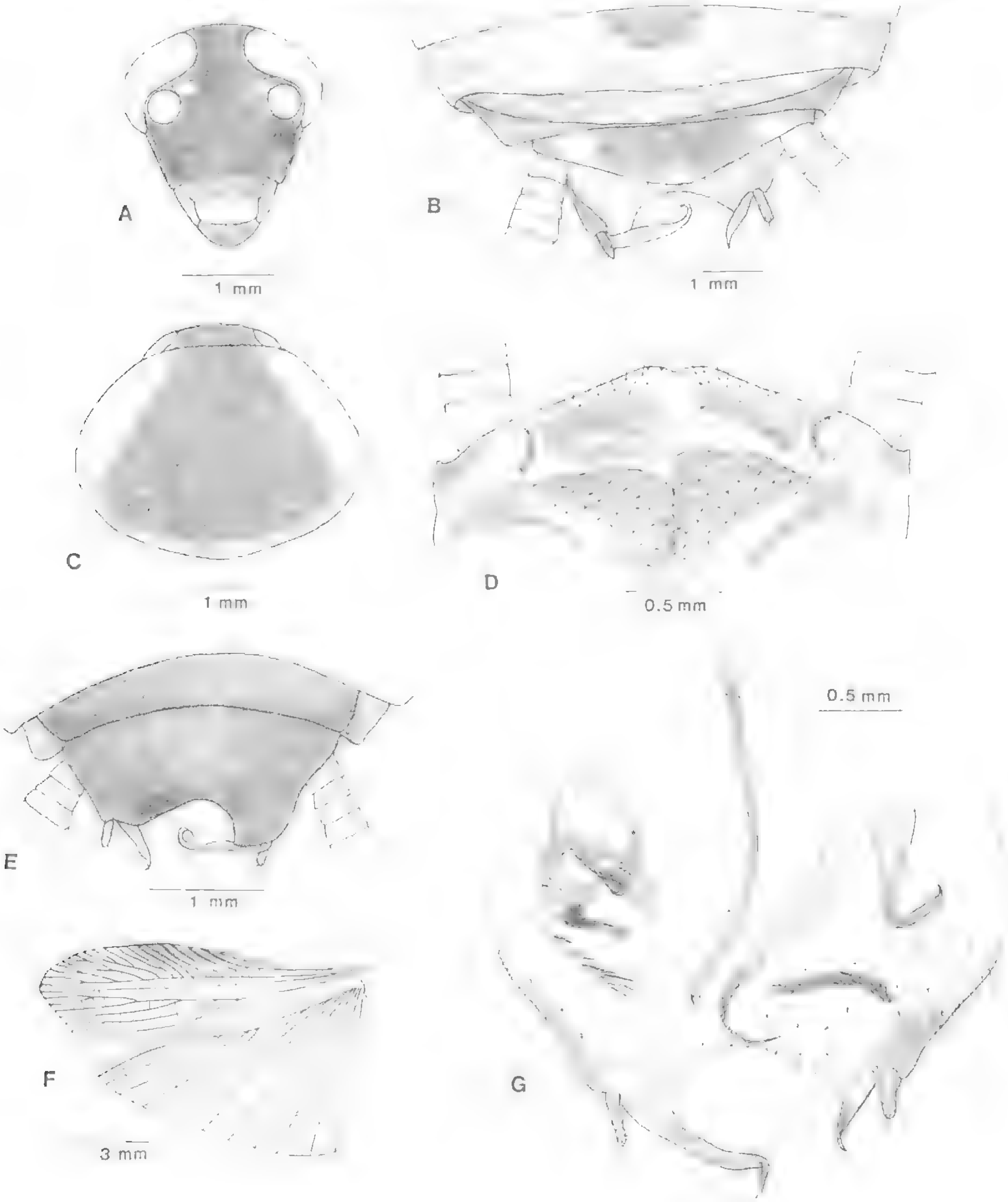

FIG. 20. *Shelfordina wailimensis* n.sp., ♂ holotype: A, Head; B, B, Abdominal terga 7 to 10 (supraanal plate), and subgenital plate (dorsal); C, Pronotum; D, Supraanal plate and paraprocts (ventral); E, Subgenital plate (ventral); F, Hind wing; G, Subgenital plate and genitalia (dorsal).

wing with discoidal and median veins simple, straight; cubitus vein weakly concave with 5 complete and 0 incomplete branches, apical triangle well developed (Fig. 20F). Front femur Type A_3; pulvilli on 4 proximal tarsomeres, tarsal claws symmetrical, ventral margins minutely toothed, arolia present. Abdominal terga unspecialised. Supraanal plate transverse, trigonal, apex weakly indented, paraprocts similar plates (Fig. 20D). Subgenital plate subsymmetrical, styles almost similar, cylindrical, small, each in posterolateral corners of plate; at base of each style a large articulated accessory style, right one only slightly longer than style, left one much larger, apex curved, acute, slender, directed towards right style, interstylar margin concavely excavated (Figs 20B,E,G). Genitalia as in Fig. 20G; hook on right side, apex acute, without subapical incision; median phallomere, slender, curved, terminating in small, slender, filament; between median and hooklike phallomeres a curved, tapering sclerite.

Colouration. Dark reddish brown. Head dark reddish brown from occiput to clypeus; basal half of clypeus light reddish brown, remainder yellowish brown, labrum light reddish brown (Fig. 20A). Pronotum with large dark reddish brown macula, areas on either side hyaline (Fig. 20C). Tegmina light reddish brown, hyaline, darker along anterior border, marginal field, and basal part of anal field. Abdominal terga 1-5 pale medially, broad lateral zones reddish brown, T6 mostly reddish brown, T7 with dark brown macula surrounded by whitish band anteromedially, laterally with poorly defined yellowish spots on light brownish background (Fig. 20B). Supraanal plate brownish with yellowish spots laterally (near each cercus) and posteromedially (Fig. 20B). Abdominal sterna reddish brown. Cerci reddish brown dorsally, brown ventrally. Legs reddish brown, tarsi pale.

Female. Unknown.

Measurements. Length, 11.5; pronotum length x width, 3.6 x 4.6; tegmen length, 14.0.

Dyakinodes Princis

Dyakinodes Princis, 1951, p.66.

Type Species

Ischnoptera centralis Walker = *Dyakinodes victoriae* Princis, by monotypy.

Diagnosis

Small, slender, habitus usually similar to that shown in Fig. 28A. Head exposed, eyes wide apart, sometimes bulging (Figs 22A,C); fifth palpal segment longer than fourth. Tegmina and wings fully developed usually extending beyond end of abdomen. Tegmina with discoidal sectors oblique. Hind wings with discoidal vein simple, straight; median vein straight, usually with basal part convexly curved anteriorly; cubitus vein straight except for concavely curved base, with 1, rarely 2, complete branches near distal part of wing, 3-6 small incomplete branches (some appear like cross veins); a characteristic enlarged 'cell' is formed by the curved bases of the median and cubitus veins (Fig. 26A, arrow), apical triangle absent (Figs 21D, 22F, 25B, 28E). Anteroventral margin of front femur with 1-4 small, stout spines succeeded by row of piliform spinules, terminating in 2 large distal spines (Type B_2; rarely with a third small distal spine), or rarely with piliform spinules only, terminating in 2 large spines (Type C_2); ventral margins of mid and hind femurs sparsely spined (2-4 small spines); pulvilli present on 4 proximal tarsomeres, tarsal claws symmetrical, simple, arolia present. ♂: First abdominal tergum unspecialised. Seventh abdominal tergum with a glandular specialisation (Figs 21B, 22E, 23A,D,G). Supraanal plate symmetrical or almost symmetrical; right and left paraprocts dissimilar (Fig. 26B,b); with or without a structure arising ventrally near base of cercus (subcercal process; Fig. 26B,a). Subgenital plate weakly asymmetrical, styles small, similar (Fig. 26E) or weakly dissimilar (Fig. 22D). Hooklike genital phallomere on left side (Fig. 21E).

Remarks

Princis (1969, p.994) lists only 1 species, *Dyakinodes centralis*, in the genus. I find 6 new species, described below. The genus is known only from Australia.

The male genital hook on the left side places *Dyakinodes* in the Blattellinae (McKittrick, 1964). However, this should be confirmed by determining if the female rotates the ootheca prior to depositing it (Bohn, 1987)

SPECIES GROUPS OF *DYAKINODES*

Based on males.

1. *kurandensis* species-group: Hind margin of supraanal plate convexly rounded, entire. Subcercercal processes absent. Species: *kurandensis*; *uptoni*.

2. *centralis* species-group: Hind margin of supraanal plate excised, indented, or deeply divided medially. Subcercal processes present (sometimes greatly reduced). Species: *bispinulifera*; *centralis*; *fraserensis*; *penibifida*; *waterhousei*.

KEY TO MALES OF *DYAKINODES*

1\. Hind margin of supraanal plate roundly convex, not distinctly indented or excavated medially (Figs 21A,22B) 2

Hind margin of supraanal plate distinctly excised medially (e.g., Figs 23A,24A) 3

2\. Styles almost equal, slender, cylindrical (Figs 21B,E). Setal tuft on T7 arising from distinct mound (Fig. 21B); Pronotum subelliptical (Fig. 22A). Front femur Type B .... *kurandensis*

Right style short, robust, left style smaller, narrower (Fig. 22D). Setal tuft on T7 in shallow depression (Fig. 22E). Pronotum suboval (Fig. 22C). Front femur Type C .... *uptoni*

3\. Supraanal plate transverse, subrectangular, with pair of long, slender, medial processes (Fig. 28B)..*fraserensis*

Supraanal plate not as above 4

4\. Supraanal plate excised medially forming pair of large, broadly rounded lobes bearing several long spines along their margins (Fig. 26B) ....*centralis*

Supraanal plate not as above 5

5\. Hind margin of supraanal plate with shallow medial excavation and small dark spines along edge (Fig. 23C). Apex of median genital phallomere divided (Fig. 23B) .... *penibifida*

Hind margin of supraanal plate much more deeply excavated medially forming pair of triangular lobes. Apex of median genital phallomere not divided 6

6\. Outer margins of triangular lobes of supraanal plate lined with small dark spines (Figs 24A,25A) .... *waterhousei*

Triangular lobes of supraanal plate each terminating in a spine, outer margins not spinose (Fig. 27B) .... *bispinulifera*

Dyakinodes kurandensis n.sp.
(Figs 21A-E,22A,29)

MATERIAL EXAMINED

HOLOTYPE: ♂ (terminalia slide 458), Kuranda north Queensland, 200m, 13.iii.1956, J.L. Gressitt; in BPBM.

PARATYPE: QUEENSLAND. QMBA: Windsor Tbld, 35km NNW of Carbine, NQ, Bargoo Ck, RF, 850m, 1♀, 15-18.iv.1982, Monteith, Yeates, and Cook.

DESCRIPTION

Male. Interocular space about same as distance between antennal sockets, slightly greater than interocellar space; fifth palpal segment enlarged, longer than the fourth. Pronotum subelliptical (Fig. 22A). Cubitus vein of hind wing thicker than other veins, cell formed by bases of median and cubitus veins small, cubitus vein with 1 complete and 3 incomplete branches, apical triangle absent (Fig. 21D). Front femur Type B_2 (with 4 small, stout proximal spines), pulvilli present on 4 proximal tarsomeres, tarsal claws simple, symmetrical, arolia present. Seventh abdominal tergum with large, semicircular, convexly raised, median elevation bearing dense setal tuft anteromedially (Fig. 21B). Supraanal plate with hind margin broadly rounded, entire, reaching hind margin of subgenital plate (Fig. 21B); paraprocts dissimilar, rectangular, right one larger without large, spinelike processes (Fig. 21A). Subgenital plate weakly asymmetrical, styles small, cylindrical, similar, widely separated, interstylar margin weakly oblique (Figs 21B,C,E). Genitalia as in Fig. 21E: hook on left side, with a subapical incision, median phallomere with distal region curved obliquely.

Colouration. Head dark brown, lower part of face lighter, gradually becoming darker dorsad. Pronotum dark brown, lateral edges and disk lighter. Tegmina brown, transparent, anterior area darker then posterior region; hind wings weakly infuscated, veins very distinct, dark brown. Abdominal terga light brown, lateral borders darker.

Female. Interocular distance slightly greater than space between antennal sockets. Hind wing with cubitus vein with 2 complete and 4 incomplete branches. Front femur Type B_2, with 4 stout proximal spines. Supraanal plate trigonal,

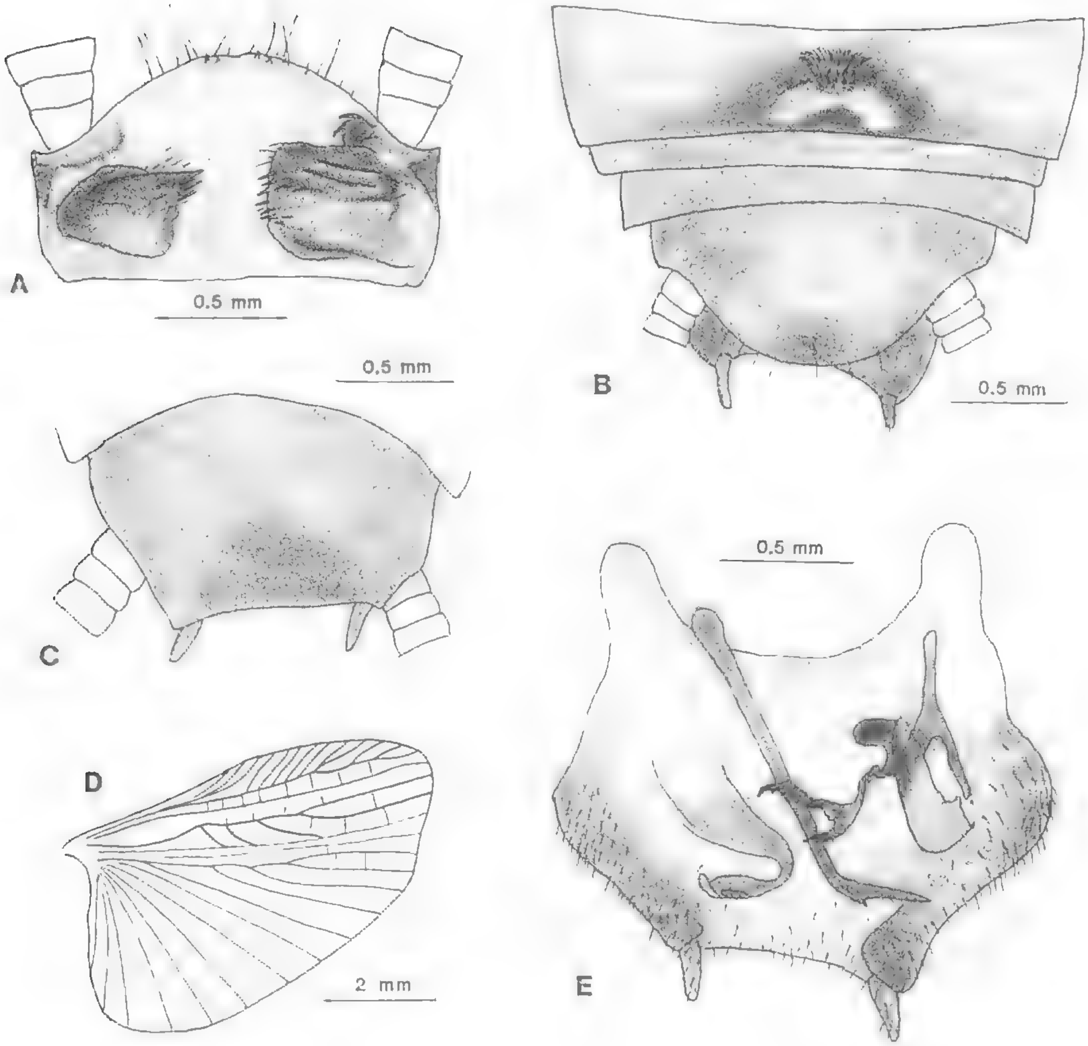

FIG. 21. *Dyakinodes kurandensis* n.sp., ♂ holotype: A, Supraanal plate and paraprocts (ventral); B, Abdominal tergum 7 to supraanal and subgenital plates (dorsal); C, Subgenital plate (ventral); D, Hind wing; E, Subgenital plate and genitalia (dorsal).

rounded apex almost reaching hind margin of subgenital plate. Top of head blackish shading to dark brown from middle of antennal sockets to yellowish clypeus and labrum. Pronotum with lateral edging yellowish brown, disk reddish brown, lateral and posterior regions dark brown. Tegmina reddish brown, humeral vein area dark brown, anterior edging and subcostal area yellowish, that part of right tegmen covered by left, colourless. Abdominal terga and sterna light brown. Cerci brown dorsally, ventral surface darker. Legs light brown.

Measurements (♀ in parentheses). Length, 7.5 (6.5); pronotum length x width, 1.9 x 2.7 (2.0 x 2.7); tegmen length, 7.7 (7.3).

Dyakinodes uptoni n.sp.

(Figs 22B-F, 29)

MATERIAL EXAMINED

HOLOTYPE: ♂ (terminalia slide 145), Bamaga, Cape York, Queensland, 26.iii.1964, I.F.B. Common and M.S. Upton; in ANIC.

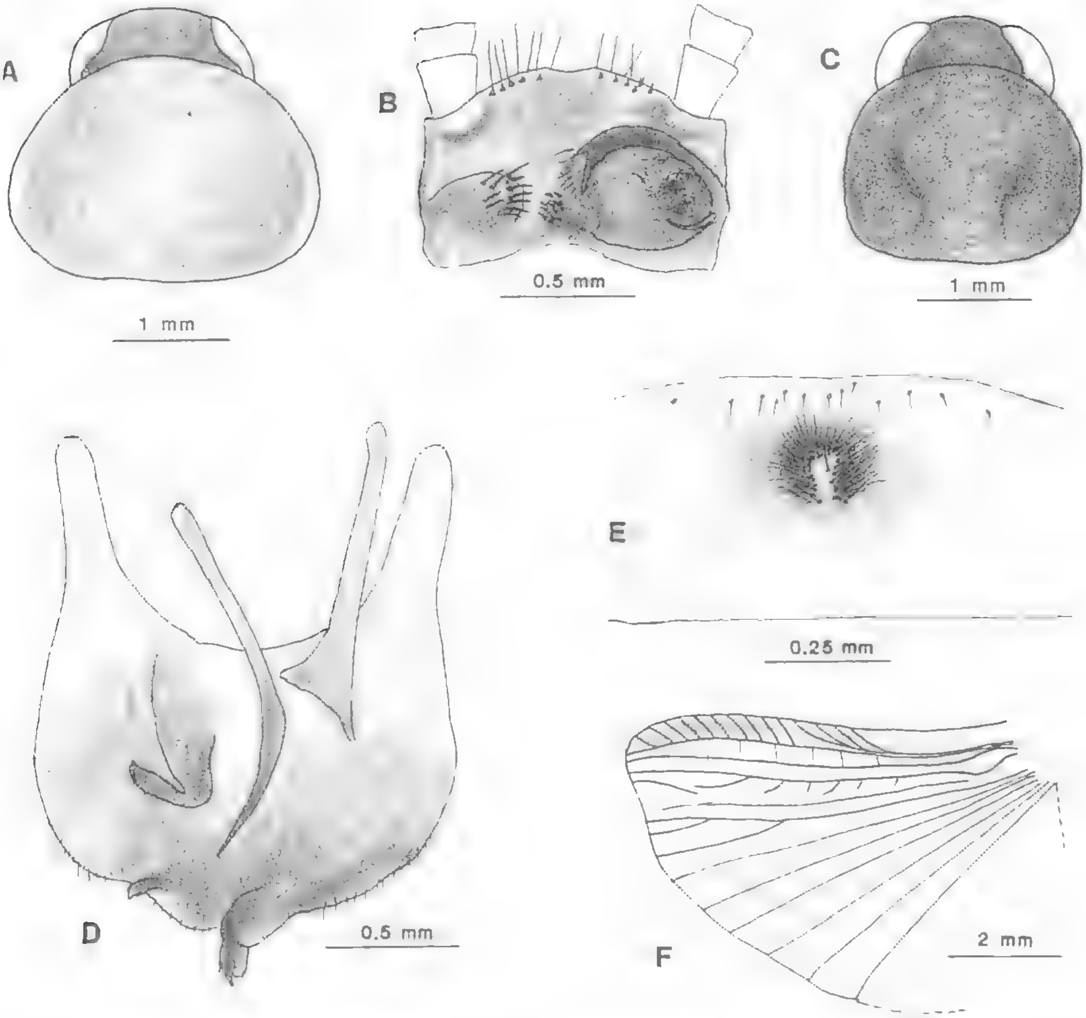

FIG. 22. *Dyakinodes* spp. A, *D. kurandensis* n.sp., ♂ holotype, pronotum. B-F, *Dyakinodes uptoni* n.sp., ♂ holotype: B, Supraanal plate and paraprocts (ventral); C, Pronotum; D, Subgenital plate and genitalia (dorsal); E, Tergal gland region on seventh segment; F, Hind wing.

DESCRIPTION

Male. Head with hardly any punctations between ocellar spots; interocular space slightly less than interocellar distance; fifth palpal segment larger than fourth. Pronotum suboval (Fig. 22C). Cubitus vein of hind wing with 1 complete (but apparently split in middle) and about 3 incomplete branches, cell formed by bases of median and cubitus veins, small, apical triangle absent (Fig. 22F). Front femur Type C_2 (stout proximal spines apparently absent). Seventh abdominal tergum with setal tuft on small mound in shallow depression (Fig. 22E). Supraanal plate with hind margin convex, some minute dark spines along margin ventrally; right paraproct with large, curved, apically bifid process, left paraproct simpler, with several large setae distally (Fig. 22B). Subgenital plate broadly rounded, right style short, bulbous, located on thickened dorsal region, left style smaller, more slender (Fig. 22D). Genitalia as in Fig. 22D: hook on left side, median phallomere curved on distal half, apex acute; some sclerites of right phallomere were probably lost in slide preparation.

Measurements. Length, 7.7; pronotum length x width, 1.6 x 2.0; tegmen length, 8.0.

Female. I am provisionally placing the following female here (non-paratype), pending collection of males from the same locality.

QUEENSLAND. ANIC: 3km NE of Mt Webb, near Cooktown, 1♀, 3.x.1980, T.A. Weir and R.A. Barrett.

The specimen lacks the dark areas on the pronotum and base of the coxae, and the dark brown regions on the subcostal and costal areas of the tegmina are greatly reduced.

Measurements. Length, 8.0; pronotum length x width, 1.8 x 2.2; tegmen length, 8.2.

Dyakinodes penibifida n.sp.
(Figs 23A-F,29)

MATERIAL EXAMINED

HOLOTYPE: ♂ (terminalia slide 148), Slaty Creek, 31km NE by E of Tenterfield, New South Wales, 16.xi.1982, D.C.F. Rentz and C.D. MacNeill, Stop 90; in ANIC.

ETYMOLOGY

The specific name refers to the divided apex of the male's median genital phallomere (virga).

DESCRIPTION

Male. Head with interocellar region and vertex minutely punctulate; interocular distance about same as distance between ocellar spots; fifth palpal segment longer than fourth. Pronotum suboval (Fig. 23E). Cubitus vein of hind wing with 1 complete and 6 small incomplete branches, cell formed by curved bases of median and cubitus veins, small; apical triangle absent (Fig. 23F). Front femur Type B_2, with 2 stout proximal spines, pulvilli present on 4 proximal tarsomeres, tarsal claws simple, symmetrical, arolia present. Seventh abdominal tergum with pair of deep, setose fossae, divided medially by mound bearing dense dark setal tuft (Figs 23A,D). Supraanal plate trigonal, apex shallowly excavated, deflexed, margins on either side of indentation with very small dark spines (Figs 23A,C); subcercal processes terminating in small spines; right paraproct with several robust, spinelike processes, left one simpler (Fig. 23C). Subgenital plate with pair of widely spaced, almost similar cylindrical styles (Figs 23A,B). Genitalia as in Fig. 23B: hook on left side, median phallomere apically bifid, right phallomere with subobsolete cleft sclerite.

Colouration. Head dark brown, vertex and occiput slightly lighter than rest of face. Pronotum dark brown, medial region lighter (Fig. 23E). Tegmina dark brown, basolateral half darker than rest of wing cover. Hind wing with part of subcostal and costal area and apex, darkly infuscated (Fig. 23F). Abdominal terga light brown, sides and terminal segments dark brown. Abdominal sterna with medial area up to subgenital plate, light brown, remainder dark brown. Coxae with brown basal maculae, remaining parts of legs very pale.

Measurements. Length, 10.7; pronotum length x width, 2.4 x 3.0; tegmen length, 12.0.

Dyakinodes waterhousei n.sp.
(Figs 24A,B, 25A-E, 29)

MATERIAL EXAMINED

HOLOTYPE: ♂, Mt Moffat, N.P., CQ, Top Shelter Shed, 1000m, 10-12.xii.1987, Monteith, Thompson, Yeates, in QMBA (Reg. No. T.11452).

PARATYPES: QUEENSLAND. ANIC: Moggill, near Brisbane, 1♂ (terminalia slide 150), ix.1966, G. Monteith. QMBA: Lake Clarendon, SEQ, 2♀♀, 11.xi.1971, E.C. Dahms.

ETYMOLOGY

The species is dedicated to Dr Douglas Waterhouse, retired Chief of CSIRO, Division of Entomology.

DESCRIPTION

Male. Head with few punctations on vertex; interocular space about same as distance between ocellar spots; fifth palpal segment swollen, longer than fourth. Pronotum suboval (Fig. 25C). Tegmina and wings fully developed. Hind wing with cell formed by curved bases of median and cubitus veins small but distinct; cubitus vein with 1 complete and some small incomplete branches and cross veins, apical triangle absent (Fig. 25B). Front femur Type B_2, with 3 or 4 stout proximal spines; pulvilli present on 4 proximal tarsomeres, tarsal claws symmetrical, simple, arolia well developed. Seventh abdominal tergum with a pair of fossae divided by large dark setose mound (Fig. 25D). Supraanal plate hind margin deeply excavated forming pair of lobes with small dark spines near their acute apices; bottom margin of excavation truncate, membranous, colourless, with few dark spines

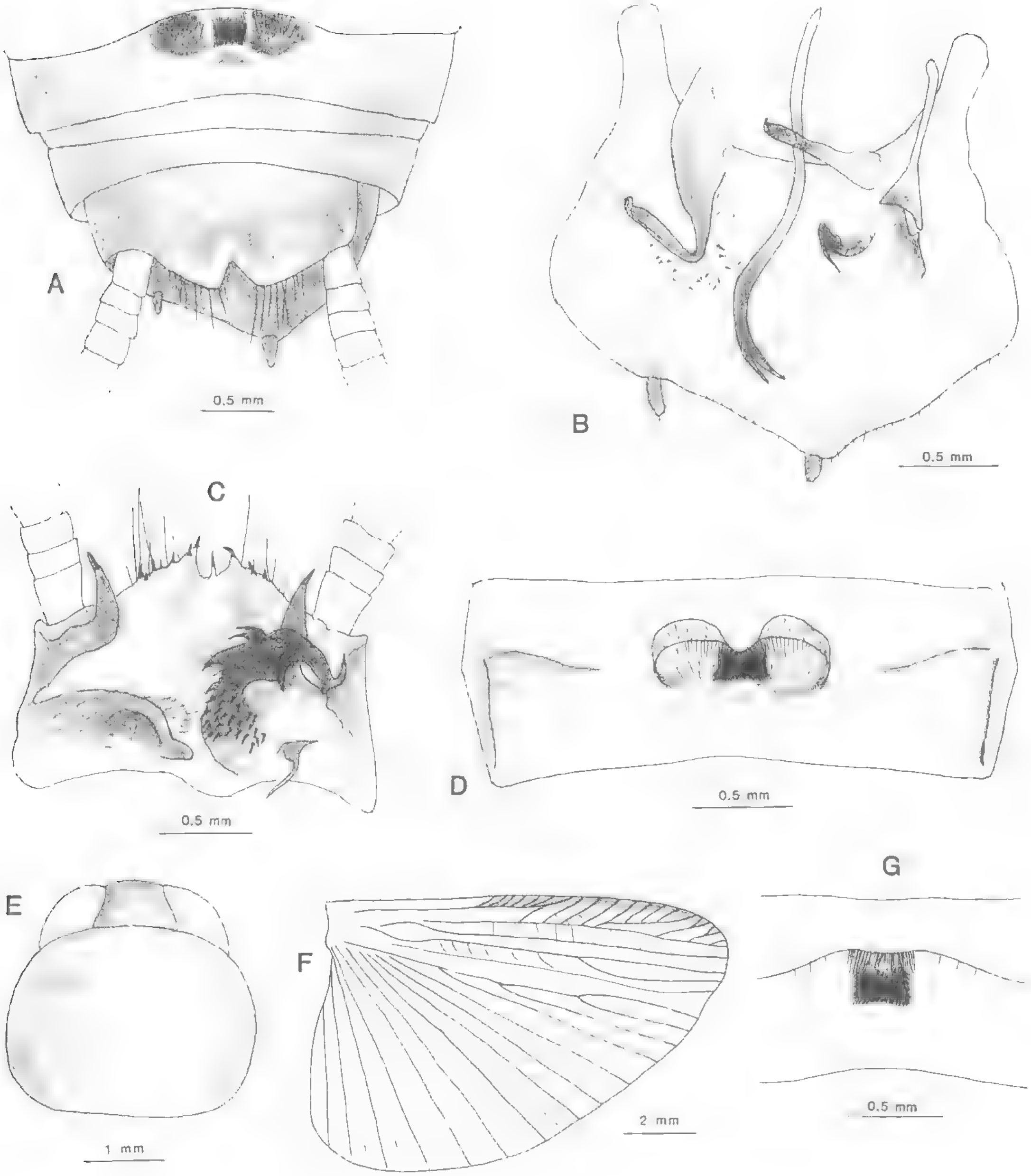

FIG. 23. *Dyakinodes* spp. A-F, *D. penibifida* n.sp., ♂ holotype: A, Seventh abdominal tergum to supraanal and subgenital plates; B, Subgenital plate and genitalia (dorsal); C, Supraanal plate and paraprocts (ventral); D, Seventh abdominal tergum; E, Pronotum; F, Hind wing. G, *Dyakinodes centralis* (Walker), ♂ from Upper Kangaroo River, NSW, Australia, glandular region of seventh abdominal tergum.

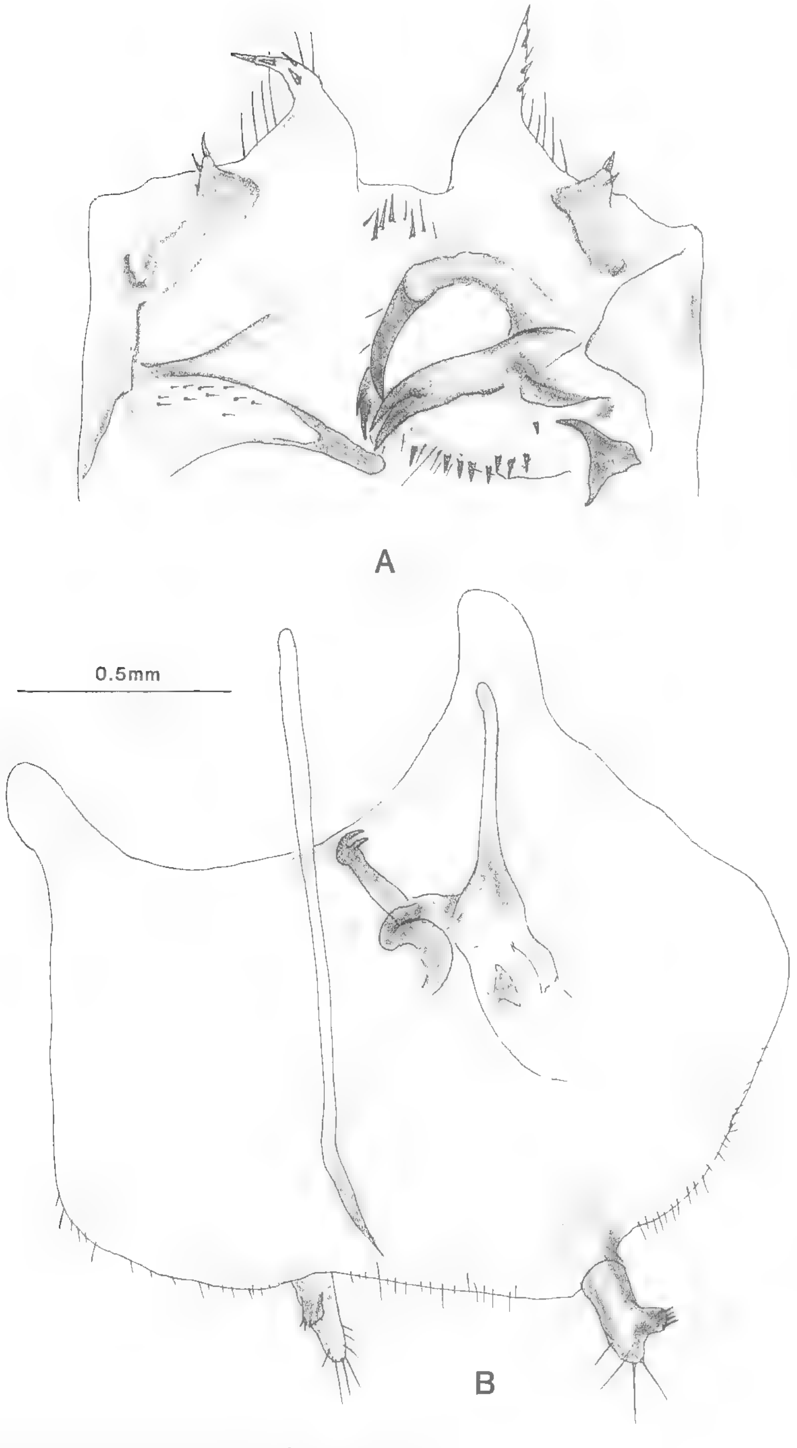

FIG. 24. *Dyakinodes waterhousei* n.sp., ♂ paratype from Moggill, Qld: A, Supraanal plate and paraprocts (ventral); B, Subgenital plate and genitalia (dorsal).

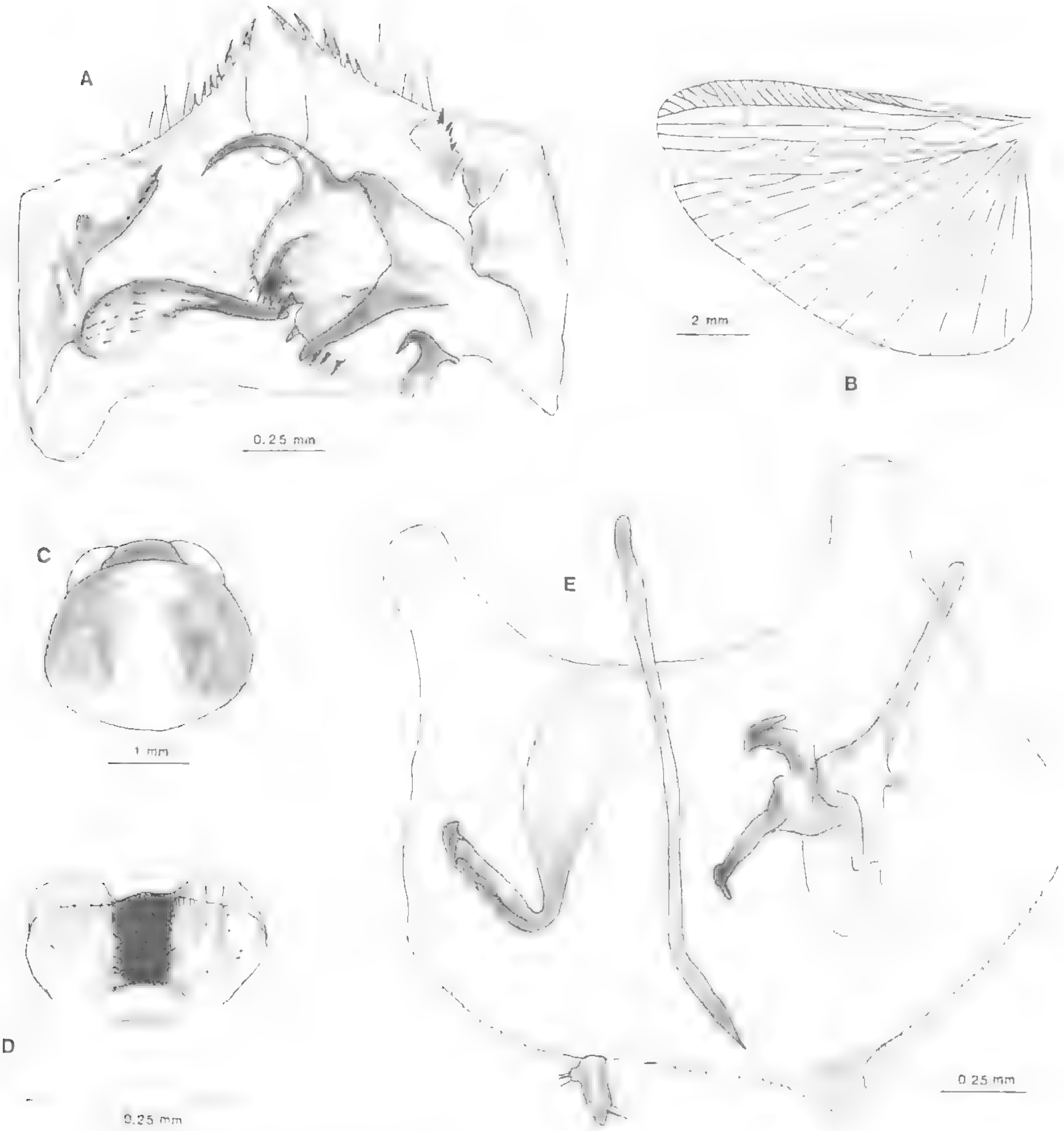

FIG. 25. *Dyakinodes waterhousei n.sp.*, ♂ variant from 4 miles southwest of Mudgee, NSW: A, Supraanal plate and paraprocts (ventral); B, Hind wing; C, Pronotum; D, Gland on seventh abdominal tergum; E, Subgenital plate and genitalia (dorsal).

ventrally; subcercal processes reduced; left paraproct with single, apically rounded process, right paraproct with pair of large spinelike processes, one strongly curved, the other apically divided (Fig. 24A). Subgenital plate with pair of weakly dissimilar styles, each with a small lateral, apically spined tubercle (Fig. 24B). Genitalia as in Figs 24B (hook lost in slide preparation), 25E: hook on left side, median phallomere slender, apically acute, right phallomere includes a reduced cleft sclerite.

Colouration. Head dark brown, occiput lighter reddish brown, clypeus pale, antennae with several black basal segments, rest pale. Pronotum with dark brown lateral areas which do not reach hind margin, remainder lighter (Fig.

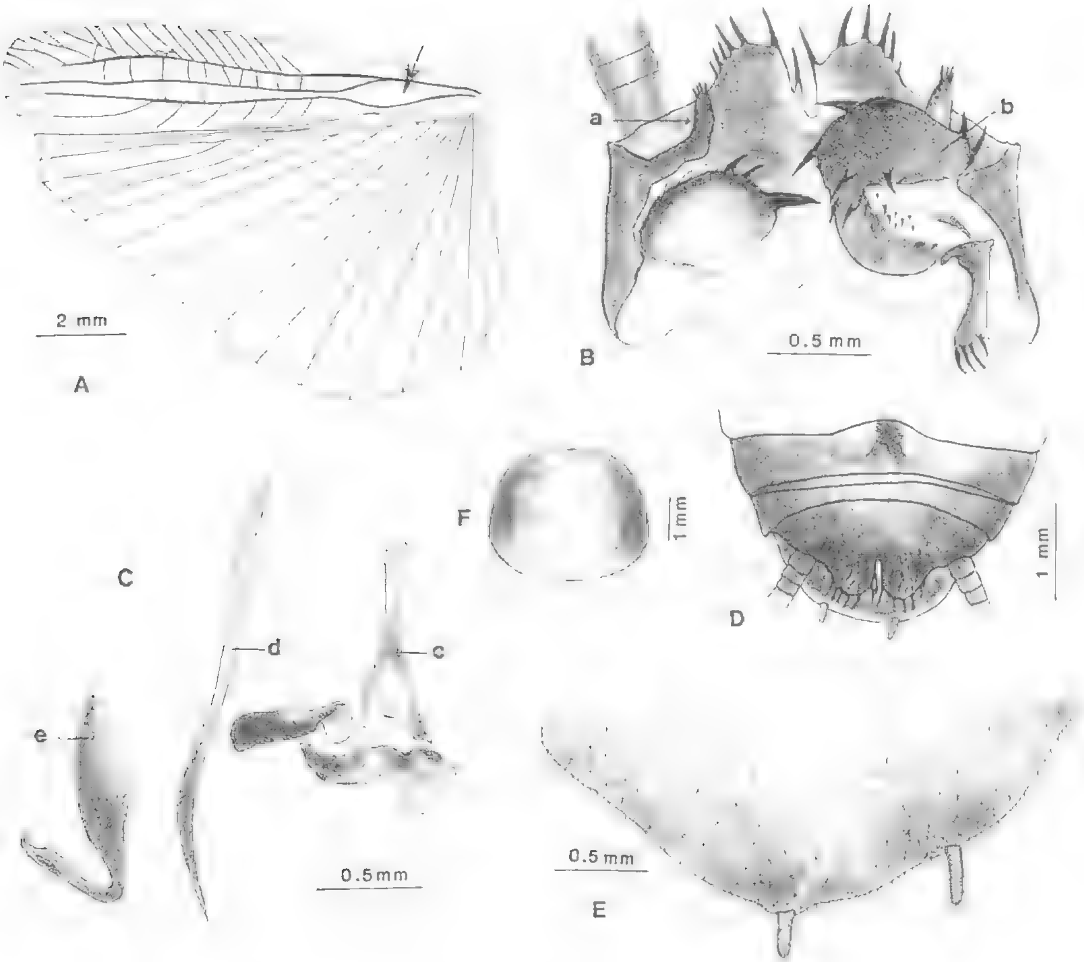

FIG. 26. *Dyakinodes centralis* (Walker), ♂ from Upper Kangaroo River, NSW: A, Hind wing (arrow indicates cell formed by curved bases of median and cubitus veins); B, Supraanal plate and paraprocts (ventral); C, Genitalia (dorsal); D, Abdominal tergum 7 to supraanal and subgenital plates; E, Distal region of subgenital plate showing styles (ventral). Abbreviations: a, left subcercal process; b, right paraproct; c, right phallomere; d, median phallomere; e, hooklike left phallomere.

25C). Tegmina with humeral area dark brown, remainder light brown, hyaline. Subcostal and costal vein areas of hind wing yellowish, remainder almost colourless. Abdominal terga yellowish brown with broad lateral zones dark brown. Abdominal sterna with broad lateral areas, and subgenital plate dark brown, remainder lighter reddish brown. Cerci dorsally pale with dark brown lateral edges, ventrally uniformly dark brown. Legs pale except for dark coxal bases.

Female. Cubitus vein of hind wing with 1 complete and 5-6 incomplete branches and cross veins. Front femur Type B_2, with 2 small stout proximal spines. Supraanal plate strongly trigonal, rounded apex extending slightly beyond hind margin of subgenital plate. Head blackish, including occiput; antennae uniformly pale. Pronotum with more extensive dark brown areas than in male.

Measurements (♀ in parentheses). Length, 10.8- 12.3 (8.3-10.4); pronotum length x width, 1.9-2.4 x 2.3-3.0 (1.9- 2.0 x 2.3-2.4); tegmen length, 10.0-11.1 (8.9-10.0).

VARIANT

NEW SOUTH WALES. ANIC: 4 miles SW of Mudgee, 32.36S 149.35E, 1♂ (terminalia slide 151). 18.xi.1968, Britton and Misko.

This male shows some minor differences in the shape of the excavation of supraanal plate, and right paraproct (cp. Figs 24A, 25A).

Dyakinodes centralis (Walker)
(Figs 23G, 26A-E, 29)

Ischnoptera centralis (Walker), 1868, p.120 (♀).
Apolyta centralis (Walker): Tepper, 1893, p.48.
Ischnoptera brunneonigra Tepper, 1895, p.155 (♀); Shaw, 1916, p.86 (♂) [misidentification]; Princis, 1969, p.1002 (sp. *incertae sedis*); Roth, 1985a, p.212 (sp. *incertae sedis*). n.syn.
Dyakinodes victoriae Princis, 1951, p.67, pl.6, figs 66,67 (♂); 1959, p.140.
Dyakinodes centralis (Walker): Princis, 1959, p.140; 1969, p.994.

MATERIAL EXAMINED

HOLOTYPE: ♀, South Australia, presented by R. Bakewell: in BMNH.

ADDITIONAL MATERIAL: VICTORIA. NMVM: Fernshaw, ♀ holotype (no. 4457) of *Ischnoptera brunneonigra* Tepper. UZMC: ♂ holotype of *Dyakinodes victoriae* Princis, Hauschild [no exact locality].

AUSTRALIAN CAPITAL TERRITORY. ANIC: Black Mt., 35.17S 149.06E, 1♂, 5.i.1987, 2♂♂, 19.i.1987. D.C.F. Rentz; Wombat Ck, 6km NE of Piccadilly Circus, 750m, 35.19S 148.51E, 1♀, flight intercept window trough trap, i.1985, Weir, Lawrence, and Johnson; Mt Ainslie, 1♂, 1♀. 10.i.1966, 1♂, 11.i.1966, M.S. Upton; Black Mt., light trap, 1♂, 12.xii.1967, I.F.B. Common.

NEW SOUTH WALES. ANIC: Depot Beach, 10 miles NE of Batemans Bay, 1♂, 27.x.1967, I.F.B. Common; 7 miles west of Rosebank, 1700ft., 1♂, 8.xi.1961, I.F.B. Common and M.S. Upton; Chiswick Exp. Stn, 1 (terminal abdominal segments missing), 10.i.1970, R.J. Roberts. MCZH: Upper Kangaroo River, 1♂ (terminalia slide 223), 28.i.1968, K H.L. Key. DARA: Barrengr. F.R. [?Barrengarry], 3♂♂, at pressure lamp, 15.1.1966, C.E. Chadwick; Bundeen, 1♂, 11-12.xi.1958, R.H. Mulder. SAMA: Forest Reefs, 1♂, Lea.

QUEENSLAND. ANIC: 'Coonardoo', Fletcher, 1♂ (terminalia slide 147), 4.xii.1966. T.G. Campbell.

DESCRIPTION

Male. Head with interocellar region minutely punctulate; interocular distance about same as space between antennal sockets; last palpal segment enlarged. Pronotum suboval (Fig. 26F). Tegmina and wings fully developed. Hind wing with cell formed by curved bases of median and cubitus rami well developed, cubitus with 1 complete and 2-5 incomplete branches, apical triangle absent (Fig. 26A). Front femur with 1-4 large proximal spines, followed by row of piliform spinules, 2 (rarely 3) large terminal spines (Type B_2 or B_3); pulvilli on 4 proximal tarsomeres, tarsal claws symmetrical, simple, arolia present. Seventh abdominal tergum with transverse fossa and setose medial mound (Figs 23G,26D). Supraanal plate with hind margin divided medially forming two broadly rounded lobes bearing large spines along the edges; subcercal processes capped by several small spines; right paraproct large, bulbous, bearing stout, dark spines, left paraproct smaller, with fewer dark spines (Fig. 26B). Subgenital plate with pair of similar, cylindrical styles (Figs 26D,E). Genitalia as in Fig. 26C: hook on left side with a subapical incision, median phallomere slender, tapering to acute apex.

Colouration. Head dark brown, vertex yellowish brown; palps whitish or pale, terminal segments weakly infuscated. Pronotal disk yellowish brown, lateral regions dark brown (Fig. 26F). Tegmina with mediastine field and proximal half of scapular field dark brown. Abdominal terga brownish yellow, lateral portions and T9 and supraanal plate dark brown. Abdominal sterna medially brownish yellow, broad lateral regions dark brown. Cerci brown dorsally and ventrally. Coxae with basal dark brown maculae, those on mid and hind legs much larger than spots on front coxae; remaining parts of legs pale.

The amount of dark brown on head, pronotum, tegmina, abdominal segments, and legs varies. A male from Fletcher, Queensland is very pale, lacks dark brown on pronotum and tegmina, although coxae and abdominal segments have dark markings; its supraanal plate, styles, and genitalia are similar to typical material. A male from Depot Beach, New South Wales., has all parts of the legs dark brown.

Female. Supraanal plate trigonal, apex rounded extending slightly beyond hind margin of supraanal plate. In very dark forms, coxae are completely dark brown.

Measurements. (♀ in parentheses). Length, 11.0-13.5 (11.7-12.8); pronotum length x width, 2.5-2.8 x 3.4-3.7 (2.6-2.8 x 3.4-3.6); tegmen length, 11.8-13.8 (11.7-12.5).

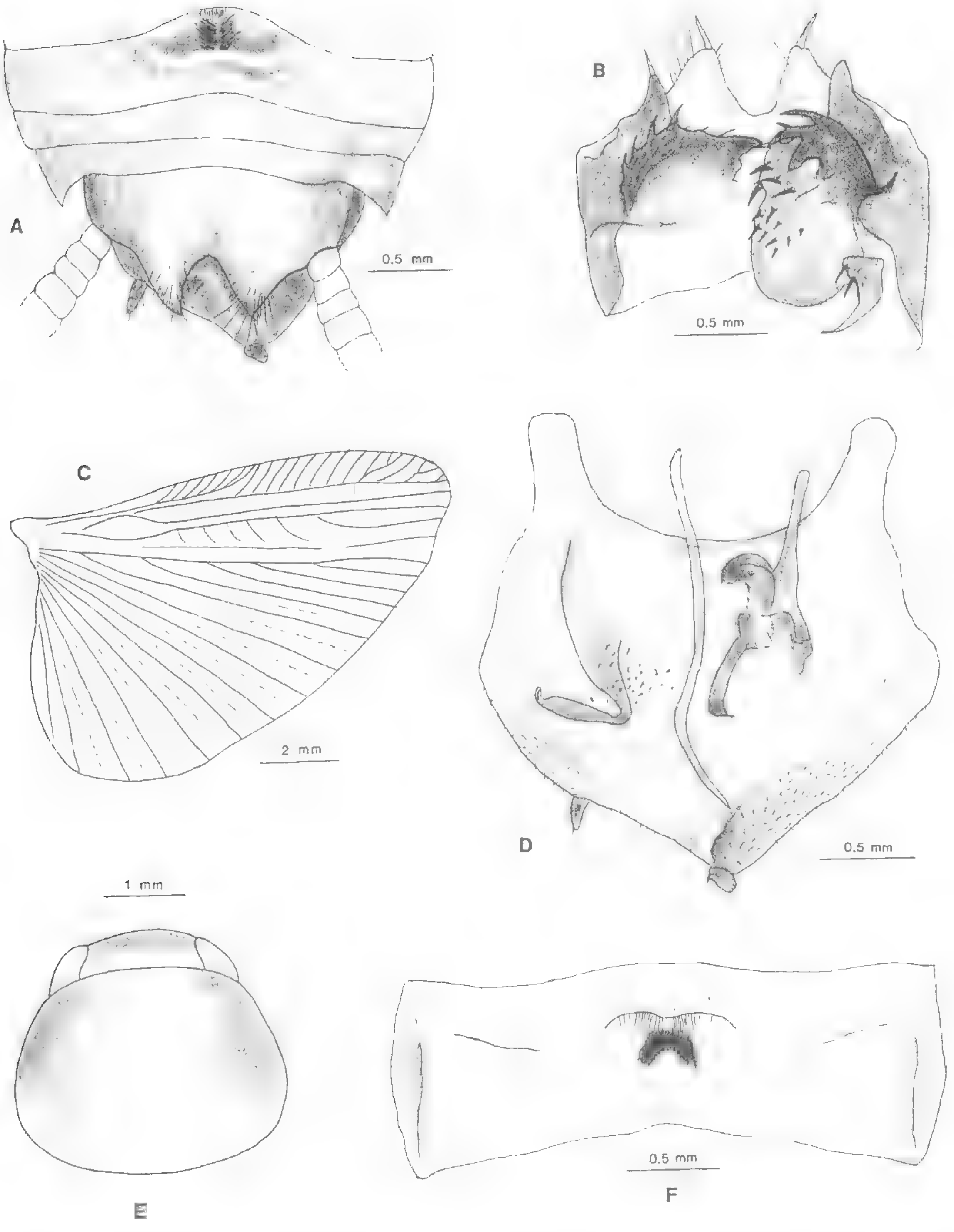

FIG. 27. *Dyakinodes bispinulifera* n.sp., ♂ holotype: A, Seventh abdominal tergum to supraanal and subgenital plates; B, Supraanal plate and paraprocts (ventral); C, Hind wing; D, Subgenital plate and genitalia (dorsal); E, Pronotum; F, Seventh abdominal tergum.

REMARKS

Tepper (1895, p.155) described *Ischnoptera brunneonigra* from a female from Fernshaw, Victoria, and indicated it is housed in the National Museum Melbourne. This specimen is very dark and greasy and it is difficult to determine its colour. However, it is clearly a *Dyakinodes* because its wings, though badly damaged, show the characteristic cell formed by the curved bases of the median and cubitus veins. Two other male specimens from Fernshaw, and labelled *Ischnoptera* n.sp. by Tepper, have no type status, because he described only the female. One of these specimens is *centralis*. The other male lacks most of the abdomen, but T1 and T2 are present and the former segment is specialised and the median and cubitus veins do not form a basal cell. It is not a *Dyakinodes*, although its front femur is Type B.

Shaw (1916, p.86) described what he believed to be the male of *Ischnoptera brunneonigra* from Healesville, Victoria, and called them cotypes. His description clearly shows that it is not *brunneonigra* because T1 and T7 are modified, and the front femur is Type A (4 large spines occupying the middle third succeeded distally by a row of smaller spines).

Dyakinodes bispinulifera n.sp.
(Figs 27A-F, 29)

MATERIAL EXAMINED

HOLOTYPE. ♂ (terminalia slide 149), Ruby Creek, 1 mile west of Amosfield, New South Wales, 15.xii.1966, T.G. Campbell; in ANIC

ETYMOLOGY

The specific name refers to the 2 spines, 1 at the apex of each triangular lobe formed by the deep excavation of the supraanal plate hind margin.

DESCRIPTION

Male. Head minutely punctulate from interocellar region to vertex; interocular space about same as distance between antennal sockets. Pronotum suboval (Fig. 27E). Cell formed by curved bases of median and cubitus veins distinct; cubitus vein with 1 complete and 5 incomplete branches, apical triangle absent (Fig. 27C). Anteroventral margin of front femur Type B_2, with 2 small, stout proximal spines; pulvilli present on 4 proximal tarsomeres, tarsal claws symmetrical, simple, arolia present. Seventh abdominal tergum with a fossa divided by a mound bearing dense, golden, setal tuft (Figs 27A,F). Hind margin of supraanal plate with deep U-shaped excavation forming pair of deflexed lobes, apices curled, each lobe bearing an apical spine (Figs 27A,B); subcercal processes dissimilar, right one more robust without apical spine (this may be aberrant), left one trigonal with apical spine; paraprocts dissimilar, right one complex with dark sclerite bearing large spinelike processes (Fig. 27B). Subgenital plate trigonal, styles small, weakly dissimilar (Figs 27A,D). Genitalia as in Fig. 27D: hook on left side; median phallomere slender, rodlike, apex acute.

Colouration. Head dark brown, occiput yellowish brown (Fig. 27E). Pronotum yellowish brown, lateral regions darkly infuscated for about two-thirds its length (Fig. 27E). Tegmina hyaline, pale, subcostal area weakly infuscated. Abdominal terga yellowish brown, broad lateral areas and terminal segments darker. Abdominal sterna with broad, light brown, medial stripe, lateral borders and subgenital plate dark brown. Cerci brown. Basal regions of coxae dark brown, remaining parts of legs very pale.

Female. Unknown.

Measurements. Length, 11.0; pronotum length x width, 2.0 x 3.1; tegmen length, 12.5.

Dyakinodes fraserensis n.sp.
(Figs 28A-F, 29)

MATERIAL EXAMINED

HOLOTYPE: ♂ (terminalia slide 146), Fraser Island, Queensland, 19km SSW of Indian Head, 25.10S 153.17E, 11- 14.x.1978, D.C.F. Rentz and J. Balderson, Stop 120; in ANIC.

PARATYPE: Fraser Island. ANIC: same data as holotype, 1♀.

DESCRIPTION

Male. (Habitus shown in Fig. 28A). Head with vertex minutely punctulate; interocular space about same as distance between ocellar spots; fifth palpal segment longer than fourth. Tegmina and wings fully developed extending beyond end of abdomen. Hind wing with a small cell formed by curved bases of median and cubitus veins; cubitus vein with 1 complete and about 3 incomplete branches and few cross veins, apical triangle absent (Fig. 28E). Anteroventral margin of front femur Type B_2, with 2 stout proximal spines; pulvilli present on 4 proximal tarsomeres, tarsal claws symmetrical, simple, arolia present.

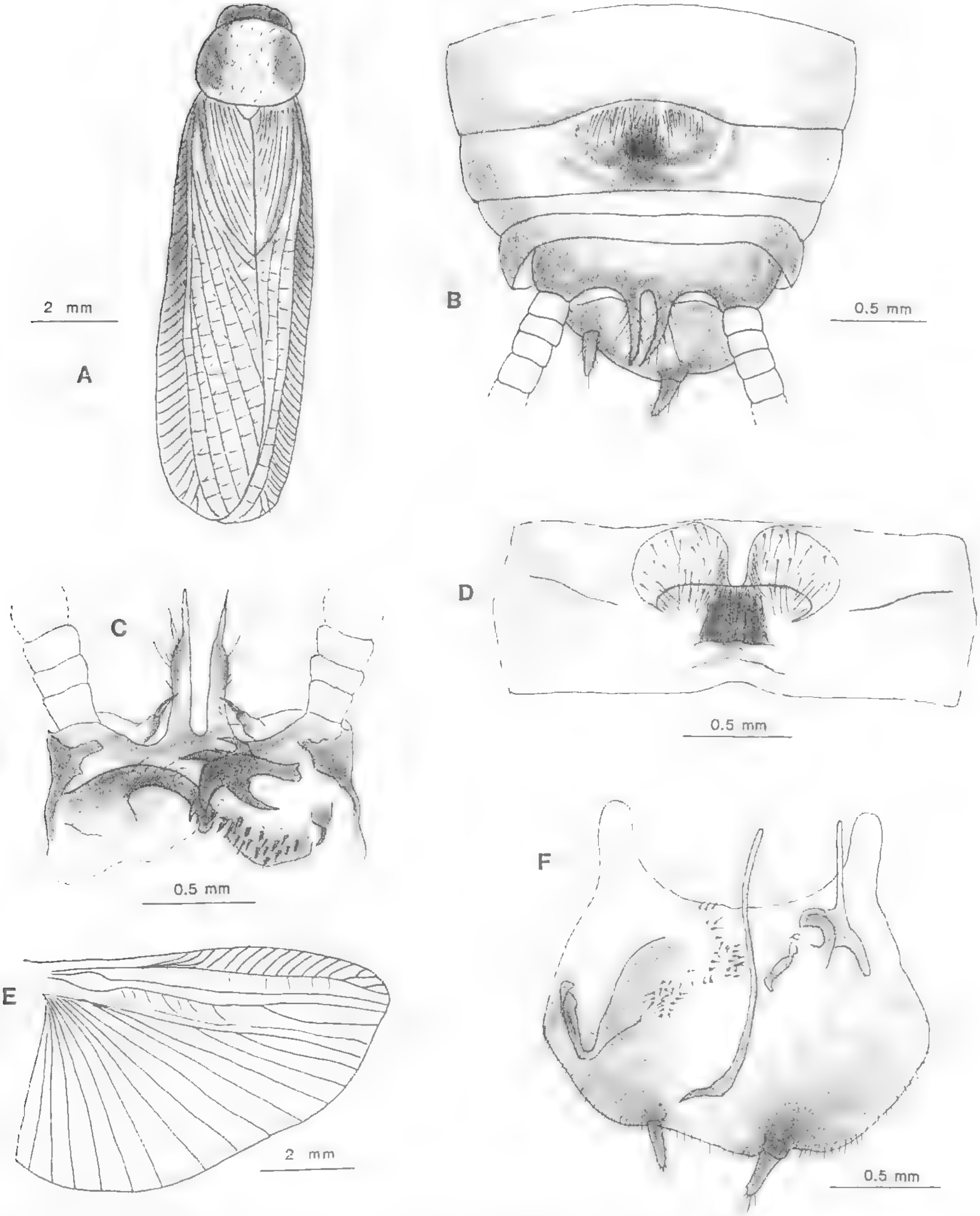

FIG. 28. *Dyakinodes fraserensis* n.sp., ♂ holotype: A, Habitus; B, Abdominal tergum 6 to supraanal and subgenital plates; C, Supraanal plate and paraprocts (ventral); D, Seventh abdominal tergum; E, Hind wing, F, Subgenital plate and genitalia (dorsal).

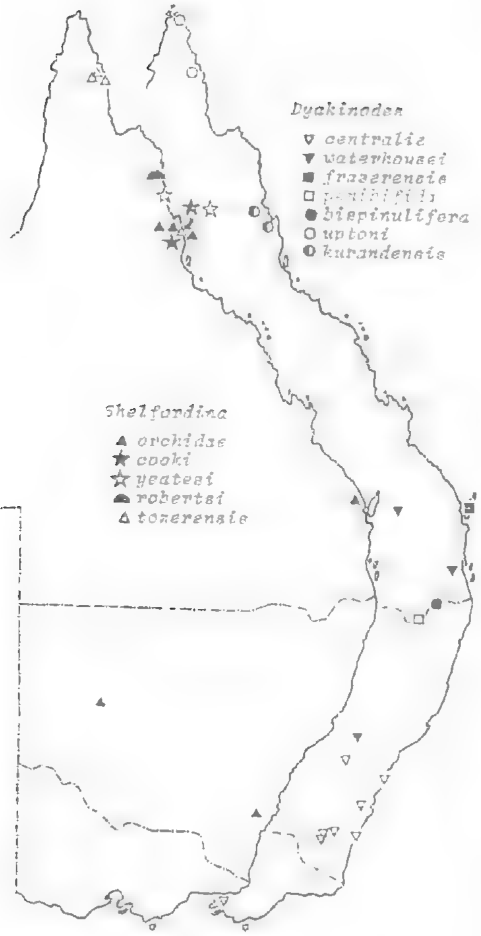

FIG. 29. Distribution of *Shelfordina* spp. and *Dyakinodes* spp. in Australia (the *D. waterhousei* record in New South Wales refers to the variant).

Seventh abdominal tergum with large transverse fossa and medial setose mound (Fig. 28B); KOH cleared preparation shows a pair of large, rounded sacs bearing scattered setae, in addition to the dense medial tuft (Fig. 28D). Supraanal plate transverse with pair of long, dark, slender processes that curve ventrad, their apices reaching hind margin of subgenital plate (Fig. 28B); between these processes and cerci, supraanal plate is membranous, colourless, with small subcercal processes each bearing an apical spine (Fig. 28C). Subgenital plate broadly rounded, convex, styles cylindrical, right one slightly more robust, arising from small tubercle on dorsal surface of plate (Fig. 28F). Genitalia as in Fig. 28F: hook on left side; median phallomere slender, slightly enlarged distally, apex acute.

Colouration. Head black, clypeus pale, labrum brownish. Pronotum yellowish brown with broad lateral areas very dark brown (Fig. 28A). Tegmina hyaline, yellowish brown, subcostal and basal half of costal areas infuscated (Fig. 28A). Costal region of hind wing light yellowish brown. Abdominal terga pale, laterally infuscated. Basal regions of coxae darkly infuscated, remaining parts of legs very pale.

Female. Supraanal plate trigonal, apex extending slightly beyond end of abdomen. Abdominal terga and sterna pale, lateral borders and terminal segments blackish.

Measurements (♀ in parentheses). Length, 8.5 (8.3); pronotum length x width, 1.9 x 2.3 (2.0 x 2.5); tegmen length, 9.1 (9.2).

Dyakinodes sp. A

MATERIAL EXAMINED

NEW SOUTH WALES. ANIC: Durras North, near Batemans Bay, 1♀, 10.i.1979, H.M. Cameron.

DESCRIPTION

Female. Head hidden under pronotum; punctulations on vertex indistinct; fifth palpal segment enlarged, longer than fourth. Pronotum subelliptical. Tegmina and wings fully developed. Hind wing with cell formed by curved bases of median and cubitus veins very large; cubitus vein with 2 complete and 3 incomplete branches, apical triangle absent. Front femur Type B_3, with 6 stout proximal spines, pulvilli present on 4 proximal tarsomeres, tarsal claws simple, symmetrical, arolia present. Supraanal plate trigonal, apex rounded protruding slightly beyond subgenital plate.

Colouration. Yellowish brown. Head pale, light reddish brown area between antennal sockets and eyes, blending gradually with pale occiput and lower part of face, interocular space almost smooth. Pronotum, tegmina, abdominal terga and sterna, and legs (including coxae), pale, dark infuscation absent. Dorsal surface of cerci pale, ventrally brown.

Measurements. Length, 9.0; pronotum length x width, 2.5 x 3.3; tegmen length, 10.0.

Anaplecta Burmeister

Anaplecta Burmeister, 1838, p.494; Bruijning, 1948, p.43; Hanitsch, 1928, p.6; Hebard, 1929, p.27; Princis, 1965, p.367.

Type Species

Anaplecta lateralis Burmeister, by designation (Kirby, 1904, p.66) (type locality: Colombia, South America).

Remarks

I have not seen Burmeister's types of the type-species *Anaplecta lateralis* from Colombia. However, I examined 5 males (1 with terminalia slide 426) from Panama (in ANSP) which Hebard (1920, p.15) determined as *lateralis*. I have seen additional specimens in MCZH from Barro Colorado Island, Panama Canal Zone (1♂, 1♀), and from Agua Caliente, Guatemala (14♂♂, 1 with terminalia slide 248, and 10♀♀). The type-species agrees with the diagnostic characters used for the genus, including basic features of the male genital phallomeres.

Hanitsch (1915, p.31) in his diagnosis of *Anaplecta* stated that the males lacked styles. Later in describing various species in the genus he stated that styles were present in some taxa but not others. The styles are small and may be overlooked unless slides are prepared of the subgenital plate. This is true of the types of *Anaplecta vittata* which Hanitsch described as females but are males (Fig. 31D). Females lack styles and have a valvular subgenital plate.

Descriptions of *Anaplecta* spp. have stressed wing venation and colouration (e.g. Shelford, 1906,pp.240-7). Often only 1 or 2 specimens were available or used by describers and there is no indication of the extent of variation in 'diagnostic' characters. Bruijning (1948, p.44) pointed out that differences in the number of costal veins and in the number of cross veins between the discoidal and median rami are variable and have no specific value; this is probably true in many cases. Colouration also may vary, and sometimes colour is not distinctive. Many of the described species are based on females and even when males were available their genitalia were not studied. These structures should be used, if possible, for specific determinations and to show species relationships. McKittrick (1964, p.26) studied only 3 *Anaplecta* (2 South American and 1 African) identified to genus only and stated that '... more than 1 genus is represented, to judge by differences in female genitalia.' The genus needs revision and at least the known species should be redescribed, using males when this sex is available.

Affinities

Princis placed *Anaplecta* in the Anaplectidae: Anaplectinae. I follow McKittrick (1964, p.25) who believed the genus to be in the most primitive subfamily of the Blattellidae and one which has structures that '... bridge the gap between 2 superficially exceedingly different groups.' (i.e., Polyphagidae and Blattellidae).

Diagnosis

Size small. Tegmina and wings usually fully developed, rarely with reduced tegmina and vestigial wings (1 species). In fully developed flight organs, tegmina narrow, usually with about 3 longitudinal or sublongitudinal sectors. Hind wings with cubitus vein simple, costal veins sometimes thickened distad, sometimes indistinct, with large subtriangular apical area (appendicular field) which when in repose is folded longitudinally and then reflexed over rest of wing; two weakly developed veins, one longitudinal along fold, the other somewhat oblique, may occur in appendicular field, other veins lacking; hind wing often infuscated, costal vein region and part of appendicular field darker than remaining parts. Anteroventral margin of front femur with few large proximal spines followed by row of piliform spinules, terminating in 2 large spines (Type B_2); tarsal claws simple, symmetrical, unspecialised (not serrated); pulvilli absent, or apparent on fourth tarsomere only; arolia present. ♂: Supraanal plate with medial specialisation. Styles present, similar or differing in size and/or shape. Genital hook on left side. ♀: subgenital plate valvular.

KEY TO ADULT *ANAPLECTA* OF AUSTRALIA

1. Tegmina reduced reaching to about T3 (Fig. 33A). Hind wings vestigial. Clypeus swollen (Fig. 33B) .... *brachyptera*

Tegmina and wings fully developed reaching to end of abdomen or beyond. Clypeus not swollen (Fig. 30A) 2

2. Tegmina with a pair of dark maculae separated by a transverse pale band (Fig. 30E), or maculae joined on one side (Fig. 30K) .... *calosoma*

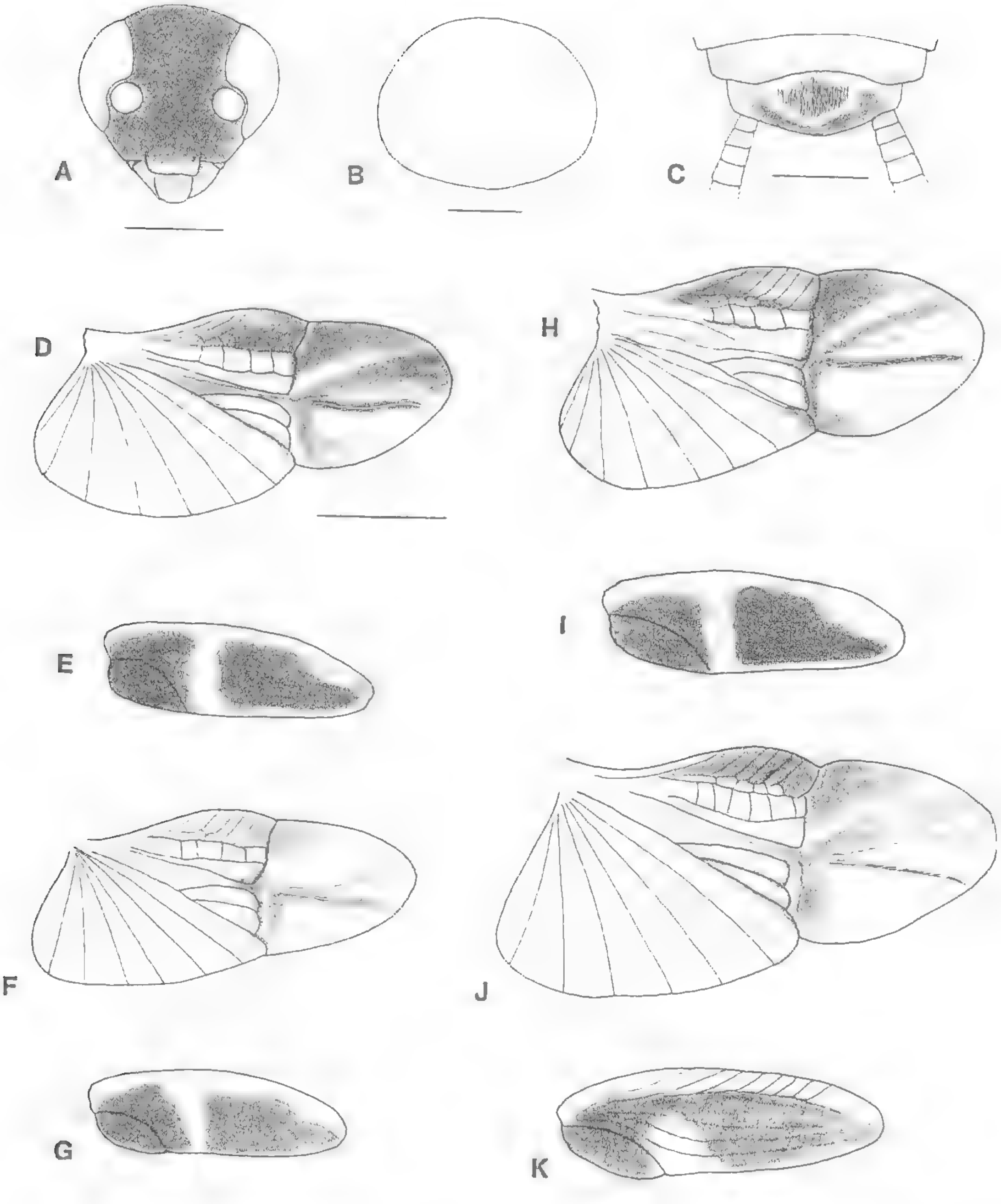

FIG. 30. *Anaplecta calosoma* Shelford. A-C, ♂ from 3km ENE of Mt Tozer, Queensland, head, pronotum, and terminal abdominal terga. D-K, Hind wings and tegmina: D,E, ♂ from 11km ENE of Mt Tozer; F,G, ♀ from Awar Bush, Papua New Guinea; H,I, ♂ from 6km ENE of Mt Tozer; J,K, ♀ from Moses Ck, 4km north by east of Mt Finnigan (veins not shown in Figs E,G,I). Scales (mm): A-C, 0.5; D, 2.0; E-K, same as D.

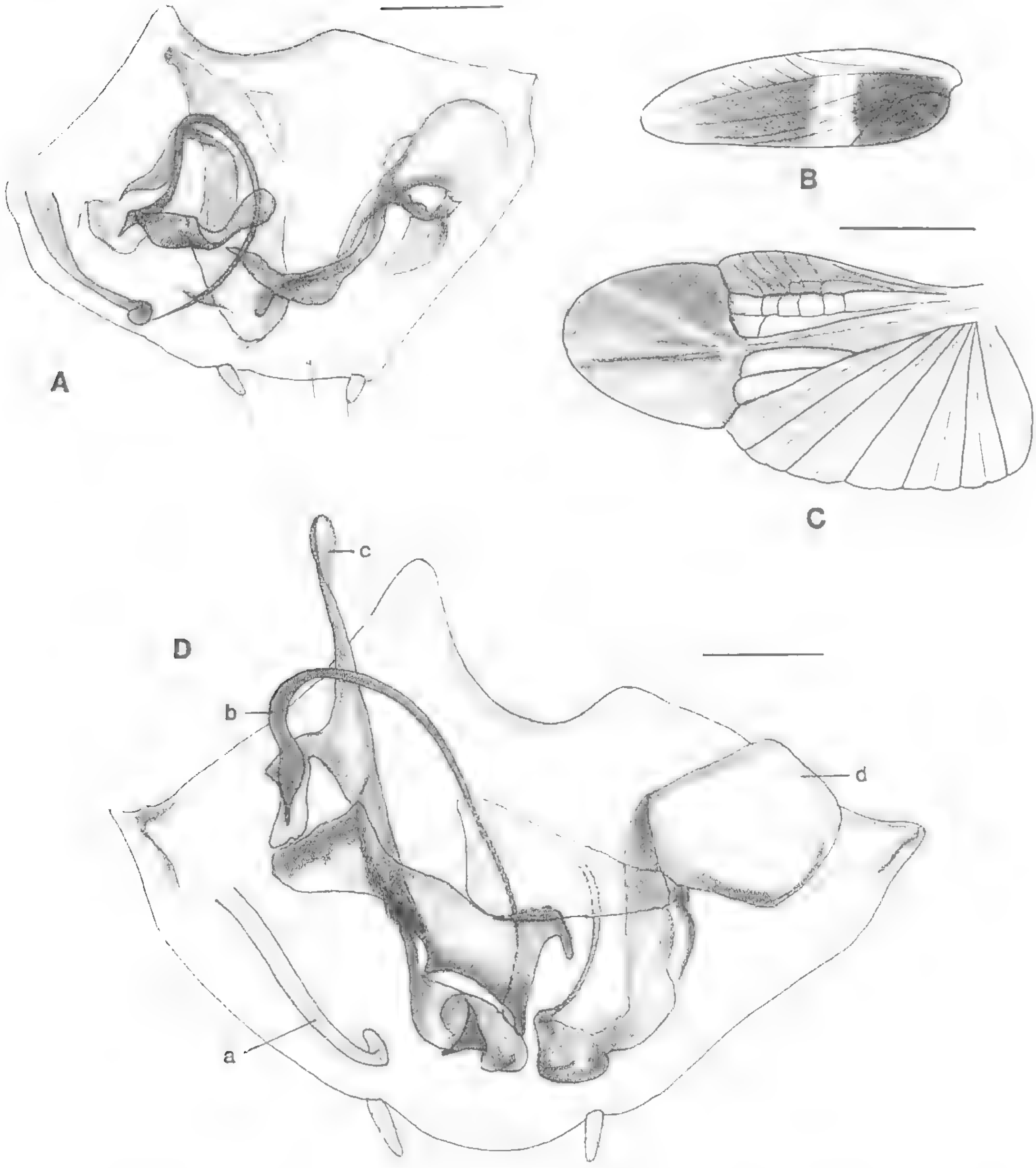

FIG. 31. *Anaplecta* spp. A, *Anaplecta calosoma* Shelford, ♂ from 11km ENE of Mt Tozer, Queensland, subgenital plate and genitalia (dorsal). B-D, *Anaplecta vittata* Hanitsch, ♂ paratype from Singapore: B, Left tegmen; C, Left wing; D, Subgenital plate and genitalia (dorsal; genital phallomeres: a, L3; b, L1; c, L2vm; d, R3 [L = left, and R = right phallomeres - terminology after McKittrick, 1964]). Scales (mm): A, 0.25; B,C, 2.0; D, 0.25.

Tegmina brown, unbanded (Fig. 32C), sometimes with a pale spot behind the anal vein (Fig. 32D) . . . *australiensis*

Distribution

Anaplecta is a large genus with more than 80 species in Central and South America, Asia and Africa (Princis, 1965, pp.367-80; 1971, p.1144; Bey-Bienko, 1969, p.839; 1970, p.533; Asahina, 1977, p.277). Until now it has not been recorded from Australia. Rehn (1904, p.542) described *Anaplecta platycephala* from Cairns but Hebard (1929, p.27, footnote 14) pointed out that it did not belong in this genus and later (Hebard, 1943, p.10) placed it in *Mediastinia* Hebard.

Distribution of Australian *Anaplecta* is shown in Fig. 34; not shown is the Northern Territory (near Darwin) record of *A. australiensis*.

Anaplecta calosoma Shelford
(Figs 30A-K, 31A, 34)

Anaplecta calosoma Shelford, 1912, p.51 (♀); Bruijning, 1947, p.215; Princis, (1953) 1954, p.212.

Holotype (not examined)

♀, German New Guinea (= Papua New Guinea), Tamimundung (= mouth of the Tami River); Shelford did not indicate where the type is housed; it is not in HDEO.

Material Examined

The following specimens have the tegminal maculae completely separated by a transverse band (Figs 30E,G,I):

Papua New Guinea. ISNB: Awar Bush, 1♂ (terminalia slide 2), 1♀, 6.vi.1982, 1♀, 21.vi.1982, P. Grootaert.

Queensland. ANIC: 3km ENE of Mt Tozer, 12.44S 143.14E, 28.v.- 4.vi.1986, 4♀♀ (Malaise trap/ethanol), J.C. Cardale, 4♂♂, 1♀ (Malaise trap), D.H. Colless. Quinn Park, Claudie River, 12.43S 143.17E, 1♂, 12- 21.ii.1985, E.D. Edwards and B. Hacobian. The following were collected by T. Weir and A. Calder: 3km ENE of Mt Tozer, 12.44S 143.14E, 3♂♂, 3♀♀, 28.vi.-4.vii.1986; 6km ENE of Mt Tozer, 12.44S 143.16E, 1♂, 30.vi.1986; 7km ENE of Mt Tozer, 12.43S 143.16E, 1♀, 1.vii.1986; 9km ENE of Mt Tozer, 12.43S, 143.17E, 2♂♂, 1♀, 5-10.vii.1986; 11km ENE of Mt Tozer, 12.43S 143.18E, 2♀♀, 11-16.vii.1986. The following were collected by D.C.F. Rentz: 11km ENE of Mt Tozer, near Iron Range National Park, 12.43S 143.18E, rainforest margin, 1♀, 11.vii.1986, at light, 1♂ (terminalia slide 185), 6♂♂, 10♀♀, 11.vii.1986; 9km ENE of Mt Tozer, 12.43S 143.18E, Iron Range National Park, at light in rainforest, 2♂♂, 10.vii.1986; 3km ENE of Mt Tozer, near Iron Range National Park, 12.44S 143.14E, at light, 5♂♂, 6♀♀, 28.vi.-4.vii.1986; 2km NNE of Mt Tozer, Iron Range National Park, 12.44S 143.13E, at light, 1♀, 3.vii. 1986. QMBA: West Claudie R., Iron Range, flight trap, rainforest, 2♂♂, 3♀♀, 3-10.xii.1985, G. Monteith and D. Cook.

Description

Male. Interocular space greater than distance between antennal sockets (Fig. 30A). Pronotum subelliptical (Fig. 30B). Tegmina and wings reaching to end of abdomen or slightly beyond. Hind wing venation as in Figs 30D,F,H. Anteroventral margin of front femur Type B_2; pulvilli apparently absent, arolia present. Supraanal plate with medial specialisation, hind margin convexly rounded (Fig. 30C). Subgenital plate weakly asymmetrical, interstylar margin practically straight (Fig. 31A). Genitalia as in Fig. 31A; L1 with long, slender, curved filament.

Colouration. Head with labrum and clypeal region pale yellow, remainder dark brown (sometimes not uniformly so) (Fig. 30A). Pronotal disk yellowish without markings, surrounding region hyaline (Fig. 30B). Tegmina with pair of dark brown to blackish maculae that are completely separated by transverse pale band posterior to anal field, marginal field also pale or hyaline; size of maculae, especially distal one may vary (Figs 30E,G,I; see variant noted below). Hind wing with appendicular field and costal vein area infuscated, remaining areas less so (Figs 30D,F,H). Abdominal terga brownish yellow, lightly infuscated, glandular setae on T10 golden, surrounding area very pale (Fig. 30C). Abdominal sterna, legs, and cerci, pale brownish yellow.

Female. Supraanal plate with hind margin convexly rounded. Colour essentially as in male except base and lateral parts of valves near apex of subgenital plate reddish brown or dark brown.

Measurements (♀ in parentheses). Length, 3.9- 4.7 (3.8-5.0); pronotum length x width, 1.1-1.2 x 1.5-1.7 (1.0- 1.4 x 1.6-1.8); tegmen length, 3.1-4.5 (3.5-4.5).

Variant

This variant generally is larger than typical material and the tegminal maculae are joined on their anterior margins along the marginal field (Fig. 30K). Female subgenital plate dark brown laterally on each side of valves. Male genitalia similar to typical material. Most records near Kuranda.

Measurements (♀ in parentheses). Length, 4.5-5.1 (4.5-5.6); pronotum length x width, 1.3-1.5 x 1.7-1.8 (1.3-1.5 x 1.8-1.9); tegmen length, 4.2-5.1 (4.6-5.2).

MATERIAL EXAMINED

QUEENSLAND. ANIC: Kuranda State Forest, 3km north of Kuranda, 360m, flight intercept trap, rainforest, 2♀♀, 25.vi.-3.viii.1982, S. and J. Peck; Black Mt. Road, 30km north of Kuranda, leafmould, rainforest, 1♀, 4.xi.1969, J.G. Brooks; Moses Creek, 4km north by east of Mt Finnigan, 1♀, 14-16.x.1960, T. Weir. The following were collected by Norris and Common: 3 miles north of Kuranda, 3♂♂, 1♀, 24.iv.1955; 1 mile east of Kuranda, 1♂ (terminalia slide 186), 2♂♂, 2♀♀, 4.v.1955. The following were collected by I.F.B. Common and M.S. Upton: 1 mile east of Kuranda, 1♀, 22.iii.1964, 1♂, 4♀♀, 19.vi.1964; 1 mile north of Kuranda, 1200ft, 3♀♀, 23.iv.1969

REMARKS

Anaplecta calosoma has banded tegmina which are not characteristic of most other species of the group. *Anaplecta vittata* Hanitsch also has banded tegmina and because of this similarity, Bruijning (1947, p.216) suggested that *vittata* may be a synonym of *calosoma*. Although *vittata* superficially resembles *calosoma*, their male genitalia are distinctly different. Although I have not seen the type of *calosoma*, the specimens from both Papua New Guinea and Australia are similar and agree well with Shelford's description.

Many specimens of *calosoma* in the series from the vicinity of Mt Tozer were collected at mercury vapour light at night. A galerucine chrysomelid beetle *Monolepta* sp. (nr *australis*) was collected with the cockroaches. The colour and pattern of cockroach and beetle are so remarkably similar that a mimicry association is indicated (Rentz, personal communication).

Anaplecta vittata Hanitsch
(Figs 31B-D)

Anaplecta vittata Hanitsch, 1923, p.396, fig. 1 (♂ not ♀ as indicated); 1929a, p.5; Hebard, 1929, p.8; Bruijning, 1947, p.217, fig. 2; 1948, p.51.

MATERIAL EXAMINED

HOLOTYPE: ♂ (not ♀ as indicated), Singapore, Thomson Rd, Impounding Reservoir, xii.1922, C.J. Saunders; Type Orth. 256 $^1/2$ in HDEO.

PARATYPE. SINGAPORE. HDEO: same data as holotype, ♂ (not ♀ as indicated; terminalia slide 223), Type Orth. 256 $^2/2$.

DESCRIPTION

Male. Interocular space slightly greater than distance between antennal sockets. Pronotum subparabolic, hind margin weakly produced. Tegmina and wings reach end of abdomen; hind wing venation as in Fig. 31C. Supraanal plate with medial setal specialisation, hind margin convexly rounded. Subgenital plate practically symmetrical, styles small, widely separated, interstylar margin symmetrically convex (Fig. 31D). Genitalia as in Fig. 31D; phallomere L1 with a long, curved filament.

Colouration. Head orange. Pronotal disk orangish, surrounding region hyaline. Tegmina black with broad transverse whitish band across about middle, marginal field pale or hyaline (Fig. 31B). Hind wing infuscated as in Fig. 31C. Abdominal sterna straw coloured.

Measurements. Length, 5.0; pronotum length x width, 1.3 x 1.7-1.8; tegmen length, 4.1-4.2

REMARKS

Bruijning (1947, p.216) pointed out the discrepancies between Hanitsch's drawing (1923, fig. 1) of the hind wing of *vittata* and that of the wing of another specimen (cp. Bruijning, 1947, fig. 2b) which Hanitsch had identified as *vittata*. My drawing (Fig. 31C) of the hind wing of the paratype of *vittata* (which Hanitsch used for his drawing) agrees with Fig. 2b of Bruijning and shows that Hanitsch erred in his original drawing.

The male genitalia of *vittata* and *calosoma* are clearly different but both have a long curved filament-like sclerite (L1) indicating that both taxa are closely related (cp. Figs 31A and 31D).

Anaplecta vittata was originally described from Singapore but Hanitsch (1929a, p.5) also recorded it from Sumatra (Medan, Tjinta Radja, and Arnhemia), West Malaysia (Kuala Lumpur, and Batang Padang, Perak). Bruijning (1948, p.51) had specimens from Bintang (West Malaysia), Rhio Archipelago (Indonesia), and Medan.

Anaplecta australiensis n.sp.
(Figs 32A-F, 34)

MATERIAL EXAMINED

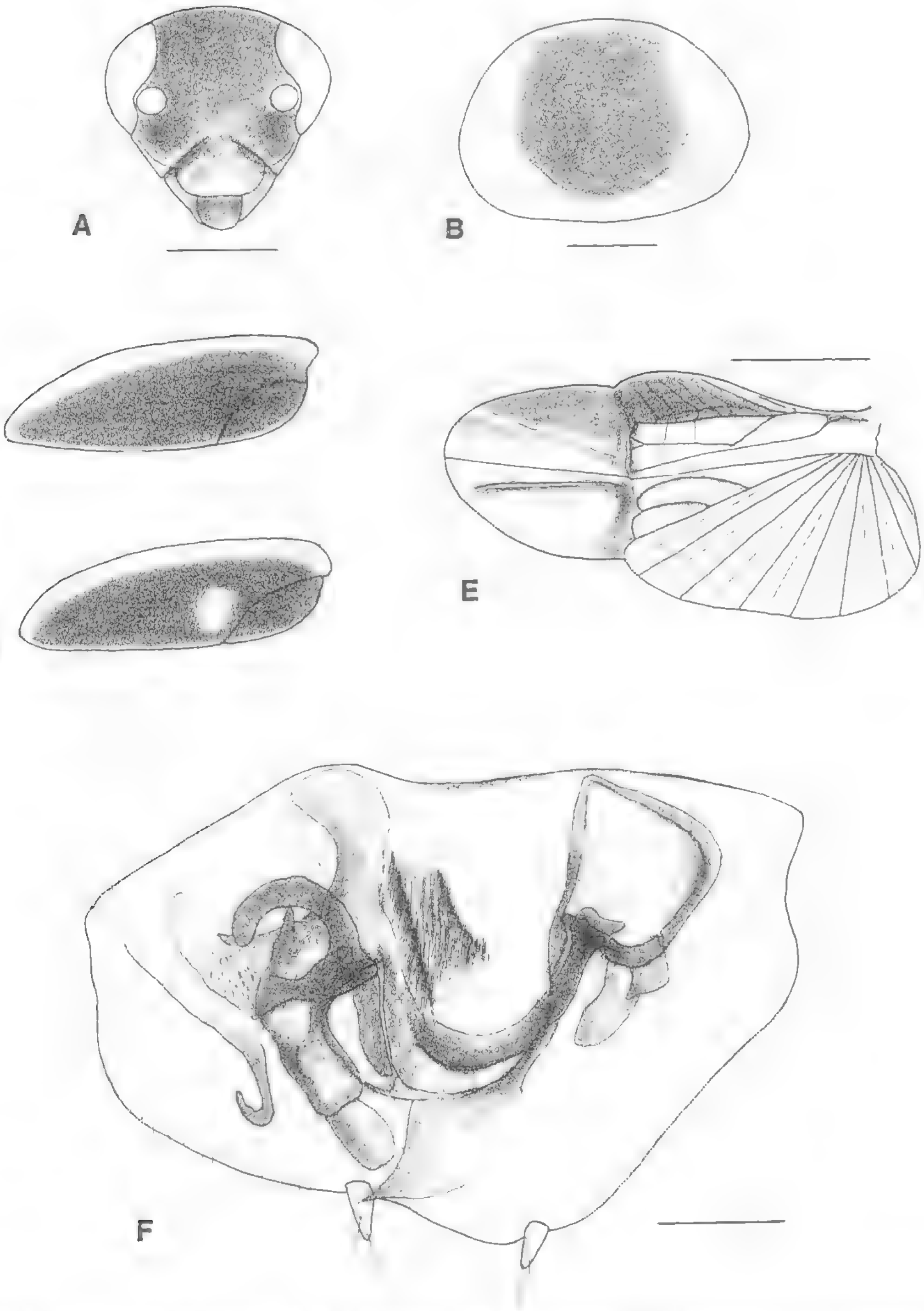

FIG. 32. *Anaplecta australiensis* n.sp. A,B, ♂ holotype, head and pronotum; C, ♀ paratype from 11km ENE of Mt Tozer, left tegmen (veins not shown); D-F, ♂ paratype from same locality as holotype, left tegmen (veins not shown), hind wing, and subgenital plate and genitalia (dorsal). Scales (mm): A,B, 0.5; C-E, 2.0; F, 0.25.

Holotype: ♂, 9km ENE of Mt Tozer, Queensland, 12.43S 143.17E, Malaise trap/ethanol, 5-10.vii.1986, J.C. Cardale; in ANIC (Reg. No. 8251).

Paratypes: Queensland. ANIC: same locality and data as holotype, 1♀, 2♀♀, (Malaise trap), D.H. Colless, 1♂ (terminalia slide 189), 3♀♀, T. Weir and A. Calder; 11km ENE of Mt Tozer, 12.43S 143.18E, 1♀ (Malaise trap/ethanol), 1 (abdomen missing; ex pantrap), 11-16.vii.1986, J.C. Cardale; 11km ENE of Mt Tozer near Iron Range National Park, 12.43S 143.18E, rainforest margin, 1♀, 11.vii.1986, D.C.F. Rentz; Cape Tribulation area, 16.03-16.05S 145.28E, littoral rainforest, 1♂, 1♀, 21-28.iii.1984, A. Calder and T. Weir.

Northern Territory. ANIC: Holmes Jungle (nr Darwin), 12.23S 130.57E, rainforest, 1♂, 6.xi.1972, R.W. Taylor.

Description

Male. Interocular space about same as distance between antennal sockets (Fig. 32A). Pronotum subelliptical (Fig. 32B). Tegmina and wings reaching slightly beyond end of abdomen. Hind wing as in Fig. 32E. Anteroventral margin of front femur with 3 large proximal spines, followed by row of piliform spinules terminating in 2 large spines (Type B$_2$); pulvilli absent, arolia small. Supraanal plate with medial setal specialisation, hind margin convexly rounded. Subgenital plate weakly asymmetrical, styles small, interstylar margin convexly skewed to left (Fig. 32F). Genitalia as in Fig. 32F; L1 without long, curved filament.

Colouration. Head brown, clypeal region brownish yellow (Fig. 32A). Pronotal disk brown, the colour extending to the anterior and posterior borders, lateral regions whitish or hyaline (Fig. 32B). Tegmina dark reddish brown, marginal field hyaline (Fig. 32C), costal veins whitish, sometimes with pale macula behind anal vein (Fig. 32D). Hind wing infuscated, darkest regions in costal vein area and anterior part of the appendicular field (Fig. 32E). Abdominal terga light brown with some darker infuscation, tergal gland region of supraanal plate pale, area behind it dark brown. Abdominal sterna brown, legs and cerci (dorsally) lighter, straw coloured.

Female. Interocular space less than distance between antennal sockets. Supraanal plate trigonal, apex rounded. Abdominal terga dark brown, anterior segments lighter. Abdominal sterna brown, subgenital plate with valves and lateral regions darker.

Measurements (♀ in parentheses). Length, 4.0-5.3 (4.1-5.5); pronotum length x width, 1.2-1.3 x 1.4-1.8 (1.2-1.4 x 1.5-1.9); tegmen length, 3.7-4.5 (3.5-4.5)

Remarks

The genital phallomere L1 of *australiensis* lacks a curved filamentous sclerite suggesting that it does not belong to the same species group as *calosoma* and *vittata*. Its close relatives may be determined by a study of the male genitalia of other species in the genus.

Anaplecta brachyptera n.sp.

(Figs 33A-C,34)

Material Examined

Holotype: ♂, Hinchinbrook Is., NEQ, Gayundah Ck, 10m, pitfalls, 8-18.xi.1984, Monteith, Thompson and Cook; in QMBA (Reg. No. T11190).

Paratypes. Queensland, QMBA: same locality as holotype, 18.22S 146.13E, rainforest, sieved litter, 10m, 5♂♂, 1♀, 10.xi.1984, 1♂ (terminalia slide 69), 1♀, 9.xi.1984, 1♂, 11.xi.1984, Thompson and Gallon.

Description

Male (habitus in Fig. 33A). Eyes somewhat reduced, interocular space distinctly greater than distance between antennal sockets (Fig. 33B). Clypeus swollen (Fig. 33B). Pronotum subparabolic. Tegmina reduced in length reaching only to about T3, apically rounded. Hind wings vestigial, lateral, reaching only to T1. Anteroventral margin of front femur with 1 or 2 proximal spines followed by row of piliform spinules with 2 large terminal spines (Type B$_2$); pulvilli absent, arolia small, tarsal claws symmetrical, simple. Supraanal plate (T10) with large setal specialisation located on mound arising from depressed region of transverse segment, hind margin weakly convex (Fig. 33A). Subgenital plate weakly asymmetrical, styles small, similar, interstylar margin weakly uneven, essentially not produced (Fig. 33C). Genitalia as in Fig. 33C; genital phallomere L1 with long, curved filament.

Colouration. Clypeus, labrum and mandibles yellowish, rest of head (Fig. 33B), pronotum, tegmina, and abdominal terga brown; glandular area on T10, cerci dorsally, abdominal sterna, and legs, lighter brown. Costal vein of tegmina and lateral edge of pronotum pale.

Female. Supraanal plate weakly trigonal, apex rounded. Subgenital plate valvular. Abdomen somewhat darker than male.

Measurements (♀ in parentheses). Length,

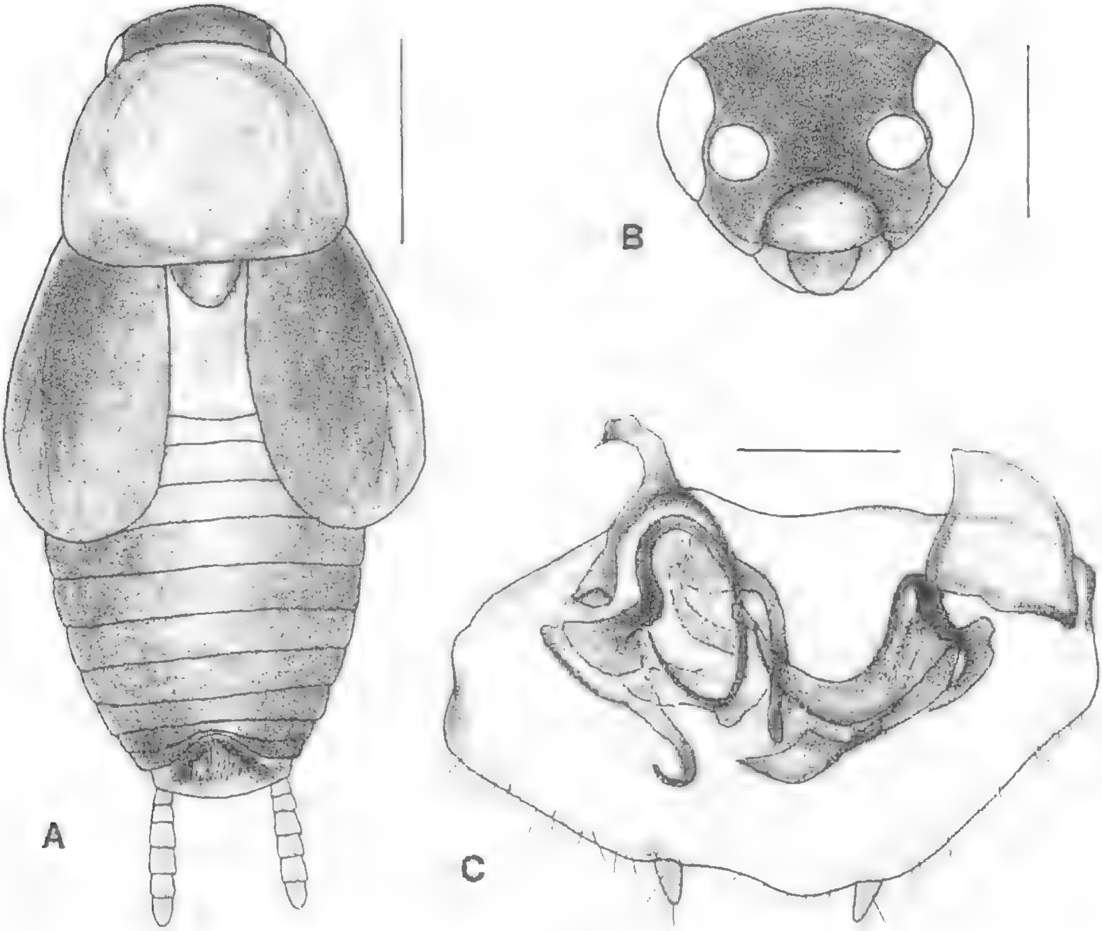

FIG. 33 *Anaplecta brachyptera* n.sp. A,B, ♂ holotype, habitus and head; C, ♂ paratype from same locality as holotype, subgenital plate and genitalia (dorsal). Scales (mm): A, 1.0; B, 0.5; C, 0.25.

3.2-3.7 (3.6-3.7); pronotum length x width, 1.0-1.1 x 1.3-1.5 (1.1- 1.2 x 1.5); tegmen length, 1.3-1.4 (1.3-1.5).

REMARKS

Anaplecta brachyptera apparently is the only member of the genus with reduced tegmina and vestigial wings. All other characters are typical of the genus. The male's right genital phallomere resembles that of *A. australiensis*, whereas the left one (L1) has a long curved filament reminiscent of those found in *calosoma* and *vittata*.

Parectoneura new genus

TYPE SPECIES

Parectoneura bivittata n.sp.

DIAGNOSIS

Sexes similar. Tegmina and wings fully developed. Tegmina with distinct venation, branches of median and cubitus veins longitudinal. Hind wing when at rest folded along plical area, with apical triangle rolled up and curled in tight spiral (Fig. 35A); discoidal vein straight, unbranched, median and cubitus veins curved, former simple, latter with a complete branch, incomplete rami absent, apical triangle large (Fig. 35B). Anteroventral margin of front femur with some large proximal spines followed by row of piliform spinules, terminating in 2 large spines (Type B_2); tarsal claws symmetrical, minutely toothed on ventral margins; ventral margins of mid and hind femurs with some large spines. ♂: Seventh abdominal tergum weakly

FIG. 34. Known distribution of Australian *Anaplecta* species in Queensland (Northern Territory record of *A. australiensis* not shown).

specialised (Fig. 35C). Subgenital plate subsymmetrical with a pair of minute, similar styles (Fig. 35D). Genital hook on left side, right phallomere reduced (Figs 35D,E).

REMARKS

Hebard (1943, p.12) placed *Ectoneura* in the Ectobiinae and the Australian species which previously had been referred to *Ectobius* in a group Ectoneurae. 'They agree with *Ectobius* in having the tegminal discoidal sectors oblique, the tarsal claws simple but asymmetrical, and the female subgenital plate simple. The general appearance of some of the species also suggests certain species of *Ectobius*. They differ widely from that genus and its allies, however, in having the ventral margins of the median and caudal femora unarmed, the ventrocephalic margins of the cephalic femora practically unarmed [there are fine hairs which are more slender than piliform spinules] with one or two large terminal spines, and the intercalated triangle of the wings (in all individuals having these organs fully developed) curled when at rest, instead of folded, with anal vein there diverging very strongly from the median fold'.

The new genus *Parectoneura* superficially resembles species of *Ectoneura*, especially those taxa that have a pair of pronotal bands which continue along the full length of the tegmina, e.g. *Ectoneura minima* (Tepper), *E. verticalis* Hebard, and *E. suffusa* Hebard. It agrees with *Ectoneura* in having the apical (= intercalated) triangle of the hind wing curled when at rest, and a gland on the male's seventh abdominal tergum. It differs in having Type B2 front femur, symmetrical, minutely toothed tarsal claws (vs. asymmetrical and untoothed) and some large spines on the ventral margins of the mid and hind femurs, which in *Ectoneura* are essentially unarmed. The *Parectoneura* male has a subsymmetrical subgenital plate with a pair of minute styles, whereas in *Ectoneura* the subgenital plate is distinctly asymmetrical and there is only one minute style. Hind wings in which the apical triangle is curled into a tight spiral when at rest are found in some other genera, e.g., *Oulopteryx* Hebard and *Dasyblatta* Hebard, both from South America (Hebard, 1921b; Rehn, 1951), *Areolaria* Brunner from the Malay Archipelago (Hebard, 1929, p.102), and *Pseudectoneura* Princis (New Caledonia), and *Theganopteryx* Brunner (Africa).

Parectoneura bivittata n.sp.
(Figs 35A-F)

MATERIAL EXAMINED

HOLOTYPE, ♂, Tindal, Northern Territory, Australia, 14.31S 132.22E, 1-20.xi.1967, light trap, W.J.M. Vestjens; in ANIC.

PARATYPES: NORTHERN TERRITORY. ANIC: Tindal, 8 miles ESE of Katherine, 14.31S 132.22E, at light, 2♀♀, 30.xi.1967, 2♂♂, 6.xii.1967, 1♂ (terminalia slide 192), 7.xii.1967, 1♀, 8.xii.1967, 1♀, 9.xii.1967, 1♀, 13.xii.1967, 2♂♂, 14.xii.1967, 1♀, 16.xii.1967, 1♀, 18.xii.1967, 1♀,1 (abdomen missing); 19.xii.1967, 1♂ (terminalia slide 191), 20.xii.1967, W.J.M. Vestjens; Goose Lagoon, 11km SW by S of Borroloola, 1♀, 18.vi.1976, Key, Balderson, et al. [Key's field trip notes; trip 191, Stop 3614.8]; Daly River Miss., at light, 3♀♀, 8.x.1974, J.F. Hutchinson. WESTERN AUSTRALIA. ANIC: 10km NW by N of mining Camp, Mitchell Plateau, Kimberley Distr., 1♂, 11.v.1983, D.C.F. Rentz & J. Balderson, Stop 15.

DESCRIPTION

Male. Head hidden under pronotum. Interocular space less than distance between ocellar spots and antennal sockets. Pronotum suboval (Fig. 35A). Tegmina and wings extending well beyond end of abdomen. Tegmina with median and cubitus veins with longitudinal branches (Fig. 35A). Hind wing folded along plical area, intercalated triangle large, rolled up, tubuliform when at rest (Fig. 35A); median and cubitus veins curved, the latter with 1 complete and 0 incomplete branches (Fig. 35B). Front femur Type B_2 (with 3 large proximal spines); pulvilli appear to be present on the fourth tarsomeres only, tarsal claws simple, symmetrical, arolia well developed. Seventh abdominal tergum with distinct medial depression containing some groups of short setae (Fig. 35C). Supraanal plate with hind margin convexly rounded, entire, not reaching hind margin of subgenital plate. Subgenital plate almost symmetrical with 2 minute, similar, widely spaced styles on rounded apex (Fig. 35D). Genitalia as in Figs 35D-F; genital hook on the left side, its apical portion expanded, with preapical incision, basal arm uniformly slender, median phallomere relatively stout, distal region tapering, apex acute or subacute, right phallomere reduced to small cleft sclerite bearing small group of setae.

Colouration. Head brown. Pronotum with pair of dark brown longitudinal bands, these continuing length of tegmina (Fig. 35A). Abdominal terga and sterna pale with lateral infuscation. Legs and cerci pale. Intensity of brown on head, pronotum, and tegmina varies and some specimens approach blackish brown.

Female. Supraanal plate trigonal, apex of hind margin medially indented, reaching upturned margin of subgenital plate.

Measurements (♀ in parentheses). Length, 5.2- 6.0 (4.9-6.2); pronotum length x width, 1.5 x 1.9-2.0 (1.5-1.7 x 1.9-2.3); tegmen length, 4.9-5.6 (4.6-6.0).

Pseudectoneura Princis

Pseudectoneura Princis, 1974, p.517.

TYPE SPECIES

Pseudectoneura kaltenbachi Princis, by monotypy.

DIAGNOSIS (based on ♂)

Tegmina and wings fully developed, former with unbranched discoidal vein, median and cubitus veins and their branches longitudinal. Hind wing with discoidal vein branched distally, median and cubitus vein practically straight, former simple, latter with complete and no incomplete branches, apical triangle developed, rolled spirally when at rest (Fig. 36D). Front femur Type B_3; pulvilli present on 4 proximal tarsomeres of all tarsi, tarsal claws symmetrical with subobsolete serrations on ventral margins, arolia present; ventral margins of mid and hind femurs with large spines. Seventh abdominal tergum strongly modified with deep fossa and large dense tuft of setae (Fig. 36E). Subgenital plate strongly asymmetrical with single style on left side, right style absent (Fig. 36G). Hooklike genital phallomere on left side (Fig. 36G).

REMARKS

Pseudectoneura differs from *Parectoneura* as follows: hind wing with discoidal vein branched, median and cubitus veins practically straight, gland on T7 much more complex, subgenital plate strongly asymmetrical, and right style absent.

Pseudectoneura kaltenbachi Princis
(Figs 36A-G)

Pseudectoneura kaltenbachi Princis, 1974, p.518, fig. 4 (♂).

MATERIAL EXAMINED

HOLOTYPE: ♂, New Caledonia, Riv. Tiari, Niaouli-Wald, 17.xi.1965, Österreichische Neukaledonien-Expedition, 1965 (PNK 80/2); in NMWA.

PARATYPE: NEW CALEDONIA. NMWA, same data as holotype, 1♂ (terminalia slide 55).

DESCRIPTION

Male. Interocular space distinctly less than distance between ocellar spots (Fig. 36A); palpal segments 3 and 5 each longer than fourth. Pronotum subelliptical, widest point behind the middle (Fig. 36B). Tegmina and wings fully developed, extending beyond end of abdomen. Tegmina with median and cubitus veins and their branches longitudinal. Hind wing with costal veins weakly thickened, discoidal vein branched beyond middle; median and cubitus veins practically straight, former simple, latter with 1 complete and 0 incomplete branches, apical triangle developed, spirally rolled when at rest (Fig. 36D). Front femur Type B_3 (with 4 large proximal spines, followed by a short row of only 5 piliform spinules); large spines on mid and hind femurs; pulvilli present on 4 proximal tarsomeres of all tarsi (Princis incorrectly claimed that the hind tarsus has a pulvillus only on the fourth segment); tarsal claws symmetrical their ventral margins with subobsolete serrations, arolia present. First abdominal tergum un-

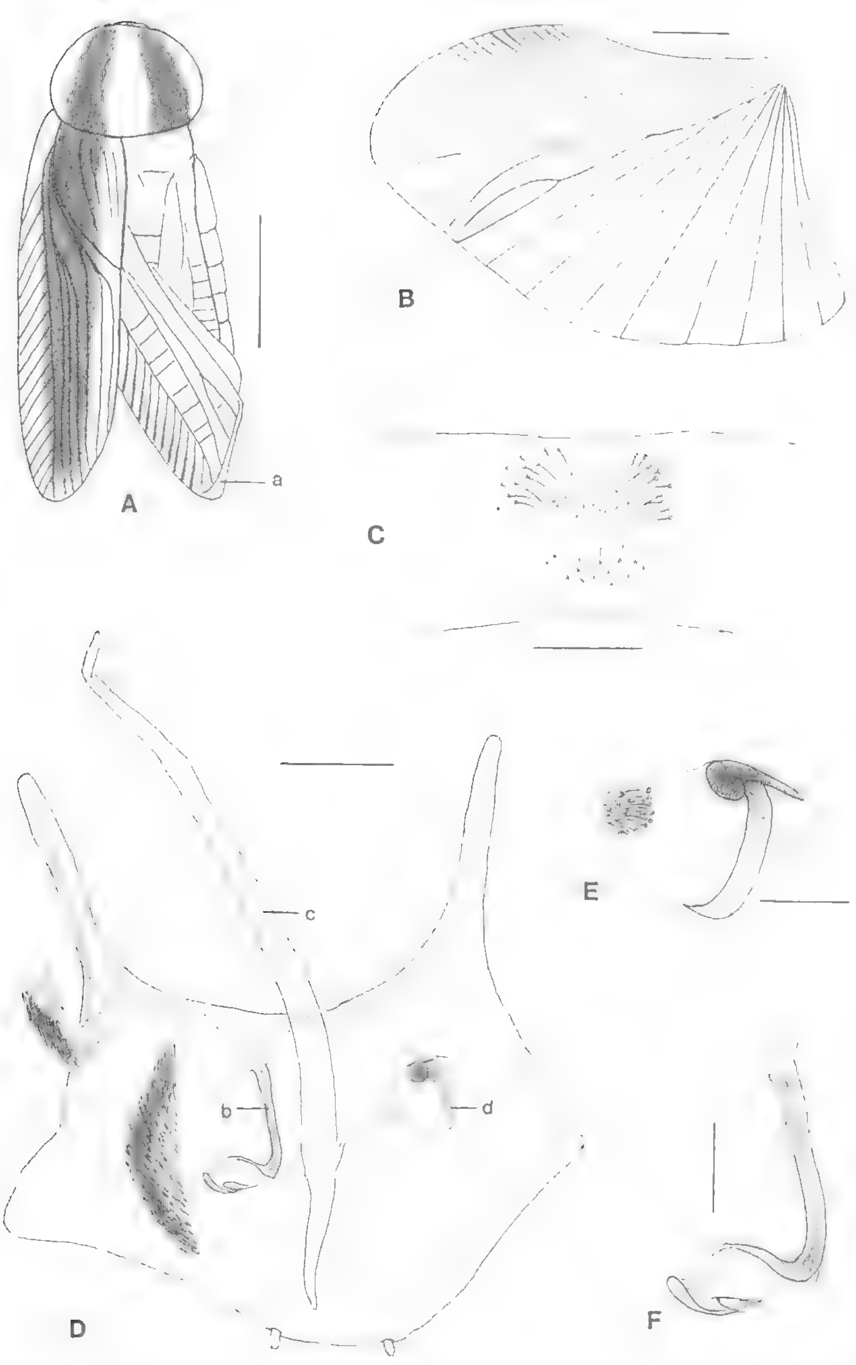

FIG. 35. *Parectoneura bivittata* n.sp., paratypes from Northern Territory. A, ♀ from Daly River Miss., habitus (right tegmen removed to show the underlying folded hind wing; a = rolled up apical triangle of left wing); B, ♀ from Goose Lagoon, hind wing; C-F, ♂ from Tindal, 8 miles ESE of Katherine: C, Tergal gland area on T7; D, Subgenital plate and genitalia (dorsal; b = left phallomere; c = median phallomere; d = right phallomere); E, right genital phallomere; F, left hooklike phallomere. Scales (mm): A, 2.0; B, 1.0; C,D, 0.25; E,F, 0.1.

specialised. Seventh abdominal tergum with a large gland anteromedially consisting of a deep fossa and a dense group of setae (Fig. 36E). Supraanal plate with hind margin concavely excavated, not reaching hind margin of subgenital plate; right and left paraprocts large dissimilar plates (Figs 36F). Subgenital plate convex, strongly asymmetrical, the left side excavated in which is located a cylindrical left style, right style absent; right half of subgenital plate produced as large lobe whose rounded hind margin is divided and forms a spinelike process which Princis claimed is the right style. However this structure is not articulated and apparently is a modification of the hind margin but not the right style, which is absent (Figs 36C,E,G). Genitalia as in Fig. 36G; hooklike phallomere on left side; apex of median phallomere with a brushlike group of dark setae, right phallomere reduced to cleftlike remnant.

Colouration. Head with vertex dark reddish brown, occiput lighter, interocellar area whitish, face yellowish brown with whitish areas laterally, labrum brownish (Fig. 36A). Pronotum with disk yellowish brown and brown parentheses-like markings on anterior half, lateral borders hyaline (Fig. 36B). Tegmina pale, hyaline, humeral vein may be darkened. Hind wing with yellowish tinge along anterior border and behind apical triangle, grayish on posterior region of apical triangle and along edges of posterior field (Fig. 36D). Proximal abdominal terga light yellowish brown with some infuscation, distal segments dark brown, glandular region of T7 pale yellowish, glandular setae dark, supraanal plate pale, laterally dark. Abdominal sterna light brown, laterally dark brown.

Female. Unknown.

Measurements: Length, 12.3-12.5; pronotum length x width, 2.6 x 3.7-3.8; tegmen length, 11.7-11.8.

Pseudectobia Saussure

Pseudectobia Saussure, 1869, p.234; Princis, 1951, p.65.

TYPE SPECIES

Pseudectobia luneli (Saussure) = *Blatta luneli* Saussure, by selection, Kirby, 1904, p.65.

DIAGNOSIS (based on ♂ and modified from Princis, 1951).

Tegmina and wings fully developed. Tegmen with discoidal sectors longitudinal. Hind wing with cubitus vein straight and with complete and no incomplete branches, apical triangle poorly developed and not rolled spirally. Front femur Type B_2; ventral margins of mid and hind femurs sparsely armed. Seventh abdominal tergum with deep fossa that occupies most of the segment. Subgenital plate symmetrical with pair of similar styles. Hooklike genital phallomere on right side (Fig. 37E).

REMARKS

This genus differs strongly from *Parectoneura* and *Pseudectoneura* in hind wing structure and in having the male hooklike genital phallomere on the right rather than the left side.

Pseudectobia luneli (Saussure)
(Figs 37A-E)

Blatta luneli Saussure, 1868, p.355 (♂); Walker, 1871, p.20.

Ectobia (*Pseudectobia*) *luneli* (Saussure), 1869, p.235.

Ectobia luneli (Saussure): Walker, 1871, p.15.

Phyllodromia luneli (Saussure): Shelford, 1908, p.12.

Pseudectobia luneli (Saussure): Kirby, 1904, p.65; Princis, 1951, p.65., pl.6, fig. 65 (♂); 1969, p.996.

MATERIAL EXAMINED

HOLOTYPE: ♂ (terminalia slide no. 1), Neelgheries, Indes [= Nilgiri, India], coll. Guérin; in MNHG. [The specimen is in very poor condition; it is greasy, the tegmina and wings are badly damaged as are most of the legs - all tarsal claws are missing; Shelford (1911:156) examined the type and described it as 'very shattered'. It obviously hasn't improved with age].

DESCRIPTION

Male. Eyes very close together, almost contiguous (Fig. 37B). Pronotum suboval (Fig. 37A). According to Princis (1951, p.65) the tegmina and wings are fully developed reaching beyond end of abdomen. Median vein of tegmen separated from discoidal vein and supplied with 1 branch, discoidal sectors longitudinal; costal veins of hind wing very weakly thickened distad. The remains of the wing shows that the cubitus is straight and has at least 3 complete and 0 incomplete branches; the apical region is missing but Shelford (1911, p.156) stated that there is 'a small and ill-defined apical triangle'. According to Saussure (1869), the reflexed field of the hind wing is crumpled in repose (therefore not tubuliform as in *Pseudectoneura*). Front femur

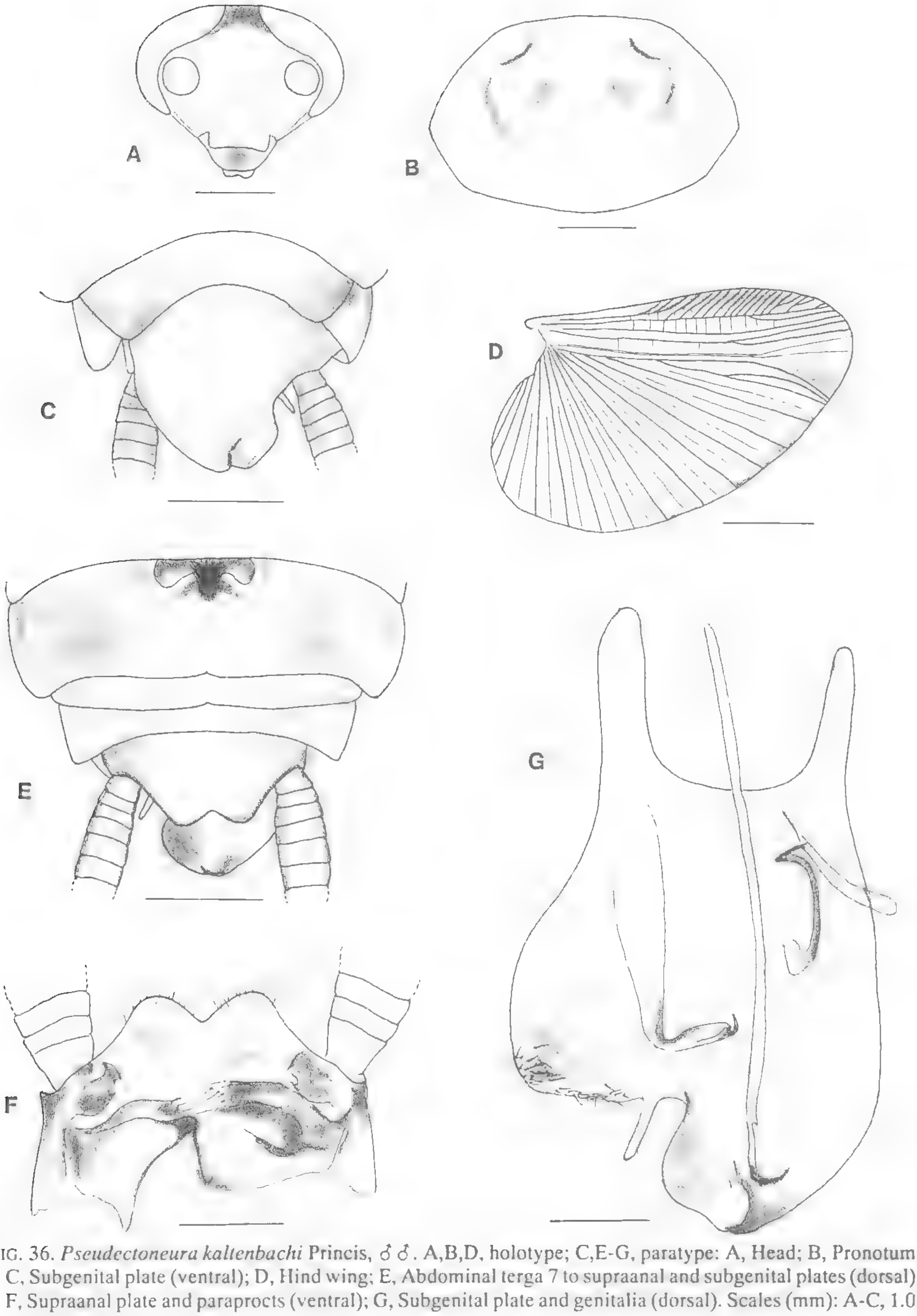

FIG. 36. *Pseudectoneura kaltenbachi* Princis, ♂♂. A,B,D, holotype; C,E-G, paratype: A, Head; B, Pronotum; C, Subgenital plate (ventral); D, Hind wing; E, Abdominal terga 7 to supraanal and subgenital plates (dorsal); F, Supraanal plate and paraprocts (ventral); G, Subgenital plate and genitalia (dorsal). Scales (mm): A-C, 1.0; D, 3.0; E, 1.0; F,G, 0.5.

Type B_2 (4 large proximal spines two of which are broken off, as is one of the terminal spines); tarsi damaged, none with claws. Seventh abdominal tergum (dried pinned specimen) with huge deep elliptical pit that occupies practically entire segment, posterior wall with minute setae (Fig. 37D); in KOH cleared specimen pit is seen to be pair of large depressions separated by longitudinal wall. Supraanal plate transverse, hind margin practically truncate, not reaching hind margin of subgenital plate (Fig. 37D); right and left paraprocts similar plates. Subgenital plate symmetrical, lateral margins of distal region indented, bearing pair of similar cylindrical styles, interstylar margin produced and in pinned specimen appears to be a single projection (Fig. 37C), but when cleared in KOH consists of 2 small lobes (Fig. 37E). Genitalia as in Fig. 37E: hook on right side, apex truncate, without subapical incision or spine; median phallomere rodlike, tapering, apically acute; a pair of curved sclerites between median and right phallomeres.

Colouration. The colour is difficult to determine because the specimen is greasy. Head with occiput black, face yellowish with black markings (Fig. 37B). Pronotum with broad, triangular black macula, lateral borders pale (Fig. 37A). Abdomen mostly light brown.

Female. Unknown.

Measurements. Length, 7.6; pronotum length x width, 2.0 x 2.9; tegmen length, 7.

REMARKS

Princis (1969, p.996) listed 2 species of *Pseudectobia*, namely the type species *luneli*, and *insularis* (Saussure) which I find belongs in *Chorisoblatta*, and describe below.

Chorisoblatta insularis (Saussure)
n.comb. (Figs 38A-G)

Ectobia (*Pseudectobia*) *insularis* Saussure, 1869, p.236 (♂).

Ectobia insularis Saussure: Walker, 1871, p.15.

Theganopteryx insularis (Saussure and Zehntner), 1895, p.14.

Lupparia insularis (Saussure): Shelford, 1908, p.16.

Pseudectobia insularis (Saussure): Kirby, 1904, p.65; Orian, 1957, p.517; Princis, 1969, p.996.

MATERIAL EXAMINED

HOLOTYPE: ♂ (terminalia slide no. 2), Ile de France [= Mauritius], Afrique, M.H. de Saussure; in MNHG.

DESCRIPTION

Male. Interocular space less than distance between antennal sockets (Fig. 38C). Pronotum subelliptical (Fig. 38B). Tegmina and wings fully developed extending beyond end of abdomen. Hind wings with costal veins weakly thickened distad, discoidal and median veins unbranched, cubitus vein straight with 3 branches that reach only to the vein demarcating the large apical triangle (Fig. 38A). Front femur Type B_2 (with 3 large proximal spines); pulvilli present on 4 proximal tarsomeres, tarsal claws symmetrical, ventral margins bearing a few large teeth, arolia well developed (Fig. 38F). Abdominal terga unspecialised. Supraanal plate subtrapezoidal, corners rounded, hind margin not reaching hind margin of subgenital plate (Fig. 38D). Subgenital plate extending well beyond supraanal plate, styles similar, widely separated, each located in posterolateral corners, interstylar margin convex, deflexed (Figs 38D,E); in dorsal view interstylar margin appears truncate because deflexed portion is not visible from above (Fig. 38D). Genitalia as in Fig: 38G: genital hook on right side, apex with minute spine; to right of hook an additional divided sclerite, its most posterior portion bearing dark setae; median sclerite long, slender, apically acute.

Colouration. Head with vertex and occiput brown; two narrow, black transverse bands, one between eyes, other between upper part of antennal sockets (Fig. 38C), remainder of face largely hyaline. Pronotum yellowish, disk with brown dots and lines, outer border regions partly hyaline (Fig. 38B). Tegmina with some yellowish and mostly reddish rectangular and dotlike spots between veins. Hind wing infuscated, anterior margin at distal ends of costal veins, white; anterior field and region posterior to apical triangle darker than rest of posterior field and apical triangle (Fig. 38A); one wing that has been mounted on a card was completely bleached and was not infuscated; the wing that was still attached to the specimen (and which I mounted on a card) had the infuscation described by Saussure. Legs light brown, femur with dark brown stripe on dorsal margin, foreleg tarsomeres with narrow brown apical rings. Abdominal terga brown, darker infuscation laterally and on terminal segments. Abdominal sterna brown with broad, somewhat darker mediolongitudinal, stripe.

Female. Unknown.

Measurements. Length, 9.8; pronotum length x width, 2.6 x 3.8; tegmen length, 11.4.

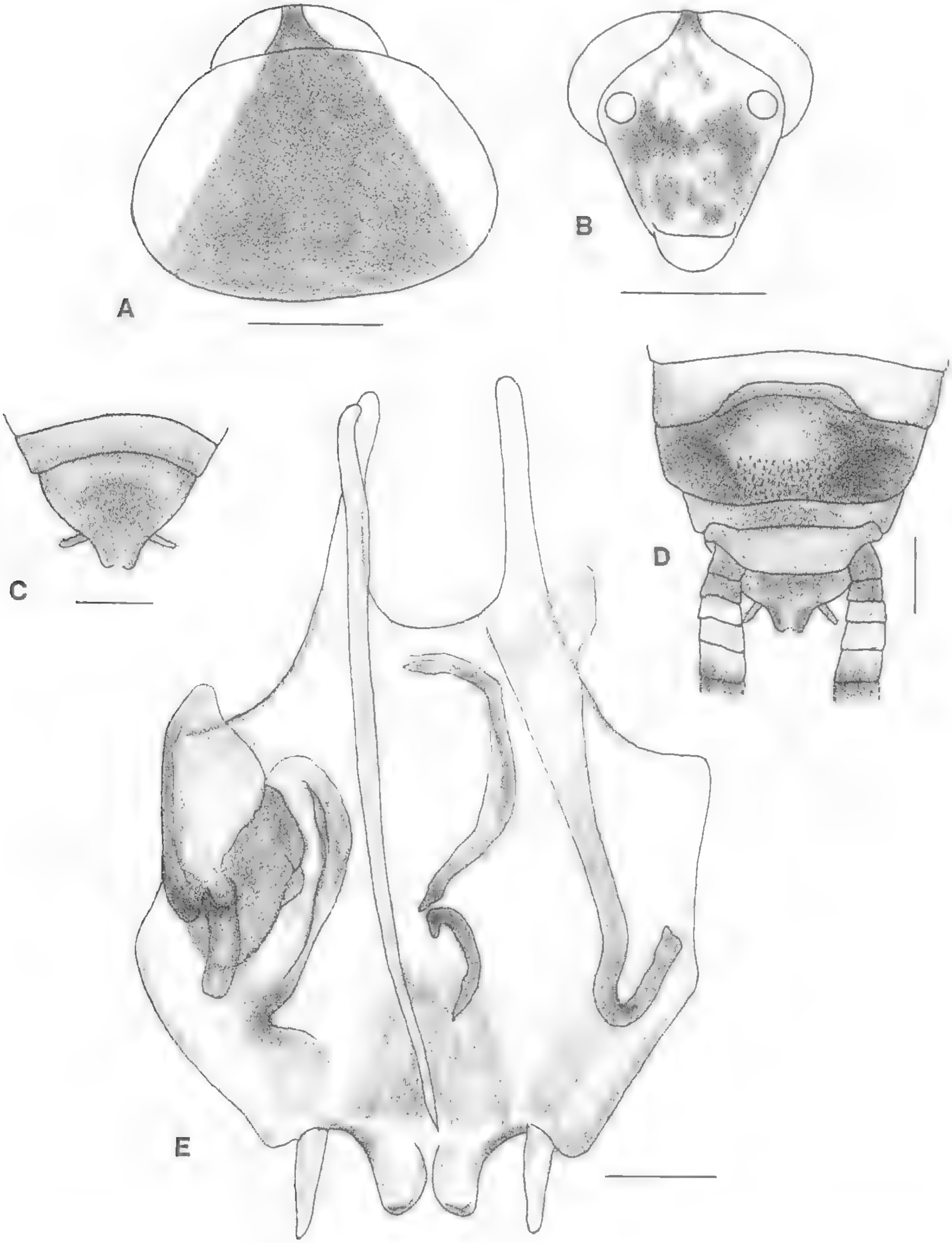

FIG. 37. *Pseudectobia luneli* (Saussure), ♂ holotype: A, Pronotum and head; B, Head; C, Subgenital plate (ventral); D, terminal abdominal segments (dorsal); E, Subgenital plate and genitalia (dorsal). Scales (mm): A,B, 1.0; C,D, 0.5; E, 0.25.

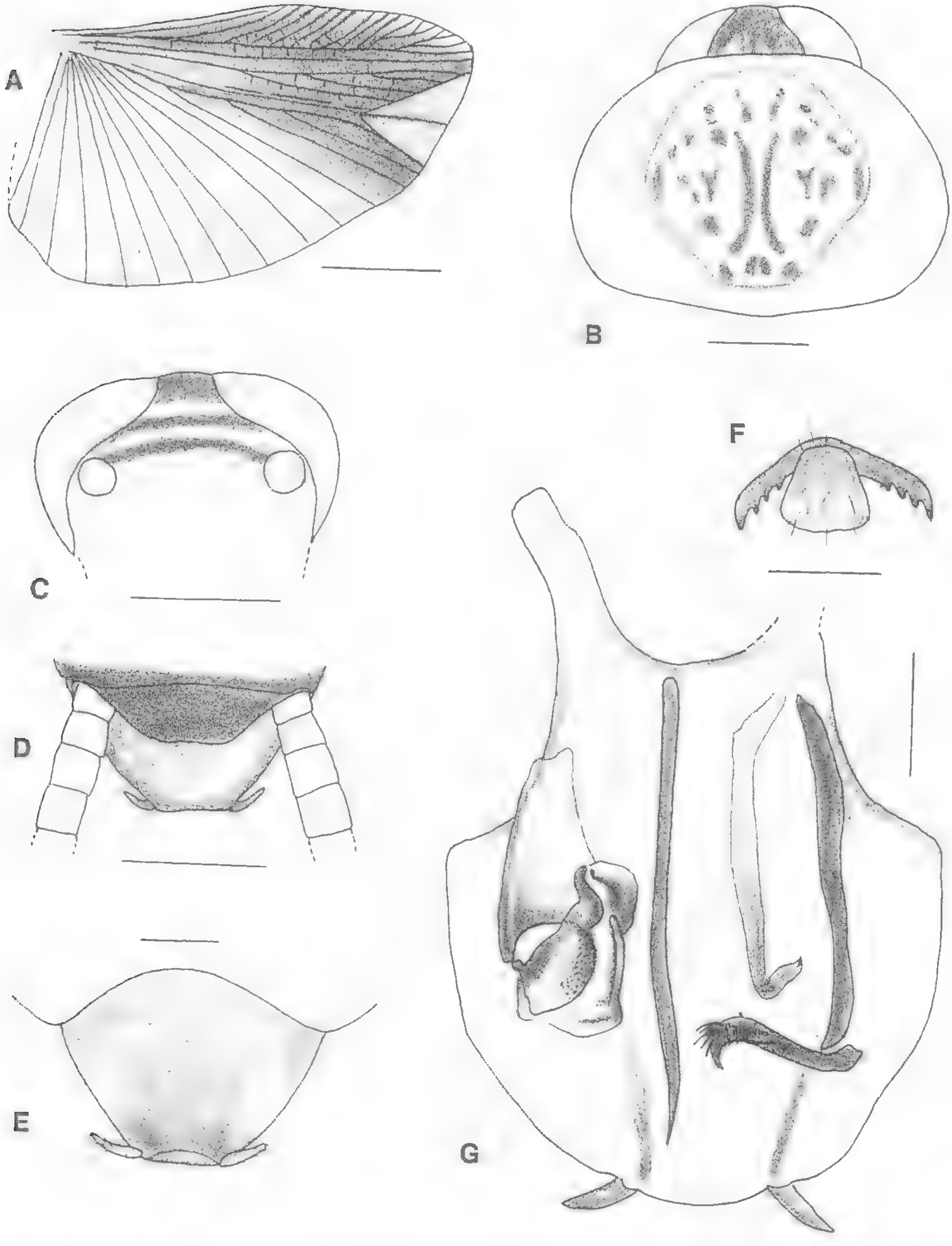

FIG. 38. *Chorisoblatta insularis* (Saussure), ♂ holotype of *Ectobia* (*Pseudectobia*) *insularis* Saussure: A, Hind wing; B, Pronotum; C, Upper portion of head; D, Terminal abdominal segments (dorsal); E, Subgenital plate (ventral); F, Tarsal claws and arolium of foreleg; G, Subgenital plate and genitalia (dorsal). Scales (mm): A, 3.0; B-D, 1.0; E, 0.5; F, 0.25; G, 0.5.

Remarks

Princis (1969, pp.925-927) listed 11 species of *Chorisoblatta* of which 7 (one with a query) are from Africa, 2 from Madagascar, and 2 are from Mauritius. Of the Mauritian species one is *C. liturifera* (Stål), the type species of the genus, and the other is *Chorisoblatta chopardi* Princis (Princis, 1969, p.926). *Chorisoblatta insularis* is the third species of the genus known from Mauritius.

SUBFAMILY PLACEMENT OF *PARECTONEURA*, *PSEUDECTONEURA*, *PSEUDECTOBIA* AND *CHORISOBLATTA*

According to McKittrick (1964), the Blattellinae and Ectobiinae (based on 2 species of *Ectobius*) males have the genital hook on the left side and their females rotate the ootheca 90° prior to depositing them. In McKittrick's Plectopterinae (= Pseudophyllodromiinae of Vickery and Kevan, 1983), the male's genital hook is on the right side and their females do not rotate the ootheca prior to deposition. However, Bohn (1987) found that the males of some Ectobiinae have the genital hook on the right side (rather than the left), yet their females rotate the ootheca. Bohn concluded that the position of the male's genital hook cannot always be used to place blattellids in their respective subfamilies and suggested that whether or not the female rotates her ootheca should be the criterion for placing a species in one or the other of these two subfamilies. I have recently found that the males of *Margattea nimbata* Shelford have the genital hook on the right side but the female rotates its ootheca and I place this species in the Blattellinae (Roth 1989). Unfortunately, whether or not the ootheca is rotated is not known for most genera and species, including the genera under discussion in this paper. However, until oviposition behaviour is determined one can place a species in the Blattellinae or Pseudophyllodromiinae provisionally, if the position of the male's genital hook is known; subfamily placement can be confirmed when the female's oviposition behaviour is determined.

With this in mind I am placing *Parectoneura* and *Pseudectoneura* in the Blattellinae and *Pseudectobia* and *Chorisoblatta* in the Pseudophyllodromiinae. Shelford (1911, p.156) believed that *Pseudectobia luneli* '... is more suitably placed in the Ectobiinae', but Princis placed it in the Blattellidae rather than the Ectobiidae. I agree with Princis because the male subgenital plate and styles, and genitalia of *luneli* are more typical of the Blattellidae than they are of the Ectobiidae (nae).

ACKNOWLEDGEMENTS

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CORRIGENDUM

RICHARD A.I. DREW. The tropical fruit flies (Diptera: Tephritidae: Dacinae) of the Australasian and Oceanian regions. *Memoirs of the Queensland Museum* **26**: 1-521.

Page 9. Line 9, paragraph 2, for '(9)' insert '(10)'.
Page 20. Line 8, paragraph 3, for 'cross-vein' insert 'crossvein'.
Page 31. for '**Bactrocera) trivialis**' insert '**Bactrocera (Bactrocera) trivialis**'.
Page 43. Line 7, paragraph 4, for 'extremitiies' insert 'extremities'.
Page 88. Under '**Bactrocera (Bactrocera) pallilda**', 'LOCATION OF TYPES', should read:
Lectotype ♂ (T. 5254) and paralectotype ♀ (T.5253) In QM;
Page 184. Last line of paragraph 1 should read:
(1 male, 1 female and the sex of 1 cannot be determined).
Page 294. The reference Smith *et al.* should read:
SMITH, E.S.C., CHIN, D., ALLWOOD, A.J. AND COLLINS, S., 1988. A revised host list of fruit flies (Diptera: Tephritidae) from the Northern Territory of Australia. *Qd J. agric. amin. Sci.* **45**: 19-28.
Page 295. FIG. 1. Caption, for 'A1' insert 'A_1'.
Page 521. Line 14, for '*trivalis*' insert '*trivialis*'.

TYPE, FIGURED AND MENTIONED FOSSIL INVERTEBRATES IN THE QUEENSLAND MUSEUM

A.C. ROZEFELDS, E.D. MCKENZIE AND C. MOBBS

Rozefelds, A.C., McKenzie, E.D. and Mobbs, C. 1990 08 31. Type, figured and mentioned fossil invertebrates in the Queensland Museum. *Memoirs of the Queensland Museum* 28(2): 665-713. Brisbane. ISSN 0079-8835.

A taxonomically arranged list of type, figured and mentioned fossil invertebrates held by the Queensland Museum is presented. Information for each specimen includes reference list, locality of collection, formation and age. Information on early collectors including de Vis, Hann, Daintree and Aplin is also included.□*Type list, figured, mentioned, fossil, invertebrate, Queensland Museum, Hann, Daintree, de Vis, Aplin.*

A.C. Rozefelds, E.D. McKenzie and C. Mobbs, Queensland Museum, PO Box 300, South Brisbane, Queensland 4101, Australia; 11 May, 1989.

This list is the third in a series that details the Queensland Museum's holdings of type, figured and mentioned fossils; two previous lists recorded the plants (Rozefelds, 1986) and fish, reptiles and amphibians (Lees, 1986). The format and coverage of our list follows the two earlier lists in that synonymies and references to specimens are listed exactly as cited by authors. The present list differs from the earlier catalogues in that specimens are listed alphabetically by their most recent generic allocations. For ease of reference, there is an index at the end of this paper that records all synonyms used for the specimens. For each specimen, the Queensland Museum registration number (prefixed by 'F') and references are recorded, and, where known, formation and age. The list, in general, reflects the most recent published opinions as to status of the material in the Museum's collection. The dating of formations follows Day *et al.* (1983).

Some material mentioned by earlier researchers has not been located (e.g. Etheridge fil., 1892, 1909; Whitehouse, 1924). These specimens were neither figured nor referred to by registration numbers and therefore cannot be identified confidently. Some specimens were never in the collection. For example, Whitehouse (1926, p.214) erroneously attributed the neotype of *Tropaeum australe* to the Queensland Museum collection. It is in the collection of the Geological Survey of Queensland (Day, 1974, p.5).

The earliest fossil type material deposited in the museum was studied by Etheridge (1872). This included the Richard Daintree Collection and material obtained from the Gympie gold field by Christopher D'Oyly Hale Aplin. Daintree was appointed Government geologist for Northern District of Queensland on the 14 April, 1868 and Aplin was appointed about the same time for Southern District (I. Sanker, pers. comm., 1989).

The history of the Daintree Collection is chequered. Etheridge (1872, p.326) recorded that 'the ship ('Queen of the Thames') which conveyed both Mr Daintree and his large collection of minerals and fossils from Melbourne, was wrecked off the east coast of Africa, near the village of Bredarsdorp; and, as may be supposed, neither minerals nor fossils were much improved by their *long* submergence prior to recovery. The labour and anxiety of many years' research to establish the age and nature of the stratified rocks of Queensland was then nearly lost; and but for the fortunate position of the ship near the shore, fresh collections must have been made to elucidate the physical character and structure of the Colony.'

Etheridge fil. (1892) refigured and discussed a large number of Daintree's specimens studied by Etheridge (1872). Subsequently, Etheridge fil. and Dun (1906, p.3) thought that the Daintree Collection was lost. This is not the case, although the whereabouts of some material described by Etheridge (1872) remains unresolved. These specimens may have been incorporated into the Queensland Museum collection. This is unlikely because the bulk of Etheridge's (1872) material was registered in 1917 and there is no mention of the missing specimens. Some of the material described by Etheridge (1872) was obtained by W.B. Clarke. It is possible that Clarke may have retained them and, subsequently, they were destroyed during the 1882 Garden Palace fire, Sydney (Etheridge fil. and Dun, 1906, p.3). There is no record of these specimens in either the Queensland Geological Survey (Susan

Parfrey, pers. comm., 1988), British Museum Natural History (R. Cocks, pers. comm., 1988), University of Queensland (Andrew Simpson, pers. comm., 1989) or the Australian Museum (Fletcher, 1971).

Aplin was involved in assessing the gold prospects in southern Queensland, including the Gympie area. The results of this field work appeared in six reports of the 'Legislative Council Journal' (Woods, 1964). The fossil collections made by Aplin from Gympie are particularly significant because many of the sites on the mining field are no longer accessible. As well, the specimens obtained were part of the initial collections of the Queensland Museum (Turner and Wade, 1986).

Aplin, in June-September, 1871, produced the first catalogue of fossils in the Museum. At that time, he was responsible for the Government's mineralogical collections in the Parliamentary Building, Queen Street, Brisbane (Mather and Belcher, 1986; Turner and Wade, 1986). Responsibility for the collections passed from the Philosophical Society to the government in that year. Aplin's catalogue included material obtained by Hackett, Daintree, Aplin and Gregory (Woods, 1964). This handwritten catalogue of 203 entries survives in the Queensland Museum.

Charles Walter de Vis became curator of the Museum in February, 1882 (Mather, 1986). He had collected extensively from the Rockhampton District. De Vis did not record separate localities for his material but in an extract from a letter quoted by Etheridge fil. (1892, p.199) dated 25th July, 1888 de Vis says:

'The fossils are from the Agricultural Reserve; from the Fitzroy at Laurel Bank, about ten miles from Rockhampton, westward to the Nine-mile Lagoon; thence to the Corporation Quarry, Athelstane Range, and to the northern outcrop (at foot of Bersekers [*sic*]) of the synclinal beneath the township and bed of river'.

Some of the de Vis collection is also from the Clermont District.

Important collections were also obtained during the Hann Expedition, 1872, which explored areas of Cape York Peninsula. Hann and Taylor (the geologist of the expedition) collected specimens from 2 sites: the first and major site was on the Walsh River, probably near 'Boomers Hole' (Fig.1). Hann (1873, p.1034) reports that:

'Having completed and satisfied myself of the nature of the country up the Walsh, I resolved to move on, which I did on the 15th July, by following down the right bank of the river for three miles, through a poor country; here I came upon a limestone formation, which I found to be similar in character to that on the Flinders and the Barcoo. In passing over the ridges I noticed some fossils, which at once induced me to draw up and prosecute a further search. The camp was fixed on the steep bank of the river, which here presented banks sixty feet in depth, composed, near the surface, of a light calcareous soil a few feet in depth, resting on a deep bed of shale, in which limestone boulders of all sizes were imbedded and suspended, and in which the fossils were mostly found.

A more interesting spot for a scientific man can scarcely be conceived; here he is surrounded by the objects of his interest, they are under his feet like pebbles on the seashore, they are hanging above his head ready to crush him if not careful, he cannot move without seeing them around him on all sides; they were of all sizes, and numbers of them beautifully perfect; what, and how many to save was the puzzle, each new find exceeded the last one in beauty, until all the beautiful ones were sufficient to load a dray, could we have saved them, and, as I had not even one packhorse to carry these and the rock specimens, I was put to my wits' end how many to transport. However, Mr Taylor and myself collected the best of the various species, which we were content to secure and carry along with us. I found two or three bones of the vertebrae of a large animal, which were attached to each other by limestone.'

The Hann Expedition material was registered into the Museum collections in 1882. It was allocated the Donor registration number D212. Remarks in that register refer to it as part of the 'Old Collection'. Presumably most of the material obtained was collected from the Walsh River, although Hann in his diary also recorded fossils on the Mitchell River. He says (p.1048) that 'two or three varieties or forms were procured - not seen at the fossil camp' (i.e. Walsh River locality). The specimens collected from the Mitchell River have not been identified in the collection.

Etheridge fil. (1892, 1894) described many of the taxa collected by de Vis from the Rockhampton District and went on to research the Cretaceous ammonites of Queensland (Etheridge fil., 1909). Significantly, a large number of ammonites were obtained by the Hann Expedition from the Walsh River area.

Whitehouse (Honorary Palaeontologist, Queensland Museum 1927-1937) revised the Cretaceous ammonites in a series of papers.

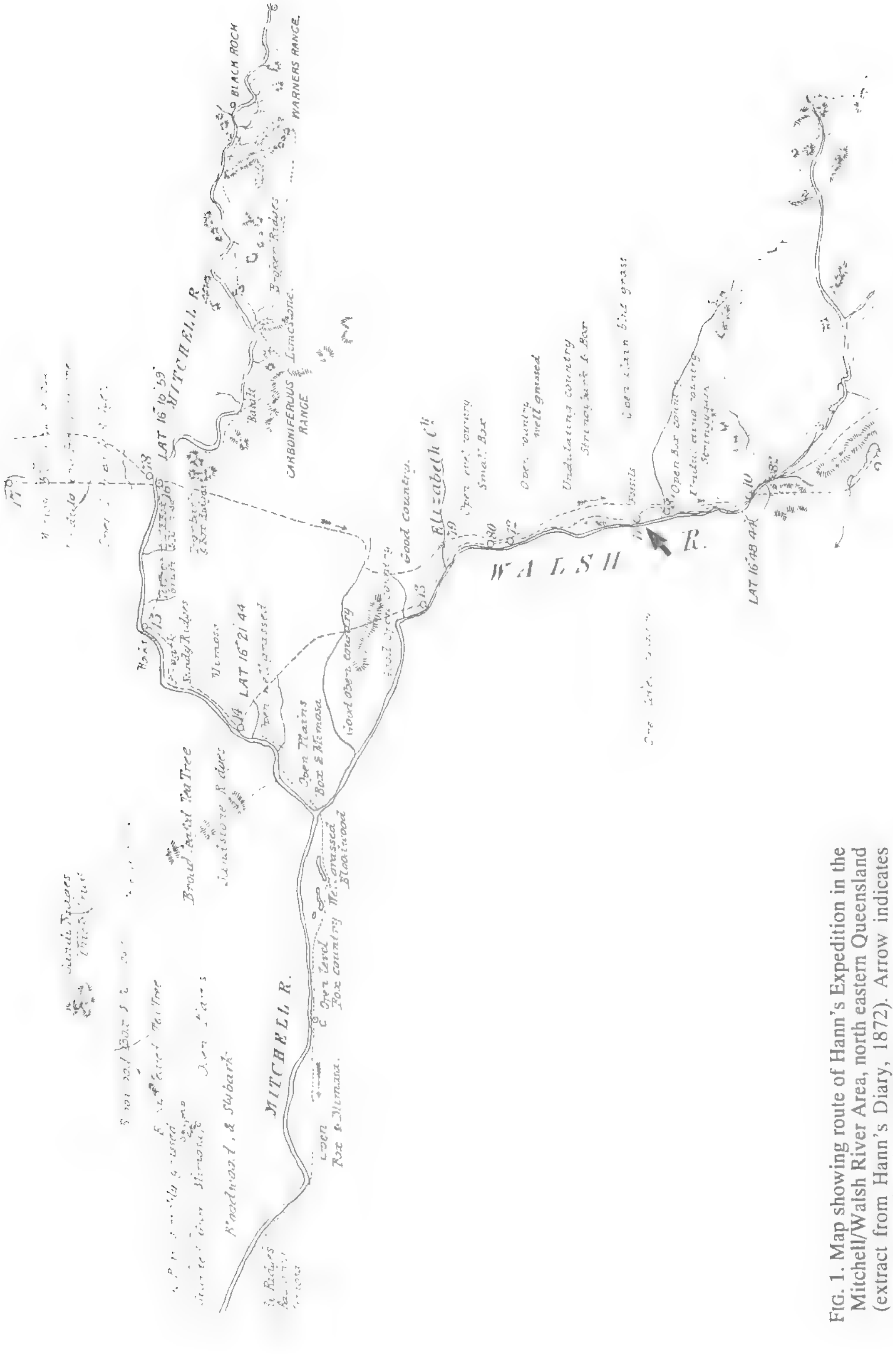

FIG. 1. Map showing route of Hann's Expedition in the Mitchell/Walsh River Area, north eastern Queensland (extract from Hann's Diary, 1872). Arrow indicates major collecting site on Walsh River.

Woods (1953, 1957) described the macrurous decapods and Brachyura from the Queensland Cretaceous. Evans (1961,1971) described Triassic Hemiptera from the Mount Crosby Formation in South Eastern Queensland. Recent foci of research in the museum have been the Cambrian trilobite faunas of North Western Queensland (Jell, 1970, 1975a, 1977); Ordovician nautiloids (Wade, 1977a,b); and Devonian crinoids Jell *et. al.* (1988).

Abbreviations used in the text are the following: Fm, Formation; GSQ, Geological Survey of Queensland; GSWA, Geological Survey of Western Australia; QML, Queensland Museum Locality; UQL, University of Queensland, Geology Department Locality.

SYSTEMATIC LIST

Aconeceras walshense (Etheridge fil., 1892)

F1272

HOLOTYPE *Ammonites walshensis* Etheridge fil., 1892, p.493, pl. 42, figs 10,11.

Aconeceras walshense (Etheridge fil.,) Whitehouse, 1926, pp.203- 4.

Aconeceras walshense (Tenison-Woods); Whitehouse, 1927, p.114, pl.16, figs 2a,b, text fig.6.

Aconeceras walshense (Etheridge, 1892); Hill *et al.*, 1968, pl. K8, fig.2.

LOCALITY: Walsh River, NQ.

FORMATION: Blackdown Fm.

AGE: Lower Cretaceous, (Aptian).

REMARKS: Collected Hann's Expedition, 1872. Whitehouse (1927) incorrectly indicated Tenison-Woods as the author of this species. It was described by Etheridge fil. (1892).

F1594

Aconeceras walshense (Etheridge fil.,) Whitehouse, 1926, pp.203- 4, pl.34, figs 1a,b, pl.37, fig.3.

Aconeceras walshense (Tenison-Woods); Whitehouse, 1927, p.114.

LOCALITY, FORMATION, AGE: As for F1272.

REMARKS: See F1272.

F1704

Aconeceras walshense (Etheridge fil.,) Whitehouse, 1926, pp.203-4.

Aconeceras walshense (Tenison-Woods); Whitehouse, 1927, p.114, pl.16, fig.3, text figs 1, 7.

LOCALITY: Walsh River, NQ.

FORMATION: Blackdown Fm.

AGE: Lower Cretaceous, (Aptian).

REMARKS: See F1272. Whitehouse records the locality for this specimen as Walsh River although the Queensland Museum Palaeontology register gives the locality as Western Queensland. The lithology is consistent with material from the Walsh River area.

F1871

Aconeceras walshense (Etheridge fil.,) Whitehouse, 1926, pp.203- 4,

Aconeceras walshense (Tenison-Woods); Whitehouse, 1927, p.114.

LOCALITY: Walsh River, NQ.

FORMATION: Blackdown Fm.

AGE: Lower Cretaceous, (Aptian).

REMARKS: See F1272.

Actinocrinus sp.

F17784

Actinocrinus sp. ind.; Etheridge fil., 1892, pp.207-8.

LOCALITY: Rockhampton District, MEQ.

FORMATION: ?Malchi Fm.

AGE: Lower Carboniferous.

REMARKS: De Vis Collection.

Alathyria pertexta Iredale, 1934

F6546

Alathyria pertexta Iredale, 1934; Hill *et al.*, 1970, pl.Cz5, figs8a,b.

LOCALITY: Maryvale Creek, 0.5 miles NW of homestead, NEQ.

FORMATION: Unnamed fluviatile deposit.

AGE: Pleistocene.

Amerianna carinata (Adams, 1861)

F6551

Amerianna carinata (Adams, 1861); Hill *et al.*, 1970, pl.Cz4, fig.11.

LOCALITY: Gowrie Creek, Darling Downs, SEQ.

FORMATION: Unnamed fluviatile deposit.

AGE: Pleistocene.

Anadara trapezia (Deshayes, 1840)

F15649

Anadara trapezia (Deshayes, 1840); Hill *et al.*, 1970, pl.Cz5, figs2a,b.

LOCALITY: Bullock Pt, Wide Bay, SEQ.

FORMATION: Unnamed marine deposit.

AGE: Pleistocene.

REMARKS: Previously registered as Mo2921 in the Queensland Museum Mollusca register.

Anidanthus springsurensis (Booker, 1932)

F2542

PARATYPE *Linoproductus springsurensis* Booker, 1932, pp.67-8, pl.3, figs 3,4.

Anidanthus springsurensis (Booker); Hill, 1950, pp.10-2.

Anidanthus springsurensis (Booker, 1932); Waterhouse and Briggs, 1986, pp.61-2.

LOCALITY: Cattle Creek, Springsure Dome, CQ.

FORMATION: Lower Bowen Basin.

AGE: Permian.

F2543

PARATYPE *Linoproductus springsurensis* Booker, 1932, pp.67-8, pl.4, fig.3.

Anidanthus springsurensis (Booker); Hill, 1950, pp.10-2.

Anidanthus springsurensis (Booker, 1932); Waterhouse and Briggs, 1986, p.61-2.

LOCALITY, FORMATION, AGE: As for F2542.

F2544

PARATYPE *Linoproductus springsurensis* Booker, 1932, pp.67-8, pl.4, figs 1,2.

Anidanthus springsurensis (Booker); Hill, 1950, p.10-2.

Anidanthus springsurensis Booker, 1932; Waterhouse and Briggs, 1986, pp.61-62.

LOCALITY, FORMATION, AGE: As for F2542.

F2545

HOLOTYPE *Linoproductus springsurensis* Booker, 1932, pp.67-8, pl.3, figs 1,2.

Anidanthus springsurensis (Booker); Hill, 1950, pp.10-2.

Anidanthus springsurensis Booker, 1932; Waterhouse and Briggs, 1986, p.61-2.

Anidanthus springsurensis (Booker, 1932); Parfrey, 1986, pp.59-60.

LOCALITY, FORMATION, AGE: As for F2542.

F2546

PARATYPE *Linoproductus springsurensis* Booker, 1932, pp.67-8, pl.3, figs 5,6.

Anidanthus springsurensis (Booker); Hill, 1950, pp.10-2.

Anidanthus springsurensis Booker, 1932; Waterhouse and Briggs, 1986, pp.61-2.

LOCALITY, FORMATION, AGE: As for F2542.

F2541

PARATYPE *Linoproductus springsurensis* Booker, 1932, pp.67-8, pl.4, fig.4.

Anidanthus springsurensis (Booker); Hill, 1950, pp.10-2.

Anidanthus springsurensis Booker, 1932; Waterhouse and Briggs, 1986, pp.61-2.

LOCALITY, FORMATION, AGE: As for F2542.

Aprathia rockhamptonensis (Mitchell, 1918)

F1233

cf. *Phillipsia woodwardi* Etheridge fil., 1892 p.215, pl.44, fig.6.

SYNTYPE *Phillipsia rockhamptonensis* Mitchell, 1918, pp.440, 459-61, pl. 50, fig.8

PARALECTOTYPE *Aprathia rockhamptonensis* (Mitchell, 1918) Engel and Morris, 1989 p.327-332, fig.12h.

LOCALITY: Rockhampton District, MEQ.

FORMATION: ?Malchi Fm.

AGE: Lower Carboniferous.

REMARKS: De Vis Collection. Engel and Morris (1989) incorrectly record the type locality as Corner Creek, Great Star River, north Queensland, Star Beds. The Palaeontology register gives the locality as Rockhampton, MEQ.

F1234a/b

Phillipsia dubia Etheridge; Etheridge, 1892, pp.214-5, pl.44, fig.4.

SYNTYPE *Phillipsia rockhamptonensis* Mitchell, 1918, pp.440, 459- 61, pl. 49, figs 9, 10.

LECTOTYPE *Aprathia rockhamptonensis* Mitchell Engel and Morris (1989), p.327-332, figs 12a-c.

LOCALITY: Rockhampton District, MEQ.

FORMATION: ?Malchi Fm.

AGE: Lower Carboniferous.

REMARKS: Mitchell (1918) referred to this specimen as 716 which is a de Vis collection number. Engel and Morris (1989) erroneously refer to counterparts F1234a and F1234b as a paralectotype and lectotype respectively. The only paralectotype is F1233 and the lectotype is F1234a/b. (See also F1233).

Archaeocidaris sp.

F17785

Archaeocidaris sp.; Etheridge fil., 1892, p.213.

LOCALITY: Rockhampton District, MEQ.

FORMATION: ?Malchi Fm.

AGE: Lower Carboniferous.

REMARKS: De Vis Collection.

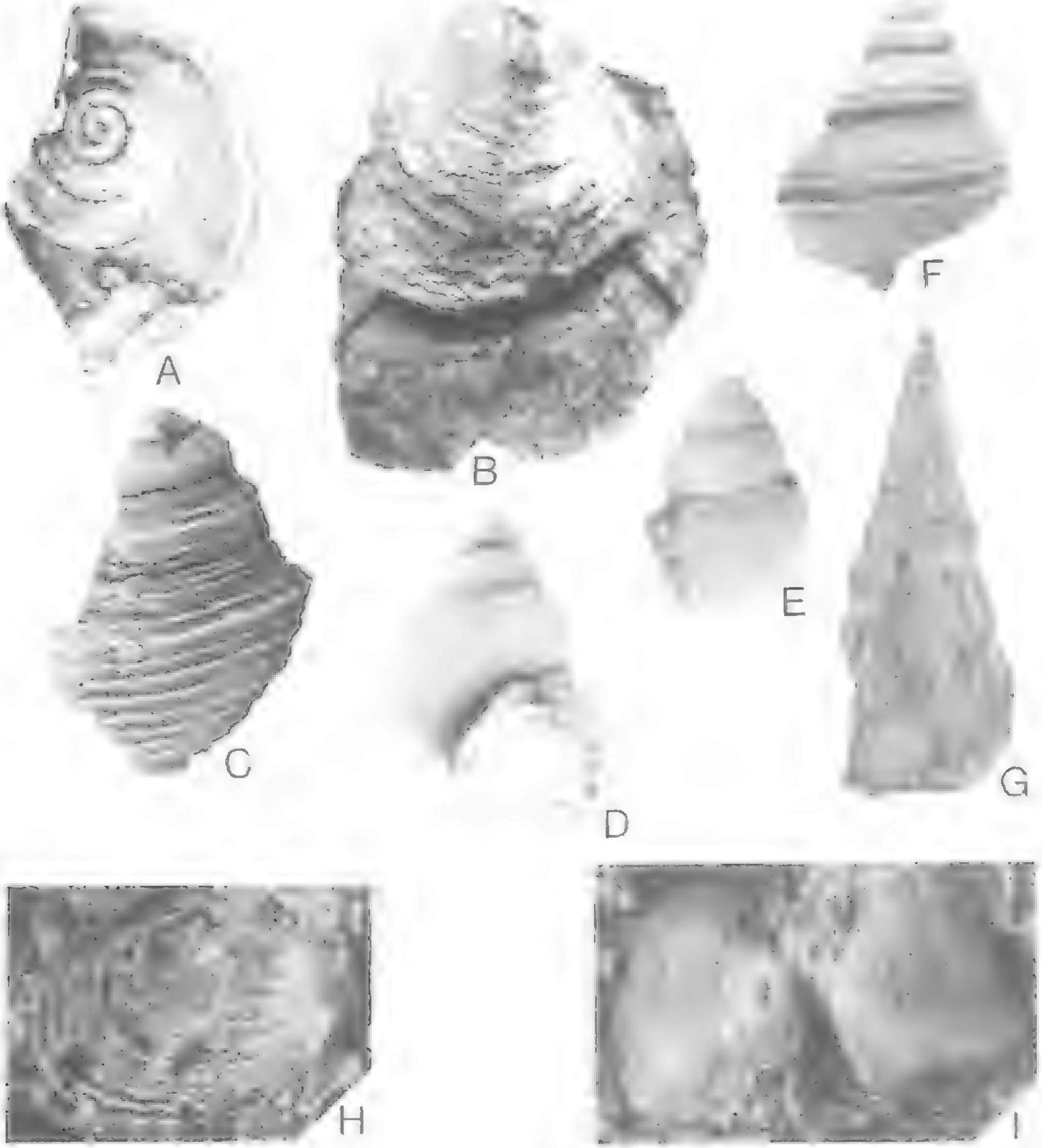

FIG. 2. A. HOLOTYPE *Luciella* (?) *grayae*, F1227, x3.2; B. *Athyris roysii* Leveillé, F1207, x3.7; C. *Baylea konincki* (Etheridge fil., 1890), F1222, x3.8; D. *Collabrina cliftoni* (Etheridge), F15648, x1.5; E. *Collabrina cliftoni* (Etheridge), F15648, x 2.0; F. *Collabrina cliftoni* (Etheridge), F15647, x2.0; G. *Loxonema* sp, F1225, x4.4; H. SYNTYPE *Edmondia* (?) *smithi* Etheridge fil., 1894, F2837, x5.2; I. HOLOTYPE *Cypricardella rectangularis* Etheridge, F15647, x5.4.

***Armenoceras* sp.**

F7229
Armenoceras sp. 4: Wade, 1977b, pp.308-9, fig.4.
LOCALITY: W side of small hill, 23°19'S, 138°06'E, CWQ.
FORMATION: Lower Nora Fm.
AGE: Middle Ordovician.

***Astacodes* sp.**

F2907
Astacodes sp.; Woods, 1957, p.159, pl.4, fig.1, text fig.2.
Astacodes sp; Hill *et al.*, 1968, pl.K11, fig.5
LOCALITY: 'Currane', 10 miles N of Dartmouth, CQ.
FORMATION: Allaru Mudstone
AGE: Lower Cretaceous, (Albian).

***Athyris roysii* Leveillé, 1835**

F1207 (Fig.2B)
Athyris roysii Leveillé; Etheridge fil., 1894, pp.529-30, pl. 39, fig.4.
LOCALITY: Rockhampton District, MEQ.
FORMATION: ?Malchi Fm.
AGE: Upper Carboniferous.

***Aucellina hughendensis* (Etheridge, 1872)**

F3848
HOLOTYPE *Avicula hughendenensis* Etheridge, 1872, p.346, pl.25, fig.3.
Aucella hughendenensis (Etheridge) Etheridge fil., 1892, pp.460-2, pl.25, fig.1.
Aucella hughendenensis Etheridge; Etheridge fil., 1902a, p.67.
Aucella hughendenensis Etheridge; Etheridge fil., 1902b, p.14.
Aucella hughendenensis Etheridge; Etheridge fil., 1907, pp. 321-2.
Aucellina hughendensis (Etheridge Snr, 1872): Hill *et al.*, 1968, pl.K4, fig.1.
LOCALITY: Hughenden Stn, *c.* 0.5 miles from Hughenden Stn, *c.* 3 miles from Mt Walker, near Hughenden, CQ.
FORMATION: Wallumbilla Fm, Ranmoor Member.
AGE: Lower Cretaceous.

***Australiceras irregulare* (Tenison-Woods, 1883)**

F1265
Crioceras jackii, Eth. fil.; Etheridge fil., 1909, pp.145-8, pl.37, fig.2.
Australiceras gracile (Sinzow); Whitehouse, 1926, pp.211-2.
Australiceras irregulare (Tenison-Woods, 1883); Day, 1974, pp. 10-12, Table 1.
LOCALITY: Walsh River, NQ.
FORMATION: Blackdown Fm.
AGE: Lower Cretaceous, (Aptian).

F1268
Crioceras jackii, Eth. fil.; Etheridge fil., 1909, pp.145-8, pl. 36, fig.1.
Australiceras gracile (Sinzow); Whitehouse, 1926, pp.211-2.
Australiceras irregulare (Tenison-Woods, 1883) in Day, 1974, pp. 1, 10-11, Table 1, pl.6, figs 2a-c.
LOCALITY: Victoria Downs, Morven (see remarks).
FORMATION: ?
AGE: Lower Cretaceous.
REMARKS: F1268 was previously registered in the Donor Register as D7710.12. D7710 is recorded in the Donor register as a 'miscellaneous collection of fossils see Catalogue of Fossils'. Unfortunately no catalogue has been found. D7710 includes material from various localities, e.g., Gilbert River, Walsh River, NQ. and the *Simbirskites* specimens (*q.v.*), which are probably from North Germany. While Whitehouse (1928) records the locality for F1268 (and the *Simbirskites* specimens) as Victoria Downs, Morven, the provenance of this specimen and other D7710 material is uncertain.

F1269
Crioceras jackii, Eth. fil.; Etheridge fil., 1909, pp.145-8, pl.35, fig.1.
Australiceras aff. *irregulare* (Tenison- Woods): Whitehouse, 1926, p.210.
Australiceras irregulare (Tenison-Woods, 1883); Day, 1974, pp. 10-12, Table 1.
LOCALITY: Walsh River, NQ.
FORMATION: Blackdown Fm.
AGE: Lower Cretaceous, (Aptian).
REMARKS: Collected Hann's Expedition, 1872.

F1391
Australiceras irregulare (Tenison-Woods); Whitehouse, 1926, p. 210, pl.37, figs 1a,b.
LOCALITY: Wrotham Park Stn, Walsh River, NQ.
FORMATION: Blackdown Fm.
AGE: Lower Cretaceous, (Aptian).
REMARKS: Collected Hann's Expedition, 1872.

F1392
Australiceras gracile (Sinzow); Whitehouse, 1926, pp.211-2, pl. 34, fig.4.
LOCALITY: not recorded.
FORMATION: ?
AGE: Lower Cretaceous.
REMARKS: This specimen was not mentioned in Day's (1974) paper, but is probably referable to *A. irregulare*.

Australiceras jacki (Etheridge fil., 1880)

F1267
Crioceras jackii Eth. fil.; Etheridge fil., 1909, pp.145-8, pl.38, fig.3.
Australiceras jacki (Etheridge fil.,) Whitehouse, 1926, pp.209-10.
Australiceras jacki (Etheridge Jr, 1880); Day, 1974, pp.9-10, Table 1.
LOCALITY: Hughenden Station, sheep wash water-hole, 800m from Stn, and 5km E of Mt Walker, near Hughenden, CQ.
FORMATION: ?Wallumbilla Fm.
AGE: Lower Cretaceous.

F1390
HOLOTYPE *Australiceras transiente* Whitehouse, 1926, p.212, pl. 34, figs 3a,b.
Australiceras jacki (Etheridge Jr, 1880); Day, 1974, pp.8-10, Table 1.
LOCALITY: Walsh River, NQ.
FORMATION: Blackdown Fm.
AGE: Lower Cretaceous, (Aptian).

F1396
Australiceras robustum Whitehouse, 1926, p.211.
LOCALITY: Walsh River, NQ.
FORMATION: Blackdown Fm.
AGE: Lower Cretaceous, (Aptian).
REMARKS: Day (1974) synonymised *A. robustum* with *A. jacki*. The matrix of this specimen originally contained F1271 and F1797, which were referred to ?*Tonohamites taylori* by Day (1974).

F1597
Australiceras jacki (Etheridge fil.,) Whitehouse, 1926, pp.209- 210, pl.34, fig.2.
Australiceras jacki (Etheridge Jr., 1880); Arkell *et al.*, 1957, pp.L211, L213, fig.240-6.
Australiceras jacki (Etheridge, 1880); Hill *et al.*, 1968, pl. K7, fig.1.
Australiceras jacki (Etheridge Jnr., 1880); Day, 1974, pp.9-10, Table 1.
LOCALITY: Walsh River, NQ.
FORMATION: Blackdown Fm.
AGE: Lower Cretaceous, (Aptian).
REMARKS: Collected Hann's Expedition, 1872. Whitehouse (1926, pp.209-10) erroneously referred to F1597 as holotype of this species. The type material however had been originally figured by Etheridge (1880) and the lectotype was selected by Day (1974) and is held in the Geological Survey of Queensland (GSQ F1385).

Aviculopecten laurienti Etheridge fil., 1892

F1209
SYNTYPE *Aviculopecten laurienti* Etheridge fil., 1892, pp.268-9, pl.43, fig.4.
Euchondria laurienti (Etheridge, 1892); Maxwell, 1964, p.49.
Aviculopecten laurienti Etheridge, 1892b; Waterhouse, 1982, p. 8.
LOCALITY: Rockhampton, MEQ.
FORMATION: ?Malchi Fm.
AGE: Lower Carboniferous.
REMARKS: De Vis Collection.

Baylea koninckii (Etheridge fil., 1890)

F1222 (Fig.2C)
Yvania konincki Eth. fil.; Etheridge fil., 1892, p.288, pl. 41, fig.7.
LOCALITY: Rockhampton District, MEQ.
FORMATION: ?
AGE: Carboniferous.
REMARKS: De Vis Collection. Generic assignment changed by Knight *et al.* (1960, p. L202).

Bellerophon **sp.**

F1223
Bellerophon sp.; Etheridge fil., 1894, p.537, pl.39, fig.8.
LOCALITY: Rockhampton District, MEQ.
FORMATION: ?Malchi Fm.
AGE: Lower Carboniferous.
REMARKS: De Vis Collection.

Bembicium melanostoma (Gmelin, 1791)

F6552
Bembicium melanostoma (Gmelin, 1791); Hill *et al.*, 1970, pl. Cz4, fig.15.
LOCALITY: Nudgee, SEQ.
FORMATION: Unnamed estuarine deposit.
AGE: Pleistocene/Holocene?

Beudanticeras daïntreei (Etheridge, 1872)

F3851

SYNTYPE *Ammonites daintreei* Etheridge, 1872, p.346, pl.24, fig.1 (apertural view only).

Ammonites daintreei Etheridge; Etheridge fil., 1892, p.495, pl.29, fig.1.

Beudanticeras (?) *daintreei* (Etheridge) Whitehouse, 1926, p.221, text fig.2.

LECTOTYPE *Boliteceras daintreei* (Etheridge) Whitehouse, 1928, pp.203-4, pl.26, fig.2.

Beudanticeras daintreei (Etheridge); Arkell *et al.*, 1957, p. L368.

LOCALITY: Hughenden - about 800m from Hughenden Stn, and about 5km E of Mt Walker, CQ.

FORMATION: ?Allaru Mudstone.

AGE: Lower Cretaceous.

REMARKS: See *Beudanticeras perlatum* (F1276). Daintree Collection.

F3852

SYNTYPE *Ammonites daintreei* Etheridge, 1872, p.346, pl.24, fig.2.

Ammonites daintreei (Etheridge) Etheridge fil., 1892, p.495, pl.29, fig.3.

Beudanticeras (?) *daintreei* (Etheridge) Whitehouse, 1926, p.221.

Boliteceras perlatum Whitehouse, 1928, p.204.

Beudanticeras daintreei (Etheridge); Arkell *et al.*, 1957, p. L368.

Boleticeras [sic] daintreei (Etheridge Snr, 1872); Hill *et al.*, 1968, pl.K8, fig.4.

LOCALITY: Hughenden, CQ.

FORMATION: Wallumbilla Fm., Ranmoor Member.

AGE: Lower Cretaceous.

Beudanticeras flindersi (McCoy, 1865)

F1382

Beudanticeras flindersi (McCoy); Whitehouse, 1926, pp.219-20, text fig.1.

Beudanticeras flindersi (McCoy); Whitehouse, 1928, pp.201-3.

LOCALITY: Coolibah, Hughenden, CQ.

FORMATION: ?Wallumbilla Fm.

AGE: Lower Cretaceous.

Beudanticeras mitchelli (Etheridge, 1872)

F1274

Ammonites beudanti Brongn., var. *mitchelli* Etheridge, 1872, p.345, pl. 23, fig.1 (lateral and apertural views).

Ammonites flindersi McCoy; Etheridge fil., 1892, pp.494-5, pl 30, figs 1,2.

Beudanticeras flindersi (McCoy) Whitehouse, 1926, pp.219-20.

LECTOTYPE *Beudanticeras mitchelli* (Etheridge) Whitehouse, 1928, p.201, pl.25, fig.2.

LOCALITY: Hughenden, CQ.

FORMATION: ?Allaru Mudstone.

AGE: Lower Cretaceous.

REMARKS: Whitehouse (1928, p.206) erroneously listed this Hughenden specimen as coming from Marathon (Daintree, 1872).

F1275

Ammonites beudanti Brongn., var. *mitchelli* Etheridge, 1872, p.345, pl. 23, fig.2.

Ammonites flindersi McCoy; Etheridge fil., 1892, pp.494-5, pl.30, fig.3.

Beudanticeras flindersi (McCoy); Whitehouse, 1926, pp.219-20.

Beudanticeras mitchelli (Etheridge); Whitehouse, 1928, pp.201-2.

LOCALITY: Hughenden, CQ.

FORMATION: ?Allaru Mudstone

AGE: Lower Cretaceous.

REMARKS: Daintree Collection.

Beudanticeras perlatum (Whitehouse, 1928)

F1276

Ammonites daintreei Etheridge, 1872, p.346, pl.24, fig.1 (see remarks).

Ammonites daintreei Etheridge; Etheridge fil., 1892, p.495, pl.29, fig.2.

HOLOTYPE *Boliteceras perlatum* Whitehouse, 1928, p.204, pl.26, fig.3.

Beudanticeras perlatum (Whitehouse, 1928) Arkell *et al.*, 1957, p. L368.

LOCALITY: Hughenden, CQ.

FORMATION: ?Allaru Mudstone.

AGE: Lower Cretaceous.

REMARKS: Whitehouse (1928, p.204) considered that Etheridge (pl.24, fig.1) was a composite figure based upon this specimen and F3851. Etheridge (1872) figured most of his material faithfully including imperfections and cracks. He also had complete specimens of this taxon to figure. It is therefore surprising and we think unlikely that he chose to produce a composite figure. However, no specimen in our collection matches Etheridge's original figure and this presumably led Whitehouse to his interpretation.

Beudanticeras sutherlandi (Etheridge, 1872)

F1273

HOLOTYPE *Ammonites sutherlandi* Etheridge, 1872, p.345, pl.21, fig.4.

Ammonites sutherlandi (Etheridge); Etheridge fil., 1892, p. 496, pl.29, fig.4.

Beudanticeras (?) *sutherlandi* (Etheridge); Whitehouse, 1926, p. 222.

Beudanticeras sutherlandi (Etheridge); Whitehouse, 1928, p.202, pl.25, fig.4.

Beudanticeras sutherlandi (Etheridge Snr., 1872); Hill *et al.*, 1968, pl.K9, fig.2.

LOCALITY: ?McKinlay's Range or Marathon Stn, CQ.

FORMATION: ?Allaru Mudstone.

AGE: Lower Cretaceous.

REMARKS: All previous authors record the locality of this specimen as Marathon or Marathon Stn. This specimen was previously registered as D222 in the Queensland Museum Donor register which records the locality as McKinlay's Range.

Beudantiella ogilviei (Whitehouse, 1928)

F1897

Cophinoceras ogilviei Whitehouse, 1928, p.205.

Beudantiella ogilviei (Whitehouse) Breistroffer, 1947, p.83.

LOCALITY: Near mouth of Bynoe River, on Normanton-Burketown Rd, NQ.

FORMATION: Normanton Fm.

AGE: Lower Cretaceous, (Albian).

REMARKS: *Beudantiella* Breistroffer (1947) replaces Whitehouse's *Cophinoceras*, which had been previously occupied by *Kophinoceras* Hyatt. (Arkell *et al.*, 1957, p.L368).

F2043

HOLOTYPE *Cophinoceras ogilviei* Whitehouse, 1928, p.205, pl.26, figs 4a,b.

Cophinoceras ogilviei Whitehouse, 1928; Hill *et al.*, 1968, pl. K8, fig.5.

LOCALITY, FORMATION, AGE: As for F1897.

REMARKS: See F1897.

Brachymetopus maccoyi* var. *spinimarginatus Hahn and Hahn, 1969

F2839

SYNTYPE *Brachymetopus dunstani* Mitchell, 1918, p.486-8, pl.51, fig.4; pl.52, fig.1.

LOCALITY: Rockhampton District, MEQ.

FORMATION: ?Malchi Fm.

AGE: Lower Carboniferous.

REMARKS: De Vis collection No. 712. Other poorly preserved *Brachymetopus* pygidial fragments are associated with this specimen (Mitchell, 1918). This specimen is referable to *B. maccoyi* var. *spinimarginatus* Hahn and Hahn, 1968 (B. Engel, pers. comm., 1988).

Bucania textilis de Koninck, 1883

F1224

Bucania textilis de Koninck ?; Etheridge fil., 1892, p.290, pl.41, fig.8.

LOCALITY: Rockhampton District, MEQ.

FORMATION: ?Malchi Fm.

AGE: Lower Carboniferous.

REMARKS: De Vis Collection.

Burrows

F1198

Burrow; Etheridge fil. 1892, pp.297-9, pl.44, fig.15.

LOCALITY: Rockhampton District, MEQ.

FORMATION: ?

AGE: Carboniferous?

REMARKS: The figure is laterally reversed in Etheridge fil., (1892, pl.44, fig.15).

F1199

Burrow; Etheridge fil., 1892, pp.297-9, pl.39, fig.1.

LOCALITY, FORMATION, AGE: As for F1198.

REMARKS: specimen missing.

F1200

Burrow; Etheridge fil., 1892, pp.297-9, pl.44, fig.16.

LOCALITY, FORMATION, AGE: As for F1198.

F1201

Burrow; Etheridge fil., 1892 ,pp.297-9, pl.44, fig.17.

LOCALITY, FORMATION, AGE: As for F1198.

F1202

Burrow; Etheridge fil., 1892, pp.297-9, pl.44, fig.18.

LOCALITY, FORMATION, AGE: As for F1198.

***?Cancrinelloides* sp.**

F14414

Productus cora d'Orb.; Etheridge, 1872, pp.328-9, pl.15, fig. 1.

Productus cora d'Orb.; Etheridge fil., 1892, p.248, pl.12, fig.14.

LOCALITY: Caledonian Reef, Gympie, SEQ.

FORMATION: Rammutt Fm.
AGE: Permian.
REMARKS: Waterhouse and Balfe (1987) considered that *P. cora* was allied to *Cancrinelloides*.

F14415
Productus cora d'Orb.; Etheridge, 1872, pp.328-9, pl.15, fig. 2.
LOCALITY: Gympie, SEQ.
FORMATION: Rammutt Fm.
AGE: Permian.
REMARKS: See F14414 above.

Carpocrinid indet.

F14881
Carpocrinid indet.; Jell *et al.*, 1988, p.364-6, figs7g-j.
LOCALITY: QML547 = (UQL5209) Burges topographic sheet [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 Stn, 150km NW of Charters Towers, NQ.
FORMATION: Burges Fm.
AGE: Early Middle Devonian, (Late Emsian-early Eifelian).

Cercopoidea *incertae sedis*

F6498a/b
Cercopoidea *incertae sedis*; Evans, 1971. p.146, fig.4a.
LOCALITY: Mt Crosby, SEQ, Upper Bed, 910805-911805, Ipswich 1 mile military map.
FORMATION: Mt Crosby Fm.
AGE: Early Late Triassic (Carnian).

F6542a
Cercopoidea *incertae sedis*; Evans, 1971, p.146, fig.4b.
LOCALITY, FORMATION, AGE: As for F6498.

F6507a/b
Cercopoidea *incertae sedis*; Evans, 1971, p.146.
LOCALITY, FORMATION, AGE: As for F6498.

Charybdis callianassa **(Herbst, 1789)**

F6559
Charybdis callianassa (Herbst, 1789); Hill *et al.*, 1970, pl.Cz 6, fig.10.
LOCALITY: Ayr, NQ.
FORMATION: Unnamed estuarine deposit.
AGE: Pleistocene/Holocene.

Chelodes whitehousei **Runnegar, Pojeta, Taylor and Collins, 1979**

F10087, F10091, F10095, F10098-F10102, F10104
PARATYPES *Chelodes whitehousei* Runnegar, Pojeta, Taylor and Collins, 1979, pp.1374-94, F10087, pl.2, figs 4-6; F10091, pl. 2, figs 12-14; F10095, pl.2, figs 24-25, 30; F10098, pl.2, figs 36-38; F10099, pl.2, figs 42-44; F10100, pl.2, fig.45; F10101, pl.2, figs 46-47; F10102, pl.2, figs 48-50; F10104, pl.2, figs 57-59.
LOCALITY: QML278, G25, Glenormiston Stn road about 5kms E of No. 21 Bore, Glenormiston Stn, WCQ.
FORMATION: Ninmaroo Fm.
AGE: Lower Tremadocian, (Datsonian).

F10088, F10090, F10092-F10094, F10096-F10097, F10103
PARATYPES *Chelodes whitehousei* Runnegar, Pojeta, Taylor and Collins, 1979, pp.1374-94; F10088, pl.2, fig.7; F10089, pl.2, figs 8-10; F10090, pl.2, figs 11-15; F10092, pl.2, figs 16-18; F10093, pl.2, figs 19-21; F10094, pl.2, figs 22-23; F10096, pl.2, figs 26-28; F10097, pl. 2, figs 33-35; F10103, pl.2, figs 51-53.
LOCALITY: QML278, G24, Glenormiston Stn road c. 8kms E of No. 21 bore, Glenormiston Stn, WCQ.
FORMATION: Ninmaroo Fm.
AGE: Lower Tremadocian,(Datsonian).

Chthamalus **sp.**

F2026a
Chthamalus sp.; Withers, 1932, pp.122-3.
Chthamalus sp.; Hill *et al.*, 1970, pl.Cz6, fig.3.
LOCALITY: Magnetic Island, NQ.
FORMATION: Raised beach rock.
AGE: Pleistocene/Holocene?
REMARKS: Withers (1932) used F2026 for four different taxa. This specimen has been reregistered as F2026a.

Collabrina cliftoni **(Etheridge, 1872)**

F15647-48, F16566 (Figs2D-F)
Pleurotomaria cliftoni Etheridge, 1872, p.347, pl.25, fig.4.
Pleurotomaria ? cliftoni Etheridge; Etheridge fil., 1892, pp. 484-5, pl.29, fig.10 (refigured Etheridge's, 1872 illustration).
Pleurotomaria (?) *cliftoni* Etheridge; Etheridge fil., 1902a, p. 79.

LOCALITY: Head of Roper Creek, Gordon Downs Stn, CQ.
FORMATION: ?Blenheim Sub-group.
AGE: Upper Permian.
REMARKS: Three specimens (F15647-48, F16566) from Gordon Downs are in the Queensland Museum collections and were collected by W.B. Clarke (Daintree, 1872, p.283). Stock Mortgages and bills of sale and other State Archive records indicate that the only Gordon Downs Stn existing in Queensland in the 1860's (at the time of collection) was in the Clermont District, north of Emerald. Maps showing station boundaries in the 1880's indicate that Roper Creek commenced near the northern boundaries of the station. Earlier maps that might show the extent of the station in the 1860's do not exist. The Gordon Downs property and adjoining Malvern Downs Stn, which includes the headwaters of the Roper Creek, were owned in the 1860's by Samuel and Roderick Travers, respectively.

Pleurotomaria cliftoni has been missed or ignored by subsequent workers possibly because of confusion regarding the locality. Etheridge (1872) considered the material equivalent to the English Oolite, presumably inferring a Jurassic age for this material. Etheridge fil. (1892) confused the whereabouts of the locality by suggesting it was near Roma, because of the existence of a Gordon Downs Stn in that area. He referred the material to the Rolling Downs Group (Cretaceous) but noted that 'the resemblance of this species to a typical *Pleurotomaria* is not a marked one, in fact it is very much more like the Palaeozoic shells called *Murchisonia* with rounded whorls'. Daintree (1872, p.283) commented that the Gordon Downs material 'on Mr Etheridge's authority may be referred to the same horizon as the Pelican Creek Beds'. These beds are now recognised as Permian in age (Olgers, 1969). Furthermore Daintree (1872, p. 286) collected a typically Permian fauna of *Spirifera* spp. and *Productus clarkei* from presumably the same area. This collection was separate to the one made by the Rev. W.B. Clarke which included *Pleurotomaria* and bivalves. All the Queensland Museum material from Gordon Downs including a specimen figured as *Myacites* sp. by Etheridge (1872) were given the No. 010. The number does not pertain to any known Museum register.

The Queensland Museum specimens of *Pleurotomaria cliftoni* differ in size from Etheridge's original figure, however there is little doubt that they are part of the original material collected and are topotypes. *Pleurotomaria cliftoni* is referable to the Permian genus *Collabrina* based on the high-spired shell with convex whorls and prominent selenizone and is probably conspecific with *Collabrina parva* (Wass). Topotypes from this locality, F15647 and F15648, are figured (Figs 3A,B).

Conophillipsia grandis (Etheridge fil. 1892)

F1232
SYNTYPE *Phillipsia woodwardi* Etheridge fil., 1892, p.215, pl. 44, fig.5.
Phillipsia woodwardi Eth. fil.; Mitchell, 1918, pp.465-71, pl.49, fig.9, pl.50, fig.11, pl.51, fig.12.
Conophillipsia grandis (Etheridge Jr, 1892) Engel and Morris, 1984, pp.53-8, figs18c, 19a.
LOCALITY: Rockhampton District, MEQ.
FORMATION: ?Malchi Fm.
AGE: Lower Carboniferous, (late Tournaisian).
REMARKS: De Vis Collection.

Conophillipsia subquadrata Engel and Morris, 1984

F2839
Phillipsia woodwardi Eth. fil.; Mitchell, 1918, pp.465-71, pl.51, fig.14; pl.52, fig.1.
Conophillipsia subquadrata Engel and Morris, 1984, pp.50-3, figs 16b,e; 17h.
LOCALITY: Trilobite Ridge, Mt Morgan, MEQ.
FORMATION: ?
AGE: Lower Carboniferous, (mid-Tournaisian).
REMARKS: The number 712 referred to in Mitchell (1918) is a de Vis collection number.

Corbiculina australis (Deshayes, 1830)

F6547
Corbiculina australis (Deshayes, 1830); Hill *et al.*, 1970, pl. Cz 5, fig.10.
LOCALITY: Maryvale Creek, 0.5kms NW of homestead, NEQ.
FORMATION: Unnamed fluviatile deposit.
AGE: Pleistocene.

Crassostrea commercialis (Iredale and Roughley, 1933)

F6548
Crassostrea commercialis (Iredale and Roughley, 1933); Hill *et al.*, 1970, pl.Cz5, fig.1.
LOCALITY: Nudgee, SEQ.
FORMATION: Unnamed estuarine deposit.
AGE: Pleistocene/Holocene.

Crinoid attachment bases

F14858
Crinoid attachment bases; Jell *et al.*, 1988, p.397, fig.27p.
Locality: UQL5318, Wando Vale [565395] 65-116m above base of formation in gully 2.2km NE of Storm Dam, Wando Vale Stn, 150km NW of Charters Towers, NQ.
Formation: Papilio Mudstone.
Age: Givetian, Middle Devonian.
Remarks: Jell *et al.* (1988) refer to this specimen as F14860 on p.397. The correct number is F14858 as on figure cpation p.396.

F14859
Crinoid attachment bases; Jell *et al.*, 1988, p.397 fig.27q.
Locality, Formation, Age: As for F14858.

Crinoid calyx

F1194
'Crinoid calyx'; Etheridge fil., 1892, p.210, pl.44, fig.8.
Locality: Rockhampton District, MEQ.
Formation: ?Malchi Fm.
Age: Early Carboniferous.

Crinoid indeterminate

F14951
Crinoid indet 1.; Jell *et al.*, 1988, p.397, figs7a-c.
Locality: QML547 (= UQL5209) Burges [648459] prominent limestone knoll on left bank 100m from mouth of 2nd left bank side creek upstream from Jacks Hill's Gorge on the Broken River, Wando Vale Station, 150km NW of Charters Towers, NQ.
Formation: Burges Fm.
Age: Late Emsian - Givetian, Early Middle Devonian.
Remarks: Jell *et al.* (1988) refer to this specimen as F14591 on p.397. The correct number is F14951 as on figure caption 365.

F14952
Crinoid indet 1.; Jell *et al.* (1988, p.397, fig.7e).
Locality, Formation, Age: As for F14951.
Remarks: Jell *et al.* (1988) refer to this specimen as F14592 on p.397. The correct number is F14952 as on figure caption p.365.

F14953
Crinoid indet 1.; Jell *et al.*, 1988, p.397, fig.7f.
Locality, Formation, Age: As for F14591.
Remarks: Jell *et al.* (1988) refer to this specimen as F14593 on p.397. The correct number is F14953 as on figure caption p.365.

F14954
Crinoid indet 1.; Jell *et al.*, 1988, p.397, fig.7d.
Locality, Formation, Age: As for F14591.
Remarks: Jell *et al.* (1988) refer to this specimen as F14594 on p.397. The correct number is F14954 as on figure caption p.365.

Crinoid cf. *Stemmatocrinus*

F1196
'Basal cup of Crinoid cf. *Stemmatocrinus*'; Etheridge fil., 1892, p.208, pl.44, fig.7.
Locality: Stony Ck, Stanwell, nr Rockhampton MEQ.
Formation: ?Malchi Fm.
Age: Lower Carboniferous.
Remarks: Preserved on the same specimen are arms of crinoids referred to by Etheridge fil.(1892, p.210).

Crosaphis anomala Evans, 1971

F6508a b
Holotype *Crosaphis anomala* Evans, 1971, p.147, fig.3a.
Locality: Mt Crosby, SEQ, Upper Bed, 910805-911805, Ipswich 1 mile military map.
Formation: Mt Crosby Fm.
Age: Early Late Triassic (Carnian).

Cucullaea semistriata Moore, 1870

F5595, F5598-F5600, F5602
Cucullaea semistriata Moore, 1870; Skwarko, 1974, pp.74-6,text fig.3.
Locality: ?Newmarracarra Limestone, Western Australia
Formation: ?Newmarracarra Limestone.
Age: Middle Jurassic, (Bajocian).

Cupressocrinites abbreviatus Goldfuss, 1839

F14582
Cupressocrinites abbreviatus Goldfuss, 1839: Jell *et al.*, 1988, pp.393-5.
Locality: UQL5293, Wando Vale [524369] gully 400m E of the divide between Dosey and Page Creeks, Wando Vale Stn, 150km NW of Charters Towers, NQ.

FORMATION: Papilio Mudstone.
AGE: Middle Devonian, (?Givetian).
REMARKS: This formation was formally named by Lang *et al.* (1989) as Papilio Mudstone.

F14585-F14586
Cupressocrinites abbreviatus Goldfuss, 1839; Jell *et al.*, 1988, pp.393-5.
LOCALITY: UQL5229. Wando Vale topographic Sheet (560371) right bank of Storm Dam Creek about 50m upstream from the confluence with the gully into which Storm Dam overflows when filled. Wando Vale Stn, 150km NW of Charters Towers, NQ.
FORMATION: Papilio Mudstone.
AGE: Middle Devonian, (Givetian).
REMARKS: Jell *et al.*, (1988) erroneously record the locality for this specimen as UQL5348. Otherwise as for F14582.

F14587-F14589
Cupressocrinites abbreviatus Goldfuss, 1839; Jell *et al.*, 1988, pp.393-5.
LOCALITY: UQL5277, Wando Vale topographic Sheet [570409], 51-56m above base of section 300m ESE of The Volcano, Wando Vale Stn, 150km NW of Charters Towers, NQ.
FORMATION: Papilio Mudstone.
AGE: Middle Devonian, probably early Givetian.
REMARKS: As for F14582.

F14598-F14599, F14601, F14603
Cupressocrinites abbreviatus Goldfuss, 1839; Jell *et al.*, 1988, pp.393-5.
LOCALITY: UQL5356, Wando Vale topographic Sheet [554367] east flank of Spongophyllum Hill, in head of eroding gully, Wando Vale Stn, 150km NW of Charters Towers, NQ.
FORMATION: Papilio Mudstone.
AGE: Middle Devonian, Givetian.
REMARKS: As for F14582.

F14788
Cupressocrinites abbreviatus Goldfuss, 1839; Jell *et al.*, 1988, pp.393-5.
LOCALITY: From float in Burdekin River near Big Bend, north of Charters Towers, NQ.
FORMATION: ?Burdekin Fm.
AGE: Middle Devonian.

F14856
Cupressocrinites abbreviatus Goldfuss, 1839; Jell *et al.*, 1988, pp.393-5, fig.26g.
LOCALITY: UQL5318, Wando Vale topographic Sheet (565395) 65-116m above base of formation in gully 2.2km NE of Storm Dam, Wando Vale Stn, 150km NW of Charters Towers, NQ.
FORMATION: Papilio Mudstone.
AGE: Middle Devonian, (Givetian).
REMARKS: This specimen was omitted from the list of material on p.393 but is figured on p.394. Otherwise as for F14582.

F14868, F14873, F14875
Cupressocrinites abbreviatus Goldfuss, 1839; Jell *et al.*, 1988, pp.393-5.
LOCALITY: UQL5321. Wando Vale topographic Sheet [562390] creek section 3km NE of Storm Dam, Wando Vale Stn, 150km NW of Charters Towers, NQ.
FORMATION: Papilio Mudstone.
AGE: Middle Devonian, (late Eifelian-Givetian).
REMARKS: As for F14582.

Cupressocrinites sp. cf. *C. gracilis* Goldfuss, 1831

F14841
Cupressocrinites sp. cf. *gracilis* Goldfuss, 1831; Jell *et al.*, 1988, p.395, figs27i,j.
LOCALITY: UQL3579, Burges [687683] one of 5 localities collected from E to W along the fence line, 600m E of Martins Well windmill, from upper part of limestone which is slightly folded, Martins Well Area, 8km E of Pandanus Creek Homestead, 200km NW of Charters Towers, NQ.
FORMATION: Upper Martins Well Limestone Member, Shield Ck Fm.
AGE: early Devonian, (early Pragian).

Cypricardella rectangularis Etheridge fil., 1894

F1216 (Fig.2I)
HOLOTYPE *Cypricardella rectangularis* Etheridge fil., 1894, pp. 531-2, pl.39, fig.5.
LOCALITY: Rockhampton District, MEQ.
FORMATION: ?Malchi Fm.
AGE: Lower Carboniferous.
REMARKS: De Vis Collection.

Decorotergum warrenae Jell, 1983

F12294
HOLOTYPE *Decorotergum warrenae* Jell, 1983, pp.195-9, figs 1a,b,c,d, text fig.2.
LOCALITY: Kolane Station, 58km ENE of Taroom, SEQ.

FORMATION: Westgrove Ironstone Member, Evergreen Fm.
AGE: Jurassic (Late Liassic).

F12295
PARATYPE *Decorotergum warrenae* Jell, 1983, pp.195-9, figs 1e,f,g,h.
LOCALITY, FORMATION, AGE: As for F12294.

F12296
Decorotergum warrenae Jell, 1983, pp.195-9.
LOCALITY, FORMATION, AGE: As for F12294.

Deltopecten limaeformis (Morris, 1845)

F1208a,b
HOLOTYPE *Aviculopecten multiradiatus* Etheridge, 1872, p.327, pl.13, fig.1.
Aviculopecten multiradiatus Etheridge; Etheridge fil., 1892, p. 268.
Aviculopecten squamuliferus (Morris); Fletcher and Dun, 1929, p.5.
Deltopecten limaeformis (Morris) 1845; Runnegar and Ferguson, 1969, p.251.
?Corrugopecten squamuliferus (Morris, 1845); Waterhouse, 1982b, pp.8,37.
Squamuliferipecten squamuliferus (Morris, 1845); Waterhouse, 1987a, p.157.
Deltopecten limaeformis (Morris) ?; Waterhouse and Balfe, 1987, pp.24, 30, pl.1, fig.10.
LOCALITY: Lady Mary Reef, Gympie, SEQ.
FORMATION: Rammutt Fm.
AGE: Lower Permian.
REMARKS: Waterhouse (1982, p.37) erroneously recorded this Daintree specimen as housed in the GSQ.

F14391
Deltopecten limaeformis (Morris) ?; Waterhouse and Balfe, 1987, pp.24, 30, pl.1, fig.11.
LOCALITY: Gympie, SEQ.
FORMATION: Rammutt Fm.
AGE: Permian.

Dielasma sp.

F1206
Dielasma sp.; Etheridge fil., 1892, p.227, pl.40, figs. 1,2.
LOCALITY: Rockhampton District, MEQ.
FORMATION: ?
AGE: Carboniferous.

Dimitobelus sp.

F6089
Dimitobelus sp.; Hill *et al.*, 1968, pl.K2, figs 15a,b,c.
LOCALITY: Marion Downs, near Boulia, CWQ.
FORMATION: ?Toolebuc Fm.
AGE: Albian.

Dolatocrinus peregrinus Jell *et al.*, 1988

F14818
HOLOTYPE *Dolatocrinus peregrinus* Jell *et al.*, 1988, pp.387-8, figs22a-d.
LOCALITY: UQL5277 Wando Vale topographic Sheet [570409] 51-56m above base of section 300m ESE of The Volcano, Wando Vale Stn, 150km NW of Charters Towers, NQ.
FORMATION: Papilio Mudstone.
AGE: Middle Devonian, (probably early Givetian).
REMARKS: This formation was formally named by Lang *et al.* (1989) as Papilio Mudstone.

F14866-F14867
PARATYPES *Dolatocrinus peregrinus* Jell *et al.*, 1988, pp.387-8; F14866, fig.22e; F14867, figs 22f,g.
LOCALITY: UQL5320 Wando Vale topographic Sheet [563392] section on ridge 2.9km NE of Storm Dam, Wando Vale Station, 150km NW of Charters Towers, NQ.
FORMATION: Papilio Mudstone.
AGE:Middle Devonian, (late Eifelian- Givetian).
REMARKS: As for F14818.

F14872
PARATYPE *Dolatocrinus peregrinus* Jell *et al.*, 1988, pp.387-8, fig.22h.
LOCALITY: UQL5321, Wando Vale [562390] creek section 3km NE of Storm Dam. Wando Vale Stn, 150km NW of Charters Towers, NQ.
FORMATION: Papilio Mudstone.
AGE: Middle Devonian, (late Eifelian-Givetian).
REMARKS: As for F14818.

Dysmorphoptiloides elongata Evans, 1956

F6493
Dysmorphoptiloides elongata Evans, 1956; Evans, 1971, p.146, fig.2.
LOCALITY: Mt Crosby, SEQ, Upper Bed, 910805-911805, Ipswich 1 mile military map.
FORMATION: Mt Crosby Fm.
AGE: Early Late Triassic (Carnian).

Echinalosia ovalis (Maxwell, 1954)

F1205
Strophalosia gerardi King; Etheridge fil., 1892, p.260-2, pl. 40, fig.7.
Strophalosia gerardi King; Prendergast, 1942, pp.45-47.
Echinalosia ovalis (Maxwell, 1954); Waterhouse, 1980, pp.37-8.
LOCALITY: Banana Creek, CQ.
FORMATION: Flat Top Formation.
AGE: Permian.

Edmondia* (?) *smithi Etheridge fil., 1894

F1219
undescribed bivalve; Etheridge fil., 1892, pl, 39, fig.8.
SYNTYPE *Edmondia* (?) *smithi* Etheridge fil., 1894, pp.533-4.
LOCALITY: Rockhampton district, MEQ.
FORMATION: ?Malchi Fm.
AGE: Lower Carboniferous.
REMARKS: De Vis Collection. The figure of F1219 is laterally reversed in Etheridge fil. (1892, pl.39, fig.8).

F2837 (Fig.2H)
SYNTYPE *Edmondia* (?) *smithi* Etheridge fil., 1894, pp.533-4, pl. 39, fig.6.
LOCALITY, FORMATION, AGE: As for F1219.
REMARKS: De Vis Collection.

***Enoploclytia* sp.**

F1280
Callianassa (?) sp.; Etheridge fil., 1917. p.10, pl.2, fig. 4.
Enoploclytia sp.; Woods, 1957, p.166.
LOCALITY: Walsh or Mitchell River (?), NQ.
FORMATION: Blackdown Fm.
AGE: Aptian, Lower Cretaceous.

Enoploclytia terraereginae Etheridge fil., 1914

F3234
Enoploclytia terrae-reginae Etheridge Jr.; Woods, 1957, pp.166-8, pl.4, figs 5,6, text fig.6.
Enoploclytia terrae-reginae Etheridge, 1914; Hill *et al*., 1968, pl.K11, fig.6.
LOCALITY: 'Currane', 10 miles N of Dartmouth, CQ.
FORMATION: Allaru Mudstone.
AGE: Lower Cretaceous, (Albian).

F3235
Enoploclytia terrae-reginae Etheridge Jr.; Woods, 1957, pp.166-8, pl.4, figs8,9.
LOCALITY, FORMATION, AGE: As for F3234.
F3236
Enoploclytia terrae-reginae Etheridge Jr.; Woods, 1957, pp.166-68, pl.4, fig.7.
Enoploclytia terrae-reginae Etheridge, 1914; Hill *et al*., 1968, pl.K11, fig.7.
LOCALITY, FORMATION, AGE: As for F3234.

Eoscartoides bryani Evans, 1956

F3693a/b
Eoscartoides bryani Evans, 1956; Evans, 1961, p.20, fig.4a.
Eoscartoides bryani Evans; Hill *et al*., 1965, pl.T14, fig.2.
LOCALITY: Mt Crosby Insect Beds, SEQ.
FORMATION: Mt Crosby Fm.
AGE: Early Late Triassic, (Carnian).
REMARKS: The counterpart of this specimen originally referred to as F3694 has been re-registered as F3693b.

F3695a/b
Eoscartoides bryani Evans, 1956; Evans, 1961. p.20, fig.4b.
LOCALITY, FORMATION, AGE: As for F3693.
REMARKS: The counterpart of this specimen originally referred to as F3696 has been re-registered as F3695b.

F3697a/b
Eoscartoides bryani Evans, 1956; Evans, 1961. p.20, fig.4c.
LOCALITY, FORMATION, AGE: As for F3693.
REMARKS: The counterpart of this specimen originally referred to as F3698 is re-registered as F3697b.

***Euastacus* ? sp.**

F5740
Parastacid; Hill *et al*., 1970, pl.Cz6, fig.4.
Euastacus ? sp.; Sokol, 1987, pp.81-2, fig.1.
LOCALITY: Brittains Quarry, Darra, SEQ.
FORMATION: Darra Fm.
AGE: Palaeocene.

Eucalyptocrinites rosaceus Goldfuss, 1831

F14533, F14541, F14544, F14546, F14548
Eucalyptocrinites rosaceus Goldfuss, 1831, in Jell *et al*., 1988, pp.377-8; F14533, fig.15q; F14546, figs 15e- g; F14548, fig. 15m.

LOCALITY: QML512 Wellington topographic Sheet [799867] richly fossiliferous limestone (Unit 18 of Johnson, 1975) 870m NNW of Mountain View Homestead on Wellington Caves Rd, 9km SSW of Wellington, NSW.
FORMATION: Garra Fm.
AGE: Early Devonian, (Pragian, *sulcatus* biozone).

Euporismites balli Tillyard, 1916

F14376
Euporismites balli Tillyard; Lambkin, 1987, pp.295-300, fig.3.
LOCALITY: Clay Pit, New Chum (near Robert Street, Ebbw Vale), SEQ.
FORMATION: Redbank Plains Fm.
AGE: Paleocene or Eocene.

Euspira reflecta (Moore, 1870)

F1259
HOLOTYPE *Natica lineata* Etheridge 1872, p.342, pl.21, fig.1.
Natica variabilis Moore; Etheridge fil., 1892 pp.485-6, 573, pl.31, fig.2. [Refigured Etheridge's 1872 illustration].
Euspira reflecta (Moore), 1870; Day, 1967, pp.8-9.
LOCALITY: Maryborough, SEQ.
FORMATION: Maryborough Fm.
AGE: Lower Cretaceous, (Aptian).

Fissilunula clarkei (Moore, 1870)

F1250
HOLOTYPE *Cyprina expansa* Etheridge, 1872, p.338, pl.19, fig. 1.
Cyprina clarkei Moore; Etheridge fil., 1892, pp.474-5, 568-9.
Cyprina? (vel *Cytherea* ?) *clarkei*, Moore; in Etheridge fil., 1902b, pp.32-3.
Fissilunula clarkei (Moore) Etheridge fil., 1902a, pp.36-7.
Fissilunula clarkei (Moore) 1870; Day, 1967, pp.14-6.
Fissilunula clarkei (Moore, 1870); Fleming, 1970, pp.8-9.
LOCALITY: Maryborough, SEQ.
FORMATION: Maryborough Fm.
AGE: Lower Cretaceous, (Aptian).
REMARKS: Daintree Collection.

Galene bispinosa (Herbst, 1783)

F1185
Galene bispinosa Herbst; Etheridge fil. and McCulloch, 1916, pp.10-1, pl.3, figs3,4.
LOCALITY: New Channel, Mouth of Brisbane River, Moreton Bay, SEQ.
FORMATION: Unnamed estuarine deposit.
AGE: Pleistocene/Holocene.
REMARKS: See *Scylla serrata* (F1187).

F6558
Galene bispinosa (Herbst, 1783); Hill *et al.*, 1970, pl.C76, fig.8.
LOCALITY: ?Moreton Bay, SEQ.
FORMATION: Unnamed estuarine deposit.
AGE: Pleistocene/Holocene.

Gasterocomid indet.

F14840
Gasterocomid indet.; Jell *et al.*, 1988, p.391, figs27a-h.
LOCALITY: UQL3579, Burges topographic Sheet [687683] one of five localities collected from E to W along fence line 600m E of Martins Well windmill. Martins Well, 8km E of Pandanus Creek Homestead, 200km NW of Charters Towers, NQ.
FORMATION: Upper Martins Well Limestone Member Shield Ck Fm.
AGE: Early Devonian, (early Pragian).
REMARKS: F14840c is erroneously referred to as G14840c in Jell *et al.* (1988, p.396).

Gastropoda (not specified)

F17640-F17641
Gastropods: Wood, 1972, p.331.
LOCALITY: Maroochydore, cnr Kuran Rd and Broadwater St, 1.5-6.5m below surface, SEQ.
FORMATION: Estuarine deposits.
AGE: Holocene.
REMARKS: These gastropods included *Polinices conicus* (Lamarck, 1822) and *P. sordidus* Swainson, 1821.

Georgina andersonorum Wade, 1977a

F7159
HOLOTYPE *Georgina andersonorum* Wade, 1977a, pp.4, 8, pl.2, figs 1-4, text fig.5, fig.6d.
LOCALITY: Halfway Dam Area, Tobermorey Stn, 25°53'S, 137°50'E, NT.
FORMATION: Top of Coolibah Fm.
AGE: Lower Middle Ordovician.

F7160-7165, 7167-7174
PARATYPES *Georgina andersonorum* Wade, 1977a,

pp.4,8, text fig. 5; F7164, pl.2, figs 5,6; F7165, pl.1, figs 1-4.

LOCALITY, FORMATION, AGE: As for holotype.

F7166

PARATYPE *Georgina andersonorum* Wade, 1977a.

LOCALITY: Pulatera Hills, Glenormiston Stn, 22°57'S, 138°21'E, CWQ.

FORMATION, AGE: As for holotype.

REMARKS: Wade, 1977a (pl.1, figs 1-4) is referred to as F7135, the correct number is F7165.

Georgina beuteli Wade, 1977a

F7219

HOLOTYPE *Georgina beuteli* Wade, 1977a, pp.4,9-10, pl.5, fig. 6, text fig.6c.

LOCALITY: near Halfway Dam, Tobermorey Stn, 22°53'S, 137°50'E, NT.

FORMATION: Upper third of Coolibah Fm.

AGE: Lower Middle Ordovician.

F7220-7221

PARATYPES *Georgina beuteli*, Wade, 1977a, pp.4,9-10, F7220, pl. 5, fig.7.

LOCALITY, FORMATION, AGE: As for holotype.

Georgina dwyeri Wade, 1977a

F7206-7212

PARATYPES *Georgina dwyeri* Wade, 1977a, pp.4,10-11, F7206, pl. 6, fig.1.

LOCALITY: Base of Oodatra Point, Toko Range, Glenormiston, 22°53'S, 138°15'E, CWQ.

FORMATION: Lower Upper Nora Fm.

AGE: Upper Middle Ordovician.

REMARKS: Half of F7200 is missing.

Georgina linda Wade, 1977a

F7175, F7178-F7185

PARATYPES *Georgina linda* Wade, 1977a, p.10; F7178, pl.5 fig. 8; F7185, pl.5, fig.5.

LOCALITY: W side of small hill in Lower Nora Formation, 23°19'S, 138°06'E, CWQ.

FORMATION: Lower Nora Fm.

AGE: Middle Ordovician.

F7176

HOLOTYPE *Georgina linda* Wade, 1977a, p.10, pl.5, figs 1-3; text- fig.6g.

LOCALITY: 4.5 miles NW of 26 Bore, Glenormiston Stn, 22°47'S, 138°10'E, CWQ.

FORMATION: Lower Nora Fm.

AGE: Middle Ordovician.

F7177

PARATYPE *Georgina linda* Wade, 1977a, p.10, pl.5, fig.4.

LOCALITY, FORMATION, AGE: As for holotype.

F7186

PARATYPE *Georgina linda* Wade, 1977a, p.10.

LOCALITY: Nora Fm, Adjacent to road at western end of Toko Range 22°43'S, 137°43'E, NT.

FORMATION, AGE: As for holotype.

REMARKS: specimen missing.

Georgina taylori Wade, 1977a

F7148

HOLOTYPE *Georgina taylori* Wade, 1977a, pp.4,8-9, pl.3, figs 1-4, text-fig.6o.

LOCALITY: Near Halfway Dam, Tobermorey Stn, 22°53'S, 137°50'E, NT.

FORMATION: Coolibah Fm.

AGE: Lower Middle Ordovician.

F7090-F7152

PARATYPES *Georgina taylori* Wade 1977a, pp.4,8-9; F7091, pl.4, fig.5; F7101, pl.3, fig.5; F7106, pl.4, fig.6; F7111, pl.4, figs 1,2; F7121, pl.4, fig.3; F7130, pl.4, fig.4; F7134, pl. 2, fig.7; F7139, pl.3, fig.6; F7149, pl.4, fig.7.

LOCALITY, FORMATION, AGE: As for holotype.

F7153

PARATYPE *Georgina taylori*, Wade, 1977a, pp.4,8-9.

LOCALITY: Pulatera Hills, Glenormiston Stn, 22°57'S, 138°21'E, CWQ.

FORMATION, AGE: As for holotype.

F7154-F7155

PARATYPES *Georgina taylori* Wade, 1977a, pp.4,8-9.

LOCALITY: 3kms S of Eurithethera Soak and 4-8kms WSW of first gap in scarp, Toomba Range, CWQ.

FORMATION, AGE: As for holotype.

REMARKS: F7114, F7122, and F7132 and portions of F7096, F7117, F7130 and F7111 are missing. F7091 and F7135 were figured in Wade (1977b). F7096 and F7109 are part of the same individual, and referred to one number, F7096.

Glauconome sp.

F1203

Glauconome sp.; Etheridge fil., 1892, p.223, pl.44, fig.11.

LOCALITY: Rockhampton District, MEQ.
FORMATION: ?Malchi Fm.
AGE: Carboniferous.

Glyphea oculata Woods, 1957

F3233
HOLOTYPE *Glyphea oculata* Woods, 1957, pp.162-3, pl.4, fig.4, text figs4a,b.
LOCALITY: 'Currane', 10 miles N of Dartmouth, CQ.
FORMATION: Allaru Mudstone.
AGE: Lower Cretaceous, (Albian).

Goniastrea aspera Verrill, 1905

F12401
Goniastrea aspera; Pickett *et al.*, 1985, pp.103-14.

LOCALITY: S of Amity Point, N Stradbroke Island (Brisbane 1:100,000 Sheet, grid reference 441658).
FORMATION: Unnamed marine sediments.
AGE: Pleistocene.
REMARKS: See *Porites* sp.

Grammatodon (Indogrammatodon) robusta (Etheridge, 1872).

F1242
HOLOTYPE *Cucullaea robusta* Etheridge, 1872, p.340, pl.20, fig. 1.
Cucullaea robusta Etheridge; Etheridge fil., 1892, p.565.
Idonearca robusta Etheridge; Etheridge fil., 1902a, p.68.
Grammatodon (Indogrammatodon) robusta (Etheridge, 1872) Fleming 1966b, pp.13-6, pl.5, figs3a,b.
Grammatodon (Indogrammatodon) robusta (Etheridge Snr., 1872); Hill et al., 1968, pl.K6, fig.12.
LOCALITY: Maryborough, SEQ.
FORMATION: Maryborough Fm.
AGE: Lower Cretaceous, (Aptian).
REMARKS: Daintree Collection.

F1243
HOLOTYPE *Cucullaea costata* Etheridge, 1872, p.340, pl.20, fig. 2.
Cucullaea robusta Etheridge; Etheridge fil., 1892, p.565.
Idonearca robusta Etheridge; Etheridge fil., 1902a, p.68.
Grammatodon (Indogrammatodon) robusta (Etheridge, 1872) Fleming, 1966b, pp.13-6, pl.5, figs4a,b,c.
LOCALITY: Maryborough, SEQ.
FORMATION: Maryborough Fm.
AGE: Lower Cretaceous, (Aptian).
REMARKS: Daintree Collection

F5472
Grammatodon (Indogrammatodon) robusta (Etheridge, 1872) Fleming 1966b, pp.13-6, pl.6, figs3a,b,c,d,e,f.
LOCALITY: Maryborough, SEQ.
FORMATION: Maryborough Fm.
AGE: Lower Cretaceous, (Aptian).

Gyaloceras smithi Whitehouse, 1927

F304
HOLOTYPE *Gyaloceras smithi* Whitehouse, 1927, pp.114-5, pl.17, fig.1, text fig.8.
Gyaloceras smithi Whitehouse, 1927; Arkell *et al.*, 1957, p. L286, fig.338-5.
LOCALITY: Walsh River, NQ.
FORMATION: Blackdown Fm.
AGE: Lower Cretaceous, (Aptian).

Gyroceras dubius Etheridge fil., 1892

F1231
HOLOTYPE *Gyroceras dubius* Etheridge fil., 1892, p.294, pl.41, fig.12.
LOCALITY: Rockhampton District, MEQ.
FORMATION: ?Malchi Fm.
AGE: Lower Carboniferous

Hamites* aff. *H. maximus J. Sowerby

F1601
Hamites aff. *maximus* J. Sowerby; Whitehouse, 1926, p.226, pl. 39, figs 2a,b.
LOCALITY: Ward River, head of Warrego River, SCQ.
FORMATION: ?
AGE: Lower Cretaceous.
REMARKS: McNamara (1980) considered that F1601 was not referable to *Hamites* based upon the presence of a trifid lateral lobe.

Hemiptera *incertae sedis*

F6540a/b
Hemiptera *incertae sedis*; Evans, 1971, p.149, fig.4d.
LOCALITY: Mount Crosby, SEQ, Upper Bed, 910805-911805, Ipswich 1 mile military map.
FORMATION: Mt Crosby Fm.

AGE: Early Late Triassic, (Carnian).

F6483a/b
Hemiptera *incertae sedis*; Evans, 1971, p.149, fig.4e.
LOCALITY, FORMATION, AGE: As for F6540.

Hercophyllum shearsbyi Süssmilch, 1914

F2479
Hercophyllum shearsbyi (Sussmilch) Jones, 1936, pp.53-5, pl.5, figs 1a-g.
Hercophyllum shearsbyi Süssmilch, 1914: Hill, 1981, p.F252, figs 160a-e.
LOCALITY: Hatton's Corner, Yass, NSW.
FORMATION: ?
AGE: Upper Silurian.
REMARKS: This species was introduced as *Cyathophyllum shearsbyi* by Etheridge (1904, p.288), mentioned by Harper (1909, pp.39-43) and figured by Süssmilch (1914, fig.143); but it was not fully described by Jones until 1936. F2479 consists of a small remaining fragment, and the thin sections, which are figs 1a-g in Jones (1936).

Heterochterus timmsii Evans, 1971

F6473
HOLOTYPE *Heterochterus timmsii* Evans, 1971, p.149-50, fig.5.
LOCALITY: Mt Crosby, SEQ.
FORMATION: Mt Crosby Fm.
AGE: Early Late Triassic, (Carnian).

Heterojassus membranaceus Evans, 1961

F3701
HOLOTYPE *Heterojassus membranaceus* Evans, 1961, p.23, fig.5b.
LOCALITY: Mt Crosby Insect Beds, SEQ.
FORMATION: Mt Crosby Fm.
AGE: Early Late Triassic, (Carnian).

Heteronella marksei Evans, 1961

F3699a/b
HOLOTYPE *Heteronella marksei* Evans, 1961, p.22, fig.5a.
LOCALITY: Mt Crosby Insect Bed, SEQ.
FORMATION: Mt Crosby Fm.
AGE: Early Late Triassic, (Carnian).
REMARKS: The counterpart of this specimen originally referred to as F3700b has been re-registered as F3699b.

Hexacrinites interscapularis Phillips, 1841

F14580
Hexacrinites interscapularis Phillips, 1841; Jell *et al.*, 1988, pp.368-70, fig.11a.
LOCALITY: UQL5305 Wando Vale topographic sheet [569404] south-westerly oriented gully 400m south of the volcano (not older than *varcus* biozone) Wando Vale Stn, NQ.
FORMATION: Papilio Mudstone Fm.
AGE: Middle Devonian, (late Eifelian-Givetian).
REMARKS: The formation was formally named by Lang *et al.*, (1989) as Papilio Mudstone.

F14594, F14595
Hexacrinites interscapularis Phillips, 1841; Jell *et al.*, 1988, pp.368-70, F14594 figs11e-h.
LOCALITY: UQL5252 Wando Vale topographic sheet [551366] south flank of low hill, 1km south of Storm Dam Creek. (?*varcus* biozone) Wando Vale Station, 150km NW of Charters Towers, NQ.
FORMATION, AGE, REMARKS: As for F14580.

F14597
Hexacrinites interscapularis Phillips, 1841; Jell *et al.*, 1988, pp.368-70.
LOCALITY: UQL5318, Wando Vale topographic Sheet [565395] 65-116m above base of formation in gully 2.2km NE of Storm Dam, Wando Vale Station, 150km NW of Charters Towers NQ.
FORMATION: Papilio Mudstone.
AGE: Middle Devonian, (Givetian).
REMARKS: As for F14580.

F14596, F14600, F14602
Hexacrinites interscapularis Phillips, 1841; in Jell *et al.*, 1988, pp.368-70.
LOCALITY: UQL5356, Wando Vale topographic Sheet (554367) east flank of Spongophyllum Hill, in head of eroding gully; (*varcus* biozone) Wando Vale Station, 150km NW of Charters Towers, NQ.
FORMATION: Papilio Mudstone.
AGE: Middle Devonian, (Givetian).
REMARKS: As for F14580.

F14604
Hexacrinites interscapularis Phillips, 1841; Jell *et al.*, 1988, pp.368-70.
LOCALITY: UQL5335, Wando Vale topographic Sheet [620418] along northern tributary of Lomandra Creek, (*ensensis* zone), Wando Vale Station, 150km NW of Charters Towers, NQ.

FORMATION: Papilio Mudstone.
AGE: Middle Devonian, (Givetian).
REMARKS: As for F14580. Locality information for this site was omitted by Jell *et al.* (1988).

F14743, F14745, F14834, F14871, F14874
Hexacrinites interscapularis Phillips, 1841; Jell *et al.*, 1988, pp.368-70.
LOCALITY: UQL5321, Wando Vale topographic Sheet [562390] creek section 3km NE of Storm Dam, Wando Vale Stn, 150km NW of Charters Towers, NQ.
FORMATION, AGE, REMARKS: As for F14580.

F14755, F14756, F14763
Hexacrinites interscapularis Phillips, 1841; Jell *et al.*, 1988, pp.368-70.
LOCALITY: UQL5320 Wando Vale topographic Sheet [563392] section on ridge 2.9km NE of Storm Dam, Wando Vale Stn, 150km NW of Charters Towers, NQ.
FORMATION, AGE, REMARKS: As for F14580.

F14843, F14845
Hexacrinites interscapularis Phillips, 1841; Jell *et al.*, 1988, pp.368-70.
LOCALITY: UQL5218, Wando Vale topographic Sheet [559389] *c.* 68m above base of formation in gully on east slope of Storm Hill, 1.2km N of Storm Dam, Wando Vale Stn, 150km NW of Charters Towers, NQ.
FORMATION: Papilio Mudstone.
AGE: Middle Devonian, (?late Eifelian).
REMARKS: As for F14580.

F14849
Hexacrinites interscapularis Phillips, 1841; Jell *et al.*, 1988, pp.368-70.
LOCALITY: UQL5267, Wando Vale topographic Sheet [543363] in gully, 1.5km SW of Storm Dam, Wando Vale Stn, 150km NW of Charters Towers, NQ.
FORMATION: Papilio Mudstone.
AGE: Middle Devonian, (Givetian).
REMARKS: As for F14580.

Hexacrinites spinosus Müller, 1856

F14746
Hexacrinites spinosus Müller 1856; Jell *et al.*, 1988, pp.370-2, figs 12d-f.
LOCALITY: UQL5277 Wando Vale topographic Sheet [570409] 51-56m above base of section 300m, ESE of The Volcano, Wando Vale Stn, 150km NW of Charters Towers, NQ.
FORMATION: Papilio Mudstone.
AGE: Middle Devonian, (probably early Givetian).
REMARKS: This formation was formally named by Lang *et al.* (1989) as Papilio Mudstone.

Homolopsis etheridgei (Woodward, 1892)

F2796
Homolopsis etheridgei (H. Woodward); Woods, 1953, pp.50-2, pl. 2, fig.2.
Homolopsis etheridgei (Woodward, 1892); Hill *et al.*, 1968, pl. K11, fig.8.
Homolopsis etheridgei (Woodward, 1892); Glaessner, 1980, pp. 173-4.
LOCALITY: 10 miles N of Dartmouth, CQ.
FORMATION: Allaru Mudstone.
AGE: Lower Cretaceous, (Albian).

F2843
Homolopsis etheridgei (H. Woodward); Woods, 1953, pp.50-2, fig.1a.
Homolopsis etheridgei (Woodward) 1892; Glaessner, 1980, pp. 173-4.
LOCALITY, FORMATION, AGE: As for F2796.

F2845
Homolopsis etheridgei (H. Woodward); Woods, 1953, pp.50-2.
Homolopsis etheridgei (Woodward, 1892); Glaessner, 1980, pp. 173-4.
LOCALITY, FORMATION, AGE: As for F2796.

F2846
Homolopsis etheridgei (H. Woodward); Woods, 1953, pp.50-2.
Homolopsis etheridgei (Woodward, 1892); Glaessner, 1980, pp. 173-4.
LOCALITY, FORMATION, AGE: As for F2796.

F2847
Homolopsis etheridgei (H. Woodward); Woods, 1953, pp.50-2, pl. 2, fig.3.
Homolopsis etheridgei (Woodward, 1892); Glaessner, 1980, pp. 173-4.
LOCALITY, FORMATION, AGE: As for F2796.

F2848
Homolopsis etheridgei (H. Woodward); Woods, 1953, pp.50-2.
Homolopsis etheridgei (Woodward, 1892); Glaessner, 1980, pp. 173-4.

LOCALITY, FORMATION, AGE: As for F2796.

F2875
HOLOTYPE *Prosopon etheridgei* Woodward, 1892, p.301, pl.4.
Prosopon etheridgei H. Woodward; Etheridge fil., 1917, pp.5-7, pl.1, figs 1-4.
Homolopsis etheridgei (H. Woodward); Woods, 1953, pp.50-2, pl.2, fig.1.
Homolopsis etheridgei (Woodward, 1892); Glaessner 1980, pp. 173-4, pl.1, fig.2.
LOCALITY: CQ.
FORMATION: Probably Allaru Mudstone.
AGE: Lower Cretaceous, (Albian).

Homoptera *incertae sedis*

F6491a/b
Homoptera *incertae sedis*; Evans, 1971, p.149, fig.4c.
LOCALITY: Mt Crosby, SEQ, Upper Bed, 910805- 911805, Ipswich 1 mile military map.
FORMATION: Mt Crosby Fm.
AGE: Early Late Triassic, (Carnian).

Hoploparia mesembria Etheridge fil., 1917

F2908
Hoploparia mesembria Etheridge Jr.; Woods, 1957, pp. 169-71, pl.6, fig.4.
LOCALITY: 'Currane', 10 miles N of Dartmouth, CQ.
FORMATION: Allaru Mudstone.
AGE: Lower Cretaceous, (Albian).

F3239
Hoploparia mesembria Etheridge Jr.; Woods, 1957, pp. 169-71.
LOCALITY, FORMATION, AGE: As for F2908.

F3240
Hoploparia mesembria Etheridge Jr., 1917, in Woods, 1957, pp. 169-71.
LOCALITY,FORMATION, AGE: As for F2908.

F3241
Hoploparia mesembria Etheridge Jr.; Woods, 1957, pp. 169-71.
LOCALITY,FORMATION, AGE: As for F2908.

F3243
Hoploparia mesembria Etheridge Jr.; Woods, 1957, pp. 169-71, pl.6, fig.2.
Hoploparia mesembria Etheridge, 1917; Hill *et al.*, 1968, pl. K11, fig.3.
LOCALITY, FORMATION, AGE: As for F2908.

F3244
Hoploparia mesembria Etheridge Jr.; Woods, 1957, pp. 169-71, pl.6, fig.3.
LOCALITY, FORMATION, AGE: As for F2908.

Hylicella colorata Evans, 1956

F3686
Hylicella colorata Evans, 1956; Evans, 1961, p.15, fig.1d.
LOCALITY: Mt Crosby Insect Beds, SEQ.
FORMATION: Mt Crosby Fm.
AGE: Early Late Triassic, (Carnian).

Indeterminate heteropteron forewing

F3702
Heteropteron wing; Evans, 1961, p.23, fig.5c.
LOCALITY: Mt Crosby Insects Beds, SEQ.
FORMATION: Mt Crosby Fm.
AGE: Early Late Triassic, (Carnian).

Ingelarella strzeleckii (de Koninck, 1877)

F946
Spirifer undifera var. *undulata*. F. Röm.; Etheridge, 1872, p. 330, pl.16, fig.3.
Spirifer strzeleckii De Koninck; Etheridge fil., 1892, p.234, pl.10, fig.6.
Ambikella strzeleckii (de Koninck) 1876; Runnegar and Ferguson, 1969, p.251.
LECTOTYPE *Ingelarella strzeleckii* (de Koninck); McClung, 1978, p.43, pl.3, fig.25.
LOCALITY: Lady Mary Reef, Gympie, SEQ.
FORMATION: Rammutt Fm.
AGE: Permian.
REMARKS: Previously registered as F66 in Aplin's 1871 Fossil Register.

F3272
Spirifer undifera var. *undulata* F. Röm.; Etheridge, 1872, p. 331, pl.16, fig.4.
Spirifer strzeleckii De Koninck; Etheridge fil., 1892, p. 234.
Ambikella strzeleckii (de Koninck) 1876; Runnegar and Ferguson, 1969, p.251.
Ingelarella strzeleckii (de Koninck, 1877); McClung, 1978, p. 43.
LOCALITY: Gympie, SEQ.
FORMATION: Rammutt Fm.
AGE: Permian

F3304
Spirifera undifera var. *undulata* F. Röm.; Etheridge, 1872, p. 330-3, pl.16, fig.5.
Spirifera strzeleckii de Koninck; Etheridge fil., 1892, p.234.
Ambikella strzeleckii (de Koninck) 1876; Runnegar and Ferguson, 1969, p.251.
Ingelarella strzeleckii (de Koninck, 1877); McClung, 1978, p. 43.
LOCALITY: Lady Mary Reef, Gympie, SEQ.
FORMATION: Rammutt Fm.
AGE: Permian.
REMARKS: Old No. F13A Aplin's Register (1871).

F5774
Ingelarella strzeleckii (de Koninck); McClung, 1978, p.43, pl. 3, fig.23.
LOCALITY: Gympie, SEQ.
FORMATION: Rammutt Fm.
AGE: Permian.
REMARKS: Previously registered as F37 in Aplins' (1871) Register.

Inoceramus carsoni McCoy, 1865

F1238
HOLOTYPE *Inoceramus pernoides* Etheridge, 1872, pp.343-4, pl. 22, fig.3.
Inoceramus pernoides Etheridge; Etheridge fil., 1892, p.464, pl.25, fig.12.
Inoceramus etheridgei Etheridge fil., 1901, p.22-3.
Inoceramus carsoni M'Coy, 1865, in Crame, 1985, pp.498-501.
LOCALITY: Marathon Stn, CQ.
FORMATION: Allaru Mudstone.
AGE: Lower Cretaceous, (Albian).
REMARKS: Daintree Collection.

F15642
Inoceramus sp. cf. *I. pernoides* Etheridge; Etheridge fil., 1892, p.464, pl.42, fig.7.
Inoceramus carsoni McCoy, 1865; Crame, 1985, pp.498-501.
LOCALITY: Bowen Downs, east of Muttaburra, CQ.
FORMATION: ?Allaru Mudstone.
AGE: Lower Cretaceous, (Albian).
REMARKS: Daintree Collection

Inoceramus elongatus Etheridge, 1872

F1240
Inoceramus multiplicatus Stol. var. *elongatus*, Etheridge, 1872, p.343, pl.22, fig.2
HOLOTYPE *Inoceramus elongatus* (Etheridge) Etheridge fil., 1892, p.464.
Inoceramus elongatus Etheridge; Etheridge fil., 1902a, p.70.
LOCALITY: Marathon Stn, CQ.
FORMATION: Allaru Mudstone.
AGE: Lower Cretaceous, (Albian).
REMARKS: The concentric ribs and elongate form of this shell suggest affinities with *I. carsoni* group (*sensu* Crame, 1985). Daintree Collection.

Inoceramus marathonensis Etheridge, 1872

F1239
HOLOTYPE *Inoceramus marathonensis* Etheridge, 1872, p.343, pl. 22, fig.1.
Inoceramus marathonensis Etheridge; Etheridge fil., 1892, p. 464.
Inoceramus marathonensis Etheridge; Etheridge fil., 1902a, p. 70.
LOCALITY: Marathon Stn, CQ.
FORMATION: Allaru Mudstone.
AGE: Lower Cretaceous, (Albian).
REMARKS: Daintree Collection.

Inoceramus* sp. cf. *I. sutherlandi McCoy, 1865

F1241
Inoceramus allied to *I. problematicus*, D'Orb.; Etheridge, 1872, p.344, pl.22, fig.4.
Inoceramus carsoni McCoy in Etheridge fil., 1892, p.463.
Inoceramus etheridgei Etheridge fil., 1901, p.22-3.
Inoceramus cf. *sutherlandi*, McCoy, 1865; Crame, 1985, pp.501-2.
LOCALITY: Marathon Stn, CQ.
FORMATION: Allaru Mudstone.
AGE: Lower Cretaceous, (Albian).
REMARKS: Daintree Collection.

Labeceras (Labeceras) compressum Whitehouse, 1926

F1600
HOLOTYPE *Labeceras compressum* Whitehouse, 1926, p.228, pl.36, fig.5, pl.39, figs 5a,b.
Labeceras (Labeceras) compressum Whitehouse; Reyment, 1964, p. 24.
LOCALITY: Tower Hill, Muttaburra, CQ.
FORMATION: ?Mackunda Fm
AGE: Lower Cretaceous.

Labeceras sp. cf. *L. compressum* Whitehouse, 1926

F6096

Labeceras cf. *compressum* Whitehouse, 1926; Hill, *et al.*, 1968, pl.K7, fig.5.

LOCALITY: Currane Station, 16km N of Dartmouth, CQ.

FORMATION: Allaru Mudstone.

AGE: Lower Cretaceous, (Albian).

Labeceras (Labeceras) laqueum (Etheridge fil., 1892)

F2148

Crioceras taylori, Eth. fil.; Etheridge fil., 1909, pp.162-3.

LOCALITY: ?Head of Walsh River, NQ.

FORMATION: ?Wallumbilla Fm.

AGE: Lower Cretaceous.

REMARKS: F2148 bears a label saying 'Head of the Walsh River', which suggests that it may be the Queensland Museum specimen referred to by Etheridge fil. (1909, p.162). However the lithology is not typical of the Walsh River material and this specimen bears donor number D222 which suggests a McKinlay's Range origin. See also *Beudanticeras sutherlandi* (F1273).

F17743

HOLOTYPE *Hamites? laqueus* Etheridge fil., 1892, pp.496-7, pl. 42, figs 14, 15.

Labeceras laqueus (Etheridge fil.) Whitehouse, 1926, pp.227-8.

Labeceras (Labeceras) laqueum (Etheridge); Reyment, 1964, p. 22.

LOCALITY: Tower Hill, Landsborough Creek, a head tributary of the Thomson River, N of Muttaburra, CQ.

FORMATION: Mackunda Fm.

AGE: Lower Cretaceous.

REMARKS: The phragmocone and part of the living chamber of this specimen is missing but a plastoholotype (L598) is held in the Australian Museum (Fletcher, 1971). The figure in Etheridge fil. (1892, pl.42, fig.14) is laterally reversed. The other Queensland Museum specimen mentioned by Etheridge fil. (1892) has not been identified.

Lasiocladia? hindei Etheridge fil., 1892

F5706

HOLOTYPE *Lasiocladia? hindei* Etheridge fil., 1892, p.199, pl.41, figs 1,2.

Lasiocladia? hindei Eth. f.; Pickett, 1969, pp.9-10, pl.1, fig.3.

Lasiocladia? hindei in Pickett, 1983, p.112.

LOCALITY: Rockhampton, MEQ.

FORMATION: ?Malchi Fm.

AGE: Lower Carboniferous.

REMARKS: De Vis Collection. Pickett (1969) discussed possible relationships of this sponge.

Leionucula quadrata (Etheridge, 1872)

F1244

SYNTYPE *Nucula gigantea* Etheridge, 1872, p.341, pl.20, fig. 4.

Nucula gigantea Etheridge; Etheridge fil., 1892, p.566.

Nucula gigantea Etheridge; Etheridge fil., 1902a, p.74.

Leionucula quadrata (Etheridge, 1872) Fleming 1966a, pp.5-8, pl. 2, figs1a,b.

LOCALITY: Maryborough, SEQ.

FORMATION: Maryborough Fm.

AGE: Lower Cretaceous, (Aptian).

REMARKS: Two specimens were illustrated by Etheridge (1872, pl.20, fig.4). Fleming (1966a) considered that the species description of *N. gigantea* would only fit the lower of the two specimens figured. He synonymised both specimens with *L. quadrata*. Daintree Collection.

F1245

SYNTYPE *Nucula quadrata* Etheridge, 1872, p.341, pl.20, fig.3.

Nucula quadrata Etheridge; Etheridge fil., 1892, pp.565-6.

Nucula quadrata Etheridge; Etheridge fil., 1902a, p.74.

Nucula quadrata Etheridge; Etheridge fil., 1902b, pp.23-4.

LECTOTYPE *Leionucula quadrata* (Etheridge, 1872) Fleming 1966a, pp.6-8, pl. 2, figs2a,b.

LOCALITY: Maryborough, SEQ.

FORMATION: Maryborough Fm.

AGE: Lower Cretaceous, (Aptian).

REMARKS: Daintree Collection.

F1246

SYNTYPE *Nucula quadrata* Etheridge 1872, p.341, pl.19, fig.5.

Nucula quadrata Etheridge, Etheridge fil., 1892, pp.565-6.

Nucula quadrata Etheridge, Etheridge fil., 1902a, p.74.

Nucula quadrata Etheridge, Etheridge fil., 1902b, pp.23-4.

PARALECTOTYPE *Leionucula quadrata* (Etheridge, 1872) Fleming 1966a, pp.6-8, pl. 2, fig.3.
LOCALITY: Maryborough, SEQ.
FORMATION: Maryborough Fm.
AGE: Lower Cretaceous, (Aptian).
REMARKS: Etheridge's (1872) figure of F1246 is slightly smaller than natural size. Daintree Collection.

Lepidoptera leaf mines

F15346
Lepidoptera leaf mines; Rozefelds, 1988, pp.77-81, fig.2.
LOCALITY: Clack Island, Princess Charlotte Bay, NQ.
FORMATION: Battle Camp Fm.
AGE: Upper Jurassic-Lower Cretaceous.

Leucosia pubescens **Miers, 1877.**

F2184
Leucosia pubescens Miers, 1877; Hill *et al*., 1970, pl.Cz6, fig.6.
LOCALITY: Cleveland Bay, near Townsville, NQ.
FORMATION: Unnamed estuarine deposit.
AGE: Pleistocene/Holocene.

Lithosmylidia baronne **Lambkin, 1988**

F14358
HOLOTYPE *Lithosmylidia baronne* Lambkin, 1988, p.447, fig.3.
LOCALITY: road cutting on Baroone Rd, *c*. 3km ENE Gayndah, SEQ.
FORMATION: Gayndah Beds.
AGE: Middle Triassic.

Lithosmylidia parvula **Riek, 1955**

F14359
Lithosmylidia parvula Riek; Lambkin, 1988, pp.447-8, fig.4.
LOCALITY: Mount Crosby Insect locality B, Mt Crosby, SEQ.
FORMATION: Mt Crosby Fm.
AGE: Early Late Triassic, (Carnian).
REMARKS: Lambkin (1988, fig.4) incorrectly refers to this specimen as F1459.

Lopha marshii australiensis **Skwarko, 1974**

F5594
Lopha marshii (J. Sowerby, 1812) *australiensis* Skwarko, 1974, pp. 89-91, pl.30, fig.6.
LOCALITY: ?Newmarracarra Limestone, WA.
FORMATION: ?Newmarracarra Limestone.
AGE: Middle Jurassic, (Bajocian).
REMARKS: This specimen was erroneously recorded in Skwarko (1974, p.90) as part of the GSWA Collection.

Loxonema **sp.**

F1225 (Fig.2G)
Loxonema sp.; Etheridge fil., 1894, pp.536-7, pl.39, fig.7.
LOCALITY: Rockhampton District, MEQ.
FORMATION: ?Malchi Fm.
AGE: Lower Carboniferous.
REMARKS: De Vis Collection. The specimen was poorly illustrated. It is refigured herein (Fig. 2D).

F1226
Loxonema sp.; Etheridge fil., 1894, pp.536-7, pl.40, fig.6.
LOCALITY: Rockhampton District, MEQ.
FORMATION: ?Malchi Fm.
AGE: Lower Carboniferous.
REMARKS: De Vis Collection.

Luciella **(?)** ***grayae*** **Etheridge fil., 1892**

F1227 (Fig.2A)
HOLOTYPE *Luciella* (?) *grayae* Etheridge fil., 1892, pp.288-9, pl.41, fig.6.
LOCALITY: Rockhampton District, MEQ.
FORMATION: ?Malchi Fm.
AGE: Lower Carboniferous.
REMARKS: De Vis Collection. Etheridge's figure of *L. grayae* bears little resemblance to the type specimen.

Maccoyella alata **(Etheridge, 1872)**

F1235
HOLOTYPE *Avicula alata* Etheridge, 1872, p.342, pl.20, fig.8.
Pseudavicula ? *alata* (Etheridge); Etheridge fil., 1892, p.563, pl.24, fig.14.
Maccoyella barklyi Moore; Etheridge fil., 1902a, pp.17-8.
Maccoyella barklyi Moore; Etheridge fil., 1902b, pp.11-2.
Maccoyella alata (Etheridge, 1872); Fleming, 1970, pp.4-5.
LOCALITY: Maryborough, SEQ.
FORMATION: Maryborough Fm.

AGE: Lower Cretaceous, (Aptian).
REMARKS: Daintree Collection.

Maccoyella barklyi (Moore, 1870)

F1236
HOLOTYPE *Streptorhynchus davidsoni* Etheridge, 1872, p.333, pl. 17, fig.1.
Maccoyella barklyi Moore; Etheridge fil., 1892, p.455.
Maccoyella barklyi (Moore), 1870; Day 1967, pp.21-2
LOCALITY: ?Walsh River, NQ.
FORMATION: Blackdown Fm.
AGE: Lower Cretaceous, (Aptian).
REMARKS: Etheridge (1872) considered this Daintree specimen to be derived from the Carboniferous of the Peak Downs and Bowen River area. Etheridge fil., (1892) considered this locality was in error and he referred it to the Cretaceous species *Maccoyella reflecta* or *M. barklyi* from either the Walsh River, NQ, or Wallumbilla, SEQ. The lithology of the specimen is similar to other Walsh River material in the collection.

Maccoyella corbiensis (Moore, 1870)

F1237
HOLOTYPE *Crenatula*(?) *gibbosa* Etheridge, 1872, p.339, pl.19, fig.3.
Maccoyella corbiensis Moore; Etheridge fil., 1892, pp.563-4.
Maccoyella corbiensis Moore; Etheridge fil., 1902a, p.21.
Maccoyella corbiensis Moore; Etheridge fil., 1902b, p.13.
LOCALITY: Maryborough, SEQ.
FORMATION: Maryborough Fm.
AGE: Lower Cretaceous, (Aptian).
REMARKS: Daintree Collection.

Macrocallista (?) *plana* Moore, 1870

F3850
Myacites sp. Etheridge, 1872, p.348, pl.25, fig.7.
Macrocallista (?) *plana*, Moore; Etheridge fil., 1902a, pp.37-8.
LOCALITY: Gordon Downs at the head of Roper Creek, CQ.
FORMATION: ?Blenheim Sub Group.
AGE: Permian
REMARKS: See *Collabrina cliftoni*. Daintree Collection. Collected by Rev. W.B. Clarke. As this material is Permian in age, assignment to a Cretaceous species is almost certainly incorrect.

Macrophthalmus latreillei (Desmarest, 1822)

F6557
Macrophthalmus latreillei (Desmarest, 1822); Hill *et al.*, 1970, pl.Cz6, fig.7.
LOCALITY: Moffat Head, Caloundra, SEQ.
FORMATION: Unnamed estuarine deposit.
AGE: Pleistocene/Holocene.

Malchiblastus australis (Etheridge fil., 1892)

F1193
HOLOTYPE *Mesoblastus ? australis* Etheridge fil., 1892, pp.210-1, pl.44, fig.2.
Malchiblastus australis (Etheridge fil.,) McKellar 1966, pp.191-8, pl.24, fig.4.
LOCALITY: Rockhampton District, MEQ.
FORMATION: Neerkol Fm.
AGE: Upper Carboniferous.
REMARKS: Specimen is missing.

F1195
HOLOTYPE *Tricoelocrinus ? carpenteri* Etheridge fil., 1892, pp. 212-3, pl.44, fig.3.
Malchiblastus australis (Etheridge fil.,) McKellar, 1966, pp. 191-8, pl.24, figs 2-3,6.
LOCALITY: Rockhampton District, MEQ.
FORMATION: Neerkol Fm.
AGE: Upper Carboniferous.

Martinia (vel. Martiniopsis) subradiata (Sowerby, 1844)

F948
Martinia (vel Martiniopsis) subradiata G.B. Sby., sp.; Etheridge fil., 1892, pl.43, fig.1.
LOCALITY: Banana, CQ.
FORMATION: ?Flat Top Formation.
AGE: Permian.

Meleagrinella sp.

F5782a,b
Meleagrinella sp.; Hill *et al.*, 1968, pl.K6, figs17a,b.
Meleagrinella sp.; Fleming 1970, pp.5-6, pl.1, figs9-10.
LOCALITY: Ridge in the Gundiah 1-mile sheet area, grid reference 675895. Bauple Mtns, SEQ.
FORMATION: Maryborough Fm.
AGE: Lower Cretaceous, (Neocomian).

F5783
Meleagrinella sp.; Fleming, 1970, pp.5-6, pl.1, fig.11.
LOCALITY, FORMATION, AGE: As for F5782.

F5784
Meleagrinella sp.; Fleming, 1970, pp.5-6, pl.1, fig.12.
LOCALITY, FORMATION, AGE: As for F5782.

F5785
Meleagrinella sp.; Hill *et al.*, 1968, pl.K6, fig.16.
Meleagrinella sp.; Fleming, 1970, pp.5-6, pl.1, fig.8.
LOCALITY, FORMATION, AGE: As for F5782.

Melocrinites tempestus Jell et al., 1988.

F14884
HOLOTYPE *Melocrinites tempestus* Jell *et al.*, 1988, pp.372-4, figs13d-g.
LOCALITY: UQL5218 Wando Vale topographic Sheet [559389] *c.* 68m above base of formation in gully on E slope of Storm Hill, 1.2km north of Storm Dam, Wando Vale Stn, 150km NW of Charters Towers, NQ.
FORMATION: Papilio Mudstone.
AGE: Middle Devonian, (?late Eifelian).
REMARKS: The formation was formally named by Lang *et al.* (1989) as Papilio Mudstone.

F14853-F14854
PARATYPE *Melocrinites tempestus* Jell *et al.*, 1988, pp.372-4; F14854, fig.13h.
LOCALITY: UQL5318/69 Wando Vale topographic Sheet [565395] 65-116m above base of formation in gully 2.2km NE of Storm Dam, Wando Vale Stn, 150km NW of Charters Towers, NQ.
FORMATION: Papilio Mudstone.
AGE: Middle Devonian, (Givetian).
REMARKS: As for F14580.

Mesaktoceras arachne Wade, 1977a

F7187
HOLOTYPE *Mesaktoceras arachne* Wade, 1977a, pp.4,11-14, pl.7, figs 1-3, text-fig.7g.
LOCALITY: 3km E of Halfway Dam, Tobermorey Stn, 22°53'S, 137°50'E, NT.
FORMATION: Middle Nora Fm.
AGE: Middle Ordovician.

F7188, F7190-F7193
PARATYPES *Mesaktoceras arachne* Wade, 1977a, pp.4,11-14; F7188, pl.7, fig.4; F7190, pl.7, fig.5.
LOCALITY, FORMATION, AGE: As for holotype.

F7189
PARATYPE *Mesaktoceras arachne* Wade, 1977a, pp.4, 11-14, pl.7, fig.7.
LOCALITY: 1km E of Halfway Dam, Tobermorey Stn, 22°53'S, 137°50'E, NT.
FORMATION, AGE: As for holotype.

F7194
PARATYPE *Mesaktoceras arachne* Wade, 1977a, pp.4, 11-14.
LOCALITY: W side of small hill in Lower Nora Fm, 23°19'S, 138°06'E, CWQ.
FORMATION, AGE: As for holotype.

F7195
PARATYPE *Mesaktoceras arachne* Wade, 1977a, pp.4, 11-14.
LOCALITY: Valley between Toko Range scarp and QML319, 23°19'S, 138°06'E, CWQ.
FORMATION, AGE: As for holotype.
REMARKS: F7193 and F7195 are missing. Wade's (1977a) pl.7, fig.5 is referred to F7193, the correct number is F7190. Wade (1977a, pl.7) incorrectly records the locality for the holotype and paratypes F7188, F7190-F7193 as 1km rather than 3km E of Halfway Dam.

Mesocicadella punctata Evans, 1961

F3681a/b
HOLOTYPE *Mesocicadella punctata* Evans, 1961, p.14, fig.1a.
LOCALITY: Mt Crosby Insect Beds, SEQ.
FORMATION: Mt Crosby Fm.
AGE: Early Late Triassic, (Carnian).

Mesothymbris perkinsi Evans, 1956

F3682a/b
Mesothymbris perkinsi Evans, 1956; Evans, 1961, p.15, fig.1c.
LOCALITY: Mt Crosby Insect Beds, SEQ.
FORMATION: Mt Crosby Fm.
AGE: Early Late Triassic, (Carnian).
REMARKS: The counterpart of this specimen originally referred to as F3683 in Evans (1961) has been re-registered as F3682b.

F3684a/b
Mesothymbris perkinsi Evans, 1956; Evans, 1961, p.15, fig.1b.
LOCALITY, FORMATION, AGE: As for F3682a/b.
REMARKS: The counterpart of this specimen originally referred to as F3685 in Evans (1961) has been re-registered as F3684b.

Myloceras ammonoides (Etheridge fil., 1909)

F1388
HOLOTYPE *Myloceras davidi* Whitehouse, 1926, p.235, pl.37, figs 2a,b,c.
Myloceras davidi Whitehouse; Reyment, 1964, p.30.
Myloceras ammonoides (Etheridge, 1909); McNamara, 1978, pp.231-7.
LOCALITY: Bowen Downs, Thomson River, CQ.
FORMATION, AGE: Lower Cretaceous, (Albian).

F2230
Myloceras ammonoides (Etheridge, 1909); McNamara, 1978, pp. 231-7.
LOCALITY: Rodney Downs, Aramac, CQ.
FORMATION: Allaru Mudstone.
AGE: Lower Cretaceous, (Albian).

F9262
Myloceras ammonoides (Etheridge, 1909); McNamara, 1978, pp. 231-7, fig.4b.
LOCALITY: Currane Stn, 5km N of Dartmouth, CQ.
FORMATION: Allaru Mudstone.
AGE: Lower Cretaceous, (Albian).

F9352
Myloceras ammonoides (Etheridge, 1909); McNamara, 1978, pp. 231-7, fig.4a.
LOCALITY, FORMATION, AGE: As for F9262.

F9396
Myloceras ammonoides (Etheridge, 1909); McNamara, 1978, pp. 231-7, fig.2.
LOCALITY, FORMATION, AGE: As for F9262.

Myloceras auritulum McNamara, 1978

F9474
HOLOTYPE *Myloceras auritulum* McNamara, 1978, pp.231,234-5, 237-40, figs 4d,5a,7,9a.
LOCALITY: Isoroy Station, 15.5km SW of Tambo, CQ.
FORMATION: Allaru Mudstone.
AGE: Lower Cretaceous, (Albian).

F9475
PARATYPE *Myloceras auritulum* McNamara, 1978, pp.231,234-5, 237-40, figs. 6a,b,9b.
LOCALITY, FORMATION, AGE: As for F9474.

Myloceras baccatum (Whitehouse, 1926)

F1262
Crioceras flindersi McCoy, sp.; Etheridge fil., 1909, pp.153-7, pl.40, figs. 3,4.
Flindersites aff. *baccatus* Whitehouse, 1926, p.237.
LOCALITY: Saltern Creek, 30km W of Barcaldine, CQ.
FORMATION, AGE: Lower Cretaceous.
REMARKS: Spath (1938) and Arkell *et al.* (1957) have referred *Flindersites* to *Myloceras*. This specimen was previously registered as D7710. See also F1268 (*Australiceras irregulare*).

Myloceras flindersi (McCoy, 1867)

F1261
Crioceras flindersi McCoy, sp.; Etheridge fil., 1909, pp.153-7, pl.39, figs 2,3.
Flindersites aff. *flindersi* (McCoy) Whitehouse, 1926, p.237.
LOCALITY: Flinders River, NQ.
FORMATION: ?Wallumbilla Fm.
AGE: Lower Cretaceous.
REMARKS: See F1262.

F1263
Crioceras flindersi McCoy, sp.; Etheridge fil., 1909, pp.153-7, pl.41, fig.2.
LOCALITY: Queensland.
FORMATION, AGE: Lower Cretaceous.
REMARKS: See F1262.

Myloceras intermedium Whitehouse, 1926

F1260
Crioceras flindersi McCoy, sp.; Etheridge fil., 1909, pp.153-7, pl.40, figs 1,2.
HOLOTYPE *Flindersites intermedius* Whitehouse, 1926, p.237.
Myloceras intermedium (Whitehouse, 1926); Hill *et al.*, 1968, pl.K8, fig.3.
Myloceras intermedium (Whitehouse, 1926); McNamara, 1978, p. 236.
LOCALITY: Mt Cornish, Aramac (near Muttaburra), CQ.
FORMATION: ?Allaru Mudstone.
AGE: Lower Cretaceous, (Albian).

F1364
Flindersites intermedius Whitehouse, 1926, p.237.
Myloceras intermedium (Whitehouse, 1926); McNamara, 1978, p. 236-7.
LOCALITY: Longreach, CQ.
FORMATION: ?
AGE: Lower Cretaceous.

Myloceras plectoides (Etheridge fil., 1909)

F1389

SYNTYPE *Crioceras plectoides* Etheridge fil., 1909, pp.152-3.
Aleteceras plectoides (Etheridge fil.) Whitehouse, 1926, p.232, pl.40, figs 2a,b,c.
Myloceras plectoides (Etheridge, 1909); Hill *et al.*, 1968, pl. K7, fig.6.
Myloceras plectoides (Etheridge, 1909); McNamara, 1978, p.240.
LOCALITY: Walsh River, NQ.
FORMATION: Blackdown Fm.
AGE: Lower Cretaceous, (Albian).

Mytilops corrugata Etheridge fil., 1892

F1214
HOLOTYPE *Mytilops corrugata* Etheridge fil., 1892, p.272, pl. 40, fig.11.
LOCALITY: Rockhampton, MEQ.
FORMATION: ?Malchi Fm.
AGE: Lower Carboniferous.

Nereites berneyi de Vis, 1911

F16373a
HOLOTYPE *Nereites berneyi* de Vis, 1911, pp.12-4, pl.3, fig.2.
LOCALITY: Wyangaria Stn, near Hughenden, CQ.
FORMATION: Allaru Mudstone.
AGE: Lower Cretaceous, (Albian).
REMARKS: Holotype is the longer trail.

Nucula sp.

F1210
Nucula sp.; Etheridge fil., 1892, p.274, pl.40, fig.10.
LOCALITY: Rockhampton, MEQ.
FORMATION: ?Malchi Fm.
AGE: Lower Carboniferous.
REMARKS: De Vis Collection.

Oblicarina carinata (Etheridge fil., 1892)

F1218
HOLOTYPE *Chaenomya? carinata* Etheridge fil., 1892, p.279, pl. 43, figs 5,6.
Vacunella curvata (Morris) 1845; Runnegar, 1967, pp.63-7.
Oblicarina carinata (Etheridge Jr.) Waterhouse, 1967, pp.53-7, pl.7, figs 2,3.
Vacunella curvata (Morris); Runnegar, 1969, p.287.
Oblicarina carinata (Etheridge, 1892); Waterhouse, 1969, p.40, pl.6, figs 4,7.
Oblicarina carinata (Etheridge Jnr. 1892); Waterhouse, 1987a, p.175.
LOCALITY: Banana Creek, CQ.
FORMATION: ?Flat Top Formation.
AGE: Permian.
REMARKS: Runnegar (1967, 1969) considered F1218 a crushed *Vacunella curvata* (Morris). De Vis Collection.

Octomeris crassa Withers, 1932

F2026c
HOLOTYPE *Octomeris crassa* Withers, 1932, pp.122-4, figs 1,2.
Octomeris crassa Withers, 1932; Hill *et al.*, 1970, pl.Cz6, fig.2.
LOCALITY: Magnetic Island, NQ.
FORMATION: Raised beach rock.
AGE: Pleistocene/Holocene?
REMARKS: Withers (1932) used F2026 for four different taxa. This specimen has been reregistered as F2026c.

Onestia etheridgei (Etheridge fil., 1892)

F1258
Genus?; Etheridge, 1872, pp.339-40, pl.19, fig.4.
HOLOTYPE *Unicardium? etheridgei* Etheridge fil., 1892, pp.569-70, pl.27, fig.1.
Onestia etheridgei (Etheridge, 1892) Hill *et al.*, 1968, pl.K6, figs 1a,b.
Onestia etheridgei (Eth. fil. 1892); Fleming, 1970, p.7, pl.2, figs 2, 3.
Onestia etheridgei (Etheridge Jnr.); Day, 1978, pp.37-44, pl. 2, figs 3, 4.
LOCALITY: Corporation Quarry (Baddow Quarry Area) Maryborough, SEQ.
FORMATION: Maryborough Fm.
AGE: Lower Cretaceous, (Aptian).
REMARKS: Daintree Collection.

Oonoton woodsi Glaessner, 1980

F2876
HOLOTYPE *Oonoton woodsi* Glaessner, 1980, pp.171, 173-4, pl.1, fig.1, text figs 1a,b.
LOCALITY: Currane Station, 16kms N of Dartmouth, CQ.
FORMATION: Allaru Mudstone.
AGE: Lower Cretaceous, (Albian).

Opisthotrigonia nasuta (Etheridge, 1872)

F1248
SYNTYPE *Trigonia nasuta* Etheridge, 1872, p.339, pl.19, fig. 2a.
Trigonia nasuta Etheridge; Etheridge fil., 1892, p.567.

Trigonia nasuta Etheridge; Etheridge fil., 1902a, pp.25-7.

Opisthotrigonia nasuta (Etheridge Snr), 1872; Skwarko, 1963, pp.23-4.

Locality: Maryborough SEQ.

Formation: Maryborough Fm.

Age: Lower Cretaceous, (Aptian).

Remarks: Daintree Collection.

F1249

Syntype *Trigonia nasuta* Etheridge, 1872, p.339, pl.19, fig.2.

Trigonia nasuta Etheridge; Etheridge fil., 1892, p.567.

Trigonia nasuta Etheridge; Etheridge fil., 1902a, pp.25-7.

Opisthotrigonia nasuta (Etheridge Snr), 1872; Skwarko, 1963, pp.23-4.

Locality: Maryborough, SEQ.

Formation: Maryborough Fm.

Age: Lower Cretaceous, (Aptian).

Remarks: Daintree Collection.

Opsidiscus microspinus **Jell, 1975a**

F6770-F6772

Paratypes *Opsidiscus microspinus* Jell, 1975a, pp.80-1; F6770, pl.26, fig.7; F6772, pl.24, fig.1.

Locality: QML154, 150m NW of gate on 1st crest of Brumby Creek Rd, 19°33'S, 138°54'E, NWQ.

Formation: Currant Bush Limestone, *Euagnostus opimus* Zone.

Age: M. Cambrian.

Pagetia fluitata **Jell, 1975a**

F6811

Holotype *Pagetia fluitata* Jell, 1975a, pp.42-3, 93, pl.8, fig. 12.

Locality: QML122, Limestone ridges, left bank of West Thornton River, S of junction of Brumby Creek, 13°32'S, 138°54'E, NWQ.

Formation: Currant Bush Limestone, *Euagnostus opimus* Zone.

Age: M. Cambrian.

F6809-10

Paratypes *Pagetia fluitata* Jell, 1975a, pp.42-3; F6810, pl.8, fig.11.

Locality, Formation, Age: As for holotype.

Pagetia howardi **Jell, 1975a**

F6738-6758

Paratypes *Pagetia howardi* Jell, 1975a, pp.43-5. F6738, pl.4, fig.7; F6739, pl.4, fig.7; F6740, pl.4, fig.7; F6741, pl.4, fig.7; F6742, pl.4, fig.7; F6743, pl.4, fig.5; F6744, pl.4, fig.8; F6745, pl.4, fig.2; F6751, pl.4, fig.10.

Locality: QML117, Low hill, 1.6km N of D Tree Bore, E of road 19°41'S, 138°54'E, NWQ.

Formation: Beetle Creek Fm, *Xystridura templetonensis* zone.

Age: M. Cambrian.

Pagetia ocellata **Jell, 1970**

F6323

Holotype *Pagetia ocellata* Jell, 1970, pp.303-13, pl.24, fig. 22; Jell, 1975a, pp.50-1.

Locality: QML113, 2.5 to 3km N of Mt Murray, 80km SW of Duchess, 21°50'S, 139°58'E, NWQ.

Formation: Beetle Creek Fm.

Age: early M. Cambrian.

F6170-F6322, F6324-F6326

Pagetia ocellata Jell, 1970, pp.303-13; F6171, pl, 23, fig.31; F6175, pl.23, fig.30; F6186, pl.23, fig.29; F6187, pl.23, fig.28; F6191, pl.23, fig.27; F6192, pl.23, fig.6; F6193, text fig.3; F6194, pl.23, fig.8; F6195, pl.23, fig.7; F6197, text fig.3; F6200, pl.23, fig.10; F6201, pl.23, fig.9; F6207, pl.23, fig.15; F6215, text fig.3; F6216, pl.24, fig. 15; F6217, pl.24, fig.14; F6218, pl.23, fig.18; F6219, pl. 23, fig.17; F6220, pl.23, fig.16; F6221, pl.23, fig.23; F6224, pl.23, fig.25; F6227, text fig.3; F6229, pl.23, fig. 26; F6230, pl.23, fig.24; F6234, text fig.3; F6236-8, text fig.3; F6239, pl.23, fig.1, pl.24, fig.16; F6240, pl.23, fig.2, pl.24, fig.17; F6244, pl.23, fig.3, text fig.3; F6245, pl.23, fig.4; F6246, pl.23, fig.5; F6248, pl.23, fig. 11; F6253, text fig.3; F6255, pl.23, fig.12; F6264, pl.23, fig.13, text fig.3; F6266, pl.23, fig.19; F6268, pl.23, fig. 14; F6269, pl.23, fig.20; F6270, pl.23, fig.21, text fig.3; F6272, pl.23, fig.22, text fig.3; F6274, pl.24, fig.18, text fig.3; F6275, pl.24, fig.19, text fig.3; F6276, pl.24, figs. 6,7; F6278, pl.24, fig.1; F6283, pl.24, fig.4; F6285, pl.24, fig.2; F6289, pl.24, fig.3; F6293, pl.24, fig.5; F6299, pl. 24, fig.13; F6306, pl.24, fig.8; F6308, pl.24, fig.9; F6309, pl.24, fig.12; F6314, pl.24, fig.10; F6322, pl.24, fig.11; F6324, pl.24, fig.20; F6325, pl.24, fig.21; F6326, pl.24, fig.23

Locality, Formation, Age: As for holotype.

Remarks: Material consists of several hundred dissociated cephala, thoracic segments, pygidia, hypostomata and free cheeks. Specimens F6223 and 6245 are missing. Some minor damage to a few of the specimens isolated from matrix –

especially F6186, 6270, 6275, 6289 - has occurred since description. The holotype and QMF6275 were pl.9 figs 2 and 3 respectively in Hill *et al.* (1971).

F6938-6945

Pagetia ocellata Jell, 1970; Jell, 1975a, pp.50-1; F6938, pl. 28, fig.1; F6939, pl.27, fig.7; F6940, pl.27, fig.8; F6941, pl.27, fig.10; F6942, pl.27, fig.9; F6943, pl.28, fig.2; F6944, pl.28, fig.3; F6945, p.50.

LOCALITY, FORMATION, AGE: As for holotype.

REMARKS: F6938 was also listed erroneously as *P. prolata* in Jell (1975a, p.52). Jell (1975b), figured F6942 (p.35, fig.1a; p.39, fig.4c) and F6945 (p.39, fig.4d).

Pagetia pollosta Jell, 1975a

F6765

HOLOTYPE *Pagetia pollosta* Jell, 1975a, pp.53-4, pl.24, figs 7a,b.

LOCALITY: QML154, 150m NW of gate, 1st crest Brumby Creek Rd, 19°33'S, 138°54'E, NWQ.

FORMATION: Currant Bush Limestone, *Euagnostus opimus* Zone.

AGE: M. Cambrian.

F6759-F6764, F6766-F6769, F6773-F6781

PARATYPES *Pagetia pollosta* Jell, 1975a, pp.53-4; F6759, pl.24, fig.5; F6762, pl.24, fig.9; F6763, pl.24, fig. 13; F6766, pl.24, fig.12; F6768, pl.24, fig.11; F6769, pl. 24, fig.3; F6778, pl.24, fig.14; F6779, pl.24, fig.8; F6780, pl.24, fig.6; F6781, pl.24, fig.10.

LOCALITY, FORMATION, AGE: As for holotype.

REMARKS: F6771 and F6772, which refer to *Opsidiscus microspinus*, were erroneously included here in Jell (1975a).

Pagetia prolata Jell, 1975a

F6872

HOLOTYPE *Pagetia prolata* Jell, 1975a, pp.39, 56-60, pl.11, fig.8.

LOCALITY: QML145, N bank of Playford River, 400m W of Barkley Stock Route to Brunette Downs, 19°4'S, 136°40'E, NWQ.

FORMATION: Burton Beds, *Xystridura templetonensis* Zone.

AGE: early M. Cambrian.

F6869-F6871, F6873-F6936

PARATYPES *Pagetia prolata* Jell, 1975a, pp.56-60; F6869 pl.11, fig.3; F6870, pl.11, fig.4; F6871, pl.11, fig.7; F6873, pl. 12, fig.2; F6874, pl.12, fig.3; F6875, pl.12, fig.4; F6876, pl.12, fig.6; F6877, pl.12, fig.10; F6878, pl.12, fig.11; F6879, pl.12, fig.12; F6880, pl.12, fig.14; F6881, pl.12, fig.16; F6882, pl.12, fig.21; F6883, pl.12, fig.22.

LOCALITY, FORMATION, AGE: As for holotype.

REMARKS: Jell (1975a) erroneously included F6937 and F6938 here. These numbers refer to *P. ocellata*. Jell (1975b) figured F6873 and F6874 (p.36, figs 2e-h). However, registration numbers are not cited for each figure.

Pagetia salebra Jell, 1975a

F6786

HOLOTYPE *Pagetia salebra* Jell, 1975a, pp.48,60-1; pl.13, fig. 9.

LOCALITY: QML146, .8km N of Burketown-Camooweal Road, 19°31'S, 138°52'E, NWQ.

FORMATION: Inca Creek Fm, *Euagnostus opimus* Zone.

AGE: M. Cambrian.

REMARKS: The holotype was erroneously numbered F6782 in the caption to pl.13, fig.9. (F6782 is an unpublished specimen referred to this species).

F6788-F6793, F6796-6798, F6800-6803

PARATYPES *Pagetia salebra* Jell, 1975a, pp.60-1; F6788, pl.13, fig.5; F6789, pl.13, fig.1; F6791, pl.13, fig.7, F6792, pl. 13, fig.3; F6793, pl.13, fig.4.

LOCALITY: QML136, Thorntonia-Burketown Road at Chummy Bore, 19°31'S, 138°52'E, NWQ.

FORMATION, AGE: As for holotype.

F6783-F6785, F6787, F6799, F6804

PARATYPES *Pagetia salebra* Jell, 1975a, pp.60-1; F6783, pl.13, figs 2a,b; F6784, pl.13, figs 2a,c; F6787, pl.13, fig.6.

LOCALITY, FORMATION, AGE: As for holotype.

Pagetia thorntonensis Jell, 1975a

F6822

HOLOTYPE *Pagetia thorntonensis* Jell, 1975a, pp.65-7, pl.22, fig 2.

LOCALITY: QML128, 1.6km W of road at gate N of Gum Lagoon Bore, W bank of W Thornton Creek, 15m from base of cliff, 19°34'S, 138°55'E, NWQ.

FORMATION: Currant Bush Limestone (Bottom 20m - *Ptychagnostus atavus* zone).

AGE: M. Cambrian.

F6812, F6813, F6815-F6824, F6841, F6843
Pagetia thorntonensis Jell, 1975a, pp.65-7; F6812, pl.22, fig. 9; F6813, pl.22, fig.1; F6815, pl.22, fig.3; F6818, pl.22, fig.5; F6823, pl.22, fig.10; F6824, pl.22, fig.6; F6841, pl. 22, fig.7; F6843, pl.22, fig.4
LOCALITY, FORMATION, AGE: As for holotype.

F6814, F6825-F6840, F6842, F6844, F6845-F6866
PARATYPES *Pagetia thorntonensis* Jell, 1975a, pp.65-7, F6814, pl.22, fig.8; F6846, pl.27, fig.2; F6847, pl.27, fig.1; F6848, pl.27, fig.3; F6849, pl.27, fig.4; F6850, pl.27, fig. 5; F6851, pl.27, fig.6.
LOCALITY: QML132, hill south of QML128 19°34'S, 138°55'E, NWQ.
FORMATION, AGE: As for holotype.
REMARKS: F6860-F6866 are missing from collection. Jell (1975b), figured F6846 (p.37, figs 3a,b) and F6853 and F6852 (p.37, figs. 3c-3f. However, registration numbers are not cited for each figure.

Pandanocrinus wellingtonensis Jell *et al.*, 1988

F14532, F14537-F14539, F14542
PARATYPES *Pandanocrinus wellingtonensis* Jell *et al.*, 1988, pp. 385-6.
LOCALITY: QML512, Wellington topographic Sheet [799867] richly fossiliferous limestone (Unit 18 of Johnson, 1975) 870m NNW of Mountain View Homestead, Wellington Caves Rd, 9km SSW of Wellington, NSW.
FORMATION: Garra Fm.
AGE: Early Devonian, (Pragian, *sulcatus* biozone).

Panopea acuta (Etheridge, 1872)

F1251
SYNTYPE *Panopaea (Mya) plicata*, Sow. var. *acuta* Etheridge, 1872, pp.342-3, pl.21, fig. 3a.
LECTOTYPE *Panopea acuta* Etheridge, 1872; Waterhouse, 1965, pp. 851-2.
Panopea plicata acuta Etheridge; Waterhouse, 1969, p.72, pl. 6, figs 1,3.
LOCALITY: Maryborough, SEQ (see remarks).
FORMATION: Maryborough Fm.
AGE: Lower Cretaceous, (Aptian).
REMARKS: In an early label and in Etheridge (1872) the locality for this Daintree specimen is given as Pelican Creek, Mitchell District. However the specimen's lithology is consistent with that of the Maryborough Fm and it also bears the number 627 which is only on the Maryborough specimens and includes material studied by Etheridge (1872). The other specimen figured by Etheridge (1872, pl.21, fig.3) was referred to the Permian genus *Vacunella* by Waterhouse (1965).

Panopea maccoyi (Moore, 1870)

F1253
HOLOTYPE *Panopaea sulcata* Etheridge, 1872, p.342, pl.21, figs 2, 2a.
Glycimeris sulcata Etheridge, Etheridge fil., 1892, p.571.
Glycimeris maccoyi Moore; Etheridge fil., 1901, p.30.
Panopea maccoyi (Moore, 1870) Fleming, 1970, pp.9-10, pl.3, figs 3,4.
LOCALITY: Maryborough, SEQ.
FORMATION: Maryborough Fm.
AGE: Lower Cretaceous, (Aptian).
REMARKS: Daintree Collection.

Parallelodon costellata McCoy, 1844

F1211
Parallelodon costellata McCoy; Etheridge fil., 1892, p.274, pl.40, fig.12.
LOCALITY: Rockhampton District, MEQ.
FORMATION: ?Malchi Fm.
AGE: Lower Carboniferous.
REMARKS: De Vis Collection.

F1212
Parallelodon costellata McCoy; Etheridge fil., 1892, p.274, pl.40, fig.13.
LOCALITY: Rockhampton district, MEQ.
FORMATION: ?Malchi Fm.
AGE: Lower Carboniferous.
REMARKS: De Vis Collection.

***Parapisocrinus* sp.**

F14842
Parapisocrinus sp.; Jell *et al.*, 1988, p.391, figs27k-m.
LOCALITY: UQL3579. Burges topographic Sheet [687683] one of five localities collected E to W along fence line 600m E of Martins Well windmill: all from upper part of limestone (limestone slightly folded), Martins Well, 8km E of Pandanus Creek Homestead, 200km NW of Charters Towers, NQ.
FORMATION: Upper Martins Well Limestone Member, Shield Ck Fm.
AGE: Early Devonian, (early Pragian, *sulcatus* biozone).

Parastacid gastrolith

F7829

Crustacean gastrolith; Archer and Wade 1976, pp.383-4, pl.54, fig.f.

LOCALITY: Terrigenous sediments underlying 'Allensleight flow' of the Nulla Basalt, overlying laterite and outcropping on Bluff Downs Station, along banks of Allingham Creek, 19°43'S, 145°36'E, NQ.

FORMATION: Allingham Fm.

AGE: Pliocene.

Pedinogyra sp.

F1358

Pedinogyra sp.; Hill *et al.*, 1970, pl.Cz4, figs6a,b.

LOCALITY: Limestone Quarry, Marmor, MEQ.

FORMATION: Unnamed cave deposits.

AGE: Pleistocene.

Penarosa netenta Jell, 1977

F7059

HOLOTYPE *Penarosa netenta* Jell, 1977, pp.119-23, pl.21, figs 1a,b.

LOCALITY: QML152, 1.7km S of Chummy Bore, which is 6km W of Thorntonia Homestead (19°31.5'S, 138°52'E) and at Chummy Bore, NWQ.

FORMATION: Chummy Bore Fm, probably *Euagnostus opimus* Zone.

AGE: M. Cambrian.

F7060-F7064

Penarosa netenta Jell, 1977, p.119-23; F7060, pl.21, fig.5; F7061, pl.21, fig.8; F7062, pl.21, fig.6; F7064, pl.21, fig. 4.

LOCALITY, FORMATION, AGE: As for holotype.

F7065-7070

PARATYPES *Penarosa netenta* Jell, 1977, pp.119-23; F7065, pl. 21, fig.3; F7068, pl.21, fig.2; F7069, pl.21, fig.7.

LOCALITY: QML136, Chummy Bore on Thorntonia-Camooweal Rd, 19°31'S, 138°52'E, NWQ.

FORMATION, AGE: As for holotype.

Permasyrinx acuta (Etheridge, 1872)

F5639

Spirifer bisulcata Sow., var. *acuta* in Etheridge, 1872, p.329, pl.16, fig.1.

Spirifer trigonalis Martin var. *acuta* Etheridge; Etheridge fil., 1892, p.230, pl.10, fig.12.

Permasyrinx acuta (Etheridge snr) Waterhouse and Balfe, 1987, pp.24, 30, pl. 1, fig.3.

LOCALITY: Gympie, SEQ.

FORMATION: Rammutt Fm.

AGE: Permian.

Phaenodesmia elongata (Etheridge, 1872)

F1247

HOLOTYPE *Leda elongata* Etheridge, 1872, p.341, pl.20, fig.5.

Adrana elongata (Etheridge) Etheridge fil., 1892, pp.566-7, pl. 33, fig.8.

Malletia elongata (Etheridge) Etheridge fil., 1902a, p.25.

Malletia elongata (Etheridge); Etheridge fil., 1902b, p.26.

Phaenodesmia elongata (Etheridge, 1872) Fleming 1966a, pp.8-9, pl.4, fig.1.

LOCALITY: Maryborough, SEQ.

FORMATION: Maryborough Fm.

AGE: Lower Cretaceous, (Aptian).

REMARKS: Daintree Collection.

'*Planorbis*' sp.

F2819

'*Planorbis*' sp.; Hill *et al.*, 1970, pl.Cz4, fig.13.

LOCALITY: Limestone Hill, Ipswich, SEQ.

FORMATION: Silkstone Fm.

AGE: Oligocene.

Platyteichum coniforme (Etheridge fil., 1892)

F1220

HOLOTYPE *Mourlonia* (?) *coniformis* Etheridge fil., 1892, pp.287-8, pl.41, fig.5.

Platyteichum coniforme (Etheridge jun.) Dickins, 1961, pp.131-4, pl.17, figs 13-14.

Platyteichum coniforme (Etheridge Jn. 1892); Waterhouse, 1987a, pp.179-80.

Platyteichum coniforme (Etheridge Jr, 1892); Parfrey, 1988, pp.20-1.

LOCALITY: Banana Ck, near Banana, CQ.

FORMATION: Flat Top Fm.

AGE: Middle Permian.

REMARKS: De Vis Collection.

Plotiopsis balonnensis (Conrad, 1850)

F6550

Plotiopsis balonnensis (Conrad, 1850); Hill *et al.*, 1970, pl. Cz5, fig.10.

LOCALITY: Darling Downs, SEQ.
FORMATION: Unnamed fluviatile deposits.
AGE: Pleistocene.

Podophthalmus vigil Fabricius, 1798

F1184
Podophthalmus vigil Fabricius; Etheridge fil. and McCulloch, 1916, p.9, pl.4, fig.3, pl.5, fig.3.
Podophthalmus vigil Fabricius, 1798; Hill *et al.*, 1970, pl. Cz6, fig.9.
LOCALITY: New Channel, mouth of Brisbane River, Moreton Bay, SEQ.
FORMATION: Unnamed estuarine deposit.
AGE: Pleistocene/Holocene.

Polinices sordidus (Swainson, 1821)

F17639
Polinices sordidus (Swainson, 1821); Hill *et al.*, 1970, pl. Cz4, fig.14.
LOCALITY: Bullock Pt, Wide Bay, SEQ.
FORMATION: Unnamed marine deposit.
AGE: Pleistocene.
Previously registered as Mo2930 in the Queensland Museum Mollusca register.

Polychaete trail

F16373b
Annelid trail; de Vis, 1911, pp.12-4, pl.3, fig.2.
LOCALITY: Wyangaria Stn, near Hughenden, CQ.
FORMATION: Allaru Mudstone.
AGE: Lower Cretaceous.

Porites **sp.**

F12385
Porites sp.; Pickett *et al.*, 1985, pp.103-14.
LOCALITY: S of Amity Point, N Stradbroke Island (Brisbane 1:100,000 Sheet, grid reference 441658).
FORMATION: Unnamed marine deposits.
AGE: Pleistocene.
REMARKS: Pickett *et al.*, (1989) redated this specimen, *Goniastrea aspera* (F12401) and *Symphyllia* sp. cf. *S. recta* (F12400). They referred these corals to isotope substage 5c, not 5e as previously cited (Pickett *et al.*, 1985).

Productus **sp. indet.**

F1204
Productus sp. ind.; Etheridge fil., 1892, p.256, pl.40, fig. 4.
LOCALITY: Rockhampton District, MEQ.
FORMATION: ?Malchi Fm.
AGE: Carboniferous.

Prohysteroceras richardsi Whitehouse, 1926

F1783
Prohysteroceras richardsi Whitehouse, 1926, pp.222-3.
LOCALITY: Toliness Station, near Augathella, CQ.
FORMATION: Allaru Mudstone.
AGE: Lower Cretaceous, (Albian).

F1784
HOLOTYPE *Prohysteroceras richardsi* Whitehouse, 1926, pp.222-3, pl.38, figs 1a,b.
Prohysteroceras richardsi Whitehouse, 1926; Hill *et al.*, 1968, pl.K9, fig.3.
LOCALITY, FORMATION, AGE: As for F1783.

Promytilus mytiliformis (Etheridge fil., 1892)

F1217
SYNTYPE. *Modiomorpha mytiliformis* Etheridge fil., 1892, p.273, pl.41, fig.4.
Promytilus mytiliformis (Etheridge, 1892); Waterhouse, 1980, pp.106-7.
LOCALITY: Banana Creek, CQ.
FORMATION: ?Flat Top Fm or Barfield Fm.
AGE: Permian
REMARKS: Etheridge fil. (1892) referred three specimens to this taxon pl.14, fig.5, pl.38, figs 12, 13 and pl.41, fig.4 (which is laterally reversed), not pl.40, fig.4 as cited in Etheridge fil. Waterhouse (1980, p.106) cited the specimen figured by Etheridge fil. (pl.41, fig.4) as the lectotype erroneously referring this Queensland Museum specimen (F1217) to the Geological Survey Collection. Waterhouse (figs 2; 6, 8) illustrated two specimens one of which (fig.2; 8) is a latex cast from an external mould, captioned 'lectotype.' Neither figure corresponds with Etheridge fil. (pl.41, fig.4), i.e., F1217. The number (Waterhouse, 1980) associated with the lectotype caption is F2188 which does not correspond with a Queensland Museum number. The specimen is apparently of Etheridge fil.(pl.14, fig.5) (GSQ F1488), (Susan Parfrey, pers. comm., 1988). The other specimen of *P. mytiliformis* figured by Etheridge fil. (pl. 38, figs.12, 13 (GSQ F1505)) is also in the Geological Survey Collections. Information for

Waterhouse's fig.2; 6 is lacking and no matching specimen can be located in the Queensland Museum Collections. Waterhouse (fig.3; 1) also figured a latex cast of the anterior hinge of the 'lectotype' but this specimen is not F1217 and is not a museum specimen.

Protocanites planorbiformis (Etheridge fil., 1892)

F1230

HOLOTYPE *Goniatites planorbiformis* Etheridge fil., 1892, p.295, pl.41, fig.9.
Protocanites planorbiformis (Etheridge); Hill and Woods, 1964, pl.C14, fig.6.
Eocanites planorbiformis (Etheridge); Weyer, 1972, p.322.
Protocanites planorbiformis (Etheridge); Campbell *et al.*, 1983, p.111-2, fig.36.
LOCALITY: Stanwell area, MEQ.
FORMATION: Malchi Fm.
AGE: Upper Carboniferous.
REMARKS: As Campbell *et al.*, (1983) pointed out, the type locality (Lakes Creek) as given in Etheridge (1892) is Permian in age. De Vis collections from the Stanwell Area in the Museum had been included amongst material from the Lakes Creek locality in the past. It is likely that the *G. planorbiformis* and the other ammonoids Etheridge described were collected from the Stanwell area. The lithology of topotypes of '*Pseudarietites ammonitiformis*' is consistent with the Malchi Formation. The holotype of *P. planorbiformis* and the other Carboniferous ammonoids (F1228 and F1209) were loaned overseas, but have been lost.

'Pseudarietites' ammonitiformis (Etheridge fil., 1892)

F1228

SYNTYPE *Nautilus ? ammonitiformis* Etheridge fil., 1892 pp.292-3, pl.39, fig.9.
Pseudarietites sp.; Bryan, 1929, p.76.
'*Pseudarietites*' *ammonitiformis* (Etheridge); Hill and Woods, 1964, pl.C14, fig.8.
'*Pseudarietites*' *ammonitiformis* (Etheridge); Campbell *et al.*, 1983, pp.120-1, fig.49b
LOCALITY: Stanwell area, MEQ.
FORMATION: Malchi Fm.
AGE: Upper Carboniferous.
REMARKS: See *Protocanites planorbiformis*. This specimen is lost, although topotypes exist.

F1229

SYNTYPE *Nautilus ? ammonitiformis* Etheridge, 1892, pp.292-3, pl.41, fig.9.
Pseudarietites sp.; Bryan, 1929, p.76.
'*Pseudarietites*' *ammonitiformis* (Etheridge); Campbell *et al.*, 1983, pp.120-1, fig.49a.
LOCALITY: Stanwell Area, MEQ.
FORMATION: Malchi Fm.
AGE: Upper Carboniferous.
REMARKS: See *Protocanites planorbiformis*. This specimen is lost.

Pterinopecten devisii Etheridge fil., 1892

F1213a,b

HOLOTYPE *Pterinopecten devisii* Etheridge, 1892, pp.270-1, pl. 40, fig.9.
Pterinopecten devisii Etheridge, 1892b; Waterhouse, 1982, p.8.
LOCALITY: Rockhampton District, MEQ.
FORMATION: ?Malchi Fm.
AGE: Lower Carboniferous.
REMARKS: De Vis Collection.

Pustulospiriferina etheridgei (Armstrong, 1970)

F6329

PARATYPE *Punctospirifer etheridgei* Armstrong, 1970, pp.317-9.
Pustulospiriferina etheridgei (*sic*) Armstrong; Waterhouse, 1987b, p.45.
LOCALITY. UQL3127, Series of E-W Ridges, 0.5 miles E of 'Homevale' Homestead, CQ.
FORMATION: Tiverton Fm.
AGE: Permian.

F6330

PARATYPE *Punctospirifer etheridgei* Armstrong, 1970. pp.317-9.
Pustulospiriferina etheridgei (*sic*) Armstrong; Waterhouse, 1987b, p.45.
LOCALITY, FORMATION, AGE: As for F6329

F6331

PARATYPE *Punctospirifer etheridgei* Armstrong, 1970, pp.317-9, pl.25, fig.9.
Pustulospiriferina etheridgei (*sic*) Armstrong; Waterhouse, 1987b, p.45.
LOCALITY, FORMATION, AGE: As for F6329

F6332

PARATYPE *Punctospirifer etheridgei* Armstrong, 1970, p.317-9, pl.25, fig.17.
Pustulospiriferina etheridgei (sic) Armstrong; Waterhouse, 1987b, p.45.

LOCALITY, FORMATION, AGE: As for F6329

Puzosia longmani Whitehouse, 1926

F1595
HOLOTYPE *Puzosia longmani* Whitehouse, 1926, pp.218-9, pl.37, fig.5, pl.39, figs 1a,b.
LOCALITY: Barcoo River, CQ.
FORMATION: ?
AGE: Lower Cretaceous.

Pyramus concentrica (Etheridge, 1872)

F14398
Pyramus concentrica (Etheridge) Waterhouse and Balfe, 1987, pp.24, 30, pl.1, fig.9.
LOCALITY: Gympie, SEQ.
FORMATION: Rammutt Fm.
AGE: Permian.

Rhipidocrinus crenatus (Goldfuss, 1831)

F14771
Rhipidocrinus crenatus (Goldfuss, 1831); Jell *et al.*, 1988, pp.360, 362-3, fig.4k.
LOCALITY: UQL5320 Wando Vale [563392] section on ridge 2.9km NE of Storm Dam. Broken River Wando Vale Station, 150km NW of Charters Towers, NQ.
FORMATION: Papilio Mudstone.
AGE : Middle Devonian, (late Eifelian-Givetian).
REMARKS: The formation was formally named by Lang *et al.* (1989) as Papilio Mudstone.

F14869
Rhipidocrinus crenatus (Goldfuss, 1831) in Jell *et al.*, 1988, pp.360.362-3, fig.4l.
LOCALITY: UQL5321 Wando Vale [562390] creek section 3km NE of Storm Dam, Broken River Wando Vale Station, 150km NW of Charters Towers, NQ.
FORMATION,
AGE, REMARKS: As for F14771.

Samarura sp.

F12996a/b
Samarura sp.; Rozefelds, 1985b, pp.25-32, figs2a,b.
LOCALITY: Brassall Quarry, near Ipswich, SEQ.
FORMATION: Aberdare Conglomerate.
AGE: Late Triassic.

Sanmartinoceras fontinale Hudleston, 1890

F1722
Sanmartinoceras olene (Tenison-Woods); Whitehouse, 1926, p. 205, pl.41, figs3a,b.
Sanmartinoceras fontinale (Hudleston); Whitehouse, 1927, pp. 116-7, text fig.4.
LOCALITY: ?Walsh River, NQ.
FORMATION: Blackdown Fm.
AGE: Lower Cretaceous, (Aptian).
REMARKS: Whitehouse (1926) records the locality for this specimen as Walsh River. The Queensland Museum Palaeontology register gives no locality.

F1869
Sanmartinoceras olene (Tenison-Woods); Whitehouse, 1926, p. 205.
Sanmartinoceras fontinale (Hudleston); Whitehouse, 1927, pp. 116-7, pl.17, fig.4.
LOCALITY: Walsh River, NQ.
FORMATION: Blackdown Fm.
AGE: Lower Cretaceous, (Aptian).
REMARKS: Collected Hann's Expedition, 1872.

F1870
Sanmartinoceras olene (Tenison-Woods); Whitehouse, 1926, p. 205.
Sanmartinoceras fontinale (Hudleston); Whitehouse, 1927, pp. 116-7, pl.17, fig.5, text fig.9.
LOCALITY: Walsh River, NQ.
FORMATION: Blackdown Fm.
AGE: Lower Cretaceous, (Aptian).
REMARKS: Collected Hann's Expedition, 1872.

Scylla serrata (Forskål, 1755)

F1187
Scylla serrata Forskål; Etheridge fil. and McCulloch, 1916, pp. 9-10, pl.2, fig.1.
LOCALITY: New Channel, mouth of Brisbane River, Moreton Bay, SEQ.
FORMATION: Unnamed estuarine deposit.
AGE: Pleistocene/Holocene.
REMARKS: Originally registered as F474, a collection of fossil crabs from Moreton Bay.

F3237
Scylla serrata (Forskål, 1755); Hill *et al.*, 1970, pl.Cz6, fig.11.
LOCALITY: Lime Pocket, near Donnybrook, Bribie Passage, SEQ.
FORMATION: Unnamed estuarine deposit.
AGE: Pleistocene/Holocene.

***Serpula* sp.**

F2026c

Serpula sp.: Withers, 1932, p.122.

LOCALITY: Raised beach rock, Magnetic Island, NQ.

FORMATION: Unnamed deposit.

AGE: Pleistocene/Holocene?

REMARKS: Withers used F2026 for 4 different taxa on the same block. This specimen has been re-registered as F2026c.

***Shimantocrinus distinctodorsus* Jell *et al.*, 1988**

F14536, F14540

PARATYPE *Shimantocrinus distinctodorsus* Jell *et al.*, 1988, pp.390-1; F14536, figs24m,n.

LOCALITY: QML512, Wellington topographic Sheet [799867] richly fossiliferous limestone (Unit 18 of Johnson, 1975) 870m NNW of Mountain View Homestead on Wellington Caves Road, 9km SSW of Wellington, NSW.

FORMATION: Garra Fm.

AGE: Early Devonian, (late Lochkovian-Pragian).

***Simbirskites morvenae* Whitehouse, 1927**

F1270

Perisphinctes kayseri Neumahr and Uhlig, 1881; Etheridge fil., 1909, pp.238-9, pl.68.

Simbirskites spp. nov. Whitehouse, 1926, pp.200-1.

Simbirskites morvenae Whitehouse, 1927, p.111.

LOCALITY, FORMATION, AGE: Uncertain, probably North Germany.

REMARKS: This is the larger of the two ammonites figured by Etheridge fil. (1909, pl.68). See F16438.

F16438

?*Perisphinctes kayseri* Neumahr and Uhlig, 1881; Etheridge fil., 1909, pp.238-9, pl.68 (doubtfully assigned specimen).

Simbirskites spp. nov. Whitehouse, 1926, pp.200-1.

HOLOTYPE *Simbirskites morvenae* Whitehouse, 1927, p.111, pl.16, fig.1, text fig.5.

LOCALITY, FORMATION, AGE: Uncertain, probably N Germany.

REMARKS: This is the smaller of the two ammonites figured by Etheridge fil. (1909, pl.68). There are considerable doubts about the provenance of these specimens. Whitehouse (1927) records their locality as Victoria Downs, Morven. The specimens were originally registered in 1893 as D7710.12 and described in the donor register as a 'miscellaneous collection of fossils'. This number also applies to material from elsewhere in Queensland, including the Walsh River. Doubts about a Queensland provenance for the specimens were evident in Whitehouse (1927) and were firmer in later papers (1946, 1955). It now seems likely that they were not found in Queensland, but came instead from North Germany (Day, 1967). Whitehouse (1927) also says that a Mr Hurst was the donor. A manuscript note in a bound copy of the Etheridge fil. (1909) paper, originally belonging to R. Hamlyn-Harris, Director, Queensland Museum (1910-1917), records Mr Hunter as donor.

***Spirifer* sp. cf. *S. bisulcata* Sowerby**

F5641

Spirifera allied to *Sp. bisulcata* Sow. in Etheridge, 1872, p. 335, pl.17, fig.4.

Spirifera trigonalis Martin sp,var. *bisulcata* G.B. Sby.; Etheridge fil., 1892, p.230, pl.9, fig.15.

LOCALITY: Bowen River, CQ.

FORMATION: ?

AGE: Permian.

***Spirifera convoluta* Phillips, 1836**

F5640

Spirifer convoluta ? Phill.; Etheridge, 1872, p.335, pl.17, fig.3.

Spirifer convoluta Phillips; Etheridge fil., 1892, p.229, pl. 10, fig.11.

LOCALITY: Bowen Basin, CQ.

FORMATION: ?

AGE: Permian.

***Spirifera* sp. cf. *S. oviformis* M'Coy**

F952

Spirifera (allied to *S. oviformis* McCoy); Etheridge fil., 1892, pl.40, fig.3.

LOCALITY: Banana Creek, CQ.

FORMATION: ?Flat Top Formation.

AGE: Permian.

***Spirifera striata* (Martin)**

F5642

Spirifera striata (Martin); Etheridge, 1872, pp.334-5, pl.17, fig.5.

Spirifera striata Martin sp?; Etheridge fil., 1892, pp.227-8, pl.9, fig.16.

LOCALITY: Bowen Basin, Peak Downs, CQ.

FORMATION: ?

AGE: Permian.

REMARKS: R. L. Jack footnote in Etheridge fil. (1892, p.228) noted that the Bowen River does not extend into the Peak Downs District.

Strangesta sp.

F6549

Strangesta sp.; Hill *et al.*, 1970, pl.Cz4, fig.7.

LOCALITY: Olsens Cave, near Rockhampton, MEQ.

FORMATION: Unnamed cave deposits.

AGE: Pleistocene.

Strophomena analoga (Phillips, 1836)

F945

Strophomena rhomboidalis var. *analoga* Phillips; Etheridge fil., 1892, p.245-6, pl.40, fig.6.

LOCALITY: Rockhampton District, MEQ.

FORMATION, AGE: Permian.

REMARKS: Referred to as *Strophomena analoga* Phillips? in Etheridge fil. (1892, pl.40, fig.6).

Struszocrinus dulciculus Jell *et al.*, 1988

F14534

PARATYPE *Struszocrinus dulciculus* Jell *et al.*, 1988, pp.367-8, fig.9n.

LOCALITY: QML512, Wellington topographic sheet [799867] 870m NNW of Mountain View Homestead on Wellington Caves Road, 9km SSW of Wellington, NSW.

FORMATION: Garra Fm.

AGE: Early Devonian, (Pragian, assumed *sulcatus* biozone.

REMARKS: Jell *et al.* (1988) incorrectly refer to this specimen as F14543 in fig.9.

F14535

PARATYPE *Struszocrinus dulciculus* Jell *et al.*, 1988, pp.367-8.

LOCALITY, FORMATION, AGE: As for F14534.

Symphyllia sp. cf. *S. recta* (Dana, 1846)

F12400

Symphyllia cf. *recta*; Pickett *et al.*, 1985, pp.103-14.

LOCALITY: S of Amity Point, N Stradbroke Island (Brisbane 1:100,000 Sheet, grid reference 441658).

FORMATION: Unnamed marine sediments.

AGE: Pleistocene.

REMARKS: See *Porites* sp.

Tellina mariaeburiensis Etheridge, 1872

F1254a/b

SYNTYPE *Tellina mariaeburiensis* Etheridge, 1872, p.341, pl.20, fig.6a.

Palaeomoera mariaeburiensis (Etheridge) Etheridge fil., 1892, p. 570.

Tellina mariaeburiensis (Etheridge, 1872) Hill *et al.*, 1968, pl. K6, fig.10.

Tellina mariaeburiensis Eth., 1872; Fleming 1970, pp.7-8, pl. 1, fig.4.

LOCALITY: Maryborough, SEQ.

FORMATION: Maryborough Fm.

AGE: Lower Cretaceous, (Aptian).

REMARKS: The counterpart of this specimen referred to as F1255 by Hill *et al.* (1968) and Fleming (1970) was reregistered as F1254b. Daintree Collection.

F1256

SYNTYPE *Tellina mariaeburiensis* Etheridge, 1872, p.341, pl.20, fig.6 (large valve).

Palaeomoera mariaeburiensis (Etheridge) Etheridge fil., 1892, p. 570.

Tellina mariaeburiensis Eth., 1872; Fleming, 1970, pp.7-8, pl. 1, fig.5.

LOCALITY, FORMATION, AGE: As for F1254.

REMARKS: Daintree Collection.

F1257

SYNTYPE *Tellina mariaeburiensis* Etheridge, 1872, p.341, pl.20, fig.6 (small valve).

Palaeomoera mariaeburiensis (Etheridge) Etheridge fil., 1892, p. 570.

Tellina mariaeburiensis Eth., 1872; Fleming, 1970 pp.7-8.

LOCALITY, FORMATION, AGE: As for F1254.

REMARKS: Daintree Collection.

Tetraclita sp.

F2026b

Tetraclita sp.; Withers, 1932, p.122.

Tetraclita sp.; Hill *et al.*, 1970, pl.Cz6, fig.1.

LOCALITY: Magnetic Island, NQ.

FORMATION: Raised beach rock.

AGE: Pleistocene/Holocene?

REMARKS: Withers (1932) used F2026 for four different taxa on the same block. This specimen has been reregistered as F2026b.

Thalassina squamifera (Herbst, 1804)

F679

Thalassina anomala, Herbst; Etheridge fil. and McCulloch, 1916, p.7.

LOCALITY: Daly River, Anson Bay, NT.
FORMATION: Unnamed estuarine deposits.
AGE. Pleistocene.
REMARKS: Campbell and Woods (1967) evaluated modern and fossil material previously referred to *T. anomala* from Australia and placed it in *T. squamifera.*

F6556
Thalassina anomala (Herbst, 1804); Hill *et al.*, 1970, pl.Cz6, fig.5.
LOCALITY: Styx River, MEQ.
FORMATION: Unnamed estuarine deposits.
AGE: Pleistocene.
REMARKS: See F679.

F13694
Thalassina anomala Herbst; Etheridge fil. and McCulloch, 1916, p.7, pl.1, fig.1.
LOCALITY: Darwin, NT.
FORMATION: Unnamed estuarine deposits.
AGE: Pleistocene.
REMARKS: This specimen is part of a collection of *T. squamifera* that was given the registration number F318. F13694 and the other figured material have been allocated new registration numbers. See F679.

F13695
Thalassina anomala Herbst; Etheridge fil. and McCulloch, 1916, p.7, pl.1, fig.2.
LOCALITY: Darwin, NT.
FORMATION: Unnamed estuarine deposits.
AGE: Pleistocene.
REMARKS: See F13694.

F13696
Thalassina anomala, Herbst; Etheridge fil. and McCulloch, 1916, p.7, pl.2, fig.3.
LOCALITY: Darwin, NT.
FORMATION: Unnamed estuarine deposits.
AGE: Pleistocene.
REMARKS: Refer F13694.

Tillocheles shannonae Woods, 1957

F3248
Tillocheles shannonae Woods, 1957, pp.171-3.
LOCALITY: 'Currane', 10 miles N of Dartmouth, CQ.
FORMATION: Allaru Mudstone.
AGE: Lower Cretaceous, (Albian).

F3250
Tillocheles shannonae Woods, 1957, pp.171-3.
LOCALITY, FORMATION, AGE: As for F3248.

F3251
Tillocheles shannonae Woods, 1957, pp.171-3, pl.5, fig.6.
Tillocheles shannonae Woods, 1957; Hill *et al.*, 1968, pl.K11, fig.4.
LOCALITY, FORMATION, AGE: As for F3248.

F3252
HOLOTYPE *Tillocheles shannonae* Woods, 1957, pp.171-3, pl.5, fig.5, text fig.8.
LOCALITY, FORMATION, AGE: As for F3248.

F3253
Tillocheles shannonae Woods, 1957, pp.171-3.
LOCALITY, FORMATION, AGE: As for F3248.

?Tonohamites taylori (Etheridge fil., 1892)

F1271
HOLOTYPE: *Ancyloceras taylori* Etheridge fil., 1892, pp.498-9, pl.42, fig.13.
Crioceras taylori, Eth. fil., Etheridge fil., 1909, pp.162-3.
Toxoceratoides taylori (Etheridge fil.) Whitehouse, 1926, pp. 216-7.
?Tonohamites taylori (Etheridge Jnr., 1892) Day, 1974, p.14.
LOCALITY: 'Wrotham Park', Walsh River, NQ.
FORMATION: Blackdown Fm.
AGE: Lower Cretaceous, (Aptian).
REMARKS: Day (1974) noted that Arkell *et al.*, (1957) regarded *Toxoceratoides* and *Tonohamites* as *nomina dubia* and possibly synonymous with *Hamiteceras* Anderson, 1938. Casey (1961, pp.76-7) resurrected Hyatt's family Helicancylidae as a subfamily of Ancyloceratidae, and concluded that *Toxoceratoides* and *Tonohamites* are recognisable taxa within this subfamily. Day (1974) was unsure of the generic placement of F1271 and F1797 but referred them to *Tonohamites.* Collected Hann's Expedition, 1872. See also F1396 (*Australiceras jacki*).

F1797
Toxoceratoides taylori (Etheridge fil.,) Whitehouse, 1926, pp. 216-7, pl.34, fig.5.
?Tonohamites taylori (Etheridge Jr, 1892) Day, 1974, p.14.
LOCALITY: 'Wrotham Park', Walsh River, NQ.
FORMATION: Blackdown Fm.
AGE: Lower Cretaceous, (Aptian).
REMARKS: Collected Hann's Expedition, 1872.

This specimen was part of the same hand specimen which contains F1271. The shaft of the specimen is missing, but the external mould of the shaft remains. (See also F1271).

Torynomma quadrata Woods, 1953

F2877
HOLOTYPE *Torynomma quadrata* Woods, 1953, pp.54-6, figs3a,c, pl. 2, fig.6.
Torynomma quadrata Woods, 1953; Hill *et al.* 1968, pl.K11, fig. 9.
Torynomma quadrata Woods; Glaessner, 1980, p.181, pl.2, fig. 8.
LOCALITY: 10 miles N of Dartmouth, CQ.
FORMATION: Allaru Mudstone.
AGE: Lower Cretaceous, (Albian).

F2878
Torynomma quadrata Woods, 1953, pp.54-6.
Torynomma quadrata Woods; Glaessner, 1980, p.181
LOCALITY, FORMATION, AGE: As for F2887.

F2879
Torynomma quadrata Woods, 1953, pp.54-6.
Torynomma quadrata Woods; Glaessner, 1980, p.181.
LOCALITY, FORMATION, AGE: As for F2877.

F2880
Torynomma quadrata Woods, 1953, pp.54-6, fig.3d.
Torynomma quadrata Woods; Glaessner, 1980, p.181.
LOCALITY, FORMATION, AGE: As for F2877.

F2881
Torynomma quadrata Woods, 1953, pp.54-6.
Torynomma quadrata Woods; Glaessner, 1980, p.181.
LOCALITY, FORMATION, AGE: As for F2877.

Triassocotis amplicata Evans, 1961

F3689a/b
HOLOTYPE *Triassocotis amplicata* Evans, 1961, p.16, fig.1g.
LOCALITY: Mt Crosby Insect Beds, SEQ.
FORMATION: Mt Crosby Fm.
AGE: Early Late Triassic, (Carnian).

Triassocotis australis Evans, 1956

F3687
Triassocotis australis Evans, 1956; Evans, 1961, p.16, fig. 1e.
LOCALITY: Mt Crosby Insect Beds, SEQ.
FORMATION: Mt Crosby Fm.
AGE: Early Late Triassic, (Carnian).

Triassocotis stricta Evans, 1961

F3688a/b
HOLOTYPE *Triassocotis stricta* Evans, 1961, p.16, fig.1f.
LOCALITY: Mt Crosby Insect Beds, SEQ.
FORMATION: Mt Crosby Fm.
AGE: Early Late Triassic, (Carnian).

Triassohyponomus dinmorensis Rozefelds and Sobbe, 1987

F13436
Insect leaf mines, Rozefelds, 1985a, pp.80-1, pl.1, fig.a.
HOLOTYPE *Triassohyponomus dinmorensis*, Rozefelds and Sobbe, 1987, pl. 51-57, figs 2,3.
LOCALITY: Dinmore, 27°31'S, 152°51'E, SEQ.
FORMATION: Tivoli Fm.
AGE: Late Triassic.

F13435
Triassohyponomus dinmorensis Rozefelds and Sobbe, 1987, p.51-57, fig.4d.
LOCALITY, FORMATION, AGE: As for F13436.

Triassothea analis Evans, 1956

F6515a/b
Triassothea analis Evans, 1956; Evans, 1971, p.148, fig.3b.
LOCALITY: Mt Crosby, SEQ, Upper Bed, 910805-911805, Ipswich 1 mile military map.
FORMATION: Mt Crosby Fm.
AGE: Early Late Triassic, (Carnian).

F6523a/b
Triassothea analis Evans, 1956; Evans, 1971, p.148, fig.3c.
LOCALITY, FORMATION, AGE: As for F6515.

F6524
Triassothea analis Evans, 1956; Evans, 1971, p.148, fig.3d.
LOCALITY, FORMATION, AGE: As for F6515.

Tricrosbia minuta Evans, 1971

F6520

HOLOTYPE *Tricrosbia minuta* Evans, 1971, pp.145-6, fig.1.

LOCALITY: Mt Crosby, SEQ, Upper bed, 910805-911805, Ipswich 1 mile military map.

FORMATION: Mt Crosby Fm.

AGE: Early Late Triassic, (Carnian).

Trifidella perfecta Evans, 1956

F3690a/b

Trifidella perfecta Evans, 1956; Evans, 1961, p.18, fig.3a.

LOCALITY: Mt Crosby Insect Beds, SEQ.

FORMATION: Mt Crosby Fm.

AGE: Early Late Triassic, (Carnian).

REMARKS: The counterpart of this specimen originally referred to as F3691 has been re-registered as F3690b.

F3692

Trifidella perfecta Evans, 1956; Evans, 1961, p.18, fig.3b.

LOCALITY, FORMATION, AGE: As for F3690.

F6504a/b

Trifidella perfecta Evans, 1956; Evans, 1971, p.146.

LOCALITY: Mt Crosby Insect Beds, Upper bed, 910805-911805, Ipswich, 1 Mile Military Sheet.

FORMATION: Mt Crosby Fm.

AGE: Early Late Triassic, (Carnian).

Trigonia moorei Lycett, 1870

F5603

Trigonia moorei Lycett, 1870; Skwarko, 1974, pp.92-3.

LOCALITY: ?Newmarracarra Limestone, WA.

FORMATION: ?Newmarracarra Limestone.

AGE: Middle Jurassic, (Bajocian).

F5606

Trigonia moorei Lycett; Whitehouse, 1924, pp.4-6.

Trigonia moorei Lycett; 1870; Skwarko, 1974, pp.92-3.

LOCALITY, FORMATION, AGE: As for F5603

F5607

Trigonia moorei Lycett; Whitehouse, 1924, pp.4-6.

LOCALITY, FORMATION, AGE: As for F5603.

Tropaeum undatum Whitehouse, 1926

F1264

Crioceras jackii Eth. fil.; Etheridge fil., 1909, pp.145-8, pl.31, figs 1,2.

HOLOTYPE *Tropaeum undatum* Whitehouse, 1926, pp.215-6.

Tropaeum undatum Whitehouse, 1926; Day, 1974, pp.6-7, Table 1.

LOCALITY: probably Walsh River, NQ.

FORMATION: ?

AGE: Lower Cretaceous.

REMARKS: Collected Hann's Expedition, 1872, probably from the Walsh River.

F1266

Crioceras jackii Eth. fil.; Etheridge fil., 1909, pp.145-8, pl.32, fig.2, pl.34, fig.1.

Tropaeum arcticum (Stolley); Whitehouse, 1926, p.215.

Tropaeum arcticum (Stolley); Day, 1964, p.18.

Tropaeum undatum Whitehouse, 1926; Hill *et al.*, 1968, K7, fig. 3.

Tropaeum undatum Whitehouse, 1926; Day, 1974, pp.1, 7-8, pl. 3, figs 2a,b, Table 1.

LOCALITY: Roma, SEQ.

FORMATION: Blackdown Fm.

AGE: Lower Cretaceous, (Aptian).

F1598

HOLOTYPE *Tropaeum rarum* Whitehouse, 1926, p.216, pl.36, figs 1a,b.

Tropaeum undatum Whitehouse, 1926; Day, 1974, pp.6-8, Table 1.

LOCALITY: Walsh River, NQ.

FORMATION: Blackdown Fm.

AGE: Lower Cretaceous, (Aptian).

REMARKS: Collected Hann's Expedition, 1872.

F1605

Crioceras jackii Eth. fil.; Etheridge fil., 1909, pp.145-8, pl.38, figs 4-5.

Tropaeum undatum Whitehouse, 1926; Day, 1974, pp.6-8, Table 1.

LOCALITY: ?Walsh River, NQ.

FORMATION: ?Blackdown Fm.

AGE: Lower Cretaceous, (Aptian).

REMARKS: Collected Hann's Expedition, 1872.

Vacunella curvata (Morris, 1845)

F1252

SYNTYPE *Panopaea (Mya) plicata* Sow., var. *acuta* Etheridge, 1872, pp.342-3, pl.21, fig.3.

Chaenomya (?) acuta Etheridge; Etheridge fil., 1892, p.280.

Vacunella curvata Morris (1845); Waterhouse, 1965, p.852.

Vacunella curvata (Morris), 1845; Runnegar, 1967, pp.63-7.
Vacunella curvata (Morris) 1845; Waterhouse, 1969, pp.38, 71-2, pl.3, figs 5,6.
LOCALITY: Pelican Creek, Bowen River, CQ (see remarks).
FORMATION: ?
AGE: Upper Permian.
REMARKS: Etheridge (1872) considered this Daintree Collection material to be Cretaceous, although the locality for this material (if accurate) would rule out this possibility. Etheridge (1892) doubted whether fig.3 and 3a were referable to the same taxon but indicated a Permian age for F1252. Waterhouse (1965) concurred in this assessment and referred F1252 to the Permian genus *Vacunella* and F1251 to the Cretaceous genus *Panopea*. Waterhouse (1969) erroneously refers to F1252 as F1952.

Vacunella dawsonensis Runnegar, 1967

F1814
Chaenomya? n.sp.; Runnegar, 1966, pp.374-5, fig.1d.
Vacunella? dawsonensis Runnegar, 1967, pp.73-4, pl.11, figs 1,2.
?*Australomya dawsonensis* Runnegar, 1967; Runnegar, 1969, pp. 287-8, figs 3a,c.
Vacunella dawsonensis Runnegar, 1967; Waterhouse, 1987a, p.174.
LOCALITY: Castle Creek, Dawson Valley, CQ.
FORMATION: ?Barfield or Flat Top Fms.
AGE: Lower Upper Permian

Velesunio ambiguus (Philippi, 1847)

F1621
Velesunio ambiguus (Philippi, 1847); Hill *et al.*, 1970, pl. Cz5, fig.11.
LOCALITY: Darling Downs, SEQ.
FORMATION: Unnamed fluviatile deposit.
AGE: Pleistocene.

Wyndhamia clarkei (Etheridge, 1872)

F2887
SYNTYPE *Productus clarkei* Etheridge, 1872, p.334, pl.17, fig. 2.
Productus clarkei Etheridge; de Koninck, 1877, p.203.
Productus clarkei Etheridge; Etheridge fil., 1878, p.51
Strophalosia clarkei Etheridge; Etheridge fil., 1892, pp.258-60
Strophalosia clarkei Etheridge; Prendergast, 1942, pp.42-3
LECTOTYPE *Strophalosia clarkei* Etheridge; Maxwell, 1954, pp.546-7, pl.56, figs 5, 6.
Wyndhamia clarkei (Etheridge Sr); Dear, 1971, pp.11-2.
Wyndhamia clarkei Etheridge; Hill *et al.*, 1972, pl.P4, fig. 11.
LOCALITY: Collinsville District, Bowen River, NQ.
FORMATION: Big *Strophalosia* Zone, Blenheim Fm.
AGE: Middle Permian.
REMARKS: Daintree Collection. Maxwell (1954) referred to this specimen as holotype although lectotypic status is correct. (See the *International Code of Zoological Nomenclature*).

F2888
SYNTYPE *Productus clarkei* Etheridge, 1872, p.334, pl.17, fig. 2a.
Productus clarkei Etheridge; de Koninck, 1877, p.203.
Productus clarkei Etheridge; Etheridge fil., 1878, p.51
Strophalosia clarkei Etheridge; Etheridge fil., 1892, pp.258-60.
Strophalosia clarkei Etheridge; Prendergast, 1942, pp.42-3.
PARALECTOTYPE *Strophalosia clarkei* Etheridge; Maxwell, 1954, pp.546-7, pl. 56, fig.8.
Wyndhamia clarkei Etheridge; Hill *et al.* 1972, pl.P4, fig.12.

LOCALITY: Collinsville District, Bowen River, NQ.
FORMATION: Big *Strophalosia* Zone, Blenheim Fm.
AGE: Middle Permian.
REMARKS: Maxwell (1954) erroneously referred to this specimen as F2887 in pl.56, fig.8. Daintree Collection.

Zaphrentis profunda Etheridge fil., 1892

F1191
HOLOTYPE *Zaphrentis profunda* Etheridge fil., 1892, p.200, pl. 44, fig.1.
Zaphrentis profunda Etheridge Jnr, 1892; Hill, 1978, pp.29, 34.
LOCALITY: Rockhampton District, MEQ.
FORMATION: ?
AGE: Permian.
REMARKS: The figure in Etheridge fil. (1892)

appears to have been drawn from a plaster cast of F1191. This holotype has not been sectioned so its generic affinities are uncertain but it may be referable to *Euryphyllum* (Susan Parfrey, pers. comm., 1989). De Vis Collection.

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CAMBRIAN EDRIOASTEROIDS FROM AUSTRALIA AND THE ORIGIN OF STARFISHES

ANDREW B. SMITH AND PETER A. JELL

Smith, A.B. and Jell, P.A. 1990 08 31: Cambrian edrioasteroids from Australia and the origin of starfishes. *Memoirs of the Queensland Museum* **28**(2): 715-778. ISSN 0079-8835.

The early Middle Cambrian edrioasteroids *Stromatocystites reduncus* sp. nov. and *Edriodiscus primoticus* (Henderson & Shergold), and the median Upper Cambrian edrioasteroids *Chatsworthia spinosa* gen. et sp. nov., *Hadrodiscus parma* gen. et sp. nov. and *Cambroblastus enubilatus* gen. et sp. nov. are described. *C. enubilatus* is a primitive edrioblastoid linking edrioblastoids to the cyathocystinid Edrioasteroidea. *Chatsworthia* and *Hadrodiscus* are primitive isorophid edrioasteroids probably retaining biserial ambulacral flooring plates. The primitive starfish *Archegonaster*, from the Llanvirn of Czechoslovakia is redescribed. It is shown to be sufficiently generalised in its morphology to belong to the common stem lineage of both asteroids and ophiuroids. The most probable ancestry of *Archegonaster* is traced to Cambrian edrioasteroids with *Edriodiscus* as its closest relative. The origin and homologies of the ophiuroid jaw are clarified on the basis of *Archegonaster* mouth elements and it is argued that mouth angle plates are homologues of first ambulacral ossicles and the torus and its mouth spines are homologues of the first adambulacral ossicles and its spines.
Edrioasteroid phylogeny is analysed using numerical cladistic methodology and an evolutionary tree constructed from stratigraphical occurrence data. Edrioasteroids diversified in paleoecological terms from being unattached low-level epibenthic suspension feeders to fill a number of different niches during the Cambrian and Early Ordovician. Different groups became semi-infaunal, vagile, semi-permanently attached or permanently cemented to a hard substratum, while one line even became convergent with crinoids by evolving a stem. The fauna described here suggests that edrioasteroids continued to diversify through the Upper Cambrian and that their rarity at this time interval is due to preservational factors.

☐ *echinoderms, Cambrian, Ordovician, Australia, Czechoslovakia.*

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Echinoderms have a good fossil record that extends back to the Lower Cambrian and possibly even into the Precambrian (Gehling, 1988). Much attention has been focused recently on the early evolutionary history of this group (Termier & Termier, 1969; Ubaghs, 1975; Paul, 1977, 1979, 1988; Sprinkle, 1976, 1980a, 1981; Paul & Smith, 1984; Smith, 1984, 1986, 1988a; Campbell & Marshall, 1987). This has greatly improved our understanding of the morphology of early, primitive echinoderms but substantial gaps remain in our understanding of both phylogenetic relationships and evolutionary patterns as echinoderms diversified. In particular the origins of certain post-Cambrian lineages remains problematic because suitable intermediates, linking the derived forms to known Cambrian fauna, have not been discovered. Two factors greatly aggravate this problem; the apparent absence of a good Upper Cambrian record for echinoderms and the strong geographical bias in the known early fossil record.

The dearth of identifiable Upper Cambrian fossil echinoderms was first pointed out by Sprinkle (1976) who noted that, although disarticulated elements of echinoderms were not uncommon in Upper Cambrian limestones of western U.S.A., whole animals were extremely rare. Sprinkle (1980a, 1981) and Campbell & Marshall (1987) argued that this low diversity is genuine and that echinoderms underwent a two phase diversification, as postulated for marine invertebrates in general (Sepkoski, 1979). Smith (1988a), however, interpreted the Upper

Cambrian as a period of preservation failure because although many Ordovician lines could be traced back to Middle Cambrian antecedents, few had described representatives from the Upper Cambrian. Of 80 species known from the Cambrian, only 12 (15%) are Upper Cambrian and of these, only 7 have formally been described. Similarly, of 40 named Cambrian genera only 7 (17.5%) come from the Upper Cambrian. Upper Cambrian echinoderms are thus considerably under represented.

A second problem that is rarely considered is the strong geographical bias of the fossil record towards North America and western Europe. For Cambrian echinoderms 46 species occur in North America, 26 in Europe, 7 are Australian and one each is known from the U.S.S.R. and North Africa. Thus, excluding one species common to both areas, 71 out of 80 (87.5%) species come from Europe and North America and only 9 (12.5%) from elsewhere in the world. This disparity must surely reflect the considerably greater amount of research effort that has been spent investigating Cambrian outcrops in western Europe and North America. Thus, although we may now have a fairly good idea of echinoderm diversity in the Cambrian of Europe and North America, there is great scope for new discoveries in suitable Cambrian sequences elsewhere in the world.

Because Cambrian faunas outside Europe and North America are less well studied and because one of the few Upper Cambrian echinoderm-bearing beds is in Queensland, Australia, we felt that a search for echinoderms in the Cambrian of western Queensland might be highly rewarding. This paper is a direct result of a two-week field collecting trip and describes the edrioasteroid species that were discovered. A new carpoid from the Upper Cambrian of Queensland will described elsewhere (Smith & Jell in prep.). In addition we give a description of the primitive asteroid/ophiuroid antecedent *Archegonaster pentagonus* Spencer,1951 from the Lower Ordovician of Czechoslovakia, as this has bearing on the phylogenetic diversification of Cambrian edrioasteroids.

The first Australian Cambrian echinoderms described were *Cymbionites craticula* Whitehouse, 1941 and *Peridionites navicula* Whitehouse, 1941 from the early Middle Cambrian Thorntonia Limestone, north of Mount Isa, western Queensland. These were subsequently considered (Smith, 1982) to be the basal circlet of two different eocrinoids and our collecting at the type locality in May 1989 confirms this view. In 1971 Henderson and Shergold described *Cyclocystoides primotica* from the early Middle Cambrian Beetle Creek Formation, associated with *Redlichia* spp. This species is not a cyclocystoid (Jell *et al*., 1985; Smith, 1986; Smith & Paul, 1982) and has been reassigned to the Edrioasteroidea and placed in its own genus *Edriodiscus*; it is elaborated upon below. Fleming (1977) showed the great abundance of dissociated echinoderm plates in the Lady Annie and Duchess phosphate deposits in the early Middle Cambrian Beetle Creek Formation, but made no taxonomic identifications. This material, collected from the vicinity of BMR locality D640 (Fig. 1), contains abundant, well-preserved disarticulated plates of edrioasteroids and is currently under investigation. Most of our knowledge of Australian Cambrian echinoderms derived from the work of Jell *et al.* (1985) who described *Cambraster tastudorum* and *Ctenocystis jagoi* from the medial Middle Cambrian part of the Cateena Group in northern Tasmania, isolated plates of *Cambraster* and probably *Gogia* from the early Middle Cambrian Coonigan Formation in western New South Wales, *?Stromatocystites* sp. (=*S. reduncus* sp. nov. below) from the type locality of *E. primotica*, and the eocrinoid *Ridersia watsonae* and an unnamed isorophid (=*Chatsworthia spinosa* gen. et sp. nov. below) from the medial Late Cambrian Chatsworth Limestone near Chatsworth Homestead, 100 km north of Boulia, western Queensland. Thus the five taxa described below represent half of the known Cambrian echinoderm fauna of Australia.

GEOLOGICAL SETTING OF LOCALITIES

The Cambrian fauna described here comes from the eastern portion of the Georgina Basin in western Queensland (Fig. 1). Sedimentation in this epicontinental basin occurred from the late Precambrian to the Devonian, although not continuously in any one area. Although the entire basin has been mapped geologically at a 1:125,000 scale, more detailed mapping has been confined to a few areas within the basin, mostly areas that were prospected for phosphate deposits in the 1960s and 1970s. The Burke River structural belt in the southeast has received considerable attention and the biostratigraphy of the echinoderm bearing Upper Cambrian Chatsworth Limestone in the area south of Lily Creek (Fig. 1) has been studied in great detail by

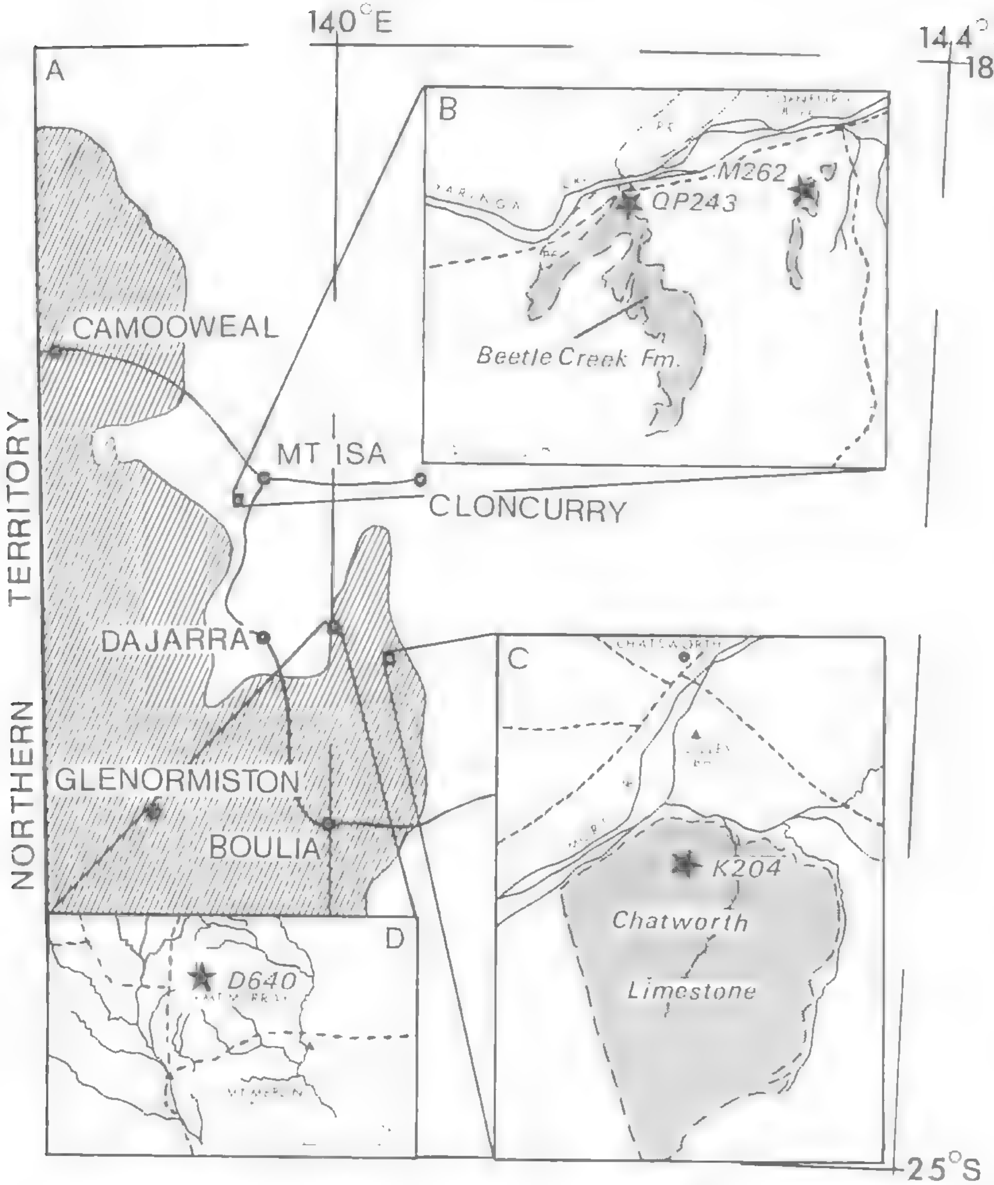
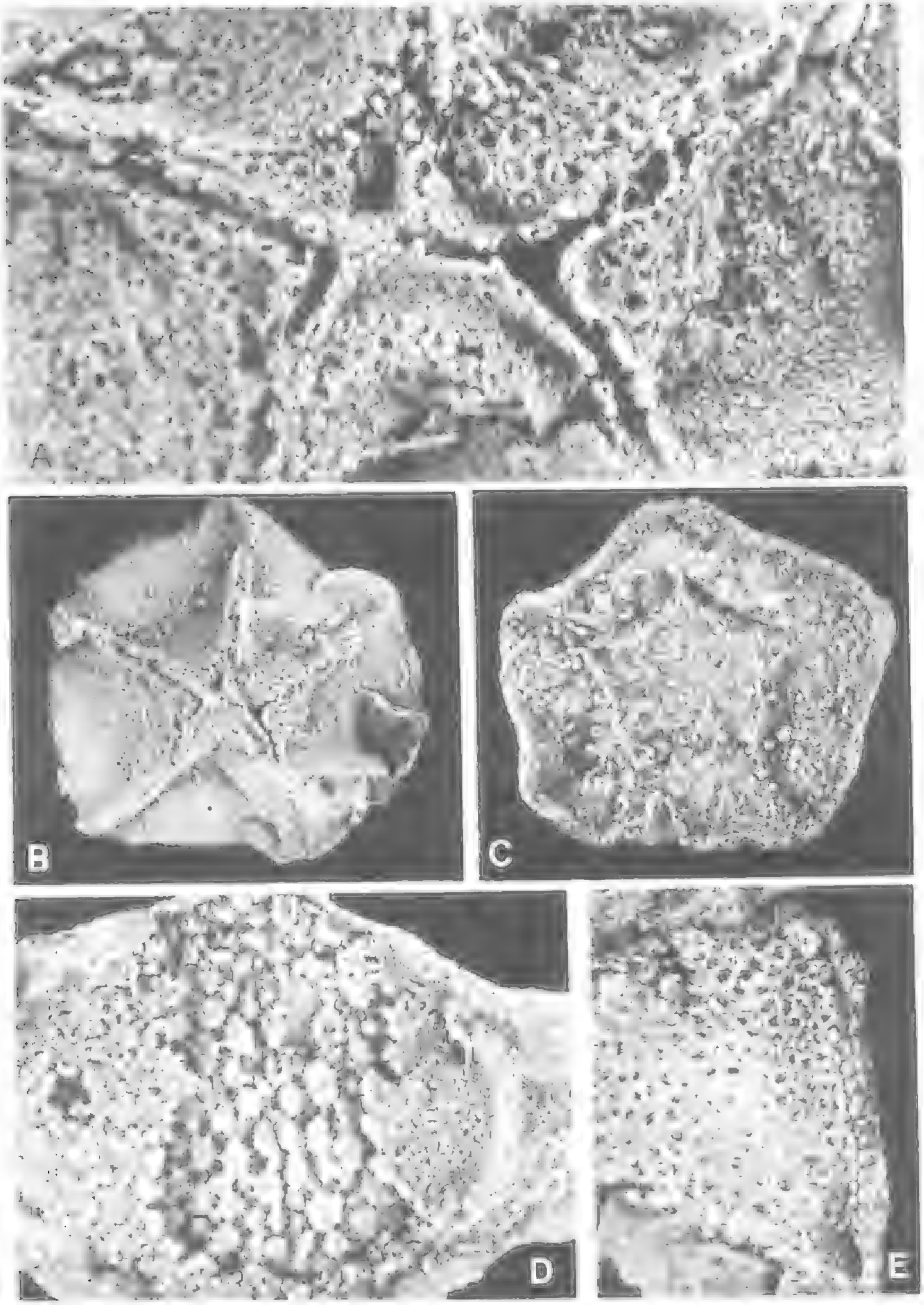


FIG. 1. Locality map. A, showing extent of Cambrian outcrop in the Georgina Basin (diagonally lined), main roads, and centres of population in far western Queensland (redrawn from Smith, 1972). B, Cornford Bore area on Yaringa Creek (from Henderson & Shergold, 1971). C, Chatsworth area (from Shergold, 1982; scale same as in B). D, Mount Murray area (from Jones & McKenzie, 1980). Triangles = water bores; stars = fossil localities mentioned in the text.

Shergold (1982). He recorded pelmatozoan debris from a number of horizons and, at his locality K204, the eocrinoid aff. *Macrocystella* sp. That fossil was later described as *Ridersia watsonae* by Jell *et al.*, (1985), together with two specimens of an indeterminate isorophid edrioasteroid. Further collecting by the authors at that locality has yielded many more specimens of *Ridersia watsonae*, the edrioasteroids *Chatsworthia spinosa* and *Hadrodiscus parma* and the edrioblastoid *Cambroblastus enubilatus*.

Shergold (1982) described the Chatsworth Limestone in its type section, south of Lily Creek, as 'dominantly sandy or silty pelletal skeletal grainstone and packstone, with subordinate wackestone and clast grainstone; the environment of deposition was high energy, shallow subtidal, intertidal and possibly aeolian;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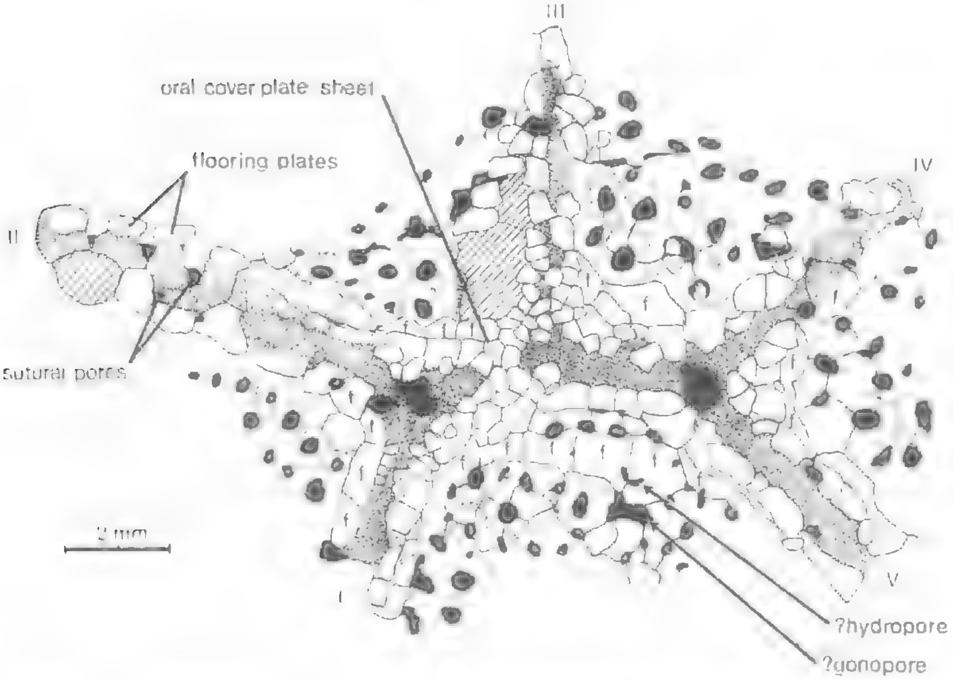


FIG. 3. *Stromatocystites reduncus* sp. nov.: camera lucida drawing of plating in the oral region of the holotype f = flooring plate; ambulacra numbered I-V.

cross-lamination and ripple marks are common; trilobites and echinoderms are predominantly dissociated and fractured skeletal parts are not uncommon; current winnowing and alignment of organisms widespread.' Horizon K204 refers to a 4 m thick unit of thin-bedded limestone which is a pelletal grainstone containing rare ooids (Shergold, 1982, p. 97). Cross lamination occurs throughout this unit and shallow but large-scale channeling results in individual beds having limited lateral extent. Current alignment of fossils is often evident and we discovered a shallow channel infill, about 2 m by 1 m, with about 100 adult specimens of *Ridersia watsonae* lying in parallel alignment.Obvious hardground surfaces are absent. In addition to the echinoderms listed above, the fauna includes the trilobites *Iveria iverensis*, *Connagnostus* sp., *Peichiashania secunda*, *Prochuangia glabella*, *Pseudagnostus parvus* and *Wuhuia silex*, inarticulate and articulate brachiopods, monoplacophorans, gastropods, sponges and an undescribed cothurnocystid. Shergold (1982) placed this horizon within his *Peichiashania secunda/Prochuangia glabella* Assemblage Zone at the top of the Idamean Stage, which he correlated internationally with the middle Franconian of North America.

The second locality from which we describe Cambrian echinoderms lies to the west of Mount Isa. At BMR locality QP243 (Fig. 1) on a low rise some 500 m south of Yaringa Creek at the bore some 3 km west of Cornford Bore situated on the north of Ardmore Station, 45 km west-southwest of Mount Isa (20° 49.5' S, 139° 03.5' E) Henderson & Shergold (1971) discovered a single specimen with two individuals of *Edriodiscus primoticus*. Here, laminated chert with silicified coquinite, algal chert and siltstone form the lower part of the Beetle Creek Formation, resting unconformably on Precambrian quartzites. Accompanying these rare echinoderms are abundant exoskeletal fragments of the trilobite *Redlichia*. Öpik (1970) described from this horizon at the nearby M262 (Fig. 1) the species *Redlichia versabunda*, *R. vertumnia* and

FIG. 2. *Stromatocystites reduncus* sp. nov., early Middle Cambrian from QP243 near Cornford Bore. A-C, QMF17914, holotype. A, oral area, x7 (see Figs 3, 4A). B, oral surface, x1.7. C, aboral surface, x1.7. D, BMNH E63523, paratype, detail of oral surface with ambulacrum, margin of disc at bottom x3.Oral plating has been lost from the central band to reveal the internal surface of aboral plates. E, QMF17920a, paratype, detail of oral surface showing interambulacral plating and, on the right hand margin, ambulacral flooring and cover plates, x3 (see Fig. 4B). All latex casts whitened with ammonium chloride sublimate.

R. mayalis, and all three described morphologies are recognizable amongst our collection from QP243. Öpik dated the horizon as late Ordian, immediately older than his *Redlichia chinensis* Zone, and early Middle Cambrian.

A further specimen of *Edriodiscus primoticus* was collected and described by Jell *et al.* (1985) from this locality and on the same slab there was also a fragment of a *Stromatocystites* sp. We recollected from this locality and extended our search some 400-800 m further south along the ridge with QP243 at its northern end. This resulted in the discovery of an additional 35 specimens of the *Stromatocystites* and 5 specimens of *Edriodiscus primoticus*, described below. They occur in distinct layers associated with much disarticulated trilobite material.

REPOSITORIES OF MATERIAL

The material described below is housed in the following institutions: British Museum (Natural History), London [BMNH]; Commonwealth Palaeontological Collection, Bureau of Mineral Resources, Canberra [CPC]; Narodní Museum, Prague [NM]; Museum of Victoria, Melbourne [NMVP]; Queensland Museum [QMF]

SYSTEMATIC DESCRIPTIONS

Class EDRIOASTEROIDEA Billings, 1858

Stromatocystites Pompeckj, 1896

Type Species

Stromatocystites pentangularis Pompeckj, 1896; Middle Cambrian of Czechoslovakia and late Lower Cambrian of Newfoundland.

Diagnosis

Edrioasteroids with fully plated aboral surface approximately as large as the oral surface. Undifferentiated oral mouth frame and cover plate series; biserial flooring plates and multiserial cover plate series. Interambulacra with well developed epispires. No differentiated peripheral rim plates. Interior of aboral surface with a series of divaricating ribs radiating from a central platform of larger plates.

Other Species

S. walcotti Schuchert, 1919 (late Lower Cambrian of Newfoundland), *S. reduncus* sp. nov. (early Middle Cambrian of Australia).

Remarks

Stromatocystites is the oldest and most primitive edrioasteroid known and is a possible antecedent to all later edrioasteroid groups. The absence of differentiated peripheral rim plates separates *Stromatocystites* from most other edrioasteroids and appears to be primitive for the class, as is the presence of epispires in interambulacra and the completely plated aboral surface. Although both previously known species have straight ambulacra, the new species described below has curved ambulacra. This is also the condition seen in the even more primitive Lower Cambrian *Camptostroma* (Paul & Smith, 1984), although the direction of curvature is not the same.

Stromatocystites reduncus sp. nov.
Figs 2-9

?*Stromatocystites* sp. Jell, Burrett & Banks, 1985, p.192, figs 7c-f, 8.

Etymology

From Latin *reduncus* curved back, in reference to the shape of the ambulacra.

Material

Holotype QMF17914 part & counterpart; paratypes, QMF17915-25, 17938, 17944, BMNH E63519-22, E63525. Other material QMF17926-37,17939-43, 17944, BMNH E63523, 63524, NMVP107478.

Age and Occurrence

From chert beds of the Yelvertoft Member, Beetle Creek Formation, early Middle Cambrian, exposed on the northern flank of a low rise 400-800 m south of the bore at Yaringa Creek, 50 km west-southwest of Mount Isa, Western Queensland (GR 980965).

Diagnosis

A *Stromatocystites* with distally recurved ambulacra; ambulacra I and V curving clockwise, ambulacra II, III and IV anticlockwise.

Description

Specimens reach 53 mm in diameter and are rounded pentagonal in outline (Fig. 2B,C). The lower (aboral) surface is flat or slightly concave while the oral surface is moderately convex. Both surfaces are fully plated and there is no sharp demarcation separating oral from aboral surface or any distinct peripheral rim plating.

Ambulacra are long and slender, forming sharp, well-defined ridges over the oral surface and meeting centrally in a 2:1:2 arrangement (Figs 2A, 3). They are straight proximally but close to the edge of the oral surface they curve sharply so that the tips of the ambulacra come to face centrally (Figs 2B, 5C,D). Ambulacra I and V curve clockwise and ambulacra II, III and IV curve anticlockwise. The recurved portion is about 1/3 of the radius in larger specimens. Flooring plates are biserially arranged (Figs 2A, 3). They are rather broad and short and there are large marginal sutural pores between adjacent flooring plates that almost reach the perradial suture. These pores lead to the interior of the theca. The outer edge of the flooring plates is exposed along the adradial margin of the ambulacra (Figs 2E, 3, 4A,B) where they appear as a row of rectangular plates. Flooring plates are more fully exposed towards the distal ends of the ambulacra. Each flooring plate carries a large primary cover plate which is broader than tall with a blunt distal point. These cover plates sit directly on top of the flooring plates. Above the primary cover plates there is a sheet of smaller secondary cover plates without regular arrangement (Figs 2D, 4A,B). These are in two or three irregular rows and are about 1/3 the size of the primary cover plates or less. Ambulacral plating decreases in size towards the arm tips.

In the oral region the ambulacral series is undifferentiated (Figs 2A, 3). There are no enlarged flooring or cover plates and there appear to be four flooring plates along the posterior border of the oral area (Figs 2A, 3). The cover plate sheets continue across the oral area without differentiation. In the flooring plate closest to ambulacrum V there is a crescentic opening which might represent the hydropore and a more ragged opening that might be the gonopore (Figs 2A, 3).

Interambulacral areas are broad and composed of many plates. Towards the centre the plates are large (1-1.5 mm diameter) and stellate in outline with prominent epispires surrounded by a rim (Figs 2A, 3). The remainder of the plate surface has a reticulate ornament but the rim and inner walls of the epispires are smooth (Figs 2D,E, 4C). The largest epispires (up to 0.5 mm diameter) are found centrally in each interambulacrum where they are oval in outline. Epispires decrease in size towards the margin of the oral surface and are more angular, either slit-like or, where developed at triple suture junctions, triangular in outline. Interambulacral plates are smooth internally and have nearly vertical sutures (Fig. 6A,B).

The periproct is a cone of lath-shaped plates, some 20-30 in number, situated close to the margin on the oral surface mid-way between the two posterior ambulacra (Figs 2B, 5C, 6B). Epispires reduce in size close to the periproct and are absent from the cone of lath shaped plates forming the periproct.

There is no differentiated peripheral rim or marginal frame. At the edge of the theca, interambulacral plates become progressively smaller and rapidly merge into a narrow zone of small granular ossicles lying subambitally (Figs 5B, 7A,B, 8). This 2-3 mm wide band usually stands out as an elevated rim when seen from the aboral surface, suggesting that there might be some

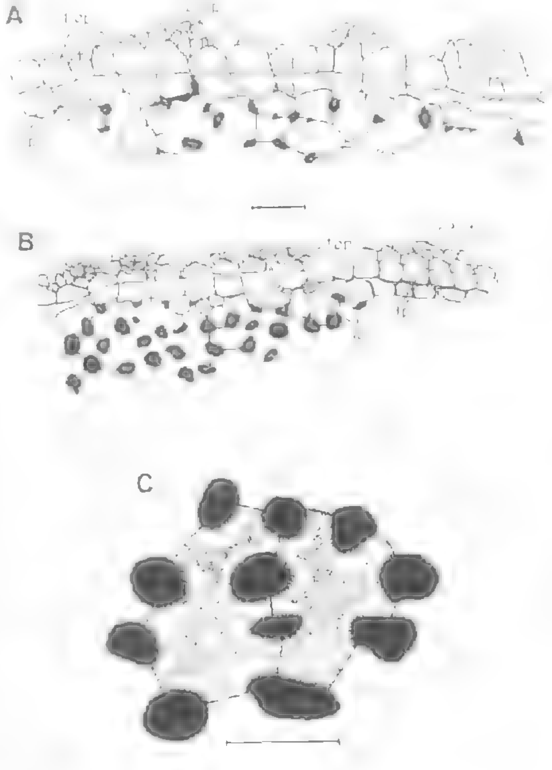
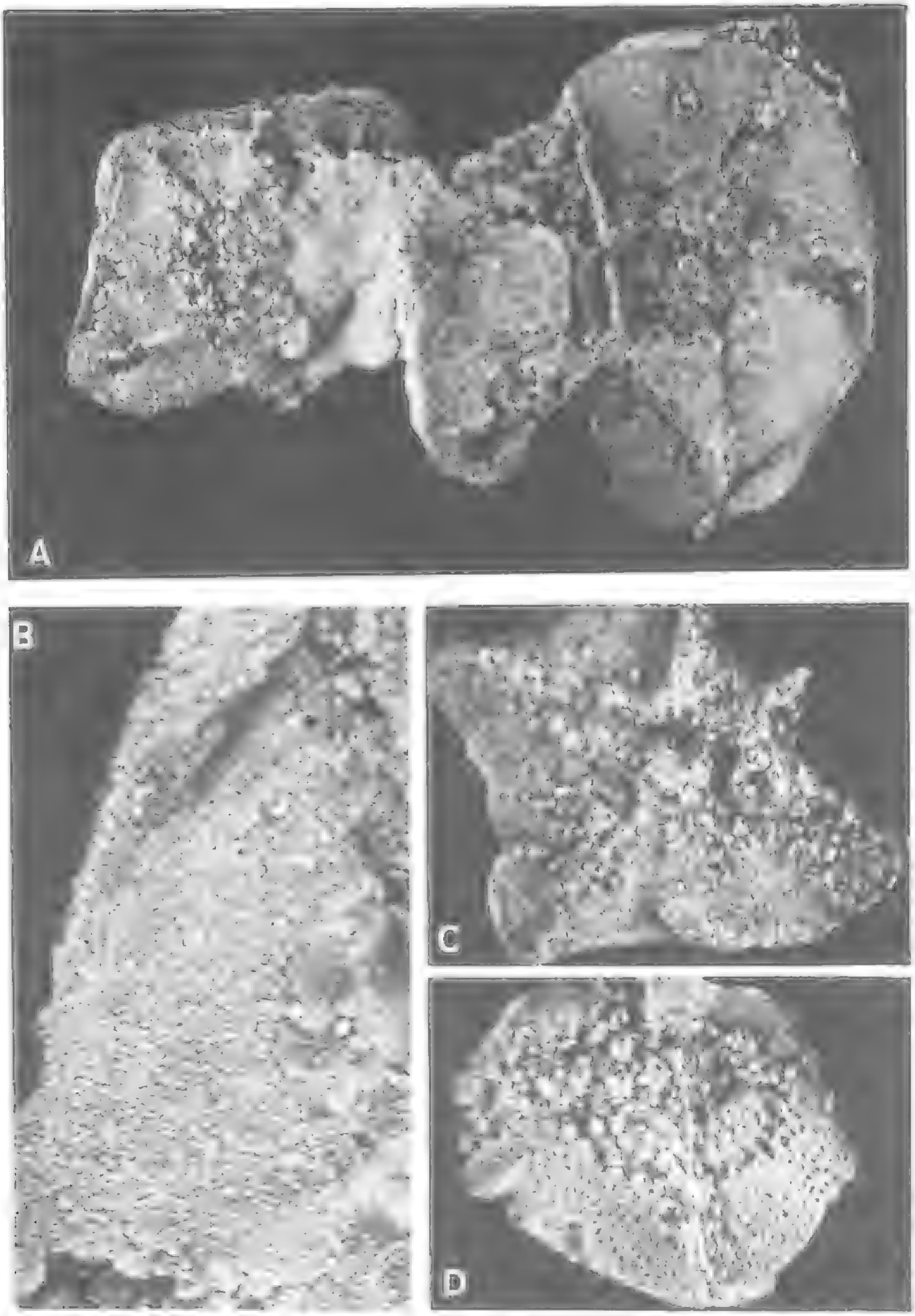


FIG. 4. *Stromatocystites reduncus* sp. nov.; camera lucida drawings of plating. A, QMF17914a, holotype; lateral view of ambulacrum V at mid-length. B, QMF 17920a, lateral view of ambulacral plating. C, QMF17927, two oral interambulacral plates in external view. cp = cover plate; fp = flooring plate; Ia p = interambulacral plate; 1° = primary; 2° = secondary. Scale bar = 1 mm.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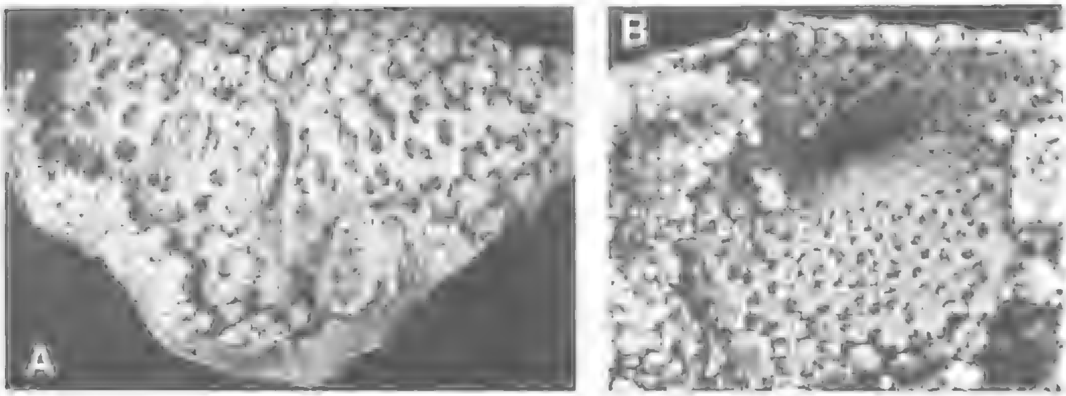


FIG. 6. *Stromatocystites reduncus* sp. nov. A, QMF17924, paratype, internal surface of aboral plates towards the margin of the disc, x3.5. B, QMF17944, paratype, internal surface of oral plating in posterior interambulacrum with lath-like plates of the periproct evident, x4. Latex casts whitened with ammonium chloride sublimate.

weak development of peripheral plates internally forming a more robust frame to the theca.

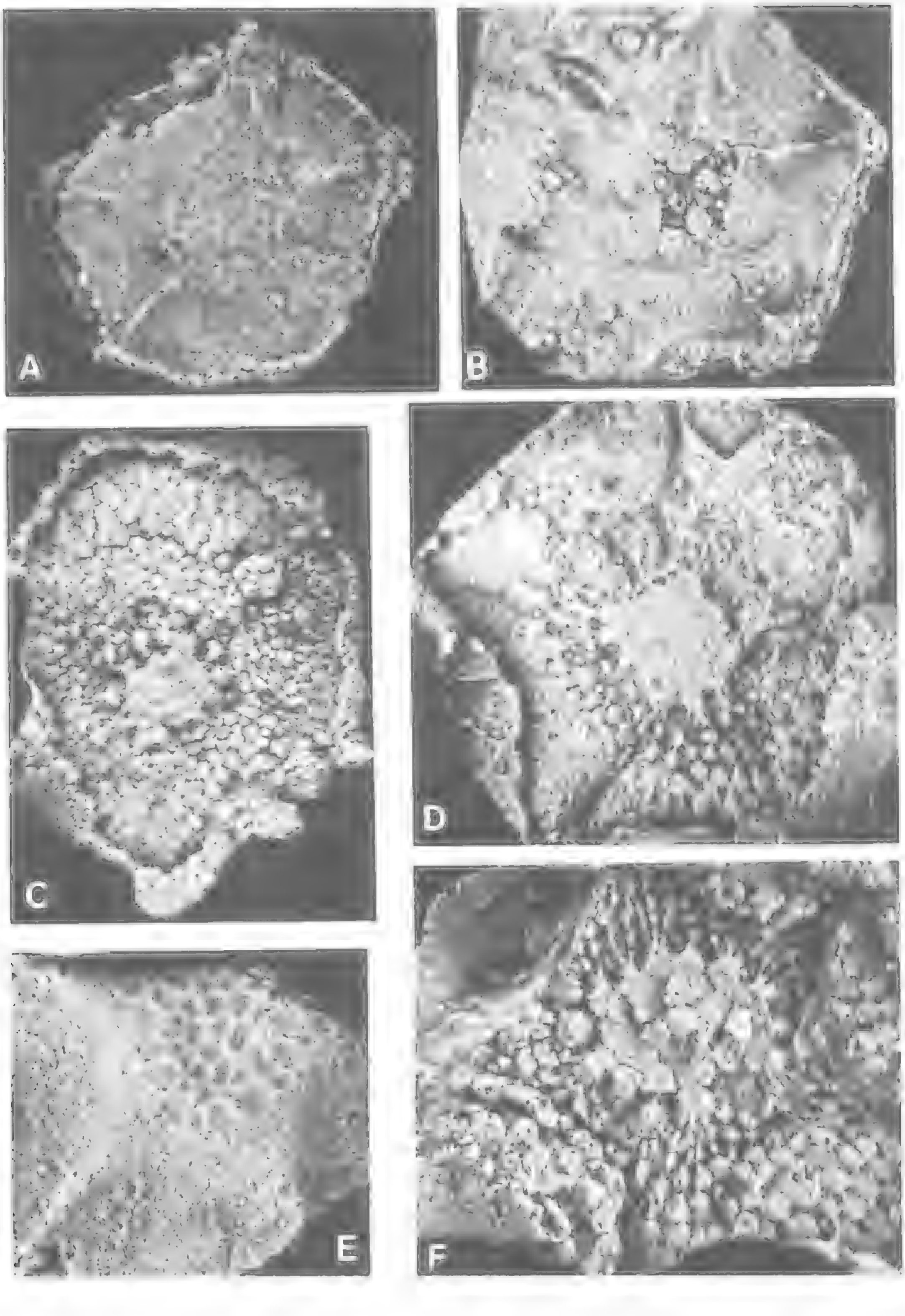
On the aboral surface, inside the marginal zone of granular plates, the majority of the surface consists of a pavement of oval to sub-polygonal plates surrounded by rings of small granular ossicles (Figs 5A,B, 7A,B, 8). The large plates are 1.5-2 mm in diameter and become larger towards the centre. They have a distinctive reticulate pattern of fine radiating ribbing (Fig. 5B). At the centre there is a small region of larger plates lacking interspersed granular plates around their borders. These are in no particular arrangement and there is no clear central plate (Figs 5A, 7A,B,E, 8). The interior of the aboral surface is very distinctive. There is an outer zone composed of rather thick stellate plates, resembling the epispire-bearing plates of the oral surface (Figs 2D, 6A). However, the spaces between the large plates are filled with small, thin platelets that appear deep down in the depressions. This outer zone is best developed interradially. Towards the centre, plates develop pronounced sharp keels that run radially and occasionally branch and merge (Figs 7C,D,F, 9). This zone of ribbed plates is extended radially to create a stellate pattern. Ribbing becomes stronger towards the centre and ends against an elevated platform of some 12-15 large polygonal plates bounded by a low peripheral ridge (Figs 7C,D,F, 9). The plates around the edge of this platform have radiating ridges on their distal half, between 2 and 6 major ridges per plate (Fig. 9). These ridges are continuous with the radial ribs on the more distant plates. The outer boundary of internally ribbed aboral plates corresponds to the elevated pentagonal area that is seen from the exterior.

REMARKS

The incomplete specimen of Jell *et al.* (1985, figs 7C-F, 8B) from this locality could only tentatively be assigned to *Stromatocystites*. Jell *et al.* (1985) noted the internal ridging to aboral plates which had previously been unrecorded from any stromatocystitid. However, we now know that a similar, but less well-developed, system of ridges occurs internally in the type species, *S. pentangularis* (Fig. 10). Re-collecting from this locality has produced a further 35 specimens and it is now the best known of all *Stromatocystites* species. It differs from the other two species of *Stromatocystites* in having distally curved ambulacra.

The oral area of the holotype is well-preserved and allows the plating of this region to be described in detail for the first time in *Stromatocystites*. The crescentic opening here tentatively identified as the hydropore lies across a suture between two flooring plates and thus

FIG. 5. *Stromatocystites reduncus* sp. nov. A,B, QMF17916, paratype. A, aboral surfaces of two individuals, x1.4. B, detail of external ornament on aboral plates, x4. C, BMNH E63519, paratype, oral surface showing ambulacra I and II, and the periproct, x2. D, QMF19738a, paratype, oral surface in external aspect with two curved ambulacra and, in the upper half, the interior of the aboral surface, x2. Latex casts whitened with ammonium chloride sublimate.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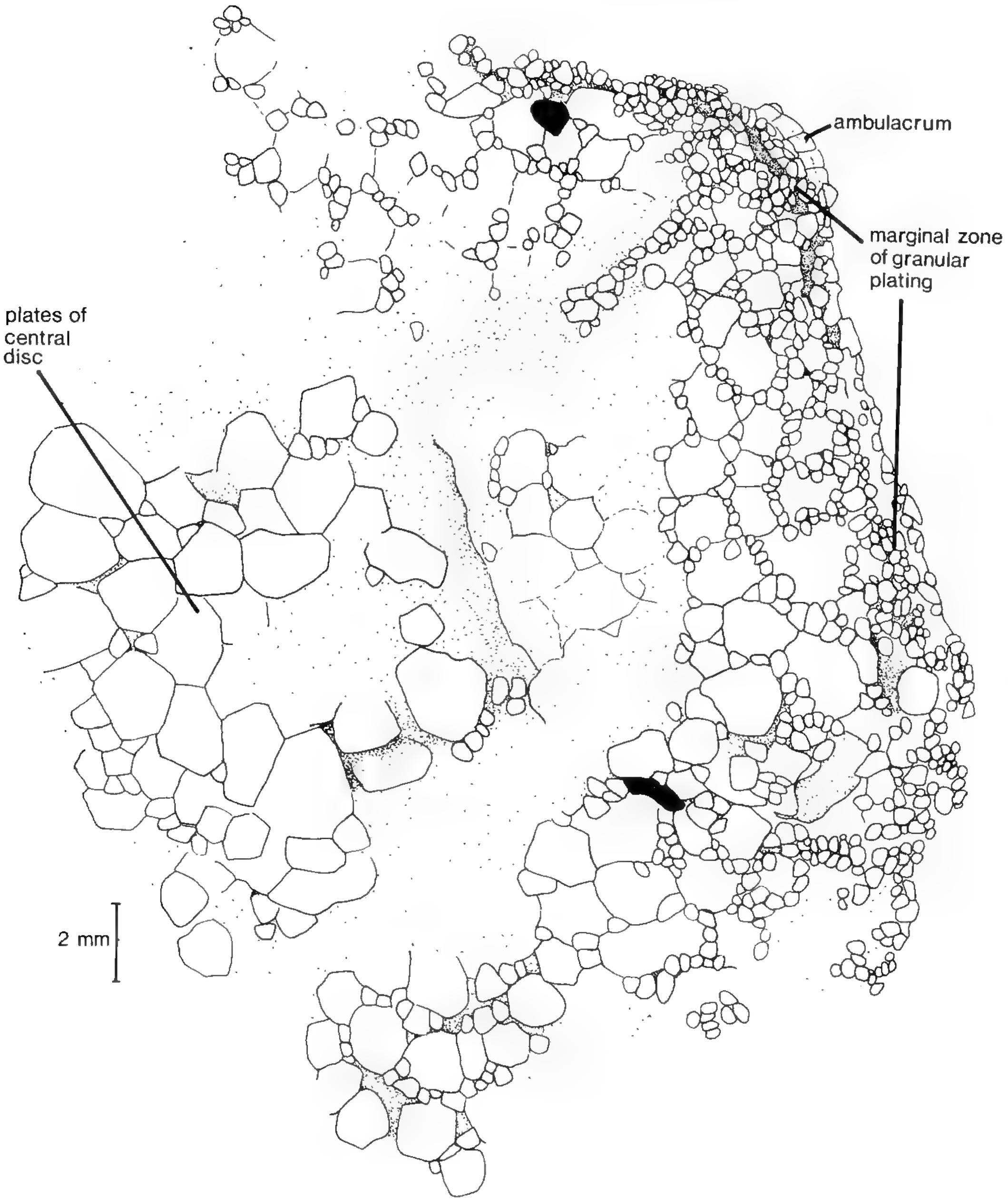


FIG. 8. *Stromatocystites reduncus* sp. nov., QMF17925, paratype, camera lucida drawing of plating on the exterior aboral surface.

FIG. 7. *Stromatocystites reduncus* sp. nov. A, BMNH E63522, paratype, aboral surface, exterior, x2. B, QMF17925, paratype, aboral surface, external, x1.8 (see also Fig.8). C, QMF17917a, paratype, aboral surface, interior, x2.3. D, BMNH E63521, paratype, aboral surface, interior, x1.7. E, QMF17919a, paratype, aboral surface, exterior, showing the central zone of larger plates towards the top, x3. F, QMF17915, paratype, aboral surface, interior, central part only, x4 (see also Fig. 9). Latex casts whitened with ammonium chloride sublimate.

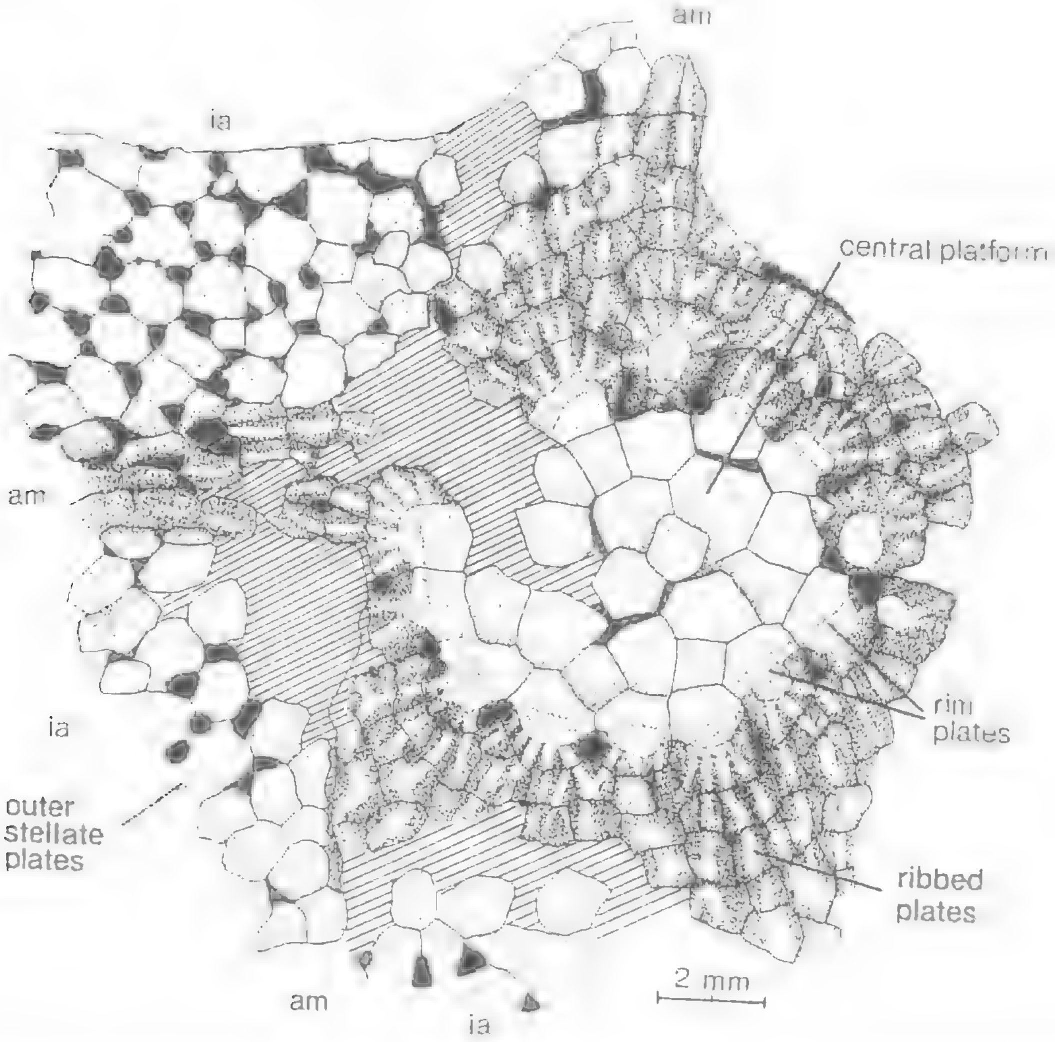


FIG. 9. *Stromatocystites reduncus* sp. nov., QMF17915, paratype, camera lucida drawing of plating in internal aspect of the aboral surface (see also Fig. 7F). am = ambulacrum; ia = interambulacrum.

resembles the arrangement in *Totiglobus* (see Bell & Sprinkle, 1978) and edrioasterids. The central part of the oral area was roofed over by what appears to have been a continuous cover plate sheet and it seems probable that the mouth was permanently covered in *S. reduncus*. An unusual feature of the oral area is the set of four small oval holes in the cover plate sheet of the posterior interray.

The aboral system of internal ridges radially arranged around a central platform of plates is particularly intriguing from a functional point of view. A similar arrangement is seen in *Totiglobus*, although its entire aboral surface is reduced to a small disc and the ridges occupy virtually the entire outer part. In *Stromatocystites* the exterior of the aboral surface usually shows a central stellate region that is elevated above the more peripheral interradial zones and the outline of this elevated region corresponds to the outer border of the internally ribbed region. The invaginated appearance of interradial zones on the aboral surface and the radial arrangement of the surrounding ridges suggests that this structure might be developed for adhesion. The disc of *Totiglobus* undoubtedly had to have had some form of aboral adhesive disc since its globose shape would have made it very unstable otherwise. Thus

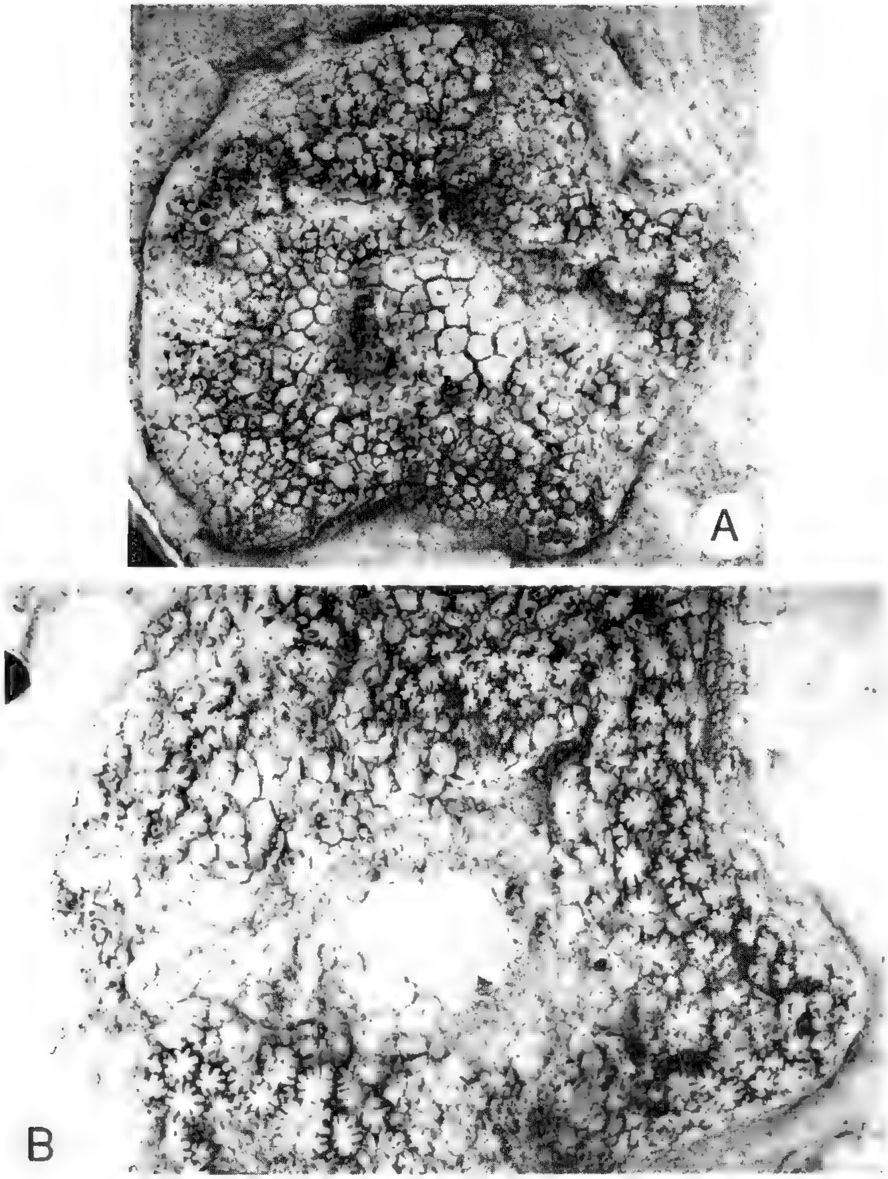
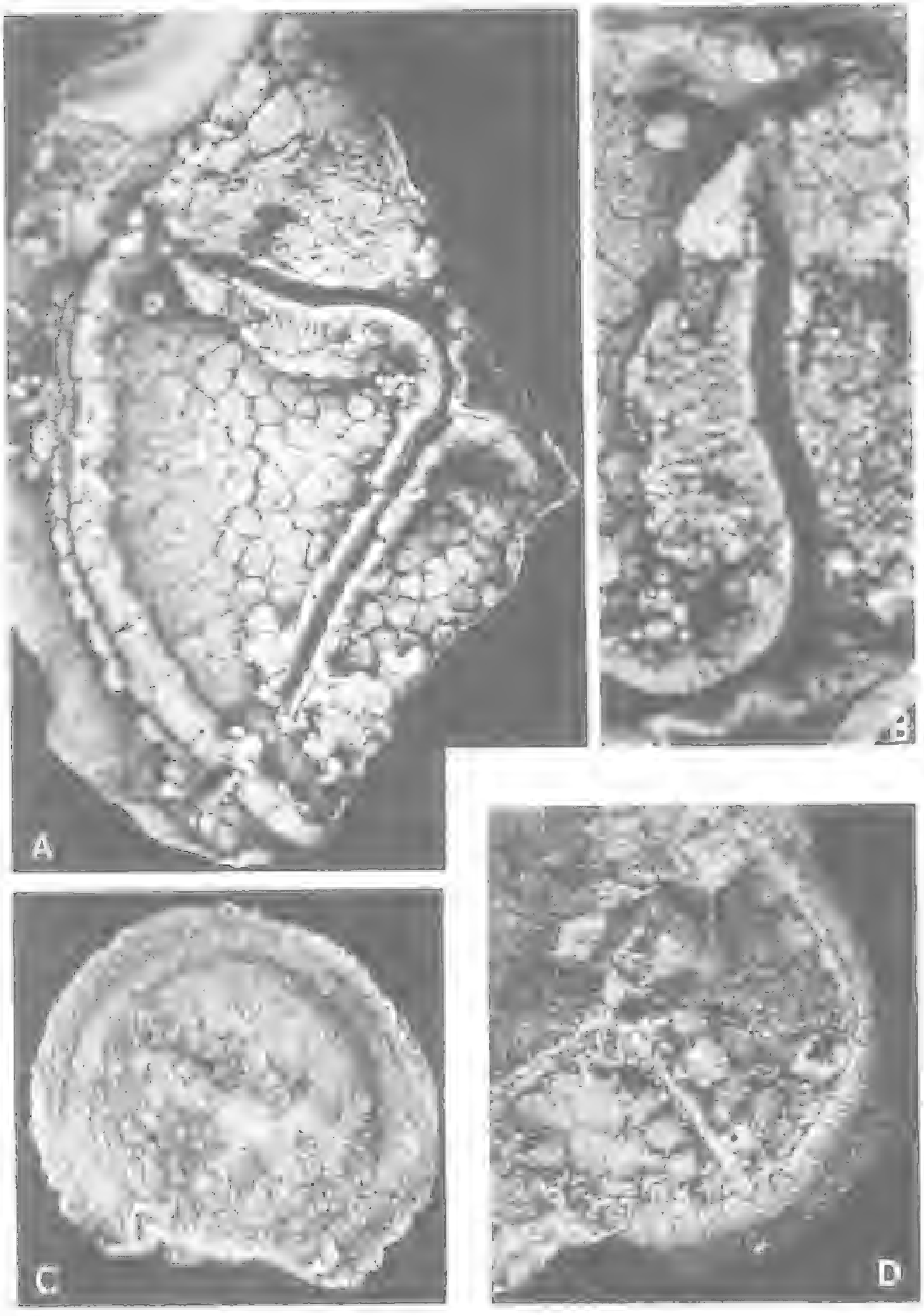


FIG. 10. *Stromatocystites pentangularis* Pompeckj, New York State Museum E1673, from the Middle Cambrian of Ginetz, Czechoslovakia. A, aboral surface, exterior, showing the central zone of large polygonal plates, x3. B, aboral surface, interior, of a second specimen showing the central platform surrounded by a stellate zone of ribbed plates, x3. Latex casts whitened with ammonium chloride sublimate.

it seems reasonable to interpret the aboral internal structures in Stromatocystites as part of an adhesive disc. We suspect that the ridges mark the site of attachment for radial muscles and that these muscles were employed to elevate the central part of the disc to create a suction pad. The distal attachment point for the muscles is, however, weakly developed in *Stromatocystites*, although in *Totiglobus* there are stout peripheral rim plates to which muscles could attach. Possibly a marginal frame of peripheral rim plates arose to provide rigidity and to secure anchorage for the radial aboral muscles, and is connected with the evolution of stronger adhesion in edrioasteroids.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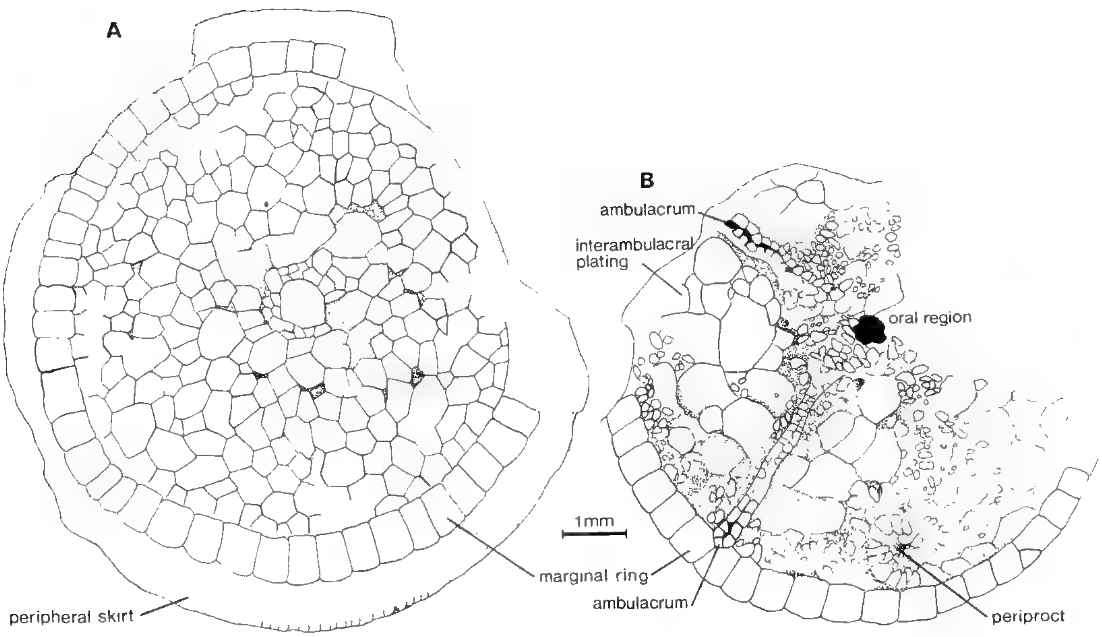


FIG. 12. *Edriodiscus primoticus* (Henderson & Shergold), QMF17856, camera lucida drawing of plating in a juvenile. A, aboral surface. B, oral surface. (see also Fig. 11C,D).

Edriodiscus Jell, Burrett & Banks, 1985

TYPE SPECIES

Cyclocystoides primotica Henderson & Shergold, 1971, by original designation.

AGE AND DISTRIBUTION

Early Middle Cambrian of Queensland.

DIAGNOSIS

Disc-like edrioasteroids with a ring of more than 40 marginal ossicles which are an integral part of both oral and aboral plated surfaces. Ambulacra extending over the marginal ossicles onto the peripheral rim.

REMARKS

This genus resembles *Cambraster* in having a well-developed marginal ring and ambulacra that extend onto and over this ring. Unlike *Cambraster*, however, it has a great many more marginal ossicles in the ring and these are tessellated into the aboral plated surface. In *Cambraster* marginal ossicles overlie the aboral plated surface and are not visible from beneath. Furthermore, the flooring plates of *Edriodiscus* are imperforate and the oral area resembles that of *Stromatocystites* more than *Cambraster*. In particular we have seen no evidence of there being a mouth frame of five large interradially positioned ambulacrals, which always appears prominently in *Cambraster* (Smith, 1986).

Jell *et al.* (1985) had only a single incomplete oral surface when establishing this genus. Further collecting has produced an additional five specimens, two of which show oral surfaces.

Edriodiscus primoticus (Henderson & Shergold, 1971)
Figs 11-14

Cyclocystoides primotica Henderson & Shergold, 1971, p. 706, pl.138, figs 1-3.

FIG. 11. *Edriodiscus primoticus* (Henderson & Shergold), early Middle Cambrian from QP243 near Cornford Bore. A,B, QMF17855a. A, general view of oral surface, x5. Note that much of the oral interambulacral plating has been lost to reveal the internal surface of aboral plates (see Fig. 13). B, enlargement of one ambulacrum to show the region of adradial plate alignment perpendicular to the ambulacral groove, x10. C,D, QMF17856, juvenile. C, aboral surface, x7. D, oral surface, x8. (see also Fig. 12). Latex casts whitened with ammonium chloride sublimate.

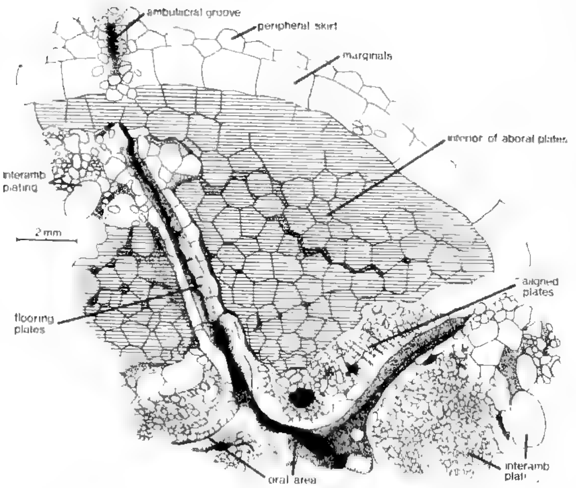


FIG. 13. *Edriodiscus primoticus* (Henderson & Shergold), QMF17855a, camera lucida drawing of oral surface. Much of the interambulacral plating has been lost to reveal the internal surface of aboral plates (horizontal lines).

'Cyclocystoides' primotica Henderson & Shergold; Smith & Paul, 1982, p. 677.

Edriodiscus primotica (Henderson & Shergold); Jell *et al*., 1985, p. 190, figs 7a-c, 8.

Edriodiscus primotica (Henderson & Shergold); Smith, 1986, p. 753, fig. 20.

MATERIAL

Holotype CPC11395; paratype CPC11396; other material NMVP107479, QMF17855-7, BMNH E63525,63526.

AGE AND OCCURRENCE

From chert beds of the Yelvertoft Member, Beetle Creek Formation, early Middle Cambrian, exposed at locality QP243 (=NMVPL1598) 400-800 m south of the bore at Yaringa Creek, 50 km west-southwest of Mount Isa, western Queensland (GR 980965).

DIAGNOSIS

As for genus.

DESCRIPTION

Individuals 9-35 mm in diameter. All are circular in outline. The smallest has c. 55 marginal ossicles in the ring. These are differentiated from other plates and are longer (radially) than broad (Figs 11C,D, 12). Larger individuals have a similar number of marginal ossicles (50-60) but these are wider than long. At all sizes the marginal ossicles are an integral part of the aboral plated surface. Oral plating attaches to a weak ridge at the upper edge of the inner face of the marginals so that much of the inner face of the marginals must have been internal. The peripheral skirt is proportionally larger in small individuals but contains approximately the same number of plate rows at all sizes examined. At 9 mm diameter 4 irregular rows of plates make up the peripheral skirt, while at 15-35 mm diameter there are 4 or 5.

Ambulacra are straight and meet centrally in a 2:1:2 pattern (no specimen shows all five ambulacra but the best oral areas (Figs 11A, 13, 14) show two lateral ambulacra converging into a single ambulacral groove leading to ambulacrum III). Plating in this region shows no organization (Fig.14), suggesting that the cover plate sheet may have formed a permanent roof to the mouth. The ambulacra are straight and extend onto the marginal ring, where they overlie the marginal ossicles at a suture. In the smallest individual (9 mm diameter) the tip of the ambulacrum does not reach the outer margin of the marginal ring (Figs 11D, 12B) whereas in the largest the ambulacrum completely covers the marginals extending beyond to the edge of the peripheral skirt (Figs 11A, 13). No other oral plating extends beyond the marginal ring as far as we can tell. Ambulacral flooring plates are biserial and steeply inclined forming a deep, narrow groove. They are about 0.5 mm broad and a small part is exposed adradially. Sutural pores are not evident along the walls of the ambulacral groove (Fig. 13). Cover plates are small and multiple, except possibly towards the ambulacral tips in the smallest individual where there appear to be only primary cover plates (Figs 11D, 12B). A multiplated skirt of cover plates roofs the ambulacra close to the oral area. The structure of the oral frame remains unknown but the oral area is similar to that of *S. reduncus* (cf. Figs 11A, 13 with Figs 2A, 3).

Interambulacra are composed of large plates that are oval or subrounded in outline. Interspersed amongst these are smaller platelets of various sizes. There are no epispires or sutural gaps in the interambulacra (Fig. 11A,D). Platelets form an outer band close to the marginal ring and are also developed to the exclusion of larger plates close to the oral area (Figs 11A, 13). In the largest specimen the platelets close to the ambulacra are rod-like and preferentially aligned perpendicular to the ambulacral groove (Figs 11B, 13). Elsewhere platelets are randomly ar-

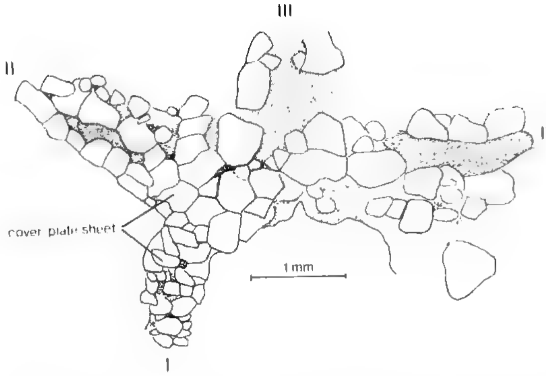


FIG. 14. *Edriodiscus primoticus* (Henderson & Shergold), NMVP107478, camera lucida drawing of plating in the oral region. Note the apparently disorganised arrangement of cover plates.

ranged. In juveniles (9 mm diameter) large plates dominate the interambulacral regions with little development of platelets (Figs 11D, 12B). This suggests that the large plates are laid down initially and that, during growth, areas of platelets developed preferentially around their interambulacral margins.

The aboral surface is a tesselate pavement of thick plates. In the smallest individual (Figs 11C, 12A) a large central plate is surrounded by a narrow ring of platelets. No circlets of plates can be recognized outside this region. The interior of the aboral surface is smooth and also forms a tesselate pavement (Figs 11A, 13). There is no sign of internal ribbing, as seen in *Stromatocystites* or *Totiglobus*, or of a central thickened platform.

REMARKS

This species was established for two specimens, both showing aboral surfaces. Henderson & Shergold (1971) interpreted this species as a cyclocystoid, but Smith & Paul (1982) later removed it from the cyclocystoids, interpreting it as a probable edrioasteroid. This was confirmed by Jell et al. (1985) when they discovered and described a third example showing part of the oral surface. Further collecting by the authors has yielded 5 more specimens, 3 of which are part and counterpart, showing details of both surfaces. The above description supplements those given previously.

Alignment of rod-like interambulacral plates bordering the ambulacra is noteworthy because of its resemblance to the arrangement of virgals in *Archegonaster*.

Order ISOROPHIDA Bell, 1976

Previously edrioasteroids have been divided into three orders, Stromatocystitida, Isorophida and Edrioasterida (Bell,1980). Stromatocystitids have a fully plated theca, biserial ambulacra, flooring plates with sutural pores, and interambulacral plates with epispires. Isorophids have an uncalcified aboral surface, a differentiated peripheral ring and uniserial flooring plates, while edrioasterids have biserial flooring plates with an exposed adradial portion, no differentiated peripheral ring and a partially or completely calcified aboral surface. A fourth group, the Cyathocystida was recently erected to accommodate turret-shaped edrioasteroids with single large 'deltoid-like' flooring plates (Bockelie & Paul, 1983). Smith (1986) modified this scheme somewhat by rejecting the Stromatocystitida as a paraphyletic ancestral group. The two Upper Cambrian edrioasteroid genera described below show mixed characteristics and appear to bridge the gap between Lower and Middle Cambrian stromatocystitids and the Ordovician and later isorophids. Synapomorphies shared with later isorophids include the disc-like body form, the imbricate plated peripheral rim, the form of the hydropore, the absence of aboral plating and the presence of simple cover plates rather than a cover plate sheet. Because of these features they are best regarded as primitive isorophids. However both *Hadrodiscus* and *Chatsworthia* may have biserial flooring plates and the former has an oral frame of five interradially positioned deltoid plates of ambulacral origin. Neither have the typical uniserial flooring plates of Ordovician isorophids as far as we can tell.

The uniserial flooring plates of later Isorophida could have arisen in one of three ways. Firstly, each uniserial flooring plate could be the result of fusion of opposite pairs of originally biserial flooring plates. Secondly each uniserial flooring plate could have originated from a single biserial flooring plate by extending the amplitude of the V-shaped perradial suture until it reached the opposite edge, (the reverse of the suggested derivation of biserial from uniserial arm plating in crinoids - viz. Bather, 1900). Finally the uniserial flooring plates could represent a new structure not homologous with biserial flooring plates. The Upper Cambrian species described below show no evidence of extended V-shaped perradial sutures, having almost straight perradial sutures instead. Furthermore, the second hypothesis would require a secondary series of primary cover plates and cover plate articulations to develop. No evidence exists to suggest that this might have been the case, in contrast, for example, to the situation with uniserial crinoid arms, where sequential uniserial arm plates carry cover plates on alternate sides.

Of the two genera described below *Hadrodiscus* appears, tentatively, to be the more primitive, having a poorly differentiated peripheral rim and small, closely fitting pentagonal cover plates. Flooring plate arrangement is inadequately known but may have been biserial. In *Chatsworthia* the peripheral rim plating is much better differentiated, as in most later isorophids, and there is a system of stout, spine-like cover plates that are non-contiguous when held erect. A similar cover plate arrangement is found in early lebetodiscids such as *Foerstediscus* for example. However, in *Chatsworthia* the relationship of cover plates to flooring plates is still unclear. Either cover plates are firmly sutured on to the flooring plates so that both generally act as a single ossicle, or the primary cover plates of later isorophids are in fact modified flooring plates that have taken on the role of protecting the radial water vessel. In either case, it would appear that the uniserial flooring plates in more derived isorophids represent a new system of plates independent of the biserial flooring plates of other edrioasteroids.

Hadrodiscus gen. nov.

ETYMOLOGY

Greek *hadros*, elegant or delicate.

TYPE SPECIES

Hadrodiscus parma sp. nov.

AGE AND DISTRIBUTION

Median Upper Cambrian (Franconian) of western Queensland, Australia.

DIAGNOSIS

An isorophid with a poorly differentiated peripheral ring, straight ambulacra with small, tightly fitting cover plates and larger oral cover plates. Hydropore/gonopore a large, prominent opening. Oral frame composed largely of stout, wing-shaped elements.

REMARKS

The taxonomic position of *Hadrodiscus* remains problematic largely because it is incompletely known. Although the ambulacra are floored we do not yet know what the plate arrangement is. The relatively small size of the cover plates seen externally and the suggestion of large, possibly biserially arranged plates forming the floor of the ambulacral grooves suggest to us that *Hadrodiscus* had both cover plates and flooring plates, as in *Stromatocystites*. However, the presence of a peripheral rim, the complete absence of aboral plating, the position and form of the hydropore opening and the large oral frame plates that are interradial in position and are undoubted flooring plates, mark *Hadrodiscus* as more advanced than *Stromatocystites*. It is less derived than *Chatsworthia* which has a system of large biserially arranged cover/flooring plates and a better differentiated peripheral rim. At present we consider it to be the most primitive known isorophid.

Hadrodiscus parma sp. nov.

Figs 15-18, 20C

ETYMOLOGY

Greek *parme*, a small shield, in allusion to its appearance.

MATERIAL

Holotype QMF17874; paratypes QMF17875, BMNH E63527

AGE AND OCCURRENCE

All specimens come from locality K204 of Shergold (1982), from a grey, 4 m thick, limestone unit of the Chatsworth Limestone, 3.5 km south of Chatsworth homestead, 60 km southeast of Duchess, western Queensland. *Peichiashania secunda-Prochuangia glabella* Assemblage Zone, median Upper Cambrian (Franconian).

DIAGNOSIS

A *Hadrodiscus* with about 10-12 primary cover plates in a column at disc diameters of 6-7 mm, these primary cover plates being small, squarish and close-fitting. Peripheral rim composed of 4 or 5 irregular rows of small imbricate plates not clearly differentiated from interambulacral areas.

DESCRIPTION

Specimens are circular in plan view and flattened hemisperical in profile. In diameter the holotype is c. 7 mm (Figs 15A, 16) and the two other specimens c. 6 mm (Figs 15B,C, 20C). The

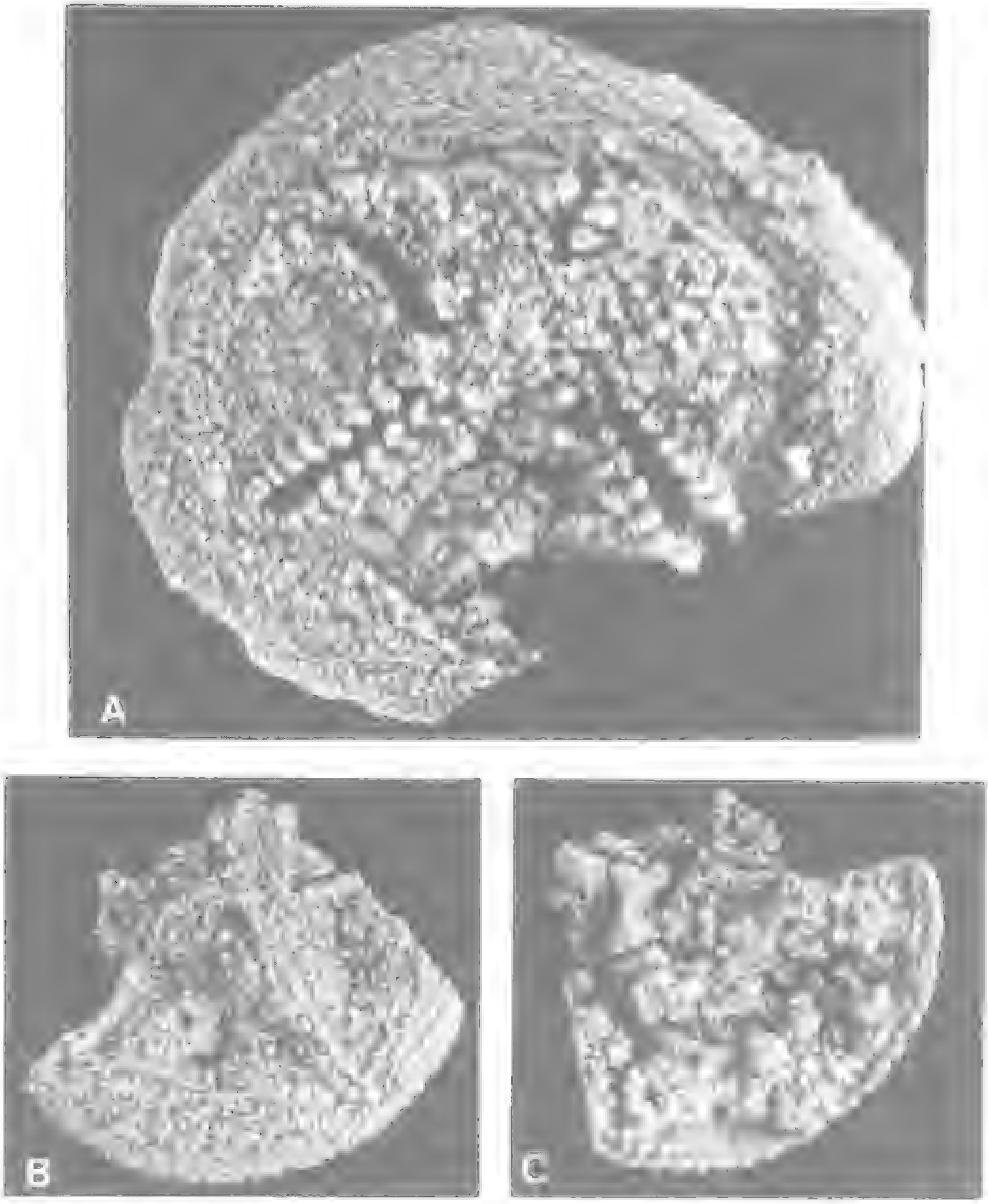


FIG. 15. *Hadrodiscus parma* sp. nov., from the Chatsworth Limestone, median Upper Cambrian of Chatsworth. A, QMF17874, holotype, oral surface, x12 (see also Fig. 16). B,C, BMNH E63527, paratype. B, external oral surface, x10. C, internal view of same, x10 (see also Fig. 18). Silica replacements coated with ammonium chloride sublimate.

aboral surface is uncalcified and the peripheral rim of the disc flares outwards. There has been no post-mortem collapse of the disc relative to the peripheral rim so that the boundary between the two regions is not well demarcated, there being virtually a smooth transition from rim to centre. The oral area forms the summit of the disc and is centrally positioned. Specimens appear to be unattached to any substratum.

The peripheral rim is composed of 4 or 5 irregular rows of small imbricate plates, 3 or 4 abreast in one interambulacral segment (Figs 15A, 16). These plates overlap towards the centre on their outer face, and have convex proximal edges. However, sutures are weakly defined suggesting that the plate boundaries, though imbricate, were almost flush and that the plates themselves did not override more proximal plates to any extent. The same is true of the inner face where no plate boundaries can be made out at all. None of the marginal plates is geniculate or has a thickened aboral edge. Instead the peripheral rim remains uniformly thin and only the base of the rim would have contacted the substratum. Plates in the rim are similar in size except towards the periphery where the outermost plates are much smaller. The boundary between peripheral rim plating and the interam-

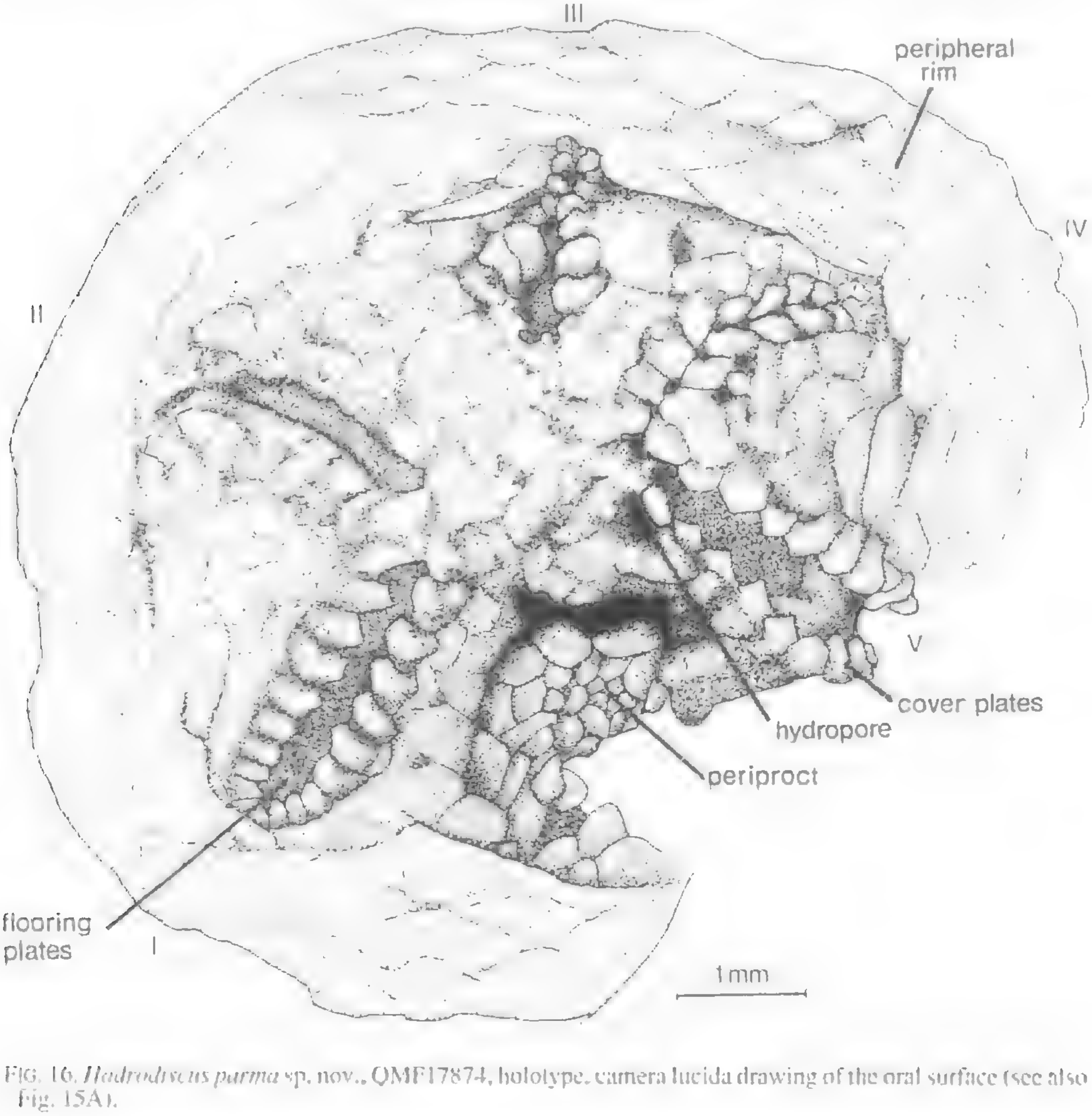


FIG. 16. *Hadrodiscus parma* sp. nov., QMF17874, holotype, camera lucida drawing of the oral surface (see also Fig. 15A).

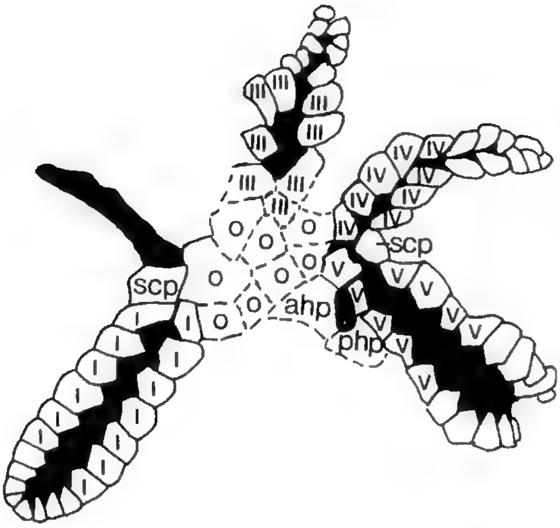


FIG. 17. *Hadrodiscus parma* sp. nov., QMF17874, holotype, interpretation of cover plate arrangement. I-V = cover plates of ambulacra I - V; o = shared oral cover plates; ahp = anterior hydropore plate; php = posterior hydropore plate; scp = shared cover plate.

bulacral plates of the disc is not marked, interambulacral plating appearing to merge gradually into that of the peripheral rim, except in the posterior interambulacrum. Again, plate boundaries here are probably subtesselate as none stand out clearly (Figs 15A,B, 20C).

The ambulacra are relatively long and reach about 80% of the radius to the edge. They indent the peripheral rim plating to a small extent (Figs 15A, 16). In the holotype, ambulacra I, III and V are straight, or virtually so, while ambulacrum II curves clockwise and ambulacrum IV curves anticlockwise (Figs 15A, 16). However, this is probably a post-mortem artefact since the disc has collapsed towards the anterior, and the 3 adjacent ambulacra (probably I, II and III) in one of the paratypes (Fig. 20C) are straight. The ambulacra are parallel-sided and have rounded, blunt tips (Figs 15A,B, 20C). In the holotype cover plates are present in all ambulacra except II, where they have been lost (Fig. 16). In ambulacra I and V the cover plates are in the open position, in ambulacra IV they are in the closed position, while in ambulacrum III they are largely disrupted from life position. Cover plates were able to open widely along the length of the arm but probably formed a permanent cover to the oral area, as no clear perradial suture is apparent in this region (Fig. 15A,B). There are about 10-12 primary cover plates in a column at this diameter. The primary cover plates abut along most of their length and end in a V-shaped edge which may be hooked towards the oral region (Figs 15A, 16, 20C). Cover plates on either side of the ambulacrum alternate to interlock, although those seen in ambulacrum IV of the holotype are almost opposite due to distortion of the disc. Sutural gaps between adjacent cover plates are not apparent.

Ambulacral grooves are moderately deep with a smooth rounded floor. Sutures are not visible suggesting that flooring plates were probably solid and robust although this appearance may be due to their coarse silicification. No part of the flooring plates can be seen along the adradial margin of the ambulacra and it would appear that the interambulacral plating abuts against the outer edge of the cover plates. In ambulacrum II of the holotype cover plates have been lost revealing the ambulacral groove (Figs 15A, 16). Upper edges of flooring plates define the walls of this groove but again the detailed structure has been lost in silicification.

The internal surface of one specimen (Fig. 15B,C) reveals the 5 ambulacral grooves. Around the mouth these are floored by large deltoid-shaped plates lying interradially and forming the mouth frame (Figs 15C, 18). Elsewhere ambulacral grooves are partially open (possibly due to incomplete silicification) although larger plates adjoin the ambulacral groove and may have floored the groove in life. If these plates are flooring plates then each plate must have carried 2-4 of the cover plates.

In external view the oral area is best seen in the holotype (Figs 15A, 16) where the cover plates form an unbroken roof to the mouth. Plate sutures are nowhere clear and our interpretation of oral plating is highly tentative. The hydropore, however, is distinct as a deep depression in the posterior interambulacrum close to ambulacrum V (Figs 15A, 16). It has a narrow, bar-like ambulacral cover plate on its adradial margin and 2 moderately large plates forming the posterior border. These posterior plates lie well below the ambulacra and would appear to be modified ambulacral flooring plates that have been enlarged into the posterior interambulacrum to incorporate the hydropore/gonopore. The remainder of the oral area consists of a number of small plates, to judge from the surface irregularities preserved. Left and right branching plates are easily identified but the plating in the

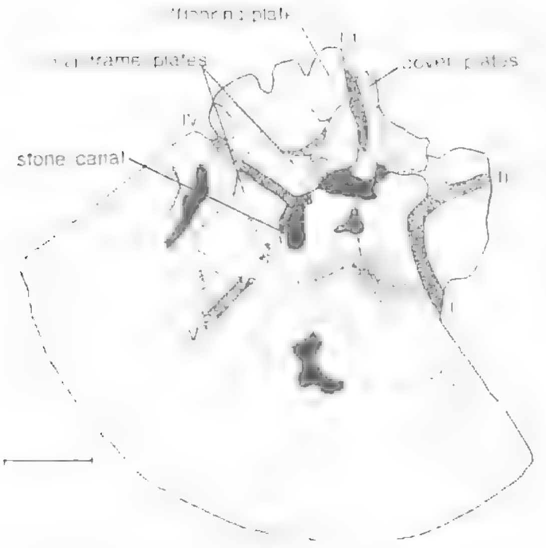


FIG. 18. *Hadrodiscus parma* sp. nov., BMNH E63527, paratype, camera lucida diagram of interior of oral surface showing the mouth frame plates and arrangement of the water vascular system. Scale bar = 1 mm.

posterior part is less clear. A continuous row of small, squarish cover plates may form the posterior edge of the oral area and connect the cover plate series of ambulacra I and V (Fig. 16). Conversely, this may be a single laterally elongate posterior oral plate that is slightly fractured. Other plates lie anterior of this but no enlarged anterior oral plates are clearly differentiated.

The interior of the oral surface (Figs 15C, 18) shows the 5 ambulacral channels around a central mouth. A sixth groove originates close to the base of ambulacrum V and rapidly curves towards the outer surface; this is the hydropore groove and terminates externally at the hydropore. At the angle between ambulacra IV and V is a large deltoidal plate. This has a median saddle and may be composed of 2 plates tightly sutured together, but the coarseness of the silicification prevents us from deciding whether this is indeed a single plate. In the posterior interray there appear to be 2 large polygonal plates, the plate closer to ambulacrum I having a prominent adoral projection. Other mouth frame plates are not evident and are presumably lost (possibly during etching).

Interambulacral plating consists of a small number of apparently subtesselate plates (Figs 15A, 16). These have curved adoral plate boundaries close to the peripheral rim but become more polygonal in outline towards the centre. Only traces of sutures are seen in both specimens.

A large periproct occupying most of the posterior interambulacrum (Figs 15A,B, 16) consists of a mound-like region of imbricate plates which become progressively smaller towards the centre. The middle of the periproct consists entirely of small platelets.

REMARKS

This species is readily distinguished from the contemporary *Chatsworthia spinosa* by its smaller, more tightly fitting and more numerous primary cover plates, its more numerous and smaller peripheral rim plates and more robust suturing between peripheral rim and interambulacra. In all specimens of *C. spinosa* the disc has collapsed well below the level of the peripheral rim and presumably marks a weak point. The marked difference in appearance of the primary cover plates between *C. spinosa* and *H. parma* makes it most unlikely that the two forms simply represent different states of preservation of the same species (cf. Fig. 20A,B with Fig. 20C).

The distinct groove leading from the circum-oesophageal ring of the water vascular system and opening close to the base of ambulacrum V in the posterior interray proves that this opening is a hydropore. Smiley (1988) speculated that primitive echinoderms might have internal hydropore openings and that the opening generally referred to as the hydropore might represent the gonopore.

Chatsworthia gen. nov.

ETYMOLOGY

For Chatsworth Station, on which the specimens were discovered.

TYPE SPECIES

Chatsworthia spinosa sp. nov.

AGE AND DISTRIBUTION

Median Upper Cambrian (Franconian) of Queensland, Australia.

DIAGNOSIS

An isorophid with short, virtually straight ambulacra and undifferentiated oral cover plates. Cover plates stout and erect, forming a single alternating biseries; well separated when open.

Biserial arrangement of flooring plates meeting perradially to floor the ambulacral groove.

REMARKS

This genus is distinguished from *Hadrodiscus* in the size and spacing of primary cover plates and plating of the peripheral rim and in the structure of the oral frame and flooring plates. In *C. spinosa* there are only 6 or so primary cover plates in each ambulacrum and the peripheral rim is composed of a small number (usually 10) of large plates with just 2 rows of small, outer platelets. In *Hadrodiscus parma* the primary cover plates are more slender and closely spaced, with about 12 in a row at an equivalent disc diameter, and the peripheral ring is composed of a greater number of relatively smaller imbricate plates. *C. spinosa* is not sufficiently well preserved for the structure of the ambulacra to be determined unambiguously, but it appears to consist of a biseries of plates that meet perradially to floor the ambulacral groove. Above and possibly continuous with these are stout, spine-like, cover plates, undoubtedly homologous to the primary cover plates of later isorophids.

Chatsworthia spinosa sp. nov.

(Figs 19, 20A,B, 21-28)

Isorophid indet. Jell, Burrett & Banks, 1985, p.195, fig. 9.

ETYMOLOGY

Latin *spinosus*, thorny, referring to its cover plate series.

MATERIAL

Holotype QMF17944; paratypes QMF 17945-51, NMVP107129, 108990, BMNH E63528-30. Other material QMF17952-9, BMNH E63531.

AGE AND OCCURRENCE

All specimens come from locality K204 of Shergold (1982), from a grey, 4 m thick, limestone unit of the Chatsworth Limestone, 3.5 km south of Chatsworth homestead, 60 km southeast of Duchess, western Queensland. *Peichiashania secunda-Prochuangia glabella* Assemblage Zone, median Upper Cambrian (Franconian).

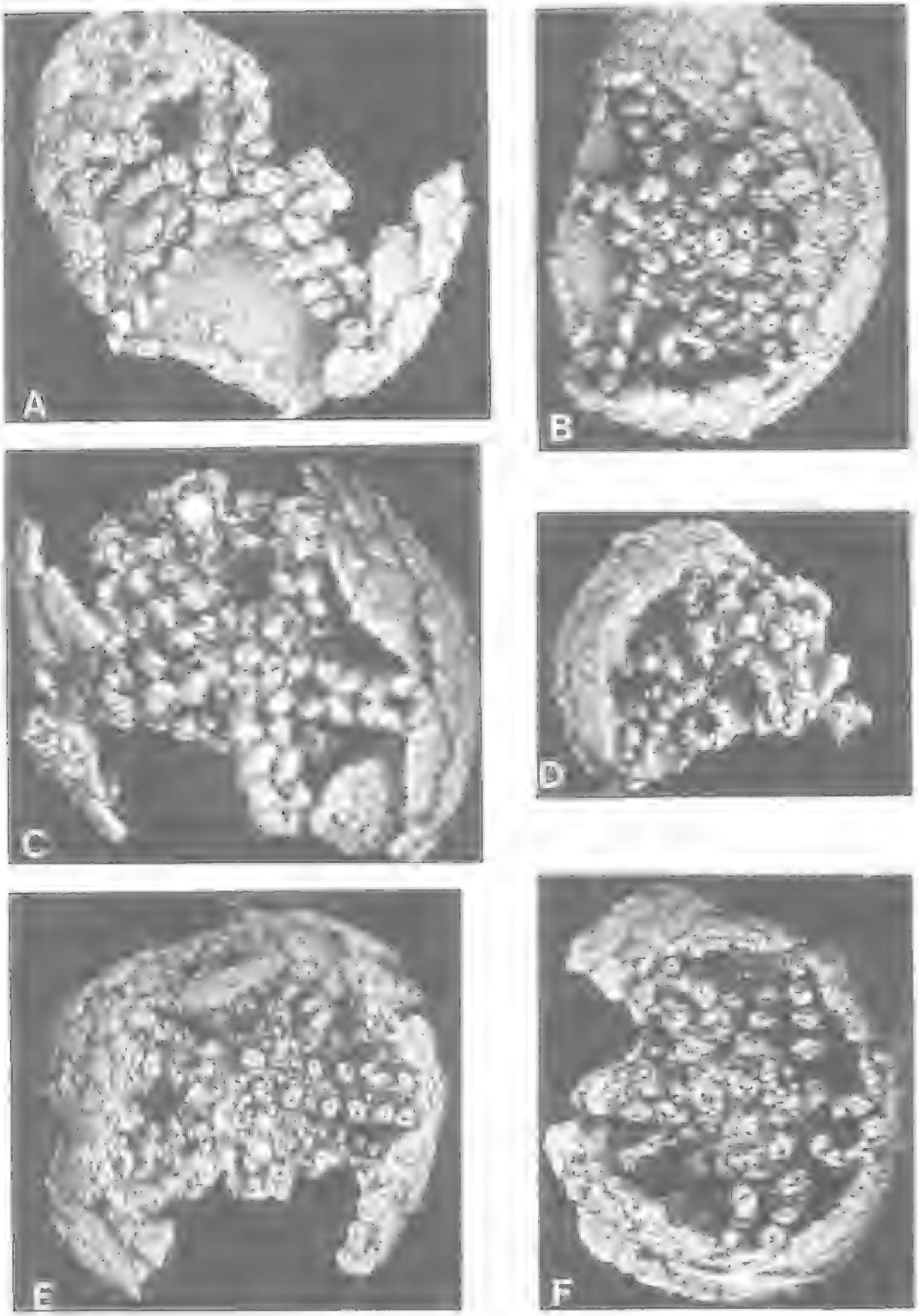
DIAGNOSIS

A *Chatsworthia* with 5 or 6 stout, spine-like cover plates in each ambulacrum and a peripheral rim composed of *c.* 10 large plates plus smaller accessory plates distally.

DESCRIPTION

Theca circular in outline with a diameter of 6-10 mm. The peripheral rim is well developed and differentiated from the disc, which in all specimens has collapsed slightly beneath the level of the rim (Fig. 19). The theca has a low profile, though in life the disc may have been low domed. Only the oral surface is heavily plated. The aboral surface, where seen, shows no evidence of having had large plates. However, the surface always appears granular (Fig. 26) and there remains the possibility of a calcified lower surface of tiny granules. The peripheral rim is relatively broad, forming up to half the radius of the theca interradially, and indented radially for the ambulacra (Figs 19B, 21). In profile the rim slopes steeply outwards at about 40°. The rim is usually composed of 5 large radial and 5 large interradial plates which alternate and overlap one another (Figs 21, 25), but the arrangement is not strict and there may be an extra plate in one or other of the interambulacral regions. Peripheral rim plates have curved outer edges and are differentiated from interambulacral plates of the disc. On the distal part of the rim there are two irregular rows of smaller plates, the outermost series being the smallest (Fig. 27A). These also appear to imbricate, although plate sutures are rarely well marked. These plates may completely overlie the 10 larger plates and are commonly lost. When viewed from the interior the peripheral rim appears smooth and no plate boundaries can be identified. This would suggest that the plates are subtesselate and firmly bound together along sutures and explains why the peripheral rim is generally preserved in an uncollapsed state. Peripheral rim plates are neither geniculate nor expand into a flattened base. Thus the rim has a uniform thickness and only the bottom of the rim would be in contact with the substratum.

Ambulacra are straight, rather short, and broad. They extend to the peripheral rim which they indent but do not overlap (Figs 19, 20A,B). The 4 to 6 large, spine-like cover plates in each ambulacral column (Figs 21-25) have a broad base and taper distally (Fig. 27B,C) and in some cases tips of the cover plates appear to be curved towards the centre of the disc. Cover plates may be preserved in the closed position with the ambulacra appearing as tall, rather narrow ridges


A
B
C
D
E
F

(Fig. 19A,C). In such cases cover plates are inclined towards the centre and overlap their neighbours forming a canopy to the ambulacral channel. They alternate across the perradius. More often specimens are preserved with the ambulacra open and cover plates erect and form-

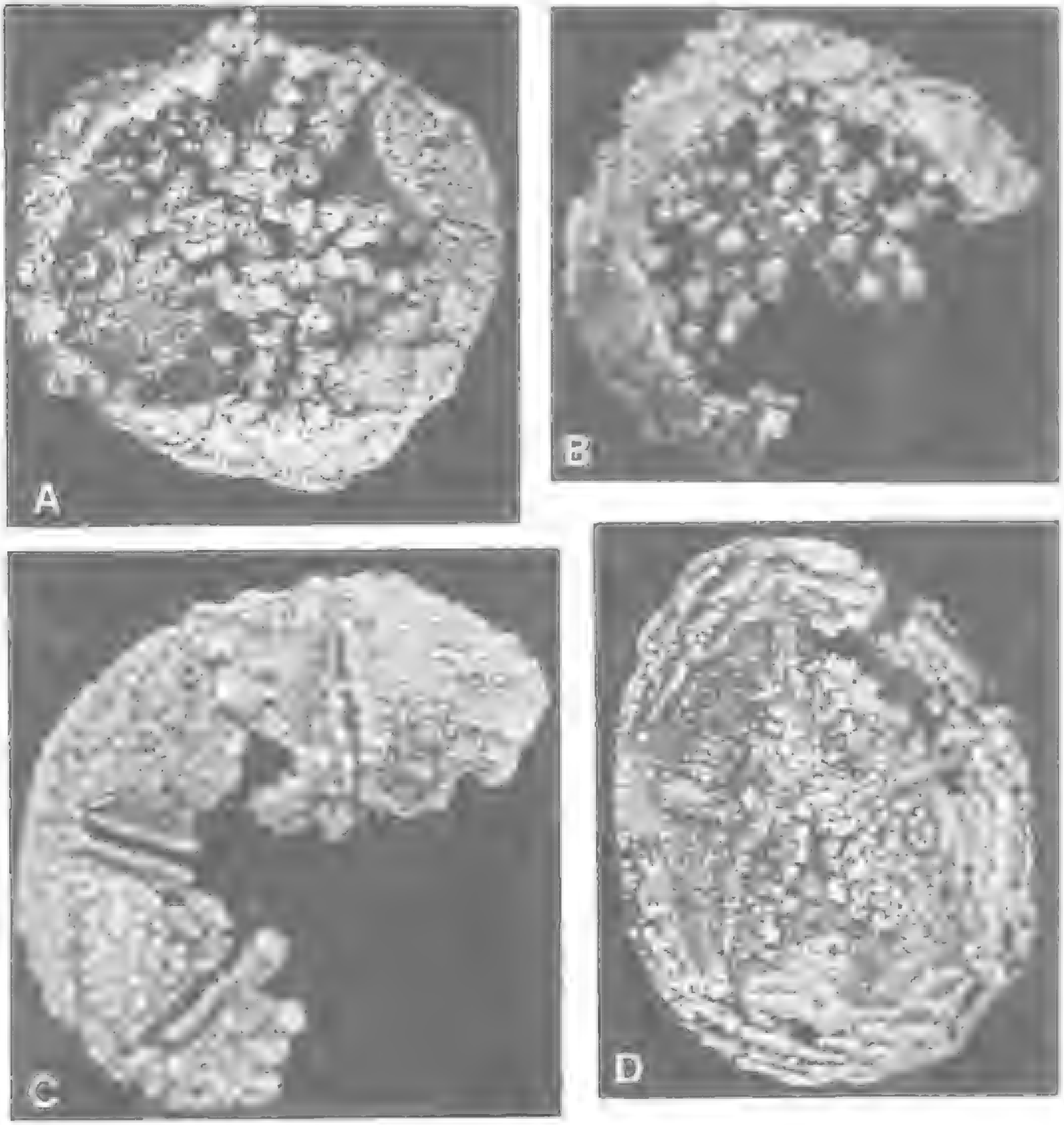


FIG. 20. A,B,D, *Chatsworthia spinosa* sp. nov. A, QMF 17949, paratype, x7. B, NMVP108990, paratype, x6. C, *Hadrodiscus parma* sp. nov., QMF17875, paratype, x12. D, ?*Hadrodiscus* sp. QMF17943, internal surface, x7. Silica replacements from the Chatsworth Limestone, median Upper Cambrian, of Chatsworth, whitened with ammonium chloride sublimate.

FIG. 19. *Chatsworthia spinosa* sp. nov., from the Chatsworth Limestone, median Upper Cambrian of Chatsworth. A, BMNH E63528, paratype, x8 (see also Fig. 22). B, QMF17944, holotype, x7 (see also Fig. 21). C, NMVP107129, paratype, x6.5 (see also Fig. 23). D, QMF17948, paratype, x8 (see also Fig. 25). E, QMF17945, paratype, x7. F, QMF17947, paratype, x9. Silica replacements coated with ammonium chloride sublimate.

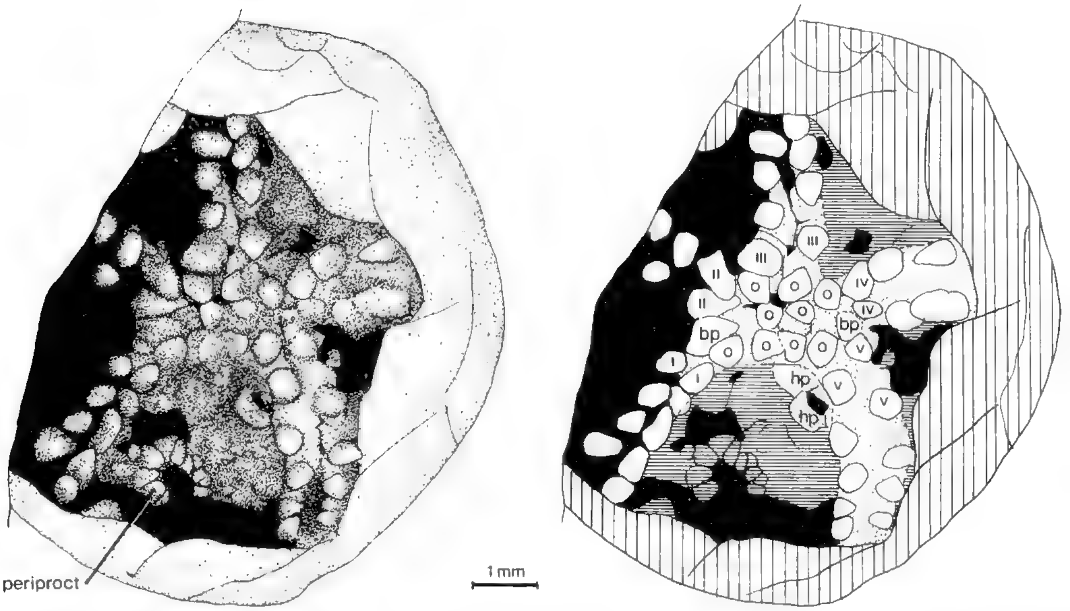


FIG. 21. *Chatsworthia spinosa* sp. nov., QMF17944, holotype, camera lucida drawing and plate interpretation diagram. Vertical hatching = peripheral rim plating; horizontal close hatching = interambulacral plating; stippling = ambulacral zones undifferentiated; blank = cover plates; black = missing. Ambulacral cover plates are labelled as follows: I-V = cover plates of ambulacra I - V, bp = lateral branch plate, o = shared oral plate, hp = hydropore plate.

ing a border to the food groove (Figs 19B,E,F, 20B). In such cases the cover plates are well separated leaving broad gaps between. Spine-like cover plates are less well-developed over the oral area.

The ambulacral groove itself may be preserved in the open position, as a broad U-shaped channel, or in the closed position, as a narrow slit-like trench. This alone indicates that the ambulacrum is floored by a biseries and in cross-section, although a perradial suture cannot be identified due to the coarse nature of the silicification, a discontinuity of shape indicates where it probably lay (Fig. 27B). Furthermore, from the interior the perradial line appears as a sharp ridge and in one specimen (Fig.26) the interior of the ambulacra show possible biserial flooring plates. However, the arrangement of flooring plates is nowhere clearly seen, due to the coarse nature of the silicification, and the junction between cover and flooring plates remains problematic.

In the oral area, the spine-like plates become less evident and cover plates appear more plate-like. Coarse silicification again hinders interpretation of oral plating. The arrangement of plates is probably best seen in the holotype (Fig. 21) and two of the paratypes (Figs 22, 23). The ambulacra meet in a 2:1:2 pattern with small lateral branch plates at the inner angles of ambulacra I and II, and IV and V. No noticably enlarged oral plates are developed. A row of 4 cover plates forms the posterior part of the oral area, the outer 2 abutting the lateral branch plates. In BMNH E63528 (Fig. 22) only a single large plate occupies this region. This could represent an oral frame plate devoid of its two cover plates. The central 2 posterior plates lie opposite 2 anterior cover plates and roof the central part of the oral area. No secondary or accessory cover plates can be distinguished, but this could be due to poor preservation. The oral frame, if our interpretation is correct, is composed of 3 large flooring plates(Fig. 22), 2 anterior plates occupying the angles between ambulacra II and III and between III and IV, and a single broad posterior plate. It is not known whether there are also enlarged flooring plates between the lateral ambulacra that also contribute to the oral frame. The hydropore/ gonopore opens in the posterior interradius close to the base of ambulacrum V. There is a large U- shaped plate that forms the posterior and interradial border to the opening and a narrower plate forms its adoral border.

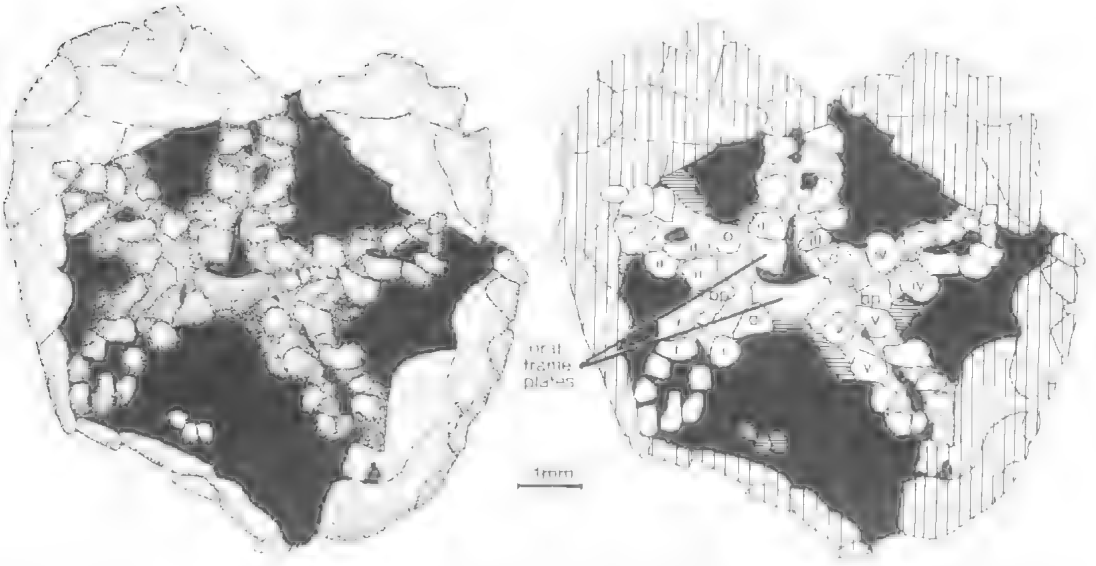


FIG. 22. *Chatsworthia spinosa* sp. nov., BMNH E63528, paratype, camera lucida drawing and plate interpretation diagram. Symbols as in Fig. 21.

Both have the position and appearance of being modified ambulacral flooring plates. When viewed from the interior (Fig. 26) the oral area stands out as a C-shaped ridge open towards the posterior. The ridge on the hydropore side lies more distal and creates a more open curve than the ridge on ambulacrum I. The posterior oral flooring plate must therefore have considerably less depth than the other oral frame plates.

Interambulacral areas are relatively small and wedge-shaped. No specimen shows undisrupted plating but small ovoid plates can be discerned in a number of specimens. There is no evidence of epispires between interambulacral plates which were presumably either imbricate or subtesselate. The periproct is a conical structure occupying much of the posterior interambulacrum (Figs 19, 21, 24, 25). About 8-10 wedge-shaped plates form the periproctal cone and possibly smaller granular plates occur at the summit.

REMARKS

This species was first illustrated and described by Jell *et al.* (1985) on the basis of 2 moderately well-preserved specimens from our type locality. They recognized it as an isorophid but, because certain key characteristics could not be identified from that material, it was left under open nomenclature. We have since collected a further 21 specimens and, although none is particularly well preserved, there is now sufficient material to establish the basic morphology of this species.

A major uncertainty remains as to whether there are separate covering and flooring plates, since once again no clear sutures can be made out. It is probable that the flooring plates form the U-shaped groove and the cover plates are the spine-like projections that arise from this. However, we have not seen any specimen in which clearly separated cover plates and flooring plates can be unambiguously distinguished, and it is therefore possible that only a single set of plates is present, acting as both flooring and cover plate, articulating perradially and carrying a long spinous projection. The similarity of the spine-like plates in *C. spinosa* to cover plates of other isorophids, such as *Foerstediscus*, is striking, and there can be little doubt that the plates seen in *Chatsworthia* are indeed homologous to those of other isorophids.

C. spinosa is distinguished from the co-occurring isorophid, *H. parma*, by its simpler and stouter peripheral rim and more robust ambulacral cover plates that are much fewer in number.

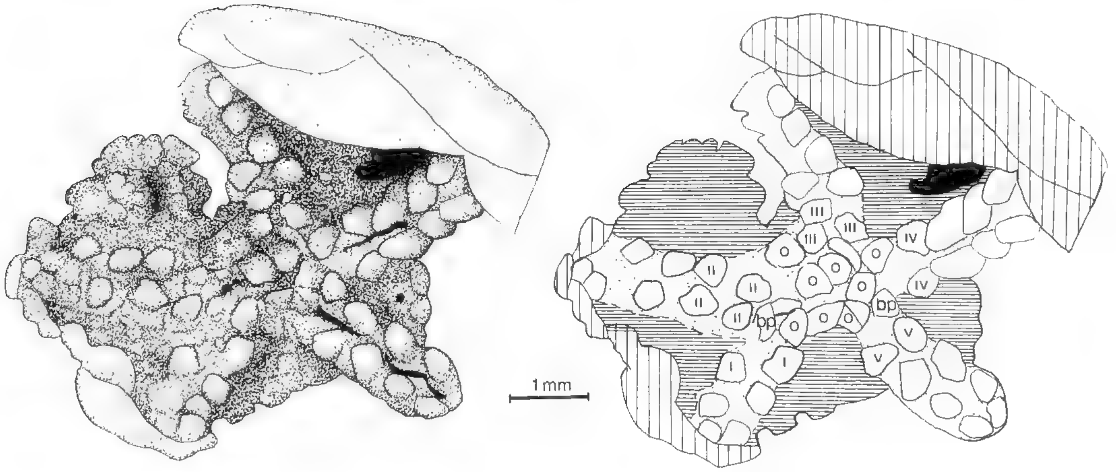


FIG. 23. *Chatsworthia spinosa* sp. nov., NMVP 107129, paratype, camera lucida drawing and plate interpretation. Symbols as in Fig. 21.

Order EDRIOBLASTOIDA Fay, 1962

Family ASTROCYSTITIDAE Bassler, 1938

TYPE GENUS

Astrocystites Whiteaves, 1897 [Type species: *Astrocystites ottawaensis* Whiteaves, 1897]; Trentonian (Caradocian, Ordovician) of Ottawa, Canada.

OTHER SPECIES

Astrocystites distans Webby from the Lower Caradocian of New South Wales [possibly a subjective junior synonym]: *Cambroblastus enubilatus* sp. nov. from the Franconian, Upper Cambrian of Queensland.

RANGE

Median Upper Cambrian to mid Ordovician.

DIAGNOSIS

Edrioasteroids with a polyplated stalk and a bud-shaped theca with 5 basals. Ambulacra prominent with primary cover plates only. Flooring plates exposed adradially, primitively biserial but may be reduced to a single mouth angle flooring plate situated at each interradial angle.

REMARKS

Edrioblastoids are probably the rarest of echinoderm groups that have been given class status. Although *Astrocystites ottawaensis* has been known since 1897 few specimens have ever

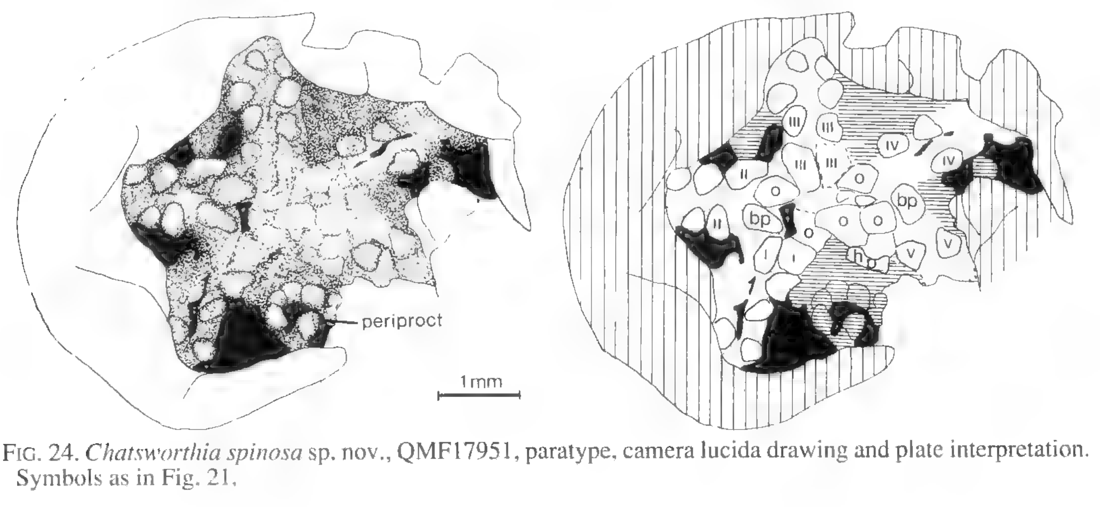


FIG. 24. *Chatsworthia spinosa* sp. nov., QMF17951, paratype, camera lucida drawing and plate interpretation. Symbols as in Fig. 21.

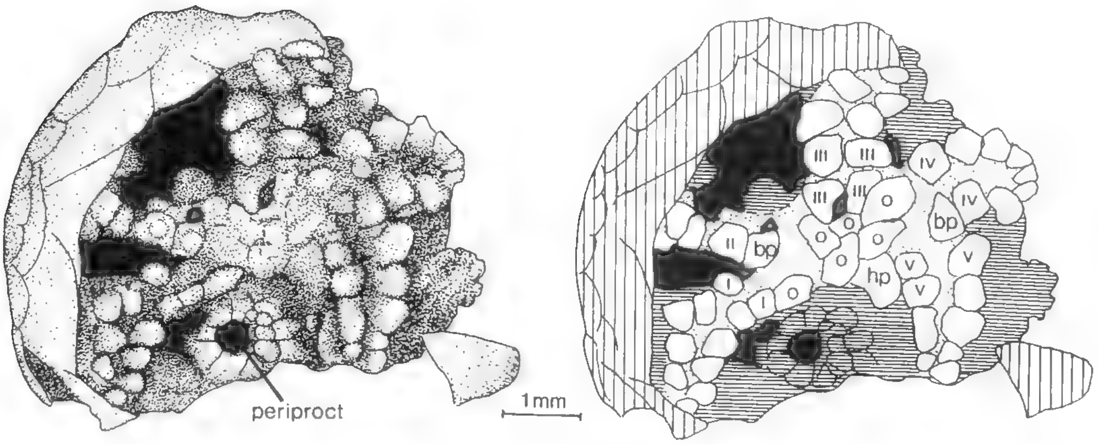


FIG. 25. *Chatsworthia spinosa* sp. nov., QMF17948, paratype, camera lucida drawing and plate interpretation. Symbols as in Fig. 21.

been collected. The species was erected on the basis of 3 specimens from the Trenton Limestone (Middle Caradocian) at Kirkfield Quarry, Ontario; 2 held in the Canadian Geological Survey collections of which one is the lectotype and the other is lost, and a third held in the British Museum (Natural History). Mintz (1970) described a fourth specimen from the type locality and horizon. A second species, *A. distans*, was described from the basal Caradocian Cliefden Caves Limestone of New South Wales (Webby, 1968) based on two tolerably complete specimens and a number of fragments. Mintz (1970) believed that *A. distans* was probably a subjective junior synonym of *A. ottawaensis*. Sprinkle (1982) described a small number of isolated deltoid plates of an edrioblastoid from the mid Ordovician Bromide Formation of U.S.A. and deltoid plates also occur in the Upper Ordovician Boda Limestone of Sweden (C.R.C. Paul, pers. comm. November, 1989).

Ordovician edrioblastoids have a highly distinctive morphology and have been difficult to relate to other echinoderm groups. When they were originally described they were thought to be most closely related to the diploporite cystoid *Asteroblastus* (Whiteaves, 1897). Bather (1900, 1914) redescribed the material then available and placed the species in its own family within the edrioasteroids. Hudson (1925, 1927), however, argued for their close association with blastoids as did Fay (1962, 1967), while both Webby (1968) and Bell (1980) have related them to edrioasteroids and Mintz (1970) to eocrinoids. Paul (1988) commented that *Astrocystites* was so unusual in its morphology that it could not be placed in his phylogenetic scheme of cystoids.

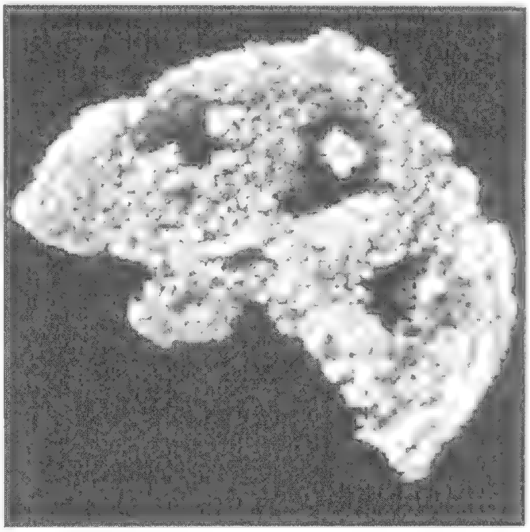


FIG. 26. *Chatsworthia spinosa* sp. nov., NMVP108990, paratype, internal surface, x6.

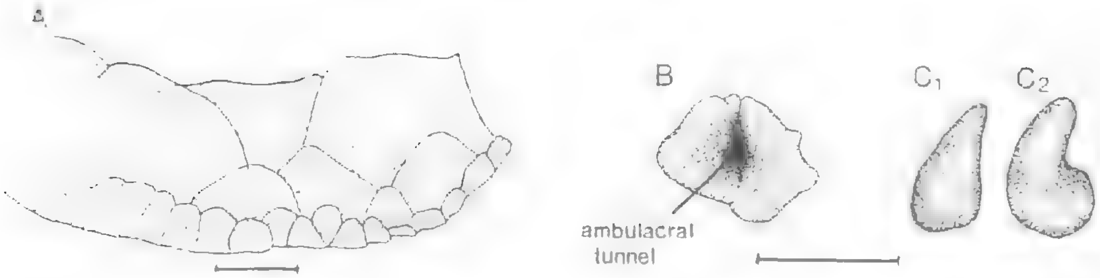


FIG. 27. *Chatsworthia spinosa* sp. nov., camera lucida drawings. A, QMF17948, peripheral rim plating in side view. B, QMF17946, view of one ambulacrum looking from the mouth cavity. C, reconstruction of one cover plate, based on NMVP108990 and QMF 17948. C1, external aspect. C2 internal aspect. Scale bars = 1 mm.

The phylogenetic placement of *Astrocystites* has been particularly difficult because there were no clear intermediate forms linking it to other echinoderm groups. It was therefore difficult to establish homologies. The discovery of a primitive form of edrioblastoid from the median Upper Cambrian of Australia bridges the gap between the mid Ordovician *Astrocystites* and certain edrioasteroids, making the phylogenetic placement of edrioblastoids much clearer.

PHYLOGENETIC POSITION OF EDRIOBLASTOIDS

Even prior to discovery of *Cambroblastus* the link between edrioblastoids and blastoids (Hudson, 1925,1927; Fay, 1967) seemed untenable. The lack of brachioles and a homologue of the hydrospire system and lancet plate clearly distinguished edrioblastoids. Furthermore, the ancestry of blastoids is now generally agreed to lie with coronates such as *Stephanocrinus* (Sprinkle, 1980b, Brett *et al.*, 1983, Smith, 1984, Donovan & Paul, 1985, Paul, 1988) which resemble edrioblastoids even less.

Two Cambrian groups seem worthy of consideration as possible ancestors to edrioblastoids, namely eocrinoids and edrioasteroids. Many eocrinoids possess a polyplated stalk like that of *Cambroblastus* that is differentiated from a bud- like theca. They also have the rudiments of an organised thecal plating with differentiated circlets of plates including basals, just as in *Cambroblastus*. The ambulacral arrangement is much different, however. Eocrinoids have short ambulacra restricted to the oral pole and these give rise to slender brachioles. Brachioles attach to the flooring plates and are believed to be homologous with the cover plate series seen in primitive echinoderms (Paul & Smith, 1984). The absence of any indication of brachioles in the Upper Cambrian edrioblastoid is strong evidence that edrioblastoids are not specialised offshoots from some eocrinoid lineage.

The derivation of edrioblastoids from edrioasteroids seems much more likely. The ambulacral structure in *Cambroblastus* is very like that in edrioasteroids, with large primary cover plates roofing a broad and deep food groove that covers much of the oral surface. The reduction of flooring plates to a single mouth angle plate, as occurs in *Astrocystites* has its precedents amongst edrioasteroids, since this is precisely what occurs in cyathocystids and probably also in rhenopyrgids. Furthermore, both of these edrioasteroid groups have elongate thecae, with the aboral surface developed into a stalk. In the

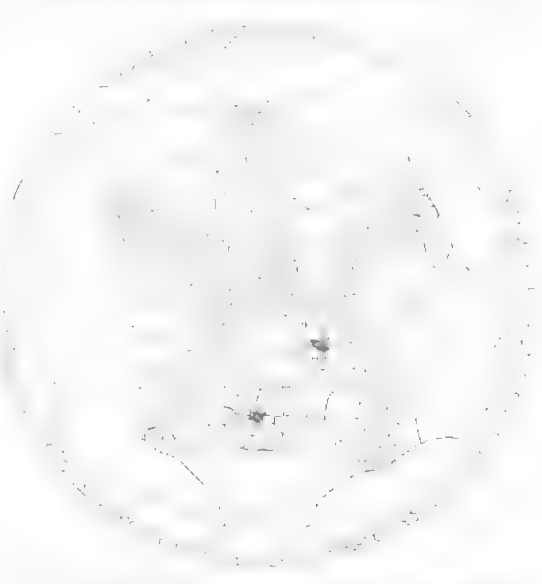


FIG. 28. *Chatsworthia spinosa* sp. nov. reconstruction; interambulacral plating stippled.

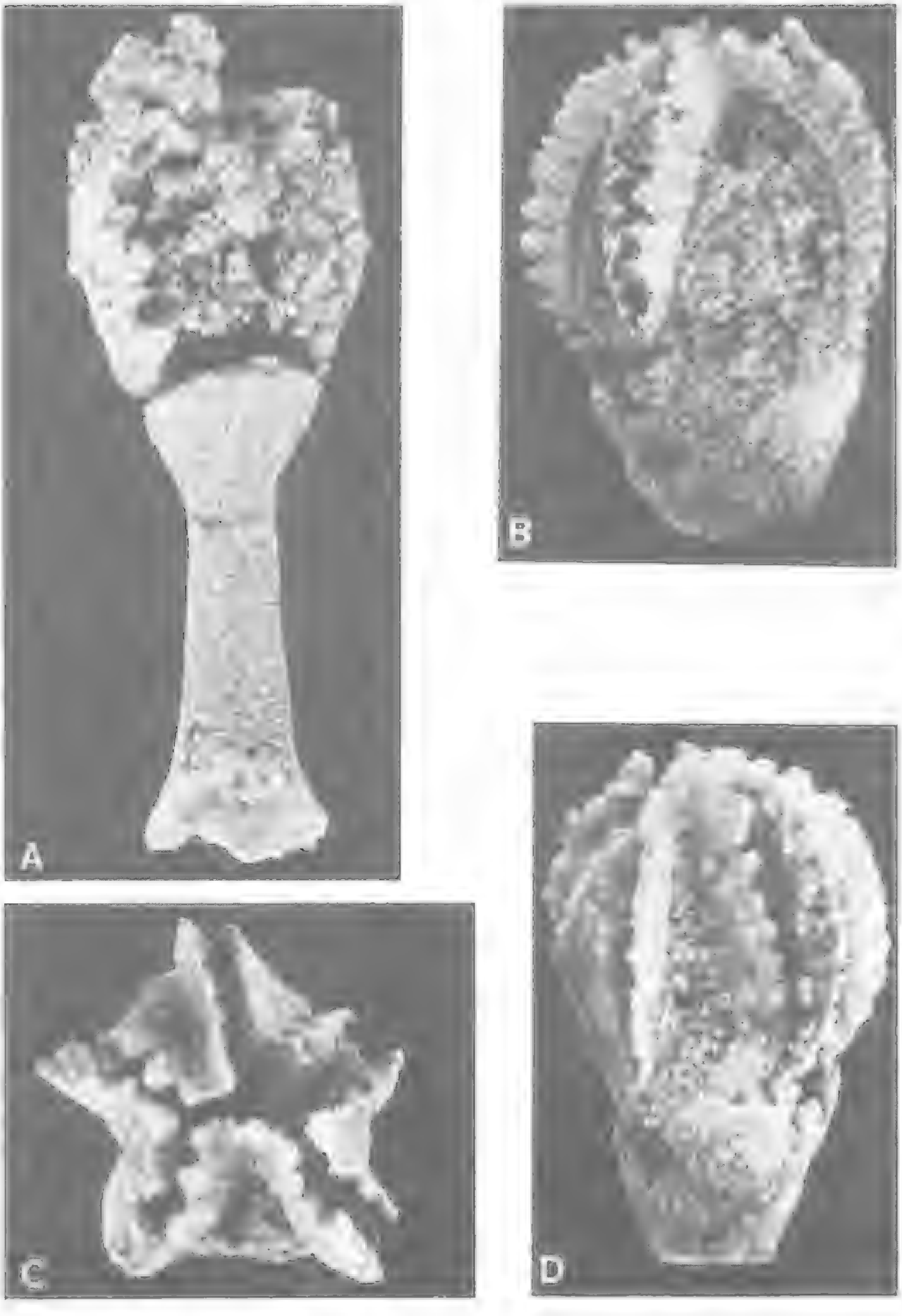
cyathocystids the stalk is a single (?fused) calcite plate in the form of a long cylindrical tube (Bockelie & Paul, 1983), while in rhenopyrgids the stalk is composed of imbricate plates. One of us has argued previously (Smith, 1986) that the stalk in rhenopyrgids is homologous with the aboral plated surface in stromatocystitids and that the circum-oral plates at the top of the stalk are homologous with the peripheral rim plates in other edrioasteroids. If this is correct then the plated holdfast in *Cambroblastus* would be homologous with the large central plates in *Stromatocystites* or *Totiglobus* and the plated holdfast of smaller platelets homologous with the peripheral rim of submarginal platelets. *Cambroblastus* has a rigid basal part to its theca and a more flexible upper part. The lower part consists of 3 circlets of tesselate plates and from its position, between the extremities of the ambulacra and the flexible subambital zone of platelets, would appear to be a direct homologue of the peripheral rim plates of other edrioasteroids. The upper semi-flexible part of the theca is composed of interambulacral and ambulacral areas similar in arrangement to those found in other edrioasteroids, especially in the biserial arrangement of flooring plates and the large simple cover plates. Over the oral area the 5 primary cover plates meet centrally, exactly as they do in cyathocystids and rhenopyrgids.

Since the plating in *Cambroblastus* can be directly homologized with that of edrioasteroids (Fig. 34), whereas eocrinoids differ in the fundamental structure of their ambulacra, we believe edrioblastoids are derived forms of edrioasteroids. Three principal groups of edrioasteroids stem from a *Stromatocystites*-type ancestor (Smith, 1986): 1, Isorophida, which are disc-shaped encrusters with an unplated aboral surface; 2, Edrioasterida, which are globose bottom dwellers that have retained biserial flooring plates and have lost the central plating of the aboral surface; and 3, Cyathocystida which are turret-shaped forms which have formed a peduncle from the aboral plated surface and have reduced ambulacral plating to 5 interradially positioned flooring plates that carry multiple cover plates. Both edrioasterids (*Walcottidiscus*) and isorophids (*Chatsworthia*) had become differentiated by the median Upper Cambrian, but the earliest cyathocystids are mid Ordovician in age. Edrioblastoids have expanded their aboral surface into a stalk and in later forms reduced their ambulacral flooring plates to 5 interradial elements (the deltoids of *Astrocystites*). They are therefore likely to represent a sister group to the Cyathocystida. *Cambroblastus* seems to be too specialised to represent a common ancestor to either cyathocystids or rhenopyrgids however, although the reduction of flooring plates to the 5 primary plates is a putative synapomorphy of *Astrocystites* plus cyathocystids plus rhenopyrgids. Until intermediates linking rhenopyrgids, cyathocystids and primitive edrioblastoids are found, relationships of these 3 groups will remain problematic.

TRANSITION TO *ASTROCYSTITES*

Although *Cambroblastus* closely resembles *Astrocystites* in general organisation (both have a polyplated stalk, a bud-shaped theca dominated by large ambulacral plates that extend below the ambitus and are roofed by primary cover plates) it retains a number of primitive characteristics. Several morphological changes must have taken place in the evolution of *Astrocystites* from *Cambroblastus*. Firstly the thecal plating became simpler with the reduction to 5 basals and 5 radials. It also became completely rigid, flexibility along the adradial margins of the ambulacra apparently being lost. Ambulacral plating was also simplified with the loss of all but the first (interradially positioned) ambulacral flooring plate. This flooring plate expanded into the deltoid plate and its distal tips grew over the adoral portion of the radial plates. The simplification of thecal plating through the loss of circlets and all but the first formed ambulacral flooring plate is most likely to have been achieved through heterochrony, with the appearance of juvenile features in adult forms being the product of neotony or paedamorphosis. Elongation of the primary oral plates into deltoids and the multiplication of coverplates would have occurred at a later stage.

A second major difference between *Cambroblastus* and *Astrocystites* is in the system of intrathecal pores developed along the adradial margin of the ambulacral groove on deltoid plates. No such system of pores is preserved in *Cambroblastus*, which would therefore appear to be a specialization of derived edrioblastoids. However, preservation is such that we cannot entirely rule out the possibility that minute pores were originally present but have become obliterated with silicification. The function of the pores in edrioblastoids has never been properly assessed. They could be the equivalent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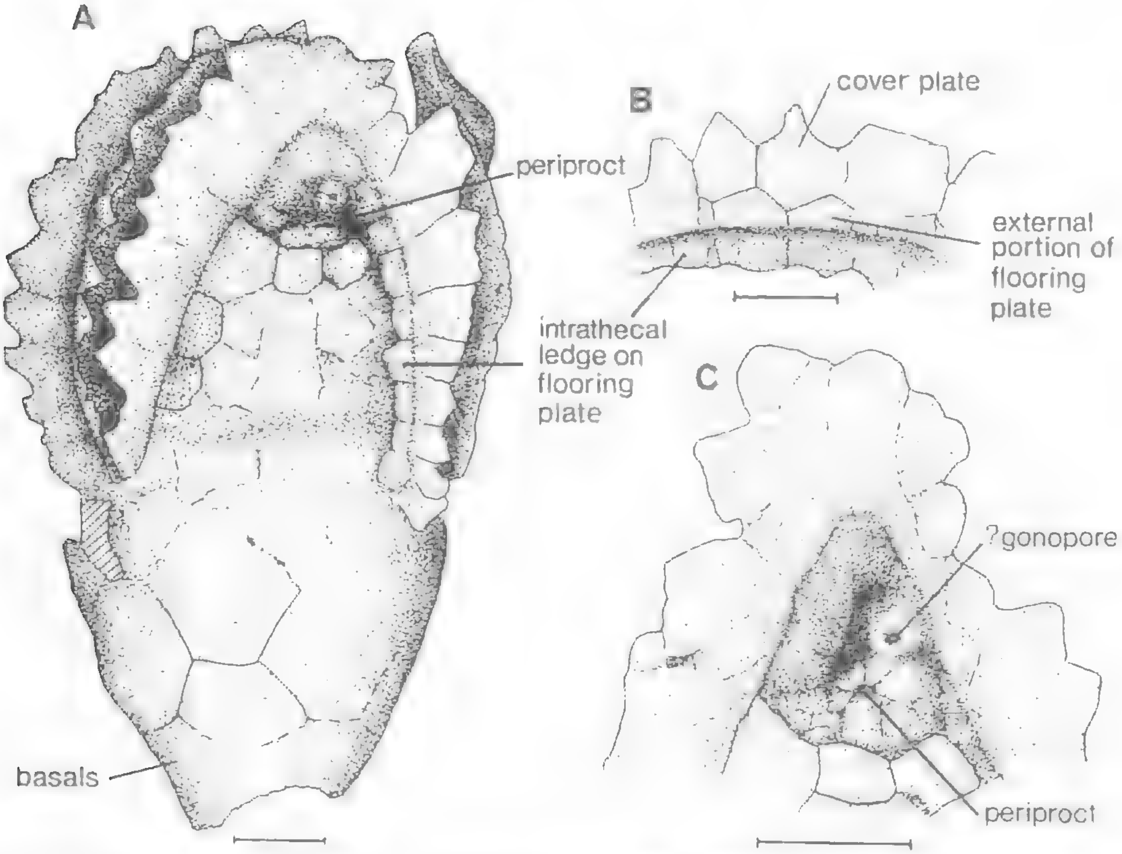


FIG. 30. *Cambroblastus enubilatus* sp. nov., QMF17872, holotype, camera lucida drawings. A, lateral view of posterior interray. B, lateral view of ambulacral plating in ambulacrum III. C, detail of periproctal region. Scale bars = 1 mm.

of the ampullar sutural pores in primitive edrioasteroids but these are absent from *Cambroblastus* as far as can be told and would have to represent an atavistic structure. Furthermore, they are not sutural pores, as in *Stromatocystites* or *Edrioaster*, but are a series of pores within a single ambulacral flooring plate. Whatever their function, they are probably unique to *Astrocystites*.

The only other significant difference is in the organization of stalk plating. Whereas there appears to be no clear lineation to stalk plating in *Cambroblastus* the stalk of *Astrocystites* is made up of 5 columns of plates (although only the proximal part of the stem is known). This again is a specialization of *Astrocystites*.

Cambroblastus gen. nov.

ETYMOLOGY

From Cambrian and the Greek *blastos*, a bud, in allusion to the shape of the theca.

TYPE SPECIES

Cambroblastus enubilatus sp. nov.

AGE AND DISTRIBUTION

Median Upper Cambrian (Franconian) of Queensland.

FIG. 29. *Cambroblastus enubilatus* sp. nov. from the Chatsworth Limestone, median Upper Cambrian of Chatsworth. A, QMF17873, paratype in side view, x8 (see also Fig. 32). B-D, QMF17872, holotype. B, lateral view of posterior interradius, x7.5 (see also Fig. 30). C, oral view, x7.5 (see also Fig. 31). D, lateral view of ambulacra III and IV, x7.5. Silica replacements whitened with ammonium chloride sublimate.

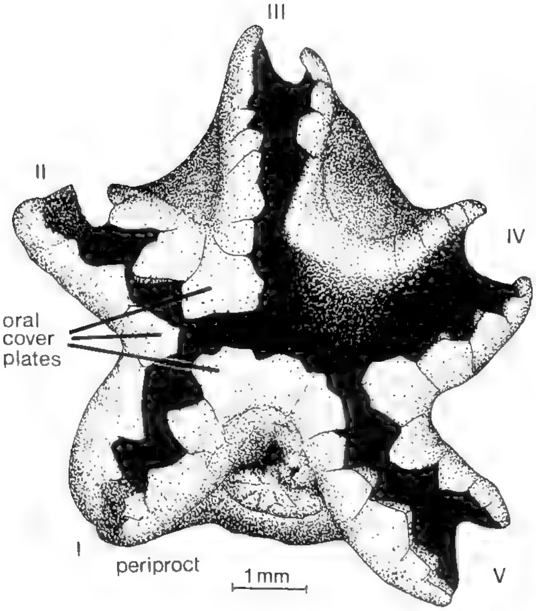


FIG. 31. *Cambroblastus enubilatus* sp. nov., QMF17872, holotype, camera lucida drawing of the oral region.

DIAGNOSIS

An edrioblastoid with an irregular polyplated stalk, 3 irregular cycles of thecal plating and ambulacra composed of biserially arranged flooring plates bearing simple cover plates. No intrathecal pores to the ambulacral grooves.

REMARKS

This genus is sister group to the Ordovician edrioblastoid *Astrocystites* on account of its very similar thecal shape and ambulacral organisation and its polyplated holdfast. It differs from that genus in having an additional circlet of thecal plates between the radials and basals, in having multiple biserial flooring plates to each ambulacrum rather than a single oral plate (deltoid), and no system of pores along the margins of the ambulacral grooves. Furthermore, the plating of the stalk is less well organised in *Cambroblastus*.

Cambroblastus enubilatus sp. nov.
(Figs 29-33)

ETYMOLOGY

Latin *enubilatus*, freed from clouds, an allusion to its importance in revealing the origins of edrioblastoids.

TYPES

Holotype QMF17872, paratype QMF17873; no other specimens are known.

AGE AND OCCURRENCE

Both specimens come from locality K204 of Shergold (1982), from a grey, 4 m thick unit of the Chatsworth Limestone, 3.5 km south of Chatsworth homestead, 60 km southeast of Duchess, western Queensland. *Peichiashania secunda-Prochuangia glabella* Assemblage Zone, median Upper Cambrian (Franconian).

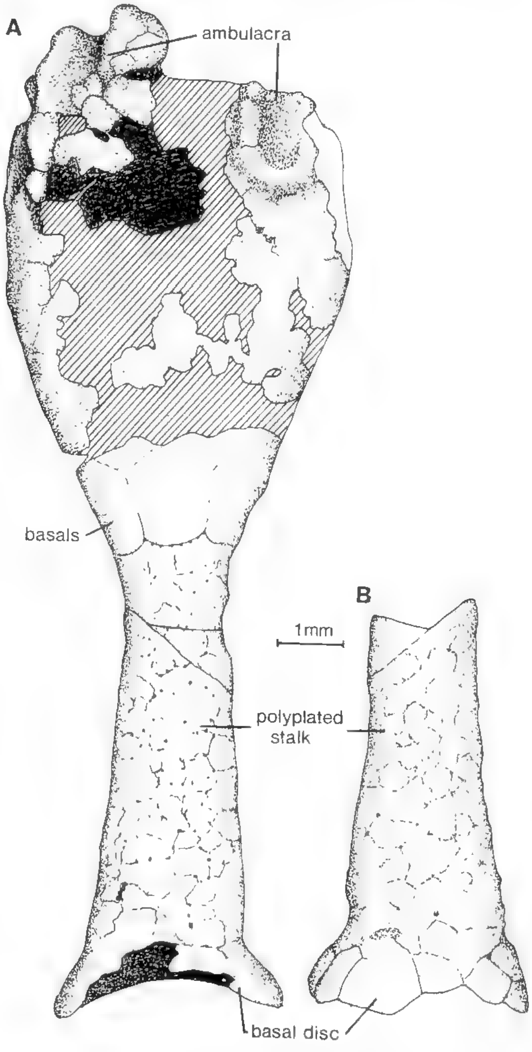


FIG. 32. *Cambroblastus enubilatus* sp. nov., QMF17873, paratype, camera lucida drawings. A, lateral view of complete specimen. Hatched lines = missing; black = plate surface badly etched. B, obverse of stalk.

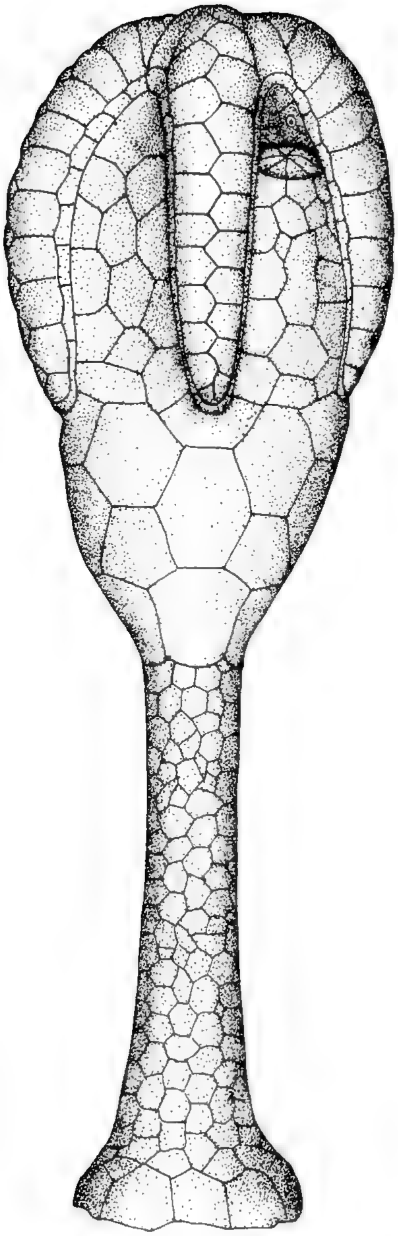


FIG. 33. *Cambroblastus enubilatus* sp. nov. reconstruction.

DIAGNOSIS

As for genus.

DESCRIPTION

The theca is 10-11 mm long and 6-7 mm in maximum diameter with the widest part being slightly above mid-height. The stem is 5.5 mm long and 1.5-2 mm wide, with a flared base (Fig. 29A). The theca tapers gradually to the stalk and has a rounded apex. In oral view the theca is rounded pentagonal in outline, with the angles formed by the prominent ambulacra (Fig. 29C). Interradial zones are concave. The mouth lies at the apex of the theca and the periproct close to the apex in the posterior interambulacrum (Fig. 30A). There are 5 large and prominent ambulacra stet that meet in a 2:1:2 pattern at the apex (Figs 29C, 31). Ambulacra are c. 2 mm wide at the apex and taper slightly to a broad rounded point situated a little below the ambitus. The ambulacral groove is completely roofed over by a series of simple cover plates. There are 9 or 10 cover plates in each column. These are largest at the apex and become progressively smaller distally (Fig. 30A,B). Cover plates are tall and form a spacious vaulted canopy to the ambulacral groove. The cover plates fit together tightly with no sutural gaps. They interlock along a zig-zag perradial suture. Individual plates are pentagonal in outline and have a single moderately well-developed sagittal strut on their inner face. The suture between cover plates and flooring plates is nowhere clearly seen. In ambulacrum II the cover plates appear to alternate with the flooring plates (Fig. 30B). Elswhere they may sit more directly above the flooring plates, although plate boundaries are nowhere clear. No secondary cover plates are present. Over the oral area there are 5 large cover plates that meet centrally, one from each interradius (Fig. 31). The posterior interradius may, however, have 2 such plates, to judge from the plate outline. These are the oral plates and the smaller adjacent cover plates may attach directly to them.

The floor to the ambulacral groove is U-shaped and smooth, with slight undulations marking the plate boundaries. Flooring plates are biserial and in places the sutures have been preferentially etched. However, no sutural pores are consistently developed and in less corroded ambulacra no pores whatsoever can be seen. We therefore believe that pores were either not present in the ambulacral groove or small and obliterated by silicification. Flooring plates are exposed along the adradial margin on the outer side of the ambulacra (Fig. 30B). Beneath the exposed portion of the flooring plates a distinct concave facet runs the length of the ambulacrum (Fig. 30A). This is the intrathecal section of the flooring plates and is an imbrication flange on which the interambulacral plates rest. In the posterior interambulacrum of the holotype, interambulacral

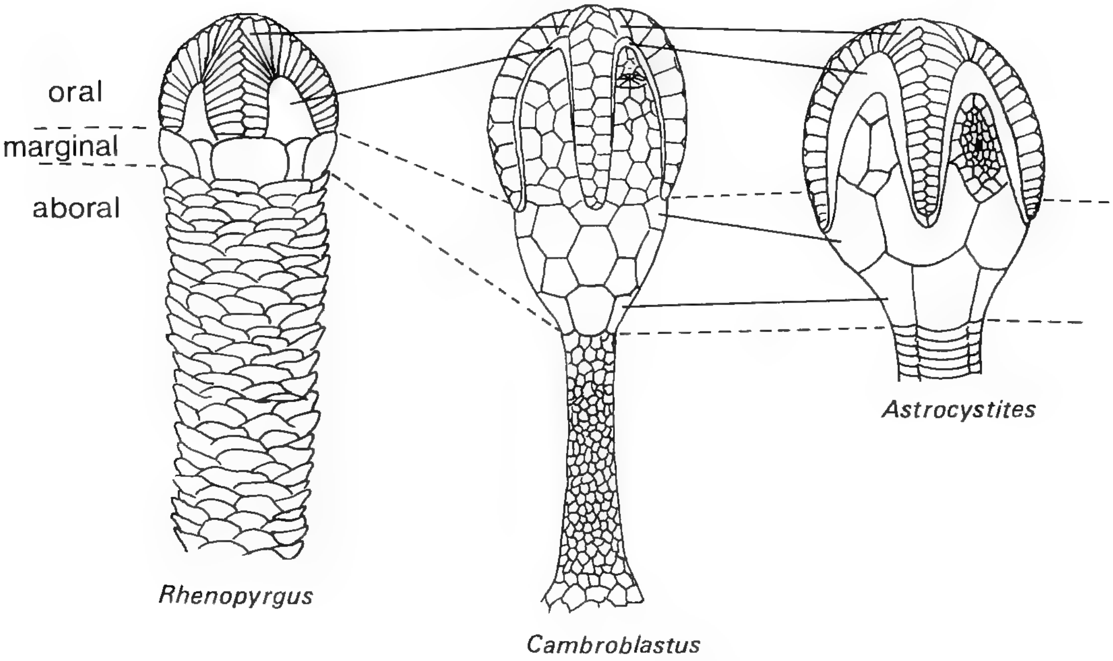


FIG. 34. Diagram indicating the homologous regions of plating in rhenopyrgids (*Rhenopyrgus*), *Cambroblastus*, and the Ordovician edrioblastoid *Astrocystites*.

plates are preserved in position against ambulacrum I, covering the facet, but have slid off the flooring plates of ambulacrum V on the other side to reveal the concave facet (Figs 29B, 30A). This suggests that the ambulacral/interambulacral boundary was imbricate not rigid and that the ambulacral flooring plates had some limited degree of flexibility. The sutures between flooring plates are well seen in the intrathecal section.

Interambulacral plating, best seen in the posterior interambulacrum (Fig. 29B, 30A), consists of a pavement of small polygonal plates with slightly swollen centres. These are 3-5 abreast, reducing to a single plate adapically. There may be a single elongate plate in the centre of the posterior interambulacrum. The interambulacral plates tend to hold together even though they are displaced from the adradial suture, suggesting that they were firmly bound together.

The periproct opens close to the oral area in the posterior interambulacrum (Fig. 30A,C). It faces towards the apex and is set back on a ledge. It is composed of a low cone of wedge-shaped plates, relatively few in number. Above the periproct and close to ambulacrum V is a small conical structure with a central depression (Fig. 30C) interpreted as the gonopore. No trace of the hydropore is seen, probably because of the coarse preservation.

The lower part of the theca is cup-like and appears to have been rigid. Plate boundaries are obscured except in the posterior part of the theca (Figs 29B, 30A). Here traces of 3 circlets of plates are visible. In the paratype there are 3 plates forming the base of the cup on one side (Figs 29A, 32) and, by inference, there must therefore be a basal circlet of 5 plates, which we homologise with the basals of *Astrocystites*. Above this, in the holotype are large hexagonal plates. Because only traces of sutures can be distinguished we are not certain of a regular pentameral pattern to this plating but there are 2 further circlets of polygonal plates above the basals. Some of these appear to be slightly concave and all are covered in a fine retiform ornament. At the base of the ambulacra an indistinctly defined plate may be the homologue to the radials in *Astrocystites*.

The stalk (Fig. 29A) is cylindrical, narrowest immediately beneath the theca, and expanding slightly towards the base. The surface appears

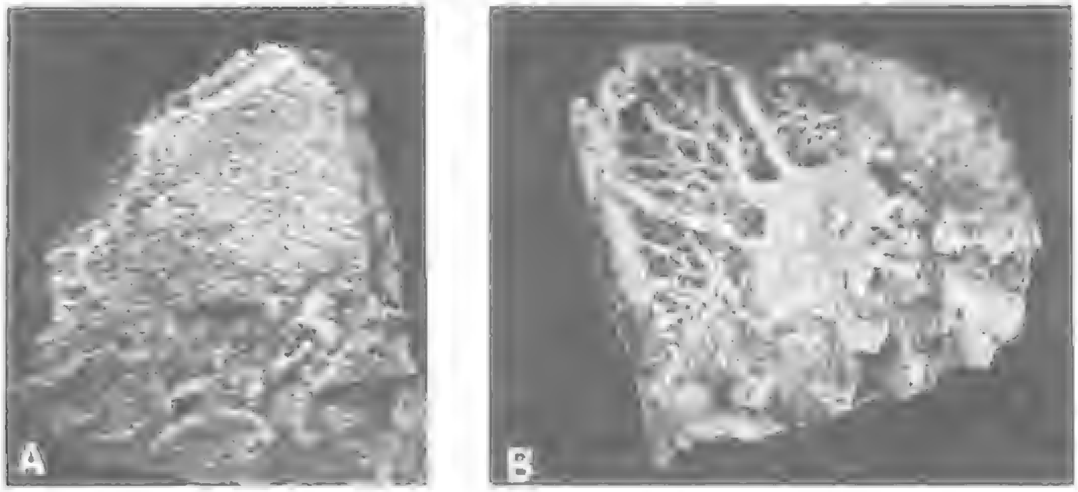


FIG. 35. Incertae sedis echinoderm fragment, QMF 17859, early Middle Cambrian from QP243 near Cornford Bore, x4. A, external surface. B, internal surface. Latex casts whitened with ammonium chloride sublimate.

different in texture to the theca, being much more granular and with many small pits. As a number of these pits appear to be linearly arranged we interpret them as traces of plate boundaries and the stalk to be composed of a relatively large number of small granular platelets. Towards the base these platelets become better defined and are polygonal in outline. At the base the stalk flares outwards into a cup-shaped holdfast of large polygonal plates (Fig. 32). The stalk is broken at the bottom and the full extent and shape of this holdfast remains unknown.

REMARKS

A comparison of this species to the only other known edrioblastoid, *Astrocystites*, has been

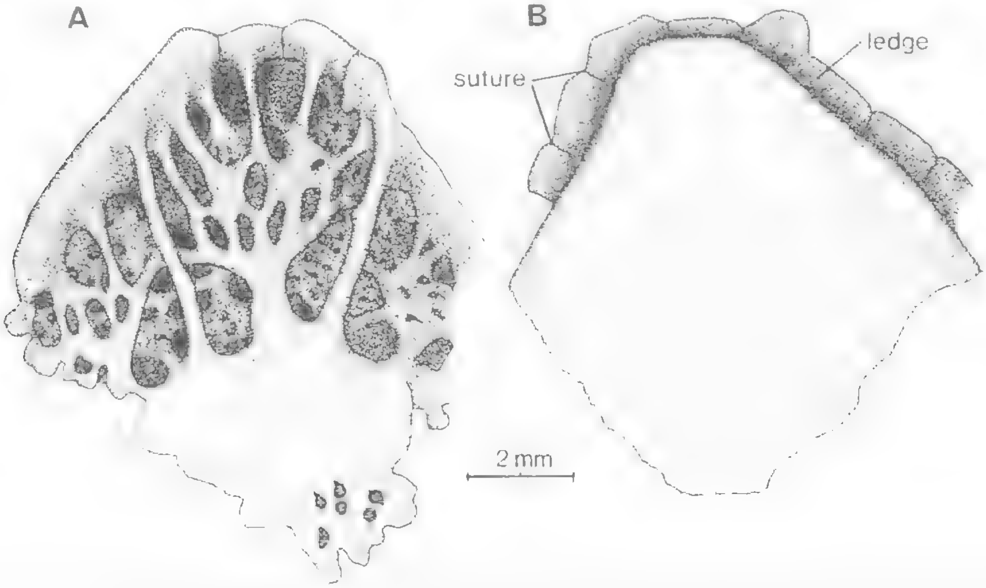


FIG. 36. Incertae sedis echinoderm fragment, QMF 17859, camera lucida drawings of internal (A) and external (B) surfaces.

given above and its phylogenetic position has also been dealt with fully. *Cambroblastus* was an erect, medium-level, suspension feeder using its ambulacra to capture suspended food particles. The stalk, which is relatively well-developed for Cambrian echinoderms, would have elevated the food capturing surfaces well above the substratum. *Cambroblastus* must have been attached to a substratum by its basal disc but, because only part of this is known, we are not sure as to how fixation was achieved. However, the shape of the basal disc is reminiscent of basal attachment discs of *Echinosphaerites* for attachment to hard substrata, and is unlikely to have been a rootlet structure for attachment within unconsolidated sediment. The apparently tesselate nature of the stalk platelets suggests that the stalk was relatively stiff and inflexible, unlike the imbricate stalk of rhenopyrgid edrioasteroids. Furthermore the stalk is relatively robust and has held together well, not having collapsed during fossilization. Both observations indicate that the stalk of *Cambroblastus* was more or less rigid and not extensible.

The broad imbricate facet between the flooring plates and the interambulacral plates implies that this boundary was flexible and that a large degree of movement was permitted between the two plate systems. Interambulacral areas are often separated from the adradial suture and are also variable in width (Fig. 29B,C,D). Furthermore, there is a distinct change between the lower cup- like portion of the theca, where plates are rigidly sutured, and the rather irregularly concave surfaces of the interambulacra between the arms. The flexibility between ambulacral flooring plates and interambulacral regions suggests to us that the ambulacra retained a certain amount of movement and that the food groove could be widened or closed by lowering or raising the flooring plates.

The absence of pores in the floor of the food groove requires that the water vascular system, presumably lying in the floor of the groove, lacked internal ampullae.

Incertae sedis
(Figs 35, 36)

MATERIAL
A single specimen, part and counterpart preserved as a mould in silica. QMF 17859a/b.

AGE AND OCCURRENCE
From chert beds of the Yelvertoft Member, Beetle Creek Formation, early Middle Cambrian, exposed on the northern flank of a low rise some 500 m south of the bore at Yaringa Creek, 50 km west-southwest of Mount Isa, western Queensland (GR 980965).

DESCRIPTION
The specimen is 10 mm x 12 mm, although the posterior(?) edge is fractured and missing. It has a narrow anterior border and 2 long straight sides that diverge at c. 80°. The external surface (Figs 35A, 36B) shows a flat, unornamented platform surrounded by a 1 mm wide ledge. This ledge is concave, dipping steeply from the platform before levelling out. It is crossed by vertical sutures approximately 0.8-1.0 mm apart. There is a central plate on the anterior border and adjacent plates occupy each of the angles. No sutures are seen on the platform.

The interior of the specimen shows a steeply dipping marginal rim surrounding a crescentic region of labyrinthine struts (Figs 35B, 36A). There is a central platform towards the posterior of the specimen. The rim is crossed by vertical sutures, at least anteriorly. Struts from the labyrinthine region run to the centre of each marginal plate. The anterior struts are rather short and dip into the labyrinthine region but there are 2 long struts that run from the side walls right to the posterior platform without branching. The floor of the labyrinthine region is pitted and the specimen must have been exceedingly thin at these points. The posterior platform is flat and smooth. Towards the posterior there are 6 small (0.2 mm diameter) pores. It is not known whether these perforate the plate as the corresponding region is not seen in the counterpart. No sutures are seen in either the labyrinthine region or the posterior platform.

REMARKS
This fragment is an enigma. We feel confident that it is echinoderm, even though calcite plating is not preserved. This is because of the presence of plate boundaries along the peripheral ledge. The absence of sutures in the main body of the plate suggests to us that the fragment is a composite element, constructed of several plates fused together. The peripheral flange and shape of this element are reminiscent of large interradial first ambulacral plates; the flange being an adradial ledge either formed of fused ambulacral flooring plates or directly flooring the am-

bulacra. Large deltoid plates, situated interradially and bearing ambulacral structures, are known in edrioasteroids, blastoids, parablastoids and edrioblastoids. The interradial plates in edrioasteroids form the oral frame and are suspected of being formed from fused ambulacral flooring plates (Bell, 1976, Smith, 1986). However, they are much smaller and none is known to have such a distinctive labyrinthine interior. In edrioblastoids the interradial deltoids are also supposedly composed of fused ambulacral flooring plates (Mintz, 1970, Bell, 1980) and here the plate is large with an adradial ledge. However, such deltoid plates are known only in the Middle Ordovician *Astrocystites* and were apparently absent in the Late Cambrian *Cambroblastus*. The deltoids in blastoids carry part of the hydrospire system and are not closely comparable. The deltoid in parablastoids is a large plate perforated by a system of canals termed cataspires (Sprinkle, 1973, Paul & Cope, 1982). It does not underlie the ambulacra but abuts the flooring plate system and no species is known to have a labyrinthine internal plate ornamentation. Because it may represent an interradial plate of fused ambulacra we suspect it might be some form of edrioasteroid derivative, but it represents a major departure in form from any reported echinoderm group.

The crescentic zone of labyrinthine struts creates an extremely thin-walled surface and we believe that this may be an adaptation for gaseous exchange. The struts provide strengthening support to the theca, bracing the ambulacral zones, while the pits are sites of gaseous exchange. Extreme thinning of calcitic plates associated with gaseous exchange is a common feature in many echinoderm groups. Amongst cystoids, for example, thin-walled regions of the plate are found in paracrinoids (deep pits), diploporites (the exterior of haplopores is a thin membrane of calcite) and dichoporites (where tube-like passageways from the interior run immediately beneath the surface of the plate). The arrangement of pits and struts in such an irregular manner rules out the presence of any sophisticated circulatory system as in most cystoids. Gaseous exchange must have taken place through simple diffusion across the thin plate.

'Subclass SOMASTEROIDEA'

Family ARCHEGONASTERIDAE Spencer, 1951

Archegonaster Jaekel, 1923

TYPE SPECIES

Archegonaster pentagonus Spencer, 1951.

Archegonaster pentagonus Spencer, 1951
(Figs 37-51)

Archegonaster pentagonus Spencer, 1951, p. 101, figs 9, 10, 12-15, 34, 37-40, 54, 55.

Archegonaster pentagonus Spencer; Spencer & Wright, 1966, p. U41, fig. 39C.

Archegonaster pentagonus Spencer; Smith, 1988b, p. 89, pl. 7.1, fig. 4, pl.7.2, fig. 6.

MATERIAL

The Narodni Museum, Prague houses 65 specimens, including the types.

AGE AND OCCURRENCE

All material comes from the Llanvirn Sarka Formation of the Osek district, Prague, Czechoslovakia.

DESCRIPTION

Archegonaster is a pentastellate echinoderm with a stout marginal frame of ossicles and narrow projecting arms (Fig. 37). There is no separation between disc and arms, the two merging imperceptibly into one another. Its size is difficult to estimate since so many specimens are incomplete or distorted. The most complete specimen (Fig. 37) has a radial length of 35 mm and an interradial/radial diameter of 60 mm, but the tips of its arms are missing. Specimens cover a large size range, from about 15 mm radial length (Fig. 49B) to around 50 mm. The body is flattened.

Ambulacra. These are composed of biserially arranged ambulacral ossicles (=flooring plates) arranged alternately and forming an open U-shaped channel (Figs 38-40). In oral view they appear as T-shaped ossicles, measuring about 3 mm perradially and with a 2 mm transverse bar in larger specimens (Figs 40A, 41B-E). The perradial suture is virtually straight and successive ambulacral plates overlap one another, the distal part of one plate passing beneath the proximal part of the next distal plate. About one third of the plate imbricates beneath the adjacent ambulacral plate. The perradial face, forming the ambulacral groove, is relatively smooth and slightly depressed centrally. The distal portion of the plate is more tapered and composed of denser stereom; this is the portion that passes underneath the next distal plate. There is a well marked rim to the top of the ambulacral groove. This runs from the proximal end of the plate to the transverse bar, where it ends abruptly at a notch (Fig. 40A). Presumably, this is the notch for the lateral branch of the radial water vessel leading to a tube foot. In larger specimens the floor to this notch has a small pit. When ambulacral plates are in life position (Figs 38E, 41B-E) the distal wall of the notch for the radial water vessel is formed by the proximal edge of the succeeding ambulacral plate. The transverse bar is tall and narrow, with steeply sloping sides. The ridge to the ambulacral groove continues along the top of this bar. At its abradial end the transverse bar is tripartite, with a large flattish central face that slopes outwards (the articulation face for the adambulacral ossicle) and two narrow rims marking the edges of proximal and distal podial basins (Figs 39G, 40C). The articulation face expands aborally and in some may be slightly convex, though it is usually flat. The flanges on either side are steeply dipping and flare out towards their base. The flange on the distal face is considerably better developed than that on the proximal face, which hardly flares out at all (Fig. 40A). Thus only the proximal part of each podial basin is floored and the narrow rims presumably mark the site of tube-foot attachment.

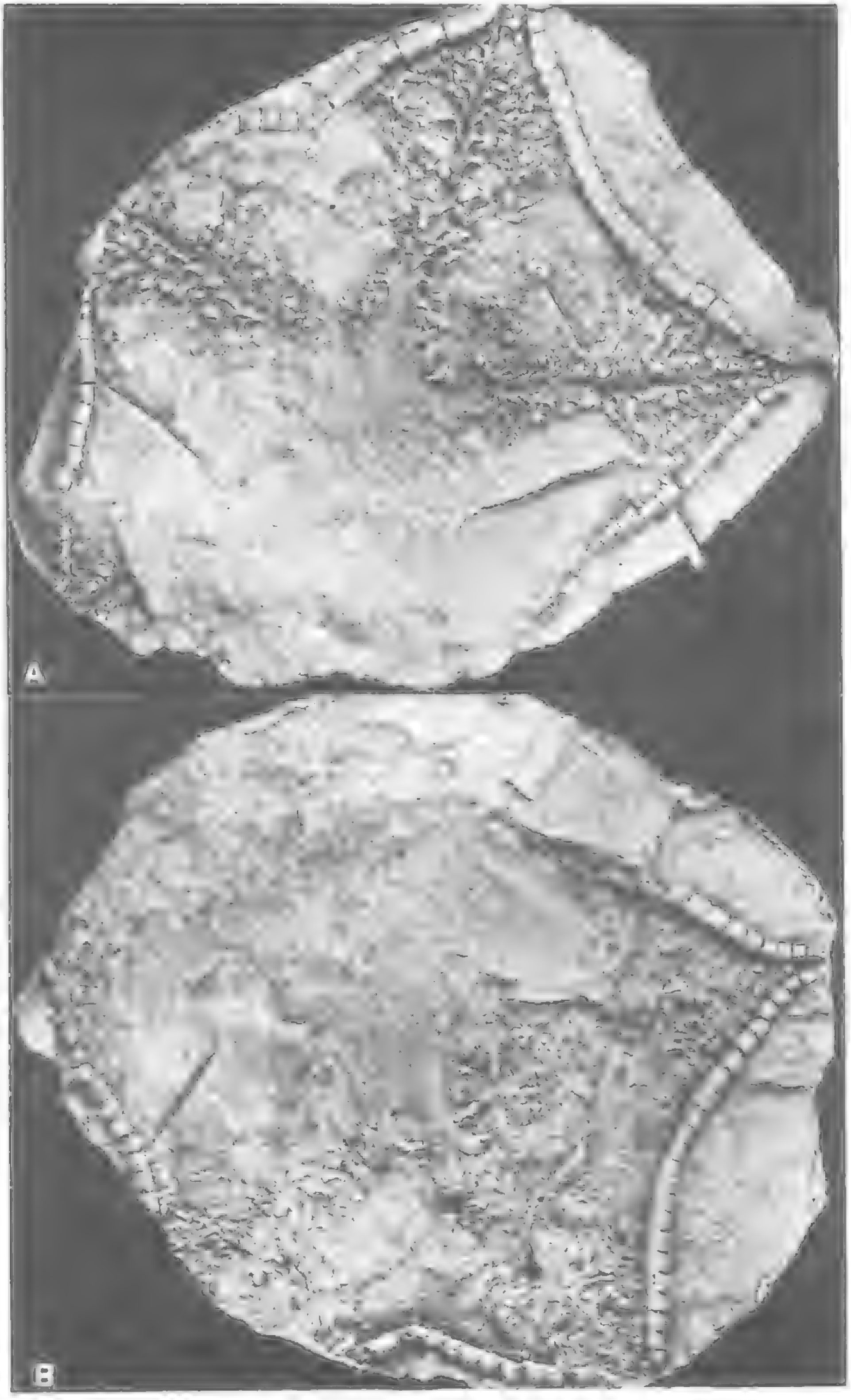
In aboral aspect the ambulacral plates are also T-shaped, with the transverse bar generally appearing much more clearly tripartite at its tip (Figs 40B, 41A). The perradial zone is rather flat and smooth, there being no evidence for dorsal inter-ambulacral muscle attachment sites. The proximal end of each ossicle is more pointed than the distal end and is marked off from the rest of the plate by a small rim. This rim becomes progressively more pronounced in plates towards the mouth and marks the limit of plate imbrication. The imbrication surface is inclined away from the perradius. The outer part of the plate also slopes downwards away from the perradius. The three regions at the tip of the transverse bar correspond to the central articulation face for the lateral arm plate and the two lateral flanges flooring the podial basins. As seen orally, the distal flange is much better developed than the proximal flange. The two flanges form a rim to the transverse bar.

The way in which opposite plates articulate perradially is not clear. There is no evidence for one series having over ridden the other or for overlapping of alternate plates. The perradial edge of ambulacral plates is thin and no tongue and groove structure could be identified. As the perradial line is virtually straight the ambulacral plates may simply have abutted along a narrow face.

In juvenile specimens, or towards the arm tips, the ambulacral plates become less strongly imbricate and more squarish in outline with a less pronounced transverse bar (Figs 40D,49 C).

Adambulacrals. Ossicles that articulate onto the ambulacral (flooring) plates are called adambulacrals in asteroids and lateral arm plates in ophiuroids. As both structures are homologous we choose to refer to such plates as adambulacrals. In *Archegonaster* the adambulacrals have a complex form, best understood by examining the camera lucida drawings that show the plate in different orientations (Fig. 42). The ossicle is L-shaped in side view and more irregular in adradial (i.e. the face that articulates with the ambulacral plate) and abradial (i.e. distal to the articulation facet) aspects. The ossicle has a laterally flattened shaft, articulating onto the ambulacral plate at its base, a swollen head and a laterally flattened abradial projection which articulates with the first virgal distally (the virgal projection). Short (1 mm) spines attach to the head (Fig. 41A). The proximal face of the shaft has a median ridge running up the length of the shaft (Fig. 42A). There is a clearly defined pit on the adradial side of this ridge towards the head of the shaft. This is presumably a muscle pit. The abradial edge of the shaft may have a small projection or flange beneath the main abradial projection, but only in larger ossicles close to the mouth. It is laterally flattened but never achieves the size of the virgal projection. The virgal projection is square-ended and compressed in the proximal/distal plane. It has a smoothly rounded distal face but is flatter or slightly concave on its proximal face and bears shallow grooves. The upper edge of the virgal projection is a well-defined rim in larger ossicles and this is separated from the median ridge of the shaft by a clear notch. The distal face has a prominent flattish platform forming the head. The upper (adoral) face of this platform carries 6 or 7 spines. The spines are largest on the proximal end and decrease in size significantly towards the distal end (i.e. towards the virgal projection). In oral view the spines sit in slight

FIG. 37. *Archegonaster pentagonus* Spencer, Llanvirn of Osek, Czechoslovakia, A,B, NM EH30. A, oral. B, aboral. Latex casts whitened with ammonium chloride sublimate, x2.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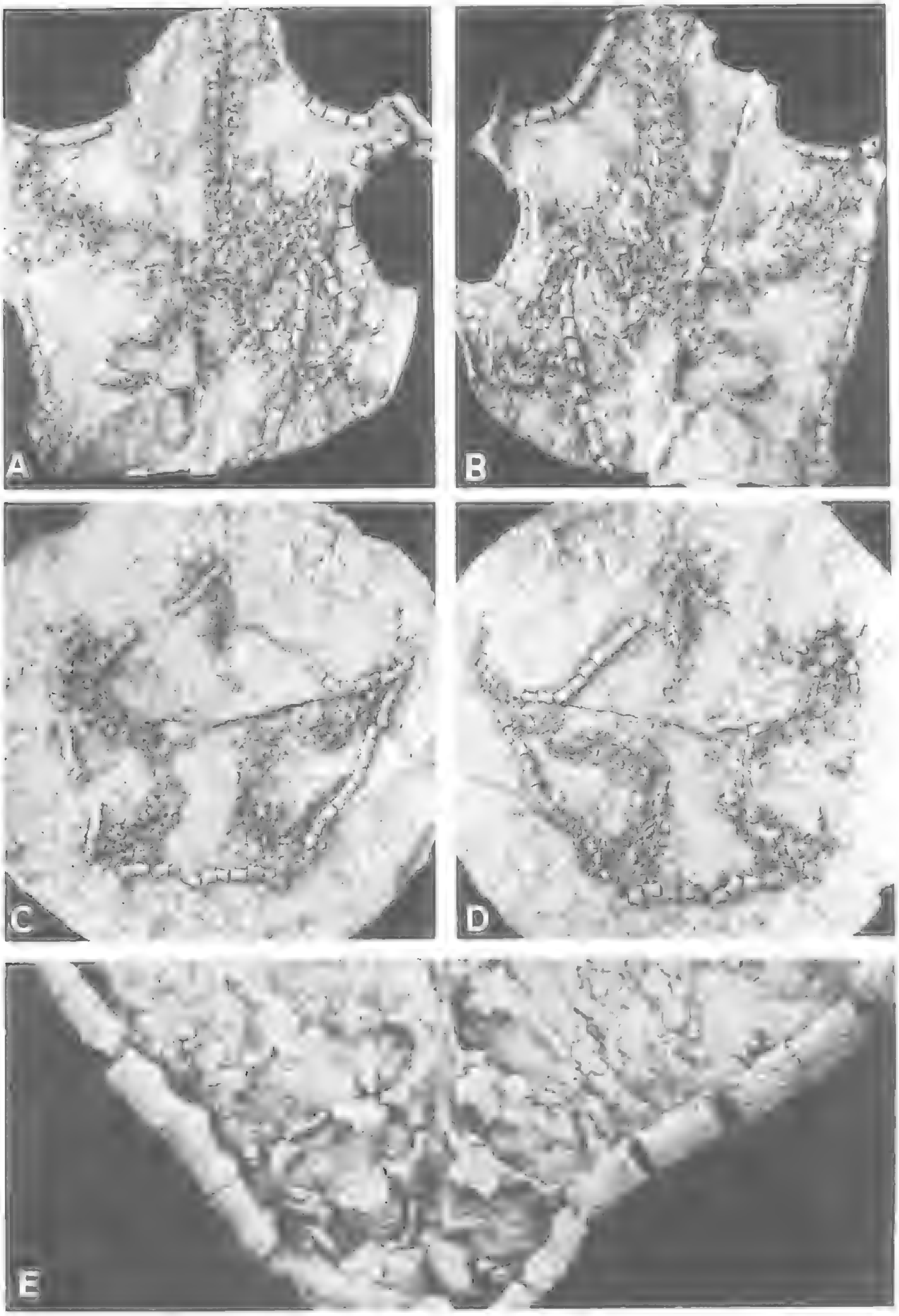
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depressions, the largest being proximal at the heel of the L-shaped plate.

Towards the mouth, the adambulacral ossicles become more slender and elongate along both the shaft and the virgal projection, while towards the arm tips the adambulacrals are much more block-like, with hardly any shaft or virgal projection. In the outer part of the ambulacra these adambulacrals attach directly to the marginal ossicles.

Interradial plating. The interradial zone, lying between the adambulacrals of the ambulacra and the marginal ring, is a complex, plated surface and commonly disrupted by post-mortem decay. Towards the tips of the ambulacra interradial plating is absent and the adambulacrals attach directly to the marginal ossicles (Figs 43C, 49C). At the interradius plating is also absent, leaving wedge-shaped uncalcified zones (Figs 37, 38A-D,43A,B). In between these two regions the adambulacrals are connected to the marginal ossicles via one or more slender rod-shaped plates termed virgals (Fig. 43). The number of virgals in a row increases towards the centre as the interradial space becomes broader. The first virgal attaches to the abradial projection on the lateral arm plate (Figs 43C, 45, 46) and is vertically orientated with slightly expanded ends. The distal face is smoothly rounded, with a central ridge that is continuous with a corresponding ridge on the lateral arm plate. The proximal face is flat or slightly concave and has spoon-shaped depressions at each end, possibly the site of muscle attachment (Fig. 44). The ends of the plate are flat suture faces. Up to 5 other virgals are present in the row (Fig. 46). These are generally similar in shape but some may fork abradially and the lower edge is often stepped (Fig. 44B). Those plates that fork show a double suture at one end and the ridge on the distal face also branches. Some plates have their plane of flattening rotated between adradial and abradial ends.

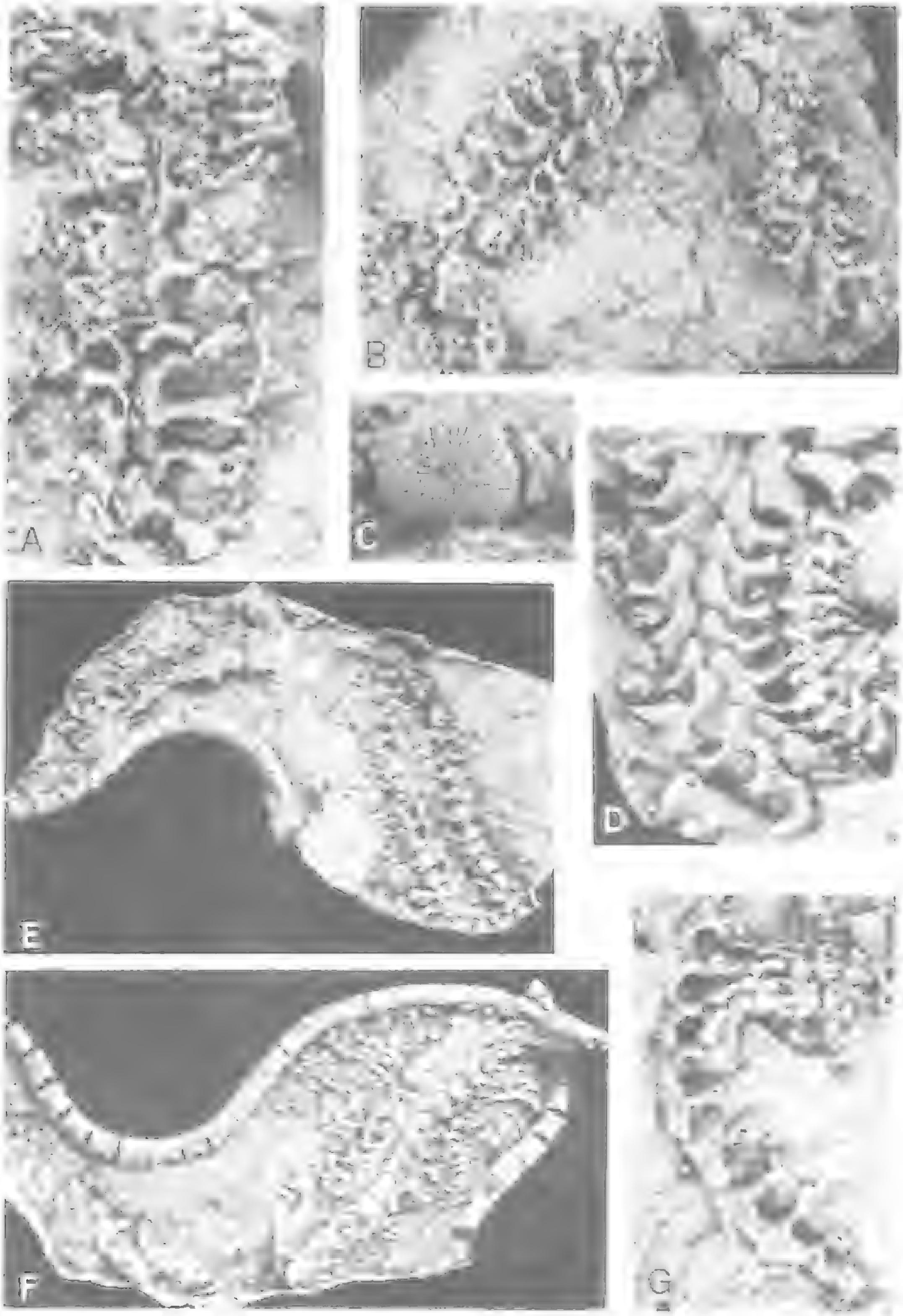
The rows of vertically elongate virgals are separated by rows of intervirgal plates (Figs 38E, 39F, 41C,D, 43C, 45, 46). These are more irregular in shape, some cross-shaped with four sutural faces. Where virgals are well preserved there is always an aboral set of plates that attach to the inner edge of the virgal row (Fig. 45). The first of these also attaches to the abradial edge of the lateral arm plate (Figs 41C, 45A). In the best preserved specimens (Fig. 39E,F) these plates form an almost complete covering to the interradial regions. There is a suggestion that the virgals form vertical ribs with the intervirgals lying flatter in the spaces in between. However, it is possible that the intervirgals are only connected to one side of the virgals and do not link adjacent virgal rows.

Mouth frame plates. The 3 most adoral ambulacral plates in each column are modified in *Archegonaster* into a jaw. Although a few specimens show large gaps down the perradial line of ambulacra (buccal slits of Spencer, 1951), this we interpret as post-mortem artefact. In well-preserved individuals only the first 2 ambulacral plates are completely separated from one another at the perradius (Figs 37, 38A). The first ambulacral plate lies interradially and is elongate radially (Fig. 47D). It is always paired with the corresponding plate from the adjacent ambulacrum and is the most highly modified of the ambulacral plates. The second plate is stouter, more cylindrical and is set obliquely to both the first and the third and subsequent ambulacral plates. The third ambulacral plate is only slightly modified from the remaining ambulacral plates in that it has a stout proximal end. Opposing third ambulacrals meet along the perradius in life.

The first ambulacrals, or mouth angle plates, are flattish plates that abut interradially along their aboral edge (Fig. 47A). The aboral face is crossed by 2 grooves. The more proximal groove is clearly marked and Vs towards the interradius. This, by comparison with the jaws of Recent ophiuroids, is the site of the circum-oral nerve ring. There is a strong projection immediately distal to the nerve ring groove and a shallower groove distal to this projection, which marks the site of the circum-oesophageal water vessel ring. The distal portion of the aboral face is a ledge and the groove for the water vascular ring runs obliquely away from the interradius along the edge of this.

In lateral view the interradial face (Fig. 47A$_2$) has a broad, relatively flat platform distally and a zone of pits and transverse bars proximally. This pitted zone is presumably the site of insertion of muscle or ligament that binds the pairs of

FIG. 38. *Archegonaster pentagonus* Spencer, Llanvirn of Osek, Czechoslovakia. A,B, NM 41/83, x2. A, oral. B, aboral. C,D, NM 42/83, x2. C, oral. D, aboral. E, NM L10446, one ambulacrum showing ambulacrals, adambulacrals, virgals, intervirgals and marginals, x7. Latex casts whitened with ammonium chloride sublimate.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plates together interradially. The platform is smooth and is an abutment surface. The proximal bar is smooth, uniformly convex and set oblique to the aboral face. The perradial face in lateral

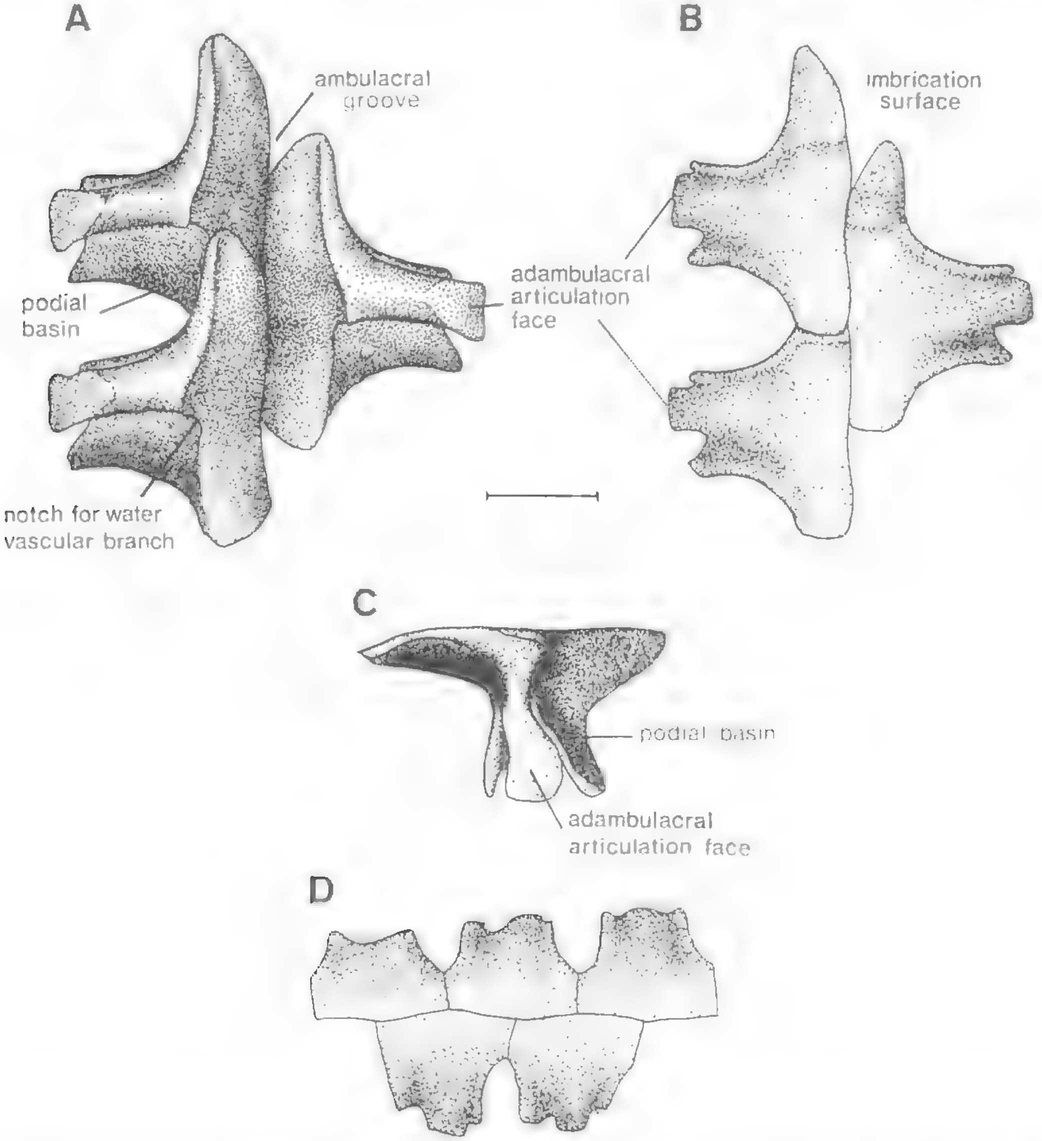
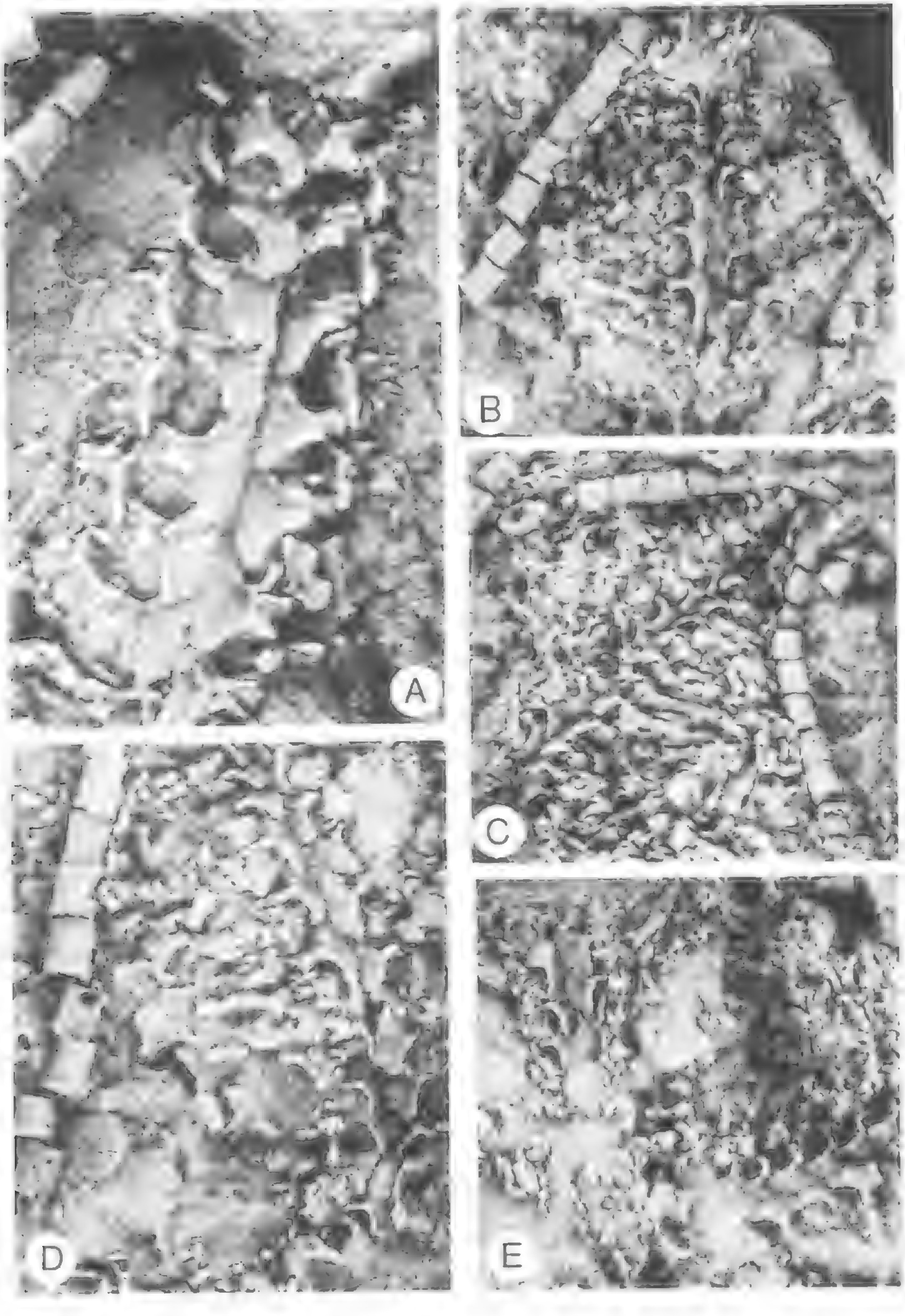


FIG. 40. *Archegonaster pentagonus* Spencer, Llanvirn of Osek, Czechoslovakia. Camera lucida drawings of ambulacral plates. A, oral face of three plates, arm tip towards bottom (slightly restored from NM L10149). B, aboral face of 3 plates, arm tip towards bottom (slightly restored from NM L10438). C, abradial face of one plate arm tip towards right (from NM L10464). D, aboral face of 5 plates towards the arm tip, arm tip towards the left (based on NM L35050). Scale bar = 1 mm.

FIG. 39. *Archegonaster pentagonus* Spencer, Llanvirn of Osek, Czechoslovakia. A-C, NM L10434. A, detail of ambulacral and adambulacral plates in oral view, x3.5. B, general view, x2. C, madreporite plate, x5. D, NM L10435, ambulacra with adambulacrals, x4. E,F, NM L10143, x2. E, oral. F, aboral (note interradial plating). G, NM L25454, lateral view of ambulacrals, aboral surface uppermost, with adambulacra and interradial plating, x3. Latex casts whitened with ammonium chloride sublimate.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view (Fig. 47A$_1$) has part of a podial basin distally and a thickened semi-cylindrical bar proximally. This proximal bar is smooth and uniformly convex. No spines were seen attaching to this proximal edge, but the plate could only be studied where the proximal plates had been disrupted and presumably mouth spines may easily have been dislodged or lost.

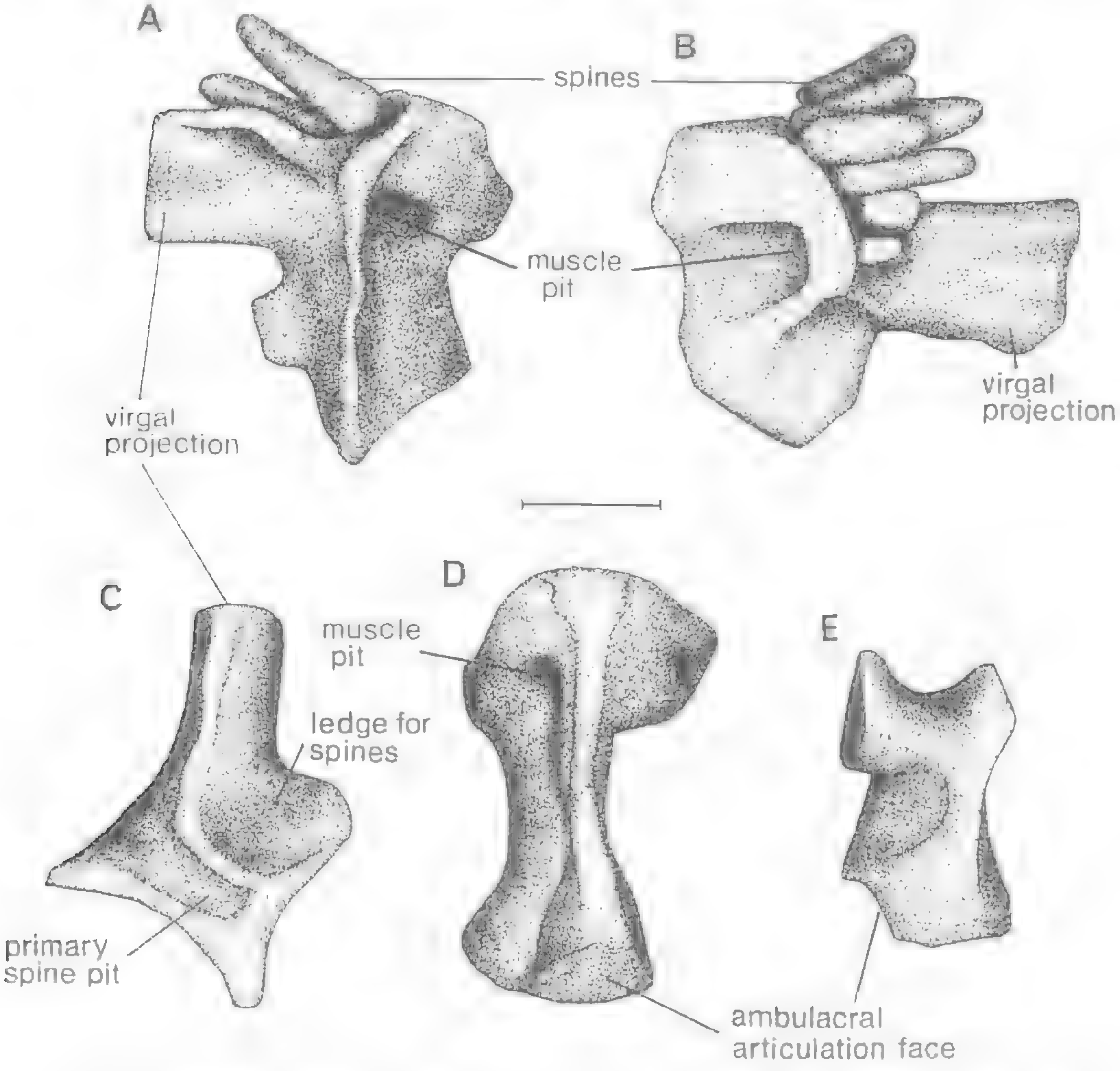


FIG. 42. *Archegonaster pentagonus* Spencer, Llanvirn of Osek, Czechoslovakia, camera lucida drawings of adambulacra. A, lateral view of proximal face (NM L10438). B, lateral view of distal face (NM L10434). C outer (oral) face (NM L10435). D, adradial face (NM L10435). E, inner (aboral) face (NM L10150). Scale bar = 1 mm and all to same scale.

FIG. 41. *Archegonaster pentagonus* Spencer, Llanvirn of Osek, Czechoslovakia. A, NM L10438, aboral view of an ambulacrum with second ambulacral at the top. Note the adambulacrals seen in lateral view, x6. B, D, E, NM L10537. B, oral face of one arm, x3. D, same enlarged to show virgals and intervirgals, x5. E, adoral portions of two ambulacra in oral view, x3. C, NM 43/83, interradial plating in one arm, x3. Latex casts whitened with ammonium chloride sublimate.

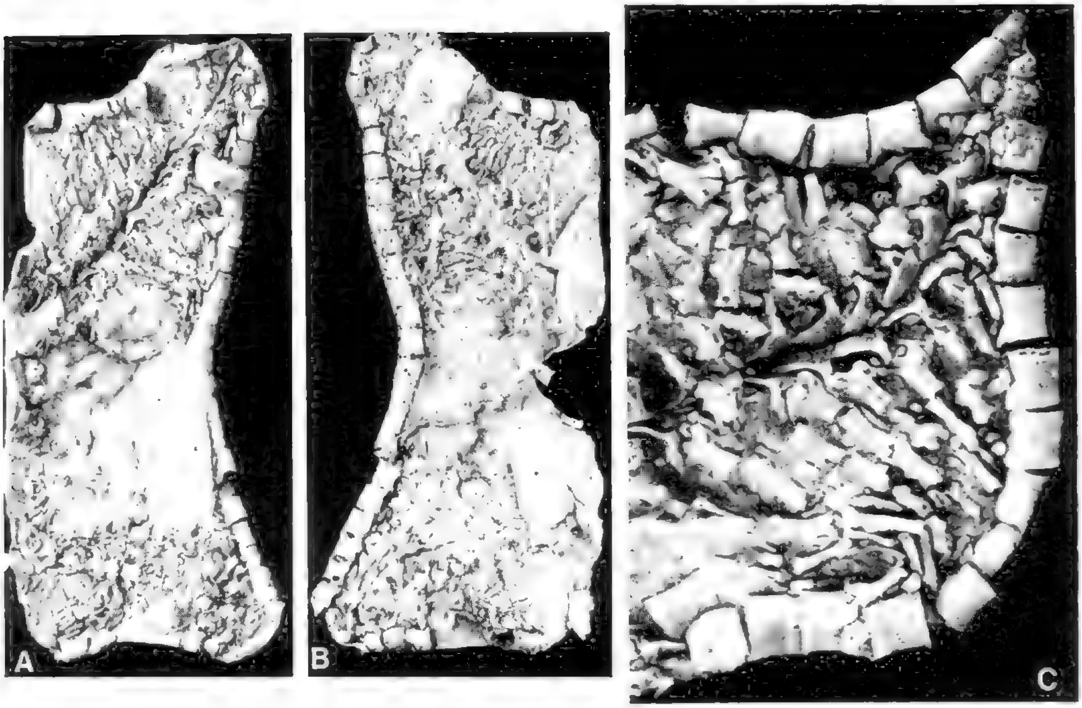


FIG. 43. *Archegonaster pentagonus* Spencer, Llanvirn of Osek, Czechoslovakia. A,B, NM 39/83, fully articulated specimen showing the interradial gap in plating, x2. A, oral surface. B, aboral surface. C, NM L10069, one arm showing ambulacrals, adjacent adambulacrals and complex interradial plating, x5.5. Latex casts whitened with ammonium chloride sublimate.

The second ambulacral plate is slightly pinched about one third of the distance from the proximal end (Fig. 47B, C). It carries two half podial basins on its perradial side separated by an oblique ridge. The smaller proximal basin faces laterally while the larger distal basin faces more adorally. The proximal half podial basin fits against the half podial basin on the distal end of the first ambulacral to create a completely enclosed basin. There is a broad distal tongue that imbricates with the third ambulacral plate. The interradial face is smooth and cylindrical. There is a small lateral arm plate that attaches to the transverse bar.

The third ambulacral plate resembles more distal ambulacral plates except that it has a much larger proximal end with a prominent raised rim abradially marking the limit of overlap of the second ambulacral plate (Fig. 47C, D).

Madreporite and stone canal. The madreporite is seen in a number of specimens (Figs 37A, 38B, 39B,C, 41D). It is a large button-shaped ossicle, circular in outline, situated in one of the interrays close to the mouth. Because the madreporite is not part of a tesselate surface and has often collapsed after death, Spencer (1951) was not sure whether it was aboral or oral in position. However, 11 specimens in which the madreporite can be seen show the central part of the disc with ambulacra undistorted and all five ambulacra facing the same direction. In all 11 specimens the madreporite lies with its outer surface facing aborally and so we conclude that the madreporite lay on the aboral surface. The outer face of the madreporite is ornamented with a series of branching grooves radiating from the centre (Fig. 48A). The inner face is more domed and is smooth (Fig. 48B). Towards the centre there is a scroll- shaped perforation which marks the site of attachment for the stone canal.

The stone canal is best seen in NM L10150 and L10438, but is present in other specimens also. It is a tube built up of a single series of stacked cylindrical ossicles. These ossicles are oval in outline and show a U-shaped outer calcitic sheath surrounding an anchor-shaped core (Fig.

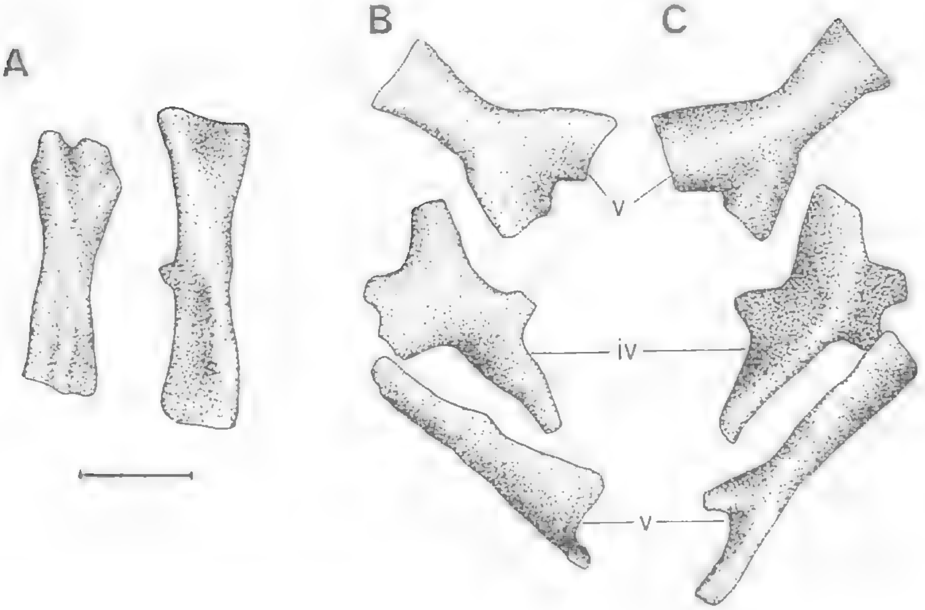


FIG. 44. *Archegonaster pentagonus* Spencer. Llanvirn of Osek, Czechoslovakia, camera lucida drawings of interradial elements; A, NM L10438, two first virgals. B, NM L10457, two first virgals (v) and an intervirgal (iv) in part and counterpart view. Scalebar = 1 mm:all to same scale.

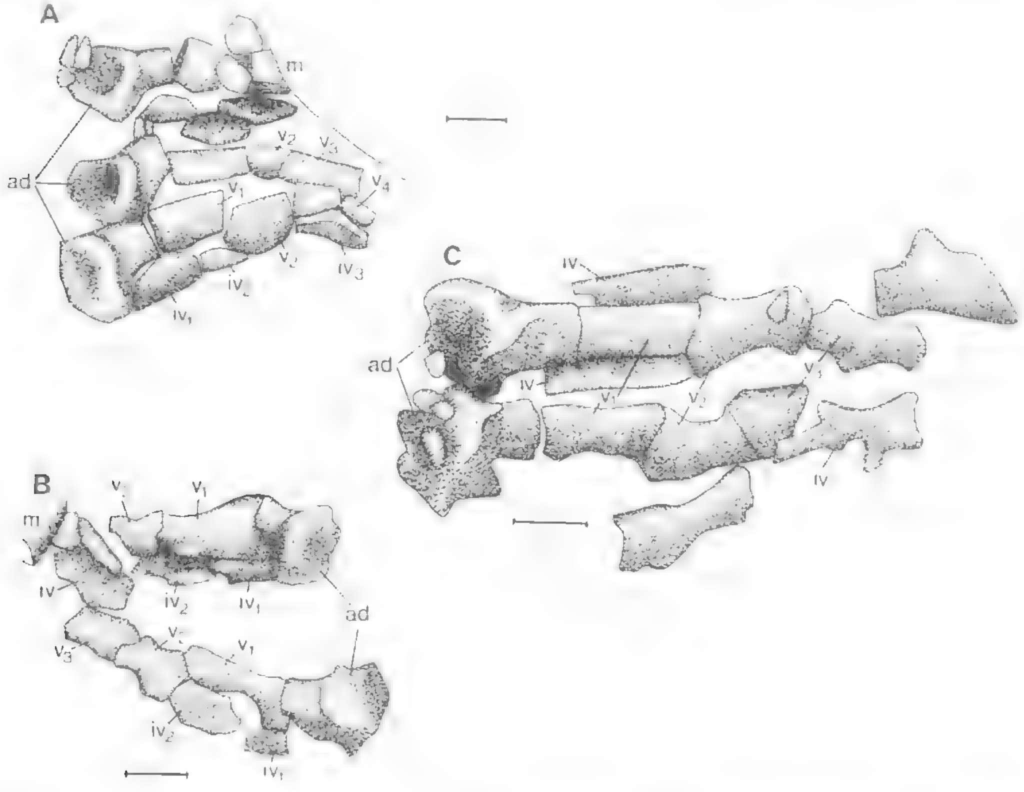


FIG. 45. *Archegonaster pentagonus* Spencer, Llanvirn of Osek, Czechoslovakia, camera lucida drawings of interradial plating. A, NM 43/83. B, NM L10446. C, NM L43183. ad = adambulacral plate. v_1, v_2, v_3, = first second and third virgal plates. iv = intervirgal plate. m = marginal. Scale bar = 1 mm.

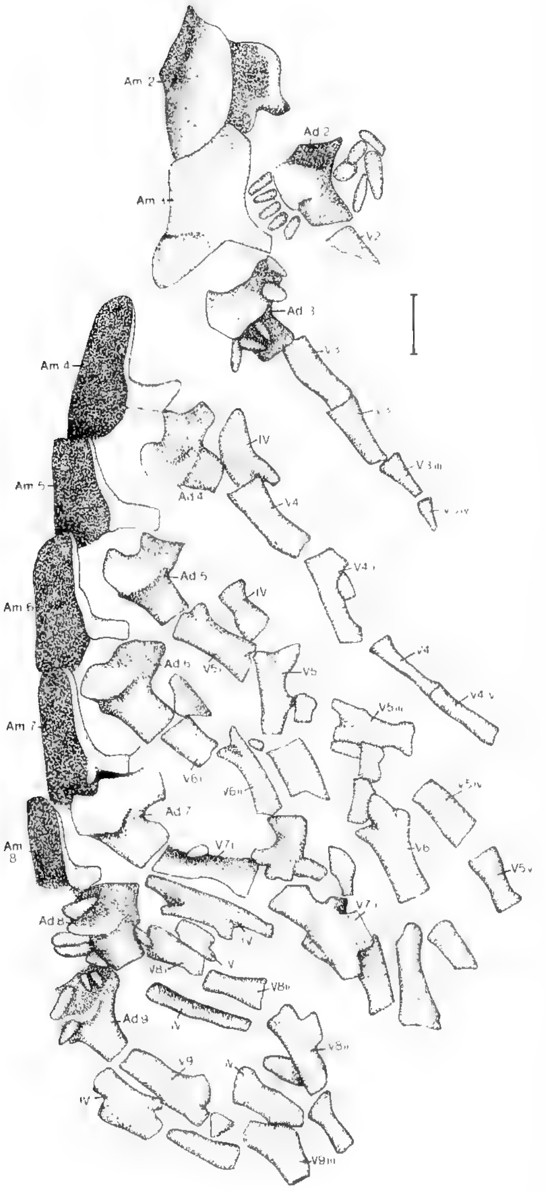


FIG. 46. *Archegonaster pentagonus* Spencer, NM L10450, Llanvirn of Osek, Czechoslovakia, camera lucida drawing of one half of an arm from the second ambulacral to the ninth showing relatively undisrupted interradial plate arrangement. am2-8 = ambulacrals 2 to 8. ad2-9 = adambulacrals 2 to 9. V2-9 = virgals forming row from adambulacrals 2 to 9 (successive virgals are labelled as i, ii, iii, iv, v). IV = intervirgal plates.

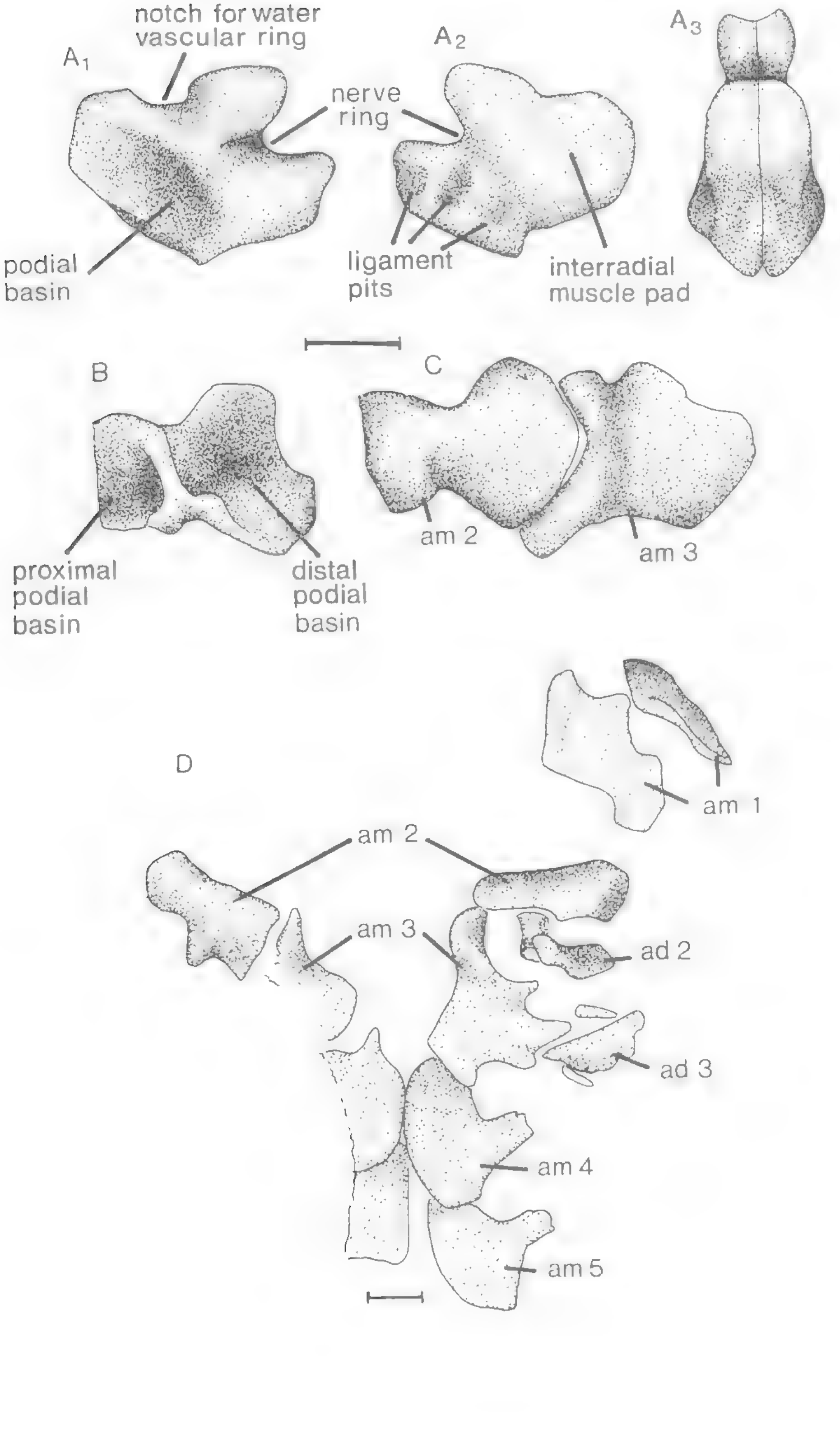
48C). A scroll-shaped cavity runs through each ossicle.

Marginals. The complete rim of stout marginal ossicles (Figs 37, 38) is formed by cylindrical ossicles that abut along smooth, slightly concave lateral faces (Fig. 50). Three specimens of disarticulated *Archegonaster* plates from a slightly higher horizon (D γ2 of Zbytky hvesdic, Šarka) have a crenulate rim to the lateral faces of marginal ossicles and may represent a separate species. The marginals are largest interradially and decrease in size towards the arm tips (Fig. 49A,D). They are slightly triangular in cross-section, with the two longer and slightly flatter faces being the external aboral and oral faces. These faces, in large ossicles, have a narrow smooth border and bear a distinct, but fine, pitted ornament (Figs 49A, 50). The inner face is more rounded and lacks the pitted ornamentation. There is a distinct ledge on the aboral face marking the boundary between inner and outer faces. Some ossicles are distinctly saddle-shaped. The inner face usually has small projecting facets that are rounded or vertically elongate (Figs 38E, 43C, 50). There is usually a single facet to each marginal ossicle, but occasional ossicles may bear two. The most interradial 5 or so ossicles lack facets (Fig. 49A). These facets are the attachment points for the interambulacral skeleton.

The 17-27 marginal ossicles from the interradius to the arm tip, indicate that there were some 170-270 marginal ossicles in the complete ring. The marginals diminish in size markedly towards the tips of the arms, where they become almost U-shaped in cross- section with a slightly concave inner face. In the outer part of the arm the marginals sheath the ambulacral groove (Figs 49B,C, 50D).

Aboral surface. Aboral plating is composed of small (c. 0.05 mm diameter) granular plates, closely packed together. In one specimen this tegmen coats the entire surface and is wrinkled, showing that it was flexible (Fig. 49C). It ends at the small ledge on the aboral face of marginal

FIG. 47. *Archegonaster pentagonus* Spencer, Llanvirn of Osek, Czechoslovakia, camera lucida drawings of proximal ambulacral plating. A, first ambulacral (= mouth angle plate). A_1, perradial face. A_2, interradial face. A_3, aboral face (two adjacent plates abutting, slightly restored) drawn from NM L10149 and L10150). B, second ambulacral plate in perradial view (NM L10476). C, second and third ambulacrals in interradial view (NM 41/83). D, proximal ambulacral plates in NM EH30, plating slightly disrupted. Scale bars = 1 mm.


A1
notch for water vascular ring
podial basin
A2
nerve ring
ligament pits
interradial muscle pad
A3
B
proximal podial basin
distal podial basin
C
am 2
am 3
D
am 1
am 2
am 3
ad 2
ad 3
am 4
am 5

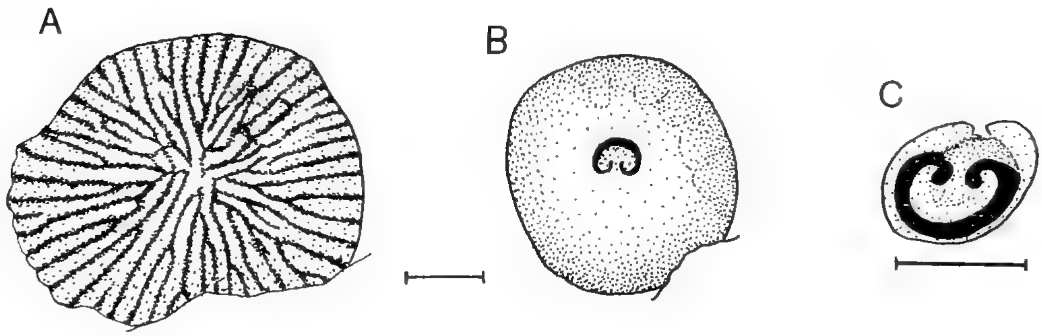


FIG. 48. *Archegonaster pentagonus* Spencer, Llanvirn of Osek, Czechoslovakia, camera lucida drawings. A, exterior of madreporite plate (NM L10434). B, interior of madreporite plate: note the scroll-shaped perforation (NM L10444). C, end view of a single barrel-shaped ossicle of the stone canal (NM L10438). Scale bar = 1 mm.

ossicles marking the boundary between the pitted ornament of the external surface and the smooth internal surface.

REMARKS

Archegonaster was described by Spencer (1951) but, because all the material was preserved as moulds and high quality latex casts were unavailable to Spencer, the description is inadequate in many respects. Spencer, for example, believed that the virgals formed a single series and that they were developed only towards the arm tips.

Archegonaster is considerably derived in comparison to any known Cambrian echinoderm and shows several characteristics that link it to ophiuroids and asteroids in particular. There is a madreporite and stone canal. The aboral position of this madreporite suggests that *Archegonaster* lived with its mouth facing the substratum, since the madreporite would need to be clear of sediment to function efficiently. It also has adambulacrals that articulate onto transverse bars from the ambulacrals and which carry spines. The most proximal ambulacral plates are modified into a jaw and the ambulacral tips extend outwards as arms, though still bound within the marginal frame.

However, it remains relatively primitive in comparison to ophiuroids. The radial water vessel is not enclosed and the ambulacral plates, at least proximally, are strongly imbricate. The adambulacrals attach directly to the marginals or via a series of interradial plates and the oral surface is bounded by a well-developed marginal frame. Spencer (1951) believed that *Archegonaster* was the most derived of his somasteroids (largely because it was slightly younger than *Villebrunaster* and *Chinianaster*), but both *Villebrunaster* and *Chinianaster* have enclosed radial water vessels and reduced marginal ossicles and are thus morphologically closer to ophiuroids than *Archegonaster*. The plate arrangement towards the tips of the arms of *Archegonaster* resembles that of asteroids, with the adambulacrals attaching directly on to the marginals, both marginals and adambulacrals being stout, block-like ossicles.

The imbricate ambulacrals are peculiar; no Cambrian edrioasteroid has such strongly imbricate plating, although limited imbrication is present in all. Nor do any of the Ordovician asteroids or ophiuroids have a comparable arrangement. However, the ambulacral plates towards the arm tip in *Archegonaster* strongly resemble ambulacral plates in Cambrian edrioasteroids such as *Cambraster walcotti* (Smith, 1986, text-fig.7). Imbrication is best developed towards the mouth and is least developed towards the arm tips, thus allowing greatest flexibility of shape towards the centre of the disc. This may be associated with the adoption of a macrophagous diet.

Mouth frame plating. The structure of the ambulacra closest to the mouth is particularly revealing when considering the origins and homologies of the ophiuroid jaw. However, conflicting nomenclature and concepts of homology are to be found in the literature and it seems

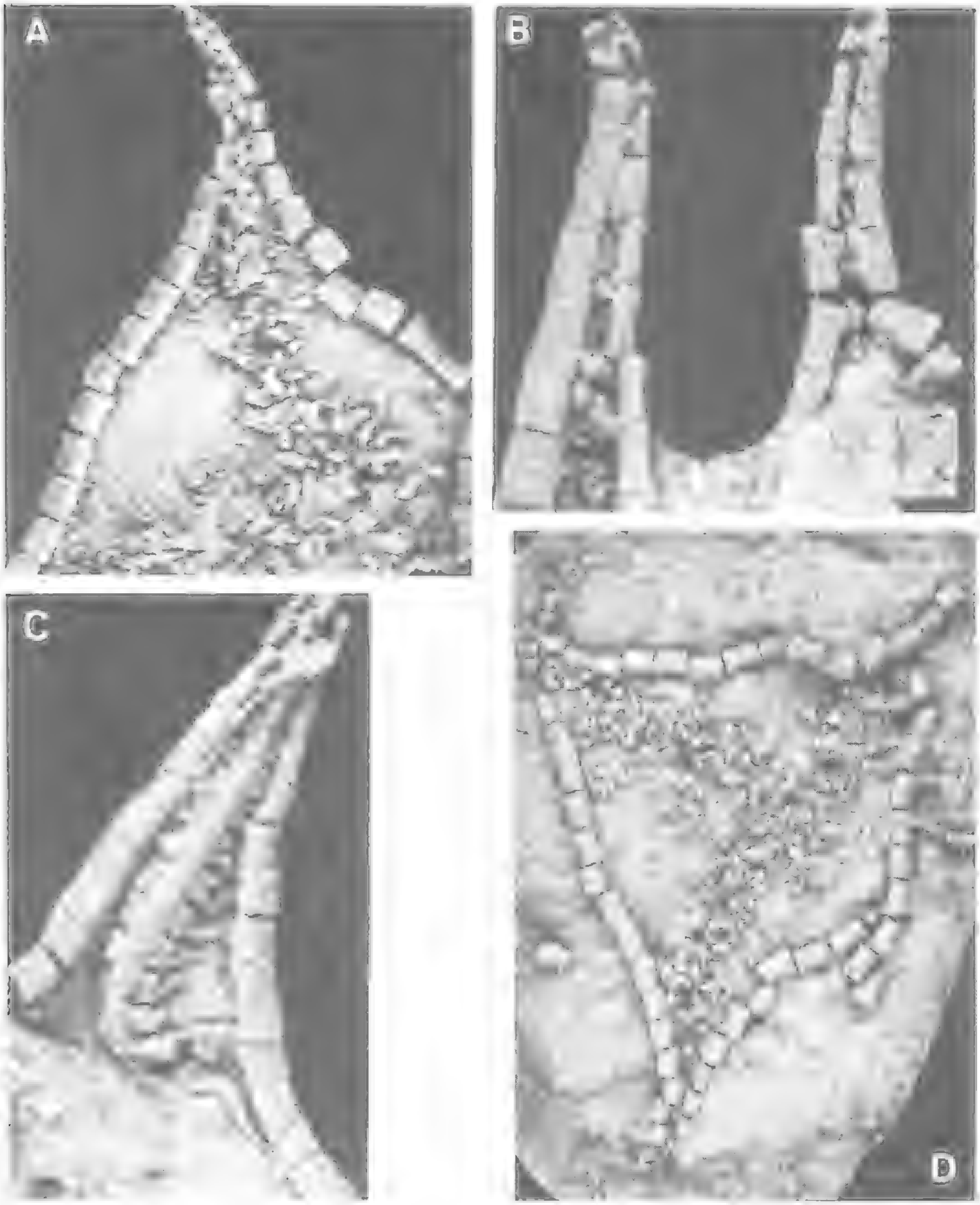


FIG. 49. *Archegonaster pentagonus* Spencer, Llanvirn of Osek, Czechoslovakia. A, NM L25172, one arm in aboral aspect, x3. B, NM L10462, two arms towards their tips in oral aspect, x8. C, NM L35050, one arm in aboral aspect, x5: note the aboral integument of granules which is wrinkled towards the base of the arm. D, unnumbered specimen in the Narodní Museum showing the tapering arms; note that the disc is folded over upon itself, x2.5.

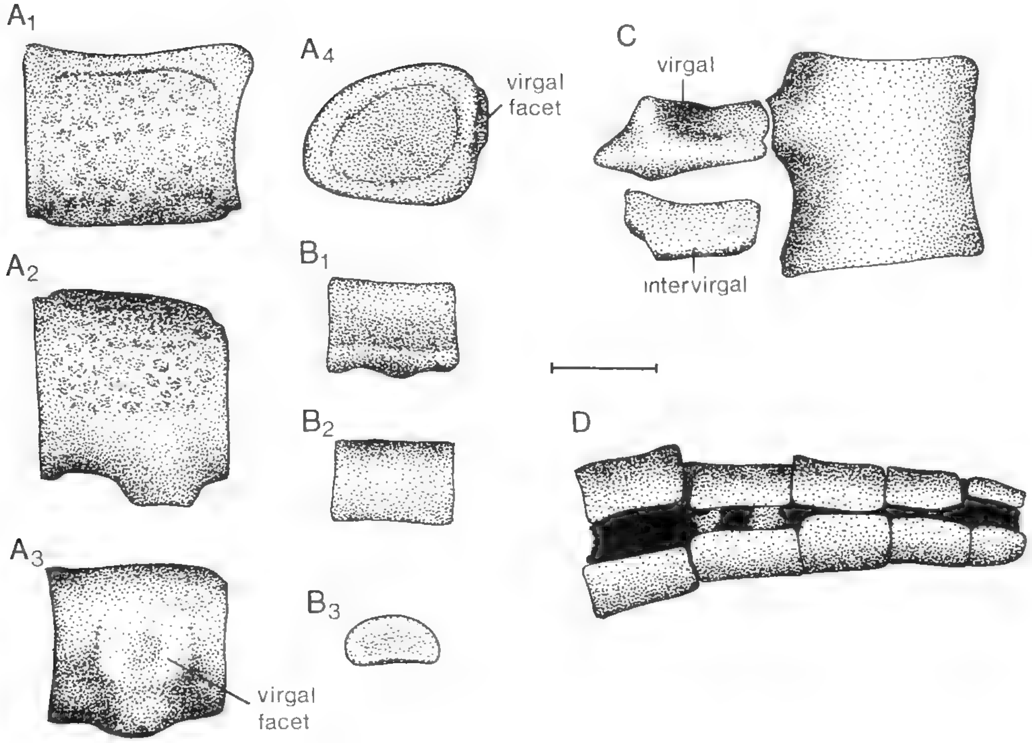


FIG. 50. *Archegonaster pentagonus* Spencer, Llanvirn of Osek, Czechoslovakia, camera lucida drawings of marginal ossicles. A_{1-4}, Aboral, oral, internal and lateral aspects of a large marginal of the central part of the disc (drawn from NM L10150, L13228 and L10438). B_{1-3}, internal, external and lateral aspects of a marginal towards the arm tips (drawn from NM L10462). C, marginal with virgal attached (NM L13228). D, distal tip of an arm in oral aspect showing how the marginals protect the ambulacral groove (NM L10462). Scale bar = 1 mm.

advisable to correct this in the interests of uniformity for future descriptions.

Spencer (1914, p. 29; 1925, p. 263) believed that the most proximal set of 10 plates in the ophiuroid mouth frame were interradial in origin and therefore modified interambulacral plates rather than ambulacral plates. These most proximal elements he named 'mouth angle plates'. In his scheme the second plates of the ophiuroid jaw, distal to each mouth angle plate were the first of the ambulacral plates and, accordingly, he termed these plates 'ambulacral 1'. This nomenclature has been followed by many subsequent authors and was reinforced in the *Treatise* by Spencer & Wright (1966), despite their acknowledgement (Spencer & Wright 1966, pp. 13,14,29) that the mouth angle plate is part of the ambulacral series. Fell (1963) affirmed the ambulacral origin of the mouth angle plates and Bjork *et al.* (1968) went so far as to denote the plate behind the mouth angle plate (which Spencer (1925) and Spencer & Wright (1966) referred to as ambulacral 1) as ambulacral 2. However, Kesling & Vasseur (1971, fig. 8) reverted to Spencer's terminology, and the *Treatise* terminology (Spencer & Wright, 1966) has become standard over the last 20 years.

Such terminology contradicts the origins and homology of the mouth plates and ought to be abandoned. We therefore advocate, and henceforth use, the following set of terms: the most proximal plate of each ambulacral column, situated interradially will be the 'first ambulacral' or 'mouth angle plate'; the succeeding plate is the 'second ambulacral' and subsequent ambulacral plates are denoted accordingly as ambulacrals 3, 4, etc.

The first ambulacral bears the anterior half of a podial basin in *Archegonaster* (Fig. 47) and a slight depression from the aboral water vascular ring canal marks the position of the lateral branch leading to this podial basin. We interpret this groove as the site of a branch of the water vascular system leading to the first tube foot in that podial basin. The position of this branch leaves it vulnerable to damage from larger particles that were ingested. Evolution led to enclosure of that branch of the water vascular system, giving greater protection, and this condition is found in most subsequent ophiuroids. Similar enclosure of a canal in the second ambulacral would lead to the arrangement that is found in *Lapworthura miltoni* (Salter), for example (Spencer, 1925, fig. 191). Likewise in each arm segment the passage connecting each podial basin with the radial water vessel, which in *Archegonaster* appears as a notch, is ultimately enclosed within the ambulacral plate. In *Lapworthura* the opening of the canal leading from the water vascular canal to the first podial basin has shifted onto the second ambulacral and thus pierces through two plates. As the first and second ambulacrals are closely fixed together, passage of this canal from one plate into the other would pose little problem. The situation in post-Palaeozoic ophiuroids and in Palaeozoic euryalinids is for there to be a single aboral pore in ambulacral two which divides internally to feed both the first and second podial basins. This is a derived condition and cannot be used to argue that the second ambulacral plate is a compound plate, as has been done by Bjork *et al.* (1968). The general one to one correspondence of podial basins to ambulacrals and adambulacrals to ambulacrals in early forms such as *Archegonaster*, *Eophiura* (pers. obs.; Spencer & Wright, 1966, fig. 70-1), and *Praedesura* (pers. obs.; Spencer & Wright, 1966, fig. 23-3) among others, gives us confidence that no ambulacrals are compound plates. Only one element has not been identified in these early forms and that is the adambulacral element of the first ambulacral. We believe that the torus that abuts the proximal end of ambulacral 1 represents the modified adambulacral 1. On this interpretation the spines on the torus would be the modified lateral spines of the adambulacral. It is not difficult to envisage the most proximal adambulacrals in primitive members becoming modified for food manipulation in the same way that the proximal tube feet became modified into buccal tentacles. Although most ophiuroids have 5 torus plates, one for each pair of interradially joined first ambulacrals, several do have 10 plates, one for each first ambulacral (e.g. Spencer, 1925, fig. 188C). Although the situation in *Archegonaster* remains unclear, we believe that the primitive condition is for there to be ten torus plates bearing mouth spines.

Structural and functional specialization of the more proximal elements around the mouth were undoubtedly associated with the change from suspension to deposit feeding. In suspension feeding a fixed mouth frame gives strength and rigidity, but for deposit feeding flexibility of the mouth is essential. The proximal ambulacrals thus became very different in appearance to more distal arm plates. Significantly the homologies that we propose allow for the development of the ophiuroid jaw from the simple ambulacral and adambulacral series through only a few steps, each relating to specific functional needs. We do not need to invoke the loss or gain of any plate, nor any compounding of plates. Furthermore it gains support from the most recent embryological work of Hendler (1978) who has also argued for the ambulacral origin of the mouth angle plates in living ophiuroids.

The most proximal elements (ambulacra 1) are highly modified in shape and carry a groove for the circum-oesophageal ring nerve and water vascular ring. Their general shape and soft tissue associations leave no doubt that they are homologous to the mouth angle plates of ophiuroids. In *Archegonaster* these plates are in direct continuity with other ambulacrals and carry a partial podial basin towards the posterior which is shared with the next ambulacral plate. Spencer (1925) thought that the first plates in the ophiuroid jaw were modified adambulacrals, since the first podial basin is found on the second of the jaw plates and the adambulacrals are in direct alignment with the first jaw plates (mouth angle plates). That the mouth angle plates cannot be modified adambulacrals of the so-called 'first ambulacrals' is further reinforced by the fact that these plates bear a small adambulacral in *Archegonaster* discrete from the mouth angle plates.

Mouth angle plates of *Archegonaster* are similar to those of primitive ophiuroids such as *Eophiura* in lying in the same plane as the rest of the ambulacrals. In later ophiuroids the second ambulacral plates are highly modified and project aborally over the third ambulacrals. However, the basic pattern of having the first ambulacral plates interradial in position and the second ambulacral plates set oblique to both the proximal elements and the rest of the ambulacra, is common to both *Archegonaster* and all ophiuroids.

The connection between *Archegonaster* and asteroids is less clear-cut. Unquestionable Ordovician asteroids (viz. *Platanaster*) differ from *Archegonaster* in having block-like ambulacrals that firmly abut, but have a comparable arrangement of plates around the mouth. As noted above, the ossicles become much more block-like distally along the arms in *Archegonaster* and the radial water vessel is not enclosed, as in all asteroids. The marginal ossicles are probably directly homologous with the marginals or submarginals of Ordovician asteroids, and forms such as *Petraster* have prominent block-like marginals framing the oral face.

Antecedents of *Archegonaster* are still unclear. Although *Archegonaster* is morphologically primitive in comparison to asteroids and ophiuroids considerable differences remain between it and any known edrioasteroid. However, despite the limited evidence with which to trace the Cambrian antecedents of *Archegonaster*, we take the pragmatic view that, amongst known forms, every taxon has another that is its closest known relative. The stout marginal ring framing the body and the projection of ambulacral tips onto the marginal ring of *Archegonaster* are suggestive of either *Cambraster* or *Edriodiscus*. However, both of these genera have a peripheral skirt of platelets and an oral periproct, neither of which is found in *Archegonaster*. The mouth plating in *Archegonaster* was flexible and presumably under muscular control, whereas *Cambraster* has a fixed mouth frame of 5 large interradial elements that represent fused first ambulacral plates from adjacent ambulacra. The mouth frame of *Edriodiscus* is unknown, but externally resembles that of *Stromatocystites* which consists of the 10 most proximal ambulacral plates (Smith, 1986). Since we do not believe that the flexible mouth plating of *Archegonaster*, comprising the most proximal 10 ambulacral ossicles, is likely to be derived from a form in which proximal ambulacrals have become fused and modified into 5 large interradial elements, a Cambrian edrioasteroid with unfused proximal ambulacrals seems the most plausible antecedent to *Archegonaster* and its descendents. Thus current evidence points to *Edriodiscus* as the closest known relative of *Archegonaster* amongst Cambrian echinoderms. We predict that further intermediates between edrioasteroids and *Archegonaster* will be found in the Middle and Late Cambrian.

GENERAL DISCUSSION

PHYLOGENY

There are five principal echinoderm groups in the Ordovician whose ancestry lies in the Cambrian edrioasteroids, namely edrioasterids, isorophids, rhenopyrgids plus cyathocystids, edrioblastoids and *Archegonaster* and its derivatives (including both asteroids and ophiuroids). Smith (1986) presented a cladistic analysis of a number of these groups but specifically excluded *Archegonaster* and its relatives, which had not at that point been studied. In this paper we have accumulated more evidence about the morphology of primitive edrioasteroids and added a number of new taxa, as well as documenting the morphology of *Archegonaster*. It is therefore appropriate to reanalyse edrioasteroid relationships in the light of this new information.

A data matrix was assembled (Fig. 51; Table 1) based on as much morphological information as is currently available. This was then subjected to a computer parsimony analysis using Hennig86 (Farris, 1988). All characters were treated as unordered and *Camptostroma* was used to root the tree. A total of 108 equally parsimonious trees were found of length 32 and consistency index 62 (Fig. 51).

Stratigraphical occurrence data for relevant early Palaeozoic eleutherozoan taxa (Fig. 52) include all Cambrian edrioasteroids and the earliest occurrences of all major post-Cambrian eleutherozoan lineages. By combining the cladistic analysis with stratigraphical data we arrive at the best corroborated evolutionary tree (Fig. 53).

The origins of edrioasteroids may be traced back to the recently described late pre-Cambrian *Arkarua* (Gehling, 1988) from the Pound Subgroup (Rawnsley Quartzite) of South Australia. *Arkarua* is still poorly known, and we do not even know whether it had a blind gut or an anus. However, it shows more resemblance to Cambrian edrioasteroids than to any known ediacaran species and we tentatively accept it as an early echinoderm and the oldest known pentaradiate species. The Cambrian fauna is better known and Paul & Smith (1984) suggested that *Camptostroma* represented an intermediate stage bridging the morphological gap between pelmatozoans such as *Kinzercystis* and eleutherozoans such as *Stromatocystites*. Pelmatozoans and eleutherozoans were already differentiated by the late Lower Cambrian.

Our cladistic analysis suggests that *Stromatocystites* represents a generalised eleutherozoan and that the origins of later eleutherozoan groups can be traced back to it. There are several species currently included in the genus which is probably paraphyletic. We recognise two distinct lineages originating within *Stromatocystites*. From *S. pentangularis* one lineage gave rise to *Totiglobus*. *Totiglobus* has internal struts on aboral plates that Bell & Sprinkle (1978) interpreted as an attachment device. Such struts are also found in *Stromatocystites pentangularis* and *S. reduncus*, where they are better developed. Two important differences distinguish *Totiglobus* from *Stromatocystites*, the structure of the oral frame and the enlargement of the oral surface relative to the aboral surface. Whereas *Stromatocystites* has an oral frame formed from the 10 most proximal ambulacral ossicles *Totiglobus* and its relatives have an oral frame of 5 large interradial elements. This character is also seen in the Late Cambrian edrioblastoid *Cambroblastus* as well as in the Ordovician and younger Cyathocystida (i.e. Cyathocystidae and Rhenopyrgidae). The late Middle Cambrian *'Totiglobus' lloydi* Sprinkle (1985) has a similarly shaped theca but the aboral portion of the theca appears in side view and, although broken off, could be interpreted as forming a short peduncle of sub-tesselate plates. In the slightly younger *Cambroblastus* the aboral surface has been greatly expanded into a polyplated stalk and this lineage continued into the Ordovician to give rise to the edrioblastoid *Astrocystites*. *Cambroblastus* is essentially the body of *Totiglobus* raised on a stalk.

Because cyathocystids have an elongate, stalk-like aboral surface and because they have reduced their flooring plates to a single large deltoid lying interradially (Bockelie & Paul, 1983), we believe that they represent a sister group to *Cambroblastus* and later edrioblastoids. Rhenopyrgids probably have a similar reduction in ambulacral flooring plates, to judge from external plating, but the precise arrangement has never been described. They differ from cyathocystids in having a polyplated, imbricate aboral surface rather than a single massive turret that is a single calcite crystal. We therefore agree with Bell (1980) and Bockelie & Paul (1983) in suggesting that cyathocystids represent a distinct line of descent from isorophids and edrioasterids, and are more closely related to edrioblastoids. However, we also include rhenopyrgids within this group because of their aboral stalk pending confirmation of their ambulacral flooring plate arrangement.

Another group with an aboral attachment disc and with an expanded oral surface relative to the aboral surface includes *Walcottidiscus* and its descendents the edrioasterids. These we believe represent a separate line of descent from a *Totiglobus*-like ancestor. In this lineage the aboral surface became uncalcified. The origin of isorophids remains problematic, but *Hadrodiscus* may represent an intermediate morphology between edrioasterid-like forms and later isorophids. *Hadrodiscus* still retains large deltoid-like oral frame plates that lie interradially and may have had biserial flooring plates, although in external appearance it has a peripheral rim and the flattened streamlined appearance of an isorophid. The peripheral rim plates in isorophids appear not to be homologous with the peripheral ring in forms such as *Edriodiscus*, to judge from the cladistic analysis. They certainly appear rather different; in *Edriodiscus* the marginals are stout, barrel-shaped ossicles that abut, whereas in isorophids the marginals are thin imbricate plates that overlap. However, there remains the possibility that isorophids were derived from a more disc-like form such as *Cambraster*.

Stromatocystites walcotti, from the Lower Cambrian, appears different from other *Stromatocystites* spp. in being flat and disc-like, with slightly differentiated marginal ossicles. This disc-like form and rather flat, simple ambulacral ossicles are also seen in the early Middle Cambrian *Edriodiscus*. As argued above, we believe that *Edriodiscus* is the sister group to *Archegonaster* and thus a possible precursor to the major post-Cambrian eleutherozoan groups of asteroids and ophiuroids.

The position of *Cambraster* is problematic because it shows a mixture of characteristics. On the one hand it has an oral frame composed of 5 large interradially positioned flooring plates (Smith, 1986) which link it to the *Totiglobus* group. On the other hand it has a virtually identical peripheral ring and body form to *Edriodis-*

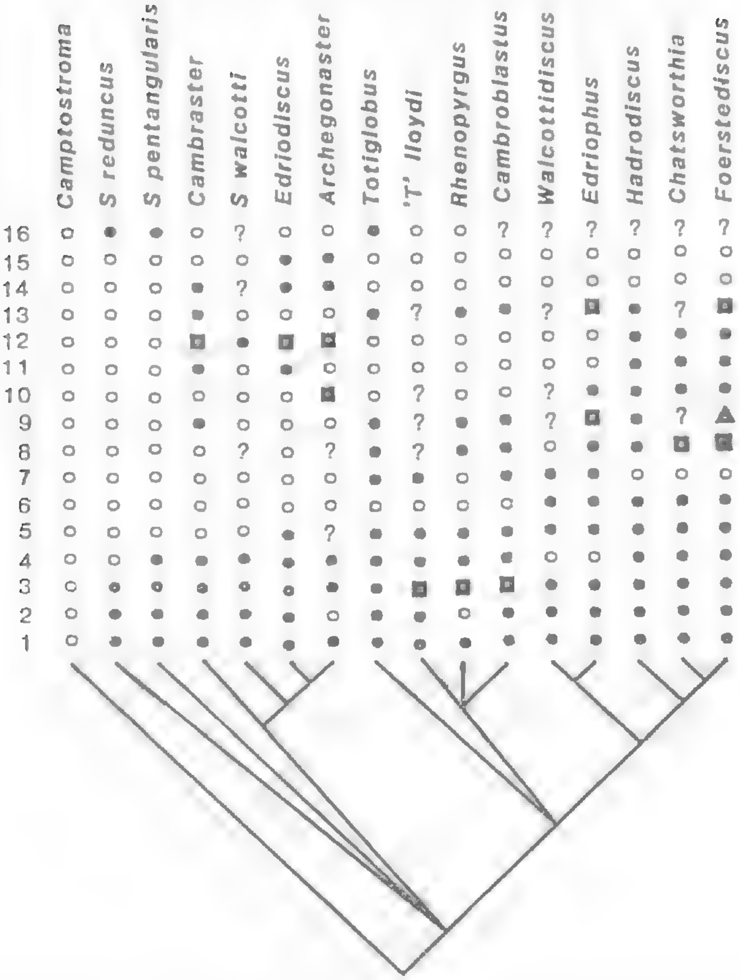


FIG. 51. Character matrix and cladogram for Cambrian edrioasteroids and related taxa. Characters 1-16 are listed in Table 1. symbols are as follows:- open circles = plesiomorphic state. solid symbols = derived state (circles, squares and triangles indicate different character states). ? = character state unknown.

cus. For the moment we have accepted its placement as shown in the cladogram (Fig. 51), pending further information.

ECOLOGICAL DIVERSIFICATION

Having examined the phylogenetic relationships of the major edrioasteroid groups we can now consider the palaeobiological significance of the various evolutionary changes that occurred. We trace edrioasteroids back to the Lower Cambrian *Camptostroma*, which lies close to the latest common ancestor of pelmatozoan and eleutherozoan echinoderms (Paul & Smith, 1984, Smith,1988b). *Camptostroma* has a broad, conical aboral surface that was contractile and it lived with its pointed base inserted into unconsolidated sediment. It was a sedentary suspension feeder using its curved ambulacra to collect food particles which were then passed to the mouth along the food grooves.

Most later groups specialised for attachment to firm or hard substrata and were thus able to colonize higher energy environments and presumably gained access to a richer food source. The evolution of attachment in edrioasteroids is thus seen as a direct adaptation for resisting dislodgement in currents. The earliest forms (*Stromatocystites*) retained a fully plated aboral surface which was modified into an attachment pad. They were certainly not permanently attached to a substratum but probably used their aboral surface to adhere to firm sedimentary bottoms. No *Stromatocystites* is known to be attached to any form of hard substratum, such as a shell and they appear to have been low level suspension feeders living in

	Primitive	Derived
1.	Thecal plating multilayered Thecal plating	1 layer only
2.	Imbricate aboral plating	Aboral plating a tesselate pavement
3.	Conical base	(◉) flat (■) aboral stalk
4.	Ambulacra curved	Ambulacra straight
5.	Epispires present	Epispires lost
6.	Aboral surface fully plated	Aboral surface partially or completely uncalcified
7.	Oral surface weakly domed	Oral surface strongly inflated
8.	Cover plates a multiplated skirt	(◉) Cover plates of large primaries plus small secondaries (■) Cover plates large, with intrathecal portion
9.	Mouth frame of 10 ambulacral plates	Mouth frame of (◉) five fused interradially positioned elements (■) five radial elements that are not flooring plates. (▲)five uniserial flooring plates
10.	Anal opening a cone of lath-shaped plates	(◉)Anal opening a periproct of small platelets (■)anal opening aboral or lost
11.	No peripheral rim of plates	Peripheral rim plates
12.	Marginals absent	(●) marginal ring of large imbricate plates (■) marginal ring of stout block-like ossicles
13.	Flooring plates of *S. pentangularis* type	Flooring plates of (◉) *S. walcotti* type (■) isorophid type.
14.	Ambulacra restricted to oral surface	Ambulacra extend through marginal rim
15.	Marginals	Marginals intergral part of both oral and aboral surfaces.
16.	No internal ribbing on aboral surface	Internal ribbing developed

TABLE 1. Characters used in the phylogenetic analysis of early Palaeozoic eleutherozoans (autapomorphies ommitted).

moderately protected environments. Edrioasterids, from *Walcottidiscus* onwards, continued in this mode of life but became uncalcified over the central part of their aboral surface, presumably to improve adhesion.

From this basic attachment style there developed 4 specialised offshoots. Firstly, *Totiglobus* evolved towards becoming a higher level suspension feeder by reducing its aboral attachment pad and expanding its oral, food-gathering area into a globular surface. Attachment remained identical to that in *Stromatocystites* and we do not believe that *Totiglobus* was capable of resisting strong currents. Secondly, isorophids became much more streamlined in profile, with a well-developed peripheral rim of plates to strengthen the theca. Isorophids have completely uncalcified aboral surfaces and are generally found attached to hardgrounds or shells. They thus lived limpet-like in areas of relatively strong current activity and were able to invade many shallow water habitats previously unavailable to edrioasteroids. Thirdly, cyathocystids evolved even more secure attachment by cementing themselves to hardgrounds. Their entire aboral surface became a single cal-

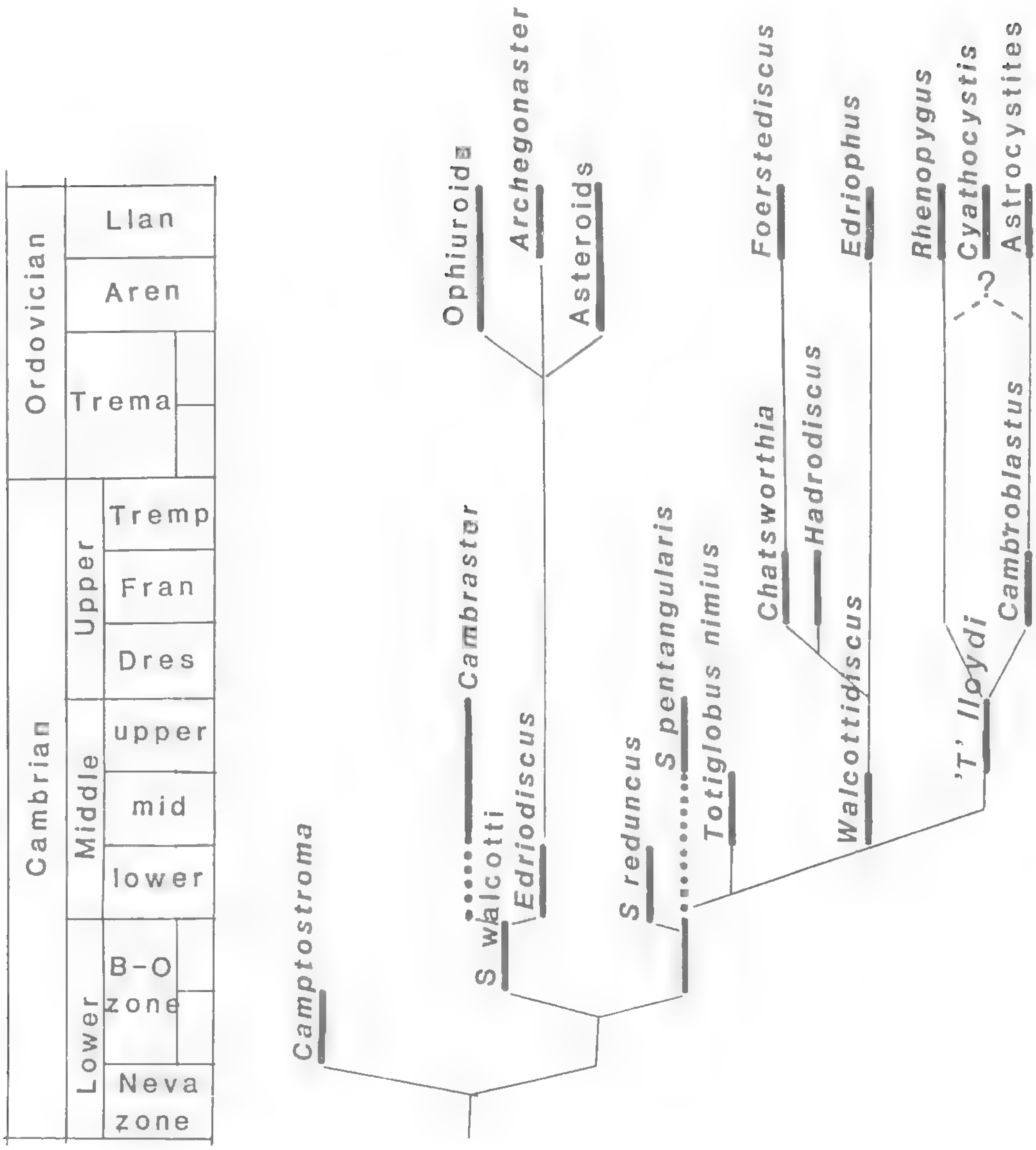


FIG. 52. Stratigraphical range chart for early Palaeozoic edrioasteroids and related taxa. Heavy lines = known stratigraphical range. thin lines show implied evolutionary relationships.

cite tube which was firmly attached to a hard substratum such as a shell. These forms must have been particularly well adapted for life in high energy regimes. Fourthly edrioblastoids also evolved an aboral attachment disc and fixed to hard substrata, though precisely how is still unknown. Their aboral surface became transformed into a stiff stalk which elevated the food gathering area well above the substratum and they represent the only edrioasteroids to become relatively high-level suspension feeders. Presumably they were adapted for habitats of intermediate current strengths.

Two edrioasteroid lineages departed from the attached mode of life to gain access to different habitats. Rhenopyrgids became infaunal suspen-

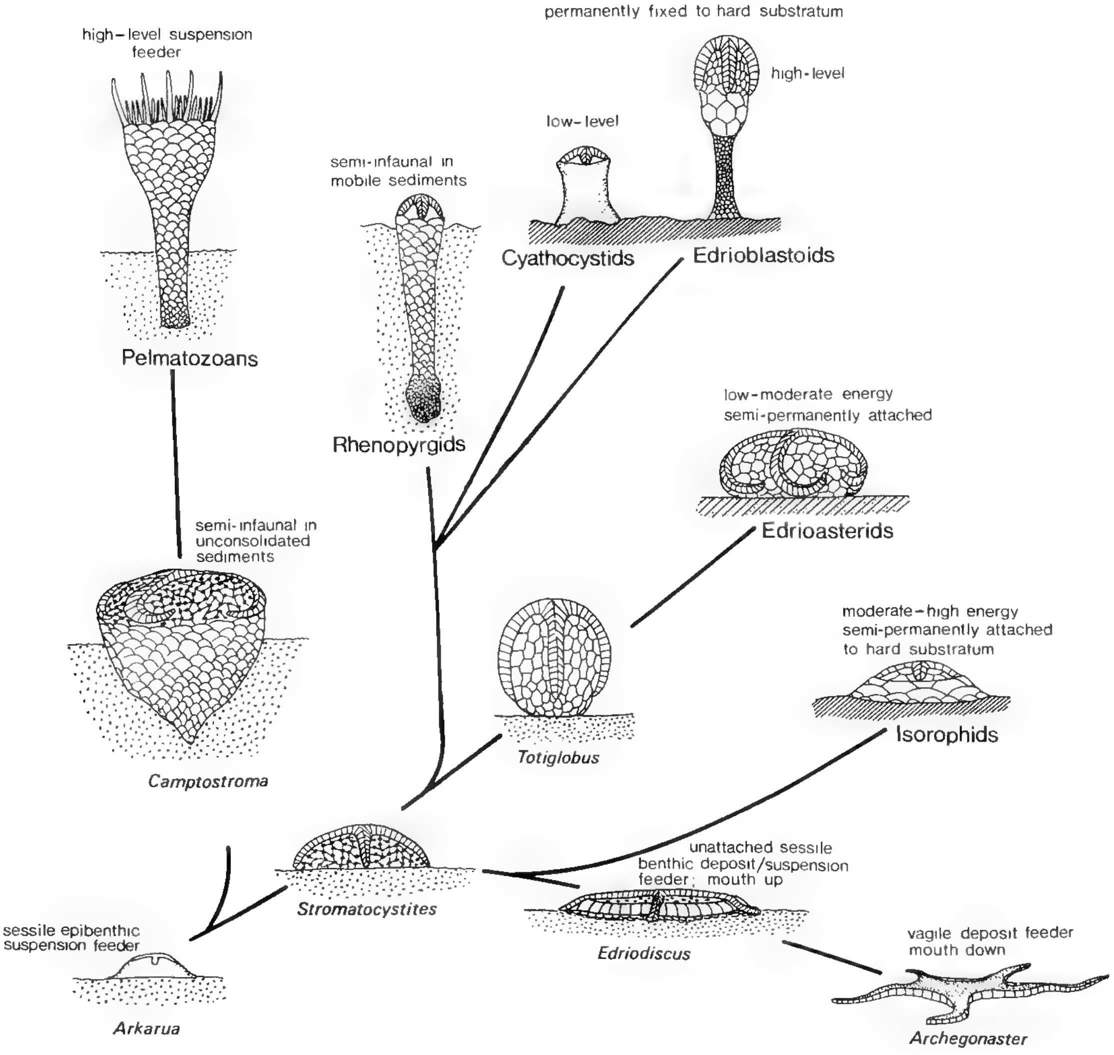


FIG. 53. Ecological diversification of early Palaeozoic eleutherozoans.

sion feeders in mobile, unconsolidated sediments. Their aboral surface is modified into a long, flexible and highly extensible peduncle which terminates in a basal sac. This peduncle we believe was inserted into the sediment so that rhenopyrgids were firmly anchored. The peduncle could then be used to retract the animal into its burrow, in an analogous way to the brachiopod *Lingula*, and was presumably adapted for life in more mobile sedimentary substrata.

The other lineage to depart from attachment includes the flattened disc-like forms *Cambraster* and *Edriodiscus*. Both either lost, or never evolved, an aboral attachment disc and have simple aboral plating instead. They presumably were low level suspension feeders in protected habitats where attachment was unnecessary. Both have a stout marginal frame to strengthen the body. This line we believe gave rise through inversion to the free-living forms such as *Archegonaster* which were deposit feeders living with their oral surface towards the substratum. From them evolved the asteroids and the opuroids.

THE CAMBRIAN DIVERSIFICATION

As noted in the introduction, there are two contrasting explanations as to why Upper Cambrian echinoderms are uncommon. One explanation is that evolutionary diversification occurred in two phases, the first in the Lower and Middle Cambrian and the second in the Ordovician (Sprinkle, 1980a, 1981; Campbell & Marshall,1987). The alternative explanation is that diversification was continuous throughout this period but that Upper Cambrian faunas were rarely preserved (Smith, 1988). The two models make very different predictions about the kinds of Upper Cambrian echinoderms that should be discovered. Under the two phase diversification model, Upper Cambrian echinoderms are numerically depauperate and were remnants of the Middle Cambrian fauna which survive through to the Early Ordovician, whereas, under the continuous diversification model Upper Cambrian echinoderms are expected to comprise intermediate taxa linking Middle Cambrian and Early Ordovician faunas.

Our collections from the Chatsworth Limestone, described here, represent the best Upper Cambrian echinoderm fauna so far reported. Although the number of Upper Cambrian species is small, they clearly bridge the gap between Middle Cambrian and Ordovician taxa. *Ridersia* is intermediate between *Gogia*-like eocrinoids and glyptocystitid rhombiferans, *Hadrodiscus* is intermediate between *Stromatocystites*-like edrioasteroids and lebetodiscid isorophids and *Cambroblastus* is intermediate between edrioasteroids and edrioblastoids. From this it would appear that echinoderms continued to diversify through the Upper Cambrian but have simply not yet been discovered, due to preservational failure. We predict that many more groups will be found to have an Upper Cambrian record when suitable fossiliferous horizons are discovered.

ACKNOWLEDGEMENTS

The research for this paper was made possible by a Royal Society Study Visit Grant to A.B. Smith; field work in western Queensland and laboratory preparation of specimens was funded by the Queensland Museum. Material was made available to us for study by R. Prokop (Narodní Museum, Prague) and D.J. Holloway (Museum of Victoria, Melbourne) for which we are grateful. Chris Paul (Liverpool University) reviewed an earlier draft and made many useful suggestions. We should like to thank the photographic studio of the BM(NH) for some of the photographs of *Archegonaster* and Gary Cranitch for assistance with the other photography.

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LIMNODYNASTES FITZINGER (ANURA: LEPTODACTYLIDAE) FROM THE CAINOZOIC OF QUEENSLAND

MICHAEL J. TYLER

Tyler, M.J. 1990 08 31: *Limnodynastes* Fitzinger (Anura: Leptodactylidae) from the Cainozoic of Queensland. *Memoirs of the Queensland Museum* **28**(2): 779-784. Brisbane. ISSN 0079-8835.

Seventy-six frog ilia representing the leptodactylid genus *Limnodynastes* are reported from the Tertiary of Riversleigh Station, Queensland. Four of these are *L.* sp. cf. *tasmaniensis* and the remainder *L. antecessor* sp. nov. Two ilia of *L. ornatus* (Gray) are reported from a Quaternary cave deposit at Riversleigh Station. ☐*Anura, Leptodactylidae, Limnodynastes, Cainozoic, Queensland.*

Michael J. Tyler, Department of Zoology, University of Adelaide, Box 498 GPO, Adelaide, South Australia 5001, Australia; 9 September, 1989.

The frog genus *Limnodynastes* Fitzinger is represented by 12 extant species (Frost, 1985). The geographic range of the genus extends throughout Australia but for the Nullarbor Plain and western Eyre Peninsula in South Australia. One species, *L. convexiusculus* (Macleay), reaches southern New Guinea (Zweifel, 1972).

The fossil record of *Limnodynastes* is principally from Quaternary sites, and includes four extant species (Tyler, 1989a). The Tertiary record is restricted to the holotype of *L. archeri* Tyler (1982) from the Etadunna Formation at Lake Palankarinna, north of Lake Eyre, South Australia. The phylogenetic affinities of *L. archeri* clearly lie with *L. ornatus* (Gray) and *L. spenceri* Parker: a pair of species that is so distinctive that recognition of a separate genus for them may be justified (Tyler, Martin and Davies, 1979; Roberts and Maxson, 1986). Given that the latest evidence suggests that *L. archeri* is from the Oligocene (Lindsay, 1987), it is clear that *Limnodynastes* (*sensu lato*) is an old lineage, and the fossil record assumes particular significance.

A large number of frogs has been recovered from Tertiary sites at Riversleigh Station in northwest Queensland. The first species to be reported there was *Lechriodus intergerivus* Tyler (1989b) and, to date, 315 (50%) of the ilia located represent that species. Numerically the second most dominant genus in the samples is *Limnodynastes*. Here I report the Tertiary taxa, and describe one as a new species. In addition I document the finding of *L. ornatus* at a Quaternary site there.

MATERIAL AND METHODS

The specimens reported here were obtained at the Vertebrate Palaeontology Laboratory at the University of New South Wales. They are now deposited in the collections of the Queensland Museum (QM), and the South Australian Museum (SAM). Letters preceding registration numbers are departmental identifications. Unassigned specimens retain the Vertebrate Palaeontology Laboratory reference numbers, which are prefixed AR.

The material consists of isolated and commonly fragmentary ilia. Their safe manipulation has been greatly simplified by the use of a Cosy M200 vacuum pump with an M202 probe which has a terminal compatible with Luer hypodermic syringe needles. The size of the ilia examined was such that 21 to 26 gauge needles were used. To buffer the contact between needle tip and specimen, a short sleeve of silicon rubber tubing was attached to the needle tip. The descriptive format of the material follows Tyler (1976, 1989b).

SYSTEMATICS

Family Leptodactylidae
Limnodynastes Fitzinger

The generic characteristics of the ilium have been defined by Tyler (1976), and exhibit variation according to the species group involved. Hence *L. ornatus* and *L. spenceri* exhibit a dis-

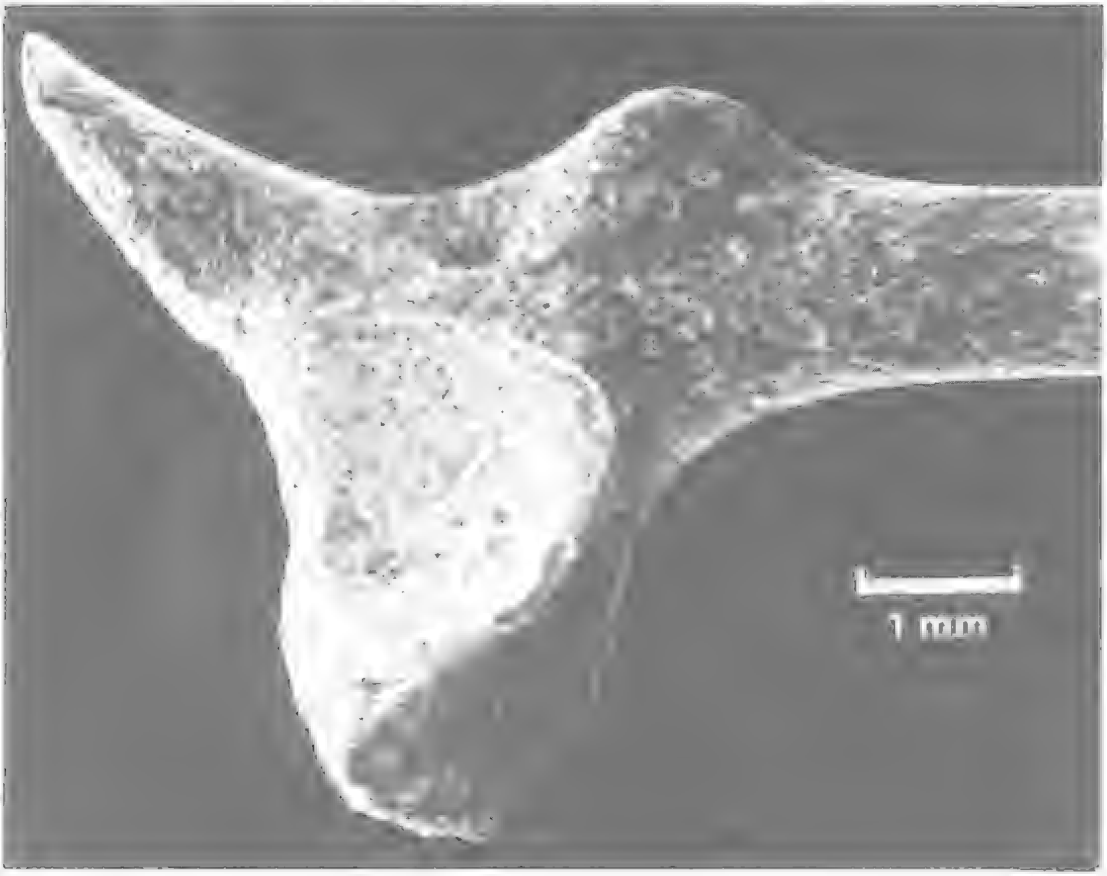

FIG. 1. S.E.M. of QM F17517: distal end of paratype of *Limnodynastes antecessor*.

tinct crest to the ilial shaft, the *L. dorsalis* group a groove upon the medial surface of the shaft, and *L. tasmaniensis* an anteriorly protruding, ventral acetabular expansion. The extension of the dorsal prominence and dorsal protuberance is equally variable. All species share an elongate and tapering dorsal acetabular expansion.

Limnodynastes antecessor sp. nov.[1]
(Fig. 1)

MATERIAL EXAMINED

HOLOTYPE: QM F17510. An almost entire right ilium collected at Gag Site, Riversleigh Station, Queensland.

PARATYPES: There are 18 paratypes: C.S. Site: SAM P29794, P30038, P30042, QM F17518; Gotham Site: SAM P29795; Upper Site: QM F17511-13, 17516-17; SAM P29797, P30050; Gag Site: QM F17514-15; Wayne's Wok Site: QM F17616-18; 17517 subject of S.E.M.).

DESCRIPTION OF HOLOTYPE

Ilial shaft slender, slightly curved, cylindrical and lacks medial groove and dorsal crest.

Acetabular fossa small, deep and with extremely prominent rim anteriorly. Dorsal margin of acetabular fossa situated slightly superior to inferior margin of ilial shaft.

Pre-acetabular zone largely vertical to ilial shaft and inferiorly merges insensibly into moderately developed ventral acetabular expansion.

Dorsal acetabular expansion extremely elongate, tapering to acute point and extending superiorly above ilial shaft.

Dorsal prominence extremely pronounced, rising high above the dorsal margin of ilial shaft. Dorsal prominence situated largely anterior to anterior rim of acetabular fossa, and exhibits localised, circular depression on level with superior margin of acetabular fossa. Dorsal protuberance poorly developed.

Length of ilium 11.0mm; DAE-VAE 5.9mm; acetabular fossa maximum diameter 2.4mm.

Variation

Almost all specimens are incomplete to varying degrees. The largest specimen is SAM P30038. It is complete and has a length of 21.5mm.

The extent of the elevation of the dorsal prominence varies, such that in some paratypes it is not as pronounced as in the holotype. The localised circular depression proximal to the dorsal prominence is variable, and is scarcely detectable in several specimens.

Referred Specimens

Portions of an additional 53 ilia are referred to this species but are so incomplete that they do not contribute to an understanding of specific characteristics. For that reason they have been excluded from the type series. Unless indicated specimens have been lodged in the Queensland Museum:

R.S.O. Site: F17591, 17527-8; Upper Site: F17519, 17522-23, 17529, 17595, SAM P30005, P30050, AR14433, F17621-2; C.S. Site: F17520-1, 17592, 17525, 17599, 17587, 17589, 17623, SAM P0006, P30039, P30043, P30046-47, AR11617; Gag Site: F17524, 17600, 17596, 17526, 17594, 17530-2, 17534, 17619, 17625-5; R.T.S.: SAM P30044-45; Wayne's Wok: F17593, 17587, 17620, 17624; Outasite: F17533; Henk's Hollow: F17588, SAM P30048; R.V. Site: F17590; Neville's Garden Site: SAM P30040-41, P30049.

Four of these specimens (SAM P30005-6, AR11617, 14433) are substantially larger than other referred specimens and the type series. Reconstructions indicate that they are derived from individuals with a snout-vent length range of approximately 60- 80mm. Either they represent the maximum size attained by *L. antecessor*, or they represent a distinct species. In the event that the latter suggestion is correct, sub-adult specimens may be indistinguishable from *L. antecessor*. Given the few specimens available I prefer to accept at this stage that they are conspecific; resolution awaits the recovery of complete specimens.

Comparison With Other Species

From *L. ornatus* (Gray) and *L. spenceri* Parker the new species is distinguished by the lack of a dorsal crest upon the ilial shaft. From *L. tasmaniensis* Günther it differs principally in the nature of the pre-acetabular zone and ventral acetabular expansion which protrude conspicuously in that species but not in the new species.

Members of the *L. dumerilii* species group have the superior rim of the acetabular fossa above the level of the inferior margin of the ilial shaft, whereas in *L. antecessor* it lies below it.

Limnodynastes salmini Steindachner has a very small, laterally situated dorsal prominence and protuberance, whereas these features in the new species extend superiorly and thus are more conspicuous.

Limnodynastes convexiusculus is distinguished by possession of a slightly developed dorsal crest to the ilial shaft, absent in *L. antecessor*.

The closest affinity of the new species lies with *L. peroni* (Duméril and Bibron). Both species have the acetabulum situated in a position inferior to the ilial shaft, a well developed acetabular rim, and a lack of longitudinal indentations upon the lateral and medial surfaces of the ilial shaft.

Limnodynastes antecessor is distinguished from *L. peroni* by its less pronounced dorsal prominence, a more acute angle between the dorsal acetabular expansion and the dorsal prominence, and by having a more concave ventral acetabular expansion.

Local Distribution and Ages

Limnodynastes antecessor occurs over a wide range of the Riversleigh Station sites. Archer, Godthelp, Hand and Megirian (1989) indicate that more than 97 sites and corresponding local faunal assemblages have been found there. They have attempted to equate the major of those sites with Sites A-E of Tedford (1967). The *L. antecessor* localities are thought to date from early to late Miocene.

Etymology

The specific name is the Latin for 'ancestor', so alluding here to the ancestral nature of the taxon.

Limnodynastes cf. tasmaniensis Günther

Material Examined

Four ilia, SAM P30007 R.S.O. Site, SAM P30008 Upper Site, QM F17627-28 C.S. Site, Riversleigh Station, Queensland.

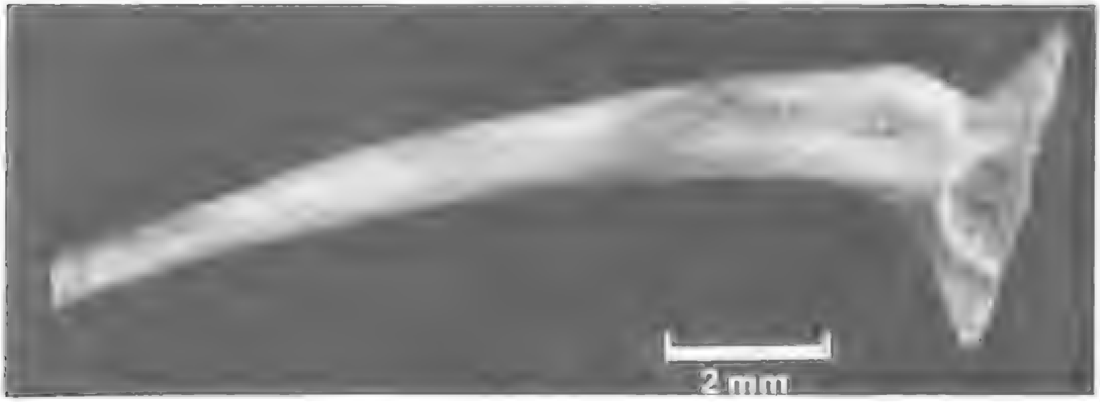

FIG. 2. Photograph of SAM P29798: *Limnodynastes ornatus* from Message Stick Cave, Riversleigh Station.

DESCRIPTIVE NOTES

The specimens form two distinct size groups for whereas SAM P30007 lacks most of the ilial shaft, the length of the proximal portion (4.7mm) equates roughly with a 15mm ilial length, and an approximate body size of 40mm, the remainder are from much smaller individuals. One (SAM P30008) is complete and measures 4.6mm. A second (QM F17627) is 5.0mm and the remaining individuals incomplete but of comparable size. These measurements indicate a body length of 15-20mm. Thus the conspecificity of the material, let alone identity, remains suspect. This is likely to be resolved if more representatives become available.

The association with *L. tasmaniensis* hinges upon the protuberant nature of the sub-acetabular zone so that the margin anterior to the acetabular region is sigmoid (narrowing in the pre-acetabular zone). Contrasting with this evident affinity is the finding that there is a distinct ontogenetic change in the form of the ilial shaft in *L. tasmaniensis*. Metamorphlings and small sub-adults exhibit a dorsal crest characteristic of the *L. ornatus* species group. Such a crest is lost in ontogeny and is lacked by the small fossils. The significance of this feature is being investigated as part of a broader study of ontogenetic trends of skeletal features in the genus in collaboration with M. Davies.

Limnodynastes ornatus (Gray)
(Fig. 2)

MATERIAL EXAMINED

Two ilia, QM F17598, SAM P29798, Message Stick Cave Site, Riversleigh Station, Queensland.

DESCRIPTIVE NOTES

The identification is based upon a combination of two features: firstly the slightly developed dorsal crest of the ilial shaft (shared by *L. ornatus* and *L. spenceri*), and the fact that the ilial shaft is curved; it is straight in *L. spenceri*.

SAM P29798 is a complete ilium, with a total length of 12.7mm, a DAE-VAE distance of 4.2mm, and a fossa diameter of 1.8mm. QM F17598 lacks the distal portion of the ilial shaft and measures 11.0mm: the DAE-VAE distance is 4.1mm, and the fossa diameter is 1.6mm.

COMMENTS

The donor of the larger of the ilial specimens would have had a snout to vent length of approximately 31mm (Fig. 3) which is at the base of the size range of adult males, and less than the range of adult females (Tyler, Smith and Johnstone, 1984).

Message Stick Cave Site is an unreported Quaternary site. The record of *L. ornatus* represents the first fossil record of that species, and the first Quaternary frog to be reported from Queensland.

DISCUSSION

To date 623 anuran ilia have been recovered from the Tertiary sites at Riversleigh Station. Of that total 76 represent *Limnodynastes*, indicating that the genus was numerically a significant component of the fauna.

It is of interest to examine whether the presence of *Limnodynastes* supports the concept of Riversleigh being cool, temperate rainforest in the Tertiary: a conclusion indicated by the predominance of *Lechriodus* there (Tyler, 1989b; Tyler, Hand and Ward, in press.).

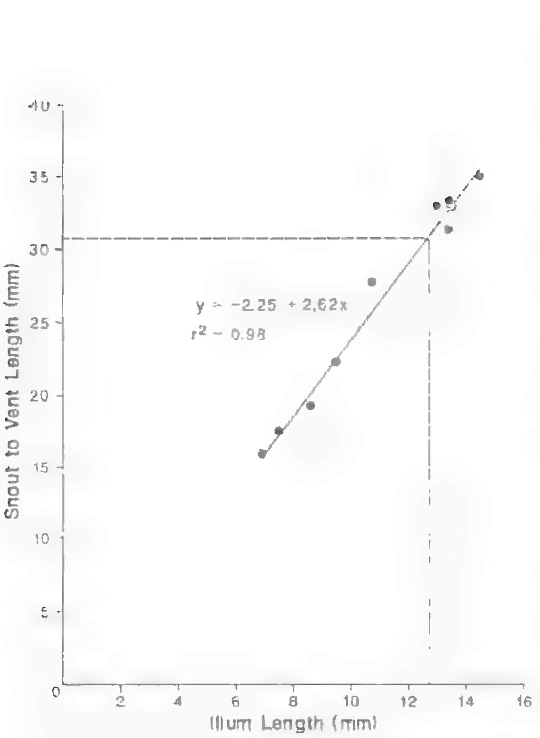

FIG. 3. Regression line of ilium length of *Limnodynastes ornatus* with snout-vent length. Estimated length of largest fossil specimen indicated by broken lines. t-value for slope 21.9735, p. .001. For x = 12.7mm, y = 31.06mm (95% confidence limits = 30.79-31.33).

Modern *Limnodynastes* occupy a diverse range of habitats, and two adaptive modes can be recognised: robust, fossorial forms with shovel-shaped, metatarsal tubercles, or more slender, sharper snouted frogs lacking enlarged metatarsal tubercles (Tyler, Watson and Martin, 1981). There is no absolute association between these modes and the environment. This is because fossorial adaptations occur in species that inhabit extremely demarcated wet-dry climatic regimes (e.g. *L. spenceri*), and also in those that spend shorter periods below the ground in temperate zones (e.g. *L. dumerilii*).

The phylogenetic affinities of the Riversleigh Tertiary *Limnodynastes* species lie with two taxa that are not fossorial. Both of these species extend throughout the East and Southeast of the continent, breeding in static or slow-moving water, but more frequently encountered in open country rather than in rainforest. Thus their presence does not conflict with the assumption of a temperate rainforest but neither does it support that interpretation. *Limnodynastes* species may be too labile in terms of their ecological requirements to be good indicators of palaeoenvironments.

A biological feature shared by *Lechriodus* and *Limnodynastes* is the habit of depositing eggs in foam nests that float upon the surface of water. The process by which the foam nest is produced in the two genera is identical (Tyler and Davies, 1979). Given that this shared biological feature originated in an ancestor to the genera, the origin of the habit is clearly ancient, and which was exhibited by 65% of the individuals at Riversleigh in the Tertiary.

ACKNOWLEDGEMENTS

I am extremely grateful to Dr Michael Archer, Dr Suzanne Hand and Mr Henk Godthelp of the University of New South Wales, for their continued aid and support throughout my study of the fossil frog fauna at Riversleigh Station.

Laboratory studies have been funded by a grant from the Australian Research Council. Miss Veronica Ward played a vital role in the sorting and documentation of the material, and prepared the illustrations. Research facilities were provided by the University of Adelaide. The assistance of Parke Davis Pty Ltd is gratefully acknowledged.

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MARINE TURBELLARIA (ACOELA) FROM NORTH QUEENSLAND

LEIGH WINSOR

Winsor, L. 1990 08 31: Marine Turbellaria (Acoela) from north Queensland. *Memoirs of the Queensland Museum* 28(2): 785-800. Brisbane. ISSN 0079-8835.

Seven species of free-living acoels are now known from Australia A new genus, new species and new combination of haploposthiid acoels are reported. They are *Waminoa litus* gen. et sp. nov., two non-sexual *Waminoa* sp., *Convolutriloba hastifera* sp. nov., and *C. japonica* (Katô, 1951) comb. nov.. The diagnosis for the genus *Convolutriloba* Hendelberg and Åkesson, 1988, is emended. The heterogeneous convolutid genus *Amphiscolops* is reviewed, and the genus *Heterochaerus* reinstated and emended to accommodate *H. australis* Haswell, 1905, and *H. sargassi* (Hyman, 1939) comb. nov. New records of *H. australis* and *Convolutriloba* cf. *retrogemma* are reported. A key to free-living acoel genera described from Australian waters is provided. □ *Acoela, tropical marine flatworms, taxonomy, key, Waminoa, Convolutriloba, Amphiscolops, Heterochaerus.*

Leigh Winsor, Department of Zoology, James Cook University of North Queensland, Townsville, Queensland 4811, Australia; 23 September, 1989.

Little is known of the free-living turbellarian acoel fauna of Australia. Until now only two species, both intertidal convolutids, have been described. They are *Amphiscolops australis* from Port Jackson, New South Wales, (Haswell, 1905) and *Wulguru cuspidata* from Townsville, north Queensland (Winsor, 1988).

This paper is mainly based upon collections of acoels from north Queensland waters. It includes descriptions of new taxa, a reappraisal of the genera *Convolutriloba* (Haploposthiidae), *Amphiscolops* and *Heterochaerus* (Convolutidae), and a key to genera of free-living Acoela described from Australia.

MATERIALS AND METHODS

Squash preparations of specimens were examined by differential interference contrast microscopy. Other material was narcotized with 7.5% magnesium chloride and fixed in marine Bouin's fluid. Specimens were processed to paraffin wax, serially sectioned at 5-7µm and stained with iron haematoxylin-eosin, trichrome stains and selected histochemical methods (Winsor, 1984). Wholemounts were stained by carmine, iron haematoxylin and histochemical methods.

Specimens for electron microscopy were fixed in 2.5% glutaraldehyde in sea-water. For scanning electron microscopy (SEM) specimens were critical point dried, gold coated and examined in secondary mode using an ETEC-SEM. Tissues for transmission electron microscopy (TEM) were post fixed in 1% osmium tetroxide, processed to Spurr's resin, sectioned at 70-90nm, stained with uranyl acetate and lead citrate, and examined using a JOEL FX200 TEM.

Terminology follows that proposed by Cannon (1986). Type and voucher specimens prefixed G are lodged with the Queensland Museum (Townsville Branch). Material from the Australian Museum, Sydney is prefixed AM.W.

The following abbreviations are used in the Figures: a - anterior end, bursa; as - algal symbiont; b - bursa; bc - bursal canal; bg - basiphil glands; c - cuboidal epithelium; cc - concrement cell; cm - cell mass (? sensory function); d - duct; e - eye; em - epidermal musculature; f - lateral body fold; fa - female antrum; fo - frontal organ; fv - false seminal vesicle; g - ganglion; m - mouth; mc - matrix cells ; n - nucleus; o - oocyte; ov - ovary; ps - prostatic secretions; pt - pit, frontal organ; r - rhabdoids; s - sperm; sb - sagittocystoblast; sg - sagittocyst; st - statocyst-statolith; sv - seminal vesicle; t - testes; y - yolk-producing part, ovary; ♂ - male genital pore; ♀ - female genital pore

Haploposthiidae Westblad, 1948
Waminoa gen. nov.

DIAGNOSIS

Haploposthiidae discoid to obcordate in shape; colour results from pigments and symbiotic algae; often with two coexisting species of algal symbionts; brain insunk; mouth ventral and in posterior third of body; rhabdoids present; ovaries and testes paired; with sub-terminal male genital pore; male atrium ciliated; seminal bursa with paired lateral bursal canals. Statocyst-statolith, eyes, frontal gland, female genital pore and penis absent. Epizoic on corals.

TYPE OF GENUS

Waminoa litus sp. nov.

ETYMOLOGY

The genus name *Waminoa* is an Aboriginal word meaning companion and alludes to the occurrence of this acoel on corals. The specific epithet is from the Greek *litos* meaning plain or unadorned, refers to the drab appearance of the species.

Waminoa litus sp. nov.
(Fig. 1a-f)

Haplodiscus sp. (in part) Trench and Winsor, 1987

MATERIAL EXAMINED

TYPE LOCALITY: Geoffrey Bay, Magnetic Island, 19°08'S, 146°50' E. Collected by G. Bull from soft coral, 9.9.1979.

HOLOTYPE: G23003, four microslides, longitudinal sagittal 5µm sections, iron haematoxylin and eosin.

PARATYPE: G23004, wholemount, iron haematoxylin.

OTHER SPECIMENS EXAMINED: Geoffrey Bay, Magnetic Island, collected by P. Osmond from the soft coral *Sarcophyton* sp. March, 1983; 30.4.1985; 21.5.86; 9.12.87; 13.4.89; Nelly Bay, Magnetic Island. Collected by P. Osmond from *Sarcophyton* sp. 13.4.1989.

DESCRIPTION

At rest living specimens are obcordate in shape and cinnamon- brown in colour with a translucent margin. Pigmentation is due to algal symbionts. The body is slightly narrower anteriorly than posteriorly, with a pronounced mid-caudal notch. Sexual specimens attain about 2mm maximum width. The mid-dorsal region is generally slightly elevated and less pigmented than the rest of the body.

Dorsal cilia are 5µm long and are less numerous than the ventral cilia, 7µm long. The dorsal epidermis is 2.5µm thick and the ventral epidermis 5µm thick. Longer sensory cilia are sparsely distributed over the body. Underlying the epidermis are circular, oblique and longitudinal muscle layers. The dorso-ventral musculature is weakly developed. Circular muscles surround the mouth and male genital pore.

The brain is insunk and consists of a bilobed ganglion. Immediately posterior to the ganglion is a non-glandular cellular mass 25µm by 50µm, possibly sensory in function. The cells are slightly ellipsoid, 6-8µm diameter with large evenly staining nuclei, prominent nucleoli and pale evenly staining cytoplasm.

A statocyst-statolith, eyes, frontal gland complex and concrement cells are absent.

Two species of algal symbionts are present. An *Amphidinium* sp. measuring 16µm-24µm diameter and a smaller *Symbiodinium* sp. approximately 8µm in diameter. The algae lie immediately below the epidermal musculature, and in some specimens appear almost completely to occupy the central parenchyma.

Fusiform packets, measuring 27µm x 5µm, of translucent acicular rhabdoids are present in the dorsal epithelium. There are two types of non-rhabditiform glands: a granular type fairly evenly distributed over the dorsal surface, slightly more abundant anteriorly and absent in the region of the caudal notch. The granular secretions are found to be composed of neutral mucopolysaccharides. The other type of gland is mainly concentrated along the margins and ventral surface. These glands have amorphous acid mucopolysaccharide secretions.

In living specimens numerous spherical refractile bodies were observed underlying the epidermis. In stained sections they are acidophilic and measure 5-7µm diameter. They do not appear to be associated with any gland or particular structure, but lie within the parenchyma. These bodies give negative histochemical reactions for mucins and lipids.

The mouth lies ventrally in the posterior third of the body. The endocytium contains amorphous sedimentary particulate matter, diatoms and remains of unidentified crustacea.

Testes are paired and lie dorso-laterally to the ovaries. Sperm pass posteriorly and accumulate before passing to the male antrum. The male genital pore is situated ventrally and subterminally on a muscular papilla. The ciliated male antrum, which appears to be a simple invagination of the ventral epidermis, communicates with a duct. The duct is well defined distally but indistinct proximally. There is no definite penial structure.

The ovaries are paired, ventrally situated and extend posteriorly behind the mouth. The seminal bursa lies ventro-medially and posterior to

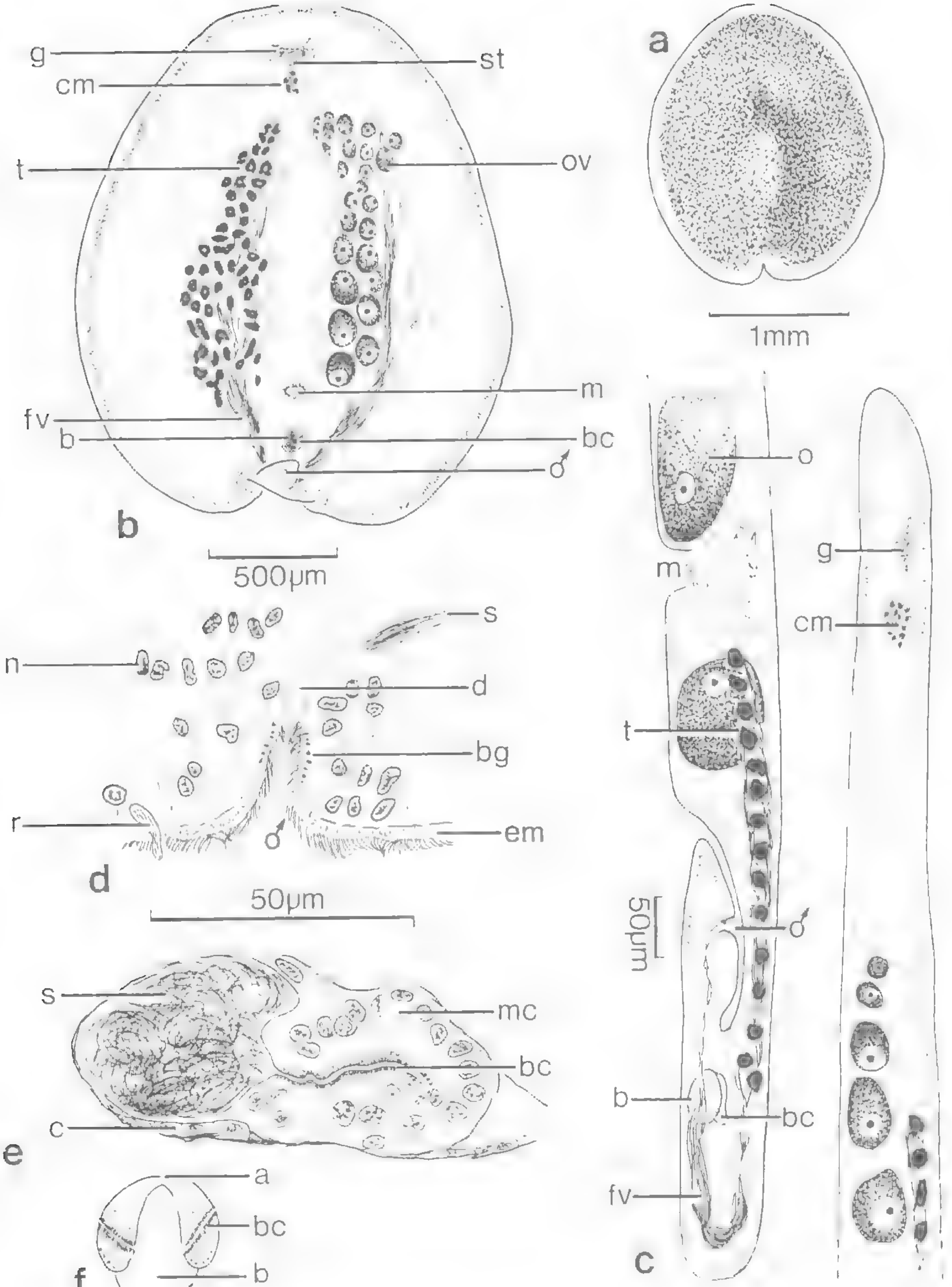

FIG. 1. *Wamhoa litus.* (a) Dorsal aspect, living specimen, (b) ventral aspect, whole mount (for clarity the ovary on right side is not shown), (c) longitudinal section (d) male copulatory apparatus, (e) bursa and bursal canal, and (f) dorsal view of bursa showing bursal canals (unscaled sketch).

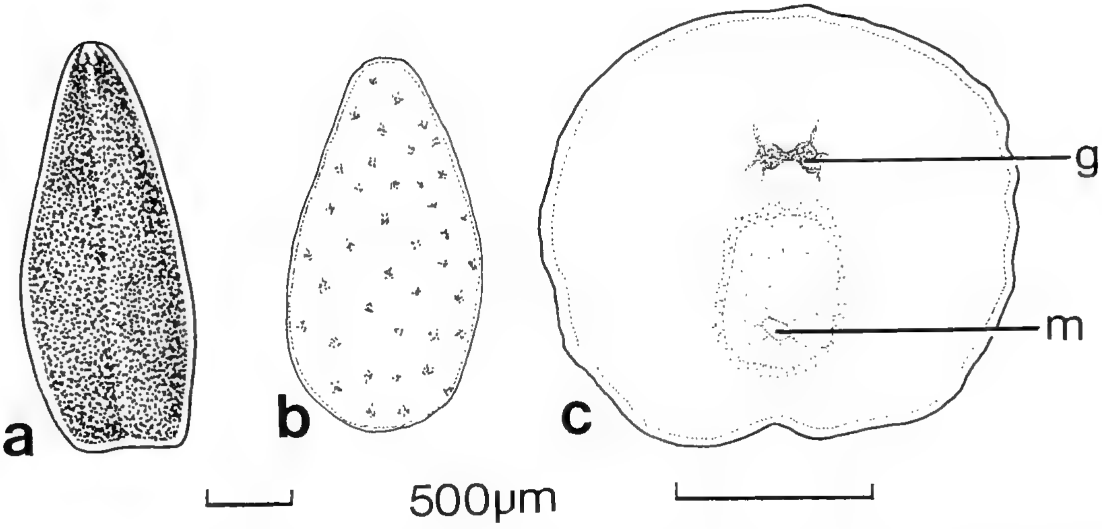

FIG. 2. *Waminoa* sp. 1. (a) dorsal aspect, living specimen by transmitted light, and (b) by incident light (black dendritic clusters represent pattern of concrement cells),(c) ventral aspect, wholemount.

the base of the muscular papilla and is partially surrounded antero-ventrally by a cellular mass, in part comprised of matrix cells. From either side of this structure two short weakly sclerotised bursal canals project antero-laterally into the parenchyma. A female genital pore is absent. No duct communicates with the bursa.

Waminoa sp. 1
(Fig. 2a-c)

MATERIAL EXAMINED

LOCALITY: Marine aquarium Australian Institute of Marine Science, Townsville. Collected by Dr S. Collard from corals, 19.11. 1981, and fixed in mercuric chloride-acetic acid.

VOUCHER SPECIMENS: G23011 Grenacher's carmine stained wholemount and G23012 a single microslide, horizontal 6µm trichrome stained sections.

DESCRIPTION

Living specimens are approximately 2mm long and ovate to obcordate in shape. Examined under incident light, the dorso-lateral surfaces are mottled with dendritic iridescent-white concrement which is retained in fixed specimens. In colour and pattern the acoels exactly resemble the retracted polyps on the coral on which they were found. Under transmitted light these acoels appear translucent brown, less dense along the dorsal mid- line. The colour is due to symbiotic algae. Three unpigmented zones are present anteriorly.

Fixed specimens are approximately 1.2mm diameter. The mouth is ventral and situated in the posterior third of the body. Statocyst-statolith, eyes and frontal gland are absent. The bilobed cerebral ganglion is insunk. There are two species of algal symbionts: the smaller species 6-7µm diameter and the larger less numerous species 9-12.5µm diameter. Male and female gonads and copulatory organs are absent.

Waminoa sp. 2

MATERIAL EXAMINED

LOCALITY: Pandora Reef, 18°49'S, 146°26'E. Collected by P. Alino from *Acropora longicyathus* 22.11.1987, and fixed in the field in marine Bouin's solution.

VOUCHER SPECIMENS: G23013 Grenacher's carmine stained wholemount and G23014 a single microslide of serial horizontal 6µm trichrome stained sections.

DESCRIPTION

Specimens are 1mm diameter, discoid with slight mid-caudal notch with mouth in the ventral posterior third of the body. The colour when live was not noted. There are no dendritic flecks on the dorso-lateral surface. Two species of algal symbionts are present: a numerous small species 7-8.5µm diameter, and a larger less numerous species 11-14µm diameter. Statocyst, eyes, frontal gland, male and female gonads and copulatory organs absent.

SYSTEMATIC DISCUSSION

In external morphology *Waminoa* species closely resemble those of the planktonic convolutid *Haplodiscus* Weldon, 1888. However with ventral subterminal male gonopore, simple tubular male antrum, and penis absent or possibly present only as a small papilla, *Waminoa* is assigned to the Haploposthiidae as defined by Cannon (1986).

Within the Haploposthiidae *Waminoa* is clearly differentiated from the other eleven genera by a combination of characters: the presence of two coexisting species of algal symbionts from which *Waminoa* species derive their colour, presence of rhabdoids, paired ovary and testis, an isolated seminal bursa with two weakly sclerotised bursal canals, and absence of statocyst, eyes, and frontal gland. *Waminoa* is closest to *Pseudohaplogonaria* Dörjes, 1968, from which it is distinguished chiefly by the presence of a well formed seminal bursa with paired lateral bursal canals, and from *Deuterogonaria* Dörjes, 1968, by the presence of the paired bursal canals and absence of a vesicular granulorum.

The presence of an *Amphidinium* sp. and *Symbiodinium* sp. in the tissues of *Waminoa*, described by Trench and Winsor (1987) represents the first observation of two dinoflagellate species co-existing in the same cell of the invertebrate host, though Yamasu and Okazaki (1987) have reported the presence of two different algal symbionts in two species of the convolutid *Amphiscolops*.

At present *Waminoa litus* is the only species found with copulatory organs. Although there is no obvious penial structure in this species, the atrium may evert to form a penis. In two mature specimens a small ventral sub-terminal papilla is present in the region corresponding to the position of the male pore. Unfortunately the absence of sperm in the immediate vicinity of the papilla makes it difficult to confirm the nature of this structure.

Waminoa sp.1 is distinguished from the other two species by the presence of concrement. *Waminoa* sp. 2 found on a scleractinian coral, is smaller in diameter than *W. litus* and *Waminoa* sp.1. As host specificity of the species is unknown it is considered prudent at present to distinguish *W. litus* and *Waminoa* sp. 2 though they may prove to be conspecific.

The *Haplodiscus sp.* of Yamasu and Okazaki (1987) from Sesoko Island (Ryukyu Islands, Japan) found on coral is possibly a species of *Waminoa*. In their preliminary report the authors remark that 'no specimens bore male and female germ cells or genital organs. Body is brown due to symbiotic algae, an *Amphidinium* type dinoflagellate.'

Convolutriloba Hendelberg and Åkesson (1988)(emend)

DIAGNOSIS

Haploposthiidae with colour and pattern resulting from pigment and symbiotic algae; frontal gland present; statocyst may be absent; brain insunk; mouth ventral; rhabdoids and sagittocysts present; ovaries and testes paired; ovaries divided into oocyte-producing and yolk-producing parts; with two ventral genital openings; male antrum ciliated passing directly into seminal vesicle: without penis; female antrum and vagina ciliated; seminal bursa with single sclerotised bursal canal.

TYPE OF GENUS

Convolutriloba retrogemma Hendelberg and Åkesson, 1988

Convolutriloba cf. retrogemma

Hendelberg and Åkesson, 1988.

MATERIAL EXAMINED

LOCALITY: The marine aquarium, University of New South Wales, found on juvenile *Tridacna gigas* clams. Specimens fixed in Bouin's fluid were forwarded by L. Goggin.

VOUCHER SPECIMENS: G23007 wholemount stained Grenacher's carmine, and G23008 four microslides of serial horizontal 6μm sections, haematoxylin and eosin.

DESCRIPTION

Non-sexual specimens 1-2mm long are similar in external morphology to *C. retrogemma* and correspond to the original description. Sagittocysts are not present in whole mounts or sectioned specimens. Algal symbionts measured 5.4-9μm diameter.

Convolutriloba hastifera sp. nov.

(Figs 3a-f, 4a-f)

MATERIAL EXAMINED

TYPE LOCALITY: Australian Institute of Marine Science (AIMS) Cape Cleveland, near Townsville, north Queensland. Collected from the aquarium by Dr Clive Wilkinson 21.9.1983.

HOLOTYPE: G23005 four microslides, longitudinal saggital sections 5μm, trichrome stain.

PARATYPE: G23006 wholemount, Gower's carmine.

OTHER SPECIMENS EXAMINED. Sexual specimens found on soft coral, Geoffrey Bay, Magnetic Island, collected by G. Bull 9.9.1979; specimens collected from the marine aquarium at AIMS by Dr Clive Wilkinson; November 1983, 27.11.84, 30.1.85.

ETYMOLOGY

The specific epithet *hastifera* is derived from the Latin *hasta* - a spear, and *ferens* - bearing, and refers to prominent anterior batteries of sagittocysts present in the species.

DESCRIPTION

Living specimens at rest measure up to 3mm long and 1.5mm wide. The body is dorsoventrally flattened, broad and rounded anteriorly. It narrows slightly in the mid third of the body, then broadens posteriorly with two lateral caudal lobes and smaller median lobe. In life the median lobe is generally slightly elevated and does not project posteriorly beyond the lateral lobes.

The ground colour is a translucent greenish-yellow to greenish-brown and is primarily the result of symbiotic algae which are fairly uniformly distributed dorsally and ventrally. A fine orange-red pigment is concentrated dorsally mainly around the base of the median caudal lobe and along the lateral body margins. It is scattered sparsely mid dorsally and anteriorly but is absent ventrally.

Iridescent-white dendritic flecks seen under incident lighting are present over the whole dorso-lateral surface apart from two unpigmented, slightly depressed areas (eye fields) about 36μm in diameter situated anteriorly. Aggregations of flecks mid-anteriorly, mid-posteriorly and laterally at the 'waist' form the points of a cruciform pattern.

Both dorsal and ventral epidermis are 2μm in thickness. The entire body surface is covered by cilia 5-6μm long. Sensory cilia 14-15μm long are spaced 75-85μm apart. Underlying the epidermis are the usual circular, oblique and longitudinal muscle layers. Dorso-ventral muscles are abundant, particularly laterally.

Two eyes are present within the unpigmented anterior areas. Each eye is oval, measures 19μm antero-posteriorly and 34μm medio-laterally, and is composed of minute reddish brown granules. The cerebral ganglion is insunk and bilobed. There is no statocyst-statolith.

Algal symbionts (Prasinophyceae, ? *Platymonas*) measure 7-12μm diameter and underlie the cutaneous body musculature dorsally and ventrally.

Three types of rhabdoids are present. The most conspicuous are sagittocysts, refractile acicular bodies 18-20μm long and about 2.5-3.6μm diameter with central stylet 1μm diameter, lying in the parenchyma at right angles to the surface with only the tips protruding from the epithelium. They are particularly numerous in batteries anteriorly, and to a lesser extent dorso-ventrally and laterally. They are sparse posteriorly. Ventrally they surround the male pore.

Histochemically the sagittocysts are strongly basiphilic and periodic acid-Schiff positive. Sagittocystoblasts are located deeper within the body and ultrastructurally comprise a lateral nucleus and thin granular cytoplasm surrounding the sagittocyst. The sagittocyst consists of a fibrillar, concentrically lamellate cortex about 3.5-4μm diameter surrounding a central stylet. The stylet is a 1μm diameter membrane bound tube. The wall is approximately 300nm thick and composed of short fibrils, with an inner thin electron dense band. In the central lumen is an eccentrically situated electron dense rod about 140nm diameter.

The conspicuous reddish-orange epidermal pigment noted macroscopically is due to orange-coloured fusiform and bacilliform rhabdoids 4.5-6.3μm long and 0.9μm diameter, contained within packets 7-36μm diameter and 24-60μm long, lying at a shallow angle to the surface of the epithelium.

Fusiform envelopes measuring 8-18μm long and 2.7- 3.6μm diameter filled with numerous acicular, refractile microrhabdoids 2.7-3.6μm long and 0.25-1.8μm diameter, lie in the epithelium at a shallow angle or parallel to the surface.

Within the dorsal and ventral epidermis are gland cells containing translucent cytoplasmic granules which give a positive alcian blue histochemical reaction for acid mucopolysaccharides. These glands are particularly numerous anteriorly. A distinct cluster of strongly basiphilic glands form a frontal gland complex and open into a antero-ventral pit. Parallel with the dorsal surface is a network of concrement cells which are the iridescent white flecks observed macroscopically.

The mouth opens ventrally and is situated in

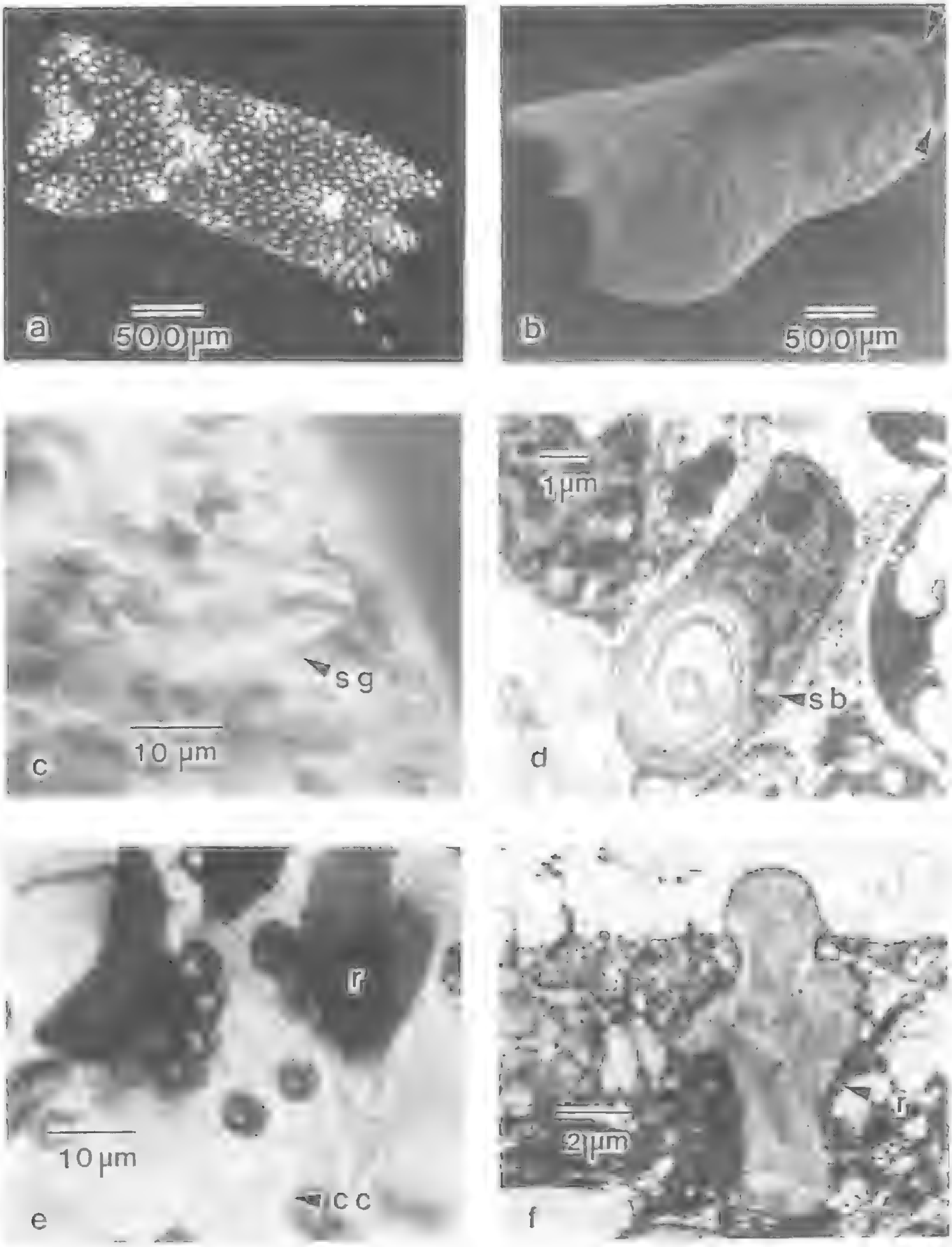

FIG. 3. *Convolutriloba hastifera*. (a) dorsal aspect, living specimen by incident light, and (b) fixed specimen (SEM). Note depressed eye-fields (arrowed) (c-f) epidermal structures: (c) anterior sagittocyst (d) sagittocystoblast (e) pigmented rhabdoids and concrement cell (f) packet of acicular rhabdoids.

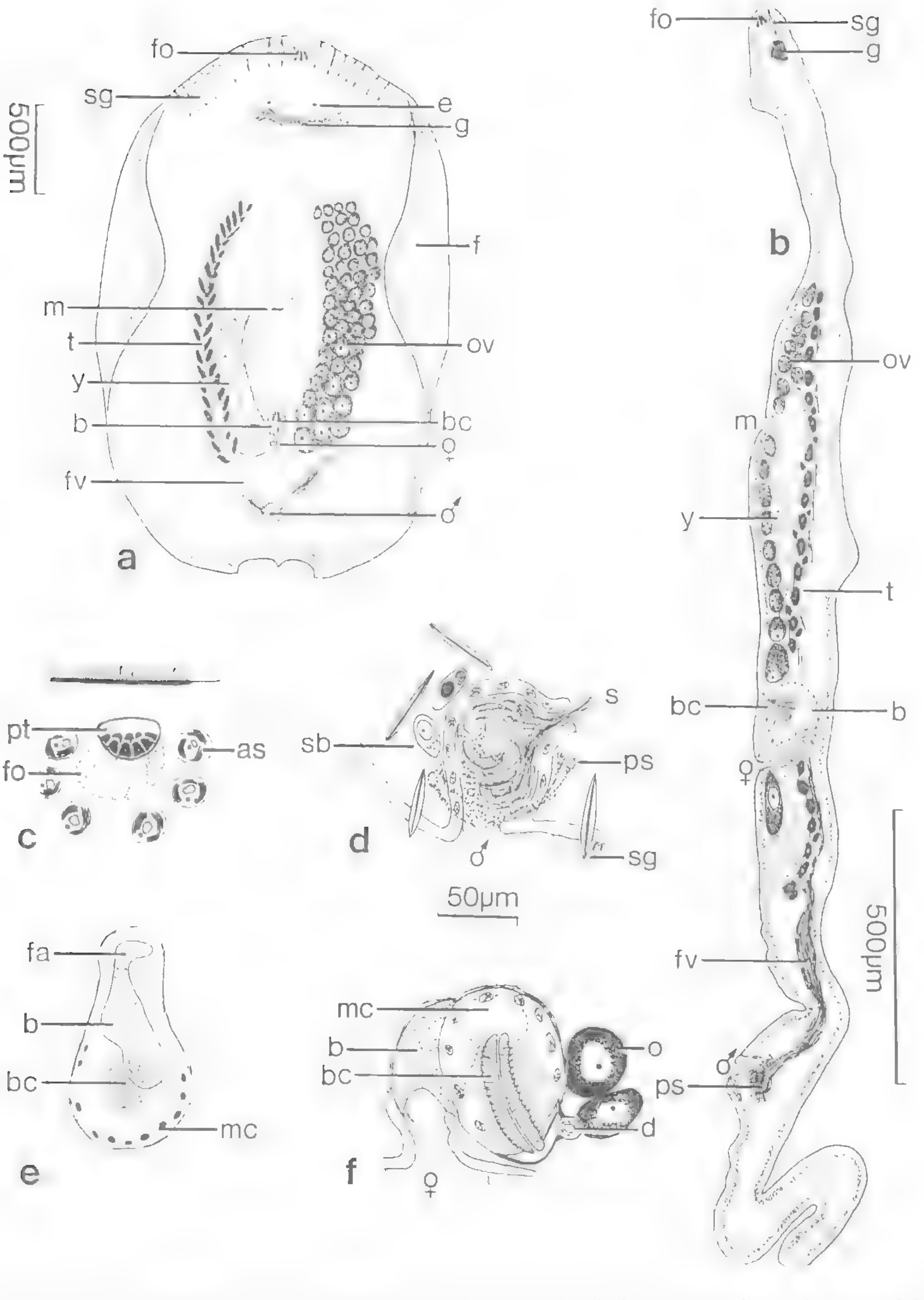

FIG. 4. *Convolutriloba hastifera*. (a) ventral aspect, whole mount (for clarity the ovary is not shown on right side) (b) longitudinal section (c) frontal organ and pit (unscaled sketch) (d) male copulatory apparatus (e) female copulatory apparatus, plan view (unscaled sketch) (f) female copulatory apparatus.

the anterior half of the body. Ingested amphipods were observed in the endocytium of live specimens.

The testes are paired and are distributed dorsolaterally. Sperm pass posteriorly, accumulate in false seminal vesicles then continue into the male copulatory organ. This organ consists of an unciliated chamber filled with sperm. Basiphilic granular secretions form a plug in the genital pore, and are derived from prostatic glands equatorially surrounding the male organ. The male gonopore is ventral and ringed by sagittocysts.

The ovaries are paired and lateral. They are divided into oocyte producing and yolk producing parts. The oocyte-producing portion is ventrad and extends posteriorly 0.5mm from the anterior tip to just behind the female genital pore. The yolk-producing part is dorsad and begins just behind the mouth and terminates posterior to the oocyte portion.

The female genital pore is ventral approximately midway between the male pore and mouth. A short, ciliated female antrum leads into the bursal complex. The bursa is elongate, thin walled and filled with basiphilic granules. It communicates with the proximal end of a single anteriorly-curved sclerotised bursal canal.

SYSTEMATIC DISCUSSION

Hendelberg and Åkesson (1988) noted that the male copulatory organ in *Convolutriloba* is a different type from that of *Convoluta*, but considered the possibility that in their asexually reproducing specimens the male organ was not fully mature. For this reason they expressed some uncertainty as to whether the genus should be assigned to the Convolutidae or Haploposthiidae. The male copulatory organs of *C. retrogemma* and mature *C. hastifera* are similar. This suggests that the male organ described from the former species was mature. Both species lack a penis. *Convolutriloba* is therefore confidently assigned to the Haploposthiidae.

Specimens of *Convolutriloba* from *Tridacna* at the University of New South Wales were nonsexual and unable to be identified fully. The specimens are not *C. hastifera* as anterior sagittocysts are absent. Examples of *C. hastifera* the same size as the Sydney material are found to have anterior sagittocysts. The species is similar to *C. retrogemma*.

Convolutriloba hastifera was first observed in 1976 by Dr John Collins of James Cook University (JCU) on the rocky part of the base of *Goniastrea* sp. and *Platygyra* sp. corals collected from the intertidal zone Geoffrey Bay, Magnetic Island. They were also present in 1976 in the aquarium at JCU, and in March 1981 collected by Dr Clive Wilkinson from the aquarium at AIMS

The characters which clearly distinguish *C. hastifera* from *C. retrogemma* are the presence of batteries of sagittocystoblasts and sagittocysts anteriorly, presence of eyes and an ovary with oocyte-producing and yolk-producing parts. The dorsal pattern of concrement in *C. hastifera* differs from that of *C. retrogemma* (Hendelberg, *in litt.*).

Convoluta japonica Katô, 1951, (and Kawakatsu, 1983) considered by Dörjes (1968) to be a species *incertae sedis*, is now assigned to *Convolutriloba*. *Convolutriloba japonica* (Katô, 1951) comb. nov. is characterised within the genus by the presence of a statocyst, a rounded posterior with disc-shaped terminal adhesive gland, and absence of lateral caudal lappets. Other features accord with the generic diagnosis.

No separate diagnosis was provided by Hendelberg and Åkesson, 1988 for the genus *Convolutriloba*, the generic characters being those of *C. retrogemma*. As other species have now been referred to *Convolutriloba* it is appropriate to revise and emend the generic diagnosis. Unfortunately the presence or absence of caudal lappets is not a reliable generic character in the acoela. Asexual reproduction with reversed polarity has so far only been observed in *C. retrogemma*, and is therefore not included in the generic diagnosis.

In both *C. hastifera* and *C. japonica* the paired ovary is divided into oocyte-producing and yolk-producing parts. At present it is uncertain whether the ovary in *C. retrogemma* is divided into the two parts as in the other species. In *C. retrogemma*, Hendelberg and Åkesson (1988) describe a germ layer in which some cells are considered to be developing oocytes. Other cells present may be yolk-producing. Confirmation of a bipartite ovary in this species must await examination of sexually reproducing specimens.

From the combination of characters which now define *Convolutriloba*, the presence of a paired ovary divided into oocyte-producing and yolk-producing parts distinguishes the genus from all others in the Haploposthiidae. Otherwise this genus is closest to *Pseudohaplogonaria* Dörjes, 1968, which also has a single bursal canal.

Although sagittocysts are present in several species of acoels they have only received scant attention at the light microscopic level (see Graff, 1905; Ivanov, 1952; and Marcus, 1959). In structure and mode of secretion, but not in size or chemical composition, sagittocysts share many features of a discharge-type rhabdite, defined by Smith, Tyler, Thomas and Rieger (1982). According to these authors the Acoela seem to lack true rhabdites. Further ultrastructural investigations are required to ascertain whether there is any homology between acoel sagittocysts and the true rhabdites of other turbellarian orders.

Convolutidae Graff, 1904
Heterochaerus Haswell, 1905 (emend)

Heterochaerus Haswell, 1905 p.425 ; Bresslau, 1933 p.264.
Amphiscolops Luther, 1912 p.52; Beauchamp, 1961 p.186.

DIAGNOSIS

Convolutidae oblong in shape, with caudal lappets; colouration and pattern due to symbiotic algae and concrement granules; rhabdoids, statocyst and statolith may be present; with eyes; brain insunk; frontal gland absent; mouth ventral in mid-body; ovary and testis paired; male genital pore ventral in posterior third of body; muscular penis surrounded by seminal vesicle; female genital pore anterior to male pore; female antrum ciliated; bursa T-shaped and bilobed, each lobe with two or more tubular bursal canals; in mature specimens a copulatory canal (cf. Laurer's canal) may be present dorsally opening into female antrum.

TYPE SPECIES

Heterochaerus australis Haswell, 1905.

Heterochaerus australis Haswell, 1905
(Fig. 5a-c)

Heterochaerus australis Haswell, 1905 p.425.
Amphiscolops australis (Haswell); Luther, 1912 p.52; Marcus, 1950 p.21; Dörjes and Young, 1973 p.350.
non *Amphiscolops sp.* (*australis* ?) Trench and Winsor, 1987.

MATERIAL EXAMINED

SYNTYPES. AM W387 Port Jackson , New South Wales, Australia, found in shallow intertidal rock pools. Approximately 33 Carmine stained serial sections of a group of 17 specimens on a single microslide. The fifteenth section is marked with ink.

VOUCHER SPECIMENS: Collected at Pioneer Bay, Orpheus Island 18° 37'S, 146°30'E, sexual, from sediments, collected J. Gray, 29 May, 1984. G23009 wholemount, picro-carmine. G23010 three microslides of serial horizontal 7μm sections, iron haematoxylin-eosin.

OTHER SPECIMENS EXAMINED: Queensland: Saltwater Creek 19°05'S, 146°28'E, nonsexual, from the surface of stones, subtidal zone in the creek, collected I. Kneipp, 28 May, 1986; Shelly Bay near Cape Pallarenda, Townsville 19°21'S, 146°45'E, non-sexual, from subtidal sediments, collected L. Winsor, 9 August, 1987.

DESCRIPTION

Specimens are spatulate in shape with two elongate latero-caudal appendages, translucent brownish-yellow in colour with a clear margin, 1-2mm by 0.5-0.75mm. The dorsal surface exhibits iridescence under incident light. A statocyst and statolith are present lying midway between two minute eyes. Brain bilobed and insunk. A frontal gland is absent. Algal symbionts, possibly an *Amphidinium* sp., measure 10-14μm in diameter.

Testes and ovary are paired. Female genital pore is ventrally situated 180μm posterior to the mouth and 80μm anterior to the male genital pore. The bursa is bilobed and T-shaped with lobes present as bulbous extremities on the transverse arm. Each lobe contains 2-3 bursal canals. Sperm accumulate in a seminal vesicle which surrounds a conical muscular penis.

SYSTEMATIC DISCUSSION

The copulatory organs and other features of the Queensland specimens agree closely with Haswell's (1905) clear description, and comparison with the syntypes. There are minor differences in length of the caudal appendages of the specimens examined. Those from Orpheus Island have elongate appendages whereas in specimens from Saltwater Creek and Shelly beach the caudal appendages are short and rounded. In some specimens from both sites the caudal appendages are unequal in length, possibly due to accidental amputation of the normally long delicate structures. Variation in the number of bursal canals in each of the two lobes of the bursae of present material is within the range reported for the species. The presence of Laurer's canal could not be confirmed in preparations of the new material.

Heterochaerus australis is characterised by the presence of multiple bursal canals in each lobe of a T-shaped bilobed bursa, rhabdoids, statocyst-statolith, and in mature specimens what may be a copulatory duct between the female antrum and the dorsal surface. The species lacks a frontal organ, and this was the principal reason Haswell (1905) considered *australis* was precluded from the genus *Amphiscolops*, all members of which had this structure. He therefore erected the genus *Heterochaerus* to accommodate this species.

However in a footnote Luther (1912 p53), considering only external features and multiplicity of bursal canals, synonymised *Heterochaerus* within *Amphiscolops*. Luther's action was not disputed in the literature until Bresslau (1933) without comment listed *Heterochaerus* in the Convolutidae, separate from *Amphiscolops*. Reinstatement of the genus was noted by Marcus (1947) who nevertheless included *australis* in a key to the species of *Amphiscolops* (see Marcus 1950) thus tacitly agreeing with Luther (1912).

In his comprehensive treatment of the Acoela Dörjes (1968) apparently overlooked *A. australis* as it was not included in a listing of *Amphiscolops* species. However he obviously accepts the validity of the species as Dörjes and Young (1973) reported the occurrence of *Amphiscolops australis* in Kenya.

To evaluate the systematic position of *A. australis* it is necessary to examine the taxonomic characters of all species in the genus *Amphiscolops* (Table 1). As it presently stands this genus is clearly heterogeneous. Westblad (1946) drew attention to the different types of bursal canals in *Amphiscolops* and with respect to these structures (Westblad, 1946, 1948) remarked on the heterogeneity of the genus. Later Steinbock (1955) commented that the absence of a statocyst in four (now seven) *Amphiscolops* species might possibly justify the erection of a new genus such as 'Alithicum' to accommodate them.

The current diagnosis for *Amphiscolops* is as follows (after Dörjes, 1968):

Coloured through pigment or symbiotic algae; statocyst may be absent; brain insunk; frontal gland weak; mouth ventral; rhabdoids may be absent; posterior as a rule with two pronounced

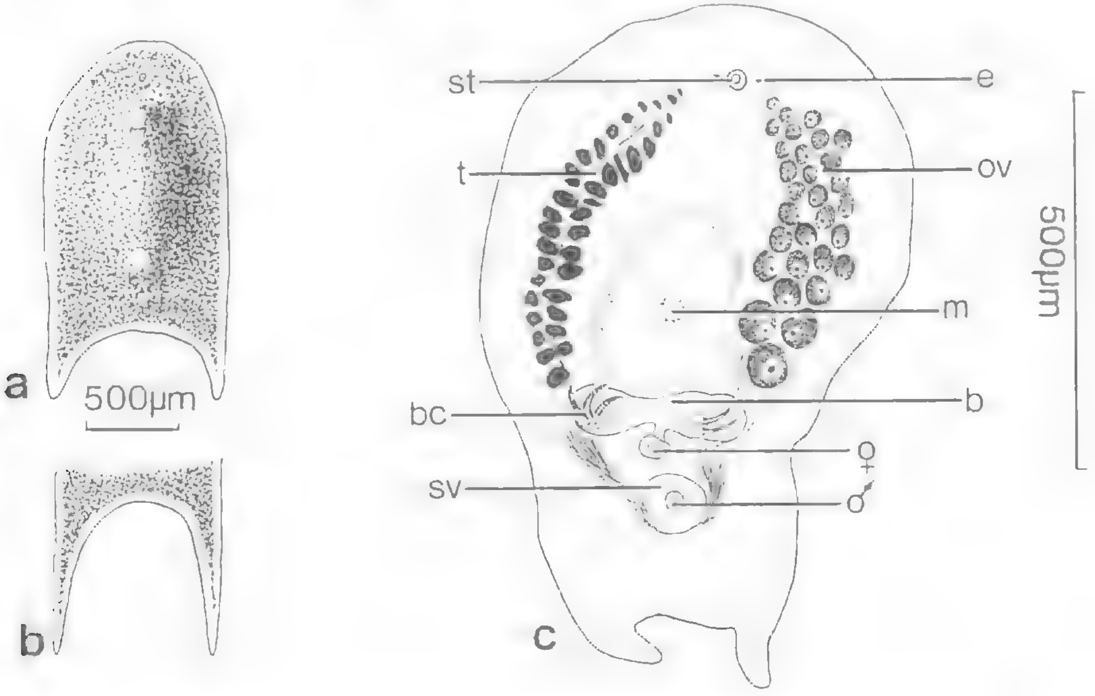

FIG. 5. *Heterochaerus australis*. (a) dorsal aspect, living specimen and (b) with elongate caudal lappets (Orpheus Island specimens) (c) Ventral aspect wholemount (for clarity the ovary is not shown on right side).

SPECIES	AUTHORITY	MORPHOLOGICAL FEATURES																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
GROUP 1																				
cinereus$_a$ *TYPE*	(Graff, 1874);1905	M	5000	R	0	+	+	+	+	+	+	1	1	BL	L	2	+	T	S	
fulgineus$_b$	Peebles, 1915	M	3000	R	0	+	+	+	+	?	+	1	1	BL	L	2	+	T	S	
	Reidl, 1956	?	600	R	0	+	?	+	?	?	?	1	1	SL	C	2	+	?	?	
japonicus$_c$	Katô, 1947	M	6000	F	0	0	+	+	+	?	0	1	1	SP	L	4	+	T	S	
evelinae$_d$	Marcus, 1947	N	2000	F	0	+	+	0	+	0	?								A	
[illegible]	Marcus, 1954	J	600	F	0	+	+	+	0	?	0	2	2					V		
GROUP 2																				
bermudensis$_e$	Hyman, 1939	M	2000	T	+	?	+	+	+	+	+	2	1	SL	L	2	+	T?	S	
sp. 2.	Yamasu & Okazuki, 1987	M	1500	F	+	?	?	?	+	?	+	1	1	SL	L	2	?	V	S	
sp. 3.	Yamasu & Okazuki, 1987	M	500	F	+	?	?	+	+	?	+	1	1	SL	L	2	?	V	S	O
GROUP 3																				
langerhansi	(Graff, 1882); Hyman, 1937	M	4600	F	+	0	+	+	+	?	+	1	1	SM	P	6-11 2-8	+	V	S	O
carvalhoi	Marcus, 1952	M	2000	F	+	?	+	+	+	0	+	1	1	SM	P	2-6	+	V	S	[illegible]
sp. 4.	Yamasu & Okazuki, 1987	M	2500	F	+		?	0	+	?	?	1	1	SM	?	many	?	V	S	O
GROUP 4																				
cf. *langerhansi*	Yamasu & Okazuki, 1987	N	1200	F	+	?	?	0	?	?	+								A	
sp. 1.	Yamasu & Okazuki, 1987	N	1300	F	+	?	?	0	+	+	?								A	
sp. form castellonensis	Steinböck, 1955	N	3000	F	+	?	?	0	+	?	?								A	
sp. form gerundensis	Steinböck, 1955	N	4000	F	+	?	?	0	+	?	?								A	
sp.	Ehlers & Dorjes, 1979	N	2000	F	+	+	+	0	+	0	0								?	
GROUP 5																				
sp. 5.$_f$	Yamasu & Okazuki, 1987	M	5000	[illegible]	+	[illegible]		?				[illegible]	1	[illegible]	[illegible]	+	[illegible]	[illegible]	[illegible]	
GROUP 6																				
[illegible]ralis$_g$	(Haswell, 1905)	M	4000	[illegible]	+	+		+	[illegible]	[illegible]	+	[illegible]	[illegible]	[illegible]	I	4 1	+	[illegible]		
[illegible]$_h$	Hyman, 1939; Marcus, 1950	J	3000	F	+		0	[illegible]	+		+	1	1	TM	I	4-[illegible]	+	[illegible]	AS	

TABLE 1. Morphological and other taxonomic characters of species of the genus *Amphiscolops*, together with a commentary on species groups within the genus. Group 6 has been transferred to *Heterochaerus* (this paper).

KEY TO MORPHOLOGICAL FEATURES IN TABLE 1.

+ = present; O = absent; ? = not mentioned in original description or uncertain.

1. sexual maturity of specimens upon which description based. N = nonsexual; J = juvenile; M = mature.
2. maximum length reported (in μm).
3. shape of posterior end. R = rounded; F = forked (bilobed); T = trilobed.
4. algal symbiont.
5. pigment.
6. frontal organ.
7. statocyst-statolith.
8. eyes.
9. rhabdoids.
10. concrement cells.
11. number of female genital pores.
12. number of male genital pores.
13. type of seminal bursa. BL = bilobed with paired lateral bursal canals; SL = spheroidal with paired lateral bursal canals; SM = spheroidal with multiple central bursal canals; SP = spheroidal with paired ventral papillae each containing two bursal canals (*japonicus*); TM = T-shaped bursa with multiple lateral bursal canals.
14. type of bursal canal. C = corkscrew shape (*zeii*); L = long tubular; P = papillate, large and small.
15. number of bursal canals; for taxa with bilaterally arranged bursal canals, half this number are present on each side.
16. seminal vesicle - penis sac.
17. posterior position of male genital pore. T = terminal-sub terminal; V = ventral.
18. reproduction apparently by A = architomy or S = sexually.
19. birth of young. O = oviparous; V = viviparous.

NOTES ON SPECIES

a. *cinereus*. Paired vaginae open into female genital duct.
b. *fulgineus*. Eyes with refractile granules. Species may be conspecific with *cinereus*.
c. *japonicus*. Eyes with refractile granules. Adhesive sucker present between mouth and female genital pore.
d. *evelinae*. Antero-dorsal fossa present.
e. *bermudensis*. Frontal organ pit present. Paired vaginae open ventrally.
f. sp. 5. Has two species of algal symbionts (as does sp. 3).
g. *australis*. Dorso-atrial duct (cf. Laurer's canal) present in mature specimens.
h. *sargassi*. Paired ?efferent female openings where ovarian stroma interrupts ventral epicytium. Seminal bursa in this species and in *australis* differ from the bilobed bursae in other species of *Amphiscolops*.

COMMENTS ON GROUPS

GROUP 1

In all members of the group (which includes the type of the genus), algal symbionts are absent, the male genital pore is terminal in position, bursae have paired lateral tubular bursal canals. The taxonomic position of *evelinae* and *gemilliporus* is uncertain (species *incertae sedis*)

GROUP 2

Similar to Group 1. Algal symbionts present, male genital pore ventral in position, bursae with paired lateral tubular bursal canals. The position of the penis in *bermudensis* is uncertain. *Amphiscolops* would be fairly homogeneous if it was restricted to Groups 1 and 2, with appropriate emendment of the generic diagnosis.

GROUP 3

A homogeneous group characterised by presence of algal symbionts, numerous papillate bursal canals in the bursa, and ventral position of the male genital pore. The structure of the bursal canals apparently differs from those structures in Groups 1 and 2. This group should be separated from *Amphiscolops*.

GROUP 4

All the species in this group have been described from non-sexual specimens. They have been placed in *Amphiscolops* primarily because they have algal symbionts and caudal lappets (bilobed posterior) although the type of the genus lacks both these features. At present these species cannot be reliably assigned even to a family level and are more appropriately regarded as species *incertae sedis*.

GROUP 5

Although little data on this species is available, the large size, presence of two species of algal symbionts, multiple bursal canals and terminal male genital pore suggest it may belong to a new genus reported from the western Pacific (Winsor, pers. obs.).

GROUP 6

This group is characterised by the presence of algal symbionts, ventral male genitalia pore, multiple lateral bursal canals and T-shaped bursae. A frontal organ is absent. This group has been transferred to the reinstated genus *Heterochaerus* (this paper).

posterior lappets; ovaries and testes paired; two genital openings, or they may be manifold; seminal bursa with two or more curved, or corkscrew-shaped sclerotised bursal canals; male copulatory organ complex conical, pyramidal or tubular; a male antrum and seminal vesicle may be absent.

Thorough revision of the genus at present is hampered by inadequate data for many of the taxa. Also some of the characters used to define the genus, in particular the frontal gland and the type, number and position of the bursal canals - key elements in the generic diagnosis - need to be re-evaluated. Ideally this should be undertaken at both light microscopic and ultrastructural levels. However despite these problems species groups within the genus can be recognised (Table 1 - comments on groups) thus indicating directions for further revision.

Of the *Amphiscolops* species for which adequate data are available, those comprising Group 6 – *A. australis* and *A. sargassi* Hyman, 1939 – are the only members of the genus in which a frontal organ is absent. Both species have similar morphology, in particular the presence of a T-shaped bilobed bursa, each lobe of which contains two or more bursal canals of the same type. As both species exhibit a combination of characters clearly different from *Amphiscolops* Group 1, which includes the type of the genus *A. cinereus*, they should be removed from *Amphiscolops*. Luther's (1912) synonymy of *Heterochaerus* within *Amphiscolops* is rejected.

Heterochaerus Haswell, 1905, is now reinstated and diagnosis emended. Both *A. australis* and *A. sargassi* are transferred to this genus.

Known only from non-sexual (Hyman, 1939) and immature (Marcus, 1950) material *Heterochaerus sargassi* (Hyman, 1939) comb. nov. nevertheless exhibits the essential characters of *Heterochaerus*. Hyman (1939) indicated that in this species there 'are no evident frontal glands nor frontal pit' (her use of the term *frontal glands* referred specifically to the group of glands forming a frontal organ, rather than cutaneous glands which open from the anterior margin). Marcus (1950) corroborated these findings noting 'As glandulas frontais desembocam, por via de regra, separadamente no bordo anterior; exceptionalmente coalescem alguns dutos eferentes delas, simulando um orgao frontal. Fosseta frontal nao ocorre.' Described are cutaneous glands which normally open from the anterior margin; occasionally the ducts of some of these glands coalesce, *simulating* a frontal organ. The statement by Ehlers and Dörjes (1979, p16) that 'Marcus ... beschreibt zwar ein Frontalorgan für *A. sargassi*..' is therefore incorrect.

The type of bursa, and the type, number and position of bursal canals in *H. sargassi* are similar to those of *H. australis*. In *H. sargassi* the ovarian stroma interrupts the ventral epithelium (Marcus, 1950). These structures may be efferent openings for the discharge of eggs. Haswell (1905) concluded that in *H. australis* eggs were discharged through the female genital pore. However he drew attention to a blind anterior diverticulum in the female antrum which he considered might be a vestige of a temporary passage formed to discharge eggs. Multiplicity of female ducts (vaginae) is known in *Amphiscolops cinereus*, *A. fulgineus*, *A. bermudensis*, *A. gemelliporus* (Table 1) and in *Wulguru cuspidata*. At present it is not known whether these ducts are copulatory or efferent in function, and whether they are homologous.

The absence of a statocyst-statolith in *H. sargassi* may be a consequence of reproduction by architomy, noted for other acoels (Hendelberg and Åkesson, 1988).

The *Amphiscolops* sp. (*australis* ?) reported from the marine lakes in the Republic of Belau (Trench and Winsor, 1987, p.2) is now considered to belong to a new genus to be described elsewhere (Winsor, pers. obs.). The *Amphiscolops* sp. 5 of Yamasu and Okazaki (1987) may possibly be referable to this genus.

KEY TO FREE-LIVING ACOEL GENERA IN AUSTRALIAN WATERS

The following artificial key is provided to facilitate recognition of free-living acoel genera presently described from Australian waters. It is based upon external features evident in living and fixed specimens. Known distributions and habitats are provided. The key is intended to supplement Cannon's (1986) invaluable guide to turbellarian families and genera. Full identification of acoel taxa requires microscopical and histological examination of sexual living and fixed specimens.

1. Body discoid to obovate in shape, posterior margin rounded or notched medially .... *Waminoa*
(1-5mm diameter, found on hard and soft corals: north Queensland and western Pacific)

1'. Body elongate, posterior pointed or with lateral caudal lappets 2

2. Posterior terminating in single pointed tip, lateral caudal lappets absent .... *Wulguru* (1-3mm long found intertidally in sand and sediments; north Queensland)

2'. Lateral caudal lappets present, posterior with or without median lobe 3

3. With posterior median lobe .... *Convolutriloba* (3-6mm long found in marine aquaria Townsville, Sydney and Gothenburg, Sweden; on corals in north Queensland waters; one species without caudal lobes found in Japan)

3'. Posterior median lobe absent .... *Heterochaerus* (1-4mm long, found in rock pools Port Jackson, New South Wales; in subtidal sand north Queensland; in shallow pools on a sandy beach, Mombasa, Kenya)

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