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REVISION OF THE AUSTRALIAN GENERA EODELENA HOGG AND ZACHRIA L. KOCH (HETEROPODIDAE: ARANEAE)

D. B. HIRST

Summary

The Australian genera Zachria L. Koch and Eodelena Hogg are revised. Zachria is here limited to include only the type species, Z. flavicoma L. Koch and Z. oblonga L. Koch. Z. magnifica (Hogg) is removed to Typostola Simon, in which genus it was originally described. Eodelena is revalidated and removed from Zachria. E. spenceri Hogg, type species and E. melanochelis (Strnad) are redescribed. Five new species, E. convexa, E. lapidicola, both from Western Australia, E. kosciuskoensis from New South Wales, E. loftiensis from South Australia and E. tasmaniensis from Tasmania are described. E. nigifrons is transferred to Delena Walckenaer.

REVISION OF THE AUSTRALIAN GENERA *EODELENA* HOGG AND *ZACHRIA* L. KOCH (HETEROPODIDAE: ARANEAE)

D. B. HIRST

HIRST, D. B. 1991. Revision of the Australian genera *Eodelena* Hogg and *Zachria* L. Koch (Heteropodidae: Araneae). *Rec. S. Aust. Mus.* **25**(1): 1–17.

The Australian genera *Zachria* L. Koch and *Eodelena* Hogg are revised. *Zachria* is here limited to include only the type species, *Z. flavicoma* L. Koch and *Z. oblonga* L. Koch. *Z. magnifica* (Hogg) is removed to *Typostola* Simon, in which genus it was originally described. *Eodelena* is revalidated and removed from *Zachria*. *E. spenceri* Hogg, type species, and *E. melanochelis* (Strand) are redescribed. Five new species, *E. convexa*, *E. lapidicola*, both from Western Australia, *E. kosciuskoensis* from New South Wales, *E. loftiensis* from South Australia and *E. tasmaniensis* from Tasmania are described. *E. nigrifrons* Simon is transferred to *Delena* Walckenaer.

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This paper is the fifth of a revision of the Australian Heteropodidae, excluding *Heteropoda* Latreille, 1804. As with other Australian genera of the Heteropodidae, *Zachria* and *Eodelena* are poorly defined, consequently confusion of the taxa has arisen. *Eodelena* is further often confused with the genus *Delena*.

L. Koch (1875) described a new genus, *Zachria* for the species *Z. flavicoma*, *Z. oblonga* and *Z. haemorrhoidalis*. Hogg (1902) synonymised the latter with *Z. oblonga*. In the same work Hogg described the new genus and species *Eodelena spenceri*. Simon (1903) placed that genus in synonymy with *Zachria* on the basis of similar male palp structure. Later, Simon (1908) appeared to reconsider its position when describing *E. nigrifrons*. Bonnet (1959) remarked on this change but left the genus in synonymy with *Zachria*. Strand (1913) described *Z. melanochelis* while Hickman (1967) commented on the description and habits of *E. spenceri* under *Zachria spenceri*.

MATERIALS AND METHODS

Larger body and leg measurements of types in poor condition are given to the nearest 0.1 mm. Leg ratios exclude coxa and trochanter. Redescriptions of type material give the present colouration of the specimen or, in the absence of any specimens, a condensed translation of the author's description is given. Female vulva is occasionally inspected without removal of the genitalia by dissecting and lifting on one side and brushing away fatty tissue. Other materials and methods are given in Hirst (1989a, 1989b, 1990). Types of newly described species are deposited in the Australian Museum, Sydney (AM), the Museum of Victoria, Melbourne (NMV), the South Australian Museum, Adelaide (SAMA), the Tasmanian Museum and Art Gallery, Hobart (TM) and the Western Australian Museum, Perth (WAM). Other acronyms are BMNH, British Museum (Natural History), London; QM, Queensland Museum, Brisbane, and ZMH, Zoologisches Museum, Hamburg.

Genus **Zachria** L. Koch

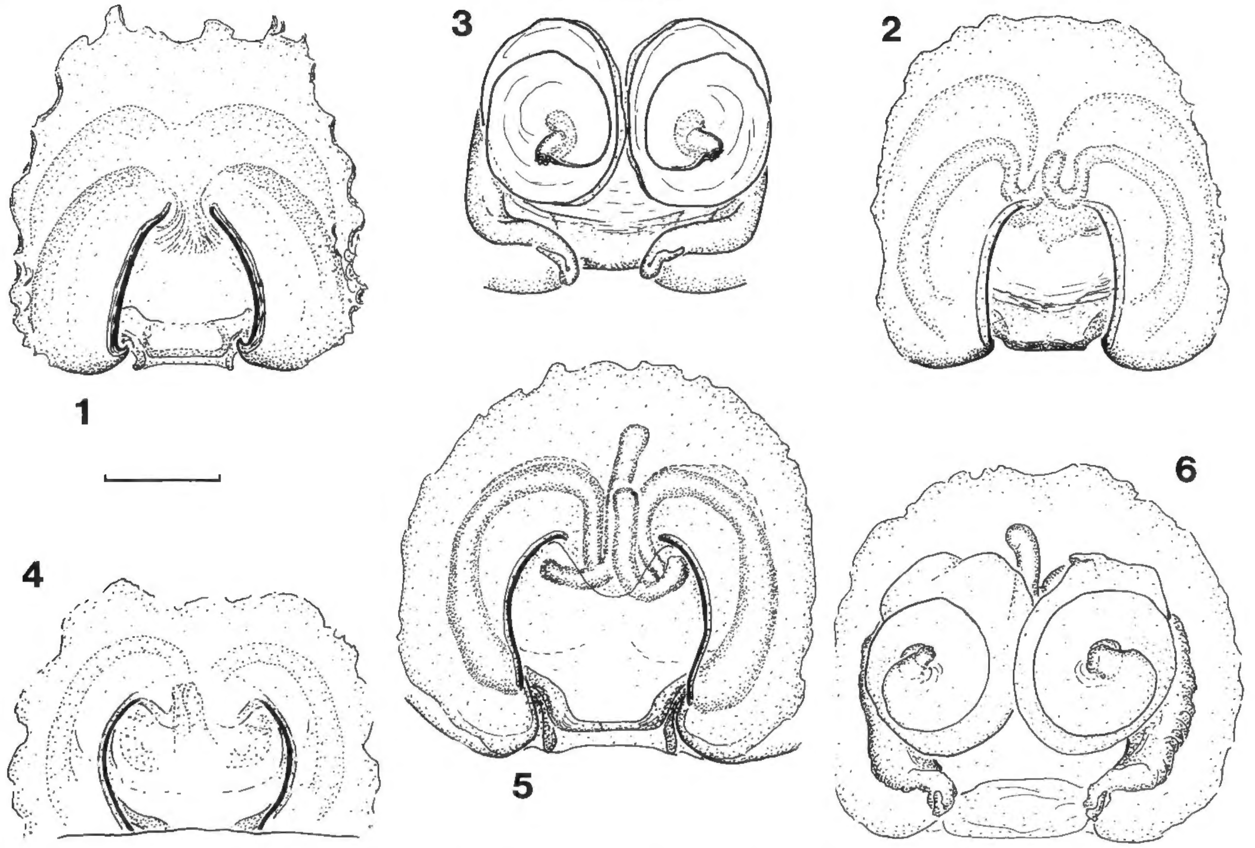
Zachria L. Koch, 1875: 649.

Diagnosis

Carapace longer than wide, low gently rounded sides, flattish medially. Anterior eyes subequal, AME closer to ALE than to each other. Sternum longer than wide, widest mid-length. Anterior legs three to three and a half times carapace length. All metatarsi subequal in length to tibiae. Female spermathecal sacs tubular, long, looped to anterior. Male [known only from L. Koch (1876), see later] with large palpal tibial apophysis and embolus coiled one turn alongside similarly coiled broad conductor in distal half of cymbium.

Description

Large spiders. Carapace longer than wide in the ratio 17:14; raised at sides, flattish above; low, about four and a half to five times longer than high, highest in region of fovea. Fovea a discernible shallow groove; surrounding area not depressed. Setae short. AME equal or subequal to ALE; distance between AME greater than between AME-ALE; posterior row slightly recurved. Chelicerae with two promarginal teeth; four retromarginal teeth, subdistal tooth largest. Labium wider than long in the ratio 7:6. Sternum longer than wide in the ratio 3:2. Legs relatively short, anterior pairs less than three to less than three and a half times



FIGURES 1–6. *Zachria* females. Figs 1–3, *Z. flavicoma:* 1, holotype epigynum; 2, epigynum and vulva of WAM 28/665, ventral; 3, vulva of WAM 28/665, dorsal. Figs 4–6, *Z. oblonga:* 4, holotype epigynum; 5, epigynum and vulva of NMV K-0956, ventral; 6, vulva of NMV K-0956, dorsal. Scale line 0.5 mm.

FIGURE 7. Distribution of *Zachria* and *Eodelena.*
Z. flavicoma □ , *Z. oblonga* ■ , *E. spenceri* ● , *E. melanochelis* ▼ , *E. tasmaniensis* ○ , *E. kosciuskoensis* ▽ , *E. loftiensis* ◇ , *E. convexa* ◆ , *E. lapidicola* △ .

length of carapace [leg measurements of the male *Z. oblonga* derived from L. Koch (1876) indicate a length of less than four times carapace length which is low for an Australian male heteropodid]; leg I, when outstretched alongside leg II, reaches to or near tarsi II. Abdomen much longer than wide, rounded, without pattern, or with dark median streak. Female epigynum with sclerotized lateral rim; fossa deeply recessed anteriorly, whitish, posteriorly with raised pigmented ridge. Spermathecal sacs tubular, long, curved to anterior and reaching to or beyond anterior of fossa.

Type species

Zachria flavicoma L. Koch, 1875 by original designation.

Remarks

Zachria differs from other genera of the Australasian subfamily Deleninae in having all metatarsi subequal in length to the tibiae. In the other genera it is more usual for either the anterior metatarsi or the fourth metatarsi, or both, to be longer than the relevant tibiae. Additionally, the significantly longer than wide carapace separates it from other genera except some *Neosparassus*. *Zachria* further differs from *Eodelena* in having the anterior eyes subequal with AME closer to ALE than to each other and in the presence of spermathecal sacs in the female vulva.

Zachria flavicoma L. Koch

(Figs 1, 2, 3, 7)

Zachria flavicoma L. Koch, 1875: 650, pl. 52, fig. 3. Holotype ♀, King George Sound, Western Australia, Bradley Collection. AM KS18911, ♀, King George Sound, [35°03′S, 117°58′E, Western Australia], agrees with the holotype in dimensions and accompanying data and is considered to be that specimen. It is believed to be part of the Bradley collection which found its way to the Macleay Museum of the University of Sydney, and is presently in the Australian Museum collection.

Diagnosis

(Male unknown). Female anterior leg ratio less than 3. Epigynum somewhat parallel-sided or narrower anteriorly. Vulva with anteriorly curved spermathecal sacs partly extending in front of fossa.

Female AM KS18911

CL 8.62, CW 6.95. AL 18.00, AW 9.90.

Colour in alcohol: Carapace yellowish-brown, striae darker, fovea reddish, caput dark reddish in ocular area. Setae brown. Chelicerae dark reddish. Maxillae and labium dark orange-red. Sternum orange-yellow. Legs dark yellow-brown, anterior metatarsi and tarsi dark orange-brown, patches of dark orange-brown on tibiae, metatarsi and tarsi. Area around sockets of heavier setae on venter and prolateral of femora dark coloured, giving spotted appearance. Abdomen creamy-yellow without pattern.

Carapace: Sides rounded, flattish medially, 5 times longer than high, lowest in ocular region, relatively level from posterior of eyes to posterior of fovea. Eyes: AME 0.52. AME: ALE: PME: PLE = 1: 1.04: 0.54: 0.73. Interspaces: AME-AME 0.58, AME-ALE 0.38, PME-PME 1.69, PME-PLE 1.65, AME-PME 0.96, ALE-PLE 1.23. MOQ, aw: pw: 1 = 2.50: 2.77: 2.31. Width of clypeus to AME 0.29. Labium: L 1.22, W 1.42. Sternum: L 4.38, W 2.90. Legs: anterior leg ratios I = 2.7, II = 2.9.

Epigynum: (Fig. 1). Lateral rims of fossa somewhat parallel; anterior of fossa recessed. Vulva of WAM 28/665 (Figs 2, 3) with spermathecal sacs moderately long and arced at anterior edge of fossa.

Variation

Carapace length of WAM 28/665 is 8.75.

Distribution and remarks

(Fig. 7). *Z. flavicoma* occurs in south-west Western Australia. The male is unknown. The female differs from *Z. oblonga* in the relatively shorter legs, the absence of markings on the abdomen, shorter spermathecal sacs and the insemination ducts with slightly reduced coiling.

Other material examined

Western Australia: Juv., Binnu, 28°02′S, 114°40′E, July 1965, M. deGraaf, WAM 88/1498; ♀, Mundaring, 31°54′S, 116°10′E, 3. vii. 1928, E. Riley, WAM 28/665.

Zachria oblonga L. Koch

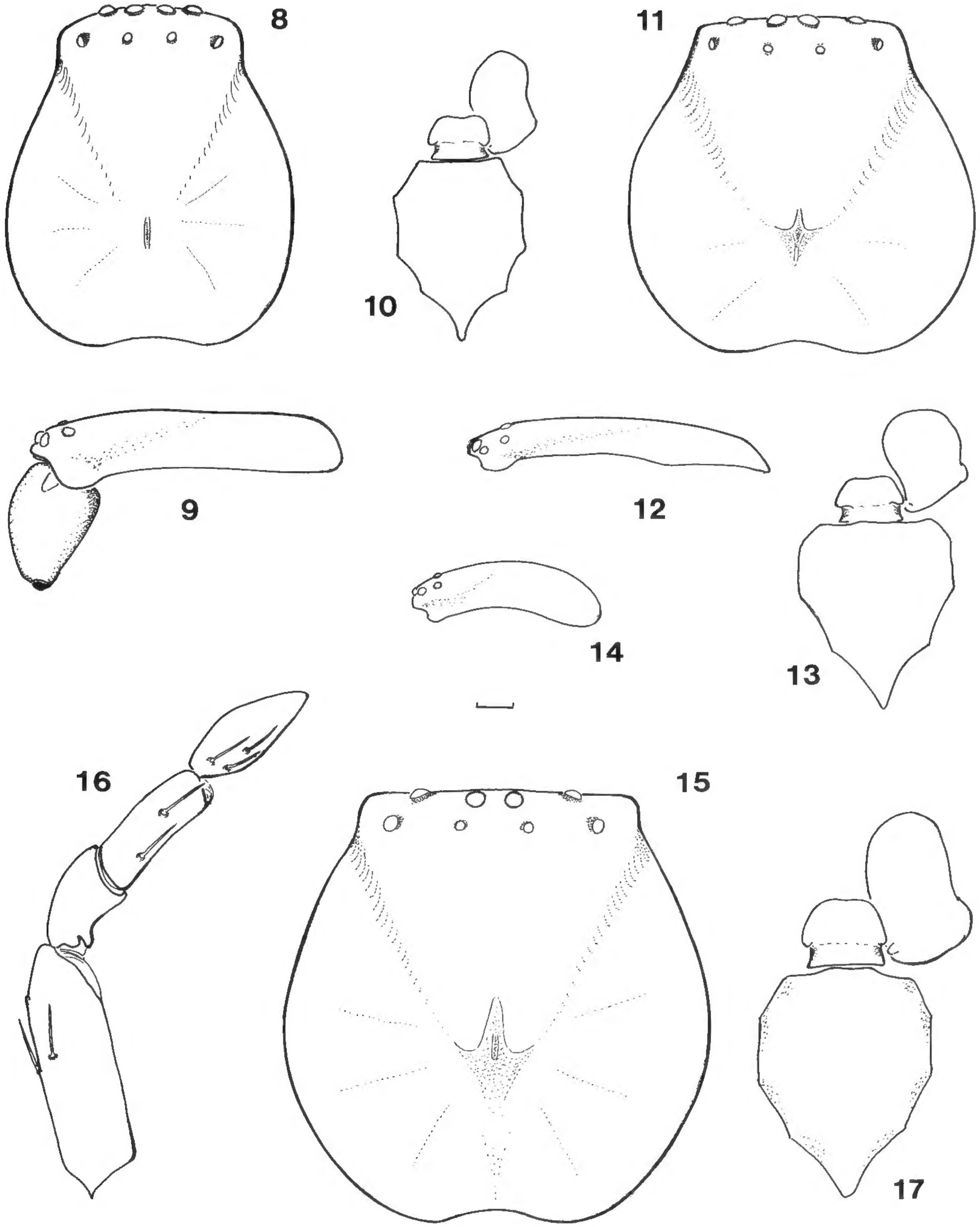
(Figs 4, 5, 6, 7, 8, 9, 10)

Zachria oblonga L. Koch, 1875: 651, pl. 52, fig. 4. Holotype ♀, Sydney, New South Wales, ZMH (Mus. Godeffroy Nr 11022), examined. A second ♀ in NMV (K-0955), [where a small part of the Godeffroy coll. is housed] not mentioned in Koch (1875), also has the number 11022 but is without further data.

Zachria haemorrhoidalis L. Koch, 1875: 653, pl. 52, fig. 5. Hogg, 1902: 454. Syntypes, 2 juveniles, Sydney, New South Wales, ZMH (Mus. Godeffroy Nr 11021), not examined.

Diagnosis

Abdomen may have a dark narrow stripe dorsally. Female anterior leg ratios between 3 and 3.5. Fossa



FIGURES 8–17. *Zachria* and *Eodelena;* carapace, sternum, maxillae, labium and palp. Figs 8–10, *Z. oblonga,* NMV K-0956: 8, carapace, dorsal; 9, carapace and chelicera, lateral; 10, sternum, labium and left maxilla. Figs 11–13, *E. spenceri:* 11, carapace, dorsal; 12, carapace, lateral; 13, sternum, labium and left maxilla. Fig. 14, *E. convexa,* carapace, lateral. Figs 15–17, *E. lapidicola:* 15, carapace; 16, left palp of holotype male, prolateral; 17, sternum, labium and left maxilla. Scale line 1mm.

broad, rounded anteriorly; spermathecal sacs long, extending well to anterior of fossa; insemination ducts coiled 1½ times.

Holotype female

CL 9.75, CW 8.40. AL 15.50, AW 8.70.

Colour in alcohol: Carapace yellow-orange, caput reddish. Chelicerae dark red-brown to blackish. Maxillae and labium reddish. Sternum yellowish. Legs yellow-brown, metatarsi and tarsi reddish. Abdomen dark yellowish dorsally; venter yellow.

Carapace: gently rounded sides, somewhat flattish medially, 4½ times longer than high. Eyes: AME 0.50. AME: ALE: PME: PLE = 1: 1.2: 0.7: 0.8. Interspaces AME-AME 0.8, AME-ALE 0.6, PME-PME 1.8, PME-PLE 2.0, AME-PME 1, ALE-PLE 1.4. MOQ, aw: pw: 1 = 2.8: 3.2: 2.8. Width of clypeus to AME 0.6. Sternum: L 4.74, W 3.07. Legs: anterior leg ratios I = 3.1, II = 3.5.

Epigynum: (Fig. 4). With broad thinly sclerotized lateral sides. Fossa whitish allowing the long tubular spermathecal sacs to be seen beneath. Vulva of NMV K-0956 (Figs 5, 6) with insemination ducts coiled 1½ times.

Description of male modified from L. Koch (1876)

CL 8.0, CW 6.5. AL 9.0 AW *ca* 6.0 (not as broad as carapace).

Colour in alcohol: Carapace brown-yellow, ocular area with black-brown patches; adpressed setae yellow, upright setae black. Chelicerae black-brown; setae grey-yellow; black bristles. Maxillae and labium pale reddish-brown. Sternum pale yellow; setae concolourous. Abdomen dorsally with yellow setae, deep blackish narrowing long stripe, anteriorly indistinct, posteriorly blackish and reaching to spinnerets; venter pale yellow with white setae forming stripes. Spinnerets brown-yellow; black setae. Palps brown-yellow, cymbium black-brown with grey-yellow setae. Leg femora brownish-yellow, remaining segments (patellae to tarsi) light reddish-brown; adpressed setae yellow, upright long setae black; scopula blackish-grey.

Carapace: 0.15 mm longer than broad, low, dorsally flat; fovea shallow, long but not reaching posterior declivity. Eyes: both eye rows straight; AME almost their diameter apart, AME-ALE also almost width of AME apart, ALE as large as AME. Legs: Anterior leg ratios *(ca)* I = 3.5, II = 3.7.

Palps: From the illustration given by L. Koch (pl. 73, fig. 3) the embolus appears to be narrow and coiled once distally while the conductor is thick and also coiled once distally. The palp resembles that of *Eodelena* but the embolus and conductor extend further proximally in the alveolus of the cymbium and the tibial apophysis appears larger and more robust.

Variation

Carapace length of females 8.12–9.15, mean 8.52 (n=4). While most specimens examined are without pattern (partly due to age as the holotype is without a median stripe, though this was clearly figured by L. Koch, 1875) the abdomen of one specimen is with a brown longitudinal median streak which is darker in the posterior half.

Distribution and remarks

(Fig. 7). Known only from Sydney, New South Wales. Females are separated from *Z. flavicoma* by the relatively longer legs, the usual presence of a dark dorsal stripe on the abdomen, fossa broader, more rounded anteriorly, longer spermathecal sacs and insemination ducts with slightly greater coiling.

L. Koch (1876, p. 850; pl. 73, fig. 3) described and figured a male collected by Daemels from *Xanthorrhoea* (grass-tree), Sydney. The institution in which it was deposited was not given nor are its whereabouts known. It is not a type. A redescription modified from L. Koch is given above.

Other material examined

New South Wales: ♀, Scouts Gully, Gordon, Sydney, 19. xii. 1948, A. Musgrave, AM KS16609; ♀, Sydney, AM KS20788; ♀, 1891, W. K., NMV K-0956.

Species Transferred

Järvi (1912) transferred *Typostola magnifica* Hogg (1902) to *Zachria* on the similarity of the female vulva. That combination is not supported by the following characters: the carapace of *T. magnifica* is higher, ALE are larger than the AME and legs are relatively longer with some metatarsi longer than the relevant tibiae. Here *Z. magnifica* is transferred back to *Typostola* Simon.

Genus **Eodelena** Hogg

Eodelena Hogg, 1902: 464. Simon, 1908: 435.
Zachria: Simon, 1903: 1024. Bonnet, 1959: 4907.

Diagnosis

Low flattish to slightly raised convex carapace, usually wider than long, occasionally longer than wide. AME largest, closer to each other than to ALE. Anterior legs about four to five times carapace length. Male embolus with tip barely coiled once. Female epigynum small, weakly sclerotized. Spermathecal sacs absent.

Description

Medium to large spiders; low flat carapace with shallow, often indistinct fovea in circular depression or with slightly convex carapace and fovea a long shallow groove. Anterior eye row straight, posterior row straight to slightly procurved; AME largest, PME smallest, laterals subequal. Clypeus half width of AME or less. Chelicerae with two promarginal teeth; three or four, rarely five, retromarginal teeth, proximal tooth small, others subequal, subdistal tooth usually larger. Labium 1½ times wider than long. Sternum truncate anteriorly, bluntly pointed posteriorly; widest between coxae II at ⅓ its length from anterior and barely longer than wide in the ratio 5:4, except *E. lapidicola* in which it is longer than wide and widest mid-length. Legs 2143. Leg I, when outstretched alongside leg II, reaches mid-way along metatarsus II. Dorsal tibial spines usually lacking, patellae usually without spines except retrolaterally on II. Tibiae ventrally with three spine pairs except IV which often has two, lacking the distal pair. Metatarsi IV without distal lateral spines. Palp femur with two or three dorsal and one prolateral spine, usually short, thin, except *E. lapidicola* which lacks palpal femur spines. All leg spines relatively short except metatarsi IV ventral spines which are longer. Legs usually with long erect setae but few adpressed setae. Scopula relatively long, sparse, on all metatarsi and tarsi. Abdomen may be flattened dorsoventrally, dorsal pattern consists of dark spots, or blackish with pale spots. Male cymbium may be with two or three prolateral spines or stout long bristles. Male palpal tibia with short retrolateral apophysis with small membranous support. Embolus long; from its base arcing around tegulum, running along prolateral side of cymbium before looping near tip for almost one complete turn. Conductor begins at prolateral side of tegulum following route of embolus to support tip of embolus. Embolic sclerite present with apex attenuated or rounded. Female epigynum small; well defined but weakly sclerotized lateral edges overhanging whitish fossa; lacking setae medially but with setae extending between sclerotized lateral sides at anterior edge of fossa. Fossa recessed anteriorly, whitish, posteriorly with pigmented 'plateau' formed by fusion of insemination duct bases to fossa. Vulva with one to one and a half insemination duct coils; spermathecal sacs absent.

Type species

Eodelena spenceri Hogg, 1902 by original designation and monotypy.

Remarks

Eodelena is removed from *Zachria* as it differs in the AME being larger than the ALE with the AME closer to each other than to the ALE, the carapace wider than long or at least not significantly longer than wide, most metatarsi longer than the tibiae and in the female by the absence of spermathecal sacs. *Eodelena* is similar in appearance to *Delena* from which it can be separated by the latter having in the male a highly coiled embolus and by the female having a larger fossa containing numerous setae medially. *E. lapidicola* is most similar to *Delena* in its large size, in having the carapace longer than wide, the sternum noticeably longer than wide and widest mid-length (Fig. 17), and a lack of distal spines on the palpal femur. It differs from *Delena* in having broader eye rows (Fig. 15), relatively shorter legs, longer palpal femur, and more leg spines in addition to the above genitalic differences.

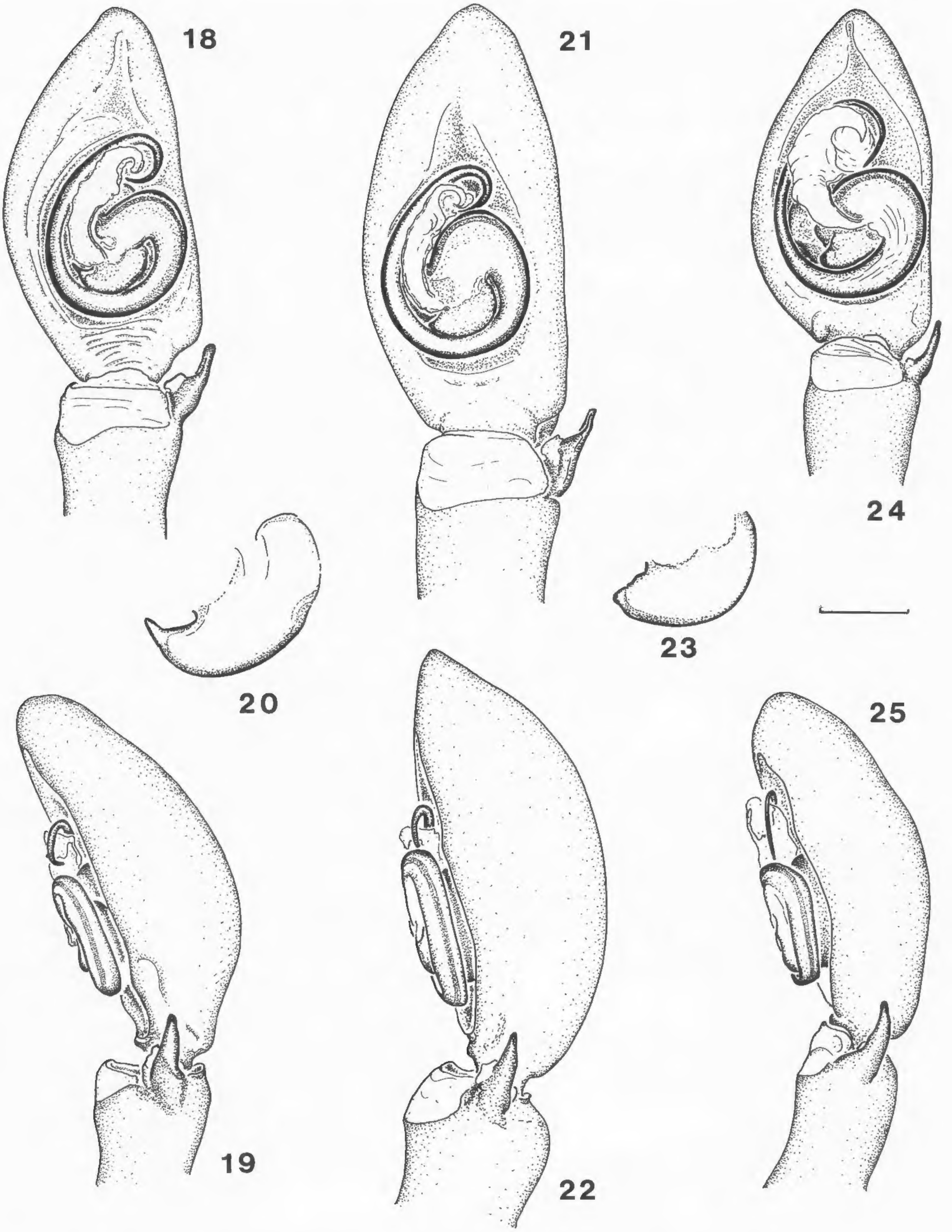
Eodelena convexa is least likely to be confused with *Delena* and other *Eodelena* species as it possesses a convex carapace (Fig. 14) and more spinose legs. As in *E. lapidicola, E. convexa* has the carapace slightly longer than broad. The remaining *Eodelena* species have the carapace wider than long (Fig. 11) and with *convexa*, the sternum only slightly longer than wide and widest about ⅓ from the anterior edge (Fig. 13).

A key to the female *Eodelena* species is given but with the exception of *E. convexa* and *E. lapidicola*, care is required in their diagnosis as colour, size and epigynum shape are very similar and variable. *E. kosciuskoensis* and *E. loftiensis* differ from other known females in the fertilization and insemination duct coiling while *E. loftiensis* differs from *E. kosciuskoensis* in the slightly higher carapace and abdomen pattern. The female of *E. tasmaniensis* is separated from those of *E. melanochelis* and *E. spenceri* by the general darker colour and the smaller epigynum with more compact insemination duct coils and *E. melanochelis* differs from *E. spenceri* in its smaller size and the narrower epigynum.

KEY TO THE SPECIES OF *EODELENA*

Males

1 — Carapace wider than long 2
Carapace longer than wide 5
2 — Embolic sclerite with attenuate or acute apex (Figs 20, 23) 3
— Embolic sclerite with rounded apex (Fig. 24) 4
3 — Embolic sclerite narrow; apex attenuate (Fig. 20) .... *spenceri* Hogg
— Embolic sclerite broad, short bluntly pointed apex (Fig. 23) .... *melanochelis* (Strand)
4 — Carapace convex but low, abdomen with scattered blackish spots. Embolic base large, angular retrolaterally (Fig. 26); embolic sclerite small .. .. *loftiensis* sp. nov.
— Carapace flattish, abdomen with numerous blackish spots. Embolic base rounded retrolaterally; embolic sclerite relatively large (Fig. 24) .... *tasmaniensis* sp. nov.



FIGURES 18–25. Left palpal tibia and tarsus, and embolic sclerite of male *Eodelena*. Figs 18–20, *E. spenceri*, holotype: 18, ventral; 19, retrolateral; 20, embolic sclerite. Figs 21–23, *E. melanochelis*, SAMA N1989589: 21, ventral; 22, retrolateral; 23, embolic sclerite. Figs 24–25, *E. tasmaniensis*, holotype: 24, ventral; 25, retrolateral. Scale line 0.5 mm except 20 and 23, 0.25 mm.

5 — Carapace convex, 4–6 mm long. Palpal femur with distal spines; palpal tarsus 2× longer than tibia, without prolateral spines.....*convexa* sp. nov.
— Carapace flat, 8–12 mm long. Palpal femur without distal spines; palpal tarsus subequal in length to tibia, with prolateral spines (Fig. 16)..................................*lapidicola* sp. nov.

Females

1 — Carapace wider than long, usually less than 8 mm long....................................2
— Carapace longer than wide, 8–12 mm long.............................*lapidicola* sp. nov.
2 — Fertilization ducts not enlarged to form coil, insemination ducts thin, membranous (Fig. 41)..3
— Fertilization ducts enlarged to form robust coil, insemination ducts partly or wholly sclerotized (Fig. 47)................................5
3 — Abdomen yellowish with patches of dark suffusion..4
— Abdomen largely with dark suffusion.........................*tasmaniensis* sp. nov.
4 — Epigynum broad, sides parallel anteriorly (Fig. 40)............................*spenceri* Hogg
— Epigynum narrow, sides incurved anteriorly (Fig. 42)....................*melanochelis* (Strand)
5 — Carapace flattish, abdomen with dark suffusion.....................*kosciuskoensis* sp. nov.
— Carapace slightly convex, abdomen spotted.............................*loftiensis* sp. nov.

Eodelena spenceri Hogg

(Figs 7, 11, 12, 13, 18, 19, 20, 33, 39, 40, 41)

Eodelena spenceri Hogg, 1902: 464, fig. 104. Syntypes, ♂ and immature ♀, King Island [39°55′S, 144°00′E], Bass Strait, Australia, 1888, Professor Baldwin Spencer, BMNH 1888.144, examined.
Zachria spenceri: Simon, 1903: 1024.

Diagnosis

Male with relatively narrow embolic sclerite with apex long, attenuated. Female epigynum relatively parallel-sided anteriorly and as broad as long.

Syntype male

CL 5.90, CW 6.10. AL 6.70, AW 5.05.

Colour in alcohol: Carapace yellow-brown, striae brown but may be an artefact of preservation, caput yellowish with reddish lateral margins and ocular area. Chelicerae reddish; sparse long yellow-brown setae. Maxillae and labium orange-red. Sternum yellow; setae yellow-white. Coxae yellowish. Legs yellow-brown; femora yellowish ventrally, anterior tibiae and metatarsi orange-brown. Palpal tarsi orange-brown. Abdomen yellow-brown with brown-black suffusion forming spots.

Carapace: 6 to 7 times longer than high, highest posterior to fovea. Fovea indistinct in shallow depression. Chelicerae: retromarginal teeth 4. Eyes: AME 0.38. AME: ALE: PME: PLE = 1: 0.79: 0.63: 0.84. Interspaces: AME-AME 0.82, AME-ALE 1.26, PME-PME 2.21, PME-PLE 1.95, AME-PME 0.79, ALE-PLE 0.84. MOQ, aw: pw: 1 = 2.82: 3.47: 2.53. Width of clypeus to AME 0.32. Labium: L 0.91, W 1.31. Sternum: L 3.19, W 3.18. Legs: anterior leg ratios I = 4.7, II = 5.9. Upright setae sparse.

Palps: (Figs 18, 19). Embolic sclerite relatively narrow with long attenuate apex (Fig. 20).

Female TM J145 (as male except as follows)

CL 6.89, CW 7.14. AL 10.25, AW 7.20.

Colour in alcohol: Carapace yellowish, striae reddish, ocular area and lateral margins of caput reddish. Chelicerae dark reddish-brown; setae yellow-brown. Maxillae and labium orange-red. Sternum yellow, margins reddish. Leg coxae and femora yellowish, anterior metatarsi and tarsi orange-red. Palps orange-red. Abdomen (Fig. 33) yellow-brown with anterior yellow streak, blackish suffusion forming spots; venter yellow, blackish suffusion medially.

Eyes: AME 0.41. AME: ALE: PME: PLE = 1: 0.78: 0.63: 0.73. Interspaces: AME-AME 0.83, AME-ALE 1.37, PME-PME 2.29, PME-PLE 2.07, AME-PME 0.83, ALE-PLE 0.95. MOQ, aw: pw: 1 = 2.83: 3.56: 2.46. Width of clypeus to AME 0.27. Labium: L 0.96, W 1.58. Sternum: L 3.67, W 3.47. Legs: anterior leg ratios I = 4.1, II = 5.1.

Epigynum: (Fig. 41). Narrow anteriorly, broadest medially.

Variation

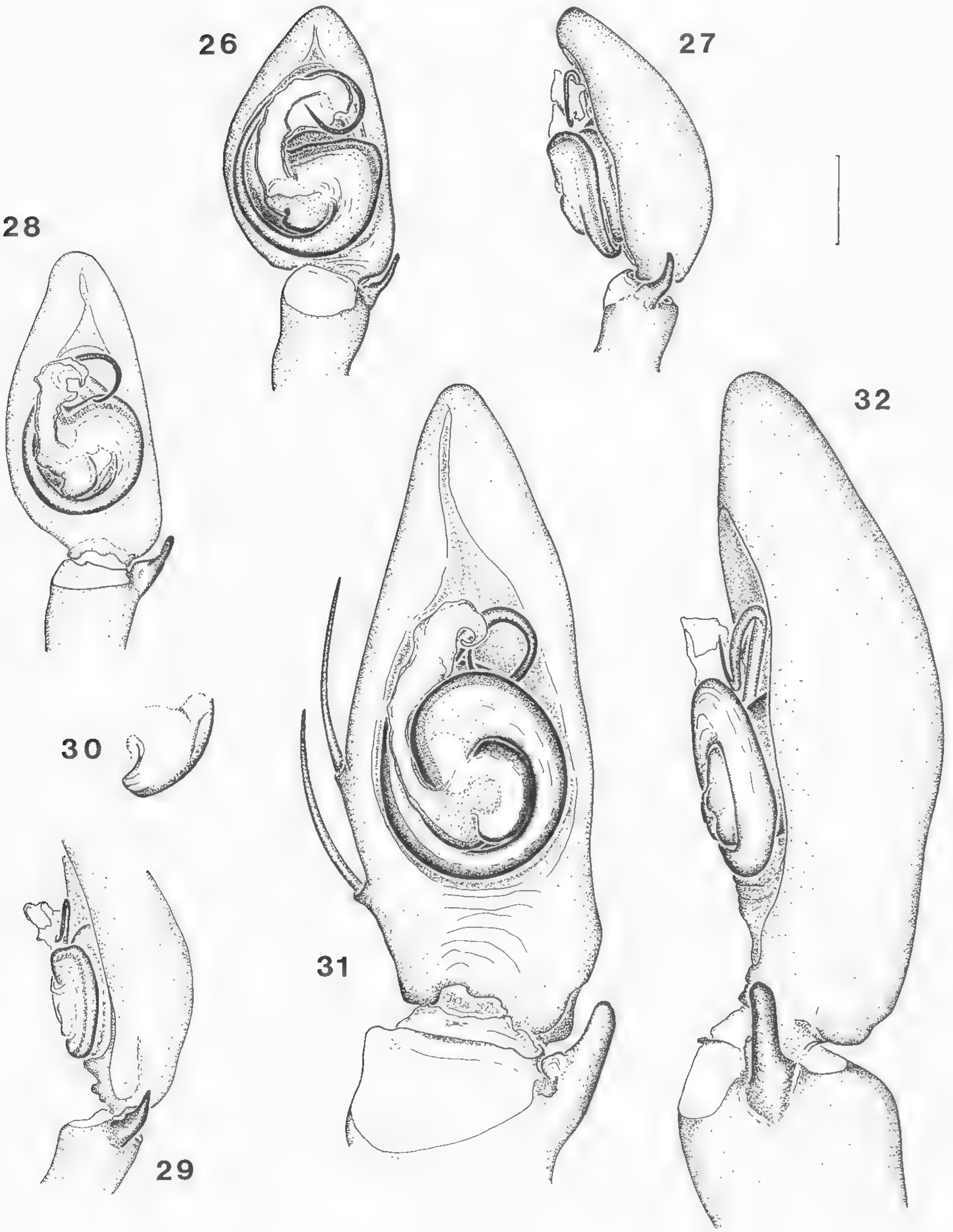
Carapace length of males 5.02–9.37, mean 6.99 (n=8). The embolic sclerite may have much of the attenuate apex broken off or rounded, but along with the sclerite shape, remains distinct from *E. melanochelis*. Carapace length of females 5.78–8.50, mean 7.50 (n=5). The usual form of the epigynum (Figs 39, 40) is broader anteriorly but is somewhat variable and occasionally may be similar to *E. melanochelis* in having the lateral sides curving inwards anteriorly (Fig. 41) rather than being parallel. The vulva has 1½ insemination duct coils.

Distribution

(Fig. 7). King Island, Bass Strait and northern and eastern Tasmania.

Other material examined

Tasmania: ♀, Blackmans Bay, 42°52′S, 147°51′E, 1924, SAMA N1989573; penult. ♂, same data, SAMA N1989574; ♂, Hermit Camp,



FIGURES 26-32. Left palpal tibia and tarsus, and embolic sclerite of male *Eodelena*. Figs 26-27, *E. loftiensis,* holotype: 26, ventral; 27, retrolateral. Figs 28-30, *E. convexa*, holotype: 28, ventral; 29, retrolateral; 30, embolic sclerite. Figs 31-32, *E. lapidicola,* holotype: 31, ventral; 32, retrolateral. Scale line 0.5 mm except 30, 0.25 mm.

(?Hermit Valley = 42°51′S, 146°09′E), 19. iii. 1972, H.D. B., A.P. A., TM J790; 4 ♂♂, Islands, Bass Strait, Dec. 1908, J. A. Kershaw, NMV; 3 ♀♀, King Island, 39°55′S, 144°00′E, Dec. 1906, J. A. Kershaw, NMV K-0957; ♂, Lake St Clair, 42°04′S, 146°10′E, Oct. 1937, A. W. G. Powell, TM J278; juv., Taroona, 42°57′S, 147°20′E, 15. ii. 1978, J. Parrott, TM J1296; ♂, ♀, Trevallyn, Launceston, 41°27′S, 147°10′E, V. V. Hickman, TM J145. Further material of 1 ♀, 2 ♂♂, 1 juv., labelled Adelaide, Jan. 1924, Cameron W, SAMA N1989575-8, is also considered to be from Tasmania. The locality 'Adelaide' is typed on a separate label while the hand written label with date and collector is similar to that of the Blackmans Bay specimens (also dated 1924).

Eodelena melanochelis (Strand) **comb. nov.**
(Figs 7, 21, 22, 23, 34, 42, 43)

Zachria melanochelis Strand, 1913: 204. Holotype ♀, Victoria. H. and A. Eberhard. Whereabouts unknown.

Diagnosis

Male embolic sclerite broad with a short, bluntly pointed apex. Female epigynum relatively long and narrow.

Male SAMA N1989589

CL 7.42, CW 7.71. AL 7.65, AW 5.20.

Colour in alcohol: Carapace creamy-yellow, caput reddish on lateral margins and around posterior eye row; clypeus and around anterior eye row dark red-brown. Chelicerae black. Maxillae and labium reddish. Sternum yellow. Coxae and basal half of femora creamy-yellow, remainder of leg segments orange-yellow, darker on metatarsi and tarsi. Abdomen yellow-brown with blackish suffusion forming spots. Venter with median pale yellow area with blackish suffusion.

Carapace: Low; sides gently sloping, flattish medially, 6 to 7 times longer than high, highest posterior to fovea. Fovea in shallow depression. Eyes: AME 0.46. AME: ALE: PME: PLE = 1: 0.78: 0.61: 0.78. Interspaces: AME-AME 0.70, AME-ALE 1.26, PME-PME 2.22, PME-PLE 2.06, AME-PME 0.67, ALE-PLE 0.85. MOQ, aw: pw: 1 = 2.70: 3.43: 2.13. Width of clypeus to AME 0.19. Labium: L 1.02, W 1.45. Sternum: L 3.98, W 3.59. Broadest ⅓ length from anterior. Legs: anterior leg ratios I = 4.4, II = 5.4. Upright setae sparse.

Palps: (Figs 21, 22). Embolic sclerite broad with short bluntly pointed apex (Fig. 23).

Female SAMA N1989592 (as male except as follows)

CL 6.70, CW 7.20. AL 10.45, AW 7.30.

Colour in alcohol: Caput with orange-red lateral margins and around ocular area; orange-red suffusion medially, dark red-brown between ALE-PLE and between AME. All eyes with blackish rims. Chelicerae glossy blue-black. Maxillae and labium orange-red, maxillae with dark brown prolateral patch. Sternum creamy-yellow. Abdomen (Fig. 34).

Eyes: AME 0.40. AME: ALE: PME: PLE = 1: 0.88: 0.70: 0.90. Interspaces: AME-AME 0.93, AME-ALE 1.38, PME-PME 2.18, PME-PLE 2.20, AME-PME 0.85, ALE-PLE 0.90. MOQ, aw: pw: 1 = 2.93: 3.58: 2.40. Width of clypeus to AME 0.33. Labium: L 1.00, W 1.58. Sternum: L 3.79, W 3.51. Legs: anterior leg ratios I = 4.0, II = 4.8.

Epigynum: (Figs 42, 43). Broader in anterior half; posterior 'plateau' long with procurved anterior edge. Vulva with a little over one complete coil of the insemination duct.

Variation

Carapace lengths of males 5.66–7.42, mean 6.45 (n=5). Carapace lengths of females 5.34–6.90, mean 6.16 (n=7). One female from Icy Creek with much darker abdomen more similar in pattern to *E. tasmaniensis.*

Distribution and remarks

(Fig. 7). Occurs in southern Victoria to the alpine area of Mt Buffalo. *E. melanochelis* is very common in the Dandenong Ranges where it is found in lengths of tightly rolled bark hanging from *Eucalyptus* or from the undergrowth beneath *Eucalyptus.* The male differs from *E. spenceri* in the relatively shorter and broader embolic sclerite with short pointed apex and the female by the smaller size and narrower epigynum with lateral sides curved inwards anteriorly.

The redescription is from recently collected material which is considered to have come from near the type locality. Although the collectors of the type material were from Melbourne, a specimen of *Lampona obscoena* L. Koch from Gippsland, Victoria, was mentioned in the same paper. It may be assumed that the types of *melanochelis* came from within those areas.

Material examined

Victoria: ♀, Belgrave, 37°55′S, 145°21′E, 12. vi. 1989, D. Hirst, SAMA N1989592; ♀, same data, SAMA N1989593; ♀, Blackwood, 37°29′S, 144°19′E, 26. vi. 1980, H. Parnaby, AM KS19695; ♀, juv., same locality, 10. x. 1977, H. Parnaby, AM KS19287; ♀ and spiderling, Emerald, 37°56′S, 145°27′E, 12. vi. 1989, D. Hirst, SAMA

N1989594-5; 1 ♂, 2 ♀ ♀, 4 km NE Icy Creek, 37°51′S, 146°07′E, 11. vi. 1989, D. Hirst, SAMA N1989589-91; juv. Macclesfield district, *ca* 37°54′S, 145°30′E, Aug. 1904, E. J., NMV; 2 ♂ ♂, camping area, Lake Catani, Mt Buffalo, 36°44′S, 146°49′E, 21. ii. 1979, H. Parnaby, AM KS19288; ♂, Pirron Yallock, 38°21′S, 143°24′E, 19. vi. 1989, D. Hirst, SAMA N1989588; ♂, no data, AM KS19289.

Eodelena tasmaniensis sp. nov.

(Figs 7, 24, 25, 35, 44, 45)

Types

Holotype: ♂, Olga Valley, 42°43′S, 145°46′E, (HEC transect 2L.6445), south-west Tasmania, 20. i. 1977, C. Howard and G. Johnston, TM J1486.

Allotype: ♀, Wedge River, Gordon Road (*ca* 42°45′S, 146°12′E) south-west Tasmania, 21. iii. 1972, A.P. A. and H.D. B., TM J789.

Paratypes: ♂, Junction Creek, W. Arthur Plains, 43°07′S, 146°18′E, 8. ii. 1966, Neboiss, NMV K-0915; ♀, same data, NMV K-0916.

Diagnosis

Abdomen blackish with small yellowish spots. Male embolic sclerite with broad rounded apex. Female epigynum horse-shoe shaped in anterior half.

Holotype male

CL 5.25, CW 5.26. AL 6.10, AW 4.40.

Colour in alcohol: Carapace orange-red with brown suffusion on lateral edges, striae and ocular area; numerous short dark brown setae around fovea. Chelicerae dark red-brown to blackish. Maxillae and labium orange-brown. Sternum yellowish. Legs yellow proximally; orange-red on femora distally and to tarsi. Abdomen dorsally with pale areas largely obscured by dark pigment. Venter dark with pale bordered median area containing dark pigment.

Carapace: Flattish, 6.5 to 7 times longer than high, highest posterior to fovea. Fovea indistinct in shallow depression. Eyes: AME 0.38. AME: ALE: PME: PLE = 1: 0.79: 0.58: 0.68. Interspaces: AME-AME 0.68, AME-ALE 0.97, PME-PME 1.79, PME-PLE 1.63, AME-PME 0.66, ALE-PLE 0.74. MOQ, aw: pw: 1 = 2.58: 3.00: 2.05. Width of clypeus to AME 0.21. Labium: L 0.70, W 1.12. Sternum: L 2.80, W 2.62. Legs: anterior leg ratios I = 4.2, II = 5.2.

Palps: (Figs 24, 25). Palpal tibial apophysis relatively longer than in preceding species. Embolic sclerite with broadly rounded apex. Embolus relatively short, distally with less than a ¾ turn.

Allotype female (as holotype except as follows)

CL 6.32, CW 6.29. AL 9.24, AW 6.30.

Colour in alcohol: Abdomen (Fig. 35).

Eyes: AME 0.40. AME: ALE: PME: PLE = 1: 0.80: 0.65: 0.75. Interspaces: AME-AME 0.85, AME-ALE 1.40, PME-PME 2.35, PME-PLE 1.95, AME-PME 0.75, ALE-PLE 1.00. MOQ, aw: pw: 1 = 2.85: 3.65: 2.35. Width of clypeus to AME 0.3. Labium: L 0.86, W 1.38. Sternum: L 3.17, W 3.06. Legs: anterior leg ratios I = 3.7, II = 4.6.

Epigynum: (Fig. 44). Small, somewhat rounded in anterior half.

Variation

Carapace length of males 4.41–7.03, mean 5.72 (n = 2). Carapace length of females 5.91–7.25, mean 6.52 (n = 3). Vulva of paratype NMV K-0916 (Fig. 45) with small compact insemination ducts.

Distribution and remarks

Known only from south-western Tasmania (Fig. 7). While the much darker general colour separates this species from the only other known Tasmanian species, *E. spenceri*, specimens of *E. kosciuskoensis* from the southern alpine area of NSW are also of comparable dark colouring but differ from *E. tasmaniensis* in the robust fertilization ducts. *E. tasmaniensis* differs from *E. spenceri* in the broad, rounded embolic sclerite in the male and the relatively small, rounded fossa of the female.

Other material examined

Tasmania: ♂, penult. ♂, 3 juv., Franklin River area, 42°27′25″S, 145°43′45″E, 14. i. 1983, ANZSES Exped., QM S14146; ♀, juv., same locality, Jan., 1983, ANZSES Exped., QM S14147; penult. ♂, Maatsuyker Island, 43°39′S, 146°16′E, 10. xi. 1970, P. Rawlinson, TM J712; ♀, Picton area (*ca* 43°10′S, 146°40′E), 27. xi. 1962, C. McCubbin, NMV; juv., same data as allotype, TM J789.

Etymology

The name reflects its known distribution as being endemic to Tasmania.

Eodelena kosciuskoensis sp. nov.

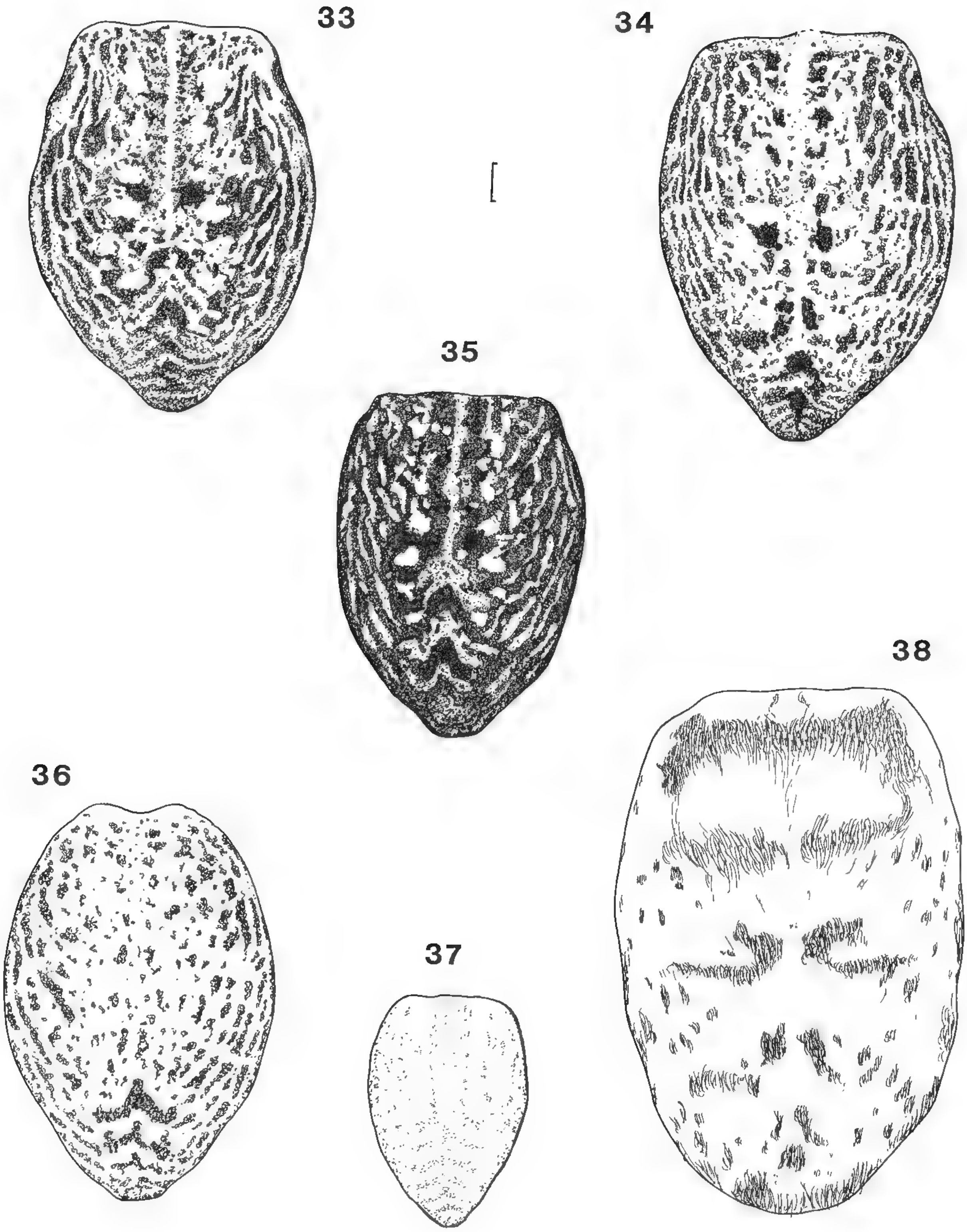
(Figs 7, 48, 49)

Type

Holotype: ♀, inside curled shed ribbon bark of eucalypt, on ground, 12 km S Thredbo (36°30′S, 148°19′E), Grid 147 476 on 1:100,000, New South Wales, 31. xii. 1983, H. Parnaby, AM KS19286.

Diagnosis

(Male unknown). Carapace flattish. Abdomen



FIGURES 33–38. *Eodelena* abdomens, dorsal pattern. 33, *E. spenceri*, TM J145, female; 34, *E. melanochelis*, SAMA N1989593, female; 35, *E. tasmaniensis*, allotype female; 36, *E. loftiensis*, allotype female; 37, *E. convexa*, holotype male; 38, *E. lapidicola*, allotype female. Scale line 1 mm.

dark coloured. Female with robust fertilization ducts and small sclerotized insemination duct coils.

Female

CL 5.18, CW 5.77. (Abdomen damaged) AL *ca* 7.0, AW *ca* 5.0.

Colour in alcohol: Carapace yellow-brown, margins of caput orange-brown, ocular area and clypeus with dark brown suffusion; setae brown. Chelicerae brown-black. Maxillae and labium orange-brown. Sternum yellow with orangish margins; sparse greyish setae. Coxae yellow; grey setae. Leg femora yellowish; patellae to tarsi orange-brown. Abdomen with epidermis partly lifted, yellow-brown with blackish suffusion.

Eyes: AME 0.35. AME: ALE: PME: PLE = 1: 0.71: 0.6: 0.74. Interspaces: AME-AME 0.74, AME-ALE 1.14, PME-PME 2.11, PME-PLE 1.89, AME-PME 0.86, ALE-PLE 0.91. MOQ, aw: pw: 1 = 2.74: 3.31: 2.46. Width of clypeus to AME 0.29. Labium: L 0.79, W 1.25. Sternum: L 3.02, W 2.84. Legs: anterior leg ratios I = 4.5, II = 5.6.

Epigynum: Rounded in anterior half, slightly narrowing towards posterior (Fig. 48). Fertilization ducts robust and heavily sclerotized (Fig. 49).

Distribution and remarks

(Fig. 7). Known only from within the Kosciusko National Park, New South Wales, hence the specific epithet. The holotype female is damaged and the abdomen pattern partly destroyed by lifting of the epidermis. Two juveniles from Tumut Reservoir have even darker abdomens. *E. kosciuskoensis* differs from *E. loftiensis* in the smaller, robust fertilization ducts and insemination ducts, the flatter carapace and darker abdomen pattern.

Other material examined

New South Wales: 2 juv., Tumut Reservoir, 35°58′S, 148°25′E, 22. v. 1988, D. Hirst, SAMA N1989596-7.

Eodelena loftiensis sp. nov.
(Figs 7, 26, 27, 36, 46, 47)

Types

Holotype: ♂, in rolled bark, Loftia Park, 35°02′S, 138°42′E, Mount Lofty Ranges, South Australia, 14. ix. 1989, J. A. Forrest, SAMA N1989579.

Allotype: ♀, same data as holotype, but L. N. Nicolson, SAMA N1989580.

Paratypes: ♀, same data as holotype, but D. Hirst, SAMA N1989582; ♀, under bark of *Eucalyptus*, Loftia Park, South Australia, 25. iii. 1984, R. V. Southcott, SAMA N1989581; ♂, Loftia Park, in rolled bark with immature female, 27. iii. 1990, D. Hirst, SAMA N1989616.

Diagnosis

Carapace low, slightly convex. Abdomen pale with numerous small blackish spots. Male embolic base large, angular retrolaterally; embolic sclerite small, apex bluntly extended and rounded. Female with small insemination ducts coiled one and a half times and enlarged fertilization ducts coiled once.

Holotype male

CL 3.34, CW 3.59. AL 4.19, AW 2.68.

Colour in alcohol: Carapace creamy-yellow; brown suffusion on lateral sides; caput with yellow lateral margins, clypeus and ocular area orangish; dark brown in median ocular quadrangle. Chelicerae dark red-brown. Labium orange, maxillae yellow with orange patch prolaterally. Sternum yellowish. Coxae and femora proximally creamy, remainder of legs orange-red but tarsi yellow-brown. Abdomen pale yellow-brown with spots formed by dark setae and pigment, yellowish anterior streak; venter yellow-brown.

Carapace: Low convex, 5 times longer than high, highest posterior to fovea. Fovea indistinct in shallow depression. Setae relatively long. Eyes: AME 0.25. AME: ALE: PME: PLE = 1: 0.8: 0.72: 0.83. Interspaces: AME-AME 0.76, AME-ALE 0.78, PME-PME 1.84, PME-PLE 1.64, AME-PME 0.79, ALE-PLE 0.92. MOQ, aw: pw: 1 = 2.76: 3.28: 2.44. Width of clypeus to AME 0.36. Chelicerae: retromargin with 3 subequal teeth. Labium: L 0.45, W 0.82. Sternum: L 1.82, W 1.92. Legs: anterior leg ratios I = 4.8, II = 7.6.

Palps: (Figs 26, 27). Tibial apophysis long, thin, slightly curved. Embolic base large retrolaterally, embolic sclerite with rounded apex.

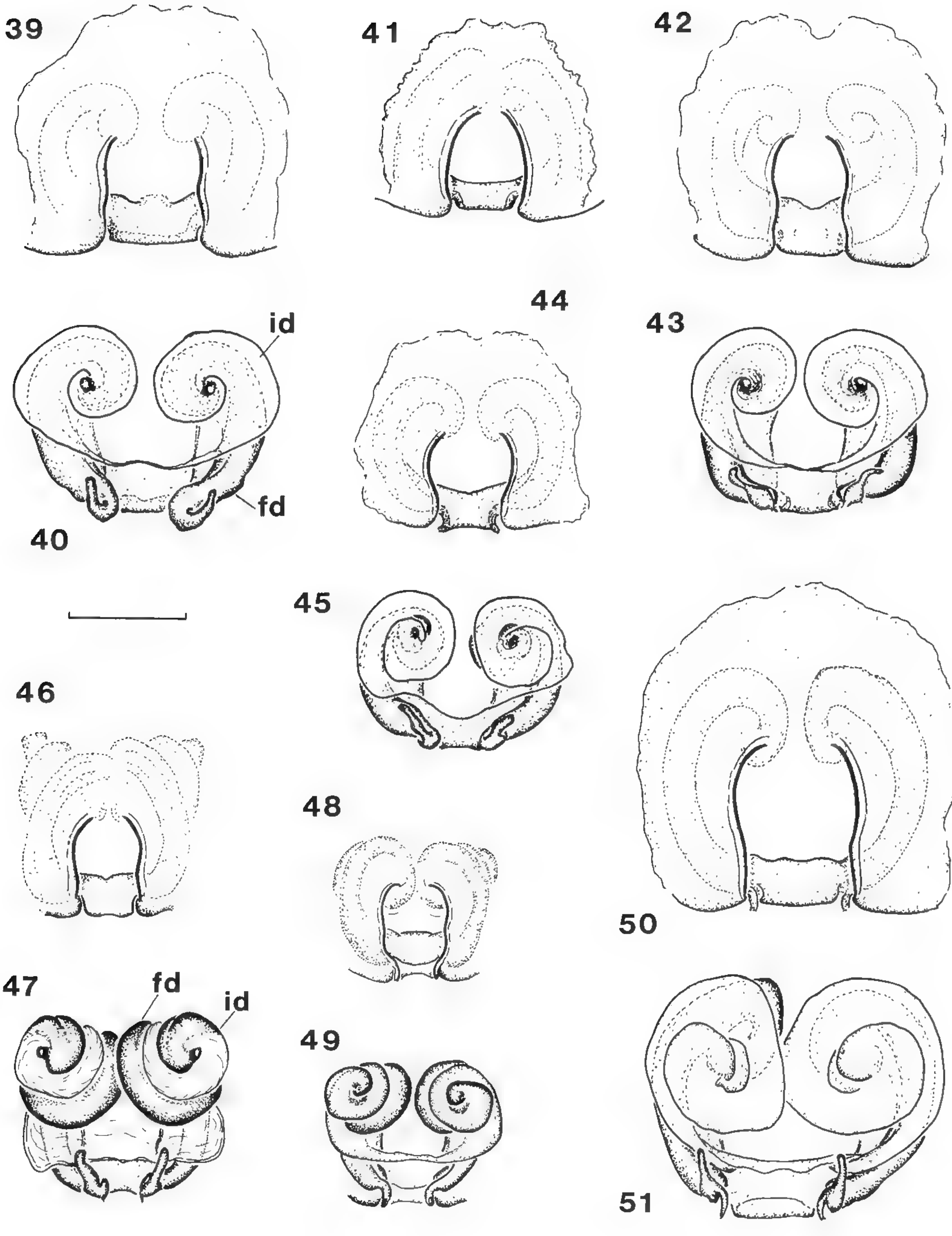
Allotype female (as holotype except as follows)

CL 5.02, CW 5.18. AL 10.50, AW 6.92.

Colour in alcohol: Chelicerae blackish, shiny. Maxillae orangish; brown prolateral patch. Sternum creamy-yellow. Metatarsi reddish. Abdomen (Fig. 36).

Eyes: AME 0.36. AME: ALE: PME: PLE = 1: 0.75: 0.67: 0.72. Interspaces: AME-AME 0.72, AME-ALE 1.06, PME-PME 1.94, PME-PLE 2.03, AME-PME 0.69, ALE-PLE 1.06. MOQ, aw: pw: 1 = 2.72: 3.28: 2.28. Width of clypeus to AME 0.17. Chelicerae: left chelicera with 4 teeth, basal minute, others subequal. Labium: L 0.71, W 1.19. Sternum: L 2.61, W 2.52. Legs: anterior leg ratios I = 4.2, II = 5.2. Upright setae more numerous than in the male.

Epigynum: (Figs 46, 47). Relatively shorter and broader than other species, somewhat parallel sided. Vulva with small insemination ducts coiled 1½



FIGURES 39–51. *Eodelena* female epigyna and vulvae, cleared. Figs 39–41, *E. spenceri:* 39, epigynum and vulva of NMV K-0957, ventral; 40, vulva of NMV K-0957, dorsal; 41, epigynum of TM J145. Figs 42–43, *E. melanochelis*, SAMA N1989592: 42, epigynum and vulva, ventral; 43, vulva, dorsal. Figs 44–45, *E. tasmaniensis*, paratype NMV K-0916: 44, epigynum and vulva, ventral; 45, vulva, dorsal. Figs 46–47, *E. loftiensis*, paratype SAMA N1989581: 46, epigynum and vulva, ventral; 47, vulva, dorsal. Figs 48–49, *E. kosciuskoensis*, holotype: 48, epigynum and vulva, ventral; 49, vulva, dorsal. Figs 50–51, *E. lapidicola*, paratype WAM 88/1979: 50, epigynum and vulva, ventral; 51, vulva, dorsal. Scale line 0.5 mm. id, insemination duct; fd, fertilization duct.

times and enlarged fertilization ducts with one coil, together appearing as being continuously coiled 2½ times.

Variation

Carapace length of paratype male 3.56. Carapace length of females 4.40–5.46, mean 4.78 (n=7).

Distribution and remarks

E. loftiensis is considered to be restricted to the high rainfall areas of the Mount Lofty Ranges in South Australia (Fig. 7). The specific epithet refers to the type locality, Loftia Park. Two females were collected with egg-sacs, one subsequently being destroyed. Eggs are loosely held in place against the substrate by a thin covering of silk from which they are easily dislodged. Differs from other species in the male having the embolic base enlarged retrolaterally, angular in shape, and the female having enlarged fertilization ducts.

Other material examined

South Australia: 5 ♀♀, Loftia Park, 21. ix. 1989, D. Hirst, N. Nicolson, C. Bonnielle, SAMA N1989583-7; penult. ♂, same data, SAMA N1990714.

Eodelena convexa sp. nov.

(Figs 7, 14, 28, 29, 30, 37)

Types

Holotype: ♂, Wanneroo, 31°45′S, 115°48′E, Western Australia, 23. iii. 1979, E. Bruen, WAM 86/681.

Paratypes: ♂, Dianella, 34°12′S, 115°04′E, Western Australia, 25. iii. 1976, A. Harding, WAM 88/1644; ♂, Gomm Spring, 34°09′S, 115°24′E, 28 km E by N of Karridale, Western Australia, 24. iv. 1983, E. S. Nielsen, E. D. Edwards, ANIC; ♂, Jandakot, Perth, Western Australia, Mar. 1977, R. P. McMillan, WAM 88/2136.

Diagnosis

(Female unknown). Carapace low convex; width subequal to length. Abdomen pale with faint pattern, embolic base rounded, embolic sclerite small.

Holotype male

CL 4.50, CW 4.45. AL 6.20, AW 4.10.

Colour in alcohol: Carapace yellow, caput darker, clypeus and ocular area reddish, dark brown pigment around eyes. Chelicerae dark reddish, darker near fang base. Maxillae and labium yellow-brown. Sternum yellow. Legs yellowish proximally; metatarsi and tarsi yellow-orange. Palps yellow-brown. Abdomen (Fig. 37) dorsally yellowish with faint reddish-brown markings; venter pale yellow. Spinnerets yellow-brown.

Carapace: Low convex, about 4 times longer than high, highest medially. Fovea a long shallow groove. Eyes: AME 0.34. AME: ALE: PME: PLE = 1: 0.76: 0.76: 0.76. Interspaces: AME-AME 0.65, AME-ALE 0.70, PME-PME 1.53, PME-PLE 1.53, AME-PME 1.00, ALE-PLE 0.76. MOQ, aw: pw: 1 = 2.59: 3.06: 2.35. Width of clypeus to AME 0.47. Labium: L 0.59, W 0.94. Sternum: L 2.34, W 2.26. Legs: anterior leg ratios I = 4.8, II = 5.5.

Palps: (Figs 28, 29). Palpal tibial apophysis positioned more dorsally, broader at base with an acutely pointed apex. Embolic base high, rounded. Embolic sclerite small; apex rounded with crenulate appearance (Fig. 30).

Variation

Carapace length of paratype males 4.69, 4.85 and 5.45. The apex of the embolic sclerite may have a smooth rounded appearance rather than crenulate, due to a more even distribution of pigment.

Distribution and remarks

(Fig. 7). Known only from the male, this species is found in south-west Western Australia. Differs from all other species by the pale abdomen with faint pattern and from the other known Western Australian species, *E. lapidicola*, by the convex carapace, smaller size, and the relative lengths and spination of palp segments. *E. convexa* is most similar to the male of *E. loftiensis* but the latter has the carapace wider than long and a retrolaterally angular embolic base. From the similar carapace shape and somewhat similar embolic base of *E. convexa* and *E. loftiensis* it is plausible to assume the female of *convexa* will also have a robust sclerotized vulva and the two species above, along with *E. kosciuskoensis*, may be originally derived from a single species which enjoyed a continuous southern distribution before becoming separated as a result of climatic changes.

Etymology

The specific epithet is in reference to the obviously convex carapace.

Material examined

Only the types.

Eodelena lapidicola sp. nov.

(Figs 7, 15, 16, 17, 31, 32, 38, 50, 51)

Types

Holotype: ♂, Yallingup, 33°39′S, 115°02′E, Western Australia, 18. ii. 1974, L. E. Koch, WAM 88/1584.

Allotype: ♀, Bremer Bay, 34°26′S, 119°23′E, Western Australia, June 1976, WAM 88/1499.

Paratypes: ♀, Salisbury Island, 34°22′S, 123°33′E, Recherche Archipelago, Western Australia, 17. iv. 1982, Burbidge and Fuller, WAM 88/1979; ♂, same data, WAM 88/1980.

Diagnosis

Distal spines on an unusually long palpal femur absent. Maxillae narrower in anterior half and sternum widest at mid-length. Male with palpal tarsus subequal in length to tibia. Female epigynum relatively broad and long with posterior 'plateau' short.

Holotype male

CL 11.67, CW 11.31. AL 13.50, AW 8.55.

Colour in alcohol: Carapace yellowish, caput margins and ocular area reddish; reddish suffusion. Chelicerae blackish; long yellowish setae. Maxillae and labium orange-red. Sternum yellow, margins reddish. Leg coxae and femora yellow; patellae to tarsi yellow-orange. Palps orange-red. Abdomen yellow-brown with blackish suffusion and brown setae forming pattern; venter pale yellow with orangish setae.

Carapace: Flattened, 11 times longer than high, highest in ocular region. Fovea indistinct in large depression. Eyes: AME 0.53. AME: ALE: PME: PLE = 1: 0.87: 0.64: 0.83. Interspaces: AME-AME 1.02, AME-ALE 2.04, PME-PME 2.87, PME-PLE 3.04, AME-PME 0.79, ALE-PLE 1.21. MOQ, aw: pw: 1 = 3.02: 4.15: 2.38. Width of clypeus to AME 0.38. Chelicerae: retromarginal teeth 4, distal well spaced from subdistal tooth. Labium: L 2.08, W 2.28. Sternum: L 6.26, W 4.91. Legs: anterior leg ratios I = 3.9, II = 4.7.

Palps: (Figs 31, 32). Palpal tarsus subequal in length to tibia (Fig. 16) with 3 prolateral spines. Embolic sclerite short; rounded apex not extending to prolateral side.

Allotype female (as holotype except as follows)

CL 11.48, CW 11.22. AL 14.00, AW 8.70.

Colour in alcohol: Carapace yellow, caput with reddish ocular area and lateral margins. Chelicerae dark red-brown. Maxillae reddish but with yellowish patch posteriorly. Abdomen (Fig. 38).

Eyes: AME 0.54. AME: ALE: PME: PLE = 1: 0.89: 0.54: 0.78. Interspaces: AME-AME 0.91, AME-ALE 1.93, PME-PME 2.85, PME-PLE 2.91, AME-PME 0.74, ALE-PLE 1.22. MOQ, aw: pw: 1 = 2.89: 4.00: 2.33. Width of clypeus to AME 0.28. Labium: L 1.90, W 2.22. Sternum: L 6.31, W 4.68. Legs: anterior leg ratios I = 3.7, II = 4.5.

Epigynum: Relatively broad with 'plateau' of fossa short. Vulva of WAM 88/1979 (Figs 50, 51) with 1½ insemination duct coils.

Variation

Carapace length of males 8.37–11.67, mean = 10.52 (n = 3). Carapace length of females 8.82–11.99, mean = 10.07 (n = 7).

Distribution and remarks

Confined to offshore islands and moist coastal areas of south-west Western Australia (Fig. 7). It has been collected in most cases from under rocks. *E. lapidicola* differs from all other species in the shape of the carapace, sternum, maxillae and in the palp spination and short tarsus.

Etymology

The specific epithet refers to its habit of living under rocks.

Other material examined

Western Australia: ♀, Bald Island, 34°55′S, 118°27′E, 29. x. 1971, A. A. Burbidge, WAM 88/1496; juv., same data, WAM 88/1497; ♂, under loose granite, Barker Bay, Albany district (probably Barker Inlet, 33°48′S, 121°20′E, Esperance district), 28. i. 1965, R. Humphries, WAM 88/1495; ♀ Boxer Island, 34°00′S, 121°41′E, Recherche Archipelago, 1950, V. Serventy, WAM 55/4996; ♀, Cape Leeuwin, 34°22′S, 115°08′E, July 1914, W. B. Alexander, WAM 14/994; penult. ♂, Eclipse Island, 35°11′S, 117°53′E, 27. i. 1938, A Blythe, WAM 38/141; ♀, Figure of Eight Island, 34°02′S, 121°37′E, Recherche Archipelago, 1950, V. Serventy, WAM 55/4990; juv., Lucky Bay, Cape le Grand, 34°00′S, 122°14′E, 19. v. 1977, R. P. McMillan, WAM 88/1545; juv., same data, WAM 88/1546; penult. ♂, Salisbury Island, 34°22′S, 123°33′E, 17. iv. 1972, N. McKenzie, WAM 88/1978; ♀, Two People Bay, 34°57′S, 118°11′E, 21. iv. 1982, G. T. Smith, WAM 88/1581; juv., same data as holotype, WAM 88/1585. [The Recherche Archipelago material collected by V. Serventy was listed by Main (1954: 47) as *Delena cancerides* and field-notes on habits by V. Serventy were given.]

Species Transferred

Although the female syntype of *Eodelena nigrifrons* Simon (1908) has not been located, a juvenile syntype in ZMB has been examined and is considered to belong to *Delena*. Further material seen (unpubl. data) from SAMA and WAM shows *Delena nigrifrons* (Simon) to be a valid new combination.

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BRACHIOPPIELLA SPECIES (ACARI : ORIBATIDA : OPPIIDAE) FROM SOUTH AUSTRALIAN SOILS

D. B. Hirst

Summary

As part of a study of oribate mites from South Australian soils, the genus Brachioppiella Hammer, 1962 is reviewed and the following four new species are described : Brachioppiella (Brachioppiella) paranasalis, Brachioppiella (Gressittoppia) magna, B. (G.) minima, B. (G.) pseudohigginsi. Brachioppiella Subias, 1989 is commented on and a key to the adults of all Australian genera, subgenera and species is provided.

BRACHIOPPIELLA SPECIES (ACARI: ORIBATIDA: OPPIIDAE) FROM SOUTH AUSTRALIAN SOILS

D. C. LEE & L. S. SUBIAS

LEE, D. C. & SUBIAS, L. S., 1991. *Brachioppiella* species (Acari: Oribatida: Oppiidae) from South Australian soils. *Rec. S. Aust. Mus.* 25(1): 19–30.

As part of a study of oribate mites from South Australian soils, the genus *Brachioppiella* Hammer, 1962 is reviewed and the following four new species are described: *Brachioppiella* (*Brachioppiella*) *paranasalis, Brachioppiella* (*Gressittoppia*) *magna, B.* (*G.*) *minima, B.* (*G.*) *pseudohigginsi.* Brachioppiinae Subias, 1989 is commented on and a key to the adults of all Australian genera, subgenera and species is provided.

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As a result of studies done in South Australia on the advanced oribate mites (Planofissurae, see Lee (1987)) of soils, numerous adults belonging to the family Oppiidae Grandjean, 1951 were extracted. Amongst them, the subfamily Brachioppiinae Subias, 1989 in Subias & P. Balogh (1989) were only represented by members of the genus *Brachioppiella* Hammer, 1962. These are described here using the notation and systematic framework (as implied by the taxon definitions and keys) of Subias & Balogh (1989). The Brachioppiinae are commented on and, because some of the included genera are very similar to *Brachioppiella*, keys are provided for all the Australian taxa.

Information on all the nine florally diverse sites which were sampled is given by Lee (1981), *Brachioppiella* having been collected from only four of these sites. Measurements are in micrometres (μm). All the material was collected by one of us (D.C.L.). The specimens are mostly deposited in the South Australian Museum (SAMA), but also in the Faculty of Biology of the Universidad Complutense of Madrid (FBUCM), the Field Museum of Natural History, Chicago (FMNH) or the New Zealand Arthropod Collection, D.S.I.R., Auckland (NZAC).

SYSTEMATICS

Brachioppiinae Subias

Brachioppiinae Subias in Subias & P. Balogh, 1989: p. 370.

Diagnosis (Adults)

Oppiidae. Genital and anal plates usually normal length and well separated. Epimeres III and IV not usually reaching behind genital plates, but if they do, then apodemes IV present. Crista notogastra absent. Seta *c*2 absent or less developed than other notogastral setae. Interbothridial tubercles usually absent. Anterior margin of notogaster lacks both protruding humeral processes and interbothridial costula. Lamellar and/or translamellar lines present. Fissurae *iad* inverse apoanal. Sensillus either pectinate, radiate or ciliate.

Distribution

The Brachioppiinae are restricted to the major southern regions (Neotropical, Ethiopian, Oriental, Australasian, Subantarctic and Antarctic). Few records are from the Northern Hemisphere or the tropics. Mostly the species are from moist southern temperate locations, indicating a Gondwanan distribution.

Within Australia all the records are from outside the tropics, either from Queensland, New South Wales or South Australia. The Queensland records are from dry or wet sclerophyll forest, the New South Wales records are from subtropical rainforest, whilst the South Australian records are from dry sclerophyll or cultivated pine forest, or from woodland or closed scrubland with a substantial litter layer. None of the records are from the extensive drier Australian regions with open vegetation and sparse litter.

Remarks

The Brachioppiinae include genera which were placed in five separate subfamilies in the classification of J. Balogh (1983). It is particularly similar to three subfamilies (Arcoppiinae J. Balogh, 1983, Lanceoppiinae J. Balogh, 1983 and Oppiinae Grandjean, 1951) amongst these five subfamilies, which lack protruding humeral notogastral processes. It is also very similar to the Multioppiinae J. Balogh, 1983. In distinguishing Brachioppiellinae from these four subfamilies, four characters are important: the shape of the sensillus, the presence or absence of prodorsal lines, the number of genital setae and the position of the paranal fissurae (*iad*). This last diagnostic character excludes *Gressittoppia luxtoni* Ayyildiz, 1989, a species superficially very similar to members of the Brachioppiinae, to be grouped in the Multioppiinae.

In the distinguishing of brachioppiine genera, the number of genital setae is given considerable value. Whilst this is considered reliable in classifying species with six pairs as compared with fewer pairs (as it also is in distinguishing the subfamily Arcoppiinae from the Multioppiinae), the differentiating of species with either four or five pairs into separate genera is sometimes considered unreliable. The unreliability is demonstrated by *Brachioppiella* (*Gressittoppia*) *magna* in this paper, since it usually has four pairs, but on only one female there are five pairs of genital setae. Despite this, four as opposed to five genital setae is still used, as by Subias & P. Balogh (1989), in order to recognise the subgenera of *Brachioppiella*, although it is pointed out under the remarks on *B.* (*Gressittoppia*) that this division into subgenera may not be valid.

The following five genera or subgenera are known from Australia: *Brachioppiella* (*Brachioppiella*) Hammer, 1962; *Brachioppiella* (*Gressittoppia*) Balogh, 1983 (here recorded from Australia for the first time); *Brassoppia* (*Brassoppia*) Balogh, 1983; *Ctenoppia* Balogh, 1983; *Kokoppia* Balogh, 1983.

KEY TO AUSTRALIAN BRACHIOPPIINAE (Adults)

1 — Sensillus large, length more than distance between it and rostral setae. Prodorsum large, length more than 0.66 × length of notogaster.... *Ctenoppia* Balogh 2

— Sensillus medium length, less than 0.75 × distance between it and rostral setae. Prodorsum size normal, length less than 0.66 × length of notogaster................................ 3

2 — Notogastral setae long (*e.g.* length of seta *la* more than 1.5 × distance between *la*–*lm*)......................... *Ctenoppia variopectinata* Balogh & Mahunka, 1975

— Notogastral setae short (*e.g.* length of seta *la* less than 0.66 × distance between *la*–*lm*......... *Ctenoppia eupectinata* Balogh & Mahunka, 1975

3 — Six pairs of genital setae. Prodorsal quadrangular field undelineated except for four small convex protruberances along posterior margin. Notogastral seta *c*2 present, small (length more than 2 × diameter of alveolus)...................................... *Kokoppia dudichi* (Balogh, 1982)

— Four or five pairs of genital setae. Prodorsal quadrangular field usually partially delineated by translamellar line; if undelineated, then notogastral seta *c*2 represented only by alveolus.......... 4

4 — Four pairs of genital setae. Prodorsal quadrangular field delineated anteriorly (translamella) and laterally (lamella) by low crest, and posteriorly by faint, transverse line. Notogastral seta *c*2 present, small (length more than 2 × diameter of alveolus). .... *Brassoppia brassi* (Balogh, 1982)

— Four or five pairs of genital setae. Prodorsal quadrangular field delineated anteriorly (translamella) and anterolaterally (lamella) by lines, and posteriorly with alveolate protruberance between setae *j*2–*j*2. Notogastral seta *c*2 present as microseta (length less than 2 × diameter of alveolus) or represented only by alveolus..... 5

5 — Five pairs of genital setae....... *Brachioppiella* (*Brachioppiella*) 6

— Four pairs of genital setae normal for a species. *Brachioppiella* (*Gressittoppia*)............. 7

6 — Notogastral seta *lm* posterior to *la*, distance apart subequal to distance between *lm*–*lp*. Sensillus caput slim (about 2 × breadth of stalk) with three or four cilia. Somal length, 425–440................. *B.* (*B.*) *biseriata* (Balogh and Mahunka, 1975)

— Notogastral seta *lm* level with and adaxial to *la*, distance apart less than 0.5 x distance between *lm*–*lp*. Sensillus caput medium breadth (about 3 × breadth of stalk), usually with five cilia, varies from three to seven cilia. Somal length, 290–345. .... *B.* (*B.*) *paranasalis* sp. nov.

7 — Apodeme *apo*4 reaching backward beyond level of genital shield. Setae in epimeral file *b* ciliate. Interlamellar seta more than 0.5 × length of lamellar seta. Sensillus with five cilia. Tibia IV slim (greatest breadth about 0.25 × length), seta *av* ensiform, long (length more than 2 x breadth of tibia). Somal length, 360–520... *B.* (*G.*) *magna* sp. nov.

— Apodeme *apo*4 reaching back only to middle of genital shield. Setae in epimeral file *b* smooth. Interlamellar seta less than 0.5 × length of lamellar seta. Sensillus with six or seven cilia. Tibia IV not slim (greatest breadth about 0.33 × length), seta *av* setose or ensiform, medium length (length subequal to breadth of tibia). Somal length less than 300................................ 8

8 — Notogastral seta *lm* nearer *lp* than *la*. No apodeme between *ep*2, epimeral *apo*2 not continuous across midline. Tibia IV with clearly delineated caput bearing setose ventral setae. Somal length, 185–220. .... *B.* (*G.*) *minima* sp. nov.

— Notogastral seta *lm* nearer *la* than *lp*. Apodeme between *ep*2, epimeral *apo*2 continuous across midline. Tibia IV with indistinct caput/stalk margin, bearing ensiform ventral setae. Somal length, 275–295.......................... .... *B.* (*G.*) *pseudohigginsi* sp. nov.

Genus *Brachioppiella* Hammer

Brachioppiella Hammer, 1962: p. 47.
Type-species (by original designation): *Brachioppiella periculosa* Hammer, 1962.

Diagnosis (Adults)

Brachioppiinae. Sensillus pectinate with single file of long cilia either on fusiform or setiform caput. Rostral setae separated by distance more than 4 × diameter of one of their alveoli. Interlamellar seta present. Lamellar seta closer to interlamellar seta than rostral seta. Rostrum not incised. Costula (but lamellar line may be present) and crista absent. Ten pairs notogastral setae, seta *c*2 vestigial (either microseta, length less than twice alveolus diameter, or just alveolus). Apodeme IV present. Four or five pairs of genital setae. Ventral seta *ad*1 postanal, *ad*3 preanal. Pore *iad* inverse apoanal. Tarsus IV with two ensiform anteroventral setae and two ciliate cuneiform posteroventral setae.

Morphology of Australian species

The prodorsum has a plateau-like quadrangular field around the lamellar and interlamellar setae. It is usually delineated (exception — *Brachioppiella biseriata* Balogh & Mahunka, 1975) anteriorly by a translamellar line (in lateral view can be seen to be a sulculus, which may be substantial but inconspicuous when seen from above, with edges that are recognisable as two parallel fine lines), whilst laterally it is bordered by a granulate slope which anteriorly forms a lamellar line (there are no costulate ridges), and posteriorly there is a protruberance between the interlamellar setae with alveolate sculpturing. There is a lateral row of large alveoli, and around the exobothridial seta the integument is granulate. The sensillus is not longer than the distance from its partner and the pectinate caput can be slim (as *Brachioppiella biseriata*, with width less than twice that of proximal stalk), broad or swollen. The notogaster shows little variation, except in setal length (large setae may have cilia and seta *c*2 may or may not be detectable) and in the position of seta *lm* relative to seta *la*. The venter has strong epimeral apodemes with weak superficial sculpturing forming shallow alveoli on the epimeres. The longer lateral epimeral setae may be ciliate. The most conspicuous varying characters are the number of genital setae, the position of apodeme IV and the presence or absence of an apodeme between epimeres 2. The size of the genital shields is sexually dimorphic, being larger on the female (Fig. 2) and smaller on the male (Fig. 8). No eggs were noted in any females collected in this study. Trochanter III has a transverse proximodorsal ridge with spurs at both ends. All the tibiae have a long flagelliform solenidium (*cf. Brachioppia cuscensis* Hammer, 1961, type-species, which has a short fat solenidium on tibia II). In all but the small *Brachioppiella minima* sp. nov., the tibiae and tarsi have stout, ensiform ventral spine-like setae, sometimes ciliate, whilst the two proximal shorter posterior spine-like setae on leg IV are ciliate cuneiform, the cilia being merged proximally and spreading out distally into an inverted triangle. Similar distal spreading out of ventral leg setae may be widespread amongst oppiids, and can involve more setae [*e.g. Brachioppiella* (*Gressittoppia*) *orkneyensis* (Kok, 1967) and *Quadroppia quadricarinata* (Michael): Lions 1977]. Somal chaetotaxy: prodorsum — 2, 2, 1; notogaster — 2, 6, 2; epimeres — 3, 1, 3, 3; genital shield — 4 or 5; anal shield — 2; ventral shield — 1, 3.

Distribution

All species of *Brachioppiella* are known only from the major southern regions, mainly in the temperate zone, with a few species from the tropics (see the remarks on the subgenus *Brachioppiella*), and the subantarctic or antarctic (see the remarks on the subgenus *Gressittoppia*).

Amongst the nine florally diverse sites sampled in South Australia, the greatest numbers of three of the four species of *Brachioppiella* were found at the dry sclerophyll forest site on Mt Lofty, which has the highest rainfall (mainly in winter, being a Mediterranean-type climate) of any site. One of these species, *B.* (*Gressittoppia*) *minima* sp. nov., also occurs in small numbers at two nearby sites in the Mt Lofty Ranges. The fourth species, *B.* (*Gressittoppia*) *pseudohigginsi* sp. nov., is from coastal closed-scrubland, which has a lower rainfall, but is a very moist site, since it is much further south and it is sometimes inundated from a permanent underground stream. The only other known Australian species, *B.* (*Brachioppiella*) *biseriata* (Balogh & Mahunka, 1975), is from dry sclerophyll forest in Queensland.

Remarks

Brachioppiella was placed by J. Balogh (1983) in the subfamily Pulchroppiinae. Later, Subias & P. Balogh (1989) considered that this subfamily should be restricted to *Pulchroppia* Hammer, 1979 and related genera, in which epimeres 3 and 4 are not bordered posteriorly by an apodeme, whilst *Brachioppiella* was the nominotype of a new subfamily. J. Balogh (1983) also established a heterogeneous subfamily, Cycloppiinae, giving considerable weight in the diagnosis to the number of pairs of genital setae. The genus *Gressittoppia* was grouped in Cycloppiinae, because of its four pairs of genital setae, whilst Subias and P. Balogh (1989) considered it to be so closely allied to *Brachioppiella* that it was given the new status of subgenus within that genus. As pointed out here, in the remarks on *B.* (*Gressittoppia*), the two genus group names might be better considered to be synonymous. The only distinguishing character that has been established for the subgenera is the normal number of genital setae. In the case of

Brachioppiella (*Gressittoppia*) *magna* sp. nov. (which on only one specimen has an increased setation from four to five genital pairs), characters are given in the remarks on the species, that distinguish the abnormal specimen from Australian members of the subgenus *Brachioppiella.*

Subgenus ***Brachioppiella (Brachioppiella)*** Hammer

Diagnosis (Adult)

Brachioppiella. Five pairs of genital setae.

Remarks

The subgenus *Brachioppiella* sens. str. is maintained as by Subias & P. Balogh (1989), delineated from *B.* (*Gressittoppia*) by having five pairs of genital setae. The possiblity that species of *Brachioppiella* should not be grouped into two subgenera is commented on in the 'Remarks' under *Brachioppiella* (*Gressittoppia*).

Brachioppiella (*Brachioppiella*) includes 10 species (Subias & P. Balogh 1989), plus a new species described here from South Australia. The subgenus is widespread in southern temperate regions with a few records from the tropics (New Caledonia, Guinea in West Africa, East Africa). The two Australian species are as follows: *Brachioppiella* (*Brachioppiella*) *biseriata* (Balogh & Mahunka, 1975) and *B.* (*B.*) *paranasalis* sp. nov..

Brachioppiella* (*Brachioppiella*) *paranasalis sp. nov.
(Figs 1, 2 and 9)

Morphology

General appearance and dimensions: Body flattened and widened, brown colour. Idiosomal length: female 320 (39, 308–344); male 309 (44, 290–328). Idiosomal breadth: female 133–143, male 122–135. Leg dimensions for holotype female (length 321): leg lengths (femur-tarsus) I–191, II–145, III–136, IV–180; tibial maximum breadths I–21.5, II–19, III–15.5, IV–15.5.

Prodorsum: Rostrum rounded, unstructured, with rostral setae dorsally ciliate. Quadrangular field with lamellar line restricted to anterior half of distance between lamellar seta and sensillus, whilst translamellar line may be inconspicuous, because although sulculus deep, margins may be unclear in dorsal aspect, and posterior protruberance narrow with two pairs of alveolar, pale patches. Usually three large alveolar, pale patches lateral to quadrangular field. Lamellar, exobothridial and interlamellar setae fine and smooth, decreasing in size in this order, lamellar seta nearly 2 × length of interlamellar seta. Granulated area around exobothridial seta not reaching profile of pedotectum I. Usually five long cilia on caput of sensillus, but varies from three to seven cilia, in single file.

Notogaster: Nine pairs of short to medium length smooth setae, *h*2 and *h*3 longest, seta *c*2 represented only by alveolus with root, but no seta, just behind pore *ia.* Seta *lm* close to and slightly anterior to seta *la.*

Somal venter: Epimeres with weak alveolar sculpturing. In setal file *b*, setae 3*b* and 4*b* like file *c*, but 1*b* similar to file *a* in being smooth and slimmer. Apodeme *apo4* reaching backward to level of mid genital shield. Pedotectum 1 profile smooth, no pedotectum 2, pedotectum 3 large and blunt. Genital setae short and subequal in length. Aggenital seta shorter (0.6 ×) than adanal seta *ad*3.

Legs: Long (mean femur-tarsus length: 50% of somal length). Legs I and IV longer than other legs, whilst legs I and II are stouter than other legs. Relative breaths of tibiae (maximum height: length): I = 56%, II = 57%, III = 43%, IV = 33%. Ventral setae on tibiae and tarsi often ensiform and ciliate. On tibia and tarsus IV, posteroventral setae shorter than anteroventral setae. Tarsus IV setae *pv*1 and *pv*2 with single file of cilia longer proximally so that terminating at same level giving seta a cuneiform appearance in posteroventral aspect.

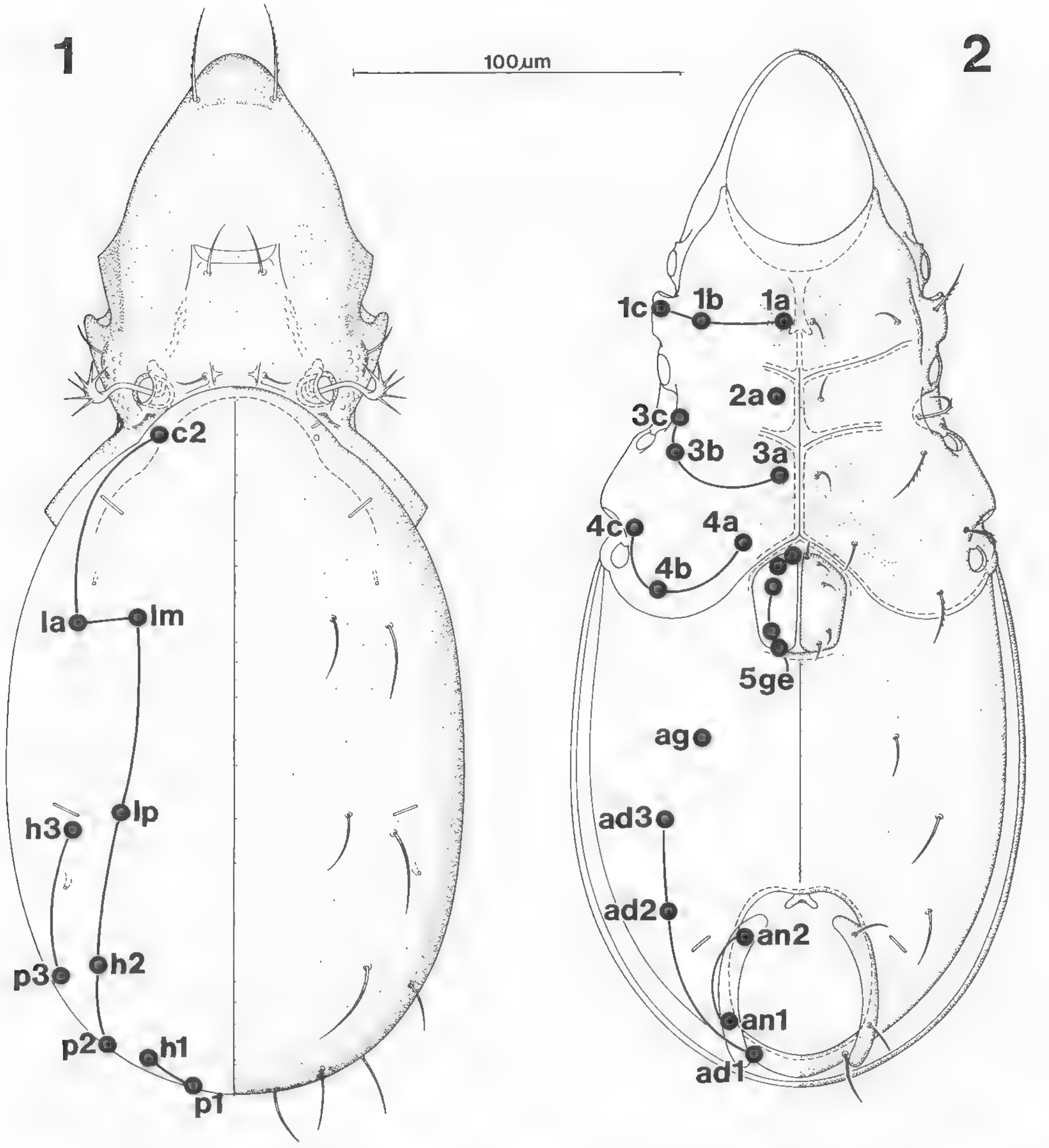
Material examined

Holotype: female (N1989277), plant litter, sparse moss and sandy soil, under sclerophyllous shrubs amongst messmate stringybark (*Eucalyptus obliqua*), dry sclerophyll forest, near summit of Mt Lofty (34°9′S, 138°5′E), Cleland Conservation Park, 9.v.1974.

Paratypes: 26 females (N1989278-N1989303) and 30 males (N1989304-N1989333); 2 females and 3 males (FBUCM); 2 females and 2 males (FMNH); 2 females and 2 males (NZAC); 6 females and 7 males lost; same data as holotype.

Remarks

Brachioppiella (*Brachioppiella*) *paranasalis* is easily distinguished from known Australian species of *Brachioppiella* by having notogastral seta *lm* transposed anteriorly to near *la.* This includes the other member of the subgenus and the larger *Brachioppiella* (*Gressittoppia*) *magna* sp. nov., which in only one of its females examined also has five pairs of genital setae rather than the normal four pairs for *Gressittoppia.* The shape of the sensillus and the nature of the lamella and translamella, in combination with the relative position of notogastral seta *lm* to *la*, distinguishes *B.* (*B.*) *paranasalis* from all known species of *Brachioppiella*, and the position of seta *lm* is only known elsewhere in Australian brachioppielline genera on *Brassoppia brassi* (Balogh, 1982). The



FIGURES 1 AND 2. *Brachioppiella* (*Brachioppiella*) *paranasalis* sp. nov., female soma. 1, notum; 2, idiosternum.

species which is most similar, and from which the species name is derived with the Greek prefix *para* meaning 'beside or new', is *Brachioppiella* (*B.*) *nasalis* (Evans, 1953), which has notogastral setae of similar length and placement. But that species has a sensillus with a slim, nearly setiform caput, with six lateral cilia, and also there are 'Anterior to the genital plate two forwardly directed projections on either side.' (Evans 1953: 260), as well as conspicuous granulation on the prodorsal quadrangular field.

Subgenus ***Brachioppiella* (*Gressittoppia*)** Balogh

Gressittoppia Balogh, 1983: p. 55.
Type-species (by original designation): *Brachioppia moresonensis* Kok, 1967.

Diagnosis (Adults)

Brachioppiella. Four pairs of genital setae.

Remarks

The subgenus *Brachioppiella* (*Gressittoppia*) was given this status by Subias & P. Balogh (1989), prior to which *Gressittoppia* was regarded by J. Balogh (1983) as a distinct genus in another subfamily (Cycloppiinae) compared to *Brachioppiella*, then included in the Pulchroppiinae. The distinction between the subgenera relies on the number of genital setae and this character exhibits intraspecific variation in *B.* (*G.*) *magna* sp. nov. (only one female has five pairs of genital setae, rather than the usual four pairs). Because of this, and because no other character state can be found to diagnose the subgenus, *Gressittoppia* and *Brachioppiella* may need to be regarded as synonymous as subgenera as well as genera. The position of the fissure *iad* being given importance here in defining families, means that similar species to *Gressittoppia*, like *Gressittoppia luxtoni* Ayyildiz, 1989, are excluded to another subfamily (Multioppiinae).

Brachioppiella (*Gressittoppia*) includes seven species (Subias & P. Balogh 1989) plus a further three new species described here from South Australia, the first records of the subgenus from Australia. The subgenus is widespread in southern temperate regions, with a few records from the far south (Tierra del Fuego and Antarctica). The three Australian species are as follows: *Brachioppiella* (*Gressittoppia*) *magna* sp. nov., *B.*(*G.*) *minima* sp. nov. and *B.*(*G.*) *pseudohigginsi* sp. nov..

Brachioppiella* (*Gressittoppia*) *magna sp. nov.
(Figs 3, 4, and 10)

Morphology

General appearance and dimensions: Body flattened and widened, dark red brown colour. Idiosomal length: female 498 (5, 480–520); male 412 (3, 362–463). Idiosomal breadth: female 212–229, male 174–206. Leg dimensions for holotype female (length 501): leg lengths (femur-tarsus) I–292, II–238, III–247, IV–307; tibial maximum breadth I–31, II–25, III–19, IV–22.

Prodorsum: Rostrum rounded, pale above ventral recess, with rostral setae dorsally ciliate. Quadrangular field with lamellar line nearly complete, whilst translamellar line with clear anterior margin to deep sulculus but posterior margin may be unclear in dorsal aspect, and posterior protruberance narrow and conspicuous with three pairs of alveolar, pale patches. Usually four large alveolar, pale patches lateral to quadrangular field. Only exobothridial seta is smooth, lamellar seta about 1.5 × length of interlamellar seta. Granulate area round exobothridial seta reaching profile to pedotectum I. Usually five, exceptionally four or six long cilia on caput of sensillus.

Notogaster: Nine pairs of medium length setae, sometimes inconspicuous dorsal cilia present, *c*2 represented by microseta. Seta *lm* nearly directly behind *la* and slightly nearer to it than to seta *lp*.

Somal venter: Epimere with strong alveolar sculpturing. In setal file *b*, all setae similar to those in file *c*. Apodeme *apo*4 reaching backward beyond level of posterior margin of genital shield. Pedotectum 1 profile granulate, small pedotectum 2 present, pedotectum 3 large and acute. Usually four pairs of genital setae, but one female with five pairs of genital setae. Anterior three pairs of genital setae short, seta *ge*4 longer. Aggenital seta longer than or subequal in length to adanal seta *ad*3.

Legs: Long (mean femur-tarsus length = 54% of soma length). Legs III and IV slim and relatively long so that leg IV longest and leg III third longest rather than shortest. Relative breadths of tibiae (maximum height: length): I = 57%, II = 43%, III = 31%, IV = 28%. Ventral setae on tibiae and tarsi (except *av*4 and *pv*4 on tarsus IV) ensiform and ciliate. On tarsus IV posteroventral setae *pv*1 and *pv*2 with cilia enlarged and fused at base so that fan-like.

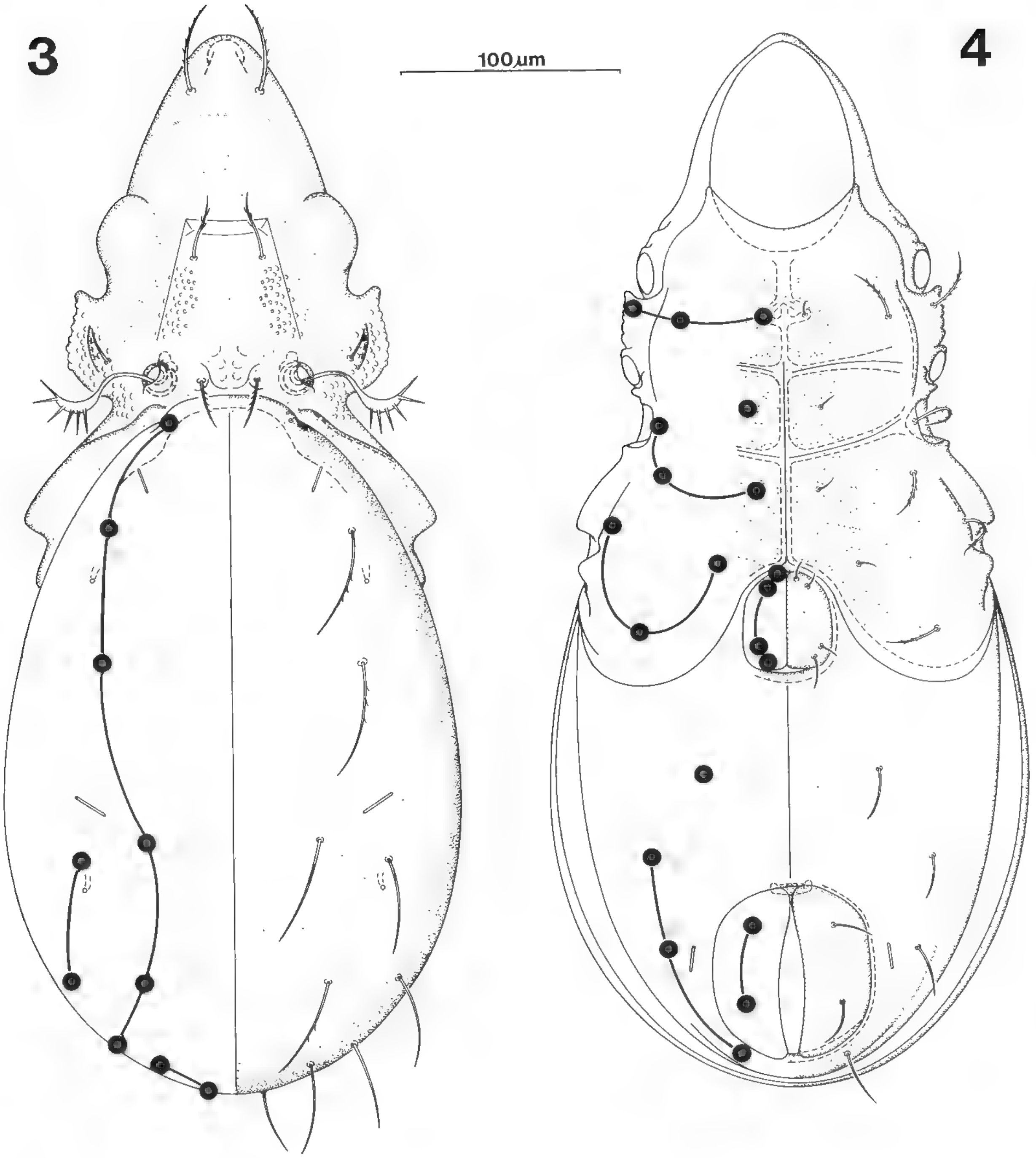
Material examined

Holotype: female (N1989334), plant litter, sparse moss and sandy soil, under sclerophyllous shrubs amongst messmate stringybark (*Eucalyptus obliqua*), dry sclerophyll forest, near summit of Mt Lofty (34°9′S, 138°5′E), Cleland Conservation Park, 9.v.1974.

Paratypes: 5 females (N1989335-N1989339) and 3 males (N1989340-N1989342); 1 female (FBUCM); same data as holotype.

Remarks

Brachioppiella (*Gressittoppia*) *magna* is variable in size, males being substantially smaller than females. The larger females are the largest within the genus, which is the basis of the species name derived from the Latin word *magnus* meaning 'large or great'. Possibly correlated with greater size are the dark colour, more extensive cuticular sculpturing and granulation, with more setae that are ciliate. *B.* (*G.*) *magna* is easily distinguished from other known Australian members of *Gressittoppia* by the backward extension of epimere 4 and the long leg IV, possibly functionally correlated character states. *B.* (*Brachioppiella*) *biseriata* (Balogh & Mahunka, 1975) from Queensland is large with a similarly extensive epimere 4 and disposition of the notogastral setae, so it may in the future be regarded as allied to this species, although they are currently in different subgenera. This possibility is more likely in the light of one female of *B.* (*G.*) *magna* having five pairs of genital setae, the extra pair making the disposition very similar to that of *B.* (*B.*) *biseriata*. But *B.* (*B.*) *biseriata* is further distinguishable as a separate species by



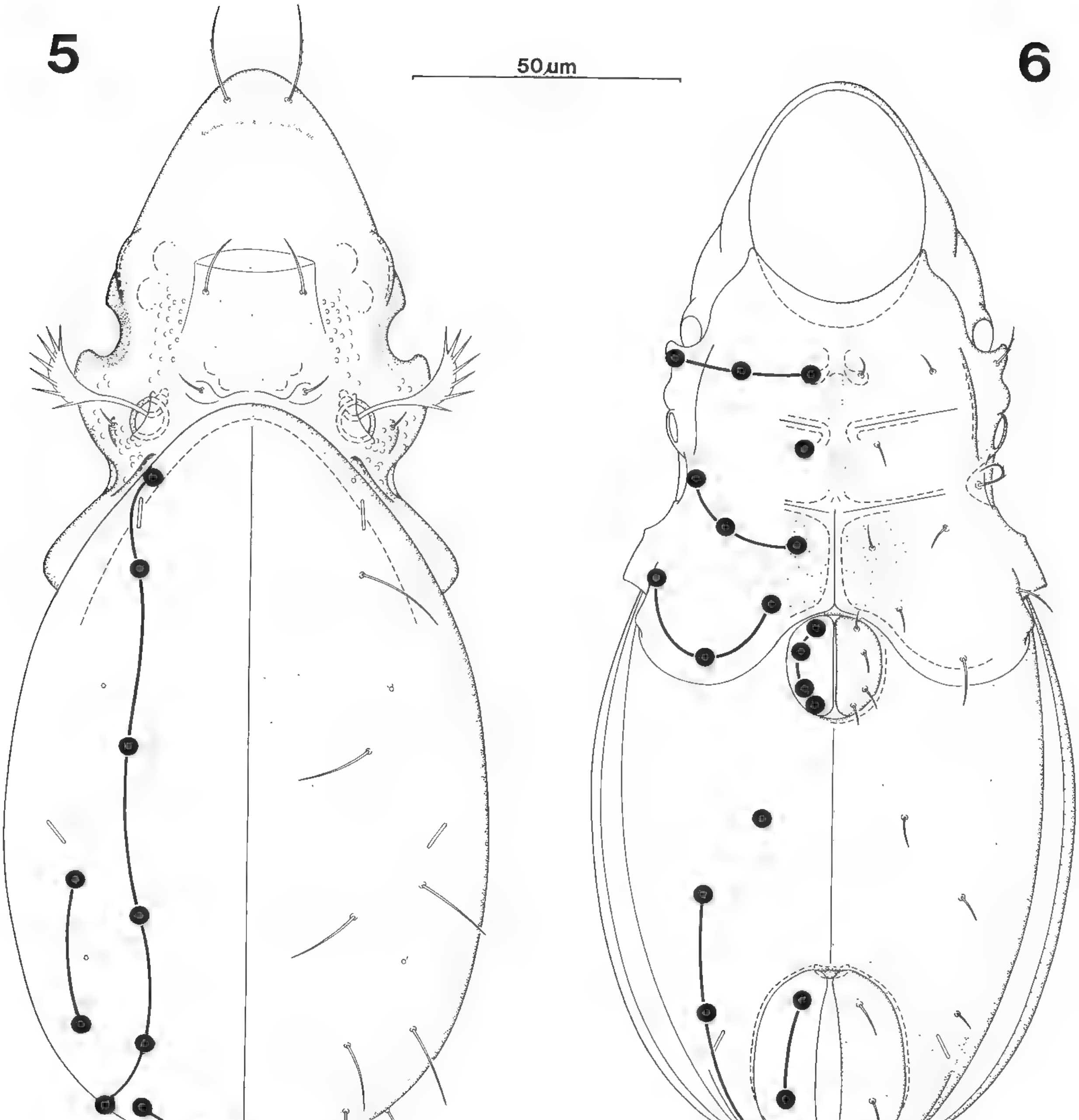
FIGURES 3 AND 4. *Brachioppiella* (*Gressittoppia*) *magna* sp. nov., female soma. 3, notum; 4, idiosternum.

having a number of shorter setae, in particular the interlamellar and aggenital setae and a slim caput to the sensillus. *B.* (*G.*) *magna* is also similar to *B.* (*G.*) *hartensteini* (Hammer, 1968), but the latter has a small seta *c*2 present, the caput of the sensillus is slimmer and notogastral seta *h*3 is anterior to pore *im*.

Brachioppiella* (*Gressittoppia*) *minima sp. nov.
(Figs 5, 6 and 11)

Morphology

General appearance and dimensions: Body flattened and widened, straw colour. Idiosomal length: female 208 (28, sclerophyll forest, 200–217),



FIGURES 5 AND 6. *Brachioppiella* (*Gressittoppia*) *minima* sp. nov., female soma. 5, notum; 6, idiosternum.

200.5 (1, pine forest); male 198 (74, sclerophyll forest, 185–206), 192 (2, pine forest, 185–200.5), 190 (1, savannah woodland). Idiosomal breadth: female 78–87, male 85–95. Leg dimensions for holotype female (length 205.5): leg lengths (femur-tarsus) I–119, II–89, III–89, IV–98; tibial maximum breadths I–14.5, II–12, III–11, IV–12.

Prodorsum: Rostrum rounded, unstructured, with rostral setae dorsally ciliate. Quadrangular field with lamellar line restricted to anterior half of distance between lamellar seta and sensillus, translamellar line inconspicuous, sulculus shallow, margins may be unclear in dorsal aspect, posterior protruberance broad, flattened with two pairs of alveolar, pale patches. Usually two large alveolar pale patches lateral to quadrangular field. Lamellar, interlamellar and exobothridial setae fine and smooth, decreasing in size in this order, lamellar seta nearly 2 × length of interlamellar seta. Granulate area around exobothridial seta not reaching profile of pedotectum I. Usually six long cilia on caput of sensillus, may be additional one or two smaller proximal cilia.

Notogaster: Nine pairs of medium length smooth setae, subequal in length, seta *c*2 only represented by alveolus with root, but no seta. Seta *lm* nearly directly behind *la* and midway between it and seta *lp*.

Somal venter: Epimeres with weak alveolar sculpturing. In setal file *b*, setae 1*b* and 3*b* like file *a*, whilst 4*b* is as long as setae in file *c*, but smooth, without cilia. Apodemes absent between epimeres 1 and 2, although linear surface sculpturing present. Pedotectum 1 profile smooth, no pedotectum 2, pedotectum 3 large with acute point. Genital setae short and subequal in length. Aggenital seta subequal in length to adanal seta *ad*3.

Legs: Medium length (mean femur-tarsus length = 48% of somal length). Legs I and IV longer than other legs, leg II being as short as leg III, but as broad as leg IV. Relative breadths of tibiae (maximum height: length): I = 57%, II = 66%, III = 45%, IV = 48%. Tibia IV shorter than tarsus IV, caput broad, more than 2.5 × breadth of stalk. Ventral setae on tarsi II-IV often ensiform and ciliate, but not on tibiae. On tibia IV, seta *av* longer and stouter than *pv*, but still setose and similar to *d*2 on tarsus IV.

Material examined

Holotype: female (N1989343) plant litter, sparse moss and sandy soil, under sclerophyllous shrubs amongst messmate stringybark (*Eucalyptus obliqua*), dry sclerophyll forest, near summit of Mt Lofty (34°9′S, 138°5′E), Cleland Conservation Park, 9.v.1974.

Paratypes: 19 females (N1989344-N1989362) and 66 males (N1989363-N1989428); 2 females and 2 males (FBUCM); 2 females and 2 males (FMNH); 2 females and 2 males (NZAC); same data as holotype. One female (N1989429) and two males (N1989430, N1989431), pine litter and sandy soil, under pine trees (*Pinus pinea*), cultivated forest, Knott Hill (35°12′S, 138°41′E), Kuitpo Forest Reserve, 22.v.1974. One male (N1989432), grass, moss, leaf litter and loamy soil under manna gum trees (*Eucalyptus viminalis*), savannah woodland, Chambers Gully (34°59′S, 138°41′E), Cleland Conservation Park, 12.vi.1974.

Remarks

Brachioppiella (*Gressittoppia*) *minima* is the smallest known species in the genus, which is the basis of the species name derived from the Latin word *minimus* meaning 'least'. It is similar to *Brachioppiella* (*Gressittoppia*) *pepitensis* (Hammer, 1962), a slightly larger species (length 270) from Tierra del Fuego. *B.* (*G.*) *pepitensis* differs in minor ways in the disposition and shape of setae as follows: sensillus with nine or ten cilia, hysteronotal seta *la* closer to *lm* than *c*2, adanal seta *ad*2 posterior to pore *iad*. Although some cuticular markings are stronger, the apodeme between epimeres 1 is absent posterior to seta 1*a*, suggesting a close relationship of *B.* (*G.*) *pepitensis* to *B.* (*G.*) *minima*, even though the shape of its tibia and tarsus IV is normal for the genus (similar to *B.* (*G*). *pseudohigginsi* sp. nov., Fig. 12) and unlike that of *B.* (*G.*) *minima* (Fig. 11). The correlation of the reduction in mid-sternal apodemes and the shape of the leg segments and their ventral setae characterizes *B.* (*G.*) *minima*.

Brachioppiella **(*Gressittoppia*)** ***pseudohigginsi*** sp. nov.

(Figs 7, 8 and 12)

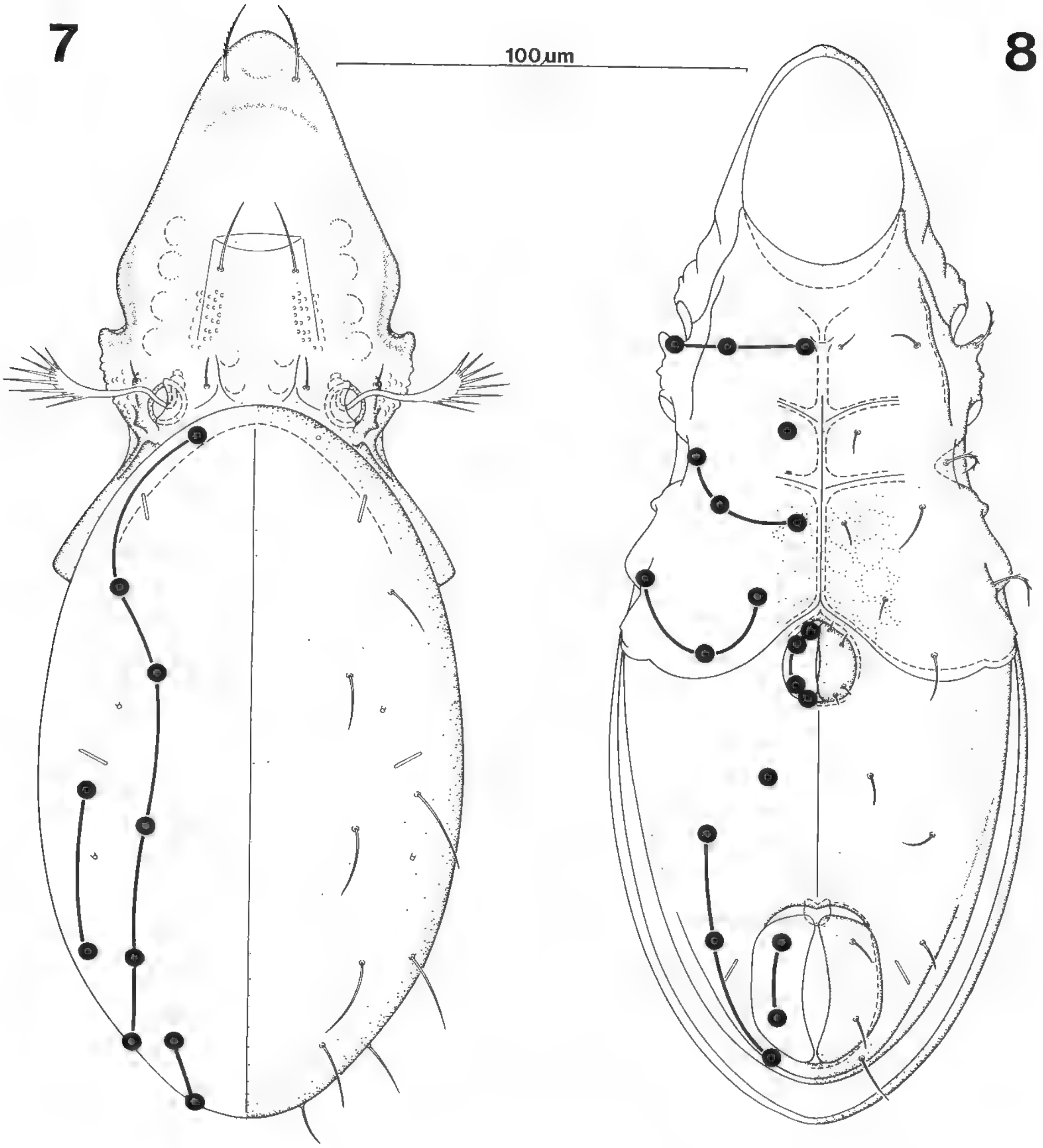
Morphology

General appearance and dimensions: Body flattened, broad for female, elongate for male, brown colour. Idiosomal length: female 295, male 275. Idiosomal breadth: female 117, male 112. Leg measurements for holotype male (length 275): leg lengths (femur-tarsus) I–156, II–118, III–109, IV–139; tibial maximum breadths I–18, II–14.5, III–12, IV–12.

Prodorsum: Rostrum round, unstructured except slight concavity between dorsally ciliate rostral setae. Quadrangular field with lamellar line nearly complete, translamellar line with moderately deep sulculus, but margins may be unclear in dorsal aspect, and posterior protruberance broad with two pairs of alveolar pale patches. Four large alveolar, pale patches lateral to quadrangular field. Lamellar, interlamellar and exobothridial setae fine and smooth, decreasing in size in this order, lamellar setae more than 2 × length of other setae. Granulate area around exobothridial seta reaching profile of pedotectum I. Six or seven long cilia on caput of sensillus.

Notogaster: Nine pairs of short to medium length smooth setae, *la* and *lm* being short, seta *c*2 represented only by alveolus with root, but no seta, just behind pore *ia*. Seta *lm* behind and closer to seta *la* than to *lp*.

Somal venter: Epimeres with weak alveolar sculpturing. In setal file *b*, seta 1*b* shorter than 1*c*, whilst 3*b* and 4*b* similar in length to 3*c* and 4*c*, but all smooth lacking cilia. Apodeme *apo*4 reaching backward to level of mid-genital shield. Pedotectum 1 profile granulate, no pedotectum 2, pedotectum 3 large and blunt. Genital setae short and subequal in length (*N.B.* male illustrated, Fig. 8, so plates appear relatively small compared to other species where females illustrated). Aggenital seta subequal in length to adanal seta *ad*3.



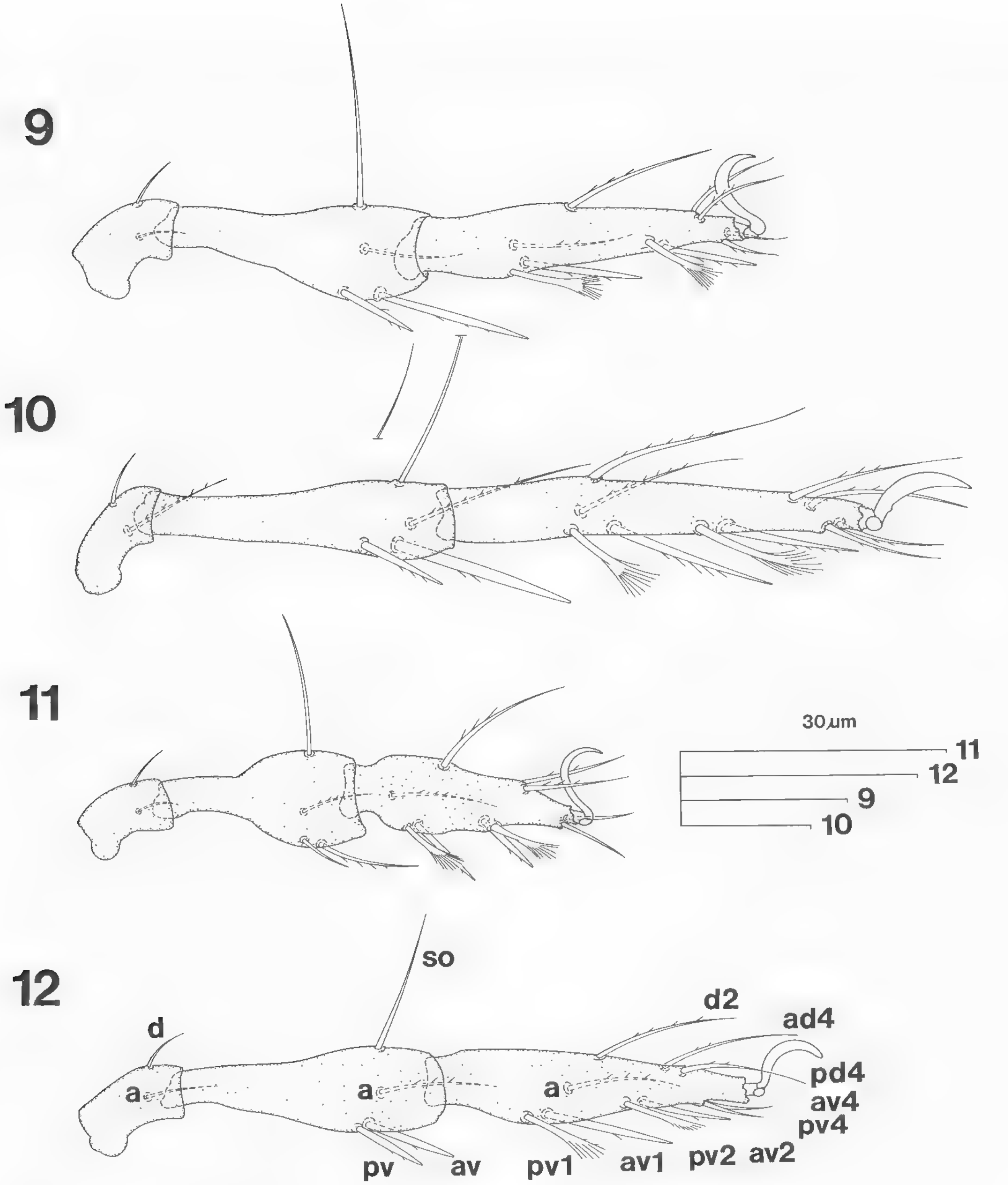
FIGURES 7 AND 8. *Brachioppiella* (*Gressittoppia*) *pseudohigginsi* sp. nov., male soma. 7, notum; 8, idiosternum.

Legs: Medium length (mean femur-tarsus length = 47% of somal length). Legs I and IV longer than other legs, whilst legs I and II are stouter than other legs. Relative breadths of tibiae (maximum height: length): I = 54%, II = 55%, III = 45%, IV = 33%. Tibia IV shorter than tarsus IV, caput medium breadth, slightly less than 2 × breadth of stalk. Ventral setae on tibiae and tarsi often ensiform and ciliate. On tibia IV, ventral seta *av* only slightly longer than *pv* and shorter than *av*1 on tarsus IV.

Material examined

Holotype: male (N1989433), plant litter, sparse grass and calcareous sandy soil, under coastal wattle (*Acacia sophorae*), coastal closed scrubland, just south of main pond (38°03′S, 150°57′E), Piccaninnie Ponds Conservation Park, 3.vii.1974.

Paratype: female (N1989434); same data as holotype.



FIGURES 9-12. *Brachioppiella*, posterior aspects of genu, tibia, tarsus, pretarsus of right leg IV. 9, *B.* (*B.*) *paranasalis* sp. nov.; 10, *B.* (*G.*) *magna* sp. nov.; 11, *B.* (*G.*) *minima* sp. nov.; 12, *B.* (*G.*) *pseudohigginsi* sp. nov. Key: a = anterior, d = dorsal, p = posterior, v = ventral, so = solenidium.

Remarks

Brachioppiella (*Gressittoppia*) *pseudohigginsi* is very similar to *Brachioppiella* (*Brachioppiella*) *higginsi* (Hammer, 1968) from New Zealand in the disposition and shape of the notal setae, which is the basis of the species name derived from the Greek word *pseudos*, meaning 'lie', and *higginsi*. *B.* (*B.*) *higginsi* has a slimmer caput to its sensillus and has five pairs of genital setae, which places it in the nominate subgenus. *B.* (*G.*) *pseudohigginsi* is also similar to two larger species from South Africa: *B.* (*G.*) *moresonensis* (Kok, 1967), length 300-344, and *B.* (*G.*) *orkneyensis* (Kok, 1967), length 330-380. *B.* (*G.*) *moresonensis* differs in that notogastral seta *h*3 is positioned well forward, anterior to fissure-like pore *im* rather than posterior to it (Fig. 7). *B.* (*G.*) *orkneyensis* differs in that seta *av* on tibia IV is twice as long as seta *pv* and acutely tapered rather than shorter and stouter (Fig. 12).

RESUMEN

Como parte del estudio de los ácaros oribátidos de suelos del sur de Australia, se discute el género *Brachioppiella* Hammer, 1962, y se describen las cuatro nuevas especies siguientes: *Brachioppiella* (s. str.) *paranasalis* sp. nov., *Brachioppiella* (*Gressittoppia*) *magna* sp. nov., *B.* (*G.*) *minima* sp. nov. y *B.* (*G.*) *pseudohigginsi* sp. nov.. También se discute la subfamilia Brachioppiinae Subias, 1989 y se dan unas claves de géneros, subgéneros y especies australianos.

ACKNOWLEDGMENTS

We wish to thank Miss Keren Shepherd for the modifying, inking in and presentation of the figures, and the Australian Biological Resources Study for funding her salary. Also the translation from Spanish to English of parts of the manuscript and correspondence by Mrs Bobbie Matthews, and the typing of the manuscript by Mrs Debbie Lowery, are much appreciated.

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REDESCRIPTION OF THE LARVA OF ODONTACARUS (LEOGONIUS) BARRINENSIS (WOMERSLEY) (ACARINA : TROMBICULIDAE : LEEUWENHOEKIINAE)

R. V. Southcott

Summary

The larva of Odontacarus (Leogonius) barrinensis (Womersley, 1945) is redescribed, the lectotype and paralectotypes are designated, and the new data are compared with those of the original description. Womersley's measurements were too large (mean error = 3.53%). Analysis of the metric data confirms the separation of O. (L.) barrinensis from its taxonomically nearest species, O. (L.) athertonensis (Wormesley, 1945).

REDESCRIPTION OF THE LARVA OF *ODONTACARUS (LEOGONIUS) BARRINENSIS* (WOMERSLEY) (ACARINA: TROMBICULIDAE: LEEUWENHOEKIINAE)

R. V. SOUTHCOTT

SOUTHCOTT, R. V. 1991. Redescription of the larva of *Odontacarus (Leogonius) barrinesis* (Womersley) (Acarina: Trombiculidae: Leeuwenhoekiinae). *Rec. S. Aust. Mus.* **25**(1): 31–37.

The larva of *Odontacarus (Leogonius) barrinensis* (Womersley, 1945) is redescribed, the lectotype and paralectotypes are designated, and the new data are compared with those of the original description. Womersley's measurements were too large (mean error = 3.53%). Analysis of the metric data confirms the separation of *O. (L.) barrinensis* from its taxonomically nearest species, *O. (L.) athertonensis* (Womersley, 1945).

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The genus *Odontacarus* Ewing, 1929 (Acarina: Trombiculidae: Leeuwenhoekiinae) is known mainly as larvae in the Australia-New Guinea region; all of these are placed in the subgenus *Leogonius* Vercammen-Grandjean, 1968 (see Southcott 1986a).

The first Australian species recognized was *O. australiensis* (Hirst, 1925), a widespread species occurring from eastern Australia to New Guinea (Hirst 1925; Womersley 1944, 1945; Domrow 1956; Goff 1979a). Womersley (1944) described five more species as larvae (as *Leeuwenhoekia* Oudemans, 1911): *O. adelaideae, O. hirsti, O. mccullochi, O. novaguinea* and *O. southcotti,* and (1945) four more as larvae: *O. athertonensis, O. barrinensis, O. echidnus* and *O. longipes* (as *Acomatacarus* Ewing, 1942).

Further species (as larvae) have been added by Southcott (1957, 1986a, b) and Goff (1979a, b). The most recent general treatments of the taxonomy of these larvae have been by Southcott (1986a, b, 1989). Of the species known as larvae, deutonymphs have been described by Womersley (1945) of *O. longipes* and *O. novaguinea*, by Domrow (1956) of *O. australiensis*, and by Southcott (1989) of *O. adelaideae.* Based on larval characters, Domrow (1956) synonymized *O. hirsti* with *O. australiensis*, and Goff (1979a) synonymized *O. longipes* with *O. novaguinea*.

Womersley (1944, 1945) relied heavily on statistical characters for his species differentiations. Difficulties in separating some of these species led Veitch and Southcott (1984) to make a study of some species referred to *O. athertonensis*, or from the Atherton Tableland, Queensland. This showed good statistical differentiating characters for *O. athertonensis* (Womersley, 1945), *O. mccullochi* (Womersley, 1944), *O.* 'species S' (now *O. swani* Southcott, 1986a), and an unnamed species (now *O. veitchi* Southcott, 1986b) from Mt Jukes, Queensland.

One species requiring redescription was *O. (L.) barrinensis* (Womersley, 1945), which Womersley placed close to *O. athertonensis.*

In the present paper the larva of *O. (L.) barrinensis* is redescribed from the type series, and its taxonomic status evaluated.

MATERIALS AND METHODS

Slide-mounted mites in the South Australian Museum, Adelaide (SAM) referred to *O. Barrinensis* were examined. The five syntypes (ACB188A-E) were all in gum chloral media, on individual slides, mounted by me on 17.xi.1943 and again on 7.v.1944, but apparently not remounted subsequently. Specimen ACB210A (N19896) showed evidence of remounting, and the mount was largely opaque and unusable. All these slides also bore a SAM number of ARA7524. No further remountings have been done.

Microscopy and drawing techniques, also terminology and abbreviations, are as in Southcott (1989). All measurements are in micrometres (μm) unless otherwise specified.

Odontacarus Ewing

Odontacarus Ewing, 1929, p. 188.
(For other synonymy see Southcott, 1986a, p. 171, and contained references).
Definition of larva as in Southcott, 1989, p. 37.
Type species: *Trombicula dentata* Ewing, 1925, p. 257.

Subgenus *Leogonius* Vercammen-Grandjean, 1968.
Definition of larva as in Goff, 1979a, p. 143.
Type species: *Leeuwenhoekia australiensis* Hirst, 1925, p. 150.

Odontacarus barrinensis (Womersley)
Figs 1A–D, 2

Acomatacarus barrinensis Womersley, 1945, p. 106. For other synonymy see Southcott, 1986a, p. 188.

Description of larva: Lectotype

Colour in life red. Length of idiosoma (mounted on slide) 245, width 200; total length from tip of cheliceral fangs to posterior pole of idiosoma 335.

Dorsal scutum wider than long (nasus included); nasus well developed, blunt pointed, slightly waisted, meeting body of scutum at approximately right angles; anterior border (omitting nasus) slightly concave, anterolateral borders convex, posterolateral borders almost straight, anterolateral and posterolateral angles rounded, posterior pole rounded, forming an obtuse angle. Scutalae narrow,

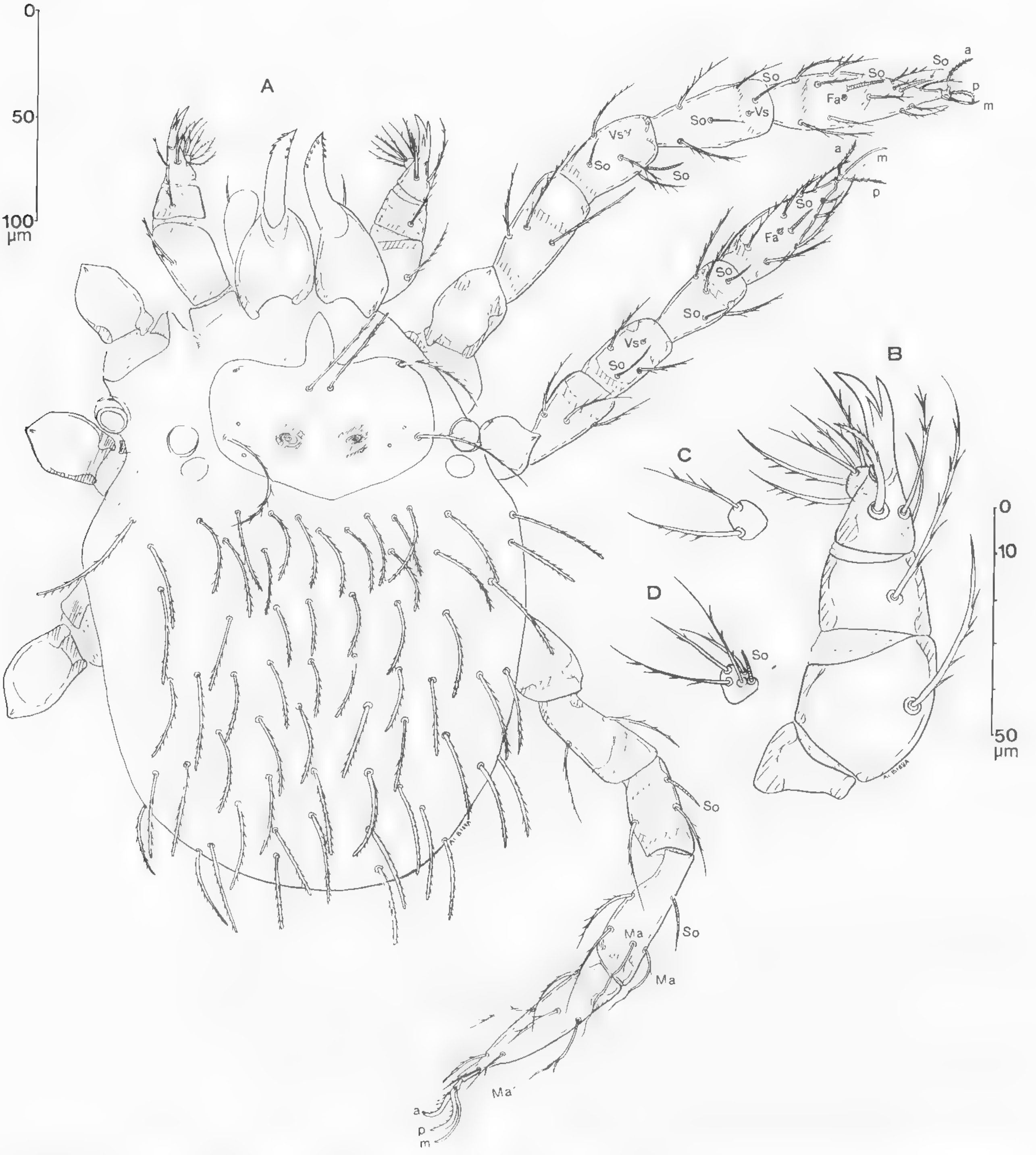

FIGURE 1. *Odontacarus barrinensis* (Womersley), larva, lectotype. A — Dorsal view, legs on left omitted beyond trochanters. B — Right palp, dorsal. C — Palpal tarsus, dorsal. D — Palpal tarsus, ventral. To standard symbols. (Each figure to nearer scale).

tapering, slightly blunted at tip, with moderately outstanding acute setules. Sensilla level with PL scutala bases; sensillary setae missing in all specimens. Scutum finely porose, with two larger pores (lacunae) near each PL scutala base.

Metric data as in Table 1.

Eyes oval, posterolateral to dorsal scutum, anterior with maximum diameter 16, posterior with maximum diameter 13.

Dorsal idiosomalae similar to scutalae, arranged: humerals 2, then approximately 18, 6, 10, 11, 9, 3, 2; total *ca* 61.

Ventral surface of idiosoma with a pair of setulose, pointed setae, bases 36 apart, between coxae III, 31 long. Behind coxae III opisthosoma with *ca* 46 setae, 28 pre-anal, 18 post-anal, pointed, setulose, 22–45 long, increasing in size posteriorad, and there resembling PDS. Anus oval, 21 long by 6 wide (valves apposed). Urstigma well chitinized, oval, 20 by 18, set in concavity in coxa I. Coxalae 2, 1, 1, well setulose, tapering, pointed; lateral coxala I 60 long, medial coxala I missing, all specimens, coxala II 44–46 long (paratypes), coxala III *ca* 42 long (paratypes).

TABLE 1. Metric data for *Odontacarus (Leogonius) barrinensis* (Womersley) larvae, type series.

Character	N19891 (ACB188A) Lectotype	n	Observed range	mean	s.d.	Coefficient of variation (%)
AW	73	5	68–73	69.6	2.07	2.98
PW	86	5	80–86	83.6	2.61	3.12
SB	31	5	26–31	28.0	2.00	7.14
ASB	55	5	52–55	54.0	1.41	2.62
PSB	27	5	26–28	27.0	1.00	3.70
L	82	5	78–83	81.0	1.87	2.31
LA	21	5	16–21	18.2	1.92	10.57
LB	61	5	61–64	62.8	1.30	2.08
LN	32	5	29–32	30.8	1.64	5.33
W	101	5	95–101	98.2	2.28	2.32
AP	31	5	27–32	30.0	1.87	6.24
AM	39	5	35–39	37.6	1.67	4.45
AL	46	5	40–46	43.2	2.68	6.21
PL	57	4	57–59	58.3	0.957	1.64
PL/AL	1.24	4	1.23–1.40	1.28	0.0818	6.40
AMB	11	5	11–12	11.4	0.548	4.80
Sens	–	0	–	–	–	–
PW/LB	1.41	5	1.28–1.41	1.33	0.0515	3.87
DS	33–60	5	57–64*	60.4*	2.70*	4.47*
Hum**	60	5	57–64	60.4	2.70	4.47
MDS	33–36	5	33–36*	35.0*	1.41*	4.04*
PDS	41–46	5	43–46*	45.2*	1.30*	2.88*
GeI	48	5	46–48	46.8	1.10	2.34
TiI	56	4	55–56	55.8	0.500	0.897
TaI(L)	80	5	79–89	84.4	4.62	5.47
TaI(H)	26	5	24–26	25.4	0.894	3.52
GeII	39	5	39–43	41.2	1.64	3.99
TiII	45	5	45–49	47.0	1.87	3.98
TaII(L)	66	5	66–72	70.2	2.68	3.82
TaII(H)	24	5	22–24	22.8	0.837	3.67
GeIII	47	5	46–48	47.0	0.707	1.50
TiIII	66	5	60–66	62.0	2.35	3.78
TaIII(L)	90	5	88–91	89.8	1.30	1.45
TaIII(H)	22	5	20–22	21.0	1.00	4.76
AW/AP	2.35	5	2.13–2.56	2.33	0.156	6.69
AW/TiIII	1.11	5	1.10–1.15	1.12	0.0241	2.14
PW/TiIII	1.30	5	1.30–1.41	1.35	0.0455	3.38
PSB/SB	0.87	5	0.87–1.08	0.968	0.0746	7.71
PW/AP	2.77	5	2.63–2.96	2.79	0.127	4.56

*For maximum values

**Humeral seta length

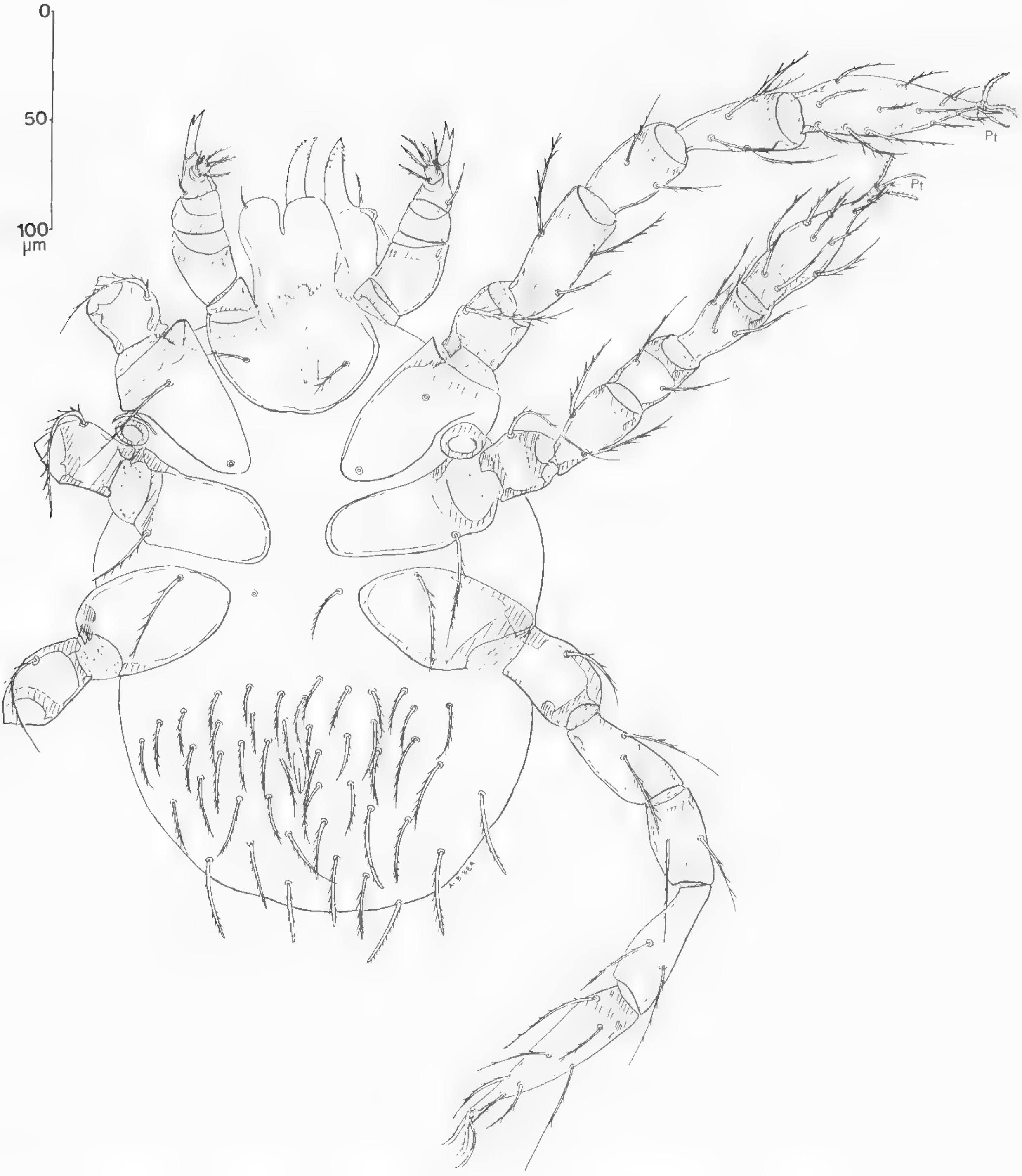

FIGURE 2. *Odontacarus barrinensis* (Womersley), larva, lectotype, ventral view, legs on left omitted beyond trochanters. Pt — pretarsala. (Some setae completed from paratypes).

Dorsal tracheal opening normal, between lateral border of palpal coxa and anterior border of coxa I.

Legs: lengths (including coxae and claws) I 370, II 330, III 390. Scobalar formula: trochanters 1, 1, 1, femora 6, 5, 4, genua 5, 4, 4, tibiae 7, 6, 6 (including 2 mastalae on III), tarsi 24, 17, 14 (including one mastala on III).

Leg specialized setae as follows (lengths in parentheses): SoGeI.30d(14), SoGeI.64p(21), VsGeI.65d(2), SoTiI.49d(16), VsTiI.77pd(3), SoTiI.89d(17) (*i.e.* distal to VsTiI). SoGeII.20d(18), VsGeII.60d(*ca*1), SoTiII.40d(12), SoTiII.86d(14). SoGeIII.23d(26), SoTiIII.37d(24).

Tarsus I with SoTaI.49d(19), FaTaI.42pd(*ca*2). Tarsus II with SoTaII.54d(14), FaTaII.47d(*ca*2).

Pretarsal formula 1, 1, 0. Tarsal claws normal; neomedian the longest, thinnest; anterior and posterior claws with double fringes of small onychotrichs.

Gnathosoma normal; combined chelicera bases 68 across; length 89 from tip of cheliceral fangs to posterior margin chelicera bases. Fangs stout, curved, with 3–4 stout dorsal teeth and 4–5 smaller ventral teeth. Galeala simple, pointed, 22 long. Gnathobasal setae (palpal coxal setae) (from paratype ACB188C) slender, well setulose, 18 long, with four or five setules.

Material examined

Queensland: Lake Barrine, 16.xi.1943, R. V. Southcott, five larvae, N19891-19895 (ACB188A-E). *O. barrinensis* was based on 'five syn-types collected free, from Lake Barrine, Queensland, 16 Nov. 1943 (R.V.S.), and a single specimen from man, Atherton Tableland, Queensland, 8 March 1944 (R.V.S.)'. Southcott *(loc. cit.)* clarified collection details of these specimens. Specimen N19891 (ACB188A) is hereby specified as lectotype, specimens N19892–19895 (ACB188B-E respectively) paralectotypes.

The lectotype is labelled: R. H. label (in writing of R.V.S.): LECTOTYPE; (in writing of H. Womersley) *Acomatacarus barrinensis* n. sp./ Co-type/ Lake Barrine/ Q. 16.11.43/R.V.S./. L. H. Label (in writing of R.V.S.) ACB188A/ Running over log./ Shores of Lake Barrine/ Q. 16-11-1943/ R. V. Southcott. On reverse of slide, in unidentified writing: ARA7524/ Trombiculidae/ *Odontacarus/ barrinensis/* syntype.

Specimen N19896 (ACB210A) was unidentifiable (see above), and is excluded.

Remarks

The measurements given in Table 1 differ from those of Womersley (1945) for the same series of five mites. A comparison of Womersley's figures (means) for the same characters as used here shows that his measurements are higher than those given here. These eight percentage increases have a range of 0.67–6.38%, with a mean of 3.53 and a standard deviation of 1.86.

Successive efforts have been made to find differentiating characters for the larval *Odontacarus* of northern Queensland and Papua-New Guinea (Womersley 1944, 1945; Southcott 1957, 1986a, b, 1989; Goff 1979a, b, 1981; Veitch and Southcott 1984). Womersley's material has been only partly restudied, so that his differentiating characters as published had perforce to be utilized in my keys (1986a: 179; 1989: 42). Prominent among Womersley's criteria were the number of dorsal and ventral idiosomal setae, the ratio PW/LB (as 'PW/SD'), and the absolute sizes of the shield characters, as well as the length of DS. Clarification of the taxonomy of several species — *O. australiensis, O. novaguinea* and *O. hirsti* — was by Domrow and Goff. Veitch and Southcott (1984) and Southcott (1986a) provided adequate differentiating characters for *O. athertonensis, O. mccullochi, O. swani* and *O. veitchi.* The inconsistent errors in Womersley's measurements made the use of his key hazardous. Two species still needing differentiation were *O. athertonensis* and *O. barrinensis,* which had been collected from two sites on the Atherton Tableland, separated by about 22 km.

Womersley (1945: 106) stated of *O. barrinensis:* 'This species is very close to *athertonensis* in the number of dorsal setae, *ca* 64 in each. It differs, however, in the Standard Data, the values for AW, PW and SB being very significantly different.'

TABLE 2. Differentiating characters of the type series of *Odontacarus barrinensis* and *O. athertonensis* larvae.

	O. barrinensis					*O. athertonensis**				
Character	Lectotype	n	mean	s.d.	Observed range	Lectotype	n	mean	s.d.	Observed range
AW	73	5	69.6	2.07	68–73	71	21	65.9	2.70	61–71
PW	86	5	83.6	2.61	80–86	80	21	77.62	2.66	75–87
SB	31	5	28.0	2.00	26–31	25	21	25.10	1.41	22–30
PL/AL	1.24	4	1.28	0.0818	1.23–1.40	1.34	20	1.36	0.0805	1.20–1.57
PW/LB**	1.41	5	1.33	0.0515	1.28–1.41	1.21	21	1.25	0.0756	1.17–1.45
AW/AP	2.35	5	2.33	0.156	2.13–2.56	2.84	21	2.34	0.201	2.06–2.84
AW/TiIII	1.11	5	1.12	0.0241	1.10–1.15	1.09	21	1.10	0.0491	1.00–1.23
PW/TiIII	1.30	5	1.35	0.0455	1.30–1.41	1.23	21	1.30	0.0691	1.17–1.53
PSB/SB	0.87	5	0.968	0.0746	0.87–1.08	1.40	21	1.16	0.124	0.93–1.40
PW/AP	2.77	5	2.79	0.127	2.63–2.96	3.20	21	2.76	0.222	2.38–3.22

*From Southcott (1986a), plus new data
**PW/SD of Womersley (1945)

In Table 2 a comparison is given of metric characters of the type series of *O. barrinensis* and *O. athertonensis*. These are the principal characters used in keys to larvae. Table 2 shows that there is a considerable overlap of all the listed characters of the two species, and in fact the ranges of values for *O. barrinensis* lie entirely within those of *O. athertonensis*, for all characters except AW, SB and PSB/SB.

Table 3 shows a comparison of the means of the characters listed in Table 2, by t-test, on the usual assumption that the variances do not differ. Table 3 shows that there are significant differences between the 'size factors' AW, PW and SB. It shows also that there are significant differences in the 'shape factors', the proportions PW/LB and PSB/SB, and borderline significance for PL/AL. Comparison of the two type series has not revealed other morphological differences.

Even though exclusive separating characters between *O. athertonensis* and *O. barrinensis* larvae have not been found, the metric differences for scutal size and shape indicate that the separation is justified.

The life history of this species will be described in a succeeding paper.

TABLE 3. Comparison of means of key characters separating *O. barrinensis* and *O. athertonensis*, by t-test.

Character	t	d.f.	P and significance
AW	2.197	24	0.05>P>0.02*
PW	4.536	24	<0.001***
SB	3.637	24	0.01>P>0.001**
PL/AL	1.856	22	0.1>P>0.05, n.s.
PW/LB	2.281	24	0.05>P>0.02*
AW/AP	0.1633	24	0.9>P>0.8, n.s.
AW/TiIII	0.9471	24	0.4>P>0.3, n.s.
PW/TiIII	1.495	24	0.2>P>0.1, n.s.
PSB/SB	3.205	24	0.01>P>0.001**
PW/AP	0.288	24	0.8>P>0.7, n.s.

*Significant at the 0.05 level of probability
**Significant at the 0.01 level of probability
***Significant at the 0.001 level of probability
n.s. not significant.

ACKNOWLEDGMENTS

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A NEW MIDDLE TERTIARY CROCODILE FROM LAKE PALANKARINNA, SOUTH AUSTRALIA

P. M. A. Willis & R. E. Molnar

Summary

Australosuchus clarkae is a new generalised Oligo-Miocene crocodilian from Lake Palankarinna, South Australia. It appears to be part of a recently recognised endemic Tertiary radiation of crocodiles in Australia.

A NEW MIDDLE TERTIARY CROCODILE FROM LAKE PALANKARINNA, SOUTH AUSTRALIA

P. M. A. WILLIS & R. E. MOLNAR

WILLIS, P. M. A. & MOLNAR, R. E. 1991. A new middle Tertiary crocodile from Lake Palankarinna, South Australia. *Rec. S. Aust. Mus.* **25**(1): 39–55.

Australosuchus clarkae is a new generalised Oligo-Miocene crocodilian from Lake Palankarinna, South Australia. It appears to be part of a recently recognised endemic Tertiary radiation of crocodiles in Australia.

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In another paper (Willis, Murray & Megirian 1990), the existence of an endemic Tertiary radiation of Gondwanan freshwater crocodilians in Australia was discussed. This speculation was based on zoogeographic considerations and apparently synapomorphic features possessed by *Pallimnarchus pollens, Quinkana fortirostrum* and *Baru darrowi.*

A new genus and species of crocodile from Oligo-Miocene sediments of South Australia appears to support this hypothesis. It is both the oldest described member of the group and, apparently, the most plesiomorphic. This species was noted by Molnar (1982) and probably by Stirton *et al.* (1968) and Estes (1984).

The following abbreviations for collections are used in this paper: AMNH, American Museum of Natural History, New York; NHMV P, Museum of Victoria, Melbourne; QM F, Queensland Museum, Brisbane; UCMP, University of California, Museum of Paleontology, Berkeley; SAM P, South Australian Museum, Adelaide.

SYSTEMATICS

Order: Crocodilia
Suborder: Eusuchia
Family: Crocodylidae
Australosuchus Willis & Molnar, gen. nov.

Type species

Australosuchus clarkae Willis & Molnar, sp. nov. (Figs 1a, b)

Generic diagnosis

Crocodiles of this genus differ from all other crocodylids in the following combination of features (apomorphies designated 'a'): moderately broad snouted; pseudoheterodont dentition; alveolar process present on premaxilla, maxilla and dentary; external nares raised, circular or ovate, with sharply defined margins; postorbital-squamosal contact on skull roof V-shaped, apex directed posteriorly (a); five alveoli occur in premaxilla; fourteen alveoli occur in maxilla; sixteen to seventeen alveoli occur in dentary; dentary tooth reception pits are excluded from margins of premaxilla and maxilla; fourth dentary tooth reception pit is semi-enclosed (a); symphysis extends posteriorly to level of fourth or fifth dentary alveolus.

Differential diagnosis and discussion

Australosuchus clarkae differs from other Australian crocodiles in the following features: *A. clarkae* lacks interlocking dentition, an anterior process of the palatines and has the fourth dentary tooth accommodated in a pit rather than a notch as in species of *Crocodylus.* The first of these features is apparently plesiomorphic for crocodiles, the second is probably apomorphic for certain Australian crocodiles (Willis *et al.* 1990), and the third is also found in alligatorines. As discussed below, *Australosuchus* seems to have no other alligatorine affinities, and so this feature is probably convergent and an apomorphy for *Australosuchus. Australosuchus* does not have ziphodont features as seen in *Quinkana fortirostrum* and it is smaller than both *Baru darrowi* and *Pallimnarchus pollens. Australosuchus clarkae* is also distinguished from these three fossil crocodilians by the fourth dentary tooth reception pit, the extent of the dentary symphysis and the more posterior position of the palatal fenestrae (a plesiomorphic feature). In these features, *A. clarkae* is sufficiently different to justify the erection of a new genus.

Etymology

The generic name is derived from the Latin *australis* meaning southern and *suchus* meaning crocodile. The gender is masculine.

Australosuchus clarkae Willis & Molnar, sp. nov.

Holotype

QM F16788 (Fig. 1a, b), an almost complete skull and mandible, incomplete cervical and dorsal vertebrae, scapula, humerus and dermal armour, collected by Michael Archer in 1975.

Type locality

An unnamed site from the base of the eastern end of the bluff that yielded the Tedford Local Fauna and Tedford East Local Fauna, Lake Palankarinna, South Australia.

Paratypes

NHMV P188441, right premaxilla and maxilla; SAM P27932, premaxillary fragment; SAM P27847, maxillary fragment; SAM P27933, maxillary fragment; NHMV P188437, right maxillary fragments; QM F18102, jugal; SAM P29580, jugal; NHMV P188439, right jugal; NHMV P188440, right jugal fragment; SAM P27841, frontals; SAM P10892, frontals; AMNH 23047, left postorbital and half of frontal; QM F17985, frontal, parietal and postorbital; AMNH 23048, right postorbital; AMNH 23049, parietal; AMNH 23052, right quadrate; AMNH 23051, left quadrate and squamosal fragment; QM F17433, right quadrate; QM F17986, squamosal (possibly from the same individual as QM F17985); QM F17984, squamosal; AMNH 23050, basioccipital; NHMV P166441, right exoccipital; QM F17983, exoccipital with quadrate fragment; SAM P27934, dentary, angular and squamosal; SAM P27827, dentary; SAM P29083, dentary; SAM P23985, dentary; NHMV P166439, right dentary; NHMV P160360 and NHMV P160357, right dentary fragment (two fragments of the same specimen that have been catalogued separately); NHMV P166442, left dentary; SAM P30162, right dentary; UCMP 57071, right dentary; UCMP 70941, left dentary; QM F18152, right dentary; QM F18151, left dentary; UCMP 100028, surangular; SAM P23985, surangular; NHMV P188436a, right surangular; NHMV P188438, right surangular; QM F17988, incomplete angular; SAM P23985, angular; SAM P29578, angular; SAM P29579, angular; NHMV P188436b, left angular fragment; AMNH 23055, cervical vertebral

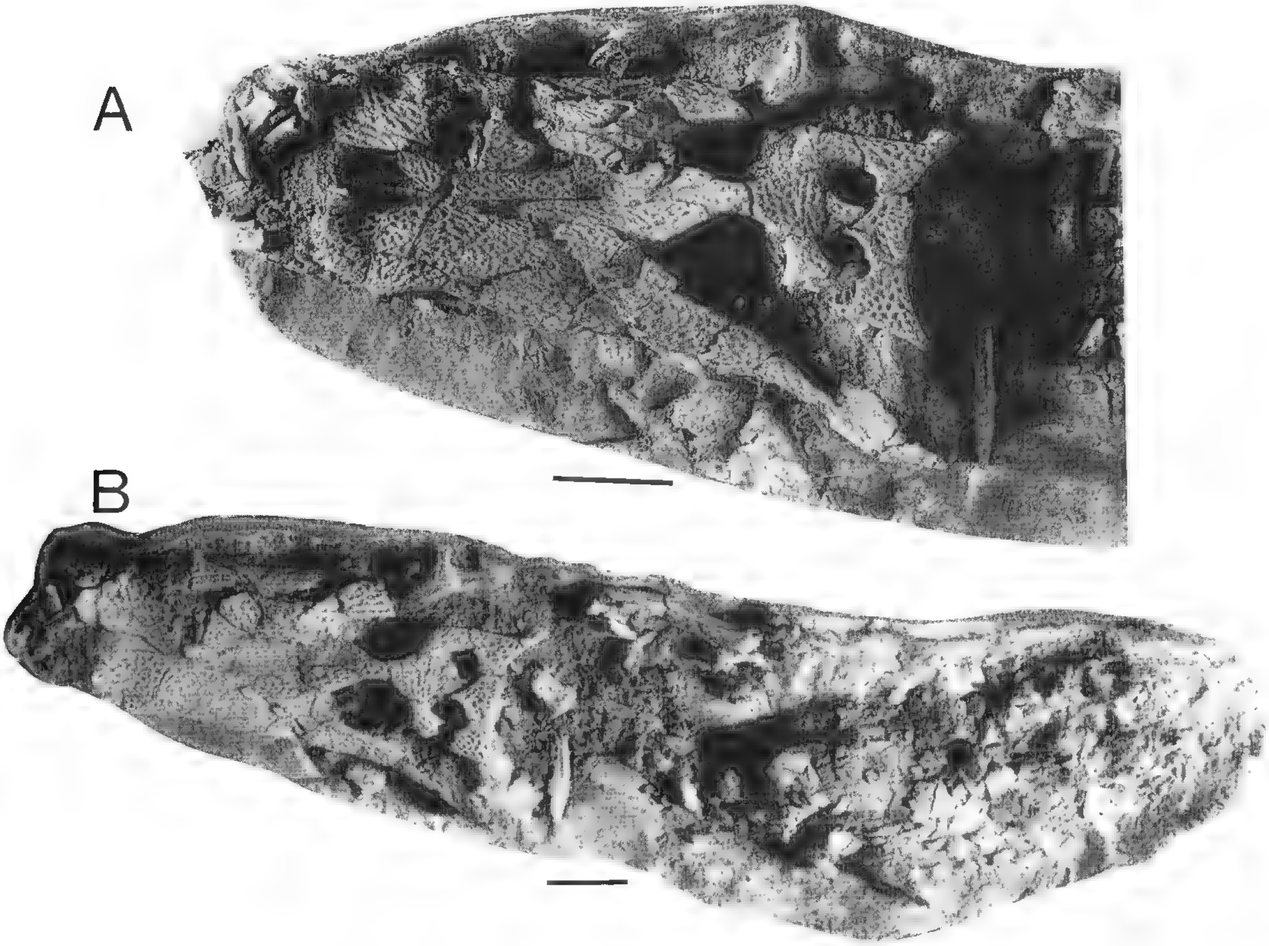


FIGURE 1. The type specimen (QM F16788), in its plaster cradle, of *Australosuchus clarkae*, gen. et sp. nov., in dorsal view. A, Skull. B, Entire specimen. Scale bars 5 cm.

centrum; SAM P27829, cervical vertebral centrum; AMNH 23056, neural arch; AMNH 23057, caudal vertebral centrum and neural arch; QM F17987, dorsal vertebra; AMNH 23054, cervical rib; SAM P24656, a right hind limb consisting of femur, tibia, fibula, a partial third tarsal, all metatarsals, one phalange and claw from the first digit, three phalanges and claw from the third digit and two phalanges from the fourth digit; SAM P30161, right femur; SAM P27830, right coracoid; SAM P27828, right third metatarsal; SAM P30160, right humerus; all from the Etadunna Formation, Lake Palankarinna, South Australia.

Paratype material from other localities includes: AMNH 12177, premaxilla and two teeth and AMNH 12200, a skull, both from the Namba formation, Lake Pinpa; NHMV P188442, right angular fragment from the Namba formation, Lake Tarkarooloo; UCMP 88192, jugal and quadratojugal and UCMP 71396, left premaxilla and maxilla both from the Wipijiri formation, Lake Ngapakaldi; UCMP 100027, frontals, UCMP 57069, dentary and UCMP 57071, dentary all from the Mampuwordu Sands, Lake Palankarinna.

AMNH 12200 is a large skull that is badly shattered (Fig 2). It can be referred to this species but is too poorly preserved to be of much descriptive value.

There are numerous other crocodilian fragments from Lake Palankarinna in the collections of the South Australian Museum and the Queensland Museum. These specimens are too small or broken to be of use. However, a search through these fragments revealed no specimens that clearly differed from those described here.

Various unnumbered specimens from the collections of the Queensland Museum and the South Australian Museum are also of use and are included here as paratypes.

Stratigraphy, fauna and age

The holotype derives from the Etadunna Formation. It belongs to an undetermined local fauna that is some two metres below the Tedford East Local Fauna and at a level that is stratigraphically comparable to the occurrence of *Muramura williamsi* (Pledge 1987; Archer, pers. comm.). This local fauna is most likely to be late Oligocene to early Miocene in age (Callen *et al.* 1987; Archer *et al.* 1990).

Paratype specimens from the Etadunna Formation belong to the Ditjimanka Fauna. AMNH 12200 and AMNH 12177 pertain to the Pinpa Local Fauna. NHMV P188442 belongs within the Lake Tarkarooloo Local Fauna. UCMP 88192 and UCMP 71396 belong to the the Kutjamarpu Fauna. Current understanding of the biostratigraphy places these faunas within the late Oligocene or early Miocene (Callen *et al.* 1987, Woodburne *et al.* 1985).

UCMP 100027, UCMP 57069 and UCMP 57071 are from the Mampuwordu Sands, Lake Palankarinna. The Mampuwordu Sands are thought to be late Pliocene or possibly early Pleistocene in age (Callen *et al.* 1987, Woodburne *et al.* 1985). Either this species of crocodile was conservative in its morphology over this period of time or the site information for these three specimens is incorrect. Considering that the Mampuwordu Sands are a channel cut into the Etadunna Formation, it is possible that these Mampuwordu crocodile specimens were reworked from the older Etadunna Formation or that their stratigraphic province was incorrectly interpreted at the time of collection. At present, we assume the site information for the supposed Mampuwordu Sands specimens is incorrect. Thus we suggest this species is most likely restricted to the late Oligocene or early Miocene.

Etymology

The specific name is in honor of Mrs Elaine Clark in recognition of her continuing support for the Riversleigh Research Project.

Specific diagnosis

As for the genus until new species are recognised.

Descriptions

The following descriptions are primarily based on the holotype, the most complete specimen. The paratypes were used to supplement this information because many elements on QM F16788 are incomplete, badly fractured or covered by matrix. Paratypes are noted where used. Fig 3 shows reconstructions of the skull, based on specimens shown in Fig. 4.

QM F16788 was chosen as the holotype for two reasons: it retains most of the skull elements and, although crushed and fractured, its skull could be reasonably well reconstructed; second, it is the only specimen that unambiguously associates cranial and postcranial elements.

Premaxillae: The premaxillae on QM F16788 are broken and incomplete so this description is based mainly on SAM P27932, AMNH 12177, NHMV P188441 and UCMP 71396 (Fig 5).

The external nares are raised. They are circular and slightly flared on SAM P27932, but on UCMP 71396 the nares are ovate, being wider than long. On both specimens the nares have sharply defined margins.

AMNH 12177 has two unattached teeth associated with it. They are ovate in cross section, with non-serrate anterior and posterior carinae. The larger has vertical ribs on the lingual surface. These

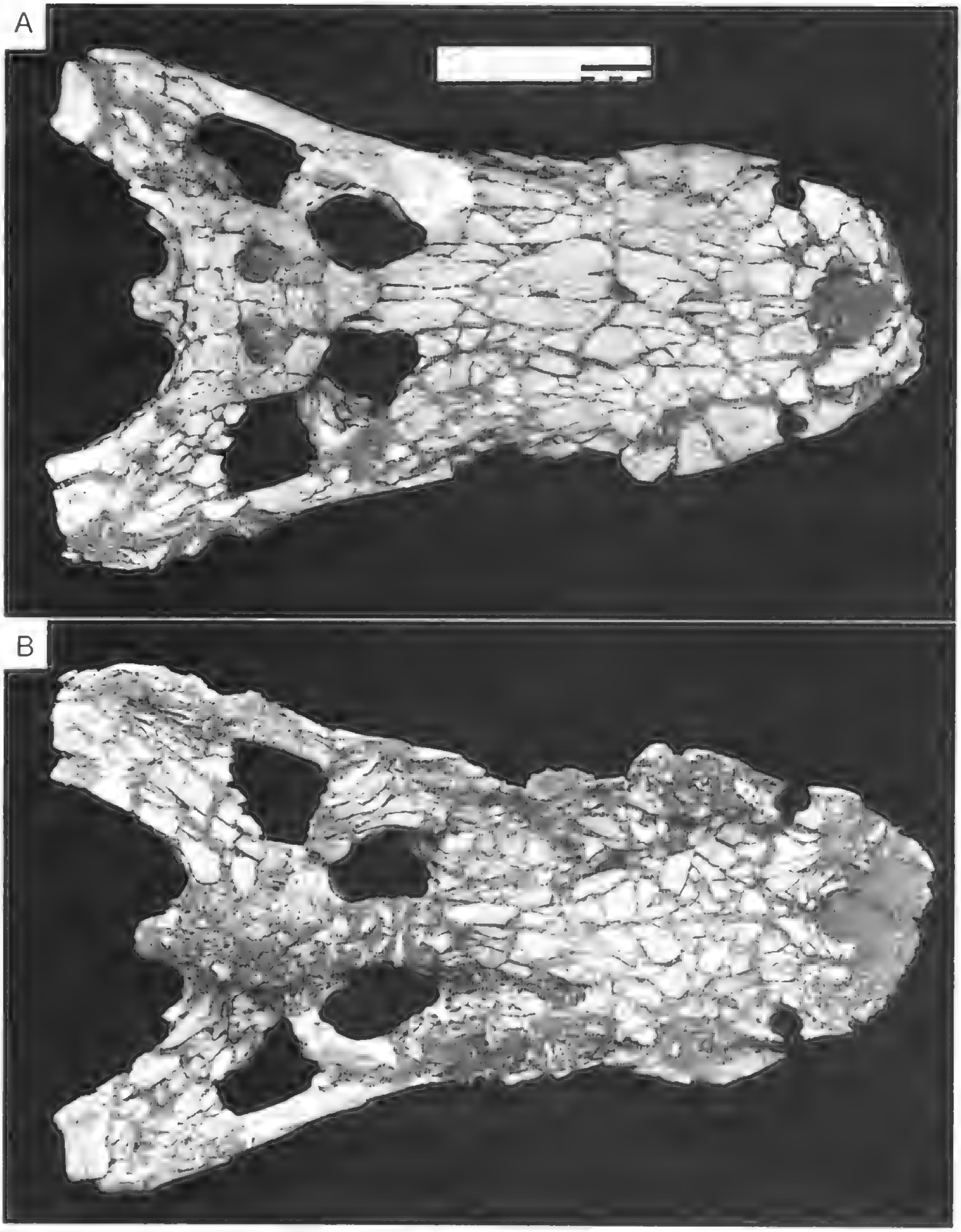


FIGURE 2. Large crocodilian skull (AMNH 12200) from the Namba Fm. of Lake Pinpa, South Australia. A, Dorsal view. B, Ventral view. This somewhat crushed specimen is probably referable to *A. clarkae*. Scale in inches and cm.

are the only teeth associated with any of the premaxillae.

There are five alveoli. The first and second are subequal in size, the third is larger and the fourth is very large. The fifth is intermediate in size between the second and third.

Dentary tooth reception niches occur between, and lingual to, the upper series and are excluded from the margins. The first niche is very deep and separates the first and second premaxillary alveoli. It does not erupt through the dorsal surface on SAM P27932 but does on UCMP 71396. The other niches are more shallow. The fourth dentary tooth reception pit is semi-enclosed, mostly hiding the fourth dentary tooth when the mouth is closed and thus resembling the alligatorine, rather than the crocodyline, condition. This is an unusual and distinctive feature. The premaxilla is built up around the tooth bases to form a distinct alveolar process. The sculpture consists of distinct oval pits around the margins and indistinct pits on the dorsal surface. The foramen incisivum is relatively large and ovate.

AMNH 12200 shows that the premaxillae are separated by the nasals on the dorsal surface, posterior to the nares, a feature not clear in any other specimen.

Maxillae: The maxillae of QM F16788 are almost complete but crushed and broken. The ventral surfaces are obscured by matrix and mandibular elements. The maxilla of UCMP 71396 is complete and uncrushed. NHMV P18841, NHMV P188437, SAM P27933 and SAM P27847 are less complete maxillary fragments. This description is based on these specimens.

The shape of the maxilla indicates a moderately broad and flat snout with fourteen alveoli. A moderately developed alveolar process is present, accommodating the anterior six alveoli.

No crowns are associated with any maxilla, except that of the type, where the left fourth and fifth are present. These are oval in section with marked anterior and posterior carinae. The alveoli are round, becoming ovate posteriorly. The sequence of tooth size is typically crocodyline (as judged by the size of the alveoli) with the fifth tooth being the largest. The alveoli increase in size from the first to the fifth then decrease in size to the seventh. They then increase in size again until the tenth and then decrease in size posteriorly. The third and tenth alveoli are about the same size but larger than the second, sixth, eighth and fourteenth alveoli which are also about the same size. The alveolar spacing is interrupted by dentary tooth reception pits between and lingual to the sixth and seventh alveoli, and between and lingual to the seventh and eighth alveoli.

Tooth reception pits are excluded from the margins and indicate that the teeth did not fully interlock. Well defined tooth reception pits are located between and lingual to the sixth and seventh alveoli, the seventh and eighth alveoli, the eighth and ninth alveoli and between the ninth and tenth alveoli. Less well defined pits occur between the first and second alveoli and posterior to the tenth.

The palatal suture with the premaxilla is a shallow W-shape and there is no clear sign of a contact with the palatine. However, the mid-line maxillary suture can be seen to extend posteriorly to the level of the anterior margins on the palatal fenestrae. This indicates that this species lacked an anterior palatal process. The ectopterygoid suture reaches anteriorly to the posterior edge of the twelfth alveolus. The palatal fenestrae reach anteriorly to the level of the ninth alveolus. The dorsal sutural contact with the nasal is nearly straight and almost parallel to the midline, but slightly constricted anteriorly.

Sculpture is shallow on the maxilla, consisting of low surface markings, pits anteriorly and grooves posteriorly.

Nasals: Both nasals on QM F16788 are crushed and broken. While no other specimens preserve the nasals, some inferences about these bones can be drawn from UCMP 71296 (premaxilla and maxilla), AMNH 12200 (a skull) and from UCMP 100027, (frontals and prefrontals).

The nasals entered the external nares, flared slightly toward the posterior until their contact with the lacrymals, then tapered posterior from that point. An anterior process of the frontals separated the posterior extremities of the nasals.

Jugals: The jugals of the type specimen are crushed and broken and the right has fallen away from the remainder of the skull so that the medial face is exposed. This description is also based on UCMP 88192, NHMV P188440, NHMV P188439 and SAM P29580 (Fig. 6a–d).

The jugals are slender and gracile. The postorbital bar is inset but there is no trough between it and the lateral face of the jugal. The postorbital bar has a weakly developed buttress on the medial surface that ventrally is deflected sharply forward. A very large nutrient foramen lies on the medial surface, anterior to the base of the postorbital bar. On UCMP 88192 and the type, there are two foramina here. The sculptured surface of the jugal extends ventrally under the region of the postorbital bar.

Quadratojugals: The quadratojugals on QM F16788 are broken and partially displaced. An almost complete quadratojugal is present in UCMP 88192. It is broad and ventrally thickened. The presence or absence of an anterior spike cannot be determined. Only subdued sculpture is present, and the ventral portion of the lateral face, behind the jugal contact, is flexed to be directed ventrolaterally.

Quadrates: The right quadrate of QM F16788 is

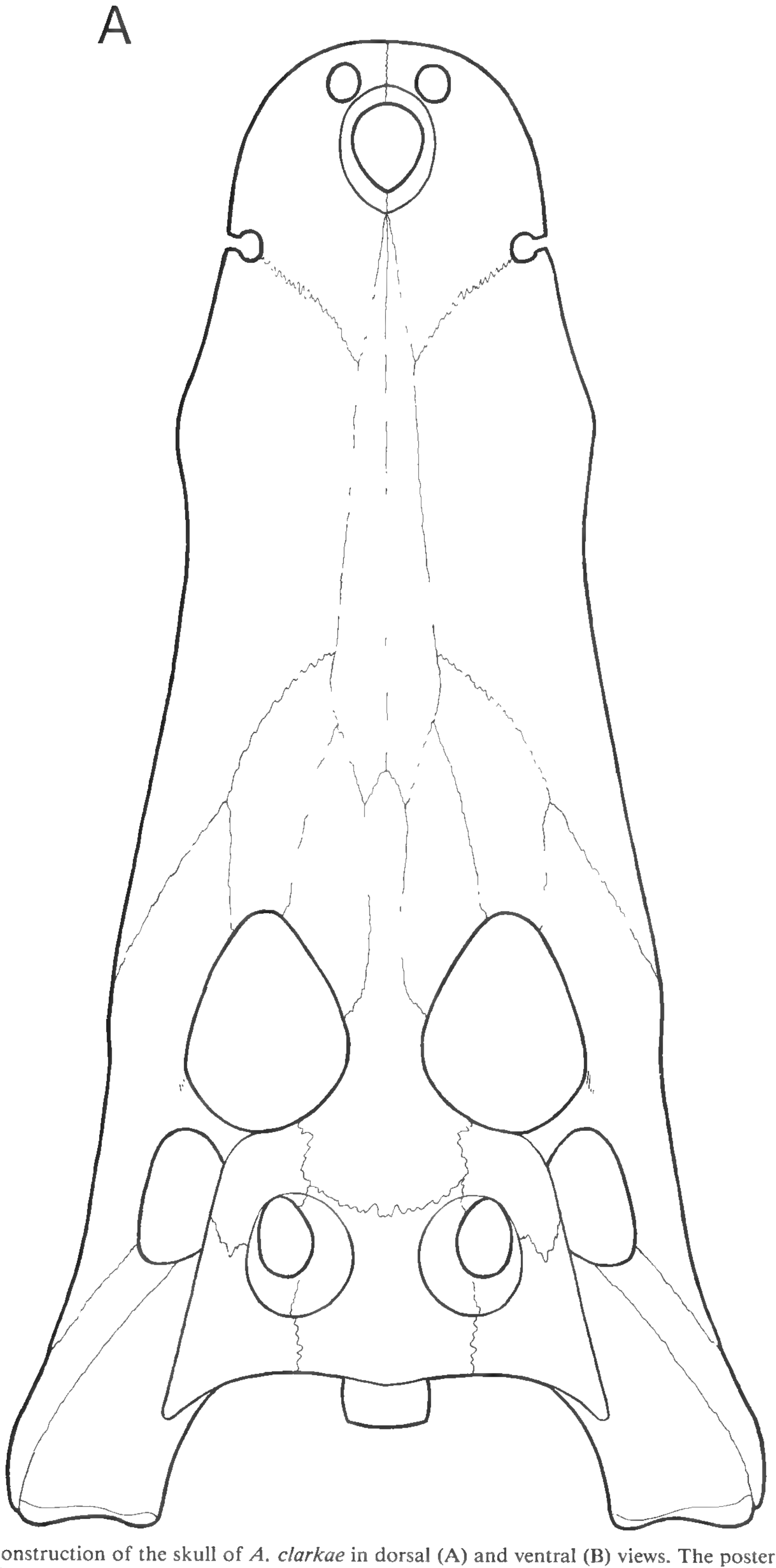
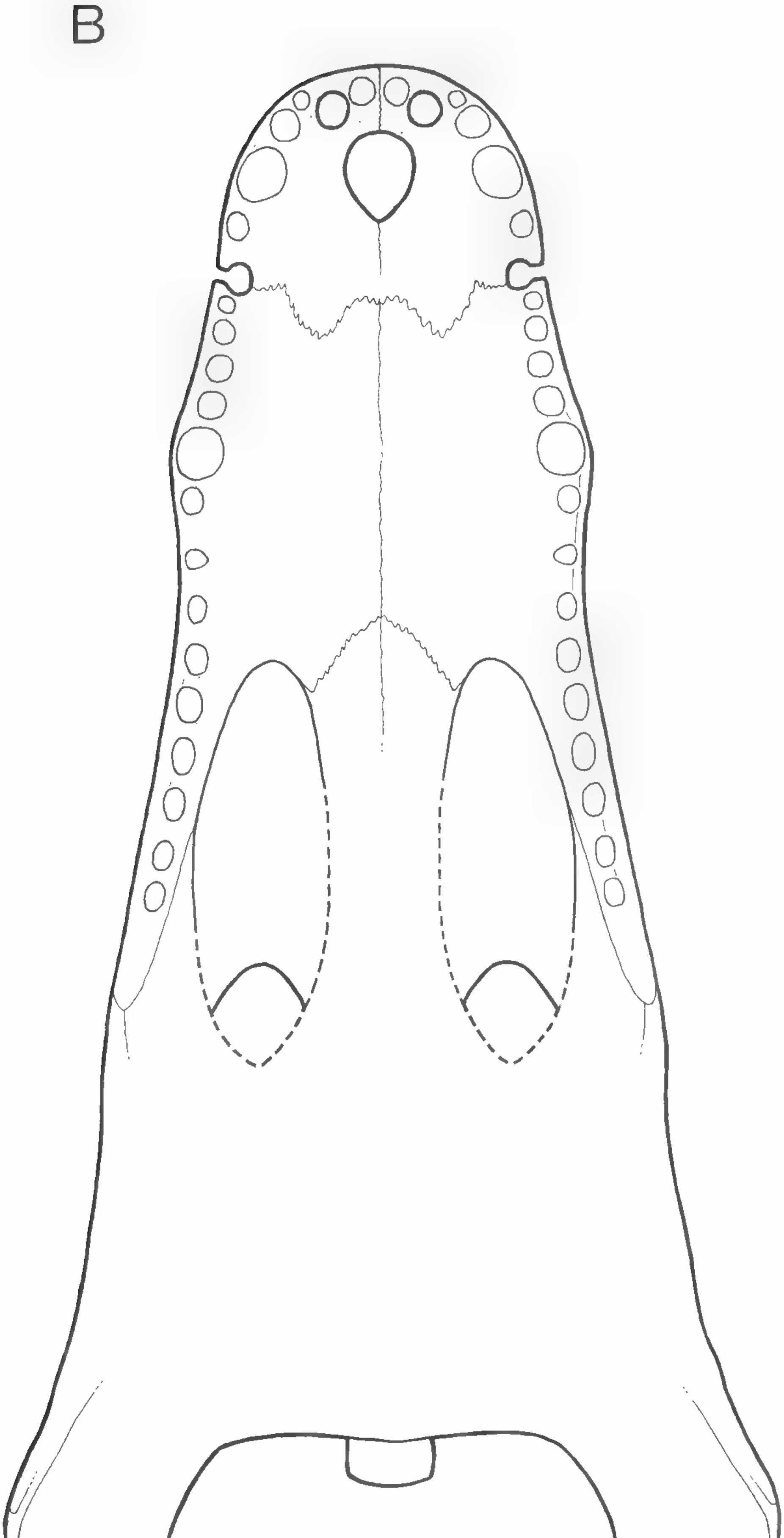


FIGURE 3. Reconstruction of the skull of *A. clarkae* in dorsal (A) and ventral (B) views. The posterior part of the palatal surface is unknown.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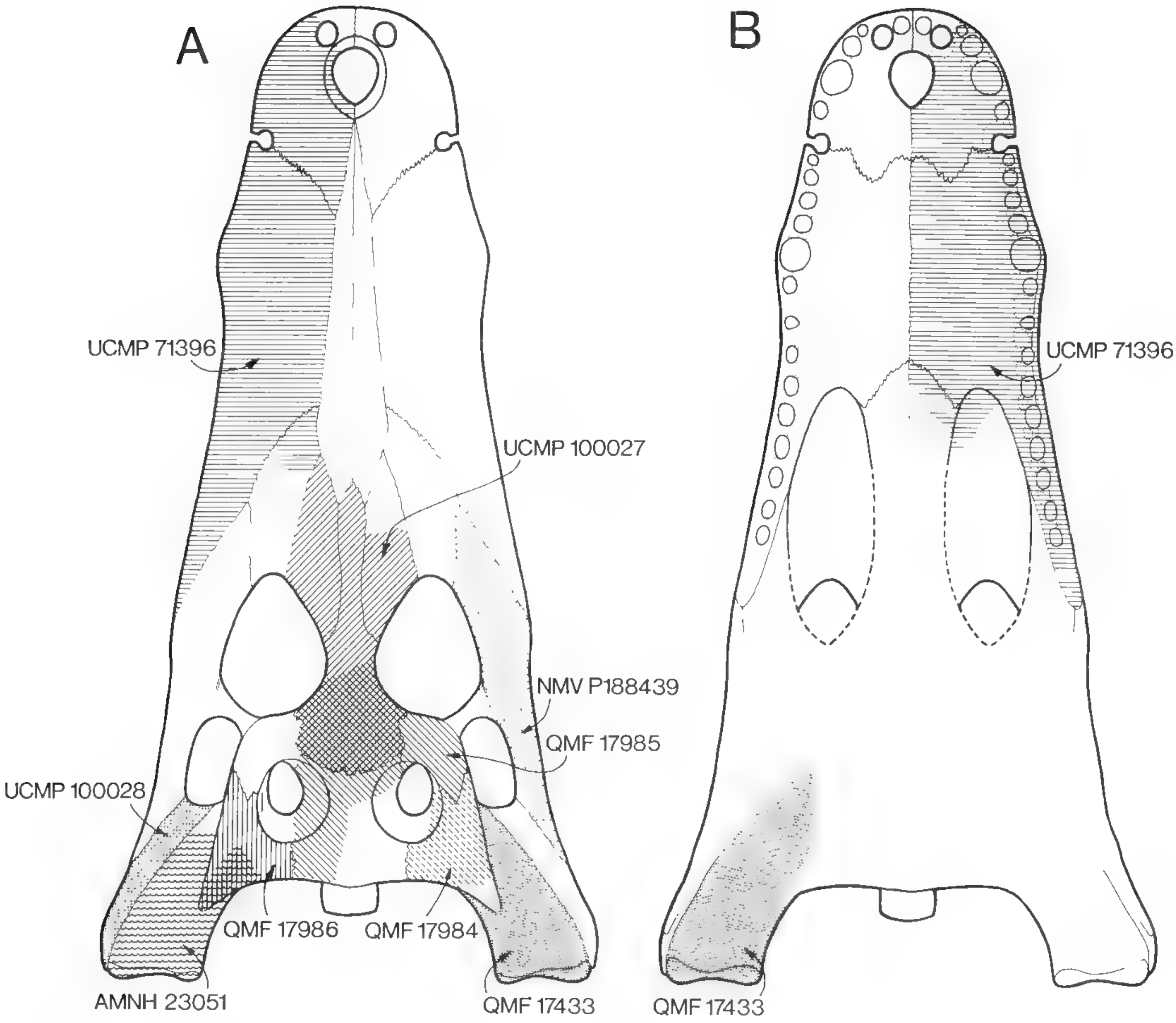

FIGURE 4. Specimens upon which the cranial reconstruction is based. A, Dorsal view. B, Ventral view.

missing and the left quadrate is broken and somewhat obscured by other elements. AMNH 23052 a right quadrate, AMNH 23051 a left quadrate and squamosal, and three unnumbered specimens (two right, one left, all missing the anterior portions) in the collections of the Queensland Museum form the basis of the description (Fig. 7)

The dorsal contact with the squamosal has a prominent plinth. A well developed crest on the ventral surface (equivalent to the B crest of Iordansky (1973)) is orientated parallel to the quadratojugal suture. Posteriorly this crest curves laterally, toward the quadratojugal suture which it meets just anterior to the condyle (Iordansky's B' crest). The sutured margin with the quadratojugal is quite deep posterior to the level of the paroccipital process, becoming more shallow anteriorly. The dorsal platform between the condyle and the paroccipital process is quite wide. A distinct, almost pit-like, excavation on the ventral face lies just anterolateral to the medial condyle.

Lacrymals: Both lacrymals on QM F16788 are crushed and broken but complete. The only lacrymal material known from the paratype collection is a small fragment attached to UCMP 71396.

The lacrymals are relatively long and narrow. They form the antero-lateral margin of the orbits which are large and constricted anteriorly. They have an extensive medial contact with the nasals. The lacrymal duct and ventral surfaces cannot be traced in these specimens.

Prefrontals: The right prefrontal of QM F16788 is severely broken, but the left has suffered only one break near its centre and is apparently complete.

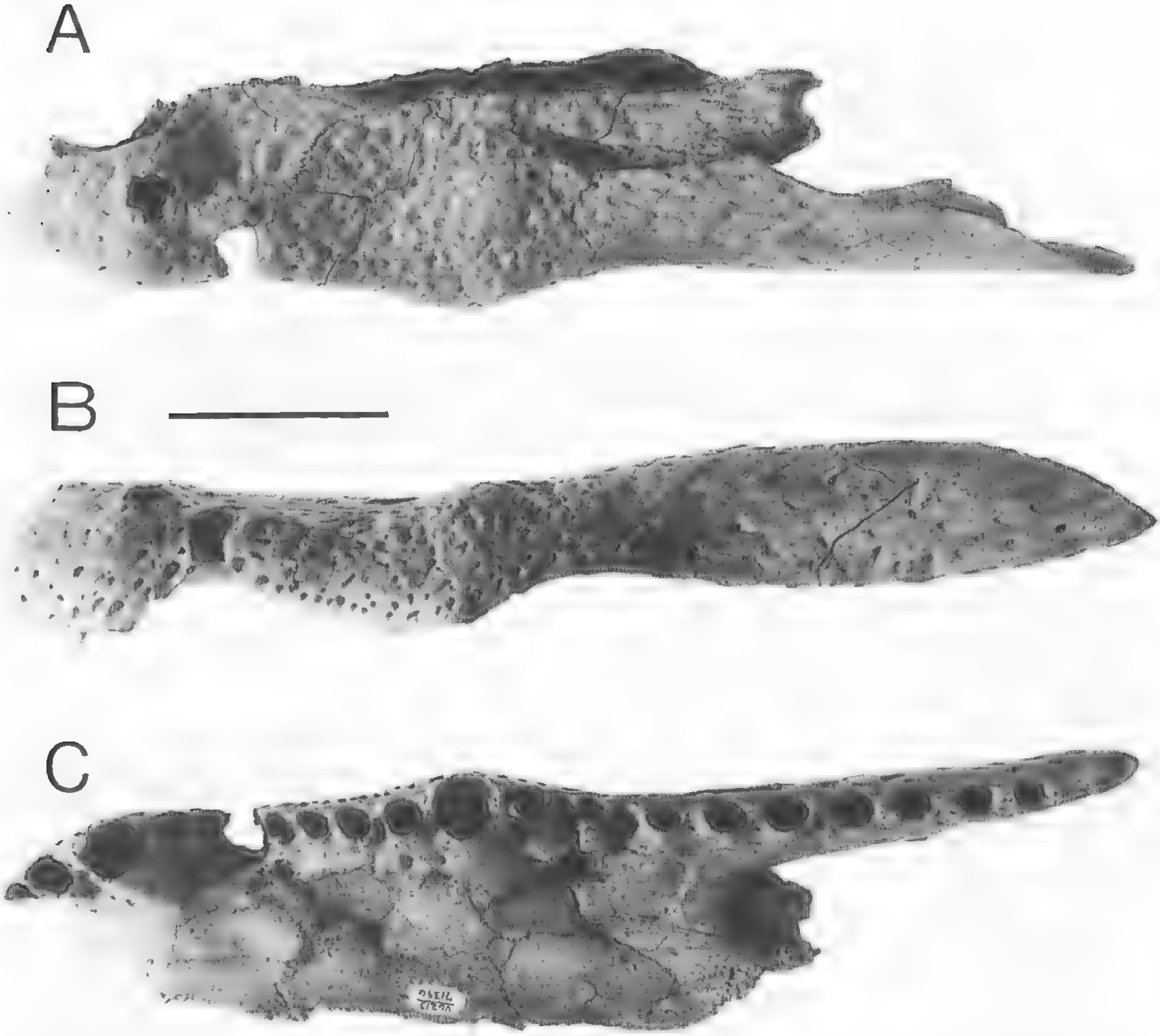

FIGURE 5. The left premaxilla and attached maxilla of *A. clarkae* (UCMP 71396) in dorsal (A), lateral (B) and ventral (C) views. Scale bar 5 cm.

UCMP 100027 preserves both left and right prefrontals; the right is incomplete anteriorly and both lack the delicate descending process.

The prefrontals are basically isosceles triangles with the apex directed laterally. The anterior process is relatively long and the posterior extremity of the nasals separates the anterior tip of the frontals from the prefrontals. Although the orbit margins are not raised, they are sharply defined and steeply angled to the external surfaces. There is a slight continuation of the *cristae cranii frontales* onto the posterior part of the ventral surface of the prefrontals. Sculpture consists of deep elongate pits.

Frontals: The frontals of QM F16788 are broken in one place. SAM P27841 and SAM P10892 are complete frontals, UCMP 100027 are complete frontals with prefrontals and part of the nasals (Fig. 6e, f) and AMNH 23047 is half a left frontal and a postorbital. All are similar but AMNH 23047 is smaller than the others.

The frontals of this species are slightly concave posteriorly due to raised orbital rims. They are heavily built (particularly posteriorly), narrow between orbits and lightly sculptured with pits. The anterior process is relatively long and anteriorly separates the posterior extremities of the nasals. Ventral ridges around orbits (*crista cranii frontales*) are not as well developed as in *C. porosus* of similar size, but in AMNH 23047 they are more pronounced than in the other specimens. The frontals do not participate in the margins of the supratemporal fenestrae. The dorsal suture with the

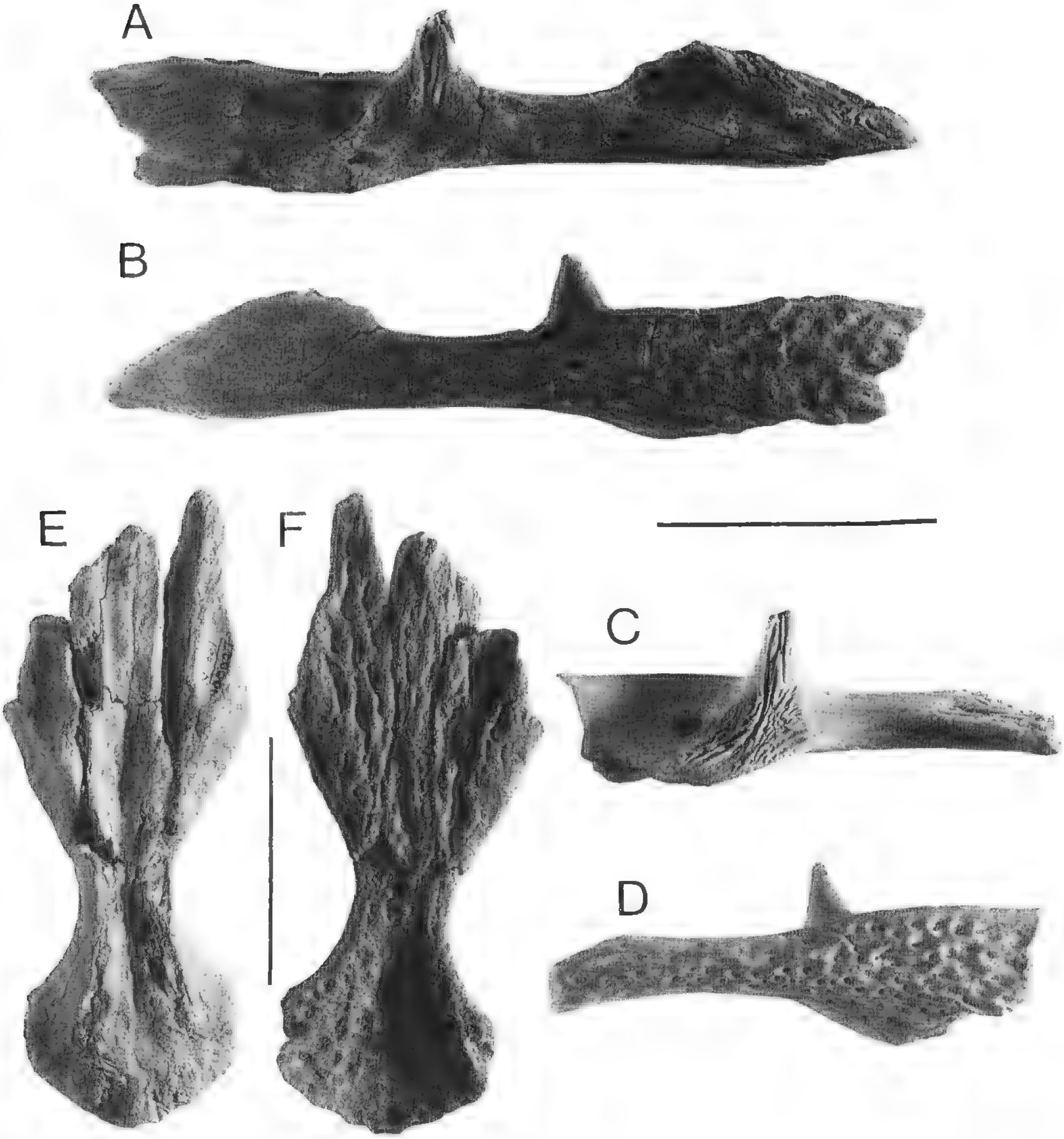

FIGURE 6. The right jugal with attached quadratojugal of *A. clarkae* (UCMP 88192) in medial (A) and lateral (B) views. The right jugal (QM F18102) in medial (C) and lateral (D) views. The frontals (UCMP 100027) in ventral (E) and dorsal (F) views. Scale bars 5 cm.

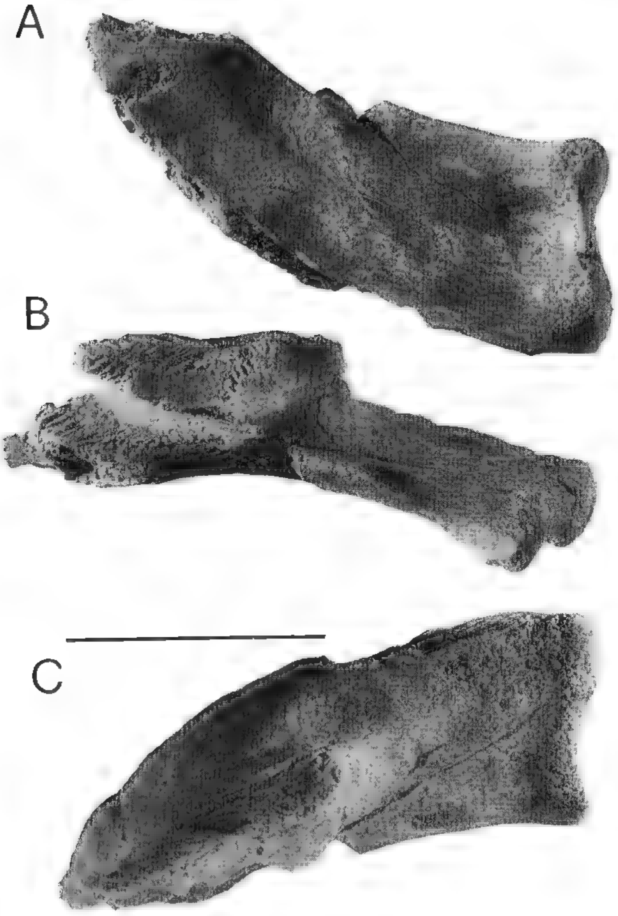

FIGURE 7. The right quadrate of *A. clarkae* (QM F17433) in ventral (A), medial (B) and dorsal (C) views. Scale bar 5 cm.

postorbital is directed medially then posteriorly in some specimens (UCMP 100027 and some unnumbered specimens in the Queensland Museum) but not in others (*e.g.* QM F16788).

Parietals: The parietals are preserved on QM F16788 but are broken between the supratemporal fenestrae. AMNH 23049 is a complete parietal, QM F17985 is a frontal, parietal and postorbital, and there are unnumbered parietals in the collection of the South Australian Museum.

The dorsal surface of this element is shallowly concave, posteriorly rising to the dorsal margins of the supratemporal fenestrae. The supratemporal fenestrae are large and round and the parietals are constricted between them. Anteriorly, the parietals send a thin lateral process to the postorbital, separating the frontals from the supratemporal fenestrae. There is a well-developed transverse bar on the ventral surface in the region of the diencephalon.

Postorbitals: QM F16788 has both postorbitals preserved, but both have the postorbital bar broken and the left is posteriorly incomplete. AMNH 23047 is a left postorbital and half frontal, QM F17985 is a frontal, parietal and postorbital, and AMNH 23048 is a right postorbital.

The postorbital is flat on the dorsal surface and relatively thick. There is a deep nutrient foramen on the anterolateral edge, at the top of the postorbital bar. QM F17985 shows a posterior process on the dorsal surface that overlaps the squamosal, separating the lateral and medial sides of its anterior extremity.

Squamosals: Both squamosals are preserved in QM F16788. AMNH 23051 is a left squamosal fragment attached to a quadrate. QM F17986 is a squamosal (possibly from the same individual as QM F17985) and QM F17984 is also a squamosal.

This relatively thick element is flat on the dorsal surface, forms the posterolateral margins of the supratemporal fenestrae and has a well-defined lateral edge forming the dorsal margin of the temporal arcade. This edge has a ventral lip. The anterior process extends under the postorbital. The squamosal extends further ventrally on the posterior wall of the skull than in *C. porosus* and the posterolateral crest of the squamosal is better developed than on *C. porosus* and continuous. The posterior face of the squamosal is concave.

Basioccipital: On QM F16788 the basioccipital is obscured. AMNH 23050 is a basioccipital. There is one unnumbered basioccipital in the UCMP collection, assumed to represent this species because of its locality and similarity to QM F16788 and AMNH 23050.

This element is narrower and extends further ventrally than in *C. porosus.* There is a deep eustachian foramen ventrally and a well-developed medial ridge on the ventral part of the posterior wall. Unlike *C. porosus,* the eustachian foramen is not enclosed by the basioccipital; the posterior half of the eustachian foramen is bounded by the basioccipital. The occipital condyle is set on a prominent neck, that projects further than in *C. porosus.*

Exoccipitals: Only the posterior wall of the exoccipitals of QM F16788 are visible. These are broken and partially obscured. NHMV P166441 is a right exoccipital. The ventral portion of QM F17983 is an exoccipital including the base of the paraoccipital process to the foramen magnum.

The positions of the foramina for cranial nerves X, XI and XII are as in *C. porosus.* The broken ventral face reveals the passage for the posterior carotid, and the broken dorsal surface exposes the internal chambers of the exoccipital that occupy the bulk of this element. The posterior face is more strongly convex than in *C. porosus* and the posterior opening of the cranio-quadrate passage is very close to the ventral margin.

Other skull elements: Palatines, vomers, basisphenoids, laterosphenoids, pterygoids and ectopterygoids have not been identified. They are all presumably present on QM F16788 but may be obscured by matrix and other bones.

Dentaries: The anterodorsal portion of the left dentary is present in QM F16788 but it is badly broken. The right dentary is possibly present but covered by matrix. Paratypes SAM P27934, SAM P27827, SAM P29083, SAM P23985, SAM P30162, NHMV P166439, NHMV P160360 (and NHMV P160357), NHMV P16644, UCMP 57071, UCMP 70941, QM F18151, QM F18152 and unnumbered specimens in the collection of the Queensland Museum are all dentaries (Figs 8 and 9).

The dentary is moderately broad and pseudoheterodont with an alveolar process that varies in development according to tooth size and extends back to at least the fourteenth alveolus. Pseudoheterodonty and the development of the alveolar process may be related to ontogeny because these features are not as strongly developed in small (presumably younger) specimens. The dentary body deepens posteriorly from the level of the fifteenth alveolus.

SAM P29083 and SAM P23985 display sixteen alveoli but QM F18152 displays seventeen in the right dentary. The teeth are arranged in a typically crocodyline sequence of enlargement. The first and fourth alveoli are the largest. The second, third and

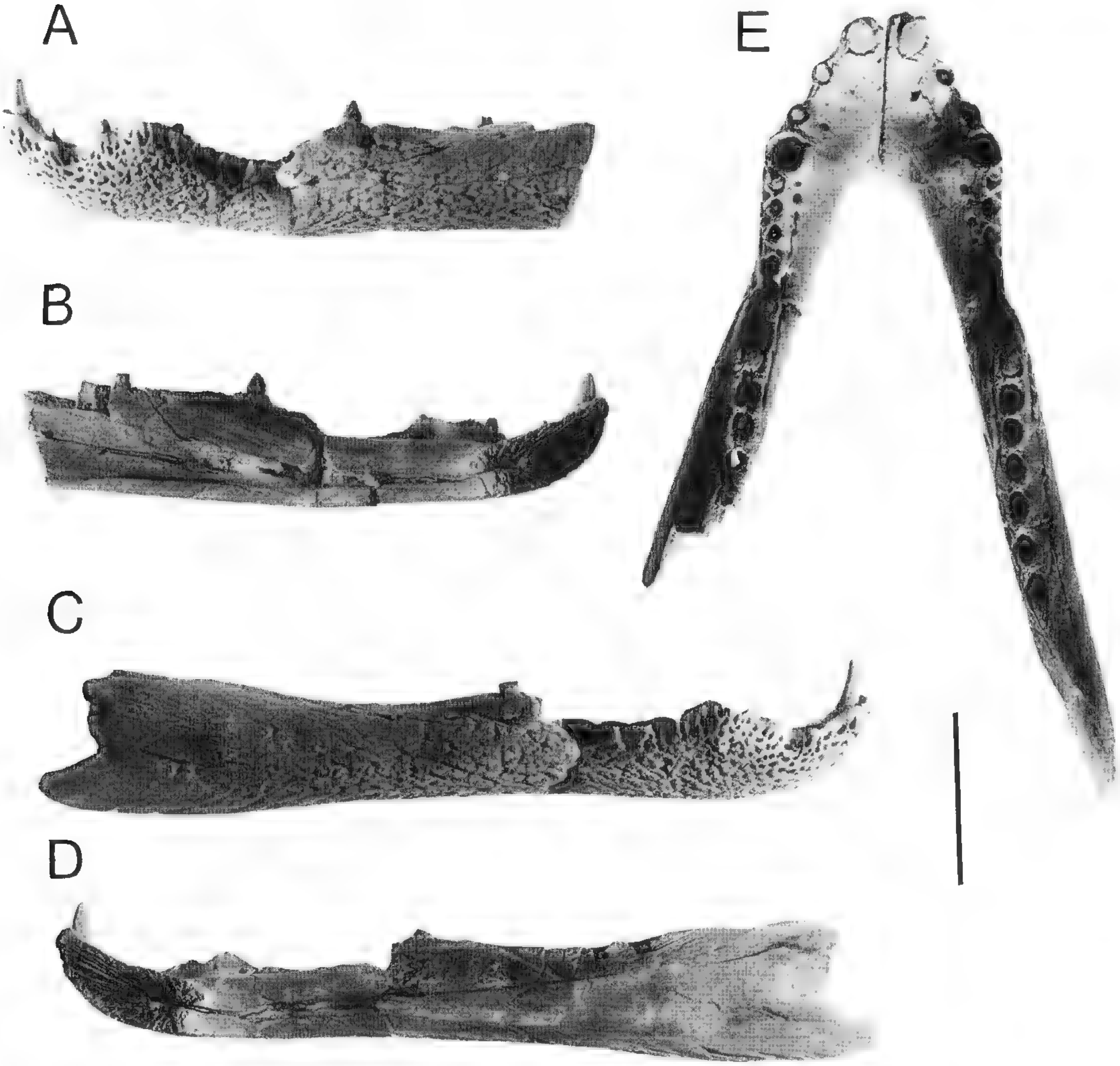

FIGURE 8. The dentaries of *A. clarkae.* A, Left dentary (QM F18151) in lateral, and B, medial view. C, Right dentary (QM F18152) in lateral, and D, medial view. E, Both dentaries articulated in dorsal view. Scale bar 5 cm.

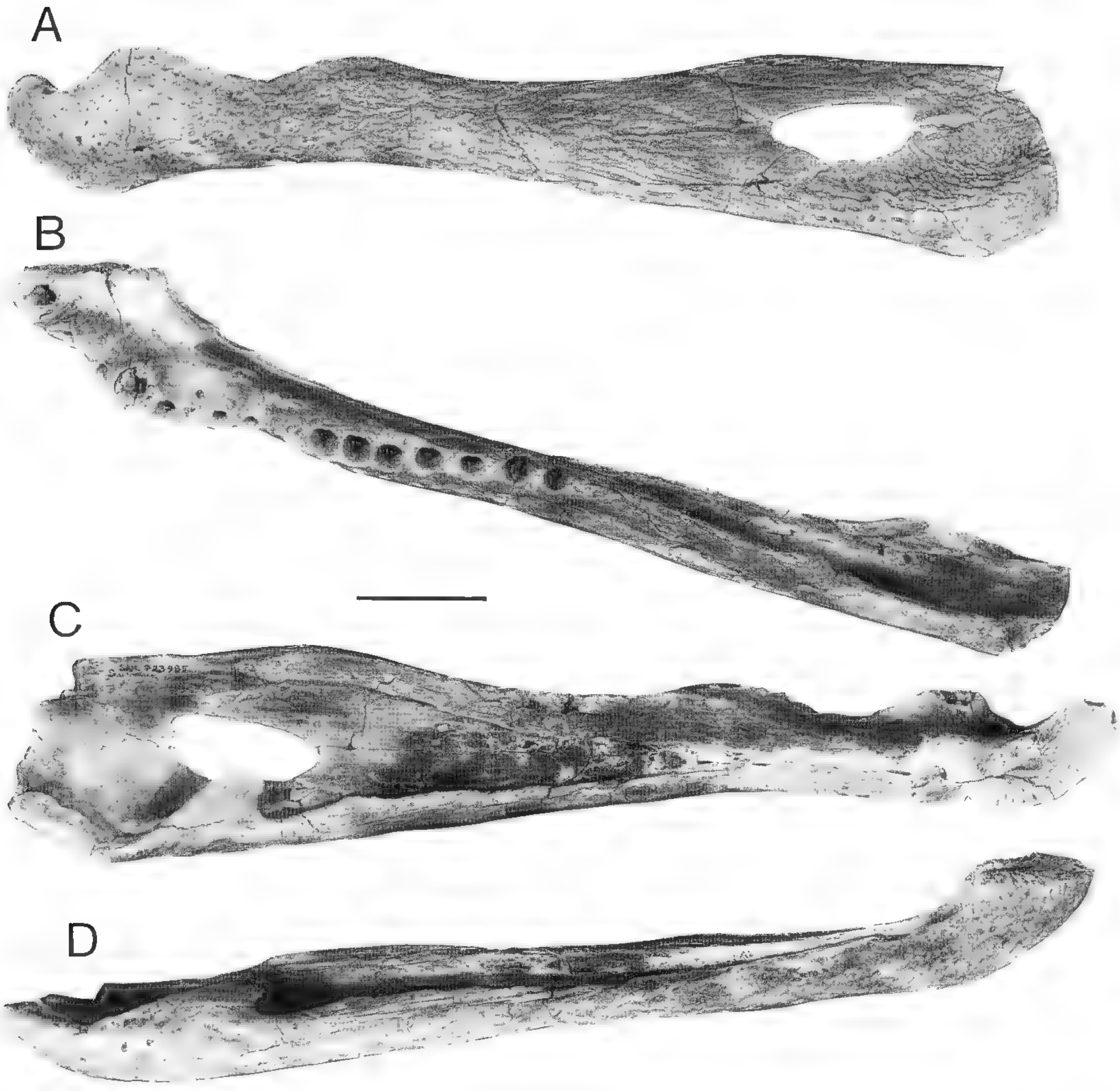

FIGURE 9. Left dentary with articulated angular and surangular (SAM P23985) of *A. clarkae*. A, Lateral view. B, Dorsal view. C, Medial view. D, Ventral view. Scale bar 5 cm.

the fifth through to the tenth teeth are all similar and smaller in size. The teeth posterior to and including the eleventh are similar in size and intermediate between the size of the smaller and larger teeth in the anterior of the dentary. The anterior alveoli are round but posterior alveoli are ovate. SAM P30162 is a more robust dentary and the fourth dentary alveolus is greatly enlarged. This has forced the third and fifth alveoli more toward the medial than in the other dentaries.

There is a deep indentation between, and buccal to, the second and third alveoli to receive the fourth premaxillary tooth. Other such indentations are located between and buccal to the first and second, fifth and sixth, sixth and seventh, seventh and eighth, and eight and ninth alveoli.

The symphysis extends posteriorly to the fourth alveolus in some (UCMP) specimens and the fifth alveolus in others. The splenial extends to the level of the seventh alveolus in some specimens and the eighth alveolus in others but this feature cannot be seen in all specimens. The symphyseal region is broad and upswept anteriorly. It is markedly broader than in *C. porosus* of comparable size.

Sculpture is of small point-like pits anteriorly and posteriorly, with sulci extending posteriorly from these pits. A distinct row of dorsally opening buccal foramina occurs parallel to the margin of the dentary from the medial side of the first alveolus to the seventh alveolus.

The first, second, third, fifth, eleventh and thirteenth crowns are present in QM F18151 and the fifteenth is present but broken. The first crown is slender, recurved and almost D-shaped in section, with mesial and distal carinae. The posterior face is longitudinally striate. In section the first crown is wider that it is long, being about two-thirds as long (anteroposteriorly) as broad (mesiodistally).

Of the second, third and fifth crowns, only the tips are visible but they appear to be laterally compressed with mesial and distal carinae.

The eleventh crown is blunt, but laterally compressed with mesial and distal carinae.

Surangulars: Neither of the surangulars of QM F16788 are clearly visible. Paratypes SAM P23985, NHMV P188438 and NHMV P188436a are surangulars. The surangular of this species does not appear to differ greatly from those of other crocodilians although it is slightly more gracile than normal.

Angulars: The angulars of QM F16788, if present, are obscured by matrix. Paratypes SAM P23985, SAM P29578, SAM P29579, NHMV P188442, QM F17988 and NHMV P188436b are all angulars.

The angulars, although basically similar to each other in general form, show a surprising amount of variation in detail. The longitudinal ridge on the floor of the internal, ventral canal may be well developed and prominent (as in SAM P23985 and SAM P23578) or low and poorly developed (as in SAM P29579). SAM P29578 has only one large foramen in the ventral canal whereas SAM P23985 and SAM P29579 have two small foramina. SAM P29578 has a flared rim extending from the posterior side of the internal ascending (coronoid) process flaring medially and extending posteriorly to the posterior ascending margin. This flared rim is not seen in the other specimens. However, these are minor differences and, considering the variation seen in comparing specimens of other crocodilians, there is no reason to suspect that these angulars do not represent the same species.

Other mandibular elements: The articulars, coronoids and splenials may be present on QM F16788 but if so are obscured by matrix. These elements were not identified among the paratypes.

Mandibular fenestrae: Both the external mandibular fenestrae and the inferior internal fenestrae are best preserved in SAM P23985.

The external mandibular fenestra is quite large for a crocodyline. It is subtriangular. The 'hypotenuse' forms the superior border, which is inclined to the ventral margin of the mandible.

The inferior internal foramen is only known from its ventral and posterior margins. These give the impression of a relatively large size for this foramen.

Postcranials: Although there are many postcranial elements associated with the holotype and paratypes, these are not described in detail here. Most are poorly preserved or do not differ significantly from comparative specimens of *C. porosus* and *C. johnstoni*. However, the following observations may be made with confidence: 1, all vertebrae apparently are procoelous; 2, cervical vertebrae (AMNH 23055) are strongly keeled; 3, dorsal arches (centra eroded prior to collection) are best preserved, lacking only the dorsal spine, and the prezygopophyseal facets are not laterally extended as in *C. porosus* (Fig. 10); 4, cervical arches are broken but resemble those of *C. porosus* (Fig. 11); 5, the humerus is broken and the articular ends are missing, but it agrees in proportions with that of *C. porosus*; 6, the coracoid and the preserved portion of the scapula visible are no different from those of *C. porosus*; 7, The numerous scutes have no keel and a sculpture of pits that are not as deep as those on the skull (Fig. 12); 8, long elements of the limbs (humerus, femur, tibia, fibula and metatarsals) are straighter than in either *C. porosus* or *C. johnstoni* but otherwise similar; 9, the vestigial fifth metatarsal is much more robust and thick than the corresponding element in other crocodilians.

PHYLOGENETIC AFFINITIES

At present, a phylogenetic systematic analysis of the affinities of *A. clarkae* is considered premature. Such an analysis will be more meaningfully conducted within the context of a broader examination of all Australian and non-Australian crocodilians, many of which are presently under study. Consequently the affinities of *A. clarkae* are here outlined in only a cursory manner.

The position of the choanae cannot be seen on any of the specimens. However, the basioccipital AMNH 23050 is notched on the ventral side of the anterior process to accommodate the narial passage. This indicates that the internal nares must have been situated posteriorly in the palate. This feature, together with the presence of procoelous vertebrae and the subdermal postorbital bar indicate that this is an advanced eusuchian crocodylid (Steel 1973). Although the semi-enclosed fourth mandibular tooth could suggest alligatorine affinities, the contact of the nasal and the lacrymal (seen in *Alligator* and some fossil alligatorines), the sequence of maxillary tooth enlargement (the fifth being the largest rather than the fourth, an alligatorine apomorphic character-state) and the general form of the skull indicate crocodyline

FIGURE 10. The dorsal neural arches as preserved in the type specimen (QM F16788) of *A. clarkae*, viewed from above. a, Nearly complete arch. b, c, d, Fragmentary arches (d in posterior aspect). Scale in mm.

FIGURE 11. The cervical vertebrae and scapula, as preserved, in the type specimen (QM F16788) of *A. clarkae*, in lateral view. c, Centrum (viewed obliquely from above). p, Prezygapophyses. pa, Parapophysis. s, Scapula. Scale in mm.

FIGURE 12. Dorsal osteoderms, *in situ*, of the type specimen (QM F16788) of *A. clarkae*, in dorsal view. Two complete osteoderms are indicated by arrows just at left of centre and at bottom-centre. Scale in mm.

affinities. Thus the semi-enclosed fourth mandibular tooth is probably a convergent feature.

Australosuchus clarkae shows some features that have been tentatively proposed as synapomorphies of an Australian Tertiary crocodile radiation (Willis *et al.* 1990). These include the lack of an anterior process of the palatine, the degree and sequence of tooth enlargement in the dentary and the presence of an overbite. The lesser development of an alveolar process on the premaxilla and maxilla and the palatal fenestrae being more posteriorly located than in other Australian crocodilians suggest that *A. clarkae* is a more plesiomorphic member of this group.

There is a striking resemblance between the anterior portion of the dentaries of *A. clarkae* and *B. darrowi* which suggests a close affinity between the two. However, they differ in the posterior extent of the mandibular symphysis. In *Baru* the symphysis extends to the level of the sixth or seventh alveolus while in *Australosuchus* it extends only to the level of the fourth or fifth alveolus.

DISCUSSION

Australosuchus clarkae is a freshwater crocodilian of moderate size from the late Oligocene and early Miocene of central Australia. To date, it is the oldest described member of the Australian Tertiary radiation of crocodiles (Willis *et al.* 1990). It shows some features that suggest it may be the most plesiomorphic member of this group. *Australosuchus clarkae* is considered to be a generalised crocodilian, that is, it lacks features commonly associated with more specialised crocodilians such as longirostrine, ziphodont or brevirostrine characters.

As discussed briefly above, the Mampuwordu specimens obstensibly represent this species in late Pliocene or early Pleistocene time in the Lake Palankarinna area. However, cataloguing or collecting errors may be involved. While the possibility that this species remained largely unchanged from the late Oligocene to the Pleistocene could not be ruled out, such extreme morphological conservatism seems unlikely even in situations where environments persisted for long times. Unfortunately, without considerably more research, details of preservation cannot be reliably used to distinguish between specimens of the Mampuwordu deposit and those from the older Etadunna deposits (Archer, pers. comm.)

Material belonging to *A. clarkae* has been mentioned by other authors. Estes (1984) commented that the only crocodilian material in a sample of fossils from Lake Palankarinna were small, unidentifiable teeth. Stirton *et al.* (1968) mentioned unidentifiable crocodilian remains from Lake Palankarinna. Molnar (1982) briefly mentioned the 'Etadunna' crocodilian suggesting that it may be related to a crocodilian from Murgon in south-east Queensland. Because there is no evidence of more than one crocodilian from Lake Palankarinna in the extensive collections of material examined in this study, it seems reasonable that crocodilian material mentioned by these authors can be attributed, at least tentatively, to *A. clarkae.*

ACKNOWLEDGMENTS

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MOLLUSC TYPE SPECIMENS IN THE SOUTH AUSTRALIAN MUSEUM. 4. GASTROPODA : MARGINELLIDAE

D. R. HEWISH & K. L. GOWLETT-HOLMES

Summary

The South Australian Museum collection of marginellid types is one of the most important collections of reference material for the Australian members of the family. The species represented originate mainly from Tasmania and southern and eastern Australia, plus two species from New Zealand, one species each from Antarctica, Sri Lanka and Madeira. The collection contains primary type material, and some secondary types, of 27 species; a further 28 species are represented by secondary types.

MOLLUSC TYPE SPECIMENS IN THE SOUTH AUSTRALIAN MUSEUM.
4. GASTROPODA: MARGINELLIDAE

D. R. HEWISH & K. L. GOWLETT-HOLMES

HEWISH, D. R. & GOWLETT-HOLMES, K. L. 1991. Mollusc type specimens in the South Australian Museum. 4. Gastropoda: Marginellidae. *Rec. S. Aust. Mus.* **25**(1): 57–70

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The Marginellidae is a family of mainly marine gastropods that is particularly well represented in Australia, and its members are especially abundant in southern Australian waters. Because of this, the Australian fauna occupies an important place in the taxonomy of the family as a whole. The majority of Australian species have been named during this century, and the primary types of most of these are held in collections of Australian museums.

The earliest marginellid type material in the South Australian Museum collection is from the work of Prof. R. Tate between 1878 and 1901. Tate described species collected by himself and by W. L. May from South Australia and Tasmania (Tate 1878; Tate & May 1900, 1901). As most of Tate's species descriptions were not accompanied by figures, these species are illustrated here, with the exception of those which were illustrated by Tate & May (1901).

A large number of secondary types and some primary types of Marginellidae in the South Australian Museum are from the collection of W. L. May, acquired by Sir Joseph Verco and presented to the museum in 1929. The May Collection contained secondary types of all of the species that May had described from Tasmania, plus the types of some species described by May's contemporaries from within Australia and from overseas.

A later series of marginellid types resulted from the work of Cotton (1944, 1949), who described several new species from southern and western Australia, mostly from material previously collected by May and Verco early this century. Cotton's types have never been adequately illustrated, as the figures accompanying the original descriptions were of poor quality and, in some cases, misleading. Figures of types of all of Cotton's species have therefore been included here. Also in the collection are specimens of several species of *Marginella* described by C. Laseron from New South Wales, which come from the type localities, and were donated to the South Australian Museum by Laseron. These specimens are believed to be from the type series, and are regarded here as syntypes.

Since Laseron (1957) little of consequence has been published on Australian Marginellidae, and the type material of only one species, *Marginella ealesae* Powell, 1958 (holotype), has been added to the collection.

As a result of the above research, the type collection in the South Australian Museum is very representative of the marginellid fauna of southern Australia and contains a very extensive range of secondary types.

All species listed in this paper were originally described under the genus *Marginella* Lamarck, 1799, but have subsequently been placed in other genera. The generic classification of the Australian Marginellidae has been neglected since Laseron (1957), and is in need of revision. The most recently published revision of genera for this family is by Coan (1965), and this scheme, although outdated, has been followed here, with modifications as indicated in the text. Other modifications are the use of *Mesoginella* Laseron, 1957 for species placed previously in *Sinuginella* Laseron, 1957, following Coovert (1988), and the use of *Austroginella* Laseron, 1957, *Alaginella* Laseron, 1957 and *Protoginella* Laseron, 1957 as valid genera, not subgenera of *Marginella*. This is considered necessary because species of *Marginella* lack radulae, while those of the above Australian genera have well developed radulae (D.R.H., unpublished results and see Coovert (1989) for review). It should be noted that a considerable amount of further work is necessary before the status of many generic and subgeneric groups can be established, and it is probable that extensive changes will be made in the future. No comprehensive revision of the Australian Marginellidae at the species level has ever been undertaken, and the species level taxonomy obviously requires considerable updating. In the following list, species are listed alphabetically according to their names at the time of description, followed by the original citation, the current generic placement (Coan 1965) and current species allocation as determined by the authors.

The following abbreviations are used in the text. AIM = Auckland Institute and Museum, New Zealand; AM = Australian Museum, Sydney; BANZARE = British, Australian and New Zealand Antarctic Research Expedition, 1929-1931; BMNH = British Museum (Natural History), London; NMV = Museum of Victoria, Melbourne; N.S.W. = New South Wales; N.Z. = New Zealand; NZGS = New Zealand Geological Survey, Lower Hutt; S.A. = South Australia; SAM = South Australian Museum, Adelaide; Tas. = Tasmania; TM = Tasmanian Museum and Art Gallery, Hobart; Vic. = Victoria; W.A. = Western Australia.

Family **MARGINELLIDAE**

Subfamily **Marginellinae**

Genus ***Marginella*** Lamarck, 1799

Marginella albida Tate, 1878
Trans. Proc. Rep. Phil. Soc. Adel. **1**: 87.
= *Volvarina (Haloginella) vincentiana* (Cotton, 1944) *(q.v.)* new name for *M. albida* Tate, 1878.
Lectotype: D13519, adult specimen, in shell sand, Marino, near Adelaide, S.A., collected by R. Tate, date of collection unknown. (Lectotype selected here.) (Figs 1A-B).
Paralectotypes: D18633, 7 specimens (2 immature), with same collection data as lectotype.
Note: We have selected the lectotype (D13519) from the lot labelled '*M. albida* Tate, Tate's type & cotypes' from Marino, S.A., the first locality listed in the original description by Tate (1878), and have designated the remainder of this lot (D18633) as paralectotypes. The specimen selected as lectotype was first separated and registered by B. C. Cotton in 1938 as the holotype of this species, as this specimen corresponded most closely to the measurements given by Tate (1878). However, as Tate (1878) did not designate a holotype, we have selected this specimen as the lectotype (ICZN Recommendation 73F). The 'two examples' mentioned by Tate (1878) most probably refer to the number of specimens from Aldinga, S.A., the last locality listed in the description.

Marginella albomaculata May, 1911
Pap. Proc. R. Soc. Tas. **for 1910**: 382, pl. 13, fig. 2.
= *Persicula concamerata* (May, 1918) *(q.v.)* new name for *M. albomaculata* May, 1911.
Paratype: D15790, adult specimen, in kelp root, Frederick Henry Bay, Tas., collected by W. L. May, date of collection unknown.
Note: Neither this specimen nor the holotype (TM E627/7968) were alive when collected. The shell surface of the paratype is slightly eroded and there is no trace of the pattern of white spots present on the holotype. This species was placed in the genus *Epiginella* by Laseron (1957), which is now considered to be a subgenus of *Crithe* Gould, 1860 (Coan 1965). However, the shell possesses a colour pattern which precludes its inclusion in that genus and suggests that it is more correctly placed in *Persicula*.

Marginella altilabra May, 1911
Pap. Proc. R. Soc. Tas. **for 1910**: 383, pl. 13, fig. 3.
= *Mesoginella altilabra* (May, 1911).
Paratypes: D15789, 15 adult specimens (1 damaged), dredged dead in 183 m (100 fm), 7 miles east of Cape Pillar, Tas., collected by W. L. May, 18.xii.1907. D16086, 2 adult specimens, with same collection data as D15789.
Note: Holotype in TM (E616/7915).

Marginella auriculata May, 1916
Pap. Proc. R. Soc. Tas. **for 1915**: 85, pl. 1, fig. 6.
= *Cystiscus tomlinianus* (May, 1918) *(q.v.)* new name for *M. auriculata* May, 1916.
Paratypes: D15811, 23 adult specimens (3 damaged), dredged in 73 m (40 fm), off Thouin Bay, Tas., collected by W. L. May, date of collection unknown. D16084, 2 adult specimens, with same collection data as D15811.
Note: Holotype in TM (E677/8018), badly broken.

Marginella baca Cotton, 1949
Rec. S. Aust. Mus. **9**(2): 200, pl. 20.
= *Kogomea eucla* (Cotton, 1944) **new synonymy.**
Holotype: D14227, adult specimen, dredged dead in 183 m (100 fm), 7 miles east of Cape Pillar, Tas., collected by W. L. May, 18.xii.1907. (Figs 1C-D).
Note: It can be seen from the figures that this shell and the type of *Kogomea eucla* (Figs 1K-L) are virtually identical and there are no distinctive features that can be used to separate the two forms. We therefore consider *M. baca* to be a junior synonym of *K. eucla.* This species is extremely similar to *K. diplostrepta* (May, 1916), but is approximately half the size of the latter, so a more

FIGURE 1. A-B: *Marginella albida* Tate, 1878 (= *M. vincentiana* Cotton, 1944), lectotype, SAM D13519, × 9.9. C-D: *M. baca* Cotton, 1949, holotype, SAM D14227, × 11.8. E-F: *M. borda* Cotton, 1944, holotype, SAM D14988, × 10.8. G-H: *M. cymbalum* Tate, 1878, adult syntype, SAM D13521, × 9.3. I-J: *M. denticulata* Tate, 1878 (= *M. elliottae* Cotton, 1944), syntype, SAM D14501, × 22.3. K-L: *M. eucla* Cotton, 1944, holotype, SAM D14985, × 11.2.

extensive investigation is required to establish their relationship. Type unique.

Marginella binivitta Laseron, 1948
Rec. Aust. Mus. **22**(1): 39, pl. 5, fig. 11.
= *Mesoginella binivitta* (Laseron, 1948).
Syntypes: D14235, 3 adult specimens, dredged dead in sandy mud in 55–64 m (30–35 fm), Crookhaven, N.S.W., collected by C. F. Laseron, date of collection unknown.
Note: These specimens were obtained from Laseron, and are believed to be from the type series. This species may be synonymous with *Mesoginella olivella* (Reeve, 1865), but a more extensive investigation is required. Other syntypes in AM (C103363).

Marginella biplicata Tate & May, 1900.
Trans. Proc. R. Soc. S. Aust. **24**: 92.
= *Kogomea diplostrepta* (May, 1916) *(q.v.)* new name for *M. biplicata* Tate & May, 1900.
Syntype: D18635, immature specimen, dredged in 44 m (24 fm), Port Esperance, Tas., collected by W. L. May, date of collection unknown.
Note: This species was figured by Tate & May (1901). The other syntype is in TM (E634/7975), badly damaged.

Marginella borda Cotton, 1944
S. Aust. Nat. **22**: 16, fig. 33.
= *Alaginella borda* (Cotton, 1944).
Holotype: D14988, adult specimen with dried animal, dredged in 100 m (55 fm), off Cape Borda, S.A., collected by J. C. Verco, January 1905. (Figs 1E-F).
Paratypes: D18645, 2 adult specimens, dredged dead in 90 m (49 fm), off Beachport, S.A., collected by J. C. Verco, date of collection unknown. D18646, 2 adult specimens (1 damaged), dredged dead in 238 m (130 fm), off Cape Jaffa, S.A., collected by J. C. Verco, date of collection unknown. D18747, 4 adult specimens (1 damaged), dredged dead in 82 m (45 fm), east of North Neptune Island, S.A., collected by J. C. Verco, date of collection unknown. D18648, 1 damaged adult specimen, dredged dead in 64 m (35 fm), King George Sound, W.A., collected by J. C. Verco, date of collection unknown. D18649, 2 adult specimens, dead collected, in beach sand, Hopetoun, W.A., collected by J. C. Verco, date of collection unknown.

Marginella caducocincta May, 1916
Pap. Proc. R. Soc. Tas. **for 1915**: 88, pl. 2, fig. 11.
= *Mesoginella caducocincta* (May, 1916).
Paratypes: D15794, 16 adult specimens, dredged dead in 73 m (40 fm), off Thouin Bay, Tas., collected by W. L. May, date of collection unknown. D16083, 7 adult specimens, with same collection data as D15794.
Note: Holotype in TM (E623/7964).

Marginella cairoma Brookes, 1924
Trans. Proc. N.Z. Inst. **55**: 154, pl. 7, figs 4–5.
= *Dentimargo cairoma* (Brookes, 1924).
Paratypes: D9447, 6 specimens (1 immature), Taipa, Doubtless Bay, N.Z., collected by A. E. Brookes, date of collection unknown.
Note: Holotype in AIM (TM1277).

Marginella cartwrighti Sowerby, 1915
Proc. Malac. Soc. Lond. **11**(4): 214, text fig.
= *Granulina cartwrighti* (Sowerby, 1915).
Syntypes: D9460, 2 adult specimens, Trincomalee, Ceylon (Sri Lanka), collector and date of collection unknown.
Note: Two other syntypes in BMNH (1919.12.31.45–46).

Marginella columnaria Hedley & May, 1908
Rec. Aust. Mus. **7**: 120, pl. 23, fig. 19.
= *Pillarginella columnaria* (Hedley & May, 1908).
Paratypes: D15798, 6 adult specimens (1 damaged), dredged in 183 m (100 fm), 7 miles east of Cape Pillar, Tas., collected by W. L. May, 18.xii.1907.
Note: Although Coan (1965) synonymised *Pillarginella* Gabriel, 1962 with *Haloginella* Laseron, 1957 (as a subgenus of *Volvarina* Hinds, 1844), examination of the radula of this species, which is the type species of the former, by one of us (DRH), suggests that *Pillarginella* is distinct from *Volvarina*. Holotype in AM (C28936), other paratypes in AM (C163392), TM (E625/7966), NMV (F30598) and BMNH.

Marginella concamerata May, 1918
Pap. Proc. R. Soc. Tas. **for 1917**: 104.
= *Persicula concamerata* (May, 1918).
Paratype: D15790, adult specimen, in kelp root, Frederick Henry Bay, Tas., collected by W. L. May, date of collection unknown.
Note: New name for *Marginella albomaculata* May, 1911 (*non* Schlüter, 1838), and therefore based on the same type series. Holotype in TM (E627/7968).

Marginella connectans May, 1911
Pap. Proc. R. Soc. Tas. **for 1910**: 387, pl. 14, fig. 11.
= *Cystiscus connectans* (May, 1911).
Paratypes: D15795, 9 adult specimens (3 damaged), dredged dead in 183 m (100 fm), 7 miles east of Cape Pillar, Tas., collected by W. L. May, 18.xii.1907. D16082, 1 adult specimen, with same collection data as D15795.
Note: Holotype in TM (E628/7969).

Marginella (Volvaria) consanguinea Smith, 1890
Proc. Zool. Soc. Lond. **60**: 266, pl. 23, fig. 11.
= *Cystiscus consanguineus* (Smith, 1890).
Syntypes: D17540, 2 damaged adult specimens, from St Helena, collector and date of collection unknown.
Note: From the May Collection. Other syntypes in BMNH.

Marginella consobrina May, 1911
Pap. Proc. R. Soc. Tas. **for 1910**: 387, pl. 14, fig. 10.
= *Mesoginella consobrina* (May, 1911).
Paratypes: D15792, 2 adult specimens, dredged dead in 183 m (100 fm), 7 miles east of Cape Pillar, Tas., collected by W. L. May, 18.xii.1907.
Note: Holotype in TM (E630/7971).

Marginella cratericula Tate & May, 1900
Trans. Proc. R. Soc. S. Aust. **24**: 91.
= *Cystiscus cratericulus* (Tate & May, 1900).
Syntype: D18634, adult specimen with dried animal, dredged in 18 m (10 fm), D'Entrecasteaux Channel, Tas., collected by W. L. May, date of collection unknown.
Note: This species was figured by Tate & May (1901). One other syntype in TM (E631/7972).

Marginella cylichnella May, 1918
Pap. Proc. R. Soc. Tas. **for 1917**: 104.
= *Balanetta (Ovaginella) cylichnella* (May, 1918).
Paratypes: D15793, 8 adult specimens (2 damaged), dredged dead in 183 m (100 fm), 7 miles east of Cape Pillar, Tas., collected by W. L. May, 18.xii.1907. D18636, 1 adult specimen, with same collection data as D15793.
Note: New name for *Marginella microscopica* May, 1911 (*non* Tapparone Canefri, 1875), and therefore based on the same type series. Holotype in TM (E632/7973), broken.

Marginella cymbalum Tate, 1878
Trans. Proc. Rep. Phil. Soc. Adel. **1**: 86.
= *Cystiscus cymbalum* (Tate, 1878).
Syntypes: D13521, 2 specimens (1 immature), in beach sand, Aldinga Bay, near Adelaide, S.A., collected by R. Tate, date of collection unknown. (Figs 1G–H).
Note: Other syntypes in BMNH (1879.10.28.7).

Marginella denticulata Tate, 1878.
Trans. Proc. Rep. Phil. Soc. Adel. **1**: 87.
= *Granulina elliottae* (Cotton, 1944) *(q.v.)* new name for *M. denticulata* Tate, 1878.
Syntypes: D14501, 7 adult specimens (2 damaged), in beach sand, Wauraltie (Port Victoria), Yorke Peninsula, S.A., collected by R. Tate, date of collection unknown. (Figs 1I–J).
Note: The type description only mentions three specimens, and as all the specimens in D14501 are of approximately equal size and form, it is impossible to isolate the actual syntypes. Therefore the status of the entire lot is questionable.

Marginella dentiens May, 1911
Pap. Proc. R. Soc. Tas. **for 1910**: 384, pl. 13, fig. 6.
= *Volvarinella dentiens* (May, 1911).
Paratypes: D15791, 7 adult specimens (2 damaged), dredged dead in 183 m (100 fm), 7 miles east of Cape Pillar, Tas., 18.xii.1907, and dredged dead in 146 m (80 fm), 10 miles east of Schouten Island, Tas., date of collection unknown, all collected by W. L. May.
Note: Holotype in TM (E633/7974).

Marginella diplostreptus May, 1916
Pap. Proc. R. Soc. Tas. **for 1915**: 76.
= *Kogomea diplostrepta* (May, 1916).
Syntype: D18635, immature specimen, dredged in 44 m (24 fm), Port Esperance, Tas., collected by W. L. May, date of collection unknown.
Note: New name for *Marginella biplicata* Tate & May, 1900 (*non* Krauss, 1852), and therefore based on the same type series. This species was figured by Tate & May (1901) as *M. biplicata*. One other syntype in TM (E634/7975), badly damaged.

Marginella ealesae Powell, 1958
BANZARE Rep. Ser. B, **6**(9): 200, text fig. B1.
=*Marginella? ealesae* Powell, 1958.
Holotype: D15505, possibly immature specimen with dried animal, dredged in 300 m, BANZARE Stn 39, off Enderby Land, Antarctica, (66°30′S, 49°45′E), collected by BANZARE, 17.i.1930.
Note: As this species comes from a population which has received very little study and which may not be contiguous with other faunas, its generic status cannot be accurately assigned on the basis of shell characters alone. Only examination of the radula will allow the genus to be assigned accurately.

Marginella elliottae Cotton, 1944
S. Aust. Nat. **22**: 13.
= *Granulina elliottae* (Cotton, 1944).
Syntypes: D14501, 7 adult specimens (2 damaged), in beach sand, Wauraltie (Port Victoria), Yorke Peninsula, S.A., collected by R. Tate, date of collection unknown. (Figs 1I–J).
Note: New name for *Marginella denticulata* Tate, 1878, (*non* Link, 1807, *nec* Conrad, 1830), and therefore based on the same type series. See note under that species concerning the status of these specimens.

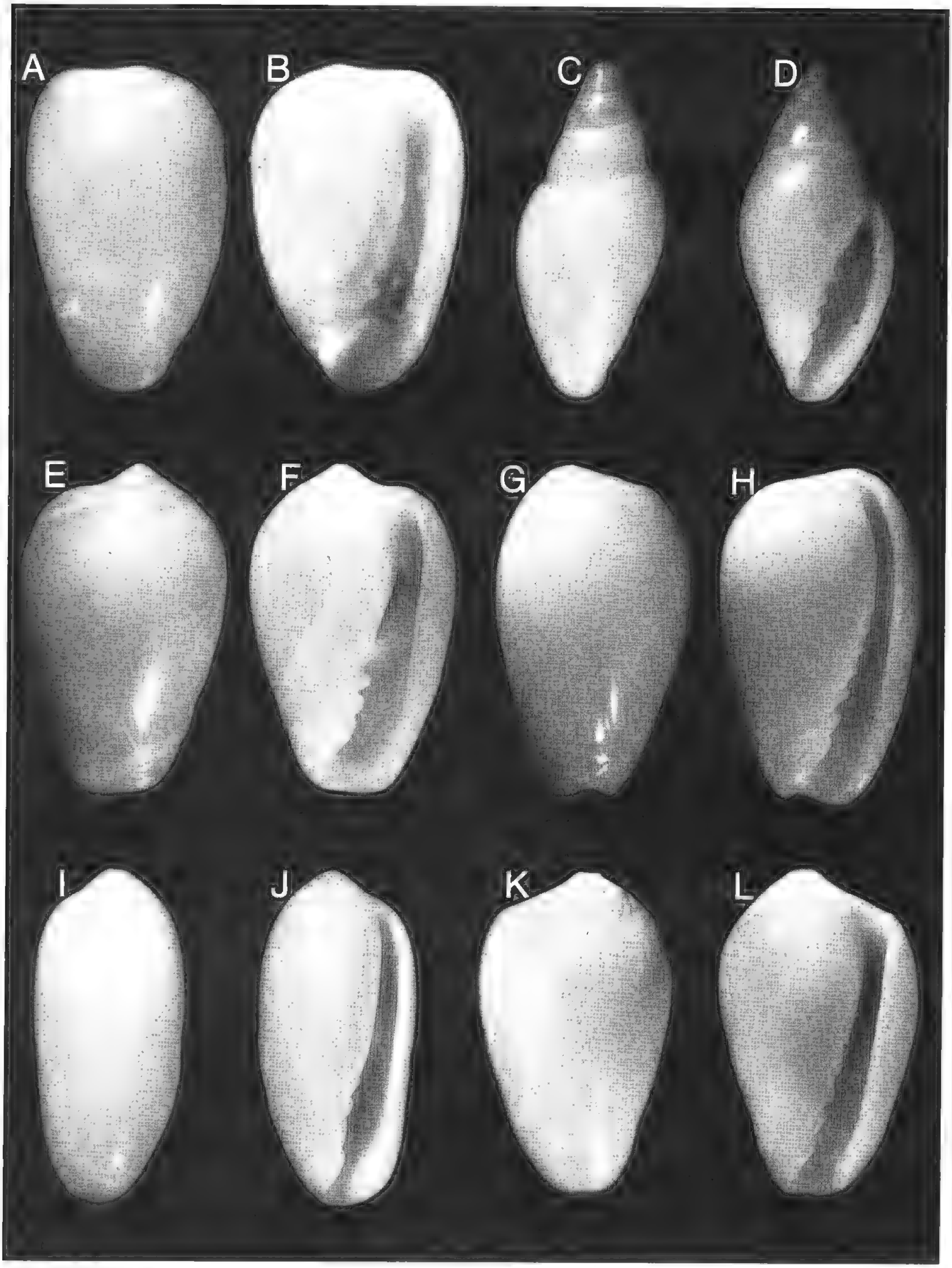

FIGURE 2. A-B: *Marginella erma* Cotton, 1944, holotype, SAM D14986, × 18.5. C-D: *M. jaffa* Cotton, 1944, holotype, SAM D14982 × 8.7. E-F: *M. leia* Cotton, 1944, holotype, SAM D14984, × 6.4. G-H: *M. newmanae* Cotton, 1949, holotype, SAM D14229, × 5.6. I-J: *M. occidua* Cotton, 1944, holotype, SAM D14987, × 4.4. K-L: *M. patria* Cotton, 1949, holotype, SAM D14228, × 13.4.

Marginella erma Cotton, 1944
S. Aust. Nat. **22**: 15.
= *Cystiscus angasi* (Crosse, 1870) **new synonymy.**
Holotype: D14986, damaged adult specimen, dredged in 183 m (100 fm), 7 miles east of Cape Pillar, Tas., collected by W. L. May, 18.xii.1907. (Figs 2A-B).
Note: This species was inadequately described and figured by Cotton (1944). It is apparently a minor variant of *Cystiscus angasi*, which is a species that exhibits considerable variability of shell shape and has a number of synonyms (Laseron 1957). Type unique.

Marginella eucla Cotton, 1944
S. Aust. Nat. **22**: 12, fig. 24.
= *Kogomea eucla* (Cotton, 1944).
Holotype: D14985, adult specimen, dredged dead in 146 m (80 fm), off Eucla, W.A., collected by J. C. Verco, March 1912. (Figs 1K–L).
Paratypes: D15915, 4 adult specimens, with same collection data as holotype. D18667, 58 specimens (21 damaged, 4 immature), dredged dead in 148 m (81 fm), 80 miles west of Eucla, W.A., collected by J. C. Verco, March 1912. D18668, 19 specimens (3 damaged, 4 immature), dredged dead in 146–220 m (80–120 fm), west of Eucla, W.A., collected by J. C. Verco, March 1912. D18669, 9 adult specimens (2 damaged), in beach sand, Hopetoun, W.A., collected by J. C. Verco, date of collection unknown. D18670, 24 specimens (5 damaged, 4 immature), dredged dead in 73 m (40 fm), off Beachport, S.A., collected by J. C. Verco, date of collection unknown. D18671, 2 adult specimens, dredged dead in 90 m (49 fm), other collection data same as D18670. D18672, 25 specimens (4 damaged, 7 immature), dredged dead in 201 m (110 fm), other collection data same as D18670. D18673, 24 specimens (4 damaged, 1 immature), dredged dead in 274 m (150 fm), other collection data same as D18670. D18674, 15 specimens (1 damaged, 6 immature), dredged dead in 366 m (200 fm), other collection data same as D18670. D18675, 33 specimens (5 damaged, 9 immature), dredged dead in 164 m (90 fm), off Cape Jaffa, collected by J. C. Verco, date of collection unknown. D18676, 16 specimens (4 damaged, 1 immature), dredged dead in 238 m (130 fm), other collection details same as D18675. D18677, 41 specimens (11 damaged, 3 immature), dredged dead in 100 m (55 fm), off Cape Borda, Kangaroo Island, S.A., collected by J. C. Verco, date of collection unknown. D18678, 30 specimens (2 damaged, 12 immature), dredged dead in 113 m (62 fm), north-west of Cape Borda, Kangaroo Island, S.A., collected by J. C. Verco, date of collection unknown. D18679, 1 adult specimen, dredged dead in 36 m (20 fm), off Newland Head, S.A., collected by J. C. Verco, date of collection unknown. D18680, 6 adult specimens (3 damaged), dredged dead in 27–36 m (15–20 fm), off St Francis Island, Nuyts Archipelago, S.A., collected by J. C. Verco, date of collection unknown.
Note: *Marginella baca* Cotton, 1949 is a junior synonym.

Marginella freycineti May, 1916
Pap. Proc. R. Soc. Tas. **for 1915**: 86, pl. 2, fig. 9.
= *Cystiscus freycineti* (May, 1916).
Paratypes: D16174, 22 adult specimens, dredged dead in 73 m (40 fm), Thouin Bay, Tas., collected by W. L. May, date of collection unknown. D16088, 3 adult specimens, from Tas., collected by W. L. May, date of collection unknown.
Note: This species may be a form of *Cystiscus angasi* (Crosse, 1870). Holotype in TM (E636/7977).

Marginella gabrieli May, 1911
Pap. Proc. R. Soc. Tas. **for 1910**: 386, pl. 13, fig. 9.
= *Volvarinella? gabrieli* (May, 1911).
Paratypes: D15805, 8 adult specimens (1 with dried animal), dredged in 183 m (100 fm), 7 miles east of Cape Pillar, Tas., collected by W. L. May, 18.xii.1907. D16077, 2 adult specimens, from Tas., collected by W. L. May, date of collection unknown.
Note: The generic placement of this species is problematical and cannot be resolved on the basis of shell characters alone. Holotype in TM (E642/7983).

Marginella gatliffi May, 1911
Pap. Proc. R. Soc. Tas. **for 1910**: 385, pl. 13, fig. 8.
= *Protoginella gatliffi* (May, 1911).
Paratypes: D15987, 47 adult specimens (9 damaged), dredged dead off Schouten Island, Tas., collected by W. L. May, date of collection unknown. D16805, 2 adult specimens, dredged dead in 73 m (40 fm), off Schouten Island, Tas., collected by W. L. May, 27.iii.1910.
Note: Holotype in TM (E643/7984).

Marginella georgeana May, 1916
Pap. Proc. R. Soc. Tas. **for 1915**: 88, pl. 3, fig. 13.
= *Austroginella georgeana* (May, 1916).
Paratypes: D15803, 3 specimens (1 immature), dredged dead in 27 m (15 fm), near George III Reef, below Southport, Tas., collected by W. L. May, date of collection unknown.
Note: Laseron (1957) placed this species in his genus *Plicaginella,* which has been synonymised with *Austroginella* by Coovert (1988) on the basis of radular morphology. Holotype in TM (E645/7985).

Marginella gracilis May, 1911
Pap. Proc. R. Soc. Tas. **for 1910**: 383, pl. 13, fig. 4.
= *Volvarinella maugeana* (Hedley, 1915) *(q.v.)* new name for *M. gracilis* May, 1911.
Paratypes: D15815, 9 adult specimens, dredged dead in 183 m (100 fm), 7 miles east of Cape Pillar, Tas., collected by W. L. May, 18.xii.1907. D16087, 2 adult specimens, with same collection data as D15815.
Note: Holotype in TM (E657/7998).

Marginella hedleyi May, 1911
Pap. Proc. R. Soc. Tas. **for 1910**: 381, pl. 13, fig. 1.
= *Volvarina (Haloginella) hedleyi* (May, 1911).
Paratypes: D15799, 11 specimens (5 immature, 3 adult and 1 immature with dried animals), dredged in 183 m (100 fm), 7 miles east of Cape Pillar, Tas., collected by W. L. May, 18.xii.1907. D16076, 2 adult specimens, dead collected, with same collection data as D15799.
Note: Holotype in TM (E646/7987).

Marginella inaequidens May, 1913
Pap. Proc. R. Soc. Tas. **for 1912**: 44, pl. 2, fig. 1.
= *Cystiscus inaequidens* (May, 1913).
Paratypes: D15804, 16 adult specimens (1 damaged), dredged dead in 183 m (100 fm), 7 miles east of Cape Pillar, Tas., 18.xii.1907, and dredged dead in 73 m (40 fm), off Schouten Island, Tas., 27.iii.1910, all collected by W. L. May. D16078, 3 specimens (1 immature, 1 damaged), dredged dead in 183 m (100 fm), off Cape Pillar, Tas., collected by W. L. May, 18.xii.1907.
Note: Holotype in TM (E647/7988), badly broken.

Marginella incerta May, 1920
Pap. Proc. R. Soc. Tas. **for 1919**: 59, pl. 16, fig. 8.
= *Cystiscus incertus* (May, 1920).
Paratypes: D15806, 14 adult specimens (2 damaged), dredged dead in 73 m (40 fm), Thouin Bay, Tas., collected by W. L. May, date of collection unknown.
Note: This species is closely related to *Cystiscus angasi* (Crosse, 1870). Holotype in TM (E649/7990).

Marginella indiscreta May, 1911
Pap. Proc. R. Soc. Tas. **for 1910**: 388, pl. 14, fig. 12.
= *Cystiscus indiscretus* (May, 1911).
Paratypes: D15813, 5 adult specimens (1 damaged), dredged dead in 183 m (100 fm), 7 miles east of Cape Pillar, Tas., collected by W. L. May, 18.xii.1907. D16080, 1 adult specimen, with same collection data as D15813.
Note: Holotype in TM (E651/7992).

Marginella jaffa Cotton, 1944
S. Aust. Nat. **22**: 11, fig. 13.
= *Volvarinella jaffa* (Cotton, 1944).
Holotype: D14982, adult specimen, dredged dead in 238 m (130 fm), off Cape Jaffa, S.A. collected by J. C. Verco, date of collection unknown. (Figs 2C-D).
Paratypes: D15914, 4 adult specimens, with same collection data as holotype. D18655, 11 specimens (1 damaged, 1 immature), dredged dead in 201 m (110 fm), off Beachport, S.A., collected by J. C. Verco, date of collection unknown. D18656, 11 specimens (1 damaged, 4 immature), dredged dead in 274 m (150 fm), other collection data same as D18655. D18657, 14 specimens (2 damaged, 3 immature), dredged dead in 366 m (200 fm), other collection data same as D18655. D18658, 1 damaged adult specimen, dredged dead in 100 m (55 fm), off Cape Borda, Kangaroo Island, S.A., collected by J. C. Verco, date of collection unknown. D18659, 20 specimens (5 damaged, 5 immature), dredged dead in 190 m (104 fm), 35 miles south-west of Neptune Islands, S.A., collected by J. C. Verco, date of collection unknown. D18660, 18 specimens (8 damaged, 7 immature), dredged dead in 148 m (81 fm), 80 miles west of Eucla, W.A., collected by J. C. Verco, March 1912. D18661, 1 adult specimen, dead collected, in beach sand, Hopetoun, W.A., collected by J. C. Verco, date of collection unknown.
Note: This species is very similar to *Volvarinella cuneata* (Laseron, 1948).

Marginella leia Cotton, 1944
S. Aust. Nat. **22**: 10, fig. 11.
= *Mesoginella turbinata* (Sowerby, 1846) **new synonymy.**
Holotype: D14984, adult specimen, dredged dead in 274 m (150 fm), off Beachport, S.A., collected by J. C. Verco, date of collection unknown. (Figs 2E-F).
Paratypes: D18653, 7 adult specimens, with same collection data as holotype. D18651, 5 adult specimens, dredged dead in 73 m (40 fm), other collection data same as holotype. D18652, 17 specimens (6 damaged, 1 immature), dredged dead in 201 m (110 fm), other collection data same as holotype. D18654, 6 adult specimens (1 damaged), dredged dead in 366 m (200 fm), other collection data same as holotype. D18650, 3 specimens (2 immature), dredged dead in 113 m (62 fm), off Cape Borda, Kangaroo Island, S.A., collected by J. C. Verco, date of collection unknown.
Note: The original illustration of this species was misleading as it did not show an anterior canal which is very well developed in the holotype. The types are heterogeneous in form and appear to be minor variants of *Mesoginella turbinata*, so we regard *M. leia* as a junior synonym of the latter. This change renders invalid the genus *Spiroginella* Laseron, 1957.

Marginella lodderae May, 1911
Pap. Proc. R. Soc. Tas. **for 1910**: 384, pl. 13, fig. 5.
= *Volvarinella lodderae* (May, 1911).
Paratype: D15814, damaged adult specimen, dredged dead in 183 m (100 fm), 7 miles east of Cape Pillar, Tas., collected by W. L. May, 18.xii.1907.
Note: This specimen was labelled by Verco 'Co-Type but somewhat uncertain'. As this specimen is from the May Collection, and was collected at the same time and locality as the type, we believe it is a valid paratype. Holotype in TM (E656/7997).

Marginella (Glabella) lurida Suter, 1909
Proc. Malac. Soc. Lond. **8**(3): 183, pl. 7, fig. 14.
= *Volvarina lurida* (Suter, 1909).
Paralectotypes: D9474, 2 adult specimens (1 broken), dredged dead in 27 m (15 fm), Foveaux Strait, N.Z., collector and date of collection unknown.
Note: Lectotype in NZGS (TM1086), selected by Boreham (1959).

Marginella malina Hedley, 1915
Proc. Linn. Soc. N.S.W. **39**(4): 725, pl. 82, fig. 65.
= *Triginella malina* (Hedley, 1915).
Paratypes: D16109, 6 specimens (1 immature, 2 broken), dredged dead in 146 m (80 fm), 22 miles east of Narrabeen, N.S.W., collected by W. A. Haswell, H.M.C.S. 'Miner', 7.vi.1906.
Note: Holotype in AM (C25936), other paratypes in AM (C18242, C163384) and BMNH (1915.12.31.114-117).

Marginella maugeana Hedley, 1915
Proc. Linn. Soc. N.S.W. **39**(4): 727.
= *Volvarinella maugeana* (Hedley, 1915).
Paratypes: D15815, 9 adult specimens, dredged dead in 183 m (100 fm), 7 miles east of Cape Pillar, Tas., collected by W. L. May, 18.xii.1907. D16087, 2 adult specimens, with same collection data as D15815.
Note: New name for *Marginella gracilis* May, 1911 (*non* C. B. Adams, 1852), and therefore based on the same type series. Holotype in TM (E657/7998).

Marginella mayii Tate in Tate & May, 1900
Trans. Proc. R. Soc. S. Aust. **24**: 93.
= *Volvarinella mayii* (Tate, 1900).
Syntypes: D13523, 1 adult specimen, dead collected, Frederick Henry Bay, Tas., collected by W. L. May, date of collection unknown. D16131, 1 broken specimen, dead collected, from Tas., collected by W. L. May, date of collection unknown.
Note: This species was figured by Tate & May (1901). Other syntypes in TM (E659/8000) and BMNH (1912.6.23.1-2).

Marginella microscopica May, 1911
Pap. Proc. R. Soc. Tas. **for 1910**: 389, pl. 14, fig. 13.
= *Balanetta (Ovaginella) cylichnella* (May, 1918) *(q.v.)* new name for *M. microscopica* May, 1911.
Paratypes: D15793, 8 adult specimens (2 broken), dredged dead in 183 m (100 fm), 7 miles east of Cape Pillar, Tas., collected by W. L. May, 18.xii.1907. D18636, 1 adult specimen, with same collection data as D15793.
Note: The generic affinities of this species are problematical and examination of the animal is necessary before accurate assignment can be made. Holotype in TM (E632/7973), broken.

Marginella multidentata May, 1920
Pap. Proc. R. Soc. Tas. **for 1919**: 59, pl. 16, fig. 7.
= *Cystiscus multidentatus* (May, 1920).
Paratype: D15802, adult specimen, dredged in 18 m (10 fm), off Gordon, D'Entrecasteaux Channel, Tas., collected by W. L. May, December 1918.
Note: Holotype in TM (E662/8003).

Marginella newmanae Cotton, 1949
Rec. S. Aust. Mus. **9**(2): 199, pl. 20.
= *Persicula pulchella* (Kiener, 1834) **new synonymy.**
Holotype: D14229, adult specimen, Esperance, W.A., collector and date of collection unknown. (Figs 2G-H).
Note: Close examination shows the presence of a faint pattern of orange zig-zag lines not mentioned in the type description. The holotype and the specimens listed and labelled *M. newmanae* by Cotton (1949) (SAM D18727-33) encompass all the forms of *Persicula pulchella* found in southern Australia, and we therefore regard *M. newmanae* as a junior synonym of *P. pulchella*. This species was placed in the genus *Epiginella* by Laseron (1957).

Marginella obesula May, 1920
Pap. Proc. R. Soc. Tas. **for 1919**: 58, pl. 14, fig. 5.
= *Cystiscus obesulus* (May, 1920).
Paratypes: D15809, 7 adult specimens, in kelp rhizophores, Frederick Henry Bay, Tas., collected by W. L. May, date of collection unknown.
Note: This species is very closely related to *Cystiscus angasi* (Crosse, 1870) and can only be distinguished from that species by the distinctive orange and brown colours of the living animal as described by May (1920). Of the SAM types, four were dead when collected and their assignment must be considered doubtful. Of the remainder, definite traces of the characteristic colours of the animal can be seen through the shell of one specimen and it is certainly this species. The animal remains in the other two have deteriorated to the stage where it is impossible to conclusively identify the species,

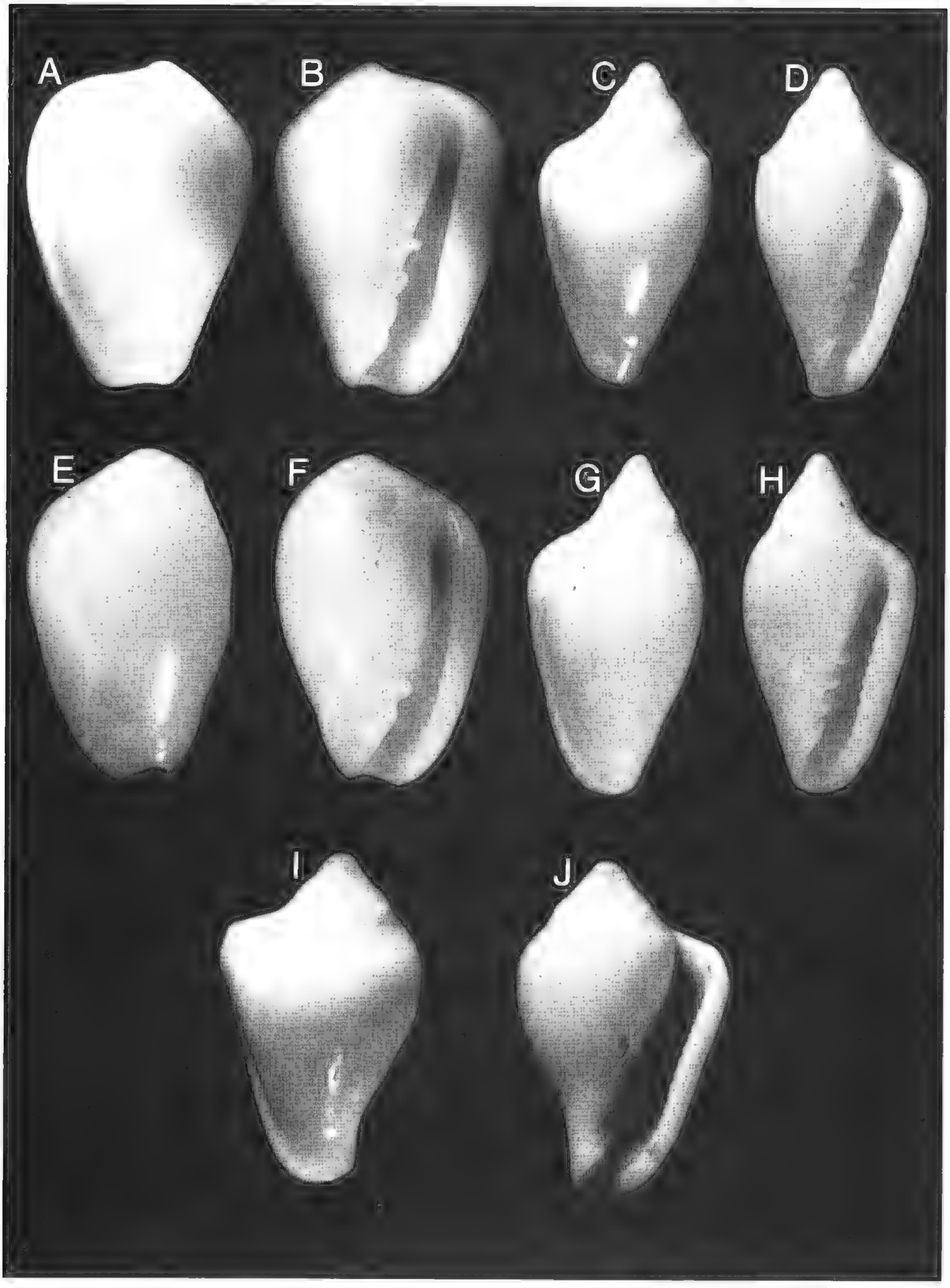

FIGURE 3. A-B: *Marginella pattisoni* Cotton, 1944, holotype, SAM D14983, × 5.3. C-D: *M. sica* Cotton, 1949, holotype, SAM D14230, × 10.0. E-F: *M. subbulbosa* Tate, 1878, syntype, SAM D13520, × 13.3. G-H: *M. vercoi* May, 1911, paratype, SAM D15816, × 7.8. I-J: *M. weedingi* Cotton, 1944, holotype, SAM D14989, × 7.8.

but it must be assumed that May's original identification was correct. More detailed taxonomic work is necessary to establish the validity of this species. Holotype in TM (E667/8008).

Marginella occidua Cotton, 1944
S. Aust. Nat. **22**: 15, fig. 24.
= *Volvarina (Haloginella) occidua* (Cotton, 1944).
Holotype: D14987, adult specimen, Albany, W.A., collector and date of collection unknown. (Figs 2I-J).
Paratypes: D18681, 2 adult specimens, dead collected, Rottnest Island, W.A., collector and date of collection unknown. D18682, 1 immature specimen, dredged dead in 40 m (22 fm), off Bunbury, W.A., collected by J. C. Verco, date of collection unknown. D18683, 8 specimens (3 immature), dredged dead in 64 m (35 fm), off Hopetoun, W.A., collected by J. C. Verco, date of collection unknown. D18684, 18 adult specimens (2 damaged), dead collected, Albany, collected by W. G. Torr, date of collection unknown.
Note: The paratype lots contain specimens of two distinct spire and columellar plication morphologies. As shell sizes and colour patterns are the same throughout, examination of the animals is necessary to establish the status of the forms.

Marginella patria Cotton, 1949
Rec. S. Aust. Mus. **9**(2): 201, pl. 20.
= *Mesoginella patria* (Cotton, 1949).
Holotype: D14228, adult specimen, dredged dead in 64 m (35 fm), off Hopetoun, W.A., collected by J. C. Verco, date of collection unknown. (Figs 2K-L).
Note: Laseron (1957) placed this species in the genus *Kogomea* Habe, 1951. However, some important shell features, notably the form of the columellar plications and labial dentition, do not correspond with those of that genus.

Marginella pattisoni Cotton, 1944
S. Aust. Nat. **22**: 11, fig. 10.
= *Mesoginella turbinata* (Sowerby, 1846) **new synonymy.**
Holotype: D14983, adult specimen, dead collected, Encounter Bay, S.A., collected by J. C. Verco, date of collection unknown. (Figs 3A–B).
Paratypes: D18862, 4 adult specimens, dredged live in 48 m (26 fm), 38 miles south-east of Newland Head, S.A., collected by J. C. Verco, date of collection unknown. D18663, 1 adult specimen, dead collected, Guichen Bay, S.A., collected by J. C. Verco, date of collection unknown. D18664, 43 specimens (19 damaged, 6 immature), in beach sand, Aldinga, near Adelaide, S.A., collector and date of collection unknown. D18665, 6 adult specimens, dead collected, Royston Head, Yorke Peninsula, S.A., collected by E. H. Matthews, date of collection unknown. D18666, 1 adult specimen, live collected, MacDonnell Bay, S.A., collected by W. G. Torr, date of collection unknown.
Note: The shell characters of this species are within the normal range of variability observed in populations of *Mesoginella turbinata*, and we consider it to be merely a broad variant of that species.

Marginella praetermissa May, 1916
Pap. Proc. R. Soc. Tas. **for 1915**: 87, pl. 2, fig. 12.
= *Austroginella praetermissa* (May, 1916).
Paratypes: D15808, 3 adult specimens, from Tas., collector and date of collection unknown.
Note: Laseron (1957) placed this species in his genus *Plicaginella*, which has been synonymised with *Austroginella* by Coovert (1988) on the basis of radular morphology. Holotype in TM (E670/8011).

Marginella procella May, 1916
Pap. Proc. R. Soc. Tas. **for 1915**: 87, pl. 2, fig. 10.
= *Mesoginella olivella* (Reeve, 1865).
Paratypes: D15810, 4 specimens (1 immature), dredged dead in 73 m (40 fm), off Schouten Island, Tas., collected by W. L. May, 27.iii.1910.
Note: May synonymised this species with *M. infelix* Jousseaume, and subsequently, *M. olivella* (see Laseron 1948). These two species have been considered to be synonymous, but the shells of *M. procella* and *M. infelix* are shorter and proportionately wider than those of *M. olivella*, and more work is necessary to determine the status of both forms. Type in TM (E652/7993).

Marginella punicea Laseron, 1948
Rec. Aust. Mus. **22**(1): 38, pl. 5, fig. 7.
= *Kogomea agapeta* (Watson, 1886) **new synonymy.**
Syntype: D14237, adult specimen, dredged alive in 11-16 m (6-9 fm), Sow and Pigs Reef, Port Jackson, N.S.W., collected by C. F. Laseron, date of collection unknown.
Note: This specimen was obtained from Laseron, and is believed to be part of the type series. The types of this species conform exactly to the description of *Kogomea agapeta* (Watson, 1886) and have been compared with a photograph of the holotype (BMNH 1887.2.9.911). The type localities for *M. punicea* are very close to that of *K. agapeta* and it is therefore considered to be a synonym. Other syntypes in AM (C103367).

Marginella ringens May, 1920
Pap. Proc. R. Soc. Tas. **for 1919**: 58, pl. 14, fig. 6.
= *Cystiscus angasi* (Crosse, 1870) **new synonymy.**
Paratypes: D15807, 8 adult specimens (1 damaged, 1 with dried animal), Kelso Bay, Tamar Heads, Tas.,

collected by W. L. May, date of collection unknown. Note: The shell morphology of this species is within the range of variability of *Cystiscus angasi*, which exhibits an extraordinarily large degree of variation in shell shape (Laseron 1957). We consider it a synonym of that species in the absence of any distinctive features. Holotype in TM (E671/8012).

Marginella (Volvarina) roberti Bavay, 1917
J. Conch. Paris **63**: 104, pl. 2, fig. 8.
= *Volvarina roberti* (Bavay, 1917).
Syntype: D17541, adult specimen, from Madeira, collector and date of collection unknown.
Note: From the May Collection, not the figured syntype. One syntype is reputed to be in the Desjardins Collection, Paris, but the collection cannot be presently located. Other syntypes are held in the Coen Collection, in the Hebrew University, Jerusalem, but they do not include the figured specimen (S. Gofas, pers. comm.).

Marginella schoutanica May, 1913
Pap. Proc. R. Soc. Tas. **for 1912**: 45, pl. 2, fig. 2.
= *Mesoginella schoutanica* (May, 1913).
Paratypes: D15811, 19 adult specimens (3 damaged, 1 with dried animal), dredged in 73 m (40 fm), 3 miles east of Schouten Island, Tas., collected by W. L. May, 27.iii.1910. D16081, 3 adult specimens, with same collection data as D15811.
Note: Holotype in TM (E672/8013).

Marginella shorehami Pritchard & Gatliff, 1899
Proc. R. Soc. Vic. **11**(2): 179, pl. 20, fig. 2.
= *Cystiscus angasi* (Crosse, 1870).
Syntypes: D16098, 3 adult specimens, Shoreham Beach, Westernport Bay, Vic., collector and date of collection unknown.
Note: This species was synonymised with *Cystiscus angasi* (Crosse, 1870) by Laseron (1957). Another syntype in NMV (F548).

Marginella sica Cotton, 1949
Rec. S. Aust. Mus. **9**(2): 200, pl. 19.
= *Austroginella vercoi* (May, 1911) **new synonymy.**
Holotype: D14230, adult specimen, dredged dead in 366 m (200 fm), off Eucla, W.A., collected by J. C. Verco, March 1912. (Figs 3C-D).
Note: As can be seen from the figures, the shell closely resembles that of *A. vercoi* (May, 1911) (Figs 3G-H). The minor differences from that species, in size, the form of the sutures, and lip dentition (Cotton 1949) are all features that exhibit variability in *A. vercoi* populations and are insufficient to justify separation on the basis of a single specimen. The dimensions of the type are similar to those of the holotype of *A. vercoi* (TM E681/8022). Type unique.

Marginella sinapi Laseron, 1948
Rec. Aust. Mus. **22**(1): 40, pl. 5, fig. 15.
= *Mesoginella sinapi* (Laseron, 1948).
Syntypes: D14232, 4 adult specimens (1 damaged), in shell sand, Manly Ocean Beach, N.S.W., collector and date of collection unknown.
Note: These specimens were obtained from Laseron, and are believed to be from the type series. Other syntypes in AM (C103360).

Marginella stilla Hedley, 1903
Mem. Aust. Mus. **4**: 367, text fig. 90.
= *Mesoginella stilla* (Hedley, 1903).
Paratypes: D19099, 2 adult specimens, trawled in mud and pebbles, 137-115 m, 8-12.7 km off Port Kembla, N.S.W., 34°28′S, 151°06-03′E, H.M.C.S. 'Thetis' Stn 49, collected by E. R. Waite, 18.iii.1898.
Note: Laseron (1957) placed this species in the genus *Kogomea* Habe, 1951. However, some important shell features, including the form of the columellar plications and labial dentition, do not correspond with those of that genus. Holotype (C16356) and other paratypes (C163382, C163383) in AM.

Marginella subauriculata May, 1916
Pap. Proc. R. Soc. Tas. **for 1915**: 86, pl. 2, fig. 7.
= *Cystiscus subauriculatus* (May, 1916).
Paratypes: D16090, 1 damaged adult specimen, dredged dead in 73 m (40 fm), Thouin Bay, Tas., collected by W. L. May, date of collection unknown. D16091, 4 adult specimens (1 damaged, 1 with dried animal), with same collection data as D16090.
Note: The species is very closely related to *Cystiscus angasi* (Crosse, 1870) and may be a form of that species. Holotype in TM (E674/8015), badly broken.

Marginella subbulbosa Tate, 1878
Trans. Proc. Rep. Phil. Soc. Adel. **1**: 86.
= *Kogomea subbulbosa* (Tate, 1878).
Syntypes: D13520, 4 adult specimens (1 damaged), in beach sand, Wauraltie (Port Victoria), Yorke Peninsula, S.A., collected by R. Tate, date of collection unknown. (Figs 3E-F).
Note: The type description only mentions two specimens, and as all the specimens in D13520 are of approximately equal size and form, it is impossible to isolate the actual syntypes. Therefore the status of the whole lot is questionable.

Marginella thouinensis May, 1916
Pap. Proc. R. Soc. Tas. **for 1915**: 86, pl. 2, fig. 8.
= *Cystiscus thouinensis* (May, 1916)
Paratypes: D16089, 2 adult specimens, dredged dead in 73 m (40 fm), Thouin Bay, Tas., collected by W. L. May, date of collection unknown. D16189, 26 adult specimens, with same collection data as D16089.
Note: Holotype in TM (E676/8017).

Marginella tomliniana May, 1918
Pap. Proc. R. Soc. Tas. **for 1917**: 104.
= *Cystiscus tomlinianus* (May, 1918).
Paratypes: D15811, 23 adult specimens (3 damaged), dredged in 73 m (40 fm), off Thouin Bay, Tas., collected by W. L. May, date of collection unknown. D16084, 2 adult specimens, with same collection data as D15811.
Note: New name for *Marginella auriculata* May, 1916 (*non* Menard de la Groye, 1811), and therefore based on the same type series. Holotype in TM (E677/8018), badly broken.

Marginella vercoi May, 1911
Pap. Proc. R. Soc. Tas. **for 1910**: 385, pl. 13, fig. 7.
= *Austroginella vercoi* (May, 1911).
Paratypes: D15816, 9 adult specimens, dredged in 183 m (100 fm), 7 miles east of Cape Pillar, Tas., collected by W. L. May, 18.xii.1907. D16079, 2 adult specimens, with same collection data as D15816. (Figs 3G-H).
Note: Holotype in TM (E681/8022).

Marginella vincentiana Cotton, 1944.
S. Aust. Nat. **22**: 15, fig. 30.
= *Volvarina (Haloginella) vincentiana* (Cotton, 1944).
Lectotype: D13519, adult specimen, in shell sand, Marino, near Adelaide, S.A., collected by R. Tate, date of collection unknown. (Lectotype selected here.) (Figs 1A-B).
Paralectotypes: D18633, 7 specimens (2 immature), with same collection data as lectotype.
Note: New name for *Marginella albida* Tate, 1878, (*non* Lamarck, 1822), and therefore based on the same type series. See note for *M. albida* for further information on types.

Marginella weedingi Cotton, 1944
S. Aust. Nat. **22**: 16, fig. 31.
= *Protoginella geminata* (Hedley, 1912) **new synonymy.**
Holotype: D14989, adult specimen with dried animal, dredged in 36 m (20 fm), Backstairs Passage, S.A., collected by J. C. Verco, date of collection unknown. (Figs 3I-J).
Paratypes: D18637, 14 specimens (11 damaged, 1 immature), dredged dead in 164 m (90 fm), off Cape Jaffa, S.A., collected by J. C. Verco, date of collection unknown. D18638, 25 adult specimens, dredged dead in 100 m (55 fm), off Cape Borda, Kangaroo Island, S.A., collected by J. C. Verco, date of collection unknown. D18639, 2 adult specimens (1 damaged), dredged dead in 110 m (60 fm), other collection data same as D18638. D18640, 42 specimens (13 damaged, 1 immature), dredged dead in 73 m (40 fm), off Beachport, S.A., collected by J. C. Verco, date of collection unknown. D18641, 1 adult specimen, dredged dead in 183 m (100 fm), other collection data same as D18640. D18642, 19 adult specimens (8 damaged), dredged dead in 201 m (110 fm), other collection data same as D18640. D18643, 13 specimens (1 damaged, 1 immature), dredged dead in 274 m (150 fm), other collection data same as D18640. D18644, 6 adult specimens (3 damaged), dredged dead in 366 m (200 fm), other collection data same as D18640.
Note: Cotton (1944) originally described the species as being larger and narrower than *P. geminata*, as well as having differently shaped columellar plications. However, the characteristics of this species are well within the normal range observed for *P. geminata* and examination of the types and other specimens from Gulf St Vincent, S.A., (SAM D6851) supports the conclusion that *M. weedingi* is a junior synonym of *P. geminata*.

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REVISIONARY NOTES ON THE GENUS DELMA (SQUAMATA : PYGOPODIDAE) IN SOUTH AUSTRALIA AND THE NORTHERN TERRITORY

G. M. Shea

Summary

Nine species of Delma are recorded from South Australia and the Northern Territory: D. australis, D. borea, D. butleri, D. fraseri, D. impar, D. inornata, D. molleri, D. nasuta and D. tincta. D. australis is formally recorded from New South Wales for the first time. D. haroldi is synonymised with D. butleri. A neotype is designated for D. fraseri, and an eastern race, D. f. petersoni described, having a greater number of scale rows at midbody and a bolder throat pattern. D. borea, D. pax and D. tincta are placed in a D. tincta species group, while D. impar, D. plebeia and D. torquata are pleced in a D. impar species group.

REVISIONARY NOTES ON THE GENUS *DELMA* (SQUAMATA: PYGOPODIDAE) IN SOUTH AUSTRALIA AND THE NORTHERN TERRITORY.

G. M. SHEA

SHEA, G. M. 1991. Revisionary notes on the genus *Delma* (Squamata: Pygopodidae) in South Australia and the Northern Territory. *Rec. S. Aust. Mus.* **25**(1): 71-90.

Nine species of *Delma* are recorded from South Australia and the Northern Territory: *D. australis, D. borea, D. butleri, D. fraseri, D. impar, D. inornata, D. molleri, D. nasuta* and *D. tincta*. *D. australis* is formally recorded from New South Wales for the first time. *D. haroldi* is synonymised with *D. butleri*. A neotype is designated for *D. fraseri*, and an eastern race, *D. f. petersoni* described, having a greater number of scale rows at midbody and a bolder throat pattern. *D. borea, D. pax* and *D. tincta* are placed in a *D. tincta* species group, while *D. impar, D. plebeia* and *D. torquata* are placed in a *D. impar* species group.

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The genus *Delma* is the most speciose genus in the family Pygopodidae. In the most recent revision, Kluge (1974) recognised 13 species, of a total of 30 species in the family. Since that time, museum herpetological collections in Australia have tripled in size, while extensive collections have been made in remote and formerly poorly-studied areas. Within the last four years, the genus has been the subject of attention in the eastern and western thirds of Australia. In eastern Australia, Shea (1987a, b) described two new species *D. labialis* and *D. mitella* from Queensland, recorded the presence of *D. nasuta* in New South Wales, and provided updated spot distribution maps for most taxa occurring in the region. In Western Australia, Storr (1987) and Storr *et al.* (1990) divided *D. nasuta* into two species (one new), described a second new species *D. haroldi*, briefly redescribed the remaining taxa, and provided distribution maps for the state.

This paper links these studies by revising the genus in the intervening area (South Australia and the Northern Territory) for the first time since Kluge's (1974) revision, and discusses the identity of *D. fraseri*, type species of the genus.

Although the monophyly of the genus is an unresolved issue (Shea 1987a), there is little doubt that the species placed in *Delma* by recent workers are at least a close-knit grade, readily differentiated from both more derived and relatively primitive members of the family (Kluge 1976), and for this paper I accept the phenetic diagnosis of the genus provided by Kluge (1974).

MATERIALS AND METHODS

This study is based on the examination of material in the Australian Museum (AM), British Museum (Natural History) (BMNH), Museum of Victoria (MV), Northern Territory Museum (NTM), Queensland Museum (QM), South Australian Museum (SAM), Western Australian Museum (WAM) and Central Australian Wildlife Collection (CAWC), the latter collection now lodged in the Northern Territory Museum.

Scalation nomenclature follows Shea (1987a) with one exception. The second supralabial scale caudal to the elongate subocular supralabial has previously been generally considered to be the caudalmost (Kluge 1974; Shea 1987a; Storr 1987). However, in specimens preserved with open mouth, the third supralabial scale caudal to the subocular supralabial is at the caudalmost extent of the circumoral scalation. Hence, the supralabial and infralabial scale counts used here are one greater than counts in previous works.

I have used only derived characters to hypothesise relationships between taxa, and have used *Pygopus lepidopodus* and *P. nigriceps*, the two most generally primitive species in the family (Kluge 1974, 1976) as outgroups to determine polarity of characters.

SYSTEMATICS

Delma australis Kluge, 1974: 77.

Diagnosis

A small species of *Delma* (maximum SVL 88 mm), with ventral body scales not markedly dilated relative to more lateral scales, a single pair of supranasal scales, modally 18 midbody scales and fourth supralabial in subocular position, loreal scale row usually interrupted by a ventral extension of prefrontal scale contacting supralabials, and body venter grey (often tinged with pink in life).

Description

See Kluge (1974) and Storr *et al.* (1990).

Distribution

In South Australia, occurs in the south-west, from the Western Australian border east to the Flinders Ranges, and including the southern fringe of the Great Victoria Desert, Gawler Ranges and Eyre Peninsula. Apparent isolates in the western part of the Lake Eyre drainage, the Tomkinson and Musgrave Ranges, Danggali Conservation Park, and to the south of the Murray River, between Tailem Bend and Scorpion Well Conservation Park (Fig. 1).

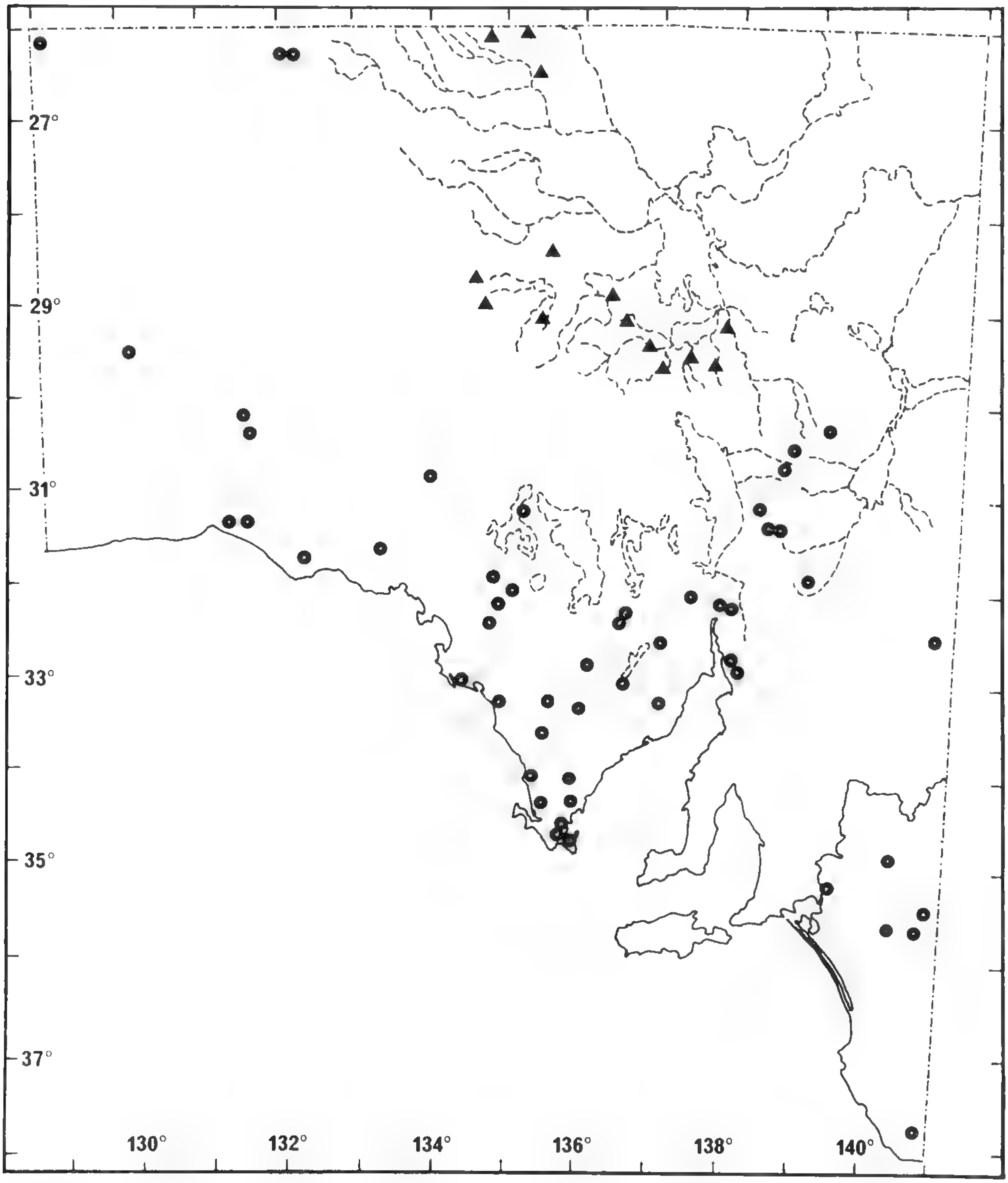

FIGURE 1. Distribution of *Delma australis* in South Australia. Triangles represent weakly patterned north-eastern population.

Also occurs in southern W.A., south-west N.S.W. and north-west Victoria (Kluge 1974; Storr *et al.* 1990; this paper).

Remarks

There is noticeable geographic variation in the intensity of the head pattern in this species in South Australia. Most specimens from the southern half of the state and the Tomkinson and Musgrave Ranges in the north-west have strong dark variegations on the head, although the pattern is reduced, particularly laterally, in a few specimens. Material from the western part of the Lake Eyre drainage (east of 134°E, north of 30°S) consistently either lack dark markings on the head or have such markings very reduced.

The single old record from the Northern Territory (SAM R2240; Alice Springs, no collector or date recorded) was considered to be suspect by Kluge (1974). Extensive collections of reptiles from the Alice Springs area since the early 1970s have included numerous *Delma tincta,* and several *D. borea, D. butleri* and *D. nasuta,* but no additional material of *D. australis.* Consequently, I consider the locality for SAM R2240 erroneous.

Delma australis has not previously been formally recorded from New South Wales, although Cogger (1975) maps the species in the south-west corner of the state. Five specimens (AM R39495, R55010, R93142, R118635, R118637) confirm the presence of the species in New South Wales.

Habitat

The majority of specimens of the southern and western populations in South Australia are from *Triodia* or mallee habitats, or combinations of both (45 specimens from 24 localities), generally taken from in or under *Triodia* clumps or mallee leaf litter. The former habitat is shared with *D. butleri.* My impression, having collected both species in W.A., S.A. and N.S.W., including the Coombah area where the two taxa are sympatric, is that *D. australis* occurs in slightly moister situations than *D. butleri.* There is some support for this view from the association of several records with watercourses (SAM R14351 'under dead log near water pond', R16205 'in burrow under *Triodia*, creek flank', R21015 'on bank of watercourse lined with Coolibah *(Eucalyptus microtheca)*', R22193 'under rock near water', R25071-72 'in storm drain along creek').

One specimen, SAM R15009, was 'pit-trapped overnight', suggesting nocturnal activity.

There are almost no habitat data associated with specimens of the north-eastern unpatterned form. SAM R30401 was taken in a pitfall on a gibber plain with *Atriplex.*

Specimens examined

New South Wales: AM R39495, 'Glenea', 70 mi. N Roto; R55010, 12 km S Matakana; R93142, Round Hill Fauna Reserve; R118635, 14.2 km N Coombah Roadhouse on Silver City Hwy; R118637, 13.5 km N Coombah Roadhouse on Silver City Hwy.

South Australia (patterned form): AM R17306-08, Mt Davies, Tomkinson Ranges; R17460, Musgrave Ranges; R62391, nr Sleaford, Port Lincoln; R79914-15, 2-3 km SE Mt Hope; R79916, N side Pillie Lake; R79917, R79919, R79943, SE side Port Lincoln; R79920-21, 8.4 km W Ungarra P.O. by Yeelanina rd; R107950, 15.6 km E Nundroo via Eyre Hwy; NTM R9252, SAM R17752a-b, Marble Range; SAM R380, Mitchell; R3123, Ernabella Mission; R3852, R10374, 15 mi. N Poochera; R3872, 'Kokatha'; R4301, Port Germein Gorge; R5375, R10376, Gawler Ranges; R5613, 5 mi. W Arkaroola; R9189, R9213, Blesing Reserve; R9224, 4 mi. S Baird Bay; R10375, nr 'Kokatha'; R10800, Watson; R12454-55, 'Corunna'; R12481, R12669, Miccollo Hill, 'Siam'; R12670, 3 mi. NW Tailem Bend; R12746-47, Mambray Creek National Park; R12751, R14695, Corunna Hills; R13227, 7 mi. WNW Kenmore Park; R13908, Lake Gilles Conservation Park; R14086, Whaler's Way, Port Lincoln; R14093, Scorpion Well Conservation Park; R14190, R16678, Billiat Conservation Park; R14351, 3 mi. past Moonabie Pass, 30 mi. S Whyalla; R14914, 'Baratta'; R14963, R24514, Mt Finke; R15009, 23 km N Koonibba Mission; R15195a-b, R15619, S of Scorpion Springs Conservation Park; R15954, Parachilna; R15958, Mt Serle; R16060, R17106, Danggali Conservation Park; R16176, abandoned piggery, W Bordertown-Pinaroo rd; R16205, Mt Hack, 38 km E Beltana; R16212, Depot Creek Gorge; R16227, Ninety Mile Desert; R16521, Gum Creek, Corunna Hills; R16522a-b, nr Millalee Creek, N Port Lincoln; R16650, 'Bibliando'; R16765, R16844, R17845, R17860a-c, R23233, R24184-86, Uro Bluff; R17144, Pinkawillinie Reserve; R19898-99, 'Koondoolka'; R22784, R23091-93, Mt Remarkable National Park, 2.1 km E Sugargum Lookout; R24298, 0.7 km SSW Old Siam H.S.; R24445, E end Brachina Gorge; R24865, nr 'Oraparinna' H.S.; R25071-73, Stoney Creek; R25349, Hambidge Conservation Park; R26333, 22 km NW Yalata Roadhouse; R26339, 20 km W Yalata Roadhouse; R26349, 50 km W Yalata Roadhouse; R28540, 77.5 km N Minnipa; R32127, 11 km SSW Maralinga; R32168, 8.5 km SW Maralinga; R32278, 50 km SW Hanilar Lake; R32498, Bascombe Well Conservation Park; R32894, Wanna; R32912, 3 km along Talia Caves rd from turnoff on Flinders Hwy; WAM R24528, 37 km ENE Wirrulla.

South Australia (unpatterned north-eastern form): AM R17622, Coober Pedy; SAM R12756a-b, 'Muloorina'; R14342, Margaret River, S of Lake Eyre; R17048, Coward Springs; R21015, Balta Baltana Hill; R22193, Hermit Hill; R25826, William Creek; R25857-58, Mt Dare; R28130, 'Stuart Creek'; R28138, W of Maree; R28172, Beresford Rail Siding; R28215, 'Dalhousie' ruins; R28248-51, R28258-60, Abminga Rail Station; R29000, SW of Warrina; R30401, Breakaways Reserve, 25 km NNW Coober Pedy.

Victoria: AM R42724, Lowan Sanctuary, 20 mi. W Piangil; R54889, 15 mi. W. Annuello; R84294, R84297-98, Hattah.

Western Australia: AM R8778, Mt Barker; R11114, Woodlands, Tambellup; R101995, R102004, Hamelin Pool, 'Hamelin'; R102005, *ca* 21.4 km N 'Nerren Nerren' turnoff via North-West Coastal Hwy; R105720, 34.7 km N Tamala turnoff on Denham rd; R105740, 3.2 km S Nanga turnoff on Denham rd; R105813–15, 45.1 km W Newman Rocks turnoff on Eyre Hwy; R105879, 39.8 km E Cocklebiddy Roadhouse on Eyre Hwy; R117736, west side Boulder; BMNH 1904.10.7.18, Coolgardie district.

Delma borea Kluge, 1974: 81.

Diagnosis

A small to moderate-sized species of *Delma* (maximum SVL 98 mm; Storr *et al.* 1990) with two pairs of supranasals, fourth supralabial usually subocular, modally 16 midbody scales and, in juveniles and subadults at least, a dark head dorsally and laterally, with narrow pale bands (one preocular, one postocular, one auricular, usually forked laterally, one branch running along each edge of ear, and one nuchal), but mid-throat region immaculate, pale.

Description

See Kluge (1974) and Storr *et al.* (1990).

Distribution

In the Northern Territory, most common in the Top End, north of 'Wave Hill', 'Helen Springs' and 50 km S MacArthur River camp, and including Groote Eylandt, Bathurst I., Cape Wessel I., Melville I. and Vanderlin I. (Fig. 2). The few records from further south (Alice Springs, Arltunga ruins, Ayers Rock, Barrow Creek, George Gill Range, Heavitree Gap, Kintore Range, Mt Doreen) are generally from rocky areas.

Also occurs in Western Australia (Kimberley and its southern fringe, eastern Pilbara, Barrow I., Hermite I., Rosemary I. and Warburton Range) and western Queensland (Storr *et al.* 1990; Shea 1987a).

Habitat

Kluge (1974) stated that *D. borea* was most frequently encountered in regions of stony, hard soil and *Triodia*, but that it did not appear to occupy *Triodia* on sandplains. However, most specimens collected from the Northern Territory are from savanna woodland lacking *Triodia*. Around Darwin, in particular, the species seems to be abundant, sheltering under debris and leaf litter. The 40 specimens from the Top End for which microhabitat data are available were found in or under leaf litter, grass, exfoliated bark, logs and rubbish (tin, cement slabs, compost and boards). However, the two Heavitree Gap specimens from further south were found under rocks beneath *Triodia* tussocks on a steep hillslope.

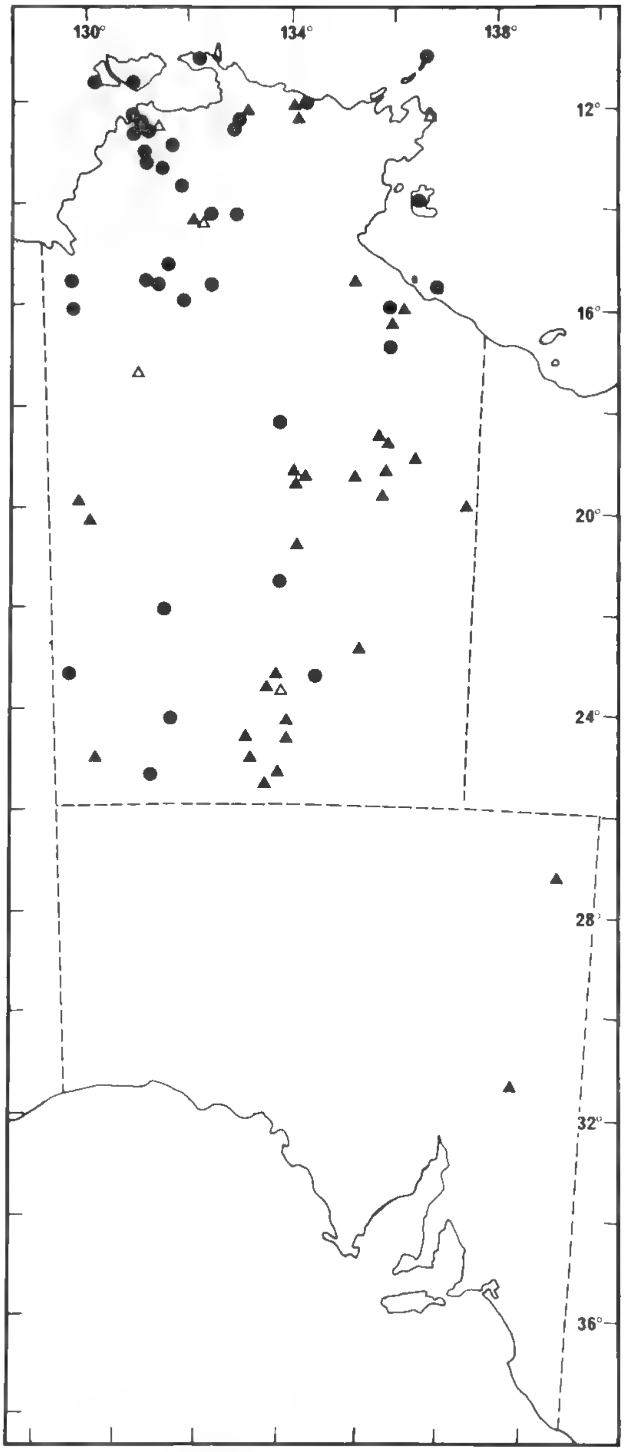

FIGURE 2. Distribution of *Delma borea* (dots) and *D. tincta* (closed triangles) in the Northern Territory and South Australia. Open triangles represent localities of sympatry or near sympatry.

Remarks

Delma borea, *D. tincta* and *D. pax* have very similar colour patterns, and largely replace each other geographically. They appear to comprise a species group, the *D. tincta* group, diagnosable by the usual presence of only a single elongate upper temporal scale bordering the parietals, a character otherwise common in *Delma* only in *D. plebeia* (frequency: *D. borea*, 93.8%, n = 65; *D. pax*, 96.5%, n = 57; *D. tincta*, 97.4%, n = 115; *D. plebeia*, 76.9%, n = 13). Within the *D. tincta* group, three scalation characters separate the species. *D. borea* typically has two pairs of supranasals, fourth supralabial below eye, and 16 midbody scales; *D. tincta* typically has one pair of supranasals, third supralabial below eye, and 14 midbody scales, while *D. pax* is intermediate in having two pairs of supranasals, third supralabial below eye, and 16 midbody scales. However, occasional specimens show different combinations of these three characters, and proved difficult to assign to species. The problem seemed most acute in the case of *D. borea/D. pax,* which differed only in the number of the subocular supralabial, and as initially described were widely separated geographically (Kluge 1974), but had both recently been recorded from the Pilbara (Storr *et al.* 1990). Examination of all material of *D. pax* in the WAM collection revealed that the two taxa may additionally be differentiated by several subtle coloration differences. In *D. pax,* the pale postocular band broadens ventrally (even width or only slightly broader ventrally in *D. borea)*, the auricular band is often broader laterally, and there is no ventrolateral series of parallel pale streaks along neck and forebody (usually present in *D. borea)*. On the basis of these additional characters, *D. pax* appears to replace *D. borea* in the western Pilbara and along the north-west coast north to 'Anna Plains', while *D. borea* is largely confined to the Kimberley, south to East Palm Spring in the Denison Range, with populations on several islands (Barrow, Rosemary, Hermite) off the Pilbara coast, and one record (WAM R25201, 32 km E Jiggalong) from the eastern Pilbara.

The identity of the single Ayers Rock specimen (CAWC R1319) is problematic. The colour pattern is similar to typical *D. borea*, but although the specimen is of adult size (SVL 86.5 mm), the head is black with narrow white bands. Such intensity of pattern is rare in adult *D. borea* and *D. tincta*, and has not been seen in *D. pax.* The specimen has two pairs of supranasal scales and 16 midbody scales, typical of *D. borea,* but the third supralabial is subocular, typical of *D. tincta* and *D. pax.* Until further material becomes available, I refer this specimen to *D. borea*, on the basis of the number of supranasal and midbody scales.

Specimens examined

Northern Territory: AM R3662, R4162, R62673, QM J1781, Port Darwin; AM R8249, R12877, R14161, R19121, R38021, R127980, R128741, CAWC R9, R1680, R4582, R3080, NTM R9930-31, WAM R21980, R40296, R40835, Darwin; AM R12794, R12841, R13004, Darwin area; R12901, Westhead, Darwin; R13471, R13609, CAWC R4950, NTM R7456, Groote Eylandt; AM R13569-70, R13648, R62670-72, Cape Arnhem; R13713, R13777, WAM R23480, Nightcliff, Darwin; AM R14336, NT; R30014-15, R107502, Black Point, Port Essington; R52135-36, Heavitree Gap, Alice Springs; R52137, Adelaide River township; R53149, Mt Doreen; R54745, *ca* 50 km S McArthur River camp; R54746, 30 km N McArthur River camp; R55904, Vanderlin I.; R61573, Maningrida; R73069, R76043, Bullo River Stn rd, 31 km NW Victoria Hwy; R75511, midreaches McKinlay River; R80369, 25 km S Larrimah on Stuart Hwy; R88876, Jabiluka project area; R98442, vicinity of 009 Gauge Stn, Magela Creek drainage; R112829, Mindil Beach Casino site; BMNH 1932.3.7.25, 'central Australia'; 1973.3285, Kintore Range (23°21′S 129°23′E) (formerly JSE 269); CAWC R1318, R1320, Arltunga ruins; R1319, Ayers Rock; R5511, Beatrice Hill; MV D174, Alice Springs; NTM R159, Riverview Caravan Park; R173-174, Pine Creek; R1040, Maclear Creek, S side Melville I.; R1317, R5371, Barrow Creek; R1779, SAM R8409, Katherine; NTM R1947-51, Millner School grounds; R2045, Mt Carr; R2082, Winellie; R2108-09, R3051, Rapid Creek; R2429, R2507-08, R3053, Millner; R2954, R3052, R8705, Stuart Park; R3144, R3146, R3194-97, R3218-21, R7593-98, Ban Ban Spring; R3299, Berry Springs; R3411, Allawa; R3791, Katherine district; R3870, Jabiru tip; R5825, R6516-17, R6609-10, Wave Hill; R6594, 70 km N Top Springs; R7744, Cape Wessel I.; R7883, R7946, Cape Fourcroy, Bathurst I.; R8120, the 17 mile, S of Darwin; R8306, 2 km W Victoria River bridge on Victoria Hwy; R8340, Ludmilla; R9133, Keep River National Park; R9457, 20 km N Mataranka; R9467, 110 km W Katherine; R9494, Bees Creek, nr Darwin; R9496, Fannie Bay; R11696, R12956, Katherine Gorge National Park; R12727, George Gill Range; R13221, Humpty Doo; R13237, Gregory National Park; QM J39334, Cahills Crossing, East Alligator River; WAM R13496, R34331-32, Yirrkala; R24198, Helen Springs; R24001, 11 km N Adelaide River; R26224, Parap.

Queensland: AM R26138-39, R28445, R107000, Mt Isa; R31627, R31629-30, Mt Isa district; R60248, 3 km W Cloncurry on Flinders Hwy; R63589, Bang Bang jumpup on Hwy 83; R90212, Inca Creek; R110534, Scotts Tank, 'Diamantina Lakes'; R110601, 6 km E Scotts Tank, 'Diamantina Lakes'.

Western Australia: AM R14160, Forrest River Mission; R40518-19, junction Ord and Behn Rivers; R49970, Balgo Mission; R56822, Halls Creek; R117604, vicinity of Cape Lefeque; R126188, Mitchell Plateau airstrip; BMNH 1966.415, Wooroloo [in error]; NTM R7286-87, 167 km E Fitzroy Crossing; R13047, 3 mi. S main Ord River Dam site; SAM R5058, Warburton Range; WAM R11240, Wotjulum; R25201, 32 km E Jiggalong; R28656, Barrow I.; R37371, Rosemary I.; R37406, Hermite I.; R37703, Hidden Valley; R43075, Crystal Creek near Crystal Head; R44566, mouth of Behn River, Lake Argyle; R44575, 2-3 mi. upstream Ord River from Behn River junction; R48559, nr Shark Point, Barrow Island; R60352, 3 km E Nicholson; R70564, 5.2 km 202° Mt Percy; R75533, 11 km WNW New Lissadell H.S.; R94881, Lake Argyle; R96944, north-west hump of the Dromedaries; R99776, 10 km SW Silent Grove.

No data: AM R55613-14, BMNH 1946.8.26.99, NTM R3558, R5811.

Delma butleri Storr, 1987: 346.

Diagnosis

A moderate-sized relatively inornate species of *Delma* (maximum SVL 96 mm) with two pairs of supranasal scales, the caudal pair contacting or only narrowly separated from the nostril, modally 16 midbody scales and fourth supralabial subocular, usually four loreals, snout short (Fig. 3), and venter without dark markings.

Description

See Storr (1987) (as both *D. butleri* and *D. haroldi*) and Shea (1987b) (as *D. nasuta*).

Distribution

Extreme south of Northern Territory (Alice Springs and vicinity of Uluru National Park) and the adjacent far north-west corner of South Australia, and arid southern South Australia, south of 43 km NE Maralinga, Mt Finke, 118 km NE Minnipa, Uro Bluff, Parachilna, Paralana Hot Springs and Danggali Conservation Park, with a possible north-eastern isolate near the South Australian/Queensland border (Figure 4). Also occurs in the arid parts of W.A. (Storr 1987, as *D. butleri* and *D. haroldi*) and south-western N.S.W. and north-western Victoria (Shea 1987b, as *D. nasuta*). An early record from St Francis I. (BMNH 1922.11.8.8-10) has not been confirmed by recent collections from that island and must be treated as suspect.

Remarks

Storr (1987) separated this species from *D. nasuta*, but referred to it only material from Western Australia and western South Australia. This distribution was followed by Wilson & Knowles

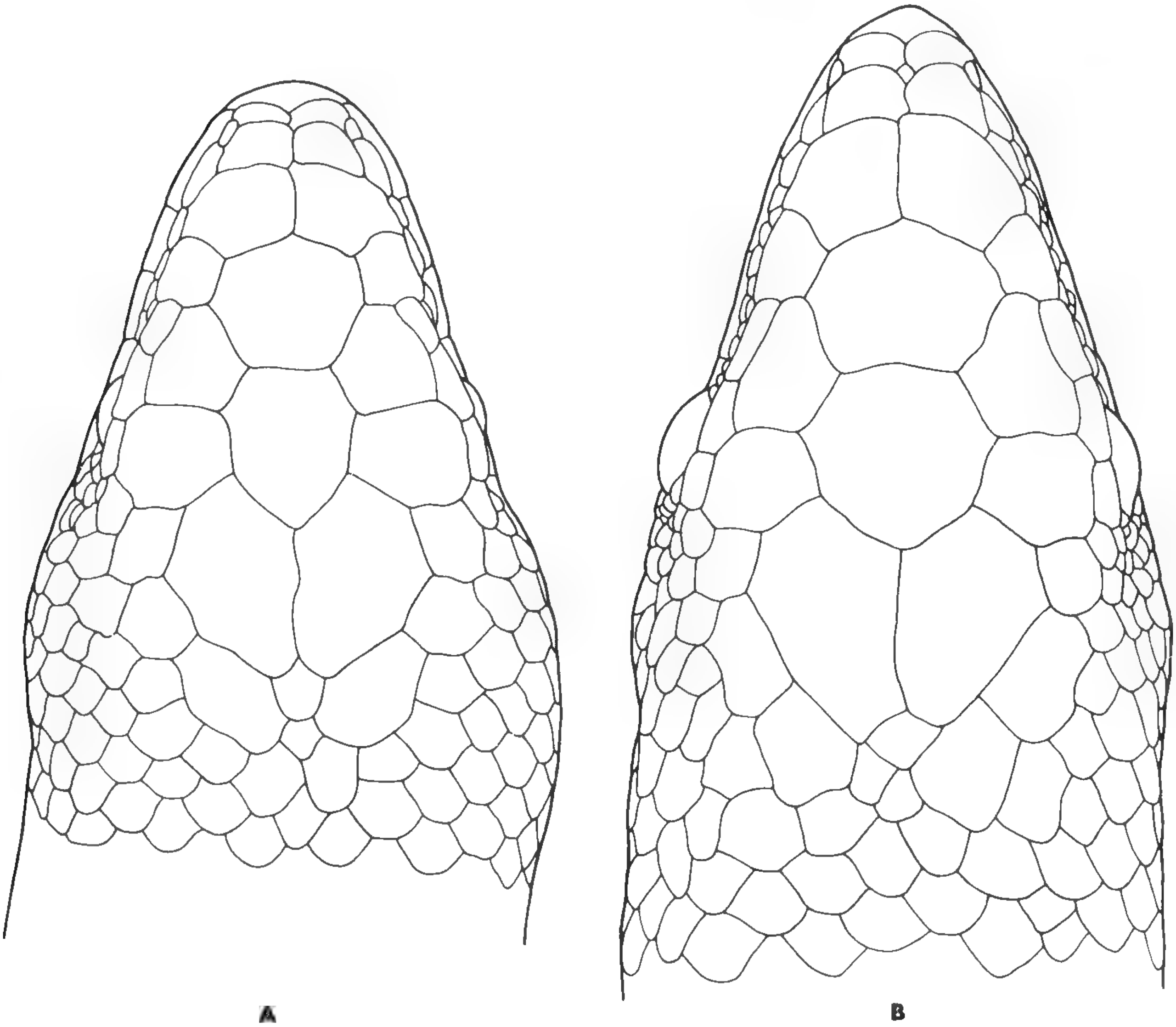

FIGURE 3. Dorsal view of heads of A. *Delma butleri* (AM R44362) and B. *D. nasuta* (AM R17376).

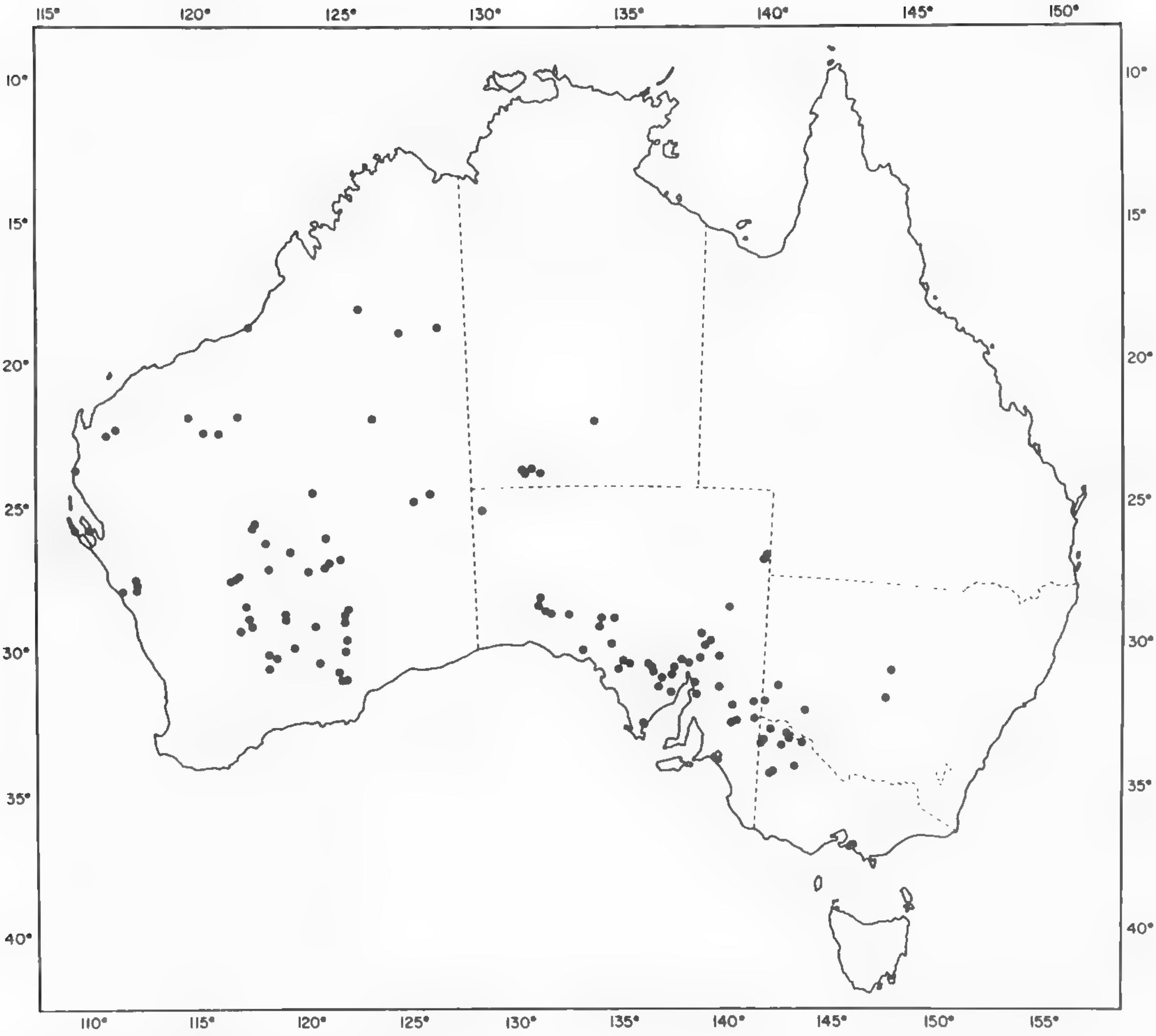

FIGURE 4. Distribution of *Delma butleri*.

(1988). However, comparison with the type series of *D. butleri* indicates that all southern populations referred to *D. nasuta* by Kluge (1974) and Shea (1987a) are *D. butleri*. To the recorded instances of sympatry between *D. butleri* and *D. nasuta* can be added SAM R12674 (*D. butleri*) and R12675 (*D. nasuta*) both from Warburton Range.

In describing *D. haroldi*, Storr (1987) only compared it with *D. borea*, to which species the type series had previously been identified. However, *D. haroldi* consistently has two or more upper temporal scales and cannot be placed in the *D. tincta* species group with *D. borea*. When the descriptions of *D. haroldi* and *D. butleri* are compared, it becomes evident that there are very few, if any, differences between these two taxa. The populations of *D. butleri* geographically closest to *D. haroldi*, in the Pilbara, are also the most similar in coloration, with well developed pale bars laterally on the face and neck. Significantly, these populations have two additional pale bars between the pale postocular and auricular bars, a character otherwise seen only in *D. haroldi*. Specimens identified as *D. butleri* (WAM R94585) and *D. haroldi* (WAM R64715; fig. 3 in Storr 1987) both from the vicinity of Marandoo, W.A. are almost identical, and clearly conspecific, as is another specimen (WAM R53760) from the same locality, and the specimen of *D. haroldi* (WAM R63632) from 19.5 km SE of Mt Meharry. Of the remaining types of *D. haroldi*, the seven specimens from the Kimberley, adjacent parts of the Eastern Division, and the Pilbara coastal lowlands (WAM R46043, R64703, R63427, R45243, R45811, R51722, R85094) have only a single pale temporal band between postocular and auricular bands. However, the paratype (WAM R73630) from Ophthalmia Range, geographically intermediate between the Marandoo and Eastern Division material, has an intermediate condition, with one pale temporal band on one side forking into two bars on the other. Seven specimens from central Australia (AM R14362, R96116, CAWC R1321, R1323, R1636; SAM R29900, R29935) are variable in this character, some having one band, others showing division of this band ventrally. Because of this wide zone of apparent intermediates, apparently an extension of the south-east to north-west gradation in the development and intensity of facial markings previously noted within *D. butleri* (Storr 1987), I synonymise *D. haroldi* and *D. butleri.* As both were described in the same publication, I nominate *D. butleri* (which has page priority) to have priority over *D. haroldi.* Whether the typical *'haroldi'* from the extreme north and north-west of the distribution can be recognised at a subspecies level awaits the collection of further material from the intervening areas.

Variation in *D. butleri* throughout the southern part of its range is minimal. Live material I have examined from 23 km ENE of Yuna, W.A. in the west of the distribution was similar to material from 23 km ENE of Kimba, S.A., and the N.S.W. material illustrated by Shea (1987b). Most of this material had only very slight development of pale facial markings, reduced to 1–2 lip bars preocularly and 2 lip bars postocularly.

The five specimens from Dirk Hartog Island differ from mainland populations in being noticeably more bulky and having 17 nuchal scales (*vs* 15–17, usually 15 for other North West Division material), more broken pale markings of reduced contrast, but with dark edges, a dark apical spot on each dorsal body scale, and a lighter brown dorsal ground.

Habitat

Like populations in W.A. (Storr 1987) and N.S.W. and Victoria (Shea 1987b), S.A. and N.T. populations are *Triodia* inhabitants. All 48 specimens for which field data are available were either taken from live or dead *Triodia* clumps or from habitats noted to contain *Triodia.* The substrate, where noted, ranged from sand dunes to rocky hillslopes, and the overstory at various localities included mallee eucalypts, *Casuarina, Melaleuca* and *Heterodendron.*

Specimens examined

New South Wales: see Shea (1987b).

Northern Territory: AM R14362, road, 'Curtin Springs' to Ayers Rock; CAWC R1321, R1323, Ayers Rock; R1636, Uluru National Park, 15 km S on Britten Jones track; R4808, Alice Springs; SAM R29900, R29935, 24 km along 'Mulga Park' road, SSE 'Curtin Springs'.

South Australia: AM R7649, Immarna; R105536–37, 23.0 km ENE Kimba; R115906–08, Pandappa Hill; BMNH 1922.11.8.8–10, St Francis I.; MV D2659, W of Kychering Soak, No. 3, Overland Railway to WA on line of march; D15453–54, Renmark; NTM R9212, SAM R13919, R17716, Immarna; NTM R9295–96, SAM R16283, 'Canopus'; SAM R54, Waikerie; R3066a–b, Birthday Well, 'Cariewerloo'; R3067, 'Coralbignie'; R3851a–d, 15 mi. N Poochera; R3878a–c, Wilson; R5022a–c, West Coast; R5376a–c, Gawler Range; R10727–28, Mamblin; R10932, Paralana Hot Springs; R12450–51, R14687, R14696, Corunna Hills; R13041, 'Hiltaba' H.S.; R14020, Baroota Reserve; R14225, Childara Rockholes; R14463, Mambray Creek National Park; R14568, Lincoln Way, 48 km SW Whyalla; R17338, 21 km E Blanchetown; R19900–01, nr Chinaman Dam, 'Yardea'; R14913, 'Baratta'; R14964, Mt Finke; R14982, 22 km E Barton Rail Station; R15353, Uno Range; R15955, Parachilna; R16211, Depot Creek Gorge, 34 km NNE Port Augusta; R16523, nr Millalee Creek, N Port Lincoln; R16524, Gum Creek, Corunna Hills; R16649, 'Bibliando'; R16755, Wilgena Hill; R16843a–b, R17844a–b, R17871, R23767, R24134, R24158–59, R24163, Uro Bluff; R17120, R17659a–b, Danggali Conservation Park; R17681, 'Balah'; R17984, R18002, Lake Gilles Conservation Park; R18121a–c, S of 'Hypurna'; R18763–64, 1 km NNE Iron Duke; R18768, 1 km W Iron Duke; R17458, Wilpena Motel; R22301, 2 km E Ooldea; R24297, S of 'Kolendo' H.S.; R24863, nr 'Oraparinna' H.S.; R25515–17, R25535, R25731, Danggali Conservation Park nr 'Canopus'; R28495, 118 km NE Minnipa; R28568, 73 km N Minnipa; R29090, Bowman Park Reserve; R31361–62, Iron Duke; R31949, S Inila Rock Waters; R32137, 9.7 km SSW Maralinga; R33795, 12 km SSE Dulingari Oil and Gas Satellite; R33803, Toolachie Gas Satellite; WAM R36649, 43 km NE Maralinga; R44362, 34 mi. NW Mt Lindsay, Birksgate Range.

Victoria: see Shea (1987b).

Western Australia: AM R86501–02, 2.5 km SW Condun Well; R96116, 150 km SW Giles Meteorological Station on road to Warburton; R105791, 36.1 km N Widgiemooltha Roadhouse on Coolgardie Hwy; SAM R12674, Warburton Range; WAM R18551, Queen Victoria Spring; R21073, 33 km W Carnegie; R26503, 35 km NE Yuna; R28359, 16 km N Ethel Creek; R45243, 28 mi. N Windy Corner; R45811, Wallal; R45850, 8 mi. S of H.S., Dirk Hartog I.; R46043, 91 mi. E McLarty Hills: R47709, Northampton; R48184–88, R48261, R48270, East Yuna Nature Reserve, 30 km SE Yuna; R51722, 2 km SW Barradale; R53255–56, Ivor Rocks; R53277, 75 km N Kalgoorlie; R53291, 27 km NE 'White Cliffs' H.S.; R53459–60, Newman Rock; R53760, R94585, Mt Bruce, Marandoo; R54556, 25 km S Denham; R57087–88, R57093, 3 km N Cape Ransonnet, Dirk Hartog I.; R57094, 5 km N Cape Ransonnet, Dirk Hartog I.; R57522, 40 km NE Yuna; R57541, 44 km NE Yuna; R57959, R58072, 4 km E Boingaring Rocks; R59854–55, 17 km N Charlina Rock; R62822, 22 km SE Mt Keith; R63427, Twin Heads; R63632, 19.5 km SE Mt Meharry; R64703, Balgo Mission; R64715, Marandoo; R64754–55, Mt Manning Range; R64794, R64813–14, Blue Hill, Lake Barlee; R65367, R65463, R65484, 30 km NW Heartbreak Ridge; R65531, R65569–70, R65654, R72503, R74557, R74597, 3.5 km SW Buningonia Spring; R65539, R65590, R74591, 1.5 km SE

Buningonia Spring; R67188, 15 km NE Bungalbin Hill; R67974, Ramona Well, 35 km 164° Dandaraga; R69080, R69104, R74658, 8.7 km ENE 'Yuinmery' H.S.; R69108, 8.0 km ENE 'Yuinmery' H.S.; R69288, 12.5 km SSE 'Banjiwarn' H.S.; R70876-77, 2 km N Mt Windarra; R70893, 1 km 45° Yowie Rockhole; R71775, 32.5 km 182° Woolgangie rail siding; R72248, R72255-56, R72285-86, R72291, nr Boorabbin; R72537, 3.0 km SW Buningonia Spring; R72669, 2.5 km NE Comet Vale; R72728, 3.5 km NE Comet Vale; R73212, R73228-29, 6 km 78° Yowie Rockhole; R73630, Ophthalmia Range area; R74677, R74679, 24 km ENE 'Yuinmery'; R74784, 9.5 km SSE Banjiwarn; R75559, East Yuna Nature Reserve; R76121, 16 km SSW Mt Jackson Hill; R76645, 3 km SE 'Gnaraloo' H.S.; R76742, 5 km SE 'Gnaraloo' H.S.; R78548, 30 km SSE Mt Keith; R78553, 29 km SE Mt Keith; R78680, 5 km W Mt Manning Range (S.E. Peak); R78688, 4 km W Mt Manning Range (S.E. Peak); R78689, 12 km W Mt Manning Range (S.E. Peak); R85094, 11 km NNW 'Uaroo' H.S.; R85305, 4 km ESE Big Shot Bore; R85600-01, R85603-04, 39 km E Laverton; R85605-06, 8 km WNW Pt Salvation; R86658, 37 km S Agnew; R90291, 9 km ENE 'Yuinmery' H.S.; R91510, 4 km E Zanthus; R94077, 53 km NNE Queen Victoria Spring; R97262, Queen Victoria Spring National Park; R97303, 23 km ENE Yuna; R99603, R99759, Mt Lawrence Wells; R99654, 9 km NNE Mt Lawrence Wells.
No data: BMNH 1966.5.

Delma fraseri Gray, 1831a: 14.

i. The identity of *Delma fraseri*

Delma fraseri was described by Gray in two works published in the same year (Gray 1831a,b). Kluge (1974) discussed the priority of these two works, and considered Gray (1831a) to be the earlier description. This conclusion was later followed by Cogger *et al.* (1983). Gray (1831a) did not state the number of specimens on which he based his description, although the single set of measurements and lack of any variation suggest that only a single specimen was before him at the time. At least one specimen was in the British Museum collection (Gray 1831b). Ten years later, Gray (1841) provided an illustration of *D. fraseri.* Still later, in his catalogue of the lizards in the British Museum, Gray (1845) lists two specimens, one adult from Western Australia presented by James Hunter (presumably the type) and a half-grown specimen from Western Australia from Gilbert's collection (presumably the naturalist John Gilbert). Boulenger (1885) in the second catalogue of British Museum lizards, lists two halfgrown syntypes, both from 'W. Australia', presented by J. Hunter, but no Gilbert specimen.

In restricting the name *D. fraseri* to a south-western species, Kluge (1974) used three characters from Gray's (1831a) description (two pairs of supranasals [presumably based on Gray's description of 'head . . . covered with four pair and three odd central plates'], three preanals, and banded head and neck) and two characters from Gray's (1841) illustration (dark throat markings, and fourth supralabial in subocular position), but did not examine the purported syntypes.

I have examined both specimens (now BMNH 1946.8.26.98-99). The former specimen is clearly that illustrated by Gray (1841), although the illustration is reversed. This juvenile specimen is conspecific with *Delma fraseri* (*sensu* Kluge). However, it is not the specimen measured by Gray (1831a), having SVL 52 mm and tail length 135 mm (*vs* '2 inches, 8 lines' [= 68 mm] and '3 inches 8 lines' [= 93 mm]). The second specimen, almost broken at midbody, has more similar but slightly greater measurements (SVL 71 mm; tail length 97 mm) to those given by Gray (1831a). This specimen, however, is conspecific with *D. borea* Kluge, 1974. No other *Delma* specimen currently in the British Museum (Natural History) is of suitable age to be a potential type.

The morphological characters provided by Gray (1831a) apply equally to *D. borea* and *D. fraseri* (*sensu* Kluge), as well as to several other *Delma* species. The description of the head and neck markings is ambiguous, and different interpretations could fit either species.

Gray's (1831a) description reads (in part): 'head and lips black, with four narrow cross lines, one between the nostril and the eyes, two just behind the eyes, the third broader over the eyes, and the last edging the occiput'. Presumably the 'four narrow cross lines' are pale bands on the black ground (Gray 1831b). Both *D. borea* and *D. fraseri* (*sensu* Kluge) have a preocular band ('between the nostril and the eyes' and presumably the first of the four cross-lines). If 'two just behind the eyes' is interpreted as a dorsally broken postocular band, the description fits *D. fraseri* (*sensu* Kluge), not *D. borea,* which has a complete postocular band. However, the position of the third band is then difficult to interpret. If 'two just behind the eyes' is interpreted as the successive second and third bands, these must be complete postocular and auricular bands, and the last band must be the pale edging to the dark nape patch, agreeing with *D. borea* and not *D. fraseri* (*sensu* Kluge), although the third band is again problematic, over the ears, not the eyes.

The 'discoverer' of *D. fraseri,* James Hunter, may be the James Hunter who was one of the naturalists on P. P. King's 1818-1822 survey of the Australian coast. This voyage visited both the south-west and north coasts of the continent, and could equally have collected either species. John Gilbert, the other collector later listed by Gray (1845), also visited both areas.

As the original description does not allow definite identification of the species, and as the type status of neither purported 'syntype' is clear (neither accurately fits the single set of measurements, and their registration history has varied), I act to conserve the usage of Kluge (1974) and all subsequent authors by designating BMNH 1946.8.26.98, the specimen illustrated by Gray (1841), as neotype of *Delma fraseri* Gray, 1831a. This specimen has the following combination of characters: two pairs of supranasals, seven supralabials (fourth subocular), 7/6 infralabials, 5/4 loreals, 4/5 suboculars, two upper temporals, 15 nuchal scales, 14 gular scales, 16 midbody scales, three preanal scales and 73 ventral scales (caudal 56 transversely enlarged).

ii. A new subspecies of *Delma fraseri*

Kluge (1974) identified three South Australian specimens as *D. fraseri*, otherwise only known from south-western Western Australia, but did not note any significant differences between two of the eastern specimens and the western population. However, additional material of the eastern population now in hand has shown consistent differences between the two populations in number of midbody scales and strength of the throat markings, and extended the known range of the eastern form into Western Australia. Consequently, the eastern form is here given subspecific status.

Delma fraseri petersoni subsp. nov.
Figs 5–7

Holotype: SAM R20804, N end stock route (32°51′S 135°57′E), S.A., Nature Conservation Society, 13.x.81

Paratypes (11): SAM R3853, 15 mi. N Poochera, S.A., F. J. Mitchell, 15.vi.56; R10586, same locality, F. J. Mitchell, vi.56; R14985, 7 km W Immarna rail siding, S.A., C. and T. Houston, A. Edwards, J. Herridge, 7–9.xi.75; R20790, 2.5 km down stock route (32°53′S 135°57′E), S.A., Nature Conservation Society, 8.x.81; R20816, N end stock route (32°51′S 135°57′E), S.A., Nature Conservation Society, 11.x.81; R32259, Scrubby Peak area, S.A., G. Armstrong, 22.i.88; R32463, Middleback Ranges, S.A., South Australian Herpetology Group, 26.vi.87; R33681, Iron Duke, Middleback Ranges, S.A., G. Johnston, xi.81; WAM R100636, 20 km NNE Queen Victoria Spring, W.A., D. Pearson, 18.vi.87; R100930, 25 km NNE Queen Victoria Spring, W.A., D. Pearson, 21.i.89; R100964, Jumpbuck Rd, Plumridge Lakes, W.A., D. J. Pearson, 17.x.86.

Diagnosis

A large *Delma* (SVL up to 128.5 mm) differing from all other *Delma* in the combination of two pairs of supranasal scales, a dark head dorsally and laterally followed by a broad, dark nape patch (both reduced in intensity in adults), broad dark throat bands, a mode of 18 midbody scales, and 67–78 ventral scales.

Description

Rostral broadly projecting between rostral supranasals, apex gabled; rostral supranasal in broad contact with first supralabial; caudal supranasals present, in point to moderate contact with nostril; postnasal distinct, single; loreals 3–5 ($\bar{x}$ = 4.1, SD = 0.45, n = 24), usually 4 (79%), in single, unbroken series; preoculars 6–13 ($\bar{x}$ = 8.3, SD = 1.82, n = 23); suboculars 3–5 ($\bar{x}$ = 3.7, SD = 0.58, n = 21), usually subequal; supraciliaries 5–7 ($\bar{x}$ = 5.3, SD = 0.55, n = 24), usually 5 (75%), caudalmost large, medial to others; supraoculars two, first longer; supralabials usually 7 bilaterally with fourth below centre of eye (n = 11), rarely 8 unilaterally with fifth below centre of eye (n = 1); infralabials 6–9 ($\bar{x}$ = 7.0, SD = 0.62, n = 24), usually 7 (75%), first pair in contact on ventral midline, second pair separated; upper temporals two; occipital present, single; nuchal scales 15–17 ($\bar{x}$ = 15.8, SD = 0.72, n = 12); gular scales 15–18 ($\bar{x}$ = 16.7, SD = 0.98, n = 12).

Midbody scales usually 18 (n = 11), rarely 17 (n = 1); ventral scales 67–78 ($\bar{x}$ = 72.0, SD = 3.30, n = 12), cranial 14–18 ($\bar{x}$ = 15.9, SD = 1.24, n = 12) small, caudal 52–61 ($\bar{x}$ = 56.1, SD = 2.68, n = 12) transversely enlarged; preanal scales three; hindlimb scales 2–4 ($\bar{x}$ = 3.3, SD = 0.61, n = 24).

Snout-vent length 78–128.5 mm; tail length 264–317% of SVL (n = 4); hindlimb length 2.5–4.0% of SVL ($\bar{x}$ = 3.1, n = 12); head length (HL) 10.1–13.2% of SVL (n = 12), proportionally shorter in adults; head width 57.0–70.7% of HL ($\bar{x}$ = 64.6%, n = 12); head depth 42.0–55.3% of HL ($\bar{x}$ = 49.5%, n = 12); mouth length 81.4–89.1% of HL ($\bar{x}$ = 85.6%, n = 12); snout length 38.4–44.6% of HL ($\bar{x}$ = 40.1%, n = 12); eye diameter 11.5–14.3% of HL ($\bar{x}$ = 13.1%, n = 11); postorbital length 38.0–43.4% of HL ($\bar{x}$ = 41.1%, n = 11); rostral depth 11.4–14.3% of HL ($\bar{x}$ = 12.8%, n = 12); rostral width 20.2–24.4% of HL ($\bar{x}$ = 21.9%, n = 12); dorsal rostral length 6.9–9.6% of HL ($\bar{x}$ = 8.1%, n = 12); ventral rostral length 8.9–14.0% of HL ($\bar{x}$ = 10.4%, n = 12).

The holotype has the following combination of character states: caudal supranasal narrowly contacting nostril; four loreals; 8/7 preoculars, four suboculars, seven infralabials, 17 nuchals, 16 gulars, 67 ventrals (caudal 52 dilated), SVL 85 mm, TL 269 mm, HLL 2.7 mm, HL 11.2 mm, HW 7.2 mm, HD 5.1 mm.

Coloration (in preservative)

Body dorsally and laterally light grey-brown, often with slightly darker centres and lighter margins to scales, producing a series of narrow alternating light and dark stripes. Tail dorsum concolorous with body basally, yellow-brown distally. Head dorsally darker grey-brown from tip of snout to just caudal to parietals, and laterally touching rostroventral angle of ear, the caudal margin generally marked by small, irregular black patches. Dark hood followed by a light cream-brown or yellow-brown band, 3–4 scales wide, laterally crossing ear, in turn followed by a light to mid-grey nuchal band about 7–8 scales wide, touching caudodorsal angle of ear, with caudal edge convex, and cranial edge marked by small, irregular black patches. Body immediately caudal to dark nuchal band pale yellow-brown.

Dark cephalic hood invaded laterally by extensions of throat ground colour: an obscure

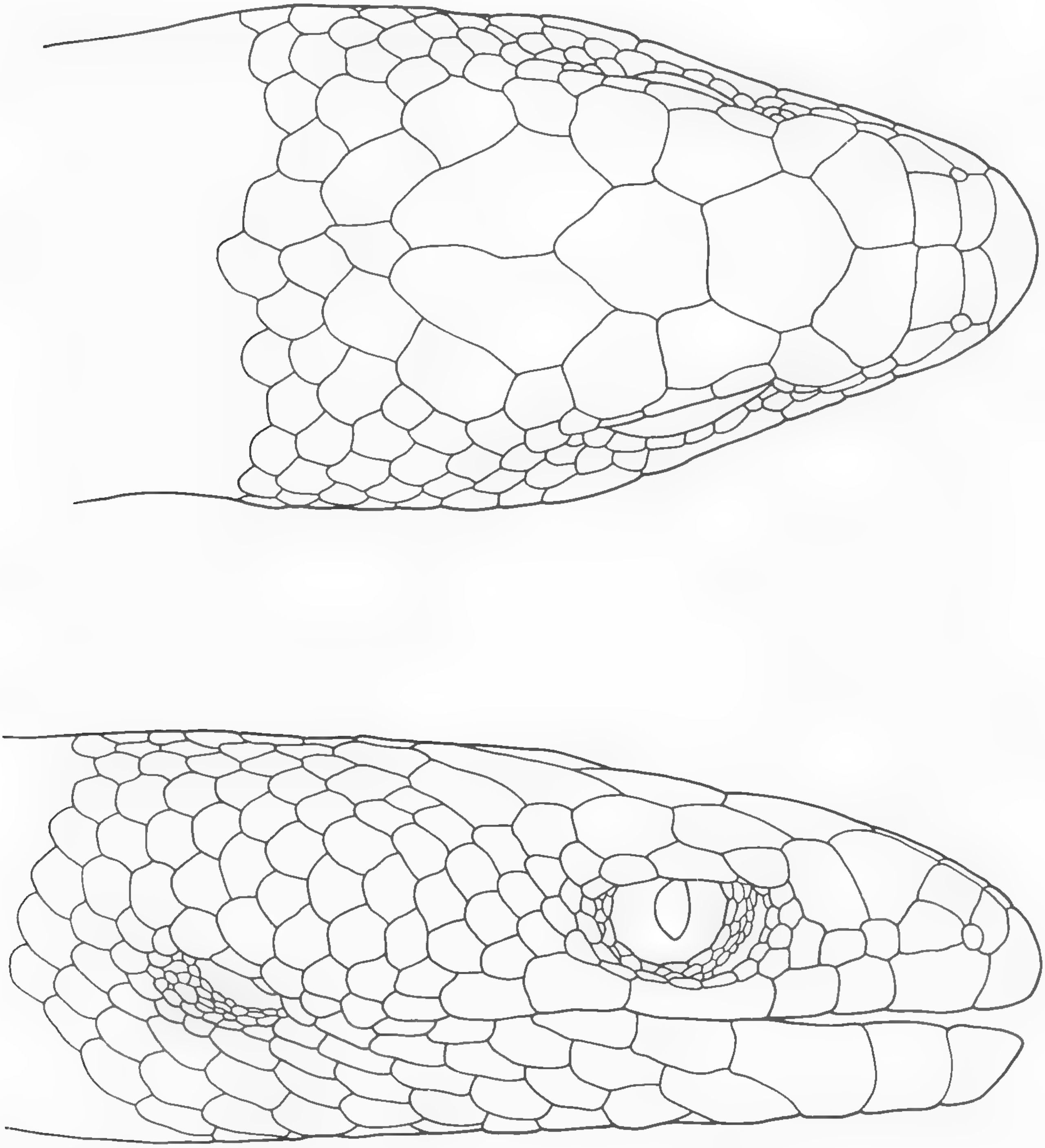

FIGURE 5. Dorsal and lateral views of head of holotype of *Delma fraseri petersoni*.

cream preocular bar and a broad triangular cream postocular bar. Laterally, dark nuchal band passes rostroventrally, narrowing ventrally, and is followed caudally by a broad triangular cream to orange-brown patch. Lateral ground on body and tail grades evenly into ventral ground.

Throat and chin cream, with dark grey bands, 2–3 scales wide, continuations of dark dorsal hood at level of orbit, rostral to level of ear, and caudal to level of ear, followed by one or two irregular bands not connected to dark dorsal markings. Dark bands often with irregular darker grey or black margins. First few infralabials usually with dark margins.

Body venter cream with grey margins to scales. Over caudal part of body and proximal part of tail, this grey perfusion almost completely covers the scales. Distal part of tail cream, generally immaculate.

Juveniles with similar pattern, but dark head markings solid black.

Distribution

Southern fringe of the Great Victoria Desert, and its extension eastwards to northern Eyre Peninsula and Middleback Range.

Comparison with other taxa

Delma f. petersoni differs from the nominate race in possessing a mode of 18 midbody scales (*vs* 16), and in having a strongly banded throat pattern. The throat pattern in adults of the nominate race consists of fine irregular dark variegations extending onto the throat from laterally (Fig. 6), unlike the broad complete bands of *D. f. petersoni.* Juvenile *D. f. fraseri* have stronger throat markings, often approaching those of adult *D. f. petersoni,* but the throat pattern of juvenile *D. f. petersoni* is even stronger, broad and evenly dark.

For comparative purposes, all material of the nominate race in the Australian Museum, British Museum (Natural History) and South Australian Museum was examined, together with Western Australian Museum material from the eastern extremity of the range. Comparative scale counts for this material in markedly variable characters were: loreals 3–6 ($\bar{x}$ = 4.1, SD = 0.50, n = 140), usually 4 (78%); preoculars 3–9 ($\bar{x}$ = 5.8, SD = 1.16, n = 136); suboculars 1–6 ($\bar{x}$ = 3.4, SD = 0.68, n = 136); supralabials usually 7, with fourth subocular bilaterally (n = 68), rarely 6 with third unilaterally (n = 1) or 8 with fifth unilaterally (n = 1); infralabials 6–8 ($\bar{x}$ = 7.0, SD = 0.44, n = 140); nuchals 12–17, ($\bar{x}$ = 14.1, SD = 0.93, n = 70); gulars 14–18 ($\bar{x}$ = 16.0, SD = 0.91, n = 70); ventrals 67–75 ($\bar{x}$ =71.1, SD = 2.09, n = 67); transversely enlarged ventrals 50–58 ($\bar{x}$ = 54.5, SD = 1.91, n = 50); midbody scales 15 (n = 1), 16 (n = 66), 17 (n = 1) or 20 (n = 1).

The distance between the easternmost records of *D. f. fraseri* and westernmost records of *D. f. petersoni* is approximately 235 km. The two races appear to differ in habitat preference, *D. f. petersoni* inhabiting mallee-*Triodia* habitats (see below), while *D. f. fraseri* inhabits a variety of less arid habitats, including woodland, heath and coastal dune complexes (Bush 1981; Chapman & Dell 1977, 1978, 1980a,b, 1985; Dell & Chapman 1977, 1978; Dell & Harold 1977; Storr *et al.* 1981).

Only three other *Delma* have a mode of 18 midbody scales: *D. australis, D. elegans* and *D. molleri. D. f. petersoni* is very much larger than *D. australis* (maximum SVL 128.5 mm *vs* 88 mm), and has two pairs of supranasals (*vs* one), loreal scale row uninterrupted (*vs* usually interrupted by prefrontal), ventral body scales transversely enlarged (*vs* equal in size to more lateral scales) and a broadly banded head pattern (*vs* finely variegated).

D. f. petersoni differs from *D. elegans* in having 67–78 ventral scales (*vs* 77–82), a broader snout, and the pale auricular band passing transversely across the entire width of the ear (*vs* angled obliquely along rostrodorsal margin of ear, and entirely separated from a second, postauricular pale bar extending dorsally from the throat to the caudoventral margin of the ear).

D. f. petersoni differs from *D. molleri* in attaining a larger size (maximum SVL 128.5 mm *vs* 111 mm), and in having two pairs of supranasals (*vs* one) and a strongly banded throat (*vs* immaculate pale throat).

The known distribution of *D. f. petersoni* overlaps those of only two other species of *Delma: D. australis* and *D. butleri,* all three having been taken at 15 mi. N. Poochera, S.A. Comparison with *D. australis* is made above. *D. f. petersoni* differs from *D. butleri* in having 18 midbody scales (*vs* usually 16), and a dark head (*vs* head concolorous with body) with strongly banded throat (*vs* immaculate pale throat).

Habitat

The limited habitat data associated with specimens suggests that *D. fraseri petersoni* is associated with *Triodia* habitats (Schwaner *et al.* 1985). The holotype was collected in a pitfall trap on a sand dune with spinifex and some *Callitris;* SAM R20816 in a pitfall in a dune system with *Triodia* and mallee; SAM R20790 in a pitfall in sandy soil with *Triodia* on the lower part of a dune slope, while SAM R14985 was taken from *Triodia* in an interdune flat with mallee. In Western Australia, WAM R100636 was taken from *Eucalyptus concinna* mallee over *Triodia basedowii,* and R100930 from marble gum woodland over *Triodia basedowii* on a yellow sandplain.

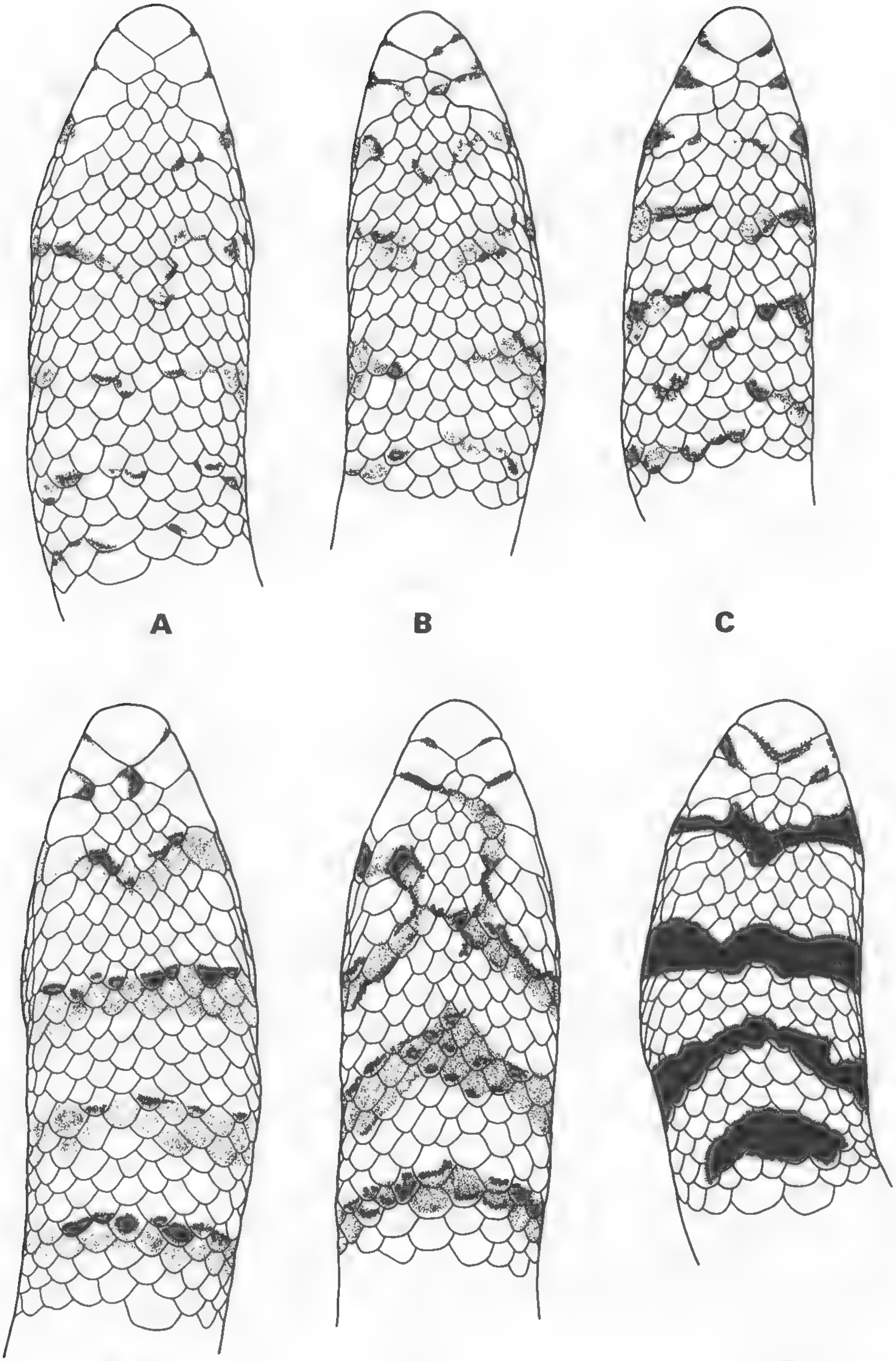

FIGURE 6. Comparison of throat patterns of *Delma f. fraseri* (A. AM R11115; B. AM R11651; C. AM R81700) and *D. f. petersoni* (D. SAM R14985; E. SAM R20790; F. SAM R33681).

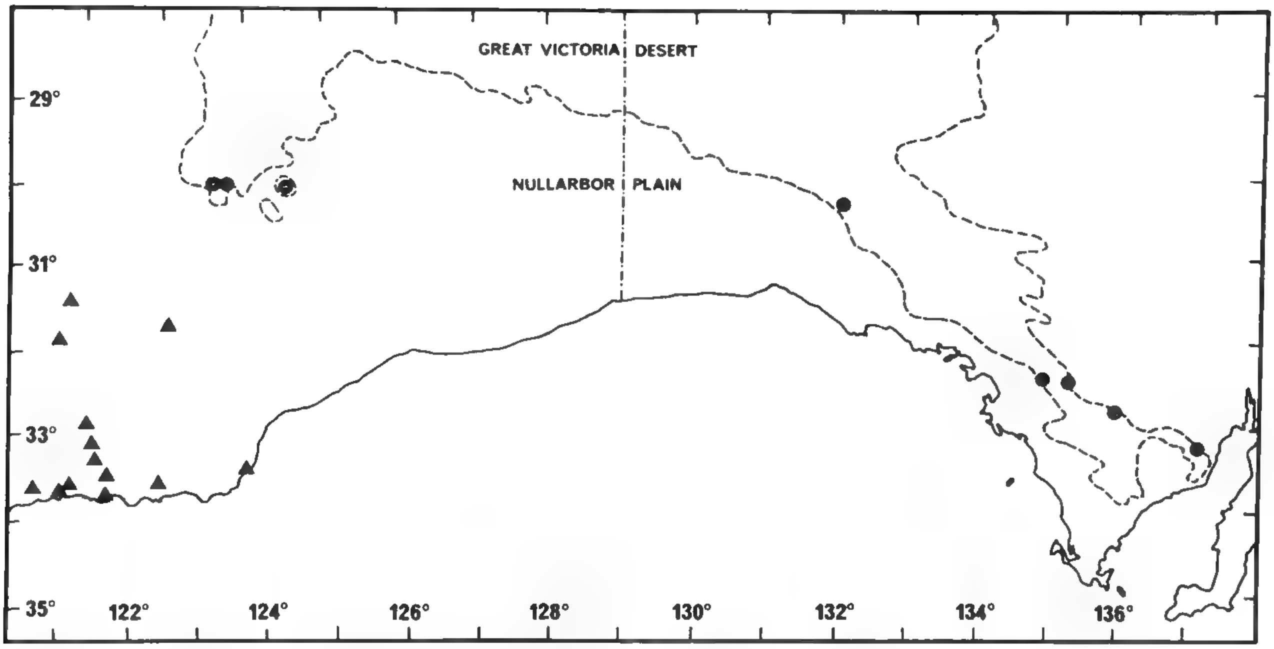

FIGURE 7. Distribution of *Delma fraseri petersoni* (dots) and nearest populations of *D. f. fraseri* (triangles). Dashed line represents approximate limit of sandridge systems of the Great Victoria Desert.

Etymology

Named for Magnus Peterson, of Perth, W.A., who initally prompted my interest in pygopodids, and who has continued to offer much discussion on their systematics and natural history.

Remarks

Although Kluge (1974) identified MV D2659 as *D. fraseri*, it agrees in all diagnostic characters with *D. butleri*, and lacks any trace of the dark head markings of *D. fraseri*. Consequently, I correct Kluge's identification of this specimen to *D. butleri*.

Comparative material of D. f. fraseri *examined* (all from Western Australia)

AM R2443-44, R2446, 'Perth, *etc.*'; R3436, Canning River, Darling Range; R9890, R9956, R10005, R11649-51, R11665, R131829-32, Tambellup; R11111-2, R11115, R12129-32, R131833, Woodlands, Tambellup; R81698, Esperance tip; R81699-700, 1.2 km E Ravensthorpe; R114824, Hopetoun; R131834, no locality; R133847, Esperance Chalet Village, end of Goldfields rd, NE Esperance; R133914, R133989-90, R134036, R134064, R134080, R134369, old rubbish tip just E Salmon Gums; R134273, SW side Grass Patch; R134372, vicinity of Scadden; BMNH 67.2.19.28,30, Champion Bay; 97.3.23.3, 1931.7.1.104-107, W.A.; 69.5.25.24-25, 69.5.25.29, Perth; 1966.411-412, Victoria Park; 1966.413, Bunbury; 1966.414, Wandering; 1966.416, Williams; 1966.417, Bengor; 1966.419, Nungarin; SAM R22828, WAM R75860-61, Lort River, Coomalbidgup; SAM R22911, Coomalbidgup tip; R22935, Burns Beach; R23258, 1 km N Wagin; R29406, 21 km N Geraldton; R29511-12, WAM R14786, Esperance; WAM R7463, Bodallin; R21993, 8 km E Gibson; R29660, Parker Range area; R29661-62, 43 km S Southern Cross; R31089, R31113, R66885, R67208, R67213, R93330-31, Israelite Bay; R36235-36, Munglinup; R37832, Split Rocks; R71179, North Ironcap; R72354, near Heartbreak Ridge; R86622, R86679, Lort River Station; R93557, Widgiemooltha; R95553, Condingup.

Delma impar (Fischer, 1882: 287).

Diagnosis

A moderate-sized species of *Delma* (SVL up to 101 mm) with single pair of supranasals, fused rostrally with first supralabial and caudally with postnasal, two preanal scales, and usually with a series of distinct narrow pale stripes laterally and dorsolaterally on body and tail, with series of dark spots between these stripes.

Description

See Kluge (1974).

Distribution

In South Australia, known only from the south-eastern border area (Fig. 8). The South Australian localities are at the western extreme of the distribution in Victoria and south-eastern N.S.W. (Kluge 1974).

Remarks

Kluge (1974) differentiated this species from other *Delma* primarily on the fusion of the supranasal to the first supralabial, a character not noted for any other *Delma*. However, two specimens of *D. plebeia* I have examined (AM R12485, Qld; R98656, 5 km N Bulga, N.S.W.) show the same complex fusion of supranasal to both first supralabial and postnasal. These two species, together with *D. torquata*, share the derived character state of only two preanal scales, and may constitute a species group, the *D. impar* group, occurring in south-eastern Australia, especially in basaltic soils.

Specimens examined

Australian Capital Territory: AM R14349, Barton; R31621, Gungahlin.
New South Wales: AM R9639, nr Tumut; R11245, Gilmore; R64276, 14.5 km N Batlow at Wondalga (off old Tumbarumba rd).
South Australia: SAM R8387, R9977, R10060-61, R10715-22, R11143, R12666-68, Bool Lagoon; R8782, 3 mi. E Naracoorte.
Victoria: AM R8777, Mt Hope; BMNH 98.10.19.7, nr Melbourne.

Delma inornata Kluge, 1974: 101.

Diagnosis

A large species of *Delma* (SVL up to 135 mm) with modally 16 midbody scales, 1-2 pairs of supranasals, caudal pair (when present) moderately to broadly separated from nostril, and no dark head or throat markings.

Description

See Kluge (1974) and Shea (1987b).

Distribution

In South Australia, apparently restricted to the vicinity of Lake Alexandrina and the lower reaches of the Murray River (Fig. 8). Widespread in Victoria, N.S.W., and south-eastern Queensland (Shea 1987b).

Remarks

As noted by Shea (1987b), Kluge misidentified a number of specimens of *D. butleri* as *D. inornata*. To those misidentifications can also be added MV D15453-54, from Renmark (J. Coventry, *pers. comm.*). It seems likely that the South Australian population is isolated from the main part of the range of this species in N.S.W. and Victoria. The South Australian population has a high frequency of individuals with only a single pair of supranasals (78%, n = 9).

Habitat

Three specimens (R21001, R23870, R26138) were found under rocks. It is probable that the South Australian population inhabits open grasslands, like eastern populations (Shea 1987b).

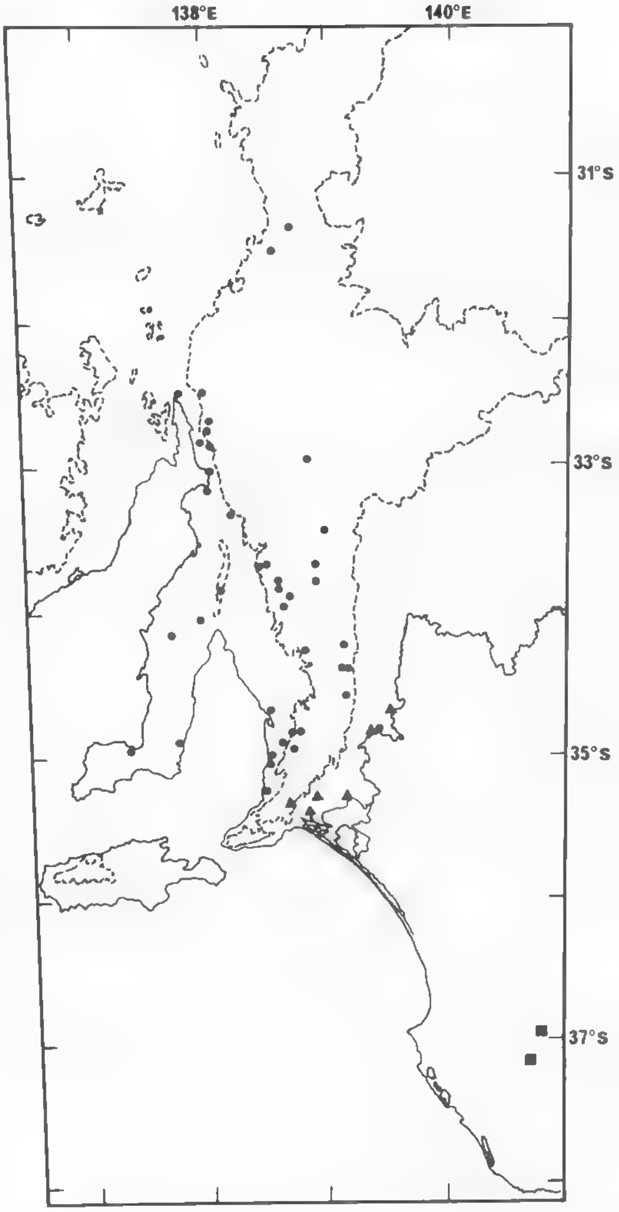

FIGURE 8. Distribution of *Delma impar* (squares), *D. inornata* (triangles) and *D. molleri* (dots) in South Australia. Dashed line represents 200 m contour.

Specimens examined

New South Wales: SAM R11095, 20 mi. N Walla Walla. See Shea (1987b) for other records from New South Wales and Victoria.
South Australia: SAM R12745, Tooperang; R17440, between Mannum and Purnong; R18648, 5 km N Walkers Flat; R18971, *ca* 16 km W Milang; R21001, River Marne; R23530, R23870, R26138, Lake Alexandrina; R32798, Strathalbyn.

Delma molleri Lütken, 1863: 296.

Diagnosis

A moderate-sized species of *Delma* (SVL up to 111 mm) with modally 18 midbody scales, a single pair of supranasals, dark dorsal head markings (of reduced intensity in large adults) and an immaculate pale throat.

Description

See Kluge (1974).

Distribution

Restricted to South Australia, to the Adelaide Plains and Yorke Peninsula and adjacent ranges, from the vicinity of Oraparinna H.S. in the north, east to 'between Mannum and Purnong' and south to Reynella (Fig. 8). The record from Hattah, in Victoria (AM R84295–96) is from a captive collection, along with other *Delma* specimens, and in the absence of any corroborating evidence is considered erroneous.

Habitat

Most specimens of this species for which data are available were found under rocks (n = 17), tin or other rubbish (n = 11) or timber (n = 2). A variety of vegetation types and topographies is inhabited, including 'sclerophyll scrub', 'tall grass in agricultural country', 'largely bare hills with occasional chenopods and mallees', '*Acacia*-scrub covered hilltop', 'eucalypt woodland on red soil with stones and sedges, scattered *Casuarina* and *Acacia* in understory', 'grass and rocky land adjacent creek', 'grassed sediment island in creek' and 'river flats'. Three of the Flinders Ranges specimens were taken in pitfalls in *Triodia* habitats.

Specimens examined (all localities except the first are in South Australia)

AM R84295–96, Hattah, Victoria [in error]; R89125, Peterborough; R115770, 3.3 mi. W Kulpara on Paskeville rd; R115813, 34°11′S 137°41′E, Yorke Peninsula; R115928, 2.5 mi. W 'Tracy'-'Caroona' rd on Mt Bryan rd; R115939–40, 4.2 km NW Mintaro on Hilltown rd; R115943–44, 33°40′S 138°30′E; BMNH 92.5.18.1, S.A.; 1923.11.11.47, SAM R1470, R12672–73, Mt Lofty; BMNH 1962.810, Morialta; 1962.811, Clare; SAM R1584, R16056, Black Hill; R2233, Mt Lofty Range; R3021, Dunstone Quarry, Burnside; R6362–70, few miles N Burra; R8140, Hummock Mt; R11186–87, 1 mi. NE Tea Tree Gully; R12514–15, N of Wilmington, on towards Mt Brown; R12550, 4 mi. E 1 mi. N Truro; R12591, 2.5 mi. S 2.5 mi. W Stansbury; R12624, R12671, Point Turton; R12918, Mambray Creek; R13150, Seacombe Gardens; R14028, Mambray Creek National Park; R14462, Mt Brown; R14656a–b, 26.5 km N 5 km E Burra; R15625a–b, 3 km E Truro; R16006, nr Port Augusta, on old Port Augusta-Wilmington rd; R16952, *ca* 5 km S Wilmington; R16954, Mt Remarkable National Park; R17464, Hallet Cove Conservation Park; R17642, between Mannum and Purnong; R17943, R25360, Wilpena Pound; R18856, 6 km SE Keyneton, nr Sedan Hill; R19018, 5 km N Clare; R20581, Burra Creek Picnic Reserve; R20825, 8 km N Auburn; R22539–40, Telowie Beach; R22787, R23088, R23106, Mt Remarkable National Park, 2.1 km E Sugargum Lookout; R23136–37, R23139, R23144, Mt Remarkable National Park, 2.6 km from Scarfe's Hut; R23143, Mt Remarkable National Park, Alligator Gorge; R23894, St Kilda; R24200, 14 km S Burra; R24208–10, 11.2 km N Dutton; R24211–14, 1 km S Burra; R24862, nr Oraparinna HS; R25786–87, Reynella, R26121–22, Pt Pirie; R28362, R28628, Bowman Park Recreation Reserve; R30310–14, Rochester Historic Site; R31718, Aldinga; R32858, Para Hills; R32889, Anstey Hill.

Delma nasuta Kluge, 1974: 109.

Diagnosis

A moderate-sized species of *Delma* (SVL up to 112 mm) with usually 16 or more midbody scales, fourth supralabial below centre of eye, long narrow snout (Fig. 3), usually five or more loreals, dorsal scales pale brown with a dark apical spot, and ventral scales usually basally edged with dark brown.

Description

See Storr (1987) and Storr *et al.* (1990).

Distribution

Arid *Triodia* habitats of Northern Territory, south of Spring Creek, Barrow Creek and 'Fish River', and far north-west corner of South Australia (Fig. 9). Also occurs in western Queensland (Shea 1987a) and northern and central Western Australia (Storr 1987).

Habitat

Like other populations (Kluge 1974; Storr 1987), Northern Territory populations of *D. nasuta* are apparently *Triodia* inhabitants. The six specimens for which microhabitat data are available were found in *Triodia*. One specimen (AM R80364) was found active on a road at 2020 hrs.

Specimens examined

Northern Territory: AM R12013, Mt Gillen; R80364, 33 km S Barrow Creek; R84566, 50 km S Alice Springs on Stuart Hwy; R120116, Dead Bullock Plains, 'Tempe Downs'; R130666, 5 mi. W 'Narwietooma'; BMNH 1973.3286, Kintore Range (23°22′S 129°26′E) (formerly JSE 305); CAWC R10, Hermannsburg; R20, 'Fish River'; CAWC R301, NTM R1590, R1601, R1869, R1871–72, R1891, Maryvale; CAWC R764, Yuendemu Settlement; R919, 20°02′S 130°16′E, Tanami Desert; R1062, Bonney Creek, 'McLaren Creek'; R1322, Ayers Rock; R1463, 23°52′S 135°42′E, Simpson Desert; R1494, 'Todd River'; R1647, Trephina Gorge; R2003–05, R2013, 'Tempe Downs'; R2008–09, George Gill Range; R2010, Ooraminna; R2011–12, Mt Peachy; NTM R1593, 20 km N Maryvale;

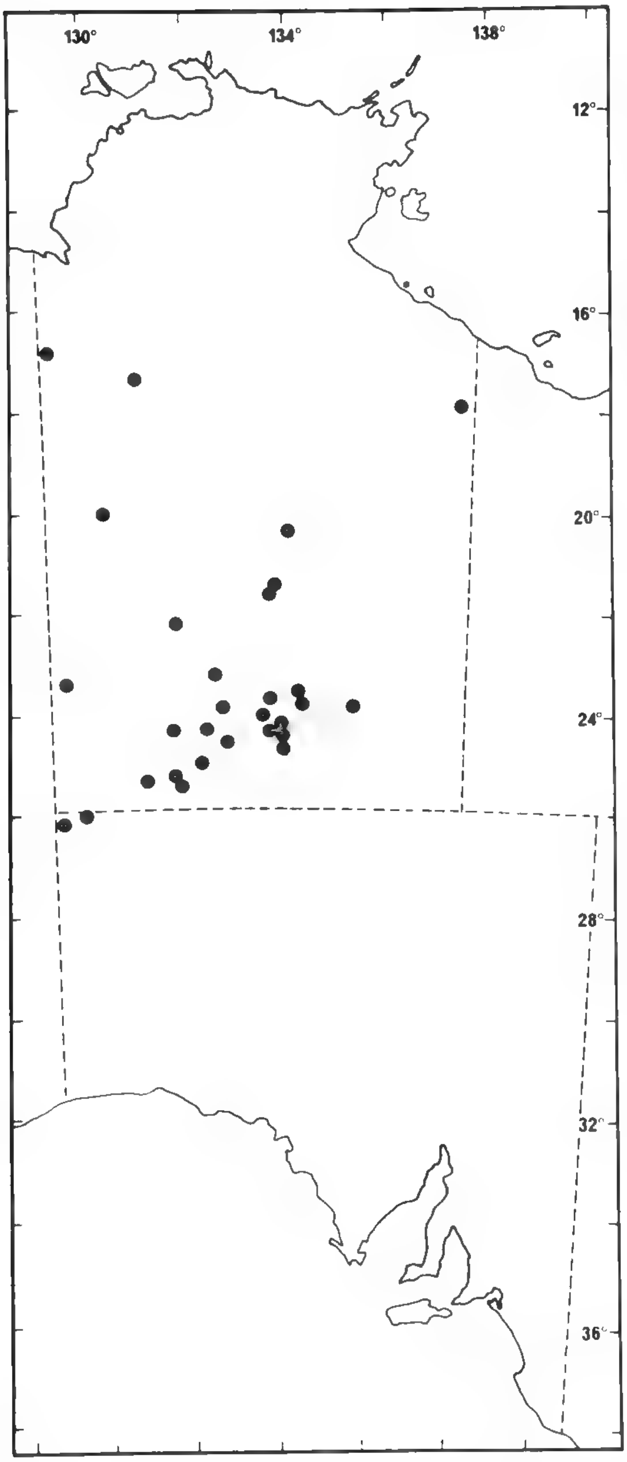

FIGURE 9. Distribution of *Delma nasuta* in the Northern Territory and South Australia.

R1621, 28.5 mi. S Alice Springs; R5568, SAM R18721, Alice Springs; NTM R5829, 'Wave Hill'; R6556, Barrow Creek; R12733-34, 'Tempe Downs', 25 km N Kings Canyon rd; SAM R29889, 7 km along 'Mulga Park' rd, SSE 'Curtin Springs' H.S.; R29940, 22 km along 'Mulga Park' rd, SSE 'Curtin Springs' H.S.; WAM R20816, 'Angas Downs'; R24354, 6 mi. SW Barrow Creek; R55348, R55398, 'Maryvale' H.S.; R60234-36, Spring Creek, 58 km N 'Wave Hill' H.S.

Queensland: AM R26010, Mt Isa; R49667, 193.7 km N Windorah; R110542, R110609, 14 km NE Scott's Tank, 'Diamantina Lakes'; R125040, between Mt Isa and 100 km to NW.
South Australia: AM R17310-15, R17376, R17646, R17939, Mt Davies, Tomkinson Range; R17535, Mann Range.
Western Australia: AM R105732-34, 28.3 km N 'Nanga' turnoff on Denham rd; R111132, SAM R13444, Wittenoom Gorge; CAWC R452, Balgo Mission; R1429, Giles Meteorological Station; NTM R6664, Nicholson River Gorge, 'Nicholson'; R6762, 16.3 km N Halls Creek; R7035-37, between Fitzroy Crossing and Halls Creek; R7282-85, 167 km E Fitzroy Crossing; SAM R12675, Warburton Range; R29375, 34 km S Denham; R29379, 24 km S Denham.

Delma tincta de Vis, 1888: 824.

Diagnosis

A small to moderate-sized species of *Delma* (maximum SVL 92 mm), with usually one pair of supranasals, third supralabial in subocular position, 14 midbody scales and, in juveniles and subadults at least, a dark head dorsally and laterally, with narrow pale bands (one preocular, one postocular, one auricular, one nuchal), but mid-throat region immaculate, pale.

Description

See Kluge (1974) and Storr *et al.* (1990).

Distribution

Southern two-thirds of Northern Territory, south of 'Wave Hill', Tennant Creek, 'Anthony Lagoon', Borroloola and 'Bing Bong', with possible isolates further north in the Katherine district (one specimen) and far northern coast (Yirrkala to Oenpelli, and possibly as far west as Humpty Doo). In South Australia, apparently restricted to the north-eastern quarter, extending south-west to 'Erudinna' (Fig. 2).

Also widespread in Queensland and northern N.S.W. (Shea 1987a) and central-west Western Australia and the Kimberley (Storr *et al.* 1990).

Remarks

Kluge (1974) reports widespread sympatry of *D. borea* and *D. tincta*. This does not appear to be the case in the Northern Territory or Queensland. Rather, they seem to have largely complementary distributions. In the Northern Territory, the two species have been collected in close proximity only at 'Wave Hill' (five *D. borea*) and old 'Wave Hill' (one *D. tincta*), in the Katherine district (three *D. borea* from Katherine and district, one *D. tincta* from Katherine Farms rd and another from 'Katherine district'), at Humpty Doo (one *D. borea* and one *D. tincta*, the latter from 'Humpty Doo district'), and in the Alice Springs area (two *D. borea* from Heavitree Gap, one from Alice Springs, 35 *D. tincta* from Alice Springs). At Yirrkala, three specimens are typical *D. borea* in all three scalation characters, while one specimen has the single pair of supranasals and third supralabial subocular of *D. tincta,* but the 16 midbody scale rows of *D. borea,* the latter character only otherwise seen once in 111 Australian Museum *D. tincta.* Further collections are needed to determine whether this specimen is really *D. tincta,* or an aberrant *D. borea.* Only in the case of two specimens (NTM R3791-92) from 'Katherine district' have the two species been possibly collected synchrosympatrically.

The single record for Renmark (NTM R1166) is considered to be erroneous. The Renmark area is otherwise well-known herpetologically, and over 325 km south of the next nearest record.

Habitat

In the N.T. and S.A., specimens have been recorded under rubbish (n = 7), in leaf litter (n = 5), under dead *Triodia* (n = 2), under rock (n = 1) and in a disused ant nest under a rock (n = 1). Habitats included grassland (n = 3), mulga plain (n = 1), red soil plain (n = 1) and black soil plain (n = 1). Four specimens were found active on roads between 1915 and 2100 hrs, while one was active in long grass at 1300 hrs.

Specimens examined

New South Wales: AM R4123, Clarence River; R16683, R60469-72, Bingara; R18582, Croppa Creek; R32595, 'Harriearra', via Tibooburra; R44737, junction of Teatree Creek and Horton River, 30 km WSW Bingara; R51703, 13 mi. E Manilla on Retreat rd; R51704-05, 0.7 mi. S Woolomin; R63985, 2 mi. S Barraba; R64330, Yalleroi; R86219, 'The Brothers', North Star; R87537-45, Moonbi Lookout; R104309, Tamworth; R105969, Chunky Creek, 'Mt King'; R107713, Moree; R110672, nr Menindee; R118978, R129322, Manilla Tip.

Northern Territory: AM R11529, Plenty River; R12364, Yirrkala; R26398, nr Peterman Ranges, 61 mi. from W.A. border; R26477-78, R26499, vicinity of Finke; R31624, Smoke Hills, Tanami Desert; R50963, CAWC R11-17, R1070, R1350, R1561, R1805-06, R2232, R2341, R3021, R3124, R4806, R5448, R5889, R5909-10, NTM R531, R5558, R5563, R5567, R8621, Alice Springs; AM R52131-32, R52134, Greenleaves Caravan Park, Alice Springs; R52133, Alice Springs Airport; R54923, 65 km upstream from sea, Liverpool River; R54924, 20 km upstream from sea, Liverpool River; R55355, 'Bing Bong', via Borroloola; R80363, 20 km W Qld/N.T. border on Barkly Hwy; R80368, 29 km E Three Ways on Barkly Hwy; R84549, 25 km N Alice Springs on Stuart Hwy; R84565, Henbury Meteorite Reserve, 146 km N Kulgera on Stuart Hwy; CAWC R291, 10 km N Deep Well; R495, Borroloola; R502, NTM R6484-86, R8416-18, R8513, R8811, Frewena Roadhouse and vicinity; CAWC R622, 'Alexandria' H.S.; R1205, R1212, Maryvale; R1262, R1330, Simpsons Gap; R5909, St Phillips College, Alice Springs; NTM R101, Katherine Farms rd; R700, Railway Yards, Alice Springs; R910, Oenpelli; R1573-74, Tanami Bore; R1861, Mt Gillen; R2467, Bradshaw Drive, Alice Springs; R3679-80, 'Brunette Downs' H.S.; R3792, Katherine district; R5278, Telecom Building, Alice Springs; R5391, Mt Watt, *ca* 25 mi. NW 'Horse Shoe Bend'; R5392-93, Mt Sunday Range, 190 km S Alice Springs; R5742, Whycliffe Well; R6557, 10 km N Alice Springs; R6622, old 'Wave Hill' H.S.; R8544-51, R9557-64, Alroy Downs; R8557, 64 km N 'Alroy Downs'; R8604, 7 km N Three Ways; QM J21786, Humpty Doo district; J26982, MIM mine, MacArthur River; SAM R8062, Tennant Creek; WAM R55406-07, R55440, 71 km W Barry Caves; R78239, 70 km W Barry Caves.

Queensland: AM R2283, Bloomfield River, Cooktown; R5853, Oakey; R7003, R10237, R84394, Cooktown; R9361, 118 mi. N Rockhampton; R9453, Winton; R11653, Cunnamulla district; R12321, Proserpine; R13010, Hughenden; R13801, Townsville; R17028, Laura; R17080, Gregory Springs via Hughenden; R31628, R31631, Mt Isa district; R37484, 15 mi. from Proserpine on Shute Harbour rd; R12201-02, Brooklyn, Winton; R13714, Mungai Junction; R16347, R16684, R16686, 'Silver Plains'; R16671, Lappa Junction; R21131, Cunnamulla; R50209, 'Tullochard', 78 mi. SW Mitchell; R51524, Grassy Hill, Cooktown; R55612, R58482, 'Gilruth Plains'; R56816, 10 mi. S Gayndah; R60249, 1.6 km E Camooweal; R61577, Lizard Island; R62301, 80.1 km N Muttaburra on Hughenden rd; R62459-62, R62706, 62.4 km N Muttaburra on Hughenden rd; R62490-95, *ca* 23.7 km NW Aramac turnoff via Muttaburra rd; R63056, Clermont; R63110, WAM R21420-22, Charters Towers; AM R63333, Croydon Tip; R63431, just NE Karumba; R63574, 0.7 km S airport entrance via old Croydon rd; R63615-17, 8.1 km W Croydon rd; R63692, 23.9 km E Croydon P.O. via Gulf Hwy; R63714, Crooked Creek at Gulf Hwy, 34.5 km W Georgetown; R81701-02, 6.6 km SE Greenvale by rd; R81703, Charters Towers Tip; R81704, 25.2 km N Yeppoon via Byfield rd; R84404, 22.0 km S Townsville on hwy; R90213, 63 km W Winton on Boulia rd; R90214, 55 km SE Winton on Landsborough Hwy; R105152, Weipa regeneration area; R113228-29, Mayne Junction Bore, 'Diamantina Lakes'; R128219, R128857, Mandalee, Innot Hot Springs; BMNH 1924.3.3.22-26, 'Alice Downs', Blackall.

South Australia: NTM R1166, Renmark [in error]; SAM R14498, Flinders Ranges; R15189a-c, 'Erudinna'; R18254, R18262-63, R32453, Coongie Lake; R30970-71, 'Coongie'; R30976, 8 km SSE 'Coongie'; R31173, 27°12′S 140°08′E, Cooper Creek area.

Western Australia: AM R4939; R40529-30, NTM R13084, 3 mi. S main Ord River Dam; AM R100565, 26.9 km N Wittenoom-Newman rd via Port Hedland rd; NTM R9940-41, Wyndham.

No data: NTM R331, R2973, R9855-57.

A KEY TO THE *DELMA* OF SOUTH AUSTRALIA AND THE NORTHERN TERRITORY

1 — Ventral scales not transversely enlarged; loreal scale row usually interrupted by prefrontal scale.... .... *australis*

— Ventral scales transversely enlarged; loreal scale row complete, prefrontal separated from supralabials 2

2 — Single pair of supranasals, fused with first supralabial rostral to nostril and with postnasal caudal to nostril; two preanal scales.....*impar*

— First supralabial and postnasal distinct from supranasals; three preanal scales...........3

3 — Usually 14 midbody scales; third supralabial scale subocular; one pair of supranasals......*tincta*

— Usually 16 or more midbody scales; fourth supralabial scale subocular; one or two pairs of supranasals.............................4

4 — Upper temporal single; size small (SVL ≤98 mm); head dark (paler in large adults) with narrow light bands; throat pale, immaculate..........*borea*

— Upper temporals two or more; size small or large; head pale or dark; throat with or without dark variegations............................5

5 — Usually 18 midbody scales; head darker than body (contrast reduced in large adults)...........6

— Usually 16 midbody scales; head concolorous with body....................................7

6 — One pair of supranasals; throat immaculate..................................... *molleri*

— Two pairs of supranasals; throat with dark bands ....*fraseri petersoni*

7 — One or two pairs of supranasals; if two, caudal pair broadly separated from nostril.......*inornata*

— Two pairs of supranasals, caudal pair narrowly separated from nostril.....................8

8 — Snout long, narrow; colour pattern (when present) of dark spots dorsally and ventrally....*nasuta*

— Snout short; colour pattern (when present) of irregular complete or incomplete narrow pale bands over head...........................*butleri*

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‘LI-MARAMARANJA’ : YANYUWA HUNTERS OF MARINE ANIMALS IN THE SIR EDWARD PELLEW GROUP, NORTHERN TERRITORY

JOHN J. BRADLEY

Summary

For many generations the Yanyuwa people in the Gulf of Carpentaria have hunted dugong and sea-turtle. Despite external pressures the skills and traditions associated with hunting these marine creatures have survived. These traditions continue to provide a sense of pride within Yanyuwa society.

'LI-MARAMARANJA' : YANYUWA HUNTERS OF MARINE ANIMALS IN THE SIR EDWARD PELLEW GROUP, NORTHERN TERRITORY

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For many generations the Yanyuwa people in the Gulf of Carpentaria have hunted dugong and sea-turtle. Despite external pressures the skills and traditions associated with hunting these marine creatures have survived. These traditions continue to provide a sense of pride within Yanyuwa society.

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The Yanyuwa group of Aboriginal people who live in and around Borroloola, Northern Territory in the south-western Gulf of Carpentaria pride themselves on being hunters of dugong *(Dugong dugon)* and sea-turtle (usually the green turtle *Chelonia mydas*). This pride is based both on historical association and the continuing spiritual identification with these marine animals. In Yanyuwa society certain people are regarded as being *maramaranja,* a term which can be translated as 'a dugong and sea-turtle hunter of excellence'. As the following song verse suggests, it is a title of which individuals and their associated families are proud:

> Wirndalbirndal
> ngamabala-wada
> ndi-ngambala li-wurralngu
> li-Maramaranja.
>
> Long and strong
> is our hair,
> for we are inhabitants
> of the sea country:
> we are dugong hunters
> of excellence.
> (composer: Jack Baju 'Akarrunda')

The Yanyuwa hunt the dugong and sea-turtle in the shallow waters about the Sir Edward Pellew Group, the mouth of the Carrington Channel and the mouths of the McArthur, Crooked and Wearyan Rivers in the Northern Territory (see Fig. 1). It is in these shallow waters that various species of sea-grass are found. Both dugong and sea-turtle feed on sea-grass. The Yanyuwa classify the sea-grass into that which is eaten by the dugong and that which is eaten by the sea-turtle. In fact both animals eat sea-grass of the same *Halophila* species (Dr I. Poiner pers. comm.). The names given to sea-grass by the Yanyuwa are as follows: *maraman* and *ma-lhanngu,* which is said to be eaten by dugong, and *na-wirrilbirril* and *na-julangal* which is said to be eaten by sea-turtles. A general term for all sea-grass is *ki-maramanda.*

Yanyuwa Terms For Dugong And Sea-Turtle

Yanyuwa hunters possess a rich and complex knowledge of the dugong and sea-turtle. This knowledge concerns both the factual details concerning the sea-turtle and dugong, and the deep spiritual significance which governs how the Yanyuwa act towards these animals. The Yanyuwa classify the dugong and sea-turtle into the following categories:

Dugong

General terms

walya – general term for both dugong and sea-turtle.
waliki – general term for dugong.
nhabal – avoidance term for all dugong.
yiwaji – archaic term for all dugong.
wundunyuka – general term for all sea-turtle.
li-waliki/a-waliki – a herd of dugong.

Female terms

a-banthamu – old cow with small tusks visible.
a-bayawiji – mature cow, capable of breeding (no tusks).
a-ngayiwunyarra
a-kulhakulhawiji –pregnant cow.
a-lhumurrawiji –pregnant cow with a calf still following.
a-miramba – non-lactating cow, but with a large calf still following.
a-ngarninybala – cow with her calf riding on her back.
a-wurduwu – young female dugong.
li-milkamilarra – small group of cows with calves.
nyanki-ardu – dugong foetus.

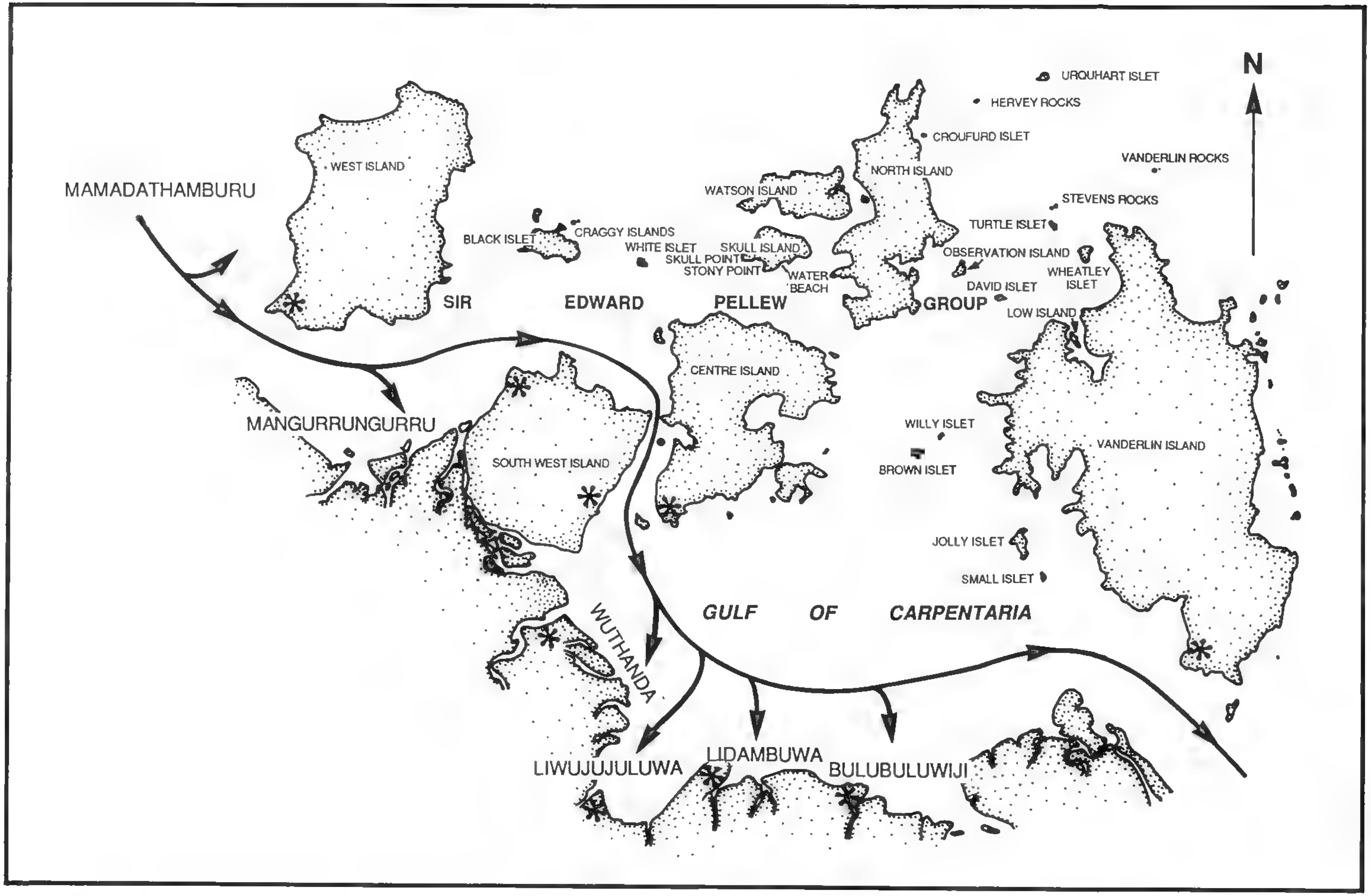

FIGURE 1. Map showing dugong migratory path (arrowed line), and favoured dugong hunters' base camps (asterisks).

Male terms

bungkurl - very fat, small male dugong.
jiyamirama/jiwarnarrila - male dugong which travels away from cow during times of threat.
mayili - bull dugong with small tusks.
rangkarraku/rangkarrangu - bull dugong travelling by itself.
wiriji - large old bull with a mottled hide, considered to be the offspring of the Rainbow Serpent.
wirumantharra - bull dugong whistling, often said to be the leader of the herd.
ngumba - very young dugong.

Sea-turtle

There are three species of turtle in the area of the Pellew Islands. The most commonly hunted is the green turtle (*Chelonia mydas*).

Green turtle

malurrba - green turtle.
warrikuliyangu - male green turtle.
ngulurru - male green turtle.
rra-tharra - female green turtle.
a-wandangumara - very large female green turtle.
bankiba - very large male green turtle.
ngajilingajili - green turtle with a light coloured shell and a lot of yellow colouring to the underside.
lijalijangulyanda - young green turtle not considered big enough to eat.
a-wathawayawiji - female green turtle containing unlaid eggs.
yabalarla - green turtle hatchling.
ngarrangarra - green turtle which lacks a lot of body fat.
wunakathangu - green turtle found with ulcerations in the stomach (not eaten).

Flat-backed turtle

wirndiwirndi - flat-backed turtle. This species of sea-turtle is occasionally captured by Yanyuwa hunters.
jadiwangarni - male flat-backed turtle.
a-karninja - female flat-backed turtle.

Hawksbill turtle

karrubu - hawksbill turtle. This species is not captured by the Yanyuwa as it is considered poisonous.
yibarriwuna - male hawksbill turtle.
a-ngurrin - female hawksbill turtle.

Loggerhead turtle

limarrwurrirri - loggerhead turtle.

General terms relating to turtles

rri-bankuja - mating turtles.
rujurru - turtle hatchling.
ngangkurrurru - female on the beach laying eggs.

Dugong And Sea-Turtle Habitats

The hunters of dugong and sea-turtle know that it is the tides which primarily affect the movement of dugong and sea-turtle. Both animals feed on the coastal sea-grass beds at high tide (*ngakan*) and move out onto the off-shore beds at low tide (*mangkuru*). A turning tide (*jalababa*), is often considered a good time to hunt dugong especially if the tide is coming in as the dugong will be travelling in towards the sea-grass beds. If the sea is calm both dugong and sea-turtle can occasionally be seen feeding on the sea-grass beds along the more exposed coastal and reef areas.

The Yanyuwa men who are versed in the 'Law' of the dugong say that the dugong is a migratory animal. This migratory path would seem to range from just south of the Limmen River mouth, through the Pellew Islands and eastward to the region of the mouth of the Robinson River. Dugong are classified into two groupings; there are those that are continually moving and those which are more territorial. In the Yanyuwa language the migration of the dugong is known as *muyu,* and those dugong who remain in one area are called *jibiya baji* or 'countrymen belonging to that place'.

In the area of the Sir Edward Pellew Group the dugong migration path would seem to run south of West Island to the north of South West Island and into the small strait between South West Island and Centre Island, then eastward past the mouths of the McArthur and Wearyan Rivers.

Both the dugong and sea-turtle frequent the same areas, due to the presence of the sea-grass beds. The Yanyuwa do not regard the sea-turtle as a migratory animal, though research has shown that the green turtle does migrate long distances to nest (Limpus 1985 pers. comm.).

The localities which dugong and sea-turtle are known to frequent are the south-west and central west coast of West Island (Mamadathamburu), the area in the vicinity of the central west coast of South West Island (Mangurrungurru), the McArthur River mouth and Dugong Creek (Wuthanda), an area around the mouth of the Crooked River (Liwujujuluwa), an area to the north-east of Sharkers Point (Lidambuwa), and an area to the north of the Wearyan River (Bulubuluwiji). At most times of the year dugong and sea-turtle can be found at any of these localities in varying numbers (see Fig. 1).

The largest numbers of dugong are found in the vicinity of the Sir Edward Pellew Group in the mid dry season (*ngardara*), usually around June, July and August. It is during this time that the Yanyuwa do the greater part of their dugong and sea-turtle hunting, though people will hunt at other times of the year. During the mid dry season however, the sea is usually calm and the strong south-easterly winds (*rra-mardu*) have ceased to blow.

HARPOONING EQUIPMENT

Yanyuwa hunters prepare or repair most of the equipment detailed below while still at camp or while travelling on the river on the way to the sea (see Fig. 2).

The Yanyuwa hunt dugong and sea-turtle with a harpoon with a detachable head to which is attached a long rope and float. Most senior Yanyuwa men possess at least one harpoon, which is called either *na-ridiridi, yirlakungka* or *ratharr.* These are usually carved from the wood of young messmate trees (*Eucalyptus tetrodonta*) and are from three to five metres in length. The harpoons are usually well cared for, being rubbed with the sap of certain trees, red ochre and sugar bag wax to help preserve them.

The base of the harpoon point rests in a socket carved into the thicker end of the harpoon shaft. This socket is called the *na-wuthula* or *na-balalarra,* or more commonly *na-mulu* ('its mouth'). The harpoon points are usually called *na-malbi* or *na-wulukayangu* and today are made of metal - usually a piece of steel rod (tappet rods from Toyota engines are a common source), approximately 15 cm in length and 1 cm in diameter. In past times these points were made out of hardwood, usually *Pemphis acidula,* which in Yanyuwa is called *na-wubulu.* These wooden points were warmed slowly in the hot white ashes of a fire to temper them. In past times the wooden points used for hunting sea-turtle were barbed because the hunters had to spear the turtle in the neck or flippers, as the wooden points could not penetrate the shell. These barbed wooden points were called *na-ngalhinbiji* which literally means 'it has a hook/barb'.

The top of the harpoon point is wrapped in cloth or paperbark and then tightly bound with string to ensure that the harpoon point rests firmly in the harpoon. The harpoon point is attached to the harpoon ropes called *ma-ngarduku* or *ma-yinymathu.* In the past the rope was made out of the inner bark of the kurrajong or banyan tree. Today commercial nylon or hemp rope is used. Kurrajong ropes are still occasionally made for sale to Aboriginal art and craft organisations.

Two ropes of about twenty metres in length are required. The harpoon point is attached to the rope by way of the *nungawu,* which is a small loop made in the end of the rope through which the harpoon point is passed. The bound end of the harpoon point is pushed firmly against the loop and then both are tied together with string. The other end of the ropes are attached to a wooden float called *mawarl.* This is made from a light piece of wood and is usually about 60–70 cm in length and about 20 cm in diameter. The float is thrown out when a dugong or sea-turtle is harpooned, to mark the course the harpooned animal takes and to tire it out. This float was of more importance in the days of bark and dugout canoes when men had to paddle to catch their prey. With the advent of motor boats the hunters can usually keep up with the sea-turtle or dugong and the float is rarely required but it is always carried and kept attached to the ropes. The float is still useful if the engine fails, the rope becomes tangled, if the hunter falls overboard when he spears the dugong, or loses the harpoon.

It is Yanyuwa tradition that the dugong and sea-turtle be harpooned twice. The first harpoon strike into the dugong is called *na-walangkarramba* or *na-walangkarrangu,* and the second is called *na-nyirriwa* or *na-nyirriwangu.*

HUNTING RULES

Yanyuwa dugong hunters must follow strict rules before leaving the land to go hunting. Hunters try to keep their noise level to a minimum, they will not break sticks, burn string or sugar bag wax or handle greasy food. The reasons behind these restrictions are not known but the restriction on making noise is said to be because the dugong has extremely keen hearing. In Yanyuwa the dugong is said to be *lingi,* a term usually reserved for a person of high intelligence or keen hearing. It is believed that if too much noise is made the dugongs will hear and dive into deep water where they cannot be hunted. Men will not handle greasy food before hunting as they believe if it contacts the harpoon points it will make them smooth and they will slip out of the harpooned dugong or sea-turtle. All of these restrictions are grouped together under the generic term, *wardimalyurr.*

While there are no such specific rules associated with the hunting of sea-turtle, this animal's keen eyesight is treated with as much respect as the dugong's acute hearing. Otherwise, the same rules are observed as the hunters do not know which of the two animals they may find when setting out on an expedition. Any person who disregards these restrictions and others concerning the Law of the dugong have the following phrase directed at them — *wardiwiji angkawangu* ('you are filled with badness, you are a mainland dweller'). This is an insulting remark to people who class themselves as sea people and the hunters of marine animals.

THE HUNT

When hunters reach the area in which they wish to hunt, they scan the water for dugong and sea-

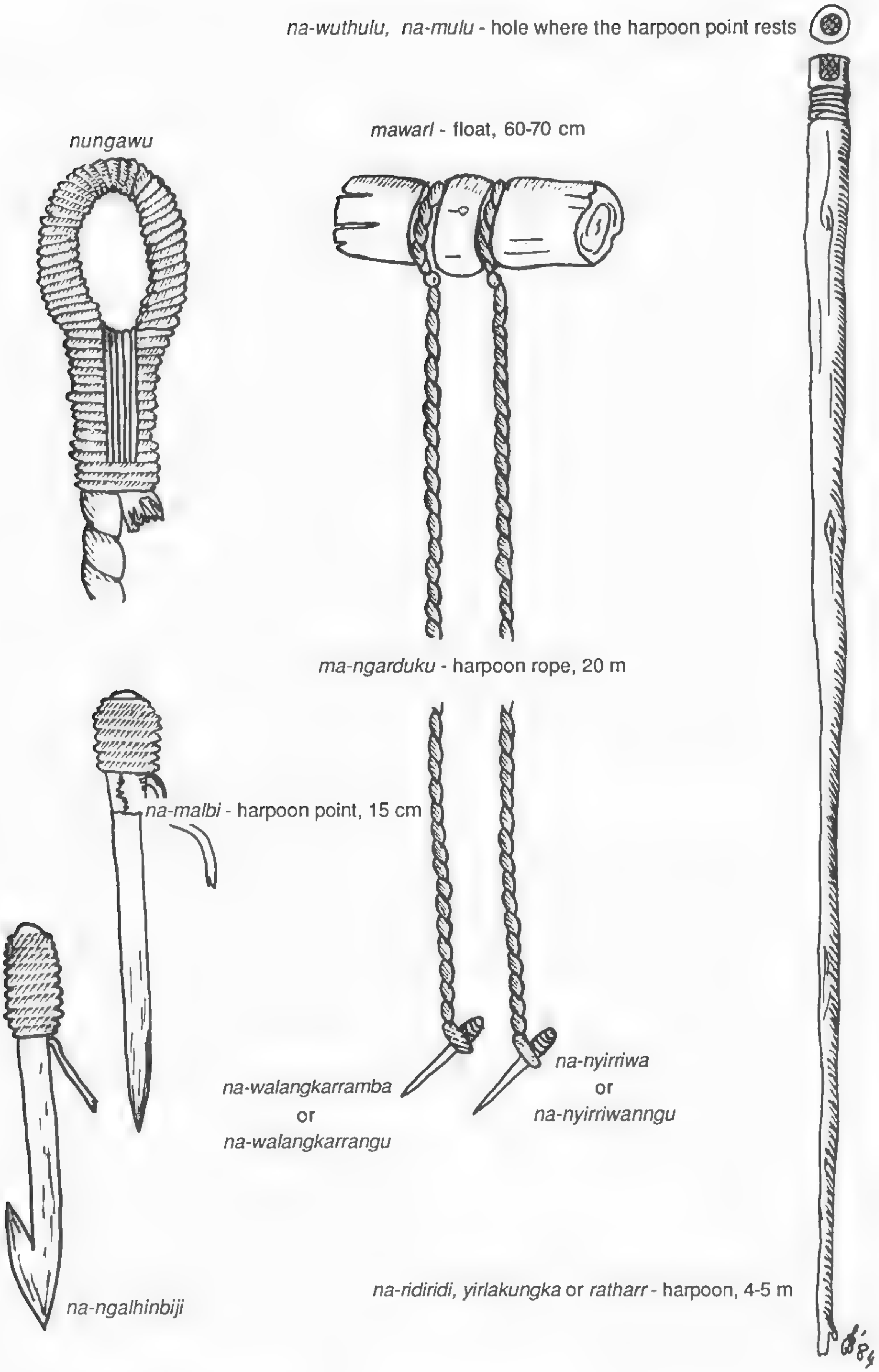

FIGURE 2. Harpooning equipment.

turtle surfacing to breathe, for muddy water which has been caused by these animals feeding, or for broken pieces of floating sea-grass and excreta. It is these signs which make visible and meaningful tracks to the hunter.

When an animal is located, the skill of the boat's 'driver' (*wuliyi/wungkayi*) is crucial. He has to follow hand signals given by the harpooner and manoeuvre him within range to spear the animal. This is often difficult as he must keep pace with the dugong which can swim at speeds of 10–12 knots for short periods. Sea-turtles are also capable of short bursts of speed and have the added advantage of keen eyesight, referred to in at least one Yanyuwa song cycle (see below). In shallow water the dugong can be tracked by the wake which is caused by the upward and downward movement of the tail, producing a series of flat circles on the surface of the water (Marsh *et al.* 1981). Sea-turtles are always tracked through the water by sight.

When a dugong has been speared once it usually tires quickly; it is then brought into range once more and speared again. The hunter usually tries to place one harpoon in the region of the neck and another in the lower back or tail region. After the animal has been speared twice the dugong is pulled alongside the boat. In Yanyuwa this action is called *lhungkayarra.* The dugong is then grabbed by the tail and a noose is placed around it, just below the flukes. The animal is turned around so its stomach is facing outwards. Its tail is braced against the gunwhale, forcing the head under water and drowning it.

In past times when the Yanyuwa hunted dugong from bark canoes the dugong was not drowned alongside the canoe for fear that the struggling animal would damage the frail craft. Instead the dugong was brought within a short distance of the canoe and then the hunter swam out to the dugong and plugged the dugong's nostrils with paperbark or even his own fingers, and he stayed with the dugong until it drowned.

From the moment a dugong is speared until it is drowned no talking takes place. It is believed that talking while the dugong is dying is a sign of great disrespect, and if someone does talk while the dugong is being pulled alongside the boat, the spirits who guard the dugong will come and remove the harpoon points.

The hunters usually try to spear young male dugongs and occasionally a cow as long as it has not got a calf or does not appear to be pregnant. The Yanyuwa dugong hunters say that they can tell the difference between a male dugong and a pregnant cow by the way in which it dives after surfacing; a pregnant cow is said to dive quicker and at a sharper angle. Large old bull dugongs are avoided because they are said to be the offspring of the Rainbow Serpent and are therefore to be feared. They can be killed but only with the assistance of special 'power songs' (*nyiri*) which are said to weaken the animal and break its back. One power song which is used in an attempt to weaken such animals is as follows:

> Miriyayurr, miriyayurr.
> Kunjurr, kunjurr.
>
> You with the spirit of the
> Rainbow Serpent,
> Your back is broken,
> truly it is cracked.
> (Isaac Walayungkuma 1985 pers. comm.).

It is said that such a dugong, if not controlled, will tow the boat to the mouth of its father, the Rainbow Serpent (*Bujimala*) and dive into the mouth, taking boat and crew with it. Quite often though, if one of these dugongs is harpooned the rope is just cut. These large dugongs are powerful, and trying to kill one by drowning would be much more hazardous.

When the dugong is drowned it is tied alongside the boat. A rope is tied around the tail which is then fixed to the back of the boat, and a harpoon point is passed through the dugong's nostrils and to this a rope is attached. This rope is tied to the front of the boat. The dugong is then taken back to land for butchering.

During times when groups of Yanyuwa people are camped on the islands they will often hunt the dugong at night. The dugong is located by listening for the sounds of dugong surfacing to breath. The dugong are followed through the water by their phosphorescent wake, called *balirrka.* As this method of hunting is considerably more dangerous there is very careful preparation of the hunting equipment before setting out.

Sea-turtle are hunted in a similar fashion to dugong. Sea-turtle can at times prove more difficult though, due to the animals' keen eyesight and the length of time which they can stay submerged. The harpooned sea-turtle will often swim under the boat, making it harder for the driver of the boat to place the harpooner in an ideal position to harpoon it for the second time. When the sea-turtle has been harpooned twice it is pulled up alongside the boat and taken hold of by its front flippers. If the sea-turtle is relatively small it is pulled directly into the boat; if it is very large and heavy it is tied to the side of the boat by the front flippers so that it hangs vertically in the water with its head above the water line. This is to ensure that the sea-turtle does not drown. The Yanyuwa believe that if they let a sea-turtle drown they will have great difficulty in finding and catching them when they go hunting again. With the sea-turtle secured either in or alongside the boat it is taken back to land for killing, cooking and butchering.

BUTCHERING AND COOKING DUGONG AND SEA-TURTLE

Figures 3 and 4 illustrate the method by which a sea-turtle is killed and gutted. The sea-turtle is cooked whole, in its shell, before it is butchered. Firstly it is laid in a shallow pit which contains hot coals; the sea-turtle is then covered with wood which is set alight. It is then left for two to three hours. As the sea-turtle cooks it is watched to make sure that the fire does not burn through the shell, causing the *mathulmathul* to be lost. *Mathulmathul* is a rich 'soup' composed of meat and fat particles, juices, and blood. This is much sought after by older people who believe that it has medicinal value (younger people used to European food find it too rich and complain that it gives them diarrhoea). After the turtle has cooled it is butchered. Figures 5, 6, and 7 show the order in which this is done. After the first cooking much of the sea-turtle meat is still somewhat raw, so after butchering the meat is placed into a ground oven on a bed of *Acacia* leaves to complete the cooking process.

When a dugong is brought back to the land for butchering its head must be faced back in the direction of the sea. This is to enable the spirit of the dugong to return to the sea. This is an act of great importance to the Yanyuwa people and is called *ki-maramanngku,* which can be literally translated as 'returning the one belonging to the sea-grass'.

FIGURE 3. The turtle is killed by hitting it hard on the head with a stone or an axe to break the hard protective covering plates. A long sharp stick is then thrust into this hole to 'mangle the brains'. This act must be performed by a person who stands in the position of a ritual guardian of the sea-turtle.

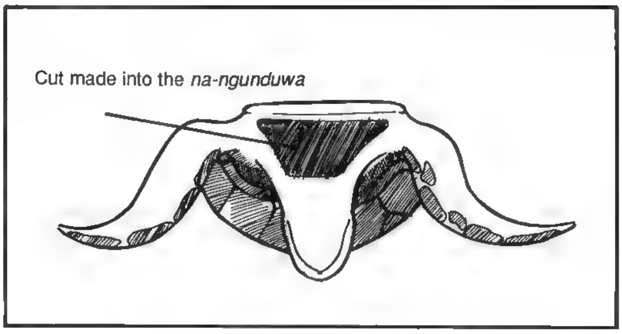

FIGURE 4. Butchering the turtle. When dead the turtle must be laid on its back, then the first cut is made. The act of making this cut is *ngunduwamantharra.* The person butchering the turtle then reaches in through this cut and removes a number of organs, listed in their order of removal: 1. *ngundurrngundurr* – section of the bronchial tube; 2. *na-widiri* – liver (eaten); 3. *rra-ngawu* – bladder; 4. *ma-mulka* – stomach (eaten; occasionally severe ulcerations are found in the stomach of old turtles, and they are called *wunakathangu*); 5. *wunakaka* – large intestines (eaten); 6. *ma-karriyalu* – small intestine (eaten). After the turtle has been gutted, paperbark is folded into small rolls and pushed into the bronchi remaining inside the turtle. The reason given for this practice is so that the turtle in the sea will not become *ngarrangarra* or without fat. The heart of the turtle is removed with the bronchial tubes and is also called *ngundurrngundurr.* The liver is also called *na-manyi,* and the stomach is also called *yalajala.*

There are two methods which can be used to butcher a dugong (see Figs 8, 9, 10). One method, called *yingkurra,* involves removing the meat in slabs with the hide still attached. This method is used when large groups of people are present and the meat can be distributed quickly. The most favoured method however is called *munbul* and involves removing the hide of the dugong in its entirety, excepting the head and tail portions. *Munbul* is considered to be the most archaic form of butchering and is therefore associated with the activities of the old people, *li-wankala,* who in contemporary times are spoken of with much emotion:

> Today that dugong was butchered in the way of my forefathers, we cut it *munbul* it really made me remember the old people, when a dugong is cut up like that and cooked, the meat is sweet. That other way, that *yingkurra* that is only new way I don't like it, it make a dugong like a bullock and that is badness. (Ida Ninganga 1986 pers. comm., translated by author).

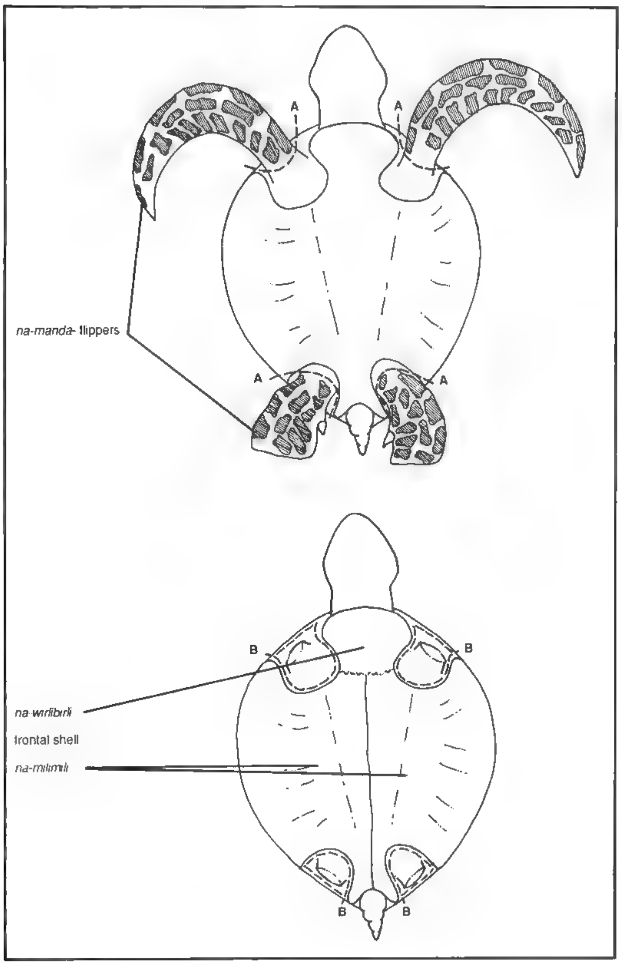

FIGURE 5. Butchering the turtle, continued. Broken lines indicate knife cuts. A. Flippers are cut off at the joint, *na-wi. B. Na-ngabala* — skin, meat and fat.

The only organ of the dugong which is eaten is the small intestine (*murajuju*). It is cut into short lengths of about 20 cm. The *murajuju* is then washed in salt water and boiled or cooked in a ground oven (*rabarr*), in similar fashion to the rest of the meat.

The oven (approximately 1 m deep, 1–2 m in width and 2 m in length) is filled with wood which is set alight. While the wood is still burning, stones are thrown into the fire to get hot. When the wood has burnt down to hot coals the heated stones are removed and green mangrove branches are laid onto the bed of coals. The meat is then placed in the oven. The head is placed at one end of the oven and the tail at the other. The smaller portions of meat are then placed between them. Onto this meat are placed hot stones, and over these cuts of meat and hot stones are placed the two halves of the rib cage which is also covered by stones. The oven is then covered with paperbark and sealed with earth. The meat is left to cook for several hours.

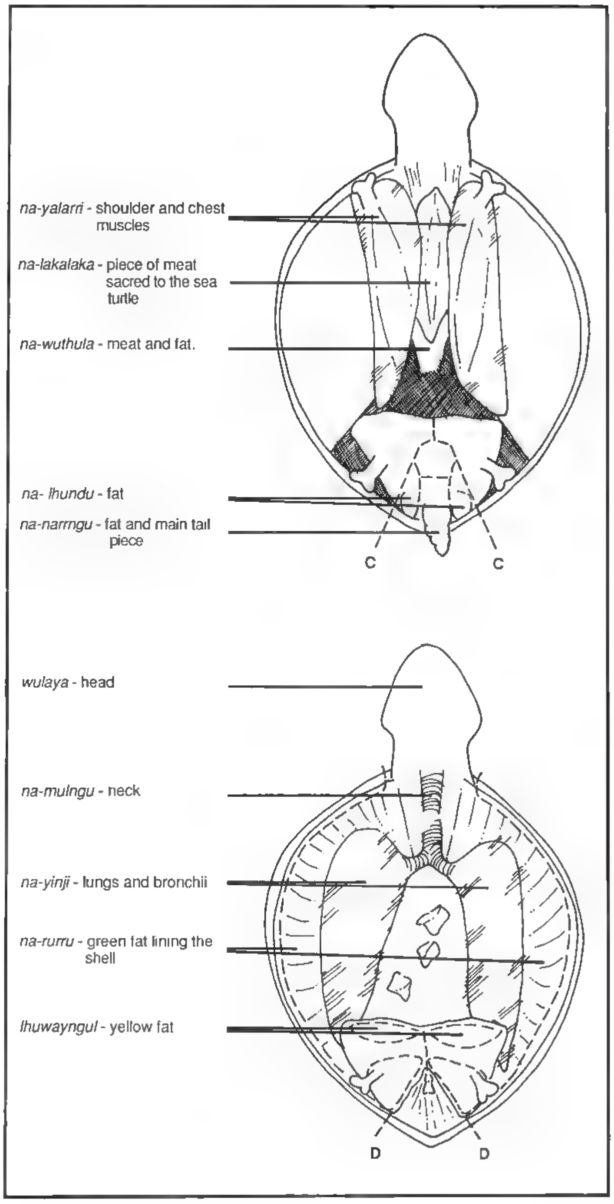

FIGURE 6. Butchering the turtle, continued. Broken lines indicate knife cuts. *C. Wurrunthulburrunthul* — tail piece, fat and meat. D. *Wundumutha* – green fat and meat.

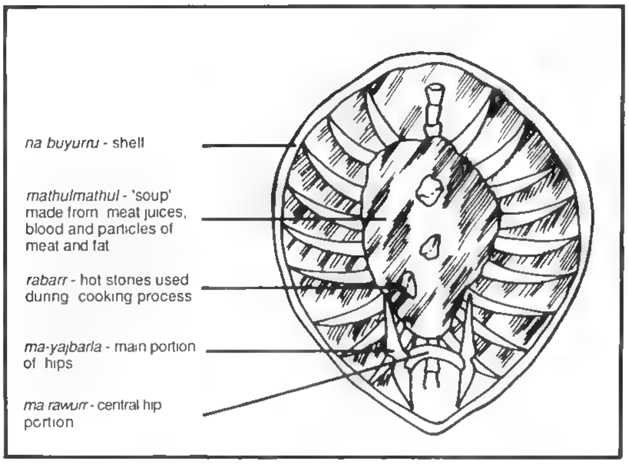

FIGURE 7. Cooking the turtle.

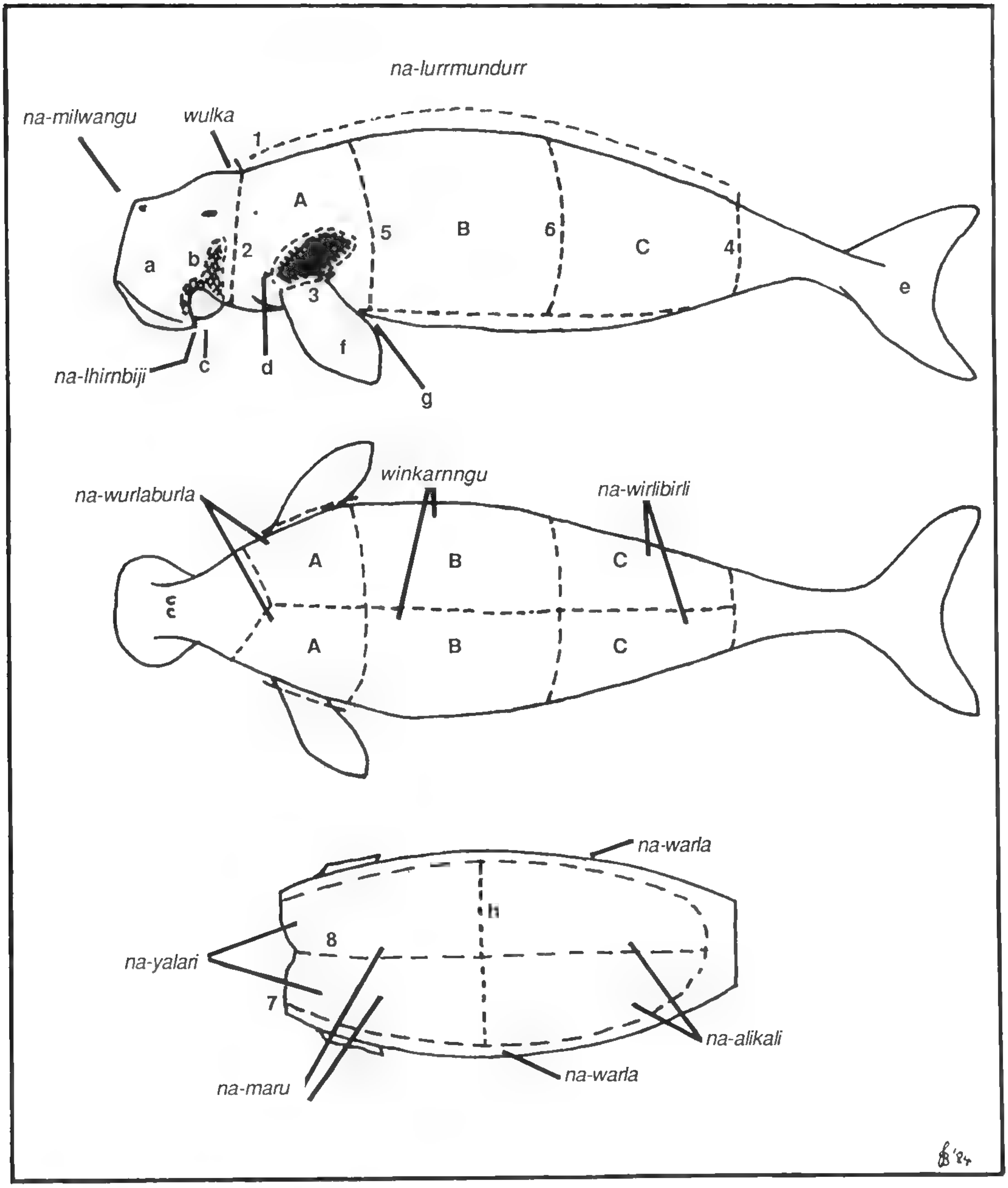

FIGURE 8. Method of butchering dugong known as *yingkurra.* Numbers refer to the order in which the cuts are made. a. *Wulaya* - head. b. *Na-rawulurr* - jaw. c. *Na-jamuka* - chin. d. *Na-yabirli* - shoulder blade. e. *Na-yirrimbi* - tail. f. *Na-manda* - flipper. g. *Na-waji* - armpit. h. *Na-wurdu* - belly section. The slabs of meat A, B, and C are called *wungal.* The hide of the dugong is called *yanjurr.* The belly section is cut in half and the two sections are called *na-yalari.*

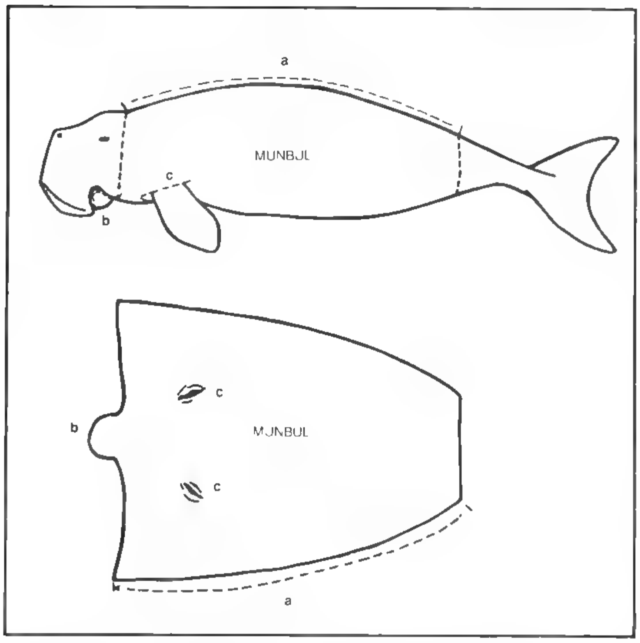

FIGURE 9. Method of butchering dugong known as *munbul.* The hide is removed in one piece and is then roasted flesh-side down on a bed of hot coals.

During certain ritual occasions parts of the dugong and sea-turtle are kept exclusively for the senior men. It is the rib-cage sections, head, and flippers which are considered sacred, and the hip and back flipper section of the sea-turtle. These are the sections which are placed into the ground oven within the confines of a restricted sacred area called *na-manda.* This area is enclosed by a semi-circular earth mound which is built to surround the ground oven. After meat cooked in the *na-manda* has been eaten all the scraps and bones are thrown back into the ground oven and burnt. The belief is that failure to dispose of the bones correctly will result in a cessation of successful hunting.

When the head of a dugong is removed from the ground oven the flesh is removed, and the jaw is separated from the skull. The jaw, skull and flesh is cooked once more. The skull of a dugong is usually thrown back into the sea or river. This is why few dugong skulls are ever found at camp sites; the head of a human or animal is deemed sacred by the Yanyuwa.

If a female dugong is killed and found to be pregnant the foetus is taken with the rest of the meat and cooked. It can only be eaten by senior men who have the dugong as their Dreaming, or by those who by Dreaming relationship call the dugong 'mother'.

The act of distributing the meat from the dugong and sea-turtle is called *wangkamantharra* and is governed by Yanyuwa law. The portion received by each person is usually based on the relationship of the people to the hunters and at times by people's Dreaming relationship to these creatures. It is not viewed favourably if the hunter does not distribute the meat. In the past such an action was enough to incite heated argument and even physical violence and this can still be the case today.

In the division of dugong meat the hunter receives some of the belly meat, the head, and if the dugong has no ritual use (in terms of *na-manda* cooking) he takes a small portion of the rib-bones and some of the intestines. The driver of the boat receives the tail, some shoulder meat and rib-bones.

If a woman's brother or sons participated in the hunt, she may not eat from the back-bone or ribs, so she is given a large portion of the intestines. The hunters' sisters, sons and daughters are not allowed to eat any of the tail portions. The hunter also makes a presentation of meat to his mother-in-law. This is done through a second person because of the strong avoidance taboo which exists between son-in-law and mother-in-law. This presentation is seen as an on-going payment in return for the man being given his wife.

The driver of a boat in a sea-turtle hunt receives some meat and associated green and yellow fat from the hip section of the turtle. He also receives some of the chest meat, intestines and green fat which lines the shell. The head and neck of the sea-turtle goes to the senior ritual guardian for the animal. The hunters' mothers and sisters are not allowed to eat the intestines of the turtle so the stomach is saved exclusively for them. As with the dugong the best meat is given to the mother-in-law of the hunter. The oil (*na-ngilili*) which the Yanyuwa obtain from the hide and meat of the dugong during the cooking process is said to have medicinal qualities and is rubbed onto the body and hair. The Yanyuwa say that it makes their hair grow strong and when rubbed on their bodies it keeps their bodies warm and free from pain.

With the advent of refrigerated storage some Yanyuwa families have the facility to store large amounts of dugong meat over a longer period. This has led to some apparent abuse of the complex rules regarding distribution of the meat, a development which is particularly resented by some older people:

> Freezer, freezer, they freeze him [dugong meat] all lot. That's *narnu-wadi* [badness], not like old people, everybody got something, selfish bugger people this day, no idea, *karawathawathamu* [swear-word]. I don't like it, that *walya* [dugong and sea-turtle] got law for everybody. (Ida Ninganga pers. comm. 1987).

Many of these problems stem from the fact that some younger Yanyuwa people have not learned the full scope of the law associated with dugong, and can thus easily offend older people:

> You know what, he brought up head [dugong head] for me, that's not the way, no idea, true, old people, my father never bin like that, I can't take head, never even been cooked, *yakayaka* [insane] true, I bin chuck that head to the dog, I never touch it, no Law, not allow . . . (Annie Karrakayn pers. comm. 1986).

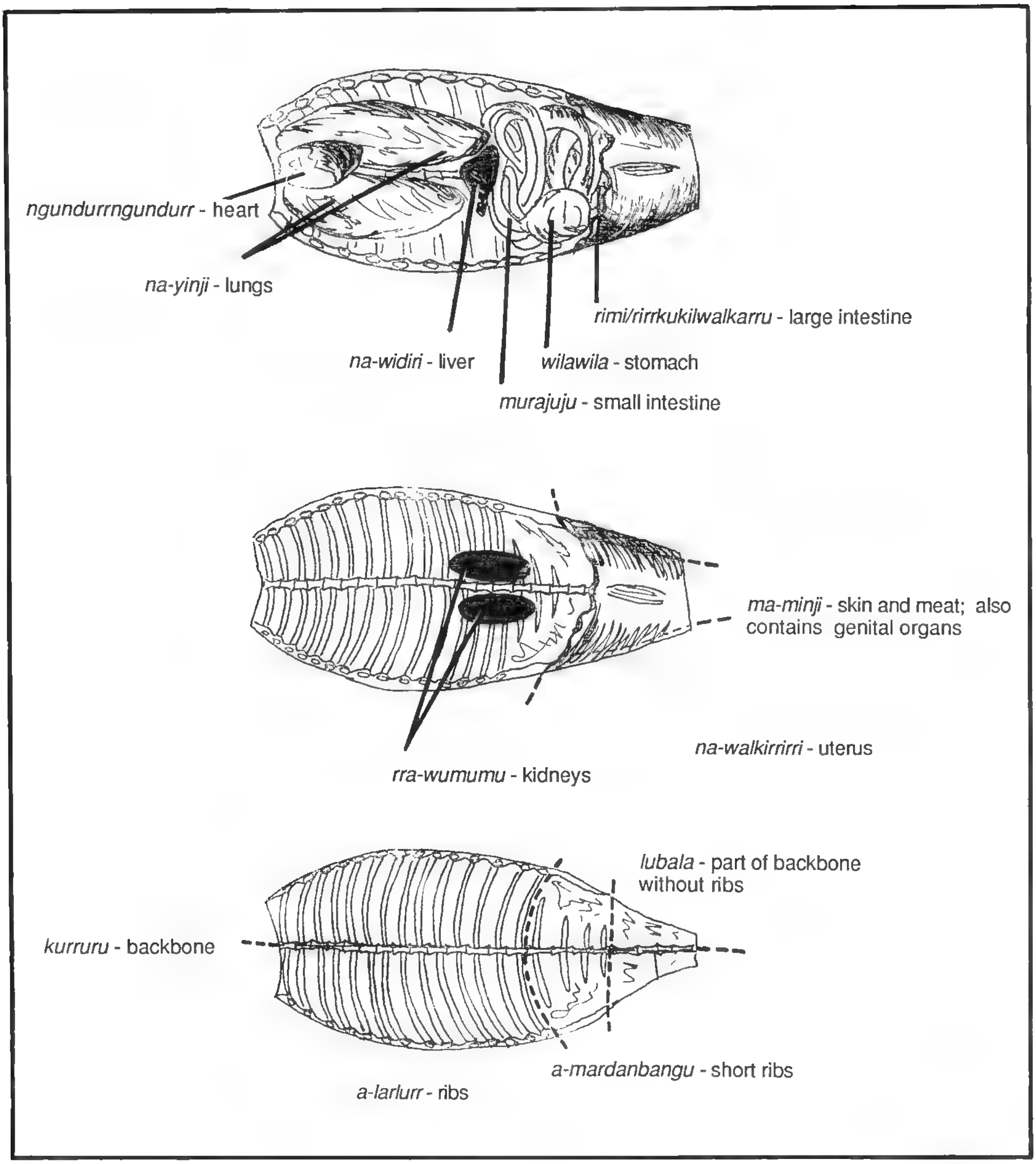

FIGURE 10. Gutting the dugong. Before the internal organs can be seen a layer of white fat called *rra-mayngul* is removed. Broken lines indicate knife cuts.

EUROPEAN ACCOUNTS

Within their oral tradition the Yanyuwa have detailed accounts dealing with the activities of dugong and sea-turtle hunting, which are both mythologically and historically based. Other sources also exist which mention Yanyuwa associations with such activities. In 1814 Matthew Flinders made the following comment:

> Turtle tracks were observed on most of the beaches, but more especially on the smaller islands, where remains of turtle feasts were generally found. (Flinders 1814: 171).

W. G. Stretton, Special Magistrate at Borroloola, commented in 1893 that

> . . . they [the Yanyuwa] are also very clever at making rope, which they use for dugong fishing. The rope is made from the bark of the Currajong tree, a species of *Brachychiton,* which these natives call 'Myaddo' [*ma-yatha*]. (Stretton 1893: 249).

One of the most detailed accounts by Europeans of a Yanyuwa dugong hunt and subsequent procedures comes from a description by W. E. Harney who spent some time with the Yanyuwa in the Sir Edward Pellew Group during the 1920s. In this book 'North of 23 Degrees' he gives this description of a dugong hunt:

> This place is the home of the dugong, which is a large sea mammal that feeds on the grass growing upon the floor of the shallow banks in this locality . . . Often I went out with them to hunt the dugong. Night was the best time, for then their path could easily be followed by the phosphorescent wake they left behind. A native would stand up in the stem of the craft, a wooden canoe, and direct the paddling native with the point of his harpoon. The canoe would glide noiselessly over the water, the men at the paddles feathering their paddles to eliminate the splash. Up would come the huge sea cow to fill its lungs with air; then bang! in would go the six-inch nail with a long rope attached to the head. The native who struck with the spear would fall overboard with it to give leverage; then quickly he would leap aboard the craft as the already wet rope went whizzing out as the dugong gathered away. The paddlers would now frantically paddle the canoe to reach a good speed when the line's end was reached; this would stop any jar which might pull out the nail. After a time the animal would tire and come to the surface for air, when another nail would be driven in to its neck or head; then down the line the hunter would go to plug up the valve with a piece of paper-bark or grass.
>
> The creature would soon die from want of air and rise slowly to the surface, to be lashed to the side, or maybe the canoe would be sunk and the animal floated in. Treading water the natives would hold the side of the canoe a little way out of the water to enable others to bail out the water. This done, they would all scramble in again and hoist sail for home. A signal would be given – a wave of the paddle or a loud blast on the conch shell, and quickly the camp would astir, as the women and children went to the bush to gather wood for the fire to roast the beef. Many were the orders given as the carcase was rolled up the sandy beach to the large fire blazing merrily away. Glass flakes, flints, and knives of the white man were all used for the cutting up. The great slabs of beef were sliced off and placed on bushes, or failing these on the sandy ground. Women would scold the eager children trying to scrape out coals to cook a little bit of meat given to them by an elder . . . The oven being now ready to take the meat, on layers of dampened bushes over hot stones are laid the first slices, then more stones and beef . . . till the whole dugong is in the oven. The latter is covered over first with paper-bark, then with sand or soil to make it airtight.
>
> Now for the waiting period. For about four hours the meat would be left there to 'stew' in its own juices; then came the sacred moment as old Friday uncovered the feast. Four to five hundredweight of . . . meat . . . As the native law of distribution now comes into force, Friday the uncle or mother's brother of the chap who caught the dugong will hand the portions out. A lovely hindquarter to the hunter's mother's mother, or Ku Ku [*sic*]; a forequarter to his mother's brother; a belly piece to this person; the head to the hunter, as well as the tail. Each receives his share, according to a just law, so that no rows may arise over the giving out of food. One group of people receives nothing; these are the women with their menses. To them it is forbidden, or taboo; they call the word 'gooda gooda' [*sic*]. Should they eat of this meat, then the dugongs would be offended and leave that locality, which, when one comes to think of it, provides a clever excuse should the hunter return without a kill. (Harney 1946: 161–163).

MYTHOLOGY AND RITUAL ASSOCIATED WITH DUGONG AND SEA-TURTLE

Both the dugong and sea-turtle are important mythological beings for the Yanyuwa and neighbouring groups to the north. The Mara people whose country lies to the north-west of the Yanyuwa have a very important Dugong Dreaming centre. This site, known as Wunubarryi (Mt Young), lies some seven kilometres south-east from the mouth of the Limmen River. The Yanyuwa people also recognise the importance of this site and they share in the control and use of the Dugong Dreaming power which is centred there.

Just to the east of Wunubarryi are a number of quartzite outcrops. These are believed by the Mara and Yanyuwa to be metamorphosed dugong and a single dolphin which were stranded on dry land by a receding king tide (*bambiliwa*) during the Dreaming. It is interesting to note that a similar occurrence happened in 1984 during Cyclone Kathy; a number of dugong and sea-turtle were stranded after a storm surge carried them up to eight kilometres inland in the vicinity of the McArthur River delta area.

The Dugong Dreaming represents a herd of dugong (see Fig. 11). Two of the rocks are males, while the others are females. It is at one of these female dugong that the Yanyuwa and Mara custodians for this site carry out dugong increase rituals. When men wish to perform these rituals they approach the Dugong Dreaming herd and brush down the 'female dugong' they have selected for use in the ritual. Surrounding the 'female dugong' are a number of hammerstones. One of these hammerstones is taken and the 'female dugong' is struck while the names of dugong hunting localities along the coast and in the area of the Pellew Islands are called out. A translated example of this recitation is as follows (see Fig. 1 for localities):

> You dugong, listen to me, you will come out from here and you will travel to Wuthanda (McArthur River mouth), Liwujujuluwa (Crooked River mouth), Lidambuwa (Sharkers Point) and Bulubuluwiji (Wearyan River mouth). Listen to these words that I am telling you! (Tommy Rilley (Nawurrungu) 1983 pers. comm.)

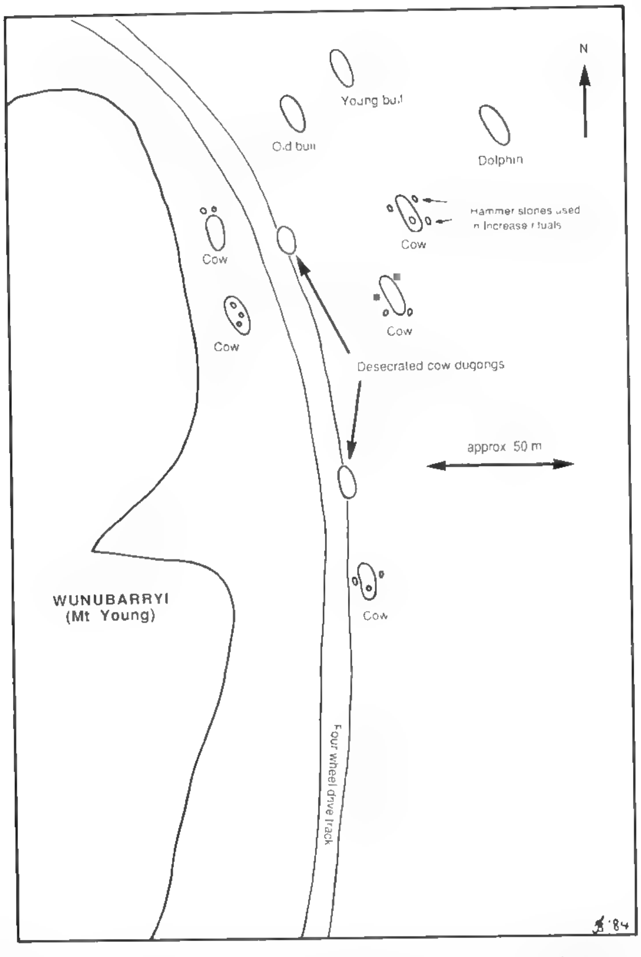

FIGURE 11. Map showing the Dugong Dreaming at Wunubarryi (Mt Young) in the Limmen Bight, Northern Territory.

Some of the 'female dugong' have deep grooves and depressions in them indicating that the rites of increase are of some antiquity.

In 1976 this Dugong Dreaming site at Wunubarryi was desecrated. The owners of the Nathan River Station, where Wunubarryi is located, dug out two of the 'female dugongs' while constructing a four wheel drive track through the area. The Yanyuwa and Mara people were extremely upset over this incident and consider that the dugong population in the area of the Sir Edward Pellew Group has suffered because of this desecration.

The Yanyuwa people have a Dreaming site for the Lone Male Dugong (*jiyamirama*) at Wungunda on the southern bank of the mouth of the Crooked River, and at Wirdiwirdila, a small island in the Wearyan River is a Dreaming site associated with the rib-bones of the Lone Male Dugong. During the singing of their ceremonial song cycles the Yanyuwa also sing of the dugong, and some of these verses are given below. These particular verses, belonging to the Yanyuwa Rrumburriya semi-moiety, are associated with the dugong hunting locality of Bulubuluwiji at the mouth of the Wearyan River:

> Wabarrkuramba
> jirrimbi ramba
>
> The tail of the dugong
> strikes the water
>
> Yarakiyara
> lhungkarrmi
> lhungka
>
> The cows are gathering,
> they travel with their calves
>
> Narnawirijarra
> yumbarrimajarra
>
> The bull dugong thrashes,
> it tires (It has been harpooned).
> (Old Tim Rakawurlma 1982 pers. comm.).

The song of the Lone Male Dugong is sung in the song cycle of the Yanyuwa *Wuyaliya* semi-moiety:

> Jiyamirama
> wukuwarrima
>
> The back of the Lone Male Dugong,
> is clearly showing.
> (Old Tim Rakawurlma 1982 pers. comm.).

The sea-turtle is associated mythologically with a number of areas over the Sir Edward Pellew Group. The west coast of West Island and the coastal margins of Bing Bong Station are associated with the Dreaming path of the Green Turtle. This sea-turtle completed its travels on a reef called Liwintha, which lies just to the south of West Island. Watson Island and the northern section of

North Island are also associated with the path of the Green Turtle Dreaming. Various rock formations along the Dreaming path of this turtle represent the shell, internal organs and segments of meat which the hunters of sea-turtle find important. One song cycle verse associated with the green turtle is as follows:

> Biyalawuna
> Yurrunjurr na-mi.
>
> The Green Turtle with round wide eyes
> like the uppermost grindstone,
> It sees a great distance.
> (Old Tim Rakawurlma 1982 pers. comm.).

YANYUWA VIEWS OF DUGONG AND SEA-TURTLE EXPLOITATION SITES

Evidence of the Yanyuwa's utilisation of dugong and sea-turtle as a food source can be found on many sites in the Sir Edward Pellew Group. Some of these sites are apparently quite old, while others were used within the last thirty years. No matter what the age of the site they share in common such things as charcoal, stones which show evidence of having been affected by heat, and scatterings of bone and skeletal remains which may give evidence of the numbers of people at these sites and from where the meat source was obtained. Minnegal (1984b) identifies four types of dugong butchering sites in Queensland's Princess Charlotte Bay region. Three of these sites have direct relevance to the Yanyuwa:

1. Initial butchering sites - where dugong were removed from the water and cut into a number of large segments to facilitate transport back to camp.
2. Primary, and primarily, dugong consumption sites - where large parcels of dugong meat were taken to be further butchered, cooked and consumed.
3. Base camps - where individuals took any remnants of dugong meat left over from the initial feasts.

(Minnegal 1984b: 15)

Figures 12, 13, 14 and 15 illustrate the factors which Minnegal (1984a and b) discusses. All of these sites, with the exception of that in Fig. 13, are still used by the Yanyuwa as base camps for the exploitation of dugong and sea-turtle and for the cooking and distribution of the meat. Each diagram is accompanied by a description of the site elements and a description of the site given by Yanyuwa people.

The Yungkurra site (Fig. 12) is still a favoured butchering site due to its close proximity to major sea-grass beds in the region of the McArthur River delta region. A unique feature of the site is a cleared 'causeway' some six metres in length. This feature seems to be of great age and was possibly constructed by clearing a pathway through the mangroves of the intertidal zone and then clearing this area down to the bedrock by removing the loose stones and rocks. The end result is an obvious cleared pathway which makes the task of rolling dead dugong, and pulling sea-turtles, ashore to a butchering point much easier. The cleared area would also have made the beaching of canoes an easier task where the rocky nature of the area makes safe mooring difficult. It also provides ease of access to the sea for people when washing the offal removed from the creatures prior to cooking. The foredune area at the end of the causeway is littered with bone fragments of turtle and dugong as well as the stones and charcoal from the ground ovens used during the cooking process. This site is still used for beaching and butchering dugong and sea-turtle. No cooking has taken place at the site in recent times though, as dugong meat or live sea-turtles are loaded directly into the boats and taken to base camps on other parts of the islands or further up the McArthur River. A senior custodian for the Yungkurra site, Tim Rakawurlma made the following comments:

> The old people long before me they threw stones to the north and south, and in doing so they made a road. The road is for dugong and turtle and maybe canoes when there was wind and waves. I cut dugong up at that place as did my father and my sons, they still use that place. Perhaps they were really clever those old people, would you think that?
> (Tim Rakawurlma 1985 pers. comm., translated by the author).

The site of Rumannguwa (Fig. 13) is located on a hill on North Island, about one kilometre from the coast. It is some distance from any of the major areas where dugong and sea-turtle are found. The site consists of a permanent fresh-water lagoon, the north-western corner of which has a large and relatively bare sand-ridge upon which evidence of past occupation can be found. On the north-eastern end of the ridge, the remains of a dugong were found after heavy rain washed the area in 1984, during Cyclone Kathy. The remains are of the head, a shoulder, and some ribs. Also in evidence are charcoal and stones used in a ground oven. Johnson Timothy, a senior custodian for the island, has reconstructed what he felt the site represented:

> This might be where my old grandfather Lithi camped, he was boss for this country. I reckon just him and his family were here; you see there is only a little bit of dugong bone here. This dugong was killed somewhere else and the meat was given to the family. Old Lithi must have got the head, shoulder and a few rib-bones. It was a long way to carry the meat but the old people used big string bags, *a-birndawarra* to carry meat in, hanging on poles or on their heads. This was

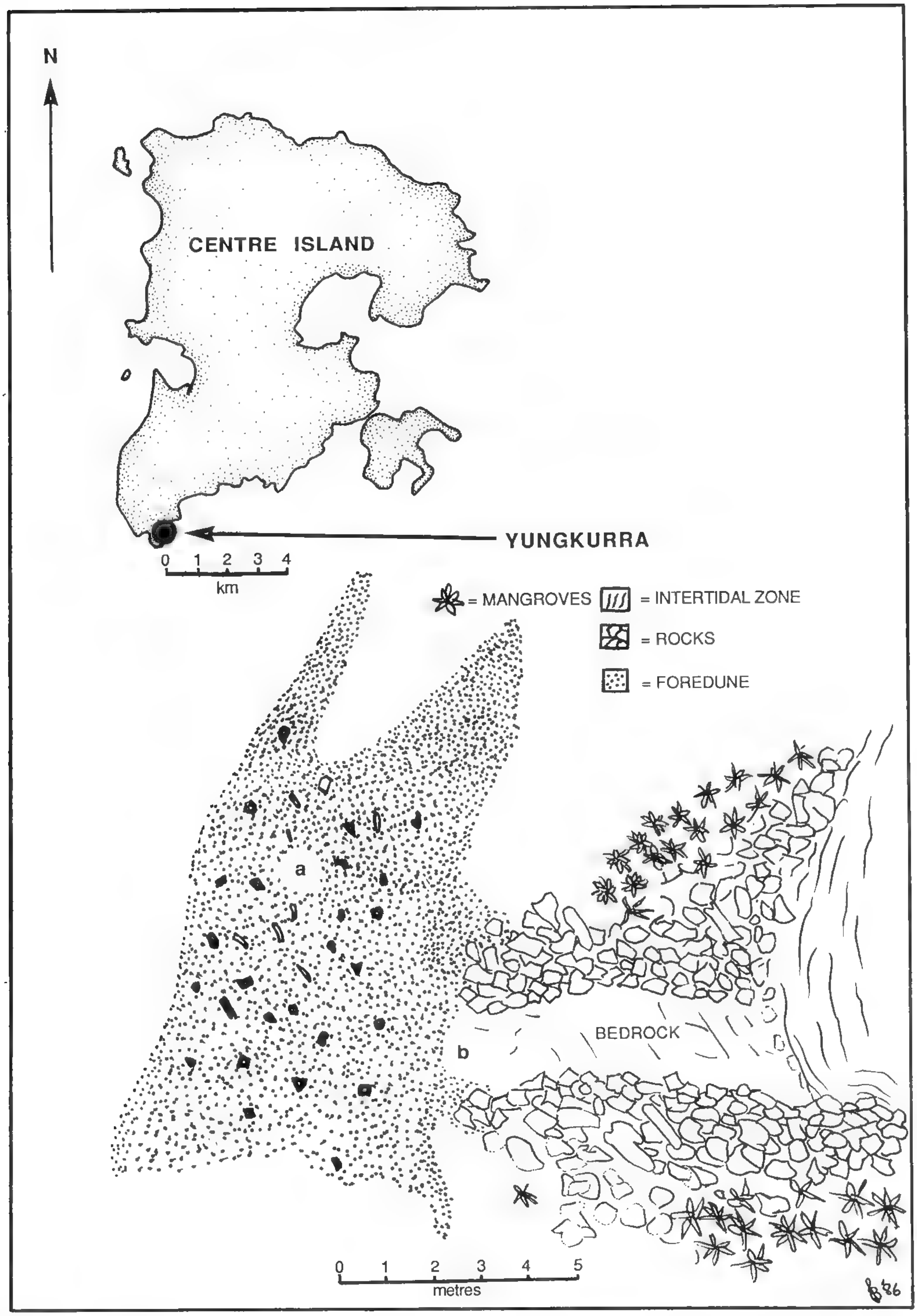

FIGURE 12. The Yungkurra site. a. Area of foredune littered with charcoal, stones used in ground ovens, and bone fragments. b. 'Causeway' – area cleared of stone to facilitate the landing and butchering of dugong and sea-turtle.

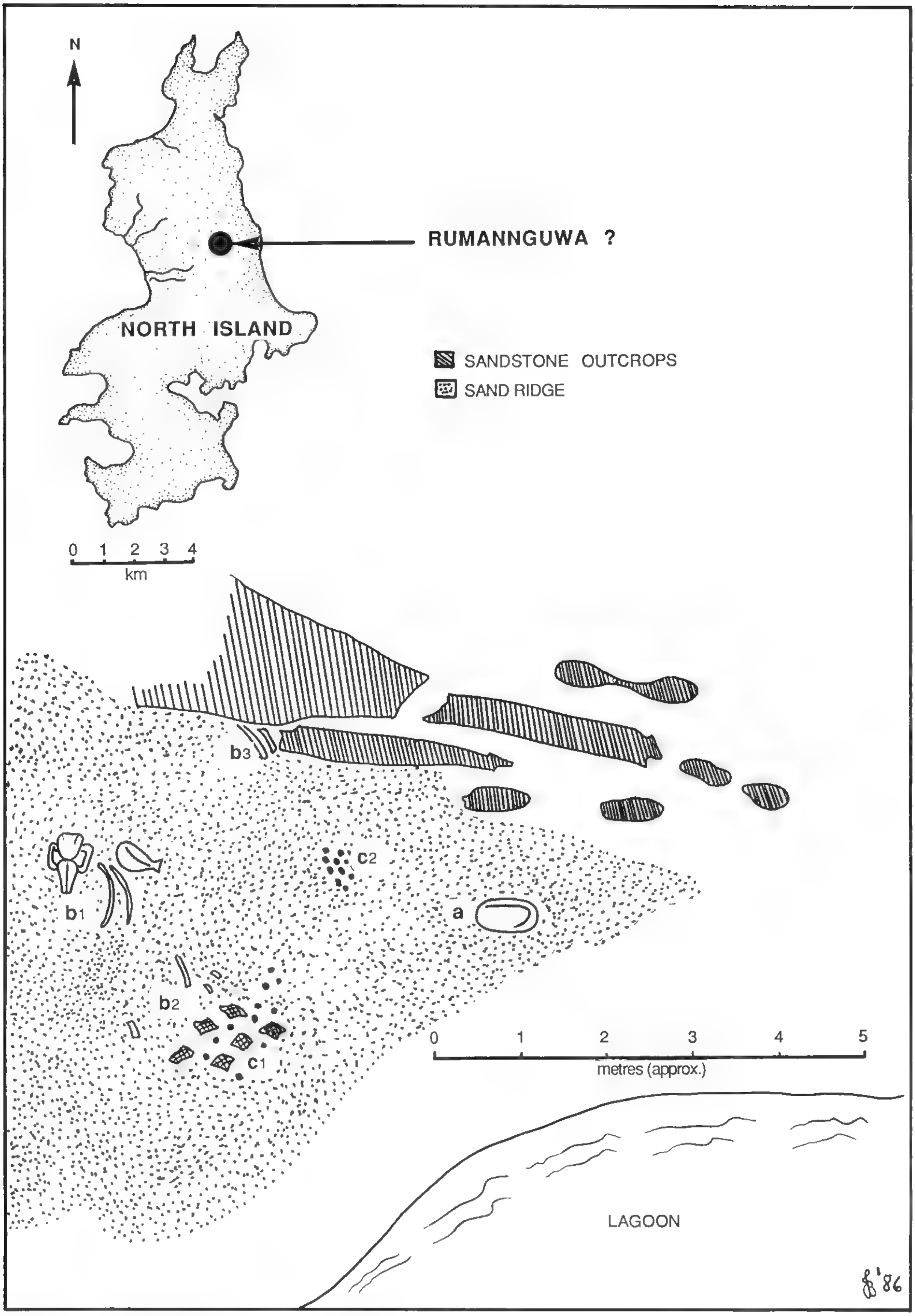

FIGURE 13. The Rumannguwa site. a: Grindstone. b^1: Dugong skull, shoulder blade, ribs. b^2: Ribs and rib fragments. b^3: Ribs. c^1: Ground oven, cooking stones and charcoal. c^2: Charcoal.

> a wet season (Ihabayi) place because water would run away. This place makes me think hard for the old people. That grindstone, they must have ground up lily seed, that *ma-rnayi,* or smashed up dugong meat to make it soft for the old people or young children. See those rib bones [b3] over in that little cave maybe a dog or kid went away by himself to eat. Old people they make me think. (Johnson Timothy 1984 pers. comm., translated by author).

Much of Johnson's speculation can be supported. The site is some 33 kilometres away from the nearest areas where dugong may be found in large numbers, and it is possible that the people responsible for leaving the remains shared in a dugong capture elsewhere and then took what meat they could carry back with them. The use of large string bags for the carrying of meat is quite often mentioned by the Yanyuwa. Today the Yanyuwa use commercially made bags and plastic boxes for the same purpose. The use of a grindstone or pounding stone for pounding meat is also still practised by the Yanyuwa. This is especially true for old people with severe dental damage or young children just beginning to take solids. The pounded meat is often mixed with water to make a form of thick broth.

The site of Nganthaa (Fig. 14) is still considered to be a favoured base camp from which to hunt dugong and sea-turtle. The site is in very close proximity to the major sea-grass beds around the McArthur River delta. The site described here was recorded in 1980 but archaeological evidence of the site was destroyed during high tides caused by Cyclone Kathy. The site is still used, but it is very rare for any cooking to take place there as the meat is usually loaded in the boats and taken back to Borroloola, or other centres. The site was described by one of the senior custodians in the following way:

> This camp here, these dugong bones belong to the camp of my father, really my father's brother, old Babawurda. We camped here in the cold season time. My father he harpooned the dugong and cut it up on the reef at low tide, he didn't worry about sharks.
>
> We cooked the dugong and we stayed there for a while. Later we killed a turtle and another dugong but we took them back home to Borroloola. We used to cook that dugong meat really well. That ground oven we used the same one all the time when we camped here. Those *rabarr* [stones used in ground oven] are probably from the old people. That first tree (b2), that where old Babawurdi camped with his wife, that why he had the head and shoulder, that other tree (b3) only ribs and some *lubala* [part of backbone without ribs] that was Billy and Graham's camp [his sons], they were only young then. That other camp (b4), that was where my aunty was camping, sister for that old man, that's why no rib-bone is there and I camped at that end tree (b5) with my wife and Douglas and Thelma. I was paddler for that canoe so I got tail and ribs.
>
> Those other ribs in the ground oven they were eaten at that place again and thrown back in the oven. (Don Miller 1980 pers. comm., translated by the author).

Another site, Walangkurra (Fig. 15), is the nearest mainland site to the sea, and more importantly it is very close to major sea-grass beds lying to the south of West Island. This site was documented one day after the people who had been camped there for a week had left to return to Borroloola. The scattered dugong bones indicate residence patterns and kinship ties and reflect the continued importance placed on the proper distribution of meat according to kinship rules.

The camp c6 at Walangkurra is of special interest, in that the person who camped there was one of the senior Jungkayi (Guardian) for the dugong and was therefore given the head of the animal by the hunter. The head is considered the most sacred part of the animal. Normally the head of the animal would be returned to the sea. The hunter's sister's camp, c1, reflects the law under which the sisters of the hunter are not permitted to eat the meat from the rib-bones or back-bone of the dugong.

CONTINUING SIGNIFICANCE OF THE DUGONG AND SEA-TURTLE TO THE YANYUWA

The Yanyuwa still regard the dugong and sea-turtle as vital elements in their economy, and cannot conceive of a time when they would not be able to have them as part of their diet. Within the Sir Edward Pellew Group sea-turtle remains present in large numbers, but the Yanyuwa have in recent times begun to fear for the safety of the dugong. With the increased use of the islands as a fishing and tourist destination, signs are becoming more and more evident that the dugong, and perhaps the sea-turtle population, will become more threatened as development increases. In November of 1983 while travelling to the islands via the Carrington Channel the author found two dead dugong on the mud flats at the mouth of the Carrington River. Both had been shot with high powered rifles. Another four dead dugong with gunshot wounds were found during the following days. This number of dugong represents approximately half the number the Yanyuwa men kill per year using traditional methods.

Yanyuwa men and women are continually finding more dugong which have suffered at the hands of visitors to the islands. Dead dugong have been found with their heads cut off or showing signs of being slashed with sharp objects. Other dugong are found showing severe abrasions and cuts caused by fishing nets. In April of 1984 a group of Yanyuwa men travelled to South West Island, and while there they found the dismembered carcass of a dugong. Attempts had been made to cover the butchered remains with stones. The method employed to butcher the dugong and the amount of waste meat

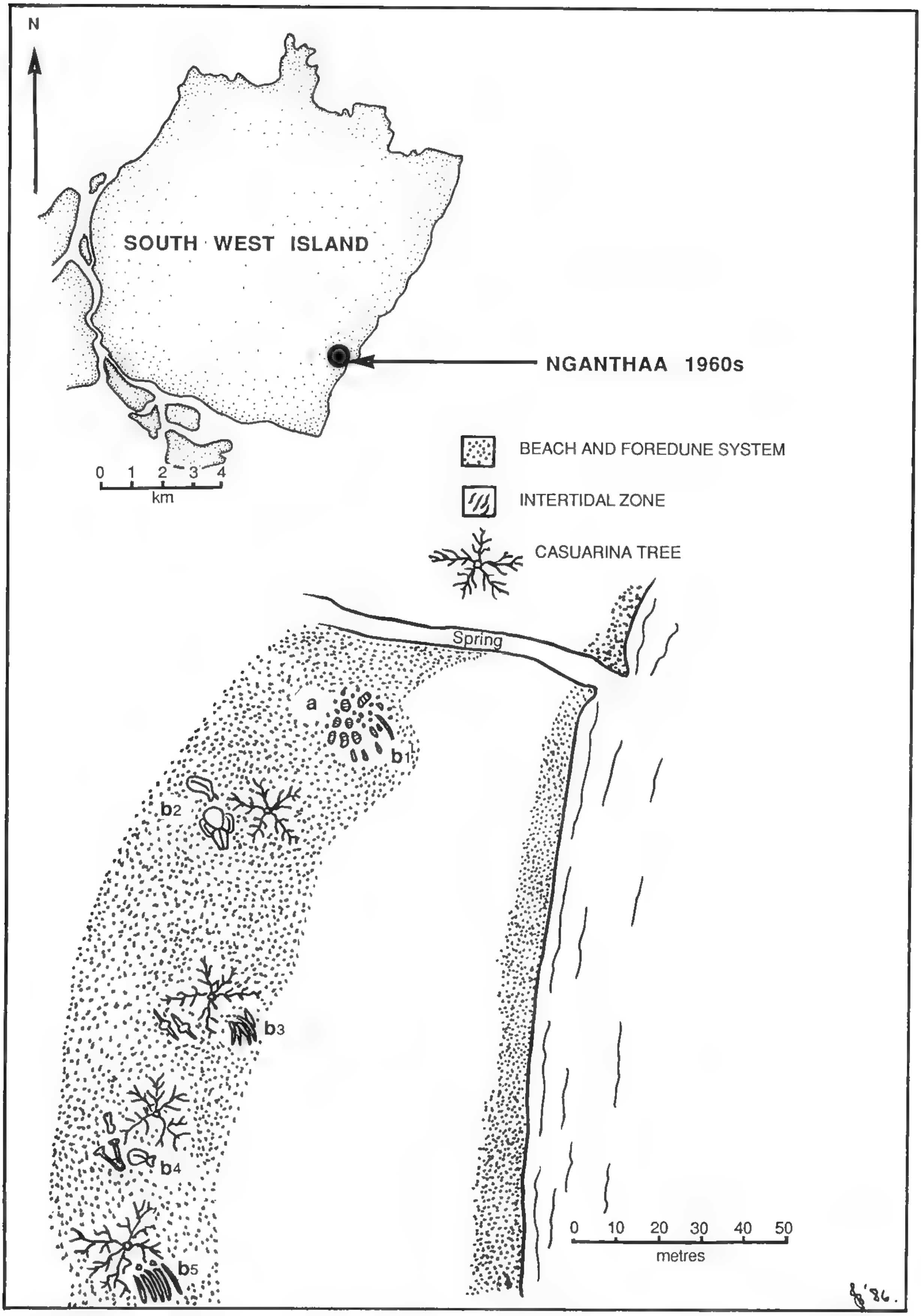

FIGURE 14. The Ngathaa site. a: Ground oven, cooking stones and charcoal. b[1]: Numerous rib fragments. b[2]: Skull and shoulder blade. b[3]: Rib-bones, lumbar vertebrae. b[4]: Jaw, shoulder blade, humerus. b[5]: Rib-bones, some fragments of vertebrae.

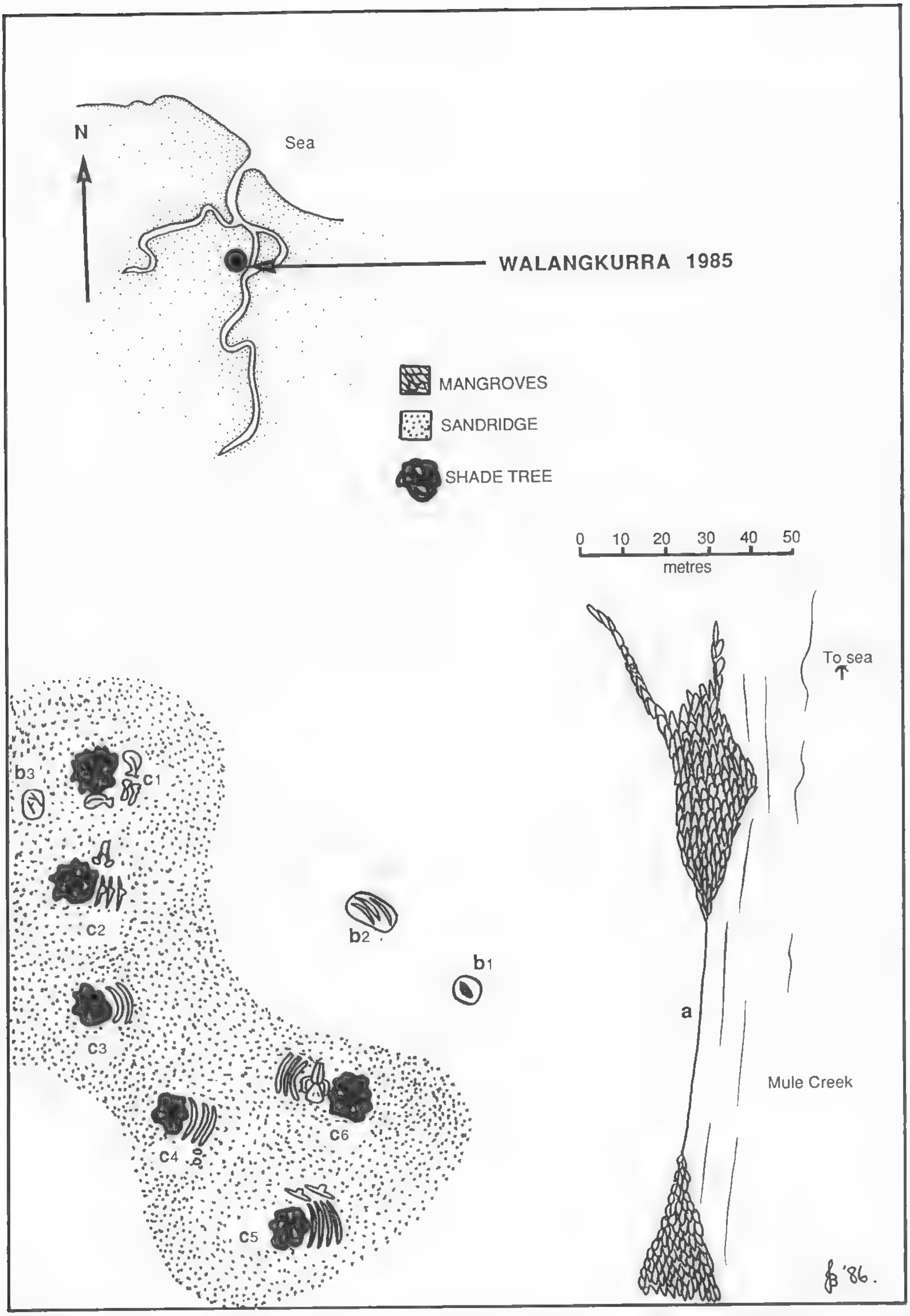

FIGURE 15. The Walangkurra site, on the Mule Creek – Bing Bong Pastoral Lease. a: Butchering area for dugong and sea-turtle. b[1]: Ground oven for sea-turtle containing burnt up shell and flippers. b[2]: Ground oven for dugong containing rib-bones and ground oven stones. b[3]: Secondary ground oven for sea-turtle meat; also contains pelvic bones of the sea-turtle. c[1]: Hunter's sister's camp; shoulder blades and humerus. c[2]: Hunter's mother's camp; jaw bone and lumbar vertebrae. c[4]: Boat driver's camp; rib-bones and small vertebrae from tail. c[5]: Hunter's camp; rib-bones and lumbar vertebrae. c[6]: Hunter's cousin's camp; *jungkayi* for dugong; head and rib-bones.

found did not correlate with the traditional methods employed by the Yanyuwa. It is reasonable to infer therefore that this dugong too was a victim of non-Aboriginal hunters.

The continuing episodes of damage to the dugong and sea-turtle population greatly concern the Yanyuwa. The dugong and sea-turtle represent Dreamings for certain individuals and groups of people. The continuing episodes of dugong slaughter, damage to important areas for sea-turtle and the desecration of important ritual centres causes unrest in terms of the functioning of a traditionally-based society. There is also concern that those people who stand in a 'mother' guardian relationship to the dugong and sea-turtle are not fulfilling their duties and obligations towards the species, an offence which is punishable under the dictates of traditional Law.

It becomes clear then, that to the Yanyuwa and Mara people the problem is not just conservation of the dugong and sea-turtle, but also the maintenance of ritual activities which reinforce the spiritual principles underlying Yanyuwa/Mara society. The Yanyuwa people are justifiably proud of their dugong and sea-turtle hunting heritage. In their oral history accounts certain men are mentioned over and over again as being 'dugong and sea-turtle hunters of excellence', *maramaranja.* Younger men will say with pride that they were 'trained' by these skillful men. Certain old men among the Yanyuwa who were skilled hunters in their youth are spoken of with high regard and their advice is still sought in terms of Law and practical knowledge concerning the dugong and sea-turtle. In a world where values are changing quickly the continuation of the hunting of these two marine animals remains one way in which the Yanyuwa people can continue to identify themselves with pride as 'salt-water people'.

ACKNOWLEDGMENTS

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THE CUSTODIANSHIP OF SACRED OBJECTS PROJECT : AN OVERVIEW

CHRISTOPHER ANDERSON

Summary

For the last five years the South Australian Museum's Custodianship of Sacred Objects Project has operated in Central Australia in an attempt to inform Aboriginal people about the Museum's Restricted Collection and to discuss with them ways to deal with it.

THE CUSTODIANSHIP OF SACRED OBJECTS PROJECT: AN OVERVIEW

For the last five years the South Australian Museum's Custodianship of Sacred Objects Project has operated in Central Australia in an attempt to inform Aboriginal people about the Museum's Restricted Collection and to discuss with them ways to deal with it.

The project, run by Christopher Anderson with the assistance of other Division of Anthropology staff especially Philip Clarke, has concentrated on the *tjurunga* and sacred boards from Central Australia. This is because these constitute almost 80% of the South Australian Museum's collection of restricted material.

There are four aspects to the project:

a) physical organisation of the collection and of its documentation; computerization of all data for immediate access;

b) planning and implementing a programme to let Aboriginal people in the relevant communities know about the collection's content and secure storage; providing details of the project for discussion regarding custodianship of the collection;

c) Narrowing the focus of discussions to particular communities and beginning the necessary background research; consulting with senior men in these communities;

d) Return of objects (if this is the outcome and if all conditions set by all parties are met); fulfilling the responsibilities and commitments that come out of the relationships created by the project (assistance with establishment of local 'keeping places', assistance with cultural activities such as joint exhibitions, and so on).

A further related aspect has been the visits to the Museum by senior Aboriginal men from Central Australia. Since 1985 we have had eleven major visits by men to view the storage arrangements for restricted objects and to discuss matters relating to them. In most cases these visits were funded from outside the project; generally, the men were already in Adelaide for other purposes. They have always been very happy with the storage and curation arrangements at the Museum.

Discussions in Adelaide and in Aboriginal communities have also been held about secret/sacred material from north-east Arnhem Land, Borroloola (Northern Territory), and Aurukun (Queensland). We have also offered advice to other communities, including Docker River, and to Eastern Aranda people in Central Australia about the location of certain secret/sacred objects which have been noted as missing from those communities.

Fieldwork

As the Curator responsible for this project, I have conducted ten field trips totalling over 160 days to the following communities:

Yuendumu and outstations (N.T.)
Yuelamu (Mt Allan) (N.T.)
Mt Liebig (N.T.)
Walungurru (Kintore) and outstations (N.T.)
Papunya (N.T.)
Fregon (S.A.)
Ernabella (S.A.)
Marree (S.A.)
Oodnadatta (S.A.)

Because of the detailed knowledge required of local community politics, I have had to rely on anthropologists who already know a given community well for background information and assistance. This has on occasion involved travel for the purposes of working with them prior to a field trip. In some cases we have funded them to come to Adelaide and also engaged them as consultants in the field. Because of the inability of one person to handle all consultations that arise from the project we are using external funding to supplement Museum resources to engage consultants to assist with at least four communities (Maryvale, Hermannsburg, Haast Bluff and Mt Liebig). Geoff Bagshaw has undertaken considerable work on the project at Haast Bluff, Kintore and elsewhere. I have also had assistance from John Kean and from staff of the Central Land Council.

Results

The South Australian Museum has returned around 130 restricted objects to Aboriginal custodians in Central Australia. Aboriginal men have thus far only been willing to discuss objects for which there is reasonably full documentation. At the very least, the 'Dreaming' or totemic affiliation and the site name are required. On this criterion only about 20% of the South Australian Museum's collection is subject to the project's consultation programme and possible transfer of custodianship. The Museum considers itself to have an important obligation to continue preserving the other material. The communities involved have supported us in this.

The future of the project

The salary of a full-time curator at a Scientific Officer Grade 3 level and office overheads have been met by the South Australian government. The redevelopment of the Restricted Collection store, including the installation of purpose-built cabinets, was completed at a cost of $100,000 as part of the overall Anthropology store and office re-organization during 1985-86. The Anthropology Division contributes annually towards the project's running costs and towards care of the collection. Field consultation trips averaging three weeks in duration cost about $5000 each, including vehicle costs and field expenses. The Department of Aboriginal Affairs has contributed $43,507 toward the cost of the project. This has been primarily to cover consultation expenses.

Existing grant funds were exhausted at the end of 1990 and with the restructuring of Aboriginal funding through the newly established Aboriginal and Torres Strait Islander Commission (ATSIC), the project will have to be funded differently. Personnel changes within the Division of Anthropology may also affect the project.

The Custodianship Project has benefited the Museum in many ways in its dealings with Aboriginal communities. The issues go far beyond those involving secret/sacred material. The project has also attracted considerable attention from the museum and anthropology professions, and has raised the national and international profile of the South Australian Museum.

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CONTENTS:

ARTICLES

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A NEW GENUS OF THE BRYOZOAN FAMILY ELECTRIDAE, WITH A PLECTRIFORM APPARATUS

D. P. GORDON & S. A. PARKER

GORDON, D. P. & PARKER, S. A. 1991. A new genus of the bryozoan family Electridae, with a plectriform apparatus. *Rec. S. Aust. Mus.* 25(2): 113–120.

A new bryozoan genus, *Mychoplectra* (type species *Lepralia pocula* Hutton), is established for two southern Australian species of Electridae with a spurred, scoop-like plectriform apparatus. These species were formerly placed in *Pyripora*, which lacks such an apparatus. It is shown that *M. pocula* is not conspecific with *Cellepora alata* Lamouroux, which is a species of *Diploporella* (Thalamoporellidae). *Mychoplectra pocula* is a protogynous hermaphrodite.

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The electrid bryozoan genus *Pyripora* d'Orbigny, 1849 is best known by the north-eastern Atlantic Recent species *P. catenularia* (Fleming). This species, like a number of related fossils including the type species *P. pyriformis* (Michelin), forms encrusting branching chains of simple pyriform zooids, each of which has a proximal gymnocyst and a coextensive membranous frontal wall with a narrow granular cryptocyst bordering the opesia. As is typical of electrids, there are no avicularia or ovicells. As Taylor (1986) has remarked, the absence of ovicells in these species suggests that the larva is of the planktotrophic cyphonautes type, though none has yet been recognized.

Three species of *Pyripora* have been reported from the southern coast of Australia: *P. polita* (Hincks, 1880), *P. crassa* (MacGillivray, 1869) and *P. catenularia* (Fleming, 1828). *Pyripora polita* (=*Lepralia pocula* Hutton, 1878, see below) is a common encruster of sea-grass stems and has been illustrated by scanning electron microscopy [Bock 1982, fig. 9.7(c)]. *P. crassa* and Australian *P. catenularia* have to date been little-known.

During an examination and subsequent taxonomic revision of F. W. Hutton's collection of South Australian bryozoans in the Otago Museum, New Zealand (Gordon & Parker 1991b), skeletal structures were discovered in '*P.' pocula* that clearly affected its generic placement. This finding led to an investigation of all three putative Australian species of *Pyripora*. The skeletal structures constitute the plectriform apparatus (Gordon & Parker 1991a), an internal elaboration of the gymnocyst, which occurs in several species of malacostegine bryozoans. It does not occur in the type species of *Pyripora* (*P. pyriformis*), however, and a new genus is required for the Australian species.

SYSTEMATICS

Mychoplectra gen. nov.

Diagnosis

Colony encrusting, uniserial to multiserial. Zooids generally pyriform, with extensive proximal gymnocyst and narrow granular cryptocyst. Kenozooids present. Plectriform apparatus present. Articulated spines, avicularia and ovicells absent. Embryos numerous, non-brooded. Simple uniporous septula present.

Etymology

Mychoplectra, f., formed from Gk *mychos*, inmost part, recess, and *plektron*, spur. Although *plektron* is a neuter noun, *Mychoplectra* is here introduced as feminine in gender [see the International Code of Zoological Nomenclature, Article 30(a) (iv) (Ride *et al.* 1985: 58–59)].

Type species

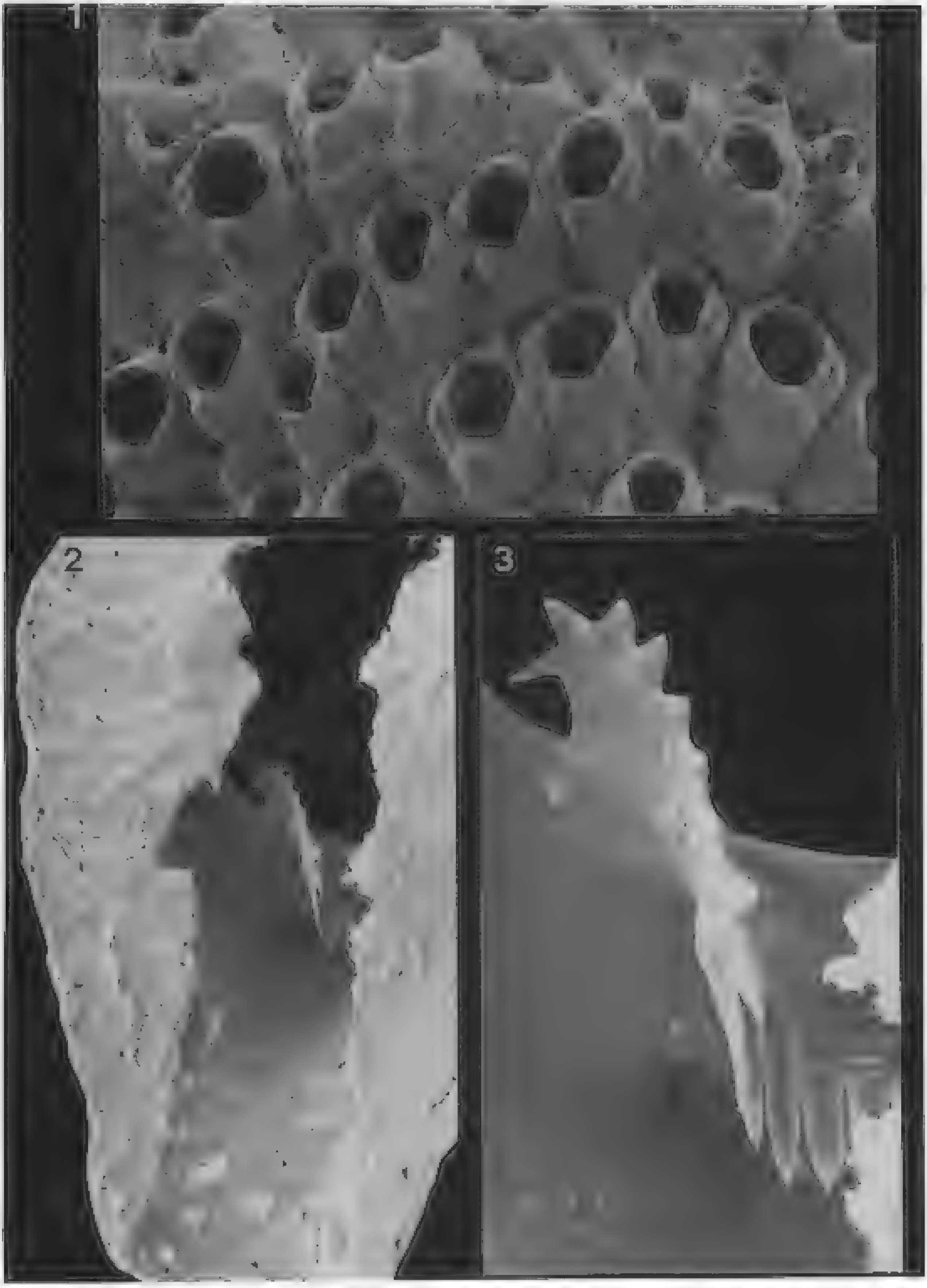
Lepralia pocula Hutton, 1878.

Mychoplectra pocula (Hutton)
(Figs 1–4)

Lepralia pocula Hutton, 1878: 24; Jelly 1889: 132.
Membranipora polita Hincks, 1880: 377; MacGillivray 1882: 118; Jelly 1889: 161.
Pyripora polita: MacGillivray *in* McCoy 1885: 24; 1887: 205; 1890: 2; Vigeland 1964: 169; Bock 1982: 343.

Material examined (localities all in South Australia)

South Australian Museum. Vials: SAM L475, 476, off Seacliff, Adelaide district, Gulf St Vincent, 11 m, coll. S. A. Shepherd, 28 Sept. 1968; L477, Port Elliot, Encounter Bay, undated; L490, no data. Slides: L189a,



FIGURES 1–3. *Mychoplectra pocula* (Hutton): 1. colony on shell of turritellid gastropod (SAM L490, no locality). × 40; 2 and 3, view of plectriform apparatus from within the zooid (paralectotype, OM A.88.160B, Gulf St Vincent, South Australia). × 275, × 890.

off Adelaide, 20–35 fms [37–64 m], coll. J. C. Verco, undated; L479–481, Glenelg, Adelaide, undated; L482, 'S. Aust.', undated. Spirit specimens: L483, West I., Encounter Bay, 3–5 m, coll. N. Holmes, 8 July 1988; L484, just E of The Bluff, Encounter Bay, upper subtidal, coll. K. L. Gowlett-Holmes and S. A. Parker, 18 July 1988; L488, Edithburgh, Yorke Peninsula, upper subtidal, coll. P. Hudson, 24–28 April 1989; L491, Port Victoria jetty, Yorke Peninsula, 1–2 m, coll. K. L. Gowlett-Holmes, 25 July 1989; L499, 5 Nm NW of Outer Harbor, Adelaide district, coll. N. Holmes, 7 Nov. 1989.

Otago Museum. Vials: OM A.88.160A, B, shores of Gulf St Vincent, coll. R. Tate (lectotype and paralectotype of *Lepralia pocula* Hutton).

N.Z. Oceanographic Institute. Vial: Stn Z6722, just E of the Bluff, Encounter Bay, upper subtidal, coll. S. A. Parker and T. Sim, 10 Feb. 1989.

Substrates

SAM L477 and L482 were on algae, L490 on a turritellid gastropod, and the remainder on stems of the sea-grasses *Amphibolis antarctica* and *A. griffithii*.

Description

Colony encrusting, pluriserial, with short uniserial runners distally that also become pluriserial as the colony expands. Colour in life pearly white, often with a pinkish tinge from thinly encrusting and/or endozoic red algae. Zooids 0.32–0.64 × 0.17–0.32 mm, elongate-pyriform, often occurring in oblique rows depending on the substratum. Frontal surface a smooth, porcellaneous gymnocyst, sometimes with transverse growth-check lines proximally, that surrounds the variably subpyriform/suboval sunken opesia; frontal membrane set at angle of *ca* 20–45° to the plane of the substratum; gymnocyst with 3 large rounded eminences bordering the opesia, 2 lateral, with a larger swelling at the highest part of the frontal wall that overhangs the proximal part of the opesia and frontal membrane; the underside of the gymnocystal overhang with a prickled surface. Cryptocyst narrow, vertical, rarely shelf-like, not or scarcely developed proximally, with no or sparse granulations. Avicularia absent. Kenozooids present interzooidally (depending on crowding of zooids), with a variably shaped membranous area. Plectriform apparatus comprising a median scoop proximally recurved with distal teeth, and a pair of lateral spurs which may project into the opesia. Additional tiny spurs may protrude into the body cavity beneath the lateral cryptocyst. Calcareous spinous processes also arise from the inner side of the frontal gymnocyst proximally, projecting into the coelom. Generally 1–2 openings of narrow intramural basal pore-chambers present frontally. Polypide with 12 tentacles. No ovicells; zooids protogynous hermaphrodites, producing numerous non-brooded embryos. Ancestrula unknown.

Remarks

Mychoplectra is established for this species and for '*Pyripora*' *crassa*, both of which are characterized by a plectriform apparatus. Like *Pyripora*, *Mychoplectra* has a well-developed gymnocyst, a partial cryptocyst, extensive area of membranous frontal wall, and kenozooids. Both genera lack oral or mural spines, avicularia, and ovicells. Whereas Recent *Pyripora* have discrete basal pore-chambers with a septular wall (these details unknown for the fossil type species), *Mychoplectra* has small tubular intramural chambers, comparable to those in *Hippothoa divaricata* (see Gordon & Hastings 1979, fig. 2, C), with a tiny uniporous septulum.

The earliest available name for the type species is *Lepralia pocula* Hutton, 1878, described without illustration, and subsequently overlooked. Recently, Hutton's collection from South Australia was discovered in the Otago Museum, Dunedin (Gordon & Parker 1991b). His specimens of *Lepralia pocula* were formally registered and a lectotype (A.88.160A) designated from the syntypes. It is not inconceivable that instead of *pocula* Hutton had meant to write the substantival form *poculum*. Even if this had been so, however, the spelling cannot now be corrected to *poculum*; for, there is in Hutton's original description no clear internal evidence of an inadvertent error, and no indication that *poculum* is the correct substantival form [see the International Code of Zoological Nomenclature, Article 32(c) (ii) (Ride *et al.* 1985: 68–69)]. We therefore suggest that *pocula* be retained, and treated as adjectival in form.

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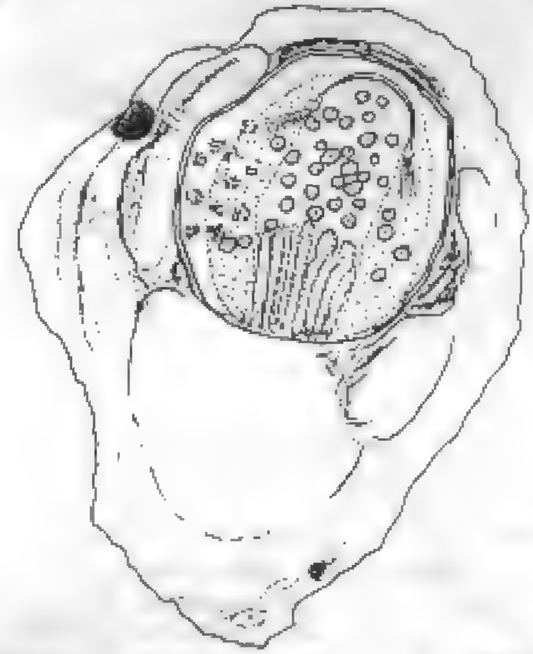
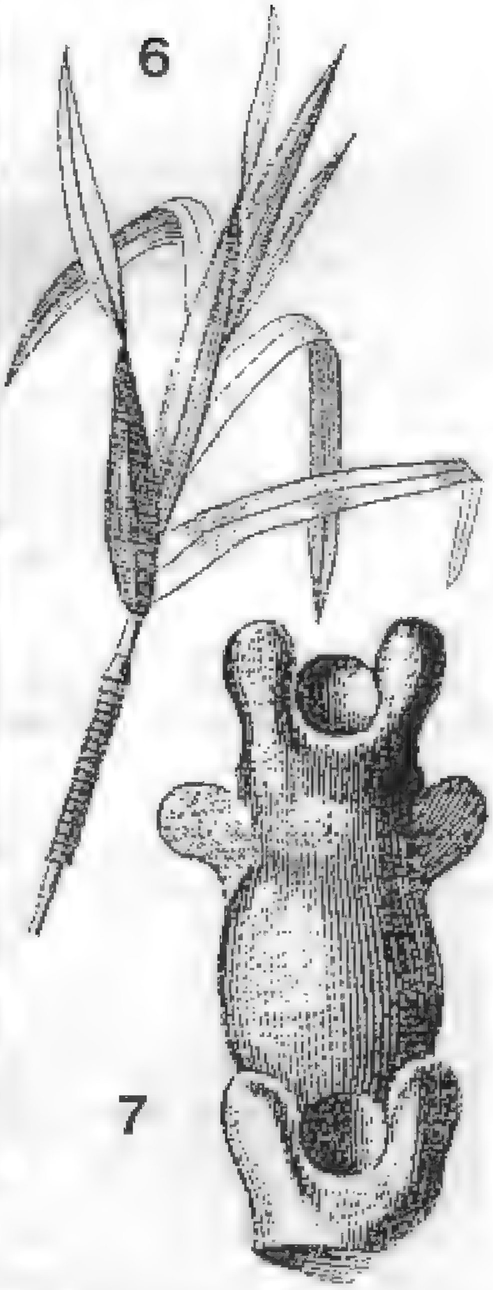


FIGURE 4. *Mychoplectra pocula* (Hutton): single zooid, with testes (left-hand side) and oocytes visible under the frontal membrane (NZOI Stn Z6722, near Victor Harbor, South Australia, from colony on stem of *Amphibolis antarctica*), × 105.



FIGURES 5–7. *Diploporella alata* (Lamouroux): 5, zooids from stem of *Amphibolis antarctica* (OM A.88.161, Gulf St Vincent, South Australia, Hutton Collection); 6 and 7, Lamouroux's (1821) illustrations of *Cellepora alata* on type material of *Amphibolis antarctica* from Esperance Bay, Western Australia.

In his account of Hincks' (1880) species *Membranipora polita*, MacGillivray (1882) commented that it probably ought to form the type species of a new genus, to include also *Hippothoa crassa* MacGillivray, 1869. While prescient, this was in contradistinction to *Membranipora*, not *Pyripora*, in which genus MacGillivray (*in* McCoy 1885) later included *M. polita*, and *H. crassa*. Concerning *M. polita* MacGillivray (1882) also stated, 'I have little doubt that it is identical with Lamouroux's *Cellepora alata*.' He repeated this assertion in McCoy (1885), in which he transferred the species to *Pyripora*. Jelly (1889), following MacGillivray, tentatively listed Lamouroux's (1821) species with *M. polita*. MacGillivray was in error, however. As suggested by Harmer (1926: 289), *Cellepora alata* is a senior synonym of the species currently known as *Diploporella cincta* (Hutton), formerly *Thairopora cincta* (Fig. 5) (see Soule *et al.* 1991). Both *Mychoplectra pocula* and *D. cincta* encrust stems of the cymodoceacean seagrasses *Amphibolis antarctica* and *A. griffithii* along the southern Australian coast. Lamouroux (1821, pl. 64, figs 10, 11) illustrated part of a leafy stem of *A. antarctica*, reproduced here (Fig. 4), showing zooids and a colony of an encrusting bryozoan (Figs 6, 7). *Mychoplectra pocula* and *Diploporella cincta* are two of only three bryozoan species [the other being *Electra flagellum* (MacGillivray)] to form regularly whorled zooidal rows on *Amphibolis*, but Lamouroux's illustration cannot be of *Mychoplectra*, for the latter produces only oblique whorls, not regularly transverse ones (verticillate) as depicted by Lamouroux. Lamouroux's illustration of the zooids confusingly fails to show the cryptocyst of *D. cincta* but his description (1821: 2) makes it clear. He describes the zooids as '*gibbeuses inférieurement, avec deux appendices ptéroïdes sur leur parties moyenne et latérale; ouverture ronde avec un tubercule très-gros et mamilliforme de chaque côté.*' This is a description of zooids with the membranous frontal wall intact. The wing-like appendages correspond to the pair of smooth gymnocystal flaps, which encroach onto the convex cryptocyst; the mamilliform tubercles occur on either side of the subcircular orifice (Fig. 5). As Harmer (1926: 289) suspected, therefore, *Diploporella alata* (Lamouroux, 1821) is the correct name for this species. The type locality is Esperance Bay, Western Australia (Womersley 1984: 104). The type specimen would be on type material of *Amphibolis antarctica*, evidently housed at the Herbarium Universitatis Florentinae, Florence, Italy, but upon enquiry, the latter has been unable to be located.

Mychoplectra crassa (MacGillivray)
(Figs 8–10)

Hippothoa crassa MacGillivray, 1869: 130.
Pyripora crassa: MacGillivray *in* McCoy 1885: 23; 1887: 205; Vigeland 1964: 169.
Pyripora catenularia: MacGillivray (*non* Fleming) *in* McCoy 1885: 24, pl. 106, fig. 5; 1887: 205; Vigeland 1964: 169.

Material examined

South Australian Museum. Vials: L189b, off Adelaide, Gulf St Vincent, 20–35 fms [37–64 m], coll. J. C. Verco (undated); L485, Chiton Rocks near Victor Harbor, Encounter Bay, coll. L. Stach, 20 Nov. 1936; L486, Kangaroo I., no other data; L487, S. Aust., no other data; L489, between Backstairs Passage and The Pages, coll. J. C. Verco (undated); L500, Shell Rock, West I., Encounter Bay, coll. S. A. Shepherd, 18–19 Aug. 1967; L502, Price I., southern Eyre Peninsula, 17 m, coll. L. Hobbs, 28 Sept. 1989. Spirit: The Pages (islets), Kangaroo I., 15 fms [27.5 m], coll. K. Sheard, 12 April 1941.

Museum of Victoria. Slides (both labelled *Pyripora catenularia*): NMV F58646, Port Phillip Heads, Victoria, coll. J. B. Wilson; NMV F58647, Hobsons Bay, Victoria (no other details).

Substrates

L189b, L485–487 on red algae (including *Pterocladia lucida*); L489 on adeonid bryozoan (with *Turbicellepora redoutei*); L498 on stalk of brachiopod *Magellania flavescens*; L500 on hydroid; L502 on flat rounded pebble; F58646 on stem of ?hydroid; F58647 on angular pebble.

Description

Colony encrusting, uniserial, branching more or less cruciform, to pluriserial. Zooids 0.23–0.64 × 0.14–0.42 mm, elongate-pyriform, the proximal caudal portion short, truncated in laterally budded zooids, longer and tapering in distally budded zooids. Frontal gymnocyst smooth, sometimes with a thick porcellaneous protuberance immediately proximal to the membranous frontal wall; cryptocyst shelf-like, moderately developed, widest proximally, pustulose; frontal membrane set at shallower angles to substratum than in *M. pocula* (0–25°). Avicularia absent. Kenozooids may be present interzooidally, replacing autozooids at distolateral budding sites when crowding occurs, the opesia irregularly circular to oval. Plectriform apparatus similar to that in *M. pocula* but the distal spurs of the apparatus tend to be more often visible, with at least one protruding somewhat into the opesial space; tiny spur-like spines may occur sparsely on the lateral walls. Internal nail-like spines occur proximally under the gymnocyst. Small intramural basal pore-chambers present, up to 2 per side but the proximal pair may be suppressed. No ovicells. Ancestrula unknown.

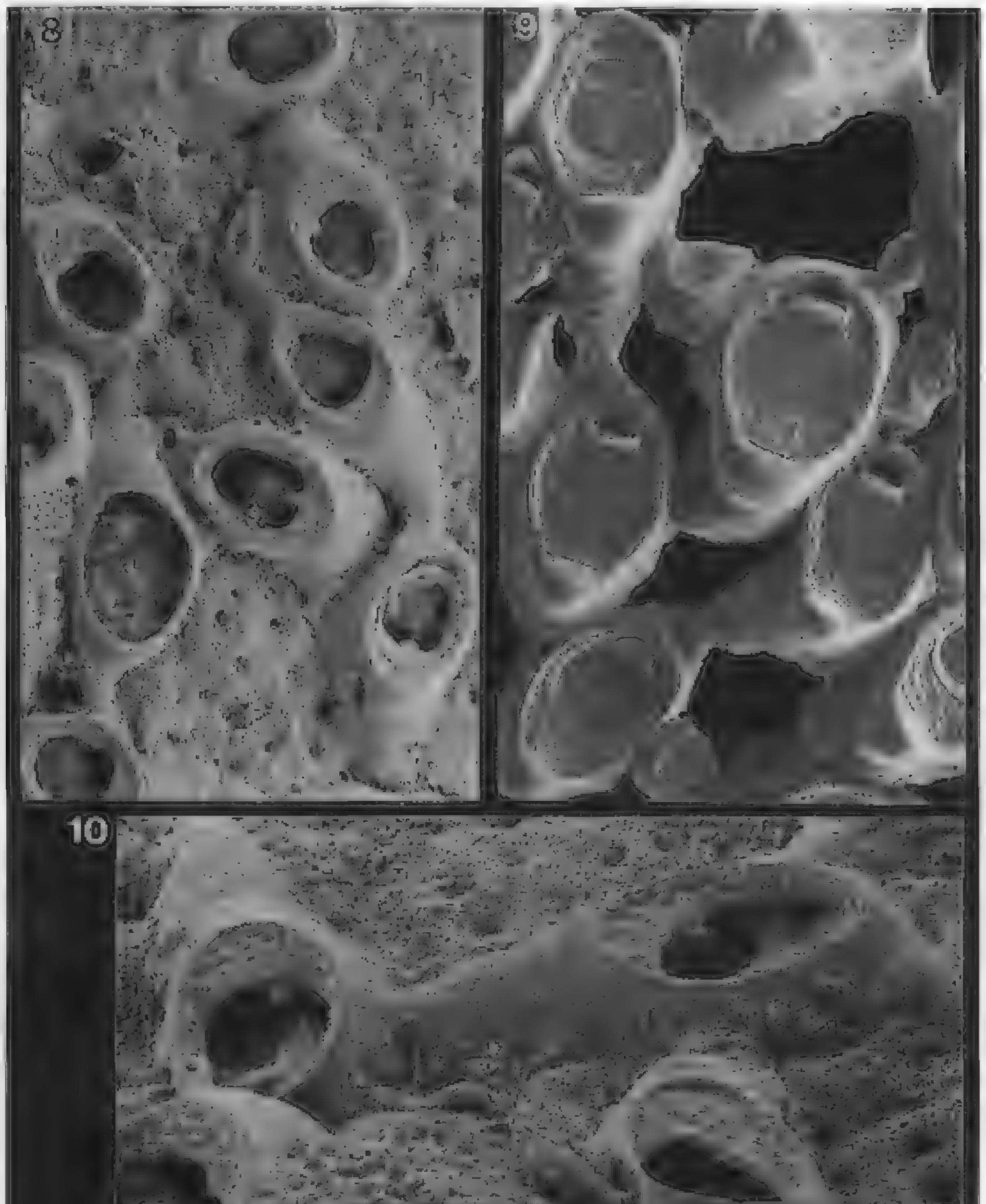
Remarks

Two types of zooids were evident in the colonies of *M. crassa* examined:

a) (Fig. 9) zooids possessing a protuberance on the gymnocyst proximal to the frontal membrane [corresponding to the 'thick lip-like projection' of MacGillivray (1869), MacGillivray *in* McCoy (1885)], the protuberance sometimes bearing a pit-like depression apparently covered with a membrane; some zooids showing additional gymnocystal thickening on the proximolateral margins of the opesia, though this thickening not encroaching over the frontal membrane as in *M. pocula*.
b) (Figs 8, 10) zooids lacking gymnocystal protuberances and thickenings, and outwardly resembling *Pyripora catenularia* (Fleming).

Type 'a' occurred in the colonies on the relatively flexible substrates (fronds and stems of red algae, hydroids and brachiopod stalk). Type 'b' occurred on the harder substrates (L489, adeonid bryozoan, and L502 and F58647, pebbles). In addition, colony L502 has many Type 'a' zooids and zooids intermediate between the two types, which leads us to regard them as expressions of the one species, *M. crassa*, rather than as representing different species.

Through the courtesy of Mr T. Stranks of the Museum of Victoria, we have been able to examine on loan two of the slides identified by MacGillivray as



FIGURES 8–10. *Mychoplectra crassa* (MacGillivray): 8 and 10, colony on adeonid bryozoan (SAM L489, between Backstairs Passage and The Pages, South Australia) × 60, × 115; 9, colony on red alga (?*Pterocladia lucida*) (SAM L485, Chiton Rocks, Encounter Bay, South Australia), × 170.

Pyripora catenularia (F58646, 58647, listed above). These colonies are both referable to *M. crassa*, the first having zooids of Type 'a', the second zooids of Type 'b'. MacGillivray's figure (in McCoy 1885) is also of type 'b', which differs from true *Pyripora catenularia* (Fleming 1828) of the north-eastern Atlantic Ocean by the possession of the plectriform apparatus, the proportionately larger cryptocyst and the beading of the mural rim less distinct to absent. Scanning electron micrographs of *P. catenularia* have been published in Taylor (1986).

Recent species of *Pyripora* appear to be restricted to the Northern Hemisphere (Ryland & Hayward 1977; Canu & Bassler 1929). *Mychoplectra*, on the other hand, is so far known only from the Southern Hemisphere. *Pyripora audens* Marcus, 1949 of Brazil is certainly a *Mychoplectra*, and from its external morphology *Membranipora eburnea* Hincks, 1891 (type locality '? Queensland') may also be congeneric.

Apart from the type species *P. pyriformis*, several other fossil species have been ascribed to *Pyripora* (*e.g.* by Canu & Bassler 1920; Thomas & Larwood 1956, 1960; Larwood 1973; Voigt 1982) and it would be instructive to examine the interior walls of these for a plectriform apparatus, which in *Mychoplectra pocula* appears to be a guide for the movements of the polypide (Gordon & Parker 1991a).

Reproduction

Details of reproduction in *Pyripora* are not known, though it is suspected of having a cyphonautes-type larva. In *Mychoplectra*, the only breeding information pertains to *M. pocula*. In South Australian waters, gonads are evident in colonies collected in February, and colonies have been found spawning in February, July and November. Testes and apparently mature oocytes occur in the same zooids. Oocytes are spherical, approximately 0.01 mm in diameter, and in living material are brownish-red and set in a clear gelatinous matrix; *ca* 30 or more are evenly distributed under the membranous part of the frontal wall.

The timing of maturation of gametes varies in electrids. *Electra pilosa* and *E. posidoniae* tend to be protandrous whereas in *E. crustulenta* male and female gametes mature simultaneously (Silén 1966). Up to 20 ova are produced by *E. posidoniae* (Silén 1966) and a much larger number by the membraniporid *Membranipora membranacea* (39 are illustrated) (Silen 1945). The cyphonautes larvae of these species have been illustrated by Ranzoli (1963) and Ryland (1964, 1965). A cyphonautes larva is presumed for *Mychoplectra*. Plankton-sweeps over *Amphibolis* beds around times of egg-release might reveal the larval form of *M. pocula*.

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We should like to thank K. L. Gowlett-Holmes, N. Holmes, L. Hobbs, T. Sim and P. Hudson for assistance in collecting material, T. Stranks for the loan of specimens in the Museum of Victoria, and P. L. Cook, P. J. Hayward and J. S. Ryland for helpful comments on the manuscript.

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DISCOVERY AND IDENTITY OF 110-YEAR-OLD HUTTON COLLECTION OF SOUTH AUSTRALIAN BRYOZOA

D. P. GORDON & S. A. PARKER

GORDON, D. P. & PARKER, S. A. 1991. Discovery and identity of 110-year-old Hutton Collection of South Australian Bryozoa. *Rec. S. Aust. Mus.* **25**(2): 121-128.

A long-overlooked collection of bryozoans from South Australia described by Hutton in 1878 has been discovered and examined. Identifications are given for the species in the collection, with annotations. Although most of Hutton's names are junior synonyms of earlier-named species, two are senior and necessitate nomenclatural changes: *Adeonellopsis zietzii* (MacGillivray, 1889) becomes *A. baccata* (Hutton, 1878) and *Pyripora polita* (Hincks, 1880) becomes *Mychoplectra pocula* (Hutton, 1878).

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Examination of a collection of South Australian Bryozoa in the Otago Museum, Dunedin, New Zealand has yielded information on the identity of several nominal taxa that affects modern nomenclature. The collection, overlooked for 110 years, was discovered in 1988 following an enquiry from one of us (S.A.P.) as to its probable whereabouts.

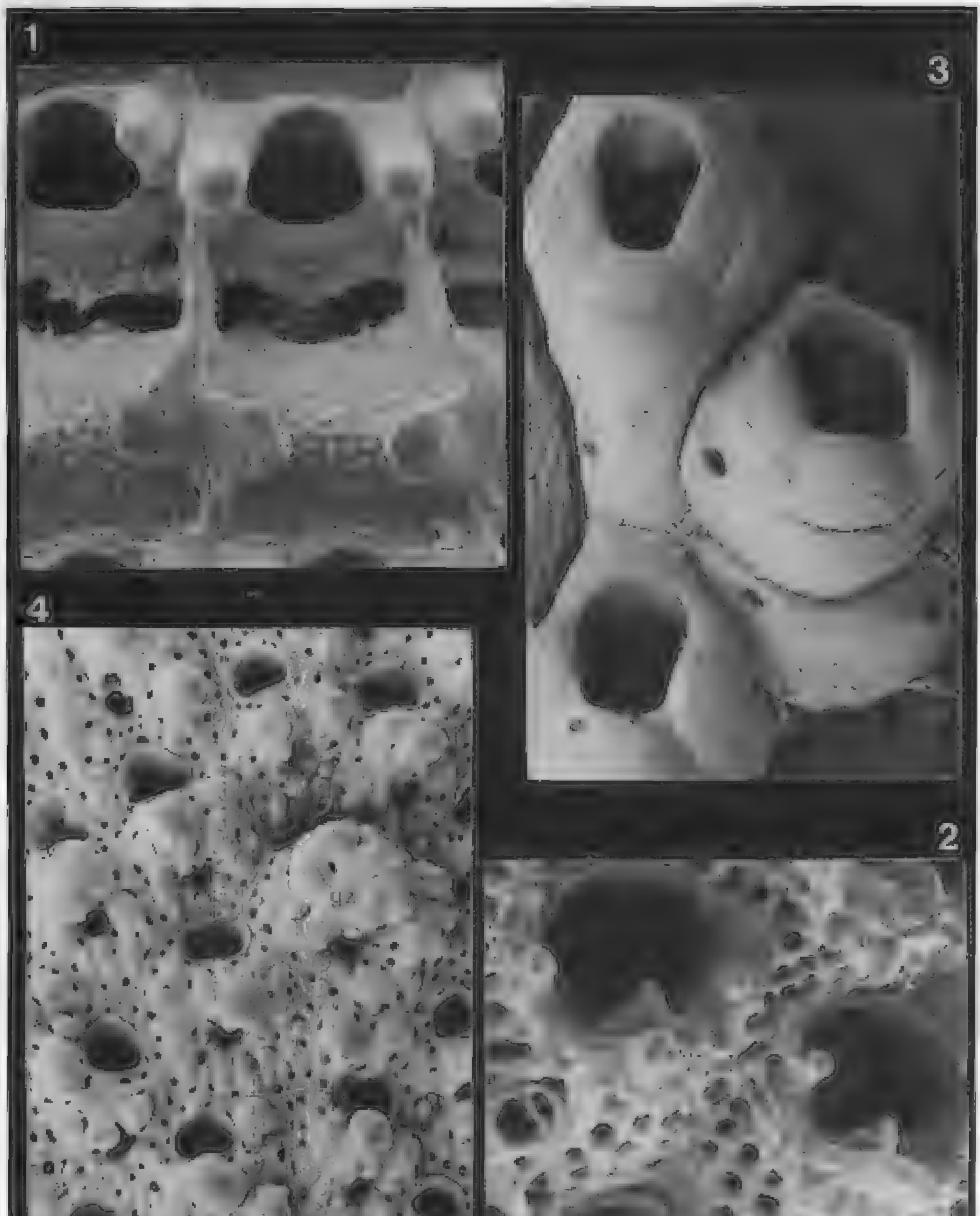
Frederick Woollaston Hutton, an English-born and -educated geologist, was an important contributor to nineteenth-century New Zealand science. During his various appointments he had found it necessary to become a botanist and zoologist as well and described a wide range of organisms, including birds, fishes, molluscs, insects, worms, hydroids and Bryozoa. When, in 1876, he was appointed Professor of Natural Science at Otago University, he also had charge of the Otago Museum, which as Director and Curator he practically founded. While in this capacity, he received from Professor Ralph Tate, an Honorary Member of the Royal Society of Tasmania, a collection of bryozoans from the shores of Gulf St Vincent, South Australia. Hutton (1878) briefly described most of these, naming six as new. Unfortunately, none was illustrated and, probably for this reason, the identity of all but one of the new species has been unrealised. Further, the specimens remained unexamined in the Otago Museum for 110 years.

The collection comprises 20 species. Two are not mentioned in Hutton's (1878) paper whereas some other species mentioned in the paper are not in the collection. One to several specimens of each species was contained in a folded piece of paper with only a number to identify it. On a separate piece of paper in the same box as the specimens and in Hutton's faded inked handwriting was a key to the number with names alongside, the new species' names in pencil only (one new species-name was subsequently changed in Hutton's paper but identifiable nonetheless). All of the specimens have now been labelled and registered (numbered A.88.148 to A.88.172 in the Otago Museum register). All six of Hutton's new species are represented. Hincks (1881) recognised that one was a senior synonym of a species described by himself in 1880. Now that the identities of the remaining five are known for the first time, it is apparent that two currently used names will have to drop into synonymy.

REVISION OF HUTTON'S LIST

In Hutton's (1878) three-page paper, 23 species are listed, nine of them (including the two resuscitated) accompanied by descriptive annotations. All are listed below, in the same order. For the 20 species still present in the Otago Museum collection, revised identifications are given where necessary. Registration numbers are given at the end of each entry.

1. *Caberea rudis*: ***Caberea grandis*** Hincks, 1881 [*non Amastigia rudis* (Busk, 1852)]. A.88.166.
2. *Membranipora lacroixi* [sic]. No specimen in collection. *M. lacroixii* Audouin, 1826 is currently regarded as a synonym of the extra-Australian *Conopeum reticulum* (Linnaeus, 1767).
3. *Membranipora* (?) *cincta*: ***Diploporella alata*** (Lamouroux, 1821), formerly *Thairopora cincta* (Hutton, 1878) (Fig. 1). Use of the generic name *Diploporella* MacGillivray, 1885a follows Soule *et al.* (1991), who reseparated this genus from *Thairopora*. Use of the trivial name *alata* follows Gordon & Parker (1991). *D. alata* is also a senior synonym of *Membranipora transversa* Hincks, 1880. A.88.161, holotype of *Membranipora* (?) *cincta* Hutton.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4. *Lepralia candida*: **Arachnopusia unicornis** (Hutton, 1873) [*non Fenestrulina candida* (MacGillivray, 1860a)]. A.88.163.

5. *Lepralia elegans*: **Adeonellopsis sulcata** (Milne Edwards, 1836) [*non Hippoporina elegans* (MacGillivray, 1860b)]. A.88.168.

6. *Lepralia tatei*: **Didymosella larvalis** (MacGillivray, 1869). A.88.158, holotype of *Lepralia tatei* Hutton.

7. *Lepralia spicea*: **Mucropetraliella ellerii** (MacGillivray, 1869) (Fig. 2). A.88.162, holotype of *Lepralia spicea* Hutton.

8. *Lepralia baccata*: **Adeonellopsis baccata** (Hutton, 1878) (Figs 4–7). Senior synonym of *Adeonellopsis zietzii* (MacGillivray, 1889). This little-known species, purplish in life, encrusts small algae and stems of the cymodoceacean seagrass *Amphibolis*. It is strictly encrusting, unlike the similarly coloured *A. sulcata*, which can begin as an encrusting form but later gives rise to bilamellar lobes. *Adeonellopsis baccata* is also readily distinguished from other *Adeonellopsis* species by its zooidal morphology — the autozooidal spiramen is single, sometimes slightly stellate, whereas that of the female zooid is compound, generally with three pores. Avicularia are rare, and the zooidal surface is knobbly, with cauliflower-like excrescences. A.88.159, holotype of *Lepralia baccata* Hutton.

9. *Lepralia pocula*: **Mychoplectra pocula** (Hutton, 1878) (Fig. 3). Senior synonym of *Membranipora polita* Hincks, 1880 and type species of the genus *Mychoplectra* Gordon & Parker, 1991. A.88.160A, lectotype and A.88.160B, paralectotype of *Lepralia pocula* Hutton (see Gordon & Parker, 1991).

10. *Cellepora agglutinans*: **Celleporaria cristata** (Lamarck, 1816). *Celleporaria agglutinans* (Hutton, 1873), widely distributed in New Zealand, is not known from Australia. In zooidal features the two species are very similar, but *C. cristata* typically forms bilamellar lobes with a crest. One of the most consistent differences between *C. agglutinans* and *C. cristata* is the insignificant or scarcely evident condyles of the autozooidal orifice in the former compared with the stout condyles in the latter (*cf.* Gordon 1989, plate 16D). Both species have a ligula on the crossbar of the columnar avicularium, like that in *C. fusca* (Busk, 1854), but *C. fusca* has a toothed rostrum (cf. Bock 1982, fig. 9.17d). A.88.167.

11. *Cellepora edax*: **Calyptotheca lata** (MacGillivray, 1883) [*non Hippoporidra edax* (Busk, 1859); *non Hippoporidra lusitania* (Taylor & Cook, 1981)]. A.88.156.

12. ?*Cellepora tubigera*: **Celleporaria cristata** (Lamarck, 1816) [*non Turbicellepora tubigera* (Busk, 1859)]. A.88.152, 153, 154, 170.

13. *Eschara contorta*: **Parasmittina unispinosa** (Waters, 1889a) [*non Escharoides contorta* (Busk, 1854)]. A.88.172.

14. *Eschara* (?) *huttoni*: **Calyptotheca variolosa** (MacGillivray, 1869) (Fig. 8). Senior synonym of *Schizoporella biturrita* Hincks, 1884 and *Schizoporella baccata* Maplestone, 1913 (P. E. Bock, *in litt.* 1988); replacement name for Hutton's original *Eschara tatei*, preoccupied (*vide* Tate's footnote to Hutton 1878: 24). Illustrated by SEM as *Gigantopora biturrita* in Bock (1982; see also Bock's 1987 *Corrigenda*). A.88.157, holotype of *Eschara* (?) *huttoni* Tate *in* Hutton.

15. *Retihornera foliacea*: **Hornera foliacea** MacGillivray, 1869. A.88.175.

16. *Retepora cellulosa*: **Triphyllozoon munitum** (Hincks, 1878) (*non Retepora cellulosa* Smitt, 1868, *non* Linnaeus, 1758). A.88.165, 173.

17. *Retepora phoenica* [*sic*]: **Petralia undata** MacGillivray, 1869 [*non Iodictyum phoeniceum* (Busk, 1854)]. A.88.171.

18. *Vinculari* [*sic*] *maorica*: **Cellaria australis** MacGillivray, *in* McCoy, 1880: 48 (*non Vincularia maorica* Stoliczka, 1865, = *Chaperia* sp., *fide* Brown 1958: 39). A.88.169.

19. *Idmonea radians*: **Mesonea radians** (Lamarck, 1816) (Fig. 9). *Mesonea radians* (see Hastings 1932; Bock 1982) is the correct name for this species, which has often been referred to as *Crisina radians*. The type species of *Crisina* is *Crisina normaniana* d'Orbigny 1851, Cretaceous, Europe, which is clearly distinguished from *Mesonea radians*, a Recent species, by the distribution and arrangement of pores and by the construction of the ovicell (Voigt 1984). *Mesonea* (Canu & Bassler, 1920) has pores on frontolateral faces of branches as well as dorsally, and the ovicell has smooth, membrane-covered porous areas. *Crisina* has only dorsal pores in longitudinal furrows and the ovicell lacks the porous areas (Voigt *in litt.*, 1988). There appear to be several species from the Indian and Pacific Oceans, with a *Crisina*-like colony form, that have been attributed to *Crisina radians*. Waters (1887), Harmer (1915), and Bock (1982) have illustrated Lamarck's (1816) species, but those of Brood (1976) from East Africa, of Ryland (1984) from Fiji, and of Soule *et al.* (1987) from Hawaii are neither conspecific nor even congeneric with it. Clearly there is an amount of work to be done in sorting out the Indo-Pacific 'crisiniform' bryozoans. A.88.164.

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FIGURES 1–4. 1. Part of holotype, A.88.161, of *Membranipora* (?) *cincta* Hutton, = *Diploporella alata* (Lamouroux), × 105. 2. Part of holotype, A.88.162, of *Lepralia spicea* Hutton, = *Mucropetraliella ellerii* (MacGillivray), × 80. 3. Part of paralectotype, A.88.160B, of *Lepralia pocula* Hutton, = *Mychoplectra pocula*, × 80. 4. Part of holotype, A.88.159, of *Lepralia baccata* Hutton, = *Adeonellopsis baccata*, showing one gonozooid (gz) surrounded by several autozooids, × 72. (All specimens from Otago Museum).

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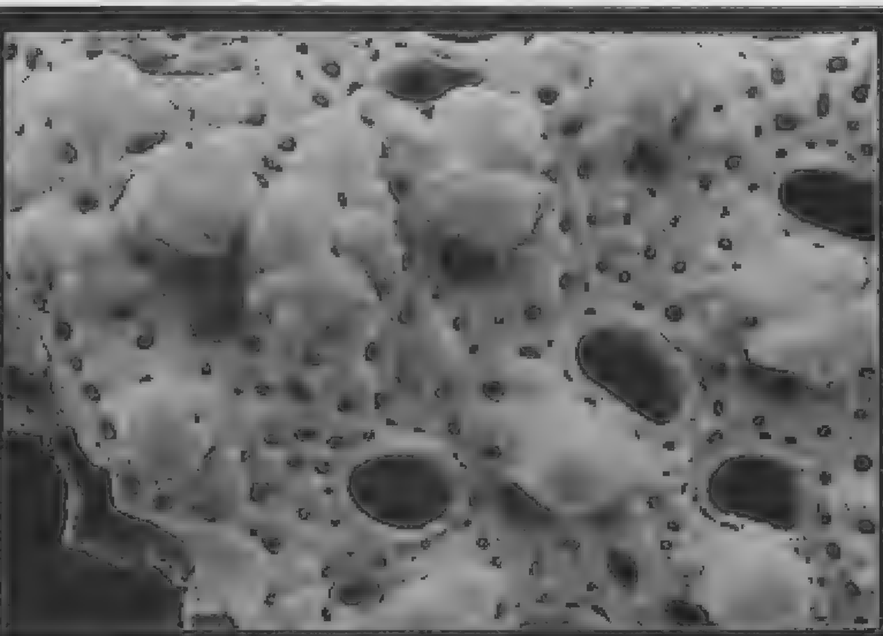

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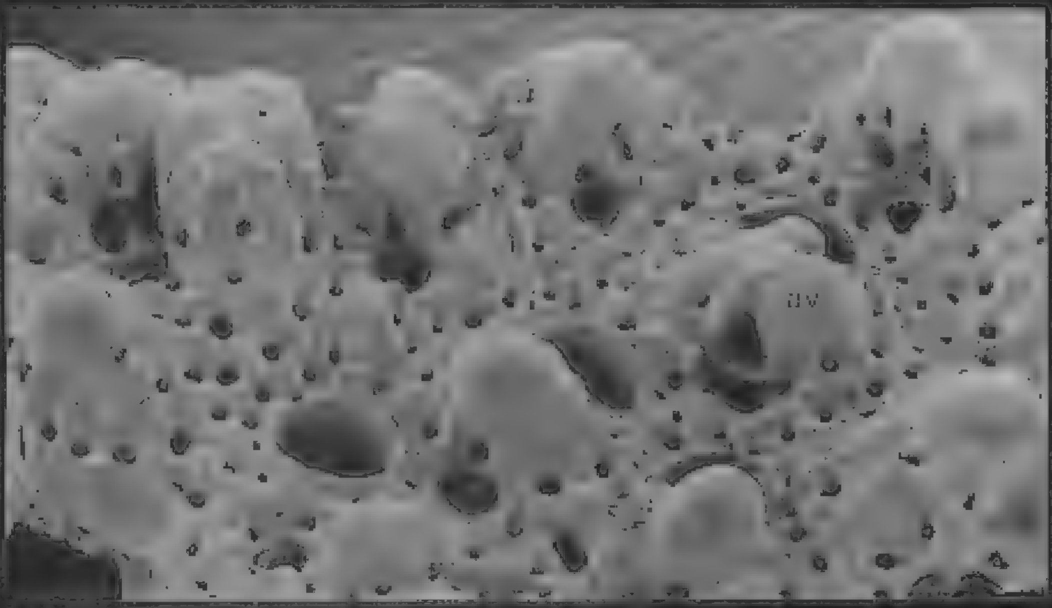

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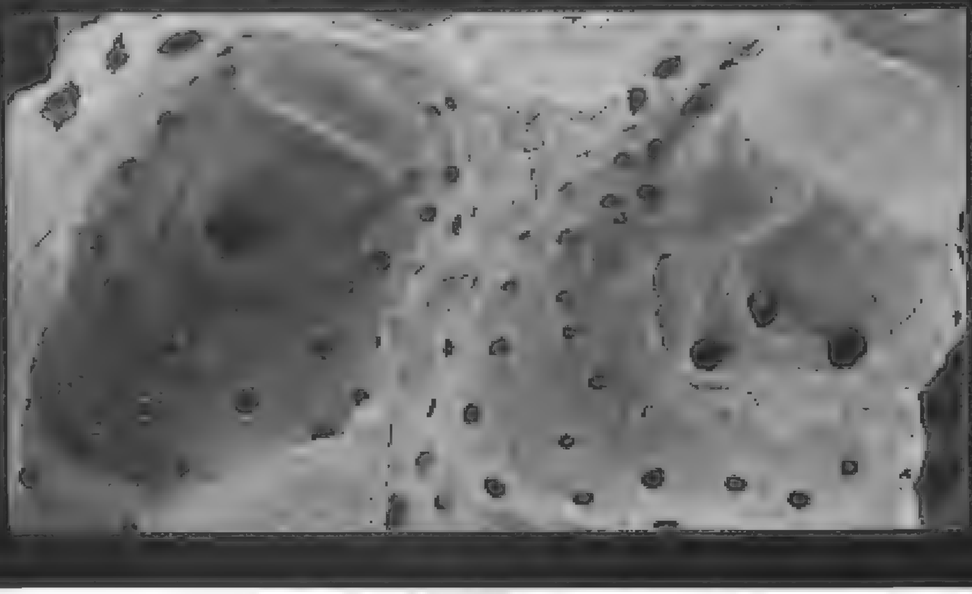

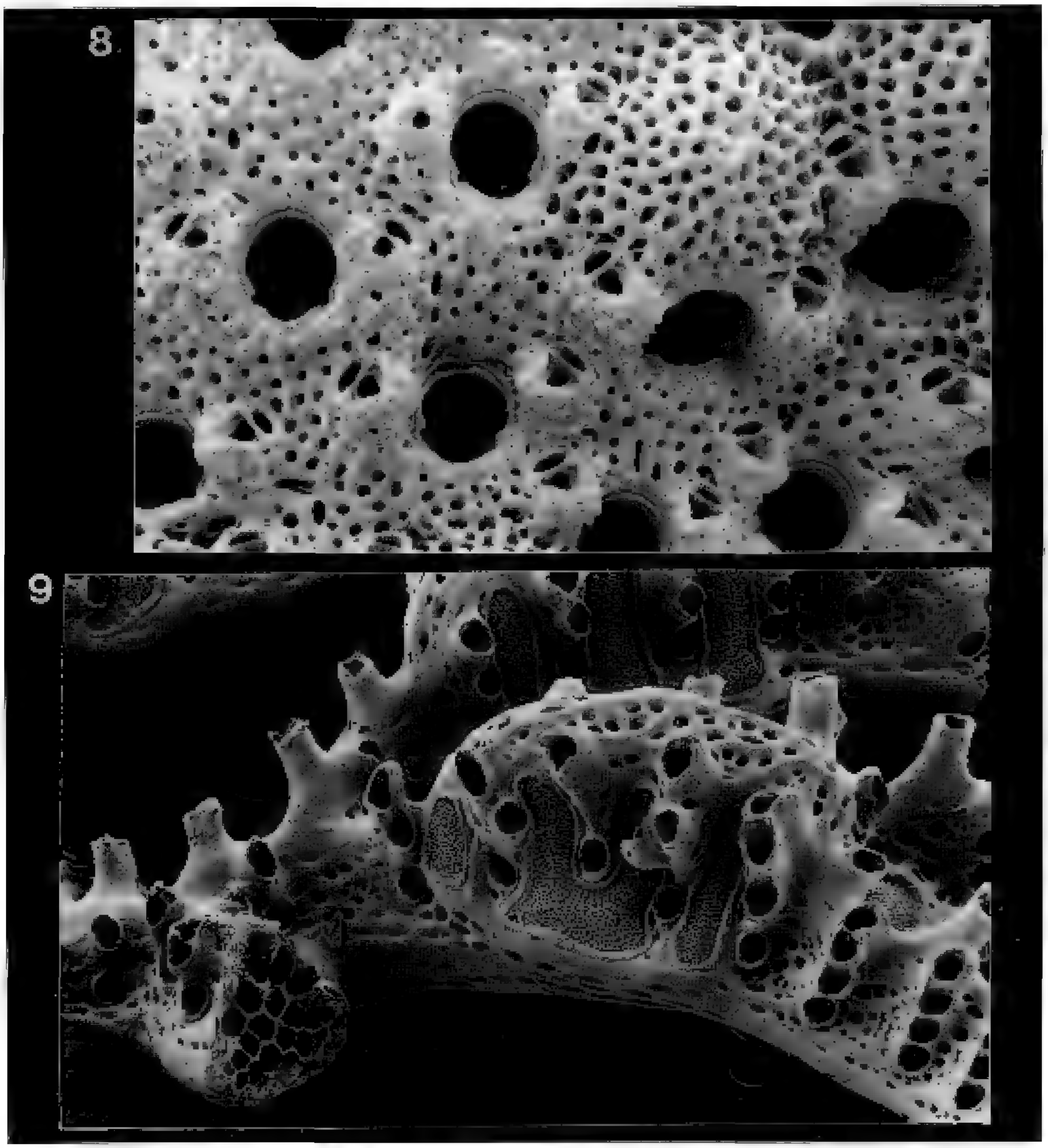

FIGURES 8 AND 9. **8**. Part of holotype of *Eschara* (?) *huttoni* Tate *in* Hutton, A.88.157, = *Calyptotheca variolosa* (MacGillivray), × 55. **9**. *Mesonea radians* (Lamarck), part of specimen A.88.164, showing brood chamber and peristome, × 53. (Both specimens from Otago Museum)

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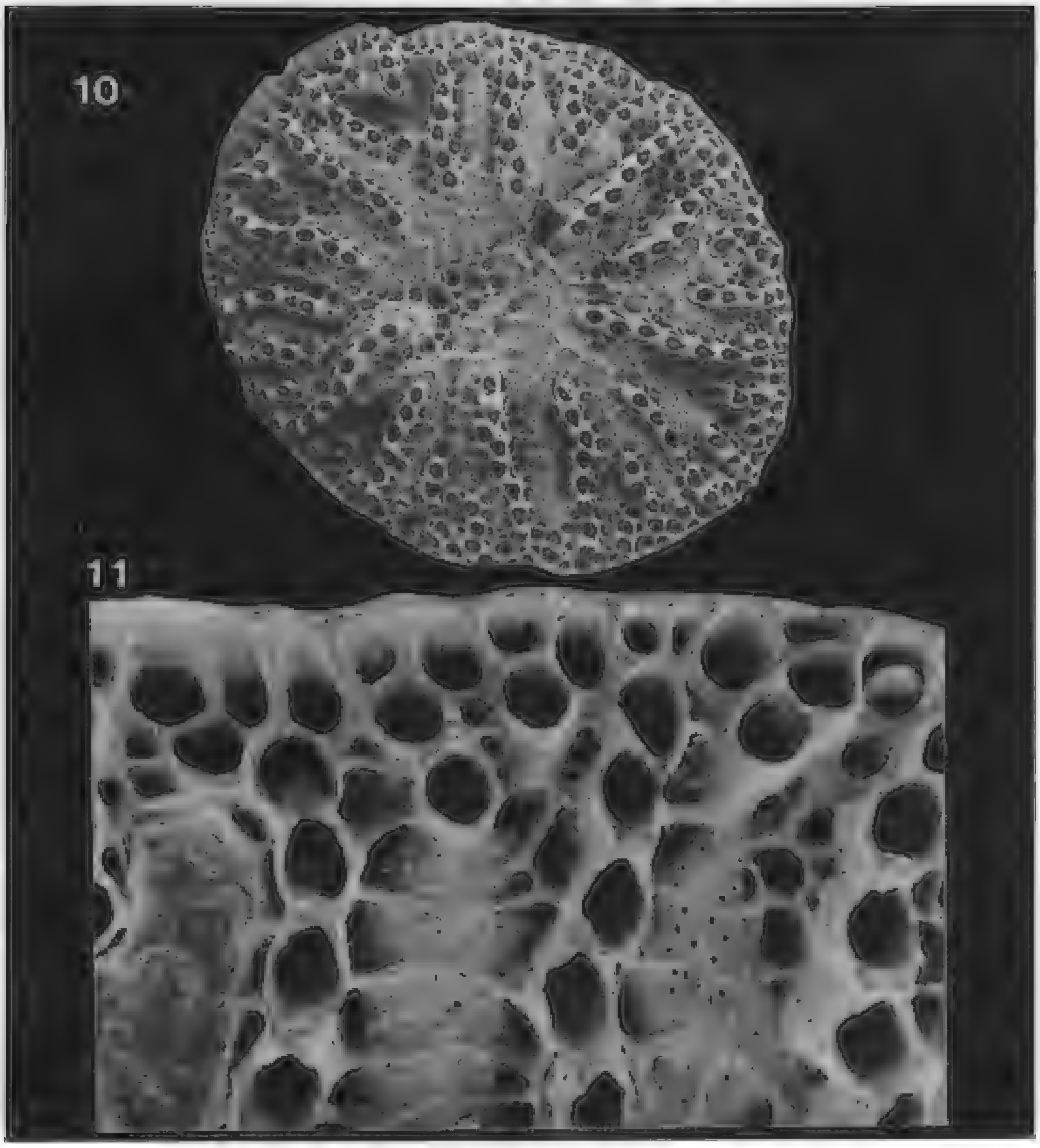
FIGURES 5–7. **5**. Part of syntype, SAM L460 of *Adeonellopsis zietzii* MacGillivray, = *A. baccata* (Hutton), showing a gonozooid (at left), with characteristic compound spiramen and several autozooids with simple spiramen; **6** is of the same specimen as in 5, but tilted to show an autozooidal avicularium (av), both × 105 (specimen from South Australian Museum). **7**. Part of holotype, A.88.159 of *Adeonellopsis baccata* (Hutton) showing the interior of the frontal shields of an autozooid (left) and a gonozooid (right), × 205.



FIGURES 10 AND 11. *Lichenopora victoriensis* Waters, specimen A.88.148, Otago Museum, showing the ramifying brood chamber (part magnified in 11), × 56, × 300.

20. *Pustulipora porcellanica*. No specimen in collection. Currently, this Hutton (1873) species is known only from New Zealand, as *Galeopsis porcellanicus* (Gordon, 1989). To date, the only species of *Galeopsis* definitely recorded for South Australia is *G. longirostris* (MacGillivray, 1885b) (specimens in South Australia Museum).

21. *Tubulipora flabellaris*. No specimen in collection. *Tubulipora flabellaris* (Fabricius, 1780) is an arctic-boreal species, unlikely to occur in Australia (Hayward & Ryland, 1985). There are several samples of *Tubulipora* from South Australia in the South Australian Museum, none identified to species. Six species of the genus have been reported from Victoria.

22. *Discoporella novae-zealandiae* [sic] : **Lichenopora victoriensis** Waters, 1889b [*non Lichenopora novaezelandiae* (Busk, 1875)] (Figs 10, 11). A.88.148, 150.

23. *Discoporella fimbriatae* [*sic*]: **Lichenopora echinata** (MacGillivray, 1884) [?*non Disporella fimbriata* (Busk, 1875)]. (*Cf.* Waters 1889b: 282 – "A 'Challenger' specimen from Tristan da Cunha was submitted to me named *L. fimbriata*. This is *L. echinata* with an ovicell, so that the name *fimbriata* must be dropped"). A.88.149, 151.

Two additional species, not mentioned in Hutton's (1878) paper, are represented in the collection. These are *Steginoporella chartacea* (Lamarck, 1816), syn. *S. truncata* (Harmer, 1900) (A.88.174) and *Rhynchozoon* sp., possibly *R. delicatulum* (MacGillivray, in McCoy 1890: 356) (A.88.155). For the priority of *Steginoporella chartacea* over *S. truncata* see d'Hondt 1979: 18, 20.

Two of Hutton's (1878) names are senior synonyms of later-described species. Thus, *Adeonellopsis zietzii* MacGillivray, 1889 becomes *A. baccata* (Hutton, 1878), and *Pyripora polita* (Hincks, 1880) becomes *Mychoplectra pocula* (Hutton, 1878).

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THE KARANGURA LANGUAGE

PETER AUSTIN

Summary

This paper examines the linguistic position of Karangura, an Aboriginal language once spoken to the north-east of Lake Eyre in South Australia. The language occupied a crucial geographic position between three major linguistic groups in the region. The paper analyses the few existing sources on Karangura to determine its relation to these other languages. The fullest known vocabulary of Karangura is presented.

THE KARANGURA LANGUAGE

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AUSTIN, P. 1991. The Karangura language. *Rec. S. Aust. Mus.* **25**(2): 129–137.

This paper examines the linguistic position of Karangura, an Aboriginal language once spoken to the north-east of Lake Eyre in South Australia. The language occupied a crucial geographic position between three major linguistic groups in the region. The paper analyses the few existing sources on Karangura to determine its relation to these other languages. The fullest known vocabulary of Karangura is presented.

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The area to the east and north of Lake Eyre was traditionally one of some linguistic diversity. In the region along the Warburton Creek and Diamantina River from Lake Eyre to the current Queensland border we find three groups of languages represented:

1. Wangkangurru – this language is closely related to Arabana, spoken to the west of Lake Eyre (Hercus 1990);
2. Ngamini and Yarluyandi – these two languages were closely related to one another and were also genetically close to Diyari and Thirrari spoken further south along Cooper Creek and the eastern shore of Lake Eyre (see Austin 1981, 1990a,b; Breen 1971: 184);
3. Wangkamadla (or Wangkamanha) – this was the most southerly dialect of the western division of the Pitta-Pitta group of languages (Blake 1979: 184).

The question is: where does Karangura, occupying as it does a position bordering on all three language groups, fit into the linguistic picture of northern South Australia? In this paper I examine all the available linguistic evidence on Karangura in an attempt to answer this question. My study thus complements the historical and ethnographic research on Karangura that Hercus has undertaken.

THE KARANGURA LANGUAGE

There are just three sources of data on the Karangura language, all of them old historical documents:

1. a vocabulary published in Wells (1894);
2. five words collected by Pastor Carl Schoknecht sometime between 1871 and 1873 (see Schoknecht 1947);
3. a few words in Reuther's monumental dictionary of Diyari (see Reuther 1981).

In the following sections each of these sources is examined in detail.

Wells' Data

Appended to Wells' (1894) paper on Aborigines of the Diamantina, Herbert and Eleanor Rivers is a section entitled 'Dialect' which gives a listing of 217 English words and their correspondences in the 'Native dialect'. The transcription of the Karangura words is quite good, essentially being a naive adaptation of English spelling. There are three notable features of Wells' transcriptions:

1. The use of the symbol ā, primarily at the end of words. This seems to indicate that Wells felt the final Karangura low vowel was longer and clearer than the English final vowel typically signified by a in English spelling, namely schwa.
2. The use of the symbol ă, primarily in unstressed syllables to signify the low vowel.
3. The transcription of initial velar nasal *ng* which appears in Wells' list as 'm', as in items 12, 13, 28, 58, 65, 74, 101, 119, 123, 170, 189; as 'n', in items 88, 207; or is simply omitted, as in items 32, 95, 135, and 147.

There are a number of forms which suggest that Wells did not have a good grasp of the language, and that he must have elicited the vocabulary by pointing to various objects. There are also simple mistakes which suggest that the Karangura speaker(s) being interviewed did not understand Wells' English prompt (see for example 'heart', 'moths', and 'no', below). We can see this by comparing some of the forms and glosses he gives with corresponding words in Ngamini.[1] Simple errors such as the following are indicative of the danger of taking Wells' list at face value without examining comparative data:

Wells vocabulary		Ngamini	Gloss
'bark of tree'	yet-an-na	*yatha-rna*	'to speak, say, bark (of dog)'
'dig'	tap-poo-lee	*thapili*	'to drink'*
'frown'	boo-choo	*puju*	'blind'
'heart'	wal-derrā	*waldrra*	'hot'
'moths'	mi-attā	*mayatha*	'boss'
'no'	wo-bā	*wapa*	'go-imperative'
'spider'	mutta-nā	*matha-rna*	'to bite'
'thighs'	wil-yi-ri	*wilyirri*	'buttocks'
'thunder'	mik-arrie	*mikiri*	'desert well'
'thirsty'	won-koola	*wangku-lha*	'nothing-now'
'wet'	kung-oo	*kangu*	'sweat'

* This is the purpose-different subject form of *thapa-* 'to drink'. It would occur in the Ngamini translation of sentences such as 'Dig the ground for water (for me) to drink!' (see below).

Classification of Karangura

There is sufficient information that can be extracted from the Wells vocabulary to show that Karangura was very closely related to Ngamini, though not identical to it. There is both lexical and grammatical evidence to support this classification of Karangura. Firstly, there are a number of lexical terms found in Wells' list that resemble words peculiar to Ngamini that are not shared with its close genetic neighbours Diyari, Thirrari and Yarluyandi. Also, there is evidence of certain grammatical forms that are only found in Ngamini. This evidence follows, as well as indicators of Karangura's distinctiveness from the Ngamini language.

1. *Peculiar lexical items*

There are five words in Wells' list that are cognate with words otherwise peculiar to Ngamini:

Wells	Ngamini	Diyari	Gloss
'dam-poo'	*dampu*	*karlu*	'testicles'
'kul-tā'	*karla*	*darla*	'skin'
'par-koo-oona'	*parrkuna*	*mandrru*	'two'
'parkoo-oona-oona'	*parrkuna ngunha*	*parrkulu*	'three' (lit. 'two one' in Ngamini)
'tip-pă'	*thipa*	*thuju*	'snake'

2. *Grammatical forms corresponding to Ngamini forms*

Here we have four pieces of evidence: the ergative case affix, the participial verb inflection, the purpose-different subject verb inflection and the verb nominalising derivation:

(a) The ergative case affix:

All the eastern Lake Eyre languages have a case inflection, which we term the ergative, that is suffixed to nouns marking the transitive subject and instrument functions. This case marker has the following forms:

Diyari	*-ndrru*	added to female personal names
	-(ya)li	added to all other nouns
Yarluyandi	*-li*	added to dual and plural nouns
	-ndu	added to all other nouns
Ngamini	*-li*	added to dual and plural nouns
	-nu	added to all other nouns

There are some examples in Wells' list of ergative case-marked nouns showing *-nu*, as in Ngamini[2]:

Wells	Ngamini	Diyari	Gloss
'munthă-unoo'	*muntha-nu*	*muntha-li*	'shame-erg'
'moo-an-oo'	*muwa-nu*	*mawa-li*	'hunger-erg'

(b) The participial inflection:

In Diyari the participial affix added to verbs is invariant and has the shape *-rna*, and in Yarluyandi it is invariably *-rnda*. Ngamini has a number of different forms, depending on the phonological shape of the stem to which it is attached (see Austin 1990a for details). Thus, most vowel-final stems take *-rna*, while verb stems ending in C*i*, (where C is a nasal consonant) delete the C*i* and add *-nda*. Thus the participial form of *mani-* 'to get' is *manda*, and of *pirnani-* 'to become big' is *pirnanda*. The participial form of *pali-* 'to die' is *palda*. With reflexive verbs there are two possibilities which occur in free variation: V-*jarrhirna* or V-*janda*, for example 'to see oneself' is either *nhirrkajarrhirna* or *nhirrkajanda*. Examples from Wells' vocabulary show that Karangura had the Ngamini patterns:

Wells	Ngamini	Diyari	Gloss
'mirra-chuntā'	*mirrhajanda*	*mirrhatharrhi-rna*	'scratch oneself-ptcple'
'muckoo-munda'	*manda*	*mani-rna*	'get-ptcple'
'pul-tā	*palda*	*pali-rna*	'die-ptcple'

Interestingly, part of this typical pattern of variation in verb forms in Ngamini and Karangura is shared with Wangkangurru where the present tense inflection is normally *-(rn)da* but verbs ending in a nasal plus *i* delete the final syllable and add *-nda*, as in *mani-* 'to get', present tense form *manda* (see Hercus 1990).

(c) Purpose-different subject verb inflection:

All the languages in the Lake Eyre region have the syntactic device of switch-reference, that is, an indication in dependent verb inflections of the sameness or difference of subjects across clauses. Thus, to express purpose there are two inflections: one for same subject and another for different subject. The forms of these inflections characteristically differ in the different languages:

	Diyari	Thirrari	Ngamini	Yarluyandi
purpose				
-same subject	*-lha*	*-lhali*	*-lha*	*-lhangga*
-different subject	*-rnanthu*	*-yani*	*-ili*	*-li*

There is one example in Wells' list that we can analyse as a purpose-different subject form, and it shows an affix cognate with Ngamini. The example is 'dig' – 'tap-poo-lee' – which clearly corresponds to Ngamini *thapili (thapa-ili)* 'drink-purpose-different subject'. Probably the Karangura speaker responded to Wells' prompt 'dig' with a sentence like '(You dig for water for me) to drink', only the last element of which ('drink-purpose-different subject') Wells was able to catch and write down. In any case, the form is clearly the same as in Ngamini.

(d) Nominalising derivation:

The languages to the east of Lake Eyre can form instrument nouns out of verbs by adding a nominalising derivational affix. In Diyari and Yarluyandi the form of this affix is *-ni* (see Austin 1981: 162), as in the Diyari example *pawa daka-ni* 'seed grinder' (where *pawa* is 'seed' and *daka-* is 'to grind'). In Ngamini the corresponding affix is *-ini* where the initial *i* replaces the final vowel of the verb stem (thus *puwa dakini* 'seed grinder'). There is one example in Wells' list which shows the Ngamini pattern, namely 'handcuffs warika-mun-drini', which we can analyse as *warrkamandrrini*, the nominalised form of *warrkamandrra-*, 'to tie up' (Diyari would have *warrkamandrrani* here).

3. *Linguistic Distinctiveness from Ngamini*

Karangura as recorded by Wells differs, however, in two interesting respects from Ngamini as recorded both in early sources such as Reuther and also in recent materials collected by Breen and myself. One of the differences is in the area of vocabulary, and the other is phonological:

(a) Vocabulary differences:

Although there are clear Ngamini cognates for almost all the words recorded by Wells (see below) and items otherwise unique to that language (see above), there are also sixteen items which differ from Ngamini and have cognates in Wangkangurru. Of great interest in this respect is the fact that most of these also have cognates in Thirrari (or 'Tirari') as recorded by Reuther[3], suggesting the existence of a local pool of lexical items shared between Thirrari, Wankgangurru and Karangura. These items are as follows:

Wells	Tirari	Wangkangurru	Ngamini	Gloss
'bul-yā arms'		*palya*	*nguna*	'upper arm, wing'
'euka-an-ri'	'wapanta'	*yuka-*	*wapa-*	'to go'
'kulyi-erra womb'		*kalyara*		'placenta'
'moo-yoo-untā sunrise'		*muyu winta*	*diji winda*	'sunset'
'mumpoo-kaddi'	'mampukati'	*mampukardi*	*thinthipirri*	'elbow'
'mundoo-rainā'		*mantura-rda**		'to snore'
'oon-too'		*unthu*	*kini*	'penis'
'pe-pe yes, I know'		*piyi*	*kawu*	'yes'
'pim-ma'	'pima'	*pima*	*mimi*	'lip'
'pre-tanā I kill you'**	'tantata'	*pirta-rnda*	*dandrra-rna*	'to hit, kill'
'queei'		*kuya*	*mankarrha*	'girl'***
'tee-rankoo'		*thirrangkurda*		'how many?'
'tunya-anna licking'	'tanjana'	*thanyana*	*tharli*	'tongue'
'u-rā'		*yurrha*		'rump'
'wee-i'		*wiya*	*kanku*	'boy'***

* This verb occurs in the eastern dialect of Wangkangurru only.

** Notice that the root of this word is apparently cognate with Wangkangurru but that it seems to contain the participial affix cognate with Ngamini *-rna* (*cf.* Wangkangurru *-rnda*).

*** Hercus points out that Wangkangurru *kuya* is also pronounced *kuyayi* and *wiya* is also pronounced *wiyayi*. These two words were borrowed from Lower Southern Aranda and probably spread along with the Warrthampa ceremony [see Hercus (1991), this volume].

(b) Phonological differences:

In Ngamini there occur intervocalic clusters of post-alveolar continuant plus peripheral stop, *i.e. rk* and *rp*. These do not occur in neighbouring languages and correspond to *lk/rlk* and *lp/rlp* in cognates in Diyari and Yarluyandi. That is, Ngamini has merged the apical laterals as *r* before *k* and *p* (see Austin 1988: 242ff). In Wells' data the laterals have *not* changed to *r*, showing that Karangura was conservative like Diyari and Yarluyandi. Some examples are:

Wells	Ngamini	Diyari	Gloss
‘bil-pa’	*pirpa*	*pilpa*	‘eyebrow’
‘mil-ki’	*mirki*	*milki*	‘eye’
‘pool-kanna’	*parka-rna*	*parlka-rna*	‘to travel’
‘pool-ko-annā’	*purka-rna*	*purlka-rna*	‘to blow’
‘thalpoo’	*tharpa*	*tharlpa*	‘ear, leaf’
‘wal-poo’	*warpu*	*(muku)*	‘bone’ (*cf.* Wangkangurru *warlpu)*
‘wil-prinnā’	*wirpa-rna*	*wirlpa-rna*	‘to whistle’

On the basis of these similarities and differences we can say that Karangura was closely related to Ngamini but showed a number of interesting differences that point to areal characteristics shared with Wangkangurru and Thirrari.

Wells’ Vocabulary of Karangura, With Corresponding Ngamini Forms

	English	Native	Ngamini
1.	ants	merri-kā	*mirrka*
2.	arms	bul-yā	(Wangkangurru cognate)
3.	anus	milyerrie	*milyirri*
4.	bad	moo-dă	
5.	bag	yak-kootā	*yakutha*
6.	bark of tree	yet-an-na	*yatha-rna* ‘to speak, say, bark (of dog)’
7.	big	tip-pee	*thipi* ‘alive’
8.	bite	mut-tănnā	*matha-rna*
9.	bone	wal-poo	*warpu* (*cf.* Diyari *muku*, Wangkangurru *warlpu*)
10.	boy	wee-i	(Wangkangurru cognate)
11.	blood	koo-marri	*kumarrhi*
12.	beard	mun-ka	*ngarnka*
13.	breasts	mum-ma	*ngama*
14.	bread	mulya-mi	*malyumayi*
15.	brother	noo-yoo	*nhuyu* ‘elder brother’
16.	blowing	pool-ko-annā	*purka-rna* (*cf.* Diyari *purlka-rna*)
17.	billycan	warra chuna	*warrajanda* (participial form of *warra-jarrhi-* ‘to hang’)
18.	bottle	koo-poola	*kupula*
19.	boot	tidna-boota	*thina puta*
20.	calf	wirri-pā	
21.	cane grass	bree-ta	*pirta* ‘tree’
22.	calves of legs	pur-rita	
23.	cutting	dum-an-nā	*dama-rna*
24.	cold	krip-pā	*kirpa*
25.	crying	indra-na	*yindrra-rna*
26.	cheeks	nal-ya	
27.	chest	pitta-witta	
28.	chin	munka-chedda	*ngarnkajarra*
29.	copi (gypsum)	wal-yoo	*walyu* ‘ground, earth’
30.	come back	tik-annā	*thika-rna*
31.	come along	kowi	
32.	cow	ammā-milki	*ngama milki*
33.	crayfish	koon-tā	*kintha*
34.	crane	poo-ral-koo	*purrhalku* ‘brolga’
35.	crow	koo-kunta	*kukunka* ‘hawk species’ (*cf. kawalka* ‘crow’)
36.	clean	warroo-koo	
37.	deaf	ya-ree	(*cf.* Wangkangurru *yarri* ‘ear’)
38.	dark	meel-ya-roo	*milyaru* ‘dark, night’
39.	dog	terri-tā	*thirritha*
40.	dead	pul-ta	*palda* (participle of *pali–* ‘to die’)
41.	dig	tap-poo-lee	*thapili* (purpose-different subject of *thapa-* ‘to drink’)
42.	diver (bird)	woochoo-buk-anni	*wujupakarni*
43.	devil	koo-choo	*kuji*
44.	dress	broo-ka	*puruka* (loan from English ‘frock’)
45.	dust	woo-too-roo	*puthurrhu*
46.	damper	wai-mal-ya	*wayimalya*
47.	dirty	warroo	*warrhu* ‘white’
48.	eyes	mil-ki	*mirki* (*cf.* Diyari *milki*)

	English	Native	Ngamini
49.	elbow	mumpoo-kaddi	(cf. Wangkangurru *mampu-kardi*)
50.	eyebrows	bil-pa	*pirpa* (*cf.* Diyari *pilpa*)
51.	eyelashes	milkie-wirrie	*mirki wirri*
52.	emu	warra-katchie	*warrkaji*
53.	excreta	koona-oonā	*kuna-kuna*
54.	eucalyptus	bulka-kulla	
55.	earth	purra-ka	
56.	fish	warrie	*wari*
57.	flame	yap-pinna	*yapi-rna* 'to burn, ignite'
58.	forehead	mool-loo	*ngulu*
59.	feet	tid-na	*thina*
60.	fingers	murrā	*mara* 'hand, finger'
61.	fat	wom-mā	*wama*
62.	fur	mul-ta	
63.	fire	too-roo	*thurrhu*
64.	fly	moon-choo	*munju*
65.	father	mul-pi	*ngarpi* (*cf.* Diyari *ngapiri*)
66.	frown	boo-choo	*puju* 'blind'
67.	four	wi-tā	*wita* 'many'
68.	feathers	kurḷ-yā	
69.	gammon	wong-koo	*wangku* 'none, nothing'
70.	grass	win-thee	*winthi*
71.	grub	mool-yi	
72.	girl	queei	(Wangkangurru cognate)
73.	go on	koppa-ri	*kaparrha* 'come here!'
74.	give	munki-ammi	*ngangki-yamayi* 'give-imperative'
75.	go back	tik-anna	*thika-rna* (*cf.* 30)
76.	gun	mukitta	*makita* (loan from English 'musket')
77.	go away	euka-an-ri	(Wangkangurru cognate)
78.	galah	killān killi	*kilankila* 'galah'
79.	hair	moo-doo	*ngurdu* 'head'
80.	hat	oo-too-maner-rie	*witiminirri*
81.	hit	tun-dera-nā	*dandrra-rna*
82.	heavy	muckoo-munda	*maku manda* 'to lift' (participle of *mani–* 'to get')
83.	hungry	moo-an-oo	*muwa-nu* 'hunger-ergative'
84.	hole	koo-doo	*kurdu*
85.	hold on	karrā	*karrha* 'hold-imperative'
86.	hand	murră	*mara* (*cf.* 60)
87.	heel	tidna	*thina* 'foot' (*cf.* 59)
88.	head	noo-doo-tun-derra	*ngurdu thandrra* (*cf.* 79)
89.	heart	wal-derrā	*waldrra* 'hot'
90.	hole thro' nose	moodla-wilpa	*mulha wirpa*
91.	handcuffs	warika-mun-drini	*warrkamandrrini* (nominalised form of *warrkamandrra-* 'to tie up')
92.	head dress	multărrā	*maltharra* 'bunch of feathers'
93.	how many	tee-rankoo	(Wangkangurru cognate)
94.	iguana	wump-pikka	*wampirrka*
95.	I don't know	a-nă-goo	*nganaku*
96.	I kill you	pre-tană	(Wangkangurru cognate)
97.	intestines	murrangarra	
98.	kangaroo	choo-koo-roo	*jukurrhu*
99.	knees	bun-chā	*panja*
100.	knife	ni-pā	*nhayipa*
101.	kissing	mun-chin-na	*nganja-rna* 'to love, like'
102.	kicking	tukka-manna	*daka-rna* 'to pierce, poke, kick'
103.	kill	tunderra-anna	*dandrra-rna* (*cf.* 81)
104.	licking	tunya-anna	(Wangkangurru cognate)
105.	lazy	mumma-anna	*ngama-rna* 'to sit'
106.	lake	wurra-li*	

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* Hercus points out that *Warrha(nha)* is the name of an important freshwater lake near Poeppel's Corner. It is possible that the speaker(s) consulted by Wells named the best-known lake of the general area.

	English	Native	Ngamini
107.	long time	minna-minna	*minha* 'what, something'**
108.	leaves	thalpoo	*tharpa* (*cf.* Diyari *tharlpa*)
109.	lips	pim-ma	(Wangkangurru cognate)
110.	lizard	kad-ni	*kani* 'sleepy lizard'
111.	louse	pir-di	
112.	long nose	mood-la	*mulha* 'nose' (*cf.* 90)
113.	lightning	mil-yar-roo	*milyaru* 'dark, night' (*cf.* 38)
114.	liver	kull-yoo	*kalyu*
115.	look out	nil-kan-nā	*nhirrka-rna* 'to look, see' (*cf.* Yarluyandi *nhika-rnda*)
116.	long way	warrā̆-tā	*warrhatha*
117.	laugh	kunkă-annā	*kingka-rna*
118.	man	kalkă-arroo	*karrkarrhu* 'old man'
119.	me	mun-yi	*nganyi* 'I'
120.	mouth	pima-mā	(Wangkangurru cognate, *cf.* 109)
121.	moon	perā	*pira*
122.	mosquito	koon-ti	*kunthi*
123.	mother	mundri	*ngandrri*
124.	mob	wit-tā	*wita* 'many' (*cf.* 67)
125.	moths	mi-attā	*mayatha* 'boss'
126.	mopoke	munkă-noo	
127.	mussel	koo-ri	*kurri*
128.	neck	oon-koo	*ngunku*
129.	nails	nirri	(Yarluyandi *nhirrhi*, *cf.* Ngamini, Diyari *pirrhi*)
130.	navel	pin-tā	*pirda*
131.	nose	mood-lā	*mulha* (*cf.* 112, 90)
132.	nostril	moodlā-wirripā	*mulha wirpa* (*cf.* 90)
133.	no	wo-bā	*wapa* 'go-imperative'
134.	no good	mun-nā	*manha*
135.	one	oon-wārrā	*ngunharra*
136.	old man	kulkă-aroo	*karrkarrhu* (*cf.* 118)
137.	old woman	widlă-prinnă	*wilhapirna*
138.	parrot	kundră-ungoo	
139.	penis	oon-too	(Wangkangurru cognate)
140.	pigeon	wappăroo	*waparu* 'flock pigeon'
141.	pelican	tum-pung-ărrā	*thampangarrha*
142.	pouch (pelican)	war-roora	
143.	quart pot	walpa-ittā	
144.	run	pool-kanna	*parka-rna* (*cf.* Diyari *parlka-rna* 'to travel')
145.	rat	mi-aroo	*mayarrhu*
146.	red ochre	kal-koo	*karrku*
147.	rump	u-rā	(Wangkangurru cognate)
148.	sister	kar-koo	*kaku* 'elder sister'
149.	sneezing	kootoo kootoo-gudda	
150.	stone	mud-dā	*marda*
151.	sand	dar-koo	*daku* 'sandhill'
152.	sandhills	dar-koo	*daku* (*cf.* 151)
153.	salt	that-too	*thaltu* 'salt' (loan from English)
154.	sleep	pur-rinna	*purrhi-rna* 'to lie, sleep'
155.	stomach	toon-droo	*thundrru*
156.	sore	minkie	
157.	string	urip-ā	*yurupa* 'rope' (loan from English)
158.	scratching	mirrā chuntā	*mirrha-janda* 'scatch oneself' (participial of *mirrha-jarrhi-*)
159.	sun	kul-ka	*kalka* 'sunset'
160.	sundown	ditchi-wirrina	*diji wirrhi-rna* (lit. 'sun enters')
161.	spear	wadna-quin	*wanakuyu*
162.	smoke	tuppa-inna	*thapa-rna* 'to drink, suck' possibly used for 'smoke (a pipe)'
163.	stick	prit-ta	*pirta* (*cf.* 21)
164.	shadow	mil-poo-ooroo	
165.	sky	mily-ya-ooroo	*milyaru* 'dark, night' (*cf.* 113, 38)

** Hercus also notes that Yarluyandi and Eastern Wangkangurru have a word *minyiminyi* which is used to describe a very old woman, the oldest person in any group.

	English	Native	Ngamini
166.	shoulders	winka-arrie	
167.	snake	tip-pă	*thipa*
168.	“venomous	tundri-prilla	*thandipila* (*cf.* Diyari, Yarluyandi *thandrripila*)
169.	spitting	kuntha-urnā	
170.	sit down	mammă-na	*ngama-rna* (*cf.* 105)
171.	stand up	tulkalla-tunda	*tharrka-rna*
172.	sick	wi-wi	
173.	snoring	mundoo-rainā	(Wangkangurru cognate)
174.	shield	murrā-numma	
175.	skin	kul-tā	*karla*
176.	shame	munthă-unnoo	*muntha-nu* ‘shame-ergative’
177.	sweat	kung-oo	*kangu*
178.	spider	mutta-nā	*matha-rna* ‘to bite’ (*cf.* 8)
179.	small	koo poo-ta	*kupa* ‘child’
180.	stink	toon-kā	*thungka*
181.	suck	tup-pannā	*thapa-rna*
182.	swimming	turra-gunna	*tharrhaka-rna*
183.	sunrise	moo-yoo-untā	(Wangkangurru cognate)
184.	scalp	wil-kā	
185.	two	par-koo-oona	*parrkuna*
186.	three	parkȯo-oona-oona	*parrkuna ngunha* (lit. ‘two one’)
187.	teeth	munna-deerie	*marnathirri*
188.	thighs	wil-yi-ri	*wilyirri* ‘buttocks’
189.	teats	mummā-brinnā	*ngama pirna* ‘big breast’
190.	testicles	damp-oo	*dampu*
191.	tickling	kicherie poo-doo poodoo	
192.	toes	tidna-nulki	*thina* ‘foot’
193.	tail	kid-ni	*kini*
194.	thunder	mik-arrie	*mikiri* ‘desert well’
195.	thirsty	won-koola	*wangku-lha* ‘nothing-now’ (*cf.* 69)
196.	tattoo mark	mundri	
197.	throw	warrinā	*warra-rna*
198.	tall	warrā li	
199.	tomahawk	kommi-yakoo	*kamiyaku*
200.	you	in-ni	*yini*
201.	you walk	wop pinna	*wapa-rna* ‘to go, walk’
202.	yawn	yuk-ki-yi	*yakayayi* ‘goodness me!’
203.	yes, I know	pe-pe	(Wangkangurru cognate)
204.	uncle	kuk-kā	*kaka* ‘mother’s brother’
205.	vagina	milyi	*milyi*
206.	veins	u-ree	*yuri*
207.	water	nap-pā	*ngapa*
208.	wood	thal-poo	*tharpa* ‘leaf’ (*cf.* Wangkangurru *jalpa ‘wood’*)
209.	wrist	oon-nā	*nguna*
210.	whistle	wil-prinnā	*wirpa-rna* (*cf.* Diyari *wirlpa-rna*)
211.	whirlwind	wom-meria	*wamara*
212.	womb	kulyi-erra	(Wangkangurru cognate)
213.	windpipe	ulkoo-anna	*ngalka-rna* ‘to swallow’?
214.	wet	kuna-oo	*kangu* ‘sweat’ (*cf.* 177)
215.	woman (married)	willa-prinna	*wihapirna* ‘old woman’ (*cf.* 137)
216.	white	wil-ye-u	
217.	whip	takoo-ippa	(*cf.* Wangkangurru *thaku wipa* ‘stock whip’, loan from English)

Schoknecht’s Data

Carl Schoknecht was a missionary to the Diyari at Killalpaninna from 1871 to 1873. In the introduction to his translation of Schoknecht’s dictionary, his grandson J. C. Schoknecht (1947) provides the following information, from a small note-book kept by the missionary:

> Karanura. Location: Same as No. 7
> Examples of the language: wirta, spear; pinawila, boomerang; mara, hand; kapa, water; wanda, vegetable food.

The annotation ‘Same as No. 7’ means that the location was recorded as being the same as the ‘Wonkamala’ tribe, namely ‘A creek to the east of the Salt Creek (kalakupa)’.

We can recognise some of these words recorded by Schoknecht, and compare them with the forms given by Wells and their Ngamini cognates:

Schoknecht	Wells	Ngamini	Gloss
wirta	–	*wita*	'spear'
pinawila	–	*kirra*	'boomerang'
mara	murrā	*mara*	'hand'
kapa	nap-pā	*ngapa*	'water'
wanda	–	*yutha*	'vegetable food'

Reuther's Data

There are a few words of Karangura scattered throughout the early pages of Reuther's massive Diyari dictionary (Reuther 1981), mostly in the form of comparative notes on neighbouring languages. The forms which appear are listed below, together with notes on them and comparison with Ngamini:

1. Under the Diyari entry *dama-* 'to cut', Reuther lists the Karangura cognate as 'dramatjanta'. We can compare this to the Ngamini verb *damajanda*, which is the reflexive participial form of the verb *damajarrhi-* 'to cut oneself'. Notice that Reuther's Karangura form shows the same reflexive participial inflection as in Ngamini and also the same as we noticed in Wells' vocabulary (see above). The initial 'dr' in the verb given by Reuther is unexpected. Wells' item 23 has 'cutting' – 'dum-an-nā' (*dama-rna* as in Ngamini and Diyari). Now, there is a regular correspondence whereby words with initial *d* in Diyari-Ngamini have cognates with *drr* in Yandrruwandha-Yawarrawarrka, as the following forms illustrate (see also Austin 1988):

Dyari	Ngamini	Yandrruwandha	Gloss
dama-	*dama-*	*drrama-*	'to cut'
daka-	*daka-*	*drraka-*	'to pierce'
danga-	*danga-*	*drranga-*	'to hunt away'
diji	*diji*	*drriji*	'sun'

Immediately preceding the Karangura entry 'dramatjanda' in Reuther's dictionary is the Yawarrawarrka cognate 'dramajandrari' *(drrama-yindrra-ri):* it is possible that he copied the initial 'dr' onto the Karangura word by mistake.

2. Under the Diyari entry for *kurda-* 'to fall' (of rain), Reuther lists the Karangura word 'burndatja' (and also the Ngamini word 'burina'). We can recognise this as the normal verb 'to fall' *purrhi-* in its participial form, namely *punda*. As noted in relation to Wells' vocabulary, Ngamini verbs have a number of participial forms, and those verbs ending in *rrhi-* add *nda* to form the participial (deleting the final syllable). Again, we have strong evidence that Karangura was grammatically identical to Ngamini in this respect.

3. Under the Diyari entry *kaldrri* 'salty', Reuther gives as Karangura the word 'kalikalitja' (as distinct from Ngamini 'kaldrikaldri'). I have no comments on this form.

4. Under the Diyari entry *kalkawarrha* 'evening', Reuther has Karangura 'kalkauratja' (and Ngamini 'kalkaura'). Again, we have a form identical to both Ngamini and Diyari. The final 'tja' may be some kind of emphatic suffix, as in the previous two examples.

These are the only instances of Karangura words in Reuther's work.

Conclusion

The vocabulary in Wells' 1894 paper is an invaluable source on the Karangura language. For most of the entries in it we are able to recognise their cognate forms in the neighbouring languages. Lexical and grammatical hints in Wells' list suggest that Karangura was very closely related to Ngamini and that it was therefore located in the eastern Lake Eyre group of languages, along with Yarluyandi, Diyari and Thirrari. Wells' data is confirmed by other fragments to be found in the writings of Schoknecht and Reuther.

We have good evidence from Hercus' research that the Karangura possessed ceremonial and mythological links with the Wangkangurru people. While the Karangura vocabulary shows a high degree of cognacy with Ngamini, there are also quite a number of cognates with Wangkangurru, reflecting an areal vocabulary (also partly shared with Thirrari). There is additionally some evidence of grammatical features shared with Wangkangurru, primarily the short participial forms of certain verbs ending in *i*. This characteristic is an areal feature of Wangkangurru, Ngamini and Karangura.

Finally, our research has demonstrated the importance of considering historical linguistic documents in their areal and comparative context, making use of all that we know from both historical and contemporary sources.

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ENDNOTES

1. Ngamini data come from: my field notes and tape recordings, my transcriptions of Gavan Breen's tape recordings, and a 'Ngaumeni' comparative vocabulary collected by J. G. Reuther. The orthography used for Ngamini and other eastern Lake Eyre languages is the same as that employed in Austin (1986) and all publications on Diyari thereafter. The spelling generally follows Australianist practical orthography conventions: *th nh lh* are lamino-dentals, *j ny ly* are lamino-palatals, *rd rt rn rl* are apico-domals (retroflex), and *ng* is the dorso-velar nasal. Note that all the languages have three 'r-sounds': *r* a retroflex continuant, *rr* an alveolar tap, and *rrh* an alveolar trill. The vowels are *a i u*.

2. In all the eastern Lake Eyre languages the ergative case is used with abstract nouns and a copula verb to predicate a psychological state of the subject (see Austin 1981: 121), as in Ngamini *nganyi muwa-nu ngana-yi* (I hunger-erg be-present) 'I am hungry'.

3. Thirrari became extinct early this century, although I was able to collect a little information on it from Ben Murray who learned the language as a child from his maternal grandmother [see Austin (1981: 4ff), Austin *et al.* (1988)]. Ben Murray's Thirrari is almost identical in vocabulary to Diyari (apart from a couple of unique lexical items such as *kurdingka-* 'to run', *cf.* Diayari *mindrri-*, and *dandrra-* 'to hit', *cf.* Diyari *nandrra-*) though there are some differences in the form of affixes, particularly the verb suffixes. The Thirrari recorded by Reuther shows exactly these differences in affixes, but additionally has a number of different vocabulary items which are not the same as the Diyari words (but which *are* identical to the corresponding Wangkangurru words). It may be that the last generation of Thirrari speakers had adjusted their speech towards that of their more numerous Diyari neighbours.

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GLIMPSES OF THE KARANGURA

PETER AUSTIN

Summary

Karangura people occupied lower Eyre Creek in the far north-east of South Australia. They had disappeared by early this century. This paper seeks out some of the causes of this tragedy, and records what has been preserved of Karangura traditions by the neighbouring Wangkangurru and Yarluyandi people.

GLIMPSES OF THE KARANGURA

LUISE HERCUS

HERCUS, L. 1991. Glimpses of the Karangura. *Rec. S. Aust. Mus.* **25**(2): 139–159.

Karangura people occupied lower Eyre Creek in the far north-east of South Australia. They had disappeared by early this century. This paper seeks out some of the causes of this tragedy, and records what has been preserved of Karangura traditions by the neighbouring Wangkangurru and Yarluyandi people.

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It is one of the many tragedies of Aboriginal people that their traditions have not been treated with general respect until relatively recently, when for vast tracts of the country it was already too late. Even this belated recognition lacks egality: it is often said that Aboriginal traditions only have significance when the groups to whom they belong still have knowledge and attachment to them. This attitude is inevitably compounded by land-rights legislation which by its nature has to deal with the claims of living people. There are no such restraints militating against European and Asian traditions. It is unlikely that anyone would claim we should forget all about the Sumerians because nobody now has any direct links to them and because a lot of what we know about them was written down by Babylonians anyway. Traditions, whether they are ancient Sumerian, recent European or Aboriginal all have significance as being part of human thought.

It is a sad fact that many of the groups that once inhabited south-eastern Australia are now known by little more than names on a tribal map. The same applies even to people who once lived in more desolate parts of Central Australia: there are groups that became extinct early this century. A typically tragic case is that of the Karangura people of what is locally called the lower Georgina – the Eyre Creek of modern maps and the Herbert River of early maps.

Though they have no modern descendants, Karangura people should not be regarded as irrelevant and their traditions deserve recognition – provided we can at least get a glimpse of them.

There are two possible sources of knowledge of Karangura country and Karangura people: these are meagre historical and ethnographic documents from last century on the one hand, and what oral evidence could be gathered over the last two decades from the oldest of their surviving neighbours, people of Wangkangurru and Yarluyandi descent. The actual text of this oral evidence is given where relevant here: some of it is in English, some in the Wangkangurru language.

KARANGURA COUNTRY

There is some measure of agreement as to the general location of Karangura country (Figs 1 and 2). Howitt in his papers (n.d., paper 5), when discussing whether a Diyari person could eat whichever animal was his matrilineal descent totem, mentions the location of the Karangura in relation to the Diyari: 'further to the north among the Karangura, Marunga and Yudlayudlanga *etc.* the mardu is not eaten'. In his map (1904: 44), based mainly on evidence gathered by him decades before, Howitt shows the Karangura as living along Eyre Creek.

Tindale (1974: 212) has the following entry:

Loc.:	South of Alton Downs on Eyre Creek; east to Pandi Pandi; on the Eleanor River south to the northern margin of Goyder Lagoon. Wells listed fourteen named hordes.
Coord.:	138°40′E × 26°25′S
Area:	3 200 sq. m (8 300 sq. km)
Alt.:	Karangura, Karangura, Kurangooroo, Andrawilla (native name of early police camp, now Andrewilla).

More recent evidence obtained from neighbouring people confirms this general location. The most senior Wangkangurru man, Mick McLean, speaking to Luise Hercus in January 1967 (Tape 66) about the Seven Sisters Myth and Song Cycle, described how the Old Man *Unthuriya*, sometimes also known as 'the Larrikin Man' went with Seven Sisters:

Text 1. Seven Sisters

M.: Take'm down Cooper's Creek and to the Diamantina then. *Thita-purrunha* 'Full of Ants', that is Karangura country, Karangura and Wangkamadla mixed, Adria Downs.
Then further is *Ngurrawani*, (Gnarrowie Well) straight down from Adria Downs.
L.: Nallamundie Waterhole, is that Karangura?
M.: That is all Karangura. *Thitirri*, supposed to have been straight down from Adria Downs.
They (the Seven Sisters) followed the creek right down, they come up half way up in that creek and cross over where the Kallakoopah starts. That's where they start to dance . . .

This account mentions the northern part of the area given by Tindale, and includes Adria Downs, slightly further north still than Alton Downs. Other

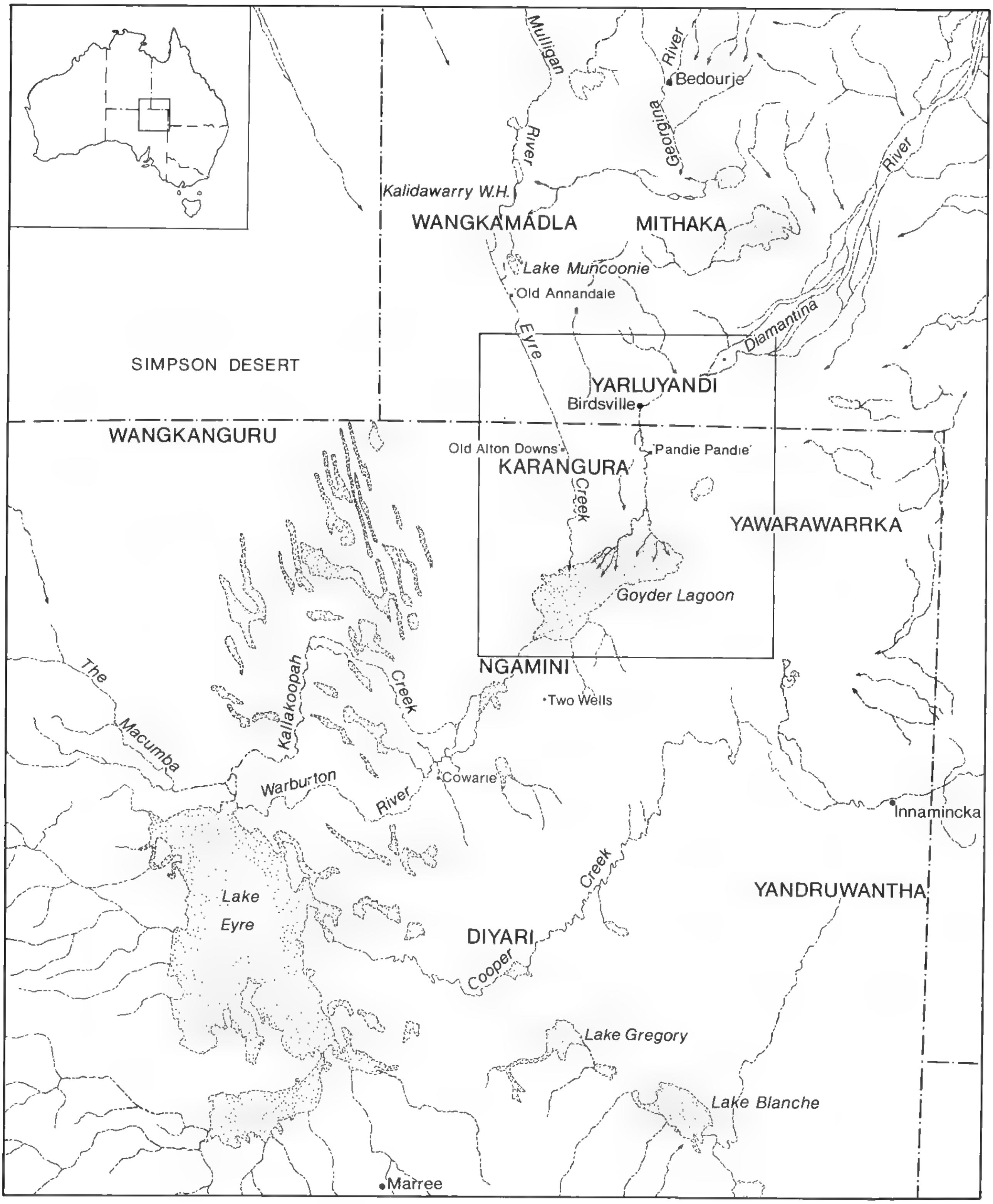

FIGURE 1. North-east South Australia and south-west Queensland, showing major Aboriginal groups at the time of European contact. V. Potezny, 1991.

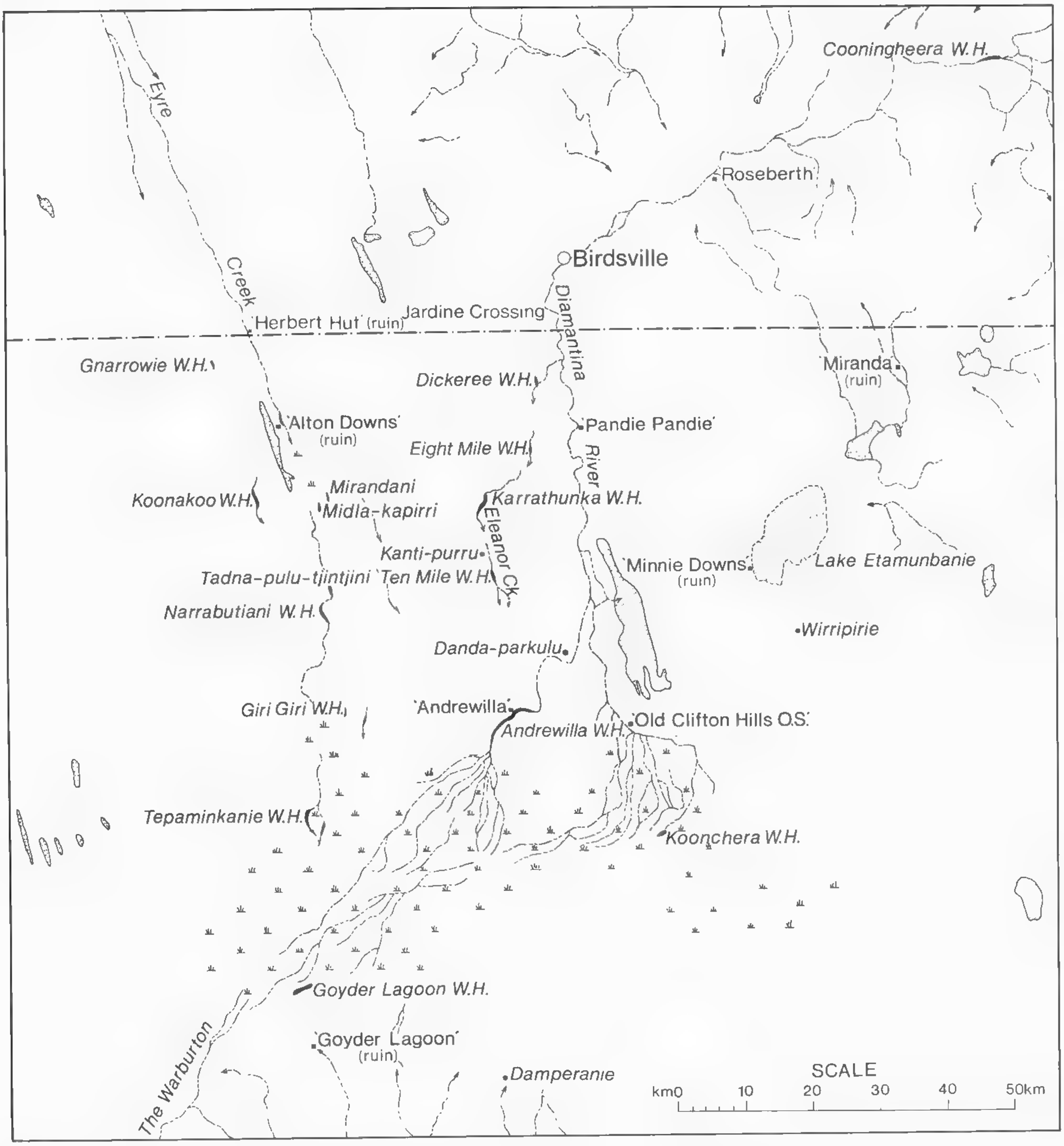

FIGURE 2. Important sites in Karangura and neighbouring country. V. Potezny, 1991.

mythological accounts, discussed below, and also identical statements made in 1974 by Maudie Naylon of Birdsville (born *ca* 1886) further corroborate Tindale's general positioning of Karangura country. One important point to note is that there is general agreement: only the western, the Eleanor channel of the Diamantina traditionally belonged to Karangura. The eastern channel belonged to Yarluyandi people and to Ngamini people further south near Goyder's Lagoon, with Yawarawarrka people coming in from the east.

Northerly Neighbours

There is one major disagreement between Tindale and the evidence gathered from people over recent years – admittedly much younger than his informants. This disagreement concerns the position of Yarluyandi country: according to Tindale Yarluyandi people were the only immediate northerly neighbours of the Karangura. The recent evidence, supported by the myths, indicates that Yarluyandi country was situated along the Diamantina and not Eyre Creek. It was the

Wangkamadla, the south-westernmost of the Pitta-Pitta group, who in traditional times lived around Annandale and extended down towards *Thita-purru* ('Full of Ants'), Adria Downs. Adria Downs was repeatedly said to be 'both Karangura and Wangkamadla mixed'.

There is an account of events in the Adria Downs country late last century, in the nineties, when a small group of Wangkangurru people arrived there, on their way out of the desert. It is evident from the account that Karangura people were no longer there. Their neighbours, the Wangkamadla people from Annandale however were still in the area and took a poor view of this visit, which unlike expeditions for pituri, was unplanned. This was described by the Wangkangurru speaker Mick McLean Irinjili who had heard about it subsequently (tape 571, 1971):

Text 2. Adria Downs

1. M.: Adria Down is what they call *Thita-purru*, whitefellow call'm . . . there is swamp, *kutha nganthu*. That is where they could be *ngurku*, plenty *paya, paya papu.*
2. *Pinja-ru paliji-rna-pirda-lhuku, uta kari-nha kaparra.*
   War-party-ERG strike-SP-kill-HIST, now
   they-ACC blood-feud.
3. *Kari-nha partjarna anthunha mapu kumpira-ma-ru* from Annandale, our mob *Wangk' aranda-kunha arluwa*
   They-ACC all my mob dead-make-NAR Speech-Aranda-POS child
   partjarna pirda-lhuku.
   all hit-HIST.
4. *Kumpira-ma-lhuku kari-kunha watji-nangka-ngura ngata-ki ngata-ngata-ki, maljka nguyu*
   Dead-make-HIST they-POS follow-CONT S-CONT after-EMPH after-after-EMPH, not one
   thangka-nha.
   sit-NP.
5. Johnnie Reese-kunha anja, he is one of them but he has gone. Pandi Pandi. He was pinja-nga join in. His brother got killed.
6. *Uka-kunha nhuthi mudlu-nga kayirra uka-kunha nhuthi idni-ngura* Birdsville, you know
   He-POS brother sandhill-LOC there he-POS brother lie-CONT
   mudlu-mudlu? There *uka-kunha nhuthi, Parraka-nhanhi,* old *Njurrili* ha!
   sandhill-sandhill he-POS brother, Bank-see
7. That pinja is no good, I don't like 'm.
   L.: *Kari-ri partjarna pirdayi-ka?*
   They-ERG all kill-PAST?
8. M.: *Ngata-ngata-ki* clean'm up; *partjarna, mankarra njurdu pirda-rnanha mankarra-kari-nha, kayirra thangka-ka*
   Later-later-EMPH all, girl too kill-IMM girl-PI-ACC, there sit-PAST
   anthunha kaku, Finke Bob been have'm, she was the last, *uka nguyu-ki tharka-rna.*
   my sister, she one-EMPH stand-IMP.

Text 2. Translation

1. 'Adria Downs' is the name that whitefellows call *Thita-purru* 'Full of Ants'. A swamp is there with water laying about in crab-holes. This was a place where they would be fine, there were lots of birds and eggs.
2. A war-party came to attack and kill them, and now they had a blood-feud.
3. Those Annandale men killed all those people there who were from my mob, they attacked our mob who had (some) Aranda-speaking parents.
4. They killed them and persecuted them later on and then later on again, so that not one should stay alive.
5. Johnnie Reese's father was one of (the group who were being pursued) but he had gone, he was at Pandi. He joined in (a reverse) war party. His brother got killed.
6. His brother is (buried) there on the sandhill, his brother was staying at Birdsville, you know that little sandhill, that is where his brother is (buried), that was *Parraka-nhanhi* 'Looking at a steep bank', they also called him old *Njurrili*, oh!
7. Those war-parties are no good, I don't like them.
   L. Did they kill everybody?
8. Later on (the Annandale men) killed the whole lot (of this small group), the girls too, but my (classificatory) sister stayed alive, the one that Finke Bob married, she was the only one left.

Ultimately the feud was abandoned, the revenge killings stopped, and early this century Wangkangurru people actually went to join the Wangkamadla group at Annandale. This was recalled by oral tradition and is proved by a letter sent from Annandale to the Office of the Chief Protector of Aboriginals in Brisbane in 1908 (a copy was made available to the author by Angus Green). It gives a list of 43 people with the comment: 'the above consist of Blacks mustered here on the 10th Oct 1908.' Many of the names on the list are English and nondescript, such as 'Judy', 'Biddy' and 'Jubilee'; some are clearly Wangkamadla like 'Muncoonie Jack' and 'Mulligan Mick', but at least a few are known to have been Wangkangurru, such as 'Yarotilli' (*i.e.* Yaratuli) and 'Pigweed', who was really Jessie *Milja-witjinangkarda,* and one, Lucy Kingkardie (*i.e. Kingkardi* 'Laughing') was Yarluyandi. The place-names along the Eyre Creek north of Adria Downs corroborate the evidence that before this influx the Annandale area was not Wangkangurru nor Yarluyandi but Wangkamadla country. The Annandale group of Wangkamadla people was well known to the oldest people of part-Yarluyandi descent at Birdsville who regarded them as outsiders but had extensive information about them. They could still point out a site called *Nganawardani* where two small creeks come out of the main channel on the western bank of the Diamantina on the Queensland-South Australian border: 'we used to have the big (*Warrthampa*) corroborees at *Ngalpura-ngura*, Jardine Crossing, just up a bit. Different people came from everywhere, and the Annandale mob camped here at *Nganawardani*.' They made it clear that the bulk of the Annadale people were not of 'our (Yarluyandi) mob': they were Wangkamadla, not Yarluyandi. In his large-scale study in south-west Queensland, working mainly with Pitta-pitta people, Breen came to an identical conclusion. As his map shows (Breen 1971: 21), the Wangkamadla were traditionally the immediate northerly neighbours of the Karangura.

The fact that Wangkamadla people were their immediate northerly neighbours had some importance for the history of Karangura people. As Austin demonstrates (1991), the Karangura belonged to the Diyari language group like their southern and eastern neighbours, the Ngamini and Yarluyandi. They were in fact the most north-westerly outpost of this group and had as less related neighbours the Wangkangurru people in the desert on the west, and the Wangkamadla people further up along Eyre Creek to the north. The Karangura were thus on the cross-roads between a number of traditions, which put them into a vulnerable position once the old order broke down.

Karangura People: A Small Tribe

Apart from the waterholes on the Eleanor in the Andrewilla area, the main country of the Karangura was along the 'Georgina', the lower Eyre Creek. Unlike the Diamantina, this creek floods only rarely: the water of the upper Eyre Creek and the Mulligan has to fill Lake Muncoonie to the north and then be high enough to back out again before it can flow down the Georgina channels. This is not, and was not, hospitable country: when the waterholes in the Georgina channels dried out the Karangura depended on soaks and some wells in the adjacent sandhill country or had to congregate by the longest-lasting Eleanor waters. They could manage this because they were a small group. Birdsell (1973: 344) made calculations intended to show that theoretically even at the time of contact the 'Karanjuru' might have consisted of as few as 32 persons. They were the very smallest of the small tribes living in an area where there was an easterly expansion of the subincision boundary. Birdsell concludes that this expansion led to a fragmentation of tribes. There is evidence, not only from Wells (1894: 515) of the existence of a number of local groups of Karangura. A population count as low as 32 is therefore highly unlikely for the time of first contact. Nevertheless the ecological evidence indicates that Birdsell was justified in thinking that the Karangura must have been amongst the smallest tribes, and may indeed have numbered only around 100 when the Europeans arrived.

Karangura People: Earliest References

The information about Karangura country may be clear in its outlines, but we know little about the people. J. W. Lewis's exploration party crossed Karangura country in February 1875 (Threadgill 1922: 165), but his map does not contain a single Karangura place-name. The surveyor Cornish worked in the area in 1880. His map was recently acquired by the Mortlock Library and was found there by V. Potezny. It shows a number of Karangura waterholes, 'Kooringala', 'Tooracky', 'Kalkaparidiginna', and 'Koonakoo'; but he does not mention the people he must have met (Fig. 3). The earliest published mention of the Karangura is by W. J. Paull in his introduction to the 'Ominee' (Ngamini) vocabulary (Paull 1886: 18). He states that:

> The marches of the lands of the Ominee, Wongonooroo, Kuranyooroo and Yarleeyandee tribes, all intimately connected, meet on the Warburton River at Cowarie head-station.

Cowarie was in Ngamini country, but there is plenty of oral traditional evidence to show that under the impact of white settlement people from adjoining groups congregated here.

The most informative early reference to Karangura people is by the police officer F. H. Wells in his article on 'The Habits, Customs and Ceremonies of the Aboriginals on the Diamantina, Herbert and Eleanor Rivers, in East Central Australia'. He starts by saying:

> The natives of the localities named belong to the Andrawilla tribe, and occupy a block of country about ninety by ninety miles. The chief tribe is subdivided into smaller tribes or clans *viz:* Andrawilla, Kuntapunchinna, Dickeri, Kyratonka, Kertie-terie, Yumalla, Kerra, Dipracoolie, Tunbulla, Koringurra, Kalkaparichinna, Mundowalla, Tippaminkinna and Dampaminnie; these tribal names being taken from the names of various waterholes in the locality inhabited by the tribe, such as Andrawilla, Kyratonka *etc.* (Wells 1894: 515).

These names do indeed correspond to names of waterholes, Most are known from three other sources besides the list given by Wells: 1. from the unpublished map produced by Hillier in 1904 according to the data of Pastor Reuther at Killalpannina mission, 2. from the more recent evidence of Aboriginal people of Wangkangurru and Yarluyandi descent, 3. from modern maps. The correspondences between Wells's list and the other sources is illustrated in Table 1. The recent Aboriginal information is given in italics.

'Koringurra', which is mentioned in the Well's list, is probably the actual tribal name Karangura, but we cannot rule out the possibility that it might be Kooringala waterhole on Eyre Creek, called *Kuringala* 'Whitewood tree' by recent speakers of Yarluyandi and Wangkangurru.

With the possible exception of this tribal name, the items on this list are all names of major waterholes, and there can be little doubt that they were centres of small local groups. Most, but not all of them, were no doubt originally Karangura centres. The Andrewilla waterhole (Fig. 4) appears to have belonged originally to Karangura people, as did the area towards the south to Goyder's Lagoon. Two of the waterholes listed by Wells are however some considerable distance outside the area: Damperanie and 'Miranda' are situated to the south-east and east in what was probably Yawarawarrka country, while 'Kuntapunchinna', Pandi Pandi, was to the north and Yarluyandi people consider it part of their original territory. It might have been a place shared by Yarluyandi and Karangura people.

Wells obtained his information at Andrewilla in the early 1890s. He writes of the 'Andrawilla tribe', but he is obviously referring to whoever happened to be living at Andrawilla at that time. He did not differentiate between the various groups, though his vocabulary must have come from Karangura people. Wells gives us further important information in that he mentions some names of persons of the 'Andrawilla tribe'. Some of these names refer to people who are known from other sources; one survived till recently, while others have relatives who recall them. They were people from various groups from the north-east of South Australia, who happened to be at Andrewilla. Only a few were Karangura, even in 1892–3:

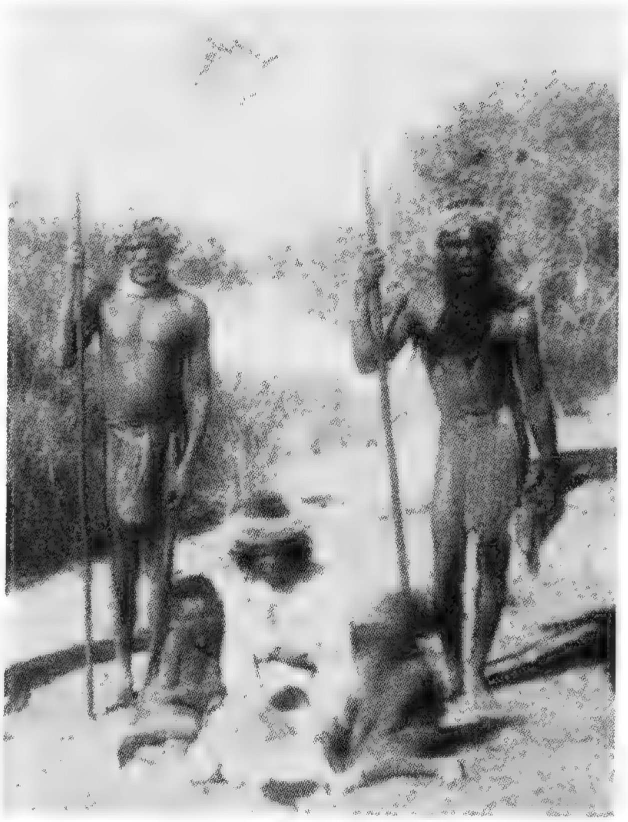

FIGURE 3. Individuals of the 'Andrewilla Tribe', photographed at the Andrewilla Police Camp during the 1890s. State Records, South Australia, GRG.52.

TABLE 1. Localities of the 'Andrawilla Tribe'.

Wells's name	Name on modern map	Aboriginal name		
		Reuther		recent
Andrawilla	Andrewilla	Nganarawirli	Y.	*Nganarawirli*
Kuntapunchinna	Pandie Pandie	(Pandi Pandi)		*Kanti-pantjini*
Dickeri	Dickeree, also	Dikiri	Y.	*Dikirri*
	Alton Downs Waterhole			*Dikirri*
Kyratonka	Karathunka	Kayiridunka	D	*Kayarathungka*
Kertie-terie	Annandale	Katijerra	Y.	*Katitharri*
Yumalla	Old Clifton Hills Outstation?	Jamarkirra?	Y.	*Yabmalkira ?*
Kerra	Giri Giri	Kiri-kiri	W.	*Kiri-kiri*
Dipracoolie	Old Lagoon	Tirpakurli	N.	*Thirpa-kurli*
Tunbulla	Toondooloo, 'Miranda'			*Thunpulu*
Kalkaparichinna	Kalkaparidiginna	Kalkapurutjini	Y.	*Kalkapuritjinha*
Mundowalla		Mandurali	Y.	*Mandawarli*
Tippaminkinna	Tepaminkanie	Tipaminka	Y.	*Thipamingkani*
Dampaminnie	Damperanie	Danpara	N.	*Danparani*

(Y. indicates that Reuther lists this place as being Yarluyandi, N. as Ngamini, W. as Wangkangurru and D. as Diyari).

FIGURE 4. Andrewilla waterhole, the largest in Karangura country. Photograph: L. A. Hercus.

Personal names listed by Wells

Male names

Kooripipinna – *Kuripipinha* was a Karangura man from Alton Downs. He was named after some special fossil bones which had magical qualities.

Appakulta – *Ngapa-kalta* 'Water-skin' could be a Karangura, Yarluyandi or Ngamini name.

Toondroo-wonko-inna – Probably represents a Wangkangurru name, *Thurndu wankayinha* 'Stomach Growing Big'.

Wadoo-woka – *Wardu-waka* 'Little short fellow' could be either a Diyari or possibly a Karangura name.

Watti-wattina – *Wati-watinha* 'Track' was a Yarluyandi man. He was the great-uncle of the Naylon family and brother to the last full Yarluyandi woman, Judy Trew *Thandripilinha.*

Tring-alli – *Thiringili* 'Sandy' was a Yarluyandi man who died at an advanced age at the Yelpawarilinna waterhole on the Diamantina in the early thirties.

Watti-kattana – *Wati-katali* was known to the oldest Yarluyandi people from their youth. He was a Karangura man and came from and also died at Alton Downs.

Oooroo-charoo – Wangkangurru *tjaru* means light cloud. This name probably is *Nguru-tjaru*, 'another white cloud'.

Female names

Paroo-moogunna – 'after a fish'. *Parru-mukunha* 'Bones of Black Bream' is remembered to this day. She was a relative of the Crombie family and was Yarluyandi. She spent most of her later life in the company of another Yarluyandi woman of the Fish totem, Polly *WaRi-WaRi* 'Yellow-belly'.

Nooyoo-nackaroo – 'after a fire' is probably the Wangkangurru name *Nguyu-Makaru* 'By one Fire'.

Akka-willi-likka – 'after a fire' is Maudie Naylon *Akawiljika,* of mainly Wangkangurru descent, who was born in the Simpson Desert about 1885 and died at Birdsville in 1980. Her name is Aranda, given by her part-Aranda father Bille Reese *Ngaltja-kintarda*. She was not only unique in her traditional knowledge, but she also happened to be at Andrewilla every time any known investigator went there. She was listed not only by Wells (1894), but also by Basedow (1919) and by Tindale (1934). In her later years she stayed in Birdsville. Her knowledge was representative of the mixed group of people who were at Andrewilla, and she maintained her attachment to traditions. Though her main language was Wangkangurru, she also had a command of Yarluyandi which she recorded for the author, and Ngamini and Yawarawarrka, which she recorded for Gavan Breen. There was also a man of this name, 'Akka-willi-likka' who was photographed at Andrewilla during the 1890s as one of a group of Wangkangurru arrivals from the Simpson Desert (Jones 1991: 172).

Naruwa – *Njaruwa* 'Wren' was known only as a man's name; there were two people of that name, 'little (*i.e.* younger) *Njaruwa*' and 'Big *Njaruwa*'. The older *Njaruwa* would have been a baby at the time of Well's stay at Andrewilla, and this may account for the mistake in gender. He was great-uncle to the Lumpkin and McLean families.

Wilyerooroo-mun-nung-arrie – 'after wind' is almost certain to stand for *Wiljaruru-maningaru* 'taken away by the storm'. This is a Wangkangurru name.

Wumma – 'after a snake'. This name is *Wabma/Wama* 'Snake', a word common to all languages in the area. The name therefore does not give any indication of which group the person belonged to.

Kal-li-irri – Nothing known

Wooti-inna – This could be the Yarluyandi name *Wutjunha* 'the blind one', but that remains uncertain.

Yarraguninna – Probably a Wangkangurru name *Yarra-kudninha* 'Putting something down on hollowed-out ground.'

It is clear from the evidence of these names that as early as about 1892–3 a mixed group was living at Andrewilla, and that the majority was not Karangura.

Karangura People: Negative Evidence

After Wells there are only few first-hand references to the Karangura. Howitt & Siebert (1904: 106) and Howitt (1904) published the same myth, originally collected by Siebert, presumably during his time at Killalpannina in 1900–1. It is about the Two Men who introduce the circumcision knife, and it is entitled 'The Malku-malku-ulu, a legend of the Karanguru and Ngameni'. Howitt and Siebert's work does not have any further specific mention of Karangura people, but it represents the last reference to the Karangura on first-hand evidence.

Gason (1874: 1895) had not mentioned the Karangura, but this is not surprising as he was writing mainly about Diyari people. It is after the evidence of Wells, from 1894 onwards, that the Karangura are conspicuous by their absence from written records. Albert Helling wrote from Cowarie to Howitt in March, and again in April, 1899, to give him information on Aboriginal people in the area. His letters, preserved in the Howitt papers, make no mention of the Karangura. Speaking of the current situation at Goyder's Lagoon he says: 'the Blacks there are Wonkaooras, Yowraworkas and Ahminys. The former tribe predominate.' (Howitt, n. d.).

The missionary Reuther in his vast work written at the turn of the century made only rare references to the Karangura. They are not named on the map that Hiller' drew, using Reuther's materials. Of the 2468 place-names which Reuther lists for the north-east of South Australia (Reuther 1981: Vol. VII), there is not one attributed to the Karangura. Place-names in what was traditionally Karangura country, as shown in the list above, he ascribes mostly to Yarluyandi, and a few to Ngamini and Wangkangurru. Not a single one of the famous toas (Jones & Sutton 1986) is attributed by Reuther to the Karangura. The Karangura do not figure among the lists of personal names (Vol. VI). All other groups, even those that had greatly declined in numbers, such as the Pirlatapa, are named on the Hillier map, and toas and personal names are listed for them. Only the Karangura are absent.

Horne and Aiston (1924) make no mention of the Karangura, neither do Tindale's and Fry's notebooks from their 1934 Diamantina expedition. F. Fenner took part in the same expedition and his article (Fenner 1936), which includes a map, also makes no reference to the Karangura.

There was no conspiracy of silence; something was clearly amiss with the Karangura, and strangely enough, this was connected with Karangura traditions and myths. The following sections will give some details of what has come down to us of Karangura traditions and how these are connected with the destruction of Karangura people.

A Karangura Song

Only one brief text has come down to us verbatim in Karangura. It came through a Diyari speaker, Mary Dixon, who was born about 1884. Mary was the daughter of a greatly respected and knowledgeable Diyari man, *Mawili,* who gave much information to Aiston (Horne & Aiston 1924: 44). She came to Killalpaninna at the turn of the century as a young married woman. Being married she was not allowed to go to the school and spent much of her time with the older women. An old Karangura woman taught her how to sing a Karangura lullaby for her first baby. She never forgot this and sang it to Luise Hercus and Dora Parker in 1966:

Text 3. Karangura Lullaby
Tjalpapa-li tjalpa-li
Warra warra kali-ma

Dora Parker (Wangkangurru) then explained:
Ngatji-rna ngataru. Wakarra pirda-lhuku,
Look-IMP behind. Neck hit-PURP.
'He might sneak up and hit you in the back of the neck if you are not looking.'

Text 3. Translation
Mary's song:
Box-tree by box-tree
(Around) the side (around) the side looking

Dora Parker: She is looking behind (the trees), in case someone were to hit you in the back of the neck. Someone might sneak up and hit you in the back of the neck while you are not looking.

In this Karangura lullaby the mother assures her baby that she has looked behind every tree by a waterhole and that all is safe. Looking behind trees is the Aboriginal equivalent of looking under beds. The lullaby is tragic since all the caution of Karangura people was obviously in vain.

FRAGMENTS OF KARANGURA MYTHOLOGY: SOME MINOR MYTHS

A. The Two Dogs

The knowledge of a number of minor myths had remained with people of Wangkangurru and Yarluyandi descent: they could still explain some of what was once Karangura country. A very localised and stereotyped myth, interesting only on account of its location, was that of the Two Dogs, told by Linda Crombie, January 1989:

Text 4. Two Dogs

1. *Karna-katjarranha* two dogs name that and there is the flat, big one too. You can go to the top of the Andrewilla sandhill and you see it. Make me sorry when I have a look at the country.

2. *Ularaka-nga madla-ru warrawa-rna warrukathi-pula-nha; puntha-li purda-lhuku*
History-LOC dog-ERG chase-IMP emu-TWO-ACC; drink-HAB get-down-HIST
puntha-li purda-lhuku
drink-HAB get-down-HIST.

3. *Warrawa-rna* right up to *Karna-katjarra,* no, *Wipala-payirri, Walka-thipani*
Chase-IMP
madla-pula-ru. pirda-rna warrukathi pula-ru
dog-two-ERG. kill-IMP emu two-ERG.

Text 4. Translation

1. *Karna-katjarranha* 'Clever Man' is named from the two dogs. It is a big flat area. You can go to the top of the Andrewilla sandhill and you see it. It makes me sorry when I have a look at the country.
2. In the history time the Dogs chased two emus there. The emus used to come and crouch to have a drink (at the Andrewilla waterhole).
3. The two dogs *Karna Katjarra*, 'the Clever Man', no (I mean) *Wipala-payirri* 'Wide Flat' and *Walka-thipani* killed the emus.

B. Kimili 'Kanti-purru' The Black Snake and Kurkari the Green Snake

Kimili, also known as *Kanti-purru* 'Carrying a waddy', is the main ancestor to whom Reuther attributed the naming of places along the Eleanor channel in what was traditionally Karangura country. Reuther regarded this as Yarluyandi ground; there must in any case have been close connections between the Karangura and the Yarluyandi who immediately adjoined this area. All the sites along the Eleanor are associated by him with *Kimili*, this includes for instance the main Andrewilla waterhole, the nearby *Karna-katjarra* sandhill of the story above (Vol. VII: 1475), *Ngampangampayarra* (Vol. VII: 1479) 'Eight Mile Waterhole', and *Tharnapulutjintji* (Vol. VII: 2044), 'Ten Mile Waterhole'. The only conspicuous exception is *Kajiridunka* Karathunka (Vol. VII: 828).

The Snakes and the Grinding Stones

There are several myths that related how people along the Eleanor and adjacent areas on the Diamantina did not have grinding stones of any kind and were trying to eat unground nardoo and grass-seeds. Then the two Snake Ancestors came from the north via Alton Downs. *Kimili,* the Black Snake, as well as carrying his waddy, came with a seed-grinding dish, while his companion *Kurkari*, the Green Snake, was carrying a *ngampa*, a nardoo stone. They separated near Old Alton Downs.

Kurkari with his nardoo stone came along the *Kutari* sandhill near Bayard's yard, to the east of Karathunka. He put down his stone and rested. *Kimili* joined him there and they camped. While they were asleep *Tjilpuru* the Bush-lark boy came sneaking up from the *Ngardu-mathani* 'Biting (unground) nardoo' sandhill by the Diamantina, which was Yarluyandi country. He was intending to steal the nardoo stone. The people at the Eight Mile Waterhole however were much closer; they called out *ngampa ngampa yarra*, 'a nardoo stone is over there, quite close!' Hence Eight Mile Waterhole has the slightly abbreviated name *Ngampampa-yarra.* These people sneaked over to the sandhill, took the nardoo stone and went back to grind nardoo. In the morning the Man from the North caught up with them and retrieved his stone. It was very heavy and he managed to carry it to *Kayirri-thungka,* Karathunka. He put it down and rested, still in company with *Kimili.* Now it was *Tjilpuru*'s turn to steal the stone.

He crept up and took it away first to *Ngardu-pandiyarranha* 'Pounding Nardoo' waterhole just north of Manganuni waterhole, where the grandmother was the first one to try it out. Then all the family went further south along the Diamantina with the stolen stone to their big camp at *Ngantji-malkani.* This is where *Tjilpuru*'s grandmother made a song about it in Yarluyandi:

Text 5. The Nardoo Stone Song

(The Grandmother's song, recorded by Maudie Naylon, Sept. 1969)

Tjilpúrung tjilpurú	*Tjilpuru*
ngandireéla ngapiréla	Your mother, your father
ngardula pirdaraí	Are cracking nardoo seed
ngampa yarra	The stone is there
Tjilpurúng tjilpurú	*Tjilpuru*

The grandmother sang to the boy *Tjilpuru* and he answered her. The Yarluyandi song consisting of the boy's verse is as follows, according to Tom Naylon (June 1981):

Ngandriteji nagpi	Mother, father
WaRila patjiyarra riimu	Fish they are catching . . .
Ngatatali kanjinina waa	Mother's father, mother's mother oh!
Ngardulu pandri	Nardoo they pound.

The Bush-lark people kept the nardoo stone for ever after and *Kurkari* travelled on without it; he was looking for a wife further south in Ngamini country.

Text 6. Kimili and the Two Women

Linda Crombie (of Wangkangurru and Yarluyandi descent) was able to relate several stories connected with *Kimili Kanti-purru*, 'Carrying a Waddy':

1. *Mathapurda-pula karna njara thidnangkara-nganha mathapurda Kanti-purru-nha. Kurkari yuka-rnda pula*
   Old man-two man young north-from, old man Kanti-purru-PROP. Kurkari go-PRES two
   Karlatjuwarri. Karlatjuwarri-nganha ngarritji-rna-yiwa-rna arnari.
   Kalidawarry. Kalidawarry-from go down-SP-TR-IMP this way.
2. *Mayarla-thu nguru thu yuka-ngura mathapurda mankarra-pula-nha thiki-ra Kurkari-thu*
   Leave him-EMPH other-EMPH go-CONT old man girl-two-ACC take-PUNC Kurkari-EMPH
   kaRu.
   there.

3. Two of them come down, *mathapurda nguru-ki Kanti-pureru-nha,* stop there at the *Kanti-purru, karna*
old man other-EMPH Kanti-purreu-PROP man
nguru yuka-ngura mankarra wapa-wapa-rna, mankarra kapu-kapu mathapurda Kurkaria.
other go-CONT girl seek-PRES, girl look for[1] old man Kurkari.
Kanti-purru katha-nangka-rda He was Snake too.
Kanti-purru wander round CONT S-PRES.
4. *Tharna-pulu-tjintjini, uljurla-pula thanga-rnda karla pangki-nga, muyu-nga. kanhangarda pula*
'Vagina-two-warming' woman-two stay-PRES creek side-LOC sun-LOC there two
thati-nangka-rda thaRalju thaRi- thaRi-nha, thaRalju thaRi, they was killing'm, tjirka-purru thaRalju
eat-CONT S-PRES frog small small-ACC frog small tail-having frog
pula tharni-thangka-rda. warpi-nangka-rda pula thangka-rda.
two eat-stay-PRES lie-CONT S-PRES two sit-PRES.
5. *Mathapurda uka yuka-ka. Ah njipa-parlu awarda thanga-rnda! tharna-ku nhanhi-lhiku warrritha-ru*
Old man he go-PAST Ah, clothes-bare there stay-PRES! vagina-DAT see-HIST afar-ABL
mathapurda-ru!
old man-ERG!
Tharna-pulu-tjintjini, they were rattling with sand.
6. *Kanti-purru ngarritji-rna-yiwa-rna. kanhangarda karla-nga thangka-ka uljurla-pula.*
Kanti-purru descent-SP-TR-IMP there creek-LOC sit-PAST woman-two.
7. *Athu nhanhi-ra minha-minh' anthunha! Thika-ngarra thika-ngarra arnari yuka-rnda arni nhanhi-lhiku!*
I SEE-PUNC what-what mine! Return-IMM return-IMM this way go-PRES us see-PURP!
8. *Uka-ru yaka-yaka rna uljurla, uljurla-pula-nha yaka-yaka-rna thika-rna thangka-lhuku.*
He-ERG chase-chase-IMP woman, woman-two-ACC chase-chase-IMP. go back-IMP sit-PURP.
9. He fell in love with those two women then, but they ran off to the *Danta-parkulu* sandhill.

Text 6. Translation

1. Two men, newly initiated, came from the north. These two men *Kanti-purru* 'the one carrying a waddy' and *Kurkari*, the Green Snake, went to Kalidawarry waterhole (near Lake Muncoonie in Wangkamadla country). From Kalidawarry they came down this way.
2. Saying 'I'll leave him' one of them went on, it was *Kurkari* who went over there (to Two Wells near Mt Gason) to take away two girls from there.
3. Two of them had come down: one was *Kanti-purru* 'Carrying the Waddy' (*i.e. Kimili,* the Black Snake) who stopped there at the *Kanti-purru* sandhill, the other one went on in search of girls, he was old man *Kurkari*, the one who was looking for girls among the Ngamini. *Kanti-puru* stayed just wandering around on the sandhill. He was a Snake too.
4. At the place called *Tharna-pulu-tjintjini* two women were resting in the sun by the bank of the creek (the Eleanor). The two of them were eating frogs, they had been killing those little tadpoles, the ones that still had a tail. They stayed there lounging about, eating.
5. The old man came – ah they were there with (of course) no clothes on! The old man saw their vaginas from afar at *Tharna-pulu-tjintjini* (as they were warming themselves up with hot sand), rattling with sand.
6. *Kanti-purru* came down as the two women were there by the creek.
7. 'Ah, I see something here that is for me!'
'He's coming down, he's coming back this way to have a look at us!'
8. He chased them, he ran and ran after the two women, he wanted to come and stay with them.
9. He fell in love with those two women then, but they ran off to the *Danta-parkulu* sandhill.

Reuther was obviously told some of this story because he has the following entry in his list of place names (Vol. VII: 2044):

> Tanabulutindi
> Tanabulu 'the female sexual organ', tindi 'to warm'.
> Kimilina observed how they (certain women) strewed hot sand on these parts for they had syphilis(!)

Reuther gives no further information.

Kimili continued along the Eleanor naming the country and lending his grinding dish. There is a song, partly in Yarluyandi, connected with him and with all the people now grinding flour. This was sung by Tom Naylon in 1982 shortly before his death but as there is no adequate translation of the words it has not been included here. *Kimili* then left, taking his grinding dish with him, and he travelled all the way to near Coongie Lake where he ultimately put it down. It had worn him out, literally crushed him, because it was altogether too big and heavy. Songs now lost described his journey. The stone is said to be still there, near Coongie, as a large rock.

The story of the two Snake Ancestors is significant in a number of ways: it illustrates the fact that there was a band of mythological lines that came from the Mulligan up north and traversed Karangura country going down the Georgina towards Yarluyandi and Ngamini country. This was one of the main routes for

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[1] This is a Ngamini expression meaning 'look for' and it is a direct quotation from the Ngamini story of *Kurkari*, see Hercus & Potezny (1990).

the pituri trade (Watson 1983: 30), and probably also for the importation of grinding stones. The Snake Ancestors thus followed a well established course and Karangura people occupied a central position in the tradition. The *Danta-parkulu* sandhill where the two women find refuge is halfway between the Eleanor and the main Diamantina channel. It was an important Grub Increase site and probably both Yarluyandi and Karangura people joined in rituals there.

C. Mirithira, the Grub-Powder Man

Reuther knew about the ancestor '*Miritira*' (Vol. X: 90) and wrote of him as coming from 'Turuwarapu on the other side of Salt Creek'. He associated *Mirithira* with grub powder [for details on the preparation of which, see Hercus (1989)] and with Grub Increase rites. Linda Crombie however knew of him mainly as the ancestor who dwelt at the Andrewilla waterhole and who created the trees at Two Wells.

Text 7. Mirithira

1. *Mathapurda Mirithira-nha Wirluma-nganha karla-li ngarritji-rnda.*
Old man *Mirithira*-PROP *Wirluma*-from creek-ADV descend-PRES.
2. *Uljurla-kari-ri Ngantarawirli-nga kari-ri pardi mapa-lhuku. kudnakardi kilta-rna, thawi-lhiku,*
. . . Woman-they-ERG Andrewilla-LOC they-ERG grub collect-HIST guts pull-out-IMP throw-PURP.
3. *Mirithira-ru mathapurda-ru uljurla kari-nha yabmi-rna kudna kilta-lhuku; kudna kilta-rna*
Mirithira-ERG old man-ERG woman they-ACC growl-IMP guts pull out-PURP, guts pull out-IMP
thawi-lhiku, wadnhi-lhiku pardi maka-ra watji-rna
throw-PURP cook-HIST grub fire-CAUS roast-IMP
4. *Pardi pulpa pirda-nangka-lhuku ngampa-ru uljurla-kari-ri.*
Grub powder beat-CONT S-HIST nardoo stone-INST woman-they-ERG.
5. *Mathapurda Mirithira-ru yabmi-rna kari-nha; uljurla kari-ri ngampa kultji*
Old man Mirithira-ERG growl-IMP they-ACC; woman they-ERG nardoo stone hammer stone
mani-ra pirda-lhuku pardi kari-nha, pardi pulpa tharni-lhiku waya-rnda.
take-PUNC smash-PURP grub they-ACC, grub powder eat-PURP wish-PRES.
6. *Pulpa-purru yuka-ka kari-ri kutha ngunhi-rna uka-ru widni-wa-rna.* Bank got washed away now,
Powder-having go-PAST they-ERG water give-IMP he-ERG take away-TR-IMP
ngarrimatha-nga. puthu parkulu there, each time he eat'm *nguru uka-ru tharni-ra*
flood-LOC. dish two other he-ERG eat-PUNC.
7. *Nganara-wirli-nga uka-ru yabmi-rnda uljurla-kari-nha. Nganara-wirli-nga, wanka-yiwa-rna yuka-lhuku*
Steep-Bank-LOC, he-ERG growl-IMP woman-they-ACC. Steep-Bank-LOC, walk up-TR-IMP go-PURP
kaRuku-thu Danta-parkulu-ruku
there-ALL Powder-two-ALL.
8. *Kanhangarda uljurla-kari-nha kaRi-lhiku-thu pardi pirda-nangka-rda-nha, pardi pulpa. widna-yiwa-rna*
There woman-PL-ACC see-HIST-EMPH grub beat-CONT S-PRES-NP grub powder steal-TR-IMP
thunka-thunka-la-ru kari-kunha,
deprive-APP-NAR they-POS.
9. *Mama-rna thunkuthunka-la- yabmi-la-mintja-nta kari partjarna, mathapurda thangka-nangka-rda*
Grab-IMP deprive-APP- growl-APP-RECIP-REFL they all, old man sit-CONT S-PRES.
10. *Kari-ri nhanhi-ra ngamarla arluwa-kari thudni-rnda wadla-ra*
They-ERG see-PUNC pitiful child-they cry-PRES hunger-CAUS
cruel, I don't like to talk about it, cruel old man *nguyu-ru tharni-lhiku arluwa-kari ma ma ma ma ma!*
alone-ERG eat-HIST child-they boohoo, boohoo, boohoo

thudni-nangka-rda ngamarla kari.
cry-CONT S-PRES pitiful they.
11. *Kudnala witji-rna. Uljurla kari thampa-rda manii-lhiku puthu 'kanha, manta puthu, pitjatja;*
Asleep become-IMP. Woman they sneak-PRES take-PURP dish he-ACC, take away dish bark dish;
wadna-rda-nhara kudnala kurda-ngura uka,
run away-SP-OPT asleep lie-CONT he.
12. *Uljurla-pula thampa-rda, mathapurda kurda-yi-ngura yatu, kangi tharni-limaru. Uljurla-ru*
Woman-two sneak-PRES, old man lie-ACT-CONT full, too much eat-PLUP. Woman-ERG
mama-rnda, mama-rna- thika-rna wardukupa ngunhi-lhiku.
grab-PRESS grab-IMP return-IMP child give-PURP.
13. *Uta thurka-rnda mathapurda thanta wapa-lhuku, uta pula wana-wana-ya-ngura*
Now get up-PRES old man things look for-HIST, now two run-run-TR-CONT
yabmi-la-mintja-nta pula mathapurda uljurla.
swear-APP-RECIP-REFL two old man woman.
14. *Mathapurda mani-lhiku waya-ngura uka-nha pardi-pulpa; mani-rnda, yabmi-rnda uljurla-ru:*
Old man take-PURP want-CONT he-ACC grub-powder; take-PRES, growl-PRES woman-ERG:
maljka maljka thiki-thiki-la-Ru!
not not take-take-APP-IMP!

15. *Mayarla* *uljurla-ru* *pirda-nha,* *mathapurda* *warlu* *thika-rna.* Two Wella-*ruku*
Let it be woman-ERG beat-NP old man sullenly enraged go back-IMP Two Wells-ALL
thika-lhuku
go back-HIST.

16. *Partjarnda* *thika-rnda* *Danta-parkulu* sandhill.. *purku-witji-rna* at two mile from Andrewilla. *Pardi*
All return-PRES finish-become-IMP Grub
patharra *witji-rna* *pardi* *pulpa* *pirrpayi-rna* that is where that *patharra* green.
box tree become-IMP grub powder spill-IMP

17. *Thika-rna* *mathapurda* *kudnangkari* *thika-rnda* them *patharra* I showed you, at Two Well, *thangka-rda*
Go back-IMP old man south go back-PRES sit-PRES
purku-witji-rna
finish-IMP.

18. *Mathapurda-ru* *pardi* *watji-rna,* *pardi* *katharrayi-rna* at the Two Well there. You know them trees we seen those
Old man-ERG grub roast-IMP grub burst-IMP
parranta-wili, but different ones again. *pardi* *paltungka-rda* *katharrayi-rna* that is how them trees come.
grub explode-PRES burst-IMP

Text 7. Translation

1. Old man *Mirithira* came from Wirluma (a fire ritual centre far to the north in Wangkamadla country).
2. At Andrewilla some women were collecting grubs. They pulled out the guts and threw them away.
3. *Mirithira* swore at the women to gut the grubs. They pulled out the guts to throw them away, and then they cooked the grubs; they roasted them on the fire.
4. The women were continually smashing the (roasted) grubs to powder on a nardoo stone.
5. Old Man *Mirithira* went on swearing at them. They got nardoo stones and hammer-stones and smashed up the grubs because they wanted to eat grub powder.
6. They would walk along carrying their grub-powder, and when they went to get water he would come and steal it. (His camp was by a) bank which got washed away by the big flood. He had two coolamons there (filled with grub powder). He would eat one lot after another.
7. At Andrewilla 'The Steep Bank' he swore at the women. They walked up and left Andrewilla, they went over there, to *Danta-parkulu,* the 'Two lots of powder' sandhill.
8. There he saw the women grinding up grubs. He stole the grub powder, he took away all they had.
9. He grabbed (the powder) taking it away from them. They all swore at him and the old man swore back at them and then he just sat there (eating their grub-powder).
10. They looked on, the poor little children, and they cried and cried from hunger. It was a cruel thing and I don't like to talk about it. He was a cruel man. He ate it all on his own and the children were crying the whole time boohoo, boohoo, the poor things.
11. He fell asleep. The women sneaked up to grab his dish. They took the dish, a bark-dish, and they wanted to run off with it as he lay there sleeping.
12. The two women sneaked up as the old man lay there, bloated, having had too much to eat. The women grabbed (the dish of grub-powder) they grabbed it and came back to give it to the children.
13. Then the old man got up to look for his things, and the two women were already running away, and both (sides), the man and the women screamed abuse at each other.
14. The old man wanted to take away their grub powder; he took it and the women yelled at him: 'Don't, don't take it away from us!'
15. 'Let the women go on pounding (the grub powder) then!' With this the old man left in a sullen rage and went down to Two Wells.
16. All (the women) went back to the *Danta-parkulu* sandhill and they finished there, two miles from Andrewilla. The grubs turned into box trees, wherever the women spilt grub powder that is where you see those green box-trees.
17. The old man went away down south, those box-trees I showed you at Two Wells, that is where he stayed and where he finished.
18. The old man had roasted some grubs there (without bothering to take the guts out). Those grubs burst. That happened at *Kurtjuru* Two Wells. You know those trees we saw there, like a type of eucalypt, but different again? The grubs exploded and burst, that is how those trees came to be there.

D. Other Minor Myths

Goannas

A small waterhole east of Kooringala is called *MiRandani* 'Feeling sore'. This Karangura place-name is comprehensible in terms of Yarluyandi, where *miRa* means 'a sore'. A female Ancestor was here. She rested at the waterhole suffering from skin sores. These ultimately became spots as she turned into a Goanna and went off to join the other Goannas in their main camp at the nearby *Midla-kapirri*, 'Goanna Nose' waterhole. It seems that this was a localised Karangura tradition, though according to Reuther (Vol. VII: 2035), *Turaki*, the Terachi waterhole was also associated with the Goanna story.

FIGURE 5. The *Pirlitji* sandhill, centre of the Willie Wagtails myth. Photograph: L. A. Hercus.

The Willie Wagtails

The *Pirlitji* sandhill (Fig. 5), south-west of Koonakoo waterhole (Fig. 6), was the centre of a Karangura myth about Willie Wagtails. Linda Crombie had only heard the outline of the story: a war-party of Willie Wagtails came from Annandale to fight the local birds camped at this sandhill. The intruders lit their camp-fire close by and shouted challenges. The word *Pirlitji* which is Karangura, apparently refers to this fire. After a big fight the war-party had to retreat to Koonakoo waterhole, where they split up. The main party returned to the Annandale country while a small group travelled south via *Kalkapurritjinha*. Koonakoo waterhole was said to be at the centre of a Dog myth, now lost.

E. Kujumokuna

This Karangura ancestor was no longer remembered by Yarluyandi and Wangkangurru people but information is obtainable in the work of Reuther. He states (Vol. III: 1211):

> Kujumokuna was one of the tribal ancestors of the Karangura. From kuju = kidni in Diari 'penis' and 'moku bone' meaning: 'the bone [-like tissue] in a man's penis.' He makes his appearance as a witchdoctor among the Karanguras to the north. He was killed at Kudnangauana. With him originated sorcery by boning. Since he possessed magical powers as a witchdoctor, even [after his death] his bones still had magical effect. They were therefore gathered up and used for purposes of witchcraft. Today, when a human bone is sharpened to a point: on a stone, his invocatory songs are [still] sung, so that the bone receives [the desired] magical power.

All these myths show that there were particularly close mythological links between the Karangura and Ngamini and Yarluyandi, and particularly with the Wangkamadla people to the north. There were close trading links, not only in pituri and probably grinding dishes as discussed above, but also in other goods. Thus speaking of some special fossil bones called 'kuripikiri', Reuther writes (Vol. III: 126):

> The kuripikiri, then, found in the district of the Marungarli tribe, is passed on as an article of trade to the Karanguras, then to the Ngamanis, coming down finally to the Diaris, and is dearly paid for in kind. The animal, from which it is derived, is unknown to the 'native' people.

Karangura people were not on their own; that is why at least some of their traditions have survived among their neighbours.

MAJOR KARANGURA MYTHS AND RITUALS: THE *WARRTHAMPA* AND THE *MINDIRI*

The myths we know most about are the major travelling myths which traverse the area and which are associated with important rituals. We get some idea of the Karangura part of these because neighbouring groups knew how the whole 'line' of myth was connected. A number of lines went through Karangura country. These were: the Swan History, which is however mainly Yarluyandi, the Seven Sisters (see text 1 above), the Initiation History of the Two Men, a short sketch of which was published by Howitt & Siebert (1904) and Howitt (1904), and the Two Boys History.

The story of the Two Men who introduced the Circumcision knife is part of the tradition of all the Lake Eyre people, but the Karangura had a special part in the myth. This is evident not only from the work of Howitt and Siebert, but also from that of Reuther. The whole song cycle has been recorded from Wangkangurru men by the author, but long sequences of it are secret.

Two rituals attracted the largest groups of people in the eastern Lake Eyre Basin. These were the *Mindiri*, which was connected with the Emu History, and the *Warrthampa*, which was connected with the

FIGURE 6. Koonakoo waterhole, adjacent to *Pirlitji* sandhill. Photograph: L. A. Hercus.

Two Boys. There is a brief description of the *Mindiri* in Berndt (1953) and Horne & Aiston (1924: 37–44). The *Mindiri* belonged basically to the Cooper, but it reached as far north as Koonchera and Lake Etamunbanie, and therefore the Yawarawarrka and their neighbours the Karangura were involved. It did not traditionally belong to the Wangkangurru. Both of these ceremonies were variously described by people who had actually taken part in them as being 'larrikin', and 'rude'; they involved sex and were 'good fun'. There is no doubt that large numbers of people took part. Gason (1895: 174), writing about the 'Mindarie' says:

> Dance or peace festival, all the tribe and the neighbouring tribes are invited to attend. Promiscuous sexual intercourse is carried on secretly: many quarrels occur at this dance. I have seen as many as 1000 take part on a hard clay flat, lit up by fires kept burning by the women.

The *Warrthampa* is mentioned only rarely in the literature. Reuther in writing about it may have misunderstood some of the comments of his informants as he attributes to the followers of the Warrthampa sentiments that seem more in keeping with German romantic ideals than with the usually more practical Aboriginal views. He writes about the *Warrthampa* as follows (Vol. X: 21):

> This muramura is venerated in the vicinity of Birdsville and further northwards. He is regarded as the father of all kana (men). Should any man be slain by a pinga (vengeance party) but have previously sung the Wadumpa-song, he can meet death fearlessly.

Further information is given by Howitt and Siebert, in their account of the legend of the 'Wapiya girls' (1904: 120):

> After a time they came to a place where a number of men had assembled for the Wodampa dance, who strangled the girls, being enraged because they had seen what it was not lawful for them to see.
> The Wodampa dance is the most sacred dance the Wonkamala and the Ngulubulu have. It recounts the origin of mankind.

Even these scarce sources leave no doubt that the *Warrthampa* was a most important ritual and it belonged to the northerly groups, precisely those that did not traditionally participate in the *Mindiri*. The one exception were the Karangura: they had an important part in both, and particularly the *Warrthampa*.

The Warrthampa is linked with the myth of the two (Rainmaker) Boys who travelled from Witjira (Dalhousie) across the Simpson desert to Karangura country. They then headed north to Itabucca Springs and Glenormiston and ultimately returned to Dalhousie. Like the other ancestors discussed above, the Two Boys followed the same pituri route, but this time from south to north: they went up the Georgina and then up the Mulligan. There was an immense song-cycle connected with this myth, part of the Simpson desert section and the Karangura portion were remembered by Mick McLean. At various times he and Maudie Naylon *Akawiljika* spoke about the *Warrthampa*:

Text 8. The Warrthampa

(From Tapes 112, 138–40 (1966); 157 January (1967), Mick McLean speaking at Marree, and Tapes 515 (1972), 675 (1975) Mick McLean speaking at Birdsville and Port Augusta)

1. Maudie was talking about *kira* *ngarra-la-lhuku* .in that *Warrthampa* - that's *kari-kunha, maljka*
boomerang rattle-APP-HIST they-POS, not
nguru thanga-rnda ngangka, partjarna wapayi-kanha,
other remain-PRES alive, all die-PERF.
2. I have been hear'm long time, *kira* *ngarra-pa-rna* *Warrthampa-ku* those days *Warrthampa* was
boomerang rattle-INT-IMP *Warrthampa*-DAT
thamunha arla, uljurla-ru *ngawi-rna* all right, *ngawi-rna* *uljurla-ru!*
secret true, woman-ERG heat-IMP hear-IMP woman-ERG!
3. *Athu unha* *nguntayi-ra arlali:* *uljurla* got to pay'm that *Warrthampa arla* in that, *Mindiri-wili.*
I you ACC tell-PUNC finally: woman *Warrthampa* true *Mindiri-* like.
4. *Warrthampa* is my country, that is more dear! *Mindiri* is nothing, rubbish! *Maljka 'ntha waya-rnda!*
Not I want-PRES!
5. *Kayi Witjira-ru* *yuka-kanha Thuthirla-pula kanhangarda nhingka-yiwa-rna,* along Lagoon waterhole,
This Dalhousie-ABL go-PERF. Boy-two there glance-TR-IMP
Kandritja, nhingka-yiwa-lhuku nhanhanga thuRu-thuRu kadnha-thidla thangka-ngura kanhangarda pula
glance-TR-HIST here *island* hill-bit sit-CONT there two
nhingka-rna-yiw-anka-lhuku *kardapu-nga nhingka-rna-yiwa-lhuku.*
glance-SP-TR-INCH-HIST head-LOC glance-SP-TR-HIST.
6. *Kandritja Ngamani-kunha wadlhu-nga.* *Tharka-ngura kaRu irlangkurda: athu 'nha ngunta-ka*
'Waterhen' Ngamini-POS country-LOC. Stand-CONT there thus: I you show-PAST
kanhangarda nhingka-yiwa-lhuku Warrthampa, kira *ngarra-la-lhuku.*
there glance-TR-PURP boomerang rattle-APP-HIST.
7. *Pula wanka-rda, wadlhu-ru* *pula wanka-lhuku, kardapu-li* *wanka-lhuku,*
Two rise-PRES, ground-ABL two rise-HIST, head-ADV rise-HIST
just the tops of their heads coming out.

8. *Pula ngatji-rna karna ngura-nganha. Wintawi-rna thika-lhuku, ThuRu-ki-thi thika-lhuku*
Two see-IMP man camp-from Dive down-IMP return-PURP, below-EMPH return-HIST
wadlhu-nga thuRu.
ground-LOC inside.

9. *Pula wadlhu-ru wanka-rda kanhangardanga. Warrthampa-kunha-lki,* they living here, *Warrthampa,*
Two ground-ABL rise-PRES there. *Warrthampa*-POS-EMPH
ngarra-l-ta kira kari-kunha ularaka.
rattle-APP-PRES boomerang they-POS History.

10. *Ngurlupurlu, Marrunga,* you know Durie. They got that full History. My country *ngalingali.*
beginning (?).

11. *KaRu yuka-ngura kanhangarda karla-nga-li, kaRu tharka-thika-lhuku Kadrikudna-nha,*
There go-CONT there creek-LOC-EMPH there stand-return-HIST *Kadrikudna*-PROP
tharka-rna kaRu irlangkurda, in the middle of that flat down from *Kuntjirri, kaRu thika-rna.*
stand-IMP there thus there return-IMP.

12. *Thutirla-pula* all the feathers of that bird they *pirda-ka pirda-rna munta-nga kalpa-lhuku yakuta-nga,*
Boy-two kill-PAST kill-IMP bag-LOC collect-HIST bag-LOC,
wantarda: paya nguru paya nguru pirda-ngura, wantarda kalpa-lhuku.
down: bird other bird other kill-CONT down collect-PURP.

13. *Kuyatiyarri paya* call'm *kuyatiyarri. wakarda pirda-rna 'kanha pula-ru, kathangka-rda, paya*
Orange chat bird orange chat that kill-IMP him two-ERG wander-IMP, bird
warrangka-rda.
chase-PRES.

14. *Wantarda iki-rna, pula-kunha thanta, pitji-lhiku, kari pitji-rna kanhangarda ngura-nganha.*
Down carry-IMP, two-POS things, paint-PURP, they paint-IMP there camp-from.

15. *Warrthampa kanhangarda nhanhi-wa-rna. pula-ru, wantarda ngunhi-wa-rna: 'nhalara urkari*
there see-TR-IMP two-ERG, down give-TR-IMP: 'this-CAUS you
pithi-nha-ka, maljka yalkirri irlangkura, yalkirri, malja malja nhanha thawi! maljka malja-ra
paint-NP-for ever, not gypsum thus, gypsum kopi, kopi this ACC throw! not kopi-CAUS
pithi-nha! nhala-ra wantarda-ra pithi-nangka-rda!'
paint-IMP this CAUS down-CAUS paint-CONT S-PRES!'

16. That is the *Warrthampa* there, *kari thika-rnaya-rna Warrthampa pula-nha wanta-thika-ngura.*
they return-TR-IMP two-PROP follow-return-CONT.
Maudie been tell you, *kari thika-rna nhanhangu-ru tharka-thika-lhuku Yabmalkira-nha yatjalka-nga*
they return-IMP here-ABL stand-return-PURP *Yabmalkira*-PROP lignum-LOC
thangka-ngura kaRu Kutiri-nga -that's *Kutiri,* supposed to be *mikiri* there, belonging to Karangura country,
stay-CONT there *Kutiri*-LOC
Karangura *ngura.*

17. *Mingka-nga witji-rna-thika-lhuku thuRu thika-lhuku, pula Kutirinja-ruku, ama-ki-ti*
Hole-LOC become-SP-return-HIST below return-HIST two Kutirinja-ALL, mother-EMPH
manta-yiwa-lhuku.
take-TR-PURP.

18. *Pula-ru paku-ru kira thawi-rna warra-rna,* didn't know *mathapurda* over there, *mathapurda*
Two-ERG empty-ABL boomerang throw-IMP play-IMP, old man old man
ngura-nganha thangka-ngura, kira-ra uka-nha palji-rna, kira uka-irnda kurda-yiwa-rna yadla
camp-from sit-CONT, boomerang he-ACC aim-IMP, boomerang he-ALL fall-TR-IMP close
uka-irnda.
he-ALL.

19. *Mathapurda-ru nhanhi-lhiku wadlhu partjarna, 'ah nhawula pula palji-ra anthirda kira*
Old man-ERG see-HIST country all, 'ah these two two strike-PUNC me ALL boomerang
antirda awarda thawi-ra!'
me ALL this throw-PUNC!'

20. *Kanti mant' uka-ru midla pula-nha puntji-lhiku; kanti mani-lhiku mitdla pula-nha uka-ru*
Waddy take he-ERG nose two-ACC flatten-PURP; waddy take-HIST nose two-ACC he-ERG
kuntili kanti nguyu-ru midla pirda-rna parkulu manhi pirda-rna.
crossways waddy one-INST nose hit-IMP two self hit-IMP.

21. *Kuti-rna pula-nha kanti-ri midla pirda-rna. Kutirinja* that's in the Georgina.
Drag-IMP two-ACC, waddy-INST nose hit-IMP.

22. *Kubmarri mani-lhiku uka-ru kubmarri puntha-ru: ah Witjira-nganha thutirla-pula Witjira-nganha!*
Blood take-HIST he-ERG blood drink-NAR: ah Dalhousie-from boy-two Dalhousie-from!

23. *'Ah, Witjira-nganha'* all them ground he tell'm then, all them water, *mikiri.* He tell'm Karangura way. Karangura and Wangkamadla mixed. All that *Parra-parra, MaRapardi,* that's the last Simpson water, that's in my country.

24. *Pula kaRuku yuka-ka Wangkamadla yani-rnda.*
Two there-ALL go-PAST say-PRES.

25. The karangura man sang:
Wĭtjirinja ngĭntja ngali karntayá,
Párra-parranja ngĭntja ngali karntayá, aah
Káruljárinja ngĭntja ngali karntayá
Párra-parranja ngĭntja ngali kárnta
MáRapardinja ngĭntja ngali kárntayá, aah
Káruljárinja ngĭntja ngalĭ karntáya
Púlawáninja ngĭntja ngali karntáya.
Wálpurakáninja ngĭnja ngali karntáya

26. I don't like singing that because I wouldn't know what he is saying there, I just know that *karntaya* means going along, going into another country. They're doubling up all those places where they've been:

27. (The Karangura man sang again):
MáRapardi ngĭntja ngali kárntayá
Káruljárinja ngĭntja ngali kárntayá
Wárru-wárru ngĭntja ngali kárntayá
Púlawáninja ngĭntja ngali kárntayá
Wálpurakáninja ngĭntja ngali kárntayá
Káruljárinja ngĭntja ngali kárntayá.

28. That sound funny to me, I don't like singing'm. Ha! That is where he names all the *mikiri*, my country, follow all that, Karangura way, That's all places, he mixes them up in that song. They change their voice over there.

29. *Wangkamadla kanhangarda thimpa-rda ularaka waRa-nganha waRa-nganha mikiri, intjali intjali*
Wangkamadla there speak-PRES History what-from what-from well, where where
yuka-kanha thimpa-rda
go-PERF speak-PRES.

30. *Nganka-ma-lhuku.* Karangura country where he tell'm that *Witjira-nganha,* then he went on to *Kuringala*
Alive-make-HIST. Dalhousie-from
waterhole, and to where Jack Gaffney got his station, *Dikirri.*

31. *Wadlhu-nga winta-kurda-lhuku thika-rna pula yuka-lhuku karla-li yuka-lhuku Kira-ngarrapani.*
Ground-LOC hide-lie-HIST return-PRES two go-HIST creek-ADV go-HIST Herbert Hut.
Walta yuka-lhuku pula ama pula-kunha ngataru yuka-rnda.
Together go-HIST two mother two-POS behind go-PRES.

32. *Yuka-lhuku kaRu tharka-yiwa-rnda* along *Kira-ngarrapani-nha.* Ah, that is where the netting crosses
Go-HIST there stand-TR-PRES Boomerang-rattling-PROP.
through the Queensland border!

33. *Kira ngarra -l-ta.* When they were singing, must have been. That is what you call
Boomerang rattle-APP-PRES.
Kirangarrapani, 'Making the boomerangs rattle.'

34. *Kanhangarda thangka-yiwa-rnda, kira ngarra-li-nda* again, *pula-kunha ngaRu Witjira-nganha*
There sit-TR-PRES, boomerang rattle-DIST-PRES two-POS style Dalhousie -from
they copied it - no, it is there.

35. And that *Kudnarri* 'Overflow' over there, what they call that? Then they go along Adria Downs, big swamp you see, those two *wiya* been go, *thutirla-pula warrukathi warrawa-rna ha ha! pula thika-rna*
young boys boy-two emu chase-PRES ha ha! two return IMP
thangka-yiwa-lhuku, must have been *kurdarna* I suppose, *Kirangarrapani.*
sit-TR-HIST sleep Herbert Hut.

36. *Wadnayi-nangka-rda paya muyu nguru muyu nguru wara-nangka-rda,* killing all the birds for different
Chase-CONT S-PRES bird day other day other play-CONT S-PRES
wantarda Warrthampa-ku
feather *Warrthampa* -DAT.

37. *Ukaliri yuka-rna -wanka-lhuku, karla-li karla-li yuka-nangka-rda ama pula-kunha yuka-rnda*
Then go-IMP-go up-HIST, creek-ADV creek-ADV go-CONT S-PRES mother two-POS go-PRES
ngataru, puthu wanpa-rda kutha-puthu kutha-purru puthu canteen *wili.*
behind, dish carry-PRES water-dish water-having dish like.

38. *Yuka-lhuku kaRu Kati-tharri,* got headache there, *Kati-tharri,* that is headache in Wangkamadla, *Kati-tharri*
Go-HIST there Old Annandale
is Wangkamadla, Wangkamadla and Karangura mixed anyway.

39. *Yuwu padni thadlhu wadlhu-lki*
Man nothing empty country-INF.

Text 8. Translation

1. Maudie (Naylon *Akawiljika*) was talking about how they rattled the boomerangs in the *Warrthampa*[2]. That (part of the ceremony) belonged to those other people (*i.e.* the Karangura), there is not a single one of them living now, they all died out.
2. I heard about it a long time ago, how they rattled the boomerangs for the *Warrthampa*, in those days it was well and truly secret, but women could listen to it all right, oh yes, women could listen to it!
3. I'll at last tell you the truth about it: the women have to pay for this (*i.e.* by means of sex), the real *Warrthampa*, it's just like in the *Mindiri*.

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[2] Maudie Naylon had demonstrated a few days earlier how people used to make boomerangs rattle in the *Warrthampa* ceremony. They held two boomerangs close together and made them touch each other with a rapid vibrating motion.

4. The *Warrthampa* belongs to my country, that costs more![3] The *Mindiri* is nothing, just rubbish! I have no time for it!
5. The Two Boys had come from Dalhousie, they had a quick glance round, that was at Lagoon Waterhole, which is called *Kandritja* (= Koondaritchinna waterhole on modern maps), they quickly glanced around. There's an island in the waterhole, a little bit of a stony rise, that is where they were, the two of them, just looking around quickly before departing. They just glanced round as they came out (from under the ground) head first.
6. The *Kandritja* 'Waterhen' waterhole is in Ngamini country. I showed you the place. That is where they were having a quick look for the *Warrthampa*, because they could hear the boomerangs being rattled (from afar at *Kira-ngarrapaninha*, Herbert Hut).
7. The two of them came up, they came up from under the ground head first, with just the tops of their heads showing.
8. The two of them saw a man belonging to that place, so they dived down under the ground again and went back, travelling underground.
9. The two of them came up from under the ground. They belonged to the *Warrthampa*, the people living there, and they rattled boomerangs for the (ritual belonging to) their History.
10. Ngurlupurlu and Marrunga people, you know those from Durie, they have got the full History. My country is the first part.
11. They went there along the creek and they stopped at *Kadrikidnanha*, that is in the middle of that flat down from *Kuntjiri*, that is where they went.
12. The Two Boys had been killing a lot of birds for their feathers, they went on killing them to collect the down-feathers in a bag, a large bag. They killed all kinds of different birds to collect down-feathers.
13. The birds called orange chats, they were the ones that the Two Boys killed. The two travelled around chasing birds.
14. They carried the down-feathers round with them, ready for painting up (for a corroboree) the Two Boys painted up the people from the camp.
15. The Two Boys had gone to have a look at the *Warrthampa* and they handed over their feathers. 'You all paint up with these from now on and for ever! Not like that with gypsum crystals, with kopi! Throw away this kopi! From now on you will always paint up with these!'
16. They had the *Warrthampa* there, and the Two Boys went round following the *Warrthampa*. Maudie was telling you, they went back from this place to stay around *Yabmalkira* 'Clifton Hills' and then at *Kutiri*. There is supposed to be a native well there, belonging to Karangura country, a Karangura camp.
17. The two of them went down inside the hole to go back underground to *Kutiri*, to pick up their mother.
18. The two threw boomerangs about for fun, playing. They didn't know an old man was over there, an old man belonging to that place was sitting there. They threw a boomerang in his direction: the boomerang landed right close to him.
19. The old man looked round in all directions: 'Ah, here are those two that threw a boomerang at me!'
20. He picked up his waddy to flatten their noses, he took his waddy and hit them both over the nose with a crossways blow, hitting both their noses with the one (blow) of his waddy.
21. He dragged the two (unconscious bodies) along the ground, he had hit them over the nose with his waddy. *Kutirinja* (which means 'dragging'), that is in the Georgina.
22. He got (a drop of their) blood and tasted it: 'Ah', he said 'Those two boys come from Dalhousie!'
23. 'Ah, from Dalhousie!' (he said) and he named all the places, all the wells, the *mikiri*. He sang about it in the Karangura way. Karangura and Wangkamadla mixed. He named them all, *Parra-parra*, and *MaRapardi*, that's the last (westernmost) Simpson Desert well, that's in my country.
24. He was talking in Wangkamadla about the places where the two of them had gone.
25. The Karangura man sang:

    (From) Dalhousie I, we two travelled,
    Karulinja that is where I, we two travelled,
    Burraburrinna, the long well-shaft that is where I, we two travelled,
    Murraburt that is where I, we two travelled,
    Karulinja that is where I, we two travelled,
    Pudlowinna that is where I, we two travelled,
    Wolporican that is where I, we two travelled.

26. I don't like singing these verses because I don't know what he is saying there. I just know that *karntaya* means going along, going into another country. They're 'doubling up' (mixing up the order of) all those places where they've been.[4]
27. (The Karangura man sang again):

    Murraburt that is where I, we two travelled,
    Karulinja that is where I, we two travelled,
    Warru-warru 'the White One' that is where I, we two travelled,
    Wolporican that is where I, we two travelled,
    Karulinja that is where I, we two travelled.

28. (Those verses) sound funny to me, I don't like singing them. These are all the places, he mixes them up in that song. They sing a different way over there (on the Karangura side, different from us Wangkangurru people).

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[3] What the extra 'payment' was for the women was never made clear.

[4] The geographic sequence of the Simpson desert wells was quite different from the order in which they are mentioned in the song. By this it is made clear that the Karangura man did not know the Simpson desert — it was not his country. Wangkangurru people relied on these wells except after rains and their location was well known to all the people in the desert. They first became known to Europeans as a result of the expedition of Lindsay in 1886 (see Hercus & Clarke 1986). The spelling of the names of wells given in the translation is that adopted by Lindsay. Murraburt was the westernmost of the wells, the one closest to Dalhousie, this is why Mick refers to it as 'the last Simpson desert water'. The location of *Karulinja* is not known.

29. He's speaking there in Wangkamadla about the History, naming whichever well they came from and wherever they went.
30. The old man resuscitated them. It was (at *Kutirinja*) in Karangura country that he said 'You come from Dalhousie'. Then the old man went on to Kuringala waterhole and from there to Dickerie, the (old) Alton Downs waterhole, where Jack Gaffney has his station.
31. The Two Boys went underground, they went following the (Eyre) creek, travelling to *Kira-ngarrapani* 'Making the boomerangs rattle' ('Herbert Hut'; see Fig. 7). They went together side by side with their mother walking behind them.
32. They went there to stay for a while at *Kira-ngarrapani-nha*, 'Making the boomerangs rattle' 'Herbert Hut'.[5] Ha, that is where the netting crosses through the Queensland border.
33. They must have been making the boomerangs rattle while they were singing. This is why the place is called *Kira-ngarrapani*, 'Making the boomerangs rattle'.
34. They stayed there for a while, making their boomerangs rattle at that place, far away. They had their own style of doing this, from Dalhousie, and they copied it in this place.
35. And that overflow there, what do you call that, the big swamp at Adria Downs? The Two Boys went there chasing the emus, ha ha![6] They turned back again to stay at *Kira-ngarrapani*, 'Making the boomerangs rattle', they must have been sleeping there I suppose.
36. Day after day they ran round chasing birds: they were killing birds to get all kinds of different feathers for the *Warrthampa*.
37. Then the two of them went up along the creek, following the creek they went. Their mother came along behind them carrying a coolamon full of water, carrying it like a canteen.
38. They went to *Kati-tharri*, 'Old Annandale'. *Kati-tharri* means headache in Wangkamadla.[7] *Kati-tharri*, Old Annandale that is Wangkamalda country, or Wangkamadla and Karangura mixed.
39. But nobody lives there now, it is empty country.

WHAT HAPPENED TO KARANGURA PEOPLE

The turmoil of early white settlement of the Birdsville area from the later 1870s onwards was an unmitigated tragedy for the Aboriginal people of the entire district. There were six major massacres, mostly well organised, and intended to wipe out whole groups of people. The immediate cause of these was cattle spearing, as in the massacre on the 'Georgina' (1) described by the solitary survivor, *Ngatu-thakali* (Hercus 1977), the massacre on the point of the Koonchera sandhill (2) (Hercus 1986) and the massacre at the Giri Giri waterhole (3). The murder of a lascivious station cook at Kooninghera near Durie on the Diamantina led to a series of revenge massacres throughout the region (Hercus & Jones, in prep.). These took place at Kooninghera itself (4), to the north at the Kalidawarry waterhole (5), and at *Mingka-ingkani* near *Ngapamanha* (6). There were lingering traditions even among white stockmen about these terrible deeds. This is clear from the evidence of Farwell (1950: 160) who estimated that at least 200 people were killed at Koonchera alone. There is hearsay evidence that the relevant police records were destroyed. Details of the Koonchera massacre were related to the next generation of Aboriginal people by the few survivors, by Charlie *Karna-piti*, who died about 1920, and by Kuranta 'Sticknest Rat' or 'Lagoon Charlie', Linda Crombie's grandfather, who died in his eighties in 1935. These survivors had been young men who were particularly skilful and able-bodied and therefore managed almost miraculous escapes. This fits with the probable date for these massacres, namely the late seventies and the early eighties of last century. In all these massacres Karangura people were among the main victims.

The events described by *Ngatu-thakali* (Hercus 1977) were a series of killings in which white horsemen, probably stockmen and not police, pursued Aboriginal people who had killed a bullock. They chased them from waterhole to waterhole on the lower Georgina, killing one small group after another, and also wiping out a larger group at the Narrabutiannie waterhole (Fig. 8). This must have been not long after 1878. In that year speculators first took up the part of the country which came to be called Alton Downs (Litchfield 1983:

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[5] Reuther (Vol. VII: 845) gave the same explanation for this name:

> Kirrangaripini, Jelj.
> kirra = 'boomerang'; ngaripini in D [Diyari] ngaribana 'to beat time'. Meaning 'to beat time with boomerangs'. Wutjukana's son here beat time for the ceremonial *mura* song with boomerangs. The *muramura* therefore named the place accordingly.

Wutjukana is the name that Reuther gives for the Two Men from the Initiation ritual centre at Mararu in the Simpson Desert.

[6] In the earlier part of the myth the Two Boys had been chasing a pair of emus. They caught up again with the same pair of emus at Adria Downs and continued their pursuit.

[7] A reference to this myth is to be found in an article by W. Fraser who lived for a while on Kaliduwarry near Lake Muncoonie. Fraser gives a summary of the story of the Two Boys and describes their chase of the Emus:

> they again followed up the tracks, which took them to a waterhole. They called this waterhole "Cuttitery" which means a sore head — for the boys had such sore heads there that they had to give up the chase. This waterhole is on the adjoining station to this. (Fraser 1899: 45)

FIGURE 7. *Kira-ngarrapani* 'Making the boomerangs rattle' waterhole, scene of major events in the Two Boys History of the Karangura. Photograph: L. A. Hercus.

FIGURE 8. Narrubutiannie waterhole, scene of a Karangura massacre in about 1880. Photograph: L. A. Hercus.

145), even before it had been surveyed. This station comprised practically the whole of Karangura country. *Ngatu-thakali*, who survived to tell the tale, was Wangkangurru, a member of a visiting group. The bulk of the people killed were local Karangura people.

A major massacre, often mentioned by Wangkangurru people, was at *Kiri-Kiri*, the Giri Giri waterhole of the maps. (Mick McLean always referred to 'the Karangura place Mikiri-kiri' as the site of this massacre, but he was probably influenced by the Wangkangurru word mikiri 'well'.) Oral traditions say that the killings were carried out by native police. One of this group of police was in fact a Lower Southern Aranda man, a classificatory uncle of Mick McLean (Tape 673):

> That was my uncle 'King George'. He was a policeman you know, and he went off shooting blackfellows in the Karlamuku country.[8]

According to oral tradition, the massacre at Koonchera was organised by police from Andrewilla and must have taken place around 1885 when police were first stationed there. This massacre and the vengeance parties that resulted from the murder of the cook at Kooninghera waterhole were by all accounts well organised: they appear intended to kill the maximum number of people, men, women and children. They seem timed to coincide with the major ceremonies, the *Mindiri* emu ritual and the *Warrthampa*. The massacre at Koonchera wiped out a large group of followers of the *Mindiri*. All the older Wangkangurru and part-Yarluyandi people who had heard about it in their youth, including Mick McLean, Maudie and Bob Naylon, Johnnie Reese, Dora Parker and Linda and Frank Crombie (Fig. 9), mentioned in their own accounts that many Karangura died there.

The massacres resulting from the events at Kooninghera, apart from the immediate action at Kooninghera waterhole, were organised to coincide with the *Warrthampa* rituals at Kalidawarry waterhole. This was the most important *Warrthampa* site belonging to the Wangkamadla, the immediate northern neighbours of the Karangura, and involved Karangura people. Another massacre eliminated a *Mindiri* group at the *Mingka-ingkanji* waterhole east of Pandie, adjoining Karangura country. There were said to be no survivors. This would again have involved Karangura people. Because they belonged to *both* the *Warrthampa* and the *Mindiri* traditions, Karangura people became victims of all the killings. By the late 1880s therefore, very few would have been left.

Apart from the organised massacres there were also private vendettas against Aboriginal people. A frontier attitude prevailed in the far north-east of South Australia and in the Birdsville area; this may well have cost some of the few remaining Karangura lives. The fragments of the Birdsville police records, made available by Angus Green, contain a particularly telling sequence of letters (Simpson Desert History Vol. 2). These are connected with a petition to the Colonial Secretary from the Diamantina Divisional Board on behalf of the residents of Birdsville in February 1887, during a drought, urging 'that the Blacks (Aborigines) and their dogs be removed from encampments on the township waterhole.' This was a very special place for Aboriginal people. Apart from being the deepest and most lasting waterhole in the district, it was *WirraRi*, an important Yarluyandi emu site, with rocks representing the ancestral emus. The police sergeant, the first ever to be stationed at Birdsville, an unsung hero named Sergeant A. McDonald, obviously did everything possible to avoid having to take the action

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[8] Karlamuku was used as a general term by desert Wangkangurru people to refer to the channel country to the east of their lands.

FIGURE 9. Linda and Frank Crombie, major sources of information on the Karangura and their traditions. Photograph: V. Potezny.

demanded of him by letters and telegrams from his superiors. He went from various delaying strategems to a straight refusal and managed to hold off the whole matter until it rained, when the Aboriginal people were prepared to leave in any case. This is clear from his lengthy letter from Birdsville to the Commissioner of Police, Brisbane, 27 September 1887. Some of his comments have sinister implications (Simpson Desert History, Vol. 2):

> About twelve months ago Mr Ward, Customs Officer here, observed a certain Squatter (a Justice of the Peace) on a Sunday illtreating the Blacks in their Camp and sent for a constable to give him in charge-this party is a member of the Board and no doubt would like to see the Blacks a long distance from the Town and the Police.

As a result of the killings the Karangura were reduced to a few survivors, some of whom lived at Andrewilla when Wells was there. From 1866 onwards many displaced people from the eastern Lake Eyre basin had sought refuge at the Killalpannina mission on the lower Cooper. According to the evidence of Mary Dixon and other elderly Diyari people who had been at Killalpannina at the turn of the century only two old Karangura people were at the mission at that time and they died soon after.

CONCLUSION

We must conclude from this that the Karangura ceased to be mentioned in the literature quite simply because they had been wiped out. Nobody lives now in what was their traditional heartland, along the channels of the Georgina. The old Alton Downs homestead is deserted; the new homestead, the only habitation in the whole of Karangura country, is at the Andrewilla waterhole. It is truly 'dead men's country', but it is also country that once had a rich tradition of mythology, now vanished.

Note on Orthography

In this paper a practical orthography has been used for Wangkangurru:
Plosive consonants other than the retroflex plosive have been written as unvoiced (*k, p, th, t*), but pre-stopped consonants have been written with voiced plosives as this corresponds most closely with the pronunciation, hence *bm, dn, dnh, dnj, dl, dlh*.
Retroflexes have been written as *r* + consonant, i.e.
rl is retroflex *l*
rn is retroflex *n*
rd is retroflex *t*
Interdentals have been written as consonant + *h*, hence *nh, th, lh*.
Palatals have been written as consonant + *j*, hence *tj, nj, lj*.
ng has been used for velar *n*.
The three r-sounds have been transcribed as follows:
r = the alveolar flap
rr = the trilled r
R = the retroflex r.

Glosses

The following abbreviations used for linguistic terms are used in glossing Wangkangurru texts:

ABL	ablative case
ACC	accusative case
ACT	active stem-forming suffix
APP	applicative stem-forming suffix
CAUS	causative case
CONT	continuous participle
EMPH	emphatic clitic
PURP	purposive
ERG	ergative
HIST	historical past
IMP	imperfective
IMPV	imperative
LOC	locative case
NAR	narrative past
PAST	past tense
POS	possessive suffix
PUNC	punctiliar present
SP	speed form, indicating action undertaken before departing
TR	transitory aspect

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OCCURRENCES OF PALORCHESTES SPECIES (MARSUPIALIA : PALORCHESTIDAE) IN SOUTH AUSTRALIA

NEVILLE S. PLEDGE

Summary

The first discovery of Palorchestes azael in South Australia was made in about 1870 in a clay pit near Adelaide. Although reported briefly by Tate, it has not been described in detail until now. Several discoveries in the past twenty years have enlarged our knowledge of the genus, expanding its geographic and stratigraphic range in the State, and increasing its taxonomic diversity. Palorchestes azael including previously undescribed anterior cheek teeth, is now reported from Naracoorte in the South-East. A second, small Pleistocene species has been found near Mt Gambier and is compared with P. parvus, and the late Miocene P. painei is reported from a cave deposit on Yorke Peninsula.

OCCURRENCES OF *PALORCHESTES* SPECIES (MARSUPIALIA: PALORCHESTIDAE) IN SOUTH AUSTRALIA

NEVILLE S. PLEDGE

PLEDGE, N. S. 1991. Occurrences of *Palorchestes* species (Marsupialia: Palorchestidae) in South Australia. *Rec. S. Aust. Mus.* **25**(2): 161–174.

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Palorchestes azael (Owen, 1874, 1875, 1880) is one of the rarer elements of the Pleistocene marsupial megafauna. Alone amongst the diprotodontoids (Archer & Bartholomai 1978), the teeth of *Palorchestes* are characterised by a mid-link between the two loph(id)s, to such an extent (with other characters of the palate) that Owen (1874) and others considered it to be a giant kangaroo. Woods (1958) showed that *Palorchestes* was not a kangaroo but more akin to the diprotodontids. Other features of the skull have since indicated *Palorchestes*' distinction from the Diprotodontidae (Archer & Bartholomai 1978).

The type specimen of Owen's *Palorchestes azael* (1874) was obtained from an unspecified deposit in Victoria in 1851. This was probably on the River Tambo in Gippsland (Mahoney & Ride 1975: 88). Lydekker (1887) listed it and three other specimens as being in the British Museum (Natural History); one of the latter came from the Wellington Caves, New South Wales, and the other two from the Darling Downs of Queensland. In his revision of the genus, Woods (1958) listed only nine specimens of *P. azael* from the eastern Darling Downs, then in the Queensland Museum. Ramsay (1886) reported *P. azael* (as a new species *P. rephaim*) from the Wellington Valley and Dun (1893) reported further occurrences of the species in the caves there. Scott (1916) recorded it in the Mowbray Swamp deposits of Tasmania, Gill & Banks (1956) from the Scotchtown Cave, in the same area, and Gill (1953) from Terang, Victoria. Dennant & Kitson (1903) had earlier listed two specimens from Werribee and Sorrento in Victoria, while Flannery & Archer (1985) mention it as occurring also at Strathdownie, Spring Creek and Buchan Caves in Victoria. Glauert (1926) reported it from the Margaret River caves of Western Australia, but Merrilees (1968) discounted it. Finally, *Palorchestes* sp. *cf. P. azael* is listed for the Tirari Formation along the Warburton River near Lake Eyre in northern South Australia (Wells & Callen 1986), and has recently been found at Riversleigh, Queensland (Davis 1990). The species appears to be widespread, as indeed is *Diprotodon*, but *Palorchestes azael* is rare by comparison. Its ancestors may not have been so rare. *P. parvus* is a not uncommon member of the Chinchilla local fauna (De Vis 1895, Woods 1958), and is reported to occur with *P. azael* at Strathdownie, Buchan Caves, Wellington Caves and Gore (Queensland) (Flannery & Archer 1985), while the earlier *P. painei* is found at Alcoota (Woodburne 1967), and also at Hamilton (Turnbull & Lundelius 1970). Recently, postcranial material with associated teeth has been found (Flannery & Archer 1985) allowing determination of other bones and tentative reconstructions.

Specimens of *Palorchestes* spp. are here described from four South Australian localities of different ages. Evidence is presented for a second (and possible third) Pleistocene species, after *P. azael*, with deciduous teeth being described for the last, while the presence of the late Miocene species *P. painei* is indicated. The localities for the specimens described are shown in Fig. 1.

Material studied is housed in the South Australian Museum (SAM), Queensland Museum (QM), Australian Museum (AM) and the National Museum of Victoria (NMV). Tooth designation follows Archer's (1978) system which is based on embryological studies of modern marsupials.

Thebarton Specimen (SAM P11546)

The first record of *Palorchestes azael* from South Australia was a mention in passing by Tate (1890). In about 1889–90 Mr W. Shearing presented to the South

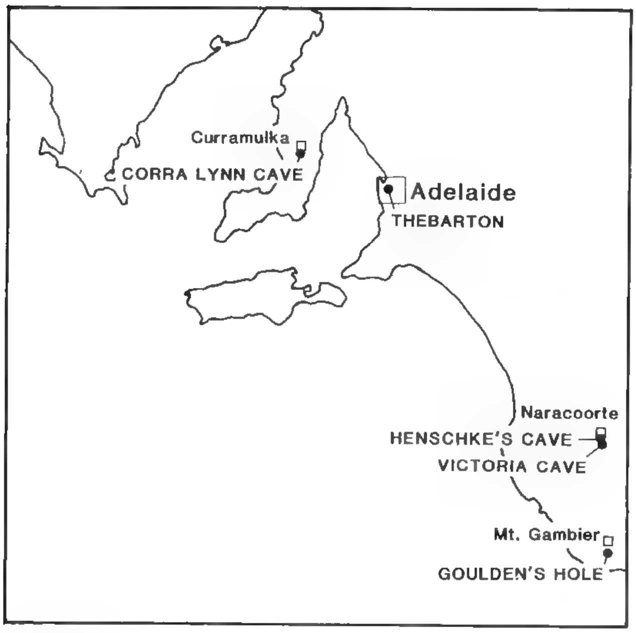

FIGURE 1. Locality map showing finds of *Palorchestes* spp. in South Australia.

Australian Museum two jaw fragments that had been found in about 1870 some 5 metres below the surface in his clay pit at Thebarton, then an outer suburb about 2 kilometres west of the city of Adelaide. The exact locality has been lost and the pit probably filled in and reclaimed. Occasionally bones were found in the numerous clay and sand pits west of Adelaide, usually *Diprotodon* (Tate 1890: 182) in various stages of disintegration, but the specimens described here are somewhat better preserved.

Material

This comprises the fused symphyseal portion of the mandibles, with evidence of the premolar and three molars (M_{2-4}) in the right ramus, and M_2 in the left jaw (Fig. 2). The anterior extremity of the symphysis is badly damaged, and much is missing. The teeth are badly chipped and greatly worn. The premolar is represented only by its roots, while of the molars, only M_3 retains any trace of enamel. M_2 has been worn to or below the base of the enamel. Nevertheless, approximate measurements can be made of M_2 and

TABLE 1. Dimensions of upper molars of *Palorchestes* spp. (in mm).

Specimen	M^2	M^3	M^4	M^5	Comments
P. azael					
BM (NH) 46316	24.1×19.6	25.4×21.2	25.7×20.3	27.1×22.7	from Woods (1958)
AM F7272 (=B.5936, type of *P. rephaim* Ramsay)	25.5×21.2 25.0×21.0	27.0×23.5 26.8×23.2	27.2×23.7 27.2×22.5	28.0×22.0 28.0×21.5	from unpublished scaled photograph
QM F773 "	26.0×22.3 26.1×21.8	26.5×23.2 26.7×22.7	26.7×22.6 27.8×22.6	28.5×21.3 27.6×22.0	from Woods (1958)
QM F3837				28.7×25.3	pers. comm., M. Archer (1973)
SAM P11546		26.0×24.0e	27.0×24.0e		e = estimated
P. parvus					
QM F789 "	18.8×14.7 17.8×14.2	20.3×16.1 20.6×16.2	21.2×16.3 21.3×16.5	24.0×16.7 23.3×16.6	from Woods (1958)
P. painei					
CPC6752	18.2×14.3	–	18.0×15.3	18.6×14.4	
UCMP 70553 (left)	16.8×14.4	18.1×15.5	19.4×16.3	20.1×15.6	from Woodburne (1967)
UCMP 70550	16.7×13.9	18.0×15.3	18.5×15.0	20.2×15.5e	e = extrapolated measurement
UCMP 66521	17.8×14.0	18.0×15.5e	18.0×15.5e	19.9×15.5e	

M_3 (Table 2). The other fragment represents part of the right maxilla, with M^3 and M^4. Again, the teeth are very worn and broken, but M^4 retains some enamel labially, and approximate measurements are possible. The size of these teeth agree with those of *Palorchestes azael* (Table 1).

Description

Mandibles. Although somewhat crushed laterally, and preserved in partly calcified clay which makes preparation difficult, the mandibles have been partially restored, particularly in order to eliminate the distortion in the symphyseal region, and to complete as far as possible the anterior portion of the right ramus. Unfortunately, the end is a mass of hardened calcific clay and cancellous bone that does not lend itself to cleaning. As a result, the full symphyseal length, and the nature of the incisor alveolus are unknown; indeed, there is no sign of the incisor. The left molar is slightly displaced linguad but this was not considered important enough to risk damage to the specimen by restoring it to its proper position.

FIGURE 2. Thebarton specimen of *Palorchestes azael*, SAM P11546, dentaries and maxilla fragment. Scale in mm.

As Woods (1958) states, the diastema is long (at least 85 mm) and the diastemal crest descends forward from the premolar position on the dorso-lingual side of the ramus. The mandibles are firmly fused, with no trace of a suture. The preserved part of the symphysis is 145 mm long, ending level with the anterior root of M_3. The lingual region of the symphysis is a deep, rounded groove. At the level of the anterior mental foramen, 40 mm anterior to M_2, the width of this lingual channel is the same as the depth, approximately 22 mm. Below M_2, a large (11 mm diam.) sub-circular genial pit straddles the symphysis. The posterior end of the symphysis is sharply rounded, forming a transverse torus 18 mm thick. Ventrally, the mandible appears narrow and attenuated. About 50 mm in front of the posterior edge of the symphysis and about 30 mm apart, are two broad shallow depressions on either side of the midline. The effect of these is to produce a slight carination of the symphysis. The mental foramina are 25 mm antero-dorsal of these depressions. Indication of a very small posterior mental foramen is seen 40 mm below the anterior root of M_3. The mandibular canal below M_4 is 14 mm high and 11 mm wide.

Maxilla. Only the portion giving rise to the right zygoma, with the remains of two molars, is preserved. The zygoma arises opposite M^3, as in Owen's specimen (1874, pl. LXXXII). M^3 is represented only by dentine and roots, but M^4 retains some enamel labially. This is smooth and mostly lies in the protection of the transverse valley.

Geological Age

The precise geological age of the specimen cannot be determined as no carbon-dateable material was obtained. The clay deposit at Thebarton has been identified as probably the Pooraka Formation of Firman (1969), which consists of up to 7 metres of late Pleistocene sandy clay overlying the older Pleistocene Hindmarsh Clay.

Victoria Fossil Cave Specimen

Early in 1972, during excavations conducted by R. T. Wells in the Victoria Fossil Cave, Naracoorte, the large mandibles of a *Palorchestes azael* (SAM P16583) were unearthed (Wells *et al.* 1984). Certain other large bones (mainly limbs) have been found in the same area,

TABLE 2. Dimensions of lower molars of *Palorchestes azael* (in mm).

Specimen	M_2	M_3	M_4	M_5	Comments
P. azael					
BM (NH) M34 (type of *P. crassus* Ow. 1880)	26.5×15.0	27.0×16.0	30.0×17.5	(33×22)	from scaled photograph of original. (Left ramus). Owen (1880) figured the other ramus.
BM (NH) 40034	22.7×16.1	27.1×17.8	29.4×20.0	–	from Woods (1958)
QM F774	23.4×14.7	28.5×17.7	27.6×18.0	–	from Woods (1958) with estimate for M_4
"	22.4×13.3	28.2×17.7	27.2×18.0	–	
QM F781	23.7×15.6	27.2×17.0	–	–	from Woods (1958)
SAM P11546	24.1×14.0	25.7×16.0	(28)×17.0	–	estimated from battered specimen
SAM P16583	24.8×17.2	–	29.0e×21.0e	29.6×21.2	
"	24.5×17.4	26.7×18.8	28.5×20.4	30.9×20.2	

and may belong to this specimen. So far, no skull has been found.

The Fossil Chamber of Victoria Cave is a large tunnel about 60 m long, and up to 15 m wide, with a maximum of about 2.5 m headroom above a silt floor up to 3 m thick, with bone scattered throughout (Wells 1975, Wells *et al.* 1984, Smith 1971). The *Palorchestes* specimen (SAM P16583) was collected by Wells in the top 15 cm near the south-western wall about halfway along the tunnel (excavation grid reference: 70–70.5 R8′–9′ D0–6″).

Material

The specimen consists of the fused mandibles, with more or less complete cheek-tooth rows (the left M_3 and half of both LM_4 and RM_4 are missing), and with enough of the ascending rami to indicate most of the form (Fig. 3). The coronoid processes are both missing, as are the spatulate incisors. The jaws are well preserved; the teeth were fractured and expanded by infiltrating silt, but the pieces have been cleaned and rejoined with little distortion or alteration from their original size and form. A few expanded cracks in the jaws have been left unrepaired as they do not materially affect any measurements. The specimen is considered to be the best preserved of all those so far discovered.

The best preserved *Palorchestes azael* previously reported is QM F774, from a well on the Darling Downs in Queensland (De Vis 1884; Woods 1958). In that specimen of a juvenile individual, the jaws are pathologically deformed (parameral differentiation), lack most of the ascending rami, and have the teeth fractured, expanded and recemented so that accurate measurements are not always possible. It does, however, retain the scoop-like incisors and possess all molars, although the M_5s had not yet erupted.

Description

The jaws of the Naracoorte *Palorchestes* are basically similar (so far as can be compared) to the Thebarton mandible fragment and also to QM F774. The only noticeable difference is the absence of the genial pit in the lingual channel. Certain anatomical features can now be described in full: most importantly, the length of the diastema is 114 mm and the total length, from anterior tip of the symphysis to the condyle is 425 mm. The symphysis is 178 mm long. The anterior mental foramen is 87 mm from the tip of the mandible and 47 mm from P_3. At the posterior edges of the alveoli of the incisors, the jaws are about 48 mm wide and 34 mm deep. At the anterior mental foramina, these dimensions are 46 mm and 52 mm (minimum transverse distance) respectively, and at P_3 78 mm and about 70 mm. The depth of the mandible at M_2 and M_5 is 76 mm and 65 mm respectively, with a ramus thickness of 46 mm at M_5. Because of damage or loss to one or other ramus (*e.g.* only one condyle is preserved), the maximum width of the jaws cannot be measured, but an estimate is given by the maximum separation of the pterygoid fossae: 205 mm. Separation

FIGURE 3. Victoria Cave specimen of *Palorchestes azael*, SAM P16583, A) dentaries in occlusal view (stereoscopic pair), B) left dentary in profile.

of the tooth rows is as follows: 43 mm at P_3, 45 mm at M_2, and about 40 mm at M_5.

In profile, the jaws are outstanding amongst the diprotodontoids, and are reminiscent of the macropodines. The predental portion is flexed downwards rather like *Macropus giganteus* and the incisor alveoli suggest the scoop-like teeth seen in QM F774. The ascending rami tend to slope backwards as in *Bettongia*, rather than rising vertically as in *Diprotodon*, *Zygomaturus* or *Macropus*. With the jaws resting on a flat surface, the height of the condyle is 195 mm. Both coronoid processes are missing, so the total height is unknown. The masseteric fossa is shallow, as is characteristic of diprotodontids, but sharply bounded and ovate. The pterygoid fossa is deep, bounded below by an upturned lip. The angular process is prolonged acutely, and directed somewhat medially. The post-alveolar shelf is separated from the ascending ramus just posterolabial to the M_5 by a thin high wall that forms a distinct rounded trough about 15 mm in diameter.

The alveolus for the incisor is roughly crescentic or reniform in section, concave dorsomedially, and tapers rapidly with a depth of only a few centimetres. The maximum diameter of the alveolus is 23.3 mm and the minor diameter is about 13 mm. The alveoli are oriented such that the incisors may be splayed a little. The cheek teeth, being worn down to the dentine and breaching the links in all molars, indicate a mature age for the animal. By contrast, the Thebarton specimen, SAM P11546, was aged and QM F774 juvenile. The enamel of the teeth is consistently smooth, though this may be due to food abrasion. The form of the teeth is the same as described by Woods (1958). Tooth-row lengths are 134 mm (left) and 130 mm (right); LP_3 is 19.4 mm × 14.5 mm, RP_3 is 19.1 mm × 14.7 mm. Other dimensions are given in Table 2.

The similarity in form of the jaws to those of some of the early 'shovel-tusker' proboscideans (*e.g. Phiomia*, see Osborn 1936) suggests a similar habit, though the analogy should not be carried too far. It should, however, be noted here that the form of the nasal region as seen in BM(NH) 46316 (the holotype of *P. azael*, Owen 1874: 83), QM F789 (*P. parvus*) and QM F91719 (*P. painei*) indicates a long, regressed nasal opening (Bartholomai 1978), such as is found in *Phiomia* and also in tapirs, and therefore the likelihood of a short trunk. This has been accepted in recent restorations (*e.g.* Flannery 1983, Flannery & Archer 1985). Such a feature has also been suggested for the diprotodontids *Zygomaturus* (Scott 1915), and *Diprotodon* (Rich 1983).

Geological Age

Uranium series and collagen racemisation dating of bone from the upper levels, which yielded this specimen, have given the results: 125 000 U/Th and 150 000 years U/Pa BP (H. Veeh in Wells *et al.* 1984) and 50 000 and 70 000 years BP ± 20% (J. Bada in Wells *et al. ibid*) respectively. Carbon dating of associated charcoal gave results of about 16 700 years BP (+ 3000, − 2180) (*ibid.*), suggesting a lag deposit with reworking (*e.g.* Archer 1974).

Henschke Fossil Cave Specimens

During the early-mid 1980s, excavations by J. Barrie in the newly uncovered deeper sections of the Henschke Fossil Cave (Barrie 1990, Pledge 1990), on the outskirts of Naracoorte, produced a number of isolated teeth of *Palorchestes azael* (Fig. 4).

The teeth are mostly from two areas in the cave, and can be distinguished by their colour/preservation. Most are from the area 'HJD' (Barrie 1990) in a reddish silt (specimens SAM P31364, 31365, 31368, 31376, 31378–31380) and show generally a darker brownish preservation, while a few were collected several metres away at area 'HSDW' in a sandier sediment and have a buff to cream colour (SAM P31377, 31381–31383). Several others were found in the intervening area (SAM P31355) or elsewhere in the cave (SAM P31367, 31384) and also show pale coloration.

Material

This comprises a pair of I^2, a second damaged LI^2 and RI^2, a pair of P^2 (one still in a fragment of maxilla) a right M^1, a pair of M^2, a pair of M^3(?), two fragmentary left I_1, a right I_1, right M_1 and fragment of left M_1, left M_2(?), non-identical left and right M_3(?), and the anterior half of a more posterior(?) molar. All the teeth are only barely worn, the enamel crests cracked rather than worn through, and it is apparent that at least two individuals were present. It is also apparent that there is some considerable morphological variation, at least in the lower molars and lower incisors. Because the teeth are so near to pristine condition, as compared with published material, they are described briefly below.

Description

I^2(?) (SAM P31364–31367). There is some uncertainty about this designation which is based on comparison with *P. parvus* (QM F789). The tooth is relatively broad (13 mm), strongly curved, and very thick (>10 mm) at the base where the cross section is trapezoidal. The cutting edge, slightly uneven, is at about 75° to the longitudinal axis, acute medially. The teeth are very similar to the otherwise very worn AM F2451.

P^2. (SAM P31368, 31369). A pair of premolars is given this designation. One of them is the only specimen in this collection to have any associated bone, and this preserves what is considered to be part of the crypt for the unerupted left P^3. In addition, the teeth are much smaller, and of different detailed morphology, than P^3 of *P. azael* (AM MF 452) from Wellington

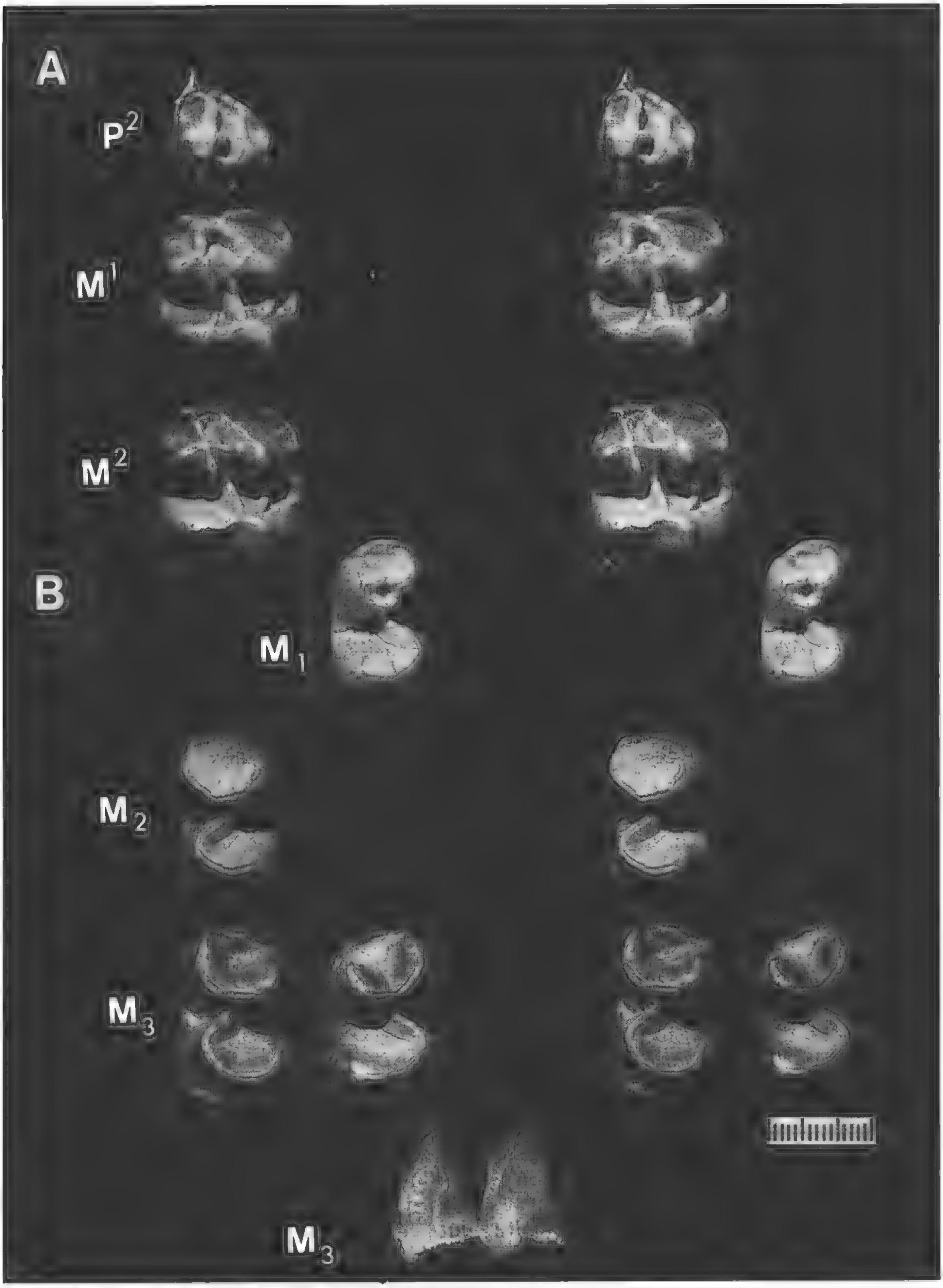

FIGURE 4. Henschke Fossil Cave specimens of *Palorchestes azael.* A) Right upper teeth, occlusal view in stereo; P^2 (SAM P31368), M^1 (P31370), M^2 (P31371). B) Lower cheek teeth, occlusal views in stereo; right M_1 (SAM P31381), left M_2 (P31369), left M_3 (P31379), right M_3 (P31378, also in medial profile). Scale in mm.

Caves. However, they closely match in size and morphology the P^3 of *Palorchestes parvus* (QM F789). They are marginally larger than that specimen and almost unworn, thus preserving the crests in great detail. (There is no other evidence of *P. parvus*, such as molars, in the deposit, and with the evidence of the P^3 crypt, the premolars are confidently referred to *P. azael.*)

The teeth are roundly triangular, the shortest side anterolingual and bearing a well defined precingulum. The longitudinal crest extends from the parastyle to a point about 2 mm lingual of the posterior corner. The metacone is about halfway along the crest and is the highest cusp. The paracone is close in front of it, and sends a deeply notched transverse crest lingually to the protocone. A parallel crest from the metacone towards the hypocone ends abruptly at a deep notch and does not meet a weak crest from the poorly expressed hypocone. A low postcrista from the protocone includes the swelling of the hypocone and continues, parallel to the longitudinal crest, to meet the posterolingual cingulum at about the halfway mark. The posterobuccal corner of the tooth is shallowly basined by the longitudinal crest, the posterobuccal cingulum and the swelling of the combined protocone-hypocone.

A damaged tooth (P31384) from a different part of the cave (HJDX) somewhat resembles in general form the teeth mentioned above. It differs in being slightly larger and in having a more complicated zig-zag longitudinal crest. The posterior moiety is similar but from the paracone(?), separated from the metacone by a notch in the crest, the crest forks into an anterior and a buccal branch, the latter not quite reaching the buccal cingulum. It is concluded that this tooth is an aberrant right P^2 rather than P^3 since it in no way resembles the P^3 of AM F452.

M^1. One tooth (SAM P31370) may represent this position. It is from the same locality in the cave as the pair of M^2s described below, but is of more solid appearance, shows slightly greater wear and some morphological differences. It generally resembles (as do the M^2s described below) the M^2 of QM F772, but differs in having converging rather than parallel forelinks from the paracone and protocone, the preparacrista being aligned longitudinally. Also there is a sharp postparacrista which converges on a slightly weaker premetacrista, and a stronger premetaconulecrista that meets the postprotocrista. In addition there is a weak postmetacrista which impinges on the postcingulum.

In view of the decreasing development of links and crests backwards in the upper molar tooth row, this hyperdevelopment of crests suggests that SAM P31370 is indeed an example of M^1. It should be noted that QM F772 preserves the posterior margin of an alveolus anterior to M^2, as well as trace of a crypt below it. Since AM F452 indicates that P^3 erupted when M^2 was quite worn, the crypt in QM F772 apparently housed P^3 which means that the alveoli above it contained M^1 of similar size to the little worn M^2

M^2. This position is represented by a pair of teeth (SAM P31371 [right] and P31372 [left]) from the same area, exhibiting identical preservation and stage of wear – virtually unworn. The teeth resemble QM F772 (Woods 1958: fig. 1 – his M^1) except that the two forelinks from the paracone and protocone are convergent instead of roughly parallel, and the postparacrista is somewhat sharper. They also resemble the putative M^1 (SAM P31370) except in lacking the premetacrista and the postmetacrista and having a weaker post-protocrista-premetaconulecrista link.

M^3. Except in being less worn and very slightly larger, the teeth ascribed to this position, (SAM P31373 [right] and P31374 [left]), are identical to M^3 of QM F772.

I_1. Three specimens represent this tooth: a fragment of left incisor (SAM P31377) and a pair (P31375 – incomplete left, and P31376 – complete right). They are virtually unworn and are interesting in showing a distinct dorsal crest ('dorsal flange' of Woods 1958) extending from the tip, posterobuccally just inside the outer edge of the tooth, for almost half the length of the enamel crown.

The tooth P31376 has the typical spoon-shape of *Palorchestes* spp. with a thicker, straighter medial margin and the anterior extremity on the mesial side. However, it differs noticeably in proportions from that of QM F2203 from Dalby, Queensland, being absolutely shorter and broader than that somewhat worn specimen. It has, in fact, the same breadth: length proportions (0.61) as that of *P. parvus* (QM F7072 from Chinchilla, Queensland), whereas the ratio for QM F2203 (*P. azael*) is less than 0.4.

M_1. Comparison of the six lower molar specimens suggests that two are in fact deciduous first molars. SAM P31381, a complete right molar, and P31382, an anterior fragment of the left, show similar preservation and stage of wear and are from the same locality (area HSDW) in the cave. They show the same unique structure that differentiates them from typical *Palorchestes azael* lower molars, a feature not previously reported in *Palorchestes*, yet reminiscent of first molars in some other diprotodontans, namely the retention of the trigonid. Instead of a simple protolophid, there is a triangular structure having the protoconid and metaconid at the ends of a narrow transverse protolophid, and these joined by lower cristids to an equidistant lower point at the end of the cristid obliqua. There is thus a deep enamel-lined basin or pit forming the 'stop' of a question mark formed by the cristid obliqua and concurrent hypolophid. Because of the apparent lateral compression of protolophid, there is a strong preprotocristid and premetacristid. The precingulum is strong and high, but unaffected by these cristids. The postlink of the hypolophid is

almost undetectable – just a slight swelling at the apex of the broad postcingulum. This postcingulum is slightly broader and definitely higher than in succeeding molars, and is seen to decrease in height to a low eminence in the M_5 of other specimens, *e.g.* SAM P16583.

Despite the triangular form of the protolophid, it cannot be interpreted as a trigonid without radical reinterpretation of the cuspid pattern of the lower molars, since the triangle is apparently headed in the opposite direction to a normal trigonid. Too few diprotodontan M_1s are preserved in a state of little or no wear for detailed comparative studies to have been made. In the primitive diprotodontid *Raemeotherium yatkolai*, M_2 possesses a small but distinct trigonid (Rich *et al.* 1978), but this cannot be reconciled with the *Palorchestes* molar unless the posterior corner of the triangle in the latter is considered to be the protoconid, which makes the buccal corner the paraconid. It would be tempting, if there were just one such tooth, to dismiss it as dental anomaly – a possibly pathological condition (Archer 1975). But with a second specimen mirror-imaging the first, and probably from the same animal, this is not so easy to accept, although symmetrical abnormalities are recorded (*ibid.*).

On balance, it is proposed that these two specimens do represent M_1 of *Palorchestes azael*.

M_2. Comparing the three remaining complete molars, from two localities, it is apparent that only one (SAM P31383) represents M_2, and it is from the same site as the putative M_1s, having the same preservation. It is slightly longer than M_1 and has a slightly lower postcingular eminence. Otherwise it has the typical form of a lower molar of *Palorchestes azael*.

M_3. Two teeth, SAM P31378 (right) and P31379 (left) are allocated this designation. Although from the same location (HJD) and having similar preservation, size and stage of wear, they are not considered to be a pair because of a distinctive postmetacristid on the left molar, which is repeated on the anterior moiety fragment of the proposed M_4, SAM P31380. This cristid forms a strong fork at the lingual end of the protolophid. Again, this feature could be considered an anomaly, possibly similar to the split cusp phenomenon recorded by Archer (*idem*), but its repetition in successive teeth in the jaw suggests a more regular feature.

M_4. SAM P31830 is the broken anterior moiety of an unerupted molar – evinced by the open-prismatic nature of the enamel, not yet fully calcified. As noted above, it displays a distinct postmetacristid.

Discussion

At least two individuals referrable to *Palorchestes azael* are represented here (Table 3). One of them is represented by both upper and lower teeth, whilst the other seems to have been just the lower jaws. Both were immature animals. Features of the M^2, I_1 and possibly M_2 call to question the specific allocation of the taxon because these teeth are noticeably different from those reported in accepted *Palorchestes azael* specimens. However, on present evidence, it is only possible to indicate that there may have been great variation in the

TABLE 3. Cheek tooth dimensions (in mm), *Palorchestes azael* from Henschke Fossil Cave.

Tooth	Specimen no.	Length (l)	width	protoloph (id) height (h)	h/l
P^2 (L)	P 31368	17.1	14.0	10.0 (pa-me)	0.58
(R)	31369	16.8	14.0	10.6 "	0.63
(L)	31384	17.5+	14.5	10.8 "	0.62
M^1 (R)	31370	28.1	22.5	14.5	0.52
M^2 (R)	31371	28.7	22.8	15.0	0.52
(L)	31372	28.5	22.6	15.0	0.53
M^3 (R)	31373	29.9	24.0	18.5	0.62
(L)	31374	30.0	25.4	18.2	0.61
M_1 (R)	P 31381	26.3	16.4	20.2	0.77
(L)	31382			20.0	
M_2 (L)	31383	27.5	17+	20.8	0.76
M_3 (R)	31378	28.6	17.4	19.9	0.70
(L)	31379	28.9	18.0	20.2	0.70
M_4? (L)	31380	–	17+	–	–

species. The features have not been reported before because most described specimens are of older individuals whose teeth are worn to the point of destroying detailed cusp morphology.

It should be noted that an unworn specimen of *P. cf. painei* from Hamilton (Turnbull & Lundelius 1970, pl. *xxx*) seems to show an incipient postmetacristid, as in SAM P31379.

Age of Deposit

Only two radiocarbon determinations have been made on the Henschke Cave deposits, both from the upper beds of the upper part of the cave (Pledge 1990). They gave a result of about 37 800 years BP for the depth interval 30–75 cm and greater than 35 000 years BP for 105–120 cm.

The *Palorchestes* teeth come only from the lower part of the cave (Barrie 1990) and are considered to be much older.

Gouldens Hole Cave

Gouldens Hole is a cenote several kilometres south of Mt Gambier in the far south-east of South Australia. Uncovered by a farmer's excavation of an access ramp to the water, there is a small simple tunnel, which gradually slopes up and away from the sinkhole. The floor of this tunnel was covered to about 15 cm with a silty deposit containing fossils. These consisted primarily of isolated teeth, but with occasional bones of modern vertebrates mixed with them as well as invertebrates dissolved out of the Gambier Limestone. The deposit thus contains a mixed vertebrate fauna ranging from (?middle) Pleistocene to Modern (such as sheep and rabbits, therefore post 1858). The end of the tunnel cannot be reached because it narrows too much, but it is apparent that the fossils are derived from a distant (and filled-in) entrance by water-winnowing of a debris pile. Virtually only small (teeth) or light (modern bones) specimens reached the lower extremity of the tunnel.

Material

Amongst the collection representing at least ten marsupial taxa are five and one half molar teeth of *Palorchestes* sp. (Fig. 5) – a pair of upper molars M^2 (P24097), a left and right M_2 (not a pair – P31396, P31397), a larger right lower molar (P31399) and half of a similar (but more anterior) tooth (P31398).

Description

These teeth are about the size of *P. parvus* molars, although possibly exhibiting greater size variation, but appear to be higher crowned than comparative topotypic material at hand (see Table 4). The upper molars are smaller and relatively narrower than that

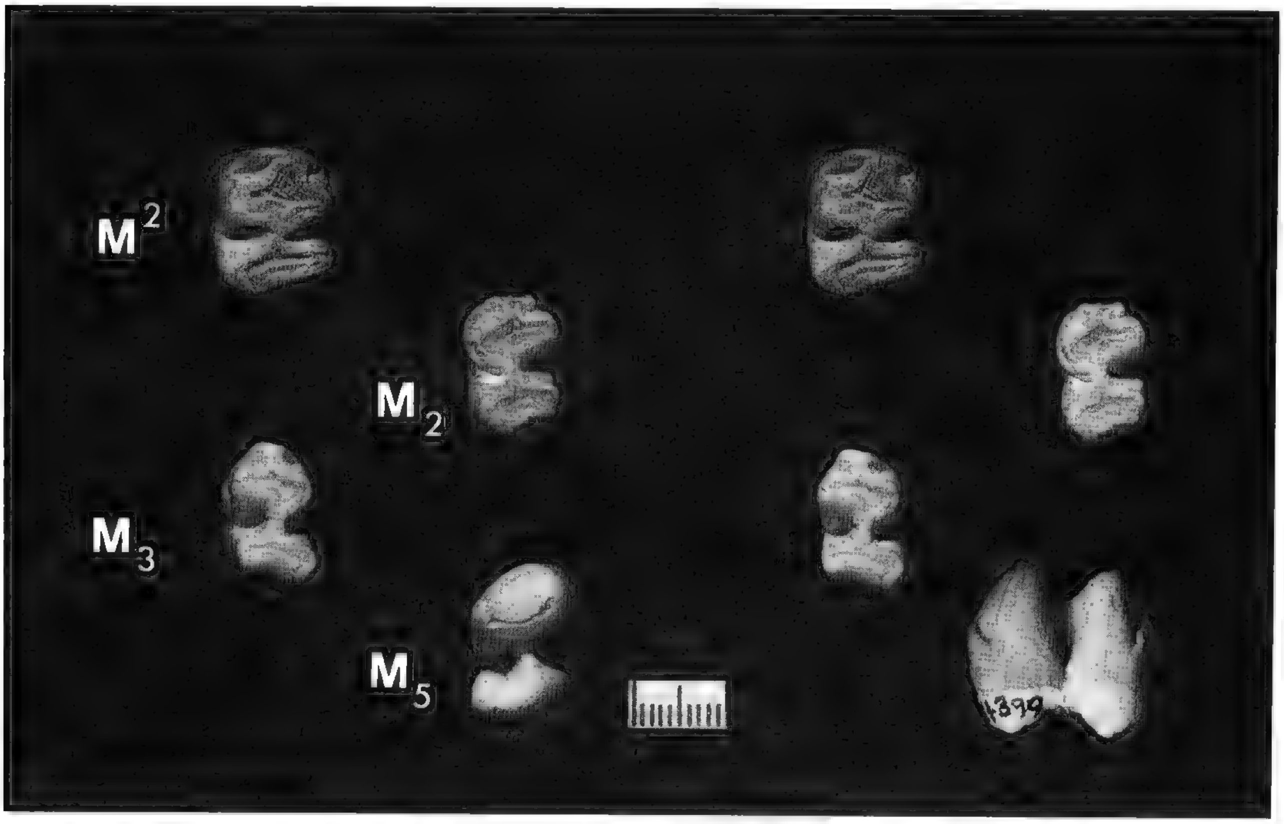

FIGURE 5. Goulden's Hole Cave teeth, *Palorchestes* sp. *cf. P. parvus.* Occlusal views in stereo. Left M^2 (SAM P24097), right M_2 (P31396), left M_3 (P31397), right M_5 (P31399, also in medial profile). Scale in mm.

(M^2) from Cement Mills, Gore, Queensland, reported by Bartholomai (1977) as *Palorchestes cf. P. parvus*.

Although the Gouldens Hole specimens differ from *P. parvus, sensu stricto*, there is not yet sufficient evidence to warrant erecting new species for them. Accordingly, they are referred, only tentatively, to *Palorchestes* sp. *cf. P. parvus*.

Geological Age

As noted above, the teeth are from a reworked mixed assemblage. The age can only be estimated at Pleistocene on the basis of other species of known Pleistocene age and similar preservation.

Curramulka Specimens

Corra-Lynn Cave (5Y1 in the National Cave register) contains a relict deposit of cemented fossiliferous silt (Pledge in prep.) which has yielded a large number of vertebrate species suggestive of a Late Tertiary age. Amongst them is a considerable number of isolated teeth (and some recognisable bones) of *Palorchestes* (Fig. 6). Measurements (Table 5) and morphological features suggest these best fit *Palorchestes painei* Woodburne, 1967 from the putative Late Miocene Alcoota Fauna of the Waite Formation (Woodburne 1967).

Material

This comprises: posterior half LM^3 (SAM P29860), LM^3 (P31331), RM^4(P29938), LM^5 (P26536, P29859), LI$_1$ (P29941), LM$_2$ (P29905), LM$_3$ (P29940), LM$_4$ (P29999), RM$_5$ (P30000). (Positional designation is based on relative size, shape and some morphological features of the 'links'.) There are also three very large, very compressed ungual phalanges of the form that has been ascribed to *Palorchestes* (Flannery & Archer 1985). These differ in detail from the damaged claw bones of phalange I of *Thylacoleo carnifex*, that have lost the protective 'hood'.

Description

Unworn molars show that these teeth are relatively high-crowned, more so than indicated for *P. painei* by Woodburne (1967, table 23) who suggests that *P. parvus* has higher crowned molars, but less so than the Gouldens Hole teeth. Turnbull & Lundelius (1970) calculated relative crown heights (*i.e.* the ratio of protolophid height to tooth length) for the Alcoota *P. painei* and their Hamilton specimen, as well as for two good *P. azael* specimens (M$_{3, 4}$) from Wellington Caves, obtaining about 0.52, 0.65, and 0.74 and 0.73 respectively. The values for specimens described herein are given in Tables 3–5. It is apparent that there are

TABLE 4. Cheek tooth dimensions (in mm), *Palorchestes* sp. *cf. P. parvus* from Gouldens Hole Cave, compared with *P. parvus* from Woods (1958) and SAM specimens.

Tooth	Specimen no.	Length (l)	width	protoloph (id) height (h)	h/l
P. sp. *cf. P. parvus*, Gouldens Hole					
M^2 (L)	SAM P24097	18.9	13.9	–	–
(R)	"	18.7	14.0	–	–
M$_2$ (R)	31396	17.7	10.0	10 ++	>0.56
M$_3$ (L)	31397	18.0	9.5	11 ++	>0.61
M$_4$ (R)	31398	–	12.2	(13+)	–
M$_5$ (R)	31399	21.2	12.6	15.0	0.71
P. parvus, Chinchilla					
M$_2$ (L)	QM F783 (type)	19.7	12.3		
M$_3$ (L)	"	20.6	12.6		
M$_4$ (L)	"	20.8	12.8		
M$_5$ (L)	"	20.6	13.1		
M$_3$ (L)	SAM P18432	18.4	12.5	10++	>>0.54
M$_4$ (L)	"	19.2	12.6	10++	>>0.52
M$_5$ (L)	SAM P18400	20.0	13.5	11+	>0.55

specific differences for this ratio, at least in lower molars, but there are also positional differences in teeth of the one species. It is suggested on this basis, at least, that the Hamilton and Curramulka specimens are conspecific, but that they differ from *P. painei, sensu stricto.*

Geological Age

Based on correlation of mammal and bird fossils, and the apparent absence of any rodent material, Pledge (in prep.) considers this deposit to be early Pliocene, or even Late Miocene, in age.

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TABLE 5. Tooth dimensions (in mm), *Palorchestes cf. P. painei* from Corra-Lynn Cave (Curramulka Local Fauna).

Tooth	Specimen no.	Length (l)	ant. width	post. width	protoloph (id) height (h)	h/l
M^3 (L)	SAM P29860	–	–	14.0		
M^3 (L)	31331	18.0	14.4	13.6		
M^4 (R)	29938	19 +	14.9	13.0	>9.0	
M^5 (L)	26536	19.2	13.4	11.6	>>8.5	
M^5 (L)	29859	20.7	14.9	12.3	11.6	0.56
I_1 (L)	29941	38.0	17.5			
M_2 (L)	29905	17.9	10.1	10.6	12 +	0.67
M_3 (L)	29940	18.1	10.5	10.6	>>9	>>0.50
M_4 (L)	29999	19.6	12.5	12.4	12.5	0.64
M_5 (R)	30000	17.8	12.4	11.0	11.0	0.62
M_3? (R) (*P. painei*, Alcoota)	P 31408	18.1	12.0	11.2	–	

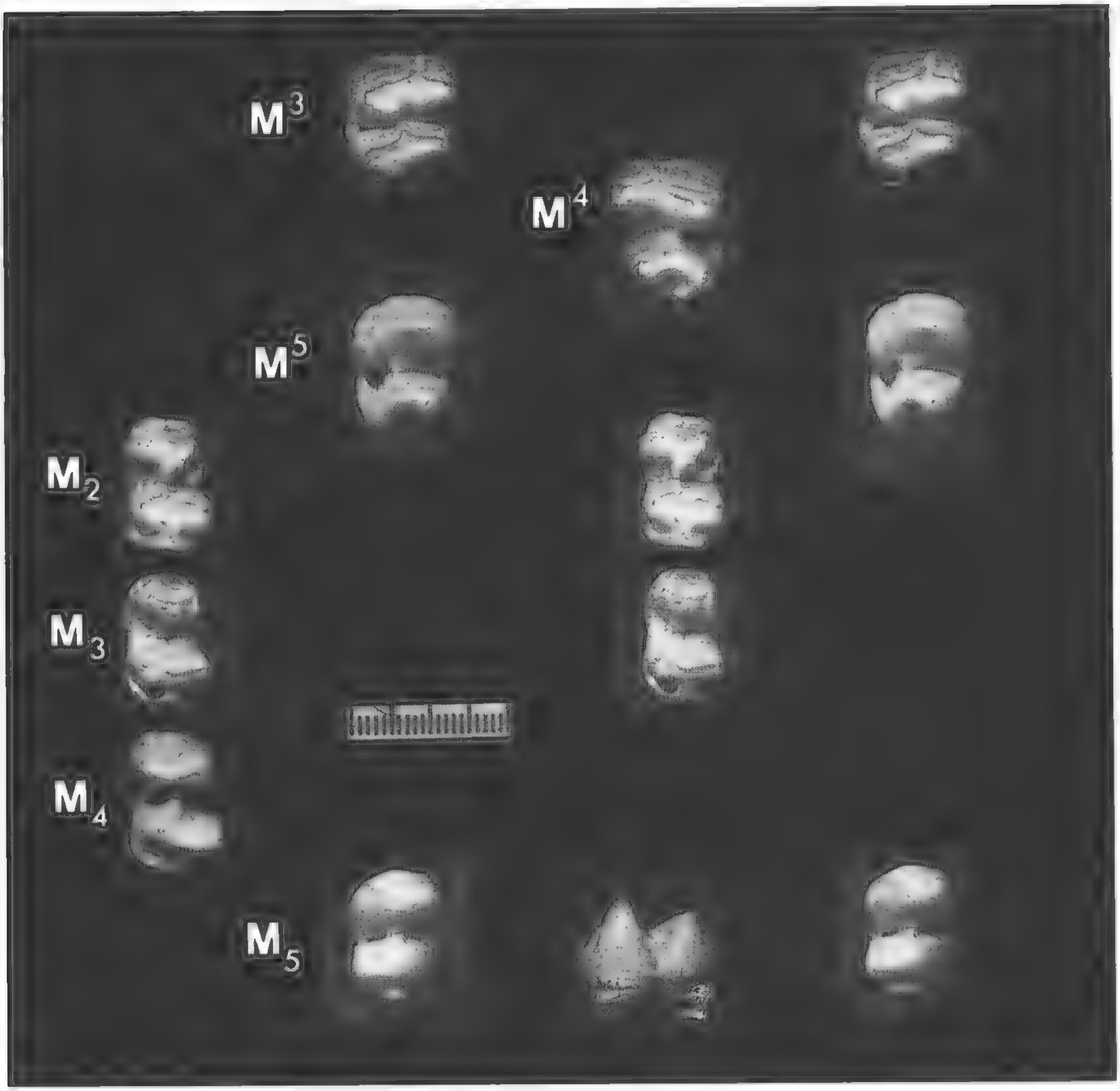

FIGURE 6. Corra Lynn Cave, Curramulka teeth, *Palorchestes* sp. *cf. P. painei*. Left M^3 (SAM P31331), right M^4 (P29938), left M^5 (P29859), M_2 (P29905), M_3 (P29940), M_4 (P29999), right M_5 (P30000, also in medial profile). (M^4 and M_4 not in stereo). Scale in mm.

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THE ARCHAEOLOGY OF THE JSN SITE : SOME IMPLICATIONS FOR THE DYNAMICS OF HUMAN OCCUPATION IN THE STRZELECKI DESERT DURING THE LATE PLEISTOCENE

M. A. Smith, E. Williams & R. J. Wasson

Summary

The earliest evidence of human occupation in the Strzelecki Desert is from the JSN site, discovered in 1979 during a geomorphic study of the dunefield. Further radiocarbon results confirm a late Plesitocene antiquity for occupation at JSN and indicate that the site was occupied on more than one occasion between 10 000-15 000 years ago. The location of the site suggests that this pattern of occupation reflects systematic use of the Strzelecki dunefield in the late Pleistocene. These findings refute the idea that there was no significant human occupation in the Strzelecki Desert-Cooper's Creek region, prior to the mid-late Holocene.

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The earliest evidence of human occupation in the Strzelecki Desert is from the JSN site (Fig. 1). The site was discovered by Wasson in 1979 during a geomorphic study of the dunefield (Wasson 1983) and takes its prosaic name from a nearby seismic line (79–JSN). A radiocarbon date of 13 850±190 yr BP (ANU–2278) for a small hearth became available as a result of this fieldwork. We can now report further radiocarbon results that confirm a late Pleistocene antiquity for occupation at JSN and which also indicates use of the site during the late Holocene. A full list of radiocarbon dates is given in Table 1.

The initial discovery raised a perennial but difficult question of interpretation. Although it showed the presence of humans in the core of the Strzelecki dunefield soon after the pronounced aridity of the last glacial maximum had passed, there was insufficient evidence to determine whether this was part of a regional pattern of occupation of the dunefield in the late Pleistocene or simply a fleeting visit. Despite considerable archaeological research in the decade since the discovery of the JSN site, other evidence of late Pleistocene occupation in the Strzelecki Desert-Cooper's Creek region has only recently come to light with the discovery of two hearths dating to about 12 000 yr BP adjacent to Cooper's Creek (Veth *et al.* 1990). Until these later finds were made the balance of archaeological evidence appeared to indicate that the region was not otherwise occupied until about 3–5 000 yr BP (Pretty 1968; Hughes & Lampert 1980; Lampert & Hughes 1987, 1988; Williams 1988). This lent support to the view that Wasson's hearth represented a single episode of occupation rather than a wider regional trend (*cf.* Lampert & Hughes 1987; Veth 1989: 87–88).

One might well expect to find some evidence of an expansion of human settlement into the Strzelecki Desert, coinciding with the progressive relaxation of arid conditions after the last glacial maximum (Singh & Luly 1991; Bowler & Wasson 1984). Initial reports

TABLE 1. Radiocarbon dates for the JSN site. All dated material was wood charcoal.

Sample code	Conventional radiocarbon age (years BP)	Context
ANU–2278	13 850±190	Wasson's hearth
ANU–2279	13 150±830	From aeolian unit below Wasson's hearth
ANU–7196	14 400±200	JSN/W3 earth oven
ANU–7197	10 500±230	Dispersed remnants of earlier oven beneath WJSN/N2
ANU–7198	2 400±270	WJSN/N2 earth oven

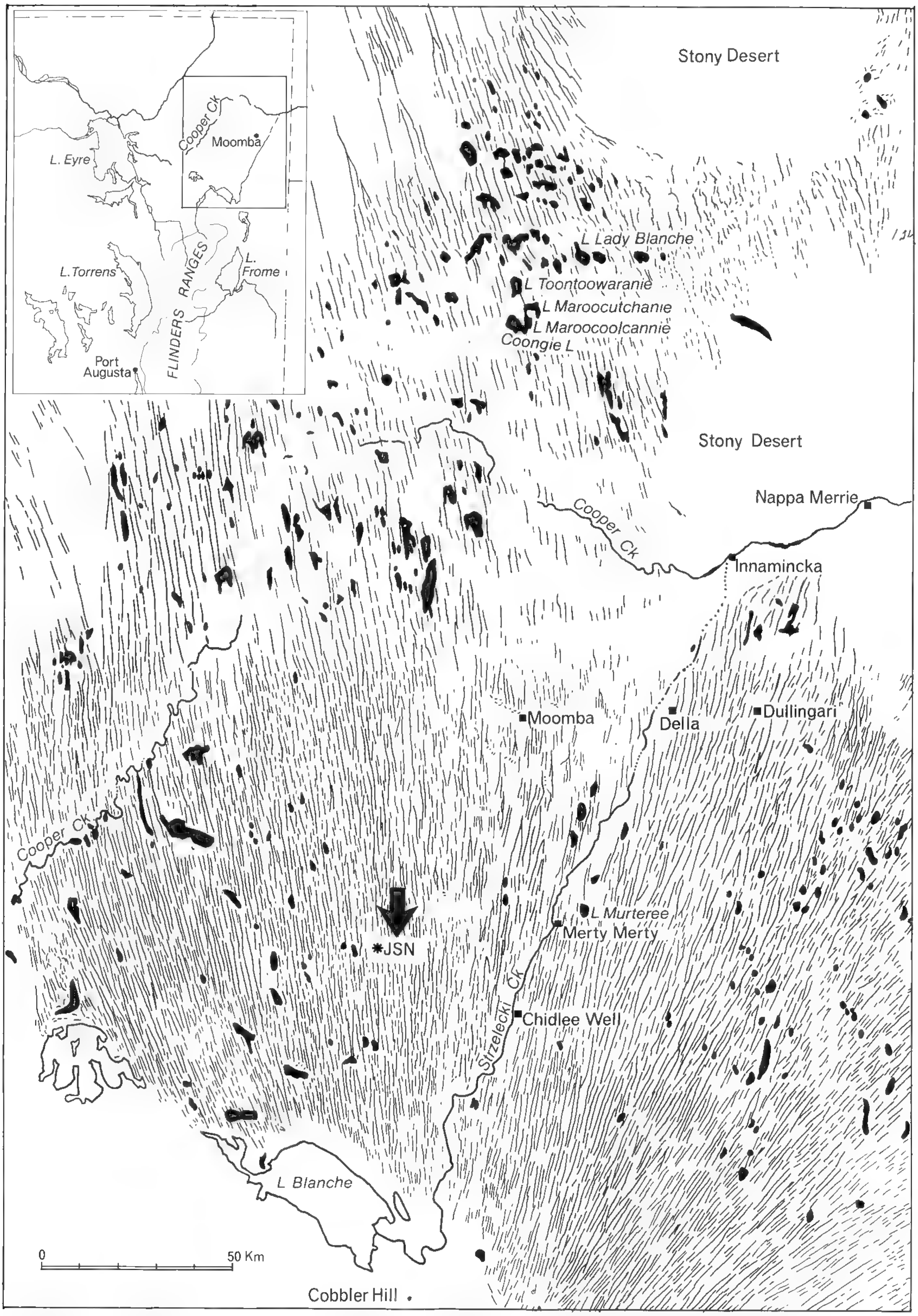

FIGURE 1. The Strzelecki Desert-Cooper's Creek region showing the location of the JSN site and places mentioned in the text.

of the age of Wasson's hearth put this at about 13 000 yr BP (Hughes & Lampert 1980), suggesting a close correlation with the end of the glacial-age climate. Moreover, the hearth was stratified above the last major aeolian unit in this part of the dunefield. The JSN evidence also seemed to fit in well with a small body of data from other parts of the arid zone suggesting that many parts of the interior, away from the comparatively well-watered montane and piedmont habitats, were reoccupied by about 10–13 000 years ago (*cf.* Smith 1988: 310–315).

In this paper we review the regional significance of the JSN site, drawing on unpublished details of the original work by Wasson in 1979, together with the results of further field investigations carried out in 1989 by Williams and Smith. Previous summary reports of JSN can be found in Wasson (1983: 102–103, 1984: 7 and fig. 6) and Hughes & Lampert (1980). Evidence now indicates that JSN was occupied on more than one occasion between 10–15 000 yr BP. We argue that this shows systematic human use of the Strzelecki dunefield during the late Pleistocene, given that JSN is not situated on obvious routes for travel within the region.

Further Investigations at JSN

Ten years ago Hughes & Lampert (1980) outlined a program for archaeological research in the Strzelecki Desert-Cooper's Creek region in which they pointed out the need for further work at JSN. In fact, the radiocarbon date for Wasson's hearth became available shortly before they began their fieldwork in October 1979 and they made an attempt to reach the JSN site. This was unsuccessful, apparently because of impassable drift sand.

In October 1989 Williams and Smith were able to relocate the JSN site using Wasson's original fieldnotes, sketch plans, and photographs together with directions keyed to the grid of shotlines established by SANTOS in the area. The objective was to clarify the nature of late Pleistocene occupation at JSN by determining whether there were other archaeological remains present and whether the setting of the site could provide any clues about its likely use. On this visit we could find no trace of the small hearth sectioned by Wasson ten years earlier. It could well have been either entirely removed by further erosion or buried by recent drift sand. However, the surrounding area was found to contain a number of other hearths and ovens and an extensive surface scatter of chipped stone artefacts, grindstones and baked clay heat-retainers scattered across several interdunal pans. Small excavations were undertaken to examine the internal structure of eleven features (Table 2), and surface collections of chipped stone artefacts and baked clay were also made in five sampling areas (Fig. 2).

TABLE 2. Features excavated in 1989.

Field code	Identification
JSN/W1	tree root
JSN/W3	earth oven
JSN/W4	hearth
JSN/W5	remnant of fire associated with JSN/W3
JSN/NE1	tree root
JSN/NE2	hearth ?
JSN/NE3	tree root
WJSN/N1	earth oven
WJSN/N2	rake out from WJSN/N1
WJSN/N3	tree roots (2)

In what follows we use the names JSN pan, WJSN pan and Wasson's hearth to refer to various components of the JSN site.

The Regional Setting

With a mean annual rainfall of 125 mm or less, the northern part of the Strzelecki Desert is within the most arid part of the continent. The major part of this region is an extensive dunefield made up of north-south trending sandridges with a dominant vegetation of *Zygochloa paradoxa* (sandhill canegrass). This is circumscribed to the north, west and east by stony plains and silcrete-capped hills (Fig. 1). Within the dunefield there are numerous small claypans and playas in the interdunal areas. There is also a major contrast between pale dunes, rich in clay pellets, to the west of Strzelecki Creek and red quartzose dunes to the east of the creek (Wasson 1983). The pale dunes lie in a structural depression in the underlying bedrock and there is a complete absence of outcropping rock in the portion of the dunefield lying between Strzelecki and Cooper's Creek. The JSN site is situated in this part of the dunefield, 40 km west of Strzelecki Creek (Fig. 1).

The channels of Strzelecki and Cooper's Creek periodically feed floodwaters from the north-east into the Strzelecki Desert. Immediately upstream of Innamincka, where the channel of Cooper's Creek is confined by rocky hills, there are a number of deep permanent waterholes. Downstream from Innamincka, Cooper's Creek floods out into the dunefield forming a maze of floodplains, shallow lakes and ephemeral swamps intersecting with the linear sandridges of the dunefield. In contrast, Strzelecki Creek has a narrow floodplain and presently fills from Cooper's Creek only rarely, when floodwaters at Innamincka top a rock bar.

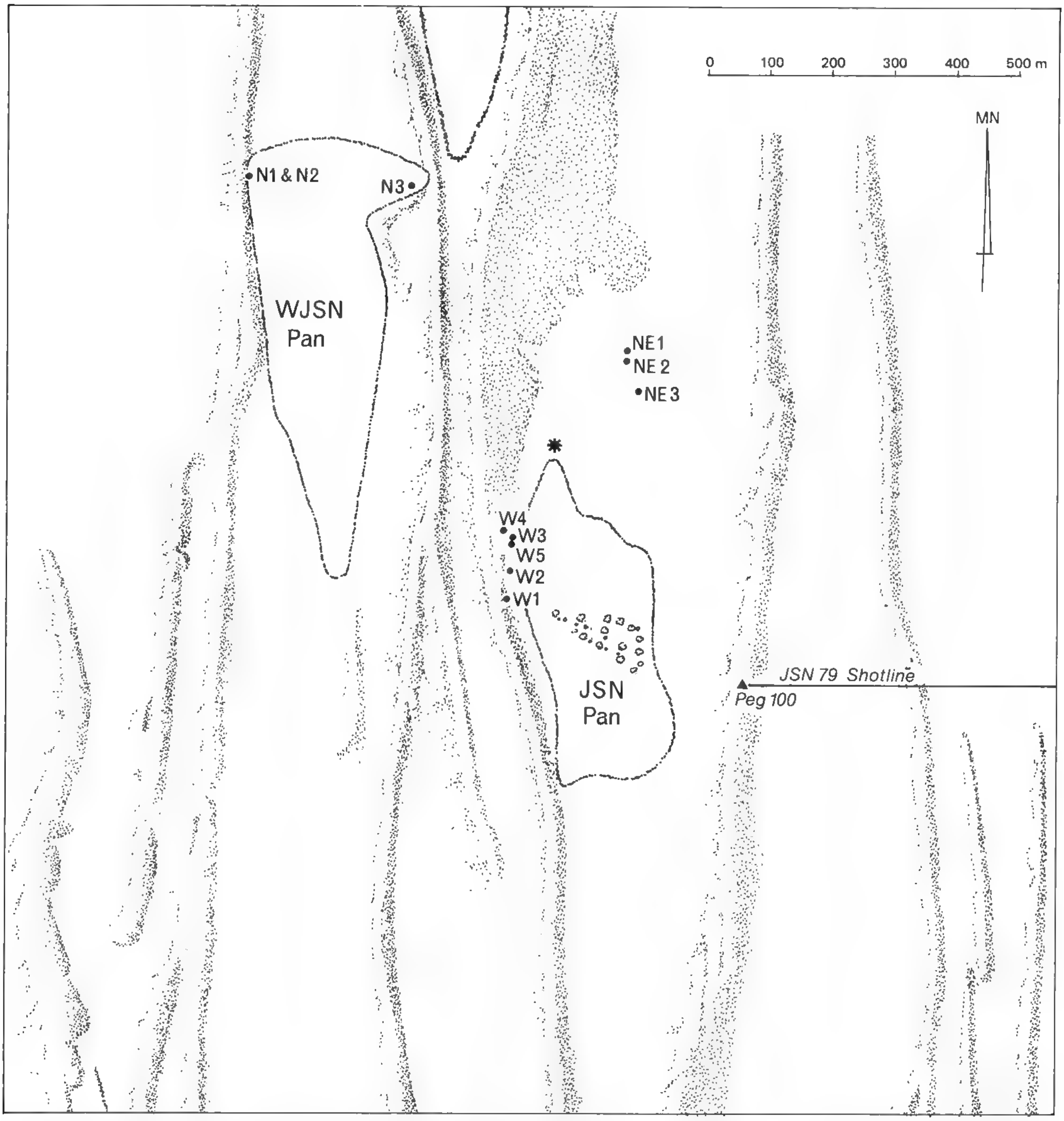

FIGURE 2. The JSN site showing the location of features excavated in 1989. Compiled from aerial photographs and 1989 survey plan. Star shows approximate position of Wasson's hearth.

Under most conditions Strzelecki Creek is a chain of semi-permanent waterholes, many of which are saline, linked by a poorly defined channel. It occupies a clear ecotone between the pale and red dune landscapes. On the floodplains the dominant perennial vegetation consists of *Eucalyptus microtheca* (coolibah) and *Atriplex nummularia* (old man saltbush).

The area around JSN is not presently reached by floodwaters from either the Cooper or Strzelecki Creeks. The configuration and stratigraphy of the dunes suggests that this was also the case in the late Pleistocene. The southern margin of the biologically productive Cooper floodout zone is 60–70 km to the north of JSN. The main channel of Strzelecki Creek, 40 km to the east, is the nearest watercourse but is a comparatively poor riverine habitat.

Description of the Site

Archaeological material at JSN is scattered over several interdunal pans (Fig. 2). There are many similar pans throughout the dunefield and the JSN area is unexceptional.

The JSN pan is about 450 m long and 200 m wide, with a surface of grey/brown sandy cracking clay. It is closed off both to the north and south by low cross dunes to form a small basin, and it clearly collects local runoff. The dunes which surround it are of pale yellow pelletal-clay and are strongly rilled and sculpted by erosion. Within these dunes, Wasson (1984) identified three aeolian units; the modern mobile crests, a possible late Holocene unit and a Last Glacial unit (Fig. 3). Underlying the dunes and exposed on the flanks of the pan is a tough yellow/grey alluvium, containing authigenic groundwater gypsum, representing the substrate on which both the pan and the dunes rest.

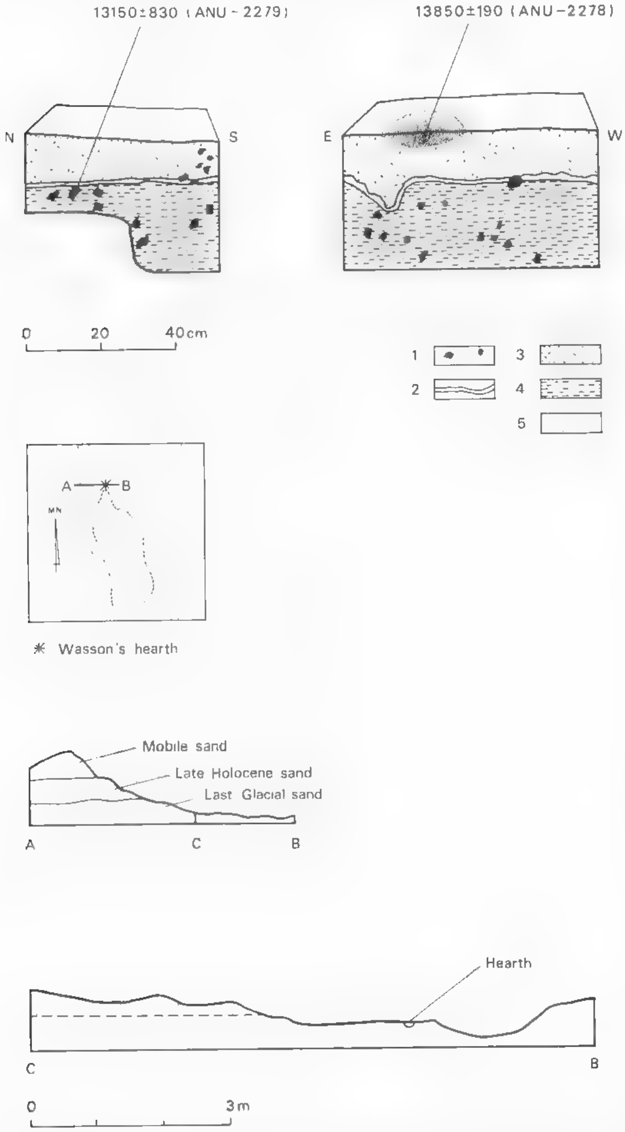

FIGURE 3. Cross-section and stratigraphic relationships of Wasson's hearth. (1) Large charcoal pieces. (2) Bleach developed in 3. (3) Yellow-grey fine sand, sub-horizontal laminae, fissile soft carbonate and clay pellets. (4) Very tough, pale yellow-grey fine sand, small hard and soft carbonate nodules and clay pellets. (5) Yellow-grey fine sand, low-angle laminae, no visible carbonate, no charcoal.

In 1989 the vegetation in the immediate area was sparse with some isolated stands of *Acacia ligulata*, *A. aneura* and other tall shrubs, such as *Hakea leucoptera*, *Eremophila longifolia* and several other species of *Acacia*. There was little ground cover apart from *Zygochloa paradoxa* on the dunes and a light cover of ephemeral plant species such as *Ptilotus* sp. on the surface of the pans.

To the west of the JSN pan there is another, larger, interdunal pan referred to here as WJSN. It is about 700 m long and 200 m wide and more sparsely vegetated than the JSN pan.

The visible archaeological remains consist of an extensive but low density scatter of chipped stone artefacts and baked clay on deflated areas at the northern ends of the JSN and WJSN pans (Table 3). In 1989 various features, either charcoal-stained sediment or concentrations of baked-clay lumps, were visible on the deflation surfaces. Eleven were excavated to test their identity (Table 2 and Fig. 2). The greatest concentration of baked clay lumps and stone artefacts occurs on the WJSN pan. Several pieces of *Velesunio* sp. shell were also recovered from this area and there is evidence of at least five individual hearths, as marked by discrete clusters of baked clay heat-retainers. On the JSN pan the density of archaeological material is lower but again there are indications of perhaps four to five hearths, in this case marked by dark charcoal staining with small pieces of burnt or baked clay.

Transects by Williams to the west and north of the JSN site and by Smith to the south and east confirmed that the site is a genuine concentration of archaeological material and not simply part of a background scatter of occupation debris. To the west and east of the site there is no appreciable background scatter of artefacts or baked clay. A light scatter of chipped stone artefacts and some grindstone fragments is evident up to one kilometre to the south of the site. Two other concentrations of archaeological material were observed. XKZ/E1 is a small hearth together with three stone artefacts and a piece of *Velesunio* sp. shell found adjacent to a floodout area five to eight km north of JSN. ESJN is a scatter of about 25 artefacts on a

TABLE 3. Distribution of archaeological material at JSN. Data excludes baked clay within discrete hearth concentrations.

sampling area	area m^2	baked clay		chipped stone artefacts	
		no.	$g/10m^2$	no.	$no./10m^2$
JSN/W1	82	20	4	9	1
JSN/W3	277	115	8	21	1
JSN/NE	400	–	–	56	2
WJSN/N2	79	400+	159	55	7
WJSN/N3	630	76	11	266	4

claypan one kilometre due east of JSN. To the east the density of artefacts only rises again within a few kilometres of Strzelecki Creek, as shown independently by Wasson during a survey transect of the dunefield. The paucity of archaeological material in this part of the dunefield has also been noted by R. Callen (pers. comm.). Hughes (1983) commented on the low numbers of artefacts on sites in the dunefield west of Strzelecki Creek.

Hearths, Earth Ovens and Other Features

As few detailed descriptions of late Pleistocene hearths or ovens are available we present our observations in full below.

Wasson's hearth

The hearth excavated in 1979 (Fig. 3) was roughly circular in plan, about 20 cm in diameter, and plano-convex in cross-section. Its depth from the eroded ground surface to the base of the shallow basin was about 10 cm. Apart from charcoal and diffuse organic matter it also contained pieces of burnt clay and tiny lamellate fragments (1–2 mm) of shell, presumed to be *Velesunio* sp. shell by comparison with similar fragments of young shell from Strzelecki Creek. From its structure and contents it appears to have been a small cooking fire.

It was dug into a finely laminated yellow-grey sand that forms the calcareous B horizon of a palaeosol at the northern end of the JSN pan. Charcoal from the hearth gave a radiocarbon age of 13 850±190 yr BP (ANU–2278). Samples from the hearth were also examined for pollen by J. Luly but proved to contain only a few very eroded pollen grains.

In 1979 several other features were noted in this sector of the site. Some of these were simply ill-defined charcoal stains. At least two closely resembled Wasson's hearth before excavation, suggesting the presence of more than one hearth here.

The stratigraphic unit beneath the Bca horizon contained large pieces of charcoal and it is probable in this environment that such charcoal is evidence of human occupation. A radiocarbon date of 13 150±830 yr BP (ANU–2279) was obtained on large charcoal lumps from this stratigraphic unit beneath Wasson's hearth. The two radiocarbon dates overlap at one standard deviation and indicate a very rapid build-up of sandy sediment in this part of the site.

JSN/W2

This appeared as a diffuse charcoal stain about 40 cm in diameter with some small pieces of reddened baked clay embedded in the feature. As it was not sectioned it is not known whether it is simply a thin lens of hearth debris (see JSN/W5 below) or an intact hearth. Because of its distance from the other hearths described below it must represent a separate feature.

JSN/W3 and related features

This is a large earth oven, roughly sub-rectangular to oval in plan, 144 cm long and 70 cm wide (Fig. 4). It is well-defined, sub-rectangular in cross-section and at least 40 cm deep. It was dug as a steep-sided pit into the tough grey-brown clayey alluvium on the western flank of the JSN pan. As it cuts through a calcareous horizon, the fill of the oven contains small pellets of carbonate.

It contains large lumps of charcoal (up to 5 cm diameter) as well as large lumps of baked clay. The latter were presumably used as heat–retainers and range in colour from yellow (10 YR 8/3) or buff (7.5 YR 7/4), sometimes with a black core, to orange or red (10 R 6/8 or 2.5 YR 6/8). The former result from underfiring while a red or orange colour is characteristic of firing in a strongly oxidising atmosphere (Goffer 1980: 119–121; Joukowsky 1980: 367–369). As the most intense red colours are produced at temperatures of 700–900 °C, it seems likely that the original position of this material would have been at the surface of the fire where temperatures of greater than 600 °C are rapidly attained (*cf.* Clark & Barbetti 1982) and where a good draught could be expected. The present distribution of reddened baked clay lumps throughout the oven suggests major disturbance to their positions since the time of firing. Such disturbance would be expected during the normal use of an oven, particularly if the clay lumps were heated on an adjacent fire and then transferred to an oven pit (*cf.* Warner 1969: 131) rather than heated on a fire in the pit itself.

More significant is the re-use of the oven on at least one subsequent occasion. The evidence for this is a basin-shaped structure within the oven, at its western end, about 35–50 cm in diameter and defined by differential charcoal staining within the oven. Baked clay and large pieces of charcoal are concentrated in this part of the oven. As the structure fits neatly within the initial oven pit and does not cut across it, it can hardly be a fortuitous superimposition. A radiocarbon sample of charcoal from within this structure gave an age of 14 400±200 yr BP (ANU–7196). This dates the latest use of the oven, though one would not expect much of a time lag between initial use of the oven pit and its subsequent re-use.

The large size of the initial pit is unusual and warrants some comment here. In the arid zone there are no plant foods that require cooking in such a structure and it is larger than would normally be required to cook an emu (*Dromaius novaehollandiae*) or large macropod. The fact that there are only relatively small quantities of baked clay and charcoal in this pit is also surprising unless the initial oven was robbed of its contents to commission the later oven. Another possibility is that it was used to steam plant foods, perhaps leaves, stems or shoots, rather than to cook meat.

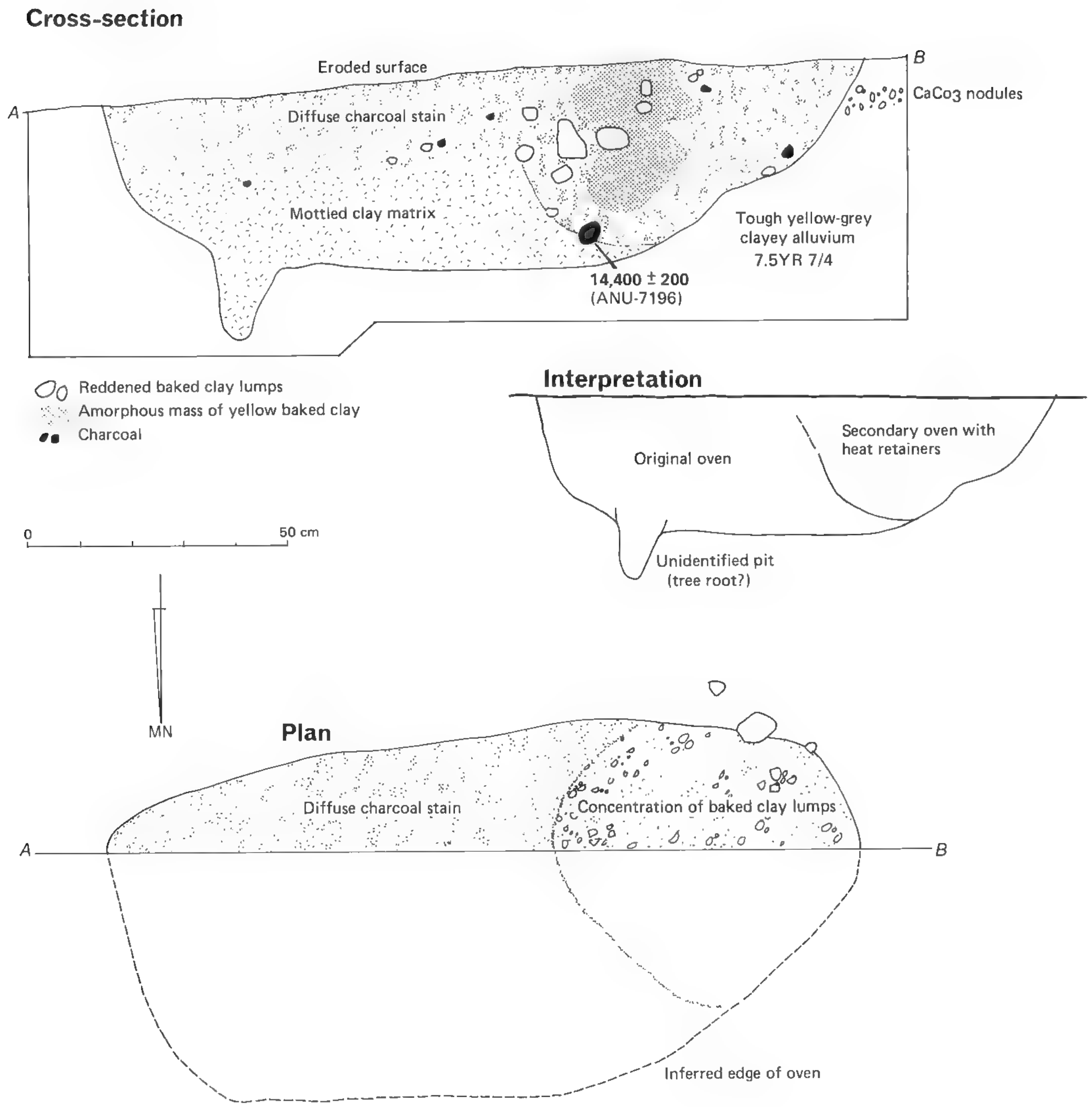

FIGURE 4. Plan and cross-section of JSN/W3 oven.

The dimensions of the secondary pit together with its roughly circular shape, concentration of baked clay lumps and large pieces of charcoal suggest subsequent use as an oven to cook an emu (*Dromaius novaehollandiae*).

JSN/W5 is a separate feature that may be associated with the JSN/W3 oven. This was visible on the surface as a large diffuse charcoal stain with some large pieces of charcoal (1–3 cm) and some small pieces of reddened baked clay embedded within it. Excavation exposed a series of large pieces of charcoal, dispersed in the sediment matrix rather than contained in a pit. Given that it is within two metres of JSN/W3 it may be a related feature, such as a dump of material removed from the oven. Another possibility is that it is the remnant of a fire to prepare the heat-retainers before they were placed in the oven pit. Clark & Barbetti (1982: 149) have drawn attention to the fact that such features are a likely archaeological correlate of the method of preparing earth ovens described by Warner (1969: 131) for north-eastern Arnhem Land.

JSN/W4

This appeared on the surface as a small circular concentration of burnt clay, about 30 cm in diameter, tightly clustered as a capping on a small residual. On

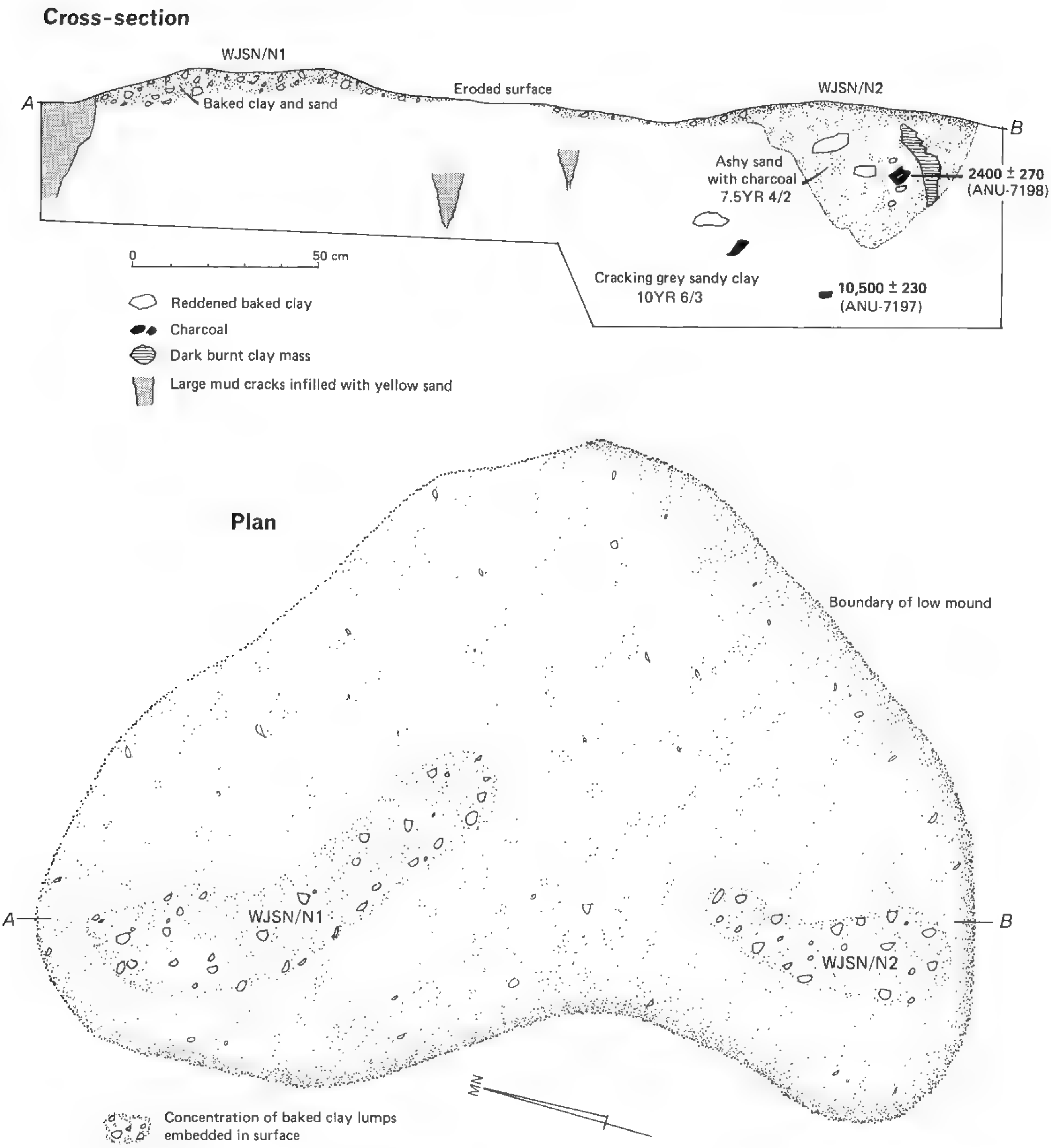

FIGURE 5. Plan and cross-section of WJSN/N2 oven.

either side of the residual a diffuse scatter of clay lumps extended outwards. None of the burnt clay was reddened. On excavation the hearth was revealed as a single layer of baked clay with~~out~~ any stratigraphic depth. This rests directly upon tough brown clayey alluvium. There was no visible charcoal or other occupation debris either within the feature or in the underlying sediment. This feature most resembles what have been described as 'hotplate' hearths (P. Clark, pers. comm.), in which a layer of heated flat rocks or burnt clay lumps is used to grill meat (*cf.* Kerwin & Breen 1981: 304).

JSN/NE2

This was a diffuse circular charcoal stain, about 45 cm in diameter, on a surface of laminated yellow-grey sand with flecks of calcium carbonate. In cross-section it is plano-convex, forming a very poorly defined shallow basin 16 cm deep. Its structure is similar to Wasson's hearth. However, as JSN/NE2 did not contain any pieces of burnt or baked clay or fragments of shell we cannot be certain that it is of human origin, particularly given the prevalence of burnt tree roots in this sector of the site (see below).

WJSN/N1 & N2

WJSN/N1 is a dense concentration of baked clay capping a low rise. Excavation showed this to be a surface veneer, 2–5 cm thick, of baked clay and sand comprising rake-out from the WJSN/N2 oven (Fig. 5). The latter is a well-defined oven pit dug into the strongly pedal clayey alluvium that forms the substrate of the WJSN pan. The oven pit is roughly circular in plan, 55 cm in diameter, conical in cross-section and 40 cm deep. It is filled with a loose grey ashy sand, reddened baked clay, black burnt clay and large (1–3 cm) pieces of charcoal. A radiocarbon sample on charcoal provides an age for this feature of 2 400±270 yr BP (ANU-7198).

Several pieces of reddened baked clay and some very large lumps of charcoal (5–10 cm long) were observed within the underlying alluvium. Where this material is stratified beneath the oven it cannot be modern intrusive material. Nor was it associated with any of the large mud cracks in this unit. We believe that it most likely represents the dispersed remnants of earlier ovens. Subsequent radiocarbon results support this interpretation. Charcoal from beneath WJSN/N2 gave a radiocarbon age of 10 500±220 yr BP (ANU-7197).

Burnt tree-roots

Several other features were revealed upon excavation to be tree roots. In plan they were usually circular and much smaller than the hearths, about 10–15 cm in diameter. In cross-section they were diffuse charcoal stains, roughly cylindrical in shape, and often set in the ground at an angle. The number of such features in the JSN/NE area, including JSN/NE1 and NE3, suggests the presence of a stand of trees here at some time in the past. A similar observation can be made about the WJSN/N3 area where a series of diffuse, roughly cylindrical charcoal stains with carbonate root casts radiating laterally from them, testify to the former presence of a stand of trees. The remaining feature, JSN/W1, was unusual in that while it conforms to the morphology described above, it was only burnt for a few centimetres depth, where it was exposed at the ground surface. The remainder of the feature was a mould formed by decay of the root.

SEM identification of archaeological charcoals

A scanning electron microscope was used to examine the ultra-structure of archaeological charcoals in order to identify the species of wood used in the ovens. This aspect of our study was limited to the examination of charcoal retained from the three samples that were submitted for radiocarbon assay.

In this sector of the arid zone the range of species that is likely to be encountered in any assemblage of archaeological charcoals is comparatively restricted. Here, the archaeological charcoal was compared with reference samples of *Acacia ligulata* and *A. aneura* collected at JSN in 1989 and with reference material from other species not present around JSN today, such as *Eucalyptus* aff. *terminalis, E. microtheca, E. camaldulensis* and *Callitris glaucophylla.*

1) ANU-7197 (10 500±230 yr BP) is from an *Acacia*, possibly one of the clonal shrubs such as *A. ligulata* that grow at JSN today. The presence of biseriate rays serves to exclude *A. aneura.*
2) ANU-7198 (2 400±270 yr BP) proved to be too

TABLE 4. Composition of the JSN assemblage.

	JSN			WJSN		EJSN	OTHER	TOTAL
	W1	W3/W4	NE	N2	N3			
cores	–	–	1	–	6	2	3	12
redirecting flakes	–	–	–	–	2	–	–	2
backed blades	–	–	1	–	–	1	–	2
pirri points	–	1	–	–	–	1	–	2
other retouched artefacts	1	2	1	2	27	–	–	33
other chipped stone artefacts	8	18	53	53	231	–	–	363
total	9	21	56	55	266	4	3	414
hammerstones	–	–	1	–	–	–	–	1
seed-grinding implements	–	–	1	–	1	–	4	6
other grindstones	–	–	–	–	5	–	2	7

crumbly to withstand prolonged SEM examination but is probably also an *Acacia.*

3) ANU-7196 (14 400±200 yr BP) was indurated and so did not provide optimal conditions for identification. However, it is also clearly an *Acacia.* A second, independent sample of charcoal from the JSN/W3 oven is from a bloodwood, probably *Eucalyptus terminalis,* which occurs in parts of the dunefield today.

The results suggest that the late Pleistocene tree and shrub vegetation around JSN may have been similar to that of today, probably with some discrete stands of various species of *Acacia* as tall shrubs and with occasional sandplain *Eucalyptus* as isolated trees. The archaeological evidence clearly points to an environment where firewood was readily available between 10 000–14 500 years ago. It is also significant that none of the charcoal is from species such as *Eucalyptus microtheca* or *E. camaldulensis*, which occur along watercourses or on floodplains. The possibility of further reconstruction of the late Pleistocene vegetation using phytoliths is now being explored.

Chipped stone artefacts

The presence of distinctive implements such as backed blades, unifacial pirri points and seedgrinders (Table 4) immediately suggests a late Holocene age for much of the JSN assemblage. Tula adze slugs are notable by their absence though they are present on other sites in the Strzelecki Desert – Cooper's Creek region. All the artefacts were resting on deflated surfaces as 'float' rather than in primary stratigraphic context.

Given the range of radiocarbon dates for occupation at this site one would expect there to be a palimpsest of material of different ages on the deflation surfaces. However an impression that the bulk of the assemblage is late Holocene in age is reinforced by the absence of artefacts with a markedly greater degree of patination or with carbonate encrustation, despite the presence of carbonate nodules and root casts in some of the sample areas. The one artefact which does show a greater degree of weathering than the bulk of the assemblage, a large retouched flake (WJSN/N3-251), is made on a quartzite containing easily weathered mica, chlorite and other clay minerals.

To test whether there were any other differences across the site that might point to some temporal patterning within it, we compared the size of flakes from the various sample areas, the proportion of flakes, cores and retouched artefacts in the various collections and the types of raw materials used (Tables 5-7). The results show only minor differences across the site in flake size, assemblage composition, and in use of various raw materials. Therefore, we are unable to point to either any significant temporal patterning across the site or to evidence for a mixture of material of greatly differing ages within the assemblage. On balance, there seem to be few artefacts of late Pleistocene age in the assemblage.

TABLE 5. Size of unretouched flakes in various sampling areas at JSN. Length is measured perpendicular to striking platform on axis through bulb of percussion. Data exclude broken flakes.

Sampling area	length (mm)			weight (g)		
	n	$\bar{x}$	SD	n	$\bar{x}$	SD
JSN/W1	3	14	6	3	1.5	0.7
JSN/W3 & W4	8	16	6	7	2.3	1.6
JSN/NE	23	13	6	23	1.5	2.2
WJSN/N2	17	16	6	15	1.9	1.6
WJSN/N3	82	19	10	78	5.1	9.7
Total	133	18	9	126	3.8	7.8

TABLE 6. Proportion of various categories of industrial debris in each sampling area at JSN. Data expressed as percentage of total number of artefacts in each area.

Sampling area	n	%			
		flakes	cores	retouched pieces	debitage
JSN/W1	9	33.3	–	11.1	55.6
JSN/W3 & W4	21	38.1	–	19.0	42.9
JSN/NE	56	41.1	1.8	3.6	53.6
WJSN/N2	55	30.9	–	3.6	65.5
WJSN/N3	266	38.0	2.3	10.9	48.9
Total	407	37.3	2.7	9.6	50.4

The majority of the retouched artefacts consist of irregular pieces with short lengths of retouch along one or more margins. One specimen (WJSN/N3-116) warrants special comment. This is a small, chunky flake, 28 mm long with retouched margins converging to form a broad point. At the apex the edge of the implement exhibits crushing, pronounced rounding and a well developed polish. Starch grains (3-5 microns in diameter), cellulose and possibly some resinous plant material are present on the edge suggesting that the implement was used in scraping a soft, moderately starchy but not fibrous material. A firm identification is not available but a rootstock or tuber seems likely.

The roots of *Typha* or *Boerhavia diffusa* (tap vine) are possible candidates, bearing in mind that the implement may well have acquired its distinctive use-wear before being brought to the JSN site.

Sources of raw materials

JSN lies in a stone-free part of the dunefield and is some distance from potential sources of isotropic stone. The nearest of these are outcrops of silcrete along Strzelecki Creek at Chidlee Well, Merty Merty and at Lake Murteree, the latter with evidence for Aboriginal quarrying of the outcrop during the late Holocene (Hughes & Lampert 1980: 63–64). These outcrops are too small to have been included on existing geological maps (see Preliminary Edition – Strzelecki Sheet G54–2 1970). It is unlikely that there are any outcrops west of Strzelecki Creek as the bedrock in this sector of the dunefield has been subject to downwarping and is over 100 m below the surface (Wasson 1983: 91). The possibility that there is a local source of stone from gravels in palaeochannels underlying the dunefield can be ruled out.

The dominant raw materials present in the JSN assemblage (Table 7) are grey-yellow cherty silcrete and pink or grey fine-grained granular silcrete. Other raw materials are present in small quantities. These include cherts of various colours but similar lithology, silicified dolomite (Namba formation dolomite beds), black silicified wood (Eyre formation), quartz, and quartzite derived from water-worn cobbles.

The likely source of the cherty silcrete, chert, dolomite and pink silcrete has been identified by R. Callen (SADME), on the basis of fine-scale geological mapping in the Strzelecki region, as the Tertiary age Namba formation between Della and Dullingari Satellite Gas Fields. This is about 115 km north-east of the JSN site amongst the red quartzose dunes east of Strzelecki Creek, adjacent to its upper reaches. The silicified wood is probably also available in the Della-Dullingari area.

Grey fine-grained granular silcrete is the nearest isotropic stone to the JSN site, as it outcrops 40–50 km to the east at Merty Merty and Lake Murteree. However, the specific source of the material used at JSN is uncertain as small outcrops are widely distributed in the dunefield to the east of Strzelecki Creek. It also outcrops in the Della-Dullingari area.

We consider that outcrops in the Della-Dullingari area are the most likely source of the grey silcrete used at JSN. If the grey silcrete had been drawn from the closest outcrops to the site, one would expect it to be the most common raw material in the JSN assemblage. However, in this case it makes up only 31% of the assemblage whereas cherty silcrete and chert, both derived from sources in the Della-Dullingari area, together make up 59% (Table 7). If it had been obtained from sources significantly closer to the site than the Della-Dullingari area, we would also expect artefacts of grey silcrete to be less reduced than those made on cherty silcrete. In fact, there is no significant difference between the two raw materials in the size-distribution of artefacts (Table 8).

The likely sources of the quartz and quartzite cobble material are Flinders Ranges fan deposits near Moolawatana, south of Lake Blanche. At JSN, quartzite cobbles appear to have been broken during use as hammerstones or anvils rather than used as cores. Much of this material consists of irregular shatter fragments. There are few flakes and no retouched artefacts or cores of this raw material. This is also generally true of other varieties of course granular material (listed as 'other' in Table 7).

Selected aspects of reduction and curation at JSN

The composition of the assemblage (Tables 4 and 6) shows that not only finished flakes and retouched implements were brought to JSN. The high proportion of debitage and the presence of worked-out cores (Table 9) shows that knapping took place at the site. This is supported by the variability in the size of flakes and

TABLE 7. Raw materials in the JSN assemblage. Data expressed as percentage of total number of artefacts in each sampling area.

	cherty silcrete	chert	quartzite cobble	silcrete	quartz	silicified dolomite	other[1]
JSN/W1	22.2	11.1	11.1	33.3	–	–	22.2
JSN/W3 & W4	47.6	4.8	–	38.1	–	4.8	4.8
JSN/NE	32.1	14.3	–	39.3	–	–	14.3
WJSN/N2	67.3	5.5	1.8	21.8	1.8	–	–
WJSN/N3	42.1	18.4	2.3	29.7	0.4	–	7.1
Total	44.0	15.2	2.2	30.5	0.5	0.3	7.4

[1] miscellaneous coarse granular materials

TABLE 8. Weight (g) of artefacts on different types of silcrete. Data are (A) cores, (B) unretouched complete flakes, (C) debitage.

Material	n	$\bar{x}$	SD	Range
A.				
cherty silcrete	9	87.9	61.8	11.1–178.0
granular silcrete	1	64.0	–	–
B.				
cherty silcrete	34	3.1	3.2	0.3–16.3
granular silcrete	43	4.7	10.6	0.1–41.6
t 0.01 (1), 75 = 0.849				
C.				
cherty silcrete	74	5.6	13.0	0.1–98.7
granular silcrete	46	3.5	6.4	0.1–38.2
t 0.01 (1), 118 = 1.020				

debitage at the site, with both categories containing many items weighing less than a gram (Table 10). The latter are presumably the fine debris produced by stoneworking.

With a core: flake ratio of 1: 22 there is no evidence to suggest that cores have been selectively removed from the assemblage. Although the proportion of flakes is a little lower than one would have expected, this might simply indicate that much of the reduction of particular cores took place before they were brought to the site. The low level of curation of the cores is further emphasised by the observation that at least half of the cores have been discarded while still suitable for removal of further flakes (Table 9). Nor is there evidence to indicate that large flakes or large items in the debitage category have been either selectively removed from the site or recycled as cores. For example, there is no significant difference between the size distributions of flakes and debitage (Table 10).

In Table 9 the cores collected from JSN are ranked roughly according to their state of reduction. They range from well-established but still viable cores to those that are at the end of their use-life. The latter are characterised by platform/core face angles of about 90°, the presence of major step-fractures that undercut the platform, a shape approaching that of a cube or sphere, and the presence of multiple striking platforms indicating rotation of the core to extend its use-life.

TABLE 10. Weight (g) of flakes and flaking debitage from WJSN/N3 surface collection.

Category	n	$\bar{x}$	SD	Range
unretouched complete flakes	79	5.1	9.6	0.1–48.9
debitage	125	6.7	12.0	0.1–45.4
t 0.01 (1), 202 = 0.989				

TABLE 9. Extent of reduction of cores. Specimens are ranked from viable cores (top) to exhausted cores (bottom).

wt (g)	shape[1] index	platform[2] angle	no. platforms	scar[3] ratio	no.[4] step fractures	cortex[5] present
64.0	6.8	55°	1	1.00	1	+
100.8	7.7	60°	1	1.00	1	+
52.7	8.1	65°	1	0.72	1	+
90.3	9.0	65°	2	0.89	0	–
30.8	10.9	75°	1	0.51	1	+
58.1	8.6	75°	1	0.55	1	+
178.0	9.0	70°	2	0.58	3	+
11.1	8.3	85°	1	0.92	2	–
173.3	9.0	85°	1	0.78	1	+
157.4	6.7	90°	1	0.59	5	+
123.4	7.3	90°	2	0.72	3	+
30.3	10.1	90°	5	?	2	–

1. Shape index is calculated as core height/$\sqrt[3]{\text{weight}}$. Values between 7–9 indicate a shape approaching a sphere.
2. Platform angle is average value to nearest 5°, measured on most viable platform.
3. Scar ratio is calculated as length of latest flake scar/core-face length. Values less than 0.5 indicate inefficient flake removal.
4. Number of major step-fracture scars.
5. + indicates more than 10% cortex.

In this assemblage several of the exhausted cores weigh more than 100 g yet there is no evidence of attempts to further reduce them by splitting the old core to create a fresh platform or by using bipolar percussion.

Inferences about site logistics in the mid-late Holocene

Studies by Byrne (1980) and Hiscock (1987) have elegantly demonstrated a general correspondence between the morphology of artefacts on a site and distance from source of the stone. This is based on the premise that with increasing distance from a source it is increasingly unlikely that the supply of stone can be replenished, while the existing stock-in-hand, sometimes called the curate set or donor assemblage, is continually being diminished. People using the dunefields in the Strzelecki Desert would presumably have carried a small stock of cores and implements with them, probably no more than 2–3 kg per family. As they moved along a chain of campsites this stock would be progressively depleted as new flakes were produced for various tasks and as existing implements were resharpened. At each site in the chain various items would be discarded, usually exhausted cores, worn out implements and the debitage from knapping. As the stock of stone diminished, one would expect criteria governing the discard of items to be tightened and attempts made to recycle, rejuvenate or ration (Hiscock 1987) the material at hand. The lack of stone in this part of the Strzelecki dunefield precludes substitution by local raw materials.

Given that the JSN site is in a stone-free sector of the dunefield and is at least 40 km from the nearest potential sources of isotropic stone and over 100 km from the sources apparently utilised, one could expect that the stone artefacts discarded at the site would show the hallmarks of extreme reduction. This is not the case and allows us to make some inferences about the scheduling and logistics of late Holocene occupation at JSN.

Comparison with sites at Coongie Lakes

The unusual character of the JSN assemblage is brought out by comparison with assemblages from other sites in the region. Archaeological sites adjacent to the Coongie Lakes, in the northern part of the Cooper floodout zone, are a comparable distance from potential sources of stone. Some of these sites are very extensive and have a comparatively high density of artefacts (Williams 1988), consistent with ethnographic accounts of large groups of people living in semi-sedentary conditions while the lakes held water. The assemblages on these sites contain few intact cores and most of these are very small (Tables 11 and 12), close to the theoretical limit at which Hiscock suggests bipolar techniques become necessary for further reduction (Hiscock 1982: 39–41). Exhausted cores appear to have been recycled as implements. Artefacts in these assemblages are also very small, with mean weights of about 3–4 g.

In contrast, artefacts and cores at JSN are much larger (Tabels 11 and 12) and cores are better represented in the assemblage. There is no evidence that cores have been recycled as implements. Many have been discarded while still viable (Table 9). Some are as large as cores at the quarry in Byrne's study (1980). Although there is no primary decortication phase represented in the JSN assemblage, nearly 20% of flakes and 75% of the cores still retain some cortex. Thus the JSN assemblage shows neither the direct effects of distance from stone sources, nor the mediating responses that one would expect to have operated to offset a diminishing stock of stone.

Interpretation

The studies by Byrne (1980) and Hiscock (1987) quoted above both use linear distance from source as an approximation of gross time since procurement. However, in the case of JSN the condition of the chipped stone material is not consistent with the distance from source irrespective of whether the actual source of much of the JSN raw material is 40 or 115 km away. This indicates that people must have travelled fairly directly from the source to the site, without spending a great deal of time foraging and camping in transit. The dumping of useful items at JSN, especially viable cores, also indicates that people must have expected to be able to replenish their stock of stone elsewhere within a day or two of leaving the site.

TABLE 11. Comparison of JSN and various Coongie Lakes sites (Williams, unpubl. data).

	no. artefacts per sq. m	mean wt artefacts g	% flakes	% retouched artefacts	% cores
JSN site	0.3	6.6	37.3	9.6	2.7
Marroocoolcanie	7.9	2.6	59.9	8.3	0.8
Toontoowaranie	7.0	2.6	63.9	7.3	–
Lake Lady Blanche	2.1	4.4	59.1	24.1	1.0

TABLE 12. Weight (g) of cores at JSN and various Coongie Lakes sites (Williams, unpubl. data).

Site	n	$\bar{x}$	SD
JSN	12	89.2	57.9
Marroocoolcanie	4	7.7	7.6
Lake Lady Blanche	2	13.7	2.6

JSN/M: t 0.05 (1), 14 = 2.744
JSN/LLB: t 0.05 (1), 12 = 1.783

Therefore, it seems likely that people intended to travel directly back to Strzelecki Creek after leaving the site. In this regard the chipped stone artefacts identify the JSN locality as a specific destination that people travelled some distance to reach, not one occupied during the course of itinerant use of the dunefield and floodplains. These ideas could be tested by further fieldwork as we would expect artefacts on other sites in the surrounding dunefield to show a degree of reduction more consistent with their distance from sources of isotropic stone. Some indication that this is indeed the case is given by Hughes (1983: 9–10).

The duration of visits to the JSN site must also have been relatively short, so that the demand for stone was easily met by the stock-in-hand without recourse to the recycling and extreme reduction of stone evident at the Coongie Lakes sites.

The fact that much of the isotropic stone at JSN is from sources in the Della-Dullingari area supports a suggestion by Hughes (1983: 11) that the predominant pattern of movement of people into this sector of the dunefield was west along the Cooper floodout zone and then south along the interdunal corridors rather than east-west across the grain of the dunefield from Strzelecki Creek. If people had simply travelled down Strzelecki Creek and then directly out to JSN it is unlikely that so much cherty silcrete and chert from the Della-Dullingari area would have been transported to the site. Fresh supplies of stone could have been acquired much closer to JSN at Lake Murteree, or at other outcrops of silcrete along Strzelecki Creek.

Grindstones

Small numbers of seed-grinding implements and other grindstones are present at the JSN site. There are 13 grindstones in the surface collection, most of which are probably fragments of larger seed-grinding implements (Table 13). Six retain enough diagnostic features to allow positive identification as fragments of either millstones or mullers (*cf.* Smith 1986). As none of the grindstones is heavily patinated or carbonate encrusted, there is nothing to suggest that they pre-date mid-late Holocene occupation of the site.

A variety of lithologies is represented, including pink, grey, brown and white varieties of sandstone. These range in texture from very fine-grained through to gritty sandstone. Some appear to be from tabular sources, others from boulder or cobble sources. Three specimens are on quartzite or metasediment cobbles. This variability is characteristic of sites in stone-free parts of the Strzelecki Desert-Cooper's Creek region where stone for grindstones was one of the commodities in the regional exchange system (McBryde 1987). One of the major conduits for the movement of exotic materials was Strzelecki Creek and it is likely that here grindstones from a variety of sources would be in use at any one time. In this respect one would expect the lithology of the grindstones at the JSN site to be more informative about exchange systems at the regional level than about local patterns of land-use and resource procurement. However, to the extent that we have been able to identify sources, the grindstones suggest a broadly similar pattern of movement of raw materials to that shown by the chipped stone artefacts.

The JSN grindstones were examined by A. Watchman. On hand examination none match material from known grindstone quarries at Anna Creek or Tooths Nob. Two specimens, including one which is a rim fragment of a millstone, are of white, coarse-grained, poorly sorted sandstone similar to that reported from the Narcoonowie quarry (Hughes 1983) 67 km south-east of Moomba. Two other specimens, on medium-grained brown sandstone, resemble material available from quarries in the Innamincka area. Both of the latter specimens are near-complete mullers.

The size of the grindstone fragments at JSN is variable (mean weight 148 g) but the largest example weighs 482 g. One specimen has seen subsequent use as an impromptu core. The majority, although broken, do not show signs of obvious recycling, such as

TABLE 13. Typological classification of the JSN grindstones.

muller	3
millstone fragment	1
pestle	2
undiagnostic fragments	6
amorphous grindstone	1
Total	13

crushing, battering or flaking. This suggests that they were brought to the JSN site as grindstones rather than as convenient pieces of sandstone recycled as hammerstones or cores. If so, the presence of seed-grinding implements is intriguing, as JSN is well away from the floodplains which are the most productive habitat for panicum (*Panicum decompositum*) and ngardu (*Marsilea* spp.). It is possible that other types of seed, perhaps from various species of *Acacia* or *Portulaca*, might have been locally available.

Mussel Shell

In the surface collection from WJSN/N3 there are 30 small pieces of freshwater mussel shell with a total weight of 12.3 g. A single small piece (1.4 g) was found elsewhere on the site and another, weighing 7.7 g, was also found adjacent to the XKZ/E1 hearth, to the north of the JSN site.

None of these fragments retain sufficient features to allow positive identification to species, which in the case of freshwater mussels requires nearly complete shells. However, the most likely species is *Velesunio wilsonii* as this is the only large bivalve present in the Cooper basin today (McMichael & Hiscock 1958; Cotton 1961). The thickness of the archaeological material, 2–3.5 mm, rules out the smaller *Corbiculina* sp. bivalve.

The shell collected in 1989 is assumed to be of mid-late Holocene age because of its association with the dense scatter of chipped stone artefacts at WJSN/N3. However, Wasson's hearth also contained tiny (1–2 mm) lamellate fragments of shell, probably also *Velesunio* sp., which must be of late Pleistocene age. Freshwater mussels are unlikely to have ever been available locally at the JSN site and must have been brought in to the site from one of the deep waterholes along either Strzelecki Creek or Cooper's Creek. The small amount of shell involved indicates that the shellfish were probably brought in as implements rather than as food. Kerwin and Breen (1981: 308–9) record the use of mussel shells as spoons for ngardu in the Innamincka area. Although fragile the shell is obviously suitable for a range of other uses. For instance, Cotton (1961: 175–176) notes the use of *V. ambiguus* shell along the Lower Murray River for cutting up fish, skinning animals and working wood. Hercus & Clark (1986) also report the presence of freshwater mussel shell on archaeological sites in the centre of the Simpson Desert.

DISCUSSION

Nature of Prehistoric Occupation at JSN

The JSN site was occupied on more than one occasion between about 15 000 and 10 000 yr BP. There seems a good chance that further excavation of features, as they are exposed by erosion, would add detail to this chronology. Occupation during this period left a series of ovens and hearths and some freshwater mussel shell at the site. The lack of any appreciable number of stone artefacts suggests that occupation at this time may well have been more transitory than later use of the site. But the rapid accumulation of sediment, evident at the northern end of the JSN pan (Fig. 3), together with the widespread occurrence of large pieces of charcoal in this unit also suggests that people and their fires may have had sufficient impact to locally destabilise dunes.

JSN was also a focus for occupation in the mid-late Holocene. The long history of use of this site is in marked contrast to the paucity of archaeological remains elsewhere in the western part of the Strzelecki dunefield. This shows that the JSN locality must have had qualities which repeatedly drew people to this point in the dunefield. Analysis of the stone artefacts reinforces this view. During the late Holocene, people appear to have travelled more-or-less directly out to JSN from the Cooper floodout zone some distance away, stayed for a short period and then travelled back towards the riverine corridor of Strzelecki Creek. This phase of occupation left ovens, hearths and mussel shell as well as chipped stone artefacts and seed-grinders.

It is not clear why the JSN locality was favoured for occupation. One possibility, given that large animals are otherwise known to have been quite rare in the Strzelecki Desert-Cooper's Creek region (Kemper 1990), is the availabilty of game. The presence of earth ovens confirms that either large macropods or emu were exploited in the area. We also observed several emus at the site in 1989. Another possibility is the opportunity to salvage raw materials, especially stone, from previous episodes of occupation of the site. However, the lack of evidence for the recycling of stone or the re-working of older artefacts seems to rule this out, as does the absence of artefacts that can be attributed to the first phase of occupation at the site.

Water must also have been a critical determinant in allowing access to this part of the dunefield, but there is nothing to suggest that JSN is better served than other interdunal pans in the region. The JSN pan collects run-off after local rain. *Conchostraca* shells were found on the surface in 1979, confirming the presence of standing freshwater at some time. However, this need not have been very substantial as these small crustaceans are only found in ephemeral pools and can flourish in a few centimetres of fresh water. In 1979, Wasson also noted that the eastern flanks of nearby dunes had been trimmed by waves, presumably after exceptionally heavy local rainfall in 1973–76, but this was also the case elsewhere in the dunefield. JSN is not strategically situated with respect to groundwater. Drilling by Delhi Australia, about 20 km to the north, showed hyper-saline water at approximately 80 m depth. Nor is the site located near any of the palaeochannels that underlie the dunefield. At best, any soakage at JSN would most likely be derived from local infiltration into the dunes, similar to the *mikiri* wells of the Simpson Desert (Hercus & Clark 1986).

Local ethnohistoric accounts shed no light on why JSN was a focus of prehistoric occupation. For instance, although the 1904 H. J. Hillier map provides Diyari and Yandruwantha place names for several places in adjacent parts of the dunefield (*cf.* Reuther 1981), none is given for the JSN locality.

Whatever the attraction may have been, humans were visiting the JSN area by at least 14 400 yr BP. Repeated use of the site since that time is unlikely to have been due simply to chance, as the site is not situated in any obvious natural corridor for travel through the region. In fact, JSN is in an otherwise undistinguished part of the Strzelecki dunefield. The most likely interpretation is that it reflects regular use of the dunefield, probably with semi-permanent occupation of the riverine corridors already in place by the late Pleistocene. The presence of *Velesunio* shell at JSN, in both late Pleistocene and mid-late Holocene contexts, is tangible evidence of some link with these riverine habitats. Although speculative, we favour the idea that the JSN area was one where people could depend on finding large game, otherwise rare in the more intensively exploited riverine and floodplain habitats. If so, it is plausible that people would have taken advantage of local rainfall to travel specifically out to the JSN area to hunt these animals, and that such visits would have been short, given the ephemeral nature of local waters.

The pattern of use of the JSN site changed sometime during the mid-late Holocene. At this time visits appear to have become more prolonged though not necessarily more frequent, and to have involved the grinding of seeds and the manufacture and maintenance of chipped stone artefacts. In contrast, late Pleistocene use of the site probably did not involve much on-site stone working. At this time, people may have brought in finished flakes and implements but did not discard them in any appreciable number at JSN.

Regional Significance

Evidence for late Pleistocene occupation at JSN, together with recently reported radiocarbon dates of about 12 000 yr BP for two hearths on the lower reaches of Cooper's Creek (Veth *et al.* 1990), refutes the idea that there was no significant human occupation of the Strzelecki Desert – Cooper's Creek region prior to about 3–5 000 years ago. Riverine, dunefield and montane habitats in this sector of the arid zone were all occupied in some fashion between 10 000 and 15 000 BP.

With radiocarbon dates of 13 850±190 (ANU–2278) and 14 400±200 yr BP (ANU–7196), first evidence of occupation at JSN coincides with the end of the first phase of climatic amelioration in this region. This phase began about 16–17 000 yr BP, a time when the pollen and sedimentary records at Lake Frome (Singh & Luly 1991; Bowler *et al.* 1986) show that a major period of lake floor deflation, coinciding with the last glacial maximum, had ended. Lake sediments began to accumulate again and trees, mainly *Callitris* and *Eucalyptus*, recolonised the region. At this time, the climate was cooler than modern, with a winter-dominated rainfall. This phase ended abruptly at about 14 500 yr BP when the trend towards gradual climatic amelioration was reversed, rainfall again declined and Lake Frome became much shallower. These more rigorous conditions persisted until about 13 000 yr BP.

The new radiocarbon dates for JSN also show clearly that first use of the site took place before the re-establishment of summer monsoon incursions into this region at 13 000 yr BP (Singh & Luly 1991). The climatic and environmental changes at this time mark the end of the glacial-age climate and we might otherwise have argued that this was the most likely time for any expansion of settlement into regions such as the Strzelecki Desert. At this time, the pollen record at Lake Frome registers the onset of summer rainfall and higher temperatures. The lake filled with water sufficiently to build beaches several metres above the floor of the modern salina. Around 12 000 yr BP, Cooper's Creek also responded to a major hydrologic change as its catchment was revegetated and sandy sediments were no longer carried in quantity.

In this context it is unlikely that the earliest dates at JSN record the initial stages of re-colonisation of the Strzelecki Desert. There is no reason now why this should not have taken place closer to 16–17 000 yr BP. If further work shows this to be the case, it would also indicate that the major impact of glacial aridity, at least upon population distribution (*cf.* Lampert & Hughes 1987; Smith 1989; Veth 1989), was restricted to a comparatively narrow time-interval, perhaps already ended by 17 000 yr BP. It is also important to note that we cannot yet dismiss the alternative possibility that people continued to occupy the Strzelecki Desert-Cooper's Creek region throughout the peak aridity of the last glacial maximum. The deep permanent waterholes along Cooper's Creek, between Innamincka and Nappamerrie, may well have supported such a population.

Finally, although the riverine corridors were probably a key focus of occupation in the Strzelecki Desert – Cooper's Creek region during the late Pleistocene, the evidence from JSN also shows that people were able to exploit the resources of the dunefields at this time. Thus they would have been in a position to gain a working knowledge of the ecology of such habitats at an early date. This weakens an argument, recently put forward by Veth (1989), that major sandridge deserts, such as the Simpson Desert to the north, would have constituted biogeographic barriers to human settlement until the mid Holocene.

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OBITUARY : WILLIAM GRANT INGLIS 9 AUGUST 1928 – 26 MARCH 1991

J. K. Ling

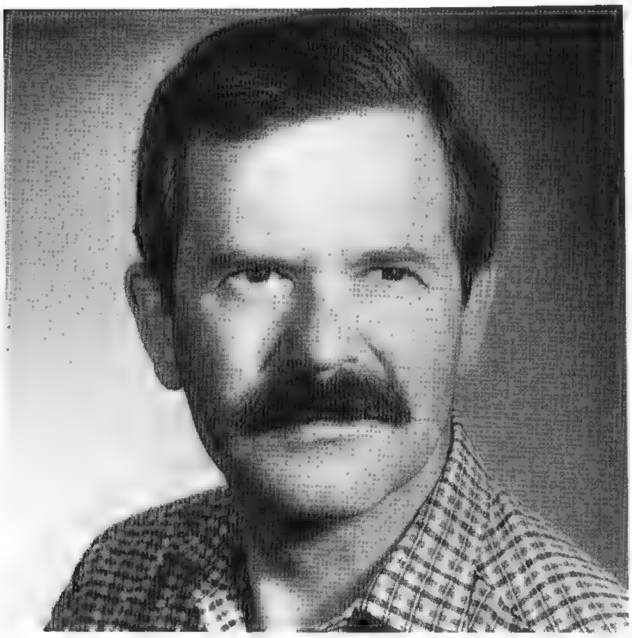
Summary

Grant Inglis was born in Cupar, Fife, Scotland, the eldest of three children, the other two being sisters. At a very early age he moved with his family to Lockerbie where his father taught music at Lockerbie Academy. The three Inglis children were educated at that establishment until their early teens and their schooling was completed at Dumfries Academy. Grant did his National Service training after leaving school and before going to Aberdeen University where he planned to take a degree in forestry. However, he changed to zoology in his second year – a profession he followed for the rest of his life.

OBITUARY

WILLIAM GRANT INGLIS

9 August 1928 – 26 March 1991



Grant Inglis was born in Cupar, Fife, Scotland, the eldest of three children, the other two being sisters. At a very early age he moved with his family to Lockerbie where his father taught music at Lockerbie Academy. The three Inglis children were educated at that establishment until their early teens and their schooling was completed at Dumfries Academy. Grant did his National Service training after leaving school and before going to Aberdeen University where he planned to take a degree in forestry. However, he changed to zoology in his second year – a profession he followed for the rest of his life.

After graduation from university he joined the staff of the British Museum (Natural History), now the Natural History Museum, in 1953. There he headed the Aschelminth Section until 1968. In 1958, Grant Inglis was awarded his Ph.D. by the University of London; and in 1965 he was awarded his D.Sc. from his old university, Aberdeen. He rose to the rank of Principal Scientific Officer at the Natural History Museum and was Dean of Studies at the Working Men's College in London. Always a keen mountaineer, he participated in and led a British Museum (Natural History) expedition to Nepal in 1961–62.

In 1966–67, Grant Inglis came to Australia as an exchange worker at the Western Australian Museum and so began his long association with this country. Soon after his return to England from Australia, the position of Director of the South Australian Museum became vacant and he was appointed to that institution on 2 September 1968.

The Directorship of the Museum also carried with it the office of Protector of Relics, as provided for in the Aboriginal and Historic Relics Act, 1965. Memorials to Grant, albeit now made obsolete by recent legislation, may still be seen throughout the State in the form of brightly painted, white-on-blue notices proclaiming this or that object to be under his protection. Through this role and that of Museum Director, Grant Inglis travelled the length and breadth of South Australia where his wit and bonhomie won him many rural friends. In turn the harsh beauty of the Australian landscape enthralled him.

Upon his arrival at the Museum, Inglis laid down his policy of emphasis on South Australia in both research and display, aided by comparative work from other regions where necessary. He also perceived a need for more resources to be expended on public programs, particularly exhibitions, than curation and research, because he felt the latter had had a good run during the preceding few years. He also saw a need for the salaries of exhibitions staff, or preparators as they were known then, to be augmented significantly in line with the importance of their role in the Museum's overall functions.

Grant Inglis, along with his predecessors and successors, inherited immense problems of inadequate and unsuitable space for work and collections in a twentieth century museum. He tackled these with vigour, and several options came and went during his tenure. Finally, during 1971, approval was near for a northward extension from the Museum's west wing to accommodate collections and research areas. In time, however, that also was superseded by yet another plan.

By this time Inglis was heavily involved with a Committee of Inquiry on Environment in South Australia (the Jordon Committee) which led to the establishment of the Department of Environment and Conservation, of which he was to become the first Director on 28 February 1972. The South Australian Museum went with its former Director to the new Department of which it became a division.

In 1976, a new South Australian Museum Act was proclaimed, which increased the size of the Board from five to six, and Grant Inglis was appointed to the Board from 18 May 1976 to 16 March 1980. However, he was rather unceremoniously removed from the position of Director (Permanent Head) of Environment and Conservation in 1977 and transferred to the Education Department as Deputy Director-General, Museums and Botanic Garden Services; these organisations were also removed to the Education Department. This situation existed until September 1979 when a new government established the State's first Department for the Arts, to which the South Australian Museum was joined. Grant Inglis then was transferred to the Department of Fisheries as Senior Scientific Adviser and ceased to have any formal administrative links with the Museum after March 1980; but he did become a familiar figure about the Museum again as he directed his remarkable mind once more to systematic zoology.

Grant Inglis remained with the Department of Fisheries until April 1987 when he retired. Officially appointed as adviser to the Department, in fact he pursued his research in systematic zoology and produced his last seminal papers. In addition, his experience in writing, editing and refereeing was put to good use as he assisted Dr Scoresby Shepherd, editor of the Department's publications, with incisive criticism and polishing of manuscripts. In 1986, Grant Inglis was awarded the Verco Medal by the Royal Society of South Australia (of which he was president in 1970–71) for notable contributions to nematology.

During his life he produced more than a hundred papers, most of them scientific, amounting to over 1300 published pages. His most productive years scientifically, were before he took up administration at a senior level; notably during his fifteen years at the British Museum (Natural History) and first three years in South Australia. However, very few subsequent years went by without some significant contribution to the field and increasing attention to theoretical and philosophical aspects of the science of systematics. He wrote his seminal paper on the purpose and judgements of biological classification in 1970 whilst heavily embroiled in administrative duties at the South Australian Museum.

The majority of publications were concerned with the classification of nematodes or round worms, small animals that may be free-living, but also include important parasites of animals and plants. Inglis worked mainly on parasites of vertebrate animals. He not only described many new species, but also made substantial changes in their higher classification. His special ability lay in clarifying the structure of parts of these small, somewhat enigmatic animals, and that in the days before scanning electron microscopy was in general usage was some achievement. Often, what had been misinterpreted as similar and homologous structures were proved to be very different in their origins, requiring considerable changes in the classification. Later he moved on to free-living marine nematodes, and he once jokingly said that it was the sheer diversity of these that drove him into administration.

During his period of administrative responsibility, Inglis developed his scientific interests in areas which did not require so much time working with a microscope, at first in the functional morphology of muscles and body wall of round worms, and later, into the procedures of biological classification. In the latter he saw evolution as progressing in waves, leading to his establishment of a classificatory process he called *stratigramy*, rather than by branching from a single event as is the basis of accepted cladistic methodology.

His new role in the Department of Environment and Conservation also gave rise to writings of a different scale and flavour as, for some, radical new concepts of nature conservation had to be promulgated to a still-learning public and new policies had to be argued with officialdom.

One of his great achievements whilst Director of Environment and Conservation was the pioneering beverage container deposit legislation that was eventually passed by the South Australian Parliament. The remarkably clean roadsides to be seen as one enters South Australia from other states will be a lasting memorial to Inglis' tenacity in getting this model legislation to and through the State Parliament. And the deposits on soft drink cans which he pioneered are now the basis of a minor industry amongst the less well-off members of today's society. Their thrift and resourcefulness would no doubt have appealed to Grant Inglis' native instincts.

Grant recognised that protection of the environment resulted from foreseeing harmful effects and avoiding them. He was an enthusiastic proponent both at the state and national level of the introduction of environmental impact statements. He hoped museums would be a rich resource base for these studies, and always insisted on the statements having a comprehensive biological basis.

With the incorporation of the Department of Fauna Conservation in 1972 into the Department of Environment and Conservation, Grant Inglis set about developing a systematic classification of the various properties that were formerly under the protection of that Department. He clearly recognised the multiple uses that parks had – conservation, recreation, and teaching purposes – and set in train the development of management plans for each of the parks.

Grant Inglis was an accomplished orator and thoroughly enjoyed public speaking. Once embarked on an administrative career, he took every opportunity to speak at conferences and seminars about environmental issues. He was in considerable demand nationally and was not averse to publicly advocating positions he was working towards.

He had an infectious – some would claim rambunctious – sense of humour, and he gathered about him a small circle of close friends. Despite heart trouble which had manifested itself before he turned 40, he enjoyed the good life and was an active member of Adelaide's Beef and Burgundy Club and all that that entailed. In 1980 and again in 1990, he underwent heart by-pass surgery, the first of which gave a new lease of life to his considerable energies.

A bachelor, Grant Inglis died of a massive heart attack in his beloved Scotland on 26 March 1991.

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