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AMPHIBIAN TYPE SPECIMENS IN THE SOUTH AUSTRALIAN MUSEUM

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Summary

Type specimens of 95 species and sub-species of frogs (Amphibia : Anura) are housed in the South Australian Museum. The collection includes holotypes and syntypes of 36 species. The majority of species (55) is from Australia, and all but one of the remainder are from New Guinea and New Britain. The total includes three fossil species.

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Type specimens of 95 species and sub-species of frogs (Amphibia: Anura) are housed in the South Australian Museum. The collection includes holotypes and syntypes of 36 species. The majority of species (55) is from Australia, and all but one of the remainder are from New Guinea and New Britain. The total includes three fossil species.

The significance of the type collection is demonstrated by the fact that it includes slightly more than 25% of the extant frog fauna of Australia.

M.J. Tyler, South Australian Museum, North Terrace, Adelaide, South Australia 5000. Manuscript received 8 May 1989.

The first type specimen of a frog to be lodged in the South Australian Museum was *Crinia affinis halmaturina* Condon (1941) from Kangaroo Island. Unfortunately the specimen involved cannot be located, and could not be found in 1960 when the entire frog collection occupied only four small shelves in a corner of the old spirit room. At that time I asked Condon whether he could cast any light on the whereabouts of the missing specimen, but he was unable to do so.

Somewhat fortuitously, the loss of the type of *C. affinis halmaturina* is of historic rather than scientific significance. The Kangaroo Island population cannot be distinguished from mainland *C. signifera* Girard (1853), and at present there are no grounds upon which subspecific status for it can be sustained.

It was not until 1963 that further type specimens were added to the collection: *Hyla micromembrana* Tyler and *H. mintima* Tyler. But in less than a further 15 years the collection had expanded to such an extent that a list of type specimens was produced (Tyler, 1976). In that list was included representatives of 34 species and subspecies, and holotypes or syntypes of 21 species.

The need for an updated type list is demonstrated by the fact that the type collection has increased by more than 150% since 1976. It now includes 95 species and subspecies, including holotypes or syntypes of 36 species. Furthermore the significance of the collection is demonstrated by the presence of the types of 55 Australian species, so representing slightly more than 25% of the known frog fauna of Australia.

AMPHIBIA: ANURA

Family **Hylidae**

Australobatrachus ilius Tyler, 1976
Trans. R. Soc. S. Aust. **100**: 13.
Holotype: SAM P18021, two fragments distal portion of left ilium, Lake Palankarinna, Etadunna Formation, S.A., Tertiary.

Cyclorana cryptotis Tyler & Martin, 1976
Rec. S. Aust. Mus. **17**: 271.
Holotype: SAM R14716, Daly Waters, N.T., B. Low and D.F. Gartside, 13 Dec. 1971.

Cyclorana maculosus Tyler & Martin, 1976
Rec. S. Aust. Mus. **17**: 269.
Holotype: SAM R14719, Daly Waters, N.T., B. Low and D.F. Gartside, 13 Dec. 1971.
Paratypes: SAM R14717–18 (collected with holotype); SAM R7612, Doomadgee Mission, Qld, G. Douglas, Feb. 1966; SAM R14736, Tennant Creek, N.T., J.F. Field, April 1907.

Cyclorana maini Tyler & Martin, 1976
Rec. S. Aust. Mus. **17**: 273.
Holotype: SAM R15191, Barrow Creek, N.T., D.F. Gartside and B. Low, 11 Dec. 1971.
Paratypes: SAM R15192, 10 km S Alice Springs, N.T., 11 Nov. 1963; SAM R6311, 14715, 27 km S Alice Springs, N.T., M.R. Warburg, 1964; SAM R13038 A–D, Toko Range, N.T., S.A. Parker, 20 Jan. 1972; SAM R1711, Well No. 26, Canning Stock Route Expedition, W.A., April 1930–Aug. 1931; SAM R5979, 15341–46, Mt Edgar, W.A., A.R. Main and G.M. Storr, Feb. 1961.

Cyclorana manya Van Beurden & McDonald, 1980
Trans. R. Soc. S. Aust. **104**: 193.
Paratypes: SAM R17420–24, Airstrip, Coen, Qld, R.G. Atherton and K.R. McDonald, 6–8 March 1979.

Cyclorana vagitus Tyler, Davies & Martin, 1981
Rec. W. Aust. Mus. **9**: 148.
Paratypes: SAM R18008–10, junction Gt Northern

Hwy and road to Derby, 41 km S Derby, W.A., A.H. Cross, M. Davies, A.A. Martin and M.J. Tyler, 14–21 Feb. 1981; SAM R16535, Parry Creek Road, Kununurra, W.A., M. Davies, A.A. Martin and M.J. Tyler, 24 Feb. 1977.

Cyclorana verrucosus Tyler & Martin, 1976
Rec. S. Aust. Mus. **17**: 267.
Paratype: SAM R14081, Sturt Ntl Pk, nr Tibooburra, N.S.W., R. Galt, May 1974.

Hyla albolabris Wandolleck, 1911
Abh. K. zool. Anthrop.-ethn. Mus. Dresden **13**(6): 12.
= *Litoria albolabris* (Wandolleck), *vide* Tyler (1971: 352).
Syntype: SAM R4947, Aitape, New Guinea, O. Schlaginhaufen, 1910.

Hyla bulmeri Tyler, 1968
Zool. Verh. (96): 56.
= *Litoria bulmeri* (Tyler), *vide* Tyler (1971: 352).
Holotype: SAM R5625, Glkm, Upper Aunjung Valley, Schrader Mts, New Guinea, R.N.H. Bulmer, 2 Jan. 1964.
Paratypes: SAM R5624, R8107 (same locality), R.N.H. Bulmer, 17 Nov. 1963.

Hyla contrastens Tyler, 1968
Zool. Verh. (96): 72.
= *Litoria contrastens* (Tyler), *vide* Tyler (1971: 352).
Holotype: SAM R5845, Barabuna, nr Kundiawa, New Guinea, F. Parker, 16 Aug. 1964.
Paratype: SAM R6450 (same data as holotype).

Hyla coplandi Tyler, 1968
Rec. S. Aust. Mus. **15**(4): 716.
= *Litoria coplandi* (Tyler), *vide* Tyler (1971: 352).
Paratype: SAM R9103, Wave Hill, N.T., K.G. Buller, 8 Aug. 1960.

Hyla dorsivena Tyler, 1968
Zool. Verh. (96): 83.
= *Litoria dorsivena* (Tyler), *vide* Tyler (1971: 352).
Holotype: SAM R7901, Telefomin, New Guinea, B. Craig, Nov. 1963.
Paratypes: SAM R7902–10 (same data as holotype). (R7911 transferred to Museum of Natural History, University of Kansas. Now KU 153143.)

Hyla leucova Tyler, 1968
Zool. Verh. (96): 119.
= *Litoria leucova* (Tyler), *vide* Tyler (1971: 353).
Holotype: SAM R6461, Busilmin, New Guinea, B. Craig, 1 May 1965.

Hyla meiriana Tyler, 1969
Rec. S. Aust. Mus. **16**(1): 2.
= *Litoria meiriana* (Tyler), *vide* Tyler (1971: 353).
Holotype: SAM R9082, 157 km N Mainoru, N.T., A. Fleming, R. Edwards and H. Bowshall, 19 Aug. 1967.
Paratypes: SAM R9014–32, 9034, 9074–81, 9083–85 (same data as holotype). (R9033 transferred to Museum of Natural History, University of Kansas. Now KU 153144.)

Hyla micromembrana Tyler, 1963
Trans. R. Soc. S. Aust. **86**: 121.
= *Litoria micromembrana* (Tyler), *vide* Tyler (1971: 353).
Holotype: SAM R4150, Mt Podamp, nr Nondugl, New Guinea, M.J. Tyler, 1 April 1960.

Hyla mintima Tyler, 1963
Trans. R. Soc. S. Aust. **86**: 123.
= *Litoria angiana* (Boulenger), *vide* Tyler (1971: 354).
Holotype: SAM R4151, Mintima, nr Kerowaghi, New Guinea, M.J. Tyler, 1 June 1960.

Hyla modica Tyler 1968
Zool. Verh. (96): 135.
= *Litoria modica* (Tyler), *vide* Tyler (1971: 354).
Paratype: SAM R8108, Oruge, Eastern Highlands, New Guinea, F. Parker, 18 April 1965.

Hyla multiplica Tyler, 1964
Amer. Mus. Novit. (2187): 2.
= *Litoria multiplica* (Tyler), *vide* Tyler (1971: 354).
Paratype: SMA R4946, Kassam, 4500 m, Kratke Mts, New Guinea, H.M. Van Deusen, 8 Nov. 1959.

Hyla prora Menzies, 1969
Trans. R. Soc. S. Aust. **93**: 165.
= *Litoria prora* (Menzies), *vide* Tyler (1971: 354).
Paratypes: SAM R10410–11, nr Efogi, Owen Stanley Mts, New Guinea (9°9′S, 147°38′E), J.I. Menzies, 12 Dec. 1968.

Hyla spinifera Tyler, 1968
Zool. Verh. (96): 167.
= *Litoria spinifera* (Tyler), *vide* Tyler (1971: 354).
Paratypes: SAM R6928–31, Oruge, New Guinea, F. Parker, 18 April 1965.

Hyla wisselensis Tyler, 1968
Zool. Verh. (96): 180.
= *Litoria wisselensis* (Tyler), *vide* Tyler (1971: 355).
Paratypes: SAM R5539–43, Enarotali, L. Paniai, Wissel Lakes, Irian Jaya, M. Boeseman and L.D. Holthius, 8 Jan. 1955.

Litoria brevipalmata Tyler, Martin & Watson, 1972
Proc. Linn. Soc. N.S.W. **97**(1): 82.
Holotype: SAM R11236, Ourimbah Creek, 8 km NW Gosford, N.S.W., F. Parker, 29 Jan. 1971.

Litoria exophthalmia Tyler, Davies & Aplin, 1986
Trans. R. Soc. S. Aust. **110**: 63.
Paratypes: SAM R27831-32, Haia Village (6°42′S, 145°00′E), South Simbu Province, Paupa New Guinea, K. Aplin, 14 June 1984.

Litoria glandulosa Tyler & Anstis, 1975
Rec. S. Aust. Mus. **17**(5): 46.
= *Litoria subglandulosa* Tyler & Anstis, *vide* Tyler & Anstis (1983).
Holotype: SAM R13504, Barwick Creek, Point Lookout, nr Ebor, N.S.W., M. Anstis, 24 Jan. 1973.
Paratypes: SAM R13505-10, Barwick and Bullock Creeks, Ebor, M. Anstis, 24 Jan. 1973; R13060 (11 juveniles), Barwick Creek, M. Anstis, Jan. 1973; R13303, Barwick Creek, M. Anstis, 10 Jan. 1971; R13626-39, Point Lookout, M. Anstis, May 1973.

Litoria longirostris Tyler & Davies, 1977
Copeia **1977**: 620.
Paratypes: SAM R15190, 15221-22, Rocky River, McIllwraith Range, Cape York Peninsula, Qld (13°46′S, 142°23′E), P.S. Laverack, B. Gray and R.J. Grimes, 26 Sept. 1975 (topotypes).

Litoria lorica Davies & McDonald, 1979
Trans. R. Soc. S. Aust. **103**: 170.
Paratypes: SAM R17348-51, Alexandra Creek, nr Thornton Peak, Qld (16°7′S, 145°20′E), J.W. Winter and R.G. Atherton, 10 Dec. 1976 (topotypes).

Litoria pallida Davies, Watson & Martin, 1983
Trans. R. Soc. S. Aust. **107**: 101.
Holotype: SAM R19555, Gulungul Creek Crossing, Arnhem Hwy, N.T., G.A. Crook, 10 Dec. 1978.
Paratypes: SAM R19539, 4 km W Baralil Creek, G.A. Crook, M. Davies and M.J. Tyler, 30 Nov. 1978; SAM R19549, 40 km N Elliot, N.T., M. Davies, A.A. Martin & M.J. Tyler, 16 Dec. 1980; SAM R19451-57, Jabiru Airstrip, N.T., G.A. Crook, 4 Nov. 1978-7 Dec. 1979; SAM R19458, 19491-504, 50 m N Retention Pond No. 2, Djalkmarra Creek, Jabiru, N.T., G.A. Crook, 5 Dec. 1979; SAM R19459-62, Coonjimba Billabong, N.T., G.A. Crook, 5 Dec. 1979; SAM R19463, 19474-90, Cannon Hill, N.T., M. King, 1 Aug. 1976; SAM R19464, soak from ore body, Jabiru, N.T., M. Davies and M.J. Tyler, 29 Nov. 1978; SAM R19465, 4 km W Baralil Creek, N.T., M. Davies and M.J. Tyler, 30 Nov. 1978; SAM R19466-69, McArthur R. Bridge on road to McArthur R. Stn, G.A. Crook, 24 Nov. 1979; SAM R19470-71, Gulungul Swamp, 150 m SE Gulungul Creek Crossing, Arnhem Hwy, G.A. Crook, 1 Feb. 1979; SAM R19472-73, 800 m W Gulungul Creek Crossing, Arnhem Hwy, G.A. Crook, 1 Feb. 1979; SAM R19506, Coonjimba Billabong, N.T., G.A. Crook, 23 Oct. 1978; SAM R19507, Jabiru Airstrip, N.T., M. Davies and M.J. Tyler, 29 Nov. 1978; SAM R19511-13, Collyer Lagoon, Carpentaria Hwy, N.T., G.A. Crook and W. Zeidler, 26 Sept. 1977; SAM R19514-33, L. Woods, N.T., G.A. Crook and W. Zeidler, 5 Oct. 1977; SAM R19540-48, Bullman Hstd, N.T., R. Edwards, 8 Aug. 1966; SAM R9602-03, 133 km N Mainoru, R. Edwards and A. Fleming, 23 Aug. 1967; SAM R14775, 19508-09, 16 km S Hooker, N.T., A. Robinson, 5 June 1975; SAM R19550-51, Jabiru Airstrip, N.T., M. Cappo, M. Davies and M.J. Tyler, 10 Jan. 1981; SAM R19552, 100 m E Jim Jim turnoff, Arnhem Hwy, M. Cappo, M. Davies, M.J. Tyler and G.F. Watson, 9 Jan. 1981; SAM R19553-54, 800 m W Gulungul Crossing, Arnhem Hwy, N.T., G.A. Crook, 1 Feb. 1979; SAM R14774, 19510, 19 km N Laura, Qld, A.R. Robinson, 23 Oct. 1974; SAM R19535, Camballin, W.A., M. Davies, A.A. Martin and M.J. Tyler, 18 Feb. 1980; SAM R19536-38, 175 km E Broome, W.A., M. Davies, A.A. Martin and M.J. Tyler, 17 Feb. 1980.

Litoria personata Tyler, Davies & Martin, 1978
Trans. R. Soc. S. Aust. **106**: 151.
Holotype: SAM R16773, Birndu, SE Cannon Hill Stn, East Alligator River Regn, N.T. (12°32′S, 132°8′E), M. Davies, G. Miles and M.J. Tyler, 27 Nov. 1977; SAM R16774-75, Cannon Hill Stn, N.T., G. Miles, Aug. 1977; SAM R16776, Bradshaw Creek, Cannon Hill, N.T., G. Miles, 2 Feb. 1977; SAM R16829, 16855-56, Cannon Hill, G. Miles and M.J. Tyler, 26 April 1978; SAM R16830-32 (topotypes), G. Miles and I. Morris, 20 May 1978.

Litoria piperata Tyler & Davies, 1985
Copeia **1985**: 145.
Paratypes: SAM R13887-90, Back Creek, Oakwood Fire Trail, approx. 38 km SE Glen Innes, N.S.W. (29°50′S, 152°08′E), G. Webb and E. Mills, 27 March 1973 (topotypes); SAM R13884-86, Diehard Creek, 45 km E Glen Innes on Old Grafton Road, N.S.W., G. Webb, E. Mills and J. Barker.

Litoria quadrilineata Tyler & Parker, 1974
Trans. R. Soc. S. Aust. **98**(2): 71.
Holotype: SAM R13489, Jalan Trikora (= Trikora Road), Merauke, Irian Jaya, F. Parker, 4 March 1973.
Paratypes: SAM R13490-93, collected with holotype by F. Parker.

Litoria timida Tyler & Parker, 1972
Trans. R. Soc. S. Aust. **96**(3): 157.
Holotype: SAM R11658, Menemsorae, Western

District, New Guinea, F. Parker, 30 March 1969.
Paratypes: SAM R11659–61 (same data as holotype).

Litoria tyleri Martin, Watson, Gartside, Littlejohn & Loftus-Hills, 1978
Proc. Linn. Soc. N.S.W. **103**(1): 25.
Paratypes: SAM R12248, Lisarow, N.S.W., F. Parker and H. Ehmann, 25 Jan. 1971; SAM R12251–52, 1 ml S, 6 ml W, Wyong, N.S.W., F. Parker, H. Ehmann and P. Krauss, 26 Jan. 1971; SAM R12250, Ourimbah, N.S.W., F. Parker and H. Ehmann, 25 Jan. 1971; SAM R12253, 12255, Ourimbah, N.S.W., F. Parker, H. Ehmann and P. Krauss, 29 Jan. 1971.

Litoria umbonata Tyler & Davies, 1983
Copeia **1983**: 803.
Paratypes: SAM R21529–32, Baliem Valley, 1600 m, Irian Jaya, P. Mathiessen, 8–10 June 1961.

Litoria xanthomera Davies, McDonald & Adams, 1986
Proc. R. Soc. Vict. **98**: 66.
Paratypes: SAM R24529–39, Henrietta Creek, Palmerston Ntl Pk, Qld (17°37′S, 145°40′E), K.R. McDonald, 13 Feb. 1980 (topotypes); SAM R16794–98, 24524–25, Gadgarra S.F., Qld (17°16′30″S, 145°40′E), K.R. McDonald and R.G. Atherton, 14 Feb. 1977; SAM R2426, Milaa Milaa Falls, 2 km from Milaa Milaa, Qld (17°30′S, 145°37′E), K.R. McDonald and R.G. Zweifel, 16 Jan. 1981; SAM R24528, Kuranda S.F., 2.6 km along Black Mt Road from Kuranda, Qld (16°48′S, 145°3′30″E), 24 Oct. 1981, K.R. McDonald, R.G. Zweifel and W. Hosmer; SAM R24529, nr Peeramon, Qld (17°19′S, 145°27′30″E), K.R. McDonald and R.G. Zweifel, 18 Jan. 1981; SAM R25736–40, Lannercost S.F., nr Wallamin Falls, Qld, K.R. McDonald and P. Minton, 16 Feb. 1984.

Nyctimystes montana Parker, 1936
Ann. Mag. nat. Hist. **17**: 80.
= *Nyctimystes cheesmani (nomen novum)* Tyler (1965: 268).
Paratype: SAM R9424, Mondo, New Guinea, L.E. Cheesman. Formerly British Museum (Natural History) 1947.2.10.93.

Nyctimystes trachydermis Zweifel, 1983
Amer. Mus. Novit. (2759): 12.
Paratype: SAM R24079, *ca* 4000′, Gapaia Creek, between Garaina and Saureli, Morobe Province, Papua New Guinea, R.G. Zweifel, 1 Sept. 1969.

Nyctimystes zweifeli Tyler, 1967
Trans. R. Soc. S. Aust. **91**: 191.
Holotype: SAM R5426, Telefomin, Western Highlands, New Guinea, B. Craig, 24 Nov. 1963.
Paratypes: SAM R8812–13, 8815–19 (same data as holotype). (R8814 transferred to Museum of Natural History, University of Kansas. Now KU 15345.)

Family **Leptodactylidae**

Arenophryne rotunda Tyler, 1976
Rec. W. Aust. Mus. **4**: 45.
Paratype: SAM R14521, 100 m from False Entrance Well Tank, Carrarang Stn, Shark Bay, W.A. (26°23′S, 113°18′E), A. Baynes and T.A. Smith, 24 Aug. 1970.

Crinia affinis halmaturina Condon, 1941
Rec. S. Aust. Mus. **7**: 114.
– *Crinia signifera* Girard, *vide* Moore (1961: 234).
Holotype: SAM R2165, Flinders Chase, Kangaroo Id, S.A., Tate Society, Jan. 1940. (Specimen missing. Note: this specimen could not be found when a specific search for it was undertaken by M.J. Tyler in 1960.)

Crinia riparia Littlejohn & Martin, 1965
Copeia **1965**(3): 319.
Paratypes: SAM R9101–02, Alligator Gorge, Flinders Ranges, S.A., M.J. Littlejohn, A.A. Martin and P. Rawlinson.

Glauertia russelli Loveridge, 1933
Occ. Pap. Boston Soc. Nat. Hist. **8**: 89.
= *Uperoleia russelli* (Loveridge), *vide* Tyler *et al.* (1981).
Paratype: SAM R9723, Creek flowing into Gascoyne R., nr Landor Stn, W.A., L. Glauert.

Kyarranus kundagungan Ingram & Corben, 1975
Mem. Qld Mus. **17**(2): 335.
Paratypes: SAM R13921–22, Mistake Mts, *ca* 800 m, 83 km SW Brisbane, Qld (27°53′S, 152°21′E), C.J. Corben and A.K. Smyth, 3 Jan. 1974.

Lechriodus intergerivus Tyler, 1989
Trans. R. Soc. S. Aust. **113**: 16.
Paratypes (ilia): SAM P29742, Henk's Hollow Site; SAM P29764–65, Last Minute Site; SAM P29768, Gag Site; SAM P29734, 29743–44, 29757–62, Upper Site; SAM P29746–50, C.S. Site; SAM P29756, 29766–67, Wayne's Wok Site; SAM P29729, 29751–55, Outasite Site; SAM P29735–41, 29745, 29771, R.S.O. Site. (All sites at Riversleigh Stn, Queensland, Tertiary.)

Limnodynastes archeri Tyler, 1982
Alcheringa **6**: 101.
Holotype: SAM P23054, distal portion of left ilium,

Tedford Locality on west side of Lake Palankarinna, Etadunna Formation, S.A., Tertiary.
Paratype: SAM P23055, distal portion of left ilium. Data as above.

Limnodynastes dumerili variegatus Martin, 1972
Aust. J. Zool. **20**: 181.
Paratypes: SAM R13174-75, 6 km N Cape Otway, Vic., A.A. Martin, 8 Dec. 1976.

Megistolotis lignarius Tyler, Martin & Davies, 1979
Aust. J. Zool. **27**: 137.
Paratypes: SAM R16228-29, L. Argyle-Kununurra Road, 6.5 km N Lake Argyle Tourist Village, L. Argyle, W.A., A.A. Martin and M.J. Tyler, 19 Feb. 1977 (topotypes); SAM R16316 (type locality), M. Davies, A.A. Martin and M.J. Tyler, 21 Feb. 1977; SAM R16317-21 (F1 progeny of topotypes); SAM R16608, Gt Northern Hwy, 4.1 km N Maggie Creek, W.A., M. Davies, A.A. Martin and M.J. Tyler, 3 Feb. 1978; SAM R16609, Gt Northern Hwy, 5.2 km S Beta Creek, W.A., M. Davies, A.A. Martin and M.J. Tyler, 3 Feb. 1978; SAM R16322, 16377, Cannon Hill, N.T., G. Miles, 1977; SAM R16324-25, Birndu nr Cannon Hill, N.T., M. Davies, G. Miles and M.J. Tyler; SAM R16323, Mt Brockman Range, N.T., R. Pengilley, 1973.

Mixophyes fleayi Corben & Ingram, 1987
Mem. Qld Mus. **25**: 233.
Paratype: SAM R31036. No data.

Neobatrachus aquilonius Tyler, Davies & Martin, 1981
Rec. W. Aust. Mus. **9**: 155.
Paratypes: SAM R18012-14, 18032-33, 18101-02, 10-41 km S Derby, W.A., M. Davies, A.A. Martin and M.J. Tyler, 13-19 Feb. 1980.

Ranidella bilingua Martin, Tyler & Davies, 1980
= *Crinia bilingua*, *vide* Heyer *et al.* (1982).
Copeia **1980**: 94.
Paratypes: SAM R16837-39, Dead Horse Spring, 1.5 km NE Lake Argyle Tourist Village, L. Argyle, W.A., M. Davies, A.A. Martin and M.J. Tyler, 19 Feb. 1977; SAM R16840-41, Spillway Bridge, 11.5 km N Lake Argyle Tourist Village, W.A., M. Davies, A.A. Martin and M.J. Tyler, 20 Feb. 1977; SAM R16842, 20 km NE Lake Argyle Tourist Village, L. Argyle, M. Davies, A.A. Martin and M.J. Tyler, 20 Feb. 1977; SAM R16833, Ivanhoe Crossing, 11.5 km N Kununurra, W.A., M. Davies, A.A. Martin and M.J. Tyler, 25 Jan. 1978; SAM R16834-36, Mitchell Plateau, W.A., M. Davies, W.E. Duellman, A.A. Martin and M.J. Tyler, 26 Jan.-1 Feb. 1978.

Ranidella remota Tyler & Parker, 1974
Trans. R. Soc. S. Aust. **98**(2): 74.
= *Crinia remota* (Tyler & Parker), *vide* Heyer *et al.* (1982).
Holotype: SAM R13524, Morehead, Papua New Guinea, F. Parker, 18 June 1973.
Paratypes: SAM R13527-28, Gubam, 16 April 1972; R13525-26, R13681-82, Morehead, F. Parker, 19 May 1969.

Rheobatrachus vitellinus Mahony, Tyler & Davies, 1984
Trans. R. Soc. S. Aust. **108**: 155.
Paratypes: SAM R25446-47, Eungella Ntl Pk, Qld, K.R. McDonald and G. Chester, 10-12 Jan. 1984.

Uperoleia arenicola Tyler, Davies & Martin, 1981
Aust. J. Zool., Suppl. (79): 26.
Holotype: SAM R16991, Birndu, East Alligator River Regn, N.T. (12°28'S, 132°56'E), G.A. Crook, M. Davies, A.A. Martin and M.J. Tyler, 30 Nov. 1978.
Paratypes: SAM R16992-96, 17347, taken with the holotype.

Uperoleia aspera Tyler, Davies & Martin, 1981
Rec. W. Aust. Mus. **9**: 159.
Paratypes: SAM R18093-97, 28 km S Derby, W.A. (17°30'S, 123°43'E), M. Davies, A.A. Martin and M.J. Tyler, 14 Feb. 1980 (topotypes), SAM R18098, Gt Northern Hwy, 8 km NE Broome, M. Davies, A.A. Martin and M.J. Tyler, 15 Feb. 1980.

Uperoleia borealis Tyler, Davies & Martin, 1981
Aust. J. Zool., Suppl. (79): 30.
Paratypes: SAM R17077-78, 17083-84, Dead Horse Spring, 3.7 km NE of Lake Argyle Tourist Village, L. Argyle, W.A., M. Davies, A.A. Martin and M.J. Tyler, 19 Feb. 1977, SAM R17082, Stonewall Creek, 20 km NE L. Argyle, W.A., M. Davies, A.A. Martin and M.J. Tyler, 21 Feb. 1977.

Uperoleia capitulata Davies, McDonald & Corben, 1986
Proc. R. Soc. Vict. **98**: 163.
Paratypes: SAM R29586-87, 64 km SW Bulloo Downs Hstd, Qld, D.G. McGreevy and S. Tickler, 2 Oct. 1976; SAM R29588, Noccundra Hotel, Qld, K.R. McDonald and D.G. McGreevy, 30 Nov. 1975; SAM R29590, Boorara Stn, 32 km N Hungerford, Qld, S. May, late 1976; SAM R29589, Boorara Stn, D.G. McGreevy, 12 Jan. 1977; SAM R29591, King Tank, Ambathala Nature Reference Site, Qld (26°00'S, 145°00'E), K.R. McDonald and D.G. McGreevy, 3 May 1979; SAM R29592-95, D.P. Swamp, Charleville, Qld., P.D. McRae, 10 Feb. 1976.

Uperoleia crassa Tyler, Davies & Martin, 1981
Aust. J. Zool., Suppl. (79): 34.
Paratypes: SAM R16904-18, 17079-80, Amax Campsite, Mitchell Plateau, W.A., M. Davies, W.E. Duellman, A.A. Martin and M.J. Tyler, 26-31 Jan. 1978.

Uperoleia fusca Davies, McDonald & Corben, 1986
Proc. R. Soc. Vict. **98**: 167.
Holotype: SAM R29596, S boundary Eungella Ntl Pk, 1.2 km along Crediton Rd from Broken R. crossing, Qld (21°10′15″S, 148°30′10″E), M.J. Tyler and K.R. McDonald, 26 Jan. 1984.
Paratypes: SAM R12590(12), Wyong, 1.6 km S, 9.6 km W Ulong, N.S.W., F. Parker, H. Ehmann and P. Krauss, 26 Jan. 1971; SAM R29597-98, Ourimbah Creek, N.S.W., M. Mahony, 3 Nov. 1981; SAM R29599-607 (topotypes); SAM R29608-13, Bellthorpe S.F., Qld (26°44′S, 152°36′E), K.R. McDonald, J.S. McEvoy and D.G. Crossman, 27 Feb. 1976; SAM R29614-16, Crows Nest Ntl Pk, Qld, K.R. McDonald, 14 Jan. 1974; SAM R29617, Mt Glorious, Qld, C.J. Limpus and K.R. McDonald, 20 Feb. 1974; SAM R29618, 2 km from Sunday Creek turnoff along Jimna/Bellthorpe Rd, Qld (26°42′S, 152°29′E), K.R. McDonald, 13 Dec. 1978; SAM R29619, nr Blue Lagoon Swamp, Moreton Id, Qld, K.R. McDonald, 16 Nov. 1976.

Uperoleia glandulosa Davies, Mahony & Roberts, 1985
Trans. R. Soc. S. Aust. **109**: 103.
Paratypes: SAM R27081-82, 3.2 km NE Wittenoom turnoff on Pt Hedland-Broome Rd, W.A., M. Mahony and J.D. Roberts, 10 Jan. 1983.

Uperoleia inundata Tyler, Davies & Martin, 1981
Aust. J. Zool., Suppl. (79): 39.
Holotype: SAM R17182, Jabiru, East Alligator River Regn, N.T., G.A. Crook, 30.1.79.
Paratypes: SAM R16997, nr Mt Brockman, N.T., G.A. Crook, M. Davies, A.A. Martin and M.J. Tyler, 2 Dec. 1978; SAM R16999-17002, Jabiru Airstrip, N.T., G.A. Crook, 4 Dec. 1978; SAM R17182-90, 17216, Jabiru, N.T., G.A. Crook, 30 Jan. 1979; SAM R17191-92, Gulungul Swamp, nr Jabiru, N.T., G.A. Crook, 8 Jan. 1979; SAM R17193-94, 17217, Leanyer Swamp, Darwin, N.T., I. Morris, 31 Jan. 1979; SAM R17195-96, 5.7 km W Mary River Crossing, Arnhem Hwy, G.A. Crook, M. Davies, A.A. Martin and M.J. Tyler, 21 Feb. 1979.

Uperoleia lithomoda Tyler, Davies & Martin, 1981
Aust. J. Zool., Suppl. (79): 43.
Paratypes: SAM R17008-10, Spillway Bridge, 11.5 km NE Lake Argyle Tourist Village, L. Argyle, W.A. (16°02′S, 128°47′E), M. Davies, A.A. Martin and M.J. Tyler, 20 Feb. 1977 (topotypes); SAM R17012, Kununurra, W.A., M. Davies, A.A. Martin and M.J. Tyler, 23 Feb. 1977; SAM R17011, Gt Northern Hwy, 81 km S Duncan Hwy junction, W.A., M. Davies, A.A. Martin and M.J. Tyler, 24 Jan. 1978; SAM R17220, Granite Creek, 14.1 km NE Lake Argyle Tourist Village, L. Argyle, W.A., M. Davies, A.A. Martin and M.J. Tyler, 22 Feb. 1977; SAM R17179-80, 17218, Arnhem Hwy at Fogg Dam turnoff, N.T., 24 km ESE Darwin, I. Morris, 31 Jan. 1979; SAM R17181, 7 km W Mary R. Bridge, Arnhem Hwy, N.T., G.A. Crook, M. Davies, A.A. Martin and M.J. Tyler, 21 Feb. 1979.

Uperoleia littlejohni Davies, McDonald & Corben, 1986
Proc. R. Soc. Vict. **98**: 174.
Paratypes: SAM R29620-21, Gorge Creek, Qld (19°33′S, 143°56′E), A. Taplin, 18 March 1984; SAM R29622, Caerphilly Stn, Qld (21°03′S, 146°05′E), B.C. Lawrie, 3 March 1981; SAM R29623, Strathtay, Qld (20°57′S, 144°12′E), B.C. Lawrie, 24 Aug. 1984; SAM R29624, Amber Stn *ca* 1.6 km from French's Crossing on Lynd R., Qld, K.R. McDonald and S.K. Reardon, 15 Jan. 1980; SAM R29625-26, Walsh R., Watsonville, Qld (17°2′S, 145°18′E), J.W. Winter, 24 Dec. 1973.

Uperoleia martini Davies & Littlejohn, 1986
Trans. R. Soc. S. Aust. **110**: 129.
Paratypes: SAM R29648-50, 6 km NNE Yarram, Vic., M.J. Littlejohn and T.G. Littlejohn, 1 Dec. 1980; G.F. Watson and M.J. Littlejohn, 1 Oct. 1976.

Uperoleia micronieles Tyler, Davies & Martin, 1981
Aust. J. Zool., Suppl. (79): 46.
Holotype: SAM R17175, Tanami Desert, N.T. (28°38′S, 130°25′E), M. Gillam and I. Andrews, 18 Jan. 1978.
Paratypes: SAM R17176-78, 17221 (topotypes).

Uperoleia minula Davies, McDonald & Corben, 1986
Proc. R. Soc. Vict. **98**: 178.
Paratypes: SAM R29627, Lannercost S.F., Qld, K.R. McDonald and P. Minton, 16 Feb. 1984; SAM R29628-40, Townsville Common, Townsville, Qld, B.J. Lyon, 9 March 1977, C.J. Limpus, K.R. McDonald, 10 Feb. 1977, K.R. McDonald, 25 Nov. 1985; SAM R29641, Bazant Outstation, Lakefield Ntl Pk, K.R. McDonald and B.J. Lyon, 23 Feb. 1981; SAM R29642, Weipa, Qld, K.R. McDonald, 3 March 1981; SAM R29643, Bamaga, Qld, B.J. Lyon and C.J. Limpus, 14 Dec. 1976; SAM R29644-45, Battery Stn, nr

Snake Creek, Qld (19°27′S, 145°39′E), B.C. Lawrie, 3 Dec. 1981; SAM R29646, base of Bluewater Range, K.R. McDonald, 3 Oct. 1983; SAM R29647, L. Louisa, Qld (19°54′S, 144°15′E), S. Garnett, 18 Aug. 1984.

Uperoleia minima Tyler, Davies & Martin, 1981
Aust. J. Zool., Suppl. (79): 49.
Paratypes: SAM R17081, 17088–89, Amax Crusher Site, 5 km SW Mining Camp, Mitchell Plateau, W.A. (14°50′S, 125°50′E), M. Davies, A.A. Martin and M.J. Tyler, 31 Jan. 1978 (topotypes); SAM R17085–87, M. Davies, A.A. Martin and M.J. Tyler, 14–18 Feb. 1979 (topotypes).

Uperoleia talpa Tyler, Davies & Martin, 1981
Aust. J. Zool., Suppl. (79): 52.
Paratype: SAM R17174, 24–41 km S Derby, W.A., M. Davies, A.A. Martin and M.J. Tyler, 13 Feb. 1979.

Uperoleia trachyderma Tyler, Davies & Martin, 1981
Trans. R. Soc. S. Aust. **105**: 149.
Holotype: SAM R20374, George Redman Causeway, 37 km N Elliot, N.T. (17°14′S, 133°28′E), M. Davies, A.A. Martin and M.J. Tyler, 16 Dec. 1980.
Paratypes: SAM R20375–76 (topotypes).

Uperoleia tyleri Davies & Littlejohn, 1986
Trans. R. Soc. S. Aust. **110**: 132.
Paratypes: SAM R29653–58, Narrabarba, A.C.T., M.J. Littlejohn and G.F. Watson, 24 Sept. 1985; SAM R29659, Cape Conran, Vic., M.J. Littlejohn and G.F. Watson, 26 Sept. 1985; SAM R29652, 7 km ENE Marlo, Vic., H.C. Gerhardt, 27 Nov. 1981.

Uperoleia variegata Tyler, Davies & Martin, 1981
Aust. J. Zool., Suppl. (79): 55.
= *Uperoleia lithomoda vide* Tyler, Davies & Watson (1987)
Paratypes: SAM R17197–215, 17219, Gibb River Stn, W.A. (16°26′S, 126°26′E), A.K. Lee, 10 June 1965 (topotypes).

Family **Microhylidae**

Aphantophryne sabini Zweifel & Parker, 1989
Amer. Mus. Novit. (2954): 4.
Paratypes: SAM R33505–6, Myola Guest House, 2080 m, 7 km S, 6 km W Mt Bellamy, Northern Province, Papua New Guinea, F. Parker, R.G. Zweifel and L.T. Penny, 8 Aug. 1987.

Barygenys cheesmanae Parker, 1936
Ann. Mag. nat. Hist. **17**: 74.
Paratype: SAM R9423, Mt Tafa, New Guinea, L.E. Cheesman, Feb. 1934.

Barygenys maculata Menzies & Tyler, 1977
J. Zool. Lond. **183**: 447.
Paratype: SAM R14001, within 1 km of type locality: approx. 3 km NW Agaun, 1500 m, Milne Bay Province, Papua New Guinea, J.I. Menzies, 8 Nov. 1974.

Cophixalus concinnus Tyler, 1979
Copeia **1979**: 119.
Paratypes: SAM R16375–76, Thornton Peake, 1250 m, Qld (16°12′S, 145°20′E), J.W. Winter, 14 Nov. 1973.

Cophixalus crepitans Zweifel, 1985
Bull. Amer. Mus. nat. Hist. **182**: 315.
Paratypes: SAM R23873, Rocky Scrub, 28 km NE Coen, 520–540 m, Qld (13°44′30″S, 143°20′30″E), J.W. Winter and R.G. Atherton, 15 May 1978; SAM R23874, Rocky Scrub, 29 km NE Coen, 520–540 m, Qld (13°44′30″S, 143°21′30″E), J.W. Winter and R.G. Atherton, 16 Nov. 1978; SAM R23875, Weather Stn, 19 km ENE Mt Croll, Qld (13°42′30″S, 143°18′30″E), R.G. Atherton, K.R. McDonald, P.A. Mathew and J.W. Winter, 16 March 1979.

Cophixalus exiguus Zweifel & Parker, 1969
Amer. Mus. Novit. (2390): 2.
Holotype: SAM R10311, Mt Hartley, 1800–2000 ft, Qld, F. Parker, 10 June 1968.
Paratypes: SAM R9796, 10035–40 (same data as holotype). (R9723 transferred to Museum of Natural History, University of Kansas. Now KU 153146.)

Cophixalus infacetus Zweifel, 1985
Bull. Amer. Mus. nat. Hist. **182**: 324.
Paratypes: SAM R23872, Henrietta Creek, Palmerston Ntl Pk, 360 m, Qld, K.R. McDonald and R.G. Atherton, 11 Feb. 1977; SAM R24080, Palmerston Ntl Pk, Qld, K.R. McDonald, 16 Feb. 1977.

Copiula fistulans Menzies & Tyler, 1977
J. Zool., Lond. **183**: 435.
Holotype: SAM R14497, approx. 11 km N Lae, Papua New Guinea, J.I. Menzies, 24 Sept. 1973.
Paratypes: SAM R5879, 6382–83, 14239–50, 14646, Martyr's Memorial School, Agenahambo nr Popondetta, B.J. Brock, 7 Oct. 1964; SAM R9443–48 (same locality), B. Kirke, 15 Feb. 1968.

Copiula minor Menzies & Tyler, 1977
J. Zool., Lond. **183**: 441.

Paratype: SAM R15245, Oirdamawa's Peak, Goodenough Id, Milne Bay Province, Papua New Guinea, J.I. Menzies, 29 Dec. 1975.

Copiula pipiens Burton & Stocks, 1986
Trans. R. Soc. S. Aust. **110**: 155.
Holotype: SAM R29779, Wirui, 1 km from Wewak, Papua New Guinea (3°35′S, 143°35′E), R. Stocks, 29 March 1983.
Paratypes: SAM R29780–82, taken with the holotype.

Copiula tyleri Burton, 1990
Trans. R. Soc. S. Aust. **114**: 87.
Paratype: SAM R33774, Mt Hunstein, 1220 m (4°31′S, 142°39′E), East Sepik Province, Papua New Guinea, R. Hoogland, 15 July 1966.

Hylophorbus rufescens extimus Zweifel, 1972
Bull. Amer. Mus. nat. Hist. **148**: 454.
Paratype: SAM R25315, Mt Riu, Sudest Id, Louisiade Archipelago, Milne Bay District, Papua New Guinea, Fifth Archbold Expedition, 23 Aug.–5 Sept. 1956.

Hylophorbus rufescens myopicus Zweifel, 1972
Bull. Amer. Mus. nat. Hist. **148**: 455.
Paratype: SAM R12534, Kulumadau, Woodlark Id, Milne Bay District, Papua New Guinea, Fifth Archbold Expedition, 1–22 Nov. 1956.

Phrynomantis humicola humicola Zweifel, 1972
Bull. Amer. Mus. nat. Hist. **148**: 471.
Paratypes: SAM R25303–04, South slope, Kotuni, 7000–8000 ft, Eastern Highlands, Papua New Guinea, H.M. Van Deusen, Sixth Archbold Expedition, 18 Aug. 1959.

Phrynomantis infulata Zweifel, 1972
Bull. Amer. Mus. nat. Hist. **148**: 476.
= *Mantophryne infulata* (Zweifel), *vide* Burton (1986: 415).
Paratype: SAM R25312, Arau, 1400 m, Kratke Mts, Eastern Highlands District, Papua New Guinea, H.M. Van Deusen, 13 Oct.–8 Nov. 1959. (Formerly AMNH 66685.)

Phrynomantis personata Zweifel, 1972
Bull. Amer. Mus. nat. Hist. **148**: 489.
Paratypes: SAM R5888, Jama, East Sepik District, Papua New Guinea, W. Ewers, 18 Oct. 1964; SAM R25313, Lumi, Sepik Province, 1750 ft, M. Loram, July–Aug. 1966.

Sphenophryne adelphe Zweifel, 1985
Bull. Amer. Mus. nat. Hist. **182**: 280.
Holotype: SAM R17344, Back Jungle, Croker Id, N.T., I. Morris, 23 Jan. 1979.
Paratypes: SAM R17345–46 (same data as holotype).

Sphenophryne dentata Tyler & Menzies, 1971
Trans. R. Soc. S. Aust. **95**(2): 79.
Holotype: SAM R12063, Alotau, Milne Bay, New Guinea, J.I. Menzies, 11 Nov. 1970.
Paratypes: SAM R11819–20 (same data as holotype), J.I. Menzies, 6–12 Nov. 1970.

Xenobatrachus multisica Blum & Menzies, 1989
Alytes **7**(4): 150.
Paratypes: SAM R31822–23, Eipomale, Irian Jaya, 1800 m, J.P. Blum, April–June 1976.

Xenobatrachus subcroceus Menzies & Tyler, 1977
J. Zool., Lond. **183**: 450.
Paratype: SAM R14002, approx. 11 km N Lae, Papua New Guinea, J.I. Menzies, 9 March 1974.

Xenorhina parkerorum Zweifel, 1972
Bull. Amer. Mus. nat. Hist. **148**: 539.
Paratypes: SAM R6404–05, Okfekaman, nr Telefomin, West Sepik District, Papua New Guinea, 5500 ft, B. Craig, 29 Nov. 1964.

Xenorhina similis Zweifel, 1972
Bull. Amer. Mus. nat. Hist. **148**: 541.
Paratype: SAM R25311, L. Habbema, Papua New Guinea, W.B. Richardson, 9 Nov. 1938.

Family **Ranidae**

Cornufer ingeri Brown & Alcala, 1963
Copeia **1963**(4): 672.
– *Platymantis ingeri* (Brown & Alcala), *vide* Zweifel (1967: 120).
Paratypes: SAM R8808, Cantaub area, Bohol Id, Philippines, A.C. Alcala, 4 May 1962; SAM R13606, Dusita area, Bohol Id., Philippines, A. Alcala, 28 April 1961.

Platymantis akarithymus Brown & Tyler, 1968
Proc. biol. Soc. Wash. **81**: 76.
Holotype: SAM R7073, Pomogu, 11 km NW Kandrian, New Britain, M.J. Tyler, 31 Jan. 1966.
Paratypes: SAM R6982 (same data as holotype); SAM R7066, R7082, near Malassait, approx. 65 km W Rabaul, New Britain, M.J. Tyler, Jan. 1966.

Platymantis mimicus Brown & Tyler, 1968
Proc. biol. Soc. Wash. **81**: 74.
Holotype: SAM R6868, Numundo Plantation, Willaumez Peninsula, New Britain, M.J. Tyler, 19 Jan. 1966.
Paratypes: SAM R7064 (same data as holotype); SAM R7069, Pomugu 11 km NW Kandrian,

New Britain, M.J. Tyler, 29 Jan. 1966; SAM R6864, Gazelle Peninsula, New Britain, M.J. Tyler, 25 Jan. 1966.

Platymantis rhipiphalcus Brown & Tyler, 1968
Proc. biol. Soc. Wash. **81**: 77.
Holotype: SAM R7071, nr Pomogu, approx. 11 km NW Kandrian, New Britain, M.J. Tyler, 31 Jan. 1966.
Paratype: SAM R7078, San Remo Plantation, Willaumez Peninsula, New Britain, M.J. Tyler, 20 Jan. 1966.

Platymantis papuensis schmidti Brown & Tyler, 1968
Proc. biol. Soc. Wash. **81**: 85.
= *Platymantis schmidti* Brown & Tyler, *vide* Menzies (1982).
Holotype: SAM R7618, Talasea, Willaumez Peninsula, New Britain, M.J. Tyler, 11 Jan, 1966.
Paratypes: SAM R6762-68, 6772-93, 6795, 6801, 6803-07, 6809-13, 6815-16, 6858-60, 6862, 6869, 6912-13, 6915, 6922-28, 7061, 7070, 7080, 7085, 7088, 7089, 7093, 7095, 7097, 7101-04, 7106, 7109, 7115, Willaumez Peninsula, New Britain, M.J. Tyler, Jan. 1966; SAM R7615, 7617-23, 7625-37, 7639-47, 7649-74, 7677-78, Baining Ranges, Gazelle Peninsula, New Britain, M.J. Tyler, 11 Jan. 1966; SAM R7043, 7045, 7099, 7132, 7134-37, 7139, 7147-48, 7151, Kerevat, Gazelle Peninsula, New Britain, M.J. Tyler, Jan.-Feb. 1966. (R7616, 7638, 7648 transferred to Museum of Natural History, University of Kansas. Now KU 153147-49.)

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A REVIEW OF THE GENUS ISOPEDA L. KOCH (HETEROPODIDAE : ARANEAE) IN AUSTRALASIA WITH DESCRIPTIONS OF TWO NEW GENERA

D. B. Hirst

Summary

The genus Isopeda L. Koch is redefined. Holconia Thorell is reinstated. Type species of those genera are redescribed. Two new genera, Isopedella and Beregama are described and a valid taxon for each is selected as type species and redescribed. All nominal Australasian species are allocated to their respective genera and synonyms of type species noted. Three species are excluded from the above genera. A further four are considered nomina dubia. Distribution of the genera is discusssed briefly.

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The genus *Isopeda* L. Koch is redefined. *Holconia* Thorell is reinstated. Type species of those genera are redescribed. Two new genera, *Isopedella* and *Beregama* are described and a valid taxon for each is selected as type species and redescribed. All nominal Australasian species are allocated to their respective genera and synonyms of type species noted. Three species are excluded from the above genera. A further four are considered nomina dubia. Distribution of the genera is discussed briefly.

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The broad definition by Koch (1875) of the genus *Isopeda* has never been questioned. The similar appearance of included species combined with a lack of any detailed study of the genitalia and corresponding morphology resulted in a heterogeneous assembly of taxa and allowed the inclusion of *Holconia* Thorell by Hogg (1903) to be readily accepted. The present paper is a preliminary work on the genus *Isopeda* with the recognition as genera of four major species groups currently contained within it. It is the third part of a revision of the Australian Heteropodidae excluding *Heteropoda* Latreille, 1804, and provides clarification of the taxa included in the genus *Isopeda* in the interim, until species involved are revised.

L. Koch (1867) described *Ocypete vasta* and *Delena immanis*. Thorell (1870) described a new genus and species, *Voconia insignis*; and also the species *Heteropoda pessleri*. L. Koch (1875) added *V. dolosa* and transferred *Delena immanis* to *Voconia*. Koch also transferred *H. pessleri* and *O. vasta* to his new genus *Isopeda* selecting *vasta* as type species. Eight new species, *aurea, conspersa, cordata, flavibarbis, flavida, hirsuta, robusta* and *villosa* were also described. Thorell (1877) found *Voconia* pre-occupied and replaced that name with *Holconia*. Thorell (1881) described *Isopeda deianira, I. herculea* and *Holconia subdola*. Hogg (1896) described *I. horni* which he subsequently (Hogg, 1903) transferred to *Pediana* Simon, 1880. Hogg (1903) in his revision of the Australasian Heteropodidae synonymised *Holconia* with *Isopeda* and described eleven new species, *ardrossana, frenchi, leai, leishmanni, montana, pengellya, pococki, saundersi, tepperi, tietzi* and *woodwardi*. Strand (1907) described *I. maculigastra* and *I. vastata*. Simon (1908) described *cana, cerussata, nigrigularis* and *woodwardi*. As the latter was a homonym, the species was renamed *I. simoni* by Rainbow (1911). Strand (1911) described *I. terangana* and later Strand (1913) added *I. conspersula, I. immigrans, I. inola* and *I. herculeana*. Rainbow (1917) described *I. gloriosa*. Lastly Chrysanthus (1965) described *I. goliath* and *I. meraukensis*.

Thus, 41 nominal species are considered here from the Australasian region (Table 1) excluding *I. horni* which was previously (see above) transferred to *Pediana*. A further eight species outside this region are not considered in this review and it is likely that many, if not all, belong to other genera.

Materials and Methods

Only the nominated type species is treated for each genus. New synonymies and lists of material examined, other than for material mentioned here, will be given in revisions of the genera which are in preparation. Non-type material is used where types are unavailable and for drawings of the internal female genitalia, which are dissected and cleared in lactic acid. Setae are generally omitted from illustrations. Descriptive format follows Hirst (1989a, 1989b). Leg ratio is the leg length divided by carapace length. Other leg comparisons are made with those legs held together at right angles to the body. Descriptions of tibial apophysis shape are given from the retrolateral aspect. Median ocular quadrat (MOQ) measurements are abbreviated to aw (anterior width), pw (posterior width) and l (length). Measurements are given in millimetres. Localities are abbreviated as ACT, Australian Capital Territory; NSW, New South Wales; Q, Queensland; SA, South Australia; V, Victoria; WA, Western Australia. Further acronyms are AM, Australian Museum, Sydney; BMNH, British Museum (Natural History), London; NHMW,

TABLE 1.

Nominal species	Revised status, this work
Ocypete vasta L. Koch, 1867	= *Isopeda vasta* (L. Koch)
Delena immanis L. Koch, 1867	= *Holconia immanis* (L. Koch)
Voconia insignis Thorell, 1870	*Holconia insignis* (Thorell)
Heteropoda pessleri Thorell, 1870	= *Isopedella pessleri* (Thorell)
Voconia dolosa L. Koch, 1875	nomen dubium
Isopeda aurea L. Koch, 1875	= *Beregama aurea* (L. Koch)
Isopeda conspersa L. Koch, 1875	= *Isopedella conspersa* (L. Koch)
Isopeda cordata L. Koch, 1875	= *Beregama cordata* (L. Koch)
Isopeda flavibarbis L. Koch, 1875	= *Beregama aurea* (L. Koch)
Isopeda flavida L. Koch, 1875	= *Isopedella flavida* (L. Koch)
Isopeda hirsuta L. Koch, 1875	= *Holconia hirsuta* (L. Koch)
Isopeda robusta L. Koch, 1875	= nomen dubium
Isopeda villosa L. Koch, 1875	= *Isopeda villosa* L. Koch
Isopeda deianira Thorell, 1881	? *Olios deianira* (Thorell)
Isopeda herculea Thorell, 1881	= *Beregama herculea* (Thorell)
Holconia subdola Thorell, 1881	= *Holconia subdola* Thorell
Isopeda ardrossana Hogg, 1903	= *Isopedella ardrossana* (Hogg)
Isopeda frenchi Hogg, 1903	= *Isopedella frenchi* (Hogg)
Isopeda leai Hogg, 1903	= *Isopedella leai* (Hogg)
Isopeda leishmanni Hogg, 1903	= *Isopeda leishmanni* Hogg
Isopeda montana Hogg, 1903	= *Isopeda montana* Hogg
Isopeda pengellya Hogg, 1903	= *Isopeda pengellya* Hogg
Isopeda poracki Hogg, 1903	= nomen dubium
Isopeda saundersi Hogg, 1903	= *Isopedella saundersi* (Hogg)
Isopeda tepperi Hogg, 1903	= *Isopedella tepperi* (Hogg)
Isopeda tietzi Hogg, 1903	= *Isopedella tietzi* (Hogg)
Isopeda woodwardi Hogg, 1903	= *Isopeda woodwardi* Hogg
Isopeda maculigastra Strand, 1907	= *Isopedella maculigastra* (Strand)
Isopeda vastata Strand, 1907	= nomen dubium
Isopeda cana Simon, 1908	= *Isopedella cana* (Simon)
Isopeda cerussata Simon, 1908	= *Isopedella cerussata* (Simon)
Isopeda nigricularis Simon, 1908	= *Holconia nigricularis* (Simon)
Isopeda woodwardi Simon, 1908	= *Holconia simoni* (Rainbow, 1911)
Isopeda ceramana Strand, 1911	= *Isopedella ceramana* (Strand)
Isopeda conspersula Strand, 1913	= *Isopeda vasta* (L. Koch)
Isopeda immigrans Strand, 1913	= *Polybetes pythagoricus* Holmberg, 1874
Isopeda inota Strand, 1913	= *Isopedella inota* (Strand)
Isopeda herculeana Strand, 1913	*Beregama aurea* (L. Koch)
Isopeda gloriosa Rainbow, 1917	= *Delena gloriosa* (Rainbow) nov. comb.
Isopeda goliath Chrysanthus, 1965	= *Beregama goliath* (Chrysanthus)
Isopeda meraukensis Chrysanthus, 1965	= *Isopedella meraukensis* (Chrysanthus)

Naturhistorisches Museum, Wien, Austria; NHRM, Naturhistoriska Riksmuseet, Stockholm, Sweden; QM, Queensland Museum, Brisbane; SAMA, South Australian Museum, Adelaide; SMF, Natur-Museum Senckenburg, Frankfurt-am-Main, Germany; SMNS, Stadtliches Museum für Naturkunde, Stuttgart, Germany; ZMH, Zoologisches Museum, Hamburg, Germany.

Discussion of Diagnostic Morphological Features

The generic diagnosis given for *Isopeda* by Koch (1875) contained few characters or character combinations, which are found only in that genus. That diagnosis includes genera found in New Guinea which are not dealt with here. Apart from the reference to the flattish carapace it could equally include *Neosparassus* Hogg, 1903. Also characters used by early workers, leg spines, number of cheliceral teeth, and to some extent, eye position, have been found in this study to be either subject to bilateral variability or to variation. Sternum colour is useful at species level and will be dealt with fully in future revisions.

Although represented by two different genitalia forms, the congeneric relationship of the two species groups of *Pediana* was supported by other characters (Hirst, 1989b). However, the species groups of *Isopeda* (sensu lato) have conflicting character states in addition to those of the genitalia. Two 'outlying' groups are easily removed from *Isopeda* and raised to generic level. These are *Holconia* and *Beregama*. Using characters which enable reinstating the genus *Holconia* and erection of the new genus *Beregama*, a further new genus, *Isopedella*, can be removed from *Isopeda* leaving three minor species groups which feasibly belong in the latter genus.

Table 2 summarises the characters for each genus in cladistic form using apomorphic characters but without the aid of computer analysis. The embolus, conductor and embolar base, which is basically an extension of the tegulum, largely obscure the tegulum. The latter partly extends pro-distally into the distal half of the cymbium and except in *Holconia*, is ventrally modified to form a tegular apophysis. The ventral edge of the tegular apophysis of *Isopeda* (Fig. 3) is usually close to the embolar base and has a flattish posterior face. The tegular apophysis of *Isopedella* often has the ventral edge spaced further from the embolar base with the posterior face concave (Fig. 13). Also, the apophysis often extends further mesally. *Beregama* has a weakly modified or rounded tegular apophysis (Fig. 18). The tegulum of *Holconia* is not modified to form an apophysis, this being replaced by a subembolic apophysis at the junction of the tegulum and embolar base (Fig. 8).

Adjacent to the junction of the embolar base and the embolus proper a sclerite occurs in *Isopeda* (Fig. 1) which presumably has its homology in the median apophysis of *Pediana* (Hirst, 1989b), but as it is not truly representative of an apophysis it is here termed the embolic sclerite. The embolic sclerite is reduced in several species of *Isopeda* where it is paralleled by one species of *Holconia*. In other *Holconia* species and also *Beregama* the

TABLE 2. Summary of diagnostic characters.

Apomorphic character state	Beregama	Isopeda	Holconia	Isopedella
1 Tegular apophysis extends mesally				*
2 Tibial apophysis narrow doubly curved				*
3 Legs I and II subequal				*
4 2nd embolic coil larger than 3rd				*
5 Embolar base large retrolaterally				*
6 Leg spination relatively greater				*
7 Chelicerae never enlarged distally			*	*
8 Embolar base without granulations			*	*
9 Embolar base with mesal ridge			*	
10 Epigynal sclerite present			*	
11 Subembolic apophysis present			*	
12 Embolar flange mesal, short, low			*	
13 Spermathecal sacs shortish, curved			*	
14 Tibial apophysis lanceolate			*	
15 Tibial apophysis angled to venter		*		
16 Spermathecal sacs shortish, straight		*		
17 Epigynum narrow anteriorly, broad posteriorly		*		
18 Embolic sclerite adjacent granulate area		*		
19 Embolus constricted ¼ to ½ turn from tip		*	*	
20 Anterior eye spacings equal		*	*	
21 Carapace low, flattish above		*	*	
22 Recurved posterior eye row		*	*	
23 Spermathecal sacs not arced to anterior		*	*	*
24 Clypeus ½ diameter of AME or less		*	*	*
25 Embolar base connects embolus more proximally	*		*	
26 Embolic flange low prodistal or absent	*			*
27 AME-ALE width ½-¾ width of AME-AME	*			*
28 Spermathecal sacs, when present, tubular	*	*	*	*
29 Embolus in single stack of 6 to 15 coils	*	*	*	*
30 Conductor originates from retro-proximal	*	*	*	*
31 Fossa lacks setae	*	*	*	*
32 Fossa with sclerotised lateral rims	*	*	*	*
33 Conductor fills 'gap' left by last embolus coil	*	*	*	*

(The combination of characters 29–33 diagnose the above genera from other closely related Australian heteropodid genera.)

sclerite is recessed to unite with the embolus more proximally (Fig. 6) and is not distinct as a separate sclerite. The embolic sclerite is obscured or absent in *Isopedella*.

The embolar base is largest in *Isopedella* where it overhangs part of the embolus retrolaterally (Fig. 11). *Holconia* species have a reduced embolar base with a prominent mesal ridge (Fig. 6). The embolar base is least developed in *Beregama*. Small granulations (Fig. 1) are present on the embolar base of *Isopeda* and *Beregama*. Granulations are also found in *Neosparassus* (unpublished data). Their significance is unknown. One species of *Holconia*, which has the embolic sclerite similar to *Isopeda* (see above), has ridges on the embolar base apparently derived from the granulations but further discussion is withheld for a paper on *Holconia* (in prep.). A flange is present on the distal margin of the embolar base (Figs 1, 3) but absent or low in some species of *Isopedella* and *Beregama*. A low, short flange in *Holconia* is positioned more mesally having been displaced by the subembolic apophysis.

The embolus rises from the embolar base and tegulum retro-distally, arcing around the tegulum proximally before continuing prolaterally into the distal half of the cymbium. Here the embolus forms a single conical stack of six to fifteen coils. The conductor originates within the embolar base and emerges proximally, running adjacent to the inner side of the embolus prolaterally then under the first coil of the embolar stack. Here it spirals tightly in cylindrical form, with the number of turns somewhat corresponding to that of the embolus, before expanding to fill the gap left by the last embolar coil and supporting the embolus tip. The embolus tapers gradually to the tip in *Isopedella* and *Beregama* but is often constricted ½ to ¼ turn from the tip in *Isopeda* (Fig. 1) and some *Holconia*. In all genera except *Isopedella* the first and second embolic coils are smaller than the third and the first coil is not easily seen in ventral view.

The distal retrolateral tibial apophysis is subequal in length to the tibia and supported by a mesal membranous thickening attached to the base which in *Holconia* and some *Isopeda* forms a smooth,

somewhat continuous line with the apophysis. In *Isopeda* the tibial apophysis turns towards the venter above the base and is angular in shape (Fig. 2). It is laterally flattened and often serrated on its dorsal edge. *Isopedella* has a more rounded tibial apophysis narrower at the base and gradually tapered with an additional forward curve (Figs 11-12). *Holconia* has a lanceolate shaped apophysis (Fig. 7), somewhat laterally flattened and directed to the anterior. The relatively shorter tibial apophysis in *Beregama* is straight or more usually, curved much as in *Isopedella*, but then broader midlength (Fig. 17) or, throughout.

The lateral rim and fossa of the epigynum lack setae. The large fossa is overhung laterally by a sclerotised rim which is narrowly divided anteriorly. The rim is relatively flat and the fossa not deeply recessed except in *B. aurea*, in which the rim slopes steeply towards a sunken fossa. The broader posterior margin (narrower in some *Beregama*) turns mesally against the epigastric furrow. *Isopeda* has an ovoid shaped epigynum (Fig. 4) often with the fossa bulged at the anterior margin, that of *Isopedella* is somewhat narrower, bell-shaped or ovate (Fig. 14). The epigynum of *Holconia* is bell-shaped (Fig. 9), or in one species rounded, but in both cases, broader anteriorly than other genera except *H. immanis* in which the epigynum may be relatively smaller. *Beregama* species have a rounded or horseshoe shaped epigynum accentuated by the continuation of sclerotisation across the anterior margin except *B. aurea* which has a bell-shaped epigynum (Fig. 19). A sclerite, termed the epigynal sclerite, on the postero-lateral corner of the epigynum extends partly over the fossa in *Holconia* (Figs 9-10).

Internally the vulva comprises paired insemination ducts coiled around central spermathecal ducts which lead back adjacent to anterior part of fossa. Here there are usually tubular spermathecal sacs, extending medially under fossa, moderately long to short and occasionally 'elbow-like' in *Isopeda* (Fig. 5), shortish and curved in *Holconia* (fig. 10), long and arced forward to the anterior in *Beregama* (Fig. 20) but absent (Fig. 15) or 'elbow-like' in *Isopedella*. The spermathecae loop to anterior of fossa then continue under the sclerotised rim as fertilization ducts to posterior of epigynum.

Relative lengths of anterior legs vary both intraspecifically and from bilateral variability, but in most *Isopeda* and *Holconia* leg II is much longer than leg I with the latter reaching about mid-length along metatarsus II or at least not reaching the distal end of the metatarsus. *Beregama* generally have leg I reaching almost to, or to the distal end of metatarsus II while leg I of *Isopedella* reaches beyond metatarsus II to mid-length of tarsus II. *Isopedella* females have relatively shorter legs than females of other genera. Spination of legs is lowest in some *Isopeda* and greatest in *Isopedella*.

The carapace is generally low and flattish in *Isopeda* and *Holconia* but higher and convex in *Isopedella* and *Beregama*. The clypeus width of *Beregama* is often subequal to the diameter of an AME but half the width or less of an AME in other genera. Anterior eye spacings are rather equal in *Isopeda* and *Holconia*, subequal in *Beregama* while *Isopedella* have the AME-ALE width about half that between the AME. A line drawn behind the posterior eye row is slightly to distinctly recurved in *Isopeda* and *Holconia* but relatively straight in the other genera. Males of *Isopeda* and *Beregama* often have the chelicerae retro-distally elongated with the distal tooth largest, angled more anteriorly and well spaced from the subdistal tooth and fang base. The remaining genera lack modified chelicerae and the distal retromarginal tooth is usually smaller than the subdistal tooth.

The dorsal pattern of the abdomen is relatively constant in each genus. *Isopeda* usually have three or four pairs of blackish spots with the middle pairs elongated and often joined. Juveniles of some species have pairs of spots which are often lacking in adults. *Isopedella* may be similar to *Isopeda* but with usually two unjoined pairs of spots. This may be supplemented or replaced by a posterior folium, or by irregular spots formed by clusters of brownish setae. *Holconia* has a pattern of large brownish patches and often a yellow-brown or black anterior streak. Two or three pairs of spots may be present. *Beregama* is without a well defined pattern except for a folium in *B. cordata*.

The genera *Isopeda* and *Beregama* appear to contain relict species. *Beregama* is closely related to *Typostola* and *Zachria*. It has likely evolved from that stock rather than from within *Isopeda*. This is supported by the female spermathecae shape, the recessed fossa of *B. aurea* and by two unnamed species of uncertain generic placement having a male palp structure intermediate between *Typostola* and *Beregama* (unpubl. data). *Isopeda* is considered to have given rise to the more derived genera, *Isopedella* and *Holconia* following xeric events. These derived genera have successfully invaded the arid areas of Australia. The genera are not known to occur in Tasmania while *Beregama* and *Isopedella* are found in New Guinea.

Key to the Genera Previously Included in *Isopeda*

1 — Carapace flattened, or low and flattish medially. Anterior eyes equally spaced 2
— Carapace convex. Anterior eyes not equally spaced 3

2 — Dorsal abdomen with 3 or 4 pairs of blackish spots, occasionally indistinct but usually without additional pattern. Male palpal tibial apophysis angled towards venter from above base and angular in shape (Fig. 2). Embolic sclerite present with adjacent granulated area on embolar base. Female epigynum ovoid, fossa narrow anteriorly, usually at least twice as broad posteriorly (Fig. 4). Spermathecal sacs shortish and straight but may be 'elbow-like' (Fig. 5). ..... *Isopeda* L. Koch

— Dorsal abdomen with large dark brown or blackish patches in addition to 2 or 3 pairs of indistinct spots. Male palpal tibial apophysis lanceolate, anteriorly directed (Fig. 7). Subembolic apophysis between tegulum and embolar base (Fig. 8), tegular apophysis absent. Female with epigynal sclerite (Fig. 9). Spermathecal sacs shortish, usually curved (Fig. 10). ..... *Holconia* Thorell

3 — Clypeus less than half width of AME. Male palpal tibial apophysis narrow, doubly curved, gradually tapered (Fig. 12). Embolar base broad, produced over embolus retrolaterally. Tegular apophysis extended distally and mesally usually with concave posterior face. Female epigynum relatively narrow, bell-shaped or ovate (Fig. 14). Spermathecal sacs absent (Fig. 15), rarely 'elbow-like'. ..... *Isopedella* gen. nov.

— Clypeus greater than half width of AME. Male palpal tibial apophysis straight and thin or doubly curved and, at least, broadest mid-length (Fig. 17). Tegular apophysis reduced or obscured. Female epigynum heavily sclerotised anteriorly, horse-shoe shaped of with broadly rounded posterior corners (Fig. 19) and fossa recessed. Spermathecal sacs long, curved to anterior (Fig. 20). . *Beregama* gen. nov.

Isopeda L. Koch

Isopeda L. Koch, 1875: 678.
Isopoda: Thorell, 1881: 293.

Type species:
Ocypete vasta L. Koch, 1867 by original designation.

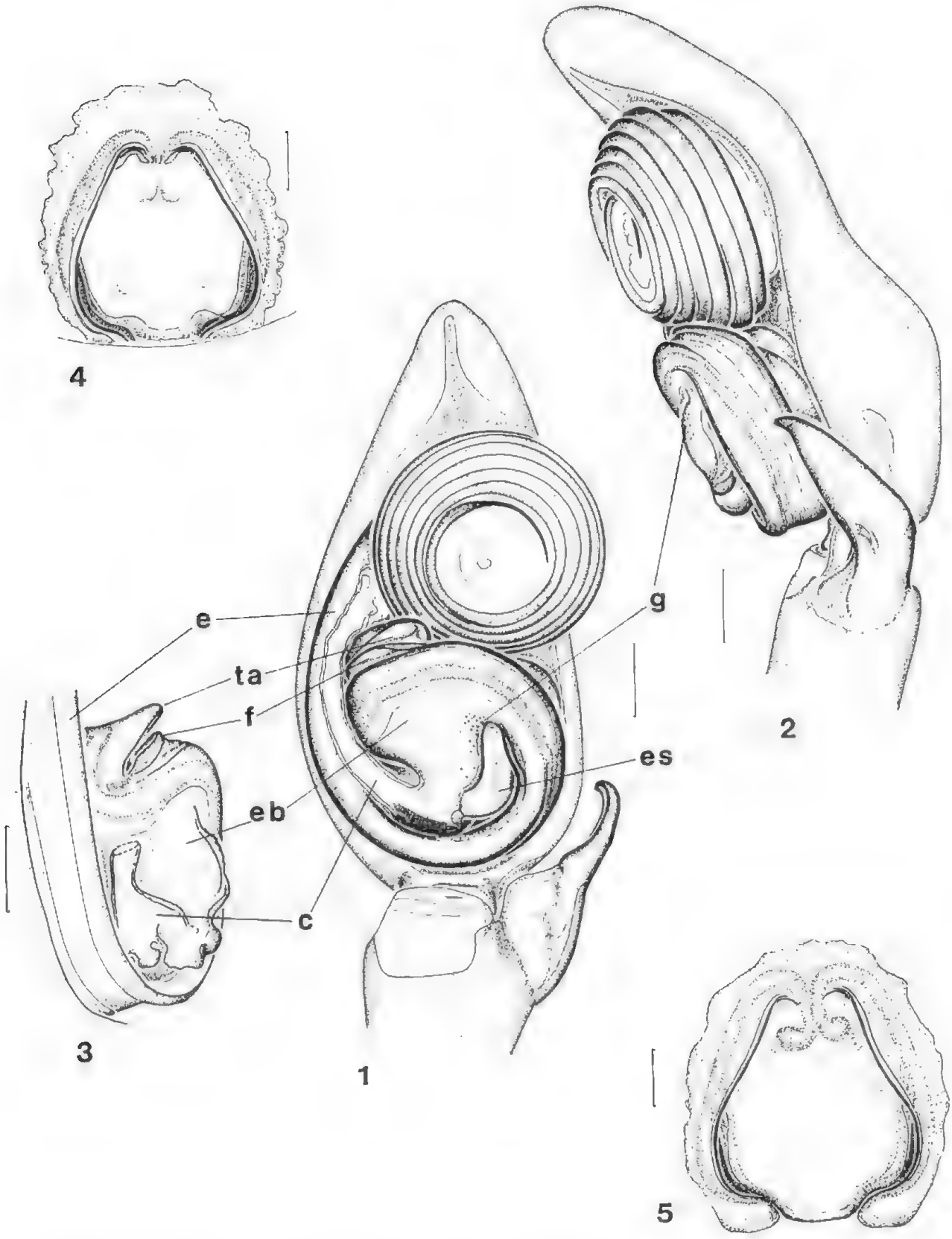
Diagnosis
Male palpal tibial apophysis angled towards venter above base and angular in shape, often serrated on dorsal edge. Female fossa anteriorly narrow, usually at least twice as broad posteriorly. Spermathecal sacs moderately long to short or 'elbow-like'.

Description
Carapace low, flattish medially to very flattened, length equals 4.5–8 times height. Anterior eyes rather equally spaced. Distance between PME subequal or greater than between PME-PLE. Line drawn behind posterior eyes recurved, rarely straight. Clypeus about half diameter or less of AME. Chelicerae may be ovoid, glabrous with some short blunt or swollen-tipped setae, or with relatively straight retrolateral side and long tapered setae. In the latter case the male may have chelicerae modified, extended retro-distally with distal tooth often angled to anterior, large and well spaced from others. Leg I, when outstretched alongside leg II, reaches from mid-length of metatarsus II to towards distal end of metatarsus. Distal margin of coxa I occasionally with a comb-like arrangement of short blunt-tipped setae. Palp femur and coxa I may have ventral stout bristles. Abdomen usually marked dorsally with four pairs of black spots, median pairs joined or narrowly separated. Male palpal tibia with large, often broad, laterally flattened retrolateral apophysis angled towards venter just above base, angular in shape, dorsal edge often serrated. Embolus coiled seven to eleven times, constricted ¼ to ½ turn from tip. Embolar base with large distal flange. Embolic sclerite large and prominent or smallish and partly overhung by the granulate area of the embolar base. Tegular apophysis with flattish posterior face, ventral edge extending to adjacent flange on embolar base. Female epigynum ovoid, lateral rims often relatively straight, diverging gradually from narrow emarginate and occasionally bulged anterior, usually at least twice as broad posteriorly. Fossa usually well separated from lateral rim at concave posterior corners. Spermathecal sacs moderately long, relatively straight to short and 'elbow' shaped, rarely absent, most often shortish.

Species included
Isopeda leishmanni Hogg, 1903, *I. montana* Hogg, 1903, *I. pengellya* Hogg, 1903, *I. vasta* (L. Koch, 1867), *I. villosa* L. Koch, 1875 and *I. woodwardi* Hogg, 1903. Several unnamed species are known. Distribution of *Isopeda* is from south-eastern Queensland along the east coast to south-eastern SA and south-western WA. It is found inland in areas with over 400 mm annual rainfall in NSW and V. Two species may be relict with one confined to alpine areas of V and NSW, the other to the Lamington Plateau in Q.

Isopeda vasta (L. Koch)
(Figs. 1–5, Table 3)

Ocypete vasta L. Koch, 1867: 207. Koch described a female from Brisbane Q., deposited in NHMW. One female (Nr 1882,II,6), examined, in the collection of NHMW, was apparently brought from the Godeffroy Museum, Hamburg, as was the holotype. Although not labelled as type, its measurements are nearer to that of the holotype as stated by Koch (1867) than the following 'syntypes' in regard to leg lengths and if the carapace length is taken to include the forward extension of the chelicerae.



FIGURES 1-5. *Isopeda vasta* (L. Koch). 1-2, left palpal tibia and tarsus of male QM S15567: 1, ventral; 2, retrolateral. 3, tegular apophysis and embolar base, prolateral, distal part of conductor not drawn. 4, epigynum of female NHMW 1882.II.6. 5, vulva of female QM S15568, ventral. Scale lines 0.5 mm. c, conductor; e, embolus; eb, embolar base; es, embolic sclerite; f, flange; g, granulations; ta, tegular apophysis.

Isopeda vasta: L. Koch, 1875: 679. Two females labelled 'Syntypes', Brisbane, Queensland, ZMH (Mus. Godeffroy Nr 298a and Nr 10299), examined, probably formed the basis of Koch's redescription in 1875, and the syntype designation is invalid. A male described by Koch (1875) has not been located. It also is not a valid type.
Isopeda conspersula Strand, 1913: 610. Holotype ♀, Queensland, SMF 4644, examined. **New synonymy.**

Female NHMW 1882.11.6
CL 9.2, CW 8.6, AL 13.5, AW 10.7.

Colour in alcohol: Carapace orange-red, caput reddish. Chelicerae red, darker retrolaterally. Anterior legs with orange-red femora and patellae, distal segments reddish, posterior pairs yellow-orange. Femur I with basal prolateral blackish patch. Coxae yellowish. Maxillae and labium red-brown, maxillae with blackish retromargin. Sternum red-brown, long yellow-brown setae. Abdomen creamish-grey, with brown setae forming 2 pairs of spots. Venter yellowish with thin transverse patch of brown setae posterior to epigastric groove. Carapace: low, sides rounded, flattish above. Eyes: AME 0.54. AME: ALE: PME: PLE = 1: 1.22: 0.66: 0.98. Interspaces: AME-AME 0.66, AME-ALE 0.70, PME-PME 1.85, PME-PLE 1.89, AME-PME 0.96, ALE-PLE 1.19. MOQ, aw: pw: l = 2.69: 3.19: 2.67. Width of clypeus 0.55. Chelicerae glabrous, geniculate at base, swollen on retrolateral side. Some short blunt-tipped setae near base, promargin and around fang base. Retrolateral teeth 4, proximal tooth small, others sub-equal, closely spaced. Sternum L 4.6, W 3.8. Legs: (Table 3) Leg II longer than leg I, ratios 3.9, 3.5 respectively. Trochanter I apically with short setae (*ca* 0.4) resembling a comb. Spination: Legs I and II, fe d2 p3 r3, pa p1 r1, ti d2 p2 r2 v6, me p2 r2 v4. Leg III, same, but ti d1. Leg IV, fe d2 p3 r1, pa p1, ti p2 r1 v6, me p4 r4 v4, Palp, fe d1 + 4 apically in transverse row, pa p1 r1, ti d1 p3 r2, ta p3 r2. Epigynum: (Figs 4–5) Lateral rim narrowly rounded anteriorly then diverging to near posterior before curving mesally. Anterior part of fossa emarginate, raised. Spermathecal sacs of QM S15568 (Browns Plains, Q) 'elbow-like'.

Male QM S15567 (Boondall, Q.) as female except as follows:
CL 8.8, CW 8.2, AL 9.2, AW 6.4.

Colour in alcohol: Carapace and legs yellow-brown. Maxillae and labium brown. Sternum brown. Abdomen yellow-brown with brown anterior streak. Eyes: AME 0.58. AME: ALE: PME: PLE = 1: 1.03: 0.66: 0.96. Interspaces: AME-AME 0.52, AME-ALE 0.52, PME-PME 1.52, PME-PLE 1.38, AME-PME 0.69, ALE-PLE 0.79. MOQ, aw: pw: l = 2.41: 2.79: 2.21. Width of clypeus 0.45. Chelicerae glabrous, geniculate. Few short blunt-ended setae around fang base. Retromargin of fang groove with 5 teeth, distal tooth barely larger than subdistal tooth. Sternum L 4.6, W 3.9. Legs: (Table 3) Leg II longer than leg I, ratios 5.1, 4.3 respectively. Trochanter of leg I apically with comb of short setae (*ca* 0.3). Spination: Leg IV, ti d1 r0 (on left), me r2 (3 on left) v4. Palp, ti r1. Palp: (Figs 1–3) Tibial apophysis equal in length to tibia. Broad at base, angled towards venter just above base, angular in form to apex, laterally flattened, serrated on dorsal edge. Embolus with 7½ coils, sharply constricted then thinly tapered for the final half turn to tip. Embolar base with elongate embolic sclerite, adjacent to which are numerous granules. Tegular apophysis with well defined ridge, almost touching flange on embolar base for part of its length.

Distribution
I. vasta occurs in south-east Queensland and north-east NSW.

Holconia Thorell

Voconia Thorell, 1870: 382.
Holconia Thorell, 1877: 485 (nom. nov. for *Voconia*; preoccupied).
Isopeda: Hogg, 1903: 429.

Type species
Voconia insignis Thorell, 1870 by original designation and monotypy.

Diagnosis
Male palpal bulb with subembolic apophysis

TABLE 3. Leg measurements of *Isopeda vasta* (L. Koch), female NHMW 1882.11.6 with male QM S15567 in parentheses.

Leg	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	9.0 (10.5)	4.7 (4.5)	7.7 (10.0)	8.4 (10.3)	2.6 (2.8)	32.4 (38.1)
II	10.3 (12.6)	5.0 (5.0)	9.0 (12.3)	9.2 (11.9)	2.6 (3.0)	36.1 (44.8)
III	7.6 (9.3)	3.5 (3.8)	6.0 (8.4)	5.8 (7.4)	2.2 (2.1)	25.1 (31.0)
IV	8.0 (9.7)	3.3 (3.5)	6.3 (8.0)	6.8 (8.7)	2.3 (2.3)	26.7 (32.2)
Pa	3.2 (3.2)	1.6 (1.5)	1.9 (1.5)	— —		
					3.6 (4.3)	10.3 (10.5)

between tegulum and embolar base. Tegular apophysis absent. Female epigynum broad with postero-lateral convex epigynal sclerite extending partly over fossa. Spermathecal sacs shortish, curved.

Description

Carapace low, flattened, length equals 6–8 times height, often with a pattern. Anterior eyes equally spaced. Distance between PME subequal to greater than that between PME-PLE. PME almost half of ALE, low. Line drawn behind posterior eye row is recurved. Narrow clypeus about ⅓ to less than ½ diameter of AME. Chelicerae of male unmodified, 4–5 retromargin teeth closely spaced, distal tooth subequal to subdistal tooth except in *H. immanis*. Leg I, when outstretched alongside leg II, reaches from midway along metatarsus II to towards distal end of metatarsus. Abdomen flattened dorso-ventrally often with mottled dorsal pattern of large brownish-black patches and occasionally two or three pairs of blackish spots. Male palpal tibial apophysis equal in length to tibia, directed anteriorly, lanceolate with short curved apex. Subembolic apophysis on embolar base adjacent its junction with tegulum. Tegular apophysis absent. Short, low flange on embolar base displaced mesally by subembolic apophysis. Embolar base small with mesal ridge. Embolic sclerite modified, recessed and connecting to embolus except in *H. nigrigularis*. Embolus coiled seven to eleven times, often slightly constricted ½ turn from tip. Female epigynum with postero-lateral epigynal sclerite extending partly over fossa. Fossa somewhat truncate posteriorly. Spermathecal sacs shortish, curved.

Species included

Holconia hirsuta (L. Koch, 1875), *H. insignis* (Thorell, 1870), *H. immanis* (L. Koch, 1867), *H. nigrigularis* (Simon, 1908), *H. simoni* (Rainbow, 1911) and *H. subdola* Thorell, 1881. Undescribed species are known. Distribution is over much of the Australian mainland. Where they occur in more xeric or arid areas they are usually found on large trees or along watercourses.

Holconia insignis (Thorell)
(Figs 6–10, Table 4)

Voconia insignis Thorell, 1870: 383. Syntypes ♂ and ♀, Australia. NHRM (Thorell collection), examined.
Holconia insignis: Thorell, 1877: 485.
Isopeda insignis: Hogg, 1903, 432.

Syntype female

CL 14.3, CW 13.8, AL 22.5, AW 14.5.

Colour in alcohol: Carapace grey-brown with brown-black markings. Chelicerae brown-black. Maxillae and labium blackish. Sternum brown. Legs dark brown with white and black patches on venter of patellae and tibiae. Abdomen greyish with darker markings and an anterior median streak of pale brown. Carapace: low, flattish, slightly concave anterior of fovea; thinly covered with short setae, long bristles on lateral edges and anterior half of caput. Eyes: AME 0.7. AME: ALE: PME: PLE = 1: 1.28: 0.71: 1.00. Interspaces: AME-AME 0.57, AME-ALE 0.71, PME-PME 1.71, PME-PLE 2.14, AME-PME 1.00, ALE-PLE 1.43. MOQ, aw: pw: l = 2.86: 3.14: 3.40. Width of clypeus 0.40. Chelicerae: retrolateral teeth 5. Sternum L 7.8, W 6.1. Legs: (Table 4) leg II longer than leg I, ratios 4.6, 3.9 respectively. Spination: Leg I, fe d2 p3 (1 on left) r3, pa pl r1, ti d2 p2 r2 v4, me p2 r2 v4. Leg II, fe d2 p3 r3, pa pl r1, ti d2 (0 on left) p2 r2 v6, me p2 r2 v4. Leg III, fe d2 p3 r2 (1 on left), pa pl r1, ti p2 r2 v6, me p2 r2 v6. Leg IV, fe d2 p3 r1, ti pl (0 on left) v6, me p4 r2 v4. Palp, fe d1 + 4 apically in transverse row, pa pl r1, ti d1 p2 r2, ta p3 r2. Abdomen: flattened dorso-ventrally, broad. Epigynum: (Figs 9–10) Convex epigynal sclerite extending from lateral rim posteriorly. Fossa with humps in posterior half, somewhat truncate posteriorly. Vulva of SAMA NJ988520 (Eidsvold, Q) with shortish, curved spermathecal sacs.

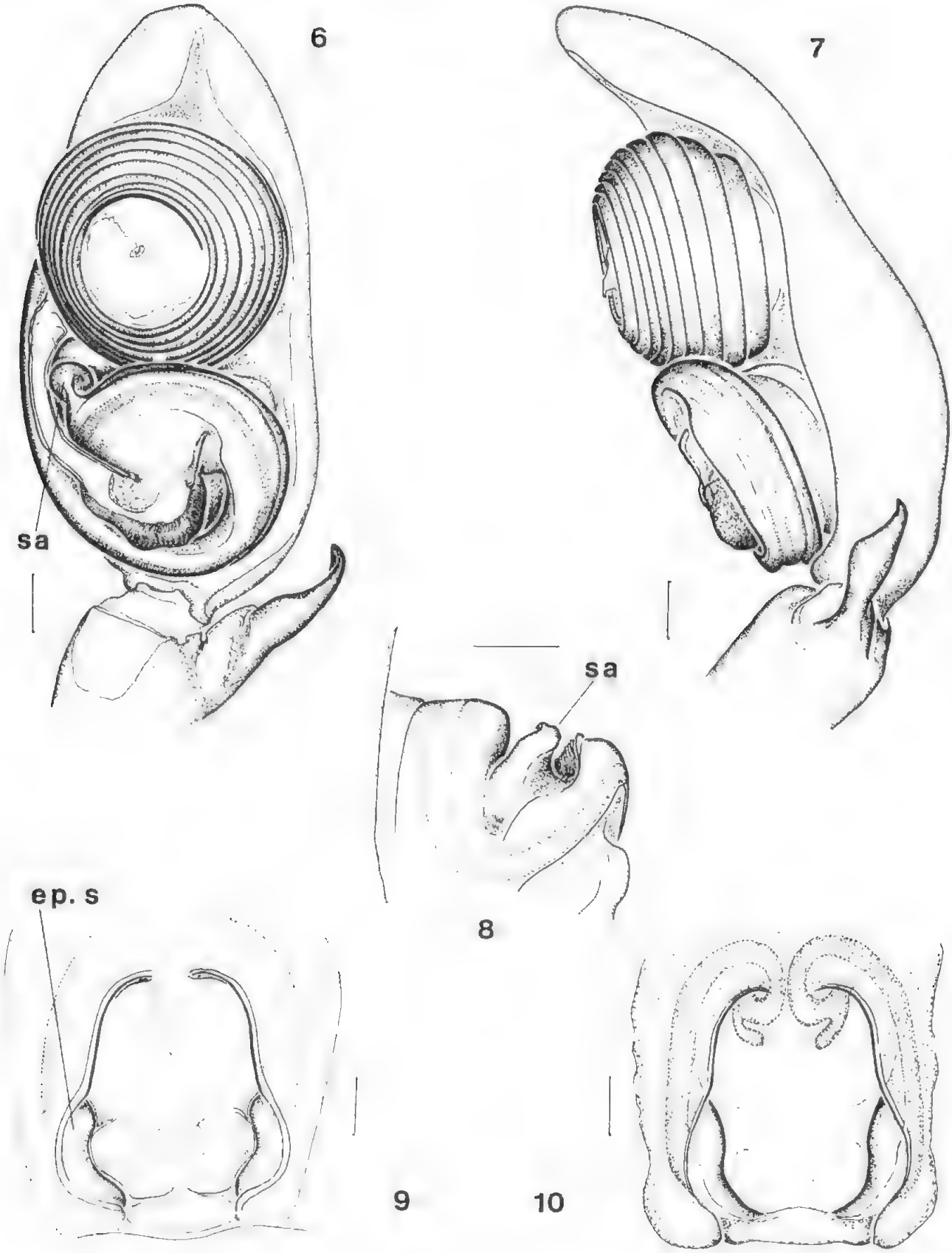
Syntype male as female except as follows:

CL 11.0, CW 10.9, AL 11.0, AW 8.2.

Eyes: AME 0.8, AME: ALE: PME: PLE = 1: 1.13: 0.63: 0.89. Interspaces: AME-AME 0.25, AME-ALE 0.25, PME-PME 1.25, PME-PLE 1.25.

TABLE 4 Leg measurements of *Holconia insignis* (Thorell), syntype female with syntype male in parentheses.

Leg	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	14.5 (15.9)	7.7 (6.9)	14.4 (15.0)	16.0 (16.6)	3.6 (3.7)	56.2 (58.1)
II	17.6 (18.9)	8.3 (7.5)	18.0 (19.8)	18.6 (19.2)	3.6 (3.7)	66.1 (66.1)
III	13.0 (13.3)	6.0 (5.3)	12.0 (11.9)	11.2 (11.2)	2.9 (3.0)	45.1 (44.7)
IV	13.8 (13.4)	5.7 (4.8)	12.0 (12.1)	12.2 (12.3)	3.1 (3.4)	46.8 (45.7)
Pa	5.0 (4.4)	2.5 (2.0)	2.8 (2.2)	— —	5.0 (6.0)	15.3 (14.6)



FIGURES 6–10. *Holconia insignis* (Thorell). 6–7, right palpal tibia and tarsus of syntype male (reversed drawing): 6, ventral; 7, retrolateral. 8, subembolic apophysis, prolateral, SAMA N1988522, embolus and conductor removed. 9, epigynum of syntype female. 10, vulva of female SAMA N1988520, ventral. Scale lines 0.5 mm. sa, subembolic apophysis; ep. s, epigynal sclerite.

AME-PME 0.75, ALE-PLE 1.00. MOQ, aw: pw: l = 2.13: 2.44: 2.25. Width of clypeus 0.25. Sternum L 6.2, W 5.0. Legs: (Table 4) leg II longer than leg I, ratios 6.0, 5.3 respectively. Spination: Leg I, fe p1, Leg III, fe r1, Leg IV, fe p2, ti p2, r1 on left, me r3. Palp, ti r1, ta 0. Palp: (Figs 6–7) Left palp abnormal, stunted. Tibial apophysis equal in length to tibia, lanceolate, laterally flattened, apex curved mesally. Embolus with 9½ coils, weakly constricted ½ turn from tip. Embolar base with short low flange mid-distal position. Subembolic apophysis at junction of tegulum and embolar base (Fig. 8 shows the prolateral aspect of the apophysis of SAMA N1988522, Pilliga Scrub, NSW).

Distribution

H. insignis occurs in south-east Queensland and eastern NSW.

Isopedella gen. nov.

Diagnosis

Male with doubly curved palpal tibial apophysis gradually tapered. Broad embolar base partly projecting over embolus retrolaterally. Female with somewhat narrow epigynum not much broader posteriorly. Spermathecal sacs absent but may be represented by short 'elbows'.

Description

Carapace convex, length equals 3–4 times height. Distance between AME-ALE about half that between AME. Distance between PME subequal to that between PME-PLE. Line drawn behind posterior eyes barely recurved to straight. Clypeus about half diameter of AME or less. Chelicerae of male unmodified, retromargin teeth closely spaced, relatively close to fang base, distal tooth subequal to subdistal tooth. Leg I subequal in length to leg II, leg I of female about 3½ times carapace length or less. Abdomen rounded with 2–3 pairs of black spots, with or without a posterior folium or with pairs of spots indistinct and whitish patches combined with a folium or with scattered brown spots. Venter usually with narrow to broad transverse band of black setae posterior to epigastric furrow. Male palpal tibia with gradually tapered, somewhat rounded retrolateral apophysis angled to venter near base before turning again to point anteriorly, curving again near apex. Embolus coiled six to nine times, gradually tapered to tip, second coil larger than third, first coil easily seen in ventral view. Embolar base broad, projecting over embolus on retrolateral side, ridge and granulations absent. Occasionally with short pro-distal flange on embolar base. Embolic sclerite absent or small and obscured by embolar base. Tegular apophysis large, ventral edge extended distally and mesally, usually with concave posterior face, most often well separated from embolar base. Epigynum relatively narrow, bell-shaped or ovate, broadest posteriorly. Area between fossa and lateral rim concave at posterior corner. Fossa may have humps, pigmentation and granulate area posteriorly. Spermathecal sacs usually absent, rarely represented as short 'elbows'.

Type species

Heteropoda pessleri Thorell, 1870.

Etymology

Isopedella refers to the generally smaller proportions of the species compared to their counterparts in *Isopeda*.

Species included

Isopedella pessleri (Thorell, 1870), *I. ardrossana (Hogg, 1903)*, *I. cana* (Simon, 1908), *I. cerussata* (Simon, 1908), *I. conspersa* (L. Koch, 1875), *I. flavida* (L. Koch, 1875), *I. frenchi* (Hogg, 1903), *I. inola* (Strand, 1913), *I. leai* (Hogg, 1903), *I. maculigastra* (Strand, 1907), *I. meraukensis* (Chrysanthus, 1965), *I. tepperi* (Hogg, 1903), *I. tietzi* (Hogg, 1903), *I. saundersi* (Hogg, 1903) and *I. terangana* (Strand, 1911). Several unnamed species are known and many synonymies are likely. The genus is widespread over the Australian mainland and parts of New Guinea. Most species frequent areas of low trees or mallee scrub.

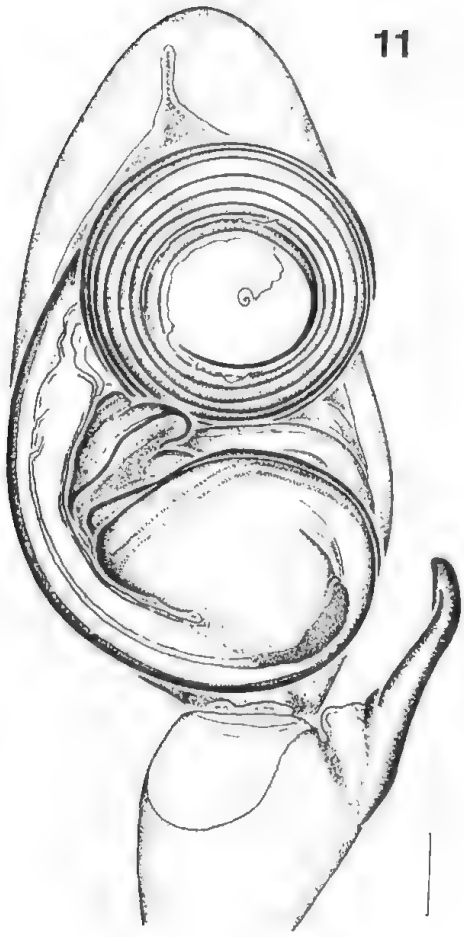
Isopedella pessleri (Thorell)
(Figs 11–15, Table 5)

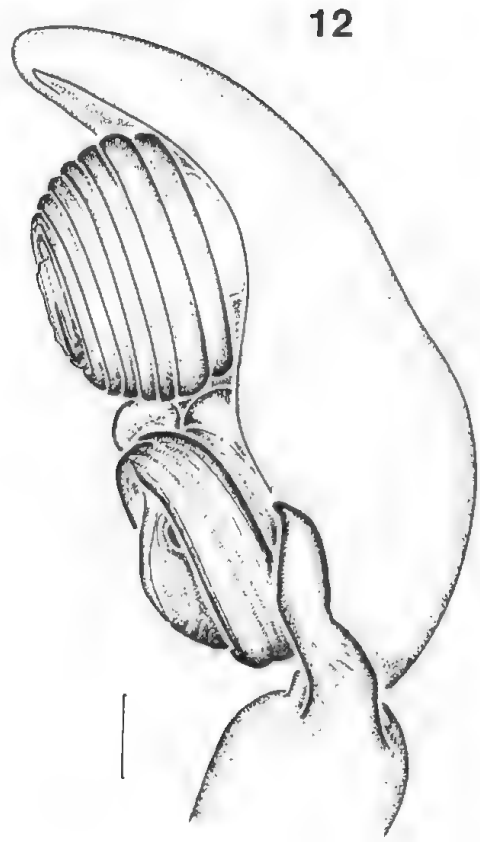
Heteropoda pessleri Thorell, 1870: 387. Holotype ♀, Australia, NHRM 1209 (Thorell Collection), examined.
Isopeda pessleri: L. Koch, 1875: 679.

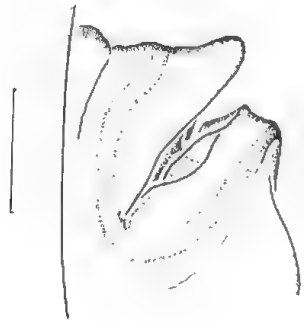
Holotype female

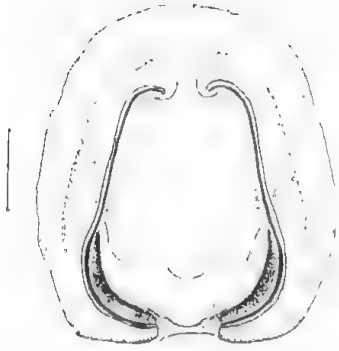
CL 9.0, CW 8.8, AL 9.8, AW 7.8.

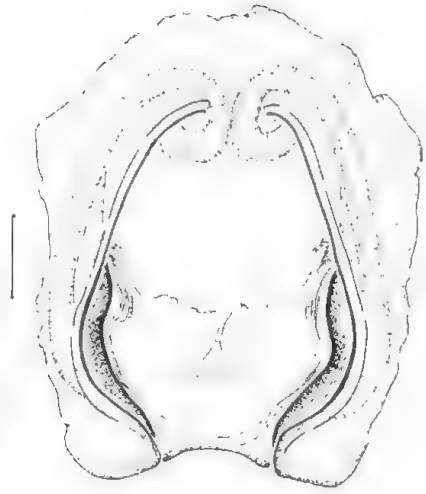
Colour in alcohol: Carapace and appendages red-brown. Sternum with thick covering of long black setae. Coxae with long black setae on basal half. Abdomen grey-brown with two pairs of black spots. Venter yellow-brown with narrow transverse band of black setae behind epigastric furrow. Carapace: moderately high, convex, covered with short setae, whitish-grey in ocular region. Eyes: AME = 0.6. AME: ALE: PME: PLE = 1: 1.16: 0.75: 1.00. Interspaces: AME-AME 0.50, AME-ALE 0.42, PME-PME 1.50, PME-PLE 1.66, AME-PME 0.91, ALE-PLE 1.15. MOQ, aw: pw: l = 2.50: 3.00: 2.50. Width of clypeus 0.50. Chelicerae: Long pointed setae around fang base. Retrolateral teeth 5, rather











FIGURES 11-15. *Isopedella pesslerí* (Thorell). 11-12, right palpal tibia and tarsus of male SAMA N1989111 (reversed drawing): 11, ventral; 12, retrolateral. 13, tegular apophysis, prolateral, SAMA N1989111, embolus and conductor removed. 14, epigynum of holotype female. 15, vulva of female SAMA N1989112, ventral. Scale lines 0.5 mm.

TABLE 5. Leg measurements of *Isopedella pessleri* (Thorell), holotype female with male SAMA N1989111 in parentheses.

Leg	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	8.1 (8.5)	4.5 (3.8)	7.2 (7.6)	8.0 (8.5)	2.5 (2.5)	30.3 (30.9)
II	9.0 (9.3)	4.6 (3.8)	7.9 (8.4)	8.3 (8.6)	2.5 (2.5)	32.3 (32.6)
III	7.2 (7.3)	3.6 (2.9)	5.8 (5.7)	5.7 (5.7)	2.0 (2.0)	24.3 (23.6)
IV	7.8 (—)	3.4 (—)	6.3 (—)	6.8 (—)	2.2 (—)	26.5 (—)
Pa	2.6 (2.7)	1.6 (1.2)	2.0 (1.1)	— —	3.5 (3.7)	9.7 (8.7)

closely spaced, subdistal tooth largest. Sternum L 4.9, W 4.0. Legs: (Table 5) leg II longer than leg I, ratios 3.5, 3.3 respectively. Spination: Leg I and II, fe d2 p3 r3, pa pl r1, ti d2 p2 r2 v6, me p2 r2 v4. Leg III, same but r2 on fe. Leg IV, fe d2 p3 r1, pa pl, ti d1 p2 r1 (r2 on left leg) v6, me p4 r4 v4. Palp, fe d1 + 4 apically in transverse row, pa pl r1 ti d1 p2, ta p2 r1. Abdomen: clumps of short black setae form paired dorsal spots. Epigynum: (Figs 14–15) Ovate, rounded anteriorly, lateral rims diverging slightly for half their length then gently arced outwards to posterior. Posterior of fossa raised, granulated and darkly pigmented. Vulva of SAMA N1989112 (Kaleen, Canberra, ACT) lacks spermathecal sacs.

Male SAMA N1989111 (Nowra, NSW), as female except as follows:

CL 6.8, CW 6.3, AL 7.0, AW 5.0.

Colour in alcohol: Carapace and legs orange-brown. Caput and chelicerae dark red. Maxillae and labium brown. Sternum red-brown with a covering of long brown-black setae. Coxae yellow-brown with few black setae, mainly on leg I. Abdomen with narrow dark brown folium along its entire length. Venter with brown spots. Eyes: AME 0.45. AME: ALE: PME: PLE = 1: 1.13: 0.76: 1.11. Interspaces: AME-AME 0.49, AME-ALE 0.22, PME-PME 1.33, PME-PLE 1.33, AME-PME 1.07, ALE-PLE 1.07. MOQ, aw: pw: l = 2.58: 2.89: 2.76. Clypeus width 0.67. Chelicerae with numerous short adpressed and long upright setae. Sternum L 3.4, W 3.1. Legs: (Table 5) leg II longer than leg I, ratios 4.8, 4.5 respectively. Spination: Leg II, fe r1 on right. Leg IV, not available, both missing. Palp, ti p3 r1, ta 0. Palp: (Figs 11–13) Tibial apophysis equal in length to tibia, angled ventrally just above base, turning again to original direction before curving mesally at apex. Slightly rounded in form. Embolus with 8 coils, gradually tapered to tip. Embolar base large, extending partly over embolus retrolaterally (Fig. 11). Short pro-distal flange. Tegular apophysis large, concave, extended mesally, well separated from embolar flange.

Distribution

I. pessleri is found in southern NSW and north-eastern V.

Beregama gen. nov.

Diagnosis

Male palpal tibial apophysis straight and thin or doubly curved and, at least, broadest mid-length. Tegular apophysis weakly modified. Embolar base small; often reduced on proximal side. Female with heavily sclerotised epigynum margin. Spermathecal sacs long and looping to anterior.

Description

Carapace convex, length equals 3–4 times height. Distance between AME-ALE subequal to half that between AME. Distance between PME much less than or subequal that between PME-PLE. Line drawn behind posterior eyes usually straight. PME dome-shaped. Clypeus width equal or subequal diameter of AME. Chelicerae of male occasionally modified, swollen retro-distally with distal tooth of retromargin well separated from subdistal tooth, larger and angled anteriorly. Leg I often reaches to distal end of metatarsus of leg II. Leg I of female up to 4½ times carapace length. Abdomen without dorsal pattern except in *cordata* which has a folium. Male palpal tibial apophysis length shorter than tibia, relatively straight to curved much as in *Isopedella* but then broader mid-length or throughout. Embolus coiled from nine to fifteen times in a stack equal in width to cymbium. Embolus gradually tapered to tip. Prodistal flange on embolar base, if present, short and low. Tegular apophysis swollen, weak ridge projecting ventrally, flattish beneath, often largely obscured by embolar base. Epigynum horse-shoe shaped or in *aurea*, lateral rim broadly rounded posteriorly, both with heavily sclerotised lateral rim often appearing to be continuous anteriorly. Lateral rim of *aurea* slopes towards recessed fossa. Spermathecal sacs long, looping to anterior.

Type species

Isopeda aurea L. Koch, 1875.

Etymology

The name *Beregama* is derived from the Aboriginal word beregegama, meaning lagoon shaped like a horse-shoe, and used in reference to the shape of the epigynum margin surrounding the fossa of most species.

Species included

Beregama aurea (L. Koch, 1875), *B. cordata* (L. Koch, 1875), *B. herculea* (Thorell, 1881) and *B. goliath* (Chrysanthus, 1965). Distribution is from north-eastern NSW along the east coast and Great Dividing Range of Q to New Guinea where it appears to be common. Unnamed species occur in north-east NSW to south-east Q and N.G. These species may belong to a yet undescribed genus as the males have between 2 to 3½ embolus coils. They appear to be more primitive species closely related to *Typostola* Simon, 1897 and *Zachria* L. Koch, 1875

Beregama aurea (L. Koch)
(Figs 16–20, Table 6)

Isopeda aurea L. Koch, 1875: 696. Syntypes immature ♀ and ♂, MacKay, Queensland, ZMH, whereabouts unknown, possibly lost. Doubtful ♀ syntype from Rockhampton, Queensland, in ZMH (Mus. Godeffroy Nr 6517), in poor condition, measured and drawn by G. Pajak.

Isopeda flavibarbis L. Koch, 1875: 698. Holotype immature, Sydney, New South Wales, ZMH (Mus. Godeffroy Nr 11015), examined. **New synonymy.**

Isopeda herculeana Strand, 1913: 610. Holotype ♀, Queensland, SMF 5020, examined. **New synonymy.** I have chosen to give the following description from the holotype *I. herculeana* as I have not personally examined the doubtful syntype from Rockhampton. Its fragile condition excludes availability for loan.

Female SMF 5020

CL 17.2, CW 17.4, AL 24.0, AW 21.0.

Colour in alcohol: Carapace red-brown with darker flecks, whitish setae in ocular region. Chelicerae dark brown, long yellowish setae. Legs light red-brown with clumps of white setae on femora, mostly ventrally, long yellowish setae. Maxillae and labium black-brown, tipped anteriorly with orange. Sternum orange-red with long yellowish setae. Coxae orangish. Abdomen yellowish with numerous concolorous long setae. Venter with faint 'V' marking. Carapace: moderately high, convex, caput slightly raised. Eyes: AME 1.00. AME: ALE: PME: PLE = 1: 1.30: 0.80: 1.00. Interspaces: AME-AME 0.50, AME-ALE 0.50, PME-PME 1.50, PME-PLE 1.80, AME-PME 0.90, ALE-PLE 1.20. MOQ, aw: pw: l = 2.60: 3.00: 2.90. Width of clypeus 1.00. Chelicerae with numerous long stout setae. Retrolateral teeth 4, distal tooth well spaced from larger subdistal tooth. Maxillae rounded. Sternum L 9.5, W 7.5. Legs: (Table 6) leg II longer than leg I, ratios 4.5, 4.3 respectively. Spination: Leg I, fe d2 p2 r3, pa pl r1, ti d2 p2 r2 v6, me p2 r2 v4. Leg II, fe d2 p3 r3, pa pl r1, ti p2 r2 v6, me p2 r2 v4. Leg III, same but fe r2. Leg IV, fe d2 p3 r1, pa pl, ti p2 r2 v6, me p4 r3 v4. Palp, fe d1 + 4 apically in transverse row, pa pl r1, ti d1 p3 r2, ta p2 r2. Epigynum: (Figs 19–20) Lateral rim heavily sclerotised anteriorly, sloping towards recessed fossa. Posteriorly rim rounded and concave. Vulva of AM KS16683 (Inverell, NSW) with long spermathecal sacs looping to anterior.

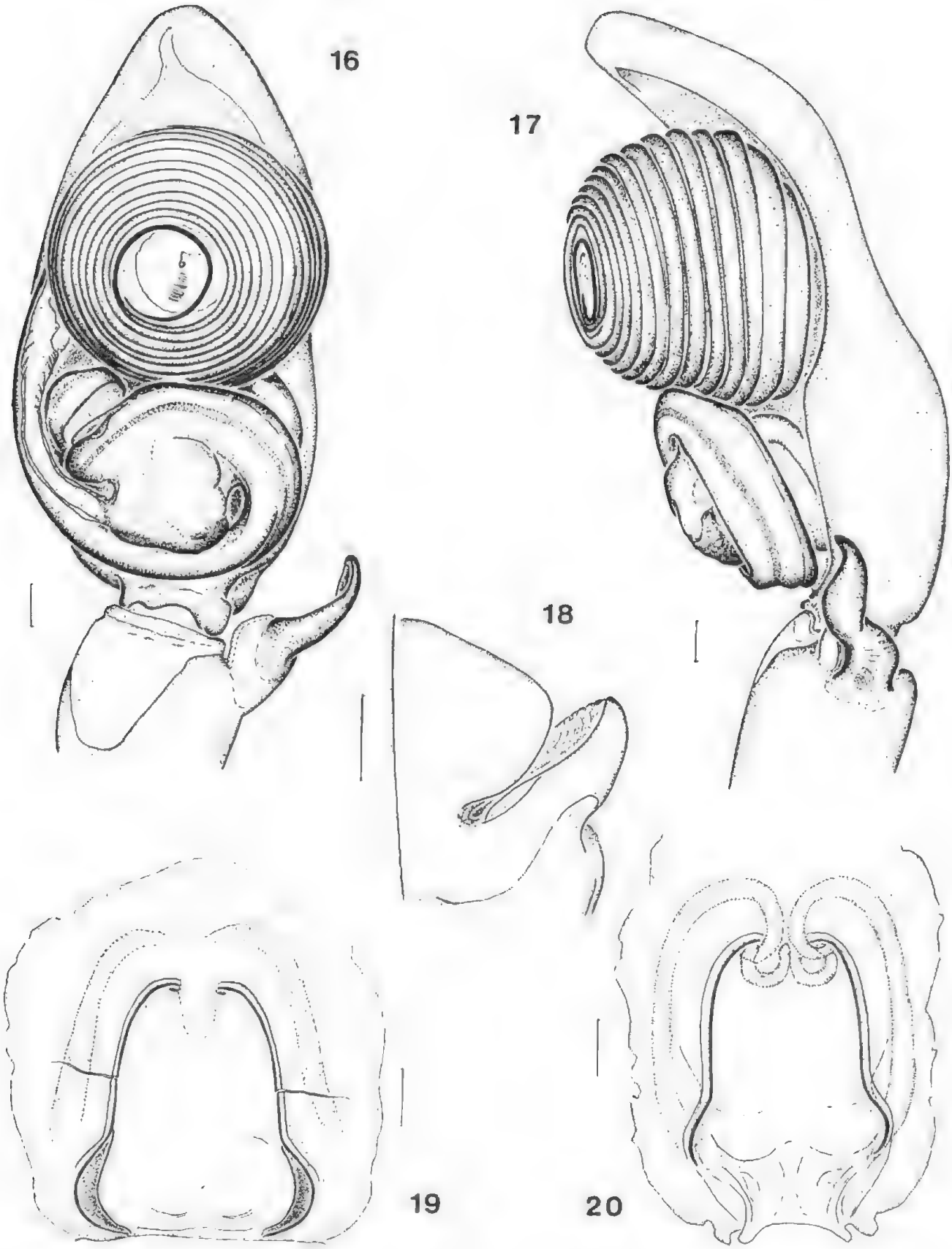
Male AM KS16662 (Emmaville, NSW) as female except as follows:

CL 14.5, CW 13.5, AL 13.8, AW 10.2.

Colour in alcohol: Carapace reddish, caput dark red, both with blackish reticulations. Chelicerae blackish-brown. Maxillae and labium dark brown. Eyes: AME 0.88. AME: ALE: PME: PLE = 1: 1.14: 0.73: 1.14. Interspaces: AME-AME 0.43, AME-ALE 0.34, PME-PME 1.20, PME-PLE 1.59, AME-PME 0.95, ALE-PLE 0.95. MOQ, aw: pw: l = 2.30: 2.64: 2.73. Width of clypeus 0.73. Sternum L 7.0, W 6.2. Legs: (Table 6) leg II longer than leg I, ratios 4.7, 4.2 respectively. Spination: Leg II, ti d1. Leg IV, ti 0 (1 on left). Palp, pa r2, ti r1, ta 0. Palp: (Figs 16–18)

TABLE 6. Leg measurements of *Beregama aurea* (L. Koch), holotype female *Isopeda herculeana* with male AM KS16662 in parentheses

Leg	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	20.0 (16.3)	10.0 (7.7)	19.0 (16.2)	21.0 (16.8)	5.0 (4.2)	75.0 (61.2)
II	22.0 (18.3)	10.5 (7.9)	21.5 (18.9)	23.0 (18.5)	6.5 (4.2)	77.5 (67.8)
III	15.5 (12.6)	7.5 (5.7)	14.0 (11.5)	12.5 (10.3)	4.0 (3.1)	53.5 (43.2)
IV	17.0 (13.8)	7.0 (5.4)	14.7 (12.5)	15.7 (12.6)	4.2 (3.2)	63.6 (47.5)
Pa	6.6 (5.2)	3.8 (2.5)	4.6 (2.5)	— —	7.4 (7.1)	22.4 (17.3)



FIGURES 16-20. *Beregama aurea* (L. Koch). 16-17, left palpal tibia and tarsus of male AM KS16662: 16, ventral; 17, retrolateral. 18, tegular apophysis, prolateral, distal part of conductor not drawn. 19, epigynum of holotype female *Isopeda herculeana* Strand, SMF 5020. 20, vulva of female AM KS16683, ventral. Scale lines 0.5 mm.

Tibial apophysis length shorter than tibia, angled above base to venter then curving back towards the anterior, broad mid-length. Embolus with 15 coils, last coil gradually tapered to tip. Embolar base small with short, low flange prodistally. Tegular apophysis a rounded protrusion barely distinct from tegulum, with weak ridge at apex.

Distribution

B. aurea occurs in eastern Q and north-eastern NSW.

Misplaced Species

Isopeda gloriosa Rainbow, 1917 is transferred to *Delena gloriosa* (Rainbow), **new combination**.

Isopeda immigrans Strand, 1913 is transferred to *Polybetes pythagoricus* Holmberg, 1874, **new synonymy**. The type locality of *I. immigrans*, 'Australia', is considered in error. Although recorded as arriving in England 'On cowhide from Australia', it probably entered the ship elsewhere.

Isopeda deianira Thorell, 1881 does not belong to any of the above genera. The vulva of dissected material and the embolus of males seen, lack spirals. A female of this species from New Guinea was described and figured by Chrysanthus (1965) as *Olios fimbriatus*. The male, as yet undescribed, has a large palpal tibia apophysis with large ventrally directed basal swellings and a curved, triangular embolic process which rests on a spoon shaped conductor. The tegulum has a prolateral flange.

Nomina Dubia

Voconia dolosa L. Koch, 1875: 648. Syntypes, two dry specimens from Australia, presumed lost (pers. comm. Dr E. Renner, SMNS).

Isopeda pococki Hogg, 1903: 440. The dry syntypes, male and female, from Australia without exact locality, are not in BMNH (pers. comm. P. Hillyard) and are probably lost. Although Hogg gives an adequate description this cannot be matched with known Australian species. The sternum colour excludes it from *Beregama aurea* with which it comes closest.

Isopeda robusta L. Koch, 1875. From Australia without exact locality, this species was described from a dry specimen which has most likely since been reduced to dust by dermestid beetles (pers. comm. Dr J. Gruber, NHMW). No further material recognisable from the original description has come to hand thus making this species very doubtful.

Isopeda vastula Strand, 1907. The female holotype without locality, has not been located, nor is its depository institution known. It is also not recognisable from the original description.

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ORIENTAL AND AUSTRALIAN SPECIES OF THE GENUS PROSTEMMA LAPORTE (HETEROPTERA: NABIDAE)

I. M. Kerzhner & N. G. Strommer

Summary

Two new species, P. walkeri (Sri Lanka, south-west India) and P. australicum (Australia), and a new subspecies P. fasciatum sulawesiense (Sulawesi I.) are established. A key to species and revised data on distribution are given. Lectotypes of P. cardeulis Dohrn, of its junior synonym P. placens Walker, and of P. fasciatum (Stål) are designated.

ORIENTAL AND AUSTRALIAN SPECIES OF THE GENUS *PROSTEMMA* LAPORTE (HETEROPTERA: NABIDAE)

I.M. KERZHNER & N.G. STROMMER

KERZHNER, I.M. & STROMMER, N.G. 1990. Oriental and Australian species of the genus *Prostemma* Laporte (Heteroptera: Nabidae). *Rec. S. Aust. Mus.* 24(1): 27-34.

Two new species, *P. walkeri* (Sri Lanka, south-west India) and *P. australicum* (Australia), and a new subspecies *P. fasciatum sulawesiense* (Sulawesi I.) are established. A key to species and revised data on distribution are given. Lectotypes of *P. curduelis* Dohrn, of its junior synonym *P. placens* Walker, and of *P. fasciatum* (Stål) are designated.

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The genus *Prostemma* Laporte, 1832 is widely distributed in the Old World. The last revision of the genus was published by Reuter & Poppius (1909). A review of palearctic species is given by Kerzhner (1981), a review of Afrotropical species by the same author is in press.

The following abbreviations are used for institutions in which the material is preserved (curators who lent material are in parentheses): AM - Australian Museum, Sydney (Dr C.N. Smithers); AMNH - American Museum of Natural History, New York (the late Prof. P. Wygodzinsky); ANIC - Australian National Insect Collection, CSIRO, Canberra (Dr J.A.L. Watson); AUW - Agricultural University, Wageningen (the late Dr R.H. Cobben); BMNH — British Museum (Natural History), London (Dr W.R. Dolling); CU - Connecticut University, Storrs, Conn. (Prof. J.A. Slater); EQU - Entomology Department, Queensland University, St Lucia (the late Dr T.E. Woodward); IB - Institut Royal de l'Histoire Naturelle de Belgique, Bruxelles (Dr A. Capart); NMP - Narodni Museum, Prague (Dr L. Hoberlandt); NRS - Naturhistoriska Riksmuseet, Stockholm (Dr P. Lindskog); QM - Queensland Museum, Brisbane (Dr G.B. Monteith); SAMA - South Australian Museum, Adelaide (Dr G.F. Gross); USNM - U.S. National Museum of Natural History, Washington, D.C. (Dr Th. J. Henry); VPG -V.P. Gapud's collection, College, Laguna, Philippines; ZIL - Zoological Institute, Academy of Sciences of the USSR, Leningrad; ZMB - Zoologisches Museum der Humboldt-Universität, Berlin, GDR (Dr U. Göllner-Scheiding); ZMH - Zoological Museum, University of Helsinki (Dr A. Jansson).

The sign '!' is used for specimens examined.

All measurements are in mm.

KEY TO THE ORIENTAL AND AUSTRALIAN SPECIES OF *PROSTEMMA*

1 — Hind lobe of pronotum, scutellum and clavus (except sometimes a spot at base of outer margin) black 2

— Hind lobe of pronotum, scutellum and clavus (except its extreme apex) red 3

2(1) — Corium black with 2 yellowish white spots: at base and near the middle; the last spot is connected with the inner margin of corium by a narrow stripe. Membrane black with a spot in inner corner and apical 1/5 white. Hemelytra covering at least 4/5 of abdomen length. Length 5.6-6.7 . . . . . *P. flavomaculatum* Lethierry

— Corium yellow with two small black spots: near the middle of outer margin and at apex. Membrane black with a white spot in outer corner. Hemelytra reaching about half of abdomen length only. Length 6.5 . . . . . *P. siamense* Noualhier

3(1) — Underside of meso- and metathorax black or dark brown (sometimes mesothorax reddish in the middle). Inner corner of membrane with a white spot. Base of corium whitish or yellowish white, with a brownish vein. Length 7.8-9.8 . . . . . *P. curduelis* Dohrn

— Underside of meso- and metathorax red or yellow red. Inner corner of membrane without white spot. Base of corium red, with a vein of the same colour. Length as a rule less than 7.5 4

4(3) — White spot at outer corner of membrane and apex of corium (triangular, part lying on corium forms about 1/10 of its length (measured at outer margin of hemelytron). White spot at apex of membrane with fore margin deeply invaginated, hind margin touching the apex of membrane, lateral corners not rounded and the outer of them connecting by a narrow whitish stripe with white spot at outer corner of membrane. Mid and hind femora brown for a least half their length. Length 6.5-7.5, width

2.0–2.4. ... . *P. australicum* sp.n.

— White spot at outer corner of membrane and apex of corium more or less quadrangular[1], the part lying on corium forms about ¼ to ½ of its length[2]. White spot on apex of membrane as a rule with fore margin straight or feebly invaginated, hind margin usually separated from apex of membrane by a more or less distinct greyish stripe, lateral corners usually rounded, never connecting with white spot at outer corner of membrane. Mid and hind femora brown less than one half, usually no more than one-third of their length. 5

5(4) — White stripe of corium with subparallel fore and hind margins. White spot on apex of membrane about twice as wide as long. White spot on outer corner of membrane usually lies on corium by half its length. Length 6.5–7.6, width 2.0–2.5. ... . *P. fasciatum* (Stål), 6

— White stripe of corium distinctly widened at the middle, stripes of opposite hemelytra widely separated. White spot on apex of membrane no more than 1.5 times as wide as long. White spot on outer corner of membrane lies on corium by a third or fouth of its length. Red colour at base of hemelytra not changing before the black stripe. Length 6.1–6.8, width 1.75–1.95..... .... *P. walkeri* sp.n.

6(5) — White stripe of corium more or less subequal in width to black stripes behind and before it, often white stripes of opposite hemelytra are connected by a white spot at base of membrane. Front margin of anterior black stripe of corium straight or wavy. Red colour at base of hemelytra usually gradually turning into yellow or white before the black stripe..... *P. f. fasciatum* (Stål)

White stripe of corium much narrower, two to three times narrower than black stripes behind and especially before it, white stripes of opposite hemelytra not connected. Front margin of anterior black stripe of corium angulate. Red colour at base of hemelytra practically not changing before the black stripe..... ..... *P. f. sulawesiense* ssp.n.

[1]The form of the spot should be examined carefully. Its inner margin is often masked by black margin of the opposite membrane lying over or under the spot, therefore it may look at first glance triangular, as in the figure of *P. fasciatum* in Reuter & Poppius (1909)

[2]It is sometimes difficult to determine the border between membrane and apex of corium. The apex of corium can be distinguished by presence of hairs; besides, it is thicker than the membrane and mostly somewhat yellowish.

Prostemma flavomaculatum Lethierry, 1883
(Figs 2a, 3)

Prostemma flavomaculatum Lethierry, 1883: 649; Distant, 1904: 393.

Nabis flavomaculatus: Reuter & Poppius, 1909: 10, 17; Bergroth, 1915: 178.

Syntype(s)

Male(s) (according to Reuter & Poppius, 1909), BURMA, Minhla, leg. Comotto, stated to be in Museo Civico di Storia Naturale in Genova, not examined.

Distribution and material examined

INDIA: Bombay! (Reuter & Poppius, 1909; Bergroth, 1915; ZMH), Chick Ballapur! (BMNH), W. Almora, Kumaon, U.P. (BMNH, Dolling *in litt.*), Padang and Gopaldhara near Darjeeling! (BMNH). NEPAL: between Kathmandu and Everest (Prof. R. Remane *in litt.*). BURMA: Minhla (Lethierry, 1883), Carin, Asciuti Ghecu (BMNH, Dolling *in litt.*). We examined 14 imagos and 1 larva.

Note. The species is very closely related to the Afrotropical *P. concinnum* Walker (*eva* Kirkaldy), which is in the main larger (length 6.4–8.0), with relatively broader pronotum (proportion width to length of pronotum in *P. flavomaculatum* 1.10–1.16, in *P. concinnum* 1.18–1.23) and usually with more distinct brown rings on the femora, while the paramere in *P. concinnum* is longer, with more broadly rounded outer corner and some other differences.

Prostemma siamense Noualhier, 1896

Prostemma siamense Noualhier, 1896: 253; Noualhier & Martin, 1904: 176, pl. 10, fig. 2; Distant, 1919: 285.
Nabis siamensis: Reuter & Poppius, 1909: 10, 15

Syntype

Female, now without head, apparently the only specimen used for description, CAMPUCHEA (Siam), Battambang (according to Reuter & Poppius, 1909), leg. A. Pavie, in Muséum National d'Histoire Naturelle, Paris (Dr J. Péricart, *in litt.*), not examined by us.

The species is known from the type only. It was examined and redescribed by Reuter & Poppius (1909).

Prostemma carduelis Dohrn, 1858
(Figs 1a, 2b, 3)

Prostemma carduelis Dohrn, 1858: 229, pl. 1, fig. 8; Distant, 1903: 253; Distant, 1904: 392, fig. 249 (part.).

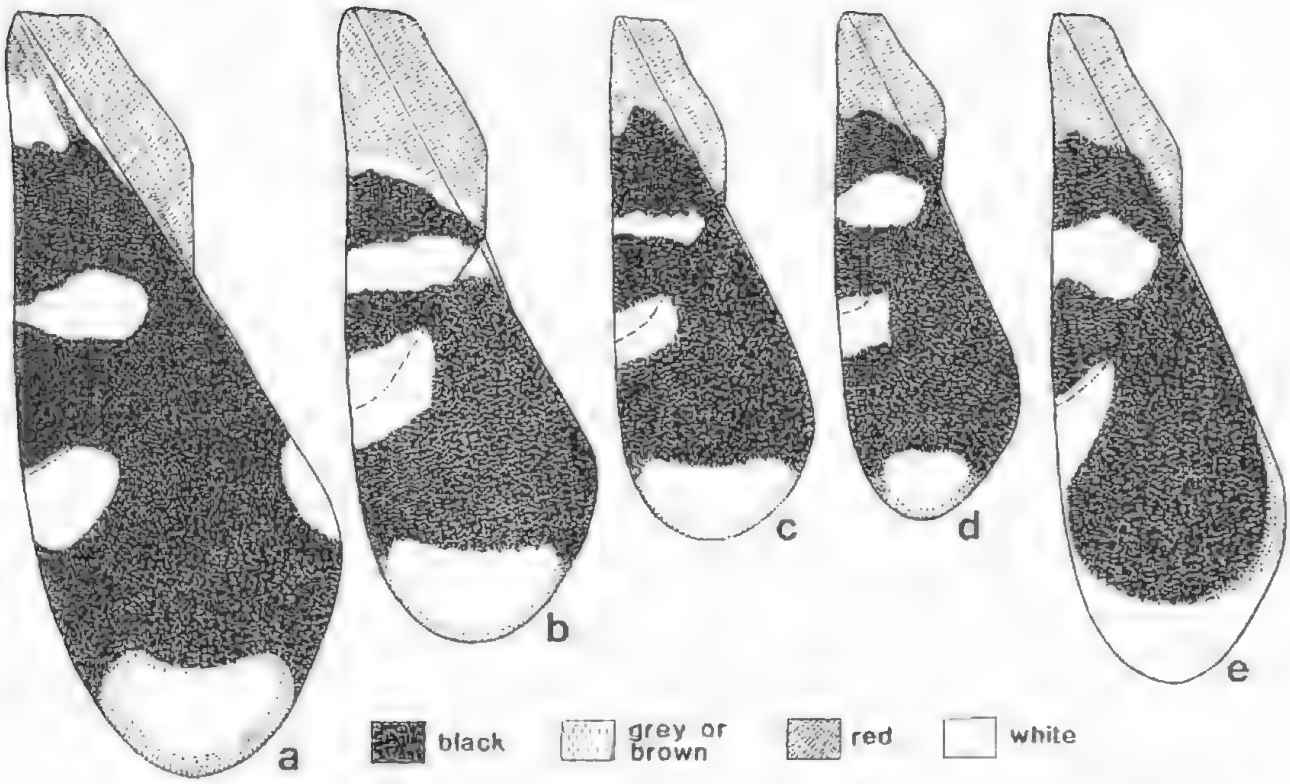

FIGURE 1. *Prostemma*, left hemelytron: a – *P. carduelis* Dohrn, b – *P. fasciatum fasciatum* (Stål), c – *P. fasciatum sulawesiense* subsp.n., d – *P. walkeri* sp.n., e – *P. australicum* sp.n.

Nabis (Poecilta) carduelis: Stål, 1873: 108.
Prostemma placens: Walker, 1873: 137 (syn. by Distant, 1903).
Nabis carduelis: Reuter & Poppius, 1909: 11, 18 (part.).
Nabis carduelis var. *placens*: Reuter & Poppius, 1909: 19

Types

Lectotypes: of *carduelis*, male, hereby designated, labelled '3259', 'Type', 'carduelis Dohrn, Ceylon, [leg.] Nietn[er]', 'Nabis carduelis Dohrn, F. Schumacher rev.', in ZMB. Syntypes from Colombo in Dohrn's collection (now in Warsaw), probably lost.

Of *placens*, female, hereby designated, labelled 'Type', 'Saunders 65.13', 'Ind.', '27. *Prostemma placens*', in BMNH. Paralectotype: male (not female as stated in the original description) labelled 'E. Ind.' (hand-written circular label), '*Prostemma placens*, Walker's Catal.', in BMNH, examined.

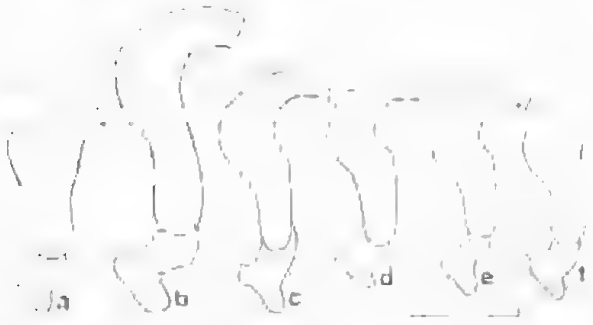

FIGURE 2. *Prostemma*, left paramere: a – *P. flavomaculatum* Lethierry, Chick Ballapur, b – *P. carduelis* Dohrn, Coimbatore, c – *P. fasciatum fasciatum* (Stål), Bhamo, d – *P. fasciatum sulawesiense* subsp.n., holotype, e – *P. walkeri* sp.n., holotype, f – *P. australicum* sp.n., Townsville.

Distribution and material examined

SRI LANKA: Colombo (Dohrn, 1858), also specimens labelled 'Ceylon' and collected by Nietner! (ZMB), by Green! (BMNH) and by unknown person! (NRS). INDIA: Coimbatore! (AMNH, CU, USNM, ZIL), Nilgiri Hills! (CU), Chick Ballapur! (BMNH), Secunderabad! (BMNH), Poona! (BMNH), Mile 4 Wiraingan to Kharagoda, Bombay! (BMNH), Mandar! (IB), Janjgir, Bilaspur! (BMNH), Pusa! (BMNH), Purnea Distr.! (BMNH), Balasore (Reuter & Poppius, 1909), also specimens without exact localities! (BMNH). NEPAL: Terai! (BMNH), Indrawati Khola, Saretar! (NMP). We examined 23 specimens.

Notes. The species is closely related to the Afrotropical *P. falkensteinii* Stein, from which it differs in the less dense punctuation of the hind lobe of pronotum and smaller paramere. Distant's (1904)

record from Burma, judging from specimens in BMNH and ZIL collected by L. Fea, refers to *P. fasciatum*. Reuter & Poppius (1909), judging from their data on the colour of thorax ('meso- et metapleuris nigris vel rufo-testaceis') and the length of the 'typical form' (6 mm), apparently confused under *P. carduelis* 3 species: their specimens of 'var. *placens*' from India belong to *P. carduelis*, whereas specimens identified as the typical form of *P. carduelis* belong in fact to *P. fasciatum* (Burma, Vietnam) and *P. walkeri* (Sri Lanka). Philippine specimens recorded as *P. carduelis* by Stål (1871) were later described by him as a new species *P. fasciatum*.

Prostemma fasciatum fasciatum (Stål, 1873)
(Figs 1b, 2c, 4)

Nabis (Poecilta) fasciata Stål, 1873: 108.
Nabis fasciatus: Kirkaldy, 1901: 220; Reuter & Poppius, 1909: 11, 19, fig 3; Poppius, 1914: 135; Gross, 1963: 390.
Prostemma fasciatum: Takara, 1957: 52; Hasegawa, 1962: 20, fig. 21; Miyamoto & Hidaka, 1963: 80; Miyamoto, 1964: 275; Kerzhner, 1970: 357; Hsiao & Ren, 1981: 544 (not pl. 82, fig. 804 representing a species of *Rhamphocoris*!).
Metastemma carduelis (misidentification): Stål, 1871: 675.

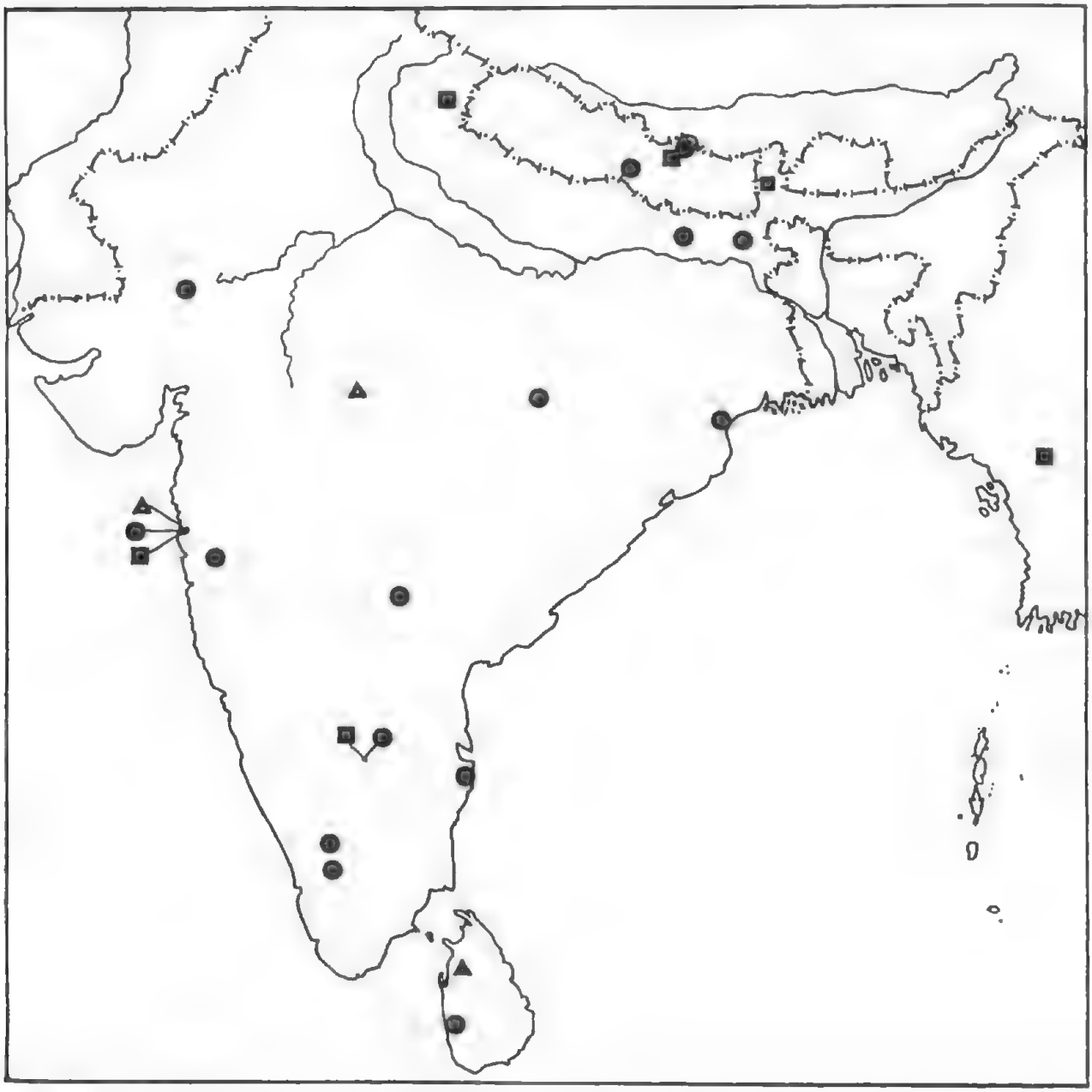

FIGURE 3. Distribution of *Prostemma flavomaculatum* Lethierry (squares), *P. carduelis* Dohrn (circles) and *P. walkeri* sp.n. (triangles).

Prostemma carduelis (misidentification): Distant, 1904: 392 (part.).
Nabis carduelis (misidentification): Reuter & Poppius, 1909: 18 (part.).

Type

Lectotype: female (not male as stated in the original description!), hereby designated, labelled *'fasciata* (Stål' (apparently in (Stål's handwriting), NRS. The species was described from the Philippines.

Distribution and material examined

INDIA: Purnea Distr.! (BMNH). BURMA: Bhamo! (Distant, 1904, as *carduelis*; BMNH, ZIL). Pegu, Palon (Kirkaldy, 1901; Distant, 1904, as *carduelis*; Reuter & Poppius, 1909, as *carduelis*), Tikekee (Reuter & Poppius, 1909, as *carduelis*). THAILAND: Bangkok! (BMNH), Ratburi! (USNM), Chieng Mai (Hasegawa, 1962). LAOS: Vientiane! (BMNH, ZIL). CAMPUCHEA: Kampong Cham and Siem Reap (Hasegawa, 1962). VIETNAM: Chiem Hoa (Reuter & Poppius, 1909, as *cardeulis*), Hanoi! (ZIL), Tam Dao! (ZIL), Dong Hoi! (ZIL), Prov. Gia Lai- Công Tum! (ZIL). S. CHINA: *Guangxi*: Yanshan (Hsiao & Ren, 1981); *Guongdong*: Guangzhou (Hsiao & Ren, 1981), Linhsien (Linchow) (= Lianxian)! (BMNH); *Fujian*: Gu Shan nr Fuzhou! (ZIL). TAIWAN (Hasegawa, 1962; Miyamoto, 1964; Hsiao & Ren, 1981). JAPAN: Amami-Oshima, Okinawa and Iriomote Islands (Takara, 1957; Miyamoto & Hidaka, 1963; Miyamoto, 1964). PHILIPPINES: no exact locality, lectotype! (Stål, 1873; NRS); *Luzon*: Alabang, Rizal Prov.! (USNM), Mt Makiling! (VPG); Mindanao: Davao! (ZMH), Momungan! (BMNH). MALAYSIA: *Selangor*: Kuala Lumpur! (BMNH); *Sabah*: 'NO Borneo' (Poppius, 1914), Mt Kinabalu, Tenom Kinangau! (BMNH), Bellotan nr Sandakan (BMNH); *Sarawak*: Ban! (BMNH), Kuching (BMNH). INDONESIA: *Sumatra* (Reuter & Poppius, 1909): Tebingtinggi! (Poppius, 1914; ZMH), Medan! (NRS), Tjinta Radja! (NRS), Tanjungmorawa! (AUW, ZIL), Paggar Barban! (AUW), Labuan Bilik! (ZMH), Fort de Kock (= Bukittingi)! (BMNH); *Java*: Chandoc (Reuter & Poppius, 1909), Sukabumi (Poppius, 1914), nr Banyumas! (BMNH), Banyuwangi! (ZIL). We examined 43 specimens. Many of them were collected at light.

Prostemma fasciatum sulawesiense subsp.n.
(Figs 1c, 2d, 4)

Diagnosis

Differs from the nominotypical subspecies by the colour of the hemelytra, as indicated in the key. The paramere is slightly smaller, but does not differ in form.

Types

Holotype: male (badly damaged, without head and some legs), INDONESIA, south of Sulawesi Island, Macassar (now Ujung Pandang), leg. W. Doherty, 1903–31 (BMNH).

Paratype: female, INDONESIA, south of Sulawesi Island, 'Lompoh Batang' (Lompobattang Mt), 200 m leg. H. Lucht (AUW).

Prostemma walkeri sp.n.
(Figs 1d, 2e, 3)

'Prostemma carduelis var.?': Walker, 1873: 137.

Description

Body covered by long black hairs. Head, pronotum, a narrow stripe at outer margin of corium, legs, underside of pro- and mesothorax and of abdomen shining, the remaining parts dull. Hind lobe of pronotum with few scattered punctures. Hemelytra reaching or slightly surpassing the apex of abdomen. Fore femora strongly thickened, but without angular projection near the middle.

Head and rostrum black or blackish brown, segment IV of rostrum yellow. Antennae yellow to brown. Fore lobe of pronotum black, hind lobe red. Scutellum red to yellowish red. Clavus red, its extreme apex with black margins and usually with a very small yellowish spot. Base of corium (about a third of its length) red, remaining part black, with a transverse spot in the middle and apex white. The white spot is distinctly narrowed to outer margin of corium, its inner margin is rounded. Membrane black, outer corner with a sub-quadrate white spot partly (by ¼ to ⅓ of its length) lying at apex of corium. Inner corner of membrane without white spot. Apex of membrane with a white spot separated from hind margin of membrane by a greyish stripe. Fore margin of this white spot nearly straight, outer corners broadly rounded, width of spot about 1.5 times its length. Hypocostal lamina red, blackish at extreme apex. Underside of body black or dark brown, except hind part of propleurae, meso- and metathorax red or yellowish red. Fore coxae dark brown, mid and hind coxae light brown. Trochanters pale yellow. Fore femora dark brown, apical fourth pale yellow. Mid and hind femora yellow with the middle third brown. Tibiae and tarsi yellow to brown.

Paramere as in *P. fasciatum*, but smaller.

Length ♂ 6.1–6.8, ♀ 6.5, width ♂ 1.75–1.95, ♀ 1.9.

Measurements: Head length (except neck and base of rostrum) ♂ 0.71–0.79, ♀ 0.71, width ♂ 0.73–0.83, ♀ 0.79, interocular distance ♂ 0.31–0.34, ♀ 0.33, antennal segments length 0.37 (0.11 + 0.79) – (0.14 + 0.93), 0.81, 0.79, pronotum length ♂

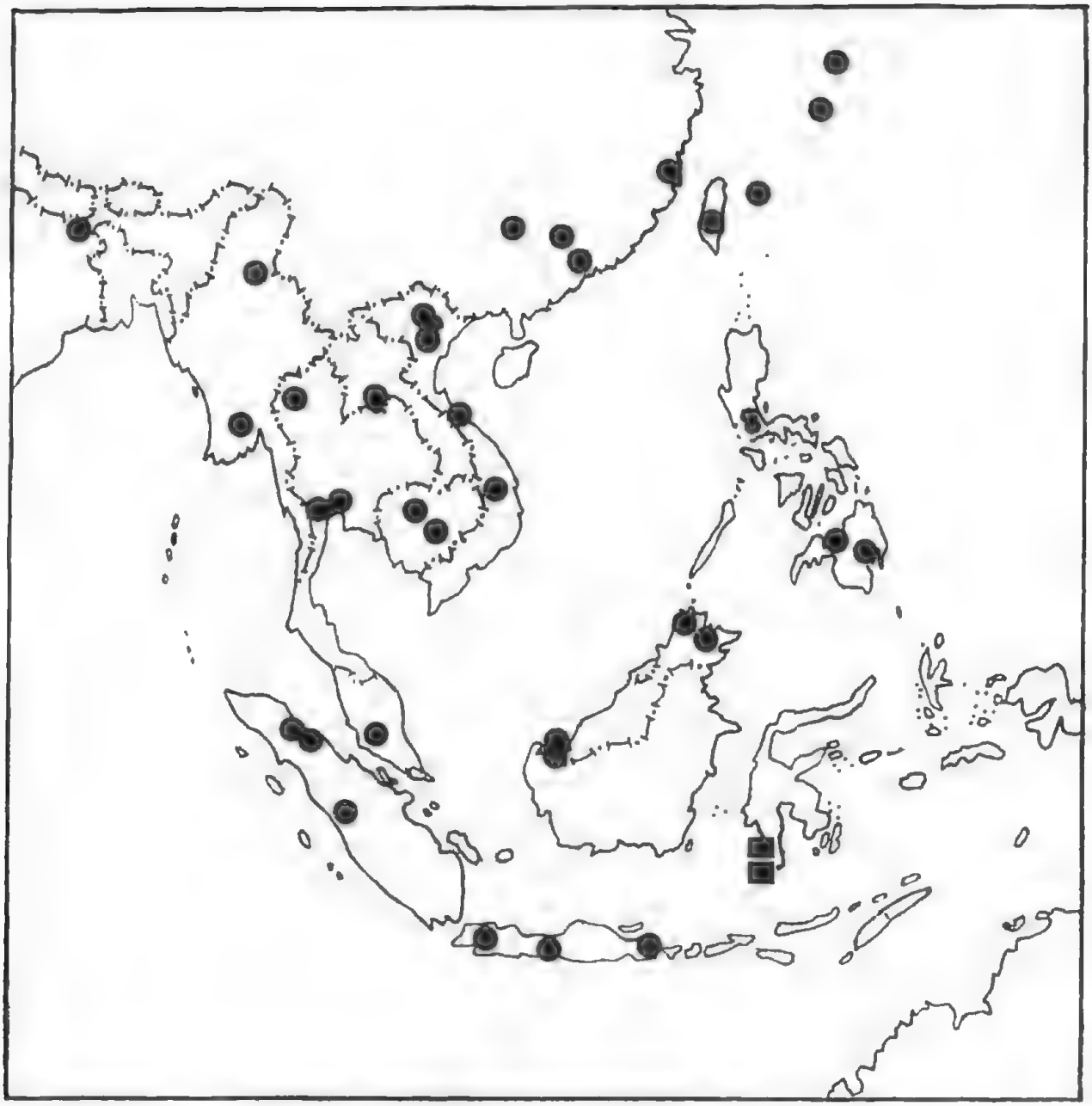

FIGURE 4. Distribution of *Prostemma fasciatum fasciatum* (Stål) (circles) and *P. fasciatum sulawesiense* subsp.n. (squares).

1.36–1.54, ♀ 1.41, width ♂ 1.79–1.96, ♀ 1.80, hind tibia length 1.80–2.15.

Types

Holotype: male, SRI LANKA, Nat. Park Wilpattu, Talawila, 13 km W. of Maradanmaduwa, 7–9 Oct. 1982, V. Zaitzev (ZIL).

Paratypes: INDIA: 1♂, Hoshangabad, at light, 14–19 Oct. 1911, T.B.F. (BMNH); 1♀ labelled 'E.Ind.' (on circular label), with explanatory label of Dr W.R. Dolling 'Wooley/Hewitson, probably Bombay, Walker's '*varduelis* var.?'', (BMNH).

Notes. The new species is closely related to *P. fasciatum*, but differs in somewhat more slender body as well as in the form of the white markings as indicated in the key. It is named in honour of F. Walker, who published its first description.

Prostemma australicum sp.n.
(Figs 1e, 2f, 5)

Description

Body covered with long black hairs. Head, pronotum, a narrow stripe at outer margin of corium, legs, underside of pro- and mesothorax and of abdomen shining, the remaining parts dull. Hind lobe of pronotum with few scattered punctures. Hemelytra reaching or slightly surpassing apex of

abdomen. Fore femora strongly thickened, but without angular projection near middle.

Head and rostrum black or blackish brown, segment IV of rostrum yellow. Antennae yellow to brown. Fore lobe of pronotum black, hind lobe red. Scutellum red. Clavus red, its extreme apex black or with black margins. Base of corium (about a third of its length) red, remaining part black with a transverse spot near middle and extreme apex white. White spot is distinctly narrowed to outer margin of corium, its inner margin is rounded or angular. Membrane black, outer corner with a triangular white spot, occupying also extreme apical margin of corium. Inner corner of membrane without white spot, but often with a greyish white margin. Apex of membrane with a white spot not separated from hind margin of membrane by a greyish stripe. Fore margin of this white spot deeply concave, outer corners prolonged along the margins of the membrane in form of greyish or white stripes reaching the white spot at outer corner of membrane and often the inner corner of membrane. Hypocostal lamina red, blackish at extreme apex. Underside of body black or dark brown, except hind part of propleurae, meso- and metathorax red or yellow. Fore coxae dark brown, mid and hind coxae deep yellow to brownish yellow. Trochanters pale yellow. Fore femora dark brown, pale yellow apically; mid and hind femora dark brown, about ⅓ basal yellow, sometimes yellow apically on the ventral side; brown part occupies more than a half length of femur. Tibiae and tarsi brownish yellow.

Paramere relatively broader than in *P. fasciatum* and *P. walkeri*, with less invaginated inner margin.

Length ♂ 6.5–7.1, ♀ 6.3–7.45, width ♂ 2.0–2.35, ♀ 2.0–2.4.

Measurements: Head length (except neck and base of rostrum) about 0.75–0.80, width 0.80–0.85, interocular distance 0.34–0.40, antennal segments length 0.35–0.45, (0.10 + 0.95) – (0.12 + 1.13), 1.00–1.07, 0.80–0.95, pronotum length 1.45–1.65, width 1.85–2.20.

Types

Holotype: male, AUSTRALIA, *Queensland*, Leichhardt Falls, 35 mi SE of Burketown, 24 May 1972, G.B. and S.R. Monteith (EQU).

Paratypes: AUSTRALIA: *Queensland*: 1♂, 2♀, same labels as in holotype (EQU); 1♂, Camooweal, 15 Sept. 1968, K. Armstrong (AM); 1♂, 1♀, Townsville, Jan. and Feb. 1945, B. Malkin (USNM); 1♂, 31 km NW by N of Longreach, 23°13′S, 144°04′E, 10 May 1973, M.S. Upton (ANIC); 1♀, Cunnamulla, Nov. 1941, N. Geary (AM); 1♀, Wallaville, T.L. Bancroft; *Western Australia*: 1♀, Kimberley Distr., March 1911, Mjöberg (NRS); *Northern Territory*: 1♀, Coastal Plains Research Station, C.S.I.R.O., nr Darwin, at light, 6 June 1966, E. Langfield (ANIC); 1♀, 5 km NNW of Cahills Crossing, East Alligator Riv., 12°23′S, 132°57′E, 8 June 1973, R. Kitching (ANIC); 2♀, 4 km W of Coolibah HS., 15°34′S, 130°54′E, 13 June 1968, M. Mendum (ANIC); 1♂, 1♀, Tindal, 14°31′S, 132°22′E, 1–20 Dec. 1967, light trap, W.J.M. Vestjens (ANIC); 1♀, Katherine Riv., 25 km NE of Katherine, 3 Oct. 1977, G.F. Gross and J.A. Forrest (SAMA); 7♀, Lake Woods, 15 km SW of Elliot, at light, 5 Oct. 1977, G.F. Gross (SAMA); 1♀, 22 mls S of Alice Springs, 15 Feb. 1966, J.A. Grant, BM/CSIRO Expedition (BMNH); *New South Wales*: 1♂, Bogan Riv., Jan. 1932, J. Armstrong (AM); 2♀, 'The Cubas', via Booligal, 21 Feb.–1 March 1965, A. Forbes (AM); *South Australia*: 2♀, Madigan Gulf, Lake Eyre, at light, 5 Nov. 1955, E.T. Giles (SAMA).

FIGURE 5. Distribution of *Prostemma australicum* sp.n.

Notes

This species represents the first record of the genus *Prostemma* from Australia, and was mentioned by Woodward & Strommer (1982), when they referred to a genus of Nabidae, not recorded from Australia. Characters differentiating *P. australicum* from the closely related oriental *P. fasciatum* and *P. walkeri* are indicated in the key.

ACKNOWLEDGEMENTS

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REVISION OF AUSTRALIAN HYDROBIOMORPHIA BLACKBURN (COLEOPTERA: HYDROPHILIDAE)

C. H. S. Watts

Summary

The Australian members of the hydrophilid genus Hydrobiomorpha Blackburn are revised and redescribed and a key to the species is given. Five species are recognised; H. troxi sp. nov., H. microspina sp. nov., H. helenae Blackburn, H. bovilli Blackburn and H. debbae sp. nov., H. tepperi Blackburn is synonymised with H. bovilli with H. bovilli Blackburn.

REVISION OF AUSTRALIAN *HYDROBIOMORPHA* BLACKBURN (COLEOPTERA: HYDROPHILIDAE)

C.H.S. WATTS

WATTS, C.H.S. 1990. Revision of Australian *Hydrobiomorpha* B. (Coleoptera: Hydrophilidae). *Rec. S. Aust. Mus.* **24**(1): 35–42.

The Australian members of the hydrophilid genus *Hydrobiomorpha* Blackburn are revised and redescribed and a key to the species is given. Five species are recognised; *H. troxi* sp. nov., *H. microspina* sp. nov., *H. helenae* Blackburn, *H. bovilli* Blackburn and *H. debbae* sp. nov. *H. tepperi* Blackburn is synonymised with *H. bovilli* Blackburn.

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The five Australian species of *Hydrobiomorpha* Blackburn, 1888, are restricted to coastal areas of northern Australia. *H. bovilli* Blackburn and *H. helenae* Blackburn are by far the commonest, sometimes being collected in large numbers at light. The other species, all new, are widespread but infrequently collected. Nothing is known of their life history.

The genus of about 30 species, which is widely distributed in tropical Asia, Africa, Australia and South America, was revised by Mouchamps (1959) who briefly redescribed the three Australian species then recognised and figured the male genitalia of *H. helenae* and *H. tepperi* (= *H. bovilli*).

The collections from which specimens were examined are listed under the following abbreviations:

AM	Australian Museum, Sydney
ANIC	Australian National Insect Collection, Canberra
BMNH	British Museum (Natural History), London
CW	Private Collection of Author
EUQ	University of Queensland, Brisbane
NMV	Museum of Victoria, Melbourne
NTM	Northern Territory Museum and Art Gallery, Darwin
QDPIM	Queensland Department of Primary Industries, Mareeba
QM	Queensland Museum, Brisbane
SAMA	South Australian Museum, Adelaide
WAM	Western Australian Museum, Perth

SYSTEMATICS

Hydrobiomorpha Blackburn, 1888

Hydrobiomorpha Blackburn, 1888, p. 814.

Neohydrophilus d'Orchymont, 1912, p. 59, syn. after Mouchamps, 1959.

Type species: *Hydrobiomorpha bovilli* Blackburn, 1888, subsequent designation of Knisch, 1924. *Neohydrophilus deplanatus* d'Orchymont from East Africa, by original designation of d'Orchymont, 1919.

The genus belongs to the sub-family Hydrophilinae, characterised by a continuous median longitudinal keel on the underside which is prolonged into a spine between the hind coxae (Figs 1, 2). Within the Australasian members of the sub-family, *Hydrobiomorpha* is characterised by having the front of the ventral keel notched, the prosternal pillar not hooded to receive the front end of the ventral keel and with a backward pointing spine in most species (Figs 16–23), the basal portion of only the profemora rugose, five rows of serial punctures on the elytra including a sub-lateral row, and the front margin of the clypeus widely emarginate exposing an extensive membranous area except in *H. troxi*.

Males differ from females by having the claws on all legs more sharply bent than in the females and with a bulbous basal portion which is lacking in the females. Compared with females the protarsi are slightly more expanded. The maxillary palpi are simple in the female but variously expanded in males, particularly the second joint.

Key to Australian *Hydrobiomorpha*

1. — Membranous areas on frons reduced to small shallow area in centre (Fig. 9); head strongly punctured; bare area at apex of last abdominal segment large . . . *troxi* sp. nov.
   — Membranous area on frons extensive (Figs 8 and 10); punctures on head variable; bare area at apex of last abdominal segment variable, usually lacking or small 2

2. — Spine on pronotal pillar lacking (Fig. 16); aedeagus without dorsal notch (Fig. 15) . . . . . *microspina* sp. nov.
— Spine on pronotal pillar well developed (Fig. 22); aedeagus with deep dorsal notch (Figs 13 and 14) 3
3. — Back portion of keel less than twice width of front portion, front portion dipping virtually at right angles beyond notch . . 4
— Back portion of keel more than twice the width of front portion, front portion gently dipping in front of notch . . . . . *helenae* Blackburn
4. — Spine on pronotal pillar long (Figs. 22 and 23); central portion of membranous area at front of frons relatively wide (Fig. 8); maxillary palpi of male weakly expanded (Fig. 3); groove along front edge of pronotum usually reaching past inner edge of eye . . . . . *bovilli* Blackburn
— Spine on pronotal pillar short; central portion of membranous area at front of frons relatively small (Fig. 10); maxillary palpi of male strongly expanded (Fig. 7); groove along front edge of pronotum usually not reaching to middle of eye . . . . . *debbae* sp. nov.

Hydrobiomorpha troxi sp. nov.

Description (number examined 10). (Figs 4, 9, 11, 21)

Length 15–17 mm. Broadly oval. Predominantly black; elytron with about ten thin lighter lines visible in some lights; ends of legs and appendages lighter. Head densely covered with strong, variably sized punctures, the largest about twice size of smallest; row of very large punctures along inner edge of eye; a rough semicircle of very large punctures forward from each eye; a few large punctures along rear edge of clypeus and a short row of large punctures in middle of clypeus; finely reticulate; membranous area between frons and clypeus black, reduced to small narrow area in middle half (Fig. 9). Pronotum with somewhat sparser and weaker punctures than on head; finely reticulate; two oblique lines of large punctures and a short line or patch of punctures in front of them on each side; groove along front edge reaching to about level of inner edge of eye. Elytron finely reticulate; punctures sparser and finer than on pronotum with five rows of large serial punctures all but the outer in well marked single row, those in third row sparser than in others. Sternal keel widely expanded in posterior half which is weakly grooved in midline, produced backwards into a short spine. Front portion of keel curving slowly upwards in front of notch, notch at or little below plane of rest of keel. Pronotal pillar narrow in lateral view, broad in ventral view with long setae, bulbous in front, small stout spine behind (Fig. 21). Meso- and metasterna and abdomen except keel, legs and large apical patch on last abdominal sternite, rugose-punctate. Non-rugose portion on apical sternite finely reticulate and with scattered very fine punctures. Lateral wings of mesosternum with extra portion on front edge. Front portion of gula lightly covered with moderate sized punctures of varying sizes, basal portion with a few similar punctures at each side only. Spines on apical edge of protibia enlarged, robust, both approximately same length and spatulate but outer a little larger.

Male

Protarsi slightly expanded, spine on apex of protibia larger, claws on all legs more sharply bent than in female with bulbous basal portion. Maxillary palpi with second joint expanded with shallow groove on ventral surface, apical joint much shorter than others (Fig. 4). Aedeagus as in Fig. 11.

Distribution

Known only from coastal Northern Territory.

Types

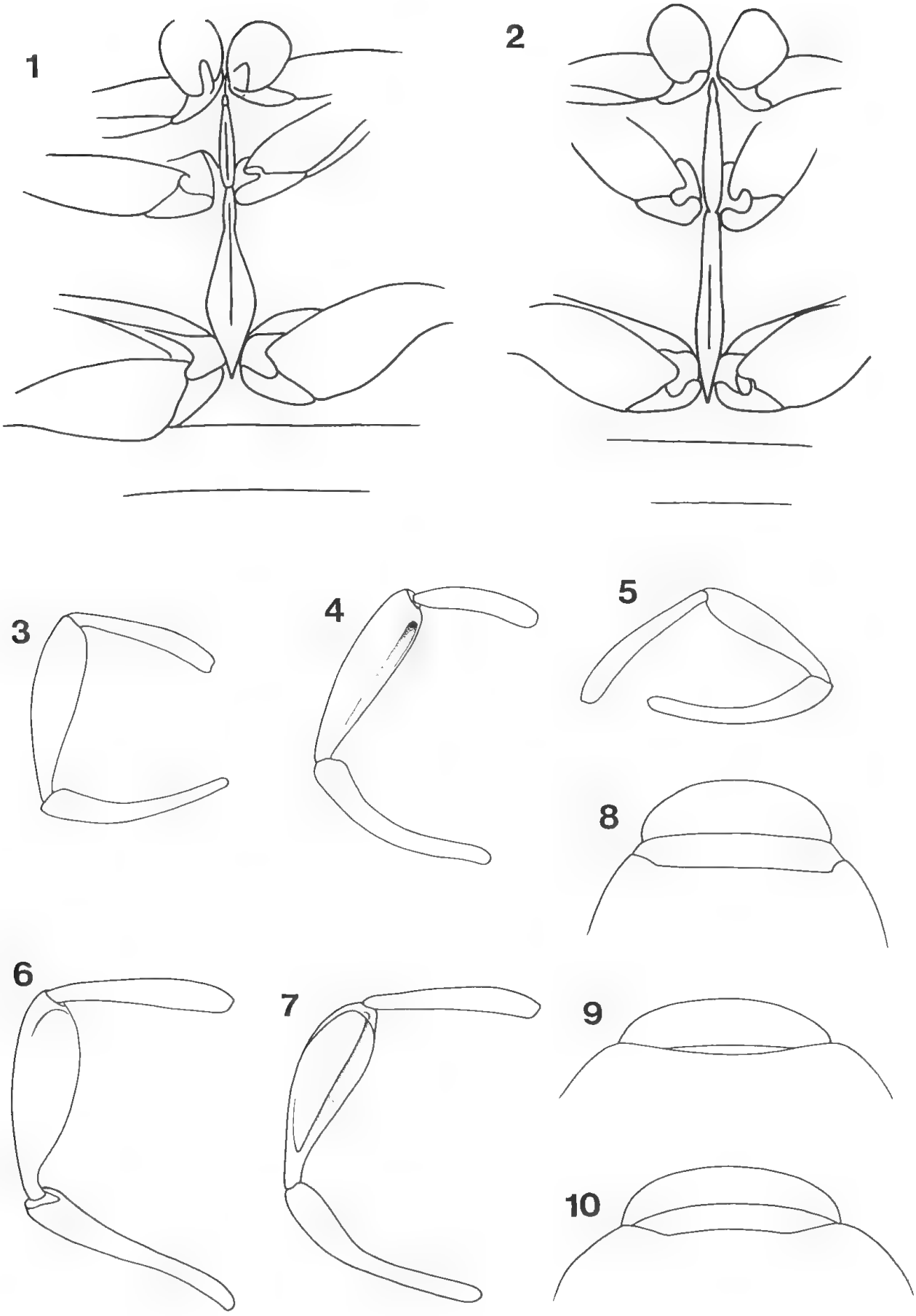
Holotype: M. 12°52′S 132°47′E, Noulangie Creek, N.T., 8 km E. of Mt Cahill, 22.v.1973, at light, E.G. Matthews, SAMA.

Paratypes: 1, same data as Holotype, ANIC; 1, Australia, N.T. Humpty Doo 6 km E. 9.ii–4.iii. 1987, R.I. Storey, QDPIM; 4, King R. N.T., 24.12.15, one with additional label, King R. N.T. Coll'd W. McLennan, 24.12.15. Pres. H.L. White 17.10v6, NMV; 1, King R. N.T., 24.12.15, CW; 1, Port Darwin N.T., SAMA; 1, N.T. Australia. Groote Eylandt 17.III.1925. G.H. Wilkins, BMNH.

Remarks

H. troxi is a distinctive species (reminding me of the trogid genus *Trox*), and is readily separated from other Australian *Hydrobiomorpha* by the lack of an extensive membranous area at the front of the frons, the strong even punctation on the frons, the large shiny area at the apex of the apical sternite, and the short apical segment of the male palpi.

FIGURES 1–10. 1, keel of *H. helenae*; 2, keel of *H. bovilli*; 3, ventral view of male maxillary palpus of *H. bovilli*; 4, ditto, *H. troxi*; 5, ditto, *H. microspina*; 6, ditto, *H. debbae*; 7, ditto, *H. helenae*; 8, frons area of head of *H. helenae*; 9, ditto *H. troxi*; 10, ditto *H. debbae*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Hydrobiomorpha microspina sp. nov.

Description (number examined 21). (Figs 5, 15, 16, 17)

Length 11–16 mm. Oval. Predominantly black; front and sides of clypeus testaceous, border of colour a little broader in midline; appendages and much of underside testaceous. Head, finely reticulate; quite densely covered in quite large (for genus) punctures; a patch of much larger punctures on inner edge of eye; a rough, broken semicircle of similar punctures forward from eye; rear margin of clypeus with several large punctures; front portion of gula covered in very strong punctures, much sparser and smaller on hind portion almost lacking in midline; membranous area between frons and clypeus broad, broadest part restricted to not much more than central half. Elytra sculptured as on pronotum, with five uneven (particularly lateral ones) rows of large serial punctures. Pronotum, with fine reticulation, covered with punctures noticeably weaker than those on head; sides with two short oblique lines of large punctures and one line parallel to edge; grooves along front edge variable in length, from virtually non-existant to nearly joining in centre. Sternal keel weakly expanded in posterior half, produced behind into a broad blunt spine. Meso- and metasternum and abdomen rugosely punctate except sternal keel and appendages. Apical abdominal sternite without, or with only a trace of, bare area at apex. Lateral wing of metasternum with narrow extra portion on front edge. Front portion of sternal keel curving upwards rapidly, notch at or a little above level of rest of keel. Pronotal pillar moderately narrow in ventral view, front edge bulbous, spine on hind edge lacking or very small (Figs 16, 17)

Male

Protarsi slightly expanded, claws on all legs more sharply bent than in female with bulbous hind portion. Maxillary and labial palps stout, particularly second segments of maxillary palpi (Fig. 5). Aedeagus as in Fig. 15.

Distribution

Restricted to wetter coastal areas of the Northern Territory and Cape York. Known only from type localities.

Types

Holotype: M. N.T. At light, 10 mi E. Daly River, 28 June 1972. B.K. Head, SAMA.

Paratypes: 2, At MV lamp. Mornington Is, Mission Qld., 15 May 1963, N.B. Tindale and P. Aitken; 1, Mornington Is. Mission Qld., 15 May 1963, P. Aitken, N. Tindale, SAMA; 3, Mataranka, N.T. 1 March 1967 M.S. Upton, ANIC, CW; 1, Daly R. Mission N.T. 19 km E. by S. of Mt Borradaile, 31.v.73, at light, E.G. Matthews, SAMA; 1, Ditto 5.vi.73, M.S. Upton, SAMA; 2, Brock Creek Burnside N. Aust. 4 May 1929 T.G. Campbell, ANIC; 1, 100 mi. E. of Kununurra W.A., light trap 27.3.66 J.A. Mahon, ANIC; 1, Australia, N.T. Murella Park, Kakadu 18.v.1987 Fay and Halfpapp at light, QDPIM; 2, Kowanyama, N. Qld., 9.x.1977, D.L. Hancock, QM; 1, at light Normanton Qld., 3 May, 1963 N.B. Tindale and P. Aitken, SAMA; 3, Hann Riv., N.Q. 100 mls S. of Coen, 23.vi 1970, J.c.le Souef, NMV; 2, 12°17′S 133°13′E. Birraduk Creek, N.T. 18 km E. of N. of Oenpelli 4.vi.1973, Upton and Feehan, ANIC.

Remarks

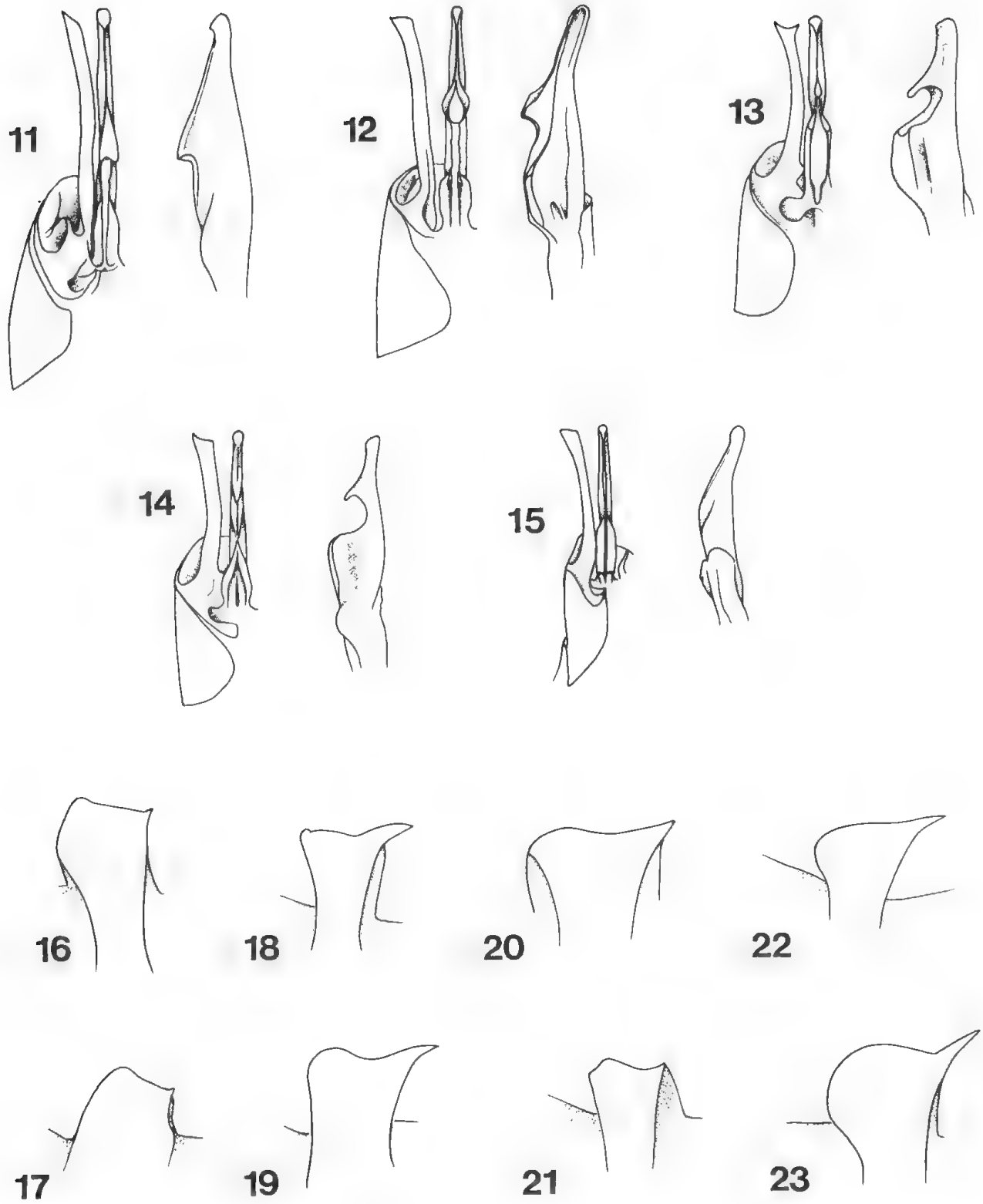
Separated most readily from other Australian species by the lack of, or virtual lack of, a spine on pronotal pillar. The aedeagus lacks or virtually lacks any trace of the deep dorsal notch present in the other Australian species.

Hydrobiomorpha helenae Blackburn

Hydrobiomorpha helenae Blackburn, 1890, p. 741; Knisch, 1924, p. 234; Mouchamps, 1959, p. 303.

Description (number examined 141). (Figs 1, 7, 8, 13, 18, 19)

Length 11–16 mm. Broadly oval. Predominantly black, front half of clypeus and appendages rufous yellow, elytra usually with alternating dark and light longitudinal stripes of green-grey separated by narrow black lines. This colour pattern of variable distinctiveness and sometimes lacking in which case elytra black. Head with evenly spaced, small, variably sized, sharply impressed, punctures and very fine reticulation; patches of much larger punctures inwards from eyes and in a rough semicircle forward from each eye; hind margin of labium with a few large punctures; membranous area between clypeus and frons broad, wide, little restricted laterally; front portion of gula quite densely covered with strong punctures, back portion with fewer, particularly in midline, similar or smaller punctures. Pronotum punctured as on head with three obliquely slanted fields of large punctures on each side; groove along front edge reaching well beyond inner border of eye. Elytra covered in very small sharply impressed punctures, very finely reticulate and with five uneven rows of large setae-bearing puncture lines, the lateral ones with scattered, poorly aligned punctures. Sternal keel widely expanded in posterior half, sharply restricted between postcoxae to a short thin carinate point; front portion curving sharply upwards with notch well above plane of mesosternum. Meso- and metasternum and abdomen rugose-punctate except sternal keel, appendages and a small triangular bare



FIGURES 11-23. 11, dorsal view of aedeagus and left paramere and lateral view of aedeagus of *H. troxi*; 12, ditto, *H. debbae*; 13, ditto, *H. helenae*; 14, ditto, *H. bovilli*; 15, ditto, *H. microspina*; 16 and 17, lateral views of different pronotal pillars of *H. microspina*; 18 and 19, ditto, *H. helenae*; 20, ditto, *H. debbae*; 21, ditto, *H. troxi*; 22 and 23, ditto, *H. bovilli*.

patch at apex of apical abdominal sternite. Lateral wing of metasternum with narrow additional portion on front edge. Pronotal pillar broad in ventral view, with well developed backward pointing spine (Figs 18, 19).

Male

Protarsi slightly expanded, claws on all legs more sharply bent with bulbous basal portion. Joints of maxillary palpi expanded, robust, second joint greatly expanded and concave on ventral surface (Fig. 7). Aedeagus as in Fig. 13.

Distribution

Restricted to wet coastal areas from Derby to Bundaberg. Also in Papua New Guinea.

Types

Lectotype: M. 3030 N.T. T; Hydrobiomorpha Helenae, Blackb.; Blackburn coll. 1910–236, BMNH, herein designated.

Paralectotypes: F. 3030 N.T.; S. Aust. 90.11; Hydrobiomorpha Helenae, Blackb., BMNH; ? sex 3030; N. Territory, Hydrobiomorpha Helenae, Blackb. Co-type, SAMA, herein designated.

Additional localities

W.A. — Barradle, ANIC; Derby, WAM, SAMA; 90 mi. E. Derby, SAMA; Fitzroy Crossing, ANIC; 100Mi. E. Kununurra, ANIC; Mitchell Plateau, ANIC; Ord River, WAM; Windjana Gorge, ANIC; Wyandotte, ANIC; Wyndham, NMV.

NT — Adelaide River, ANIC; 31 km W.S.W. Borroloola, ANIC; Brock Ck Burnside, ANIC; Daly River Mission, ANIC; Darwin, NWV, SAMA; Groote Is., SAMA; Horn Islet, Sir Ed. Pellew Gp, EUQ; Howard Springs, ANIC; 17 mi. N.N.E. Borroloola, ANIC; Humpty Doo, QDPIM; Katherine, ANIC, UQIC; King River, NMV; Koongarra, ANIC; Oenpelli, NMV; Wessel Isl., ANIC.

QLD — Bloomfield River, EUQ; Bundaberg, ANIC; Cairns, SAMA; Cape York, QM; Cooktown, QM; Ingham, ANIC; Kowanyama, QM; Mornington Isl. Mission, SAMA; Mutchilba, NMV; Normanton, ANIC, SAMA; Saibai Isl., EUQ.

PNG — Morehead River, ANIC.

Remarks

Apart from *H. troxi*, which lacks the membranous portion between the frons and clypeus, *H. helenae* is the only Australian *Hydrobiomorpha* with alternating dark and light stripes on the elytra of most specimens and a widely expanded posterior portion of the keel. Some specimens, particularly large females lack the elytral stripes.

Hydrobiomorpha bovilli Blackburn

Hydrobiomorpha bovilli Blackburn, 1888, p. 816; Knisch, 1924, p. 234; Mouchamps, 1959, p. 305. *Hydrobiomorpha lepperi* Blackburn 1888, p. 817; Knisch 1924, p. 234; Mouchamps 1959, p. 305. Syn. nov.

Description (number examined 118). (Figs 2, 3, 14, 22, 23)

Length 11–17 mm. Narrowly oval, black; front of clypeus, membranous area on head and much of underside testaceous, small circular patches of grey around punctures on head, pronotum and elytra. Head finely reticulate, moderately densely covered with small fine punctures. A field of large punctures along inner border of eye, a rough semicircle in front of eye, a few large punctures along rear edge of clypeus and a couple in middle of clypeus. Membranous area between frons and clypeus broad, angularly restricted in lateral quarter. Pronotum sculptured as head, with oblique field of punctures in middle on each side and an oblique broken row towards the front on each side, groove along front edge of pronotum reaching beyond edge of eye. Elytron punctured as on pronotum, with five rows of relatively small serial punctures, the lateral three rows with sparser punctures, a few linear rows of small punctures visible in some lights towards apex. Sternal keel virtually same width throughout, produced into short sharp blunt point behind. Meso- and metasternum and abdominal sternites rugose-punctate except keel and quite large triangular to semicircular bare area at apex of apical sternite, bare area often longitudinally wrinkled. Pronotal pillar narrow in ventral view with strong slightly downward pointed spine (Figs 22, 23). Front portion of keel dipping sharply upwards in front of notch which is on same plane as rest of keel. Front area of gular region moderately covered with moderately sized punctures, rear portion with some much larger punctures on lateral portions, midline impunctuate.

Male

All claws sharply bent with bulbous area at base. Maxillary palps stouter particularly second joint which is expanded to about twice width of apical joint (Fig. 3). Aedeagus as in Fig. 14.

Distribution

A northern coastal species which is relatively common from the Northern Territory around to the Townsville – Home Hill region of Queensland. Also known from New Guinea.

Types

H. bovilli Blackburn. Holotype: E. 2310 N.T. T;

Hydrobiomorpha Bovilli. Blackb.; Blackburn coll. 1910–236. Mounted on cutaway card, in BMNH. Locality given as Palmerston N.T. by Blackburn (1888).

H. tepperi Blackburn. Lectotype: F. 2356 N.T. T; Hydrobiomorpha Tepperi, Blackb; Blackburn coll. 1910–236. On card. Card once contained two specimens, the right hand one labelled 'T' remains. In BMNH. Locality given by Blackburn (1888) as Palmerston N.T. Herein designated. Paralectotype: M. N. Territory J.P. Tepper Hydrobiomorpha Tepperi Blackb., in SAMA; N. Territory, Tepperi, Blackb., in SAMA. Herein designated.

Additional localities

QLD — Cairns, SAMA; 21 k N.W. Cooktown, ANIC; Home Hill, CW; 14 k N.W. Hope Vale Mission, ANIC; Ingham, QDPIM; Iron Range, ANIC, EUQ; Kowanyanna, QM; Laura, ANIC, QDPIM; Mornington Isl., SAMA; Mt Baird, ANIC; Mt Webb Nat. Pk, ANIC; 38 k S. Musgrave, ANIC; Normanton, SAMA; Rounded Hill 15°17′S 145°13′E, ANIC; 40 k S. Weipa, QDPIM.

NT — Adelaide River, ANIC; Bentinck Isl., SAMA; Cooper Creek, ANIC; Darwin, CW; Dirraduk Ck, SAMA; Howard Springs, ANIC; King River, NMV; 16 k N.E. Mt Cahill, ANIC; 18 k N.E. Oenpelli, Sire Edward Pellew Gp, EUQ; 6 k S.W. Oenpelli, SAMA; Rimbija Isl., ANIC.

PNG — Morehead, ANIC; Rouku, Morehead River, ANIC; Weam, ANIC.

Remarks

The strong spine on pronotal pillar, relatively even width of keel and long groove on the front of the pronotum separate this common species from other Australian *Hydrobiomorpha*. The male maxillary palpi are not as expanded as in the related, but rather larger species, *H. debbae*.

Hydrobiomorpha debbae sp. nov.

Description (number examined 5). (Figs 6, 10, 12, 20)

Length 15–18 mm. Oval. Predominantly black; front of clypeus, membranous area on head, tarsi and appendages testaceous; punctures on elytra, particularly serial ones, are in the centre of small grey spots. Head with scattered fine punctures of varying size; very finely reticulate; row of seriferous punctures along inner border of eye, a field of extremely large punctures in front of eye, a few large punctures along rear edge of clypeus and a few scattered ones in middle; membranous area between frons and clypeus broad, narrowing rather slowly in lateral quarters (Fig. 10). Pronotum with very fine weak reticulation sparsely covered in fine punctures; three oblique lines of moderately large punctures on each side; groove along front edge reaching to level of middle of eye. Elytron with reticulation and punctures somewhat stronger and denser than on pronotum; with five rows of moderately large serial punctures, sparser in third row and lateral two close together. Sternal keel with hind portion a little broader than front portion, produced into a blunt point between hind coxae; front portion slopes sharply upwards in front of notch which is on approximately same plane as rest of keel. Pronotal pillar quite broad in ventral view, bottom edge produced backwards in short stout spine (Fig. 20). Front portion of gular area well covered in strong punctures, back portion similarly punctured except for small impunctate area in midline. Wings of mesosternum without additional portion on front edge. Meso- and metasternum and sternites rugose-punctate except for keel and triangularly shaped bare patch at apex of apical sternite.

Male

Protarsi a little expanded, all claws sharply curved and with a small bulbous portion at base. Second joint of maxillary palpus broadly expanded, concave beneath (Fig. 6). Aedeagus as in Fig. 12.

Distribution

Known only from the type localities on the eastern coast of Cape York.

Types

Holotype: M. Cairns dist. A.M. Lea, SAMA.

Paratypes: 1, Cape York Pen. Lockerbie N.Q., 9–15 April 1975. Coll. M. Walford-Huggins, CW; 1, Cairns, SAMA; 1, same data as Holotype, SAMA; 1, 'Bald Hills' Stn, 44 km N. of Isabella Falls, Qld., 15°15′S 145°00′E, 29 Dec. 1984 mv lamp, G. and A. Daniels, EUQ.

Remarks

H. debbae can be separated from *H. bovilli* by the short pronotal spine and short length of groove along front of pronotum, which seldom reaches to level of the inner edge of eye and is usually much shorter, the relatively short width of wide portion of membranous area at front of frons (Fig. 10) and the more strongly expanded second segment of male maxillary palpus (Fig. 6). *H. debbae* is generally longer and broader than *H. bovilli*.

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THE ARCHAEOLOGICAL SIGNIFICANCE OF THE LOWER COOPER CREEK

P. VETH, G. HAMM & R. J. LAMPERT

Summary

A systematic survey of the Lower Cooper Creek has revealed an exceptionally rich record of prehistoric occupation, trade and subsistence strategies. Preliminary analysis of Holocene assemblages suggests significant differences in settlement/subsistence strategies between the floodplain unit and the dunefields proper, to the west. The location and dating of two hearths incorporated within dune cores clearly establishes a human presence in the central Lake Eyre Basin during the late Pleistocene.

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INTRODUCTION

It is something of a paradox that the Lower Cooper Creek, lying in the driest region of the Australian continent, should have an extraordinarily rich and diverse record of prehistoric human occupation. This apparent anomaly, however, can be explained largely by the periodic supply of huge volumes of water from a catchment originating in the eastern Highlands of central Queensland.

Although the catchment is 306 000 square kilometres the Lower Cooper only flows into Lake Eyre about once in every 10 years. To reach Lake Eyre the Lower Cooper passes through extensive dunefields of the Tirari Desert, an area receiving less than 125 mm of rain annually. Here the Cooper channel provides a string of pools and soakages which are differentially rejuvenated by both floodwaters and local rainfall, thus acting as a relatively well watered conduit through an intensely arid landscape (Bonython 1963).

During a six-week field season by Veth and Hamm, on a section of the Lower Cooper between the Birdsville Track and the eastern shore of Lake Eyre, 204 sites were recorded, the majority of which appear to date from the mid- to late Holocene. They include lithic scatters of varying complexity, stratified and deflated burials and hearths with ant-bed heat retainers, stone arrangements and a number of quarries with associated reduction areas.

Of interest on the Lower Cooper are frequent exposures of ancient flood plain sediments which contain a wide range of megafauna. The sediments date from Miocene to late Pleistocene times. Frequent exposures through these sediments have brought to light the remains of such aquatic species as lungfish and crocodile as well as such megafauna as diprotodontids, macropods and *Sthenuris*, fauna that provide evidence for previous lacustral phases when fresh water was abundant along the creekline (Wells 1986).

Climatic events witnessed in these sequences reflect global glacial cycles. Phases of high stream discharge and lake-full conditions are succeeded by dune building periods with aridity increasing towards the glacial maximum at 18 000 B.P. The periodic reactivation of this arid heartland has been summarised by Wells (1986: 101):

> The present desert landscape is one of ephemeral rivers, saline lakes and extensive dune fields. A sparse woodland survives along the ancestral river valleys. Beyond the valleys the great dunefields of the Tirari and Simpson Deserts sweep away to the north. In years of high rainfall the streams are rejuvenated, Lake Eyre floods and teems with fish and birdlife much as it has throughout the Pleistocene, only the crocodiles seem to be missing.

Three floodplain sedimentary units are exposed along different sections of the Lower Cooper channel. The oldest of these, the Tirari Formation, dates from the late Pliocene, and an intermediate unit, the Kutjitara, dates from the Middle Pleistocene. Only the youngest unit, the Katipiri Formation, could have relevance for the potential presence of early humans, although a terminal date around 80 000 B.P. is indicated (Tedford *et al.*, 1985; Callen & Nanson 1989). Mammals represented in the Katipiri Formation on Cooper Creek include the now extinct *Sarcophilus*, *Thylacoleo*,

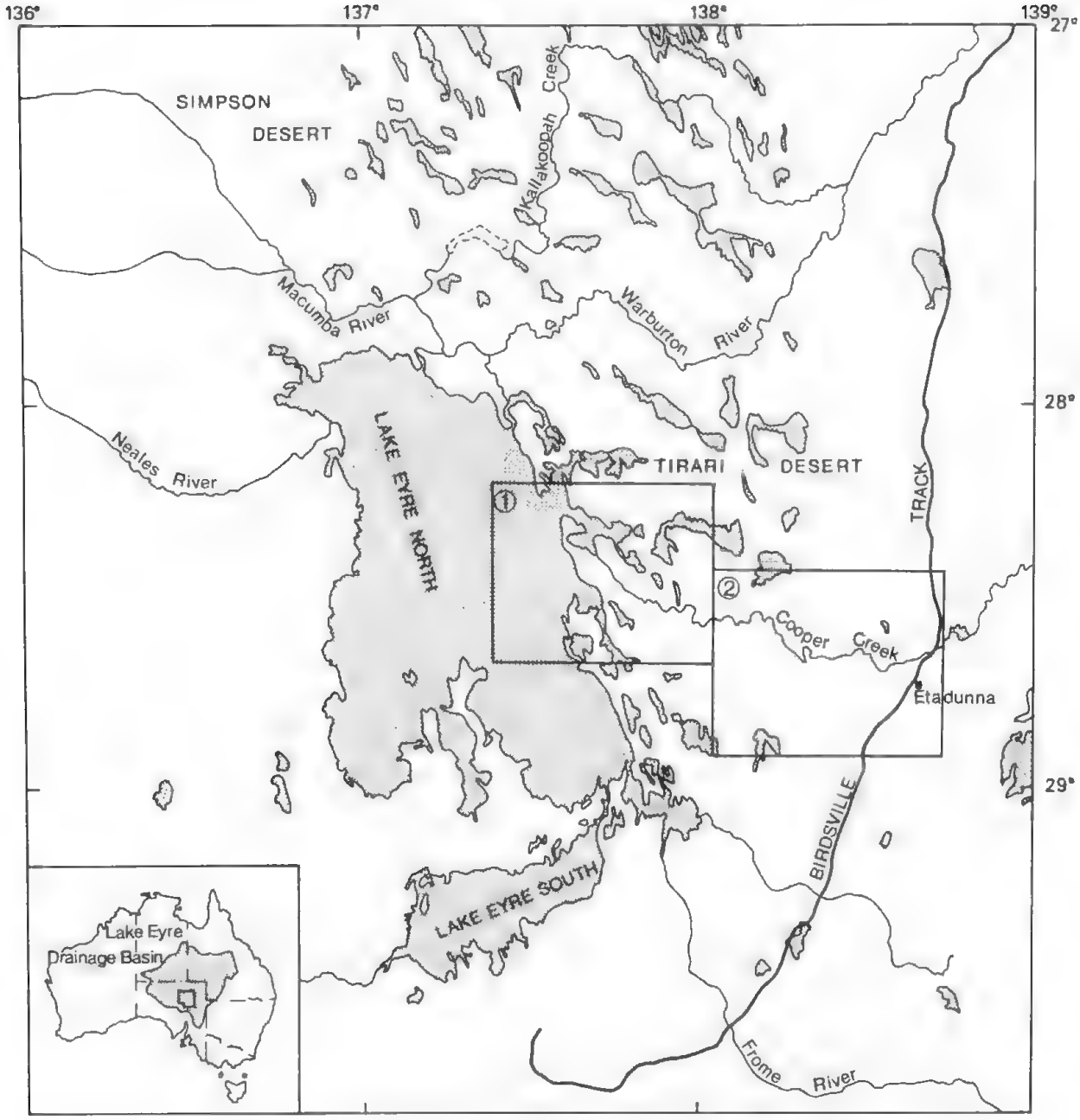


FIGURE 1. Regional context of Lower Cooper survey area. Map insets comprise Figs 2 and 3.

FIGURE 2. Location of archaeological sites, Lower Cooper Creek (inset 2).

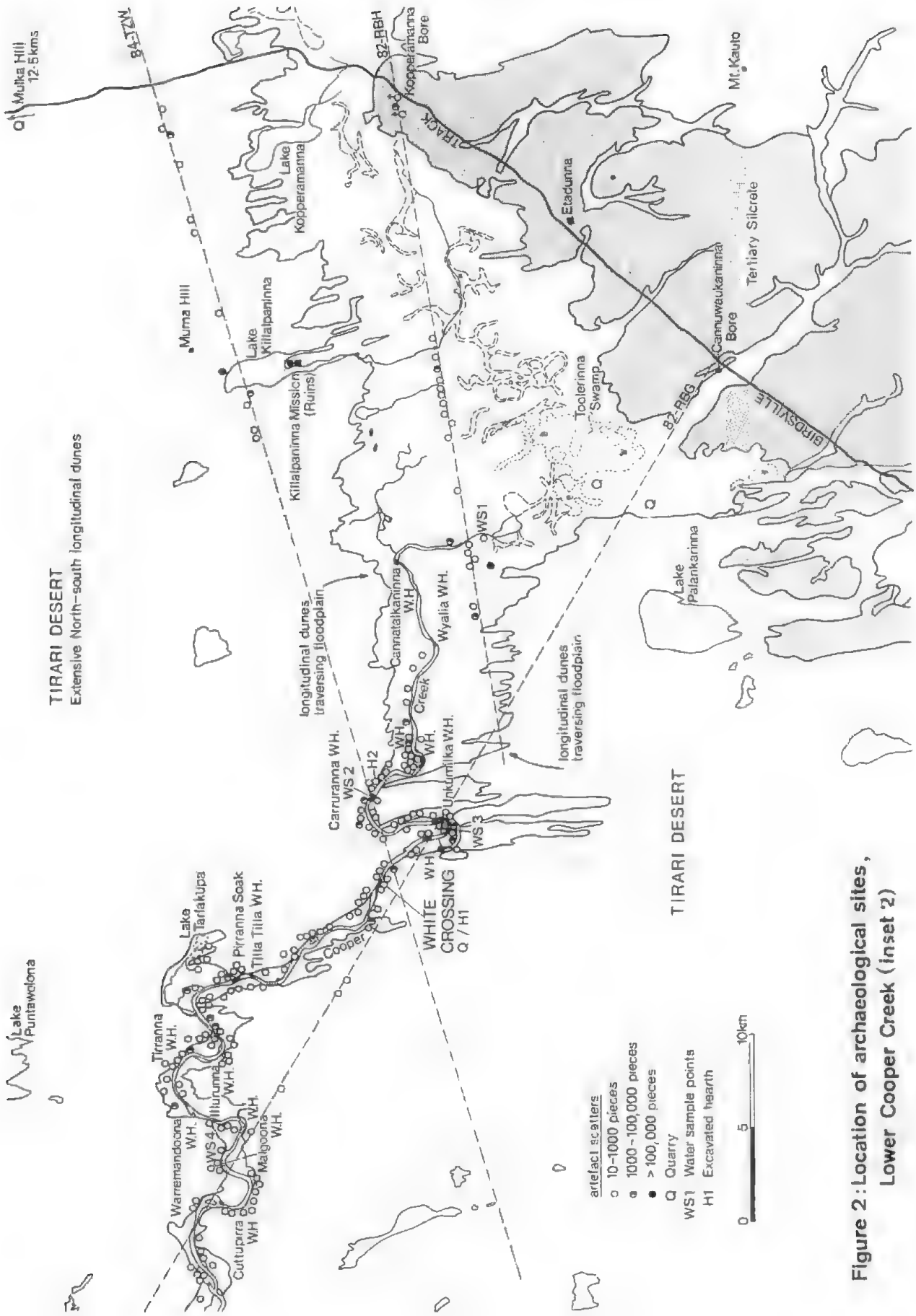


Figure 2: Location of archaeological sites, Lower Cooper Creek (inset 2)

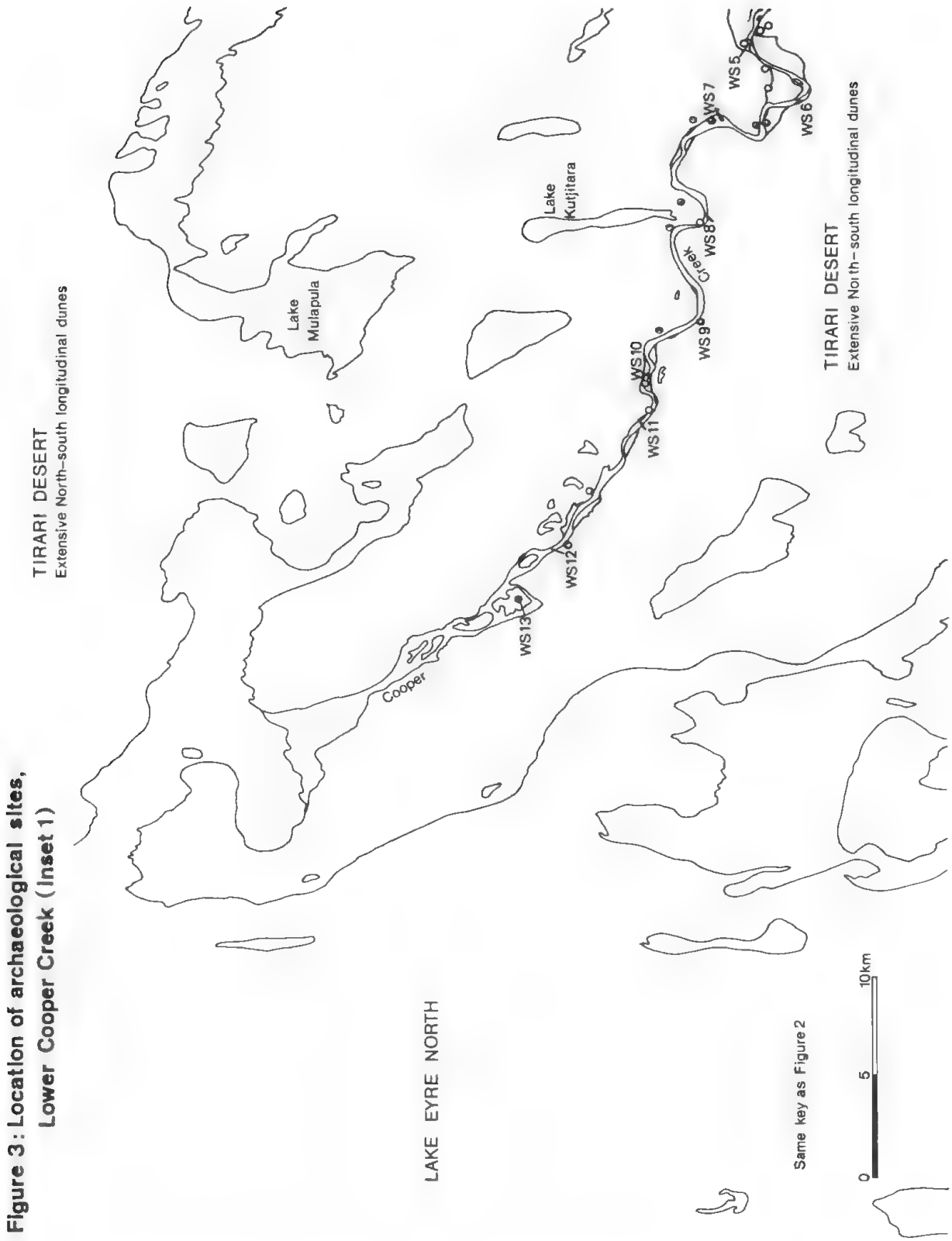


FIGURE 3. Location of archaeological sites, Lower Cooper Creek (inset 1).

Diprotodon, *Protemnodon*, *Sthenurus* and *Procoptodon* (Stirton *et al.* 1961). As Lampert *et al.* (1988) noted for Katipiri exposures along the Warburton, our systematic survey of these sediments along the Cooper did not reveal any cultural material *in situ*.

Of greater relevance to the generally accepted time for human occupation in the Lake Eyre Basin are widespread occurrences of calcreted dune cores, well exposed along the Lower Cooper channel through the deflation of overlying Holocene sands caused by stock and rabbits. The calcrete units can contain rhizoconcretions and nodules of calcrete as well as mammal remains and egg shell. While calcreted dune cores have been dated in two places to 34 700 B.P. and 40 000 B.P., on egg shell carbonates, their formational histories are still poorly understood (Wasson, pers. comm.). Finally, many deflated areas within the Holocene sands of the present dunefield expose lower, indurated levels which overlie the calcrete unit.

To date we have recorded three probable hearths and three burials clearly within Pleistocene calcrete units. Two of the hearths, located five kilometres apart (Fig. 2, H1 and H2), were tested and have returned dates of 11 830±320 B.P. (WK-1509) and 11 770±180 B.P. (WK-1510). Both flaked and edge-ground artefacts, as well as burials, have also been recorded within the later and presumably Holocene indurated dune unit. The results of this systematic archaeological survey of the Lower Cooper Creek provide substantial evidence for the presence of humans during the late Pleistocene in the interior of the Lake Eyre Basin.

Recent research in different areas of the arid zone, including both regional survey and excavation, has provided new perspectives on both the timing and the variability of arid zone adaptations. These stand in stark contrast to the previous archaeological assumptions (*cf.* Gould 1977) for conservative and unchanging cultural, economic and demographic behaviour within Australia's deserts (Hiscock 1989; Lampert & Hughes 1988; Smith 1986, 1988; Veth 1987, 1989a, 1989b; Williams 1988). The notion of a conservative desert culture is now, from an archaeological point of view, well and truly dead.

There are a number of relevant research questions which may be addressed by the data collected from the archaeological survey of the Lower Cooper Creek and these are outlined below.

With a reliable near basal date of approximately 21 950±270 B.P. at Puritjarra Rockshelter (Smith 1988: table 4.3) there is concrete evidence for Pleistocene occupation, albeit ephemeral, on the rim of the Lake Eyre Basin. A further date for human occupation of 15 270±210 B.P. has also been obtained from a rockshelter, Cuckadoo 1, located some 20 km south of Cloncurry in semi-arid Queensland (S. Sutton, pers. comm.). Further dates from Puritjarra, between a vertical gap separating the 21 950 B.P. near basal level and a higher level dated to 12 020±240 B.P., of 17 460±840 B.P. and 13 080±260 B.P. (Smith 1989), suggest some continuity of occupation in the permanently watered 'refuge' of the Cleland Hills. When the interior of the Lake Eyre Basin was actually colonised is currently a matter for debate, especially given the relative dates of greater than 40 000 B.P. claimed for an unstratified fragment of cranial vault from the Warburton River, east of Lake Eyre (Webb 1988). Clearly, a sequence of absolute dates on cultural assemblages from the interior of the Basin is needed before inferences can be made about human behaviour in the region during the late Pleistocene.

If the minimum end of Webb's relative dates for humans is accepted it is appropriate to ask whether this occupation represents a specialised adaptation to the relatively well watered drainage systems feeding the Lake Eyre megalake, or if prehistoric economies would have been generalised allowing widespread use of all land systems, including the extensive dunefields, sandsheets and margins of the saline playas? If there was early occupation, did it continue during earlier dune building phases through to the height of the glacial maximum and especially between 20 000 and 16 000 B.P. (*cf.* Bowler & Wasson 1984)? The mobilisation of dunefields, lowering of regional water tables and local restriction or extinction of potentially economic plant and animal species during the glacial maximum would have caused severe stress, even to small and highly mobile groups. The recently proposed biogeographic model for the colonisation of the interior of Australia views the occupation of the arid zone as a dynamic process with significant changes in the climate and hydrology of the interior, from after 40 000 B.P., forming a backdrop against which changes in demography, economy and social organisation occur (Veth 1989a).

These changes essentially result in some regions being permanently occupied before and during the height of the glacial maximum while others, such as the lowland sandsheets surrounding Lake Eyre, are predicted to have been abandoned during the period from 20 000 to 16 000 B.P. It is significant that sediments spanning both lacustral and arid phases are well represented along the Lower Cooper Creek and that spatially, these units might be logically correlated with former occupation loci. That the terminal Pleistocene series are less well expressed than overlying sediments is fully acknowledged, as are the limitations inherent in making quantitative comparisons of cultural assemblages between these units. It is still extremely

productive, however, to note such obvious trends as the total absence of material in some units and its presence in others, especially if this is repeated over a wide geographic area.

In terms of Holocene occupation patterns, previous work in the Lake Eyre Basin within the Simpson Desert (Hercus & Clarke 1986; Smith 1988), the Strzelecki Desert (Lampert & Hughes 1980, 1987, 1988), the Cooper Creek floodout zone (Williams 1988), the Warburton River (Lampert 1988) and the mound spring complexes (Florek 1987; Hughes & Lampert 1985) has documented a plethora of sites assigned to the mid- to late Holocene. Only a few, low density assemblages have been dated to the terminal Pleistocene/early Holocene (Lampert & Hughes 1988; Wasson 1983). The apparent increase in the number of occupation sites within the Lake Eyre Basin during the late Holocene correlates with significant increases in the rate of artefact discard noted from other stratified rockshelter and cave sites within the arid zone. Three stratified sites within the Little Sandy Desert, for which depth/age curves were constructed, all show a consistent trend in increasing rates of artefact discard, accelerating during the period 1400 to 800 B.P. (Veth 1989b: figure 6.12). This pattern is almost identical to that noted by Smith (1988: 315) from central Australian sites, where a significant increase in the density of flaked stone artefacts, grindstones, charcoal and bone is noted between 1400 and 600 B.P. It is therefore relevant to ask whether the same pattern of relatively intense late Holocene occupation occurs along the Lower Cooper, especially given the better than usual visibility of older sediments.

It was noted by Lampert (Lampert *et al.* 1988) that there was variation in the proportions of formal implement types between habitation sites on the Warburton River. Such variability between assemblages might be expected due to differences in the functions of sites. If it is assumed that the procurement and use of resources, be they lithic, plant or animal, are embedded within an overall economic system, then the functionally specific nature of sites can be accepted (*cf.* Binford 1980). Here, the function of sites is seen to reflect the repeated presence of different activity sets that might be associated with encampments of varying numbers of people and of varying residential permanency. An extreme example would be the differences that might be expected between major aggregation and redistribution sites (for trade goods) as opposed to ephemeral habitation camps. Assemblages from the Lower Cooper can be constructively examined for possible differences in reduction strategies as these reflect differences in social and economic behaviour (*cf.* Hiscock 1989). Also structuring the archaeological assemblages, although probably of lesser importance, are various behavioural responses to increasing distance from raw material sources; i.e. decreasing procurement efficiency. These behavioural responses may include more stringent criteria for discard (Byrne 1980), rationing (Hiscock 1984), use of alternative materials (O'Connell 1977) and more efficient reduction strategies (Bird 1985). These issues may be actively pursued along the Lower Cooper as there are well provenanced supply zones for many of the raw materials from which artefacts found on occupation sites have been manufactured. A range of ochres, bivalves, axes and sculptured stone objects found on the open sites are also known to have sources well outside the study area (McBryde 1989, pers. comm.; McConnell 1976).

Relevant questions for the Holocene might include, to what extent are habitation base-camps tethered to the more reliable water sources along the creek and to what extent do these differ from habitation sites located away from drainage lines in the dunefields and adjacent intermittent claypans and playas? Is habitation focused along a riverine 'conduit' through an otherwise harsh landscape or is there evidence for widespread use of all land systems within the Tirari Desert? Are these settlement patterns likely to have changed through time? Is there evidence for different settlement patterns with movement west along the Cooper Creek towards the shores of Lake Eyre and away from extensive swamp and floodplain systems? What are the significant changes in the structure of artefact assemblages with movement further west away from raw material supply zones? What is the archaeological evidence for long distance trade and exchange and what does this imply about social relations between the resident dialectal group, the Diyari, and adjoining language groups? Is it possible to identify a 'core' territory for the Diyari from the archaeological record and how does this relate to ethnographic and ethnohistorical accounts of demography and economy? Is there evidence in the archaeological record, from predominantly open sites, for an increase in population in the late Holocene? What are the likely mechanisms for an assumed late Holocene increase in population and how is this related to the extensive trade and exchange networks known to have operated through the Lower Cooper at contact? These and other questions can all be viewed within the broader framework of humans gradually recolonising the arid sandy lowlands from the refuges of the glacial maximum; refuges such as the Flinders Ranges and the central Australian Ranges (after Veth 1989a). It is possibly only by the terminal Pleistocene that groups colonising areas such as eastern Lake Eyre would have become truly adapted to arid conditions and developed regionally unique economies and

social structures which eventually produced the diversity of ethnographic desert cultures.

Settlement and Subsistence Modelling for the Lower Cooper

The Lower Cooper passes through the boundaries of the Diyari and Thirrari language/dialectal groups (Hercus 1987, 1988; O'Grady *et al.* 1966; Tindale 1974). While Thirrari has been argued to represent both a 'horde' (Howitt 1904) and a dialectal variant of Diyari (Austin 1981) the fact that the territory flanking the eastern shore of Lake Eyre and east along Cooper's Creek was part of a Diyari emic geomorphic distinction (Karling-alpa, *cf.* Wilson 1981: 51) suggests that at least a different pattern of settlement may have operated in this less watered country. Indeed, the boundary 'separating' Diyari territory from that of Thirrari marks the boundary between gibber plain and sandhill geomorphic units (Wilson 1981: figure 4). In simple terms, the section of the Lower Cooper channel and its floodplain, east from White Crossing and lying within Diyari territory, is relatively well watered and contains several large swamp systems, a string of semi-permanent pools and an extremely broad system of claypans and floodplain flats (Fig. 2).

Both Lake Killalpaninna and Lake Koppernunanna occur within this zone. By contrast, the western section of the channel, from White Crossing to Lake Eyre, has a negligible floodplain and the waterholes tend to be smaller, more discrete and of increased salinity (Fig. 3). It is significant that Cooper Creek and its floodout lakes, further north and east into Diyari territory, are seen historically to have been the main focus for regional settlement, on the basis of sightings of large numbers of people and semi-permanent camps (*cf.* Williams 1988: 56) and the highest density of named places on the Hillier map (Reuther 1981 in Wilson 1981: 87). The swamplands and lakes of the eastern portion of the Lower Cooper are seen to be most analogous to these 'core' Diyari areas.

A number of conclusions about settlement and subsistence behaviour from the Lakes area have been made by Jones (1979) and, on the basis of these, several archaeological predictions have been offered by Williams (1988). In summary, Jones argues for groups closely tethered to the rivers and lakes, penetrating somewhat opportunistically into the dunefields after rain. The sandhill unit is argued to be more productive, for plant foods and small mammals, than the lakes and rivers and these, in turn, are seen to be more favoured than the stony country. After viewing Jones' model, Williams (1988: 57) predicts that:

> . . . the largest sites will be found in areas which have permanent or semi-permanent water sources. Surface campsite material will be found in the dunefields but sites will be smaller than those on the margins of lakes and permanent waterholes.

While at a general level these predictions appear to be supported by Williams' survey of Coongie Lakes, it seems useful to predict in more detail what some of the differences in artefact assemblages between landform units might be, other than just size, as a result of different structuring of economic plant and water resources. Such assemblage differences might include variation in both formal implement and debitage classes as a reflection of different reduction strategies; strategies indicative of the site's role within a specific settlement system and its spatial relationship to key economic resources such as water, lithics and economic plants.

Hydrological and Rainfall Data

The precipitation patterns around Lake Eyre have been characterised in detail by Tetzlaff (1976). Over a 90 year period the long term precipitation is the lowest for the continent at approximately 120 mm per year. Although frequent shifts in mean circulation patterns cause variability in rainfall, a trend is noted in which maximum rainfall occurs in February with the minimum in late winter (July and August). A second weak maximum is noted in spring with another period of little or no precipitation in December. Most importantly, the rainfall in the Lake Eyre region only contributes a small amount to each flooding of the lake. Intermittent waterholes along the Cooper channel are clearly rejuvenated by local rainfall, however, either by direct run-off or by slow circulation of freshwater from saturated source-bordering dune and alluvial sediments. The importance of these saturated sediments in providing potable water through soakages, when the free-standing water becomes saline, is stressed in historical accounts (*cf.* Gregory 1906).

To characterise the quality of both surface and subterranean water sources along the Lower Cooper in more detail, we arranged for a series of controlled hydro-geological measurements to be taken at both pools and freshly dug soakages at intervals between the Birdsville Track and the shores of Lake Eyre; Locations WS1 to WS13 (Figs 2 and 3). The results of chemical analyses and electrical conductivity readings at both waterholes and soakages (made by John Noonan at the School of Earth Science, Flinders University) are shown in Table 1. The known upper tolerance for humans is 2–5 mS. At the time of our survey potable water could only be obtained from the three easternmost water sample points, significantly all located to the east of White Crossing within the broad floodplain unit. Interestingly, much lower readings were obtained

from soakages than from directly adjacent pools at all water sample locations. The consistently lower readings for soakage water support the notion of relatively fresh sub-surface water supplies. A mechanism for the replenishment of subsurface waters has been proposed (Noonan, pers. comm.) in which floodwaters, having scoured the creek bed of salts, saturate the remaining clean quartz levels as water velocity drops, and become entrapped under a slowly setting silt/clay blanket. Many of the saline pools of the Cooper Creek probably post-date flooding and actually lie on top of this impermeable skin. Water falling on source-bordering dunes could seep under the clay horizon, rejuvenating the entrapped waters.

Limited bore hole data, from the South Australian Department of Engineering and Water Supply, also provide evidence for an extremely high local water table at the important occupation site of Unkumilka Waterhole within the eastern floodplain unit (see Fig. 2).

A range of sources (Bonython 1955, 1963; Litchfield 1983; Madigan 1946, Mason 1955) note that between 1885 and 1984 at least one portion of th Lower Cooper probably flowed some 25 times. These waters probably reached Lake Eyre at least five and possibly as many as 20 times. Many of the accounts note that the floodwaters coming down as far as the Lower Cooper often only reached Lakes Kopperamanna and Killalpaninna in the vicinity of the Birdsville Track (see also Mollemans *et al.* 1984, Appendix 2). As Gregory (1906: 59) notes of Lake Killalpaninna:

> [It] is a veritable oasis in the wilderness. The lake, unlike most of the so-called lakes in this country, actually contains some water . . . When full, the lake water is fresh and photographs taken of the mission at such periods show that the situation is then quite picturesque.

Bonython (1963) has documented the progress of a typical flood which reaches the shores of Lake Eyre. At the end of March, heavy rains occurred at the headwaters of the Cooper and Diamantina, following on from minor falls in January. By April 19th the Cooper flood had reached Innamincka in South Australia. The flood then reached the Coongie Lakes (already holding water from an earlier flood) and went to Kanowana by May 9th. The flood was halted for a period of 10 days here and then by May 20th was moving again to reach Lake Hope. After being held here for two weeks it finally reached the Birdsville Track at Kopperamanna on July 10th. By July 15th, the flood had reached Lake Killalpaninna, where it was held up for two further weeks while filling the floodout area (e.g Toolerinna Swamp, see Fig. 2). Around July 28th the Cooper appeared to burst through a veritable dam, reaching the shores of Lake Eyre by August 8th.

This, and other accounts, suggest that the Kopperamanna and Killalpaninna floodout zone was reached more often than the western half of the Lower Cooper Creek, and in turn that the Lower Cooper as a whole flooded less often than the Coongie/Kanowana region. On the basis of the hydrological data there appears to be further reason for delineating a 'boundary' between Thirrari and Diyari territory along the central portion of the Lower Cooper.

TABLE 1. Chlorine content and electrical conductivity of water samples taken from waterhole and soakage sample points (WS1 to WS13), Lower Cooper Creek (Figs 2 and 3).

Location	Dist. Downst. (km)	Cl-WH (mg/l)	Cl-Soaks (mg/l)	EC-WH (mS)	EC-Soaks (mS)
1	0	337		0.630	
2	22	4970	1278	13.300	3.200
3	27	2272	781	13.000	2.600
4	62	46150		104.200	
5	76	92300		126.000	
6	82	53250	6745	110.300	56.300
7	89	134900	46150	131.600	39.300
8	98	67450		126.400	
9	105	81650		125.800	
10	111	113600	23430	128.900	20.900
11	113		8165		16.800
12	121	184600		117.600	13.000
13	125	198800		115.400	

Economic Plant Species

A wide range of economic plants are likely to have been available to the prehistoric occupants of the Lower Cooper Creek. Notwithstanding the recent changes in the ecology of the area, a number of sources, including ethnohistorical and ethnographic records (*cf.* Gason 1879; Cleland & Johnston 1943a, 1943b), recent vegetation surveys of the Lower Cooper (Badman, n.d.) and adjacent areas (Mollemans *et al.* 1984) and comparative ethnobotanical data from similar desertlands (Clarke n.d.; Walsh 1987a, 1987b), illustrate that at least 30 seed and fruit-bearing species were available in addition to five rootstocks and a variety of fleshy-leafed herbs. Contrary to Jones' (1979) assumptions about the comparatively high productivity of the sandhill country of the Cooper Lakes districts, the distribution of economic food species in the Lower Cooper region appears to be fairly even between the sandhill and floodplain land units. Indeed if the quantitative ethnobotanical data available from the central and northwestern arid zone is examined (O'Connell & Hawkes 1984; Walsh 1987a; Kalotas, pers. comm.), in relation to the comparative productivity of different landform units, it is clear that it is at the ecotone between the drainage line and sandplain units that the greatest richness and diversity of economic plant foods occur. The arguably greater productivity of these environmentally fine-grained riverine 'conduits', however, in no way diminishes the importance of the extensive and easily accessible seed stands of the dunefields which are well documented as having comprised major groups of staples (*cf.* Veth & Walsh 1988).

On the available evidence, the majority of economic plant species are likely to have yielded edible components between March to November with the period of lowest productivity assumed to coincide with the intensely hot summer period. The period of greatest economic plant productivity follows several months after the highest average monthly rainfall. From March on, a number of seed-bearing species would be available with the later (winter) addition of further seeds, fruits, herbs and acacias. While rootstock are available all year, they are documented to be most palatable during and after periods of high local rainfall. Acacia seeds are likely to be available well towards and into summer, both on the plant and as seedfall. The deliberate storage of hard coated species for the lean summer months may also have occurred (*cf.* Veth & Walsh 1988)

Faunal Resources

Large fauna appears to have been virtually absent from Diyari and Thirrari country (Gason 1879: 278; Johnston 1943; Jung 1877: 70). Instead, medium and small marsupials which could survive without permanent surface water were commonly exploited. These included the bilby *(Macrotis lagotis)* and lesser bilby *(M. leucura)*, the desert rat kangaroo *(Caloprymnus campestris)*, the hopping mouse *(Notomys cervinus)*, the native cat *(Dasyurus geoffroii)* and the marsupial mouse *(Sminthopsis crassicaudata centralis)*. Quail *(Coturnix novaezelandiae pectoralis)*, a range of ducks *(Anas superciliosa, Chenonetta jubata, Dendrocygna eytoni, Tadorna tadornoides* and *Aythya australis)* and teal *(Anas gracilis)* are also noted to have been a food source, in addition to the plumage being used in ceremony (*cf.* Gason 1879; Howitt 1891). Reptiles exploited included the woma python *(Aspidites ramsayi)*, the death adder and brown snake *(Acanthophis antarcticus* and *Pseudechis australis)*, the bearded dragon and sleepy lizard *(Pogona barbata* and *Trachydosaurus rugosus)*, the perentie *(Varanus giganteus)* and Gould's goanna *(Varanus gouldii)* (*cf.* Gason 1879; Berndt & Vogelsang 1941; Johnston 1943). The water holding frog *(Cyclorana platycephala)* is noted as a food source, being also a totem for some Diyari groups (*cf.* Gason 1879; Howitt 1904). Numerous other smaller frogs and lizards are also recorded in the ethnohistorical sources.

Apart from the majority of the birds, which would only be seasonally abundant on the Lower Cooper, the medium and small marsupials, reptiles and amphibians (while fluctuating in numbers) would be generally available across most landform types in the study area. There is no sound reason for viewing the sandhills as being depauperate in fauna after local rains in comparison to the floodplain flats (*cf.* Jones 1979: 151-154). The riverine/sandhill interphase is still likely to have had the greatest diversity and richness of economic fauna.

Distribution of Lithic Resources

There are sources for three classes of lithic material represented in the artefact assemblages of the Lower Cooper. These sources are spatially discrete and it is therefore possible to define 'supply zones'. The dominant lithic material at most sites comprises fine to medium-grained silcrete. Large exposures of Tertiary silcretes outcrop on extensive gibber surfaces at the eastern margin of the study area (Forbes 1974). The westernmost extension of the silcretes approximates the route of the Birdsville Track (see Fig. 2). The silcrete commonly takes the form of large gibber nodules up to 20 cm in diameter. Flaked gibber nodules, reduction areas and decortification flakes were noted in numerous places over the Tertiary silcrete unit. There are no exposures of silcrete along the Lower Cooper between this unit and the shores of Lake Eyre.

Another stone material found on sites, and dominant at a few, is a white siliceous calcareous mudstone outcropping as part of the Etadunna formation. Only several outcrops are documented in the Lower Cooper region; one at White Crossing on the channel itself and several others on the margins of lakes such as Palankarinna (see Fig. 2). The exposure at White Crossing has clearly been quarried and reduction areas are visible on the upper slopes of adjacent banks.

Finally, there is a variety of Cretaceous and Tertiary sandstones which are also located on lake margins in the region and which appear as whole and fragmented grinding material on open sites. Other raw materials found on sites, yet which have no known local source, include chalcedony, a range of cherts and Innamincka-quality red-brown sandstone. The trade of the high quality Innamincka sandstone into the Lower Cooper area is discussed below.

Trade

Wilson notes that the Diyari, and it can also be assumed here, the Thirrari, had to procure many raw materials from outside their territory (Wilson 1981: 69). The most notable of those traded into their territory included large boomerangs, stone axes, grinding stones, softwood shields, various ochres, pituri and gum (*cf.* Jones 1984; McConnell 1976; McBryde 1989). These were also obtained through expeditions to the sources of these materials. It appears that the Diyari were intermediaries in a large trade network which focused on the Middle Cooper Creek region (Howitt 1904). Grindstones and red ochre are known to have been procured from the western flanks of the Flinders Ranges at Parachilna (Howitt 1904: 711-12; Jones 1984) and millstones to have been obtained from Innamincka amongst other regional sources (see McConnell 1976: figure 19). The characteristic red-oxide sandstone grinding blanks which have been recorded at the Innamincka quarries (Luebbers, pers. comm.) are often found as partial and fragmented grinding bases on many of the Lower Cooper habitation sites. Their mineralogical similarity has been confirmed by recent petrological analysis (McBryde, pers. comm.). This grinding material was highly prized, as Reuther (quoted in Wilson 1981: 70) notes:

> These millstones are brought from Jidniminka (Innamincka) for the purposes of trade. The Jandruwanta and Jauraworka people are owners of this stone-pit, which is of great importance to them for the bartering trade.
> A good millstone passes for a considerable fortune. In the first place, one has to pay heavily for it; what is more it is not a trifling matter to carry such a (large and heavy) stone on the head. Many an older brother has traded his sister for a good millstone.

Two ochre samples collected from open sites located west from White Crossing have been analysed by x-ray diffraction in order to characterise their mineralogy and assess regional quarry sources. One of these, a red ochre fragment (CC61) comprises major quartz (SiO_2) and hematite, trace feldspar and kaolinite. The other, a yellow ochre fragment (CC66) is described as major goethite ($FeOOH$) with minor quartz and kaolinite. A sample of red ochre from the famous Parachilna quarry of the northern Flinders Ranges demonstrated a major dolomite [$CaMg(CO_3)$] phase with minor hematite (Fe_2O_3) and trace calcite ($CaCO_3$) (Raven, pers. comm.). Clearly the regional sources are mineralogically diverse and more sampling at the known quarries (*cf.* McConnell 1976: figure 14) is required before meaningful statements about exchange routes for ochre can be made.

Other trade items found on some of the Lower Cooper sites, in addition to ochre and grinding material, include edge-ground axes, valves of the freshwater mussel (*Velesunio wilsonii*) and a cylcon. Several of the axes have been thin-sectioned and comprise dolerite, probably from a major quarry source, such as at Mt Isa, Queensland (McBryde, pers. comm.). The mussel valves are likely to have originated upstream from an area such as the Coongie Lakes, while the source of the cylcon, manufactured from calcareous sandstone, is unknown.

The exchange networks of the Lake Eyre Basin linked the two extremes of the Australian continent, from Spencer Gulf in the south to the Gulf of Carpentaria in the north. Ceremonies, song and both sacred and mundane knowledge also moved along these trade routes (*cf.* McConnell 1976). The adaptive significance of these massive reciprocity networks has been elegantly summarised by McBryde (1989: 174), who notes:

> ... some anthropologists have seen the long-distance desert trading networks as adaptive, social mechanisms for desert survival rather than economic mechanisms for coping with environments where resources are sparse and lack diversity.

Proposed Settlement/Subsistence Strategy for the Lower Cooper

Here, we propose a land-use model which aims to predict landform associations which would have provided access to reliable water and plant resources and which are likely to have been targeted most often for both residence and foraging. In other words, predictions are made for those areas which

are likely to have been the site of relatively large and/or long term occupation and which are likely to reflect more complex and varied economic/social behaviour. Other areas are also identified which are likely to have been used in a transient mode and, finally, those portions of the landscape which would only have been used for task-specific activities (i.e. not for residence) are predicted. This model ultimately aims to make general predictions about the complexity of economic and social behaviour that might be expected in different parts of the Diyari/Thirrari landscape. The model is only applicable to the period after climatic amelioration following the glacial maximum, that is after 14 000 B.P. Although climatic oscillations are recorded for this period, they are minor compared with those preceding it (*cf.* Tedford *et al.* 1985). It is assumed that the area would have been abandoned by humans, as would many sandy lowland plains of the arid zone, during the height of the glacial maximum, i.e. 20–16 000 B.P. (*cf.* Smith 1988; Veth 1989a, 1989b). The possibility of human occupation in this area before 25 000 B.P., the time of the onset of intensified aridity, is raised only by Caldwell and Webb's claim for relative fluorine dating on a fragment of human cranial vault to greater than 40 000 years (Caldwell & Webb 1988: 10).

The provisional settlement/subsistence model for the Lower Cooper region may be summarised, as follows:

The ecotone between the dunefields, floodplains (including the few freshwater lakes and swamps) and drainage course of the Lower Cooper represents the most productive habitat for plant food staples and for structural materials for shelter, storage and the manufacture of mundane and non-secular wooden artefacts. It is also the site of the largest and most reliable water sources, both in the form of free-standing pools and as subterranean soakage. Where the floodplain is widest and the dunes either abut or partially traverse it, the widest range of staple plants with the most evenly staggered fruiting and seeding times will be accessible to resident groups. These associations are found along the Lower Cooper course from approximately Toolerinna Swamp, west, to the vicinity of White Crossing (see Fig. 2).

The ecotone between the dunefields and drainage course, in the absence of a significant floodplain, will be less productive for plant-food staples and certainly for structural materials. Potable water sources are more sporadic with a trend towards higher salinity. Permanent soakages are rare. This association is found along the Lower Cooper from approximately White Crossing, west, to the shore of Lake Eyre (see Figs 2 and 3).

The homogeneous dunefield landscape unit, in itself, is seen to be the least productive. Although the dunefields provide a wide range of staples (particularly seeds) some time after local rains, their distribution will be sporadic. Both (ephemeral) water sources and fauna may also be assumed to be widely distributed within this landform. Although more permanent interdunal soaks may occur at a distance from the Lower Cooper, it is unlikely they were common, given the lack of reference to them in historical records and the fact that none were intersected during survey transects through the dunefields.

It is predicted that it is at the ecotone of the dunefields, floodplain and drainage courses that the most 'intensive' occupation will have occurred. These areas would have been the loci for major aggregations of people and also of continual use throughout the emic resource calendar. Aggregation cycles may have followed a loosely seasonal pattern, peaking with the local abundance of water and plant staples from March to August. These localities should reflect more complex and varied economic and social behaviour. The ecotone between the dunefields and the drainage line of the western section will sometimes have been the site of large basecamps, however these will be strongly focused on more intermittently spaced water sources. Less intensive occupation might be expected along adjoining portions of the creek lacking reliable water sources. Finally, habitation sites will only be located in the homogeneous dunefields where ephemeral water sources occur and these sites will reflect less intense and variable economic and social behaviour than those on the drainage lines. All other sites located within the dunefields, away from water sources, are assumed to be task-specific and to reflect either resource procurement or maintenance activities. Many of these predictions can be tested, as demonstrated later in this paper, through an analysis of assemblage variability.

Survey Strategy

Given that the survey aimed to characterise occupation patterns both at and away from the Cooper drainage course, a number of complementary survey strategies were employed. A corridor of approximately 500 m each side of the Creek from Toolerinna Swamp to the shore of Lake Eyre was surveyed intensively. Linear traverses were made on foot at intervals of up to 100 m apart, these being parallel to the drainage course.

Transects at a remove from the Cooper Creek were usually aligned along seismic tracks, which run approximately east/west from the Birdsville Track to Lake Eyre. While not always running parallel to the creekline, they offered controlled samples intersecting the extensive north-south oriented dunes.

Those surveyed were located up to 5 kms from the creekline; with an average distance of 3 km. These transects were 100 m in width (major seismic routes are shown in Fig. 2). Several 100 m wide transects were also made at right angles to the creek down interdunal corridors. These were made to the north of the creek terminating at Lake Tarlakupa and to the south of the creek at Unkumilka Waterhole and at Malgoona Waterhole.

It is estimated that approximately 125 km^2 (125 km x 1 km) of the riverine conduit was surveyed. A total of approximately 50 km^2 of the sandhill landform was surveyed. Further transects through the dunes and around the large saline lakes are planned.

Description and Patterning Sites

Introduction:

A total of 204 archaeological sites were recorded during the 1989 field season on the Lower Cooper Creek. These are all open sites, the majority of which are lithic scatters of varying size and complexity. The location of these sites is shown in Figs 2 and 3; and the estimated number of artefacts in each is broken into three size ranges (see key). The study area is divided into four analytical units:

(i) the western drainage system (no. of sites = 101);
(ii) the western dunefields, all west of White Crossing (no. of sites = 3);
(iii) the eastern drainage system (no. of sites = 86) (inclusive of floodplain); and
(iv) the eastern dunefields (no. of sites = 13), all east of White Crossing.

A quarry at Mulka Hill (Fig. 2) does not fall into any of these areas. The majority of sites in both the western and eastern half of the Lower Cooper (94.23% and 87.88%) consist only of stone artefact scatters but others also contain burials, hearths and quarries. Importantly, a higher proportion of sites containing more than one of these components occurs within the eastern sector, where there is also a higher proportion of sites with evidence for stratification (i.e. 7.78% as compared to 0.96%).

As the artefact population coding in Figs 2 and 3 illustrates, the majority of open surface scatters comprise fewer than 1000 pieces. While intermediate-sized scatters, containing from 1000 to 100 000 pieces, occur both to the west and east of White Crossing, none are recorded west from Warremandoona Waterhole for approximately the 75 km stretch down the Lower Cooper to Lake Eyre. No large scatters, comprising more than 100 000 pieces, are located outside the eastern floodplain zone; i.e. none occur west of White Crossing.

Silcrete quarries were located near Toolerinna Swamp east of Lake Palankarinna, near Etadunna Station and at Mulka Hill (see Fig. 2). These large complexes are all located on gibber outcrops of Tertiary silcrete at the eastern edge of the survey area. The silcrete varies from extremely fine-grained, which appears to have been selectively utilised for the production of unifacial points, geometric microliths and blade endscrapers, to medium to coarse-grained; the latter usually represented in the tula adze, retouched/utilised and 'chopper' categories. Only decortification and low intensity gibber reduction has occurred at the quarries with implement manufacture occurring at other localities. As is common at such sources, the proportions of retouched/utilised pieces and of other lithologies are low; i.e. < 0.5% (*cf.* Clark 1987; Veth 1982). Intensive survey and sampling of the Tertiary silcrete quarries will be undertaken by one of us (G.H.) as part of a postgraduate project starting in 1990 on the Lower Cooper. It is worth noting that stone arrangements occur in the vicinity of the quarries, usually in the form of circular to oval alignments of flaked and thermally fractured silcrete gibber boulders.

Burials and hearths usually occur within site complexes that also contain stone artefacts, only one isolated burial being located. Most lie within major basecamps, usually containing numerous grinding bases, several thousand pieces of flaked stone, and such trade items as ochre and axes, often in stratified contexts. Hearths characteristically contain mixtures of burnt ant bed, charcoal and oxidised sediments.

There are no geological features within the study area that might provide rockshelters or caves with stratified occupation deposits. The only known cave, a mythological site located on a creek draining into Lake Palankarinna (Ditji-mincka) has collapsed and, in any event, would not be an appropriate place to excavate given its continuing religious associations to the Diyari (Hercus 1987).

Preliminary observations on variability in debitage, cores and implements on the Lower Cooper:

Debitage was divided into four mutually exclusive classes based on the hierarchical key proposed by Sullivan and Rozen (1985: 758). The classes are complete flakes, broken flakes, flake fragments and debris. While the characterisation of 'distinct assemblages of debitage' must await detailed sampling of individual sites, it is possible to make several general comments on variation in debitage proportions. Whole and broken flakes (i.e. those with bulbs) are proportionally dominant at major sites within the western section of the Lower Cooper in the silcrete and silicified sandstone categories. Conversely, the proportion of flake fragments and

debris is higher at the larger sites within the eastern zone in the same material categories. Predictably, silcrete decortification flakes appear to make up a higher proportion of debitage assemblages within the eastern floodplain zone, closer to the Tertiary silcrete outcrops.

Mean flake size in both silcrete and silicified mudstone also appears to decrease in the western zone. While blades are found on sites in both zones, almost always in fine-grained silcrete and chert, they represent a much lower proportion of debitage within the western zone. There is a concomitant scarcity of blade cores in the western zone. Of interest is the lack of heavily reduced and exhausted cores in the western zone, given the decreased procurement efficiency here for the silcretes. The highest proportion of such cores is found at what are assumed to be major aggregation sites within the floodplain unit, i.e. those with over 100 000 pieces. Interestingly, larger gibber boulders with only cortex removed were found at sites from near the Birdsville Track to almost the shores of Lake Eyre, although these did represent a greater proportion of cores found at sites in the eastern zone than in the west. A recently deflated cache of such cores was recorded at the major occupation site of Unkumilka, located some 50 km west of the Tertiary silcretes.

A wide range of retouched/utilised flakes occur on the sites which do not conform to the technological criteria for tula adzes, unifacial points, backed pieces and graving implements. These include pieces often referred to in the literature as core scrapers, steep sided scrapers, concave scrapers, notched and denticulate pieces (*cf.* Isaac 1977; Lampert 1981; McCarthy 1976). The differences in morphology of the working edge of the implements is seen to be largely the result of the degree of their reduction and edge rejuvenation and the raw material on which they were manufactured (*cf.* Hiscock 1982; Witter n.d.). A commonly recurring form comprises blades and elongated flakes, distally retouched onto the dorsal surface to produce a medium to steep-angled step and scalar retouched working edge which is convex in plan (Fig. 4, no. 1). Most robust flakes typically show greater variability in edge shape, demonstrating steep angled, step terminated or notched edges (Fig. 4, nos 2–5).

The majority of tulas from the sites are in slug stage, exhibiting some variation in both platform and orientation of retouch to the platform. A number of obliquely truncated slugs suggest that the implements have been consistently applied to the worked material at an angle not parallel to the striking platform (Fig. 4, nos 6–9). Whole tulas were found in some numbers at the major lithic scatters within the floodplain unit. Clusters of between 15 and 35 unutilised tulas, all in medium ground silcrete, were located at three sites and it is likely that these standardised items had been cached and exposed on recently deflated surfaces. Sites with tula clusters are located between 20 to 55 km west from the silcrete supply zone. Most tula flakes and slugs on the open sites have been fashioned from medium-grained silcrete, although a minor proportion occur in chert and chalcedony (Fig. 4, nos 10 and 11).

Backed implements, although never in large numbers, occur at a variety of sites within the eastern floodplain zone. As noted from Central Australian samples (Smith 1988: 90) geometric forms, such as segments, are dominant over non-geometric forms, such as asymmetric and obliquely truncated points (Fig. 5, nos 1–5). Backed implements are predominantly fashioned from fine-grained silcretes, although occasional examples in chert and chalcedony were noted. Unifacial (pirri) points are relatively abundant at some of the larger sites on the floodplain zone. In contrast, they are virtually absent from the western drainage unit. They are almost exclusively fashioned from fine-grained silcretes and display little variation in size attributes, although a few 'notched' specimens were noted. These points, with few exceptions, have had their platforms removed by retouch onto the ventral surface (Fig. 5, nos 6–9). Where the ratio of formal to other retouched/utilised pieces at sites was estimated to be greater than one, there appeared to be an inverse relationship between the proportion of unifacial points and the proportion of tula adzes.

Hafted engraving implements located on the open sites are represented by two formal types, the marni wadna and pirri graver (Fig. 6; 1–2, 3–4) (Kamminga 1985). Only a total of seven specimens (four and three, respectively) were recorded, and these all on larger sites on the eastern floodplain unit. The cross-sections through these archaeological specimens clearly show the different wood gouging profiles; v-shaped versus concave.

Edge-ground axes were recorded from major sites at Unkumilka, Lake Killalpaninna and north-west from Toolerinna Swamp (Fig. 2). All of the axes are symmetrical in section and conform to items traded from the north, as described by McConnell (1976). Two of the axes have had thin sections made and are identified as dolerite, with a petrology identical to that of the Mount Isa axe quarry (McBryde, pers. comm.) (Fig. 7).

As noted, partially flaked silcrete gibber occurs on sites across all geographic zones. Sometimes, when bidirectionally flaked, the boulders have margins with evidence for step fracturing and crushing, suggesting their use as implements. Given the evidence for similar edge damage on cores without microscopic evidence of use-wear

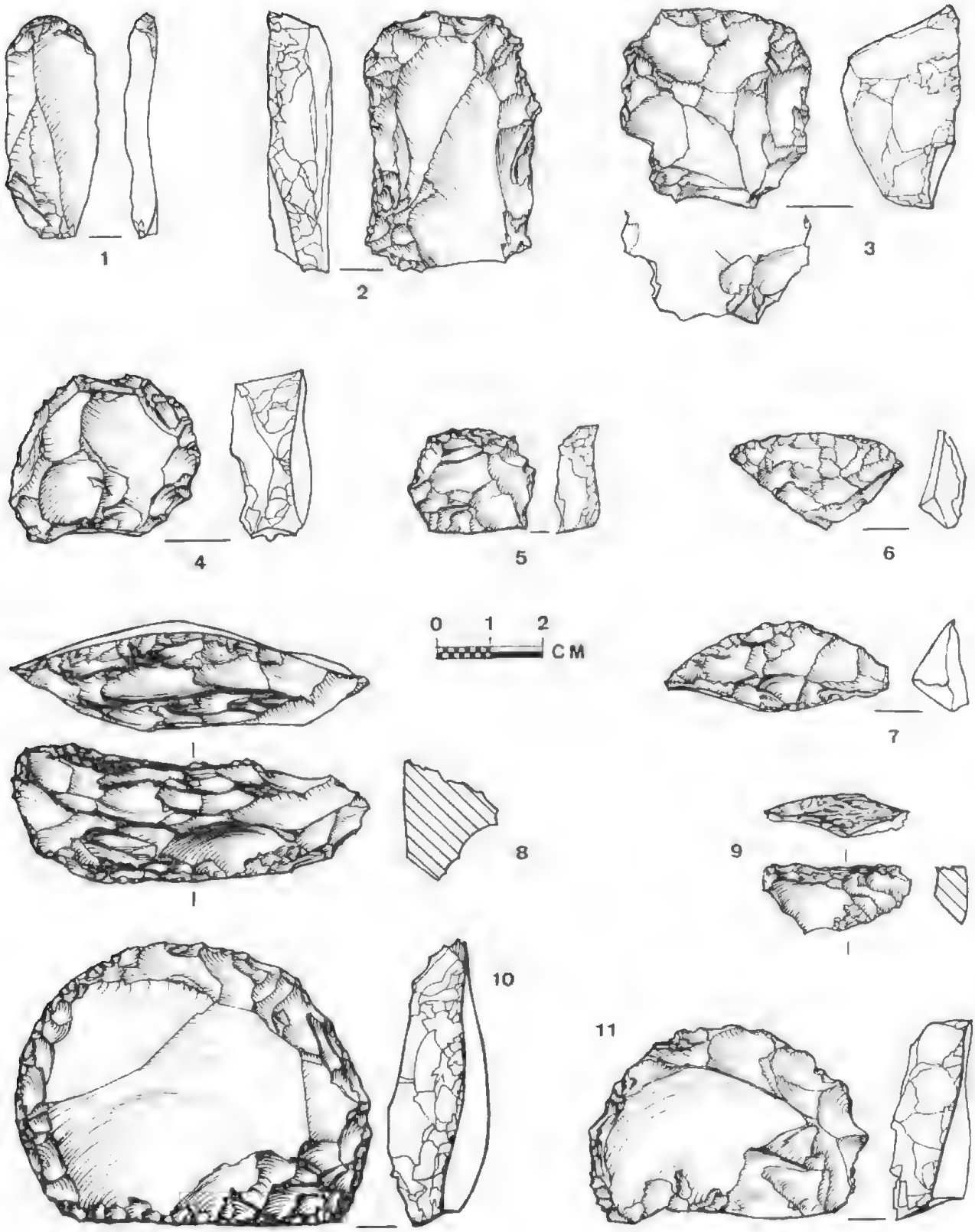


FIGURE 4. 1 Distally retouched blade.
2–5 Retouched utilised flakes.
6–9 Tula adze slugs.
10–11 Tula flakes (Field site nos CC 89, 66, 66, 126, 126, 57, 57, 54, 56, 65, 97).

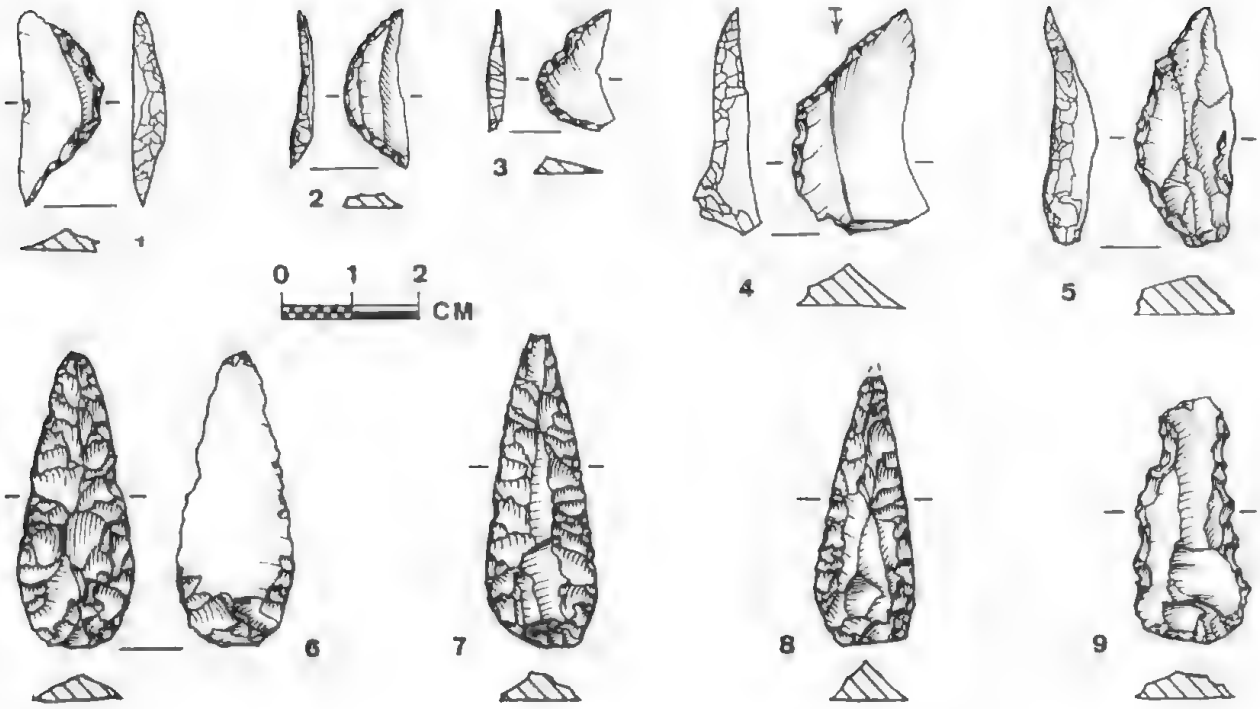


FIGURE 5. 1–5 Backed pieces (segment and point).
6–9 Unifacial points (CC 140, 118, 105, 105, 133, 66, 159, 88, 129).

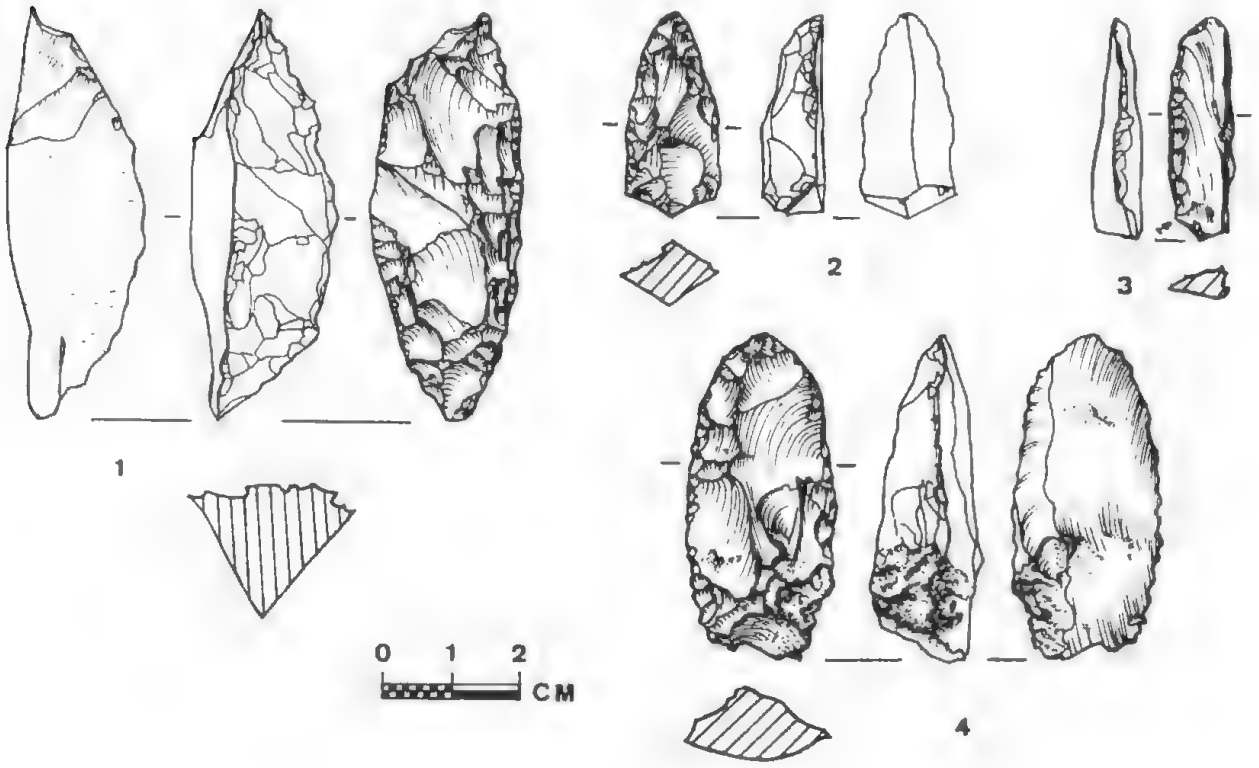
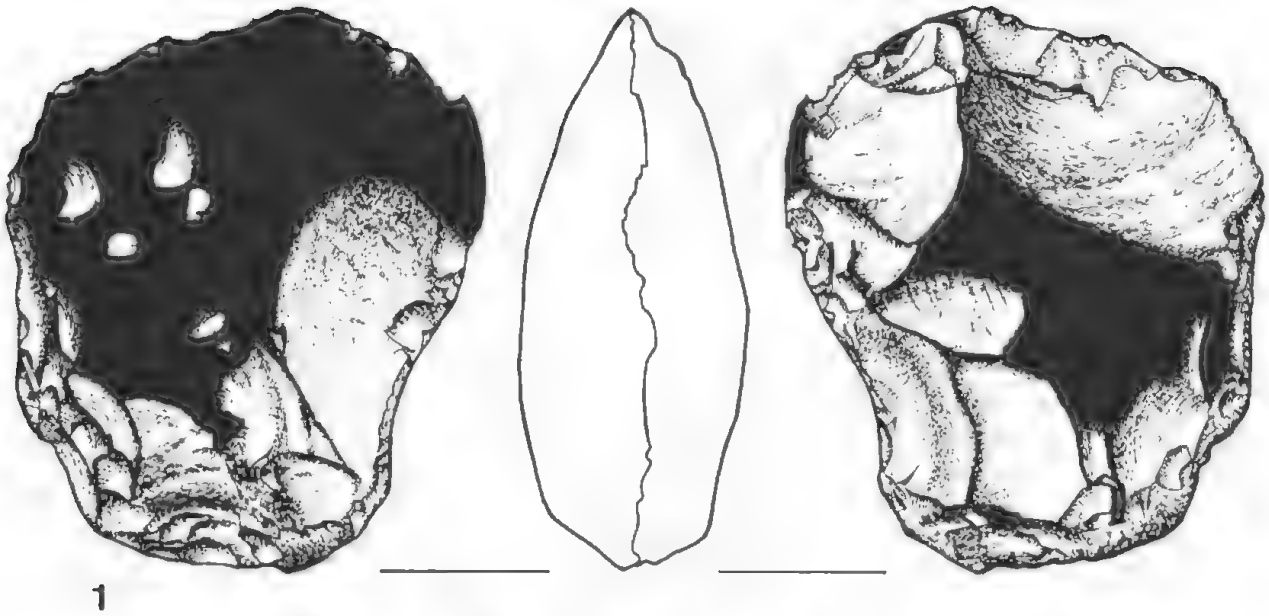


FIGURE 6. 1 Marni wadna.
2 Marni wadna (laterally snapped).
3–4 Pirri gravers (CC 65, 93, 139, 54).



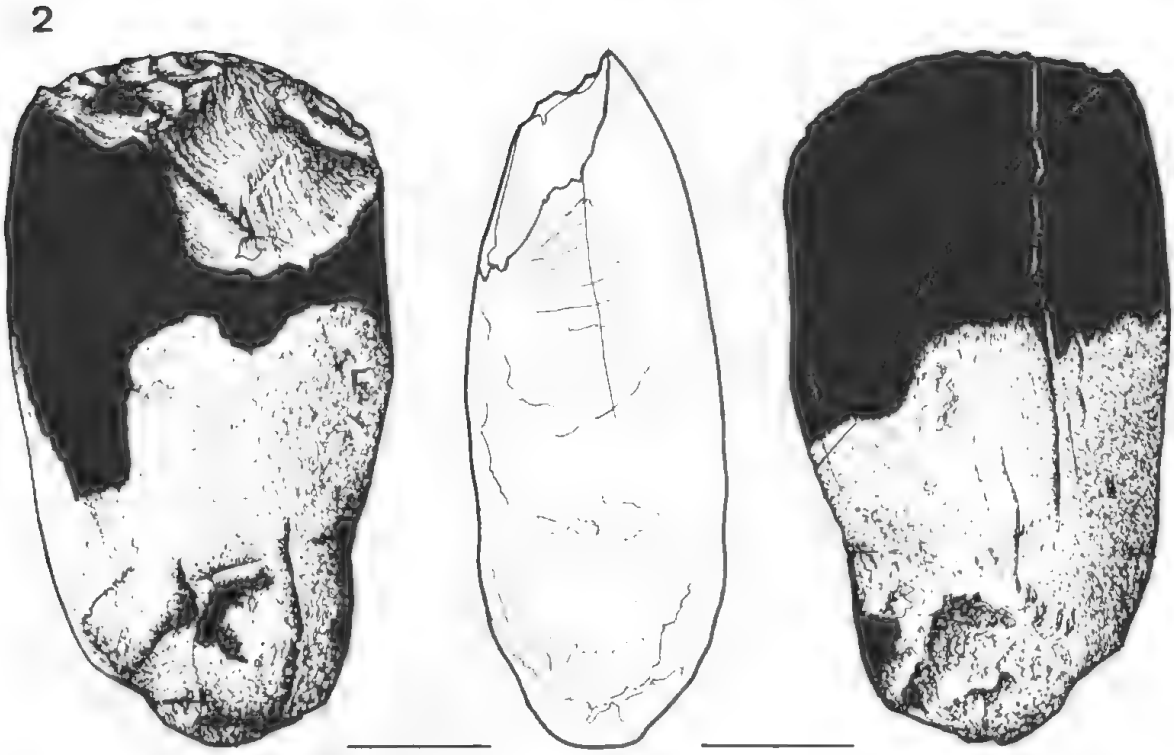


FIGURE 7. 1-2 Edge-ground axes (CC 65, 65).

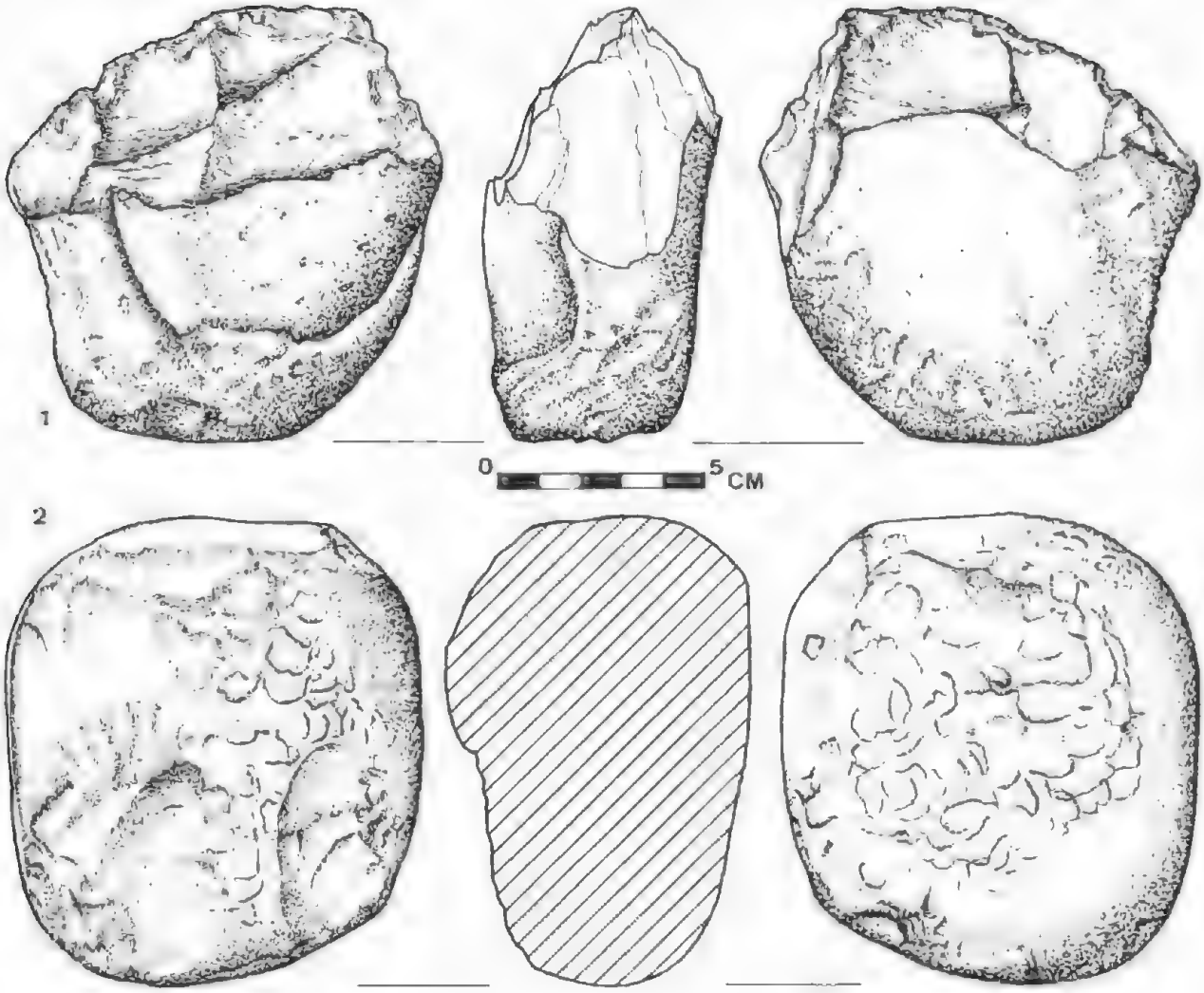


FIGURE 8. 1 Bi-directionally flaked gibber.
2 Pitted/fractured quartzite pebble (CC 68, 115).

(Kamminga 1978: 310–314, 1982: 85–91), however, these are best treated as equivocal implements (Fig. 8, no. 1).

Rounded to sub-rounded quartzite boulders were often located at the major sites or as isolated artefacts, usually near large stands of acacia (e.g. *Acacia salicina*) on the backs of drainage courses. These inevitably have pitting, crushing and fracturing on their opposing faces and extensive crushing on their rounded margins (Fig. 8, no. 2 and Fig. 9, no. 2). These are assumed to be multifunctional items probably serving as preparation platforms for processing seeds and vegetable and animal foods, for grinding ochre, for implement manufacture and also as hammerstones. (*cf.* Smith 1988: 98).

Several cylindrical-sectioned quartzite 'pestles' were also recorded, all with crushing on opposing ends (Fig. 9, no. 3). One heavily weathered cylcon (*cf.* Hamm 1987) manufactured from calcareous sandstone was recorded from a site located 1 km north of Unkumilka Waterhole (Fig. 9, no. 1). Finally millstones, fragments of these and mullers (after Smith 1986) were located from sites within all zones. Significant differences in the number and in the lithology of these millstones were noted, however, between environmental zones on the Lower Cooper (see below).

Testing the Archaeological Predictions of the Proposed Settlement/Subsistence Model

Preliminary assemblage data recorded during the survey allows a number of archaeological predictions to be addressed here.

Prediction 1:

Mean assemblage population and artefact density will be significantly higher within the eastern flood-

plain unit of the survey area in comparison with the western unit. Figures for the floodplain sites will be significantly larger than those recorded from sites within the adjacent dunefields, while those from the drainage line of the western half and adjacent dunes will be of a similar order.

The null hypothesis that assemblage population and artefact density will be the same between floodplain and drainage zones is rejected. Mean number of artefacts for the floodplain sites (N = 86) is substantially greater at 25 464 pieces compared with 339 pieces (N = 101) for the western drainage sites. These differences are significant at an alpha level of 0.05 ($t = -2.383$, $p = .0182$). Mean density of artefacts, expressed here as square metres per single artefact, is also significantly higher at 12 m^2 artefact for the floodplain sites compared with 45 m^2 artefact for the western drainage zone ($t = 2.743$, $p = .0067$). Mean assemblage populations are not significantly different from the drainage units in comparison to sites from the adjacent dunefields ($t = .843$, $p = .4013$ and $t = .412$, $p = .6809$). Interestingly, the density of artefacts from the floodplain sites is significantly higher than that of adjacent dunefield sites ($t = -2.659$, $p = .0092$) while the density of artefacts from the western drainage sites is statistically similar to that of the adjacent dunefields ($t = .212$, $p = .8328$).

There is general support for the notion of larger and more dense sites being associated with the floodplain unit of the Lower Cooper in comparison with the drainage unit, west of White Crossing. There is limited support for homogeneity of lithic scatters located on the western drainage line and adjacent dunefields and for differences in scatters located within the floodplain unit and adjacent dunefields.

Prediction 2:

Mean site density, per survey unit area, will be significantly higher within the floodplain unit in comparison with the western drainage unit.

An area of approximately 45 km^2 was actually surveyed within the eastern floodplain unit as compared to 120 km^2 in the western drainage unit, giving site densities of 1.91/km^2 versus 0.92/km^2. Site density on the floodplain unit, therefore, is double that on the western section. The arguably greater productivity of the floodplain unit receives further support. Further survey work is required within the dunefields before comparisons of site density between these and the riverine 'conduits' can be made.

Prediction 3:

Lithic diversity will be higher in sites within the eastern section in comparison to the western section and both will have higher values than the dunefield sites.

A comparison of the proportional distribution of sites with varying numbers of lithic materials between the different environmental units is presented in Table 2. There is a clear trend towards fewer sites with four or more, raw material types with movement west from the floodplain unit down the Lower Cooper. The lower lithic diversity of the dunefield sites is evident in that 86% have three, or fewer, raw materials present. A breakdown of the proportional distribution of different stone materials found at sites within the different environmental units is given in Table 3. Interestingly, there are few major differences in the proportions of raw material utilised between the riverine units or between these and adjacent dunefield sites. The decreasing proportion of silcrete, the dominant raw material, with movement west and the increasing reliance on some alternative materials can be explained simply in terms of the decreasing procurement efficiency of silcrete. Silicified mudstone appears to be only found in significant quantities at open sites within a 5 km radius of the large local quarry at White Crossing.

Prediction 4:

The mean number of whole seed-grinding bases per site will be significantly higher for the eastern section in comparison to the western section and both will have similar values to sites in adjacent dunefields.

The mean number of basal grinding stones per site is significantly higher for the floodplain unit in comparison to the western drainage unit; i.e. 10.79 versus 0.29 ($t = -3.046$, $p = .0027$). Prediction 1 demonstrated that the floodplain sites had

TABLE 2. Proportion of sites with different numbers of stone raw materials for environmental units.

	No. sites	No. of stone material types 1	2	3	4	5	6	7	8	9
Eastern floodplain unit	86	14	20	28	23	9	3	0	1	2
Western drainage unit	101	17	33	28	17	2	3	0	0	0
Dunefield units	16	48	23	15	7	7	0	0	0	0

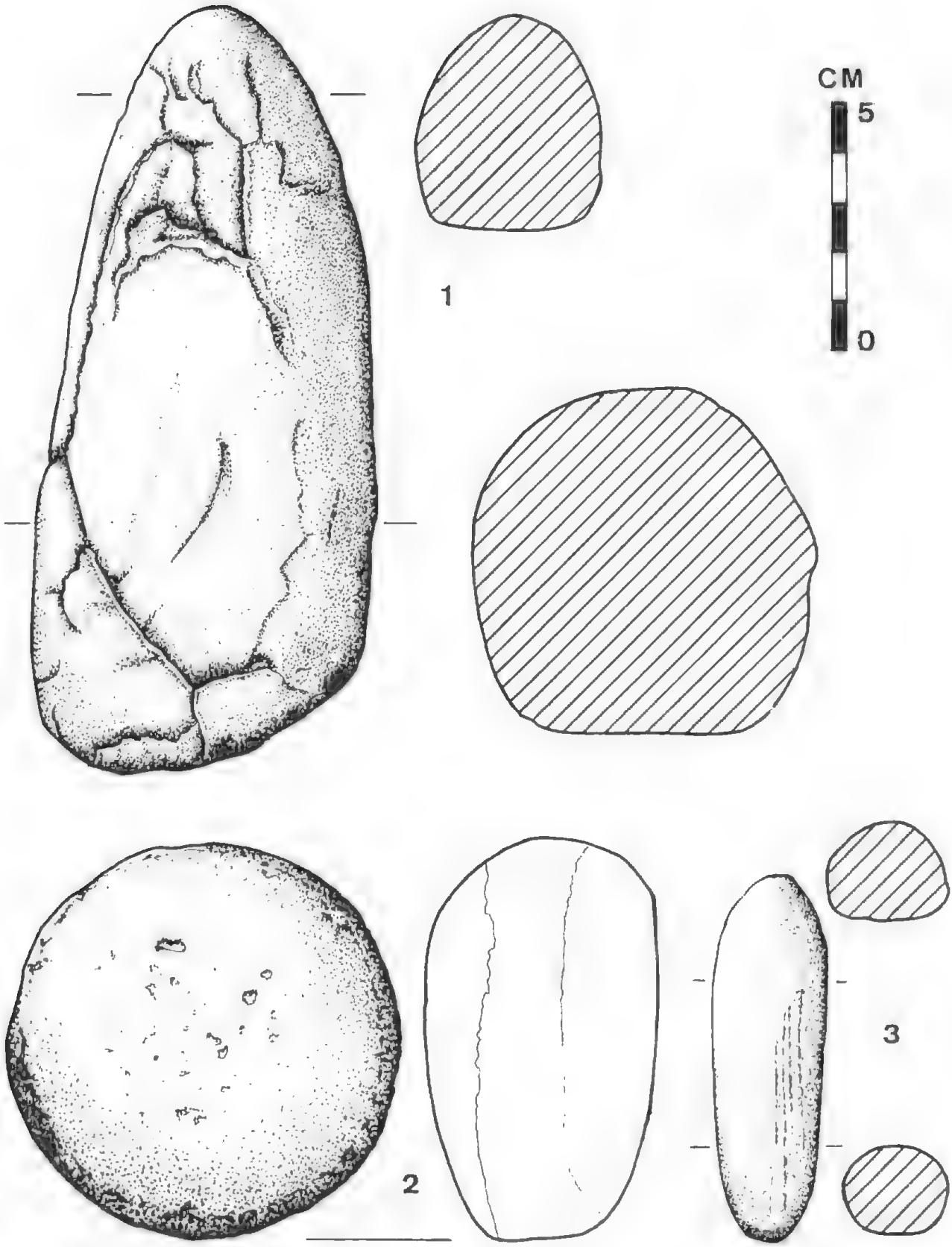


FIGURE 9. 1 Cylcon.
2 Pitted/edge-abraded quartzite pebble.
3 Pestle (CC 134, 54, 151).

TABLE 3. Proportion of different stone materials comprising assemblages between environmental units.

	Eastern floodplain unit	Eastern dunes	Western drainage unit	Western dunes
No. of sites	86	13	101	3
		% different raw materials		
Silcrète	88	96	86	92
Chert	1	2	3	1
Chalcedony	0.50	0.39	3.00	3.00
Red/brown Sandstone	0.39	0.15	0.10	0.00
Ferruginised Sandstone	0.30	0.23	0.12	0.00
White Sandstone	0.87	0.38	0.95	0.00
Silicified Mudstone	7.94	0.77	6.19	4.00
Quartzite	1.00	0.08	0.64	0.00

significantly larger artefact populations, however, and when the ratio of basal grinding stones to other flaked artefacts within assemblages is compared, the relative differences appear much smaller; i.e. 1:1172 versus 1:2359. There is no significant difference in the mean number of grinding bases between the floodplain unit and adjacent dunefield ($t = .789$, $p = .4322$). No grinding bases were recorded from the (small) sample of three sites in the western dune unit.

Prediction 5:

The proportion of formal implements to other retouched/utilised items will be higher in the floodplain unit than in the western drainage unit.

The proportion of formal implements to other retouched/utilised items was, on field estimates, divided into four categories: Nil, 0–33%, 34–66% and > 67%. Formal implements, here, include tula adzes (and slugs), unifacial points, backed segments and asymmetrical points, pirri gravers, the marni wadna and edge-ground axes. The breakdown of sites for these categories between the eastern and western sections is given in Table 4. There is a substantially greater number of sites without formal implements in the western drainage unit in comparison to the eastern floodplain unit (34.62%, N = 36 versus 2.02%, N = 2). The noticeably reduced proportion of morphologically and/or technologically standardised implements at sites on the western section of the Lower Cooper is of interest as it probably relates to real differences in manufacture, curation and discard behaviour. This is seen to occur in a more environmentally homogeneous land system which lacks alternative stone supplies.

TABLE 4. Proportion of sites in different formal/non-formal implement categories.

	Proportion of formal to non formal implements				
	Nil	0–33%	34–66%	>66%	No. Sites
Eastern units	2.02	80.81	15.15	2.02	99
Western units	34.62	60.58	1.92	2.88	104

Prediction 6:

Trade goods such as ochre, exotic seed-grinding bases, edge-ground axes, mussel shell fragments and cylcons will be more numerous on assumed aggregation and redistribution sites within the eastern section in comparison to sites of the western section.

The number of different categories of trade items represented at sites was tabulated and the sites are subsequently divided as those with one or less categories of trade items and those with more than one. These tabulations are presented in Table 5.

TABLE 5. Proportion of sites with trade items between western and eastern section.

	No. of trade categories	
	≤ 1	> 1
Eastern floodplain unit	70 (70.70%)	29 (29.30%)
Western drainage unit	94 (90.38%)	10 (9.62%)

There is clearly a higher proportion of sites with one, or more, categories of trade items within the

eastern floodplain unit, and this is significant at the .05 level (chi = 12.389, p = .0004). A general trend was noted in this unit that the sites which had the largest number of trade categories and the largest number of trade items were also the sites with the largest lithic scatters, the highest proportions of grinding material, the greatest diversity of lithic materials, the highest ratios of formal to non-formal implements and were those containing the most spatially discrete activity areas. Although the major sites recorded so far lie to the west of the major trade and exchange route documented to the east of Lake Eyre (McBryde 1989), it is significant that they are part of the same floodplain land system. They are suggested, here, to have served as major aggregation and redistribution points within the floodplain unit. In terms of their size and material complexity they are distinct from any sites located west from White Crossing to Lake Eyre

The suggestion that the eastern floodplain unit, and specifically the ecotone between it and the dunefields, would provide archaeological evidence for the most complex and varied economic and social behaviour finds general support from an examination of preliminary assemblage data along the Lower Cooper Creek. Significant differences are noted between sites in the eastern and western units in respect of debitage assemblages, assemblage size and density, site density, diversity of lithic materials, proportion of formal implements and number of trade items. Greater homogeneity was noted between sites on the western drainage unit and adjacent dunes in comparison to the floodplain unit and its adjacent dunefield.

We argue that homogeneity of sites in the western section, collectively, reflects a 'dunefield adaptation' in which the function (*cf.* Binford 1980) of sites varies little across drainage and dunefield units. In contrast, there is consistent variation in sites between the eastern floodplain unit and adjacent dunefields and this is argued to reflect differences in seasonality and duration of site occupation, group size and residential mobility between these units. This is seen to reflect a 'riverine-tethered' adaptation.

Dated Hearth Features

Two shallow depressions, saucer-shaped in profile and containing charred wood and burnt ant-bed material, are almost certainly hearths, though further investigation is needed to verify this beyond doubt. They are clearly in situ within calcreted dune cores located 5 km apart along the Lower Cooper (Field numbers CC77 and CC139; H1 and H2 in Fig. 2). Both are surrounded by artefacts lying on deflationary surfaces and at H2, artefacts appear to be within, and eroding from, the same horizon as the hearth. At each site the hearth itself was excavated to examine its relationship with the calcreted sediment unit, to test its vertical development and to gather charcoal from its burnt and consolidated matrix for radiocarbon dating. The dates obtained are shown in Table 6.

TABLE 6. Radiocarbon dates from charcoal in hearths (H1 and H2, Fig. 2)

Sample No	Field Site No	Quantity	Conv. Age (yrs BP)	New Age (yrs BP)
Wk-1509	CC77 (H1)	18 g	11,500 ±320	12,180 ±330
Wk-1510	CC139 (H2)	12.6 g	11,770 ±150	12,100 ±190

Both hearths have late Pleistocene dates which statistically overlap at one standard deviation. With stratified artefacts appearing both at hearth level and in more recent horizons, field site CC139 has the potential to yield cultural assemblages spanning the terminal Pleistocene/early Holocene period, which is poorly represented in the present population of excavated arid zone sites (*cf.* Smith 1988).

As noted above, the other major site with clearly stratified cultural material, at Unkumilka Waterhole (CC65; infilled circle in Fig. 2), is likely to yield cultural material from the mid- to late Holocene period. Both flaked and ground artefacts, as well as at least two burials, were noted to be within, and eroding from, vertical sections of the weakly indurated sediments of a leeside dune series. In combination, this site and CC139 have the potential, through excavation, to yield dateable cultural assemblages spanning the terminal Pleistocene to the contact period.

Conclusion

Systematic archaeological survey of the Lower Cooper Creek has revealed probable evidence for human occupation by approximately 12 000 B.P. and a possible efflorescence in the numbers of sites which can be assigned to the late Holocene, witnessed in the extraordinarily rich record of sites containing Small Tool components. That such an increase in assumed late Holocene occupation may be related to different factors such as regional changes in hydrology, more intensive use of existing resources, [e.g. the advent of hafted woodworking implements and formal grindstones (*cf.* Smith 1988; Veth 1989b)], intensified social relations (Lourandos 1985), exponential population growth

following colonisation (*cf.* Beaton 1985), or simply differential site preservation must await excavation and dating of the stratified sites and geomorphological work on both source-bordering and linear dunes. This is likely to include thermoluminescence dating of various dune series.

Significant differences in site densities and assemblage structure noted between the environmentally finer-grained and expansive floodplain unit and the sinuous drainage unit, west to Lake Eyre, are argued to reflect real variations in Holocene settlement/subsistence strategies. This analytical division was based on hydrological, botanical and emic criteria.

The Lower Cooper is argued to have excellent research potential at a number of levels. Broader questions relating to the timing of colonisation and nature of human adaptation in the dunefield habitats of Sahul's pulsating arid core during the late Quaternary may be addressed, given the unique suites of fluviatile and aeolian sediments associated with the Lower Cooper's modern drainage course. Stratified open sites potentially spanning the terminal Pleistocene to Contact, through excavation, may provide data on local technological industries, general economic behaviour within the floodplain unit and address the issue of intensity of occupation through time. The presence of numerous trade goods, particularly at major sites within the floodplain unit, suggests that these loci (lying outside the major trade routes) have acted as places for secondary exchange and/or redistribution. Detailed analysis of these assumed 'aggregation' sites and comparison of assemblage structure and reduction strategies with satellite occupation sites is likely to illuminate the relationships between social organisation and resource distribution. Given that there are well-defined stone supply zones, particularly for the silcretes, the Lower Cooper provides an ideal natural transect to examine both trade in stone materials as well as behavioural phenomena such as rationing, discard criteria and use of alternative materials.

For a wide range of interrelated theoretical and methodological issues, the Lower Cooper provides an optimum focus for future problem-oriented archaeological work.

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REVIEW

T. Morrell

Summary

Dreamings : the art of Aboriginal Australia edited by P. J. Sutton, Christopher Anderson, Philip Jones, Francoise Dussart, Steven Hemming. Viking, published in association with the Asia Society Galleries, New York, 1988. 266 pp., 260 numbered figs (155 in colour). Hardback $A65.00, paperbound $A35.00. Reviewed together with the exhibition 'Dreamings. The art of Aboriginal Australia', organised by the Asia Society Galleries, New York and the South Australian Museum.

REVIEW

Dreamings: The Art of Aboriginal Australia edited by P.J. Sutton, with contributions by Peter Sutton, Christopher Anderson, Philip Jones, Françoise Dussart, Steven Hemming. Viking, published in association with the Asia Society Galleries, New York, 1988, 266pp., 260 numbered figs (155 in colour). Hardback $A65.00, paperbound $A35.00. Reviewed together with the exhibition 'Dreamings. The Art of Aboriginal Australia', organised by the Asia Society Galleries, New York and the South Australian Museum.

The exhibition *Dreamings*, organized by the South Australian Museum and the Asia Society in New York, will probably be remembered for having amplified white Australia's 'discovery' (after 200 years) of Aboriginal art, and broadcast it to the United States. Although not the first exported exhibition of Aboriginal art, it has been the most significant historically, because of its size and quality, and because of various factors which made the timing ideal. The exhibition reflected a major resurgence in Aboriginal painting, and coincided with a period of strong overseas interest in Australia.

The exhibition will become an important marker in the cultural history of Australia. The book which accompanies the exhibition however will continue to live not just in the memory, but in the active discourse of people who concern themselves with how we should go about understanding Aboriginal culture in general.

First and foremost the book *Dreamings* is a record of the exhibition, which was on the whole very well received when it opened in New York. This is particularly impressive considering it is nothing like a knock-down-drag-out block-buster, although it includes many objects of great beauty and rarity. It would have been easier to cater to several romantic notions of Aboriginal Australia. For example the organisers could have offered an exhibition about a mysterious ancient race of artists creating earthy, but spiritual objects out of wood, bark and ochre; or alternatively, untutored modern masters producing an extravagant feast of big, visually powerful Western Desert paintings. Instead a great amount of work and thought was put into constructing a view of Aboriginal Australia which conveys problematic complexity rather than dramatic unity.

Dreamings is not the kind of exhibition which saturates the viewer with a sense of familiarity and understanding of one particular kind of art. It leaves the viewer still asking questions, most of which can be answered by the book. The publication *Dreamings* is large, extensively illustrated with images from the exhibition or relevant to it, and contains material for three different books; one about the history and development of Aboriginal art, one about how to interpret and respond to various Aboriginal artforms, and one tracing the way non-Aboriginal interpretation of the art has evolved. It is essential to the character of this book, however, that these (and other) seemingly disparate strands of study are combined and often closely interwoven. As Peter Sutton, curator of the exhibition and the book's editor, explains on page 14 of the book:

> A central message of this book is that while the literal meanings, the visual devices, the aesthetic potential and the social-contextual significance of Aboriginal art may each be distinguished in theory, they all interact in practice to constitute the total meanings of the works for Aborigines. Those who seek an understanding of the art need to approach it on all fronts.

The book carefully satisfies several needs in the field of literature on Aboriginal art, and avoids covering ground which has been covered already. Certain artefacts (for example shields) are given detailed discussion in terms of meaning or history without actually explaining what they were for, while elsewhere the social uses of paintings are dealt with. Artefacts which cannot be discussed in terms of iconography are excluded. With its subject matter and this fresh approach the book naturally reads as a highly innovatory study. The methodologies of the social historian, the economist and the political scientist come into play from time to time, enhancing the more conventional tactics of study. The surprising combinations of illustrations reflect the unconventional approach. Across one double-page spread, painting on aluminium is juxtaposed with painting on bark and painting on canvas (but in this case the canvas of a pair of sandshoes). The three chapters by Peter Sutton are a detailed lesson in 'reading' Aboriginal art, objectively explaining terms which have acquired a misleading sentimental mythology in white Australian culture and using diagrams to explore individual works. The chapter by Christopher Anderson and Francoise Dussart provides a much-needed, substantial introduction to the Western Desert paintings which have attracted such a blinding flurry of popular interest over the past several years. The historiography of Aboriginal art contributed by Philip Jones provides a necessary reminder that ideas change, and gives a context into which we can fit the current interpretations which the book offers. The last chapter by Sutton, Jones and Steven Hemming explains the responses of Aboriginal art to the imported culture and society which has threatened it.

Implicit in the stance taken by this book is an argument against the preconceived distinction between art and anthropology which has for so long distorted the way Aboriginal art has been viewed. This comes at a time when the figure most influential (indirectly) on contemporary art writing is an anthropologist, the late Claude Levi-Strauss. The need for a structured understanding of the social and intellectual context of artists in the intelligent study of what has conventionally been called art, and the importance of a visual response in the field of anthropology have made it increasingly difficult for any specialist to claim an artefact (or art object) for his or her particular discipline. This book demonstrates that it is our ways of looking at and thinking about Aboriginal art that need to be redefined, for the exhibition has demonstrated that the objects themselves exist splendidly independent of ways in which viewers may wish to categorize them. The thoroughness of scholarship and care in looking at works which *Dreamings* combines is an example to everyone who writes about material culture, whether as an art critic/historian or anthropologist.

T. MORRELL, Director, The College Gallery, South Australian College of Advanced Education, Holbrooks Road, Underdale, South Australia 5032. *Rec. S. Aust. Mus.* **24**(1): 67–68, 1990.

THE AURUKUN PROJECT

P. J. Sutton

Summary

Over the last five years the Division of Anthropology of the South Australian Museum has hosted a research project focused on Aboriginal relationships with the land in western Cape York Peninsula. Most of the land in this case lies within the the Aurukun Shire.

THE AURUKUN PROJECT

Over the past five years the Division of Anthropology of the South Australian Museum has hosted a research project focused on Aboriginal relationships with the land in western Cape York Peninsula. Most of the land in this case lies within the Aurukun Shire.

Peter Sutton, manager of the project, has worked in the Cape York Peninsula region as an anthropologist and linguist over a period of twenty years. Detailed cultural landscape mapping has been a major feature of this work. This involves visiting the homelands of Aboriginal people whose intimate knowledge of local geography, mythology, history and natual history is recorded, usually on site. Analysis of these systems of knowledge is integrated with adjoined studies of local languages, social structure, religion, politics and social change, for example. This research has been funded by the Australian Institute of Aboriginal Studies, Aurukun Shire Council and Aurukun Community Incorporated (both using Department of Aboriginal Affairs funds); the Australian Research Council, the Australian Heritage Commission, and the South Australian Museum.

Since the mid 1980s Dr Roger Cribb has been employed from time to time to collaborate on the integration of this detailed information in a computer database. He has also carried out archaeological survey work in the region, and has assisted with ethnographic site recording. Together with David Martin of the Australian National University, who has very extensive research experience of the same region, he recently worked with Peter Sutton to produce a report combining the western Cape York Peninsula Aboriginal site data of several researchers, including that of von Sturmer, Sutton, Martin, Cribb and Chase. The November 1989 draft of this report, which covers a narrow coastal strip between the Embley and Edward Rivers, contained 2085 site records and spanned 1050 pages.

The immediate rationale for the production of this particular version of the data was that the Aurukun clan leaders had requested supporting evidence for their opposition to seismic survey work in their area by the mining company Comalco. Comalco wished to bulldoze seismic lines over much of the Shire in its search for oil, and the traditional landowners appealed to the Federal Minister for Aboriginal Affairs to make an emergency declaration of the Shire as a significant area under the 1984 Aboriginal and Torres Strait Islander Heritage Protection Act as amended. At the time of writing Comalco has suspended its exploration activity and has not announced its exploration intentions for the 1990 dry season. No emergency declaration has been made, but preparation of the relevant documentation is proceeding nonetheless.

There is another reason for the construction of this database in the complex form it has now taken. It can produce map graphics as well as tabulated versions and reworkings of the various site records and their many fields, and is a fully-fledged if rather mechanical research tool in the field of people-land ecological and socio-cultural relationships.

In essence, the academic dimension of the project aims to marry the rich insights of a cultural anthropological perspective with the quantification and systematic detail made possible by a very large and powerful machine-readable body of observations and statements. A great deal is now known, for example, about the particular knowledge system that in this region traditionally integrated social and political groupings, religious symbolism, land ownership, the demographic pattern, landforms, vegetation zones, seasonality and economic resources. Using the project's database it is now possible to quantify, for example, the relationship between site density, site type, and vegetation or landform zone.

The database manager, IBM PC-FOCUS, thus allows us to test for statistically significant degrees of spatial association or segregation between kinds of places. We can quantify degrees of association between cultural and physical properties of sites and the ecological zones (Aboriginal- or scientist-defined) in which they occur. We can provide a precise test for the hypothesis that clan estates tend to be so constructed as to maximise their ecological diversity, or that cremation mounds and ritually dangerous places are closely associated with clan estate boundaries. The vitally important cultural categories of clan totemism, local cult ceremonies, environmental 'nickname' groupings and broad regional political groupings, all well understood from social anthropological studies of the last 15 years, can now be given far greater definition at the level of their geographical content. And we can now provide the kind of hard data on so-called ethnographic sites that is of direct relevance to the work of archaeologists.

Complemented by rich interpretative material linking the sites together under historical, religious, political and other local cultural perspectives, and by a detailed ethnobotanical study carried out by Peter Sutton and ecologist Dermot Smyth in 1978–9, linked to a micro-level vegetation zone survey by Smyth, this study is now ready for a major publication.

There is probably no other region of Australia that has been so thoroughly researched in this way, although the work of Neville White and his

associates in eastern Arnhem Land, albeit with a different focus, is probably the nearest parallel. It is unlikely that a project of similar depth, detail, length and expense will ever be replicated in Australia, if only because of the loss of intimate traditional landscape knowledge among Aboriginal people. Without publication, however, the considerable impact of in-depth studies such as this cannot be realised.

The theoretical significance of this work is at two main levels: that of generalisations about Australian Aboriginal land relationships, and that of the broader issue of the relationship between cultures and the environments in which they are reproduced. Our essential theoretical contribution in this context has been to integrate the analysis of land relations with the shifting dynamics of political life rather than to present them as if they were a relatively static and self-contained backdrop to action.

At a broader level, this study will seek to build on contemporary anthropological theory, with its phenomenological strengths, while avoiding the extreme subjectivist stance under which all forms of knowledge appear to belong to the same phenomenal order. Formal or systemic knowledge, for example, does not have the same epistemological status as conscious and substantive knowledge, and is culturally constituted in a different way. I look at this issue by focusing on the constitution of Aboriginal geographical knowledge. Perhaps definable as 'neo-objectivist', my approach is also to try to improve the theoretical status of the notion of evidence in the anthropological enterprise. The operational metatheories of many current anthropological paradigms rest overmuch on criteria such as internal coherence and completeness of scope, and insufficiently on those such as degrees of testability and degrees of fit with the available ethnography. My critique of this kind of theoretical value-system arises in part out of the problem of describing how Aboriginal environmental knowledge is related to Aboriginal environmental experience.

In most of Cape York Peninsula an era of relative stability has followed the initial catastrophic impact of colonisation. That era may soon be at an end. The region has suddenly become a focus of attention by major development interests, conservation groups, and governments charged with responsibility not only for tourism and other infrastructure but also for major aspects of Aboriginal welfare. Proposed and planned developments, including a commercial space base, a large tourist resort at Iron Range, the sealing of the Peninsula road, sand mining, gas and oil exploration, and many other new activities, are ominous signs as far as the Aboriginal population is concerned, since Aborigines are still the region's majority, constituting two-thirds of all people in the Peninsula. If this balance is radically shifted in favour of non-Aboriginal outsiders, experience elsewhere suggests that further social and cultural decline and disintegration will occur among the Aborigines.

This project has had very keen support from the Aurukun Aboriginal people, who have at times raised their own funds to assist its field programme, and who hold a key interest in the data. The clan leaders in 1985 gave their support in principle to the proposal for a publication containing this representation of their knowledge, pending final consultation over contents. They are deeply concerned that their land-based traditions be recognised and respected by a wider public.

P.J. SUTTON, Research Associate, Anthropology Division, South Australian Museum, North Terrace, Adelaide, South Australia 5000. *Rec. S. Aust. Mus.* 24(1): 69–70, 1990.

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CERORIBATULA GEN. NOV., FOVORIBATULA GEN. NOV. AND FOVORIBATULINAE SF. NOV. (ACARIDA: CRYTOSTIGMATA: ORIBATULIDAE) FROM SOUTH AUSTRALIAN SOILS

D. C. Lee & C. M. Birchby

Summary

Ceroribatula gen. nov. (including two species-complexes) and Fovoribatula gen. nov. are established, with seven new species as follows: Ceroribatula incrustata-complex, C. incrustata (type-species), C. bizygata, C. monozygata, C. trirostrata; C. megaforamina-complex, C. megaforamina; Fovoribatula brevisetosa (type-species), F. mesosetosa. They are grouped in the Fovoribatulinae, a new subfamily in the Oribatulidae, with four other genera. The new species are from plant litter, moss or soil at the four drier (arid, semi-arid, mallee-broombush, mallee-heath) sites of the nine florally diverse South Australian sites sampled. Four species carry a conspicuous cerotegument, which in C. incrustata forms patches of thick wax. The leg chaetotaxy of the Oripodoidea is briefly discussed and the absence of setae on femora I and II is given taxonomic significance. There is a key to adults of Australian species of Fovoribatulinae.

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D. C. LEE & C. M. BIRCHBY

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This is a further part of an ongoing study of sarcoptiform mites in South Australian soils, sampled from nine florally diverse sites, and for which an introduction to the relevant work on the advanced oribate mites (Planofissurae) has been published (Lee 1987). The mites considered here have been referred to as 'seven species of *Oribatula*-like mites' in the publication describing *Decoribatula* Lee & Birchby, 1989. They are grouped here in two new genera. With *Brassiella* Balogh, 1970, *Decoribatula*, *Reticuloppia* Balogh & Mahunka, 1966 and *Romanobates* Feider, Vasiliu & Călugăr, 1970, they make up the Fovoribatulinae, a new subfamily within the Oribatulidae Thor, 1929.

The Fovoribatulinae has a deficient chaetotaxy on femora I and II, which is unusual amongst the Oripodoidea. This has had some consideration with the description of *Decoribatula* Lee & Birchby, 1989, but is further commented on here. Also the sejugal apodeme notation and the terms used to describe sculpturing of the integument are briefly reconsidered.

The notum is illustrated for all seven species, but the idiosterna are so similar for some pairs of species that they are only illustrated for four species. The only complete set of legs illustrated is for *Ceroribatula incrustata* (Fig. 4), where, because of the variations in leg chaetotaxy, the setae are drawn on femora I and II. Some legs are illustrated for a further four species, mainly to represent the variations in chaetotaxy on femora I and II, but also the relative sizes of the tarsi and pretarsal claws. Measurements are in micrometres (μm). The mites examined were all collected by one of us (D.C.L.) and are mainly deposited in the South Australian Museum (SAMA), but also in the Natural History Museum, London (BMNH), the Field Museum of Natural History, Chicago (FMNH) and the New Zealand Arthropod Collection, DSIR, Auckland (NZAC).

NOTATION AND LEG CHAETOTAXY

The modifications in morphological notation presented in papers on *Setobates* (Lee & Pajak 1988) and *Scheloribates* (Lee & Pajak in press) are followed here, but elaborations are made in defining apodemes and describing the integumental sculpturing, whilst the relevent leg chaetotaxy is discussed.

Three types of apodemes are associated with the sejugal somal division: *dorsosejugal apodeme* (= dorsophragmatic apophysis of Norton 1983); *pleurosejugal apodeme* (= bothridial apodeme of Lee 1987, which merges dorsally with the integument near the bothridium of sensory seta *z*2); *ventrosejugal apodeme* (= sejugal apodeme of the podosternum). Also, two further thickenings in the podosternal integument, other than apodemes I, II and III associated with the coxites, are apparent in the largest species (*C. trirostrata*, Fig. 9), *midsternal apodeme* dorsal to seta *III*1, and the *postpodal apodeme* abaxial to seta *IV*2 (not homologous with

apodeme IV, which is absent in the mites considered here).

It is characteristic of Fovoribatulinae that the integument is sculptured and incrusted with a substantial and sometimes conspicuous cerotegument. The sculpturing often consists of many small pits, each in the centre of a shallow depression. The depression may be circular or, if bounded by reticulate ridges, hexagonal. The reticulate ridges probably consist partly of the cerotegument (the superficial layer of the integument developed by exudation through pores in the cuticle), since they are conspicuous and more raised around the patches of thick wax on *Ceroribatula incrustata* (Fig. 3). The thick wax is columnar, white and strongly refractile, the hexagonal columns growing out at right angles to the integument surface, both in this species and *Reticuloppia reticulata* Balogh & Mahunka, 1966. On the other hand, the wax may form a thinner layer, uniformly covering the integument, and sometimes containing small, refractile wax granules making it either generally dirty white in colour as on *Ceroribatula bizygata* or forming white patches as on *Ceroribatula trirostrata* and *Fovoribatula mesosetosa*. The microsculpturing varies, the different states merging into a continuum, but they are categorized as follows: *foveate*, pitted; *reticulate-foveate*, pitted, with each pit in a hexagonal space delineated by reticulate ridges; *reticulate*, reticulate lines or ridges without pits; *alveolate*, depressions that may be separated by indistinct reticulation.

The chaetotaxy of five setae on both femora I and II is the same for most members of the Oripodoidea. Using only the four major files of setae on a leg segment (see Lee 1981, fig. 19), this chaetotaxy is represented by the number of setae that are *anterior, dorsal/ventral, posterior* and is given as follows: I – 0,2/2,1; II – 0,2/2,1. Exceptionally some setae are absent, either just the posterior seta as in Symbiontbatidae Aoki, 1966 and a few genera of Oripodidae Jacot, 1925, or always the distoventral seta (*v*2) on femur II and some other ventral or posterior setae on femora I and II, as in Lamellareidae Balogh, 1972, Crassoribatulinae Balogh & Balogh, 1984, and the genera grouped here in the Fovoribatulinae sf. nov. The absence of such setae, at least within the latter two subfamilies of Oribatulidae, is considered primitive because they are also absent in the Licneremaeoidea, regarded as the most primitive group within the Poronota and a sister group to the Oripodoidea. But it should be noted that the Galumnoidea, regarded as the most derived superfamily within the Poronota, always lacks seta *v*2 on femur II.

The relevant femoral chaetotaxy in the Oribatulidae has a number of forms when it is deficient as in the Fovoribatulinae and Crassoribatulinae. These are listed, with the most deficient first, as follows:

I – 0,2/1,0; II – 0,2/1,0 some *Ceroribatula*
I – 0,2/2,0; II – 0,2/1,0 some *Ceroribatula* and *Reticuloppia*
I – 0,2/1,1; II – 0,2/0,1 *Brassiella*
I – 0,2/1,1; II – 0,2/1,1 *Fovoribatula* and *Decoribatula*
I – 0,2/2,1; II – 0,2/1,1 *Romanobates* and *Crassoribatula*.

The chaetotaxy of *Brassiella* and *Crassoribatula* is not given in the literature, but is newly recorded here after examining the holotypes of *Brassiella penicillifer* Hammer, 1973 and *Crassoribatula maculosa* Hammer, 1967. Not all variations are reflected in the above presentation of chaetotaxy, for example, in *Fovoribatula* the ventral seta on femur I is distoventral (*v*2 – see Fig. 13), whilst in *Decoribatula* it is proximoventral (*v*1 – see Lee & Birchby 1989, fig. 2). Also illustrations sometimes suggest a different setal position because of the orientation of leg segments, as for femur I of *Ceroribatula monozygata* (Fig. 5), where *v*1 appears to be in position *p*1. Such possibilities for confusion are greater when the greatest number of setae are absent compared with the usual complement for the Oripodoidea, since the seta present may be located in an intermediate position between its usual place and the expected position of the absent seta. In previous papers on the Planofissurae by one of us (e.g. Lee 1987) only a seta 'v' has been shown on femur II, in order to indicate its relationship to a ventral flange that is sometimes present; more specifically this is seta *v*2.

Systematics

Subfamily **FOVORIBATULINAE** sf. nov.

Nominotype genus: *Fovoribatula* gen. nov.

Diagnosis

Oribatulidae. Hysteronotum with 14 pairs of short, medium length or long setae. Translamella either absent, lineate or costate; if laminar it is confined to the lateral part and not present across midline. Lateral proteronotal foramen (*F*1) small but clearly multiporose. Sensory seta (*z*2) clavate with subglobose caput. Integument usually with extensive foveate and/or reticulate sculpturing, often with substantial cerotegument, sometimes forming thick, white, refractile, columnar wax. Anterior margin of hysteronotum either convex with dorsosejugal furrow curving around lenticulus or truncated with straight dorsosejugal furrow and no lenticulus. Femur II with fewer than normal five setae, at least seta *v*2 absent (0, 2/1, 1). Legs slim, medium length or long, leg IV (femur-tarsus)

usually longest, sometimes subequal in length to leg I.

General Morphology and Character State Polarization

On the basis of the absence of femoral setae, both Fovoribatulinae and Crassoribatulinae are regarded as a primitive group within the Oribatulidae (see section on 'Notation and Leg Chaetotaxy'). The Oribatulidae in turn is regarded as a primitive family within the Oripodoidea because of its multiporose hysteronotal foramina and a lack of pteromorphs. The Fovoribatulinae is, therefore, recognised by the absence of derived character states. The Crassoribatulinae, which also lacks seta v2 on femur II, is distinguishable from the Fovoribatulinae by three derived character states: ten pairs of hysteronotal setae, six pairs of genital setae and a midsternal gap in the ventrosejugal apodeme.

The classification established here for genera within the Fovoribatulinae is based on the premise of a polarization of the increasing number of setae on femur I and II being more derived. There are considered to be two lineages, a primitive one in which there is no posterior seta on femur II, including *Ceroribatula* and *Reticuloppia*, and a derived lineage in which this posterior seta is present. On the basis of this, the similarities between *Reticuloppia* and *Decoribatula*, although due to derived characters (long hysteronotal setae and divided hysteronotal foramen *F3*), are convergent. The same is true for *Ceroribatula megaforamina* and *Fovoribatula mesosetosa*.

On the basis of this polarization, the states of other possibly important characters are polarized as follows. The seta sl on the proteronotum, seta v on trochanter I and the hysteronotal setae are regarded as primitive if they are shorter and as derived if they are longer. For the proteronotal ridges, the presence of weakly laminar, complete lamellae or the presence of one or two translamellae (as *Ceroribatula bizygata*, Fig. 6) is considered to be primitive, whilst the absence of lamellae and translamellae (as *Reticuloppia reticulata* Balogh & Mahunka, 1966) is considered derived. For the hysteronotum, the presence of a lenticulus associated with a mid-dorsal, forward pointing protruberance and an undivided anterior multiporose foramen (*F3*) is regarded as primitive, whilst a straight anterior hysteronotal margin with no lenticulus and a divided anterior multiporose foramen (*F3a* and *F3b*), as for *Decoribatula pustulosa*, is derived. For the pretarsal claws, relatively short (*cf.* tarsus) claws with slim lateral claws (Fig. 4, leg II) is regarded as primitive, whilst long claws with stout lateral claws (Fig. 12) is derived.

Distribution

The Fovoribatulinae appears to be endemic to the Oriental and Australasian Regions. Within these regions it has not yet been found in cooler temperate southern Australia and New Zealand. This is based on few data, but from the South Australian sampling, *Ceroribatula* and *Fovoribatula* are represented by seven species (substantial species diversity) which are confined to the four drier, hotter sites. The previous records are of *Brassiella* from Ceylon, New Guinea, Samoa, New Caledonia and Tonga, *Decoribatula* from Singapore, *Reticuloppia* from tropical Queensland and *Romanobates* from southern Roumania. This suggests that the relevant faunas of the mallee and arid regions are derived from tropical faunas either as relicts from tertiary tropical climates in the region or as invaders from recent tropical climates to the north. As viewed here, the most primitive species occur in the mallee and arid region faunas, suggesting that they are the relicts.

Remarks

The Fovoribatulinae includes oribatulid genera that have a lack of certain femoral setae, and compared with the oribatulid Crassoribatulinae with a similar lack of setae, they have fewer genital setae, an entire rather than an incomplete ventrosejugal apodeme; and more hysteronotal setae. These latter three character states they share with Oribatulinae. The Fovoribatulinae are very different from the Lamellareidae, which also has a primitive lack of the same femoral setae. Without the recognition of the reduced chaetotaxy, members of a particular fovoribatuline group would be included in the Oribatulinae with species in either *Oribatula* Berlese, 1895 or *Zygoribatula* Berlese, 1916. There has, therefore, been a considerable reweighting of the importance of particular characters. The relationships between the six included genera, as presented here based on the femoral chaetotaxy, place them in two sister-groups: the primitive *Ceroribatula* and *Reticuloppia*, and the derived *Brassiella*, *Decoribatula*, *Fovoribatula* and *Romanobates*. On the other hand, *Ceroribatula* is superficially most similar to *Fovoribatula*.

The nature and possible adaptive significance of the incrustation can only be given preliminary consideration. What is probably a similar incrustation is described on the humeral hysteronotal region of *Oribatula exudans* Travé, 1961, but it is a homogeneous wax and not made up of columns. Wax blooms, although not so substantial, have also been described on an *Oppia* species (Brody 1970). The temporary presence of wax filaments making an arid region tenebrionid beetle white rather than black has been observed

as an adaption to control water loss (Louw & Seely 1982). This possible relevance of wax incrustations to water conservation could be true for *Reticuloppia* and *Ceroribatula*, but it is also possible that it is an excretory product.

The following six genera are included in the Fovoribatulinae: *Brassiella* Balogh, 1970, *Ceroribatula* gen. nov., *Decoribatula* Lee & Birchby, 1989, *Fovoribatula* gen. nov., *Reticuloppia* Balogh & Mahunka, 1966 and *Romanobates* Feider, Vasiliu & Călugăr, 1970. A key is provided for the eight Australian species included in the subfamily.

Key To Australian Fovoribatulinae (Adults)

1 — Hysteronotal setae longer than distance between their bases. Lamella absent or incomplete, not reaching bothridium to seta *z2*, which is turret-like (height subequal to diameter of pore). Five pairs of hysteronotal multiporose foramina. . . . . *Reticuloppia reticulata* Balogh & Mahunka

— Hysteronotal setae shorter than distance between their bases. Lamella present, reaching bothridium to seta *z2*, which has low profile (height less than 0.5 × diameter of pore). Four pairs of hysteronotal multiporose foramina. 2

2 — Femora I and II lack posterior setae (Fig. 4). Pretarsal claws smaller, central claw less than 0.3× length of tarsus II. . . . *Ceroribatula* gen. nov., 3

— Femora I and II with a posterior seta (Fig. 13). Pretarsal claws larger, central claw greater than 0.3× length of tarsus III. . . . . *Fovoribatula* gen. nov., 7

3 — Long proteronotal seta *sl* (subequal to distance *j2* - *z1*, Fig. 10) and trochanter I seta *v* (able to reach seta *v2* on femur I). *C. megaforamina* sp. nov.

— Short proteronotal seta *sl* (0.6× or less distance *j2* - *z1*, Fig. 1) and trochanter I seta *v* (only able to reach seta *v1* on femur I or shorter). 4

4 — Femur I with seta *v2* present (Fig. 4). Translamella present or absent. 5

— Femur I without seta *v2* (Fig. 5). Translamella present. 6

5 — Translamella absent. Rostrum without incisions. Hysteronotal foramen *f3* with longitudinal axis less than 2× breadth (Fig. 1). *C. incrustata* sp. nov.

— Translamella present. Rostrum divided by two incisions into three points. Hysteronotal foramen *f3* with longitudinal axis more than 3× breadth (Fig. 8). . . . . *C. tritostrata* sp. nov.

6 — No ridge between proteronotal setae *j2*-*f2*. Setae *j2* and *z1* ciliate and clavate (Fig. 7). Mid-sternal and hysteronotal integumental sculpturing foveolate. . . . . *C. monozygata* sp. nov.

— Lamella-like ridge present between proteronotal setae *j2*-*f2*. Setae *j2* and *z1* smooth and lorate (Fig. 6). Midsternal and hysteronotal integumental sculpturing reticulate. . . . . *C. bizygata* sp. nov.

7 — Translamella present. Hysteronotal setae short (*J2* length less than 0.5× distance from setal base *J3*) (Fig. 14). Lateral pretarsal claws depth more than 0.5× depth of central claw (Fig. 12). . . . . *F. brevisetosa* sp. nov.

— Translamella absent. Hysteronotal setae medium length (*J2* length 0.5-1.0× distance from setal base *J3*) (Fig. 16). Lateral pretarsal claws depth less than 0.5× depth of central claw (Fig. 13). . . . . *F. mesosetosa* sp. nov.

Genus *Ceroribatula* gen. nov.

Type-species: *Ceroribatula incrustata* sp. nov.

Diagnosis

Fovoribatulinae. Hysteronotal setae short or medium-length (shorter than distance between their bases). Lenticulus present, associated with mid-dorsal forward pointing protruberance of hysteronotum. Lamellae present, laminar and complete (between *z1*-*z2*). Translamella present (may be second costate ridge) or absent. Rim of bothridium (base of seta *z2*) low, not turret-like. Four pairs of hysteronotal multiporose foramina. Discidium present as costate ridge. Femora I and II without posterior setae usually three setae (0, 2/1, 0) but femur I may have four setae (0, 2/2, 0). Pretarsal claws short (central claw II less than 0.3x length of tarsus II).

Remarks

Ceroribatula is superficially similar to *Fovoribatula* gen. nov., but it is regarded as more closely allied to *Reticuloppia* Lee & Birchby, 1989, because of the chaetotaxy on femora I and II. The name is derived from the Latin '*cera*' meaning wax, as used in the term 'cerotegument'. The cerotegument is sometimes particularly conspicuous and comprises contiguous merged vertical columns of wax as on *C. incrustata* (also is present on *Reticuloppia*). The genus includes two species-complexes: the *incrustata*-complex and *megaforamina*-complex.

incrustata-complex

Diagnosis

Ceroribatula. Hysteronotal setae (shorter than 0.5× distance between bases), proteronotal seta *sl* (shorter than diameter of bothridial aperture) and trochanter I seta *v* (shorter than distance between setae *J1*-*J2*) short. Translamella present or absent. Femur I either with (0,2/2,0) or without (0,2/1,0) seta *v2*.

Remarks

The *incrustata*-complex is regarded as the more primitive group within *Ceroribatula*, having some species with only three setae on femora I and II and short somal (except for proteronotal setae *j1*, *j2* and *z1*) and trochanter I setae. It is diverse, comprising four new species as follow: *C. incrustata* (type-species), *C. bizygata*, *C. monozygata*, *C. trirostrata*.

Ceroribatula incrustata sp. nov.

Figs 1–4

Female

Dorsal profile of hysteronotum subcircular, colour dark brown, cerotegument substantial posteriorly and pleurally around legs, white incrustation of wax always on proteronotum, rarely on hysteronotal humeral region (Fig. 3), sometimes on venter of femora I and II. Idiosomal length, 468 (mallee-heath, n = 9, 406–504) and 497 (mallee-broombush, n = 3, 488–509). Leg lengths (femur-tarsus for idiosomal length 488, mallee-heath): I – 239, II – 224, III – 222, IV – 270. Tibial maximum heights (for 488): I – 26, II – 18, III – 18, IV – 16.

Proteronotum with weakly laminar lamellae and costate sublamellae, translamella absent. Seta *j2* shorter (less than 0.75) than *z1*, both ciliate, and clavate, cerotegument may increase size of caput. Dorsolateral aspect illustration (Fig. 3) represents the right seta *j2* as shorter due to parallax. Conspicuous cerotegument anterior to seta *z1* is undivided (Fig. 3) or may be bilobar, with the lateral subhexagonal wax columns being longer and curving outwards. Posterior to thick cerotegument, integument conspicuously reticulate-foveate and may have small vertical tubercles at angles of hexagons, and no incrustation further back where integument foveate or weakly alveolate with well-spaced circular shallow depressions. Lamella usually carries highly refractive segmented strip of cerotegument. Sensory seta *z2* clavate with globose caput and many fine pointed cilia, smaller and more numerous than represented (Figs 1 and 3).

Hysteronotal setae subequal in length, with two longitudinal distal files of cilia (usually only one file visible when viewed from above). Lenticulus smooth, pale, surrounding integument weakly alveolate, further laterally cerotegument conspicuous, either reticulate-foveate or forming columns in places (Fig. 3), posterodorsally mainly foveate. Multiporose foramina subequal in size and oval, position of *F5* and *F6* usually as illustrated (Fig. 1), sometimes closer to mid-line, when *F5* on adaxial side of seta *S5*.

Podosternum with circumpedal ridge merged with rest of subpedal ridge; extending to weak custodial ridge fading just anterior to pedotectum II. Two adaxial setae on coxite I similar in length (*I1* and *I2* subequal). Central region with foveolate sculpturing similar to that illustrated (Fig. 2) around posterior margin of genital orifice.

Opisthosternum with setae of fairly uniform length, *Sa1* subequal to *Sa3*. Adanal pore *Saf* nearly longitudinal, further from anal orifice than its length. Eggs oval, 170 × 75 (mean of 11 horizontally aligned eggs, 40% of mean female length), smooth or wrinkled exochorion. Number of eggs in female (number of females) as follows: four (2), six (2), eight (5).

Legs medium-length (mean femur-tarsus: 49% of soma), slim (mean maximum tibial height: 30% of mean length). Dorsal porose areas and weak alveolate abaxial sculpturing, usually with reticulate cerotegument on all femora and trochanters III and IV. Only three setae on femur II (0,2/1,0) and four setae on femur I (0,2/1,0).

Male

As for female except genital orifice not or only narrowly abutting onto ventrosejugal apodeme. White proteronotal incrustation present on 16 of 20 males ex mallee-heath and all 5 males ex mallee-broombush. Soma smaller, idiosomal length 425 (mallee-heath, n = 20, 398–475) and 429 (mallee-broombush, n = 5, 416–445).

Material Examined

Holotype: ♀ (NI989164), sand, litter, under banksia shrubs (*Banksia ornata*), Tamboore Homestead (35°57′S, 140°29′E), 4.viii.1974.

Paratypes: 6 ♀♀ (NI989165–NI989169), 16 ♂♂ (NI989170–NI989183); 1 ♀, 2 ♂♂ – BMNH; 1 ♀, 2 ♂♂ – FMNH; 1 ♀, 2 ♂♂ – NZAC; same data as holotype.

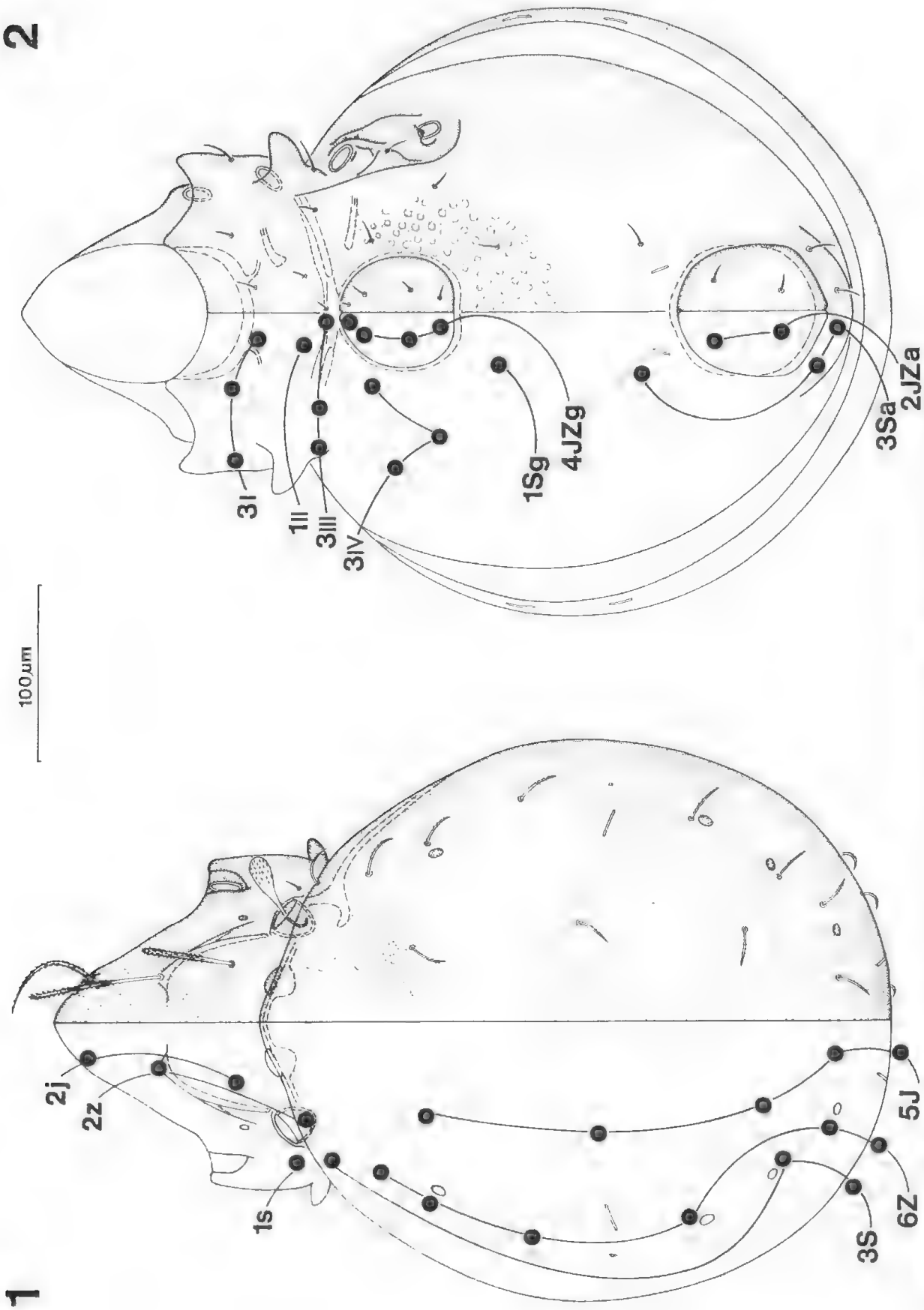
Undesignated: 3 ♀♀ (NI989184–NI989186), 5 ♂♂ (NI989187–NI989191), sand, litter, sparse moss, under ridge-fruited mallee (*Eucalyptus incrassata*) amongst broombush shrubs (*Melaleuca uncinata*), Ferries-McDonald Reserve (35°15′S, 139°09′E), 20.vi.1974.

Distribution

Australia (Aa), South Australia. Mallee-broombush, open scrubland (Ferries-McDonald Reserve), Murray-Darling basin, 3 ♀♀, 5 ♂♂ (4 of 8 × 25cm²). Mallee-heath, tall open shrubland (Tamboore Homestead, near Mt Resente Conservation Park), Murray-Darling basin, 9 ♀♀, 20 ♂♂ (6 of 8 × 25cm²).

Remarks

Ceroribatula incrustata is the type-species of the genus and the species-complex. The name is derived from the Latin '*incrustatio*' meaning 'crust' or 'hard coating', referring to the wax incrustation often



FIGURES 1 and 2. *Ceroribatula incrustata* sp. nov., female soma. 1, notum without incrustation; 2, idiosternum.

3

FIGURE 3. *Ceroribatula incrustata* sp. nov., female anterior soma, dorsolateral aspect showing proteronotal and hysteronotal incrustation of wax.

present on the proteronotum and sometimes on the humeral region of the hysteronotum (Fig. 3). The hysteronotum is circular in horizontal aspect, but otherwise specimens without an incrustation are similar to *C. monozygata*, because of the size and the form of the notal setae. On the other hand, the presence of a distoventral seta (*v*2) on femur I means that *C. incrustata* is similar to *C. trirostrata* in its chaetotaxy. The wax incrustation, hysteronotal shape and femoral chaetotaxy are similar to those of *Reticuloppia reticulata* Balogh & Mahunka, 1966, and this is regarded as reflecting a close relationship between these genera, as opposed to what are regarded as convergent similarities between *Ceroribatula* and *Fovoribatula*.

Ceroribatula bizygata sp. nov.
Fig. 6

Female

Dorsal profile of hysteronotum ovoid, colour dark brown, cerotegument forms continuous notal (except over lenticulus) and pleural layer, substantial thickness (greater than diameter of setal bases) including abutting refractile wax granules and vegetable detritus, giving translucent dirty white appearance and obscuring setae. Idiosomal length 617 (n = 2, 609–625). Leg lengths (femur-tarsus for 625): I – 319, II – 301, III – 280, IV – 334. Tibial maximum heights (for 625): I – 31, II – 26, III – 21, IV – 21.

Proteronotum with costate translamella, laminar lamellae, costate sublamellae (not merging anteriorly with lamellae). Seta *j*2 shorter (about 0.75 ×) than *z*1, both hyaline and lorate, weakly ciliate (not illustrated in Fig. 6). Integument mainly weakly reticulate. Costate ridge between setae *z*2–*j*2–*j*2–*z*2 appearing as second 'translamella'. Short curved subtutorium. Sensory seta *z*2 with globose caput, smooth, without cilia.

Hysteronotal setae subequal in length, lorate, weakly ciliate distally (not illustrated in Fig. 6), rank 5 (*J*5, *Z*5, *S*5) curved upwards. Anterior margin extends forward to lie close to seta *j*2. Lenticulus smooth, pale, otherwise integument with reticulate sculpturing. Anterior foramen (*F*3) as illustrated (Fig. 6) or may encompass adaxial margin of *Z*2 setal base and be attenuated anteriorly, posterior foramina (*F*4, *F*5, *F*6) less than 0.5 × size of *F*3. Pore to hysteronotal gland (*hGf*) opens into refractile sac.

Podosternum with deep cavity behind acetabulum IV, forms circumpedal ridge level with seta *IV*2, which does not merge with discidial ridge so subpedal ridge not continuous (i.e. as *C. trirostrata*, Fig. 9, not as *C. incrustata*, Fig. 2). Setae on coxite I differ in size, *I*1 0.5 × *I*2. Integument reticulate.

Opisthosternum with setae of differing form and lengths: *JZg*, *Sg* and *JZa* short and setose (similar to *C. incrustata*, Fig. 2); *Sa*1 lanceolate, length about 0.33 × distance *JZa*1–*JZa*2; *Sa*2 and *Sa*3 lorate, similar to hysteronotal setae, length subequal to distance *JZa*1–*JZa*2. Most of integument reticulate, genital shield smooth, anal shield mainly reticulate-foveate, just foveate near lateral margins. Eggs subcylindrical with convex ends, 202 × 79 (mean of 7 horizontally aligned eggs, 32% of mean female length), smooth exochorion. Number of eggs in female (number of females) as follows: four (1), six (1).

Legs medium-length (mean femur-tarsus: 49% soma), slim (mean maximum tibial height: 30% of mean length). Dorsal porose areas and strong reticulate abaxial sculpturing on all femora and trochanters III and IV. Only 3 setae on femora I and II (0–2/1–0).

Male

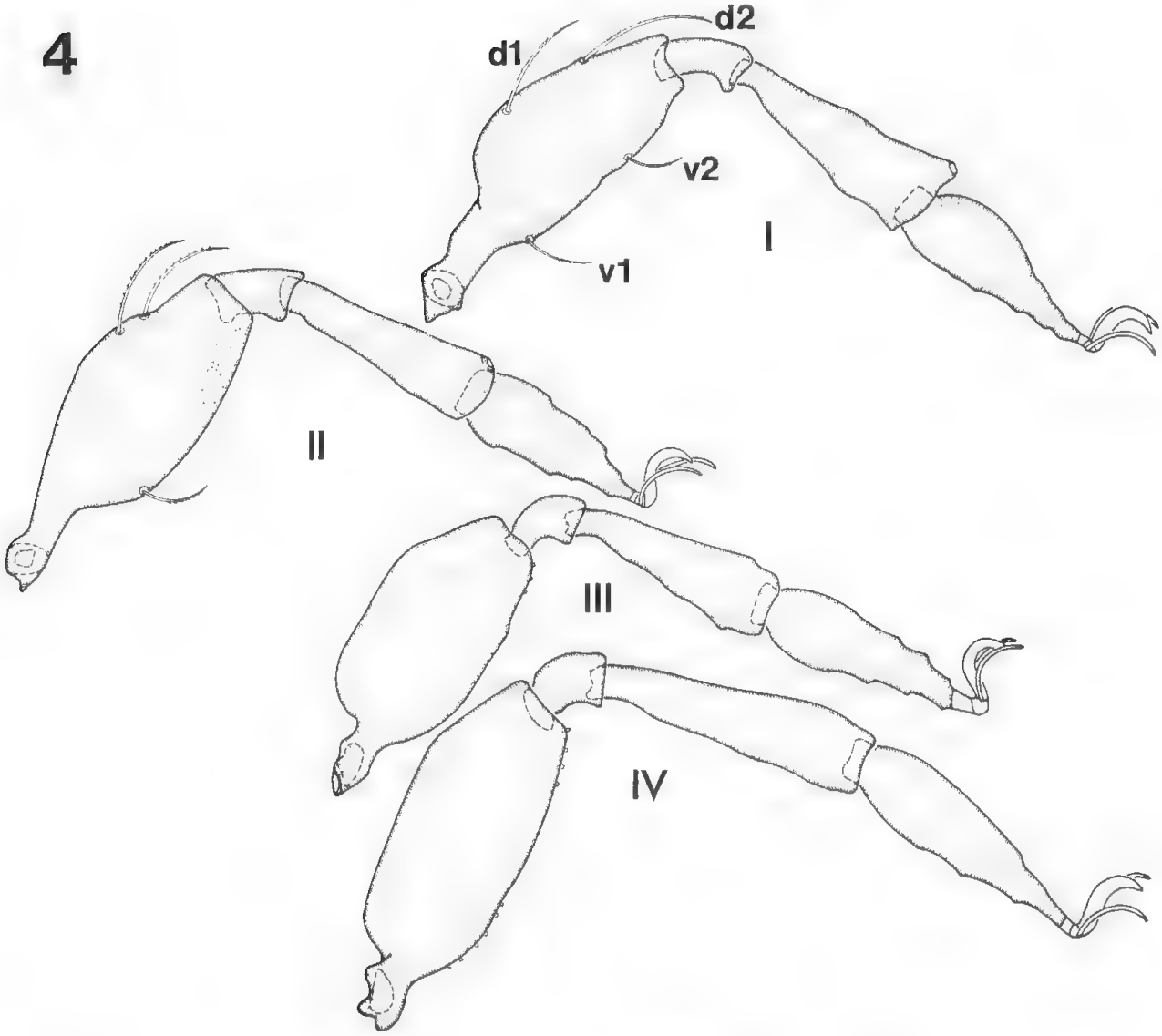
Unknown

Material examined

Holotype: ♀ (N1989192), soil, litter, moss and other low growth plants under bladder saltbush (*Atriplex vesicaria*) amongst sparse false sandlewood (*Myoporum platycarpum*), Koonamore Vegetation Reserve (32°07′S, 139°21′E), 27.vi.1974.

Paratype: 1 ♀ (N1989193) same data as holotype.

4



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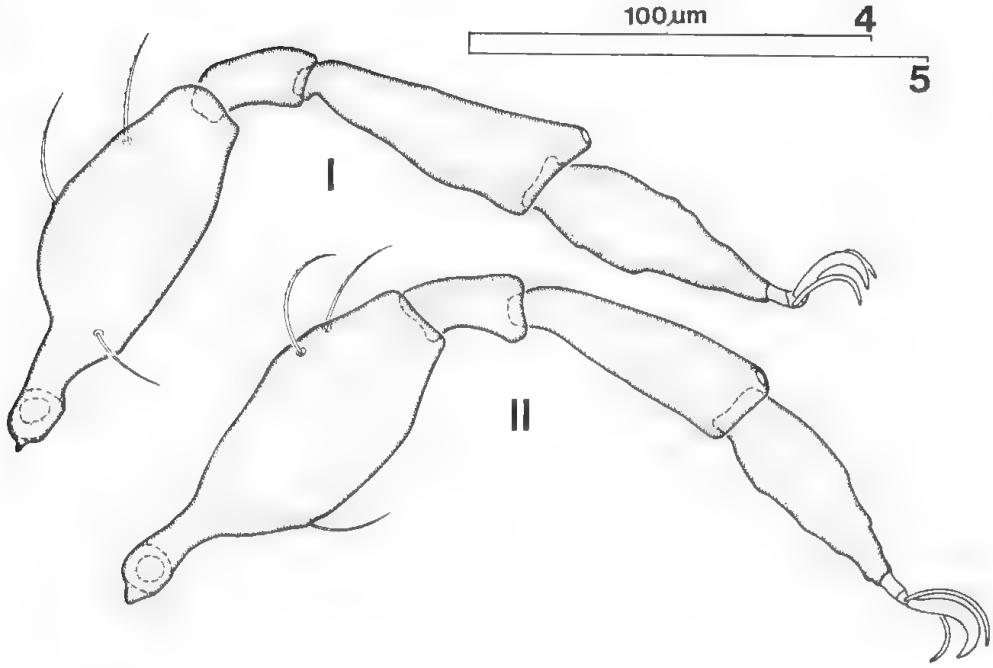


Distribution

Australia (Aa), South Australia. Semi-arid low shrubland (Koonamore Vegetation Reserve), Lake Eyre Basin, 2 ♀♀ / 2 of 8 × 25cm².

Remarks

Ceroribatula bizygata is regarded, along with *C. monozygata*, as the most primitive species in the genus, having the lowest number of femoral setae. It is the second largest species, and is strongly sclerotized, with the result that some characters are clear, but the thick dirty cerotegument and weakly refractile lorate setae make the chaetotaxy difficult to assess. The prefix of its name is derived from the Latin '*bis*' meaning '*two*', whilst the rest is based on the Greek '*zygon*' meaning 'yoke' or 'pair', referring to the translamella as in *Zygoribatula* Berlese, 1916 (Oribatulidae), and so to the presence of a second 'translamella', i.e. the costate ridge between the lamellae and setae *j2–j2*.

Ceroribatula monozygata sp. nov.
Figs 5 and 7

Female

Dorsal profile of hysteronotum ovoid, usually brown with some straw coloured specimens regarded as teneral, cerotegument forms continuous notal (except over lenticulus) and pleural layer, thin, foveate indentations matching those of integument, either hyaline or finely granulate; some attached plant detritus, but little effect on mite's appearance. Idiosomal length 495 (semi-arid shrubland, n = 6, 465–519); 530 (arid grassland, n = 1); 454 (mallee-heath, n = 3, 425–482). Leg lengths (femur-tarsus for idiosomal length 493, semi-arid shrubland): I – 225, II – 220, III – 208, IV – 272. Tibial maximum heights (for 493): I – 23, II – 21, III – 18, IV – 17.

Proteronotum with translamella costate across midline but laminar laterally, weakly laminar lamellae, sublamellae costate, merging anteriorly with lamella. Setae *j2* and *z1* subequal in length, both refractile and clavate, conspicuously ciliate. Integument weakly foveate around rostrum, otherwise smooth. Indistinct line near seta *j2*. No subrutorium. Sensory seta *z2* with globose caput, covered in minute cilia.

Hysteronotal setae subequal in length, setose, ciliate distally. Lenticulus smooth, pale, otherwise integument foveate. Anterior foramen (*F3*) as illustrated (Fig. 7) or may abut onto posterior margin of *Z2* setal base, posterior foramina (*F4*, *F5*, *F6*) subequal in size to *F3*.

Podosternum with circumpedal ridge merging with discidial ridge to form a continuous subpedal ridge weakening anteriorly, similar to *C. incrustata* (Fig. 2). Coxite setae in ranks 1 and 2 similar in size to each other and longer than on *C. incrustata*. Integument with reticulate sculpturing anteriorly, on coxite IV small alveoles.

Opisthosternal setae in file *S* similar in size, setae on genital and anal shields (*JZg*, *JZa*) slightly smaller. Most of integument with foveate sculpturing, anterior zone of smaller pits more extensive than on *C. incrustata* (Fig. 2), genital shield smooth. Eggs oval, 188 × 85 (mean of 5 horizontally aligned eggs, 33% of mean female length), smooth exochorion. Number of eggs in female (number of females) as follows: none (2), one (1), two (1), four (1), eleven (1).

Legs medium length (mean femur-tarsus: 46% of soma), slim (mean maximum tibial height: 31% of mean length). Femora I and II both with three setae (0,2/1,0). Cerotegument rarely visible on legs.

Male

As for female except margin of genital orifice well separated from ventrosejugal apodeme. Soma smaller, idiosomal length 438 (semi-arid shrubland, n = 24, 411–465); 403 (mallee-heath, n = 10, 382–420).

Material examined

Holotype: ♀ (N1989194), soil, litter, moss and other low growth plants under bladder saltbush (*Atriplex vesicaria*) amongst sparse false sandlewood (*Myoporum platycarpum*), Koonamore Vegetation Reserve (32°07′S, 139°21′E), 27.vi.1974.

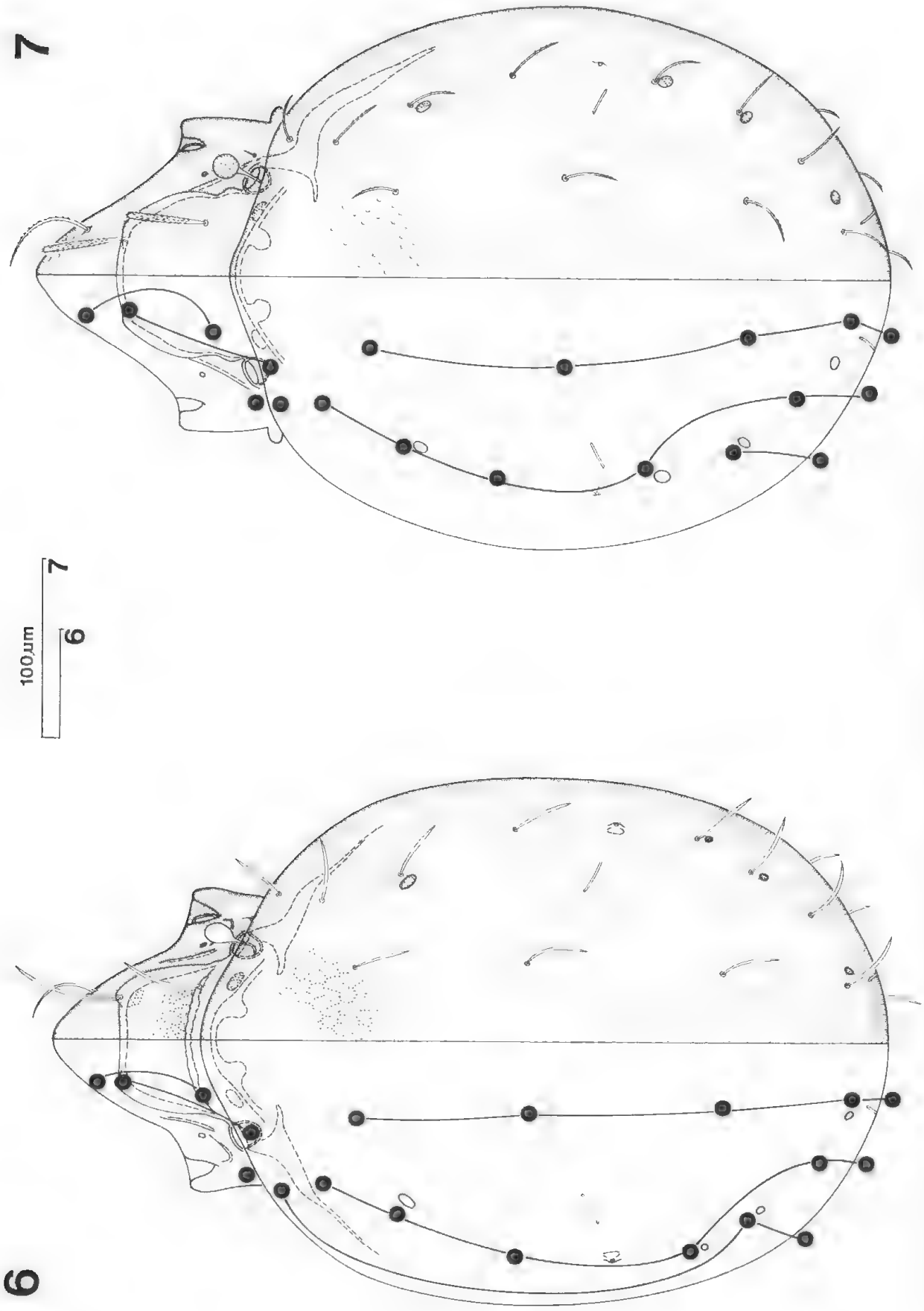
Paratypes: 5♀♀ (N1989195–N1989199), 18♂♂ (N1989200–N1989217); 2♀♀ – BMNH; 2♀♀ – FMNH; 2♀♀ NZAC; same data as holotype.

Undesignated: 1♀ (N1989218), bases of love grass (*Eragrostis eriopoda*) tussocks, near Emu (28°41′S, 132°08′E), 11.x.1976. 3♀♀ (N1989219–N1989221), 10♂♂ (N1989222–N1989231), sand, litter, under banksia shrubs (*Banksia ornata*), Tamboore Homestead (35°57′S, 140°29′E), 4.vii.1974.

Distribution

Australia (Aa), South Australia. Arid tussock grassland (Great Victoria Desert), West Plateau, 1♀ / 1 of 8 × 25cm². Semi-arid low shrubland (Koonamore Vegetation Reserve), Lake Eyre Basin, 6♀♀, 24♂♂ / 4 of 8 × 25cm². Mallee-heath, tall open shrubland (Tamboore Homestead, near Mt Rescue Conservation Park), Murray-Darling Basin, 3♀♀, 10♂♂ / 3 of 8 × 25cm².

FIGURES 4 and 5. Right legs, posterior aspect to femur-pretarsus, showing setae only on femora I and II. 4, *Ceroribatula incrustata* sp. nov., legs I – IV. 5, *Ceroribatula monozygata* sp. nov., legs I and II. Notation: d – dorsal, v – ventral.



FIGURES 6 and 7. Somal notum. 6, *Ceroribatula bizygata* sp. nov.; 7, *Ceroribatula monozygata* sp. nov..

Remarks

Ceroribatula monozygata is regarded, along with *C. bizygata*, as the most primitive species, having the least number of femoral setae. The cerotegument is thin and inconspicuous and because of the size of the notal setae and form it looks very similar to *C. incrustata* without any incrustation. The prefix of its name is derived from the Greek '*monos*' meaning 'one' and, in a similar manner to the formation of the name of *C. bizygata*, it refers to the presence of a single translamella, without a second 'translamella'.

Ceroribatula trirostrata sp. nov.
Figs 8 and 9

Female

Dorsal profile of hysteronotum ovoid, dark brown, cerotegument forms continuous notal (except over lenticulus) and pleural layer, medium thickness (subequal to 3 × diameter of setal base), including refractile wax granules (where thick, form irregular white patches) and attached vegetable detritus, obscuring setae, sculpturing and foramina. Idiosomal length 745 (n=1). Leg lengths (femur-tarsus): I – 368, II – 342, III – 352, IV – 427. Tibial maximum heights: I – 33, II – 26, III – 21, IV – 21.

Proteronotum with translamella mainly costate (brief laminar part near seta *z1*), laminar lamellae, sublamellae costate (merging anteriorly with lamellae). Setae *j2* and *z1* subequal in length, hyaline, ensiform, weakly ciliate. Short subtutorium. Caput of seta *z2* without cilia. Integument reticulate between *j2*-*J2*. Rostrum tripartite with two incisions.

Hysteronotal setae subequal in length, short, ensiform, without cilia. Lenticulus smooth, pale, otherwise integument foveate. Anterior foramen (*F3*) long and narrow compared with suboval posterior foramina (*F4*, *F5*, *F6*).

Podosternum with subpedal ridges fragmented into distinct parts and custodial ridge absent. Coxite setae in rank 2 of legs I,II,III longer than in rank 1. Midsternal and postpedal apodeme present. Integument foveate, and patch of finely punctate sculpturing between setae *I1*-*I1* (not illustrated in Fig. 9).

Opisthosternal setae either setose (*JZg1*-4, *Sg*, *Sa1*) or ensiform (*JZa1*-2, *Sa2*, *Sa3*). Integument foveate. Eggs oval, 237 × 106 (32% of female length), smooth exochorion, 14 eggs in single female.

Legs long (mean femur-tarsus: 50% soma), very slim (mean maximum tibial height: 24% of mean length). Leg III with long femur, unusual in being longer than leg II. Femur I with four setae (0,2/2,0), femur II with three setae (0,2/1,0). Some cerotegument around basal leg segments.

Male

As female, except hysteronotal foramen *F3* about half length although similarly narrow, and margin of genital orifice well separated from ventrosejugal apodeme. Soma smaller, idiosomal length 639 (n = 2, 660, 617).

Material examined

Holotype: ♀ (N1989232), soil, litter, moss and other low growth plants under bladder saltbush (*Atriplex vesicaria*) amongst sparse false sandlewood (*Myoporum platycarpum*), Koonamore Vegetation Reserve (32°07'S, 139°21'E), 27.vi.1974.

Paratypes: 2♂♂ (N1989233, N1989234), same data as holotype.

Distribution

Australia (Aa), South Australia. Semi-arid low shrubland (Koonamore Vegetation Reserve), Lake Eyre Basin, 1 ♀, 2 ♂♂/ 3 of 8 × 25cm².

Remarks

The name of *Ceroribatula trirostrata* is from the Latin '*tres*' meaning 'three' and it refers to the rostrum which is broken up by two incisions into three parts. It is similar to *C. incrustata* in having four setae on femur I, but is superficially like *C. bizygata* because of its proteronotal ridges and setae. It is also similar to species of *Zygoribatula*, especially those with a long, slim hysteronotal multiporose foramen *F3* such as *Z. longiporosa* Hammer, 1953 from Queensland. Whilst *Z. longiporosa* is similar, it has five setae on both femora I and II, the integument is smooth with an inconspicuous cerotegument.

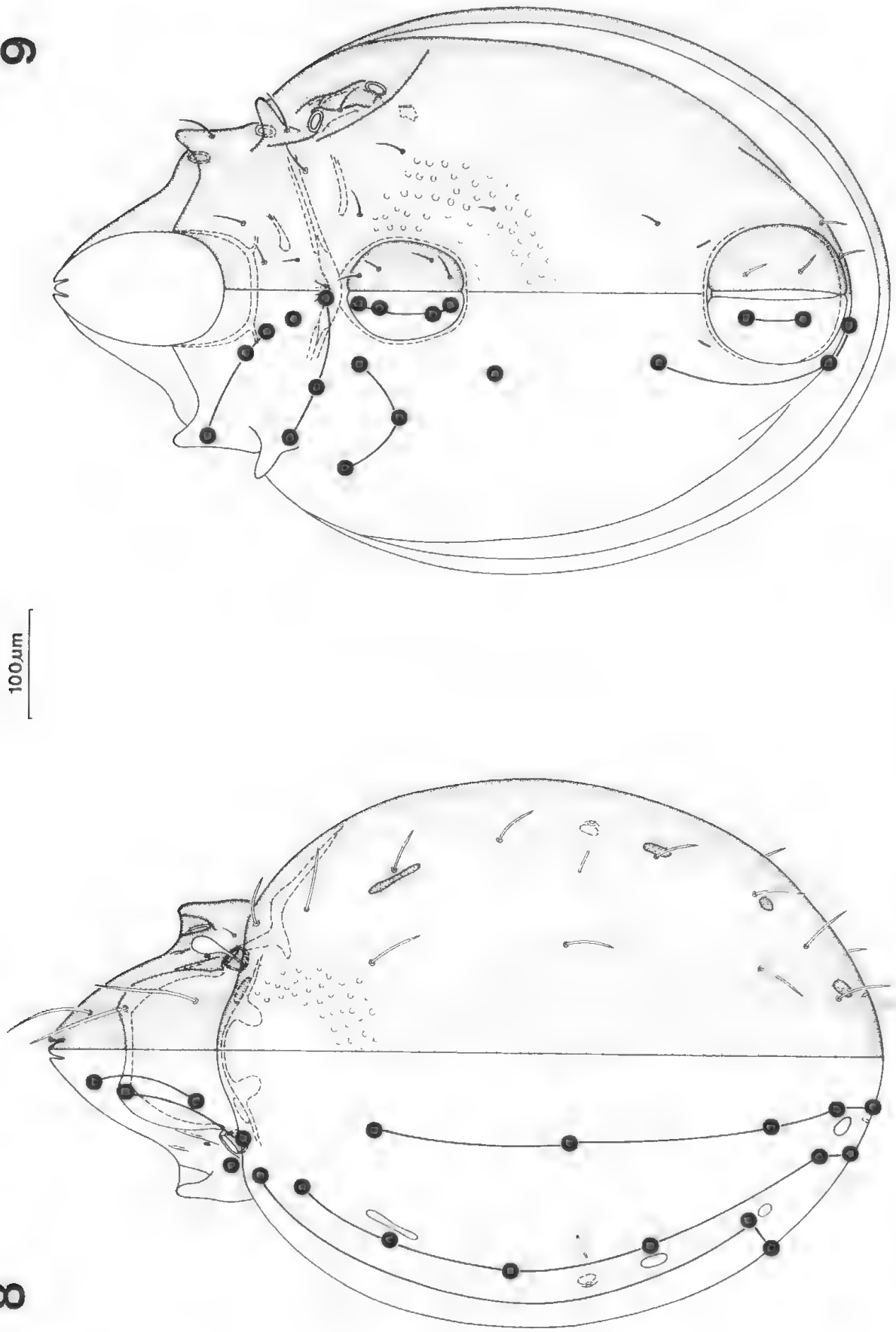
megaforamina-complex

Diagnosis

Ceroribatula. Hysteronotal setae (longer than 0.5× distance between bases), proteronotal seta *s1* (longer than diameter of bothridial aperture) and trochanter I seta *v* (longer than distance between setae *I1*–*I2*) medium length. Translamella absent. Femur I with seta *v2* (0,2/2,0).

Remarks

The *megaforamina*-complex is regarded as derived from the *incrustata*-complex in having four setae on femur I and medium-length setae on the hysteronotum and elsewhere. These character states and the absence of a translamella make it similar to *Fovoribatula mesosetosa* sp. nov., but the absence of posterior setae on femora I and II indicates that it belongs to a separate lineage. It includes only the nominate species, *C. megaforamina*.



FIGURES 8 and 9. *Ceroribatula trirostrata* sp. nov., female soma. 1, notum; 2, idiosternum.

Ceroribatula megaforamina sp. nov.
Figs 10 and 11

Female

Dorsal profile of hysteronotum subcircular, colour light brown, cerotegument inconspicuous. Idiosomal Length: 580 (n = 6, 540-617). Leg lengths (femur-tarsus for idiosomal length 609): I – 332, II – 311, III – 306, IV – 386. Tibial maximum heights (for 609): I – 26, II – 21, III – 19, IV – 18.

Proteronotum with weakly laminar lamellae and costate sublamellae. Seta *j*2 slightly longer (more than 1.1×) than *z*1, both ciliate and bacilliform. Integument smooth. Sensory seta *z*2 clavate, with globose caput and many fine, pointed cilia, smaller and more numerous than represented (Fig. 10).

Hysteronotal setae mostly subequal in length, but *S*1 shorter, with three longitudinal files of cilia. Lenticulus smooth, pale, surrounding integument foveate with small, well spaced pits. Multiporose foramina large, anterior one (*F*3) largest, oval.

Podosternum with circumpedal ridge merged with rest of subpedal ridge, extending to weak custodial ridge fading just anterior to pedotectum II. Two adaxial setae on coxite I similar in length (*I*1 and *I*2 subequal). Integument foveate around midline, smooth peripherally.

Opisthosternum with setae of fairly uniform length, *Sa*1 subequal to *Sa*3. Adanal pore *Saf* nearly longitudinal, further from anal orifice than its length. Eggs oval, 223 × 100 (mean of 15 horizontally aligned eggs), 39% of mean female

10

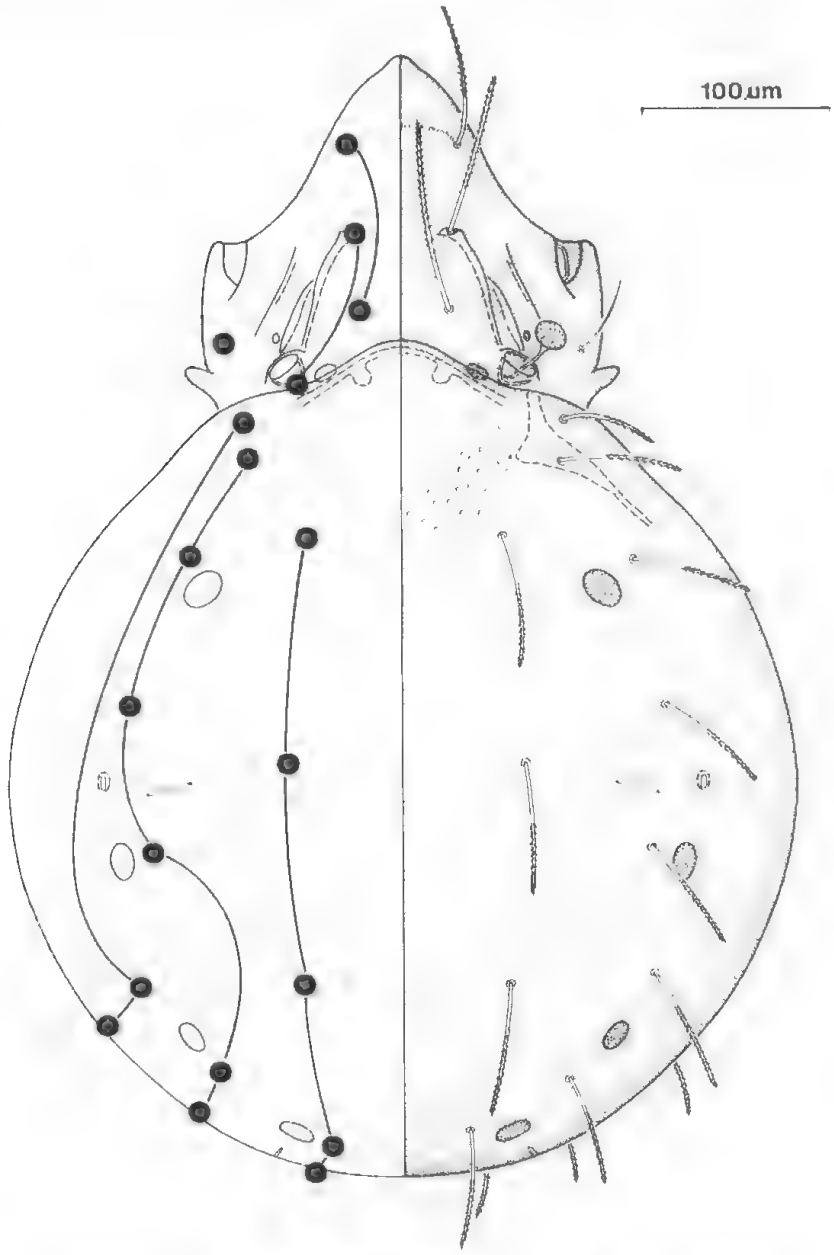


FIGURE 10. *Ceroribatula megaforamina* sp. nov., female notum.

length, smooth or wrinkled exochorion. Number of eggs in female (number of females) as follows: six (2), seven (1), eight (3).

Legs long (mean femur-tarsus: 54% of soma), slim (mean maximum tibial height: 22% of mean length). Leg IV unusually long and slim with spinate ventral setae on tibia and tarsus (Fig. 11). Only four setae on femur I (0,2/2,0) and three setae on femur II (0,2/1,0).

Male

As female except two specimens (idiosomal length 486 and 563) with clear, finely punctate cerotegument covering hysteronotum other than over lenticulus, all specimens with margins of genital orifice not merging with ventrosejugal apodeme. Soma smaller, idiosomal length: 518 (arid grassland, n = 15, 439–568); 439 (Semi-arid shrubland, n = 1).

Material examined

Holotype: ♀ (N1989235), bases of lovegrass (*Eragrostis eriopoda*) tussocks, near Emu (28°41′S, 132°08′E), 11.x.1974.

Paratypes: 5 ♀♀ (N1989236–N1989240), 12 ♂♂ (N1989241–N1989252); 1 ♂ – BMNH; 1 ♂ – FMNH; 1 ♂ – NZAC; same data as holotype.

Undesignated: 2 ♂♂ (N1989253, N1989254) same data as holotype. 1 ♂ (N1989255), soil, litter, moss and other low growth plants under bladder saltbush (*Atriplex vesicaria*) amongst sparse false sandlewood (*Myoporum platycarpum*), Koonamore Vegetation Reserve (32°07′S, 139°21′E), 27.vi.1974.

Distribution

Australia (Aa), South Australia. Arid tussock grassland (Great Victoria Desert), West Plateau, 6 ♀♀, 17 ♂♂/ 4 of 8 × 25cm². Semi-arid low shrubland (Koonamore Vegetation Reserve), Lake Eyre basin, 1 ♂/ 1 of 8 × 25cm².

Remarks

The relationships of *Ceroribatula megaforamina* are considered under the 'Remarks' on the *megaforamina*-complex. Its name is based on the Greek '*mega*' meaning 'large' and the Latin '*foramen*' meaning 'hole', referring to the large size of the multiporose hysteronotal foramina. The integument is very clean for a species of *Ceroribatula*, most specimens being without any evident cerotegument or attached vegetable detritus. Even the two males that are covered in fine, regular deep punctata, apparently representing fine canals through a shallow cerotegument, are without attached detritus. Besides their punctata, no differences from other specimens were recognised for these two males. It is assumed that they belong to the same species and have an ephemeral cerotegument, but they are not included in the type series in case this is contradicted by further evidence.

Genus *Fovoribatula* gen. nov.

Type-species: *Fovoribatula brevisetosa* sp. nov.

Diagnosis

Fovoribatulinae. Hysteronotal setae short or medium-length, not longer than distance between their bases. Lenticulus present, associated with mid-dorsal forward pointing protruberance of hysteronotum. Lamellae present, laminar and complete (between *z1–z2*). Translamella present (costate) or absent. Rim of bothridium (base of seta *z2*) low, not turret-like. Four pairs of hysteronotal multiporose foramina. Discidium present as costate ridge. Femora I and II with four setae, posterior setae present (0,2/1,1). Pretarsal claws long (central claw II more than 0.3× length of tarsus II).

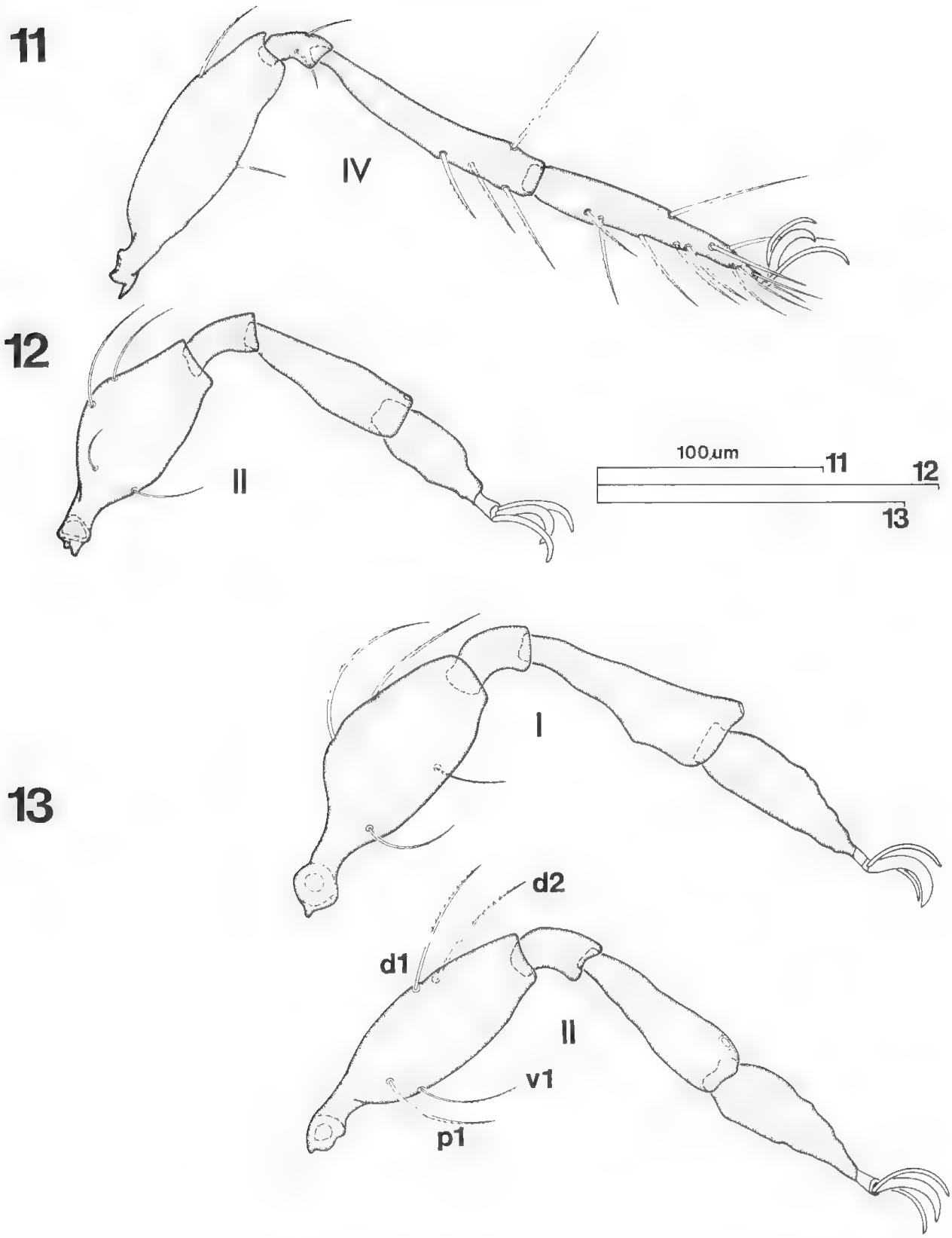
Remarks

Fovoribatula is superficially similar to the South Australian genus *Ceroribatula* gen. nov., but it is regarded as more closely allied to *Decoribatula* Lee & Birchby, 1989, from Singapore, because of the chaetotaxy on femora I and II. But it is noted that on femur I the ventral seta is positioned as *v2* not *v1* as on *Decoribatula*. Other similarities to *Decoribatula* are the larger pretarsal claws (not conspicuously so on *Fovoribatula mesosetosa*) and leg II being shorter than leg III (femur-tarsus), only known for *C. trirostrata* among the *Ceroribatula*. The name is derived from the Latin '*fovea*' meaning 'pit', refering to the foveate (pitted) integument of its members, whilst the cerotegument is not conspicuous as in most members of *Ceroribatula*. It includes two species which are dissimilar in their proteronotal ridges, hysteronotal setae and pretarsi. Whilst the type-species is unusual in appearance and is considered as being the more derived, the other species (*F. mesosetosa*) is similar to *Ceroribatula megaforamina* sp. nov., both possessing derived character states. Whilst *F. brevisetosa* has unusually large lateral claws on the pretarsus approaching the relative size of *Decoribatula pustulata*, those on *F. mesosetosa* are larger than for *Ceroribatula* although not obviously so. *Fovoribatula* includes two new species as follows: *F. brevisetosa*, *F. mesosetosa*.

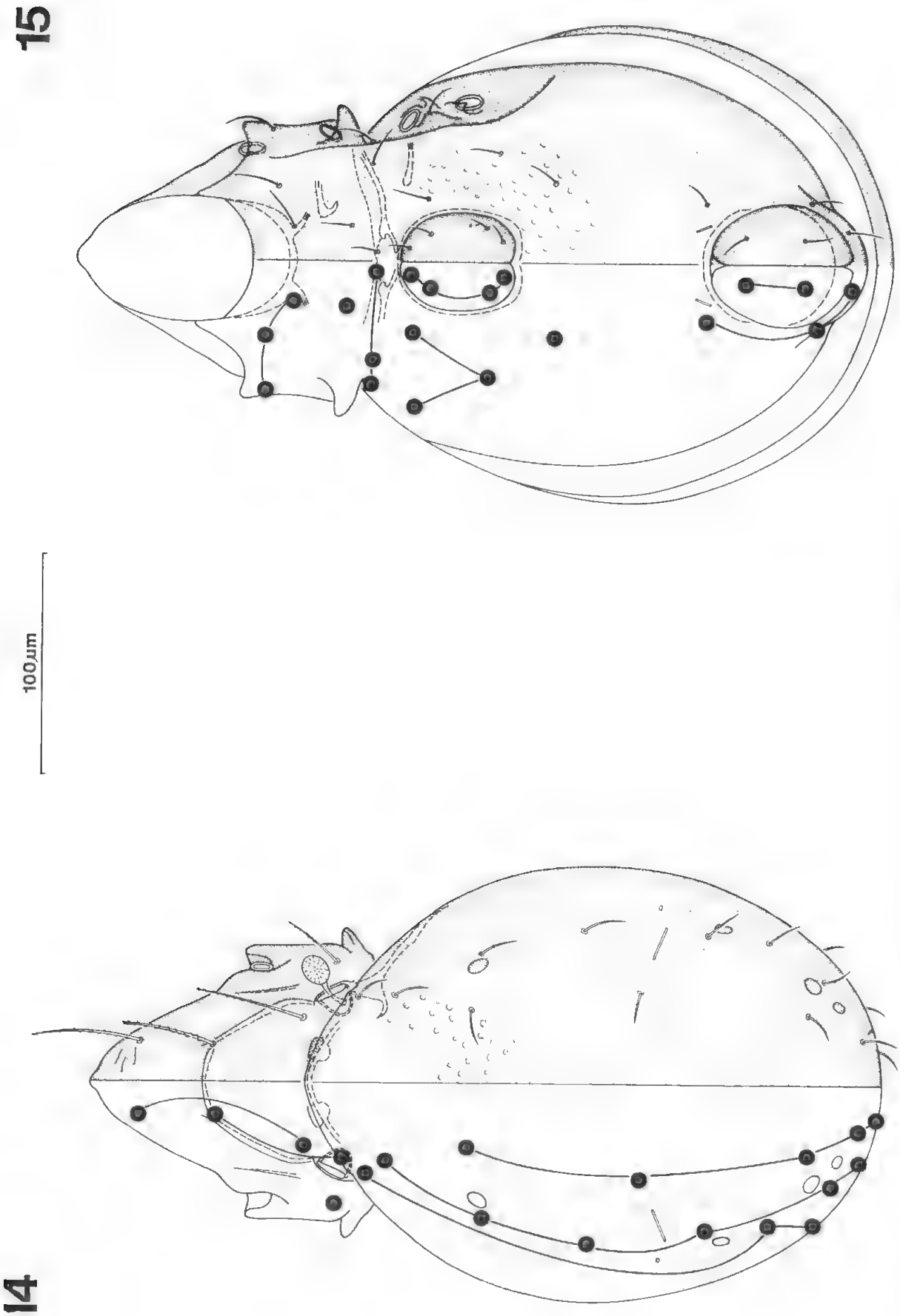
Fovoribatula brevisetosa sp. nov.
Figs 12, 14, 15

Female

Dorsal profile of hysteronotum ovoid, light brown, cerotegument inconspicuous. Idiosomal



FIGURES 11, 12 and 13. Right legs, posterior aspect to femur-pretarsus showing setae on all segments of leg IV and femora only of legs I and II. 11, *Ceroribatula megaforamina* sp. nov., leg IV. 12, *Fovoribatula brevisetosa* sp. nov., leg II. 13, *Fovoribatula mesosetosa* sp. nov., legs I and II. Notation: d = dorsal, v = ventral, p = posterior.



FIGURES 14 and 15. *Fovoribatula brevisetosa* sp. nov., female soma. 14, notum; 15, idiosternum.

length 375 (n = 1). Leg lengths (femur-tarsus): I – 213, II – 170, III – 193, IV – 213. Tibial maximum heights: I – 21, II – 18, III – 13, IV – 13.

Proteronotum with translamella costate, lamellae weakly laminar, costate near seta *z1*, no sublamellae, linear subtutorium. Setae *j2* and *z1* subequal in length, *z1* more robust. Caput of seta *z2* with minute cilia. Integument smooth except for transverse wrinkles on rostrum.

Hysteronotal setae subequal in length, short, setose, weakly ciliate. Lenticulus smooth, pale, otherwise integument with weak, sparse foveate sculpturing. Anterior foramen (*F3*) oval, similar in size to *F5*.

Podosternum with circumpedal ridge merged in with a continuous subpedal ridge, extending to weak custodial ridge fading level with seta *I3*. Two adaxial setae on coxite I similar in length (*I1* and *I2* subequal).

Opisthosternum with setae of fairly uniform length, adaxial shorter. Adanal pore *Saf* oblique, sloping inwards anteriorly, closer to anal orifice than its length. Eggs oval, 175 × 69 (mean of 3 eggs present), 47% of female length, smooth exochorion.

Legs long (mean femur-tarsus: 52% of soma), slim (mean maximum tibial height: 26% of mean length). Seta *v* on trochanter I reaches forward to level of *v2* on femur I. Claws large, lateral claws more than half as stout as central claw.

Male

Differs from female in that anterior margin of hysteronotal shield has tectum extending forward to cover posterior half of bothridium to seta *z2*. Genital shield smaller, anterior margin to genital orifice not abutting onto ventrosejugal apodeme, level with seta *IV1*. Soma smaller, idiosomal length 368 (n=1).

Material examined

Holotype: ♀ (N1989256), sand, litter, under banksia shrubs (*Banksia ornata*), Tamboore Homestead (35°57′S, 140°29′E), 4.viii.1974.

Paratype: 1 ♂ (N1989257) same data as holotype.

Distribution

Australia (Aa), South Australia. Mallee-heath, tall open shrubland (Tamboore Homestead, near Mt Rescue Conservation Park), Murray-Darling basin, 1 ♀, 1 ♂/ 2 of 8 × 25cm².

Remarks

Fovoribatula brevisetosa is the type-species of the genus. The prefix of the name is derived from the Latin '*brevis*' meaning short and this refers to the length of the hysteronotal setae. It is unusual amongst the Fovoribatulinae in having short tarsi and the largest pretarsal claws for an Australian species, approaching the size of those in *Decoribatula* from Singapore, as well as having the largest known egg. The larger pretarsal claws are considered derived and an indication that *Fovoribatula* is allied to *Decoribatula*. The shortness of the dorsal setae is regarded as a regression, convergent with a similar character state on the primitive species of *Ceroribatula*, because certain setae (*s1* on proteronotum and *v* on trochanter I) are relatively long and, therefore, considered derived.

Fovoribatula mesosetosa sp. nov.
Figs 13, 16, 17

Female

Dorsal profile of hysteronotum oval, colour medium brown, cerotegument shallow, containing wax granules in white patches anteriorly and posteriorly on soma and on hysteronotal humeral region. Idiosomal length: 536 (n = 2, 519,553). Leg lengths (femur-tarsus for idiosomal length 519): I – 254, II – 236, III – 244, IV – 303. Tibial maximum heights (for 519): I – 26, II – 18 , III – 18 , IV – 18.

Proteronotum without translamella, lamellae substantially laminar anteriorly, costate near seta *z2*, sublamellae costate or more rarely linear and weak, linear subtutorium. Seta *j2* shorter (about 0.85×) than *z1*, both ciliate and bacilliform. Sensory seta *z2* with fine, pointed cilia on caput. Integument smooth.

Hysteronotal setae mostly subequal in length, but *J6*, *Z6*, *S1* and *S6* shorter, with three longitudinal files of cilia. Pale lenticulus with sparse, very shallow alveolae, surrounding integument clearly foveate. Multiporose foramina small, subequal, oval.

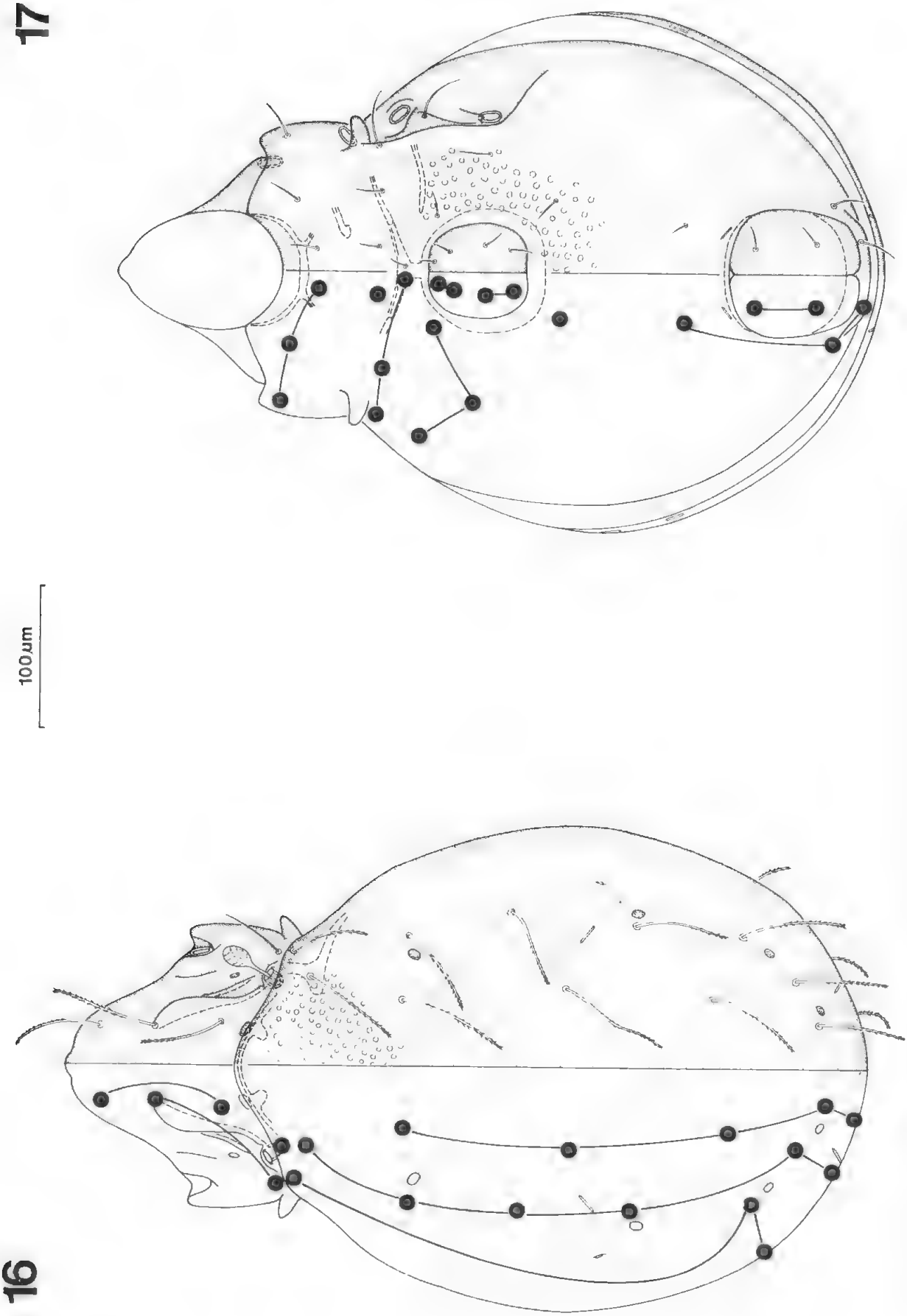
Podosternum with circumpedal ridge merging with subpedal ridge as far anterior as pedotectum II. Two adaxial setae on coxite I similar in length (*I1* and *I2* subequal), peripheral setae, especially *III3*, longer. Integument smooth.

Opisthosternum with setae fairly uniform in length, except that *Sa1* is short and *Sa2*, *Sa3* are long. Adanal pore *Saf* nearly parallel to margin of anal shield. Eggs oval, 161 × 77 (mean of 6 horizontally aligned eggs), 30% of mean female length, smooth exochorion. Number of eggs in female (number of females) as follows: one (1), ten (1).

Legs long (mean femur-tarsus: 50% of soma), slim (mean maximum tibial height: 29% of mean length). Claws large, but lateral claws less than half as stout as central claw.

Male

As female except that margin of genital orifice not merging with ventrosejugal apodeme. Soma smaller, idiosomal length: 491 (n = 7, 455–514).



FIGURES 16 and 17. *Fovoribatula mesosetosa* sp. nov., female soma. 16, notum; 17, idiosternum.

Material examined

Holotype: ♀ (N1989258), soil, litter, moss and other low growth plants under bladder salt bush (*Atriplex vesicaria*) amongst sparse false sandlewood (*Myoporum platycarpum*), Koonamore Vegetation Reserve (32°07′S, 139°21′E), 27.vi.1974

Paratypes: 1♀ (N1989259), 4♂♂ (N1989260–N1989263); 1♂ BMNH; 1♂ FMNH; 1♂ NZAC; same data as holotype.

Distribution

Australia (Aa), South Australia. Semi-arid low shrubland (Koonamore Vegetation Reserve), Lake Eyre basin, 2♀, 7♂♂/ 3 of 8 x 25cm².

Remarks

The prefix of the name of *Fovoribatula mesosetosa* is derived from the Greek '*mesos*' meaning 'middle', referring to the medium-length of the hysteronotal setae. It is easily distinguished from the only other species in its genus by the larger hysteronotal setae, absence of a translamella and relatively slimmer lateral prearsal claws and shorter central claws. Central claw II (for example) is only slightly larger than those of *Ceroribatula*. It is superficially similar to *Ceroribatula megaforamina* as commented on in the 'Remarks' on *Fovoribatula*.

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We are indebted to the Australian Biological Resources Study for funding the salary of C.M.B. in a grant to D.C.L., as well as to Dr Henrik Enghoff (Zoological Museum, Copenhagen) for making two types available. Thanks are also due to Mrs Kathy Bowshall-Hill for the notation and presentation of the figures and Mrs Debbie Lowery for typing the manuscript.

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REVISION OF AUSTRALIAN SPECIES OF THE GENUS HOLCONIA THORELL (HETEROPODIDAE: ARANEAE)

D. B. Hirst

Summary

Australian species of the genus Holconia Thorell, 1877 are revised. Holconia hirsuta (L. Koch), H. immanis (L. Koch), H. insignis (Thorell) type species, and H. nigrigularis (Simon) are valid taxa. Holconia subdola Thorell is a synonym of H. hirsuta. Isopeda simoni Rainbow is a synonym of H. nigrigularis. Mygale whitei Bonnet is synonymised with H. immanis. The following new species are described: H. colberti, H. flindersi, H. murrayensis, H. neglecta and H. westralia.

REVISION OF AUSTRALIAN SPECIES OF THE GENUS *HOLCONIA* THORELL (HETEROPODIDAE: ARANEAE)

D. B. HIRST

HIRST, D. B. 1991. Revision of Australian species of the genus *Holconia* Thorell (Heteropodidae: Araneae). *Rec. S. Aust. Mus.* 24(2): 91-109.

Australian species of the genus *Holconia* Thorell, 1877 are revised. *Holconia hirsuta* (L. Koch), *H. immanis* (L. Koch), *H. insignis* (Thorell) type species, and *H. nigrigularis* (Simon) are valid taxa. *Holconia subdola* Thorell is a synonym of *H. hirsuta*. *Isopeda simoni* Rainbow is a synonym of *H. nigrigularis*. *Mygale whitei* Bonnet is synonymised with *H. immanis*. The following new species are described: *H. colberti*, *H. flindersi*, *H. murrayensis*, *H. neglecta* and *H. westralia*.

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This is the fourth part of a revision of the Australian Heteropodidae excluding *Heteropoda* Latreille, 1804. Hirst (1990) revalidated the genus *Holconia* when outlining the genera and relimiting Australasian species involved in the genus *Isopeda (sensu lato)*. Here, Australian taxa of the genus *Holconia* are revised.

Koch (1867) described *Delena immanis* from Brisbane, at that time understandably selecting that genus as morphologically similar. Thorell (1870) erected the genus *Voconia*, for a new species, *V. insignis*; Koch (1875) transferred *immanis* to *Voconia* and described *V. dolosa*. Koch's understanding of that genus is questionable as at the same time he described *Isopeda hirsuta*, a species which should have been difficult to separate from *dolosa* or *insignis*, the latter which he redescribed. Finding *Voconia* preoccupied, Thorell (1877) replaced that name with *Holconia*. Three more species, *H. subdola*, *H. armillata* and *H. beccarli* were described by Thorell (1881, 1887, 1892). The latter two, being non-Australian, are not included in this revision. Hogg (1902) saw no reason for retaining *Holconia*, and synonymised it with *Isopeda*. Two further species, *I. nigrigularis* and *I. woodwardi* were described by Simon (1908). As the latter name was a homonym of *Isopeda woodwardi* Hogg, Rainbow (1911) replaced this with *simoni*. Little has been produced in the following years concerning this group of heteropodids regarded here as *Holconia*, but Bonnet (1957) proposed the name *Mygale whitei* for a species briefly described and illustrated by J. White (1790) and named only 'White-jointed spider'. Main (1985: 48) noted that the species was 'a sparassid (Sparassidae - Heteropodidae)'. The illustrations are undoubtedly of *H. immanis* and Bonnet probably chose the genus *Mygale* solely on the reference to that species as 'Mygale de White' by Walckenaer (1837).

MATERIALS AND METHODS

Measurements were made with an eyepiece graticule on a Wild microscope and are given in millimetres except eye diameters, interspaces and MOQ (median ocular quadrangle) dimensions which are expressed as relative to the diameter of an AME. Other materials and methods are given in Hirst (1989). Acronyms are: AM - Australian Museum, Sydney; ANIC - Australian National Insect Collection, Canberra; BYM - Dr B.Y. Main, Zoology Department, University of Western Australia, Nedlands; MCG - Museo Civico di Storia Naturale 'Giacomo Doria', Genoa; NHMW - Naturhistorisches Museum, Wien; NHRM - Naturhistoriska Riksmuseum, Stockholm; NMV - Museum of Victoria, Melbourne; NTM - Northern Territory Museum, Darwin; QM - Queensland Museum, Brisbane; SAMA - South Australian Museum, Adelaide; SMNS - Stadtliches Museum für Naturkunde, Stuttgart; WAM - Western Australian Museum, Perth; ZMB - Museum für Naturkunde an der Universität Humboldt zu Berlin; ZMH - Zoologisches Museum, Hamburg.

DISCUSSION

The term 'subembolic apophysis' (Figs 1-7, 15) was introduced (Hirst 1990) to describe the apophysis found in species of *Holconia* and distinguishing it from the tegular apophysis found in several other genera of the Deleninae. Those structures are probably homologous in function. With the exception of *H. nigrigularis* the subembolic apophysis bridges a 'gap' between the embolic base and the tegulum. Rising prodistally from the embolic base to a rounded point or 'knob', the subembolic apophysis is connected to the tegulum on the prodorsal side of the apophysis.

Holconia nigrigularis differs in having the subembolic apophysis rising more prolaterally on the embolic base (Fig. 14) adjacent to its junction with the tegulum, and not being fixed to the tegulum. This state also occurs in one species of a sister genus (Hirst in prep.) but then is smaller and accompanied by a reduced tegular apophysis.

A distinctive character of female *Holconia* species required a second term, the 'epigynal sclerite' (Fig. 25) in reference to a lateral convexity in the posterior half of the epigynum (Hirst 1990). The epigynal sclerite is a narrow to broad extension of the lateral rim of the epigynum over the postero-lateral corner of the fossa. In *Isopeda* and related genera the lateral rim turns sharply downwards to produce a concavity adjacent to the postero-lateral edge of the fossa. The epigynal sclerite is a useful diagnostic female character when used with epigynum shape and number of insemination duct coils.

Holconia Thorell

Voconia Thorell, 1870: 382.
Holconia Thorell, 1877: 485 (nom. nov. for *Voconia* Thorell, pre-occupied). Hirst, 1990: 17.
Isopeda: Hogg, 1902: 429 (in part).

Diagnosis

Males with subembolic apophysis. Tegulum prodistally rounded without apophysis. Female epigynum with convex epigynal sclerite extending over posterior lateral corner of fossa.

Description

Large spiders, carapace length often 9-15 mm; 6-9 times longer than high, highest posterior to ocular area; caput 'U' shaped; fovea long, narrow, deep. Anterior eye row slightly recurved; line drawn behind posterior eyes recurved; ALE largest; PLE often subequal to AME; PME smallest, low-domed, barely, or not visible in lateral view; AME closer to each other than to ALE. Clypeus 1/8 to 1/2 width of AME. Cheliceral groove with two promarginal teeth; four or five retromarginal teeth, distal tooth subequal or rather equal to subdistal tooth except in *H. immanis* in which it is larger. Labium barely wider than long, apex somewhat truncate. Sternum longer than wide, truncate anteriorly, broadest mid-length between second coxae, narrowing to a point between fourth coxae. Leg I, when outstretched alongside leg II, reaches to mid-length of metatarsus II, rarely to near distal end of metatarsus II. Three pairs of ventral spines on all tibiae with distal pair adjacent to articulation with metatarsi. Scopula on all metatarsi and tarsi, sparse on metatarsi IV, largely replaced by stout bristles. Abdomen usually with pattern of large ill-defined brown or blackish patches, broadly ovate in its normal condition, flattened dorso-ventrally. Male palpal tibial apophysis subequal in length to palp tibia, relatively straight, lanceolate, usually with incurved apex; membranous support on inner edge of apophysis base forms a somewhat continuous straight line with apophysis. Tegular apophysis absent. Embolic base with prodistal knob-like subembolic apophysis connected to tegulum, or semicircular and not connected to tegulum; embolic base rarely with granulated area, when present appears as a series of fine ridging (Fig. 14); area between conductor base and embolus broad, depressed (Fig. 14). Embolus with 7½ to 11½ coils in distal half of cymbium. Coil stack almost width of cymbium; first complete coil smaller than several subsequent coils, difficult to see in ventral view without manipulation of embolus. Tip of embolus constricts and tapers to a fine point in the last half a turn or less. Female epigynum large, roughly oblong but broader posteriorly; sclerotised lateral rims often somewhat parallel in anterior half; in posterior half a convex extension of the lateral rim, the epigynal sclerite, extends partly over fossa. Fossa smooth, rarely darkly pigmented, often narrower and somewhat truncate posteriorly; posterior section often with depressed or raised areas. Fossa and sclerotised rim lack setae. Vulva with paired insemination ducts coiled 8-11 times; spermathecae with moderately long, usually curved, spermathecal sacs.

Type species

Voconia insignis Thorell, 1870.

Remarks

Spermathecal sacs may be widely separated (fig. 10, Hirst 1990) or close together (Fig. 23). They appear to be intraspecifically variable and diagnostically useful only at generic level. Colouration of *H. immanis* and *H. nigrigularis* is distinctive but other species are uniformly coloured. Spination and leg lengths are very similar within the genus. Leg ratios (leg length / carapace length) are also intraspecifically variable. Leg lengths and spination are given for the type species, *Holconia insignis* in Hirst (1990)

Four species groups or sister groups are outlined within the genus, but these are equivocal as definitions of the groups alter if different character combinations are used. *Holconia nigrigularis* lacks the fixed subembolic apophysis of other species and has a much flatter carapace which isolate this species from others in the genus. On the other hand, the presence of four retromarginal cheliceral teeth and a broader male palpal tibial apophysis ally this species with a further group, comprising *H. colberti* and *H. westralia*, but which has more coils in the

embolus and insemination duct as well as a relatively higher carapace, and in the case of *H. colberti*, occasionally five retromarginal cheliceral teeth.

Grouping of remaining species may be determined by the degree of coiling of the embolus or insemination ducts and carapace height. The largest group comprises *H. insignis*, *H. flindersi*, *H. murrayensis* and *H. immanis*. While *H. immanis* is easily diagnosed by its distinctive pattern and larger subembolic apophysis, other species in this group are difficult to separate. This is further complicated by the sympatric occurrence in part of the distributions of *insignis/murrayensis* and *murrayensis/flindersi* (Fig. 36). Grouping by another character, the distal retromarginal cheliceral tooth, isolates *H. immanis* from all other *Holconia* species in having that tooth the largest.

Holconia hirsuta and *H. neglecta* can be grouped on their reduced embolic and insemination duct coiling but may well be included in the previous group. *H. hirsuta* differs in the marginally greater spacing between the median and subdistal retromarginal teeth (Fig. 20), in which it is paralleled by *H. westralia* (Fig. 21), but a similar spacing of those teeth is occasionally found in *H. insignis* (Fig. 19).

Key To The Species Of *Holconia*

1 — Abdomen with ventral pattern 2
— Abdomen lacks ventral pattern 3

2 — Abdomen without strong dorsal pattern, venter with ill-defined grey-black patch. Carapace very flat, depressed medially. Clypeus less than ¼ width of AME. Embolic base with low rounded subembolic apophysis. Epigynum broad and rounded; epigynal sclerite narrow, short to moderate length ..... *nigrigularis* (Simon)
— Abdomen with conspicuous black stripe in anterior half; venter with blackish badge markings, pale bordered. Distal retromarginal cheliceral tooth largest. Subembolic apophysis high, knob-like. Epigynum lateral rims slightly diverging; epigynal sclerite broad, long. ..... *immanis* (L. Koch)

3 — Carapace low, about 7–8 times longer than high; clypeus about ⅓ width of AME, 5 retromarginal cheliceral teeth 4
— Carapace higher, about 6 times longer than high; clypeus ½ width of AME. Usually with 4 retromarginal cheliceral teeth 8

4 — Males with 7½ to 8 embolic coils. Females with a similar number of insemination duct coils ... 5
— Males with 9 to 10 embolic coils. Females with a similar number of insemination duct coils 6

5 — Males with small subembolic apophysis. Female epigynum with somewhat parallel lateral rims at first then sharply diverging; epigynal sclerite small, short ..... *hirsuta* (L. Koch)
— Males unknown. Females with 8 insemination duct coils; epigynum with gradually diverging lateral sides, broad posteriorly; epigynal sclerite narrow at posterior only ..... *neglecta* sp. nov.

6 — Males with 9½ to 10 embolic coils. Female with about 10 insemination duct coils 7
— Males with 9 to 9¼, rarely to 9½ embolic coils. Female with about 9 insemination duct coils; epigynum with anterior half of lateral side slightly diverging; epigynal sclerite less than ⅓ length of epigynum ..... *murrayensis* sp. nov.

7 — Male subembolic apophysis broad at apex. Female epigynum with anterior section of lateral side parallel over ⅓ length of epigynum; epigynal sclerite 2/5 length of epigynum ..... *flindersi* sp. nov.
— Male subembolic apophysis narrow at apex. Female epigynum with anterior section of lateral side slightly diverging for ½ length of epigynum; epigynal sclerite usually ½ length of epigynum ..... *insignis* (Thorell)

8 — Male with 9¾ to 10¼ embolic coils; subembolic apophysis smallish. Female epigynal sclerite long, narrow ..... *westralia* sp. nov.
— Males with 11 to 11¾ embolic coils; subembolic apophysis broad. Female epigynal sclerite short, broad ..... *colberti* sp. nov.

The *insignis* Group

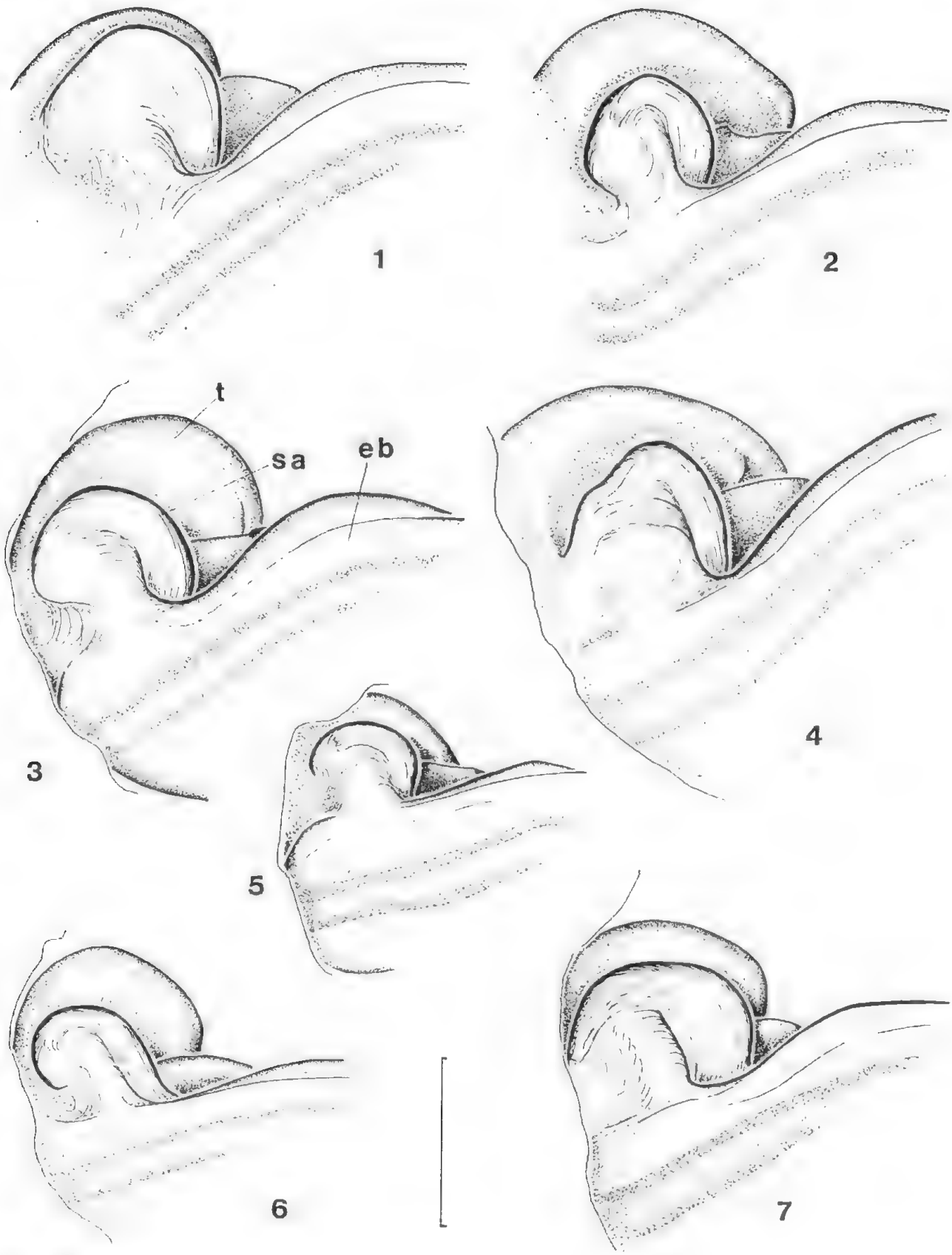
Clypeus width about ⅓ diameter of AME. Male with 9 to 10 embolus coils; subembolic apophysis largish. Female epigynum relatively narrow to broad; lateral rims not diverging greatly to posterior. *H. insignis*, *H. flindersi*, *H. murrayensis* and *H. immanis* are included in this grouping although the last differs in having a larger distal retromarginal cheliceral tooth and possesses a distinctive pattern. In other respects *H. immanis* is most similar to *H. insignis*. The group has an eastern and south-eastern distribution.

Holconia insignis (Thorell)
(Figs 2, 19, 24, 36)

Voconia insignis Thorell, 1870: 383. Syntypes ♂ and ♀, Queensland, Australia, Pessler, NHRM (Thorell Coll.), examined.
Holconia insignis: Karsch, 1878: 791. Hirst, 1990: 18, figs 6–10, table 4.
Isopeda insignis: Hogg, 1902: 432.

Diagnosis

Male subembolic apophysis rounded, apex curved slightly to venter; embolus with 9½ to 10 coils. Female epigynum broad anteriorly; lateral rims somewhat parallel or slightly diverging in anterior half, broadest posteriorly; epigynal sclerite long, usually greater than half length of fossa. Insemination ducts with about 10 coils (Fig. 24).



FIGURES 1–7. Subembolic apophysis of *Holconia* males: 1, *H. immanis* (L. Koch), SAMA N1988515; 2, *H. insignis* (Thorell), SAMA N1988522; 3, *H. flindersi*, holotype; 4, *H. murravensis*, holotype; 5, *H. hirsuta* (L. Koch), QM S12592; 6, *H. westralia*, holotype; 7, *H. colberti*, holotype. eb, embolic base; sa, subembolic apophysis; t, tegulum. Scale line 0.5mm.

Variation

Carapace length of males, 9.68–12.90, mean 11.78 (n=8), 2 with 9½ embolus coils, 4 with 9¾ and 2 with almost 10 coils. Carapace length of females, 12.10–15.80, mean 13.44 (n=7). Usually with 5 retromarginal cheliceral teeth; distal tooth often angled more anteriorly, spaced about a tooth width apart and rather equal or subequal to subdistal tooth (Fig. 19).

Distribution

Occurs in Queensland and New South Wales in and west of the Great Dividing Range from near Rockhampton to south of Sydney. In Queensland it occurs westward to Injune and, in New South Wales, to Cobar and Lake Cowal (Fig. 36).

Other material examined

Queensland: ♀, 2 juv., Banana, 24°28′S, 150°08′E, AM KS19737; ♀, Condamine, 26°56′S, 150°08′E, AM KS19646; ♀, Eidsvold, 25°22′S, 151°07′E, QM S12595; ♀, same locality, SAMA N1988520; 2 juv., Enfield Station, 27°06′S, 151°02′E, QM; ♀, Goondiwindi, 28°33′S, 150°18′E, QM S12596; ♂, ♀, Injune, 25°51′S, 148°34′E, QM 14143; juv., Kroombit Tops, 24°26′S, 150°43′E, QM; 3 ♀♀, 6 juv., Lake Nuga Nuga, 25°01′S, 148°42′E, QM S12597; juv., Marlaybrook 26°54′S, 151°36′E, QM; ♂, Moombah, *ca* 27°59′S, 149°18′E, QM S12598; juv., Mt Archer, Kilcoy, 26°59′S, 152°38′E, QM; ♂, Ottley, 28°20′S, 149°04′E, QM 14142; ♀, St George, 100 km S of, AM KS19736; ♀, Theodore, 24°57′S, 150°05′E, QM; ♂, Wallumbilla, 26°35′S, 149°11′E, QM 14144. **New South Wales:** ♀, Bathurst, 33°25′S, 149°35′E, AM KS16701; ♂, Bonnet Bay, Sydney, AM KS19675; 3 juv., Brooklana, 30°16′S, 152°53′E, AM KS19677–8; ♀, Crowther, 34°06′S, 148°30′E, AM KS19651; ♂, Lake Cowal, 33°36′S, 147°26′E, ANIC; ♀, Loftus, 34°03′S, 151°03′E, AM KS16693; juv., Marrickville, Sydney, AM KS19649; ♂, Nyngan, 31°34′S, 147°12′E, AM KS16478; ♂, penult, ♀, Pilliga Scrub, 30°40′S, 148°50′E, SAMA N1988522–3; penult, ♀, Ryde, Sydney, AM KS13799; ♀, Sydney, 33°53′S, 151°13′E, AM KS16705; ♀, Woronora, Sydney, AM KS16695; ♀, Young, 34°19′S, 148°18′E, AM KS16598.

Holconia flindersi sp. nov.
(Figs 3, 9, 26, 36)

Types

Holotype: ♂, Wilmington, 32°39′S, 138°06′E, South Australia, March 1986, H. Kairl, SAMA N1989264.

Allotype: ♀, Warren Gorge, 32°11′S, 138°00′E, South Australia, 19. vi. 1988, G. and H. Kairl, SAMA N1988559.

Paratypes: ♀, Creekbed S of Woolshed Flat, Pichi Richi Pass, 32°28′S, 137°58′E, South Australia, 27. iv. 1987, D. Hirst, SAMA N1988544; ♂, same data, SAMA N1988545; ♀, Mambray Creek, 32°40′S, 138°02′E, South Australia, 24. iv. 1972, P. Martinson, SAMA N1988546.

Diagnosis

Most similar to *insignis*, separated in the male by the straighter palpal tibial apophysis and thicker more upright subembolic apophysis, and in the female by the longer parallel sided anterior section of the epigynum and shorter, narrower epigynal sclerite.

Holotype male

CL 10.32, CW 10.13, AL 9.80, AW 6.85.

Colour in alcohol: Carapace orange-brown with brown suffusion; caput darker orange-red. Brown-black setae form cross-banding posterior to caput; whitish setae in ocular area. Chelicerae reddish with yellowish upright setae; proximally with adpressed white setae. Maxillae and labium dark brown. Sternum yellow-brown; long greyish setae. Legs yellow-brown; blackish suffusion proventrally on femur I; short blackish setae at proximal ends of anterior femora and tibiae and around spine bases of femora prolaterally; white setae ventrally on femora, patellae and medially on tibiae. Abdomen yellowish with brown-black patches of setae forming transverse banded pattern, anterior band broken by yellowish streak; venter yellowish with orangish setae.

Eyes: AME 0.68. AME: ALE: PME: PLE = 1: 1.16: 0.69: 1.15. Interspaces: AME–AME 0.37, AME–ALE 0.38, PME–PME 1.38, PME–PLE 1.59, AME–PME 0.85, ALE–PLE 1.06. MOQ, aw: pw: l = 2.37: 2.76: 2.44. Width of clypeus to AME 0.29. Chelicerae: retromarginal teeth 5, similar to *insignis*. Labium: L 1.92, W 2.11. Sternum: L 5.53, W 4.59. Legs: anterior leg ratios I = 5.6, II = 6.0.

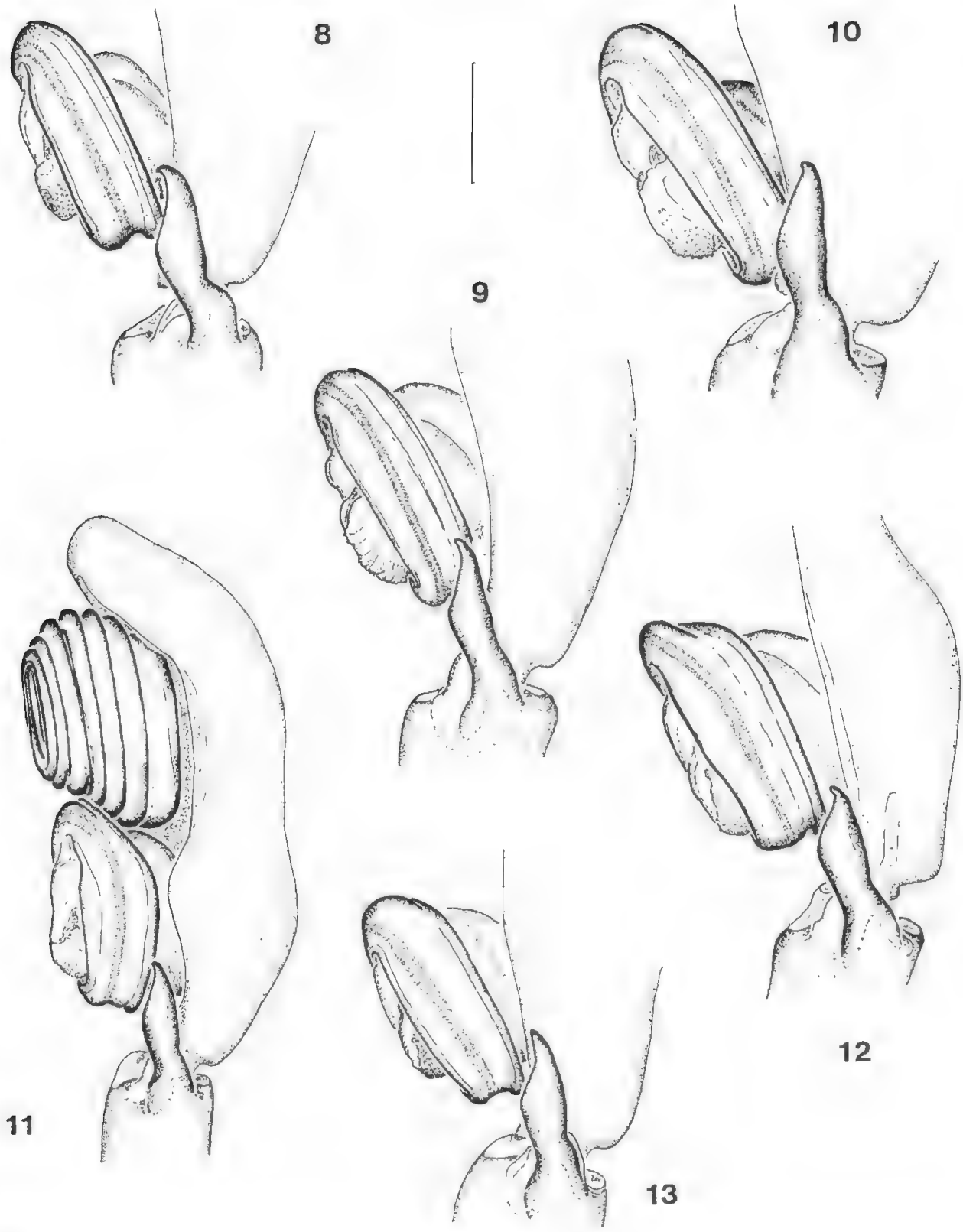
Palps: Tibial apophysis relatively straight. Embolus with 9¾ coils.

Allotype female (as male except as follows)

CL 12.35, CW 11.89, AL 14.95, AW 11.40.

Eyes: AME 0.74. AME: ALE: PME: PLE = 1: 1.16: 0.69: 1.16. Interspaces: AME–AME 0.39, AME–ALE 0.54, PME–PME 1.43, PME–PLE 1.72, AME–PME 0.91, ALE–PLE 1.22. MOQ, aw: pw: l = 2.39: 2.81: 2.54. Width of clypeus to AME 0.32. Labium: L 2.11, W 2.66. Sternum: L 6.53, W 5.30. Legs: anterior leg ratios I = 4.2, II = 5.0.

Epigynum: lateral sides somewhat parallel in anterior section for more than half length of fossa; epigynal sclerite moderately large, curved, extending less than ¼ length of fossa.



FIGURES 8-13. *Holconia* males. 8-10, left palpal tibial apophysis and proximal portion of tarsus, retrolateral: 8, *H. immanis* (L. Koch), SAMA NI988515; 9, *H. flindersi*, holotype; 10, *H. murrayensis*, holotype. 11, left palpal tibial apophysis and whole tarsus of holotype *H. hirsuta* (L. Koch). 12-13, left palpal tibial apophysis and proximal portion of tarsus: 12, *H. colberti*, holotype; 13, *H. westralia*, holotype. Scale line 0.5mm.

Variation

Carapace length of males, 10.02–13.41, mean 11.43 (n = 6). Embolus coils 9½ to 10. Carapace length of females, 11.72–14.78, mean 13.14 (n = 20). Retromarginal cheliceral teeth usually 5, occasionally with 4 on one chelicera. Insemination duct coils about 9½ to 10.

Distribution and remarks

Occurs throughout the Flinders Ranges in South Australia, east to Broken Hill in New South Wales and Meringur in the north-west corner of Victoria (Fig. 36). It is frequently found near creeks on *Eucalyptus camaldulensis*, and often under *Casuarina* bark when away from waterways.

Other material examined

South Australia: ♀, Arcoona Creek, 30°28′S, 138°58′E, SAMA N1989265; ♀, Gadnina Station, *ca* 30°25′S, 139°05′E, SAMA N1988561; ♀, Hawker, 31°53′S, 138°25′E, SAMA N1988550; ♀, Holowilena Station, 31°53′S, 138°50′E, SAMA N1990275; ♀, Mainbray Creek, 32°49′S, 138°05′E, SAMA N1988546; 2 ♂♂, penult. ♀, Melrose, 32°50′S, 138°11′E, SAMA N1988541–3; penult. ♀, Mooloolo, 30°59′S, 138°35′E, SAMA N1989266; juv., Mt Serle, 30°30′S, 138°54′E, SAMA N1989267; 2 ♀♀, 'North' (no exact locality), SAMA N1988497; ♂, Oakbank Station, 33°03′S, 140°35′E, SAMA N1988563; ♀, Orroroo, 32°44′S, 138°37′E, SAMA N1989268; ♀, Quorn, 32°21′S, 138°02′E, SAMA N1988549; ♂, ♀, Sturt Vale Station, 33°15′S, 140°02′E, SAMA N1988564–5; 8 ♀♀, penult. ♂, Wilpena, 31°30′S, 139°19′E, SAMA N1988552–60; ♂, ♀, Wirrealpa, 31°08′S, 138°58′E, SAMA N1988547–8; ♀, Yunta Dam, 32°37′S, 139°34′E, SAMA N1988562. **New South Wales:** ♀, Broken Hill, 31°58′S, 141°27′E, SAMA N1988521; ♀, same locality, AM KS5094; ♀, Wangumma, 34°09′S, 141°27′E, NMV. **Victoria:** ♂, Meringur, 34°24′S, 141°25′E, NMV.

Holconia murrayensis sp. nov.
(Figs 4, 10, 27–28, 36)

Types

Holotype: ♂, Mildura, 34°11′S, 142°10′E, Victoria, July 1955, Favalora, NMV K-0917.

Allotype: ♀, Nampuo Stn, Lake Victoria, 34°03′S, 141°10′E, SW New South Wales, under bark of red gum, 26. vi. 1967, R.R. Blackwood, NMV K-0918.

Paratypes: ♂, Balaklava Gliding Club Airfield, *ca* 2 km N of Whitwarta, 34°05′S, 138°20′E, South Australia, 28. i. 1989, A. Horton, SAMA N1989276; ♀, rafters of shack, few km S of Morgan on River Murray, 34°02′S, 139°40′E, South Australia, 28. xii. 1978, A. Edwards, SAMA N1988538.

Diagnosis

From *insignis* and *flindersi* by the male having a lower embolic coil number of 9 to less than 9½ and subembolic apophysis with slightly larger apex. Female with about 9 insemination duct coils.

Holotype male

CL 14.21, CW 13.92, AL 17.40, AW 11.25.

Colour in alcohol: Carapace reddish, lateral and posterior edges orange-red; caput dark reddish. Setae brownish medially; whitish adpressed setae on caput margins and posterior to ocular area; posterior half of caput with yellow-orangish adpressed setae. Chelicerae dark red-brown to blackish; setae yellow-brown. Maxillae and labium red-brown. Sternum orange-brown. Coxae yellow to orange-brown. Legs orange-red; dense white setae on femora dorsally, venter of patellae and tibiae. Abdomen yellowish with brown patches of setae divided anteriorly by yellow-brown streak. Venter yellow.

Eyes: AME 0.82. AME: ALE: PME: PLE = 1: 1.20: 0.71: 1.12. Interspaces: AME–AME 0.41, AME–ALE 0.51, PME–PME 1.34, PME–PLE 1.78, AME–PME 1, ALE–PLE 1.12. MOQ, aw: pw: l = 2.41: 2.76: 2.61. Width of clypeus to AME 0.37. Chelicerae: retromarginal teeth 5; distal and subdistal teeth separated by ½ tooth width. Labium: L 2.41, W 2.64. Sternum: L 7.42, W 6.28. Legs: anterior leg ratios I = 4.6, II = 5.5.

Palps: Subembolic apophysis broader distally and less curved than in *insignis*. Embolus with 9 coils.

Allotype female (as holotype male except as follows)

CL 14.35, CW 13.89, AL 16.25, AW 12.70.

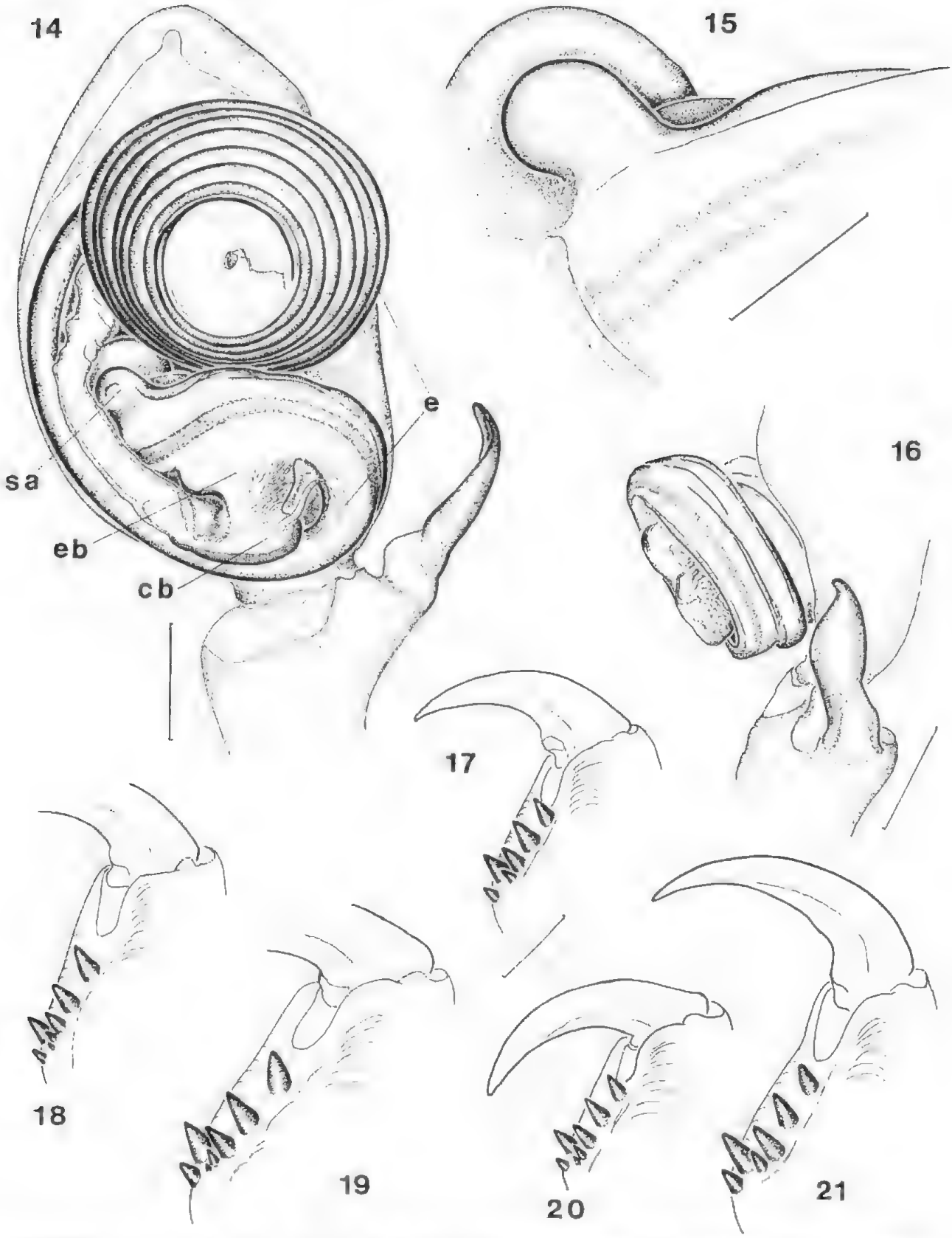
Colour in alcohol: Generally darker than male; legs reddish from patellae to metatarsi. Abdomen with anterior yellow-brown streak.

Eyes: AME 0.81. AME: ALE: PME: PLE = 1: 1.19: 0.69: 1.12. Interspaces: AME–AME 0.44, AME–ALE 0.60, PME–PME 1.44, PME–PLE 2.20, AME–PME 0.83, ALE–PLE 1.14. MOQ, aw: pw: l = 2.44: 2.83: 2.48. Width of clypeus to AME 0.43. Labium: L 2.47, W 2.87. Sternum: L 7.69, W 6.42. Legs: anterior leg ratios I = 4.1, II = 4.8.

Epigynum: epigynal sclerite begins midway along lateral side, broad near anterior (Fig. 27).

Variation

Carapace length of males, 11.62–12.49, mean 12.16 (n = 3). Embolic coils 9, but a male from Unley Park has almost 9½. Carapace length of females, 13.08–16.22, mean 14.32 (n = 19). Epigynal sclerite often rather broad anteriorly (Fig. 28). Insemination ducts with 9 coils. Usually with 5 retromarginal cheliceral teeth, much as in *insignis*. Colour generally darker than in *H. flindersi*.



FIGURES 14-21. *Holconia* males. 14-17, *H. nigrigularis* (Simon): 14, left palpal tibial apophysis and tarsus of syntype male ZMB 28.740, ventral; 15, embolic apophysis, SAMA N1988485; 16, left palpal tibial apophysis and proximal portion of tarsus, retrolateral, SAMA N1988498; 17, left retromarginal cheliceral teeth, SAMA N1988485. 18-21, left retromarginal cheliceral teeth: 18, *H. immanis* (L. Koch), SAMA N1988515; 19, *H. insignis* (Thorell), SAMA N1988522; 20, *H. hirsuta* (L. Koch), QM S12592; 21, *H. westralia*, holotype. e, embolus; eb, embolic base; cb, conductor base; sa, subembolic apophysis. Scale lines 0.5mm, 17-21 to same scale.

Distribution

Generally occurs along the Murray River and its tributaries in northern Victoria, southern New South Wales and South Australia (Fig. 36). In South Australia it is found along the Murray River from the Victorian border south to Murray Bridge, westwards along the River Marne and through the Barossa Valley to the Adelaide Plains in areas supporting *Eucalyptus camaldulensis*, and is known as far north as Whitwarta. In New South Wales it extends to Lake Cowal where it is sympatric with *H. insignis*. A penultimate specimen from Wilcannia is included in this taxon and indicates that the species is found along the Darling River system northwards to this locality. A female from Walwa in north-eastern Victoria is tentatively included until males from the area become available. Two populations appear to be isolated from the Murray River population. The first occurs on the floodplains and waterways of Lake Albacutya and Wyperfeld National Park in north-western Victoria while the second includes the Adelaide Plains and Barossa Valley west of longitude 139°00′.

Other material examined

Victoria: 2 ♀♀, Benalla, 36°33′S, 145°59′E, AM KS19950, AM KS19953; ♀, Gunbower, 35°58′S, 144°22′E, NMV; ♀, Kerang, 35°44′S, 143°55′E, NMV; juv., Lake Albacutya, *ca* 35°46′S, 142°03′E, AM KS19954; ♀, penult. ♂, Merbein, 34°10′S, 142°04′E, AM KS19971–2; ♀, Walwa, 35°58′S, 147°44′E, AM KS19956; 5 ♀♀, ♂, Wyperfeld, 35°32′S, 141°58′E, AM KS19944–7 (♂ = KS19945). **New South Wales:** juv., Balranald, 34°38′S, 143°34′E, SAMA N1988524; ♂, Lake Cowal, 33°36′S, 147°26′E, ANIC; ♀, Lake Mungo, 33°44′S, 143°02′E, SAMA N1989269; penult. ♀, Wilcannia, 31°34′S, 143°22′E, AM KS16657. **South Australia:** 3 ♀♀, Adelaide, 34°56′S, 138°36′E, SAMA N1988525–7; ♀, Bagot Well, 34°19′S, 138°59′E, SAMA N1988532; ♀, Blanchetown, 34°21′S, 139°37′E, SAMA N1988536; ♀, Chowilla, 34°01′S, 140°50′E, SAMA N1988540; penult. ♂, same locality, SAMA N1988405; 2 juv., Glen Osmond, Adelaide, SAMA N1989270–1; ♀, Henley Beach, Adelaide, SAMA N1988528; ♀, Hoyleton, 34°02′S, 138°34′E, SAMA N1988533; 2 ♀♀, Junction of River Marne and River Murray, 34°40′S, 139°19′E, SAMA N1988534–5; ♀, Lake Bonney, 34°13′S, 140°27′E, SAMA N1985143; ♀, Morgan, 34°02′S, 139°40′E, SAMA N1988537; ♂, same locality, SAMA N1988539; ♀, Murray Bridge, 35°07′S, 139°16′E, SAMA N1989272; ♀, Sandy Creek, 34°36′S, 138°49′E, SAMA N1988531; ♂, Unley Park, Adelaide, SAMA N1988529; ♀, Virginia, 34°40′S, 138°34′E, SAMA N1988530; juv., Woods Flat, 34°12′S, 139°38′E, SAMA N1989273.

Holconia immanis (L. Koch)
(Figs 1, 8, 18, 22–23, 35)

Delena immanis L. Koch, 1867: 208. Syntypes ♂, ♀, Brisbane, Queensland, NHMW, not located, presumed lost. One ♂ in NHMW [1884.1.454 (960)] with red 'T' on label but locality is Rockhampton, Queensland. Other material in NHMW seen (1882.11.38.) is not marked 'type' and does not match data given by Koch (1867). 'Syntypes', Brisbane, Queensland, ZMH (Mus. Godeffroy Nr 2285), may not be valid syntypes but material determined later by Koch (1875). One 'syntype' female examined.
Voconia immanis: L. Koch, 1875: 642, pl. 51, fig. 4.
Holconia immanis: Karsch, 1878: 792. Hirst, 1990: 18.
Isopeda immanis: Hogg, 1902: 432.
Mygale whitei Bonnet, 1957: 2994. Determination of 'white jointed spider', illustrated but not named by White, 1790. **New synonymy.**

Diagnosis

Abdomen dorsally with black anterior streak; venter with blackish badge markings. Chelicerae with retromarginal distal tooth largest. Male with relatively large subembolic apophysis; embolus usually with between 9¼ to 10 coils. Female epigynum relatively smaller than in other species, narrow anteriorly; lateral rims in anterior half usually diverging gradually or somewhat parallel to slightly broader posterior; epigynal sclerite large.

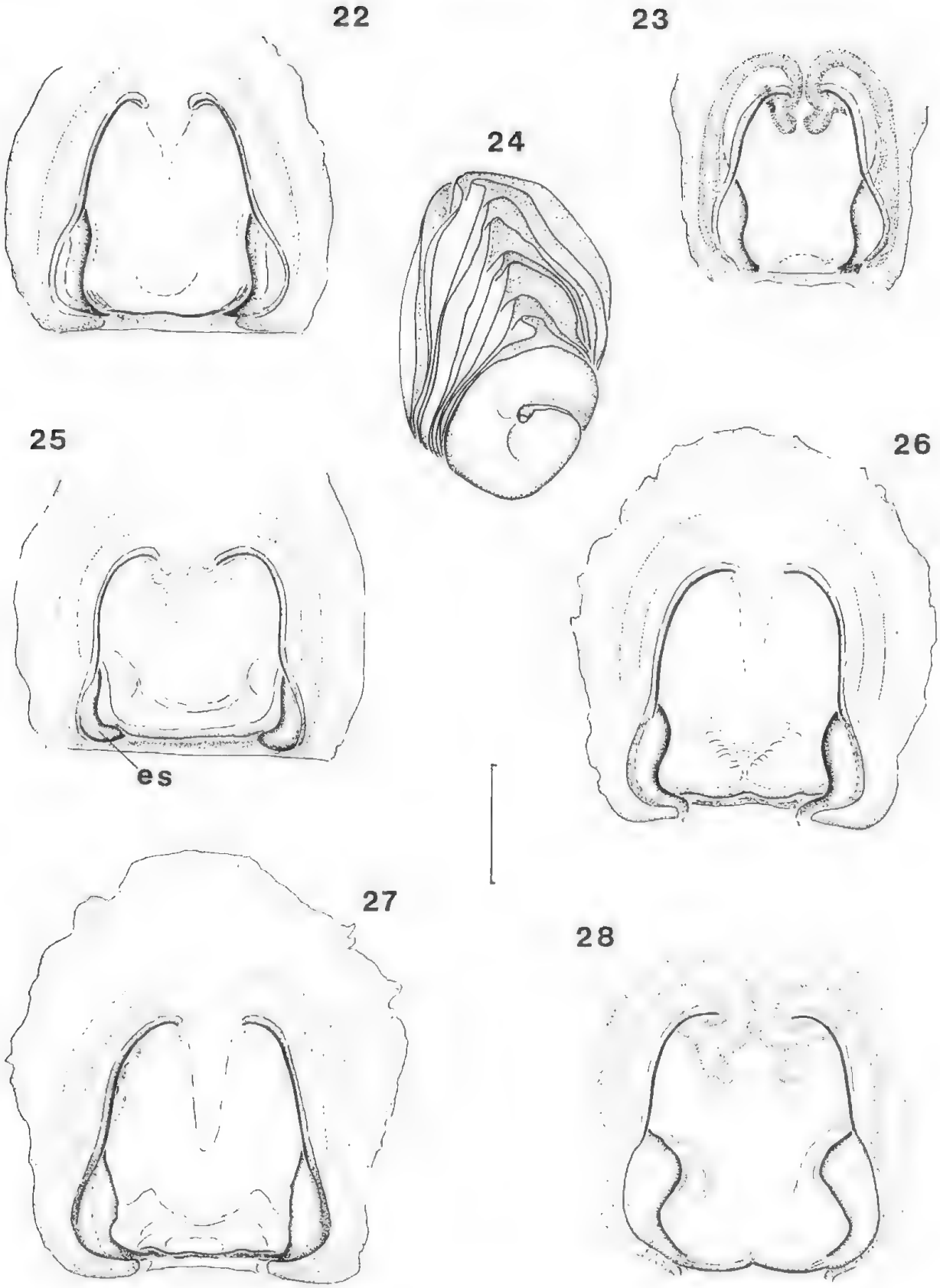
Female ZMH 2285

CL 13.5, CW 13.9, AL 20.5, AW 17.0.

Colour in alcohol: Carapace red-brown; orange-brown posterior and lateral margins. Setae brown-black medially; adpressed whitish setae around ocular area; long whitish setae on lateral margins. Chelicerae dark red-brown to blackish; long yellow-white setae. Maxillae and labium brown-black. Sternum dark red-brown; long blackish setae. Legs dark red-brown; venter of anterior tibiae with whitish setae medially. Abdomen yellowish with brownish suffusion giving rise to brown-black setae and forming a pattern dorsally and laterally; venter with blackish markings contained within 2 pale 'U' shaped lines.

Eyes: AME 0.90, AME: ALE: PME: PLE = 1: 1.11: 0.55: 0.66. Interspaces: AME–AME 0.44, AME–ALE 0.56, PME–PME 1.44, PME–PLE 1.78, AME–PME 0.77, ALE–PLE 1.11, MOQ, aw: pw: l = 2.33: 2.54: 2.22. Width of clypeus to AME 0.33. Chelicerae: retromarginal teeth 5; distal tooth largest. Sternum: L 7.4, W 6.0. Legs: anterior leg ratios, I = 4.4, II = 4.9.

Epigynum: (Fig. 22) lateral sides gradually diverging from relatively narrow anterior, posterior half broader; epigynal sclerite long, broad



FIGURES 22-28. *Holconia* female epigyne. 22-23, *H. immanis* (L. Koch): 22, syntype ZMH 2285; 23, SAMA N1988510, spermathecae. 24, *H. insignis* (Thorell), SAMA N1988520, right insemination duct, dorsal. 25, *H. nigrigularis* (Simon), holotype *Isopeda simoni* Rainbow. 26, *H. flindersi*, allotype. 27-28, *H. murrayensis*: 27, allotype; 28, SAMA N1988536, spermathecae and epigynal sclerites. es, epigynal sclerite. Scale line 0.5mm.

Male SAMA N1988515 (as female except as follows) CL 10.54, CW 10.32, AL 12.80, AW 9.65.

Eyes: AME 0.74, AME: ALE: PME: PLE = 1: 1.03: 0.59: 0.96. Interspaces: AME–AME 0.34, AME–ALE 0.36, PME–PME 1.38, PME–PLE 1.50, AME–PME 0.72, ALE–PLE 0.81. MOQ, aw: pw: l = 2.34: 2.57: 2.27. Width of clypeus to AME 0.46. Labium: L 1.84, W 2.04. Sternum: L 5.56, W 4.79. Legs: anterior leg ratios I = 5.0, II = 5.9.

Palps: Subembolic apophysis large, knob-like. Embolic coils slightly greater than 9¾.

Variation

Carapace length of males, 10.64–14.21, mean 12.45 (n=3). Embolic coils of 28 males examined showed a range greater than one complete coil, most had 9½ coils (n=16), others were with 9¾ (n=5), 10 to 10½ (n=4) and 9 to 9¼ (n=2). Carapace length of females, 13.38–15.02, mean 14.37 (n=6). Insemination duct coils 10. Epigynum occasionally narrow, having somewhat parallel lateral rims in anterior half. Sternum occasionally dark reddish-brown.

Distribution

Occurs along the east coast of Australia from Thursday Island, Queensland, southwards to Nowa Nowa, Victoria. It is largely restricted to the eastern side of the Great Dividing Range (Fig. 35).

Other material examined

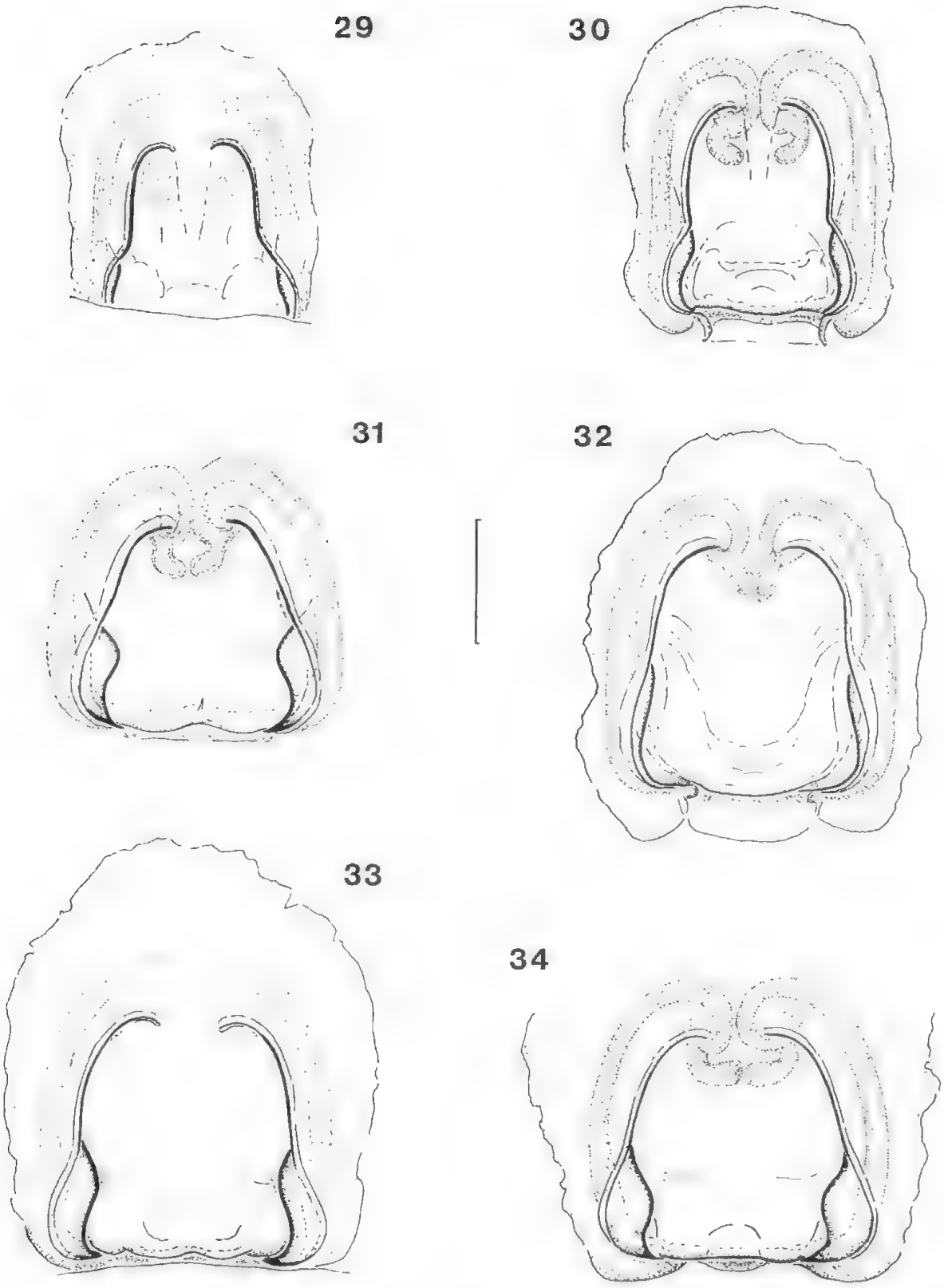
Queensland: ♂, Atherton, 17°16′S, 145°29′E, QM S12604; ♀, same locality, AM KS19702; ♀, Boonah, 28°00′S, 152°41′E, QM S12605; ♂, Brisbane, QM S12606; ♀, Byfield, 22°51′S, 150°39′E, AM KS19723; ♀, Cairns, 16°55′S, 145°46′E, QM S12607; ♀, same locality, AM KS19700; ♀, Calliope, 24°00′S, 151°12′E, QM S12608; ♀, Cape Hillsborough, 20°54′S, 149°03′E, QM S12609; 2 ♂♂, Closeburn, Brisbane, 27°20′S, 152°52′E, QM S12610–11; 2 ♀♀, Coolum, 26°33′S, 153°05′E, NMV; ♀, Cunninghams Gap, 28°03′S, 152°24′E, QM S12613; 2 ♀♀, Dunk Island, 17°57′S, 146°09′E, SAMA N1988513–4; ♀, Eumundi, 26°29′S, 152°57′E, NMV; ♂, Eurambala, Brisbane, QM S12614; ♂, Ferny Hills, Brisbane, QM S12615; ♀, Fitzroy Island, 16°56′S, 146°00′E, AM KS19708; 2 ♀♀, Fraser Island, 25°33′S, 152°59′E, AM KS19698, AM KS19701; ♂, Gin Gin, 25°00′S, 151°57′E, QM S12616; ♂, Gumdale, Brisbane, QM S12617; ♀, Gympie, 26°11′S, 152°40′E, QM S12618; juv., Herberton, 17°23′S, 145°23′E, AM KS19645; ♂, Highvale, Brisbane, QM S12619; ♂, penult. ♀, Holloway Beach, 16°50′S, 145°44′E, SAMA N1988515–6; ♀, Jimboomba, 27°50′S, 153°02′E, QM S12620; ♀, Koongal, 23°23′S, 150°33′E, AM KS16630; ♀, Logan River, 28°16′S, 152°44′E, SAMA N1988512; ♂, Marlaybrook, 26°54′S, 151°36′E, QM S12621; ♀, North Pine River, 27°16′S, 152°55′E, QM S12622; ♂, Nundah, Brisbane, 27°25′S, 153°03′E, QM S12623; 4 ♂♂, Percy Island, 21°42′S, 150°20′E, QM S12624; ♂, Proserpine, 20°24′S, 148°35′E, QM S12625; ♂, Redbank, 27°36′S, 152°52′E, QM S12626; ♀, Rockhampton, 23°22′S, 150°32′E, AM KS16659; juv., same locality, AM KS19644; ♂, Scarborough, 27°12′S, 153°07′E, QM S12627; ♂, Stradbroke Island, *ca* 27°50′S, 153°25′E, NMV; 2 ♂♂, Thursday Island, 10°35′S, 142°13′E, QM S12628; juv., Warwick, 28°13′S, 152°02′E, AM KS20501. **New South Wales:** 2 ♂♂, juv., Brooklana, 30°16′S, 152°53′E, AM KS19706; 2 ♂♂, Brunswick Heads, 28°32′S, 153°33′E, SAMA N1988508–9; ♀, Charlestown, 32°58′S, 151°41′E, AM KS19707; ♀, Congarinni, 30°44′S, 152°52′E, AM KS17879; ♀, Coraki, 29°00′S, 153°17′E, AM KS16535; 2 ♂♂, Cudgen, 28°16′S, 153°33′E, QM S12612; ♂, Engadine, Sydney, AM KS16607; ♀, Gladesville, Sydney, AM KS19655; ♀, Glenhaven, 31°11′S, 151°58′E, AM KS19697; ♀, Goonengerry, 28°37′S, 153°26′E, AM KS19717; ♀, Gordon, Sydney, AM KS19704; juv., Gosford, 33°26′S, 151°20′E, AM KS19673; ♀, Grafton, 29°41′S, 152°56′E, NMV; ♀, same locality, AM KS17183; juv., Macksville, 30°43′S, 152°55′E, AM KS18271; ♀, Mona Vale, Sydney, AM KS18390; ♀, Mooney Mooney, 33°31′S, 151°12′E, AM KS19674; penult. ♂, Mullumbimby, 28°33′S, 153°30′E, AM KS19716; ♀, Mumbulla, *ca* 36°33′S, 149°52′E, AM KS19715; juv., Nadgee, 37°28′S, 149°58′E, AM KS19705; ♀, Nelligen, 35°39′S, 150°08′E, AM KS16595; ♂, 2 juv., Nowra, 34°53′S, 150°36′E, SAMA N1988505–7; ♀, Pennant Hills, Sydney, AM KS19672; ♂, Stotts Island, Tweed River, 28°16′S, 153°30′E, QM S12593; juv., Taree, 31°54′S, 152°29′E, AM KS16680; ♂, Tooloom, 28°37′S, 152°25′E, AM KS16605; 2 juv., same locality, AM KS16631; ♀, Turramurra, 31°20′S, 150°59′E, AM KS19699. **Victoria:** ♂, 3 ♀♀, Noorinbee, 37°31′S, 149°10′E, AM KS19948, AM KS19719–21; ♀, Nowa Nowa, 37°44′S, 148°06′E, AM KS19718.

The *hirsuta* Group

Two species, *H. hirsuta* and *H. neglecta*, differ from the *insignis* group only in the lower number of coils in the embolus of the male and spermathecae of the female, the retromarginal cheliceral teeth being closer to the fang base and the female epigynum relatively broader posteriorly. The group has a northern distribution.

Holconia hirsuta (L. Koch)
(Figs 5, 11, 20, 29–30, 36)

Isopeda hirsuta L. Koch, 1875: 693, pl. 59, fig. 1. Holotype ♂, Bowen [20°01′S, 148°15′E],



FIGURES 29-34. *Holconia* female epigyne. 29-30, *H. hirsuta* (L. Koch): 29, holotype *H. subdola* Thorell; 30, SAMA N1988517, spermathecae. 31, *H. neglecta* holotype, spermathecae. 32, *H. westralia* allotype, spermathecae. 33-34, *H. colberti:* 32, allotype; 33, paratype NMV K-0922, spermathecae. Scale line 0.5mm.

Queensland, ZMH (Mus. Godeffroy Nr 11013), left palp examined (whole specimen in poor condition, not able to be sent).
Holconia hirsuta: Hirst, 1990: 18.
Holconia subdola Thorell, 1881: 304. Holotype, ♀, Somerset [10°45′S, 142°35′E], Queensland, 1875, L.M. D'Albertis. MCG, examined. **New synonymy.**

Diagnosis

From other species by the male having only 7½ to 8 embolic coils (except *H. neglecta* in which the unknown male is also expected to have a similar coil number), a shorter palpal tibial apophysis and small subembolic apophysis. From *H. neglecta* in the female by the epigynum lateral rims being somewhat parallel in anterior half then diverging sharply to broad posterior half; epigynal sclerite small and relatively short.

Female (holotype *H. subdola* Thorell)

CL 11.8, CW 11.1, AL 12.5, AW 9.0.

Colour in alcohol: Carapace and legs dark reddish-brown; caput and striae darker. Abdomen yellow-brown with patches of orange setae.

Eyes: AME 0.78, AME: ALE: PME: PLE = 1: 1.18: 0.62: 1. Interspaces: AME–AME 0.44, AME–ALE 0.51, PME–PME 1.36, PME–PLE 1.32, AME–PME 0.74, ALE–PLE 1.10. MOQ, aw: pw: l = 2.33: 2.56: 2.31. Width of clypeus to AME 0.36. Chelicerae: retromarginal teeth 5; distal tooth subequal to subdistal tooth. Labium: L 1.96, W 2.42. Sternum: L 6.20, W 5.38. Legs: anterior leg ratios I = 3.7, II = 4.5.

Epigynum: (Fig. 29) lateral rims diverging sharply mid-length to broad posterior; epigynal sclerite small, relatively short.

Male QM S12592

CL 9.32, CW 9.08, AL 10.65, AW 6.75.

Colour in alcohol: Carapace orange-red, suffused with black; posterior margin yellowish; caput reddish. Chelicerae maxillae and labium reddish. Sternum and coxae orange. Legs yellow to orange-red. Abdomen yellowish-brown with faint mottled pattern and dorsal anterior pale streak of brown and orange setae; venter yellowish with brown suffusion.

Eyes: AME 0.66, AME: ALE: PME: PLE = 1: 1.15: 0.69: 1.14. Interspaces: AME–AME 0.27, AME–ALE 0.30, PME–PME 1.18, PME–PLE 1.41, AME–PME 0.82, ALE–PLE 0.85. MOQ, aw: pw: l = 2.27: 2.59: 2.30. Width of clypeus to AME 0.27. Labium: L 1.67, W 1.83. Sternum: L 5.01, W 4.41. Legs: anterior leg ratios I 4.7, II not available (legs missing).

Palps: Embolus with 8 coils. Holotype with 7½ coils (Fig. 11).

Variation

Carapace length of male QM S12603, 11.3. Embolus with 7¾ coils. Carapace length of females, 11.48–14.50, mean 13.22 (n = 9). Vulva of SAMA N1988517 with 8 insemination duct coils. Cheliceral teeth usually with a space subequal to a tooth width between median and subdistal teeth

Distribution

Occurs in north-east Queensland from Cape York south to Townsville, westwards to Hughenden (Fig. 36). A juvenile from Floraville Station near Burketown and a female from Burketown are tentatively included although the epigynum shape of the female is not characteristic.

Other material examined

Queensland: ♀, Burketown, 17°45′S, 139°33′E, AM KS16643; ♀, Cape Pallarenda, 19°11′S, 146°46′E, QM S12599; ♀, Chillagoe, 17°09′S, 144°31′E, QM S12600; ♀, Davies Creek, 16°55′S, 145°32′E, QM S12601; ♂, Finch Hatton, 21°09′S, 148°38′E, QM S12592; penult. ♂, Hughenden, 20°51′S, 144°12′E, QM S12602; juv., Floraville Stn 18°14′S, 139°52′E, QM; juv., Mingela, 19°53′S, 146°38′E, QM; ♂, 3 ♀♀, 3 juv., Mt Molloy, 16°41′S, 145°20′E, QM S12603; juv., Townsville, 19°16′S, 146°49′E, SAMA N1988518; ♀, Wenlock Goldfield, 13°05′S, 142°57′E, SAMA N1988517.

Holconia neglecta sp. nov
(Figs 31, 36)

Types

Holotype: ♀, on snappy gum, 50 km SW Wave Hill, 17°27′S, 130°50′E, Northern Territory, 31. viii. 1981, H. Parnaby, AM KS18913.

Paratype: ♀, same data as holotype but 2130 hours, riverside vegetation, AM KS19957.

Diagnosis

Males unknown. Females diagnosed by the epigynum with lateral rims diverging gradually to broad posterior margin; epigynal sclerite broad at first then rapidly narrowing. Vulva with insemination ducts coiled 8 times.

Holotype female

CL 12.85, CW 12.42, AL 14.50, AW 9.80.

Colour in alcohol: Carapace orange-red; caput reddish with white adpressed setae, dense in ocular area; sparse black-brown setae form transverse band in region of fovea. Chelicerae dark reddish; yellow-brown setae and adpressed white setae. Maxillae and labium red-brown. Sternum orange-brown; sparse upright yellow-brown and adpressed white setae.

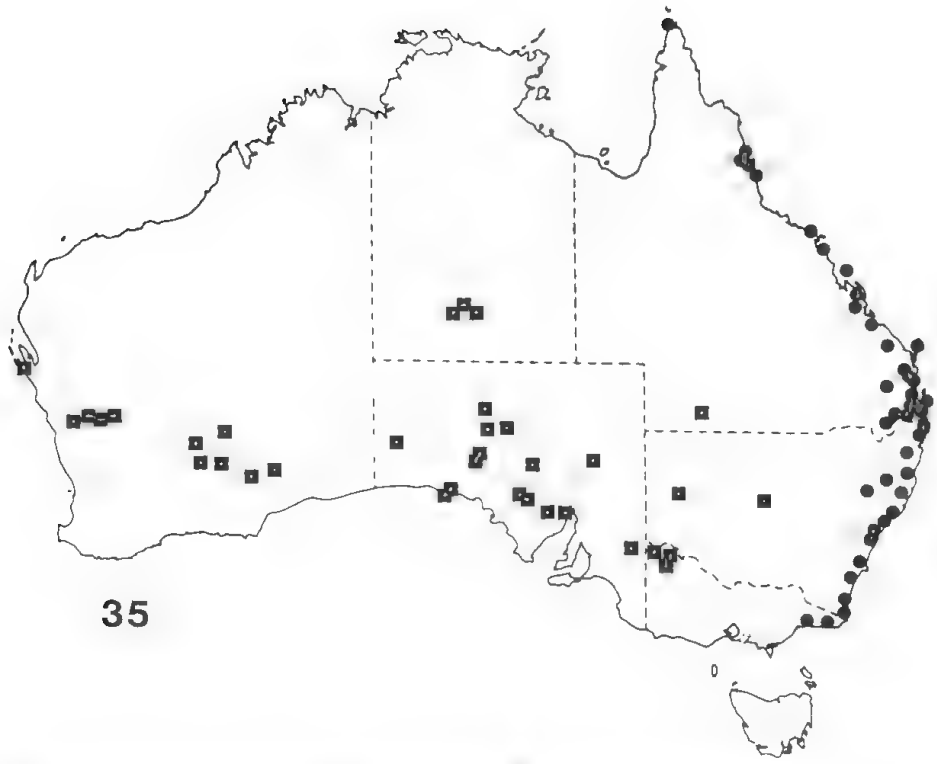


FIGURE 35. Distribution of *Holconia nigrigularis* (Simon) ■ and *H. immanis* (L. Koch) ●.

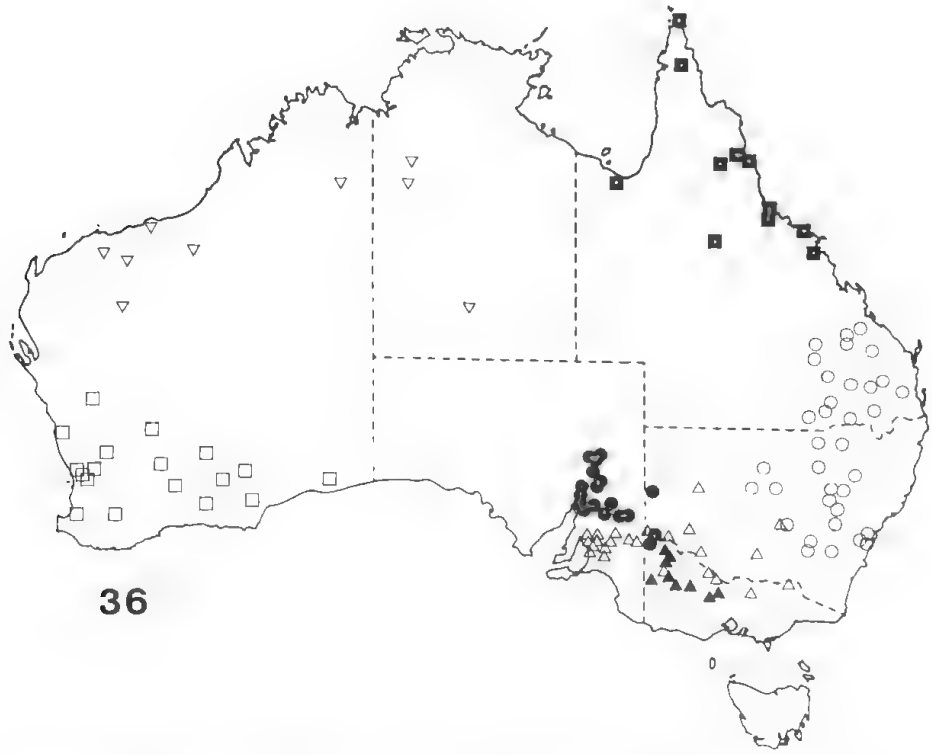


FIGURE 36. Distribution of *Holconia insignis* (Thorell) ○, *H. flindersi* ●, *H. murrayensis* △, *H. hirsuta* (L. Koch) ■, *H. neglecta* ▽, *H. colberti* ▲ and *H. westralia* □.

Coxae yellow-brown. Legs with yellow-brown femora, anterior pairs red-brown distally with blackish suffusion; remaining segments red-brown; tibiae with blackish suffuston at ends. White setae ventrally on femora, patellae and medially on tibiae. Abdomen yellowish with yellow anterior streak; orange-brown setae forming a spotted pattern; venter yellow.

Eyes: AME 0.78. AME: ALE: PME: PLE = 1: 1.09: 0.64: 1.10. Interspaces: AME–AME 0.50, AME–ALE 0.58, PME–PME 1.68, PME–PLE 1.85, AME–PME 0.79, ALE–PLE 1.23. MOQ, aw: pw: l = 2.50: 2.96: 2.33. Width of clypeus to AME 0.32. Chelicerae: retromarginal teeth 5; distal tooth curved towards anterior, subequal to subdistal tooth. Labium: L 2.26, W 2.68. Sternum: L 7.12, W 5.73. Legs: anterior leg ratios I = 3.8, II = 4.3.

Epigynum: (Fig. 31) lateral sides diverging to posterior; epigynal sclerite large, curved, narrowing posteriorly.

Variation

Carapace length of paratype, 12.54.

Distribution and remarks

Northern Territory and northern Western Australia (Fig. 36). A female from Alice Springs is tentatively considered to belong to this taxon. A juvenile from Mitchell Plateau is probably not conspecific as it has a reddish-brown sternum with blackish suffusion anteriorly and a yellow-brown posterior margin. The abdomen is not as distinctly marked dorsally while the venter resembles that of *H. immanis* but is orangish with orange-brown contained within whitish 'U' shaped markings.

Etymology

The specific epithet reflects the paucity of mature specimens available for study and the consequent incomplete treatment of this species.

Other material examined

Northern Territory: ♀, Alice Springs, 23°42′S, 133°52′E, SAMA NJ988519; 2 juv., Hooker Creek, 18°20′S, 130°38′E, AM KS18912, AM KS20502. **Western Australia:** juv., Halls Creek, 18°14′S, 127°40′E, SAMA NJ989274; penult. ♂, De Grey River, 20°20′S, 119°13′E, WAM 88/871; juv., Hooley, 21°53′S, 118°13′E, WAM 88/881; juv., Lower Carawine Gorge, 21°29′S, 121°02′E, WAM 88/1822; penult. ♂, Millstream, 21°35′S, 117°04′E, WAM 88/898; juv., Mitchell Plateau, 14°49′S, 125°50′E, WAM 88/2014; penult. ♂, Mt Vernon, 24°09′S, 118°02′E, WAM 88/906.

The *colberti* Group

The two species, *H. colberti* and *H. westralia*, have a slightly higher carapace, clypeus width about half diameter of AME and four retromarginal cheliceral teeth. The male embolus is coiled between 10 to 11⅔ times. The group has a southern distribution.

Holconia colberti sp. nov.
(Figs 7, 12, 33–34, 36)

Types

Holotype: ♂, site 59, drift fence pitfall trap, 14.4 km SE Walpeup, 35°11′S, 142°11′E, Victoria, Jan. 1987, A.L. Yen, NMV K-0919.

Allotype: ♀, Lake Hattah, 34°44′S, 142°21′E, Mallee, Victoria, Oct. 1915, J.E. Dixon, NMV K-0920.

Paratypes: ♀, same data as allotype, NMV K-0921; ♀, Kewell, 36°31′S, 142°21′E, Victoria, Nov. 1892, J.A. Kershaw, NMV K-0922.

Diagnosis

Carapace high but flattish above. Male embolus with 11¼ to 11⅔ coils; subembolic apophysis broad. Females with relatively short, broad epigynal sclerite; insemination ducts coiled 11 times.

Holotype male

CL 10.95, CW 10.42, AL 13.50, AW 8.65.

Colour in alcohol: Carapace reddish-brown, darker suffusion; lateral eye surrounds blackish mesally. Blackish setae on carapace; some white setae in ocular area. Chelicerae dark red-brown to blackish; long yellowish and short recumbent setae. Maxillae and labium as chelicerae. Sternum orange-yellow. Coxae yellowish. Legs red-brown; femora paler with blackish suffusion at base proventrally; spine bases darker red-brown; setae blackish; sparse white recumbent setae on femora, patellae and tibiae, mostly proventral. Abdomen dorsally yellowish with brown markings; anterior median streak indistinct; venter pale yellow.

Eyes: AME 0.64. AME: ALE: PME: PLE = 1: 1.22: 0.75: 1.19. Interspaces: AME–AME 0.56, AME–ALE 0.38, PME–PME 1.47, PME–PLE 1.75, AME–PME 1.16, ALE–PLE 1.25. MOQ, aw: pw: l = 2.56: 2.97: 1.31. Width of clypeus to AME 0.52. Chelicerae: retromarginal teeth 4, closely spaced; distal subequal, angled more anteriorly. Labium: L 1.78, W 2.14. Sternum: L 5.58, W 4.99. Legs: anterior leg ratios I = 4.3, II = 4.9.

Palps: Embolic base relatively large; subembolic apophysis broader than in other species (Fig. 7). Embolus coiled almost 11⅔ times.

Allotype female (as male except as follows)

CL 12.95, CW 12.65, AL 17.00, AW 12.50.

Colour in alcohol: dark red-brown.

Eyes: AME 0.72. AME: ALE: PME: PLE = 1: 1.28: 0.67: 1.15. Interspaces AME–AME 0.55, AME–ALE 0.61, PME–PME 1.61, PME–PLE 2.06, AME–PME 1, ALE–PLE 1.36. MOQ, aw: pw: l = 2.56: 2.94: 2.64. Width of clypeus to AME 0.54. Labium: L 2.36, W 2.65. Sternum: L 6.74, W 5.68. Legs: anterior leg ratios I = 4.0, II = 4.7.

Epigynum: (Fig. 33) not much broader posteriorly; epigynal sclerite relatively short.

Variation

Carapace length of males, 10.56–12.65, mean 11.53 (n=3; embolus of 2 specimens coiled 11¼ times and 1 coiled 11½ times). Carapace length of females, 11.02–14.89, mean 12.70 (n=16). Vulva of paratype NMV K-0922 (Fig. 34) with sharply curved spermathecal sacs and 11 insemination coils. Two specimens have 5 retromarginal teeth on either left or right chelicera and a further two are with 5 on both chelicera. One male has only 3 teeth on the left chelicera. Leg II may be relatively shorter than in other species and the anterior legs appear more robust.

Distribution

Western Victoria from Broughton eastwards to Elmore, and Hattah Lakes southwards to at least Marong near Bendigo (Fig. 36). One female from Melbourne may have been transported in with timber.

Etymology

Named after the owners of a property SW of Broughton, Victoria, where I had the opportunity to collect several specimens.

Other material examined

Victoria: 2 ♂♂, 8 ♀♀, penult. ♂, SW Broughton, 36°12′S, 141°19′E, SAMA N1989605–15, juv., same locality, SAMA N1989275; ♂, 3 ♀♀, Charlton, 36°16′S, 143°21′E, AM KS19949; ♀, Elizabeth St, Melbourne, NMV; juv., Elmore, 36°30′S, 144°37′E, SAMA N1990273; ♀, Hattah Lakes, 34°44′S, 142°21′E, AM KS19951; penult. ♀, juv., same data as allotype, NMV; juv., Kewell, same data as paratype, NMV; penult. ♂, juv., mallee scrub, western district, Feb. 1884, NMV; 2 ♀♀, Marong, 36°44′S, 144°08′E, AM KS19952, AM KS19955; juv., Ouyen, 35°04′S, 142°19′E, NMV; ♀, juv., Warracknabeal, 36°15′S, 142°24′E, NMV.

Holconia westralia sp. nov.
(Figs 6, 13, 21, 32, 36)

Types

Holotype: ♂, Salmon Gums Pre-Primary School, 32°59′S, 121°39′E, Western Australia, 11. iii. 1983, N. Contreau, WAM 86/688.

Allotype: ♀, on log, WL South Camp, Woodline, 31°54′S, 122°24′E, Western Australia, WAM Goldfields Survey, Aug. 1980, W.F. Humphreys *et al.*, WAM 88/926.

Paratypes: ♂, Yellowdine, 31°18′S, 119°39′E, Western Australia, 6. xi. 1970, W.H. Butler, WAM 86/683; ♀, N of Lake Hope, 32°16′S, 120°16′E, Western Australia, 26. ix. 1978, Barron and Harold, WAM 88/890.

Diagnosis

Carapace slightly convex; chelicera usually with 4 retromarginal teeth. Male embolus with 10 to 10½ coils. Female with long narrow epigynal sclerite.

Holotype male

CL 11.82, CW 11.01, AL 11.95, AW 8.25.

Colour in alcohol: Carapace orange-red, posterior and laterals paler; caput dark red. Chelicerae dark red-brown; yellow setae; some adpressed white setae proximally. Maxillae and labium dark red-brown. Sternum yellow-brown; brownish and white setae. Coxae yellowish. Anterior legs orange-red, posterior legs yellow-red; metatarsi and tarsi reddish. Setae bases dark coloured; numerous clumps of whitish setae dorsally. Venter of patellae and tibiae medially with long whitish setae. Abdomen yellow-brown with darker patches; 3 indistinct pairs of blackish spots; anterior streak with orange-red setae; venter yellowish; yellow-brown setae.

Eyes: AME 0.71. AME: ALE: PME: PLE = 1: 1.24: 0.73: 1.07. Interspaces: AME–AME 0.41, AME–ALE 0.35, PME–PME 1.15, PME–PLE 1.30, AME–PME 0.86, ALE–PLE 0.87. MOQ, aw: pw: l = 2.41: 2.62: 2.56. Width of clypeus to AME 0.51. Chelicerae: retromarginal teeth 4 consisting of a small basal tooth and 3 well-spaced larger teeth of which the distal is smallest (Fig. 21). Labium: L 1.94, W 2.24. Sternum: L 5.96, W 5.18. Legs: anterior leg ratios I = 4.5, II = 5.3.

Palps: Tibial apophysis barely curved inwards at apex. Subembolic apophysis small, base inclined (Fig. 6). Embolus with 10 coils.

Allotype female (as holotype except as follows)

CL 11.93, CW 11.18, AL 14.45, AW 11.65.

Eyes: AME 0.71. AME: ALE: PME: PLE = 1: 1.20: 0.69: 1.10. Interspaces: AME–AME 0.42, AME–ALE 0.38, PME–PME 1.29, PME–PLE 1.61, AME–PME 0.92, ALE–PLE 1.01. MOQ, aw: pw: l = 2.42: 2.68: 2.44. Width of clypeus to AME 0.45. Chelicerae: right chelicera with additional small basal tooth on retromargin; teeth more closely spaced. Labium: L 1.96, W 2.38. Sternum: L 6.09, W 5.38. Legs: anterior leg ratios I = 3.9, II = 4.5.

Epigynum: (Fig. 31) epigynal sclerite long, narrow.

Variation

Carapace length of males, 9.80–11.65, mean 10.91 (n=7). Embolus coils 10 to 10¼. Carapace length of females, 11.55–13.52, mean 12.53 (n=11). Most often with 4 retromarginal cheliceral teeth, rarely with 5 on both chelicera.

Distribution

Semi-arid and areas of moderate rainfall in south-west Western Australia (Fig. 36).

Other material examined

Western Australia: ♀, Booanya, 32°46′S, 123°26′E, NMV; 2 juv., same locality, AM KS19647, AM KS19658; 6 juv., Buningonia Spring, *ca* 31°25′S, 123°34′E, WAM 88/2047–50, WAM 88/2052–3; juv., Cottesloe, Perth, WAM 12/5132; 2 ♂♂, 2 ♀♀, 3 juv., Darlington, 31°55′S, 116°04′E, WAM 86/642–4, WAM 88/1833–4, WAM 88/1836–7; juv., Diemals, 29°40′S, 119°18′E, WAM 88/872; ♀, Fremantle, Perth, WAM 88/1845; juv., Glen Forrest, 31°55′S, 116°06′E, WAM 88/1533; ♀, Gooseberry Hill, 31°57′S, 116°03′E, WAM 88/1850; ♀, Hovea, 31°52′S, 116°06′E, WAM 88/1856; 2 ♂♂, Kalamunda, 31°58′S, 116°03′E, WAM 88/1858–9; ♂, Kalgoorlie, 30°45′S, 121°28′E, NMV; 2 ♀♀, 1 juv., Katanning, 33°41′S, 117°33′E, WAM 88/884–6; juv., Lake Indoon, 29°52′S, 115°09′E, WAM 88/2440; juv., Madura, 31°53′S, 127°03′E, WAM 88/894; juv., Mahogany Creek, 31°54′S, 116°08′E, WAM 88/1871; ♀, Midland Junction, Perth, WAM 88/897; juv., Mt Pleasant, Perth, WAM 88/1881; ♂, Parkerville, 31°53′S, 116°08′E, WAM 86/667; ♀, Pearce, 31°40′S, 116°01′E, WAM 88/915; ♂, Perth, 31°57′S, 115°51′E, WAM 86/668; ♀, Toodyay, 31°33′S, 116°28′E, WAM 88/916; 2 juv., Walk Walkin, 30°49′S, 117°19′E, WAM 40/1075–6; juv., Wanneroo, 31°45′S, 115°48′E, WAM 88/1772; penult. ♂, Wellard, 32°16′S, 115°51′E, WAM 88/1919; ♀, Wembley, Perth, WAM 88/1921; 5 juv., Woodline, 31°53′S, 122°27′E, WAM 88/2090, WAM 88/2099–100, WAM 88/2104; juv., Wundowie, 31°46′S, 116°23′E, WAM 88/931; juv., Yalgoo, 28°21′S, 116°41′E, WAM 26/683.

The *nigrigularis* Group

This 'group' consists of only one species, *H. nigrigularis*, which has a flatter carapace, subembolic apophysis of the male not connected directly to the tegulum, female with broad epigynum and relatively straight spermathecal sacs. It occurs in arid to semi-arid areas.

Holconia nigrigularis (Simon)
(Figs 14–17, 25, 35)

Isopoda nigrigularis Simon, 1908: 438. Syntype ♂, Stat[ion]. 70, Tamala [26°42′S, 113°43′E], Western Australia, ZMB 28.740, examined. Simon (1908) also lists Northampton, Western Australia, as a locality record but without giving further details of any specimen. Whereabouts of that specimen is unknown.

Isopoda woodwardi Simon, 1908: 437. Holotype ♀, Stat[ion]. 93, Kalgoorlie [30°45′S, 121°28′E], Western Australia, ZMB 28.739, examined.

Isopeda simoni Rainbow, 1911: 234. Nom. nov. for *Isopeda woodwardi* Simon, 1908, homonym of *Isopeda woodwardi* Hogg, 1902. **New synonymy.**

Holconia nigrigularis: Hirst, 1990: 18.

Diagnosis

H. nigrigularis is separated from other species by the flatter carapace, 8–9 times longer than high, depressed medially. Clypeus width about ¼ diameter of AME. Abdomen without a distinct pattern but with grey-black venter. Chelicera usually with 4 retromarginal teeth. Male embolic base with prodistal low rounded subembolic apophysis not fixed to tegulum; striations near embolus origin; embolus usually with 9 to 9¼ coils but may have a half coil more or less. Female epigynum broad, rounded. Epigynal sclerite narrow; short to moderate length. Spermathecal sacs straight to gently curved.

Holotype male

CL 7.7, CW 7.5, AW 9.0, AL 5.5

Colour in alcohol: Carapace reddish-yellow, striae reddish; white and brown-black adpressed setae. Chelicerae reddish with erect yellow-white setae. Maxillae and labium orange-red brown. Sternum yellowish medially; margins and anterior portion yellow-brown. Palps yellowish; cymbium yellow-brown. Coxae cream-yellow. Legs orange-yellow. Abdomen dorsally yellowish with clusters of reddish-brown or orange setae forming a vague pattern; venter with large ill-defined grey-black patch.

Eyes: AME 0.54. AME: ALE: PME: PLE = 1: 1.11: 0.51: 1. Interspaces: AME–AME 0.25, AME–ALE 0.32, PME–PME 1.33, PME–PLE 1.50, AME–PME 0.74, ALE–PLE 0.97. MOQ, aw: pw: l = 2.44: 2.50: 2.10. Width of clypeus to AME 0.13. Chelicerae: retromarginal teeth 4, closely spaced; distal tooth shorter than subdistal. Labium: L 1.26, W 1.54. Sternum: L 4.4, W 3.7. Legs: anterior leg ratios I = 4.7, II = 5.5.

Palps: Embolus coiled 8½ times.

Female ZMB 28.739 (holotype *Isopoda woodwardi* Simon)

CL 12.0, CW 11.5, AL 16.4, AW 13.7.

Colour in alcohol: cephalothorax and legs darker than holotype, abdomen without pattern; venter yellow-brown.

Eyes: AME 0.74. AME: ALE: PME: PLE = 1: 1.11: 0.54: 0.69. Interspaces: AME-AME 0.38, AME-ALE 0.53, PME-PME 1.43, PME-PLE 1.35, AME-PME 0.73, ALE-PLE 1.08. MOQ, aw: pw: l = 2.35: 2.54: 2.11. Width of clypeus to AME 0.14. Labium: L 2.00, W 2.50. Sternum: L 6.70, W 5.40. Legs: anterior leg ratios I = 3.8, II = 4.5.

Epigynum: (Fig. 25) Anterior broadly rounded; lateral rims somewhat parallel, barely diverging, not much broader posteriorly. Epigynal sclerite narrow, less than half length of fossa.

Variation

Carapace length of males, 9.58–11.86, mean 10.64 (n=9). Embolic coils 9 to 9¼ but one specimen has 8½ as in the holotype while another has 9¾. Carapace length of females, 10.24–13.67, mean 12.02 (n=21). Insemination duct coils 9. Abdomen dorsally may have a pattern consisting of 3 pairs of large brown-black patches.

Distribution and remarks

Occurs in arid and semi-arid areas of Australia from the west coast of Western Australia through South Australia and southern Northern Territory to south-western Queensland, western New South Wales and north-western Victoria (Fig. 35). Although a large spider, is often found in areas of low trees or mallee where it lives in hollows in the trunk as well as under bark. Hogg (1896) incorrectly identified two female specimens (in NMV) of this taxon from Alice Springs as *Voconia dolosa*. The three male specimens from the same locality have not been seen but are probably also *H. nigrigularis*.

Other material examined

Western Australia: ♀, Buningonia Spring, 31°24′25″S, 123°34′20″E, WAM 88/865; 3 juv., same locality, WAM 88/2052–4; juv., Burnabinmah Station, 28°47′S, 117°22′E, WAM 88/866; ♀, Goongarrie, 29°53′S, 121°10′E, WAM 88/880; ♀, Gullewa, 28°39′S, 116°19′E, WAM 88/1853; ♀, Kalgoorlie, 30°45′S, 121°28′E, NMV; ♀, Messengers Patch, 28°41′S, 116°57′E, WAM 88/896; ♂, Mt Margaret, 28°48′S, 122°11′E, WAM 86/663; ♀, Naretha 31°00′S, 124°50′E, WAM 88/1887; ♀, North Irwin River, 28°50′S, 115°42′E, WAM 88/910; ♂, Randells (Siding), 30°57′S, 122°15′E, BYM 56/A37; juv., Yundamindra, 29°18′S, 122°25′E, WAM 88/2127. **South Australia:** ♂, Bookabie, 31°51′S, 132°42′E, SAMA N1988496; penult. ♀, Cook, 29°49′S, 130°07′E, SAMA N1988480; 2 ♀♀, Durkin, 30°17′S, 133°44′E, SAMA N1988476–7; ♂, Fowlers Bay, 32°00′S, 132°27′E, SAMA N1988486; ♀, Gawler Ranges (without exact locality), SAMA N1988488; juv., Lake Acraman, 32°00′S, 135°32′E, SAMA N1988489; 2 ♀♀, penult. ♂, Lake Gilles, 32°38′S, 136°53′E, SAMA N1988490–2; ♀, Lincoln Gap, 32°36′S, 137°35′E, SAMA N1988495; ♀, ♂, Locks Well, 30°40′S, 136°03′E, SAMA N1988482–3; 2 ♂♂, Mabel Creek, 29°10′S, 134°10′E, SAMA N1988484–5; ♀, Mt Ives Station, 32°26′S, 136°04′E, SAMA N1988487; juv., Mt Willoughby, 27°58′S, 134°09′E, NMV; ♂, 'North' (no exact locality), SAMA N1988497; ♂, ♀, juv., Renmark, 34°10′S, 140°45′E, SAMA N1988498–500; juv., Stuarts Range, *ca* 29°00′S, 135°00′E, SAMA N1988481; 2 ♀♀, Yardea Station, 32°23′S, 135°31′E, SAMA N1988493–4; 2 juv., Yokes Hill (no exact locality), SAMA N1988478–9; 3 ♀♀, Wynbring Rocks, 30°33′S, 133°32′E, NMV. **Northern Territory:** ♀, Alice Springs, 23°42′S, 133°52′E, NTM A78; ♀, same locality, NMV; juv., Hermannsburg, 23°57′S, 132°46′E, SAMA N1988502; penult. ♂, MacDonnell Ranges, *ca* 23°40′S, 133°00′E, SAMA N1988501; ♂, Mt Gillen, 23°43′S, 133°48′E, NTM A95; ♀, Todd River (no exact locality), NTM A14. **Queensland:** ♂, Thargomindah, 28°01′S, 143°48′E, QM S12594. **New South Wales:** ♀, Nymagee, 32°04′S, 146°19′E, AM KS16632; 2 ♀♀, Springs Creek, 31°43′S, 142°41′E, SAMA N1988503–4. **Victoria:** ♂, Hattah, 34°41′S, 142°18′E, NMV; ♂, Meringur, 34°26′S, 141°26′E, NMV; juv., same locality but 34°24′S, 141°23′E, NMV; ♂, Millewa, 34°44′S, 141°04′E, NMV; ♂, Walpeup, 35°11′S, 142°11′E, NMV.

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ABORIGINAL – ACACIA RELATIONSHIPS IN CENTRAL AUSTRALIA

JOHN KEAN

Summary

This paper collates existing information on Aboriginal perceptions and uses of Acacia species in Central Australia. Aspects of Aboriginal knowledge of the taxonomy, morphology and diversity of these species are presented, as part of a wider discussion of their economic, social and spiritual significance to Aboriginal people. The nature and extent of traditional Aboriginal – Acacia relationships demonstrate a sophisticated level of indigenous knowledge of Acacia and Acacia dominated ecosystems, that while being unique, is comparable to Western scientific systems.

ABORIGINAL – *ACACIA* RELATIONSHIPS IN CENTRAL AUSTRALIA

JOHN KEAN

KEAN, J. 1991, Aboriginal-*Acacia* relationships in Central Australia. *Rec. S. Aust. Mus.* 24(2): 111-124.

This paper collates existing information on Aboriginal perceptions and uses of *Acacia* species in Central Australia. Aspects of Aboriginal knowledge of the taxonomy, morphology and diversity of these species are presented, as part of a wider discussion of their economic, social and spiritual significance to Aboriginal people. The nature and extent of traditional Aboriginal–*Acacia* relationships demonstrate a sophisticated level of indigenous knowledge of *Acacia* and *Acacia* dominated ecosystems, that while being unique, is comparable to Western scientific systems.

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Trees and shrubs of a wide variety of *Acacia* species are dominant in most vegetation formations in Central Australia. The most notable among these is *Acacia aneura*, which gives its popular name 'mulga' to vast tracts of country throughout the region. Taken together *Acacia* shrubs form much of the living mantle over the Centre's ancient infertile soils and, as such, are critical to the ecology of the region. The characteristics and attributes of the genus were well known to Aborigines who used them in a diversity of ways to create secure and comfortable lives. The significance of the genus to Aborigines went beyond its economic and dietary contribution, for *Acacia* was predominant in the environment in which desert cultures developed. Accordingly, its importance is reflected in language, sociality and religious belief.

The first part of this paper establishes a broad overview of the genus *Acacia* and its distribution in the vegetation formations of Central Australia. The second section documents aspects of Aboriginal knowledge of the taxonomy, morphology, diversity and distribution of particular *Acacia* species. It also outlines some Aboriginal perceptions of the genus in relation to its environmental associations, ecology and management by fire. The final section examines the diversity of *Acacia* use by Aborigines with particular emphasis on the contribution of *Acacia* seeds to the diet of desert groups. The economy of seed processing is discussed and recent findings on the likely benefits to health from eating *Acacia* seeds are considered and cases of social and spiritual identification are cited to indicate the complexity of Aboriginal–*Acacia* relationships.

Study Area

The area regarded as Central Australia, for the purposes of this paper, lies between 125°30′ and 140° east and 20° and 29° south. This is the overlap between the areas defined as Central Australia by Jessop (1981) and by Hobson (1985). Both are depicted in Fig. 1, which has been based on a vegetation map prepared by Beard (1978 in Jessop 1981).

Orthography

Aboriginal statements and explanations will be used in the text. Where possible, the orthography used will conform with systems that have been developed for particular languages by the collaborative work of linguists, school teachers and community leaders. Orthographies and language names are drawn from the map 'Current Distribution of Central Australian Languages' (Hobson 1985) (Fig. 2).

The words *Anangu* and *Yapa* both mean 'people' in Western Desert and Warlpiri/Kukatja languages respectively.

BOTANICAL BACKGROUND

The Genus *Acacia* of the Family Mimosaceae

Species of the genus *Acacia* are indigenous to all continents except Europe and Antarctica. Simmons (cited in Doran 1983) estimates that there are 1,200 species worldwide. Australia has been the major centre of proliferation in the genus, with 729 species recognised and about 120 species yet to be described

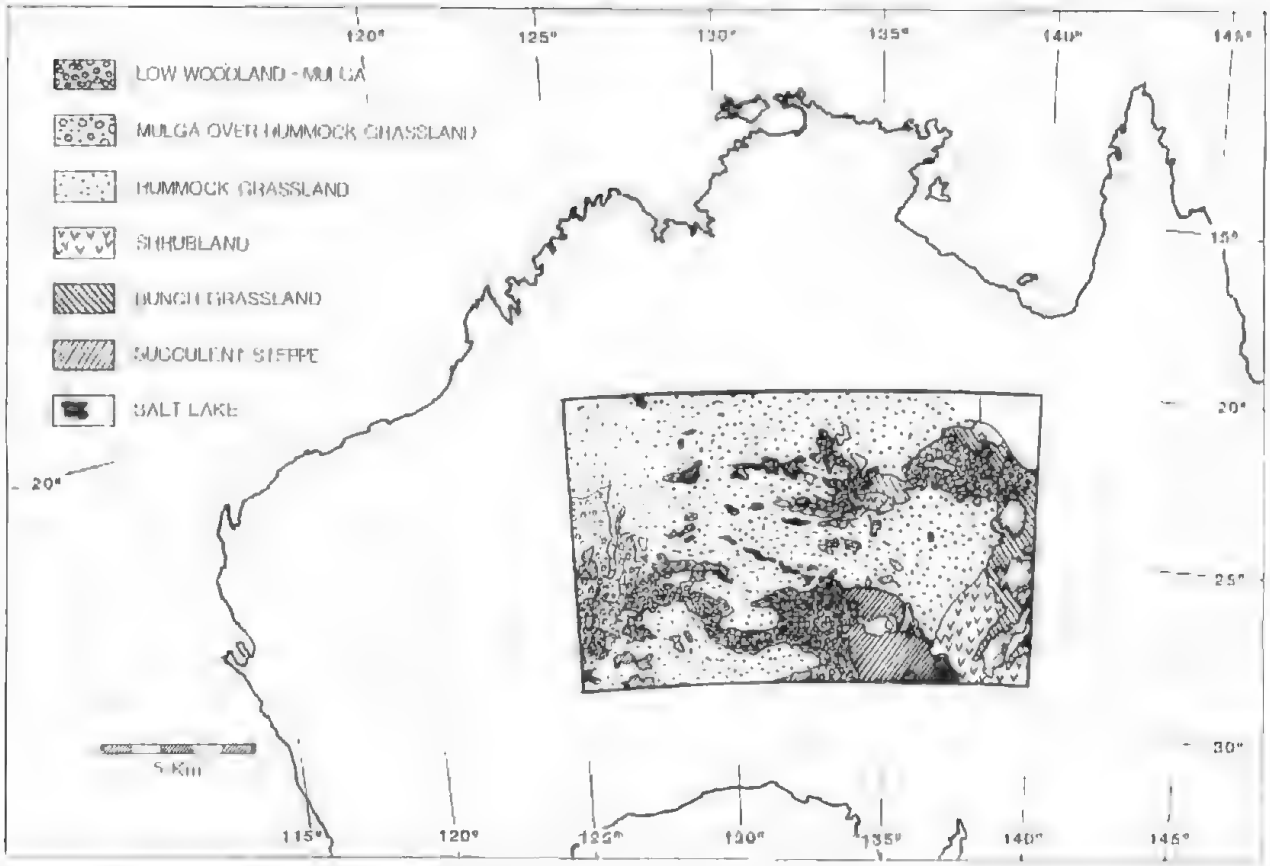

FIGURE 1. Vegetation of Central Australia (adapted from Beard 1978 in Jessop 1981).

(Maslin in Doran 1983). The majority of these species occurs in south-west Western Australia and 80% of those are endemic to that area (Hopper & Maslin, cited in Doran 1983).

In Australia, *Acacia* species are popularly called 'wattles' and are dominant in many of the savannah ecosystems, as they are in various regions around the world. 'The Flora of Central Australia' (Jessop 1981) describes 116 species of *Acacia* and although many of these are of economic importance to Aborigines, only a handful of these will be discussed in detail in this paper.

Most Australian *Acacia* are of the subgenus *Phyllodinae* which have their leaves modified to phyllodes and generally do not have either the thorns or bipinnate leaves characteristic of the genus in other parts of the world (Simmons 1981: 7).

The genus *Acacia* has several attributes and specific adaptations which has made it successful in Central Australia. *Acacia* species have been able to colonise the ancient infertile soils characteristic of the area through their capacity to fix nitrogen in specialised root nodules (Doran 1983). Latz (1982) describes many of the xeromorphic (desert) adaptations that have enabled *Acacia* to grow in conditions of low soil moisture. He puts particular emphasis on attributes such as enhanced germination and vegetative regeneration after fires that have recurrently swept the area.

Acacia in the Major Vegetation Formations of Central Australia

Beard (1981) defined the four major vegetation formations in Central Australia as bunch grassland, hummock grassland, low woodland and succulent steppe. To the north of the Tropic of Capricorn the two types of grasslands predominate. South of the Tropic, where significant rainfall can occur either in winter or summer, and grading to the extreme south where rain is as likely to occur at any time during the year, hummock grassland is contiguous with low woodland and succulent steppe. Beard also indicates that hummock grassland can occur in response to recurrent firing of areas that would normally carry low woodland.

In the north the bunch grasslands are confined to cracking clays. Hummock grasslands occupy other substrates including some calcareous soils. In the south hummock grassland (usually *Triodia* spp.) and low woodland (usually mulga, *A. aneura*) are found on the acid to neutral soils, while the

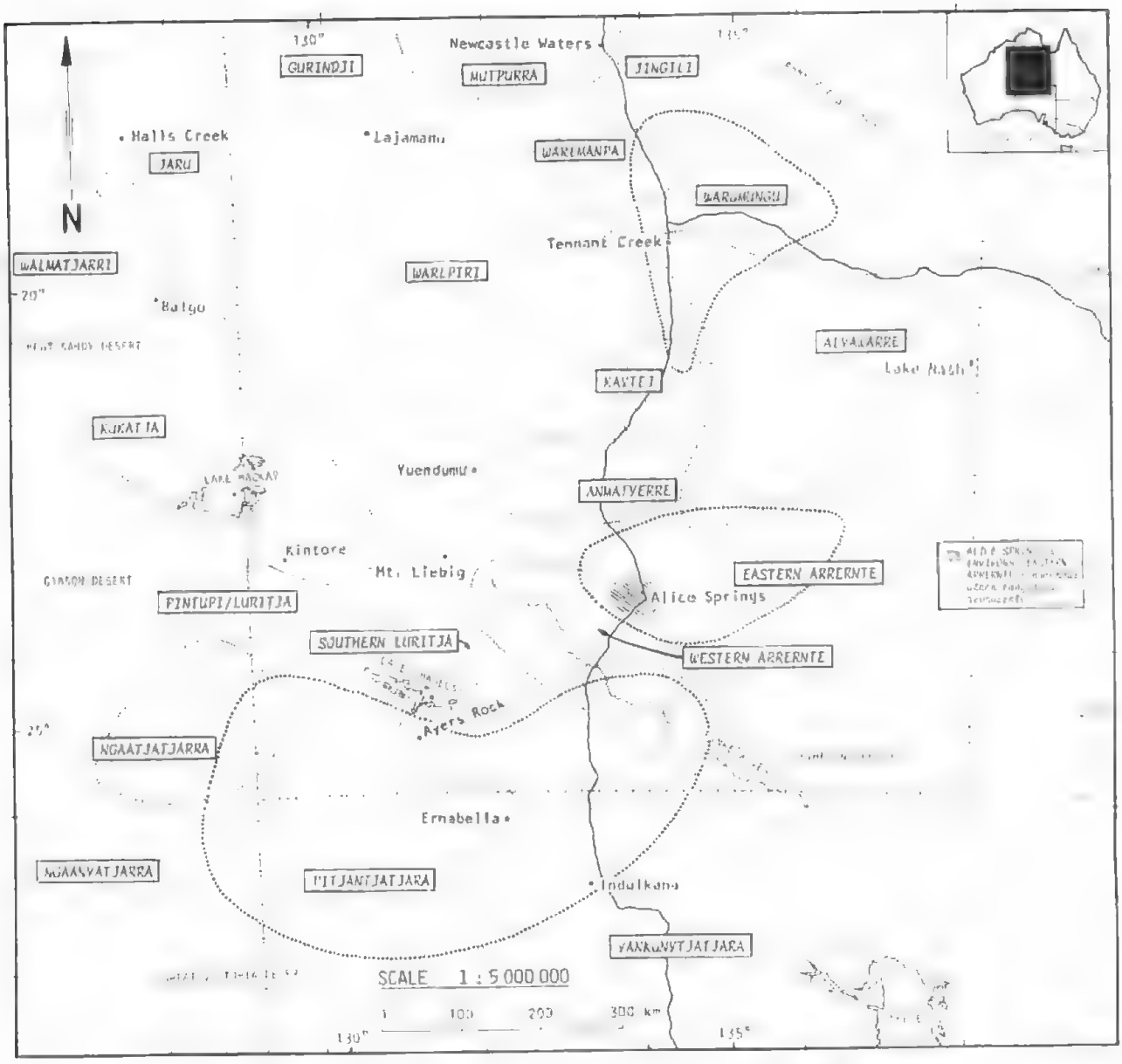

FIGURE 2. Current distribution of Central Australian languages (adapted from Hobson 1985).

succulent steppe occupies the alkaline and saline soils. Beard discusses this basic dualism. He notes the typical Australian sclerophyllous matrices, such as *Acacia* and *Triodia* communities, occur on poor leached siliceous soils. A different, more varied, floral array is associated with the base rich alkaline and saline soils.

The two most widespread formations are sclerophyllous in character. They are the hummock grassland and low woodland. Hummock grasslands, or 'spinifex' communities as they are better known, cover dunefields and sand plains throughout Central Australia. They are rarely treeless. *Acacia* species are prevalent and scattered throughout these communities. Most of the *Acacia* species mentioned in the text occur in these communities.

The low woodlands are usually dominated by *A. aneura* (mulga) and these communities are the second most extensive in the arid zone. Midgely & Gunn (1983) state that 1.5 million km^2 of Australia's arid and semi-arid zone are dominated by mulga communities, often forming dense monospecific stands. These mulga scrubs are in themselves extremely variable both morphologically and because of the composition of the understorey.

Latz (1982) describes two clearly discernible types of mulga scrub. 'Perennial mulga' has an understorey of perennial grasses such as *Eragrostis eriopoda* (woollybutt grass) while in 'annual mulga' an understorey of annual grasses and herbs predominates. Mulga can also harbour an occasional eucalypt or contain other *Acacia* species

such as *A. cambagei* or *A. pruinocarpa* (Beard 1981). Mulga can also occur in scattered stands in many of the other plant communities of the arid zone. It is only in the salt lakes and Mitchell grass communities that it is totally absent (Latz 1982).

The succulent steppe formation is divided into a number of distinct communities. In the south of the study area calcareous soils are often dominated by *Maireana* sp. (bluebush) and a number of *Acacia* have adapted to these alkaline conditions, becoming dominant trees in some areas. *A. calcicola* is significant in the south of the area, while *A. georginae* is common in the east (Latz 1982).

The calcareous but slightly saline soils are dominated by *Atriplex* (saltbush) communities and *Acacia* species are less common. The highly saline areas are vegetated principally by *Halosarcia* sp. (samphire) and *Acacia* are absent.

There are many smaller environmental associations whose size may belie their ecological significance. *Acacia* shrublands often merge with low woodland, forming composite mosaics or (as it happens in the south-east of the study area) they may stand as distinct entities. There *A. ligulata* and *A. tetragonophylla* form sparse shrublands (Beard 1981). Similarly distinct are some *A. kempeana* (witchetty bush) shrublands which can inhabit the alluvial soils associated with limestone or dolomite outcrops around the central ranges (Latz 1982).

Aboriginal Classification and Description of *Acacia*

Taxonomy

It is unlikely that there is a single system of plant classification that will be shared by all Central Australian language groups. Even within these groups there are inconsistencies. Each clan may possess a distinctive linguistic and classificatory knowledge (pers. obs., Walungurru, 1984–5). However, the following discussion of Aboriginal plant taxonomy reveals trends that can be compared with popular European and western scientific systems.

In Warlpiri, flora classification distinctions are made on the basis of the following properties: woodiness, habitat, growth habit, relative size and usefulness, including edibility. For example, an initial assessment is made according to whether a plant is woody or not. Woody plants, such as *Acacia*, are *watiya*, and non-woody plants, such as grasses, are *marna*. If a plant produces edible parts it is *miyi*. If those parts are seed, as is often the case with *Acacia*, then it is *ngurlu*. If the edible substance provided by a plant is insect gall or lerp or larvae it is *parma*. This category also refers to nectar and honey, which are not utilised from *Acacia*.

From my research into Central Australian nomenclature there is no generic term for legumes or for *Acacia*. Most names for *Acacia* are species specific. Conversely, Aborigines differentiate between varieties and subspecies that have not as yet been recognised by western taxonomists. Piele (1980: 62) refers to the case of *A. ptychophylla* which Gugadja [Kakatja] speakers recognise as two distinct entities, *nyirrtjalu* and *tjamunpa*. European taxonomists do nonetheless accept that mulga (*A. aneura*) is a variable species or species complex.

Because of the widespread dominance and economic importance of mulga (*A. aneura*) it is not surprising that there has been a proliferation of terms to describe it in indigenous languages. Goddard & Kalotas (1988) found that the Yankunytjatjara differentiate between five varieties of mulga (see Table 1). Despite this recognition of differences the Yankunytjatjara also acknowledge generic uniformity by using the term *Kurku* for all five varieties.

Knowledge of Species Diversity

Table 1 demonstrates that the absence of a written system for recording plant names did not inhibit the development of sophisticated skills of linguistic recognition and differentiation in Aboriginal

TABLE 1. Five *Acacia aneura* varieties as recognised by Yankunytjatjara speakers (adapted from Goddard & Kalotas 1988).

Name of Variety	*Leaf Characteristic*	*Most Notable Use*
Kalpilya	Long, narrow; flat	For making boomerangs [Kali]
Minyura (desert mulga)	Shrubby, blue	Resin for implement manufacture and repair
Puyukara	Long, narrow, flat	—
Tjamalya	Long, narrow, flat	Seeds not used as food
Wintalyka	Common variable leaf form	Seed important food source

culture. But not everybody in the community had the same level of botanical knowledge (Piele 1980). The acquisition and retention of such information would be affected by many factors — regions traversed, sex, age and even individual spiritual associations with particular areas of land and associated totems. Accordingly, knowledge can be viewed as either an individual or a community/cultural attribute.

Latz (1982), in the most systematic study of ethnobotany of Central Australia, lists 32 *Acacia* species as being used for food alone. Nash (n.d.) lists 37 *Acacia* as being recognised by Warlpiri, Warlmanpa, Warumungu and Alyawarre speakers living in areas to the north of Alice Springs. Twenty-six *Acacia* species are described by the Warlpiri Lexicography Group (1986) and 24 *Acacia* species are listed by O'Connell *et al.* (1983) in their work with Alyawarre speakers.

Plant Related Terminology

As well as an extensive knowledge of floral diversity, speakers of Central Australian languages can call on a sufficiently specific vocabulary to allow detailed descriptions of plants and their parts. In Western Desert languages the same terms are often used to describe plant parts as those for human/animal anatomy. Table 2 sets out some Yankunytjatjara terms that are relevant to the description of *Acacia*.

Acacia Distribution and Soil Associations

Transcriptions of Yapa statements indicate that they identify the presence of *Acacia* and other plant species with particular environmental units and soil types. In a long explanation of the distribution,

TABLE 2. Yankunytajatjara terms relevant to the description of *Acacia*. (From Goddard & Kalotas n.d.).

Yankunytajatjara Term	*English Meaning*	*Literal Translation*
Unturuntu	Flower	
Pilyuru	Pod (mainly of *Acacia* and *Cassia*)	
Kalka	Seed	
Yuti	Seed appendage e.g. coloured aril on some *Acacia*	Iris of eye
Kalpi	Broad leaf	Feather
Parka	Narrow leaf	
[?] Tjanikiri	Small leaf	
Miina	Branch, stem	Arm
Anangu	Tree trunk, main stem	Body
Tjarapa Kutjara	Tree fork	
Wata	Base of trunk	
Muti	Log, stump	Knee
Likara	Bark	
Aturu	Lateral root	
Tjiilpa	Tap root	
Tjilka	Prickle, thorn	
Taltja	Knot in timber	
Murtjul	Insect gall	Knot, tangle
Unytjunytju	Fallen leaves, leaf litter	
Piltirrpa	A dried tree	
Wiirwirpa	A bare tree	

growth and use of *Kanarlarrampi (A. cowleana)* the following observations were made:

> Kirrirdi-kirrirdi yika karri kanarlarrampiji. Wantiki. Kulaka karruwanarlangu karri, karrungkaju kujaka karri kanarlarrampipiyayijala nyanungupiyayijala ngulaju jintapardukarija. Kalá nyampuju — manangkarrangawurrpa. manjangawurrpa kanarlarrampiji.
>
> The *Kanarlarrampi* is rather tall and wide. It does not grow along creeks in white sandy soil. The tree which does grow along sandy creeks and which is like the *Kanarlarrampi* is a different one. Whereas the *Kanarlarrampi* belongs to the spinifex country and to the mulga scrub. (Warlpiri Lexicography Group 1986: 10).

While knowledge of the presence of a plant in a particular habitat can be linked to the potential for its exploitation, the following account of the exclusion of mulga from a specific soil type points to an understanding of soil as a limiting factor to the growth of particular plants:

> Manja kalu pardimi walya yangka palinyayirnirla kujaka larra-larra-parnka. Jarnuga kalu karrimi yulyurrpurla manu wantangka. Kulaka yatujumparra pardimi manjaju walya maru-maniirlaju.
>
> The mulga tree grows in very hard firm soil which cracks. They grow all the year round - in winter and summer. The mulga doesn't grow in the north which is black soil country. (Warlpiri Lexicography Group 1986: 21)

Kimber (pers. comm.) has also observed that Aboriginal people distinguish differences in the 'flavour' of some fruits, particularly *Kampurarrpa* (bush raisin), when they grow on different soil types. He notes that both men and women possess a knowledge of preferred localities for obtaining sweet fruits.

Much of the ethnobotanical research conducted so far has been concerned with the compilation of species lists, details of plant use, methods of preparation and ritual associations. The Aboriginal concepts of soil/plant relationships have been largely ignored in the published literature of Central Australia.

Acacia–Animal Relationships

Aboriginal knowledge of the bush and its animal resources, though popularly accepted, has often been mystified. Aboriginal explanations of *Acacia*–animal interactions indicate how specific knowledge of habitat and feeding relationships was used to efficiently exploit local environments.

Animals are often linked with their habitats and it is not surprising that the red kangaroo *(Macropus rufus)* is called *ngarrirni manjangarna* or 'mulga dweller' by the Warlpiri who associate it with mulga woodlands. Skills of observation and a detailed knowledge of feeding relationships are revealed in the following statement by Mollie Everard who explains how the presence of birds can act as an indicator for the availability of edible 'honey dew', which forms on the upper branches of mulga trees when sap sucking scale insects are present (Latz 1982):

> 1. Nyakukatipai. Ka 'Tjulpu nyara nyawa! Tjulpu nyara ilura waninyi.'
> 2. Pika ngurpatja nyakukatipai, pirpipirpira wanani.
>
> 1. You spy it as you're on the move. 'Look at the birds over there! They're all over the place.'
> 2. You see — oh, just too much honeydew for words, glittering along the branchlets. (Everard, cited in Goddard & Kalotas 1988: 41).

The red lac scale if not collected by Anangu may be used by honey ants *(Camponotus inflatus)* which are also associated with mulga woodland. Edimintja (pers. comm., Ilpili Road, 1978) explained how ants collected the *turatja* (honey dew) from mulga trees and carried it via a tiny hole in the ground to feed other ants with swollen abdomens in caverns a metre under the surface. From there the honey ants could be extracted by humans, after a considerable effort (see also Cleland & Tindale 1959: 134)

Witchetty Grubs *(Xyleutes biarpiti)* are specifically associated with *A. kempeana* and in the recent past formed a crucial part of the diet of many desert groups. Tindale (1953, 1981) stressed the importance of this and other species of cossid larvae in the nutrition of desert people and in particular during the weaning of children.

After a visit to the Mt Liebig area in 1932 Cleland and Johnston reported that witchetty grubs

> . . . are much sought after by rabbit-bandicoots, *Thalacomys lagotis* [now *Macrotis lagotis*]. These scratch the soil away from the roots, but they may be disturbed or may find the root containing the insects too difficult for their extraction. The natives, in searching for these grubs, look for places where marsupials have been burrowing. If they find the root has been gnawed through they proceed no further; but if the root is still intact, then they wrench it out and frequently find the insect (Cleland & Johnston 1933: 120).

The *Ninu (Macrotis lagotis)* is now an endangered species throughout its range. The opportunities for Anangu to exploit the witchetty grubs excavated by the *Ninu* have largely disappeared with the animals. On a field trip in June 1988, the author together with Dr Christopher Anderson of the South Australian Museum were travelling with three Pintupi men in the area to north of the Walangurru Community when similar

observations were made to those of Cleland & Johnston (1932). As the car passed through sandhill country there was suddenly an area of several hectares dominated by *A. kempeana*. Conversation turned to the animals. We stopped the car and within a minute Willie Tjungurrayi, who had grown up traditionally in the desert, located a witchetty root that had been excavated by *Ninu*. The root was levered out and the grub extracted.

Acacia and Land Management by Fire

The most important land management tool available to Aborigines was fire (Hallam 1975; Jones 1969; Kimber 1983; Latz & Griffin 1978). Latz (1982) indicates that the vegetation of Central Australia was so adapted to the traditional Aboriginal fire regime that in many ways it was better able to survive fire than drought. According to Latz & Griffin (1978) a great number of food producing plants respond positively to the incidence of fire: 50% of the plants they judge as being most important to the pre-contact economy increased in numbers after burning while only 10% showed a long term reduction. However, fire was not used indiscriminately and the relative tolerance of various species to burning was taken into acount as specific stands of vegetation were burnt for anticipated results. Latz (1982) described an idealised result of a typical Central Australian fire regime:

> Maximum *Acacia* seed production will be available from a given area when burning is carried out in such a way as to produce a mosaic of plant communities in different stages of fire recovery. This includes some areas which have been protected from hot summer fires for considerable periods or have only been subjected to cooler winter fires (Latz 1982: 58).

Latz defines three typical responses of *Acacia* species to fire and in so doing indicates the potential for their management as a food resource:

i) species that are not much affected and quickly recover, often producing seed six months after a fire event (e.g. *A. coriacea*);
ii) species in which individuals are killed but seed germination is enhanced, with seed production commencing 2–4 years after fire (e.g. *A. dictyophleba*);
iii) species killed by fire with significant seed production commencing only after 5–10 years (e.g. *A. aneura*).

It seems that Aboriginal people were also aware of the effect fire had on specific plants and plant associations, and that they took these factors into account in their use of fire. Kimber (1983) concludes that there was an understanding of the susceptibility of mulga (*A. aneura*) to fire and a general avoidance of burning wooded areas. Conversely he indicates that spinifex and other grasslands were burnt routinely in both small patches and on a broad scale.

European settlement generally suppressed traditional Aboriginal burning practices. However, the introduction of land rights, increasing Aboriginal ownership of vehicles, and the growth of the outstation movement have been among the factors that have led to the resumption of widespread burning, particularly by Pintupi, Luritja and Warlpiri people (Cane & Stanley 1985) (see Fig. 3).

ACACIA: ASPECTS OF USE AND SOCIAL IDENTIFICATION WITH THE GENUS

Acacia: The Diversity of its Use

Acacia plants composed much of the living mantle of the arid zone. Mulga woodland enveloped its human inhabitants, giving them shelter and

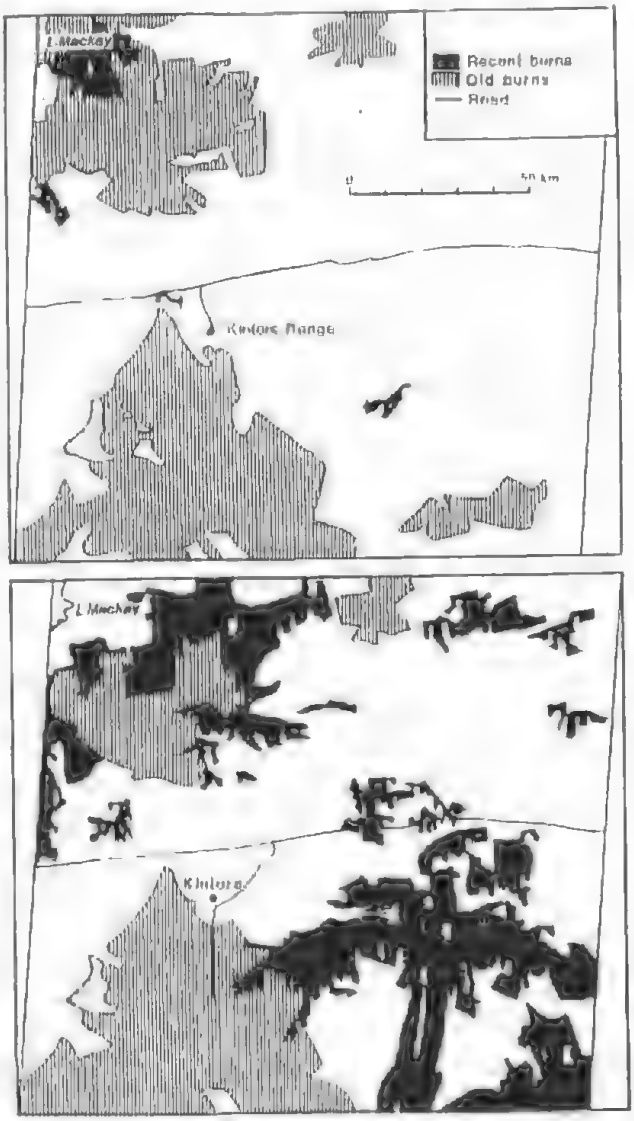

FIGURE 3. Fire patterns in the Pintupi homelands, 1981, 1983 (Cane & Stanley 1985).

warmth from firewood that could burn right through a freezing night. The same trees provided a habitat for important food animals and timber for weapons to hunt them. The seed production from various *Acacia* species would have made it possible for large groups of people to gather for ceremonies and be assured of an abundant supply of nutritious food (Latz 1982). A variety of *Acacia* trees and shrubs provided many of the medicines that were used to maintain health and well-being. *Acacia* was thus deeply interwoven with the economic, social and spiritual lives of Central Australian people.

Acacia Seeds as Food

The Grinding Process

Smith (1986), in a comprehensive survey of the archaeological evidence for seed grinding technology, has demonstrated its vital role in shaping occupation and patterns of land use in Central Australia. In balancing the forces of population density and carrying capacity, seed grinding may have variously facilitated higher population densities, extended the range of foods available to people, and intensified the use of resources. This technology remained an integral part of desert culture until the advent of wheat flour with the coming of Europeans. Murika, a Yankuny-tjatjara woman, explains the process of dry milling mulga seeds:

1. Punu putungka tjunkupai. Punungka tjunanyi munu wantinyi.
2. Munu nyinara yankula nyanganyi. Piltiringanyi.
3. Ka 'Ai! Ngayuku mai piltiringu!' Panya palunya yalkanilta.
4. Yalkara ka purputukatinyi.
5. Ka nyulkara palunya pungku-pungkula kalkani, munu palunya wirangka tjunanyi.
6. Munu paluru kanini, kanini palunya Wirangka kanini, winlalyka palunya.
7. Kanini, munu tjaruwaninyi, mimpungka tjaruwaninyi.
8. Munu palunya tjalira kulpanyilta.
9. Munu ngurangka paluru katira tjunkula, ipangka pauni, mai palunya, ka paluru pilta-piltatjunanyi.
10. Ka paluru paura, ararangkula, kaninilta. Kanira kalkani, mai palunya.
11. Tjiwa urani, munu palunya rungkani, rungkara anytjuni
12. Munu nyaangka, tapaltjura palunya mai rungkani, mai palunya. Ka paluru tapalta pulaparingu.
13. Ka ngura tjitji tjutangku nganana ngalkupai. Nganana talturingkupai.
14. Mai paluru pulka, tjamuku kamiku, mai kunpu. Nganana mai palula pulkaringu, palawa wiyangka.

1. You put some mulga branches on an old flat termite nest and leave them there.
2. Then after a while, after travelling around a bit, come back and check it. It dries out.
3. 'Ah! This food of mine has dried out nicely!' Then you thresh it.
4. As you thresh it, the pods fall out all over the place.
5. By rubbing them and tapping them you get the seed out, and put it in a dish.
6. Then you yandy [winnow] the mulga seed in the dish.
7. Once it's yandied, you tip the clean seed into *mimpu* bowls.
8. Then load up on your head and return to camp.
9. Having brought it to camp, you parch the seeds in hot ashes, and the hard seed cases crack open.
10. After roasting it, you winnow and yandy it again, to separate the seed inside.
11. Then you get a grindstone, and grind it up, wetting it as you grind.
12. You put a collecting vessel beneath the lower grindstone and it builds in that.
13. We used to eat it as kids. We'd get full.
14. It's an important food: a food of our grandfathers and grandmothers, a strong food. We grew up on this food, without flour. (Murika, cited in Goddard & Kalotas 1988: 39–40).

Murika provides a general description of the process, but seeds may be used in several ways depending on the species. For instance, larger seeds are pounded after parching and before grinding. Other reports indicate that seeds were sprinkled with water during grinding and the resulting paste was baked as damper (O'Connell, Latz & Barnett 1983). Seeds of some species, such as *A. coriacea*, are collected green from the bushes and roasted briefly on a small fire or burning clumps of spinifex. In this form they have a delicious nutty flavour

Seed Processing — Efficiency and Energy Return

While 'bush tucker' is still avidly collected and usually preferred to 'canteen' food by people on the 100 or so outstations scattered throughout the Central and Western Deserts, the abundant seed resource is now largely neglected (Cane & Stanley 1985). Ready availability of processed white flour as a direct substitute for 'bush' flour has prompted the decline in the use of a wide variety of seed yielding species (O'Connell, Latz & Barnett 1983). This is not surprising as although native seeds are more nutritious and flavoursome than wheat flour, they are also very time consuming to collect and process.

O'Connell, working with Alyawarre women in 1974, recorded the data (presented in Table 3) for the energy return per unit time taken to collect and process seed from three *Acacia* species. Values for other desert staples are also included for comparison.

These data confirm that traditional methods of collecting and processing *Acacia* seed are inefficient, especially when compared with energy returns per

TABLE 3. Collecting and processing times and energy returns for bush foods (including seed of three species of *Acacia*). *(Adapted from O'Connell, Latz & Barnett 1983).*

Species		*Collecting and processing time (h/Kg)*	*Energy Value (K cal/Kg)*	*Energy return per unit time spent collecting and processing (K cal/h)*
A. aneura		6.50	3778	580
A. coriacea	ripe	5.25	3551	676
	unripe	0.60	2600	4333
A. coweleana		6.59	3589	552
Ipomoea costata		0.25	1563	6252
Solanum centrale		0.50	2992	5984
Cossidae grubs		1.75	2600	1486

unit time for other favoured and now more frequently collected bush foods, such as cossid grubs (from *A. kempeana* and a variety of other plant species), *Ipomoea costata* (wild potato) and *Solanum centrale* (bush raisin).

Acacia coriacea can be relatively efficiently collected for it grows as a low tree with 8–12 seeds in each pod, but when milled for use as damper, the energy return is only slightly greater than that for *A. aneura*, which has smaller seeds with only about three seeds per pod. From these data it would appear that the grinding stage of seed processing is the most time consuming as well as the most arduous for the Aboriginal women who have traditionally carried out this task.

When the grinding stage is omitted and the lightly roasted seeds are eaten at an unripe stage the energy return is increased sixfold. In this form the energy return for *A. coriacea* is comparable with values for the other frequently collected staples (see Table 3). Consequently this species is still utilised when the unripe seeds are available during October and November (pers. obs., Walangurru, 1984).

Contemporary Implications for the Use of Acacia *Seed as Food*

The urge to escape the drudgery of traditional food-gathering life and particularly the incessant seed grinding that was an integral part of it, must have been a key incentive for the people of the Western Desert to abandon their economic independence. During most of this century 'sweet tucker' in the form of processed flour, sugar and tea has been provided to Aborigines by the missions and later government settlements fringing the Western Desert.

Pupulu Tjupurrula describes how (when he was a boy) white flour was used by Lutheran missionaries to lure his family from the Walangurru/Mitukatjirri area to a state of economic dependence in the mission station at Haast's Bluff:

> They [the missionaries] bin makin big home in Ilpili aerodrome, they're sitting down. Alright, that's the time we tasted tea and flour. Really sweet! Sweet this tucker, we'll follow this one east. We bin travelling this way now. Tjina [on foot] we bin travelling. Right, we saw Putati [spring site/ration depot]. Oh! mayi too much here — flour. Oh [the missionaries] got'im proper big box that they put on the camel. That time our mob was eating flour. (Kean 1984).

The last ten to fifteen years have seen the resurgence of an Aboriginal determination for political and cultural independence. A key manifestation of this movement has been the creation of many small outstations throughout the Western and Central Deserts. There are now more than 2,400 people living on outstations in Central Australia (see Cane & Stanley 1985). Although these communities are largely financially dependent on government subsidies, bush resources in the form of food, building materials and materials for artefacts for sale are also significant in the outstation economy. Cane & Stanley (1985) have estimated that in the 53 outstation communities they surveyed, the equivalent of one meal in four came from the bush. In financial terms, they calculated a contribution of $616 per person per year from bush tucker when the average yearly income was only $2,500 per person. Given the development of an appropriate milling technology, *Acacia* seed could again be widely used to further

enhance economic independence of outstation communities.

Warlpiri and Western Desert women have proved by their involvement with the seed industry that there is still an enthusiasm for the collection and processing of *Acacia* seed. When *Acacia* seed has been in demand by the organisers of local and overseas re-afforestation programmes, the amount of seed collected by the women has invariably outstripped the market (Baarda 1983; Horner pers. comm.). Given the demonstrated urge for independence and the fact that many outstations are already established on resource rich areas, it is likely that an efficient milling technology would be accepted by such communities.

A suitable mill should be robust and virtually maintenance free to be practical on outstations where there are few if any substantial buildings. The availability of appropriate milling technology could mean the resumption of use of this important traditional food source where highly developed skills for seed collecting and winnowing could be incorporated without suffering the back-breaking grinding stage of the process.

As tastes have undoubtedly changed since contact with European foods, a mixture of *Acacia* and wheat flour may now be most palatable to Aboriginal people. Cherikoff (pers. comm.) suggests that a mixture with 70 per cent *Acacia* produces a good textured damper. It would be Aboriginal experimentation, however, that finally determined how and to what extent ground *Acacia* meal was used. Resumption of use of the *Acacia* seed resource could lead to improvements in the economic and political independence of remote Aboriginal communities.

Nutrition and Health

Analyses by Brand & Cherikoff (1985a, 1985b) demonstrate that *Acacia* seeds have higher energy, protein and fat contents than crops such as wheat and rice. Their results, together with those of other workers, for the composition of nine *Acacia* seeds and one gum exudate are presented in Table 4.

TABLE 4. The composition of *Acacia* products per 100g edible portion (adapted from Brand & Cherikoff 1985b).

Foods	*Description*	*Energy*	*Water*	*Protein*	*Fat*	*Carbohydrate*	*Fibre*	*Ash*	*Na*	*K*	*Mg*	*Ca*	*Fe*	*Zn*	*Cu*	*Vitamin C*
		kJ	*g*	*g*	*g*	*g*	*g*	*g*	*mg*	*mg*	*mg*	*mg*	*mg*	*mg*	*mg*	*mg*
Acacia aneura and *Acacia kempeana* mulga and witchetty bush	seeds	2220	4.3	23.3	37.0	25.5	—	9.7	37	805	—	113	—		—	—
Acacia coriacea dog wood	green seed	627	56.8	23.7	3.3	6.4	8.2	1.6	3	362	75	137	3.2	1.0	0.4	—
	dry seed	1240	4.1	20.9	9.3	33.8	28.2	3.7	4	784	170	318	7.7	5.8	1.0	—
	dry seed	1491	17.0	23.8	7.7	48.1	—	3.7	61	357	—	84	—	—	—	—
Acacia cowleana	seed	1507	15.6	22.2	10.1	44.6		7.2	96	290	—	114	—	—	—	—
	seed	—	5.5	23.4	9.8	36.4	—	—		—	—	—	—	—	—	—
Acacia dictyophleba	seed	1519	11.2	26.8	6.3	49.0		6.5	84	221	—	89	—	—		
Acacia estrophiolata ironwood	gum	1429	7.1	0.2	0	89.1	0	3.6	6	721	37	587	10.9	2.6	0.4	
Acacia kempeana	seed	1631	5.6	22.9	10.2	51.0	—	10.1	112	392	—	72	—	—	—	—
Acacia murrayana Murray's wattle	seed	1107	5.4	18.1	5.8	37.6	28.9	4.2	4	800	218	213	6.6	3.7	0.7	—
Acacia pachycarpa	seed	1598	7.1	22.2	8.3	57.1	—	5.3	—	—	—		—	—	—	—
Acacia tenuissima	seed	1469	1.6	25.0	15.6	29.2	25.7	2.9	5	678	116	144	6.8	3.2	1.4	—
	seed	1592	14.5	24.8	16.4	33.0	—	11.1	89	372	—	80	—	—	—	
Acacia victoriae bramble wattle	seed	1782	4.9	[illegible]	[illegible]	40.8	29.4	4.1	8	756	136	353	14.6	1.7	[illegible]	—

In some *Acacia* species, such as *A. coriacea* and *A. tenuissima*, most of the oil is in the aril (seed attachment). The aril is easy to detach and was traditionally mashed and used as a drink (Brand & Cherikoff 1985a). The bare seed remains may then have an oil content of less than five per cent (Cherikoff pers. comm.).

Cherikoff (pers. comm.) suggests that the traditional practice of parching the seed before milling served two functions — the first being that they were easier to grind once the hard seed coat became brittle and, secondly, that small quantities of enzyme inhibitors are destroyed, resulting in a food of high nutritional value.

Cherikoff (pers. comm.) also suggests that one potentially significant advantage of using *Acacia* seed as food is its demonstrated protective role against Type 2 (non-insulin dependent) diabetes mellitus. This is a disease of major proportions among the now sedentary, white flour and sugar dependent indigenous people of Australia. Mobbs (pers. comm.), while acknowledging the extent of diabetes among Aborigines in the Centre, warns against regarding the eating of *Acacia* as a panacea for a disease which she views as also largely lifestyle related.

It is interesting to note that the Kukatja were aware of the medicinal qualities of *Acacia* seeds over and above their value as food. The following description is of *Mulunturu (A. coriacea)*:

> Mulunturu. Yalpa . . . good medicine . . . Kalyu - kurlu - lu. mix - em - up tjikila - latju wiyala. Mimi kaniny - tjarra - lu palya ringu tjikirinu - ka palya - rringu, tjurni ngawu - lu might be tjarlu - tjarlu tjikirnu palya - rringu

> *Acacia* seed is good medicine. Mix it with water. Drink it and it will make an end (of sores and sickness). When you are sick internally. Say bad stomach. Perhaps you might have diarrhoea. Drink it and you will become better. (Piele n.d.).

Social and Linguistic Identification with *Acacia*

The search for an appropriate idiom is, in my experience, as enthusiastically pursued by some Pintupi and Luritja speakers as it is by the most imaginative English speakers. The Warlpiri language also offers colourful expressions. One *Acacia*-related analogy *Jurru-mirntirla*, is used of a person who is hard-headed, stubborn, obstinate and insensitive; literally it means 'head — *A. pruinocarpa*', a tree which is noted for the hardness of its wood (Warlpiri Lexicography Group 1986: 25).

On a broader level Warlpiri recognise the major vegetation division that runs east-west across their country (at about 22° south) and incorporate it into expressions of their identity:

> Manjawardingki karnalu kurlirra nyampurla nyinami Panukari kalu nyinami yatijarra manangkarrarla Warlpiriyijala.

> We are the people of the mulga country who live in the south here. Others live to the north in the spinifex country. They are Warlpiri also. (Warlpiri lexicography Group 1986: 21).

Spiritual and Ritual Links with *Acacia*

Many of the Anangu/Yapa descriptions cited in the previous pages have their origin in Tjukurrpa ('Law' or Dreaming). For the Warlpiri and Western Desert groups, Tjukurrpa encompasses both events of a distant 'Creative Era' and the precedents that were established by the ancestral heroes which have been passed down to the contemporary custodians of traditional Aboriginal Law. The activities of *Acacia* ancestors are among the host of human, animal, plant, celestial and atmospheric constituents of the pre-European world commemorated at sites throughout Central Australia. Individual custodians are spiritually and ritually linked to these sites and the particular ancestors associated with them.

In the following account by Hercus & Clark (1986: 57) of the *Acacia* ritual centre Pudlowinna in the Simpson Desert, a recurrent link between ancestral grindstones and sites associated with edible seed bearing *Acacia* species is established:

> There is a song cycle usually referred to as 'the Grinding Stone from Pulawani' by Mick McLean who was the last person who could chant the verses. The Grinding Stone referred to is a *ngampa*, that is not a flat grinding dish but a thick lower mill-stone on which the seeds of small trees were pounded. The trees were *Acacia ligulata*, the sandhill wattle, *Acacia dictyophleba*, and *Cassia nemophila*. This song-cycle is a most moving piece of literature. It begins with a description of drought, and dry leaves falling from the trees. The next few verses are whispered with sharp intensity — let the dry roots and stumps become green, bright green. Then comes a description of shoots gradually appearing and roots spreading out. Then a *kultji* a small round stone is put under the tree to make it fruit with profusion. The seeds form, they ripen and are ground and the dough is cooked. In the meantime the ancestral *ngampa* stone disappears, but the Pudlowinna people paint up for a ceremony. An Ancestor (unnamed) finds the stone — it now has a handle like an axe. He takes it back to the well and it grinds the seed continually. The song ends with the ceremonial verses.

A bilingual version of 'The seed song from Pulawani' by Mick McLean has now been published (see Hercus 1990). In her introduction to the translation Hercus notes that it '. . . was the main song used for the increase in *ngarrulja*, that is hard seed, such as *Acacia* and pigface seed' (1990: 117).

Widespread association of grindstones with particular *Acacia* plants is further emphasised by a 1978 painting by Toby Brown Tjampitjinpa. In this painting (see Fig. 4) Tjampitjinpa depicts the travels of an anthropomorphic grindstone/woman through Anmatyarre country. Tjampitjinpa said that when the grindstone/woman stopped, mulga trees grew out of her. He explained, that the grindstone/woman was a mother and the trees were children from which mulga seeds could be collected for food. In his painting the two largest sets of concentric circles represent the 'mother' at her camps, while the smaller sets of circles emanating from her represent her children, the mulga trees of the area.

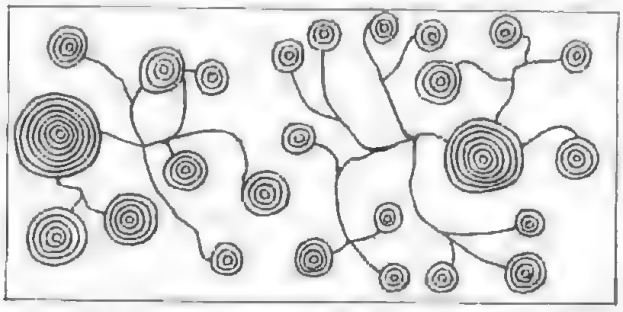

FIGURE 4. Mulga trees growing out of a grindstone/woman in Anmatyarre country. By Toby Brown Tjampitjinpa (Papunya Tula Artists).

Clifford Possum Tjapaltjarri, a countryman of Tjampitjinpa, has also depicted many of the 'mulga seed' ritual centres of the dense mulga woodland of the western Anmatyarre area. In the late 1970s Tjapaltjarri completed a series of paintings which mapped the intersecting paths of many Dreaming trails over large areas of Anmatyarre country. In one of these paintings several sites associated with mulga seeds were illustrated as surrounded by the symbols of other significant sites and stories. That is, the sites are represented as an integral component of a 'Totemic Landscape' (Strehlow 1970).

Tjanypapakanu is an increase centre for mulga seed and in Tjapaltjarri's painting (Fig. 5) the site is represented by the grey concentric circles from which lines of grey dots appear to be exploding. This is the site from which mulga trees in this area are believed to be spread. Established mulga groves are represented as clusters of grey dots scattered throughout the painting; the small black overdotting represents the mulga seeds themselves.

At Rrunyalyitja, to the east of Tjanypapakanu (see Fig. 6) a seated woman is depicted grinding mulga seed; her top stone is represented as the adjacent oval. Tjapaltjarri indicated that this stone still survives as a smooth white rock at Tjanypapakanu (pers. comm. 1978, 1984). The sections reproduced in Figs 5 and 6 represent approximately one quarter of the total area of the painting.

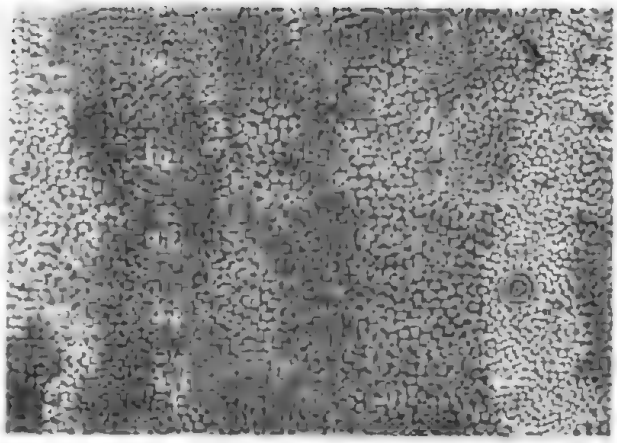

FIGURE 5. A mulga seed increase centre at Tjanypapakanu. Details of a painting by Clifford Possum Tjapaltjarri (collection of the author).

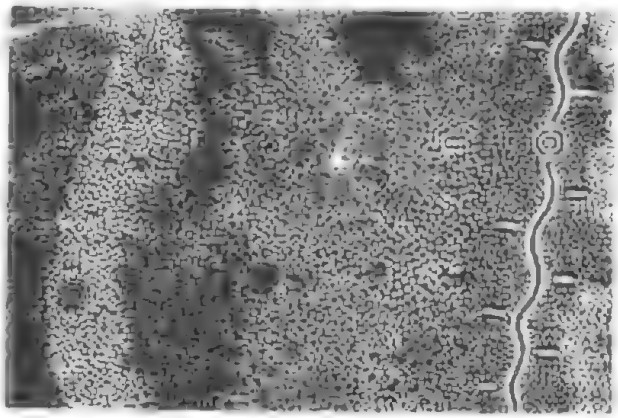

FIGURE 6. A woman grinding mulga seed at Rrunyalyitja, a site to the east of Tjanypapakanu (above). Detail of a painting by Clifford Possum Tjapaltjarri (collection of the author).

Nash (1984) describes traces left in the landscape by the grinding of *A. tenuissima* by an old woman of the Tjukurrpa. The following account illustrates how distant events are recreated in ceremony by the contemporary custodians of this story:

> The northern series of hills adjacent to Mt Liebig are believed to have been formed by an old woman who sat at the top of the mountain and ground seeds of *Acacia tenuissima* incessantly, creating huge piles of seeds, the hills. The woman's songs and actions for this dreaming contain many references to wattyawana. They simulate many aspects of gathering and processing such as 'winnowing' of sand on dancing boards to represent the wattyawana seeds being winnowed in wooden dishes. The dancing boards themselves are painted with wattyawana designs depicting important places and events in the sequence of Dreaming events. Yellow dots are painted to represent the yellow *Acacia* blossoms. (Nash 1984: 34).

A 1986 painting by Sandra Nampitjinpa of the Watiyawana story (see Fig. 7) depicts the same ceremony as described by Nash. In this small painting the women are represented as the crescent shapes, while the adjacent shapes are the dancing boards in the performers' hands. Fighting sticks topped with cockatoo feathers and decorated with watiyawana imagery are evoked standing erect at focal points in the ceremonial ground. This painting is in the collection of the South Australian Museum (A65163).

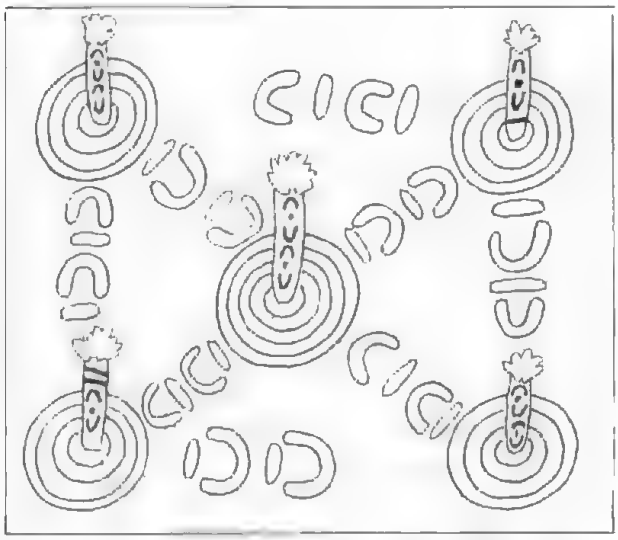

FIGURE 7. Watiyawana by Sandra Nampitjinpa (adapted from South Australian Museum A65163)

While each of the *Acacia*-related Tjukurrpa documented here are unique and of significance to particular Aboriginal groups, they are at the same time representative of general trends in the belief systems of Central Australia. Some of the recurrent themes of the ceremonies, songs and paintings described include the importance of the grinding technology in the use of *Acacia* seed as food, the traditional involvement of women with seed processing and the expansion of *Acacia* species from ritual centres scattered widely around Central Australia. That these ancient themes and precedents are still of considerable importance is supported by their continued ceremonial celebration. That they are now also depicted in the contemporary paintings of the area adds to their significance.

CONCLUSION

Central Australian Aborigines have developed a specific and substantial knowledge of *Acacia* and the ecology of *Acacia* dominated ecosystems. This knowledge has been the basis for the rational exploitation of these ecosystems and for their management by fire. There are still many Aboriginal experts who are the contemporary custodians of this cumulative body of knowledge.

Acacia trees and shrubs and the habitats that they formed were used by Aborigines in a diversity of ways to create secure and comfortable lives. But *Acacia* was important for reasons other than direct economic benefit. Species of the genus permeated the lives of Central Australian people and their languages and belief systems reflect this importance.

Many traditional economic and social aspects of Aboriginal–*Acacia* relationships are still relevant. The resumption of use of *Acacia* seed as food is one important area for investigation and development. If accepted by Aboriginal communities, the use of *Acacia* seed could lead to significant improvements in their health and economic independence.

There is currently widespread concern over the ecological change and environmental deterioration that has occurred in Central Australia during the last century. The lack of regeneration of long-lived *Acacia* species, particularly in the southern area of the study zone, is pronounced. This has been largely due to the combined over-grazing by rabbits and cattle. If this trend is not reversed it may lead to the virtual extinction of mulga and other tree species in some areas.

For Aborigines to be assured of a sustainable flow of benefits from *Acacia* species, the health and diversity of the Central Australian environment must be maintained. Although the ecology of the region has been disturbed by external factors for which there are no traditional prescriptions, it is only the Aborigines who have a history of rational and sustainable use of the area.

ACKNOWLEDGMENTS

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LOWER MURRAY SHIELDS : AN HISTORICAL PERSPECTIVE

S. J. Hemming

Summary

This paper traces the history of one element in the material culture of the Aboriginal people of the Lower Murray River region – the shield (Fig. 1). The types of shields used in this area at the time of British colonisation are identified and the techniques used in their construction and the variations in their use are analysed. The engraved, and to a lesser extent the painted, designs on nineteenth century Lower Murray River shields are considered as providing the clearest identifiable examples of the art style of the region. The impact of British colonisation on the production and function of shields is examined and the survival of certain elements of this 'tradition' is discussed. A few shields are being made in the region today and the significance of this phenomenon is considered.

LOWER MURRAY SHIELDS: AN HISTORICAL PERSPECTIVE

S. J. HEMMING

HEMMING, S. J. 1991. Lower Murray shields: an historical perspective. *Rec. S. Aust. Mus.* 24(2): 125-138.

This paper traces the history of one element in the material culture of the Aboriginal people of the Lower Murray River region - the shield (Fig. 1).[1] The types of shields used in this area at the time of British colonisation are identified and the techniques used in their construction and the variations in their use are analysed. The engraved, and to a lesser extent the painted, designs on nineteenth century Lower Murray River shields are considered as providing the clearest identifiable examples of the art style of the region. The impact of British colonisation on the production and function of shields is examined and the survival of certain elements of this 'tradition' is discussed. A few shields are being made in the region today and the significance of this phenomenon is considered.

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British colonisation of the Lower Murray River region started in 1836 with the establishment of the colony of South Australia. At the time this area, like so much of temperate south-eastern Australia, did not have the elaborate painting traditions that characterised the north of the continent. What it did have, however, was a rich tradition of wood engraving. Today, the nineteenth century art of south-eastern Australia is best represented by weapons and other artefacts that the Aboriginal people engraved and painted in a variety of highly localised designs. The early interests of museums and other collectors were focused upon items associated with warfare. As a consequence, objects such as shields, spears and of course boomerangs, were mainly collected and have survived to the present day.

For the Lower Murray River region it is the shield which provides the most spectacular examples of the local art style. The engraved designs are the most complex element in the decoration and these were often highlighted with colours. The British artists George French Angas and William Cawthorne carefully recorded the distinctive forms and colours of Lower Murray shields in their watercolours of the 1840s (Angas 1846, Cawthorne 1844-64). Without these artists' records, knowledge of the ephemeral painted designs of this particular tradition would be very thin indeed.

When the British first arrived in South Australia, the peoples of the Lower Murray region were identified by a large number of local clan and language-group designations (Tindale 1974, Berndt & Berndt in press).[2] Today the majority of the Aboriginal people from this area, excluding the Adelaide metropolitan area, identify themselves as Ngarrindjeri people (Hemming, Jones with Clarke 1989). The Ngarrindjeri community numbers several thousand people, spread throughout the Lower Murray region. It is mainly members of this community who still produce wooden artefacts that can be traced back to the pre-European tradition of the region. However, the principal decorative elements of the 'Old People's' material culture, the engraving and painting traditions, have not survived.[3] In contrast, some of the basketry styles of this region have virtually survived intact. They were encouraged by missionaries as a civilised means of generating money for the missions and the Aboriginal people themselves. New forms of art are being developed in the community, combining new media with old skills and Aboriginal philosophies. Some Aboriginal people are also trying to revive the art of making old-style artefacts like shields, using information obtained from the South Australian Museum and early records.

Shields As Part Of The 'Old Peoples' Culture

Perhaps the earliest evidence of the existence of shields in the material culture of the Lower Murray region appears in a rock painting near Macclesfield in the Adelaide Hills (Mountford 1960: 468). It depicts human figures with various material possessions and at least one of the figures (A) appears to be carrying a shield (Fig. 2). Although there have been no dates obtained for the antiquity of this rock art, it is assumed by archaeologists that

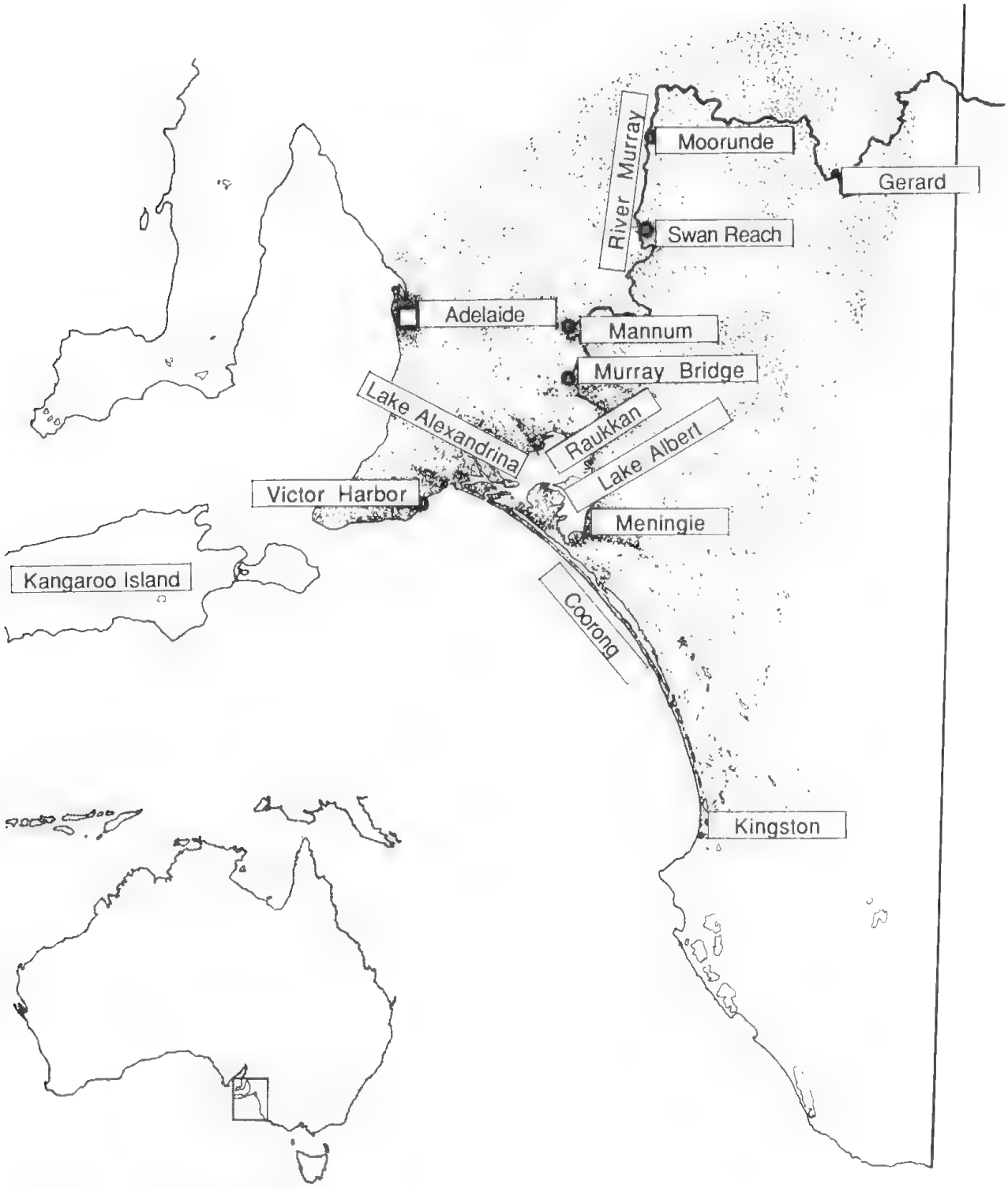

FIGURE 1. Lower Murray River region.

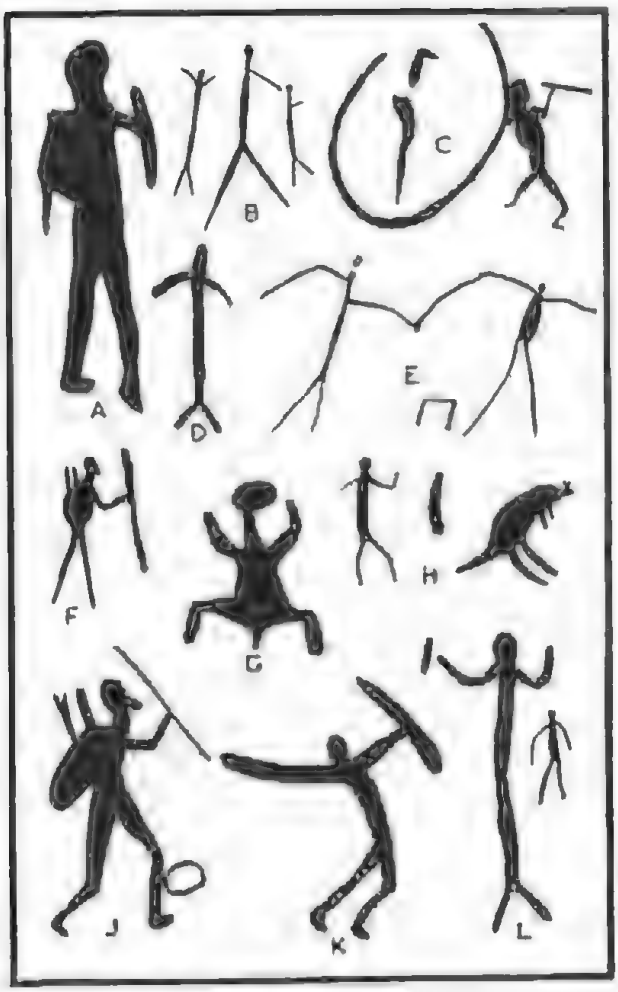

FIGURE 2. Figures from cave paintings in the Mount Lofty Ranges (after Mountford 1960).

it dates from a period long before British colonisation. This suggests that some elements in the material culture of this area were constant over a long period. However, it does not provide any evidence for a lengthy tradition of one particular style of art. There are certainly no apparent similarities between the style of decoration seen on the extant nineteenth century shields and the painting style found in this rock art.

In 1836 the Aboriginal people of the Lower Murray region were utilising three types of shields. These were the wooden parrying shield used in close combat and the wooden and bark spear-shields used to deflect spears and other weapons thrown from a distance. One of these, the bark spear-shield, was distinctive to the region. The combat in which these shields were used was highly ritualised and organised to settle disputes, which were most often between individuals and families. It bore little resemblance to warfare in the European sense, not involving heavy loss of life and usually stopping when a severe wound was inflicted upon one of the combatants (Fig. 3) (Stephens 1889: 477).

The bark spear-shield was decorated with predominantly painted designs and made from the bark of smooth barked eucalypts (Fig. 4). Angas' watercolour of South Australian Aboriginal men depicts two warriors with spear-shields (Fig. 5) (Angas 1844: AA8/10/8). The one in the top right-hand corner of the painting, a warrior from Mt Barker in South Australia, is holding a bark spear-shield. This variety of shield was often preferred in spear-fights to the wooden spear-shield, since it had the advantage that it was less likely to break when struck directly by a spear. The bark spear-shield is described in the following early account as only lasting for a very short time:

> The Wocaitee [bark spear-shield] is made and lasts but for a fight - for the bark soon loses its moisture, the sun warps it and so renders it unfit for use (Cawthorne 1926: 6).

Perhaps for this reason very few examples of these shields have survived. Their rarity may also be due to the vigour with which the early European authorities prevented spear fights in and around Adelaide and then seized and destroyed all the weapons (Cawthorne 1842–46: CY Reel 363, 623–625).

The other type of spear-shield used in the region was made from sap wood, the first layer of wood under the bark (Fig. 6). It was less likely to warp than a bark shield and of course it lasted longer. However, it was prone to breaking during fights, as the hardwood from which it was constructed was very brittle. Intricate engraving covered the faces of these shields and pigments were added to highlight the designs. In other parts of south-eastern Australia wooden spear-shields were most often used.

It appears that all groups in south-eastern Australia used the solid wooden parrying shield for defence against clubs and other weapons, during close fighting (Fig. 7) (Cooper *et al.* 1981: 32). In the Lower Murray region they were triangular in cross section and cut out of a solid piece of hardwood. Like the wooden spear-shields their faces were decorated with detailed engraved and painted designs (Fig. 8).

The best accounts of shield construction techniques describe the making of the bark shields of the Adelaide Plains area. In the early days of the colony Aboriginal groups from throughout the region travelled to Adelaide for a range of reasons including the distribution of rations and the availability of new articles brought in by the British (Foster 1989). This provided an opportunity for meetings between groups and at these meetings old disputes were settled and sometimes new conflicts arose and fights took place. As a result there were many opportunities for early observers, like Edward

FIGURE 3. Fending off spears with a shield, Adelaide area, *ca* 1844. Watercolour by William A. Cawthorne. Mitchell Library, Sydney (Cawthorne *ca* 1855, ML Z PXA 1490).

Stephens, to document the shield-making process. According to Stephens, the bark shields were made from eucalypt bark and were only obtainable during the 'spring of the year when the sap was flowing freely in the trees, and the bark could be readily taken off.' (Stephens 1889: 486). A handle was attached from the back and consisted of green pieces of wood pushed through holes in the centre of the shield. As the pieces dried they became very tight and formed a strong handle. The face of the shield was smoothed with stones and hardened with hot ashes. Once cool, it was covered with pipe-clay or lime, providing a smooth white surface on which red bands were usually painted.

By combining information on the shields of closely related areas in south-eastern Australia, we can assemble further detail about the techniques of manufacture and decoration of the two other types of shield used in the Lower Murray region. Baldwin Spencer, in his 1922 catalogue of the collections of the National Museum of Victoria, describes the method of manufacture of the wooden spear-shield of the Victorian region, which is made from the outer wood of the gum tree:

> . . . it is said that a mound of earth some 3 feet in length and about the same width as the shield is made; hot ashes are placed on the mound, and the slab of green wood on top of them; then sods of grass and stones are piled above it, and by the time that the ashes are cold the shield has assumed the curve of the mound (Spencer 1922: 17).

The parrying shields of the Lower Murray region were made from hardwoods and stone tools were needed for their initial shaping. Erhard Eylmann records the use of the Australian cherry *(Exocarpos cupressiformis),* at Point McLeay Mission in 1900.[4] George Taplin, the missionary who established Point McLeay in 1859, described this tree as possessing special powers in the eyes of the local Aborigines. They believed that if Australian cherry wood was burned then all the fish would leave the Coorong inlet (Taplin 1874: 90, Howitt 1904: 763–4). Perhaps they also believed that the inherent

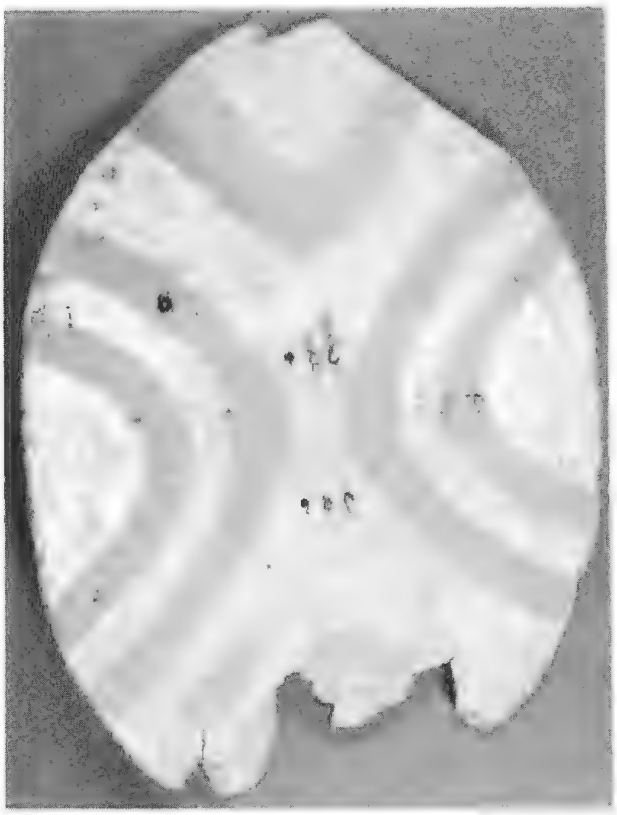

FIGURE 4. Bark spear-shield, Point Malcolm, South Australia, *ca* 1840. South Australian Museum A2210 (66 × 48 cm).

powers of this wood strengthened the effectiveness of a shield.

In 1881 Dawson described the method of carving designs onto the faces of the wooden shields in western Victoria and stated that pieces of flint and volcanic glass were the carving tools (Dawson 1881: 25). Smyth describes another method of carving which involved the use of possum-tooth engravers (Smyth 1878, 1: 349). A possum jaw with a tooth still embedded was used to create designs on wooden surfaces. From an examination of the oldest shields from the Lower Murray region, this appears to be the primary engraving technique used in this region at the time of British settlement (Fig. 9). According to Cooper designs were often marked out first in straight sharp lines and then deeply engraved with the tooth engravers (Cooper 1975: 59).

The decoration of the bark shield was less involved than the decoration of the wooden shield. The majority of bark shields were painted with relatively simple designs and this was probably due to their ephemeral nature. The wooden ones, on the other hand, were intricately engraved and colours were also added (Fig. 10). The Aborigines obtained pipe-clay from the salt pans of the Lower Murray area to be used as white pigment. The red colours were created by using at least two materials, the ochres from the available mines in the area and a

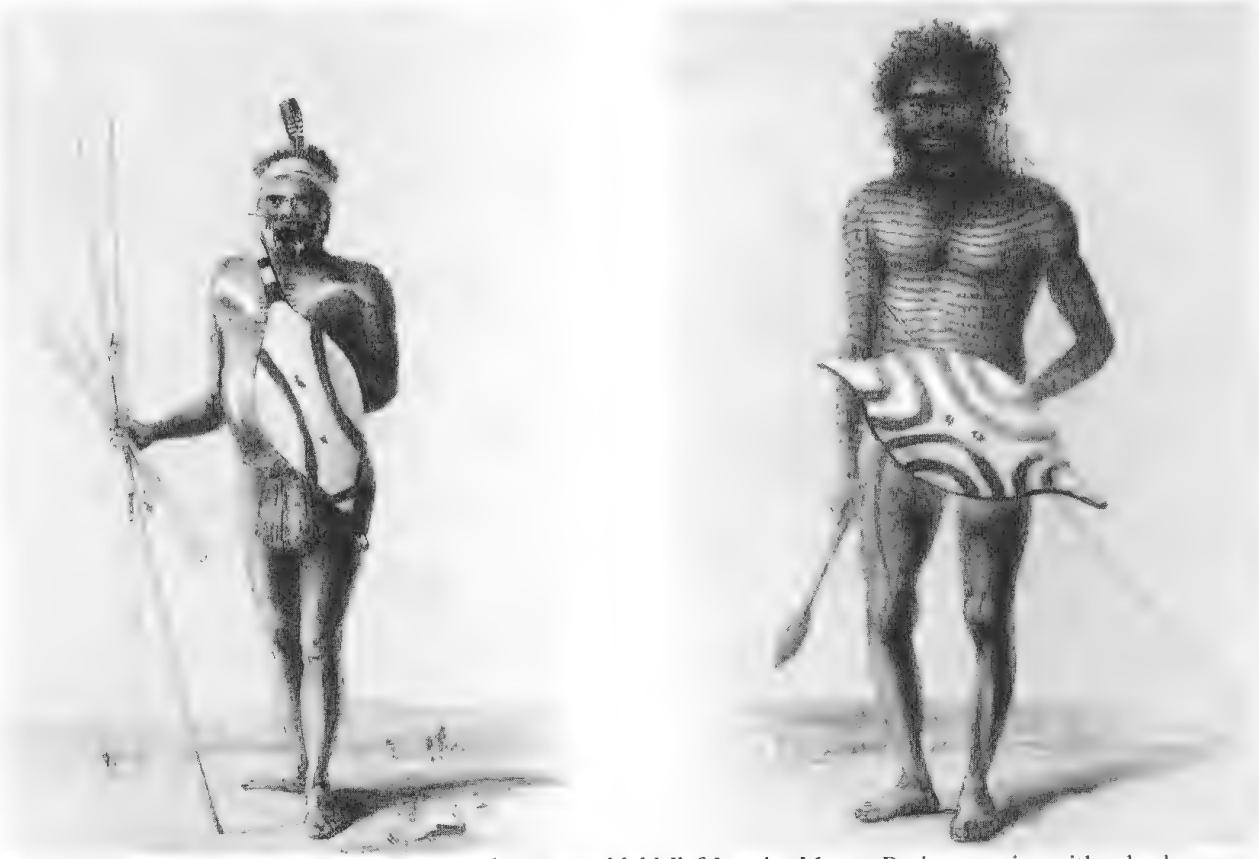

FIGURE 5. An Adelaide warrior with a wooden spear-shield [left] and a Mount Barker warrior with a bark spear-shield, *ca* 1844. Watercolour by George French Angas. South Australian Museum Anthropology Archives, AA8/10/8.

FIGURE 6. Wooden spear-shield, Mannum, South Australia, *ca* 1855. South Australian Museum, A2283 (84 × 24.5 cm).

red dye obtained from a particular root (Stephens 1889: 487).[5] The bark shields were decorated with a complete cover of white pigment and then a variety of combinations of curved red bands. These shields were seldom engraved, but George French Angas, in one of his 1844 watercolours, provides an interesting example of one with engravings on its painted surface (Fig. 11). It has what appear to be kangaroo tracks, carved with quartz into the surface between the usual red bands.

Strangely enough the painted designs in this region bear no resemblance to the engraved ones. Curved bands are the most common element in the painted decoration, whereas angular lines predominate in the carving (Fig. 12). The painted designs seem to act as a visual deflector, focusing the eye of the attacker away from the centre of the shield. This would have been a useful quality for these shields in spear fights. Herring-bone, cross-hatching, zig-zag, chevron, lozenge, diamond, interlocking diamond and rhombic forms are the main design elements in the engraved decoration (Fig. 13). The wooden spear-shield in Fig. 14 is a classic example of the zig-zag design. The shield from Mannum (Fig. 6) provides a fine example of the use of the lozenge. There are few figurative motifs in the designs on the early shields, although this seems to have changed with the influence of contact with Europeans. Cooper writes:

> The gradual substitution of a complete range of new motifs for the old was an attempt by Aborigines – now [late 1800s] virtually dependant on European foods and other goods – to win an economic market for their wares. This trend towards naturalism and an increased figurative content has been observed as relatively common in the changing arts of 'conquered' peoples (Cooper *et al.* 1981: 38).

From an examination of the designs on the South Australian Museum's collection of Lower Murray spearthrowers, the majority of the motifs appear

FIGURE 7. Men fighting with clubs and parrying shields, near Point McLeay, South Australia, *ca* 1905. South Australian Museum Anthropology Archives, Chester Schultz collection.

FIGURE 8. Parrying shields, Lower Murray River, South Australia, *ca* 1880. South Australian Museum [left] A2300 (front and back; 96 × 13 cm), A2290 (85 × 9.5 cm).

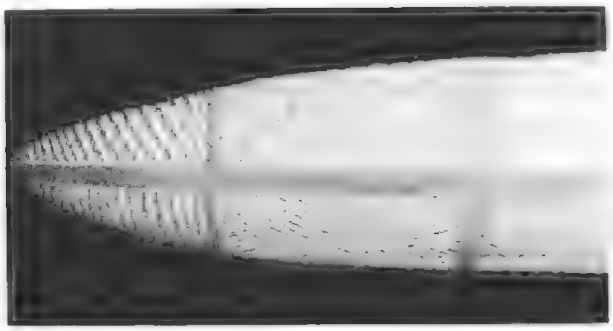

FIGURE 9. Detail of a parrying shield showing engraved designs that appear to have been made with a possum-tooth engraver. Lower Murray River, South Australia, *ca* 1880. South Australian Museum A2298.

to be figurative (Fig. 15). These examples may have all been influenced by European contact. However, for this region there is not enough evidence to reach any conclusions on this issue.

Like other 'traditional' Aboriginal art, the painting and carving of this region most certainly had a personal and social link with the maker. Even though the meanings of the designs of the Lower Murray region have been lost for several generations, the fact that they had a specific meaning and that they belonged to particular groups is still recognised. Henry Rankine, the 1990 Chairperson of Point McLeay Community Council, made this point very strongly in a meeting with South Australian Museum staff in 1987. He was

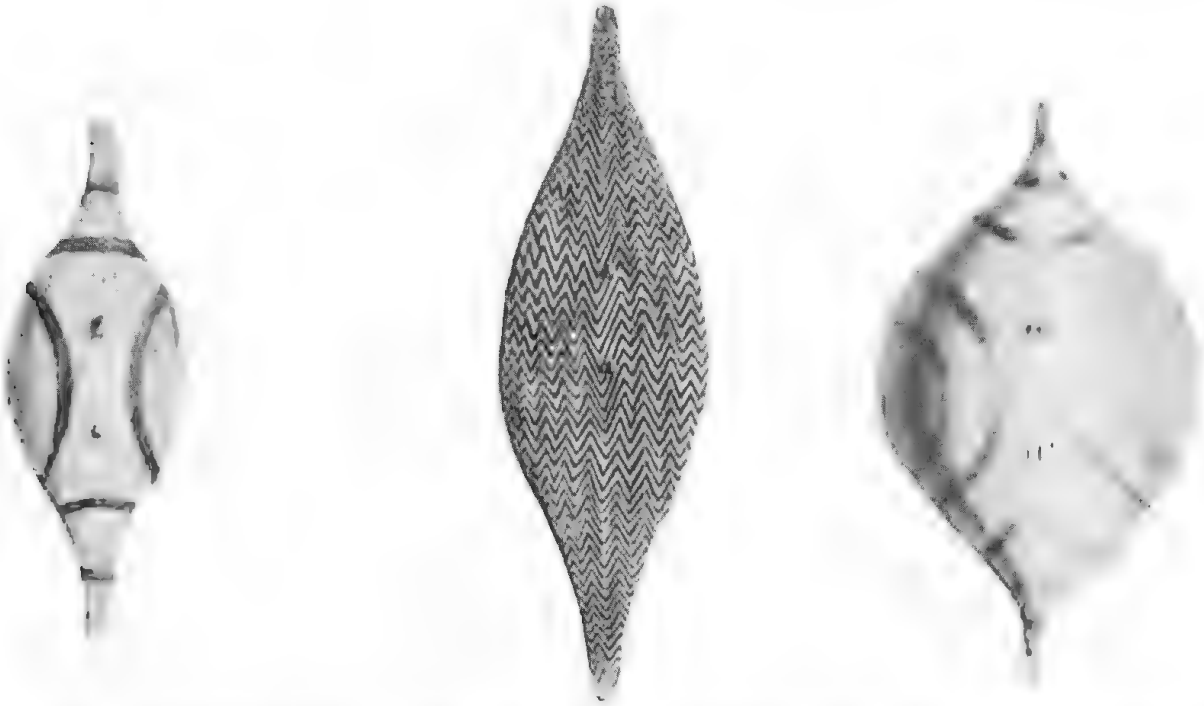

FIGURE 10. Spear-shields, wood [left 2] and bark, Lower Murray Region, South Australia, *ca* 1844. Watercolour by George French Angas. South Australian Museum Anthropology Archives, AA8/10/2.

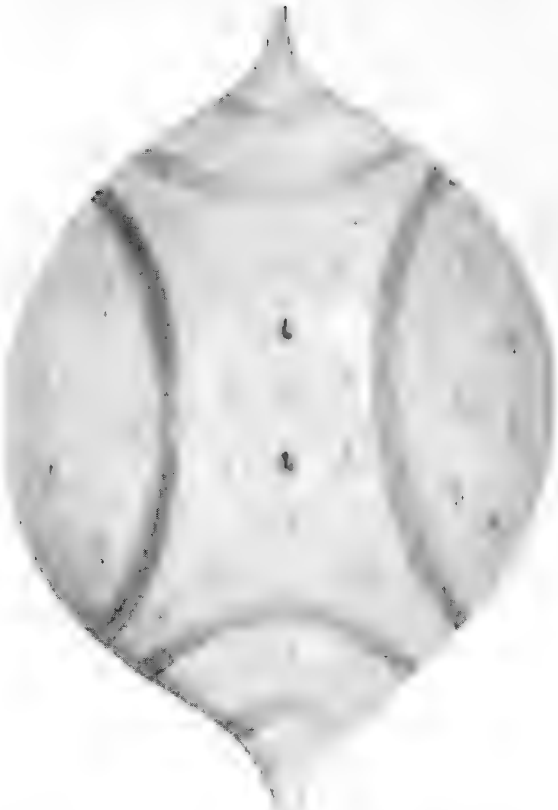

FIGURE 11. Bark spear-shield decorated with painted and engraved designs. Watercolour by George French Angas, *ca* 1844. South Australian Museum Anthropology Archives, AA8/10/16.

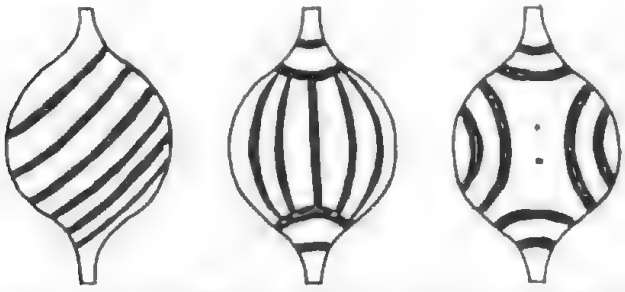

FIGURE 12. Examples of designs on bark spear-shields, Adelaide area, *ca* 1840. (After Stephens 1889).

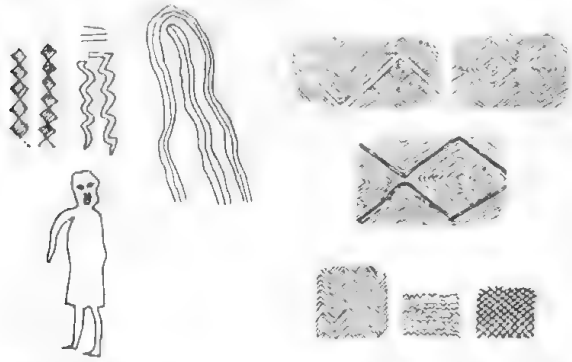

FIGURE 13. Common designs on weapons, south-eastern Australia, mid 1800s. (After Brough Smyth 1878).

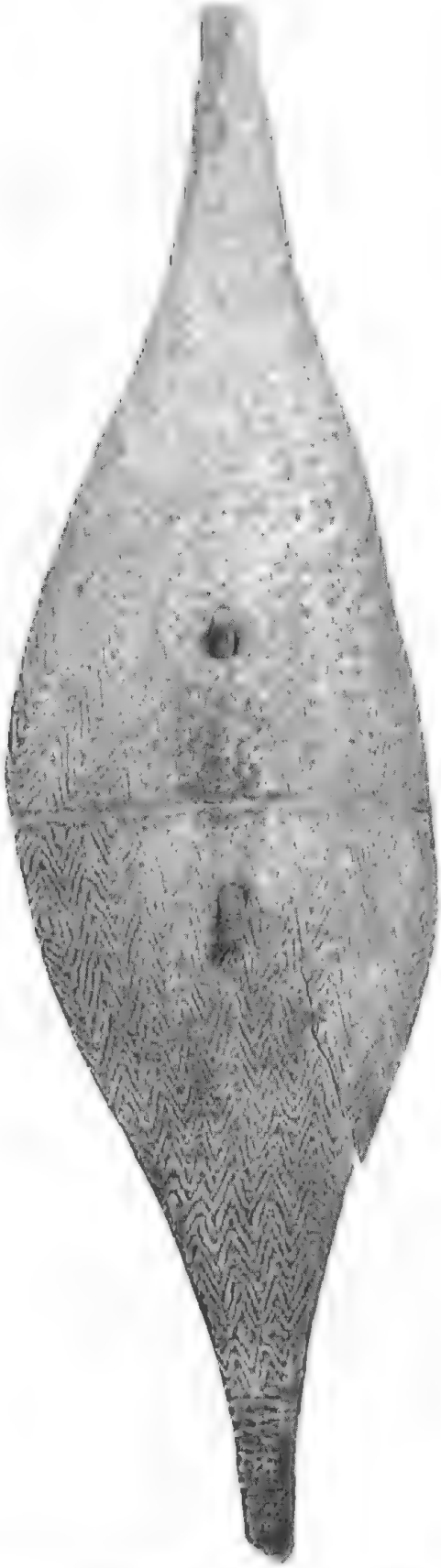

FIGURE 14. Wooden spear-shield, Moorunde, South Australia, *ca* 1850. South Australian Museum, A42736 (94 × 27 cm).

commenting on his grandfather Clarence Long's shield, which was made in the 1930s for Norman B. Tindale, curator at the South Australian Museum (Fig. 16).[6] Henry Rankine knows the area from which his grandfather originated and he argued that the designs on the shield must relate to this place.

Some evidence to assist with the interpretation of the meanings of the designs on the shields from this area can be obtained by comparing information available relating to similar designs in other parts of south-eastern Australia. A mortuary carving made as a memorial for an important Aboriginal man from the Yarra area of Victoria, was capable of interpretation by other members of his group and illustrates something of the meaning of the artwork (Barwick & Barwick 1984: 9–11). It is interesting to note that the designs on one of the spearthrowers in Fig. 15 includes very similar human-like forms to the shapes on this mortuary carving from Victoria. Much the same as the art of the northern Australian bark painting and the Western Desert acrylic, the designs on Lower Murray region shields probably related to the artist's important 'Dreaming' sites.

Survival Of The Shield-Making Tradition Until The 1930s And 1940s

The shield-making tradition of the Lower Murray region continued in a modified form until the 1930s

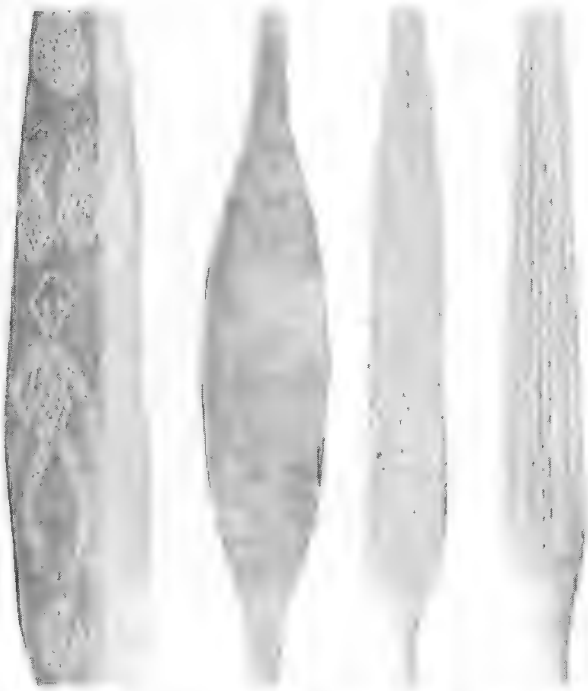

FIGURE 15. Designs on spearthrowers, Lower Murray Region, South Australia, mid to late 1880s. South Australian Museum, [left] A54461, A3998, A3999, A15355.

FIGURE 16. Bark spear-shield, Clarence Long, Coorong, South Australia, 1932. South Australian Museum, A17537 (67 × 26 cm).

and 1940s. Of the designs used to decorate the shields, the painted designs used on the bark spear-shields appear to have survived the longest. Clarence Long's South Australian Museum examples are probably the last to have been made (Fig. 16).[7] He also made a parrying shield in the early 1930s which was obtained by the Museum in 1979 (Fig. 17). It is not decorated and gives a good indication of the period when carved designs were no longer used. Clarence Long was an initiated man, one of the last for the area, and if the intricate engraved designs used on the wooden shields had not been forgotten by the 1930s, then men like Clarence Long had made the decision that they could no longer be used, perhaps due to their 'sacred' nature. Lindsay Wilson, a Ngarrindjeri man, remembers as a child helping Clarence Long with artefact making at Point McLeay. He remembers Clarence Long burning the design of an owl onto shields that he sold to tourists brought to Point McLeay on paddle-steamers. In Tindale's 1937 film on basket making the owl is identified as being Clarence Long's

FIGURE 17. Clarence Long [left] holding a parrying shield and Gollan Seymour, Point McLeay, South Australia, *ca* 1933. South Australian Museum Anthropology Archives, AA326.

ngaatji or totem (Tindale 1937). An engraved boomerang (A66883) in the South Australian Museum's collection, made in the early 1930s by another Point McLeay man, Gollan Seymour, is decorated with motifs carved in low relief which were common in that period and are based on the style of designs on the coins of the time (Tonkin 1933–4). They depict the hunting of different animals. Aboriginal people in this period made boomerangs for sale and for use in demonstrations of their famous ability to return when thrown.[8]

To some extent the shield-making tradition survived for as long as it did because of the interest shown by tourists, curio hunters and museums. Bellchambers was a South Australian naturalist who regularly visited the Lower Murray area through the late 1800s and early 1900s. He said the following about the history of weapon making in the area:

> This [the double-pointed fishing spear] was the last of the native weapons to disappear from general use, although it lingered well into the eighties of last century. About that time I saw young fellows training in the use of both light and heavy hunting spears; but, like the longbow of the British, these weapons were now looked upon more as a means of sport. The manufacture of weapons is still carried on in a desultory manner by the survivors [*ca* 1910], more for the purpose of sale to relic hunters (Bellchambers 1931: 21–22).

Lindsay Wilson says that before his time (prior to the 1920s) Point McLeay had a sportsday when spearthrowing and other old skills were tested. This event took place near the old jetty on the shore of Lake Alexandrina. Shields may well have been used during these sporting occasions.

Many of the earliest shields in the South Australian Museum's collection come from the Point McLeay Mission and were most likely being made specifically for sale. Some date back to the period of the first missionary, George Taplin, who founded the mission in 1859 (SA Museum Anthropology Register). This link between the Museum and the region was continued and several parrying shields were obtained for the collection in the late nineteenth century. The unique collection made by Erhard Eylmann in 1900, now a part of the holdings of the Ubersee-Museum in Bremen, provides a clear indication of the styles existing in the area at the time (Eylmann 1900). From an examination of this collection it is clear that men

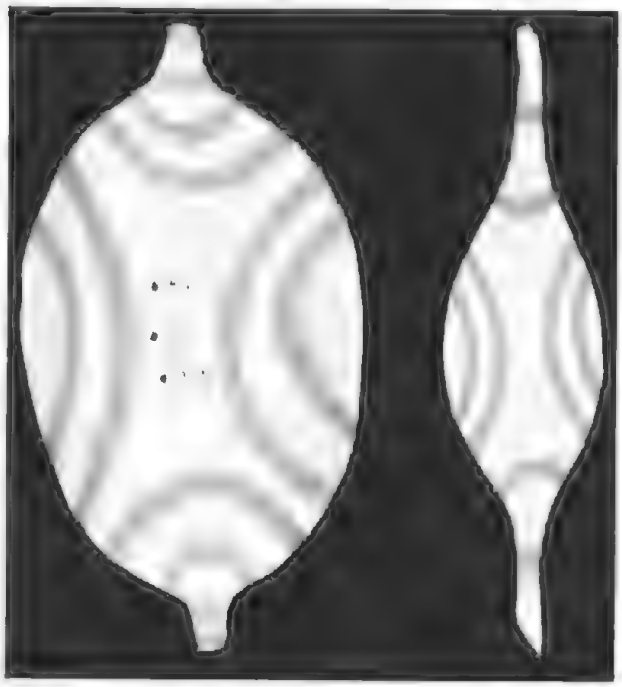

FIGURE 18. Bark spear-shield [left], Joseph Koolmatrie, Point McLeay, South Australia, 1914. South Australian Museum, A1001 (74 × 43 cm).

FIGURE 19. Recent bark spear-shield, Paul Kropinyeri, Mount Barker, South Australia, 1987. South Australian Museum, A65245 (91 × 24 cm).

at Point McLeay were using metal tools to make their shields (Hemming 1986). They decorated them with new, simplified geometric designs and highlighted them with introduced colours like blue.

In 1914 the South Australian Museum acquired one of its few examples of a bark spear-shield. It was made by Joseph Koolmatrie of Point McLeay (Fig. 18). It appears from a letter that he wrote to Edward Stirling, the Museum's Director, that he made it specifically to sell to the Museum (Luebbers 1984: A1001). In the 1930s Tindale acquired two similar shields from Clarence Long (see Fig. 16). These were probably among the last spear-shields to be made in the area until the 1980s. Tindale was anxious to collect examples of the material culture of the Lower Murray area and in the 1930s he worked with several Aboriginal people who were keen to preserve a record of their pre-European culture (Pretty & Tindale 1978: 9). Clarence Long was Tindale's main informant and he made many items for the Museum's collection, based on his experiences in his younger years.

By the late nineteenth century shields had little practical value to Aboriginal people in the Lower Murray region. The traditions that required the use of shields had been destroyed by the impact of British colonisation. A small demand for these objects came from private collectors and museums. However, once the knowledge of the significance of the designs on the objects like shields was lost, and innovations were attempted, this limited market lost interest, with collectors and museums sharing the view that these objects were no longer 'authentic' Aboriginal artefacts.

Revival Of The Shield-Making Tradition

During the 1980s there have been several Aboriginal people making shields in the Lower Murray region. However, this is not a direct continuation of the shield tradition of this area. These artists are all descended from Lower Murray people, but their knowledge of shield-making has almost entirely come from European records of Aboriginal culture or from actually looking at objects in the South Australian Museum. In fact, the collection policy of Museum anthropologists like Tindale has proven to be very useful for people interested in reviving a lost tradition. These wood-carvers bring with them a knowledge of the suitable local woods in their own areas and of wood-carving techniques in general. Clubs for hunting rabbits, and boomerangs usually made for sale, have occasionally been made in the region up to the present day.

John Lindsay, a wood-carver from Gerard Aboriginal Community in South Australia's Riverland, makes small-scale sets of weapons that include shields. He says that he saw one of the old people making these when he was younger and with information he obtained from the South Australian Museum, he decided to try to replicate these sets. In 1983, Colin Cook (the Chairperson of Gerard Aboriginal Community) and John Lindsay contacted the South Australian Museum and asked for information about the material culture of the people who occupied the Gerard area at the time of European contact. They explained that most of the people living at Gerard have no 'traditional' links with the area and that knowledge of the local material culture had almost completely disappeared. They wanted, however, to start making objects that were distinctive to the region. The Museum supplied information gathered by explorers and other early observers and the carvers used it as a guide for making sets of weapons based on the pre-European material culture of the region.[9] Although Lindsay and Cook did not have an understanding of the carved and painted designs on the objects that they were attempting to copy, they still considered that these designs were the property of their original makers. For this reason the artefacts produced during this project were not decorated and it was therefore felt by the carvers that an offence under Aboriginal law had not been committed.

Both Lindsay and Cook had prior experience with making boomerangs and clubs. The techniques that they knew were a combination of the woodcarving skills of their ancestors, the river Aboriginal people and Aboriginal people from the West Coast and north-western regions of South Australia. These different groups were brought together partly as a consequence of the Government, in the early 1950s, moving people from the Ooldea area to the newly formed Gerard Mission. Many of the people who had been living at Swan Reach Mission further down the River Murray had already been moved to Gerard when the former was closed in the late 1940s.

To some extent Lindsay and Cook's idea to produce replicas of pre-European material culture from the Riverland was an attempt to establish a cultural link with the area. They told me that they were often asked about Riverland Aboriginal culture by tourists and other visitors and that they felt a sense of inadequacy in not being able to answer their questions. Making the weapons gave them something tangible connected with Riverland culture to show visitors and members of their own community. However, it also gave them a personal link with the culture of the Riverland Aboriginal people, the prior owners of the land on which Gerard Community is situated.

Paul Kropinyeri, who indentifies as a Ngarrindjeri, is another craftsperson who makes

and sells wooden artefacts. He produces decorated boomerangs and other weapons and has an interest in making replicas of 'traditional' weapons. His particular speciality is the bark spear-shield of the Lower Murray region (Fig. 19). Many of his wood-carving skills were learnt through watching old people when he was young. He has also undertaken considerable research into the old styles and has inspected the South Australian Museum's collection of Lower Murray shields. As a descendant of the people of this region, he has an interest in recreating its weapons and art style. He decorates his bark spear-shields with painted designs based on the classic style. He has also experimented with making parrying shields and wooden spear-shields which are decorated with engraved geometric designs.

The South Australian Museum shop is one of Paul Kropinyeri's main outlets and the principal clientele are overseas and interstate visitors. His shields have also been useful to the Education Department and the Museum's education and information sections have purchased examples for teaching purposes. The Ngarrindjeri community at Meningie, on the shores of Lake Albert, has obtained several of his shields as a cultural resource to be used in discussions about the Aboriginal culture of the area. This community is actively involved in educating their younger people and the general community about Ngarrindjeri culture and history. They run a cultural camp called 'Camp Coorong' which has its own museum and they work in schools and with local community groups. Ngarrindjeri community leaders in Meningie, like George Trevorrow, see shields and other artefacts as being valuable teaching resources and important symbols of Ngarrindjeri culture.

The revival of Lower Murray art and craft has generally been supported by the local Aboriginal communities and there has been a growing sense of pride in these traditions. This attitude has not always been present. In the southern areas of South Australia, from the 1950s to the 1970s, there was a movement of people away from the former missions and rural areas, and into Adelaide (Gale 1972). Economic opportunities and government policies encouraged Aboriginal people to move into the major cities. The pressures that many missionaries had placed on Aboriginal people to give up their own culture were, in fact, being continued in a different form. During this period of 'assimilation', the practice of encouraging the younger generation to be ashamed of Aboriginal culture was continued by the authorities and one result was that few took an interest in the old arts and crafts. Since the 1967 Australian Constitutional Referendum, Aboriginal people have had increased control over their own affairs and through new employment opportunities in State and Commonwealth public services, their views have had a direct effect on government policy. There has been a corresponding growth in the understanding and appreciation of Aboriginal culture in the wider community. Albert Namatjira's central Australian landscapes, Arnhem Land bark paintings and Western Desert art have created an interest in Aboriginal art and this has provided – at least since the 1980s – a growing market for the art and craft of the Lower Murray region. Innovation, however, is still something upon which the majority of potential buyers frown, although, with the 1989 opening in Adelaide of the Aboriginal Cultural Institute (Tandanya), there has been increased acceptance of contemporary urban Aboriginal art and the strength of innovation.

This new interest has been promoted, for example, by exhibitions like Bluey Roberts' (a Ngarrindjeri artist) 'River Spirit Dreaming: The Art of Bluey Roberts' (Aboriginal Cultural Institute 1990). As part of this major exhibition he produced a large-scale piece of artwork featured on the footpath in front of the Tandanya Centre. He is both a painter and a carver and his work most often involves interpretations of his relationship with the environment and the Dreaming. One of his specialities is large boomerangs decorated with incised and burnt designs (Sutton *et al* 1988: 189). In his art he is very conscious of the value of continuing traditions. This is well illustrated by his interpretation of a carved walking stick that he sold to the South Australian Museum in 1985. The handle is a human hand 'hanging on to the culture, . . . hanging on to it as much as I can'. The shaft of the walking stick is a snake, decorated with painted animals, the snake and the animals representing the culture. However, unlike the revival-based activity of making shields, which has only a minor role in present day Aboriginal culture, Roberts' art is a functioning part of contemporary Aboriginal culture. It combines the past with the present and presents a new urban Aboriginal philosophy of life.

Conclusion

In a period when the strengthening of Aboriginal identity is a central concern in south-eastern Aboriginal communities, the revival and development of local arts and crafts is providing one of the foci in this process. This phenomenon has followed several decades in which wooden works by Aboriginal people of this region were largely restricted to hunting clubs, which they used themselves, and returning boomerangs, which they sold on the curio market. The wood-carving tradition in the Lower Murray River region had been

almost totally destroyed by the effects of British colonisation. In particular, the region's style of engraved and painted designs - the 'art' tradition – did not survive, even in a changed form, much past the Second World War. Discontinued first were the intricately decorated objects. Their place was in the religious ceremonies and in ritual warfare. It was these cultural activities that were the most affected by the impact of British colonisation. Consequently, little is known among contemporary groups of the ceremonial body painting style of this area, the decoration of ceremonial objects, or the meaning of the designs on the weapons such as shields.

In 1990, however, there is a growing number of Aboriginal artists working in the Lower Murray River region. Some like Bluey Roberts are gaining Australia-wide recognition. It is in the area of contemporary urban art, rather than in the production of 'traditional' artefacts like shields, where the most significant impact on Lower Murray culture is occurring. In the 'new' art tradition important contemporary issues are being explored such as urban Aboriginal identity. Artists who make shields do so mainly for a restricted educational market and for museum and cultural centre collections.

Acknowledgments

Much of the information gathered for this paper resulted from research and fieldwork associated with the development of the South Australian Museum's *Ngurunderi* exhibition. During this period of several years I have been taught about Lower Murray Aboriginal culture by many Aboriginal people. I wish in particular to thank Henry and Jean Rankine, George, Tom and Ellen Trevorrow, Ron Bonney and Lola Cameron-Bonney of Kingston, Lindsay Wilson, Bluey Roberts, and Doreen Karlinyeri who works with me at the South Australian Museum. John Lindsay, Colin Cook and Paul Kropinyeri, the contemporary artists mentioned in this paper, have also been very helpful.

Philip Clarke has been working with me on Lower Murray Aboriginal culture for several years and his expertise in the area of ethnobiology has been particularly valuable. I am grateful for comments on various drafts on this paper made by Philip Clarke, Robert Foster, Chris Anderson, Peter Sutton, Leonn Satterthwait and John Stanton.

The photographs of specimens were taken by Michael Kluvanek.

Endnotes

1. This paper is an expanded version of a section of Survival, Regeneration, and Impact (Chapter 6) in 'Dreamings: The Art of Aboriginal Australia' edited by Dr Peter Sutton.

2. Professor R.M. Berndt and Dr N.B. Tindale have both carried out detailed research with the people from this region. They generally agree on the names of the groups of people occupying this area at the time of contact, i.e. Tangane, Yaralde etc.

3. I borrow the label 'Old People' from Ngarrindjeri people today who use it in a number of ways. Sometimes as a term for today's older Ngarrindjeri people, but also, very often, for the people who lived according to the traditions of the pre-contact Aboriginal culture.

4. This information is included on a label for a shield in the Eylmann collection held in the Ubersee Museum in Bremen, West Germany.

5. Perhaps the most important mine in the region was at Ochre Cove, near Port Noarlunga. The root mentioned by Stephens has been tentatively identified in a recent article as *Drosera whitakeri* (Clarke 1987: 67).

6. Dr Norman Tindale worked at the Museum until his retirement in 1965. He gathered extensive information about the culture of the people of the Lower Murray area in South Australia. Much of this information will be presented in a book he is working on about the Aborigines of southern South Australia and it features the life of Clarence Long, his main Aboriginal informant.

7. Clarence Long made two bark spear-shields for the South Australian Museum's collection, A17537 and A17538.

8. In the late 1930s and early 1940s Professor Ronald Berndt worked with Albert Karloan, an initiated man of the Yaralde people of the Lower Murray region. In conversations with Berndt he describes Karloan's shame at having to give boomerang throwing demonstrations to tourists as a means of making a living. It is ironic that many Ngarrindjeri people today remember Albert Karloan for his skills at throwing the returning boomerang, not for his great knowledge of the Aboriginal culture of the Lower Murray area. This will no doubt change with the publication, jointly with Karloan, of Berndt's book on Yaralde culture (Hemming, personal correspondence).

9. Provision of the information sought by John Lindsay and Colin Cook was organized at the South Australian Museum by Graeme Pretty, Curator of Archaeology.

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LOCATING ABORIGINAL SITES : A NOTE ON J. G. REUTHER AND THE HILLIER MAP OF 1904

L. A. Hercus & V. Potezny

Summary

This paper provides a critique of the detailed map of Aboriginal sites in the eastern Lake Eyre region which was prepared by H. J. Hillier at Killalpaninna Mission in 1904. Research has shown that while most of the 2468 named sites can be connected with recorded mythological events, the map cannot be used satisfactorily as a topographic guide to these sites unless supplemented by Aboriginal traditions. This principle is illustrated by specific examples drawn from fieldwork undertaken by the authors.

LOCATING ABORIGINAL SITES: A NOTE ON J. G. REUTHER AND THE HILLIER MAP OF 1904

L. A. HERCUS & V. POTEZNY

HERCUS, L. A. & POTEZNY, V. 1991. Locating Aboriginal sites: a note on J. G. Reuther and the Hillier map of 1904. *Rec. S. Aust. Mus.* 24(2): 139-151.

This paper provides a critique of the detailed map of Aboriginal sites in the eastern Lake Eyre region which was prepared by H. J. Hillier at Killalpaninna Mission in 1904. Research has shown that while most of the 2468 named sites can be connected with recorded mythological events, the map cannot be used satisfactorily as a topographic guide to these sites unless supplemented by Aboriginal traditions. This principle is illustrated by specific examples drawn from fieldwork undertaken by the authors.

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The Lutheran missionaries on the Lower Cooper Creek, South Australia, made a major contribution to the knowledge and understanding of Aboriginal mythology and sites in the Lake Eyre basin. The best known work emanating from Killalpaninna is the vast manuscript written by Pastor Johann G. Reuther around the turn of the century, now available in the translation by Scherer in microfiche edition (Reuther 1981). Practically all the thirteen volumes, even the dictionary, have references to place-names and to sites. Particularly important from this point of view are Volume X which deals with mythology and the two volumes (XII and XIII) on the famous *toas* or so-called 'direction posts' (Jones & Sutton 1986). The bulk of the information on place-names is to be found in Volume VII, which contains 2468 entries.

Nearly all the 2468 place-names listed by Reuther in Volume VII were added to the then current 1: 500 000 map by Henry J. Hillier who arrived at Killalpaninna in 1894 and subsequently became the mission schoolteacher. Hillier and Reuther had the great advantage that in their day Aboriginal geographical knowledge of the north-east of South Australia was intact: older people who had come to Killalpaninna from different parts of the region all knew their respective 'country' in minute detail. They were obviously willing to give information. R. B. Reuther described to Tindale (Jones & Sutton 1986: 52) how his father, Pastor Reuther, only had to go out to the nearest sandhill and call 'Cooee' and 'half an hour afterward you'd see all these old fathers come in', and 'they would be talking about one word for a terrible long time'. So with accomplished speakers who contributed all the information for the work, Reuther (in collaboration with C. Strehlow), produced a translation of the New Testament into Diyari (Reuther & Strehlow 1897), he produced grammars and a voluminous Diyari dictionary, as well as an annotated list of personal names, the two volumes of descriptions of *toas*, and comments on the places to which these objects refer. Hillier produced the map which is now held in the South Australian Museum Anthropology Archives (AA263) (Fig. 1). It looks as if we could simply go out and follow the map, use the information from the volumes and locate all the important Aboriginal sites in the north-east of South Australia. This would be a remarkable step forward, in terms of knowledge and conservation of sites. Future maps of the region would have a significant Aboriginal content. Unfortunately this is too good to be true.

The aim of the present paper is to show that matters are not so easy for the following reasons:

1. There are internal inconsistencies and inevitable inadequacies in the various volumes of the Reuther manuscript. Specialised knowledge, found only in Aboriginal traditions, is necessary for their successful interpretation.
2. There are practical difficulties which in most cases make it impossible to locate sites from the map.

INTERNAL INCONSISTENCIES

The place-names volume is of quite a different order to the volume on mythology. Volume VII gives explanations of the place-names usually based on the day to day activities of minor ancestors — where they saw particular plants growing or hunted for various animals, noticed tracks or made sundry comments. Volume X however, deals with major myths or sections of myths, and there is very little

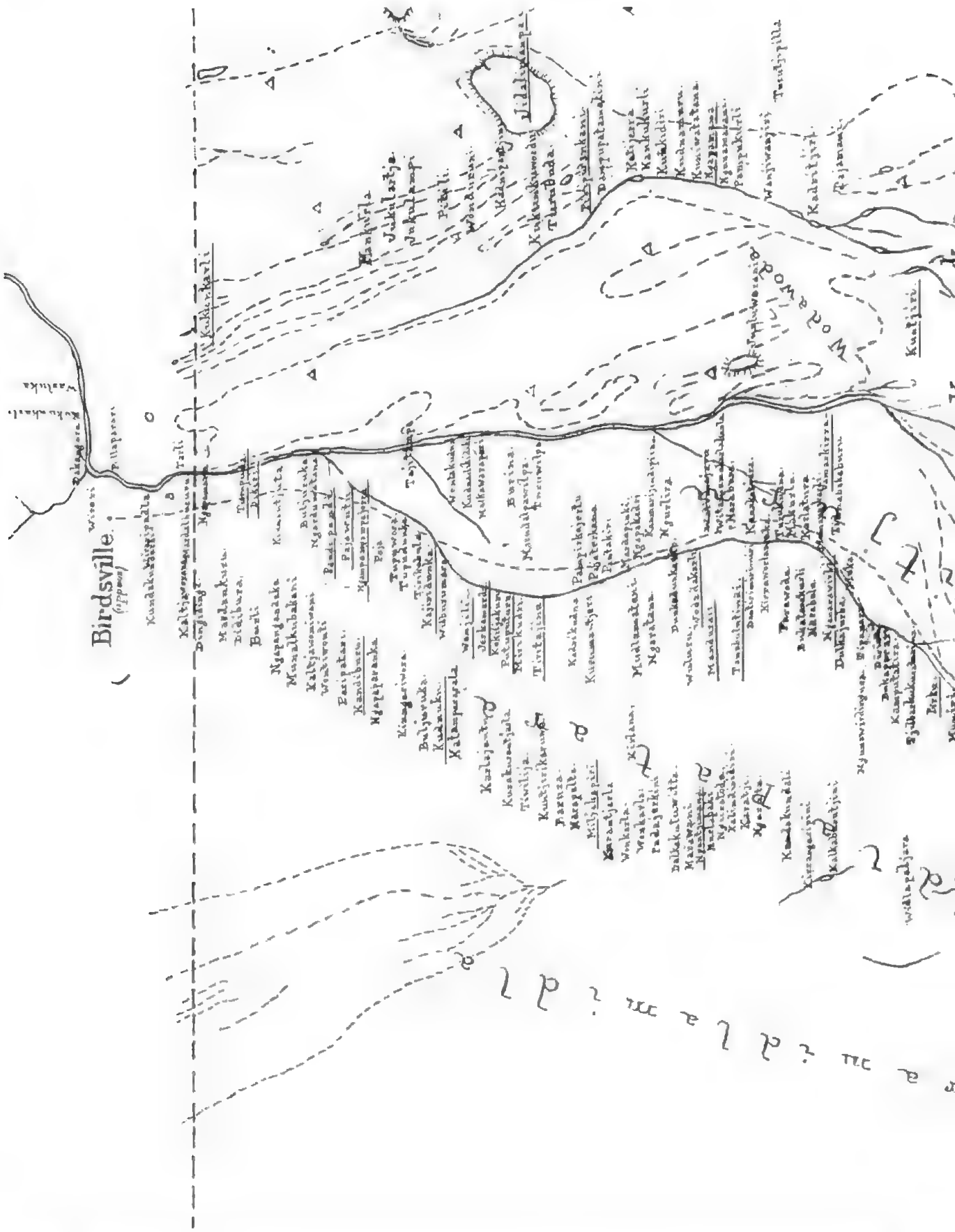
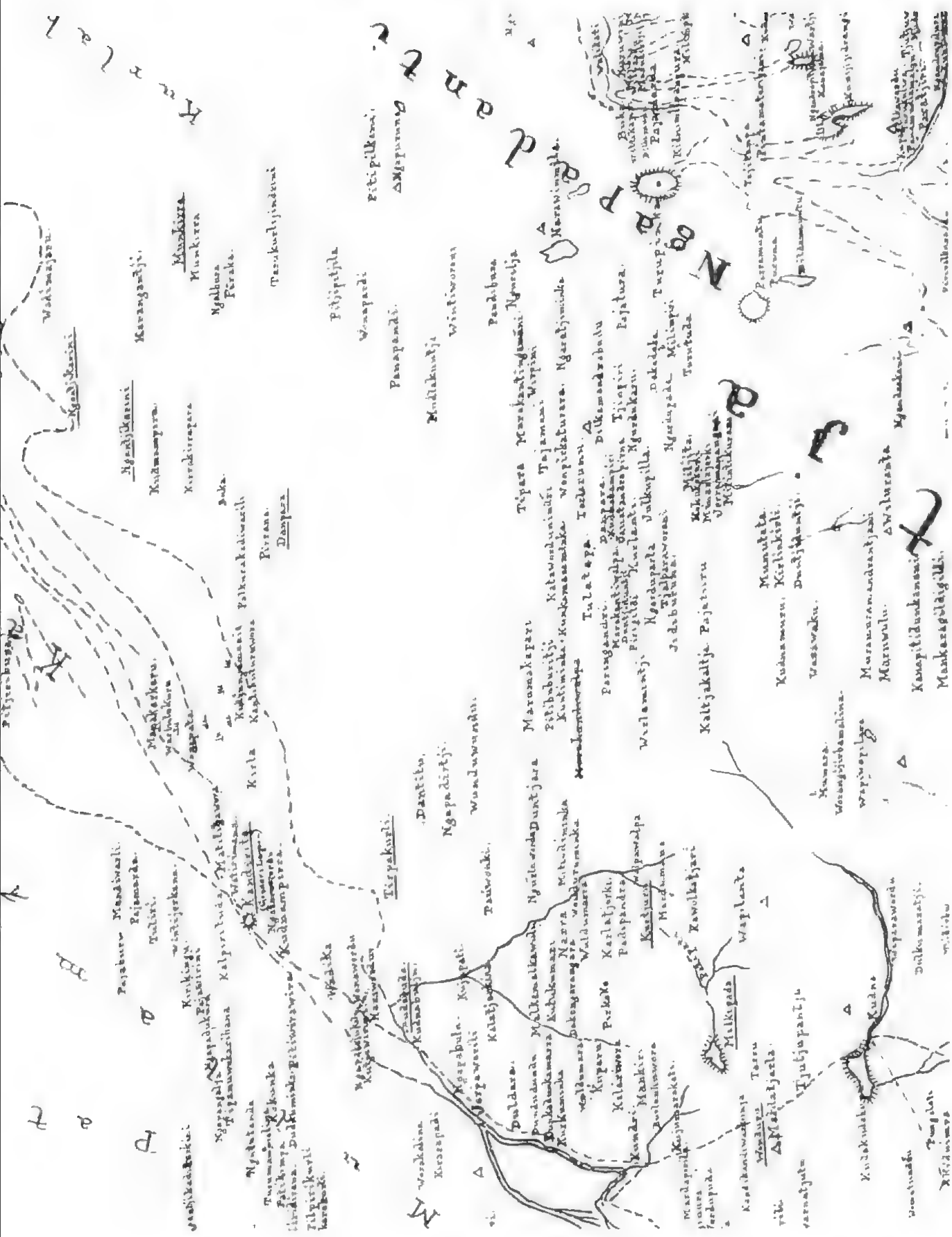


FIGURE 1. Detail from H. J. Hillier's 1904 map of Aboriginal place-names in the eastern Lake Eyre region. Underlining indicates that the site has been located, as identified in Fig. 2. S.A. Museum AA266.



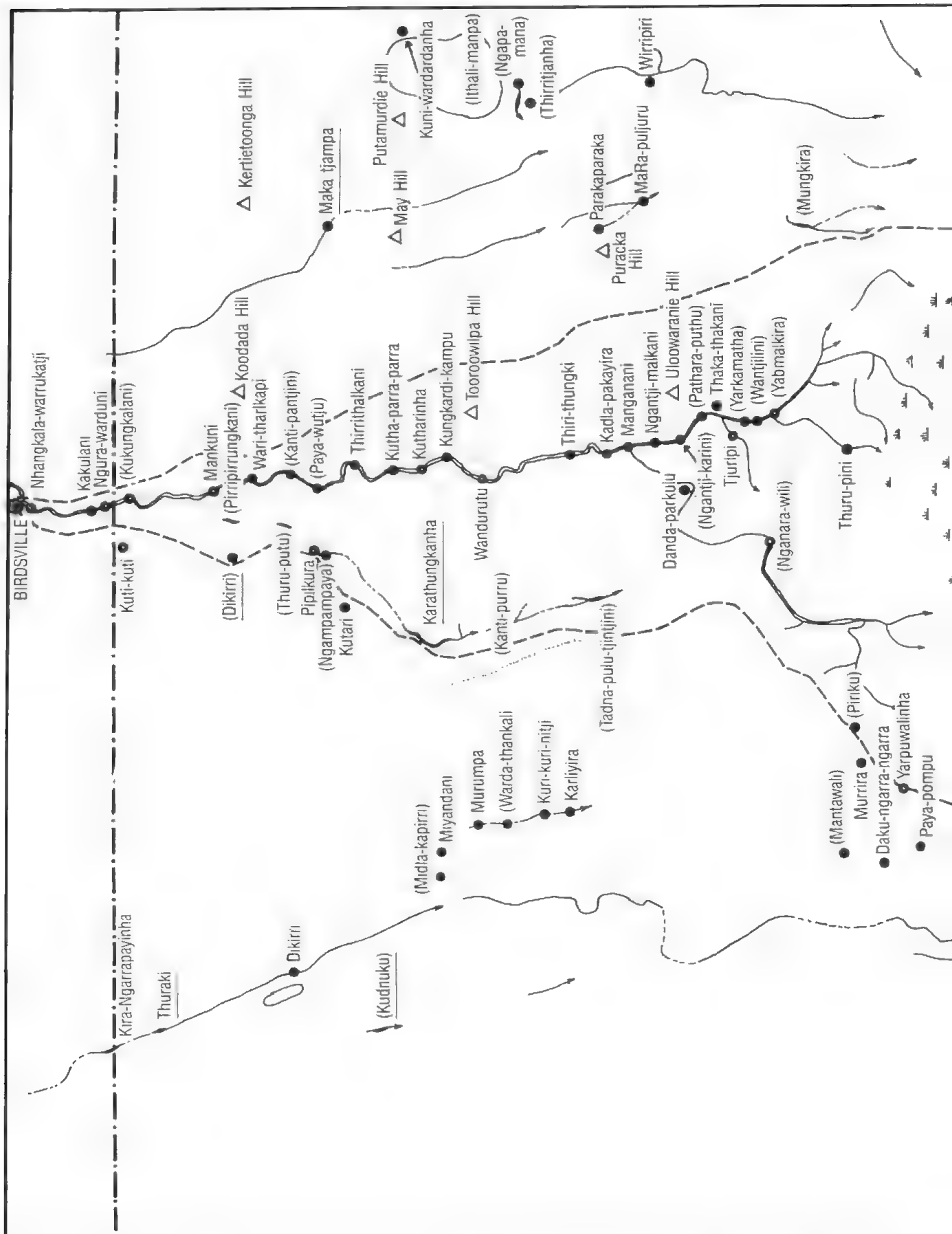
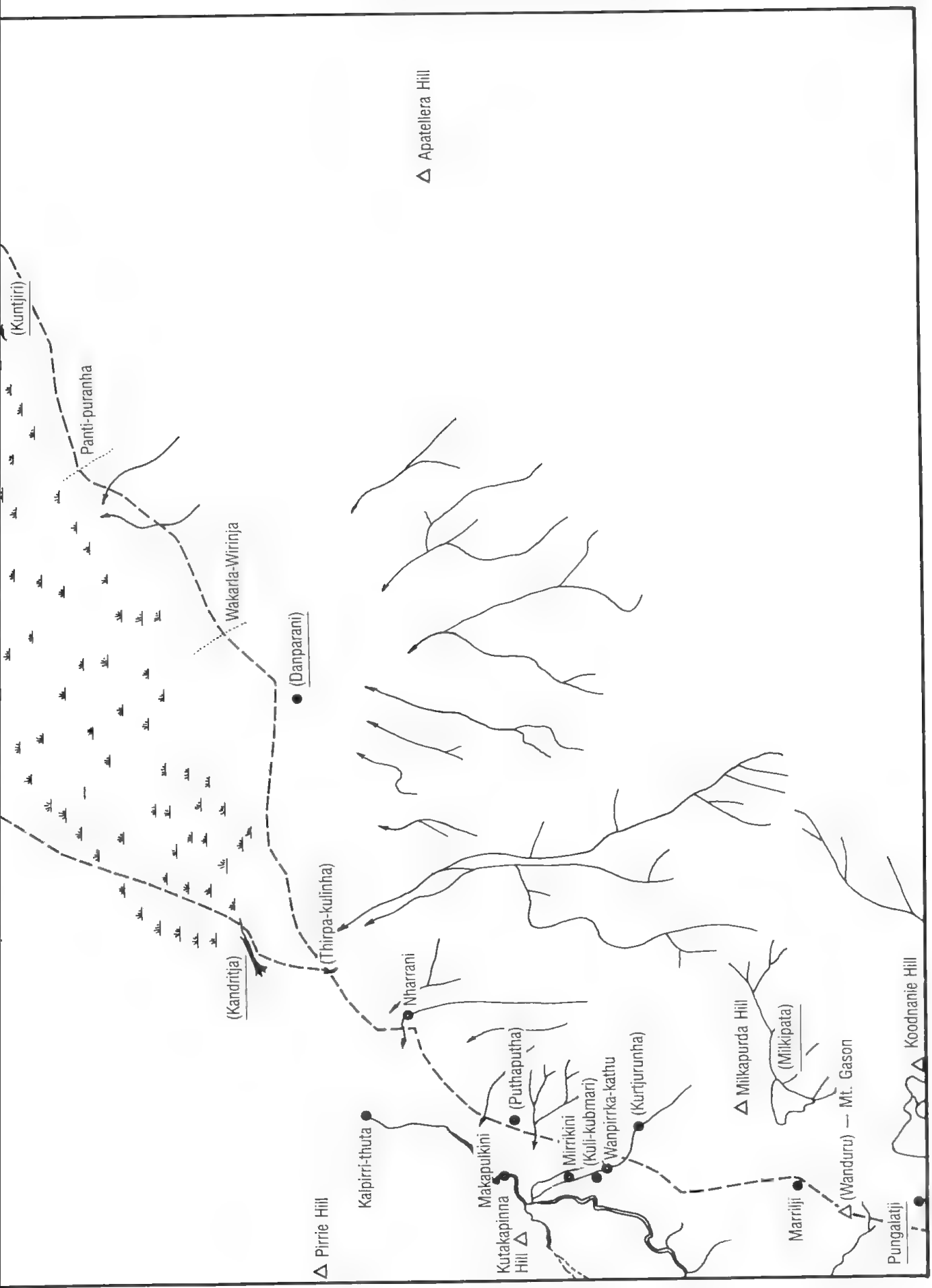


FIGURE 2. Aboriginal sites from Hillier's map (Fig. 1), as fixed in correct locations by Hercus and Potezny. Brackets indicate sites referred to in this paper. V. Potezny, 1989.


Apatellera Hill
(Kuntjiri)
Panti-puranha
Wakarla-Wirinja
(Danparani)
(Kandritja)
(Thirpa-kulinha)
Nharrani
(Puthaputha)
Mirrikini
(Kuli-kubmari)
Wanpirrka-kathu
(Kurtjurunha)
Milkapurda Hill
(Milkipata)
Koodnanie Hill
Mt. Gason
(Wanduru)
Marrilji
Pungalatji
Kaipirri-thuta
Makapulkini
Kutakapinna Hill
Pirrie Hill

connection between the two volumes. This disjunction can best be illustrated by two examples.

1 The story of the Erotic Green Snake

One of the stories told in detail by Reuther in the mythology volume is that of a Snake Ancestor whom he calls 'Marikilla', (Volume X: 114–123). This is equivalent to *marrakila*, the Diyari word for 'green snake', *Pseudechis australis* (Johnston 1943: 290). Reuther also gives this Ancestor the names 'Ngaltimpara', and 'Ngurapata'. There is very little in his text that gives us an idea of location; only four places are named:

1. 'Ngamara', 'a tall and stout tree', which is said to be far away to the north.
2. 'Burinapalkitutu', 'first to lie down and then to go on', where he left his mob behind.
3. 'Mudlakubmari'
4. 'Warankirpamalini' or 'Warangijirthamalina'.

Of these four only two appear in the place-names volume. The first is 'Ngamara':

No. 1443 'Ngamara' Judlajudlanja.
Meaning 'thick bush, scrub'.
This is the name of a district. It is mainly overgrown with trees and shrubbery, wherefore it has acquired the above name. This area is the Province of the Kankuwulana.

The translator (Scherer) has added a comment on 'Kankuwulana': 'this is Reuther's first reference to this tribe'.

'Kankuwulana' however is not the name of a tribe; it is a Diyari word, *(kanku-wurlanha* in P. Austin transcription, Austin 1981) and it means 'the two boys'.

The second Green Snake site to appear in the place-name volume is 'Mudlakubmari'. This name means 'nose-blood' in a mixture of Wangkangurru and either Diyari or Ngamini: *kubmarri* is Wangkangurru for 'blood', but *mudla* 'nose' is Diyari and Ngamini. There are two entries for this. No. 1069 is said to be from Wangkangurru and refers to the Ancestor 'Palungipina' beating his two sons to death. 'Palungupina' belongs to the Simpson Desert and to Pirlakaya Well in particular. The entry seems to have no locational relevance to the story of Marakilla. There is also no. 914 which is said to be in Diyari country and again has no evident connection. It refers to the Ancestor Darana's dog having a bloody nose from digging a hole.

The combined evidence of Reuther's volume on myths and the list of place-names therefore leaves us with no proper location. Even with the combined evidence of Volumes VII and X and the Hillier map we remain quite unable to relate the story of Marikilla to the landscape.

There seemed no hope of learning more. The story belonged to Ngamini people, and Dinta, the last traditionally knowledgeable Ngamini, had died in Marree in 1964, shortly before L. Hercus's first visit. Fortunately however three Wangkangurru people knew the myth of what they called *Kurkari*, the ancestral Green Snake. *Kurkari* is simply the Wangkangurru name for the species of snake that was called 'marrikilla' by Reuther's Diyari informants. Mick McLean, a senior Wangkangurru man, had heard the myth from Dinta and from another old Ngamini man called Pinmili, while Linda and Frank Crombie had learnt it long ago from old people at Pandie Pandie Station. Their story clearly belonged to the same tradition as the story of Marikilla written down by Reuther at the beginning of the century. There are however three major differences. In the first place, the Wangkangurru speakers evidently did not know those northern traditions that form the beginning of Reuther's version. Secondly, their recitation was much more lively than Reuther's version, and lastly, in contrast to Reuther's version it relates the story directly to the landscape.

Mick McLean and Linda Crombie at an interval of 18 years, told the same story almost verbatim. Both spoke in Wangkangurru, and direct speech was kept in Ngamini. In translation the Wangkangurru version is as follows:

Kurkari the Green Snake and a companion (who left him after a while) came from far away to the north, from near the Toko Range, where they had been initiated. *Kurkari* travelled south via Annandale and followed the Georgina down to Goyder's Lagoon. He went on to the area near Two Wells *Kuturunha*. This was the country of the Goanna people. The big Old Man Goanna was resting in *Wampirka kutu* 'Goanna Shelter', also known as 'Slippery Swamp', while the main camp was by the small watercourse that comes in from Two Wells. *Kurkari* lay down to rest in a sheltered place with a few coolibah trees, a site which Mick McLean called *ThuRamani*. It is an unusual little grove, being right alongside a sandhill which Linda calls *Kuti-Kubmari* 'Swan Blood'. Two boys from the camp played around on this sandhill throwing boomerangs, picking them up again and then throwing them again. One of them threw his boomerang into the little grove and just hit *Kurkari's* nose as he lay there: green snakes still have a peculiar-looking snub nose. As the boys came to pick up their boomerang they saw *Kurkari* there with his strange face and huge long hair — said to be at least four metres long — holding their boomerang in his hand. Terrified, they ran away. He called out to them in Ngamini:

Kanku-kuli,	*kanku-kuli*	*nganji*	*karna!*
Boys-two,	boys-two	I	man!

Wata parnda-nu nganu!
Not afraid-ERG he!

'Eh you two boys, eh! I am a man! Don't be frightened of me!'

They ran and ran, and he came running after them, still calling out and still holding their boomerang. The boys didn't look back and when they got home they told everybody that a strange-looking creature had arrived, *nhuyu, nhuyu thutju!*

Kurkari slowed down, still following them. He came to the top of a sandhill, and looked down on the Goanna camp. In the evening the Goanna people had a big ceremony with beautiful girls dancing. *Kurkari* became infatuated with two of the girls. As he sat there on the sandhill he swallowed his spittle and his eyes went white (a standard description of extreme lust) as he watched them dancing. This was at Two Wells, *Kutjurunha*. *Kurkari* called out to the two girls in their language, Ngamini:

Nganji mankarra kapukapu ngalthimpara
I girl seeking bachelor
warritha-ngundu nganji nhuwa kapukapu
afar- from I wife seeking
wapa-rna warayi.
come-participle auxiliary.

'I have come from afar, as a bachelor seeking a wife!'

Nobody took any notice of him, so he called out to the two boys that he had seen before:

Kardi-maru-yi!
Brother in law-pair-emphatic!

'Eh, my two brothers in law!'

They answered:

Wibma ngalki-tha!
Corroboree dance-fut!

'We are having a corroboree!'

They were asking him to come and watch the corroboree. He answered:

Ah! nganji kuthari-yi!
Ah! I being tired-present

'I am too tired!'

Kuthari-yi nganji wap-rna warayi
Tired-present I come-participle auxiliary
mankurra kapukapu ngalthimpara
girls seeking bachelor.

'I am tired, I have come from afar, a bachelor looking for girls!'

Nobody else paid the slightest attention to him. They all went on with their ceremony. *Kurkari* knew the women would have to go down to a small waterhole to get water the next day, so overnight he started to dig a tunnel beneath the track leading there, and he lay hidden there. The next day people from the camp all came to get water. They came and went, they made many trips. He watched them and he watched the sun. The two girls he fancied were the last, they came on their final trip near sundown. He crawled out of the tunnel and as they came he grabbed them. He tied them up with his long hair and carried one on his head and one on his back. He put a spell on them to lull them to sleep, and carried them off to *Milkipatanha* Swamp (Lake Milkapurda).

The spell made the older girl go to sleep altogether: she died, leaving just *Kurkari* and the younger girl, but she too died at the Swamp, suffocated by his long hair. Before the two girls died *Kurkari* had a tremendous time. It was too much for him and he collapsed[1]. All three are still there as a set of rocks in the *Milkiputanha* swamp. According to Linda Crombie one large red rock, which represents the Erotic Green Snake, looks like a man lying down with one knee bent upwards. His long black hair is also visible as black soil among the rocks. Anyone suffering from baldness can go there and rub himself with some of the soil and it is said that he will grow luxurious hair like *Kurkari's*. The girls are there, in one version as rocks and in another as prickly *ngama-ngama* bushes. *Kurkari* ultimately revived. He left the swamp and ended up as a rock on the west bank of the Diamantina at *Makupulkini*, after he had 'lost all his front part' on account of his activities.

This myth was one of the most popular among the people on the eastern side of Lake Eyre. P. Austin recorded a brief outline of it from Leslie Russell, a Wangkangurru man who also spoke Diyari, in 1974. The songs that originally belonged to the myth have been lost, except for the five lines transcribed by Reuther in his version of the story. There was however, at the turn of the century, an old man at the Killalpaninna Mission who was in spirit transported to important places in the Lake Eyre Basin and was 'given' songs about them. He in turn passed the songs on to Leslie Russell and his brother Jimmy who sang them in the 1960s. One of the verses belongs to the Green Snake. It contains the Diyari word *kapirri* 'goanna' and the phrase *minha thutju* ('what serpent is this'), identical in Diyari and Ngamini, uttered by the terrified Ngamini Goanna-boys.

Kapirreré	Goannas (say)
Aminhanga thutjungera	What serpent is this?
Minhangera thutjungera	What serpent is this?
Kapingere nginée	Goannas indeed
Minhangera thutjungera	What serpent is this?
Kapingere ringerée	Goannas indeed
Minhangera thutjungera	What serpent is this?
Kapirr . . .	Goanna . . .

Reuther's version of the myth and that told to L. Hercus by Wangkangurru people sixty years later corroborate and elucidate each other in many ways. For example, the alternative names given by Reuther to the Green Snake become meaningful in the context of the Wangkangurru story. 'Ngurapata', which means 'camp in wet sand' in both Wangkangurru and Ngamini, derives from the fact that *Kurkari* lay in an underground tunnel near the waterhole. The alternative name 'Ngaltimpara' also becomes clear. The ordinary common noun 'ngalthimpara', 'a young unmarried man in search of a bride' — which is what *Kurkari* says about himself over and over again — was evidently interpreted by Reuther as a proper name. This process is very common in the Reuther manuscript: many of his names for Ancestors are either nouns describing them or nicknames derived from what they say. The expression 'ngaji ngalthimpara', 'I am a bachelor', is the exclamation most associated with *Kurkari*. The Ancestor 'Ngaltimpara' is linked by Reuther with Lake Milkapurda.[2] There are even two toas (105 and 178) belonging to 'Ngaltimpara'. These toas lead us to places, 'Karlatjerkini' and 'Dakungarangaranni', both of which appear on Hillier's map a short distance north of 'Kutjuru', i.e. Two Wells. 'Dakungarangara' (*Duku-ngara-ngara*, 'sandhill heart'), 'the heart-shaped sandhill named by Ngaltimparana' is noted a short distance north-west of Karlatjerkini. Both are in the Two Wells area and confirm the location of the myth as told by Wangkangurru people.

Some of Reuther's comments in the place-names volume intermesh with the traditions recorded from Mick McLean and the Crombies. Thus Reuther's 'Judlajudlanja' tribe could immediately be identified once we learnt from Mick McLean that *Kurkari* came from near the Toko Range. This is the country of the northern group of Wangkamadla people, who, as shown by Breen (1971: 7) are referred to as Ulaolinja, Ulla-la-linya and Yoolalnanya by Roth (1897), Curr (1886–87), W. G. Field (1898) and R. H. Mathews (1898) respectively. Tindale (1974) calls them Julaolinja. 'Judlajudlanja' is a German spelling for the same name, with the prestopped *l* (i.e. the pronunciation *-dl*) which a Wangkangurru or Diyari speaker would have used.

The mysterious comment by Reuther that the area from where the Green Snake came was 'the Province of the Kunkuwalana' (Diyari *Kunku-wurta-nha*, 'the Two Boys') makes sense in the light of the Wangkangurru traditions recorded over the last few decades. The long myth of 'the Two Boys from Dalhousie' goes through Sandringham and Glenormiston. There are major Two Boys sites on Sandringham, and the main ritual centre was *Ithapuka*, Ethabucca Spring, about 60 km north-west of Sandringham.

The elucidation is not all one way. The story as told by Reuther has a much more elaborate beginning: it relates the myth of the Green Snake to Central Australian creation mythology and gives an added perspective of depth.

ii The story of 'Minalajerkina', the Ancestor who made bags

Reuther's place-name entry no. 1932 reads as follows:

> *Tirpakurli*, Ngam.
> *Tirpa* in D. = *kajiri* = 'creek, watercourse'; *kurli* in D. = *mandru* = 'two'. Meaning: 'two creeks'. Marumakapurini discovered two creeks here between the hills. He therefore named the place accordingly.

There is no mention of any major myth in connection with this place.

In Volume X there appears the story of the Ancestor 'Minalajerkina'. We are told (p. 57):

> Together with his wife he emerged out of the earth at a place called Narani (= to chase away). The place mentioned is situated on the Salt Creek near the present waterhole of Ngapabulu.

Further down the page we read 'he devoted himself to his main and favourite occupation, making *bilis* [bags].'

There is no obvious connection between the two entries, and on Reuther's evidence we would have little hope of finding the places mentioned. Tirpakurli is shown, but Narani does not seem to appear on the Hillier map. The name 'Ngapapulu' is given in a location just north of Jarpawarili, i.e. the Yelpawaralinna waterhole south-east of Clifton Hills, some considerable distance away.

Aboriginal traditions can however help us out of this dilemma. In 1969 the late Mick McLean took Graham and Luise Hercus to a double waterhole in Goyder's Lagoon. He named the place *Thirpa-kuli* and he showed us the ruins of the Old Lagoon Homestead close by. He took us to another channel, not far away to the east, to a waterhole which he called *Nharrani*, 'Seven Mile'. This was a place of special significance to him, because it was there that he had taken part in the big Mudlungga ceremony in 1901 (Hercus 1980). The descriptive detail given by Reuther is misleading: there are no hills anywhere in the vicinity. *Thurpa-kuli* is right in Goyder's Lagoon and there is only some slightly raised ground between the channels.

In 1987, long after Mick McLean's death, Frank and Linda Crombie directed Vlad Potezny, Luise Hercus and Philip Jones to the same sites, to *Thirpa-kuli* and to *Nharrani*. Linda is of part Yarluyandi descent and she knows the Yarluyandi Swan History. In this story and song-cycle the Swan Woman gave presents of flour and meat to a man

from *Thirpa-kuli*. He in turn gave her numerous bags that he had made. She did not realise that they contained lizards and poisonous snakes; she put them over her shoulder. The small child she was carrying peered into one of the bags and was immediately bitten by a snake. 'Why is my baby so quiet?' she asked herself after a while — only to find that the child was dead. She cursed the man from *Thirpa-kuli*. The Swan History fits in perfectly with Reuther's myth of 'Minnalajerkina', the Ancestor who made bags. Only Reuther's mention of the waterhole called 'Ngapa-pulu', near *Nhurrani*, remained unexplained. It is tempting to suggest that Reuther learned the myth and got the place-names from eastern Wangkangurru people who used the translation *Ngapa-pula* 'two waters' for *Thirpa-kuli*.

The quality of Reuther's information in other volumes of his great work leaves no doubt that he was an exceedingly careful writer. He painstakingly recorded what he was told, knowing that much of the traditional knowledge he put down would soon disappear. If anything, he lacked imagination: he did not improvise. As shown previously in connection with *ioas* (Hercus 1987), there are inconsistencies between the volumes rather than straight contradictions. The inconsistencies with regard to place-names and mythology are so great that they leave us with only one explanation. Reuther wrote with the kind of dedication and endurance that one would associate with someone who spends 18 years of his life in isolation from the outside world, in the heat and discomfort and often misery that was Killalpaninna, because he felt that this was his duty to God. He went painstakingly ahead. He presumably asked his old advisers — whom he never names (see Jones & Sutton 1986: 52) — and simply wrote down what they told him about one myth. When they finished he did not ask for explanations or implications nor for exact reference to places. He asked for another myth, and then another. He numbered the song verses and put them into a separate book in sequence. Though this book of verses is now lost, information obtained by L. Hercus from the late Mick McLean makes it clear that these verses were numbered in the sequence they were sung — a matter very important in Aboriginal recitation, and they were highly accurately transcribed, but with major omissions. Reuther 'ploughed through' the material he was given. This is how he wrote the volume on mythology. When he wrote the place-names volume he presumably asked for names in certain areas — the sequence makes it likely that he would get hold of different groups of people every evening for weeks and weeks and ask them about places in their area, and expect the answer to conform to the formula of his entry:

a. What was the meaning of a place-name? If it was not in Diyari, what would be the Diyari equivalent?
b. Why was it so called?
c. Who named it?

Aboriginal mythology is not an inventory of site-related facts, it does not explain every feature, it highlights important features. It creates a vision: this has been brilliantly described by T. G. H. Strehlow for Akâr'Intjôta in Lower Southern Aranda country (Strehlow 1970: 134). In the same way, looking at the rocky hills near Mt Gason, traditional people with their mind's eye could see that these were the storm people from Coober Pedy arriving from the south. They could look across to Two Wells and see the hills that are the Goanna Girls; they could glance over to the sandhill near the old bore and see the weeping Swan Woman, lost, and carrying her dead baby. There was more than a vision, there was also music: as traditional people looked at the landscape they could hear the songs that belonged there. Back in 1900 those old men had been summoned with a 'cooee' and sat amid unfamiliar surroundings in the study of the meticulous Reuther. Even with all their nostalgia for their own sites they could not have conveyed to him any concept of the vision or the music. He must have gone on asking his three basic questions about place after place. Notwithstanding the fact that he was at Killalpaninna in the first place to stamp out the rituals belonging to the 'heathens', Reuther showed extraordinary esteem and understanding for Aboriginal traditions. Under the circumstances he could not possibly have been expected to discover which places were important for rituals; he could not have been expected to ask for instance whether *Pitikiri* (a waterhole on the Diamantina with a Ngamini name) was a major ritual centre where great ceremonies had been taking place. He simply asked what the name meant, and they told him. If one is making a vast inventory, such as he was, it is equally difficult to discern which things are relatively unimportant. A place need not have a special significance, it need not be connected with any Ancestor. In other words not every named location was a totemic site. Places could simply have names and even if a great Ancestor visited them the name need not have any relevance to him. Those old men were obviously asked about the many places that are not on the direct line of travel of any Ancestor, but were in the general area where such an Ancestor had been. To the question 'Who named it?', there was only one logical type of answer: 'It must have been the Goanna mob', or 'Miritirana's mob' and so forth. It was all detail; the highlighting, the vision and the music had gone, as had the lively humour of the mythology. It is important however, to remember that if it had not

been for Reuther's careful and accurate investigations much knowledge would have been entirely lost.

PRACTICAL DIFFICULTIES

The most obvious practical difficulty in finding places by means of the Hillier map is that with the exception of hills and lakes the names are written on the map, but no actual location point is given. We therefore cannot know what is being named, whether it is a waterhole, a small claypan, a sandhill, or a swamp. The list of place-names does not always help us here, and can in fact be misleading (Hercus 1987: 63). Sometimes a place-name is shown twice in an immediately adjacent location. In the case of 'Munkirra' for example, one listing represents the Moongara *(Munkira)* waterhole and another is the site of the Moongara swamp. This fact can only be learnt on the ground: there is nothing on the Hillier map to indicate which is what, or why indeed the name appears twice. Moreover, since there is no dot to show the precise point, we cannot know whether the place is to be found near the centre, near the beginning, or at the end of the written name. This makes quite a difference when one is dealing with a 1: 500 000 map; as R. S. Wilson has pointed out in his thesis (1981: 6), a name can be spread over 15 kilometres. It is therefore inevitable that a small site or a buried *mikiri* well in the Simpson Desert would be nearly impossible to find by means of the data on the map.

The second problem is that in the area which was known best to Reuther and Hillier, namely the Lower Cooper and to a lesser extent the Diamantina, the writing is so crowded that the exact location of a place becomes most uncertain, although it is precisely in those areas that the map is reasonably accurate. The further one goes into desert country and the further one goes from Killalpaninna the more inaccurate the locations. The Simpson Desert was largely unexplored by Europeans at the beginning of the century and it is not surprising that Hillier simply gave up here. He has written in a long column of names which are not in any geographical sequence. Recent work in the Simpson Desert makes this clear (Hercus & Clark 1987). Even those names which are not in the big column appear to be random in this area: for instance *Kudlalumba*, 'Karlalumba', which is the northernmost well in South Australia, is shown about 150 km south-west of its correct location. Some places are given twice, both in the column and in the more dispersed listing: 'Jadalnga' and 'Jatalnga' *(Yutalkngu*, the Goanna totemic centre of the western Simpson Desert). It would have been physically impossible to put these names accurately on a map where even the big salt-lakes were as yet not marked. The lower Macumba, the Kallakoopah and the lower Diamantina were also not well known to surveyors. For these reasons it is not surprising that the great Fish and Crane totemic centre at *Payanta*, 'Pajanta', appears on the Kallakoopah instead of the Diamantina, and *Pultjaru*, 'Buldjala', is written some 60 km east of where it should be. Sometimes, though rarely, in Aboriginal traditions two places have the same name, but this could hardly be an explanation for all these highly inaccurate locations. The inaccuracy was inevitable because of the state of non-Aboriginal geographical knowledge at the turn of the century.

The far south-western corner of the Hillier map, where more geographical features were known to Europeans at the time, was a considerable distance from Killalpaninna. Not even the creeks are marked here and we would have no hope of finding any of the places if, for instance, we did not know from the late Mick McLean, Arthur McLean and Brian Marks that *Warliyara*, 'Warlijera' was the Stuart Creek Station waterhole, that *Paparla* 'Head' was a waterhole immediately to the south-west and that *Thidnapirri*, 'Tidnapiri' ('Toenail') shown as some 10 to 15 km away to the north-east was a small waterhole close by; the body parts refer to the story of the Dead Woman from Stuart Creek. We could guess that 'Walkararana', 'She is sorry', refers to the Walcarina Spring, but nothing other than the surviving traditions could tell us that *Urkardu-kurdi-parraparra* 'Ulatukadiparapara' ('Long fruit of the wild melon creeper') was the name of Pound Creek, nor that 'Kudnangamba', 'Guts', was a spring by the North Creek near Curdimurka (Hercus 1976).

In order to demonstrate the difficulties of the Hillier map we will take just a small area which was reasonably well known by Europeans at the turn of the century, namely Andrewilla, south of Birdsville on the Diamantina River. We have compiled a map of sites in this area (Fig. 2) on the information available to us up to date in order to compare it with the Hillier map (Fig. 1). Our information comes from Linda Crombie and the late Frank Crombie who have spent their lives in this country and know it intimately. It was in this general location that the Hillier map was particularly perplexing.

It has been assumed that Hillier based his map on an existing pastoral map, as these were the earliest maps produced of the far north of South Australia to show the distribution of pastoral leases. For this reason a slightly more recent pastoral map of the same scale was shown as the base of a comparative map to show the location of sites documented by Hercus and Potezny. Prominent hills or high spots (indicated by small triangles on

both maps) are in near identical positions on both maps. Prominent hills were accurately located by explorers and surveyors from the earliest days of European colonisation. The most conspicuous difference between the two maps is the outline of drainage indicated on the Hillier map.

The Lower Diamantina in South Australia consists of a main channel with numerous minor channels in a very broad floodplain. The main channel eventually divides before emptying into Goyder's Lagoon, an extensive lignum swamp. Further to the west the channels of what is locally called the 'Georgina' (the lower Mulligan River of the maps) empty into the same floodplain. Access to sites within the floodplain has over recent years been difficult with unseasonal rains and subsequent high water levels. Then, in the dry, access has also been hampered by extensive 'crabhole' country and deeply scoured channels. At the turn of the century travel by Europeans in this area would have been a daunting task indeed. Journeys that now take days would have taken many months with attendant logistical problems. We can therefore take it for granted that neither Hillier nor Reuther could have had the time or means to visit the majority of places around Andrewilla that are listed on the Hillier map.

The Crombies pointed out and named numerous places from a distance. On account of their uncertain location, these places have not been included on our map. In order to establish a solid basis for comparison only sites whose position is accurately known are listed. Because of difficulties of access the only portion of the Diamantina that has been mapped in any great detail is the western side of the main channel for some 15 km south from the junction of the Andrewilla channel. This has produced virtually a name for each bend of the river, and most of the prominent dunes and waterholes on minor channels. From information on sites which have not had their exact locations verified, it appears that a corresponding density of place-names will occur for the remainder of the floodplain. This would correspond to the density of sites listed on the Hillier map.

Practical considerations lead us to think that there were four categories of sites on the Hillier map:

1. Places within reasonable reach of Killalpaninna Mission, along the old Kalamurina track and the southern portion of the Birdsville Track which Reuther and/or Hillier are likely to have been able to visit personally.
2. Places with Aboriginal names that were shown on the pastoral map: these are mainly the prominent features mentioned above, such as hills and lakes as well as some very conspicuous waterholes such as 'Tipaminka' and 'Kandirtja'.
3. Places for which Aboriginal people were able to supply series of names in lines of travel or following watercourses in areas where European geographical knowledge was adequate for reasonably accurate positioning on maps.
4. Places for which Aboriginal people were — as always — able to supply series of names in sequence, but where European knowledge was so inadequate that the names simply appear as lists or are just put in a general location.

Sites of the categories 2 and 4 are to be found in the section of the Hillier map centred on the Andrewilla region.

On Hillier's map the Georgina channels look as if they had no sites on them. There are, however, four columns of names running parallel to the floodplain of the Diamantina. The westernmost column contains near the top some sites that are on the Diamantina channel: such as the *Ngapängandaka* waterhole. *Kunti-purru*, 'Kandiburu' ('Waddy having') is the name of a sandhill which (with some interruptions) reaches from a few kilometres east of the Georgina to the Eleanor channel of the Diamantina; the Black Snake ancestor travelled along this sandhill carrying a waddy. All the sites listed below 'Kandiburu' belong not to the Diamantina, but to the various Georgina channels. Linda Crombie recognised every single name in the column and said 'That is all Georgina country'. The few names that do appear on modern maps confirm her view. The people who gave the original information obviously imagined themselves travelling along the Georgina and named the places accordingly. The list includes different channels: 'Kudnuku' for instance is a waterhole on a separate outlying western channel of the Georgina and is the Koonakoo waterhole on modern maps, while 'Karatji', the Karachie waterhole of modern maps, is on an outlying eastern channel. This westernmost list includes the major Aboriginal habitation sites for the Georgina west and south of the *Kunti-purru* sandhill. It is absolutely Aboriginal-oriented and does not include the waterhole at Old Alton Downs on the Georgina which had the rather common name *Dikirri*, 'Canegrass'; another *Dikirri*, the one on the western branch of the Diamantina, appears roughly in its right location. Similarly the second column which contains names of places on the Eleanor channel of the Diamantina does not mention the large Karathunka waterhole. Karathunka was well known to Europeans and had been the site of a police camp since the mid-1880s. It seems almost as if, in the case of Old Alton Downs, Aboriginal people had purposely ignored European habitations. The location of the Georgina sites in a column, away from the channels where they should be, clearly indicates that these were sites of the fourth category: European geographical

knowledge was as yet inadequate for their accurate location.

The main Diamantina channel looks as if it had no sites on it, though some of the names in the third column belong to it. The situation with all the Diamantina sites is perplexing. Some of the sites are in the position where we would expect to find them. These are largely sites of category no. 2, which correspond to prominent features, like Lake Etamunbanie (Hillier's 'Jidalimanpa'). Other sites are in the position relative to each other where we would expect to find them, but not in a geographically accurate position. Examples are:

Ngapa-manha, 'Bad Water', the Appamurna waterhole of modern maps. Located on the edge of Lake Etamunbanie, this was the site of the old Minnie Downs station (Jones in prep.). On the Hillier map it appears far to the south of its location as does the nearby *Kuniwardunha*, Kuniwatatana sandhill. They are exactly where we would expect to find them in position relative to each other.

Thadna-pulu-thintjini, 'Tanabulutindi', and *Yabmalkira*, 'Jamakirra' (the Old Clifton Hills Station). These sites are shown at about the right distance and direction from each other in the second and third column, but far to the south of their true location.

A number of other sites are a long way from where we would expect them. This applies for instance to *Thirithayinha*, Tiritjina ('Dog-swallowing' waterhole — a reference to an incident in the story of the Rainbow Snake) which, according to the evidence of the Crombies, is in fact close to Pandie Pandie; and immediately south of *Paya-wutju*, 'Pajawutu' ('Blind Bird'), though not as yet mapped by us. *Ngantji-karini* is even further misplaced far to the east of Goyder's Lagoon, though there is of course always a chance that it may refer to another site of the same name.

All these are examples of sites of category 4, where both the Aboriginal informants and Hillier made a valiant effort to position the sites, but European geographical knowledge was simply not detailed and accurate enough. This can take nothing away from the fact that the map remains a unique and brilliant piece of work; Hillier and Reuther have come close to achieving the near impossible of showing so many sites in such near-accurate general locations despite the impossibility of visiting them. We must be reconciled however to the situation that without additional information from archival sources or from knowledgeable Aboriginal people the map can not be used to locate otherwise unknown Aboriginal sites on the ground.

Notes on Orthography

In this paper a practical orthography has been used for Aboriginal words as recorded, and written in italics.

Plosive consonants other than the retroflex plosive have been written as unvoiced *(k, p, th, t)*, but prestopped 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, hence: *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*, and *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* = retroflex r.

Acknowledgment

We are indebted to P. Austin for his advice and for correcting the translation of the Ngamini sentences.

Endnotes

1. The old men apparently did not like telling Reuther about this, and he says in his version (Volume X: 122) 'Why Marikilla died the legend does not say'.

2. Reuther (Volume VII: 1001) says that the name 'Milkipata' is Wangkangurru and that it comes from *milki* 'eye' and *pata* 'clay, dirt', and says also that it was the name both of the place and of an Ancestor, who smeared the clay on his face in order to approach some waterbirds to within throwing distance. 'When *Ngaltimpara* met up here with Milkipata, he said to him: *Pirnarulai jidni milkipata* "Oh venerable old man, your eyes are still dirty". That gave rise to the naming of this place.' The words *milki* 'eye' and *pata* 'wet soil' are shared by Ngamini and Wangkangurru. The place is certainly not in Wangkangurru country, and the Ancestor was talking in Ngamini.

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THE SOUTH AUSTRALIAN MUSEUM'S NITRATE NEGATIVE COPYING PROJECT

P. G. Jones

Summary

The photographic collections of the South Australian Museum's Anthropology Archive have accumulated over the course of a century. As well as documenting the activities of staff on various expeditions, these collections in two main regions, the islands of the western Pacific and within Australia itself. The Australian photographic collections are by far the largest component of the Archive: over 60, 000 of the approximately 70, 000 images dating mainly from the 1880s are from this country.

THE SOUTH AUSTRALIAN MUSEUM'S NITRATE NEGATIVE COPYING PROJECT

The photographic collections of the South Australian Museum's Anthropology Archive have accumulated over the course of a century. As well as documenting the activities of staff on various expeditions, these collections reflect the diversity of the Museum's anthropology collections in two main regions, the islands of the western Pacific and within Australia itself. The Australian photographic collections are by far the largest component of the Archive: over 60,000 of the approximately 70,000 images dating mainly from the 1880s are from this country.

Since being assembled as a single archival collection during the 1970s, the photographs have been subject to two main organisational and cataloguing operations. The first occurred during 1979-80, when an archivist was employed to organise the Anthropology Archives according to professional archival principles. This project resulted in the successful cataloguing of the bulk of all archival manuscripts, sound tape, cine film, works on paper, and photographs received up until that time. A series of 'AA' (Anthropology Archive) numbers was applied to the individual collections, and material was catalogued and shelved according to this numbering system. Filing cabinets were used to store the extensive collections of loose prints and negatives, comprising original material and copies. A programme to generate copy negatives and prints from the large series of glass negatives was largely completed during the decade following the initial project.

A second phase of organisation began during 1989 and will continue at least until the mid-1990s. This involves the separation of negatives from prints in a new storage system of archivally-sound photograph albums, developed in consultation with the State Conservation Centre. The accessibility of the photographic collection to researchers and staff has already been tremendously improved through this project. It has also enabled much greater opportunities for evaluating the present conservation status of the collection and its individual parts.

It was while undertaking this second phase that an extremely large proportion of cellulose-nitrate based negatives was identified, dispersed throughout the photographic collection. Advice from the State Conservation Centre confirmed that these negatives would eventually degrade, threatening the rest of the collection with toxic fumes and posing the threat of possible self-ignition. As overseas examples have shown, a fire involving nitrate stock can be potentially disastrous, as the burning material generates its own oxygen and cannot be extinguished by conventional means.

The necessity for immediate action to deal with this dilemma was apparent. The Museum Board provided funds in the first instance, to employ a person to isolate all nitrate negatives from the archive collections and to interleave the individual negatives with acid-free tissue paper. This was successfully achieved with a number of smaller collections totalling some 12,000 images, while a separate single collection (the W.D. Walker collection) comprising about 8,000 nitrate images was carefully inspected.

Given the potential state of degradation of nitrate negatives, the collections were found to be still in extremely good condition, with very few exceptions. Of the possible seven or eight stages of decomposition, the great majority have reached only the stage of discolouration or silvering on the emulsion surface. Nevertheless, bearing in mind that the decomposition process can accelerate and is still unpredictable, it was decided to apply to the Federal Department of Aboriginal Affairs (now reconstituted as the Aboriginal and Torres Strait Islander Commission) for a grant to enable the most significant images to be copied onto safety film. We were extremely fortunate in being awarded a grant of $20,000 from the Department in April 1989. An equivalent sum was also awarded by the Department for the Museum's programme of consultations about secret-sacred material with Central Australian Aboriginal communities.

With this grant the Museum was able to employ a qualified photographer, Scott Bradley, for six months on the project. Scott worked under the direction of the Museum's photographer, Trevor Peters, who had undertaken research on the problem and had devised the most effective and cost-efficient method of transferring the images. This involved re-photographing the negatives onto Agfa safety-base film, archivally processed to American National Standards Institute specifications (ANSI) to produce positive 2.25 sq. inch transparencies. These were then cut into strips of three and stored within polypropylene sleeves in custom-made albums, for eventual vertical storage in filing cabinets. Once these copied images have been catalogued and incorporated within the Anthropology Archives, they will be available for staff and external use.

The copying project has been a major success. The initial estimate of about 50 processed images per day was exceeded by 50%, and a final total of almost 10,000 images has been copied. This has left a balance of a similar number requiring the same treatment, but we are optimistic about obtaining the necessary support for this, following the success of the initial project.

A variety of photographers and their collections have been represented in the work so far completed. Examples include:

— George Aiston Collection. Photographs from the Birdsville Track region, taken during the 1920s and 1930s, depicting traditional Aboriginal activities as well as themes of station life, transport and the landscape.

— Cecil Hackett Collection. Hackett mastered the use of the pocket Kodak and his 1920s and 1930s photographs document several anthropological expeditions to Central and Western Australia.

— Aborigines' Friends' Association. This collection includes the photographs taken by Ernest Kramer, a non-denominational evangelist who travelled into the heart of Pintupi and Loritja country to the north-west of Alice Springs during the 1920s and 1930s.

— Edgar Waite Collection. Waite was Director of the South Australian Museum from 1914–29. His photographs cover a series of Museum expeditions during the period, including the 1916 expedition by camel to the north-east of South Australia.

— Norman B. Tindale Collection. Part of a larger collection, these nitrate negatives were produced by Tindale during the course of several Central Australian expeditions.

— Rex Battarbee Collection. This recently acquired collection includes some beautifully composed images of Central Australian landscapes and much important documentation of the Hermannsburg Mission.

— William D. Walker Collection. This huge collection of over 8,000 images contains a large component documenting Walker's 1927–28 journey through Central Australia, travelling in his T-Model Ford. The collection is supplemented by his own and his wife's detailed diaries.

Until quite recently it has been accepted practice for archives to destroy their original nitrate negatives once the images have been safely transferred to copies. Research indicates that if a collection of nitrate stock is in a stable condition, and is undisturbed by variations in temperature or humidity, it may well last satisfactorily for many more years. In the case of the South Australian Museum's collection, which still appears to be in excellent condition despite it dating to more than fifty years ago, there is every reason to attempt to preserve it in the same state. A positive image obtained from the original negative will always be superior in every way to that obtained from a second-generation copy. The intention, therefore, is to store the nitrate collection in a secure, off-site location with controlled conditions of temperature and humidity.

The importance of preserving this unique series of photographic collections in its original form will be apparent to a large public audience in 1991. A selection of images from five of the nitrate collections – photographs by S. A. White, G. Aiston, W. D. Walker, E. Kramer and R. Battarbee – will be included in a major photographic exhibition at the South Australian Museum, titled 'Images of the Interior'.

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