ANNALS OF THE SOUTH AFRICAN MUSEUM

ANNALE VAN DIE SUID-AFRIKAANSE MUSEUM

VOLUME 102

BAND 102

ANNALS OF THE SOUTH AFRICAN MUSEUM
ANNALE VAN DIE SUID-AFRIKAANSE MUSEUM

VOLUME 102 BAND

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SOUTH AFRICAN MUSEUM
CAPE TOWN

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- (b) *Abstract* of not more than 200 words, intelligible to the reader without reference to the text
- (c) *Table of contents* giving hierarchy of headings and subheadings
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Fischer, P. H., Duval, M. & Raffy, A. 1933. Études sur les échanges respiratoires des littorines. *Archives de zoologie expérimentale et générale* **74** (33): 627–634.
Kohn, A. J. 1960*a*. Ecological notes on *Conus* (Mollusca: Gastropoda) in the Trincomalee region of Ceylon. *Annals and Magazine of Natural History* (13) **2** (17): 309–320.
Kohn, A. J. 1960*b*. Spawning behaviour, egg masses and larval development in *Conus* from the Indian Ocean. *Bulletin of the Bingham Oceanographic Collection, Yale University* **17** (4): 1–51.
Thiele, J. 1910. Mollusca. B. Polyplacophora, Gastropoda marina, Bivalvia. *In:* Schultze, L. *Zoologische und anthropologische Ergebnisse einer Forschungsreise im westlichen und zentralen Süd-Afrika ausgeführt in den Jahren 1903–1905* **4** (15). *Denkschriften der medizinisch-naturwissenschaftlichen Gesellschaft zu Jena* **16**: 269–270.

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QUATERNARY OSTRACODS FROM THE CONTINENTAL MARGIN OFF SOUTH-WESTERN AFRICA PART I. DOMINANT TAXA

By

R. V. DINGLE

Cape Town Kaapstad

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QUATERNARY OSTRACODS FROM THE CONTINENTAL MARGIN OFF SOUTH-WESTERN AFRICA
PART I. DOMINANT TAXA

By

R.V. Dingle

Micropalaeontology Research Unit, South African Museum, Cape Town

(With 59 figures and 6 tables)

[*MS accepted 28 February 1990*]

ABSTRACT

Eighteen species belonging to eleven genera account for 87 per cent of the total fauna of benthic ostracods from the continental shelf and upper slope between the Kunene River and Cape Peninsula. Seven new species, one new subspecies and a new genus are described. These are: *Cytherella namibensis, Palmoconcha? walvisridgensis, Kuiperiana angulata, Neocytherideis boomeri, Ambostracon (A.) keeleri, Paracypris lacrimata,* and *Xestoleberis hartmanni; Bensonia knysnaensis robusta;* and *Pseudokeijella.* Eleven of the species have been previously recorded from the area. The remaining 14 per cent of the total ostracod fauna, none of which occur as dominants, will be described in Part II of this report.

The faunas have been subdivided into 'modern' and 'relict' assemblages and, on a regional scale, the dominant taxonomic groupings in both assemblages are the same. The shelf north of Walvis Bay has a loxoconchid–*Cytherella–Bensonia* fauna, whereas south of the Orange River a *Ruggieria cytheropteroides–Pseudokeijella lepralioides* fauna occurs. The intervening area has a mixed assemblage.

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INTRODUCTION

Sea-floor sediment samples from the continental shelf and upper slope (<950 m water depth) off south-western Africa have been investigated for their benthic ostracod fauna. Of the 269 samples examined, 192 contained ostracod valves, whereas 77 were barren (Fig. 1). Details of these faunas will be presented in three parts: Part I (present report) deals with the dominant taxa, Part II (in press) deals with those species that occur as minor constituents of the fauna, and Part III (in preparation) is a discussion of the ecology of the ostracod populations and palaeo-oceanographic implications. Earlier publications have dealt with the fauna from a further 45 sediment samples collected in water depths >950 m (Dingle *et al.* 1989, 1990).

The continental shelf off south-western Africa extends latitudinally from 17°S to 35°S, a distance of nearly 2 000 km. To the north, surface waters are affected by the

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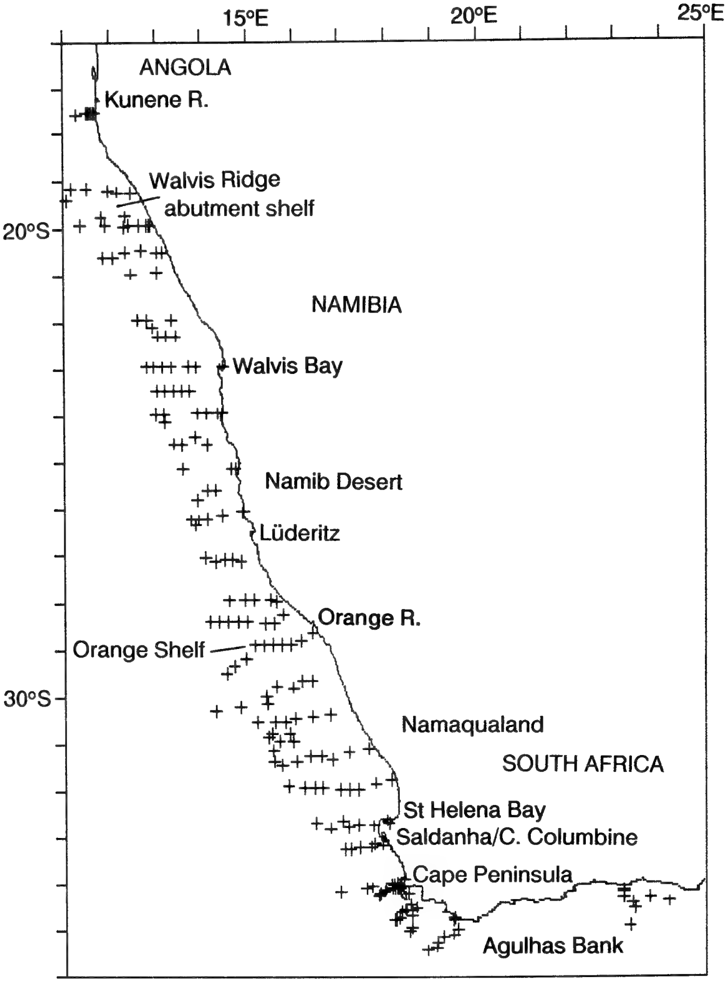

Fig. 1. Ostracod-bearing samples from water depths less than 950 m along the continental margin off south-western Africa. Those on the eastern Agulhas Bank were reported on by Keeler (1981).

subtropical Angola Current, whereas most of the region lies under the influence of the northward flowing Benguela System, which is subject to intense upwelling in quasi-permanent zones (Lutjeharms & Meeuwis 1987). This phenomenon gives rise locally to steep water-temperature, salinity, and dissolved-oxygen gradients, as well as strongly influencing local substrates. Much of the area lies adjacent to an arid hinterland with low and episodic fluvial runoff. The extreme southern part of the region is periodically influenced by inflow of subtropical Agulhas Current water from across and around the Agulhas Bank. A more detailed discussion of the oceanography and substrates will be given in Part III.

Modern marine Ostracoda were first reported from this region by Brady (1880), who identified 14 species of podocopid Ostracoda from two samples collected in 1873 during the 1873–76 HMS 'Challenger' expedition: Station 140 (15–20 fm) (27–37 m): False Bay) and Station 142 (150 fm (274 m): off the Cape of Good Hope). Brady's 'Challenger' collection (including types of the South African species; see Table 1) was re-illustrated, and lectotypes established by Puri & Hulings (1976). Subsequently, several authors have worked on ostracod collections taken mostly from coastal sites (Table 1): Müller (1908) reported on the fauna from one sample in Simonstown Harbour (in the course of describing material collected on the German South Polar Expedition 1901–03); Klie (1940) reported on ostracods from the vicinity of Lüderitz and Swakopmund; Benson & Maddocks (1964) described the fauna from Knysna Lagoon (and illustrated a specimen from False Bay); and Whatley & Dingle (1989) reported from the margin off south-western Africa the first known sighted species of the genus *Poseidonamicus*. Also, in a major regional survey, Hartmann (1974) recorded faunas from numerous localities on the coast between northern Angola and Mozambique.

Unpublished theses dealing with modern marine ostracods from the area have been produced by Keeler (1981—eastern Agulhas Bank) and Boomer (1985—continental margin, south-western Africa). Both these studies used samples collected by the Marine Geoscience Unit at the University of Cape Town.

Tankard (1976), in his account of the Pleistocene deposits of the coastal plain between Saldanha Bay and Elands Bay (Cape Deseada), identified 18 species of marine Ostracoda, 13 of which he was able to refer to previously described taxa (Table 1).

TABLE 1

Previous records of ostracods from south-western and southern Africa".

	Walvis Bay*	Lüderitz	Saldanha area	Cape Pen.	False Bay	Knysna Lagoon
BRADY 1880						
Pontocypris subreniformis sp. nov.					x	
Macrocypris maculata Brady					x	
Bairdia ovata Bosquet					x	
Cythere exilis sp. nov.					x	
Cythere flabellicostata sp. nov.					x	
Cythere lepralioides sp. nov.				x	x	
Cythere craticula sp. nov.					x	
Cythere melobesioides Brady				x		
Cythere cytheropteroides				x		
Cythere stolonifera					x	
Loxoconcha subrhomboidea sp. nov.					x	
Xestoleberis africana sp. nov.					x	
Cytherura mucronata sp. nov.					x	
Cytherura clausi sp. nov.					x	
Cytherella dromedaria sp. nov.					x	
MÜLLER 1908						
Macrocypris dispar sp. nov.					x	
Macrocypris africana sp. nov.					x	
Pontocypris gaussi sp. nov.					x	
Pontocypris flava sp. nov.					x	
Xestoleberis capensis sp. nov.					x	
Xestoleberis ramosa					x	

Table 1 (*cont.*)

	Walvis Bay*	Lüderitz	Saldanha Area	Cape Pen.	False Bay	Knysna Lagoon
KLIE 1940						
Pontocypris flava Müller		x				
Eucythereis mirabilis sp. nov.	x					
Eucythereis levetzovi sp. nov.		x				
Procythereis serrata sp. nov.		x				
Procythereis major sp. nov.		x				
Procythereis minor sp. nov.		x				
Xestoleberis ramosa Müller		x				
Xestoleberis crenulata sp. nov.		x				
Xestoleberis ferax sp. nov.		x				
Xestoleberis baja sp. nov.		x				
Xestoleberis humilis sp. nov.		x				
Sclerochilus incurvatus sp. nov.		x				
Sclerochilus meridionalis Müller		x				
Cytherois minor Müller		x				
Paradoxostoma caeruleum sp. nov.		x				
Paradoxostoma griseum sp. nov.		x				
Paradoxostoma angustissimum sp. nov.		x				
Paradoxostoma auritum sp. nov.		x				
Paradoxostoma reflexum sp. nov.		x				
Paradoxostoma semilunare sp. nov.		x				
BENSON & MADDOCKS 1964						
Cytherella aff. *punctata* Brady						x
Bairdia villosa? Brady						x
Paracypris westfordensis sp. nov.						x
Aglaiella railbridgensis sp. nov.						x
Perissocytheridea estuaria sp. nov.						x
Sulcostocythere knysnaensis sp. nov.						x
Cytheretta knysnaensis sp. nov.					x	x
Loxoconcha parameridionalis sp. nov.						x
Loxoconcha megapora sp. nov.						x
Xestoleberis capensis Müller						x
Hemicythere? sp.						x
Nereina? sp. A						x
Nereina? sp. B						x
Aurila dayii sp. nov.						x
Urocythereis sp.						x
Mutilus sp.						x
Bradleya? sp.						x
HARTMANN 1974						
Cytherella aff. *punctata* Brady						x
Bairdoppilata sp. 44		x				
Perissocytheridea estuaria B & M					x	
Sulcostocythere knysnaensis B & M		x			x	
Cyprideis limbocostatc sp. nov.	x					
Cyprideis remanie Klie		x				
Mutilus bensonmaddocksorum sp. nov.		x				x
Aurila kliei sp. nov.		x		x		
Aurila levetzovi (Klie)		x				
Aurila petricola sp. nov.		x		x		x
Procythereis major Klie		x				
Procythereis minor Klie		x		x		
Procythereis serrata Klie		x				
Procythereis foveata sp. nov.						x
Caudites knysnaensis sp. nov.						x
Cytheretta knysnaensis B & M						x
Loxoconcha walvisbaiensis sp. nov.	x					
Loxoconcha megarora var. *magna* n. var.		x				x
Loxoconcha parameridionalis B & M					x	
Australoxochonca favornamentata sp. nov.						x
Australoxochonca parafavornamentata sp. nov.						x
Semicytherura dayi sp. nov.						x
Hemicytherura? kazmaierae sp. nov.		x				

Table 1 (*cont.*)

	Walvis Bay*	Lüderitz	Saldanha Area	Cape Pen.	False Bay	Knysna Lagoon
TANKARD 1976						
Paracypris westfordensis B & M			x			
Aglaiella railbridgensis B & M			x			
Cytheretta knysnaensis B & M			x			
Cyprideis cf. *limbocostata* Hartmann			x			
Perissocytheridea estuaria B & M			x			
Cytherura sp.			x			
Hemicytherura parvifossata Hartmann			x			
Bairdia cf. *villosa* Brady			x			
Aurila dayii B & M			x			
Caudites knysnaensis Hartmann			x			
Procythereis sp.			x			
Urocythereis sp.			x			
Loxoconcha parameriodionalis B & M			x			
Loxoconcha peterseni Hartmann			x			
Cytheromorpha sp.			x			
Bradleya sp.			x			
Xestoleberis capensis Müller			x			
Cytherella punctata Brady			x			

"—excludes Myodocopida
*—includes Swakopmund and Sandwich Harbour
B & M—Benson & Maddocks

Additional relevant studies of modern and late Tertiary ostracod faunas from adjacent areas include the following: Skogsberg (1939—Subantarctic), Benson (1964—Antarctica), Bold (1966—Gabon), Neale (1967—Antarctica), Maddocks (1969, 1977—Southern Ocean), Valicenti (1977—Patagonia), Babinot & Kouyoumontzakis (1986—Congo estuary), Hartmann (1986, 1987, 1988—Antarctica), Whatley *et al.* (1987, 1988—Antarctic and south-western Atlantic), and Coimbra & Pinto de Ornellas (1989—Brazil).

DOMINANT TAXA

Approximately 120 species have been identified from the continental shelf and upper slope off south-western Africa within a total collection of 24 058 specimens from 192 ostracod-bearing sediment samples. In this paper I discuss the 11 dominant groups (10 genera and one family) that individually account for 2 per cent or more of the total specimen count (Table 3). This is merely a convenience for handling the large data set, but the eighteen species concerned account for 87 per cent of the overall population and give a first order impression of regional taxa dominance. Distribution patterns for the total fauna will be discussed in Part III.

Table 2 lists the locations and faunal contents of the 183 ostracod-bearing sediment samples that contain one or more of the species described in this paper (Table 3). The eleven dominant taxa constitute a mean of 82 per cent of the fauna of each sample but it is notable that, in relation to the depth distribution of the total fauna, these taxa are most important in water depths 60–400 m (mean 86%—Fig. 2). At inshore sites they constitute 74 per cent, and at depths >400 m 66 per cent, although they are relatively more abundant between 800 m and 950 m than in the

TABLE 2

Location of ostracod fauna of sediment samples.

TBD sample no.	Latitude (°S)	Longitude (°E)	Water depth (m)	Total no. of valves	*Pseudokeijella lepralioides*		*Ruggieria cytheropteroides*		*Ambostracon (A.) flabellicostata*		*Ambostracon (A.) keeleri*		*Ambostracon (A.) levetzovi*		*Henryhowella melobesioides*		*Doratocythere exilis*		*Neocytherideis boomeri*		*Palmoconcha walvisbaiensis*	
					R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M
3509	22,895	14,4916	15	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
6821	34,0597	18,355	15	126	-	-	-	-	-	5	-	2	-	-	-	-	-	-	-	-	-	-
3089	32,6833	18,0833	18	72	-	-	-	-	4	-	5	7	11	8	-	-	-	-	-	-	-	-
3265	26,05	14,9333	31	240	-	-	-	-	4	-	1	-	-	-	-	-	-	-	-	-	5	-
5254	34,2033	18,51	40	574	95	40	-	-	182	29	-	-	-	-	-	-	3	-	2	1	-	-
6822	34,09	18,3333	42	36	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
3087	32,62	18,0417	42	334	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3217	25,1166	14,7466	50	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3264	26,05	14,9	51	59	-	-	-	-	8	-	-	-	-	-	-	-	-	-	-	-	1	-
3011	27,95	15,6366	52	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-
1341	34,74	19,5216	53	2	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
271	34,45	18,575	55	5	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
2224	33,1566	17,955	58	145	-	-	-	-	1	8	3	-	-	-	-	-	-	-	-	-	-	-
3892	17,5333	11,6833	65	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	2
3953	19,9166	12,8933	67	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
344	34,7733	19,5083	73	37	-	1	-	-	-	1	3	1	-	-	-	-	-	-	-	1	-	-
3219	25,1166	14,6666	75	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3966	20,45	13,1467	76	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2
3469	23,9333	14,355	79	90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	88	2
6836	33,9608	18,2733	80	769	9	187	-	-	13	-	24	-	-	-	-	-	39	-	62	10	-	-
3952	19,9166	12,86	82	27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25	2
3304	31,0883	17,6467	88	17	11	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3010	27,925	15,5166	88	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6824	34,09	18,2825	90	2020	26	528	-	-	12	-	11	-	-	-	-	-	71	-	312	5	-	-
3951	19,9166	12,8233	92	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
6847	34,0923	18,2717	94	936	14	428	-	4	-	-	-	-	-	-	-	-	29	-	63	8	-	-
6846	34,015	18,264	95	486	2	4	-	-	-	-	15	5	-	-	-	-	-	-	5	-	-	-
6835	34,0267	18,2	100	65	-	-	-	1	3	2	28	9	-	-	3	-	-	-	-	-	-	-
2257	32,7467	17,7617	100	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2991	28,255	15,79	100	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3891	17,5333	11,6416	104	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16	-
3969	20,45	13,0367	112	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2
3890	17,5333	11,6	115	31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	4
6823	34,0925	18,215	120	1098	18	10	69	16	6	-	593	9	-	-	3	-	1	-	8	-	-	-
3862	19,9166	12,6416	122	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-
2935	28,8	16,1833	126	18	16	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2344	31,8333	17,8083	128	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3889	17,5333	11,5666	130	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
270	34,5167	18,6833	131	1460	478	700	22	-	26	1	50	-	-	-	2	-	2	-	1	-	-	-
346	34,97	19,6	133	15	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2970	28,4333	15,6	135	305	241	13	39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3519	22,9333	13,8883	138	2	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
3927	19,21	12,1766	139	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
3829	20,9166	13,0366	140	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	8
3587	33,995	18,1483	140	167	2	-	45	4	1	-	43	1	-	-	6	-	-	-	-	-	-	-
3520	22,9266	13,7133	142	54	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	38	7
3007	27,93	15,1583	147	12	2	2	5	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2928	28,8666	15,9666	149	94	87	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3863	19,9166	12,4333	150	189	2	-	100	26	-	-	-	-	-	-	-	-	-	-	-	-	1	-
2337	31,95	17,4333	153	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
341	35,08	19,5083	153	9	1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3888	17,5333	11,5333	154	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3414	24,6	14,1333	154	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
2222	33,135	17,7766	155	5	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2924	28,9	15,1666	158	76	24	8	18	2	1	-	3	-	-	-	-	-	10	-	2	-	-	-
6825	34,09	18,1733	160	222	68	-	33	2	5	-	24	-	-	-	7	-	20	-	1	-	-	-
3786	21,9166	13,3583	160	24	-	-	-	-	2	-	2	-	-	-	-	-	-	-	-	-	3	-
3467	23,93	14,1066	161	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	1
3559	23,43	13,7567	162	83	10	-	-	-	14	-	18	-	-	-	-	-	-	-	-	-	27	1
2971	28,4333	15,4	162	1095	949	2	46	-	30	-	8	-	-	-	-	-	-	-	-	-	-	-
2861	29,6333	16,4167	165	13	10	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3887	17,5333	11,5	167	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3770	22,25	13,45	169	37	-	-	-	-	2	-	2	-	-	-	-	-	-	-	-	-	16	1
2860	29,6333	16,2167	170	135	84	-	14	-	-	-	4	-	-	-	-	-	7	-	-	-	-	-
2752	29,7833	16,0167	170	374	145	-	68	-	26	-	21	-	-	-	-	-	43	-	-	-	-	-

Kuiperiana angulata		*Palmoconcha? walvisridgensis*		*Palmoconcha subrhomboidea*		*Cytherella namibensis*		*Cytherella dromedaria*		*Paracypris lacrimata*		*Bensonia knysnaensis knysnaensis*		*Bensonia knysnaensis robusta*		*Xestoleberis africana*		*Xestoleberis hartmanni*		Total Relict	Total Modern	Subtotal	% Total
R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M				
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	5	5	100
-	-	-	-	-	-	-	-	-	-	1	1	1	48	-	-	-	-	-	2	2	58	60	47
-	-	-	-	-	-	-	-	-	-	-	-	4	5	-	-	-	-	-	-	24	20	44	61
-	-	-	-	-	-	-	-	-	-	-	-	214	10	-	-	-	-	-	-	224	10	234	97
-	-	-	-	21	14	-	-	39	-	1	1	8	7	-	-	43	3	-	-	394	95	489	85
-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	1	-	1	6	7	19
-	-	-	-	-	-	-	-	-	-	-	-	292	42	-	-	-	-	-	-	292	42	334	100
-	-	-	-	-	-	-	-	-	-	-	-	79	21	-	-	-	-	-	-	79	21	100	100
-	-	-	-	-	-	-	-	-	-	-	-	46	1	-	-	-	-	-	-	55	1	56	94
-	-	-	-	-	-	-	-	-	-	-	-	6	5	-	-	-	-	-	-	14	5	19	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	1	50
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	1	1	20
-	-	-	-	-	-	-	-	-	-	-	-	33	92	-	-	-	-	-	-	37	100	137	94
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	2	7	87
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0	3	100
-	-	-	-	-	-	-	-	-	1	1	1	-	4	-	-	1	-	-	-	5	10	15	40
-	-	-	-	-	-	-	-	-	-	-	-	13	-	-	-	-	-	-	-	13	0	13	86
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	3	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	88	2	90	100
-	-	-	-	-	-	-	-	85	-	114	9	17	2	-	-	51	17	-	-	414	225	639	83
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25	2	27	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	6	17	100
-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	1	1	2	100
-	-	-	-	2	-	-	-	372	-	10	1	166	74	-	-	54	1	-	-	1036	609	1645	81
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0	2	100
-	-	-	-	-	2	-	-	180	6	9	-	5	1	-	-	89	27	-	-	389	476	865	92
-	-	-	-	-	-	-	-	2	-	151	42	-	-	-	-	47	16	-	-	222	67	289	59
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	38	12	50	76
-	-	-	-	-	-	-	-	-	-	3	1	-	-	-	-	-	-	-	-	3	1	4	50
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	1	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16	0	16	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	4	100
-	-	-	-	-	-	5	1	-	-	-	-	-	-	-	-	-	-	-	-	25	5	30	96
-	-	-	-	-	-	13	-	2	-	98	-	-	-	-	-	26	-	-	-	837	35	872	79
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	0	8	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16	2	18	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0	3	100
-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	1	2	100
2	-	-	-	-	-	-	-	2	-	7	-	-	-	-	-	51	-	-	-	643	701	1344	92
-	-	-	-	-	-	-	-	-	-	3	1	-	-	-	-	-	-	-	-	4	4	8	53
-	-	-	-	-	-	5	5	-	-	-	-	-	-	-	-	-	-	-	-	285	18	303	99
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0	2	100
-	-	-	-	-	-	-	3	-	-	-	-	1	-	-	-	-	-	-	-	2	3	5	100
-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	13	8	21	100
1	-	-	-	-	-	-	-	-	-	7	-	-	-	-	-	4	-	1	-	110	5	115	68
-	-	-	-	-	-	6	-	-	-	-	-	-	-	1	-	-	-	-	-	47	7	54	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	3	10	83
-	-	-	-	-	-	2	-	-	-	-	-	1	-	-	-	-	-	-	-	94	0	94	100
-	1	-	-	-	-	36	-	-	-	-	-	-	-	-	-	-	-	-	-	139	27	166	87
-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	4	0	4	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	0	4	44
-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	2	2	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	1	50
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	3	60
2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	60	12	72	94
-	-	-	-	-	-	-	-	-	-	2	-	3	-	-	-	2	-	13	-	178	2	180	81
-	-	-	-	-	-	5	-	-	-	-	-	-	-	10	-	-	-	-	-	22	0	22	91
1	-	-	-	-	-	2	-	-	-	1	-	-	-	-	-	-	-	-	-	19	1	20	100
-	-	-	-	-	-	6	-	-	-	-	-	-	-	4	-	-	-	-	-	79	1	80	96
-	-	-	-	-	-	3	1	-	-	2	-	41	-	-	-	2	-	-	-	1081	3	1084	98
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	0	11	84
-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	1	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	-	-	-	-	-	34	1	35	94
-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	113	0	113	83
-	-	-	-	-	-	-	-	-	-	5	-	2	-	-	-	3	-	-	-	313	0	313	83

Table 2 (*cont.*)

TBD sample no.	Latitude (°S)	Longitude (°E)	Water depth (m)	Total no. of valves	*Pseudokeijella lepralioides*		*Ruggieria cytheropteroides*		*Ambostracon (A.) flabellicostata*		*Ambostracon (A.) keeleri*		*Ambostracon (A.) levetzovi*		*Henryhowella melobesioides*		*Doratocythere exilis*		*Neocytherideis boomeri*		*Palmoconcha walvisbaiensis*	
					R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M
1690	34,5833	18,5867	172	930	238	1	594	5	5	-	2	-	-	-	1	-	9	-	-	-	-	-
2927	28,8833	15,7666	172	125	107	-	2	-	-	-	1	-	-	-	1	-	1	-	-	-	-	-
2973	28,4167	15	173	1460	781	4	392	6	51	-	42	-	-	-	-	-	13	-	2	-	-	-
2715	30,35	16,8166	173	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3585	33,1916	17,7033	174	3	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
352	35,1333	19,2833	176	12	2	-	5	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-
2336	31,9583	17,2366	180	7	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2975	28,4167	14,5833	180	892	61	2	404	25	6	-	-	-	-	-	-	-	208	-	6	-	-	-
2926	28,8833	15,5666	182	72	52	-	6	-	-	-	2	-	-	-	-	-	2	-	-	-	-	-
1689	34,7	18,6	182	42	14	-	1	14	-	-	-	-	-	-	1	-	2	-	1	-	-	-
2925	28,9	15,3666	183	284	209	2	31	-	5	-	13	-	-	-	-	-	7	-	-	-	-	-
3940	19,7267	12,3417	184	31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17	9
311	34,55	18,45	184	400	137	-	154	-	19	-	15	-	-	-	38	-	-	-	-	-	-	-
2974	28,4167	14,8	186	2011	1297	-	585	6	6	-	2	-	-	-	-	-	10	-	3	-	-	-
2369	31,1533	17,23	188	13	3	-	1	-	4	-	2	-	-	-	-	-	-	-	-	-	-	-
3006	27,9333	14,96	189	60	53	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3387	25,6	14,3167	190	11	4	-	2	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-
2754	29,7667	15,65	195	747	233	-	431	3	-	-	1	-	-	-	-	-	22	-	-	-	-	-
3864	19,95	12,3233	196	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-
3558	23,4317	13,5733	197	47	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	1
6833	34,1183	18,0317	200	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2913	29,1666	14,9833	200	216	142	-	61	2	-	-	1	-	-	-	-	-	1	-	-	-	-	-
3972	20,4333	12,6833	200	130	-	-	-	-	1	-	17	-	-	-	-	-	-	-	-	-	69	1
2472	30,775	15,925	201	322	2	-	222	11	-	-	-	-	-	-	-	-	19	-	3	-	-	-
3169	27,1167	14,8667	202	7	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3259	26,1166	14,4666	202	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
2736	29,95	15,4167	205	555	48	-	360	2	-	-	-	-	-	-	1	-	72	-	2	-	-	-
2840	30,9166	15,7	205	108	3	1	28	7	-	-	2	-	-	-	-	-	11	-	2	-	-	-
6832	34,15	17,995	210	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
353	35,2366	19,1466	210	8	1	-	4	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-
2717	30,4	16,4333	218	112	29	-	49	-	-	-	6	-	-	-	-	-	8	-	-	-	-	-
3466	23,93	13,9066	220	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2703	30,1333	15,4333	220	239	13	-	194	1	-	-	-	-	-	-	3	-	1	-	-	-	-	-
1691	34,5667	18,4833	220	516	344	-	87	-	-	-	-	-	-	-	60	-	-	-	-	-	-	-
3769	22,25	13,2333	223	39	21	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-
300	34,9333	18,6	227	74	37	-	-	29	-	-	-	-	-	-	1	-	1	-	2	-	-	-
3386	25,6	14,1333	227	4	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2485	30,9166	16	227	114	1	-	72	5	-	-	-	-	-	-	-	-	9	-	1	-	-	-
6831	34,185	17,945	230	8	-	-	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-
3926	19,1916	11,9833	236	66	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25	13
2335	31,9666	17,0416	238	9	-	-	2	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
2719	30,45	16,0666	240	140	19	-	74	-	-	-	4	-	-	-	6	-	1	-	-	-	-	-
2361	31,3133	16,8583	241	70	-	-	19	1	-	-	6	-	-	-	2	-	2	-	-	-	-	-
2884	29,3166	14,7166	252	159	2	-	133	-	-	-	-	-	-	-	1	-	7	-	-	-	-	-
2259	32,7333	17,4333	255	3	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2691	30,5333	15,6166	265	43	8	-	33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2690	30,5166	15,8333	271	137	21	-	89	1	-	-	3	-	-	-	-	-	1	-	-	-	-	-
2460	31,2333	16,625	272	39	-	-	21	-	-	-	2	-	-	-	2	-	1	-	-	-	-	-
354	35,35	19,1333	275	3	-	-	2	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
3557	23,4333	13,3967	278	8	5	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3170	27,0833	14,6833	279	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3768	22,25	13,05	280	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-
3428	24,4333	13,87	283	10	2	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
104	34,0666	17,7216	285	7	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6829	34,2383	17,8667	290	13	-	-	1	1	-	-	-	-	-	-	3	-	-	-	-	-	-	-
3523	22,9283	13,1633	295	152	-	-	56	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3257	26,1833	14,1333	300	7	1	-	2	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-
2443	32,65	17,0883	300	2	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2459	31,2333	16,3833	300	299	-	-	266	2	-	-	-	-	-	-	2	-	-	-	-	-	-	-
2260	32,758	17,22	303	17	-	-	3	-	-	-	1	-	-	-	2	-	-	-	-	-	-	-
3974	20,45	12,34	303	2	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2693	30,5166	15,2166	305	41	-	-	36	4	-	-	-	-	-	-	-	-	1	-	-	-	-	-
1692	34,6	18,3667	305	9	-	-	4	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-
2446	31,9333	16,6583	310	39	2	-	17	-	-	-	-	-	-	-	11	-	-	-	-	-	-	-
3248	25,7833	13,925	320	8	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Kuiperiana angulata		*Palmoconcha? walvisridgensis*		*Palmoconcha subrhomboidea*		*Cytherella namibensis*		*Cytherella dromedaria*		*Paracypris lacrimata*		*Bensonia knysnaensis knysnaensis*		*Bensonia knysnaensis robusta*		*Xestoleberis africana*		*Xestoleberis hartmanni*		Total Relict	Total Modern	Subtotal	% Total
R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M				
3	-	-	-	-	-	3	-	2	-	1	-	1	-	-	-	9	-	-	-	868	6	874	93
-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	114	0	114	91
11	1	-	-	-	-	-	-	-	-	-	-	12	-	-	-	14	-	-	-	1318	11	1329	91
-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	0	1	12
-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	3	0	3	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	0	9	75
-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	-	-	-	7	0	7	100
11	2	-	-	-	-	14	-	-	-	-	-	3	-	-	-	1	-	-	-	714	29	743	83
-	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	-	-	-	70	0	70	97
-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	21	14	35	83
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	266	2	268	94
-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	20	9	29	93
-	-	-	-	-	-	2	-	2	-	-	-	-	-	-	-	1	-	-	-	368	0	368	92
14	-	-	-	-	-	3	-	-	-	-	-	20	-	-	-	14	-	-	-	1954	6	1960	97
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	0	10	76
-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	60	0	60	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	1	8	72
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	687	3	690	92
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	0	4	100
-	-	-	-	-	-	2	-	-	-	-	-	2	-	-	-	-	-	-	-	43	1	44	93
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	1	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	205	2	207	95
-	-	2	-	-	-	23	-	-	-	-	-	-	-	13	-	-	-	-	-	125	1	126	96
-	-	-	-	-	-	3	-	-	-	1	-	-	-	-	-	-	-	-	-	250	11	261	81
-	-	-	-	-	-	1	3	-	-	-	-	-	-	-	-	-	-	-	-	4	3	7	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	1	100
-	1	-	-	-	-	6	-	-	-	-	-	-	-	-	-	7	-	-	-	496	3	499	89
-	-	-	-	-	-	2	-	1	-	-	-	-	-	-	-	-	-	-	-	48	9	57	52
-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	1	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	0	7	87
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	92	0	92	82
-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0	3	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	211	1	212	88
-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	2	-	-	-	494	0	494	95
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	24	0	24	61
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	41	29	70	94
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	0	4	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	83	5	88	77
-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-	-	-	6	0	6	75
-	-	-	-	-	-	10	6	-	-	-	-	9	1	-	-	-	-	-	-	45	20	65	98
-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	8	0	8	88
-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	105	0	105	75
-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	31	1	32	45
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	143	0	143	89
-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	2	0	2	66
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	41	0	41	95
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	116	1	117	85
-	-	-	-	-	-	-	-	-	-	7	-	-	-	-	-	-	-	-	-	33	0	33	84
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0	3	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	0	7	87
-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	-	-	-	-	-	8	0	8	100
-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	8	0	8	100
-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	9	0	9	90
-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	2	0	2	28
-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	1	-	-	-	7	1	8	61
-	-	-	-	-	-	49	6	-	-	-	-	-	-	-	-	-	-	-	-	105	25	130	85
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	0	6	85
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0	2	100
-	-	-	-	-	-	3	-	1	-	6	-	-	-	-	-	-	-	-	-	278	2	280	93
-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	8	0	8	47
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	1	50
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37	4	41	100
-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	8	0	8	88
-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	31	0	31	79
-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	4	0	4	50

Table 2 (*cont.*)

TBD sample no.	Latitude (°S)	Longitude (°E)	Water depth (m)	Total no. of valves	*Pseudokeijella lepralioides*		*Ruggieria cytheropteroides*		*Ambostracon (A.) flabellicostata*		*Ambostracon (A.) keeleri*		*Ambostracon (A.) levetzovi*		*Henryhowella melobesioides*		*Doratocythere exilis*		*Neocytherideis boomeri*		*Palmoconcha*
					R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R
4015	22,0833	12,9333	325	10	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3789	21,9	12,8166	325	8	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3522	22,9333	13,345	344	44	-	-	33	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2470	30,755	15,55	345	59	-	-	52	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3866	19,9166	11,9133	348	7	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3171	27,0833	14,5167	349	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2447	31,925	16,4666	350	49	-	-	24	1	-	-	-	-	-	-	8	-	-	-	-	-	-
2976	28,4167	14,3833	350	18	-	-	2	-	-	-	2	-	-	-	-	-	-	-	-	-	-
3256	26,2166	13,95	352	7	-	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3923	19,1566	11,5	368	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3943	19,7333	11,8167	373	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2825	34,1	17,6	375	8	-	-	4	-	-	-	-	-	-	-	4	-	-	-	-	-	-
3556	23,4333	13,2167	379	31	-	-	7	2	-	-	-	-	-	-	-	-	-	-	-	-	-
3826	20,9333	12,4666	382	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3359	26,325	13,875	385	12	-	-	8	2	-	-	-	-	-	-	-	-	-	-	-	-	-
3255	26,2166	13,7833	390	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3562	24,6067	13,5833	391	69	-	-	20	6	-	-	-	-	-	-	-	-	-	-	-	-	-
2448	31,925	16,255	392	37	-	-	20	-	-	-	-	-	-	-	9	-	-	-	-	-	-
3172	27,1167	14,3	403	3	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1694	34,75	18,3267	425	31	1	-	1	-	-	-	-	-	-	-	19	-	-	-	-	-	-
3462	23,9583	13,1916	430	40	-	-	13	2	-	-	-	-	-	-	-	-	-	-	-	-	-
2488	30,8416	15,4666	430	14	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3179	27,0333	14,1	437	79	-	-	49	3	-	-	-	-	-	-	-	-	-	-	-	-	-
2262	32,7917	16,8167	450	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2440	33,2416	17,15	450	18	-	-	1	-	-	-	-	-	-	-	8	1	-	-	-	-	-
3577	31,3667	16,0833	453	96	-	-	35	-	-	-	-	-	-	-	1	-	-	-	-	-	-
2700	30,2167	14,85	469	13	-	-	5	3	-	-	-	-	-	-	1	-	-	-	-	-	-
2780	33,2416	17,25	475	42	-	-	20	1	-	-	-	-	-	-	6	1	-	-	-	-	-
3524	22,9333	12,9666	475	64	-	-	5	2	-	-	-	-	-	-	-	-	-	-	-	-	-
301	35,0333	18,5333	500	7	3	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-
1698	34,7833	18,2167	502	10	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-
3225	25,1166	13,6	530	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2879	29,4833	14,55	530	61	-	-	3	-	-	-	-	-	-	-	3	2	-	-	-	-	-
1697	34,7667	18,25	545	112	-	-	-	-	-	-	-	-	-	-	16	-	-	-	-	-	-
2785	33,225	17,45	560	12	-	-	4	-	-	-	-	-	-	-	4	-	-	-	-	-	-
3845	20,5917	12,0833	566	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3555	23,4433	13,03	590	19	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3112	31,45	15,7667	648	11	-	-	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-
3561	24,58	13,4167	655	9	-	-	-	-	-	-	-	-	-	-	9	-	-	-	-	-	-
3458	24,1	13,2	725	16	-	-	-	-	-	-	-	-	-	-	3	2	-	-	-	-	-
3346	31,12	15,575	730	23	-	-	-	-	-	-	-	-	-	-	13	-	-	-	-	-	-
2978	28,4	14,2	736	38	-	-	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-
3921	19,1366	11,1666	738	4	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-
3885	17,5666	11,2833	779	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3846	20,5833	11,8667	810	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
3869	19,9167	11,3667	825	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
3113	31,3667	15,5833	840	16	-	-	-	-	-	-	-	-	-	-	11	-	-	-	-	-	-
3525	22,9333	12,8	850	14	-	-	-	-	-	-	-	-	-	-	10	2	-	-	-	-	-
3461	23,9583	13,0166	850	13	-	-	-	-	-	-	-	-	-	-	7	2	-	-	-	-	-
3109	31,9	15,9	900	80	-	-	-	-	-	-	-	-	-	-	41	1	-	-	-	-	-
2697	30,2833	14,3167	940	12	-	-	-	-	-	-	-	-	-	-	9	-	-	-	-	-	-
3704	19,3666	11,06	941	16	-	-	-	-	-	-	-	-	-	-	14	2	-	-	-	-	-
3341	32,6833	16,5167	945	36	-	-	-	-	-	-	-	-	-	-	23	-	-	-	-	-	-
Total valves				24059	6235	1946	5266	223	442	48	989	35	11	8	415	14	637	0	486	25	414
% Relict					34,5	-	29,1	-	2,4	-	5,4	-	0,0	-	2,2	-	3,5	-	2,6	-	2,2
% Modern					-	68,0	-	7,7	-	1,6	-	1,2	-	0,2	-	0,4	-	0	-	0,8	-
% Subtotal					39,1	-	26,2	-	2,3	-	4,8	-	0,0	-	2,0	-	3,0	-	2,4	-	2,2
% Total ostracod fauna					33,8	-	22,7	-	2,0	-	4,2	-	0,0	-	1,7	-	2,6	-	2,1	-	1,9

Abbreviations: R = relict fauna, M = modern fauna

Kuiperiana angulata	*Palmoconcha? walvisridgensis*		*Palmoconcha subrhomboidea*		*Cytherella namibensis*		*Cytherella dromedaria*		*Paracypris lacrimata*		*Bensonia knysnaensis knysnaensis*		*Bensonia knysnaensis robusta*		*Xestoleberis africana*		*Xestoleberis hartmanni*		Total Relict	Total Modern	Subtotal	% Total
M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M				
-	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	10	0	10	100
-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	5	0	5	62
-	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	43	0	43	97
-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	53	0	53	89
-	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	7	0	7	100
-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	4	0	4	100
-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	33	1	34	69
-	-	-	-	-	-	1	-	-	6	-	-	-	-	-	-	-	-	-	10	1	11	61
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	0	7	100
-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	6	0	6	75
-	-	-	-	-	8	-	-	-	2	-	-	-	-	-	-	-	-	-	10	0	10	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	0	8	100
-	-	-	-	-	14	-	-	-	2	-	-	-	-	-	-	-	-	-	23	2	25	80
-	-	-	-	-	22	-	-	-	-	-	-	-	-	-	-	-	-	-	22	0	22	95
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	2	10	83
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	1	100
-	-	-	-	-	32	-	-	-	1	-	-	-	-	-	-	-	-	-	53	6	59	85
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	29	0	29	78
-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	3	0	3	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21	0	21	67
-	-	-	-	-	13	-	-	-	-	-	-	-	-	-	-	-	-	-	28	2	30	75
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	1	7,1
-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	51	3	54	68
-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	0	1	33
-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	12	1	13	72
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	36	0	36	37
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	3	9	69
-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	27	2	29	69
-	-	-	-	-	43	-	-	-	-	-	-	-	-	-	-	-	-	-	49	2	51	79
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	0	6	85
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	0	6	60
-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	0	1	100
-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	7	2	9	14
-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	1	-	3	-	23	0	23	20
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	0	8	66
-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	1	100
-	-	-	-	-	6	-	-	-	3	-	-	-	-	-	-	-	-	-	11	0	11	57
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	0	10	90
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	0	9	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	2	7	43
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13	0	13	56
-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	12	0	12	31
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	2	50
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0	2	20
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	1	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	1	100
-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	12	0	12	75
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	2	13	92
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	2	10	76
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	41	1	42	52
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	0	9	75
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	2	16	100
-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	24	0	24	66
7	3	2	23	16	396	27	695	7	490	57	993	318	43	0	436	64	18	2	18046	2861	20907	87
-	0,0	-	0,1	-	2,1	-	3,8	-	2,7	-	5,5	-	0,2	-	2,4	-	0,0					
0,2	-	0,0	-	0,5	-	0,9	-	0,2	-	1,9	-	11,1	-	0	-	2,2	-	0,0				
-	0,0	-	0,1	-	2,0	-	3,3	-	2,6	-	6,2	-	0,2	-	2,3	-	0,0	-				
-	0,0	-	0,1	-	1,7	-	2,9	-	2,2	-	5,4	-	0,1	-	2,0	-	0,0	-				

Table 2 (*cont.*)

TBD sample no.	Latitude (°S)	Longitude (°E)	Water depth (m)	Total no. of valves	*Pseudokeijella lepralioides*		*Ruggieria cytheropteroides*		*Ambostracon (A.) flabellicostata*		*Ambostracon (A.) keeleri*		*Ambostracon (A.) levetzovi*		*Henryhowella melobesioides*		*Doratocythere exilis*		*Neocytherideis boomeri*		*Palmoconcha walvisbaiensis*		*Kuiperiana angulata*		*Palmoconcha? walvisridgensis*		*Palmoconcha subrhomboidea*		*Cytherella namibensis*		*Cytherella dromedaria*		*Paracypris lacrimata*		*Bensonia knysnaensis knysnaensis*		*Bensonia knysnaensis robusta*		*Xestoleberis africana*		*Xestoleberis hartmanni*		Total Relict	Total Modern	Subtotal	% Total
					R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M				
4015	22,0833	12,9333	325	10	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	10	0	10	100
3789	21,9	12,8166	325	8	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	5	0	5	62
3522	22,9333	13,345	344	44	-	-	33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	43	0	43	97
2470	30,755	15,55	345	59	-	-	52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	53	0	53	89
3866	19,9166	11,9133	348	7	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	7	0	7	100
3171	27,0833	14,5167	349	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	4	0	4	100
2447	31,925	16,4666	350	49	-	-	24	1	-	-	-	-	-	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	33	1	34	69
2976	28,4167	14,3833	350	18	-	-	2	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	6	-	-	-	-	-	-	-	-	-	10	1	11	61
3256	26,2166	13,95	352	7	-	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	0	7	100
3923	19,1566	11,5	368	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	6	0	6	75
3943	19,7333	11,8167	373	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-	2	-	-	-	-	-	-	-	-	-	10	0	10	100
2825	34,1	17,6	375	8	-	-	4	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	0	8	100
3556	23,4333	13,2167	379	31	-	-	7	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	-	-	-	2	-	-	-	-	-	-	-	-	-	23	2	25	80
3826	20,9333	12,4666	382	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22	-	-	-	-	-	-	-	-	-	-	-	-	-	22	0	22	95
3359	26,325	13,875	385	12	-	-	8	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	2	10	83
3255	26,2166	13,7833	390	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	1	100
3562	24,6067	13,5833	391	69	-	-	20	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	32	-	-	-	1	-	-	-	-	-	-	-	-	-	53	6	59	85
2448	31,925	16,255	392	37	-	-	20	-	-	-	-	-	-	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	29	0	29	78
3172	27,1167	14,3	403	3	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	3	0	3	100
1694	34,75	18,3267	425	31	1	-	1	-	-	-	-	-	-	-	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21	0	21	67
3462	23,9583	13,1916	430	40	-	-	13	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	13	-	-	-	-	-	-	-	-	-	-	-	-	-	28	2	30	75
2488	30,8416	15,4666	430	14	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	1	7,1
3179	27,0333	14,1	437	79	-	-	49	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	51	3	54	68
2262	32,7917	16,8167	450	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	0	1	33
2440	33,2416	17,15	450	18	-	-	1	-	-	-	-	-	-	-	8	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	12	1	13	72
3577	31,3667	16,0833	453	96	-	-	35	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	36	0	36	37
2700	30,2167	14,85	469	13	-	-	5	3	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	3	9	69
2780	33,2416	17,25	475	42	-	-	20	1	-	-	-	-	-	-	6	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	27	2	29	69
3524	22,9333	12,9666	475	64	-	-	5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	43	-	-	-	-	-	-	-	-	-	-	-	-	-	49	2	51	79
301	35,0333	18,5333	500	7	3	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	0	6	85
1698	34,7833	18,2167	502	10	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	0	6	60
3225	25,1166	13,6	530	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	0	1	100
2879	29,4833	14,55	530	61	-	-	3	-	-	-	-	-	-	-	3	2	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	7	2	9	14
1697	34,7667	18,25	545	112	-	-	-	-	-	-	-	-	-	-	16	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	1	-	3	-	23	0	23	20
2785	33,225	17,45	560	12	-	-	4	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	0	8	66
3845	20,5917	12,0833	566	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	1	100
3555	23,4433	13,03	590	19	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	3	-	-	-	-	-	-	-	-	-	11	0	11	57
3112	31,45	15,7667	648	11	-	-	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	0	10	90
3561	24,58	13,4167	655	9	-	-	-	-	-	-	-	-	-	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	0	9	100
3458	24,1	13,2	725	16	-	-	-	-	-	-	-	-	-	-	3	2	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	2	7	43
3346	31,12	15,575	730	23	-	-	-	-	-	-	-	-	-	-	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13	0	13	56
2978	28,4	14,2	736	38	-	-	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	12	0	12	31
3921	19,1366	11,1666	738	4	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	2	50
3885	17,5666	11,2833	779	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0	2	20
3846	20,5833	11,8667	810	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	1	100
3869	19,9167	11,3667	825	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	1	100
3113	31,3667	15,5833	840	16	-	-	-	-	-	-	-	-	-	-	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	12	0	12	75
3525	22,9333	12,8	850	14	-	-	-	-	-	-	-	-	-	-	10	2	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	2	13	92
3461	23,9583	13,0166	850	13	-	-	-	-	-	-	-	-	-	-	7	2	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	2	10	76
3109	31,9	15,9	900	80	-	-	-	-	-	-	-	-	-	-	41	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	41	1	42	52
2697	30,2833	14,3167	940	12	-	-	-	-	-	-	-	-	-	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	0	9	75
3704	19,3666	11,06	941	16	-	-	-	-	-	-	-	-	-	-	14	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	2	16	100
3341	32,6833	16,5167	945	36	-	-	-	-	-	-	-	-	-	-	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	24	0	24	66
Total valves				24059	6235	1946	5266	223	442	48	989	35	11	8	415	14	637	0	486	25	414	61	55	7	3	2	23	16	396	27	695	7	490	57	993	318	43	0	436	64	18	2	18046	2861	20907	87
% Relict					34,5	-	29,1	-	2,4	-	5,4	-	0,0	-	2,2	-	3,5	-	2,6	-	2,2	-	0,3	-	0,0	-	0,1	-	2,1	-	3,8	-	2,7	-	5,5	-	0,2	-	2,4	-	0,0					
% Modern					-	68,0	-	7,7	-	1,6	-	1,2	-	0,2	-	0,4	-	0	-	0,8	-	2,1	-	0,2	-	0,0	-	0,5	-	0,9	-	0,2	-	1,9	-	11,1	-	0	-	2,2	-	0,0				
% Subtotal					39,1	-	26,2	-	2,3	-	4,8	-	0,0	-	2,0	-	3,0	-	2,4	-	2,2	-	0,2	-	0,0	-	0,1	-	2,0	-	3,3	-	2,6	-	6,2	-	0,2	-	2,3	-	0,0	-				
% Total ostracod fauna					33,8	-	22,7	-	2,0	-	4,2	-	0,0	-	1,7	-	2,6	-	2,1	-	1,9	-	0,2	-	0,0	-	0,1	-	1,7	-	2,9	-	2,2	-	5,4	-	0,1	-	2,0	-	0,0	-				

Abbreviations: R = relict fauna, M = modern fauna

TABLE 3

Taxa described in this paper, and their abundance as a percentage of the fauna of the 183 samples in which they occur.

	Percentage of fauna		
	Total	Modern	Relict
Pseudokeijella lepralioides (Brady)	39,0	67,9	34,5
Ruggieria cytheropteroides (Brady)	26,2	7,7	29,1
Bensonia sp.	6,4	11,1	5,6
Bensonia knysnaensis knysnaensis (Benson & Maddocks)	6,2	11,1	5,4
Bensonia knysnaensis robusta subsp. nov.	0,2	0	0,2
Ambostracon spp.	7,2	3,0	7,9
Ambostracon keeleri sp. nov.	4,8	1,6	5,4
Ambostracon flabellicostata (Brady)	2,3	1,2	2,4
Ambostracon levetzovi (Klie)	0,1	0,4	0,1
Henryhowella melobesioides (Brady)	2,0	0,4	2,2
Cytherella spp.	5,3	1,1	5,9
Cytherella dromedaria Brady	3,3	0,2	3,8
Cytherella namibensis sp. nov.	2,0	0,9	2,1
Paracypris lacrimata sp. nov.	2,6	1,9	2,7
Doratocythere exilis (Brady)	3,0	0	3,5
Neocytherideis boomeri sp. nov.	2,4	0,9	2,6
Xestoleberis spp.	2,4	2,3	2,4
Xestoleberis africana Brady	2,3	2,2	2,4
Xestoleberis hartmanni sp. nov.	0,1	0,1	0,1
Loxoconchidae	2,7	2,9	2,8
Palmoconcha walvisbaiensis (Hartmann)	2,3	2,1	2,3
Palmoconcha? walvisridgensis sp. nov.	0,1	0,5	0,1
Kuiperiana angulata sp. nov.	0,2	0,2	0,3
Palmoconcha subrhomboidea (Brady)	0,1	0,1	0,1

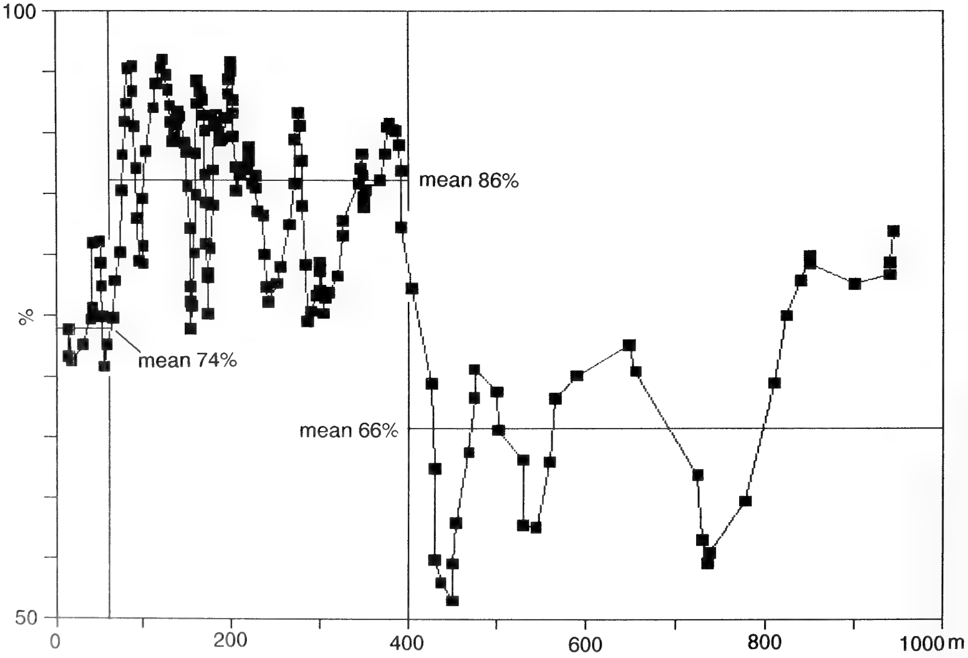

Fig. 2. Distribution with depth across the continental margin of south-western Africa of the combined abundances of the dominant species (5-point running mean of percentage of total ostracod fauna). Mean values for various shelf zones are shown by horizontal lines. The faunas described herein are seen to be primarily typical of the continental shelf (60–400 m water depths).

range 400–800 m. In summary, the species dealt with in this paper are dominantly a mid-shelf to outermost shelf assemblage (60–400 m).

Using criteria based on shell preservation, all individual specimens have been classified into one of two categories: ‘modern’ (i.e. living, or dead but well preserved, translucent valves) and ‘relict’ (opaque valves that are abraded and/or corroded). In terms of overall population abundance, the rankings of the dominant taxa are similar for the two categories (Fig. 3), the main difference being the relatively greater importance of *Bensonia knysnaensis* in the modern fauna (2nd) compared to the relict populations (5th). However, the dominance of *Pseudokeijella lepralioides* is much greater in the modern (67,9%) than in the relict fauna (34,5%), and contrasts with a

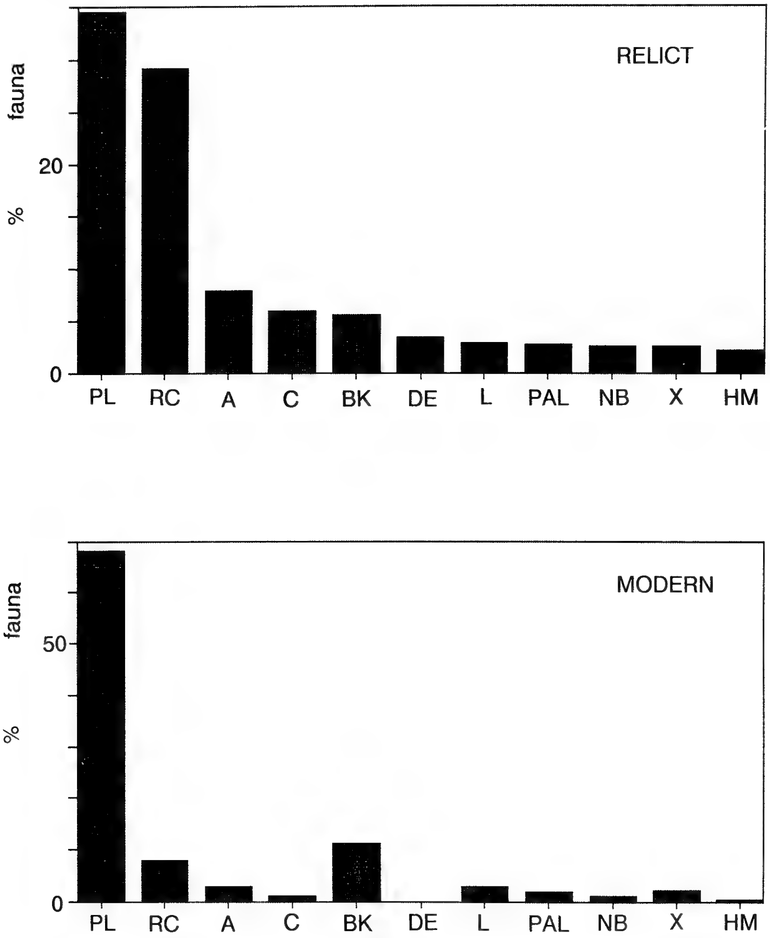

Fig. 3. Rankings of the dominant taxa in the total relict and modern ostracod assemblages from the continental margin of south-western Africa (shown as a percentage of the fauna of the samples in which they occur). Abbreviations: PL—*Pseudokeijella lepralioides*, RC—*Ruggieria cytheropteroides*, A—*Ambostracon (A.)* spp., C—*Cytherella* spp., BK—*Bensonia knysnaensis*, DE—*Doratocythere exilis*, L—loxoconchids, PAL—*Paracypris lacrimata*, NB—*Neocytherideis boomeri*, X—*Xestoleberis* spp., HM—*Henryhowella melobesioides*.

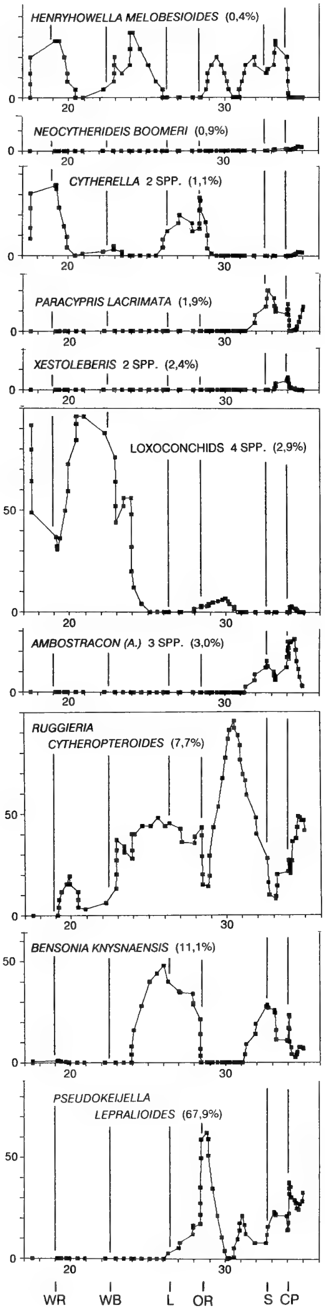

Fig. 4. Latitudinal abundances of species in modern populations expressed as percentages of the modern fauna, arranged in descending order of overall abundance (in parenthesis). Data are double 5-point running means. Vertical scale = percentage, horizontal scale = degrees of latitude. Abbreviatons: WR—north edge of Walvis Ridge abutment shelf; WB—Walvis Bay; L—Lüderitz; OR—Orange River; S—Saldanha; CP—Cape Peninsula.

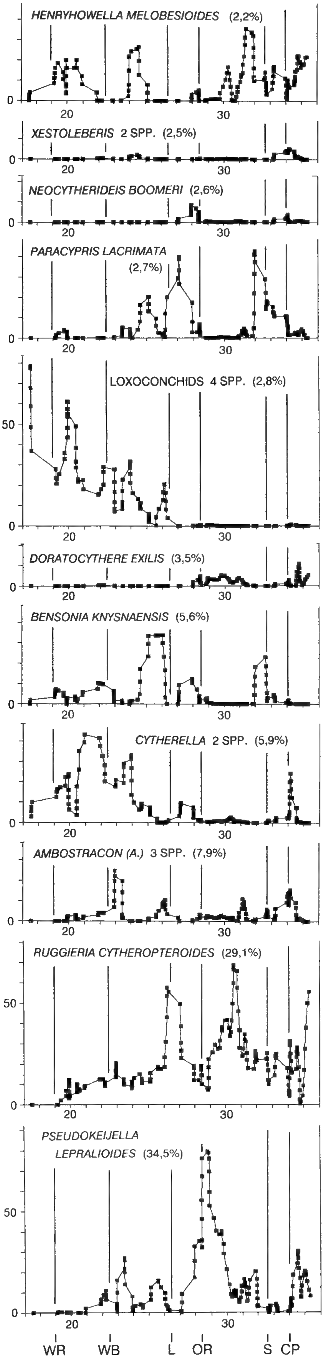

Fig. 5. Latitudinal abundances of species in relict populations expressed as percentage of the whole fauna; arranged in descending order of overall abundance (in parenthesis). Data are double 5-point running means. Vertical scale = percentage, horizontal scale = degrees of latitude. Abbreviations: WR—north edge of Walvis Ridge abutment shelf; WB—Walvis Bay; L—Lüderitz; OR—Orange River; S—Saldanha; CP—Cape Peninsula.

corresponding diminution in importance in *Ruggieria cytheropteroides* (7,7% and 29,1%, respectively). In addition, *Doratocythere exilis* (6th ranking in relict populations), has not been identified in the modern fauna. Invariably, the regional distribution of the modern and relict populations of each species show differences (Figs 4, 5), details of which will be presented for individual species in the taxonomic notes, with a brief summary in the discussion section at the end of the paper.

Sediment samples used in this study were retrieved from the top 10 cm of the seafloor using a Van Veen grab. They were collected from the University of Cape Town's research vessel 'Thomas B. Davie' (sample numbers have a TBD prefix), and the original samples are retained in the store of the Marine Geoscience Unit, University of Cape Town.

Microfossils were picked from 125-micron and larger sieve fractions, and numbered specimens are lodged in the micropalaeontology collections at the South African Museum, Cape Town, under the catalogue prefix SAM–PQ–MF.

LIST OF GENERA AND SPECIES

The genera and species of Ostracoda discussed in this work are given below:

PAGE

Cytherella Jones, 1849 17
  Cytherella dromedaria Brady, 1880
  Cytherella namibensis sp. nov.
Paracypris Sars, 1866 25
  Paracypris lacrimata sp. nov.
Doratocythere McKenzie, 1967 29
  Doratocythere exilis (Brady, 1880)
Bensonia Rossi de Garcia, 1969 32
  Bensonia knysnaensis knysnaensis (Benson & Maddocks, 1964)
  Bensonia knysnaensis robusta subsp. nov.
Neocytherideis Puri, 1952 35
  Neocytherideis boomeri sp. nov.
Ambostracon Hazel, 1962 42
  Ambostracon (Ambostracon) flabellicostata (Brady, 1880)
  Ambostracon (Ambostracon) levetzovi (Klie, 1940)
  Ambostracon (Ambostracon) keeleri sp. nov.
Palmoconcha Swain & Gilby, 1974 54
  Palmoconcha walvisbaiensis (Hartmann, 1974)
  Palmoconcha? walvisridgensis sp. nov.
  Palmoconcha subrhomboidea (Brady, 1880)
Kuiperiana Bassiouni, 1962 61
  Kuiperiana angulata sp. nov.
Ruggieria Keij, 1957 63
  Ruggieria cytheropteroides (Brady, 1880)
Henryhowella Puri, 1957 68
  Henryhowella melobesioides (Brady, 1869)

Pseudokeijella gen. nov. 71
Pseudokeijella lepralioides (Brady, 1880)
Xestoleberis Sars, 1866. 77
Xestoleberis africana Brady, 1880
Xestoleberis hartmanni sp. nov.

SYSTEMATIC DESCRIPTIONS

The classification used here is based on (Moore 1961), with various additions necessitated by subsequent work.

Abbreviations used: AM = anterior margin; ATE = anterior terminal element; C = carapace; CA = cardinal angle; DM = dorsal margin; LV = left valve; MA = marginal area; ME = median element; MPC = marginal pore canal; MS = muscle scars; NPC = normal pore canal; PM = posterior margin; PTE = posterior terminal element; RV = right valve; SCT = subcentral tubercle; VM = ventral margin.

In the discussion of ostracod distributions, UDL, and LDL = upper depth limit, and lower depth limit, respectively.

Class CRUSTACEA Pennant, 1777
Subclass OSTRACODA Latreille, 1806
Order PODOCOPIDA Müller, 1894
Suborder PLATYCOPINA Sars, 1866
Family **Cytherellidae** Sars, 1866

Genus *Cytherella* Jones, 1849

At least twelve species of *Cytherella* have been reported from the late Cenozoic of southern Africa, seven from the Quaternary. Four of these occur on the continental shelf of south-western and southern Africa: *Cytherella dromedaria* Brady, 1880—west coast shelf; *Cytherella namibensis* sp. nov.—west coast shelf; *Cytherella* aff. *C. punctata* Brady, 1866 (Benson & Maddocks 1964)—Knysna Lagoon; and *Cytherella omatsolai* Hartmann, 1974—coastal zone, Luanda to Sandwich Harbour.

Cytherella dromedaria Brady, 1880

Fig. 6A–D

Cytherella dromedaria Brady, 1880: 173, pl. 43 (figs 6a–b). Puri & Hulings, 1976: 312, pl. 24 (fig. 14).
Cytherella sp. aff. *C. cuneiformis* Hartmann, 1974. Keeler, 1981: 185–187, pl. 11 (figs 1–3).

Illustrated material.

SAM–PQ–MF–0509, LV, TBD 6824, 90 m
SAM–PQ–MF–0510, RV, TBD 6824, 90 m
SAM–PQ–MF–0511, RV, TBD 6824, 90 m
SAM–PQ–MF–0512, C, TBD 6824, 90 m

Material

702 valves.

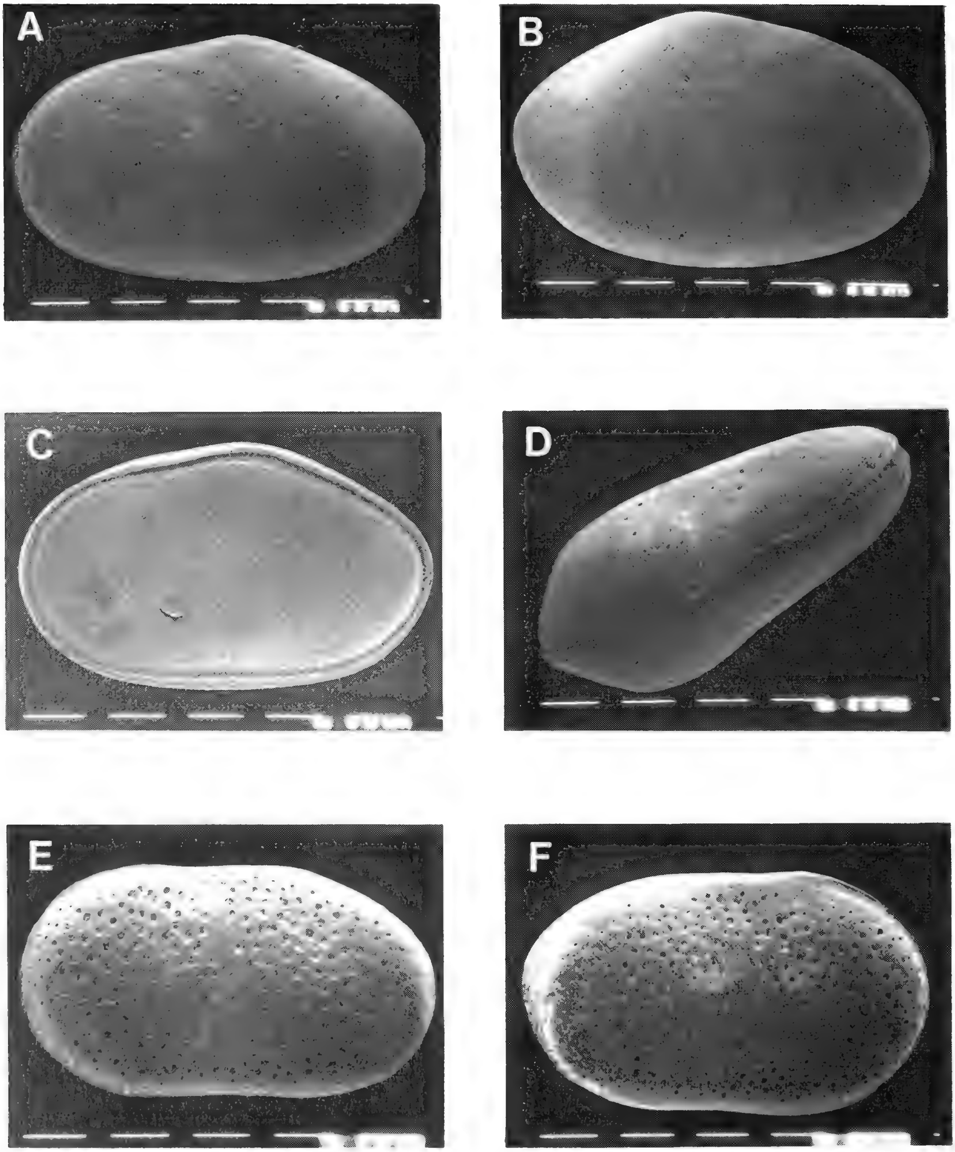

Fig. 6. A–D. *Cytherella dromedaria* Brady, 1880, TBD 6824, 90 m. A. SAM–PQ–MF0509, LV SEM 2575. B. SAM–PQ–MF0510, RV, SEM 2573. C. SAM–PQ–MF0511, RV, SEM 2577. D. SAM–PQ–MF0512, carapace, dorsal view, SEM 2582. E–F. *Cytherella namibensis* sp. nov. TBD 2975, 180 m. E. SAM–PQ–MF0513, holotype, LV, SEM 2643. F. SAM–PQ–MF0514, RV, SEM 2640. Scale bars = 100 microns.

Remarks

This distinctive species has a strongly gibbous DM, and numerous large normal pore openings on the lateral surface. The AM in each valve has a very narrow rim that is clearly seen in dorsal view.

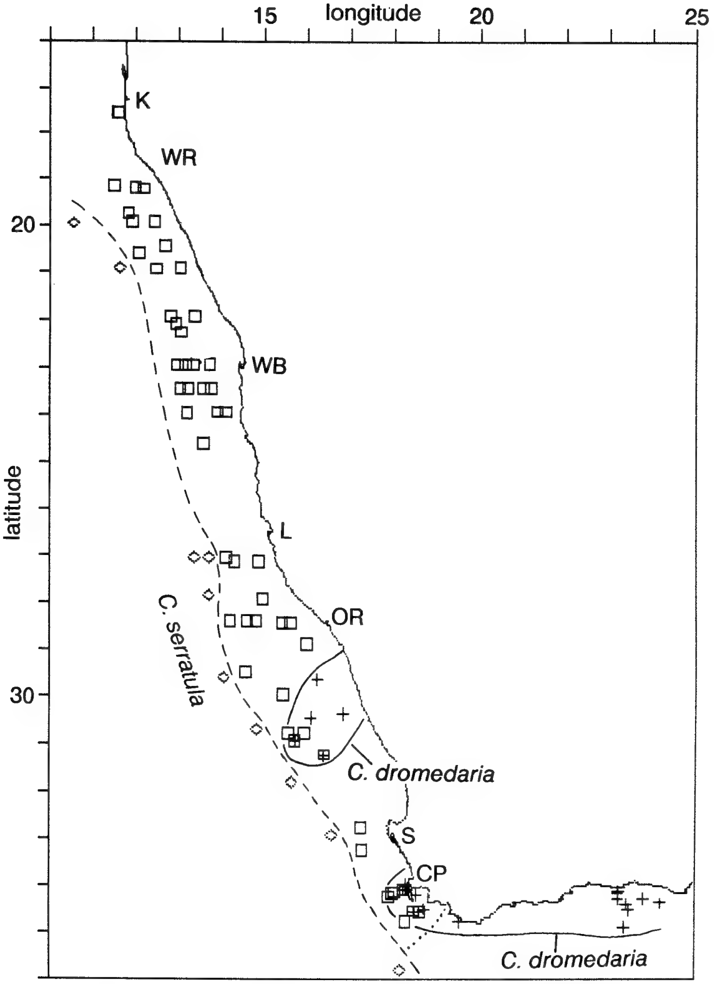

Fig. 7. Distribution of *Cytherella* spp. Squares—*C. namibensis* sp. nov. (southern limit shown as dotted line south-east of the Cape Peninsula); crosses—*C. dromedaria* (Brady) (seaward limit shown by solid line); diamonds—*C. serratula* (Brady) (landward limit shown by dashed line, after Dingle *et al.* 1990). Abbreviations for this and subsequent distribution maps: K—Kunene River; WR—Walvis Ridge abutment shelf; WB—Walvis Bay; L—Lüderitz; OR—Orange River; S—Saldanha; CP—Cape Peninsula.

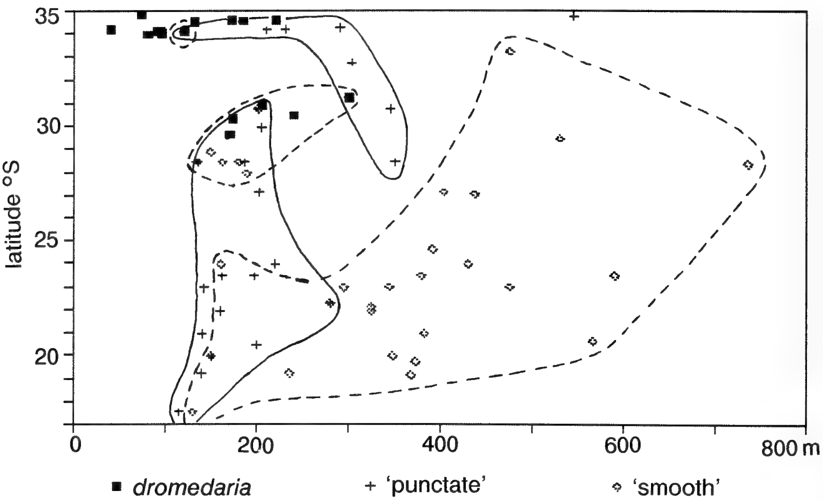

Fig. 8. Latitudinal water-depth distribution of sites with *Cytherella dromedaria* and *C. namibensis* sp. nov. Field outlines: solid line = 'punctate' variety of *C. namibensis*; dashed line = 'smooth' variety of *C. namibensis*.

Distribution

Brady (1880) originally recorded this species from 'Challenger' Station 104 in False Bay. The present data indicate that it is confined to the west and south coast continental margins south of 29,5°S (Fig. 7).

Modern specimens were recovered from two sites: west of Hout Bay (94 m) and west of Cape Agulhas (73 m).

Relict populations are confined to two areas. The northernmost lies on the middle to outer shelf (170–300 m—Fig. 8) between the Orange and Olifants rivers, where abundances are generally low (>5% at one of four sites). A southern population (central Cape Peninsula to the eastern Agulhas Bank) has UDL and LDL of 40–220 m, and includes the two modern sites. Abundances in the southern sector are relatively high (>5% at four of eleven sites), and the preferred water depth of the relict populations of *Cytherella dromedaria* was *c.* 100 m (Fig. 11).

Cytherella namibensis sp. nov.

Figs 6E–F, 9A–D, 10A

?*Cytherella sordida* Müller, 1894. Bold, 1966: 158–159, pl. 1 (fig. 10).
?*Cytherella* aff. *C. sordida* Müller, 1894. Dingle, 1976: 39, fig. 12 (39).
Cytherella spp. Boomer, 1985: 12–13, pl. 1 (figs 16–17).

Derivation of name

From the type locality of the species adjacent to the Namib Desert, south-western Africa.

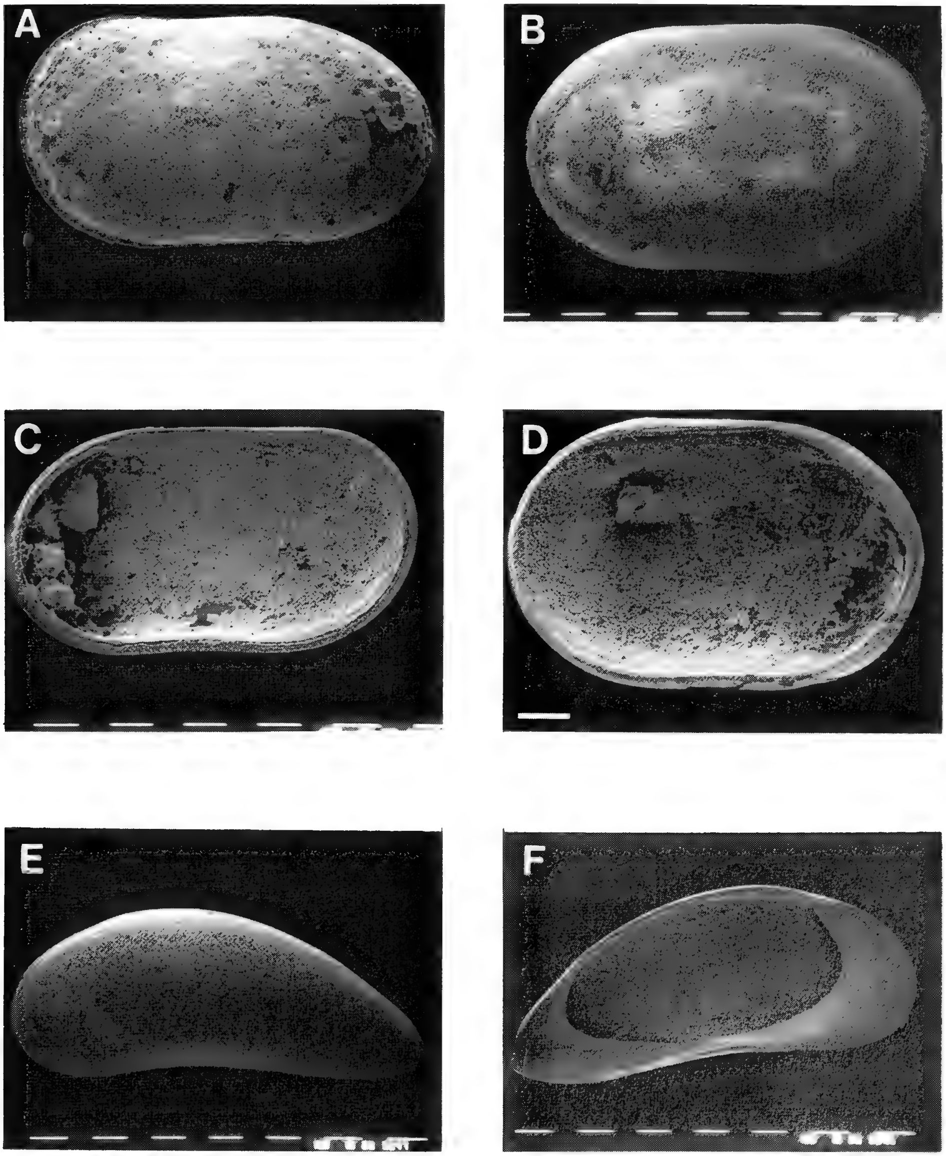

Fig. 9. A–D. *Cytherella namibensis* sp. nov. A–C. TBD 2971, 162 m. A. SAM–PQ–MF0515, LV, SEM 2648. B. SAM–PQ–MF0516, RV, SEM 2647. C. SAM–PQ–MF0517, LV, SEM 2650. D. SAM–PQ–MF0518, RV, TBD 2975, 180 m, SEM 2645. E–F. *Paracypris lacrimata* sp. nov., TBD 6846, 95 m. E. SAM–PQ–MF0519, holotype, LV, SEM 3047. F. SAM–PQ–MF0520, LV, SEM 3045. Scale bars = 100 microns.

Holotype

	length	height
SAM–PQ–MF–0513, LV, TBD 2975, 180 m	0,68 mm	0,39 mm

Paratypes

	length	height
SAM–PQ–MF–0514, RV, TBD 2975, 180 m	0,70 mm	0,42 mm
SAM–PQ–MF–0515, LV, TBD 2971, 162 m	0,75 mm	0,42 mm
SAM–PQ–MF–0516, RV, TBD 2671, 162 m	0,93 mm	0,60 mm
SAM–PQ–MF–0517, LV, TBD 2971, 162 m	0,80 mm	0,48 mm
SAM–PQ–MF–0518, RV, TBD 2975, 180 m	0,72 mm	0,50 mm

Material

423 valves.

Diagnosis

Punctate species of *Cytherella* with greatest height in anterior third. AM outline has a bulbous appearance, posterodorsal outline slopes steeply posteriorly, DM is straight, but the dorsal outline in lateral view is distinctly concave. Posteroventral area of valve is inflated, and has a curved, angular outline.

Description

The AM is broadly and symmetrically rounded. Bulbous in lateral view because the greatest height lies in the anterior third of the valve. PM outlines differ: in LV the outline is asymmetric, with a distinctive posterodorsal slope, whereas in RV the outline is more symmetric, although there is slight acumination along the line of greatest length. In both valves the DM and VM are essentially straight, but the outline of the former in lateral view is distinctly concave around mid-length. In both valves there is a small but distinctive posteroventral angularity, that in RV forms a slight angular projection.

Surface ornamentation punctate, it grades from punctate overall, to specimens in which the main punctation is confined to the PM, with rare, scattered puncta in the anterior half of the valve.

Internal features are typical for the genus.

Remarks

The end members of the 'punctate' and 'smooth' series are easily distinguished, and overall their geographical distributions are distinct. It is tempting to split the group into two species but, in the case of numerous individuals, the distinction would be arbitrary.

Brady (1880) did not record *Cytherella* from 'Challenger' Station 142 on the continental shelf off the Cape of Good Hope, but illustrated several punctate specimens from widely separated localities under the name *C. punctata* Brady, 1866. The types of the latter are from the eastern Mediterranean and have a distinct dorsomedian depression, and have a straighter DM than *C. namibensis*. Of the specimens allocated to *C. punctata* in the 'Challenger' report (Brady 1880), those from Port Jackson (Australia) are closest to the types, whereas all others all have a distinct reniform outline. In the latter category he presumably included material from Tristan da Cunha.

Benson & Maddocks (1964) recorded living punctate specimens of a species referred to *Cytherella* aff. *C. punctata* Brady, 1866, from the Knysna Lagoon. These differ significantly in lateral outline from *C. namibensis*. Their highest point is in the posterior half and they have relatively narrow AM outlines and a straighter DM. Similarly, Hartmann's (1974) species *C. cuneiformis* (coastal Angola) has a strikingly different DM outline to my species (Fig. 10).

In their survey off the River Congo estuary (R. Zaire, 11 m to at least 50 m water depth), Babinot & Kouyoumontzakis (1986) found *Cytherella* sp. aff. *C. punctata* Brady to be the most abundant ostracod taxon. From their clear illustrations it is confidently concluded that they were not dealing with *C. namibensis* because the highest point in the valve outline lies in the posterior part.

Two previously reported Tertiary species from the region are close to *C. namibensis*. These are *C. sordida* Müller (Bold 1966) from Gabon, and *Cytherella* aff. *C. sordida* Müller (Dingle 1976). Both are punctate, and differ only slightly in lateral outline from *C. namibensis*, with which they may be conspecific.

Distribution

Cytherella namibensis sp. nov. occurs along the entire south-west African continental shelf (Fig. 7), but usually there is a subdivision into areas populated by the 'punctate' and 'smooth' varieties.

Modern specimens occur at locations scattered along the shelf from 17,5°S to 28°S (Orange River), where they occupy a depth range 115–295 m. The main cluster lies on the Orange Shelf. Both 'punctate' and 'smooth' varieties occur here.

Relict specimens occur from 17,5°S to the Cape Peninsula, but Keeler (1981) did not find the species on the eastern Agulhas Bank. Almost invariably, the 'punctate'

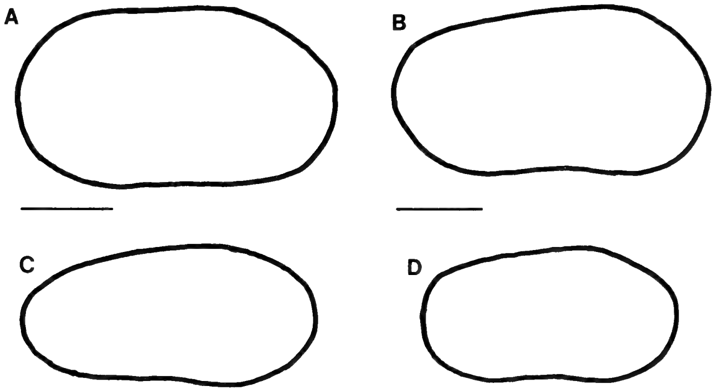

Fig. 10. Outlines of LV of *Cytherella* species. A. *C. namibensis* sp. nov., SAM–PQ–MF0513, holotype, TBD 2975, 180 m. B. *Cytherella* aff. *C. punctata* Brady, 1866, Benson & Maddocks 1964, Knysna estuary, traced from Benson & Maddocks (1964, pl. 1 (fig. 2)). C. *C. cuneiformis* Hartmann, 1974, Angola, traced from Hartmann (1974, pl. 13 (fig. 104)). D. *C. omatsolai* Hartmann, 1974, Angola, traced from Hartmann (1974, pl. 11 (fig. 82)). Scale bars = 200 microns; other scales not known.

variety of the species occurs at shallower water depths than the 'smooth' variety. The 'punctate' variety also predominates off the Cape Peninsula; only two sites south of 31°S yielded the 'smooth' variety. The depth-related partition between the two varieties is well-illustrated in Figure 8. This shows that the 'punctate' type has UDL and LDL between 115 m and 280 m off the Walvis–Orange sector and between 120 m and 345 m off the south-western Cape, in contrast to a 130–590 m range for the 'smooth' variety. (The two sites at 535 m and 736 m, with 'punctate' and 'smooth' types, respectively, are considered allochthonous.) The depth-related preferences of the two morphotypes is further emphasized when abundances are plotted against depth (Fig. 11). The 'punctate' variety peaks at about 220 m, and the 'smooth' variety at about 380 m. Presumably this distribution is linked to depth-related environmental factors.

General remarks on the distribution of the genus Cytherella

Three species are widely distributed on the continental margin of south-western Africa: *C. dromedaria* occurs on the continental shelf south of 28°S, *C. namibensis* occurs on the continental shelf between 17,5°S and the Cape Peninsula (34°S), and *C. serratula* (Brady, 1880) occurs on the continental slope in water depths >1 000 m. Less widely distributed are two coastal species, *C. omatsolai* (as far south as Sandwich Bay, 40 km south of Walvis Bay), and *Cytherella* aff. *C. punctata* (Knysna Lagoon), and the deep-water taxon *Cytherella* sp. 3027 (Dingle *et al.* 1990—2 916 m).

The shelf species *C. dromedaria* and *C. namibensis* both have restricted modern distributions: the former is confined to the Cape Peninsula area, and the latter to areas north of 28°S. In relation to the abundances of other taxa, the modern population of *C. dromedaria* is insignificant but, between the Orange River and Lüderitz, and north of the Walvis Ridge abutment shelf, *C. namibensis* is an important component of the modern fauna (Fig. 4). This distribution suggests that *C. dromedaria* and

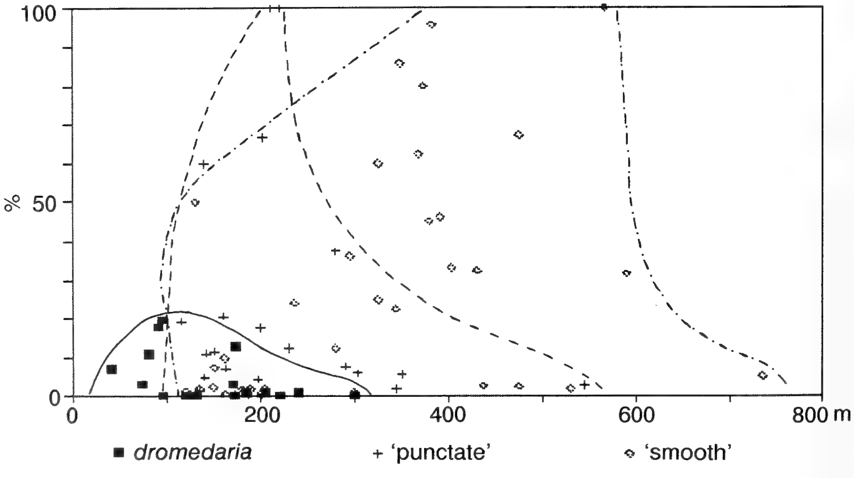

Fig. 11. Abundance of *Cytherella dromedaria* and *C. namibensis* sp. nov. as percentage of ostracod fauna plotted against water depth. Field outlines: solid line = *C. dromedaria*, dashed line = 'punctate' variety of *C. namibensis*, dot-dashed line = 'smooth' variety of *C. namibensis*.

C. namibensis can be considered characteristic of shallow, warm, Agulhas water, and cold west-coast mid-shelf conditions, respectively.

The range of both species is extended in the relict faunas; *C. dromedaria* to the north, and *C. namibensis* to the south, although this was mainly in the 'punctate' variety, exhibiting the tendency of this morphotype to favour inner shelf areas. Considering their relative abundance by latitude (Fig. 5), *C. dromedaria* locally forms an important component of the relict population in the Cape Peninsula–Saldanha Bay area, whereas *C. namibensis* is either the dominant, or one of the dominant species, in the relict ostracod populations over a wide sector of the continental shelf from north of the Walvis Ridge abutment to between Walvis Bay and Lüderitz. South of this it is generally a minor component.

There is a sharp break between the distribution of the neritic (shelf) species and the bathyal *C. serratula*. This has been attributed to the environmental barrier formed by the core of the salinity minimum zone in the Antarctic Intermediate Water at about 750 m (Dingle *et al.* 1989, 1990, fig. 3).

Superfamily CYPRIDACEA Baird, 1845

Family **Paracyprididae** Sars, 1923

Genus *Paracypris* Sars, 1866

In the open literature, only one Quaternary species of this genus has previously been recorded from southern Africa: *Paracypris westfordensis* Benson & Maddocks, 1964, from Knysna Lagoon. No records were made by Brady (1880), Müller (1908), Klie (1940), and Hartmann (1974) in their studies of the region, nor was it recorded by Bold (1966) in the Neogene of Gabon.

Fossil records of the genus in southern Africa have been made from the Cretaceous (e.g. Dingle 1981) and Tertiary (Dingle 1976).

Paracypris lacrimata sp. nov.

Figs 9E–F, 12C, F

Paracypris sp. aff. *P. polita* Sars, 1866. Keeler, 1981: 34–35, pl. 1 (fig. 14).
Paracypris sp. Keeler, 1981: 35–36, pl. 1 (fig. 15).
Pontocypris sp. Boomer, 1985: 16–17, pl. 4 (fig. 64).

Derivation of name

Lacrima—Latin, tear. Refers to tear-shape of valve.

Holotype

	length	height
SAM–PQ–MF–0519, LV, TBD 6846, 95 m	1,24 mm	0,50 mm

Paratypes

	length	height
SAM–PQ–MF–0520, LV, TBD 6846, 95 m	1,20 mm	0,50 mm
SAM–PQ–MF–0521, RV, TBD 6846, 95 m	1,31 mm	0,48 mm
SAM–PQ–MF–0522, LV fragment, TBD 6846, 95 m		

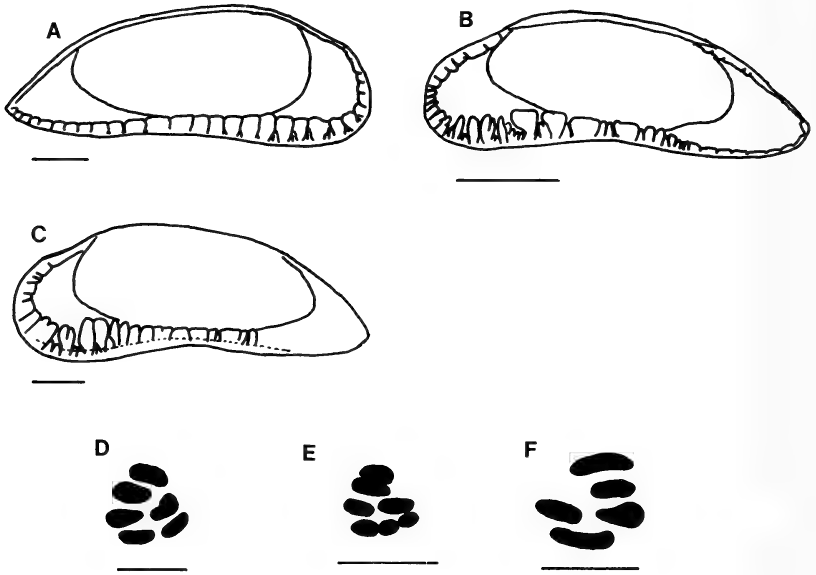

Fig. 12. A–F. *Paracypris*. A, D. *P. polita* Sars, internal view and MS, LV, north-western Europe, traced from Sars (1928, pl. 31). B, E. *P. bradyi* McKenzie, internal view and MS, RV, south-eastern Australia, traced from McKenzie (1967, fig. 2d). C, F. *P. lacrimata* sp. nov., TBD 6846, 95 m. C. SAM–PQ–MF0521, internal view, RV. F. SAM–PQ–MF0522, MS, LV. Scale bars: A–C = 200 microns; D–F = 100 microns.

Material

547 valves.

Diagnosis

Species of *Paracypris* with long, asymmetrical, pointed PM whose apex is strongly ventrally directed. DM strongly convex and VM concave. Highest point lies at about one-quarter valve length. There are *c.* 15 branched anterior radial pore canals, and a MS pattern in which the four anterior-most scars are longitudinally aligned.

Description

External features. Broadly rounded AM that is somewhat ventrally directed, and a strongly acuminate PM that is also ventrally directed. DM strongly arched, with the highest point at about one-quarter valve length. VM concave. Overall the outline is tear-drop or comma shaped. RV outline has an anterodorsal step.

Internal features. Wide anterior and posterior vestibulae with *c.* 15 simple and branched anterior radial canals that are larger and more complex anteroventrally. The MS consist of five scars, all elongate, with the four anterior-most aligned longitudinally. The hinge is adont.

Remarks

Many of the penultimate instars have a reddish-brown ?chitinous lining to the outer lamella, which gives the valves a reddish hue seen externally. Also, because these instars appear to be particularly susceptible to decalcification in deeper waters, the presence of the species is recorded as residual brown 'husks'. Sars (1923: 70) in his re-appraisal of his genus mentions that the type species *P. polita* has a reddish brown hue along the ventral side of the valves and that the marginal areas are 'highly chitinized'.

Paracypris lacrimata sp. nov. is very close in both outline and internal features to the holotype *P. polita* Sars, 1866. The new species is slightly more arched along the DM and concave on the VM, giving it a more pronounced tear-drop or comma-like appearance. The definitive differences are in the greater asymmetry and complexity of the AM radial pore canals of the new species, and differences in MS pattern (see

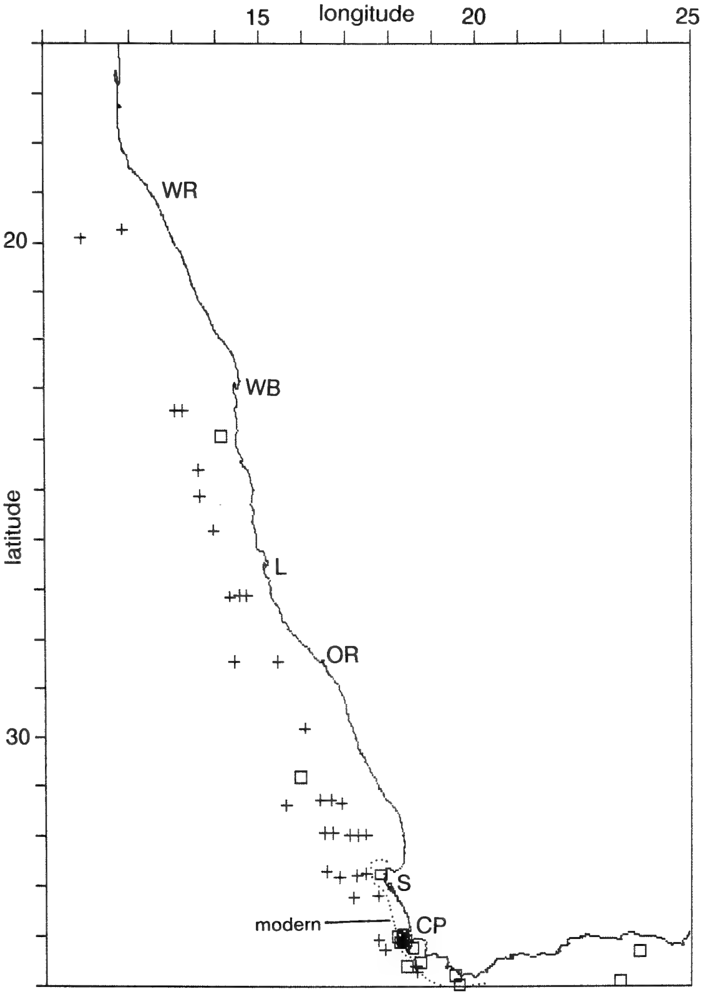

Fig. 13. Distribution of *Paracypris lacrimata* sp. nov. Squares = sites with calcareous valves; crosses = sites with red/brown husks. Dotted line is the seaward limit of modern populations. See Fig. 7 for abbreviations.

Fig. 12). *Paracypris lacrimata* lacks the prominent eye spot described by Sars (1923) for *P. polita*.

A further close relative is *P. bradyi* McKenzie, 1967, from south-east Australia. This species has more numerous AM radial pore canals and a different outline in both the AM and PM inner lamella. There is a slight difference in MS disposition between the two species (Fig. 12).

Although it occurs geographically close by, *P. westfordensis* Benson & Maddocks, 1964, from the Knysna Lagoon is easily distinguished by being less acuminate posteriorly, and having a less broadly rounded AM outline.

Distribution

Specimens of *P. lacrimata* occur along the continental shelf from 19°S (Walvis Ridge shelf) to the south-western Cape and across to the eastern Agulhas Bank (Fig. 13).

Modern populations all lie in a depth range 15–133 m between Saldanha Bay and Cape Agulhas.

Relict distribution is complicated by post-mortem decalcification (?by oxygen-depleted waters). These populations extend as far north as the Walvis Ridge but, with two exceptions, all the specimens north of 33°S consist of chitinous husks. These presumably represent decalcified material, because the two calcareous valves mentioned are in a poor state of preservation. Off the south-western Cape, relict populations consist of calcified material, with only a small proportion of chitinous 'valves'. The depth ranges over which these relict populations are found varies with latitude (Fig. 14). North of 27°S, the UDL is >200 m (with the exception of the calcite valve from 24°S at 161 m), but farther south, the UDL of the chitinous material is *c.* 150 m, and off the south-west the shallowest depth with 'husks' is 94 m. The LDL increases

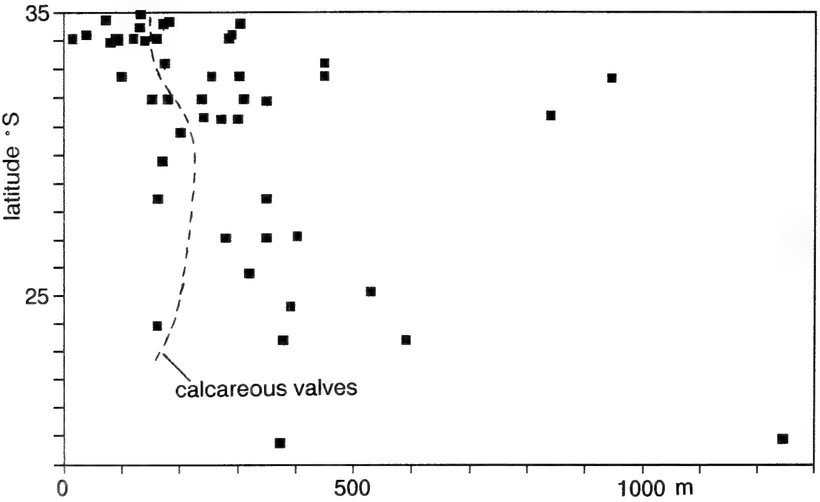

Fig. 14. Latitudinal water-depth distribution of sites with *Paracypris lacrimata* sp. nov. Dashed line shows LDL of specimens with calcareous valves.

northwards, from 450 m in the south, to 590 m near Walvis Bay. The three records of single specimens at >800 m are probably allochthonous because they are so much farther downslope.

Superfamily CYTHERACEA Baird, 1850

Family **Campylocytherididae** Puri, 1960

Subfamily Campylocytheridinae Puri, 1960

Genus *Doratocythere* McKenzie, 1967

McKenzie (1967) erected this genus for certain species that occur at inshore locations along the coast of southern Australia. It has since been reported from Japan (Ishizaki & Matoba 1985), but the illustrations in this publication do not appear very close to the types illustrated by McKenzie (1967). Kempf (1988) cited no additional records of the genus, so currently available records probably confine the genus to the Southern Hemisphere.

Doratocythere exilis (Brady, 1880)

Fig. 15A–F

Cythere exilis Brady, 1880: 69, pl. 16 (figs 5a–h). Puri & Hulings, 1976: 276, pl. 10 (figs 1–11).
Doratocythere exilis (Brady, 1880) Keeler, 1981: 39–41, pl. 1 (figs 20–22).
Reymentia exilis (Brady, 1880) Boomer, 1985: 49–50, pl. 2 (fig. 21).

Illustrated material

SAM–PQ–MF–0523, LV, TBD 2975, 180 m
SAM–PQ–MF–0524, RV, TBD 2975, 180 m
SAM–PQ–MF–0525, LV, TBD 2975, 180 m
SAM–PQ–MF–0526, RV, TBD 2975, 180 m
SAM–PQ–MF–0527, C, TBD 6824, 90 m

Material

673 valves.

Remarks

Brady's (1880) species accords well with McKenzie's (1967) descriptions and illustrations of the type species (*D. foveata*). There are three points of difference:

1. In *D. exilis* there is no appreciable thickening of the valve wall in the vicinity of the ATE.
2. The small 'micropunctate interscar' area of *D. foveata* could not be identified in *D. exilis*, although in well-preserved specimens a small spot lies in this position.
3. *Doratocythere exilis* has a prominent fulcral point anterodorsal to the MS. No similar feature was mentioned in the species described by McKenzie.

Of these points, the first appears to be the most significant because McKenzie (1967) emphasized its presence as generically diagnostic. However, we do not consider the difference important enough to warrant the erection of a new genus for the South African taxon.

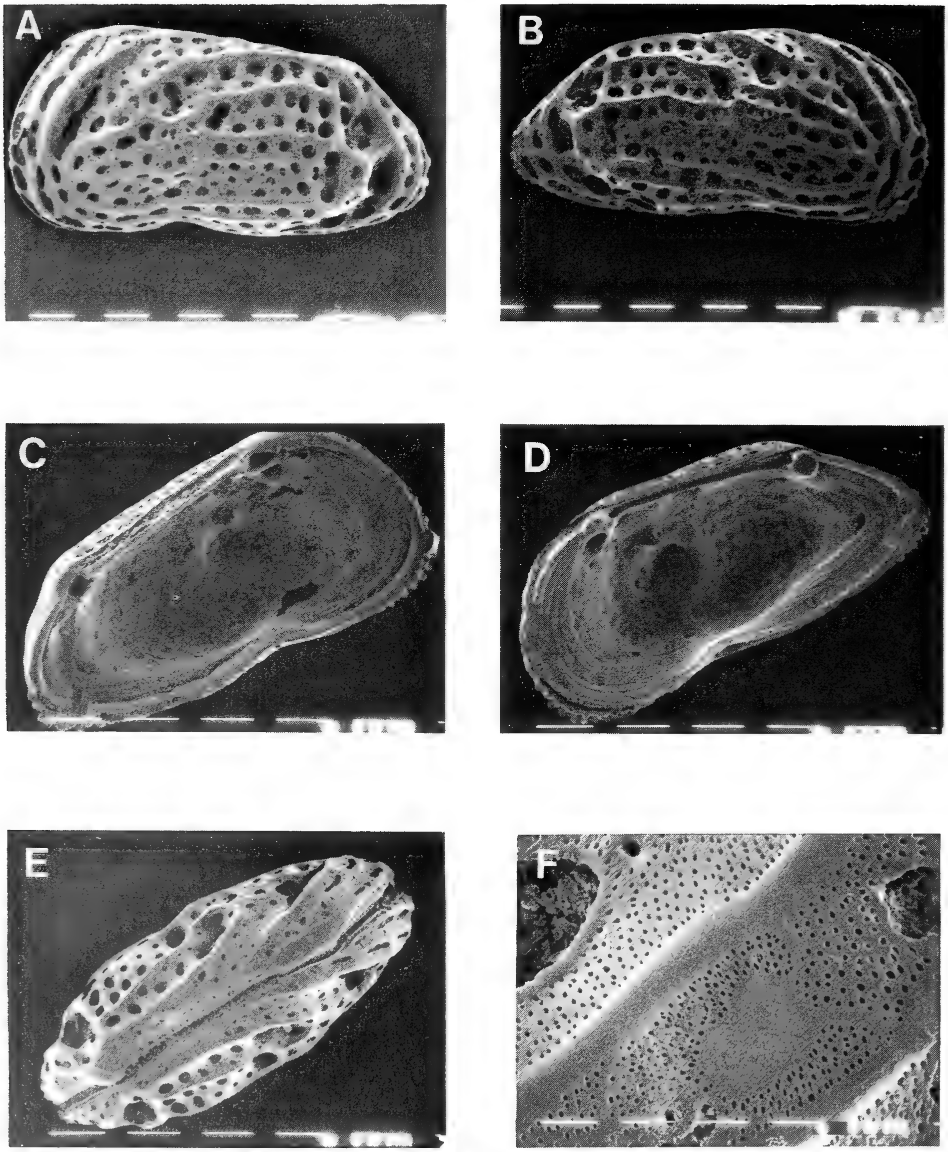

Fig. 15. A–F. *Doratocythere exilis* (Brady, 1880). A–D. TBD 2975, 180 m. A. SAM–PQ–MF0523, LV, SEM 2476. B. SAM–PQ–MF0524, RV, SEM 2478. C. SAM–PQ–MF0525, LV, SEM 2489. D. SAM–PQ–MF0526, RV, SEM 2480. E–F. SAM–PQ–MF0527, carapace, TBD 6824, 90 m. E. Dorsal view, SEM 2494. F. Detail of ornamentation, dorsal surface, mid-length, LV. Scale bars: A–E = 100 microns; F = 10 microns.

SEM photographs of *D. exilis* reveal that the crests of the prominent longitudinal ribs consist of a narrow, smooth cord, and that the flanks and non-punctate intercostal areas have a delicate secondary reticulation.

Distribution

No modern specimens of *D. exilis* were recovered.

Relict populations occur on the continental shelf from 22°S to south-western Cape, and Keeler (1981) reported the species on the eastern Agulhas Bank (Fig. 16).

The main distribution lies between 28° and 31,5°S (Orange–Namaqualand shelves), where, in several samples, the species constitutes >10 per cent of the total ostracod population. The depth range in this area is 158–305 m (Fig. 17), with the greatest abundances between 155 m and 200 m.

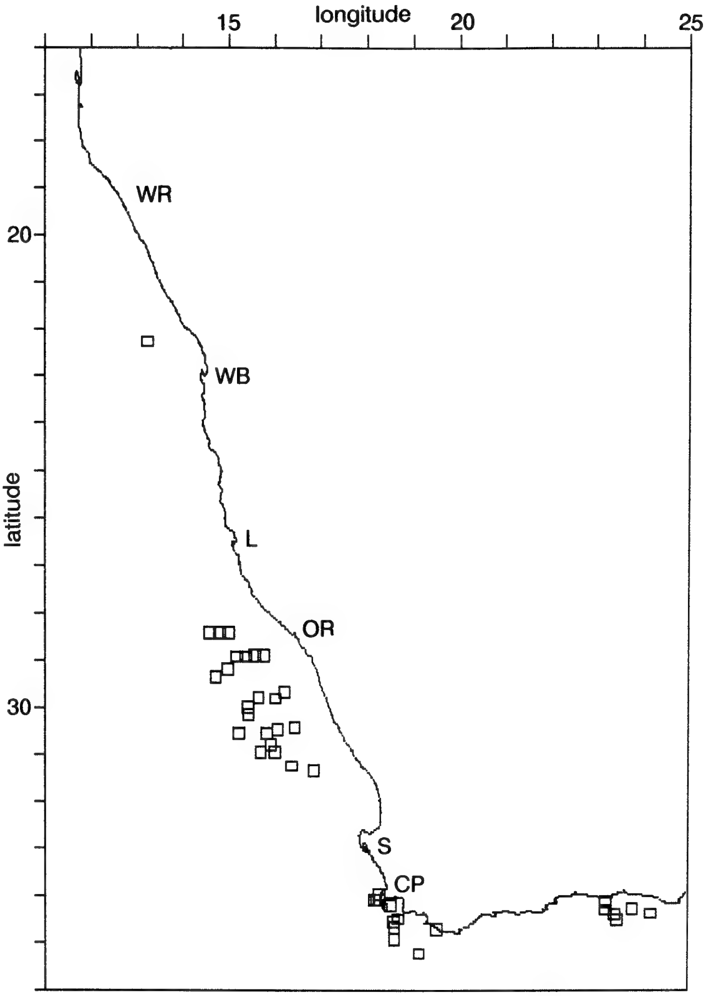

Fig. 16. Distribution of *Doratocythere exilis* (Brady). See Fig. 7 for abbreviations.

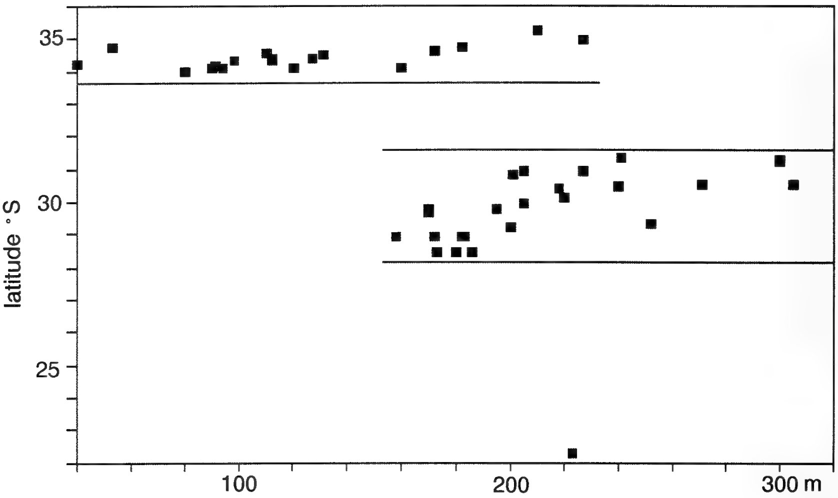

Fig. 17. Latitudinal water-depth distribution of sites with *Doratocythere exilis*. Horizontal lines delimit across-shelf populations.

A barren zone occurs between the mid-Namaqualand shelf and Saldanha, to the south of which the south-western Cape population occurs in a depth range 40–227 m. Although in this area the UDL is much shallower than farther north, the greatest abundances occur in a similar depth range to the Orange–Namaqualand population. This centre may be continuous with that on the eastern Agulhas Bank, which is within the same depth range.

A single, worn valve occurred anomalously at 22,25°S at 223 m.

Comparing the latitudinal abundance of *D. exilis* with the other dominant taxa (Fig. 5), shows that it is never more than a secondary component of the overall ostracod populations, although locally west of the Cape Peninsula it is the fourth most abundant taxon. In addition, together with *Ambostracon* spp., *D. exilis* is a characteristic element of the northern part of the Namaqualand shelf fauna.

Family **Cytherettidae** Triebel, 1952

Subfamily Cytherettinae Howe, 1961

Genus *Bensonia* Rossi de Garcia, 1969

This genus appears to be confined to the Atlantic Ocean. It probably first appeared in southern Africa in the Upper Eocene.

Bensonia knysnaensis knysnaensis (Benson & Maddocks, 1964)

Fig. 18A–F

Cytheretta knysnaensis Benson & Maddocks, 1964: 22–23, text-figs 11–12, pl. 2 (figs 7–11).
Bensonia knysnaensis (Benson & Maddocks, 1964) Keeler, 1981: 43–45, pl. 2 (figs 2–4).
Cytheretta sp. Boomer, 1985: 24–25, pl. 3 (fig. 44).

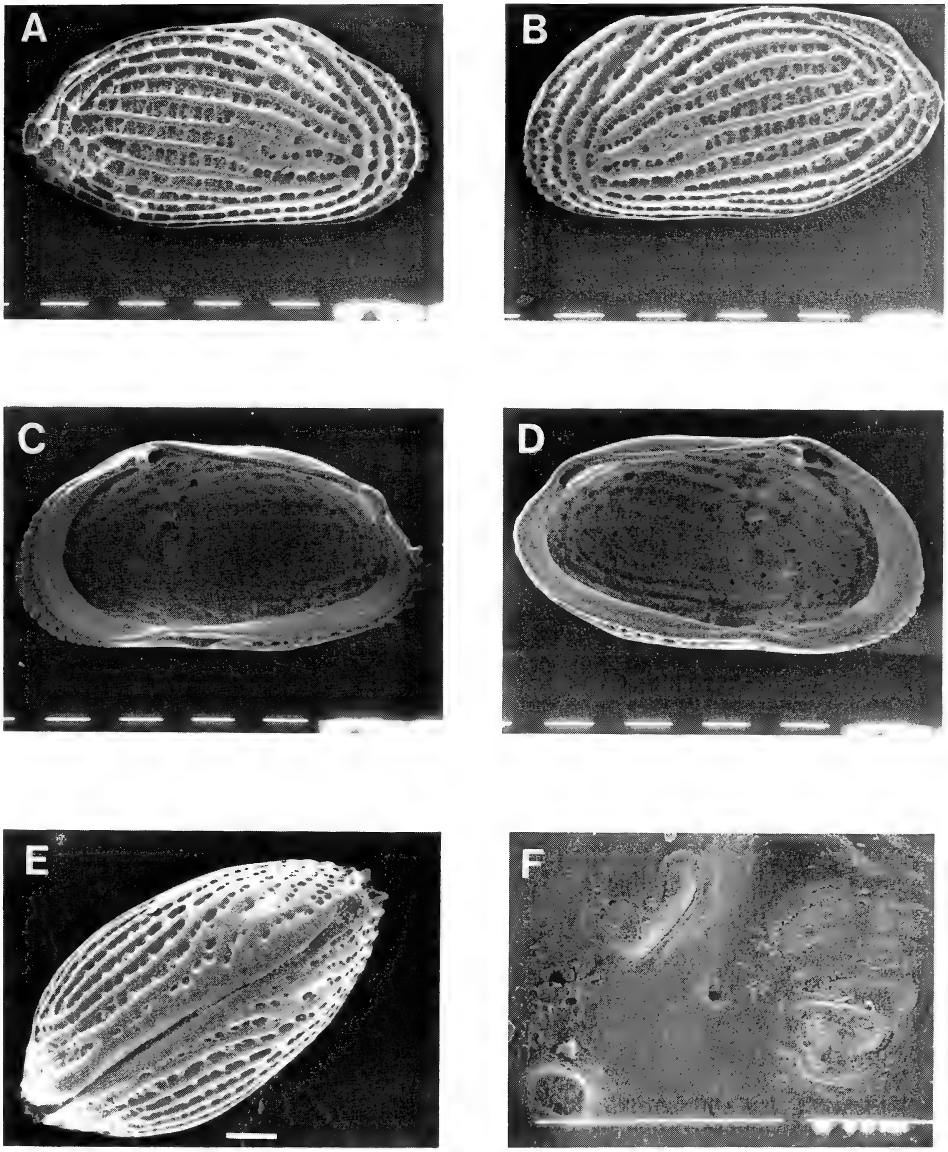

Fig. 18. A–F. *Bensonia knysnaensis knysnaensis* (Benson & Maddocks, 1964), TBD 2224, 58 m. A. SAM–PQ–MF0528, RV, SEM 2455. B. SAM–PQ–MF0529, LV, SEM 2452. C. SAM–PQ–MF0530, RV, SEM 2462. D. SAM–PQ–MF0531, LV, SEM 2459. E. SAM–PQ–MF0535, carapace, dorsal view, SEM 2456. F. SAM–PQ–MF0530, RV, MS, SEM 2464. Scale bars = 100 microns.

Illustrated material

SAM–PQ–MF–0528, RV, TBD 2224, 58 m
SAM–PQ–MF–0529, LV, TBD 2224, 58 m
SAM–PQ–MF–0530, RV, TBD 2224, 58 m
SAM–PQ–MF–0531, LV, TBD 2224, 58 m
SAM–PQ–MF–0532, C, TBD 2224, 58 m

Material

1 311 valves.

Remarks

Our material is identical to that described by Benson & Maddocks (1964) from Knysna Lagoon. The marginal areas are not typical of the genus *Cytheretta* (as mentioned by Benson & Maddocks in the original description), and the species is best accommodated in *Bensonia*, erected by Rossi de Garcia (1969) for material from the Miocene of Argentina.

A, species with very similar ornamentation (slightly coarser ribbing), lateral outline, and hinge structure was recorded as *?Leguminocythereis* sp. 1 from the Upper Eocene of the JC–1 borehole offshore Natal (Dingle 1976). This specimen should probably also be referred to the genus *Bensonia*.

Distribution

Benson & Maddocks (1964) recorded this species from Knysna Lagoon, where it was the dominant taxon (30%) at Leisure Island. They quoted the high- and low-water salinity ranges at this site as 33–35‰, suggesting that *B. k. knysnaensis* can tolerate salinities slightly below 'normal' marine values.

Modern populations of *B. knysnaensis knysnaensis* have been encountered in two main offshore areas (Figs 20, 21): off Lüderitz (31–88 m) and between the south-western Cape and the eastern Agulhas Bank (15–94 m), and also in Knysna Lagoon, where Hartmann (1974: 296) reported a relatively sparse fauna at Leisure Island. This pattern suggests that south of 25°S the species has a modern distribution of inshore to mid-shelf. I record a geographically isolated single modern valve at 19°S at 236 m on the Walvis Ridge abutment, the presence of which is difficult to reconcile with the main population centres. Smoothed plots of latitudinal variations in abundance of modern *B. k. knysnaensis* (Fig. 4) show that, together with *Ruggieria cytheropteroides*, it is the dominant taxon in the Orange River–Lüderitz sector, and the southern part of the Lüderitz–Walvis Bay shelf sector. It is also locally one of the main elements in the modern fauna in the Saldanha–northern Cape Peninsula region.

Relict specimens have a wide distribution, from 19°S on the Walvis Ridge abutment, to the eastern Agulhas Bank. The LDL increases from 172 m on the Agulhas Bank, to 236 m on the Walvis Ridge, whereas the UDL varies from inshore (15–31 m) off the south-western Cape and Lüderitz, to 139–149 m in the Orange River and Walvis Ridge areas. Plotting water depth against the percentage of the species in the total ostracod assemblage (Fig. 22) suggests a preferred water depth of 35–95 m. Latitudinal distributions (Fig. 5) show that *B. k. knysnaensis* is an important element in the relict faunas immediately north of Lüderitz, and immediately north of Saldanha.

Bensonia knysnaensis robusta subsp. nov.

Fig. 19A–D

Derivation of name

robustus, Latin, strong—reference to thickened rib ornamentation.

Holotype

	length	height
SAM–PQ–MF–0532, LV, TBD 3972, 200 m	0,71 mm	0,37 mm

Paratypes

	length	height
SAM–PQ–MF–0533, RV, TBD 3972, 200 m	0,68 mm	0,35 mm
SAM–PQ–MF–0534, RV, TBD 3972, 200 m	0,70 mm	0,35 mm

Material

43 valves.

Diagnosis

A heavily celated subspecies of *Bensonia knysnaensis* with thickened rib ornamentation and a smooth anterodorsal surface.

Description

Overall valve architecture and ornamentation are the same as in *B. knysnaensis knysnaensis*, but in the new subspecies individual longitudinal ribs are thicker, with a consequent diminution in size of intercostal grooves and pits. In addition, the anterodorsal region is heavily calcified, resulting in a smooth, plate-like area centred on the eye spot. Similarly calcified, but less extensive areas occur posterodorsally, and over the subcentral region that overlies the MS. Internal features are identical with *B. knysnaensis knysnaensis*.

Remarks and distribution

The morphological features that differentiate the two subspecies of *B. knysnaensis* are attributed to environmental factors. No modern specimens of *B. knysnaensis robusta* have been recovered, and the geographical distribution of the subspecies is restricted to water depths of 140–200 m in a narrow latitudinal range between 20° and 24°S, seaward of the modern mud belt to the west and north-west of Walvis Bay. Only two samples from this area contained *B. knysnaensis knysnaensis* (both relict), and in only one were both subspecies found together.

Family **Cytherideidae** Sars, 1925

Subfamily Neocytherideidinae Puri, 1957

Genus *Neocytherideis* Puri, 1952

This genus has world-wide distribution in shallow-water environments. Its taxonomic status has recently been reviewed by Athersuch (1982).

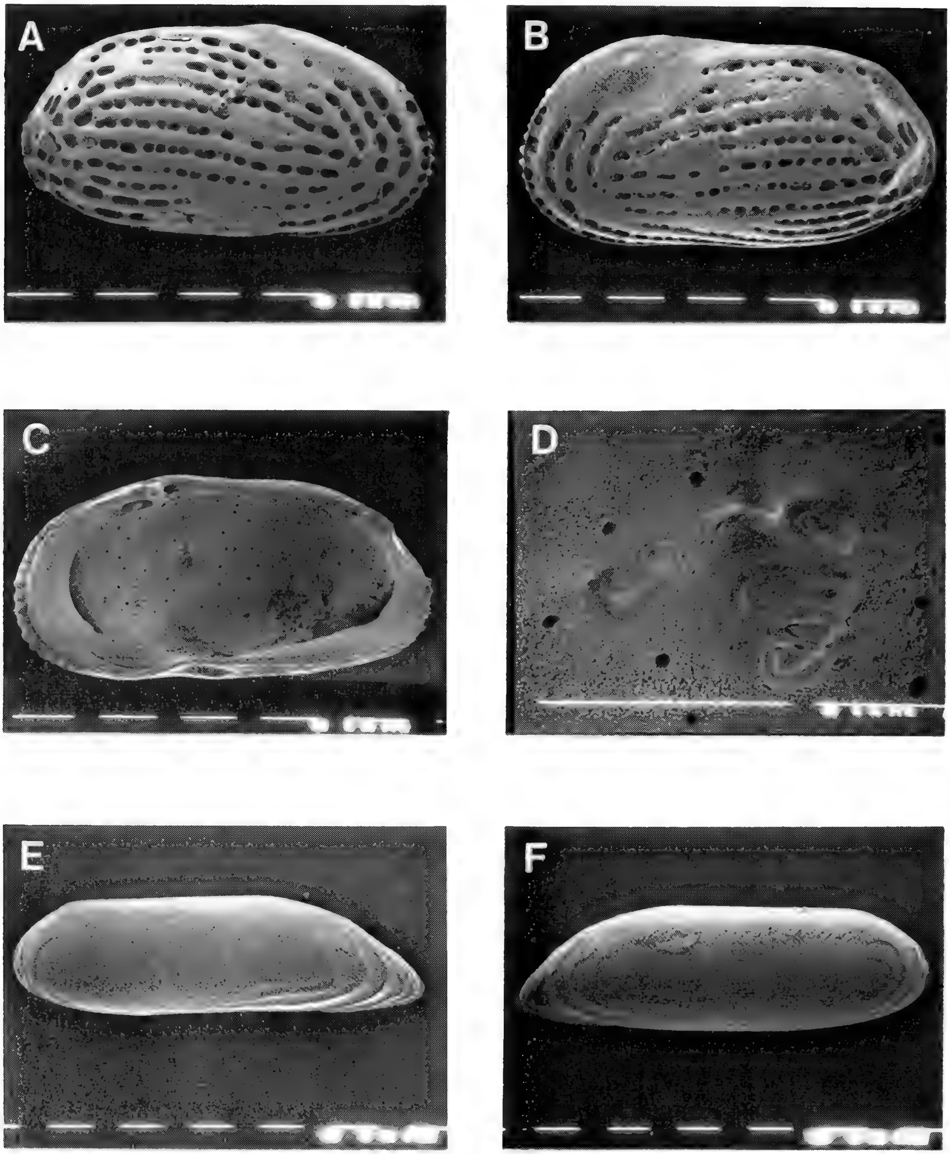

Fig. 19. A–D. *Bensonia knysnaensis robusta* subsp. nov. TBD 3792, 200 m. A. SAM–PQ–MF0533, RV, SEM 2467. B. SAM–PQ–MF0532, holotype, LV, SEM 2469. C–D. SAM–PQ–MF0534, RV. C. Internal view, SEM 2472. D. MS, SEM 2473. E–F. *Neocytherideis boomeri* sp. nov., TBD 6836, 80 m. E. SAM–PQ–MF0536, holotype, RV, SEM 2435. F. SAM–PQ–MF0537, LV, SEM 2433. Scale bars = 100 microns.

Neocytherideis boomeri sp. nov.

Figs 19E–F, 23A–D, 24

Neocytherideis sp. Keeler, 1981: 56–57, pl. 2 (fig. 19).
Copytus sp. Boomer, 1985: 58–59, pl. 3 (fig. 43).

Derivation of name

Named for Dr I. D. Boomer (University of East Anglia) who first noted the species off south-western Africa.

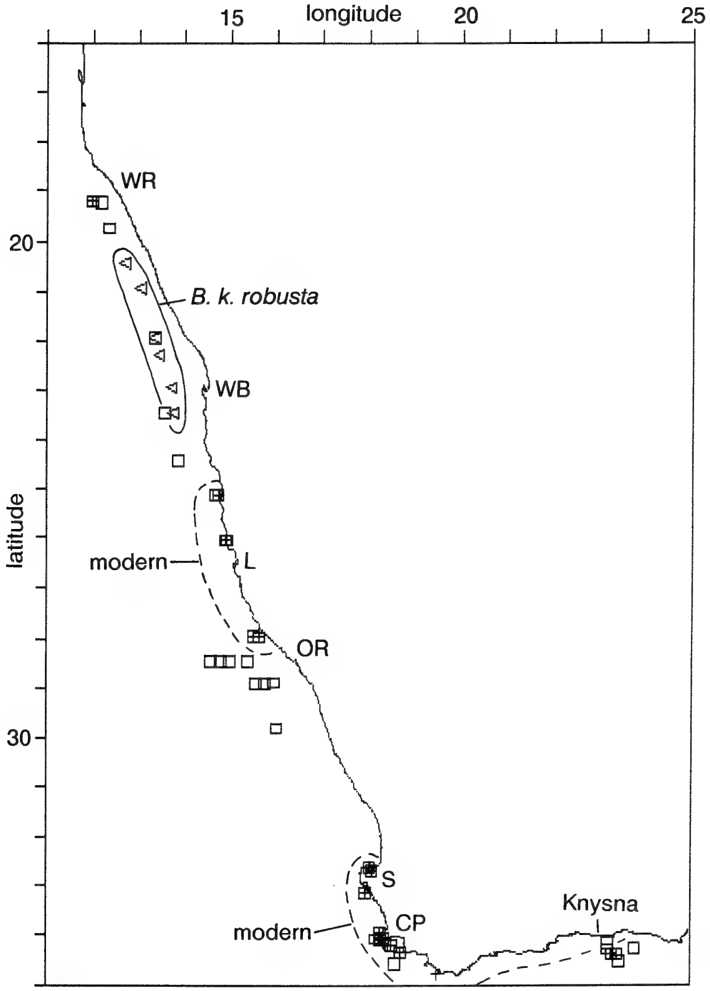

Fig. 20. Distribution of *Bensonia knysnaensis* (Benson & Maddocks, 1964). *B. k. knysnaensis* shown as squares (relict) and crosses (modern: dashed line is seaward extent); *B. k. robusta* subsp. nov. shown as triangles. See Fig. 7 for abbreviations.

Holotype

	length	height
SAM–PQ–MF–0536, RV, TBD 6836, 80 m	0,98 mm	0,28 mm

Paratypes

	length	height	width
SAM–PQ–MF–0537, LV, TBD 6836, 80 m	0,96 mm	0,29 mm	
SAM–PQ–MF–0538, LV, TBD 6836, 80 m	0,97 mm	0,29 mm	
SAM–PQ–MF–0539, RV, TBD 6836, 80 m	0,95 mm	0,27 mm	
SAM–PQ–MF–0540, C, TBD 6836, 80 m	1,00 mm	—	0,23 mm
SAM–PQ–MF–0541, RV, TBD 6847, 94 m			

Material

511 valves.

Diagnosis

Species with acuminate AM outline that is ventrally directed in RV, relatively strong narrow surface ridges sub-parallel to AM and PM, and a prominent fulcral point. The adductor MS lie on an elongate platform.

Description

External features. Elongate, cylindrical valves with strongly acuminate AM, particularly in the RV, where the line of greatest length is directed ventrally. PM is acutely rounded. Surface ornamentation consists of narrow ridges extending sub-parallel to the valve margins. These are most prominent anteriorly and posteriorly.

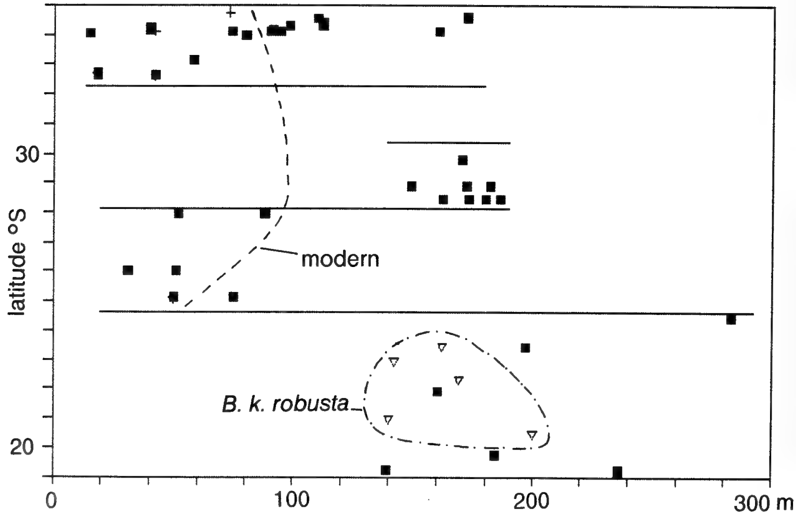

Fig. 21. Latitudinal water-depth distribution of sites with *Bensonia knysnaensis* (Benson & Maddocks, 1964). Horizontal lines delimit across-shelf populations. Crosses and dashed line = LDL of field with modern *B. k. knysnaensis*, triangles and dot-dashed line = field with *B. k. robusta* subsp. nov.

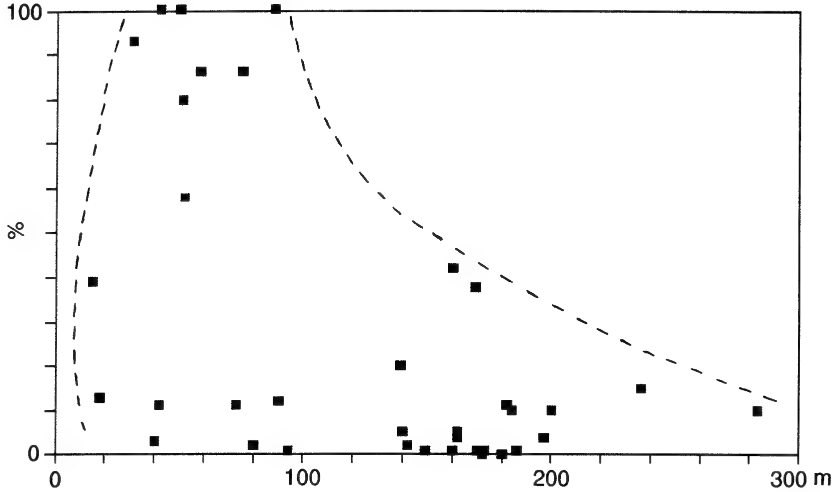

Fig. 22. Abundance of *Bensonia knysnaensis* (Benson & Maddocks, 1964) as percentage of ostracod fauna plotted against water depth.

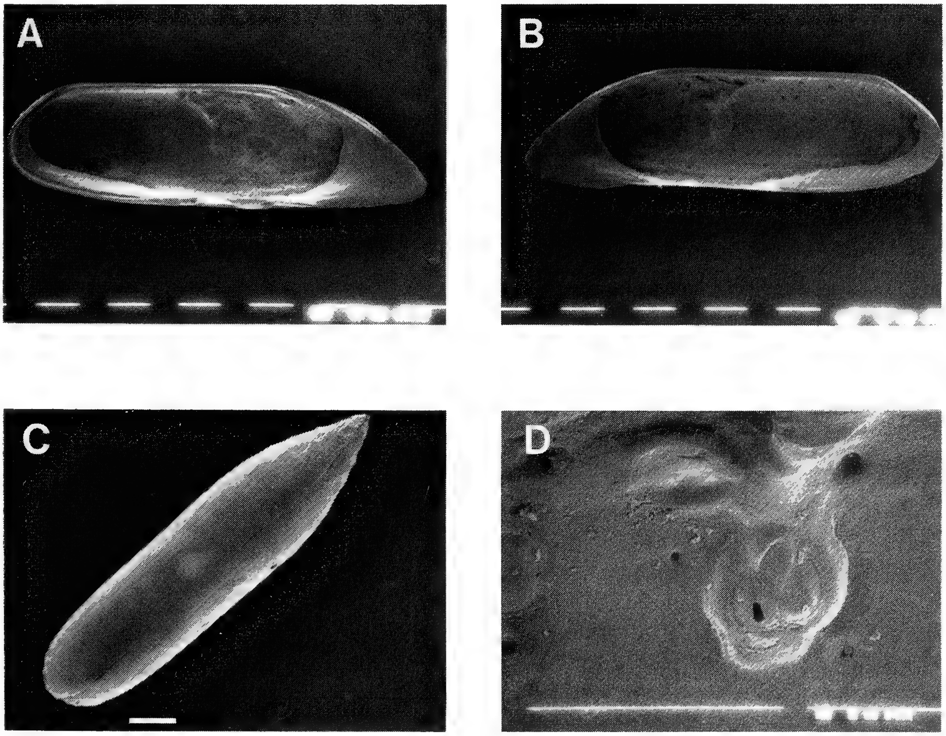

Fig. 23. A–D. *Neocytherideis boomeri* sp. nov., TBD 6836, 80 m. A. SAM–PQ–MF0538, LV, SEM 2443. B. SAM–PQ–MF0539, RV, SEM 2447. C. SAM–PQ–MF0540, carapace, dorsal view, SEM 2439. D. SAM–PQ–MF0539, RV, MS, SEM 2449. Scale bars = 100 microns.

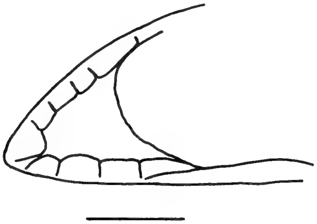

Fig. 24. *Neocytherideis boomeri* sp. nov., SAM–PQ–MF0541, RV, detail of MA, TBD 6847, 94 m. Scale bar = 100 microns.

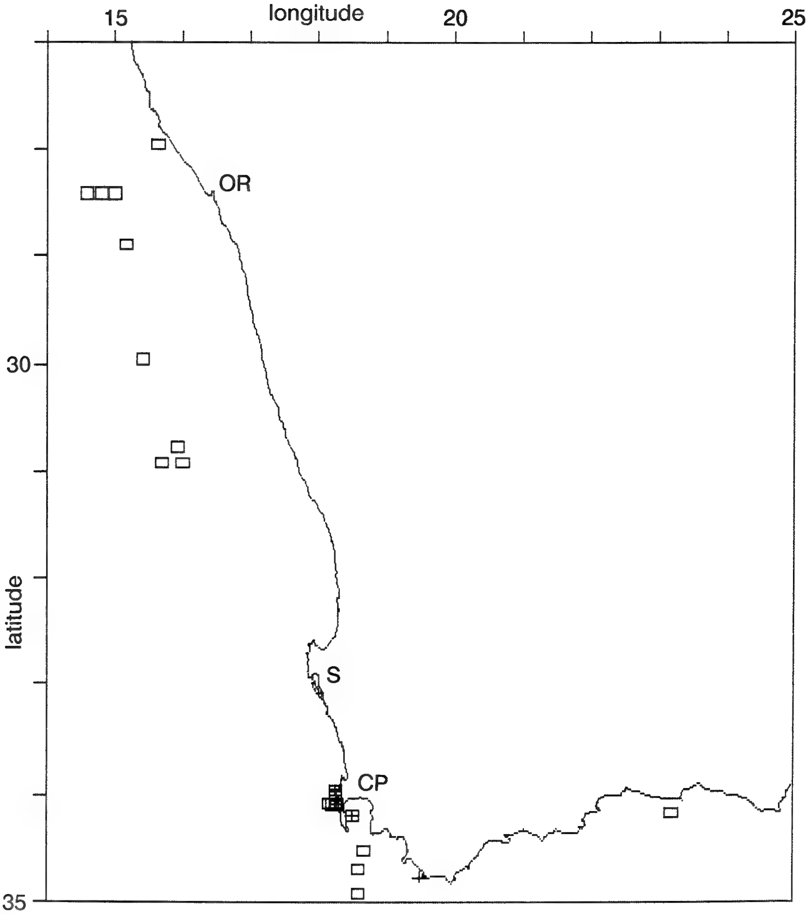

Fig. 25. Distribution of *Neocytherideis boomeri* sp. nov. Squares = relict sites; crosses = modern sites. See Fig. 7 for abbreviations.

Internal features. Normal pore canals are prominent, but their surface expression is faint. MA are broad anteriorly, with a wide triangular-shaped vestibulum, and moderately wide posteriorly and posteroventrally. There are approximately ten short, straight anterior radial pore canals. Hinge weakly lophodont. MS are prominent; adductors consist of a closely adjacent row of four, set on a raised platform that is linked to the prominent fulcral point by a ridge. The anterior scar is ovate and lies relatively far anterior to the adductors.

Remarks

Although species of *Neocytherideis* have been reported world-wide (Kempf 1986), the genus has until now not been formally recognized from the South Atlantic area. Two species of the related genus *Copytus* have, however, been recorded from the south-western Atlantic and nearby Antarctic regions: *C. caligula* Skogsberg, 1939, and *C. elongatus* Benson, 1964 (e.g. Skogsberg 1939; Benson 1964; Neale 1967; Hartmann 1986). *Copytus* does not occur off southern Africa but is widespread in the Australasian area, where *C. rara* McKenzie, 1967, occurs in the Eocene to Recent in Australia and New Zealand (McKenzie 1967; Swanson 1969). The two genera are distinguished by AM shape, and hingement.

Neocytherideis boomeri sp. nov. has all the generic characters, but its AM outline and surface ornamentation serve to distinguish it from previously described species of the genus. It is overall slimmer and more acuminate than the type (*N. subulata* (Brady, 1867)), and has a longer DM than *N. cypria* Athersuch, 1982, which lacks the posterior ornamentation of *N. boomeri*. The two species of *Neocytherideis* that have been recorded from the Southern Hemisphere (*N. mediata* Swanson, 1969—Miocene New Zealand; and *N. muehlenhardtae* Hartmann, 1982—Recent New Zealand) both differ from *N. boomeri* in ornamentation and AM outline.

A similar taxon is that illustrated by Hartmann (1978) from Wilie Creek on the west coast of Australia as *Copytus* aff. *C. rara* McKenzie, 1967. This specimen has a

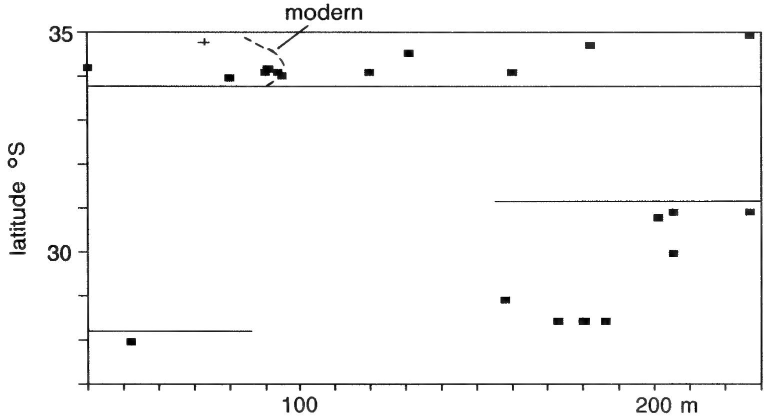

Fig. 26. Latitudinal water-depth distribution of sites with *Neocytherideis boomeri* sp. nov. Horizontal lines delimit across-shelf populations. Crosses and dashed line delimit LDL of modern fauna.

similar AM outline and surface ornamentation (somewhat more reticulate) to *N. boomeri*, but a different hinge and MS.

Distribution

Neocytherideis boomeri has been found on the continental shelf between Chamais Bay (28°S) and at least as far east as 23°E on the Agulhas Bank (Figs 25, 26). It was not recorded by Brady (1880), Klie (1940) or Hartmann (1974). Modern populations are confined to an inner shelf region between Hout Bay, False Bay and Quoin Point (19,3°E) on the south-western Cape coast in water depths between 40 m and 94 m. Here, modern valves make up between 2 and 100 per cent of the total *N. boomeri* assemblage. Relict populations occur in two regions. Between Chamais Bay and the Olifants River the species has UDL and LDL of 52 m and 227 m, whereas south of Hout Bay, the UDL and LDL are 40 m and 227 m, respectively. Although the populations in both areas have similar depth limits, their abundance distributions are different; the northern populations favour deeper water (>173 m), whereas in the south the species is most abundant in <100 m.

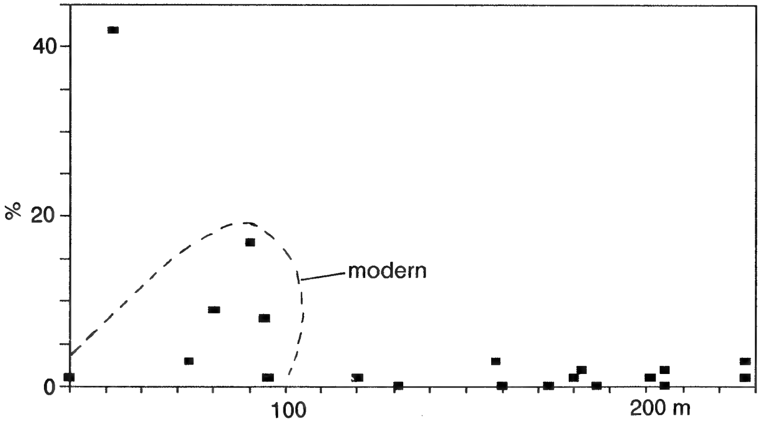

Fig. 27. Abundance of *Neocytherideis boomeri* sp. nov. as percentage of ostracod fauna plotted against water depth. Dashed line delimits modern fauna.

Family **Hemicytheridae** Puri, 1953

Subfamily Hemicytherinae Puri, 1953

Genus *Ambostracon* Hazel, 1962

The genus is interpreted in the sense of Valicenti (1977), who used the strength of the ocular ridge as a criterion for distinguishing between the two subgenera *Ambostracon* Hazel, 1962, and *Patagonacythere* Hartmann, 1962.

Three species of the genus occur off south-western Africa, all belonging to *A. (Ambostracon)*.

Subgenus *Ambostracon (Ambostracon)* Hazel, 1962

Ambostracon flabellicostata (Brady, 1880)

Figs 28A–D, 29C, F

Cythere flabellicostata Brady, 1880: 88–89, pl. 1 (figs 6a–h). Puri & Hulings, 1976: 276–277, pl. 8 (figs 1–4).
Ambostracon sp. B Keeler, 1981: 113–115, pl. 6 (figs 9–10).
Ambostracon sp. D Keeler, 1981: 116–118, pl. 6 (figs 13–14).
Ambostracon sp. 2 Boomer, 1985: 45–46, pl. 4 (figs 62, 65).
Ambostracon (Patagonacythere) sp. A468 Frewin, 1987: 40, pl. 13A.

Illustrated material

SAM–PQ–MF–0542, LV, TBD 2973, 173 m
SAM–PQ–MF–0543, RV, TBD 2973, 173 m
SAM–PQ–MF–0544, C, TBD 2224, 58 m
SAM–PQ–MF–0545, RV, TBD 2224, 58 m

Material

490 valves.

Remarks

In Brady's (1880) material, the strong ocular ridge crosses the eye tubercle and extends sub-parallel to the AM. In the anteroventral corner it curves and is continuous with a ventrolateral ridge. The SCT is prominent and joined to the anteroventral corner by a short ridge. The main features of the ornamentation and MS pattern are shown in Figure 29.

As Valicenti (1977, table 1) has shown, the genus is mainly represented in the South Atlantic–Antarctic area by species of *A. (Patagonacythere)*, and the only record of *A. (Ambostracon)* from the area outside southern Africa is from the Miocene of Argentina (*Ambostracon (A.)* sp. 1 Rossi de Garcia, 1970). This is a relatively elongate species with a prominent diagonal ridge extending between the posterodorsal and anteroventral corners. No records of the genus were made from the Tertiary of Gabon by Bold (1966), but Frewin (1987) has recorded two (possibly three) species from the Lower Tertiary of the Agulhas Bank. One of these (described as *A. (Patagonacythere)* sp. A468,) appears identical in ornamentation to *A. (A.) flabellicostata*, and occurs in a sample of Lower Palaeocene–Upper Eocene age (TBD 1275). A second specimen from the Upper Eocene (described as *Ambostracon (P.)* sp. B1457 by Frewin (1987) may be conspecific, but this has stronger ornamentation, and the dorsolateral rib pattern differs slightly from Brady's types.

Distribution

Brady (1880) recorded this species only from 'Challenger' Station 140 (30–40 m) in False Bay.

Modern specimens are restricted to nearshore sites off the south-western Cape between Saldanha Bay (33,16°S: 58 m) and Cape Agulhas (34,77°S: 73 m), where they have UDL and LDL of 15 m and 131 m, respectively (Fig. 30A). Keeler (1981) did not differentiate modern specimens from the eastern Agulhas Bank.

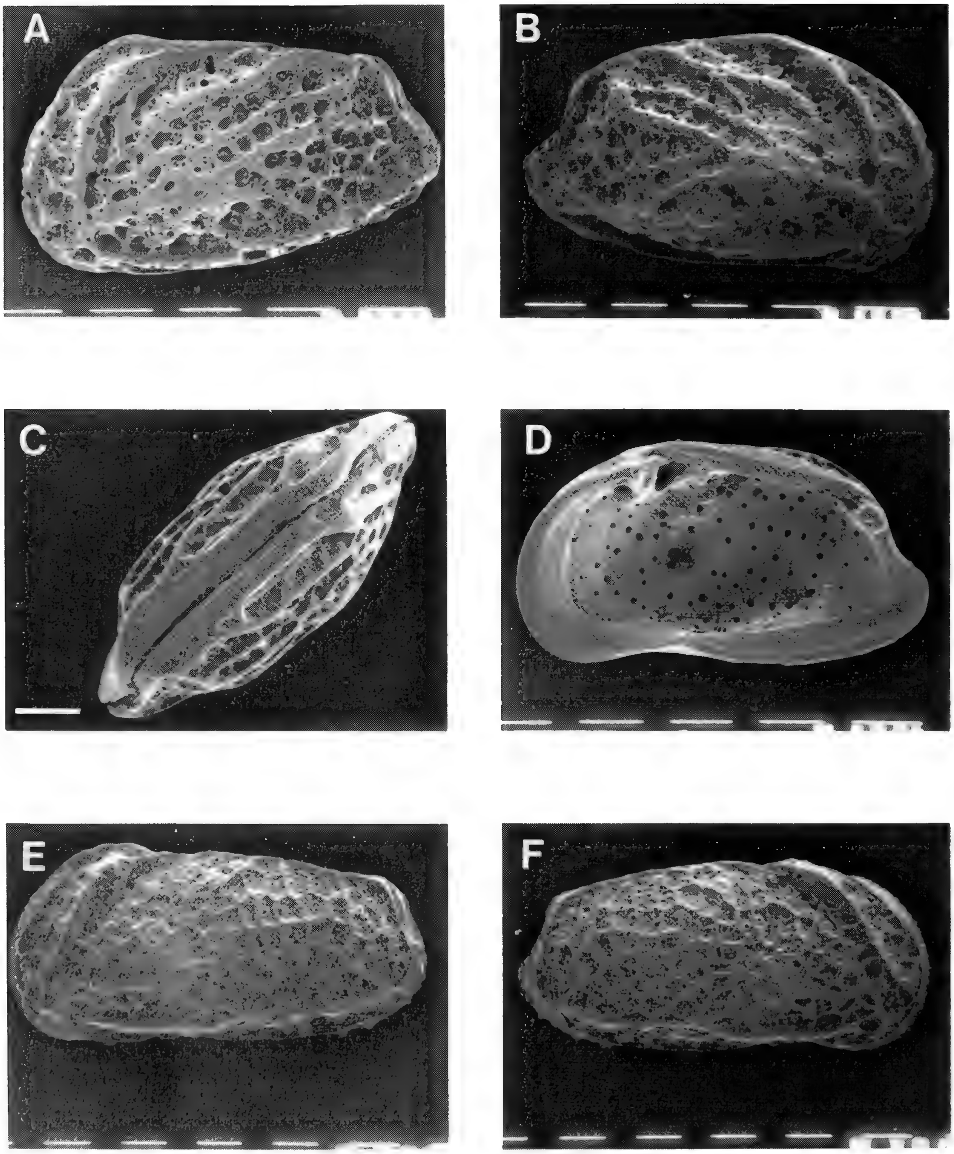

Fig. 28. A–D. *Ambostracon (A.) flabellicostata* (Brady, 1880). A. SAM–PQ–MF0542, LV, TBD 2973, 173 m, SEM 2515. B. SAM–PQ–MF0543, RV, TBD 2973, 173 m, SEM 2500. C. SAM–PQ–MF0544, carapace, dorsal view, TBD 2224, 58 m, SEM 2522. D. SAM–PQ–MF0545, RV, TBD 2224, 58 m, SEM 2516. E–F. *Ambostracon (A.) levetzovi* (Klie, 1940), TBD 3089, 18 m. E. SAM–PQ–MF0546, LV, SEM 2502. F. SAM–PQ–MF0547, RV, SEM 2505. Scale bars = 100 microns.

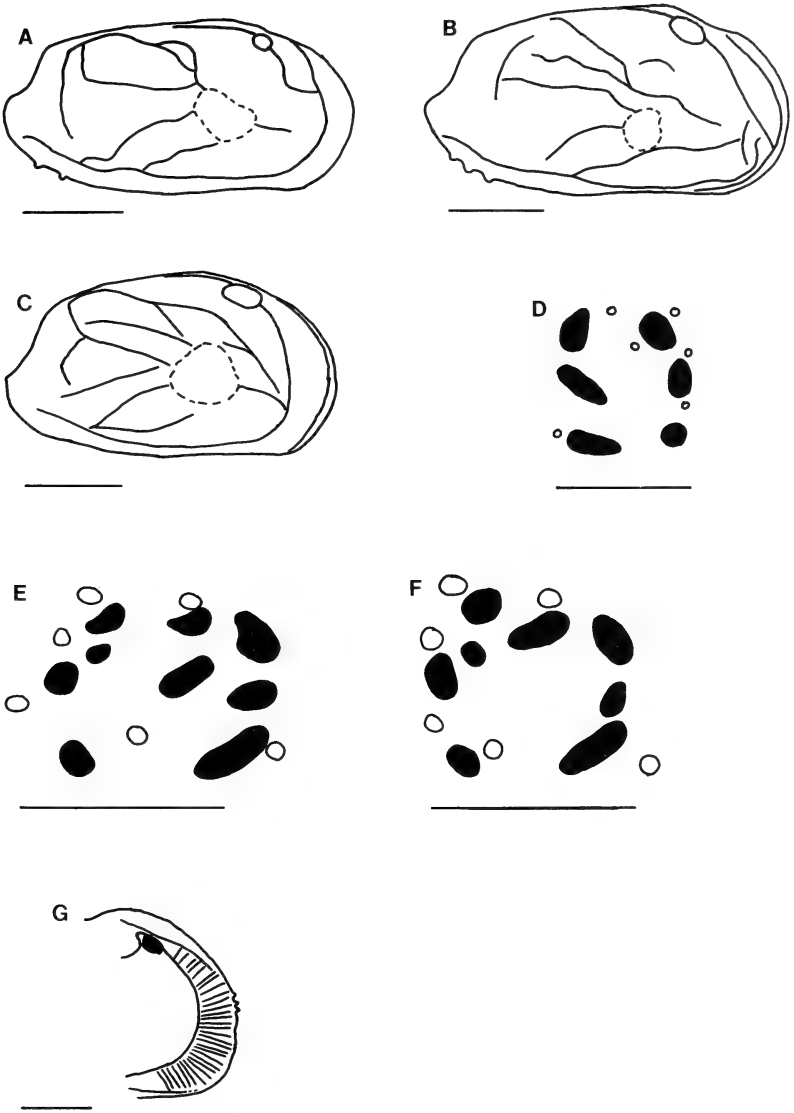

Fig. 29. *Ambostracon (Ambostracon)*: comparison of three species. A–F. Main rib patterns of RV, and MS. A. *A. (A.) keeleri* sp. nov., SAM–PQ–MF0552, TBD 6823, 120 m. B. *A. (A.) levetzovi* (Klie, 1940), SAM–PQ–MF0548, TBD 3089, 18 m. C. *A. (A.) flabellicostata* (Brady, 1880), SAM–PQ–MF0543, TBD 2973, 173 m. D. *A. (A.) keeleri* sp. nov., SAM–PQ–MF0555, LV, TBD 6835, 100 m. E. *A. (A.) levetzovi* (Klie, 1940), SAM–PQ–MF0549, RV, TBD 3089, 18 m. F. *A. (A.) flabellicostata* (Brady, 1880), SAM–PQ–MF0545, RV, TBD 2224, 58 m. G. *A. (A.) keeleri* sp. nov., SAM–PQ–MF0556, LV, MA and radial pore canals, TBD 6823, 120 m. Scale bars: A–C, G = 200 microns; D–F = 100 microns.

Relict populations occur in a narrow zone between latitude 20,43°S and the eastern Agulhas Bank (Fig. 31A). Although this zone is widest on the Orange Shelf, it is here that abundances are lowest (<5%). Two continuous areas with relatively high abundances (>5%) lie along the coast: southern Namaqualand and south-western Cape, and the vicinity of Walvis Bay. Over the latitudinal range of relict specimens, the UDL falls into two well-defined groups: off Walvis Bay and on the Orange Banks they are 142 m and 158 m, respectively, whereas off Lüderitz and south-western Cape they are 31 m and 40 m, respectively (Fig. 32A). The latter values are similar to modern UDL. In all areas the LDL lies between 184 m and 223 m. Plotting abundance against water depth suggests that there is an abundance minimum between about 70 m and 90 m water depth off the south-western Cape (Fig. 33A).

Ambostracon (Ambostracon) levetzovi (Klie, 1940)

Figs 28E–F, 29B, E, 34A–C

Eucythereis levetzovi Klie, 1940: 419–421, figs 23–29.
Aurila levetzovi (Klie, 1940) Hartmann, 1974: 284, pl. 149 (fig. 7).

Illustrated material

SAM–PQ–MF–0546, LV, TBD 3089, 18 m
SAM–PQ–MF–0547, RV, TBD 3089, 18 m
SAM–PQ–MF–0548, RV, TBD 3089, 18 m
SAM–PQ–MF–0549, RV, TBD 3089, 18 m
SAM–PQ–MF–0550, LV, TBD 3089, 18 m

Material

19 valves.

Remarks

Klie (1940) and Hartmann (1974) both recorded this species on algae at inshore sites in Lüderitz Bay (no depth given). The present material is from one site (TBD 3089: 18 m) in St Helena Bay, along with relict and modern *A. (A.) keeleri* sp. nov. and relict *A. (A.) flabellicostata*. It is easily distinguished from the latter by the straightness and strength of the ocular ridge, and from *A. (A.) keeleri* by the fact that the ocular ridge crosses the eye tubercle.

Ambostracon (Ambostracon) keeleri sp. nov.

Figs 29A, D, G, 34D–F, 35A–B

Ambostracon sp. C Keeler, 1981: 115–116, pl. 6 (figs 11–12).
Ambostracon sp. E Keeler, 1981: 118–119, pl. 6 (figs 15–17).
Ambostracon sp. F Keeler, 1981: 119–120, pl. 6 (figs 18–19).
Ambostracon sp. 1 Boomer, 1985: 45–46, pl. 4 (figs 67–69).

Derivation of name

Named for Mr N. P. Keeler, formerly of University College of Wales, Aberystwyth, who first recovered the species.

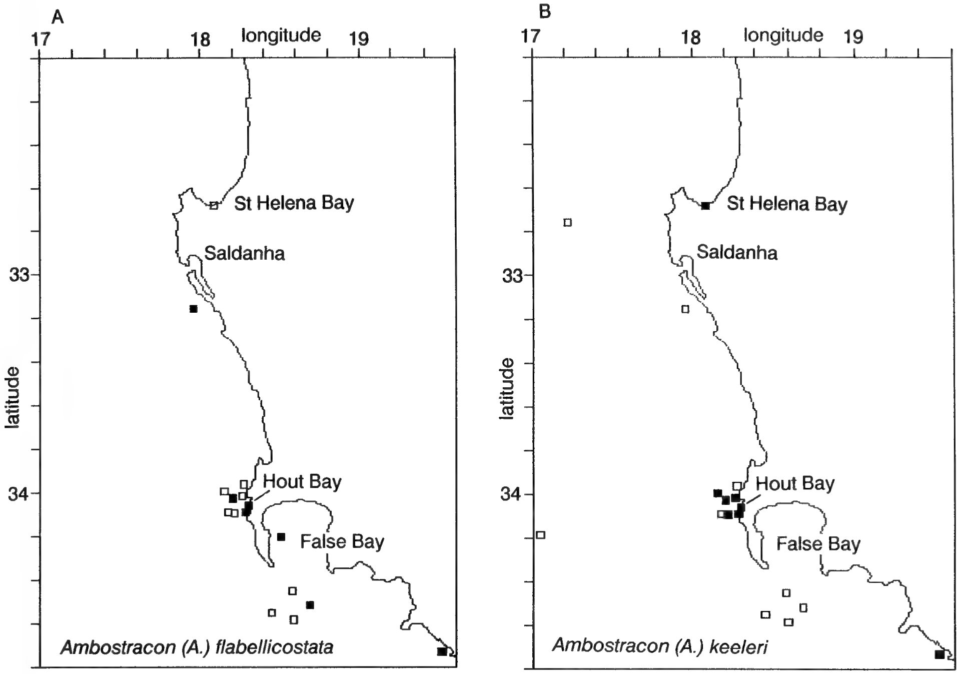

Fig. 30. Distribution of *Ambostracon (A.)* spp. off the south-western Cape. A. *A. (A.) flabellicostata* (Brady). B. *A. (A.) keeleri* sp. nov. Solid squares are modern sites.

Holotype

	length	height
SAM–PQ–MF–0551, LV, TBD 6823, 120 m	0,70 mm	0,38 mm

Paratypes

	length	height	width
SAM–PQ–MF–0552, RV, TBD 6823, 120 m	0,68 mm	0,33 mm	—
SAM–PQ–MF–0553, C, TBD 6823, 120 m	0,73 mm	—	0,30 mm
SAM–PQ–MF–0554, RV, TBD 6823, 120 m	0,68 mm	0,35 mm	—
SAM–PQ–MF–0555, LV, TBD 6835, 100 m	0,69 mm	0,38 mm	—
SAM–PQ–MF–0556, LV, TBD 6823, 120 m			

Material

1 024 valves.

Diagnosis

Species with a strong ocular ridge that runs anterior to the eye tubercle, and is not continuous with the ventrolateral ridge. Ribs radiate centrally from SCT.

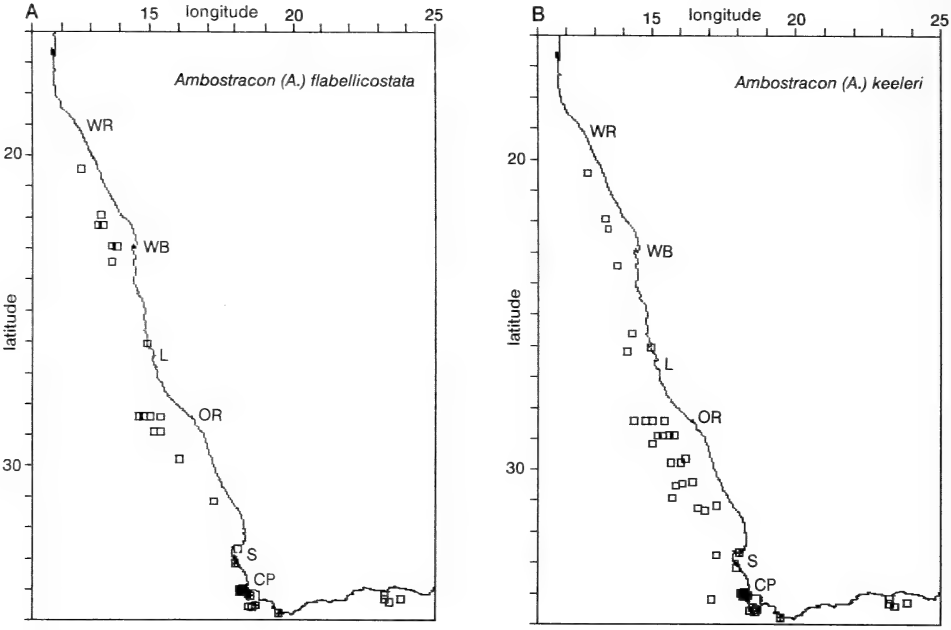

Fig. 31. Distribution of *Ambostracon (A.)* spp. A. *A. (A.) flabellicostata* (Brady). B. *A. (A.) keeleri* sp. nov. Squares = relict sites, crosses = modern sites. See Fig. 7 for abbreviations.

Description

External features. Sub-quadrate lateral outline, with males more elongate than females. AM has numerous small spines, PM has three short stout spines posteroventrally. Central ornamentation consists of ribs radiating from a SCT with intercostal reticulation, and a semi-elliptical ridge in the posterodorsal area. Peripheral ribs consist of: a prominent, almost vertical rib that extends across the anterior area, and does not cross the eye tubercle, which it skirts anteriorly with a sickle-shaped deflection; a ventrolateral rib that runs from the PM and which, in the LV, abuts the anterior ridge, and in RV, is continuous with the anterior ridge; a thin rib that extends from the eye tubercle along the DM; and a curved rib that loops from a position near the SCT, via the posterodorsal shoulder down across the valve almost to the ventrolateral ridge. The eye tubercle is a large dome. In juveniles it is linked to the SCT by a prominent short curved rib.

Internal features. Typical of the genus. AM areas are avestibulate, with numerous (at least 30) straight, hair-like marginal pore canals. Hinge amphidont, with a prominently lobed PTE in the RV. MS could not be clearly seen, despite the large number of specimens available. They appear to be simpler than those in *A. flabellicostata* and *A. levetzovi*, with a total of six scars (Fig. 29D).

Remarks

Ambostracon (A.) keeleri is easily distinguished from *A. (A.) flabellicostata*, with which it usually co-occurs, by the difference in AM ridge pattern (see Fig. 29).

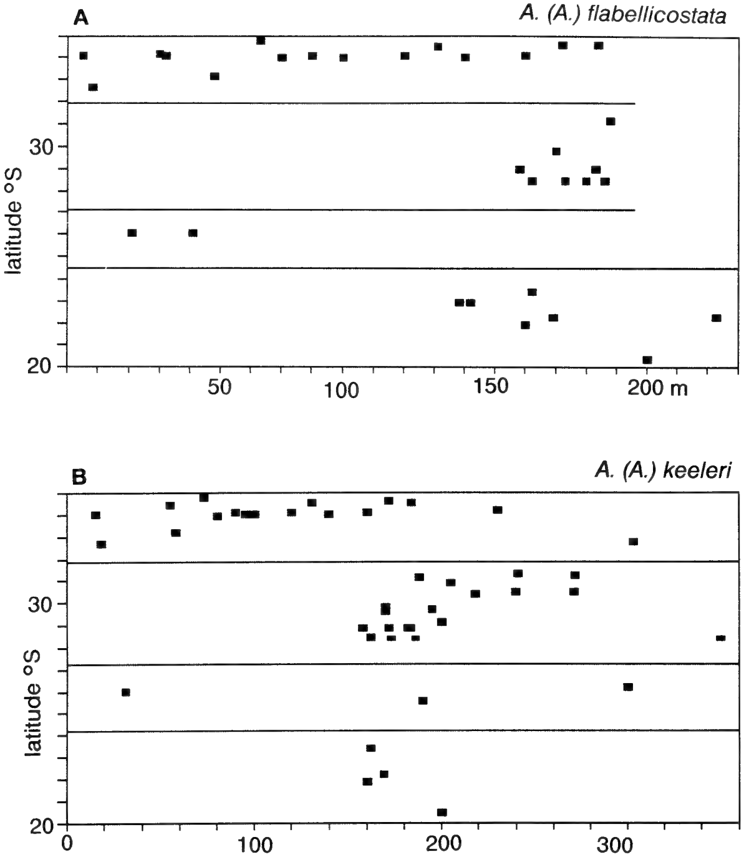

Fig. 32. Latitudinal water-depth distribution of sites with *Ambostracon (A.)* spp. Horizontal lines delimit across-shelf populations. A. *A. (A.) flabellicostata* (Brady, 1880). B. *A. (A.) keeleri* sp. nov.

Ambostracon (A.) sp. A463 Frewin, 1987, from the Upper Palaeocene–Lower Eocene of the Agulhas Bank has a similar ocular rib to *A. (A.) keeleri*, but a different central area ornamentation, which is closer to that of *A. (A.) flabellicostata*.

Its closest relative is probably *A. (A.) longiducta* (Skogsberg, 1928), which also has a similar ocular rib that is deflected anterior to the eye tubercle. The two species differ in the course of the ocular rib, which is parallel to the AM margin in *A. (A.) longiducta*; in the disposition of ribs posterodorsally and in *A. (A.) longiducta* being somewhat plumper in outline. The latter species has been reported from various localities in Antarctica and the Subantarctic area: Ross Sea, 57 m (Benson 1964); Bransfield Strait, 133 m (Hartmann 1986, 1987); and South Georgia, 12–52 m (Skogsberg 1928).

Distribution

Modern specimens of *A. (A.) keeleri* are confined to nearshore sites off the south-western Cape between an isolated occurrence in St Helena Bay (32,68°S: 18 m) and

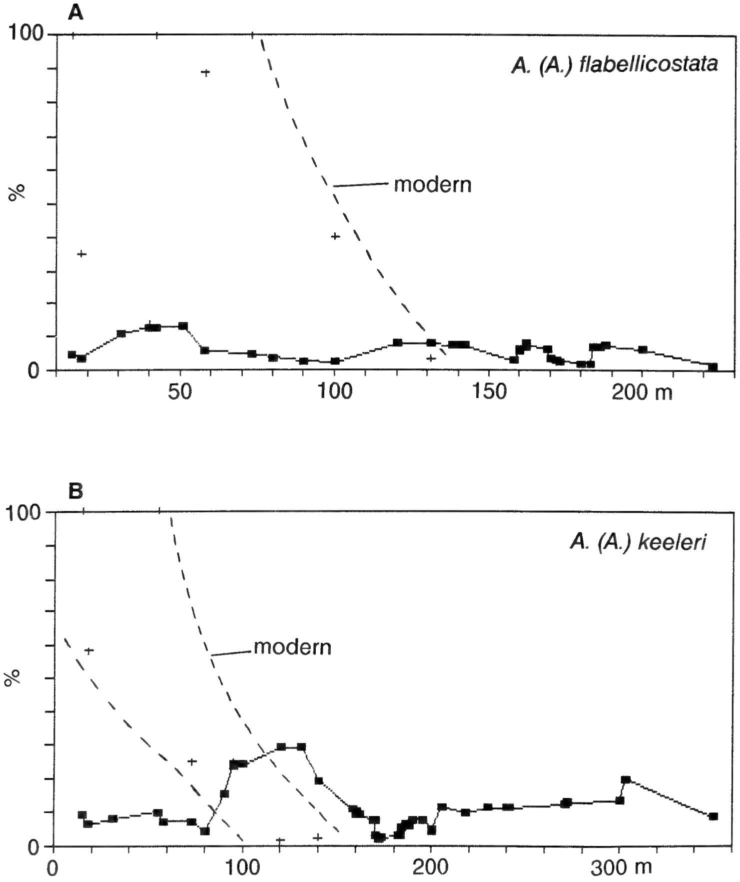

Fig. 33. Abundance of *Ambostracon (A.)* spp. as percentage of ostracod fauna plotted against water depth. Dashed lines = LDL (A), and UDL and LDL (B) of modern faunas. A. *A. (A.) flabellicostata* (Brady, 1880). B. *A. (A.) keeleri* sp. nov.

Cape Agulhas (34,77°S: 73 m). The main concentration of samples lies off Hout Bay on the Cape Peninsula. UDL and LDL are 15 m and 140 m, respectively (Fig. 30B).

Relict specimens are recorded between latitude 20,43°S and the eastern Agulhas Bank (Fig. 31B). A narrow zone of relatively high abundance (>5% total ostracod fauna) stretches from the south-western Cape, to the vicinity of Lüderitz (25,6°S), where it forms a broader zone on the mid-shelf. A further narrow zone lies between 20,43°S and 23,43°S on the Walvis shelf. Over the latitudinal range of the relict specimens, UDL falls into two well-defined groups: off Walvis Bay and on the Orange Banks they are 160 m and 158 m, respectively, whereas off Lüderitz and south-western Cape they are 31 m and 15 m, respectively (Fig. 32B). The latter values are similar to those for modern UDL. Off the Walvis Shelf the LDL is at 200 m, whereas in all the southern areas the LDL lies between 252 m and 303 m. Plotting abundance against water depth suggests that there is an abundance peak between 90 m and 160 m water depth off the south-western Cape (Fig. 33B).

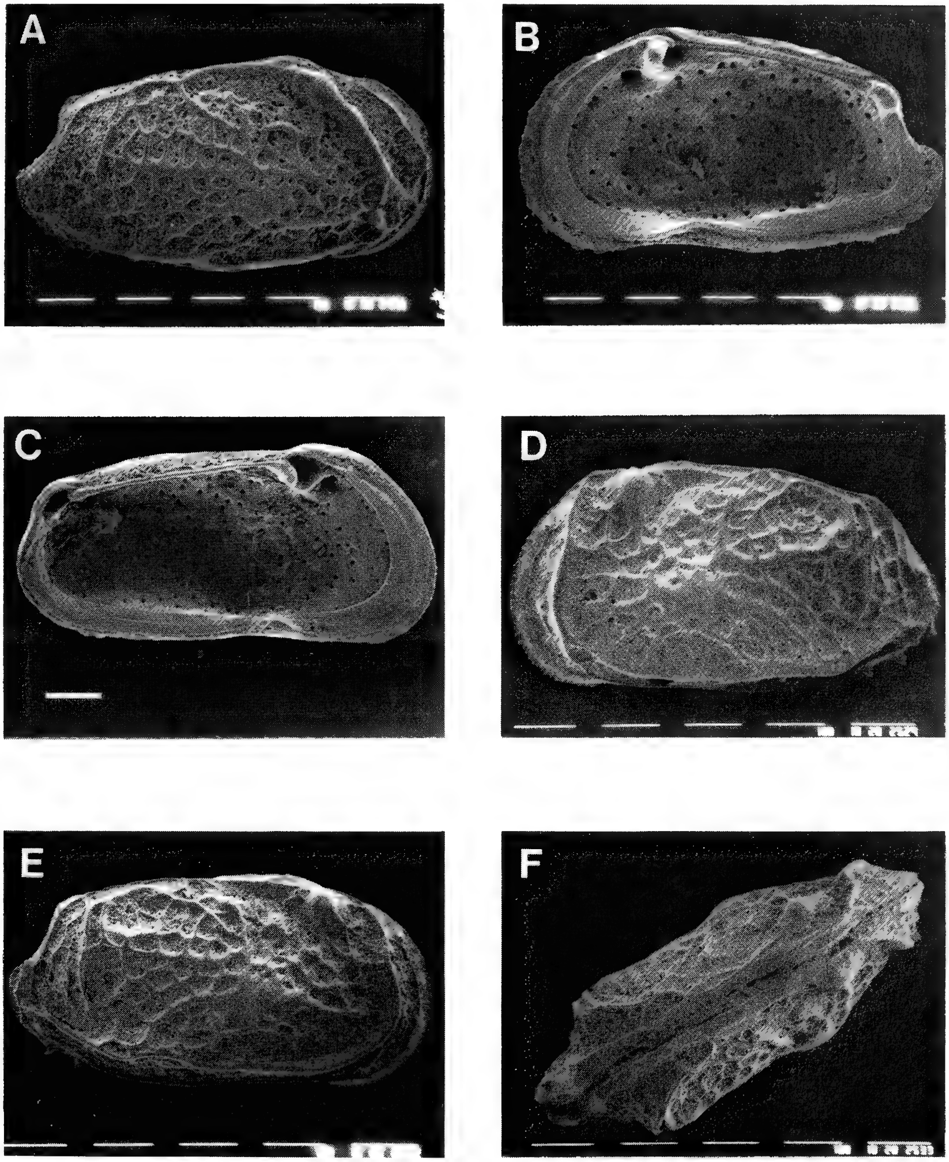

Fig. 34. A–C. *Ambostracon (A.) levetzovi* (Klie, 1940), TBD 3089, 18 m. A. SAM–PQ–MF0548, RV, SEM 2498. B. SAM–PQ–MF0549, RV, SEM 2506. C. SAM–PQ–MF0550, LV, SEM 2525. D–F. *Ambostracon (A.) keeleri* sp. nov., TBD 6823, 120 m. D. SAM–PQ–MF0551, holotype, LV, SEM 2529. E. SAM–PQ–MF0552, RV, SEM 2532. F. SAM–PQ–MF0553, carapace, dorsal view, SEM 2533. Scale bars = 100 microns.

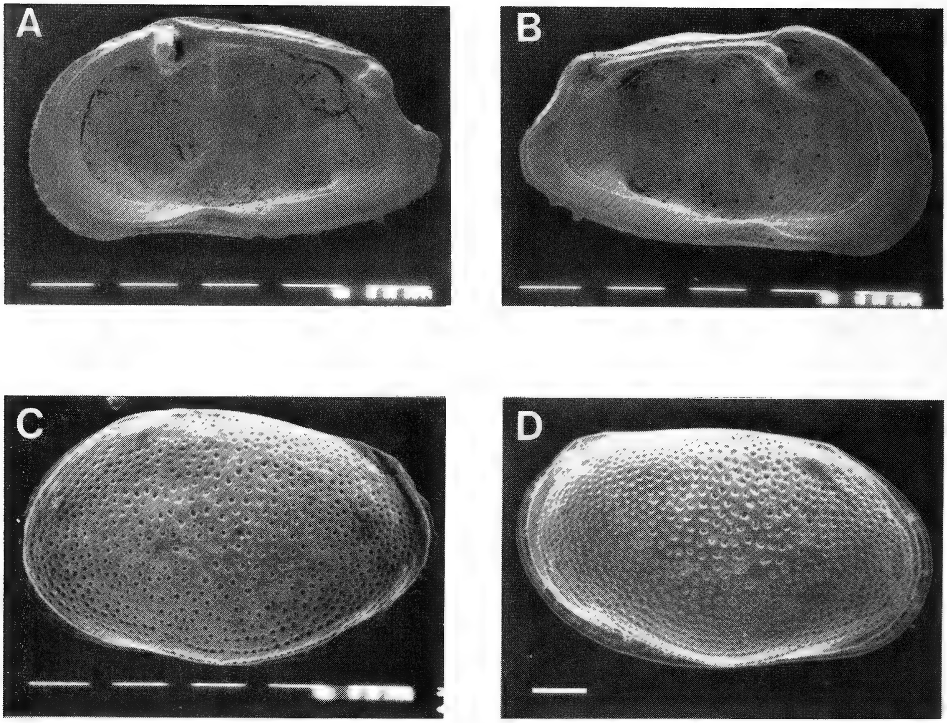

Fig. 35. A–B. *Ambostracon (A.) keeleri* sp. nov. A. SAM–PQ–MF0554, RV, TBD 6823, 120 m, SEM 2544. B. SAM–PQ–MF0555, LV, TBD 6835, 100 m, SEM 2540. C–D. *Palmoconcha walvisbaiensis* (Hartmann, 1974), TBD 3940, 184 m. C. SAM–PQ–MF0562, LV, SEM 2420. D. SAM–PQ–MF0563, RV, SEM 2417. Scale bars = 100 microns.

Summary of the distribution of the genus Ambostracon

Ambostracon (A.) flabellicostata and *A. (A.) keeleri* have very similar distribution patterns, particularly for modern specimens, where they are both confined to the south-western Cape (Fig. 4), and best developed off the middle part of the Cape Peninsula in almost identical depths: 15–131 m and 15–140 m, respectively.

There are subtle differences in their relict distributions. *A. (A.) keeleri* is best developed in a more or less continuous zone from the south-western Cape to the vicinity of Lüderitz, with the Walvis Shelf populations relatively sparse. In contrast, *A. (A.) flabellicostata* is best developed off the south-western Cape and on the Walvis shelf, with only a relatively sparse representation on the Namaqualand–Orange shelves. Both species show a very similar latitudinal UDL variation, with the areas off the Walvis and Orange shelves having values *c.* 100 m deeper than areas to the north and south. Regionally, relict *Ambostracon* faunas are an important component of the ostracod populations at the northern end of the Cape Peninsula, and immediately south of Walvis Bay (Fig. 5).

Depth versus percentage plots (Fig. 33) suggest that *A. (A.) keeleri* prefers mid-shelf environments (*c.* 120 m), whereas *A. (A.) flabellicostata* has peaks in the nearshore (*c*. 40 m) and mid- to outer-shelf (*c*. 130–200 m) zone. *Ambostracon (A.) levetzovi* is confined to coastal and inshore sites between Lüderitz and St Helena Bay.

Family **Loxoconchidae** Sars, 1925

Taxonomically the family Loxoconchidae is complex. It has a relatively long geological history (late Cretaceous to Recent) and the various genera within it have world-wide distribution. The generic classification followed here is an emended version of that discussed by Athersuch & Horne (1984).

The family is relatively well-represented in the Quaternary around southern Africa with 12 species, eight of which occur off the south-western and southern coasts (Fig. 36):

Loxoconcha megapora Benson & Maddocks, 1964. Reported from Knysna Lagoon (Leisure Island—Benson & Maddocks 1964), whereas the variety *L. megapora magna* occurs at Lüderitz and Kommetjie (Cape Peninsula—Hartmann 1974).

L. parameridionalis Benson & Maddocks, 1964. Reported from Knysna Lagoon, associated with sandy substrates with *Zostera* and a maximum salinity of 30‰ (Benson & Maddocks 1964; Hartmann 1974).

Australoloxoconcha favornamentata Hartmann, 1974. A subtropical coastal species living on fine sand substrates. Reported from coastal sites at Knysna, St Lucia, and Maputo.

Australoloxoconcha parafavornamentata Hartmann, 1974. Reported only from Knysna Lagoon.

Palmoconcha walvisbaiensis (Hartmann, 1974). Reported from coastal and inner shelf areas, Walvis Bay to south of Lüderitz.

Palmoconcha? walvisridgensis sp. nov. An inner shelf species reported only from the Walvis Ridge abutment area.

Palmoconcha subrhomboidea (Brady, 1880). An inner shelf species reported between the Cape Peninsula and eastern Agulhas Bank.

Kuiperiana angulata sp. nov. An outer–inner shelf species reported from the Walvis Ridge Shelf to south of the Cape Peninsula.

Fossil representatives of the family from south-western Africa have been reported from the Agulhas Bank (4 species, Palaeocene–Eocene—Frewin 1987), the Natal off-

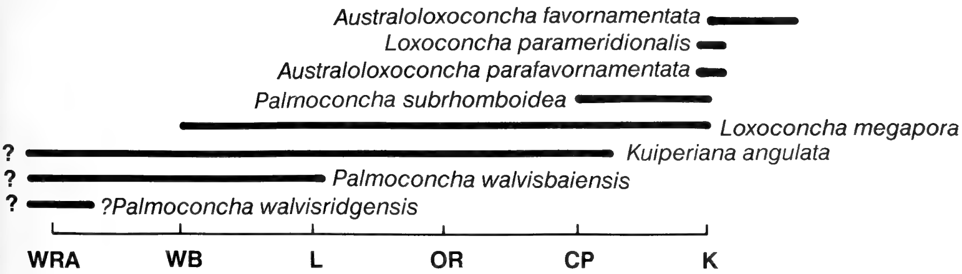

Fig. 36. Distribution of coastal and shelf species of the family Loxoconchidae around south-western Africa. Abbreviations: WRA—Walvis Ridge abutment shelf; WB—Walvis Bay; L—Lüderitz; OR—Orange River; CP—Cape Peninsula; K—Knysna.

shore (1 species, Oligocene—Dingle 1976), and Gabon (2 species, Mio–Pliocene—Bold 1966).

Genus *Palmoconcha* Swain & Gilby, 1974

This genus is distinguished by its gongylodont hinge with smooth ME, its Y-shaped anterior MS and a fulcral point adjacent to the second or third adductor scar (Swain & Gilby 1974; Horne & Kilenyi 1981; Athersuch & Horne 1984). Its known geographical range is Europe (including the Mediterranean and Black seas), the east and west coasts of North America, and the south-east Atlantic.

Palmoconcha walvisbaiensis (Hartmann, 1974)

Figs 35C–D, 37A–E

Loxoconcha walvisbaiensis Hartmann, 1974: 297–298, pl. 65 (figs 488–497). Boomer, 1985: 54–56, pl. 1 (figs 14–15).

non *Loxoconcha* cf. *L. walvisbaiensis* Hartman, 1974. Frewin, 1987: 50, pl. 14 (fig. G).

Illustrated material

SAM–PQ–MF–0562, LV, TBD 3940, 184 m
SAM–PQ–MF–0563, RV, TBD 3940, 184 m
SAM–PQ–MF–0564, RV, TBD 3926, 236 m
SAM–PQ–MF–0565, LV, TBD 3926, 236 m
Hamburg University Catalogue No. K30069, LV, Walvis Bay.

Material

475 valves.

Remarks

The smooth ME of the hinge, the Y-shaped anterior MS, and the position of the fulcral point allow me to confidently re-assign Hartmann's species to the genus *Palmoconcha*.

Frewin's (1987) record of *Loxoconcha* cf. *L. walvisbaiensis* Hartmann, 1974, is not conspecific with Hartmann's species, and possibly belongs in the genus *Saida*.

Distribution

This species was originally recorded by Hartmann (1974) from Walvis Bay lagoon. Our study has shown it to be confined to areas north of about 26°S (Fig. 38) and, although there are no precise data on its northern latitudinal range, Hartmann (1974) did not record it from Moçamedes (15°S: Angola).

Modern populations of *Palmoconcha walvisbaiensis* occur from north of the Walvis Ridge shelf (17,5°S) to just south of Walvis Bay (*c.* 24°S), where the UDL and LDL are 15 m and 236 m, respectively (Fig. 39).

Relict populations extend 2 degrees farther south (to just north of Lüderitz) but the depth range is similar to that for the modern specimens (31–280 m).

In a high percentage of cases, this species is the only ostracod recovered from the sample in which it occurs (10 of 30 sites), whereas in 22 out of 30 it constitutes >50 per cent of the total ostracod assemblage. Although absent from within the main

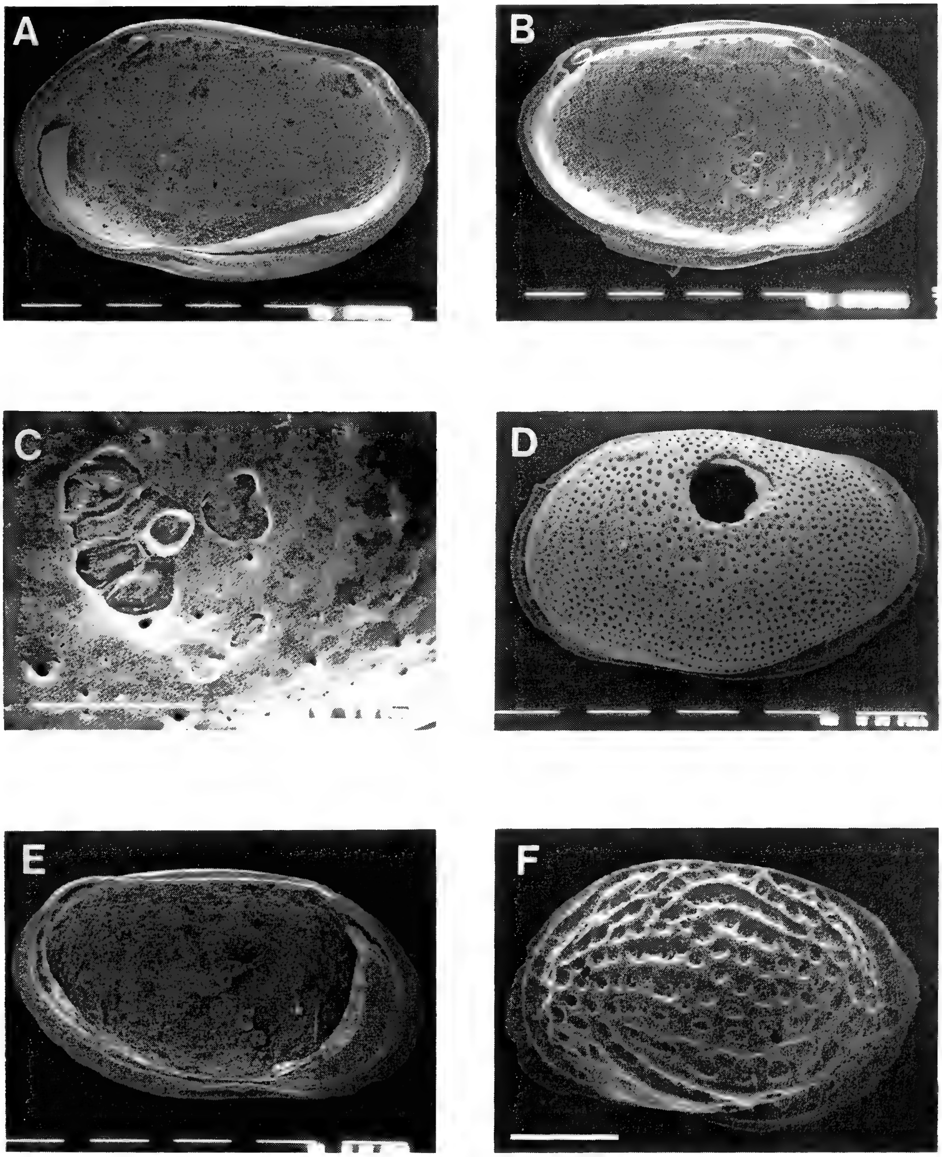

Fig. 37. A–E. *Palmoconcha walvisbaiensis* (Hartmann, 1974). A–C. TBD 3926, 236 m. A. SAM–PQ–MF0564, RV, SEM 2428. B–C. SAM–PQ–MF0565, LV. B. Internal view, SEM 2421. C. MS, SEM 2423. D. Paratype, Hamburg University catalogue slide No. K30069, LV, Walvis Bay, SEM 2566. E. Paratype, Hamburg University catalogue slide No. K30069, LV, Walvis Bay, SEM 2568. F. *Palmoconcha subrhomboidea* (Brady, 1880), SAM–PQ–MF0568, LV, TBD 5254, 40 m, SEM 2965. Scale bars = 100 microns.

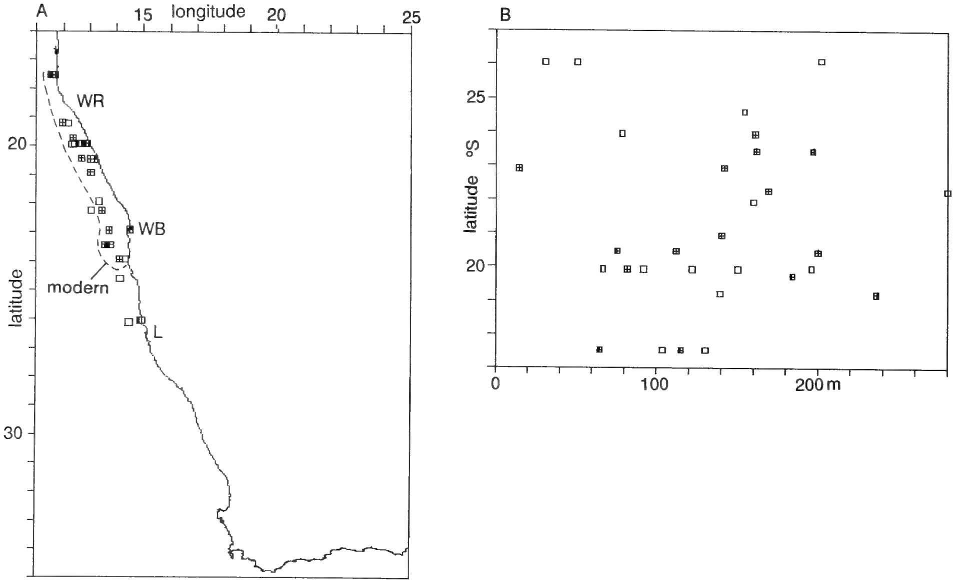

Fig. 38. A. Distribution of *Palmoconcha walvisbaiensis* (Hartmann, 1974). Squares = relict sites, crosses = modern sites (seaward and southward extent shown by dashed line). See Fig. 7 for abbreviations. B. Latitudinal water-depth distribution of sites with *P. walvisbaiensis* (Hartmann, 1974). Squares—relict sites, crosses—modern sites.

diatomaceous mud belt, this species seems relatively tolerant of oxygen-depleted water, in which ostracod assemblages are generally sparse and of low diversity. In addition, its southward modern limit lies in the vicinity of the maximum southerly intrusion of warm, saline Angola Current water (e.g. Shannon 1985).

Palmoconcha? walvisridgensis sp. nov.

Figs 40B, 41B–C

?Loxoconcha sp. aff. *L. australis* Brady, 1880. Bold, 1966: 170, pl. 3 (fig. 6).

Derivation of name

Named for the type locality of the species, the Walvis Ridge abutment shelf.

Holotype

	length	height
SAM–PQ–MF–0566, C, TBD 3888, 154 m	0,50 mm	0,30 mm

Paratype

	length	height
SAM–PQ–MF–0567, C, TBD 3972, 200 m	0,50 mm	0,30 mm

Material

5 valves.

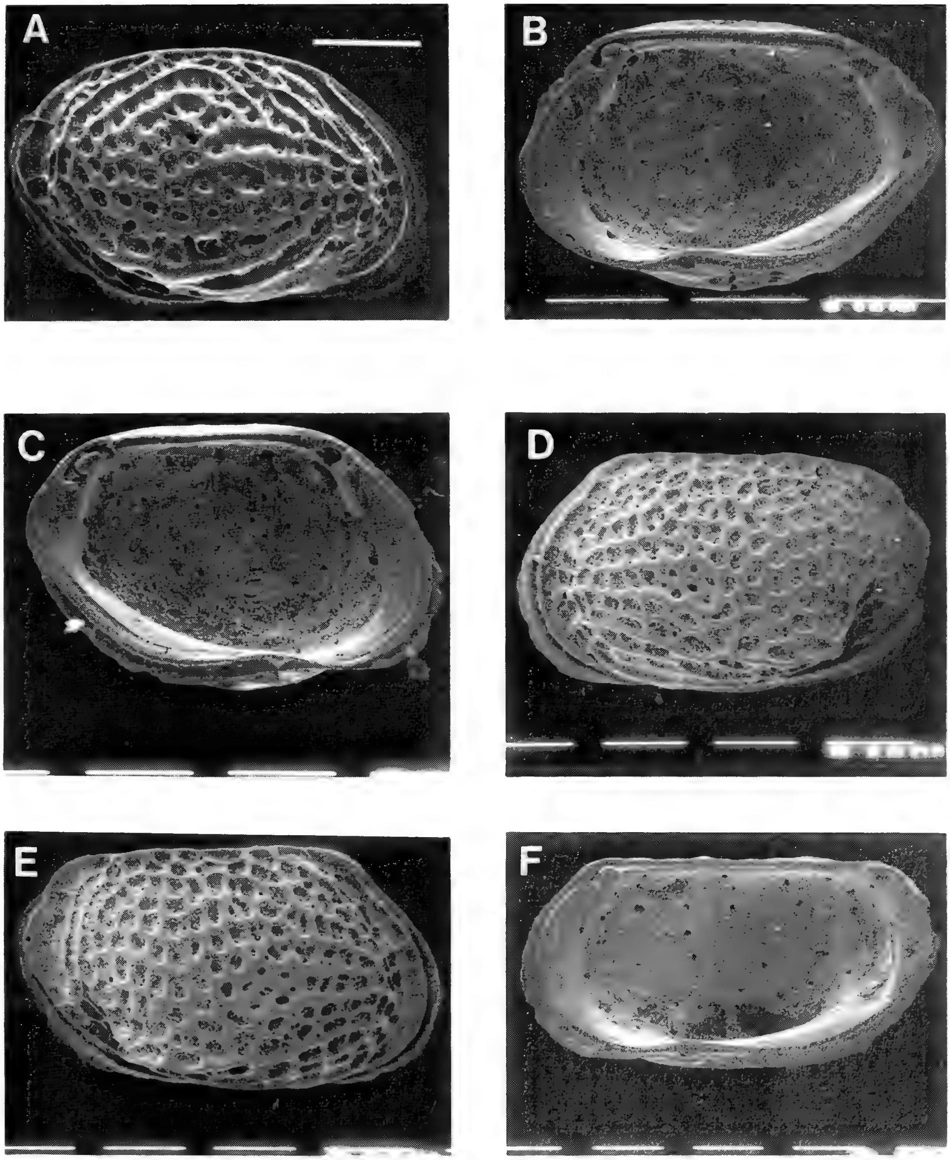

Fig. 39. A–C. *Palmoconcha subrhomboidea* (Brady, 1880), TBD 5254, 40 m. A. SAM–PQ–MF0569, RV, SEM 2968. B. SAM–PQ–MF0570, RV, SEM 2969. C. SAM–PQ–MF0571, LV, SEM 2962. D–F. *Kuiperiana angulata* sp. nov. D. SAM–PQ–MF0572, holotype, LV, TBD 2924, 158 m, SEM 2919. E. SAM–PQ–MF0573, RV, TBD 3587, 140 m, SEM 2916. F. SAM–PQ–MF0574, RV, TBD 3524, 475 m, SEM 2923. Scale bars = 100 microns.

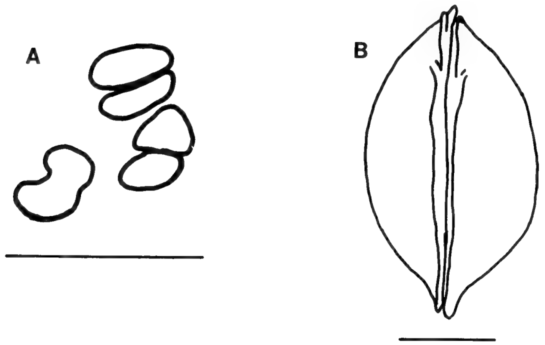

Fig. 40. A. *Kuiperiana angulata* sp. nov., SAM–PQ–MF0576, RV, MS, TBD 2974, 186 m. B. *Palmoconcha? walvisridgensis* sp. nov., SAM–PQ–MF0566, holotype, carapace, dorsal outline, TBD 3888, 154 m. Scale bars: A = 100 microns, B = 200 microns.

Diagnosis

Species with asymmetrically rounded, ventrally directed AM outlines, straight DM, and two strong, curved ventrolateral ribs.

Description

External features. Elongate ovate lateral outline. Broad, asymmetrically rounded AM with wide rims, ventrally directed. PM rounded, semi-caudate, with apex dorsally directed. DM straight, with a small step at the anterior cardinal angle. VM slightly convex, partly obscured by lateral surface overhang. Surface strongly reticulate, with two curved, sub-parallel ribs on ventrolateral surface. Reticulation is coarsest in subcentral areas.

No internal features were observed in specimens that were either poorly preserved, or carapaces.

Remarks

Palmoconcha? walvisridgensis is probably conspecific with the taxon recorded from the Pliocene of Gabon by Bold (1966) as *Loxoconcha* aff. *L. australis* Brady. The specimen illustrated in Bold (1966, pl. 3 (fig. 6)) appears to be somewhat abraded and consequently has less robust surface ornamentation than my material, but its overall valve shape and reticulation pattern is very similar. The lectotypes of *L. australis* Brady, 1880, as illustrated by Puri & Hulings (1976, pl. 18 (figs 17–18), pl. 19 (figs 1–4)) show that *P.? walvisridgensis* differs from Brady's species in lacking the strong upward sweep of the posteroventral outline, and in the outline of the posterodorsal margin, which is more acuminate in our species. In addition, *L. australis* has a distinct posterodorsal hinge ear that gives the posterior end of the DM outline a slight concavity.

An Indo-Pacific species that has a similar outline and ornamentation to *P.? walvisridgensis* is *Loxoconcha paiki* Whatley & Quanhong, 1987, from the Persian Gulf–Malacca Straits region. This differs from my species in the outline of the antero-

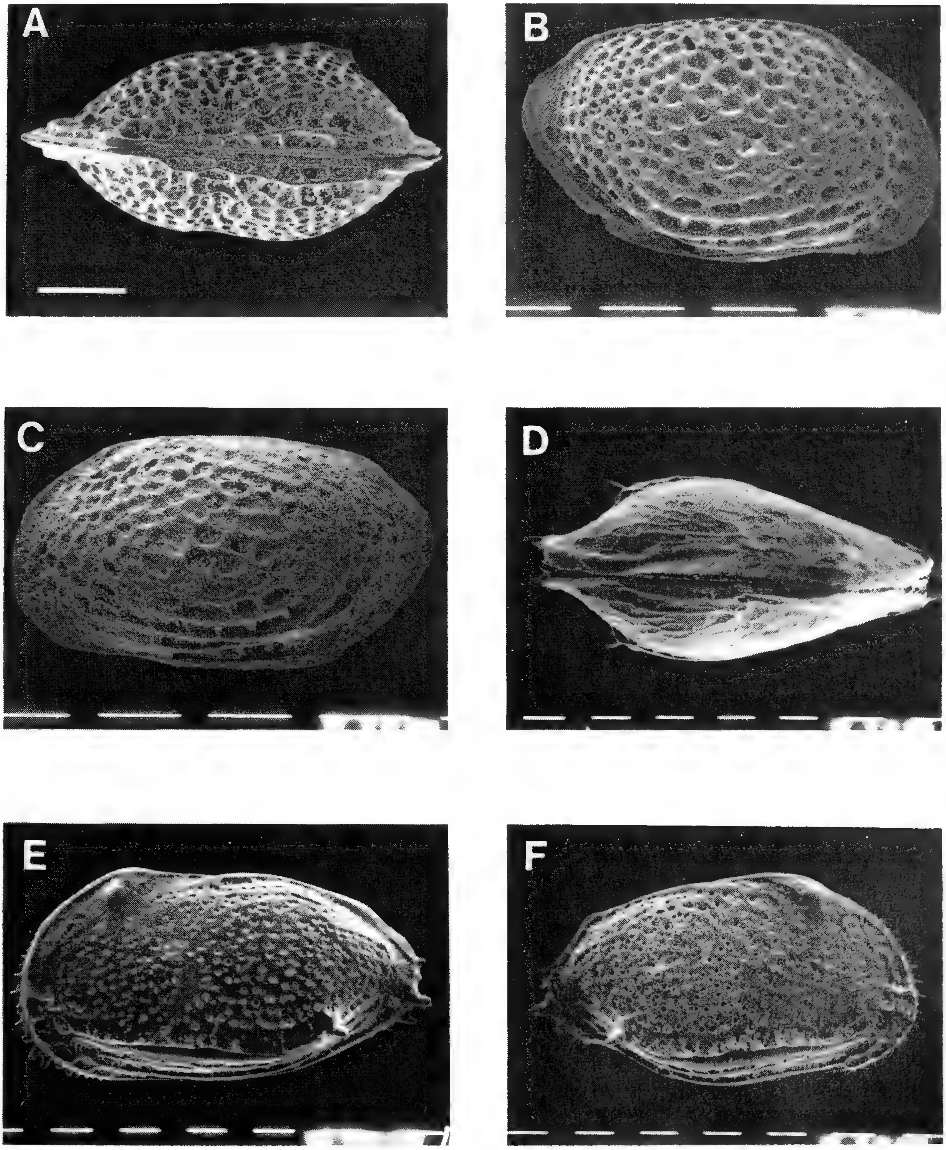

Fig. 41. A. *Kuiperiana angulata* sp. nov., SAM–PQ–MF0575, carapace, dorsal view, TBD 2924, 158 m, SEM 2920. B–C. *Palmoconcha? walvisridgensis* sp. nov. B. SAM–PQ–MF0566, holotype, carapace, right view, TBD 3888, 154 m, SEM 2972. C. SAM–PQ–MF0567, carapace, left view, TBD 3972, 200 m, SEM 2973. D–F. *Ruggieria cytheropteroides* (Brady, 1880). D. SAM–PQ–MF0588, carapace, dorsal view, TBD 2472, 201 m, SEM 2426. E. SAM–PQ–MF0589, LV, TBD 2975, 180 m, SEM 2403. F. SAM–PQ–MF0590, RV, TBD 2975, 180 m, SEM 2399. Scale bars = 100 microns.

ventral area, and in its more strongly curved muri in the reticulum of the central valve area.

Distribution

Palmoconcha? walvisridgensis was found at three stations in the northernmost part of the study area: on the southern part of the Walvis Ridge abutment shelf (20,4°S) and to the north of the abutment on the narrow shelf at the southern end of the Angola Basin, just south of the Kunene River (17,5°S) (Fig. 42). Modern valves were recovered only from the latter area.

The depth range suggested by these sites is relatively narrow and deep (154–200 m) with the modern population occupying the shallower depth.

These data suggest that *P.? walvisridgensis* is a subtropical species that inhabits the middle to outer shelf.

Palmoconcha subrhomboidea (Brady, 1880)

Figs 37F, 39A–C

Loxoconcha subrhomboidea Brady, 1880: 121, pl. 28 (figs 4a–d). Puri & Hulings, 1976: 298–299, pl. 18 (figs 15–16).
Loxoconcha sp. B Keeler, 1981: 143–154, pl. 8 (figs 10–11).
Loxoconcha sp. B192 Frewin, 1987: 46–47, pl. 16A–F, text-fig. 2.11A.

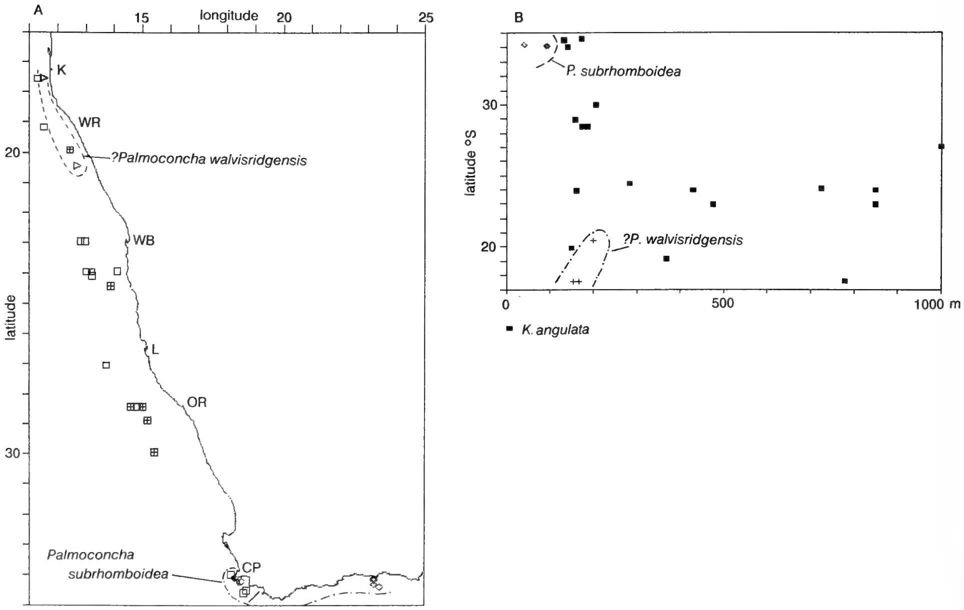

Fig. 42. A. Distribution of *Palmoconcha? walvisridgensis* sp. nov. (triangles, dashed line shows extent), *Kuiperiana angulata* sp. nov. (squares = relict sites, solid line south-east of Cape Peninsula shows southern extent; crosses = modern sites), and *Palmoconcha subrhomboidea* (Brady, 1880) (diamonds, dot-dashed lines shows seaward extent). See Fig. 7 for abbreviations. B. Latitudinal water-depth distribution of sites with *P. subrhomboidea* (Brady, 1880) (triangles), *K. angulata* sp. nov. (solid squares), and *P. ?walvisridgensis* sp nov (crosses).

Illustrated material

SAM–PQ–MF–0569, RV, TBD 5254, 40 m
SAM–PQ–MF–0570, RV, TBD 5254, 40 m
SAM–PQ–MF–0571, LV, TBD 5254, 40 m

Material

39 valves.

Remarks

The characteristic features of this species are a strong, curved, ventrolateral ridge and furrow, and a sharply arched dorsomedian rib. Its placement within *Palmoconcha* is not certain because no unequivocal views of the MS were available.

Distribution

Brady (1880) found this species only at 'Challenger' Station 140 in 15–20 fm (27–37 m) in False Bay, and in the present study I have established that it does not extend farther north, having recorded it only from False Bay (40 m), and at two sites west of the Hout Bay area (90–94 m) (Fig. 42A–B). Modern specimens occur in False Bay and at 94 m off the western side of the Cape Peninsula, whereas relict valves occur in False Bay and at 90 m off the Peninsula. Its extension on to the Agulhas Bank, where Keeler (1981) noted it at four sites with a water depth range 65–112 m, indicates that *P. subrhomboidea* is a warm-water taxon. It is not known whether any of Keeler's (1981) material was from modern populations.

Frewin (1987) illustrated this species from Palaeogene (?Upper Palaeocene–Middle Eocene) sediments of the Agulhas Bank, where she recorded five valves. A similar (but not conspecific) species (*Loxoconcha* sp. A3243 Frewin, 1987: 48) occurs in Upper Eocene strata of the same area.

Genus *Kuiperiana* Bassiouni, 1962

This genus was erected by Bassiouni (1962) to differentiate species of *Loxoconcha* that possess a long DM and consequently a long hinge ME. Previous records of this genus have been confined to Oligocene–Miocene strata of north-western Europe (e.g. see Uffenorde 1981; Kempf 1986)

Kuiperiana angulata sp. nov.

Figs 39D–F, 40A, 41A

Derivation of name

Angularis—Latin = angular, reference to angular, truncated alae.

Holotype

	length	height
SAM–PQ–MF–0572, LV, TBD 2924, 158 m	0,48 mm	0,29 mm

Paratypes

	length	height	width
SAM–PQ–MF–0573, RV, TBD 3587, 140 m	0,50 mm	0,30 mm	—
SAM–PQ–MF–0574, RV, TBD 3524, 475 m	0,58 mm	0,29 mm	—
SAM–PQ–MF–0575, C, TBD 2924, 158 m	0,51 mm	—	0,25 mm
SAM–PQ–MF–0576, RV, TBD 2974, 186 m			

Material

62 valves.

Diagnosis

Reticulate species of *Kuiperiana* with small, posteriorly angular alae.

Description

External features. Small sized, sub-quadrate in lateral outline. AM asymmetrically rounded, PM with a blunt caudal process. DM straight, with small, prominent cardinal angles. There are narrow AM and PM rims. Surface overall reticulate, with short longitudinal ribs that converge anterior of the central area. There is a small, posteriorly angular ala that is ventrally directed. This enhances the convex VM outline. In dorsal view the carapace tapers anteriorly, and has a slight median constriction.

Internal features. Hinge gongylodont, with a smooth ME and a strongly lobed PTE in RV. MS small, consisting of four rounded/elliptical adductors as two compound pairs, and a rounded eight-shaped frontal scar. Normal pore canals prominent and widely spaced.

Remarks

Reference of this species to *Kuiperiana* is not unequivocal because Bassiouni's type (*Loxoconcha wanneri* Kuiper, 1918) does not possess alae. However, the overall shape, ornamentation and hinge of *K. angulata* sp. nov. fit such a placement reasonably well. Whatley & Quanhong's (1987) genus *Alataconcha* is an alate loxoconchid, but it has a short hinge, a convex LV DM, and relatively large alae. In external view, *Kuiperiana angulata* is reminiscent of *Loxoconcha heronislandensis* Hartmann, 1981, which occurs widely in the south-eastern Pacific (see Whatley & Quanhong 1987), but lacks the latter species's prominent eye tubercle, and has more longitudinally aligned ornamentation. None of the loxoconchids previously reported from southern Africa can be confused with the alate *K. angulata*.

Distribution

This is the most widely distributed loxoconchid on the continental shelf of south-western Africa (Fig. 42A, B), although it rarely constitutes >10 per cent total ostracod assemblage.

The modern population of *Kuiperiana angulata* sp. nov. lies in a narrow belt between latitudes 19,9°S (Walvis Ridge abutment shelf) and 30°S (Hondeklip Bay, Namaqualand coast), where its UDL and LDL are 150 m and 283 m, respectively.

The main relict populations lie on the Walvis and Orange shelves, but there are three sites off the Cape Peninsula. Although the relict UDL is similar to that of the modern fauna (131 m off the Cape Peninsula—Fig. 42B), the LDL suggests a large increase into deeper water compared to modern sites, and in the Walvis–Orange sector it may increase to 1 000 m (although the latter may be an allochthonous occurrence).

Plotting abundance against water depth for the total assemblage suggests two peaks: *c.* 300 m and 750 m. The shallower of these is probably real, but the veracity of the latter is uncertain.

Overall distribution of loxoconchids

Only two of the species that have been reported from the continental shelf off south-western Africa have a widespread distribution: *Palmoconcha walvisbaiensis*, which is confined to areas north of 27°S, and *Kuiperiana angulata*, which occurs along the whole margin from the Walvis Ridge abutment to south of the Cape Peninsula (Fig. 36). *Loxoconcha megapora* (including the variety *magna*) also has a wide geographical range, but so far reports of it have been confined to widely spaced coastal sites.

Two other shelf species have much more limited ranges: *Palmoconcha? walvisridgensis* is restricted to the subtropical northernmost area in the vicinity of the Walvis Ridge abutment, and *P. subrhomboidea* is restricted to the Agulhas Bank region, and penetrates along the west coast only as far as the Cape Peninsula.

Plotting the summed and smoothed abundances of the loxoconchids shows that north of approximately 25°S (middle of the Lüderitz–Walvis Bay shelf sector) they constitute the dominant modern ostracod taxon (Fig. 4). This is particularly so in the shelf sector between Walvis Bay and the Walvis Ridge abutment, where *P. walvisbaiensis* accounts for 98 per cent of the loxoconchid population. They are minor components of the modern fauna on the northern Orange Banks, and off the Cape Peninsula. Within the relict assemblages, the loxoconchids become increasingly abundant north of approximately 26°S, with peaks off Walvis Bay, on the Walvis Ridge abutment, and in the vicinity of the Kunene River (Fig. 5). They are an insignificant component of the relict fauna on the Orange Shelf, and areas farther south.

Changes in the relict and modern distributions of these taxa show that within the older populations two subtropical Atlantic species penetrated up to 200 km farther south: *P. walvisbaiensis*—2 degrees; and *P.? walvisridgensis*—2,5 degrees, whereas *Kuiperiana angulata* established a population off the Cape Peninsula, 400 km south of its modern limits, but did not inhabit the intervening area off the Namaqualand coast. In contrast, there was no corresponding extension north of the Cape Peninsula of the range of the warm water ('Agulhas') species *Palmoconcha subrhomboidea*.

Family **Trachyleberididae** Sylvester-Bradley, 1948

Genus *Ruggieria* Keij, 1957

Ruggieria cytheropteroides (Brady, 1880)

Figs 41D–F, 43A–B, 44

Cythere cytheropteroides Brady, 1880: 78, pl. 15 (figs 5a–d). Puri & Hulings, 1976: 272–273, pl. 9 (figs 5–8).
Bosquetina sp. Keeler, 1981: 41–43, pl. 2 (fig. 1).
Ruggieria cytheropteroides (Brady, 1880) Boomer, 1985: 19–21, pl. 1 (figs 1–3).

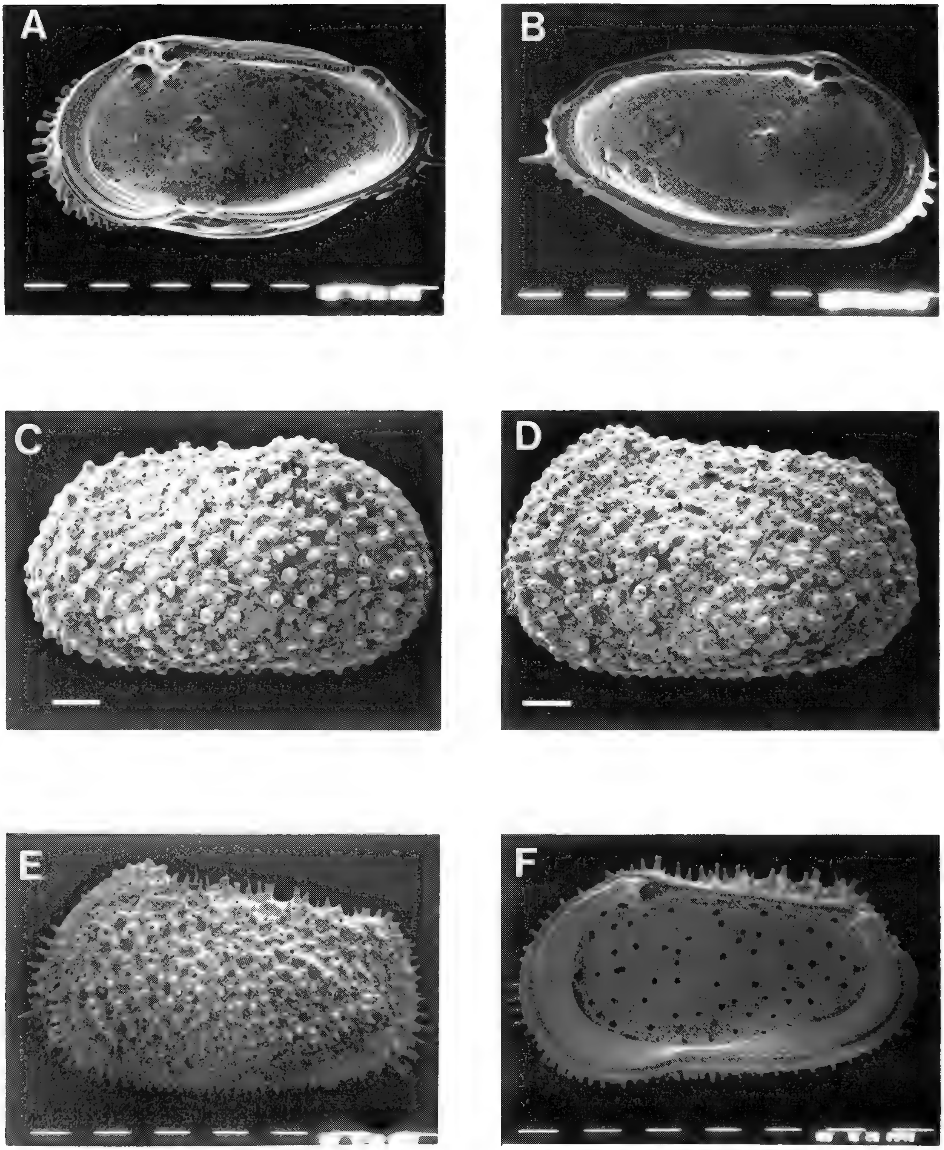

Fig. 43. A–B. *Ruggieria cytheropteroides* (Brady, 1880). A. SAM–PQ–MF0591, RV, TBD 3863, 150 m, SEM 2410. B. SAM–PQ–MF0592, LV, TBD 2975, 180 m, SEM 2405. C–F. *Henryhowella melobesioides* (Brady, 1869). C. SAM–PQ–MF0475, RV, TBD 311, 184 m, SEM 2625. D. SAM–PQ–MF0478, LV, TBD 311, 184 m, SEM 2626. E. SAM–PQ–MF0480, LV, TBD 3561, 655 m, SEM 2591. F. SAM–PQ–MF0481, RV, TBD 3561, 655 m, SEM 2493. Scale bars = 100 microns.

Illustrated material

SAM–PQ–MF–0588, C, TBD 2472, 201 m
SAM–PQ–MF–0589, LV, TBD 2975, 180 m
SAM–PQ–MF–0590, RV, TBD 2975, 180 m
SAM–PQ–MF–0591, RV, TBD 3863, 150 m
SAM–PQ–MF–0592, LV, TBD 2975, 180 m

Material

5 489 valves.

Remarks

Ruggieria cytheropteroides differs from Keij's genotype (*Cythere micheliniana* Bosquet, 1852—see Uffenorde 1981, pl. 6 (figs 7, 10, 12)) from the Eocene–Oligocene of north-western Europe, in being slightly plumper, with a more prominent ventrolateral overhang. Otherwise the essential generic components are well seen in Brady's species (e.g. 1880, pl. 15 (fig. 5a)), although the lectotypes selected by Puri & Hulings (1976) are worn, broken and probably instars. Features of note are the prominent ventrolateral keel with a sharp posterior spine, the large ocular sinus, the denticulate hinge ME and the elongate and weakly lobate RV ME, and the MS with four large adductors, a relatively small U-shaped anterior scar, and a prominent pit and antero-adjacent boss in front of the dorsal adductor.

Ruggieria cytheropteroides is similar in outline and general appearance to two species that range along the northern Indian Ocean area (Gulf of Oman to Java Sea—Whatley & Quanhong 1988): *R. darwinii* (Brady, 1868) and *R. indopacifica* Whatley & Quanhong, 1988. Both these species differ from *R. cytheropteroides* in being coarsely reticulate.

Ruggieria and related genera are a widely distributed and diverse group on the continental shelf of western and south-western Africa. Three species of the genus have been recorded from the Tertiary of west and equatorial Africa: *R. tattami* Reyment, 1963 (Palaeocene–Eocene of Nigeria), and *R. tetraptera tetraptera* (Seguenza) and *R. rotundata* (Ruggieri) (Bold 1966—Mio–Pliocene of Gabon), but none of these species seems close to *R. cytheropteroides*, and may not be congeneric with Keij's types. Dingle (1976) did not report *Ruggieria* from the Tertiary of the Natal continental shelf, but Frewin (1987) illustrated an elongate species with strong posteroventral spines (*Ruggieria* sp. A485) from the Upper Eocene of the eastern Agulhas Bank.

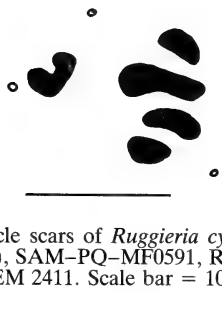

Fig. 44. Muscle scars of *Ruggieria cytheropteroides* (Brady, 1880), SAM–PQ–MF0591, RV, TBD 3863, 150 m, SEM 2411. Scale bar = 100 microns.

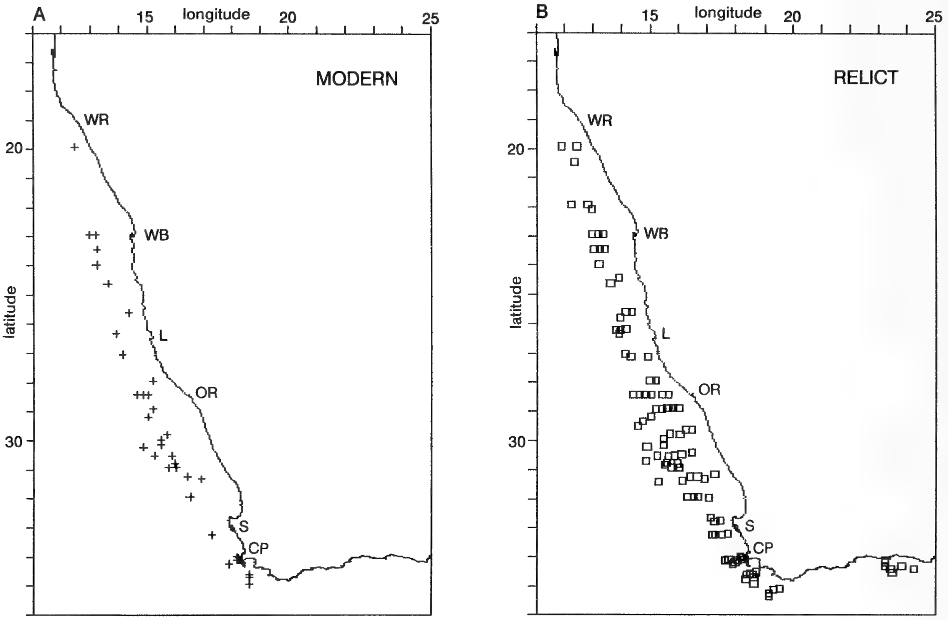

Fig. 45. Distribution of *Ruggieria cytheropteroides* (Brady, 1880). A. Modern sites. B. Relict sites. See Fig. 7 for abbreviations.

Keen (1975) recorded eight Recent species of the genus from the continental shelf off West Africa (although he suspected that they are in fact not congeneric with the holotype): *R. triangulata* Omatsola, 1972 (20–80 m), *R. beninensis* Omatsola, 1972 (20–30 m), *R. lekkii* Omatsola, 1972 (20–30 m), *R. nigeriana* Omatsola, 1970 (20–30 m), *R. martinssoni* Omatsola, 1972 (0–110 m, 10–60 m living), *R. tricostata* Omatsola, 1972 (20–30 m), *R. boldi* Keen, 1975 (20 m), and *R. leonensis* Keen, 1975 (sandy sediments, 60–110 m). The last-named is very similar in shape, ornamentation and internal features to *R. cytheropteroides*. It differs in having a faint surface reticulation, a weak AM ridge, and in being slightly more triangular in lateral outline over the anterior cardinal angle. Clearly, the two species are closely related.

Babinot & Kouyoumontzakis (1986) have recorded three of the West Africa taxa from modern sediments off the mouth of the Congo River: *R. lekkii* (38–44 m); *R. martinssoni* (38 m); and *Ruggieria* aff. *R. triangulata* (38 m).

Distribution

Brady (1880) recorded this species from 'Challenger' Station 142 off the Cape of Good Hope (300 m).

Ruggieria cytheropteroides (combined modern and relict specimens) is overall the second most abundant ostracod taxon (after *Pseudokeijella lepralioides* (Brady, 1880)) on the south-western African continental shelf (22% of all specimens recorded in the present study, 39% of specimens in the samples containing the dominant taxa).

Modern specimens extend over a latitudinal range of 15 degrees between 19° and 35°S (Figs 4, 45A, 46). Off the Cape Peninsula (Fig. 46C) the species occurs in water

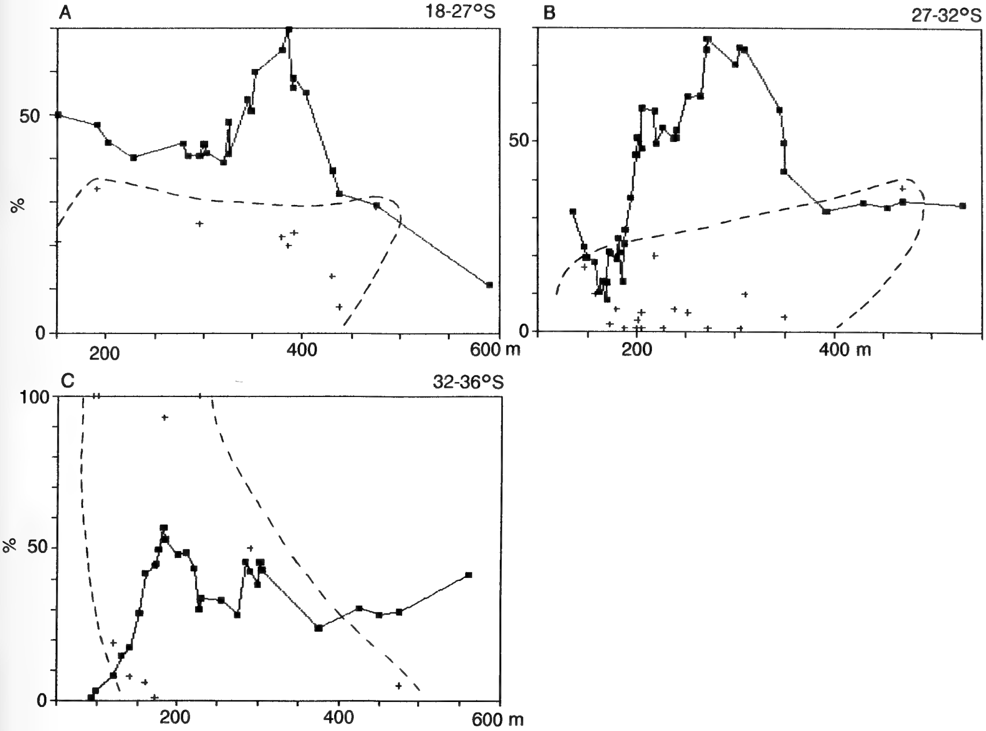

Fig. 46. Abundance of *Ruggieria cytheropteroides* (Brady, 1880) as percentage of ostracod fauna plotted against water depth (5-point running means). Modern populations (crosses) enclosed by dashed line. A. 18–27°S. B. 27–32°S. C. 32–36°S.

depths between 94 m and either 290 m or 475 m (the latter may be allochthonous), whereas north of 32°S (Fig. 46B) it occupies mid-outer shelf depths between 147 m and 469 m. The species becomes less abundant north of 27°S, and occurs in water depths between 150 m and 475 m (Fig. 46A). In the vicinity of Walvis Bay (23–25°S) the UDL of *R. cytheropteroides* increases to 295 m and the species is confined to the outer shelf area. The northernmost sample site on the Walvis Ridge shelf is a single valve.

These distributions give overall UDL and LDL of modern specimens for the west coast as 94–475 m, with water depths of the main population abundances for the Walvis, Lüderitz–Orange–Namaqualand, and south-western Cape areas decreasing steadily southward from 400 m, via 200 m to 150 m.

Relict specimens of *R. cytheropteroides* occur over the same latitude range as the modern populations (i.e. Walvis Ridge abutment 19°S to south-western Cape 35°S: Fig. 45B). The overall pattern of their latitudinal abundances is also similar (Figs 4, 5), with the main concentration of high abundance samples on the Namaqualand –Orange Shelf sector. Across-shelf profiles (Fig. 46A, B) show that in the northern sector, the maximum population abundance lies on the outer shelf (*c.* 370 m), and that it moves inshore to *c.* 300 m on the Orange Shelf. The abundance/water depth profile is more complicated off the south-western Cape (Fig. 46C) where the major abundance peak occurs at *c.* 190 m, with only a minor peak at the *c.* 300 m.

Table 4 and Figure 47 summarize the depth range changes for the various *R. cytheropteroides* populations.

Subfamily Trachyleberidinae Sylvester-Bradley, 1948

Genus *Henryhowella* Puri, 1957

Aspects of the status of this genus have recently been reviewed by Dingle *et al.* (1990), particularly as they pertain to local species. The present publication adopts their taxonomic strategy.

Henryhowella melobesioides (Brady, 1869)

Fig. 43C–F

Cythere melobesioides Brady, 1869: 162, pl. 12 (figs 10–11); 1880: 108, pl. 18 (figs 1e–g). Puri & Hulings, 1976, pl. 25 (figs 1–2).
non *Cythere melobesioides* Brady, 1869. Brady, 1880, pl. 18 (figs 1a–d).
Cythere nodulifera Brady, 1869: 163, pl. 19 (figs 24–25).
Henryhowella sp. Keeler, 1981: 162–163, pl. 9 (fig. 14).
Henryhowella sp. Boomer, 1985, pl. 1 (figs 6–8, 18).
non *Henryhowella* sp. Boomer, 1985: 25–27, pl. 3 (figs 38–39).
Henryhowella melobesioides (Brady, 1869) Dingle *et al.*, 1990: 311–318, figs 42C–F, 43A–F, 44A–D, 47A.

Illustrated material

SAM–PQ–MF–0475, RV, TBD 311, 184 m
SAM–PQ–MF–0478, LV, TBD 311, 184 m
SAM–PQ–MF–0480, LV, TBD 3561, 655 m
SAM–PQ–MF–0481, RV, TBD 3561, 655 m

TABLE 4

Water depth distribution of *Ruggieria cytheropteroides*.

	UDL (m)	LDL (m)	Depth range (m)	Main conc. (m)	Shift (m)
MODERN					
North	150	475	325	400	
Orange–Namaqualand	147	469	322	200	
South-western Cape	94	475 or 290	381 or 200	150	
RELICT					
North	150	590	440	370	-30
Orange–Namaqualand	135	530	395	290	+90
South-western Cape	94	560	466	190 and 300	+40 and +150

UDL – upper depth limit
LDL – lower depth limit
Main conc. – depth of the sites with greatest abundances
Shift – difference between relict and modern depths of greatest abundances

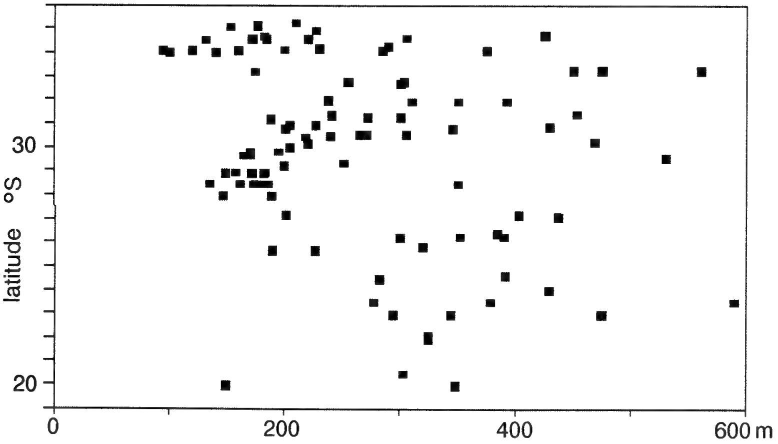

Fig. 47. Latitudinal water-depth distribution of sites with *Ruggieria cytheropteroides* (Brady, 1880).

Material

429 valves.

Remarks

Dingle *et al.* (1990) could not recognize any geographical consistency in the morphological variation of individuals in the populations of *Henryhowella* on the continental margin off south-western Africa. Consequently, in view of the uncertainty surrounding the taxonomy of widely reported species such as *H. asperrima* (Reuss, 1850), they considered all morphological variants on the continental margin off south-western Africa could be accommodated in Brady's species *H. melobesioides* (Brady, 1869), which he regarded (Brady 1880) as conspecific with the type specimens from Mauritius (Brady 1869). I adhere to this view.

Brady (1880) recorded *H. melobesioides* from *c.* 300 m (150 fm) off the Cape Peninsula, and his figured specimens have relatively nodose spines. Dingle *et al.* (1990) remarked that the deeper-water populations tend to have more slender spines, and that coarsely spinose individuals are representative of the continental shelf populations (compare Figs 43C, D with Fig. 43E). I regard this as a response to environmental factors (e.g. energy of bottom water).

Distribution

Henryhowella melobesioides is widely distributed along the continental margin of south-western Africa (Fig. 48A, B) but, because Keeler (1981) did not find it on the eastern Agulhas Bank, the eastward limit of the species lies between 19,28°E and 23,21°E. It is essentially a cold-water, west-coast taxon around southern Africa.

Modern populations occur along the west-coast margin between 35° and 19°S. Off the Cape Peninsula the depth range is 140–290 m, but it increases to 430–990 m at the latitude of Saldanha Bay. Consequently, north of the Cape Canyon (33,5°S) there are no modern populations of *H. melobesioides* on the continental shelf. A wide barren

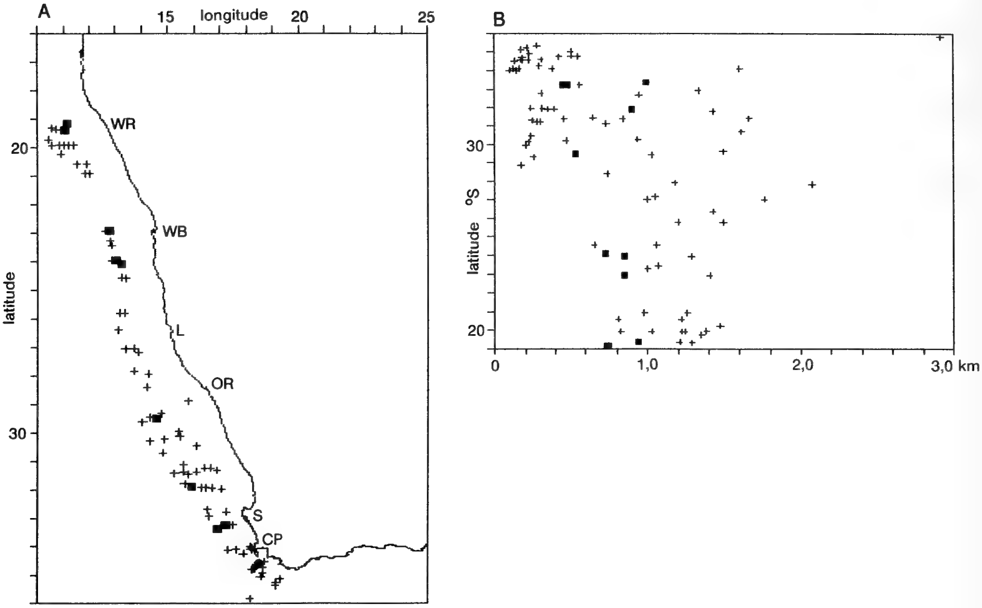

Fig. 48. A. Distribution of *Henryhowella melobesioides* (Brady, 1869). Crosses = relict sites, solid squares = modern sites. See Fig. 7 for abbreviations. B. Latitudinal water-depth distribution of sites with *H. melobesioides* (Brady, 1869). Crosses = relict sites, solid squares = modern sites.

zone between the Orange River and Lüderitz separates the Namaqualand and Lüderitz–Walvis Bay upper slope populations (Fig. 4), where in the latter the UDL and LDL are 725 m and 1 430 m. Clearly, the whole of the low dissolved oxygen environment of the Walvis shelf, and the suspensate rich and lower-salinity shelf adjacent to the Orange River are environmentally unsuitable for modern populations.

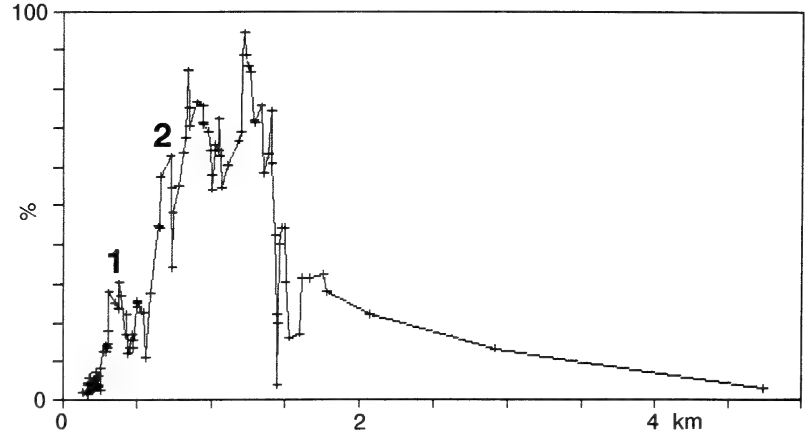

Fig. 49. Abundance of *Henryhowella melobesioides* (Brady, 1869) as percentage of ostracod fauna plotted against water depth (5 point running means). 1 = abundance peak on outer shelf off south-western Cape. 2 = abundance peak off Namaqualand.

Relict distribution patterns are similar to those of the modern populations, with the exception of the area off Namaqualand, where the UDL is similar to that off the Cape Peninsula (*c.* 100 m). A notable similarity between the two populations is the absence of both modern and relict faunas in the Walvis–Orange shelf area. A major difference is in the overall greater LDL of relict populations, with specimens occurring to a maximum of 2 916 m in the extreme south.

Dingle *et al.* (1990) have previously considered the distribution of *H. melobesioides* in deep water (>950 m), and Figure 53 shows a summed population profile across the margin into abyssal depths. The species dominates the ostracod populations between about 750 m and 1 500 m (from the core of the salinity minimum zone to the base of the Antarctic Intermediate Water mass). Dingle *et al.* (1989) have suggested that this is an Atlantic-wide phenomenon. The minor peak at the shallow (left side) of Figure 49 reflects an abundance of *H. melobesioides* on the upper slope west of the Cape Peninsula.

Genus *Pseudokeijella* gen. nov.

Diagnosis

Plump, ovate genus. Ornamentation is densely reticulate, with two anteromarginal ribs emanating from a moderate to prominent eye spot. PM is spinose posteroventrally. There is no ventrolateral carina or tendency to develop ventrolateral spines or ridges. Hinge is holamphidont with denticulate LV ME. MS have an anterior structure consisting of two very small, close-lying or partially fused scars (in a compressed U-shaped), and four adductors of which the second is long and curved and the others small and rounded.

Type species. Cythere lepralioides Brady, 1880.

Derivation of name

Pseudo- plus *Keijella* with reference to similarity to this genus.

Remarks

This genus is erected to accommodate a species that is closely allied to the two genera *Ruggieria* Keij, 1957, and *Keijella* Ruggieri, 1967, but which differs from both on significant features of outline, ornamentation and MS.

The type species of *Ruggieria* is *Cythere micheliniana* Bosquet, 1852, which is carinate with a posteroventral spine, and bears several further longitudinal ridges. Keij (1957) specifically mentioned in his remarks that *Ruggieria* lacks ornamentation with concentricity. This genus is represented off south-western Africa by a typical species, *Ruggieria cytheropteroides* (Brady, 1880).

Keijella is based on the species *Cythere hodgii* Brady, 1866. The type specimen of this species, from the eastern Mediterranean, is lost, but Doruk (1973) has illustrated topotypic material, as well as erecting two new species of the genus from Turkey. This is an elongate taxon with a postero-ventrolateral spine and/or swelling whose valve surface is either smooth, or has longitudinal rows of elongate fossae ('slots' of Doruk 1973).

Pseudokeijella has some features of both these genera, and on balance is closer to *Keijella* (hence the name) (Fig. 51). It differs from *Ruggieria* by lacking the characteristic ventrolateral carina, but the MS are similar, with the third scar small and round and set distinctly posterior to the fourth, and the second elongate. *Keijella* lacks a ventrolateral carina, and prominent longitudinal ridges, with the result that the overall shape and surface ornamentation are more similar to those of *Pseudokeijella*. However, *Pseudokeijella* has an ovate outline (in contrast to the elongate subquadrate outline of *Keijella*), is plumper, and lacks any postero-ventrolateral spine or swelling. The MS of *Keijella* and *Pseudokeijella* differ to the extent that the adductors of the former are more elongate, and the anterior scar of the type species has the shape of three sides of a rectangle.

Whatley & Quanhong (1988) have reported 10 species of *Keijella* from the Malacca Straits region. I suspect that at least two of these (*K. japonica* (Ishizaki) and *K. reticulata* Whatley & Quanhong) belong to *Pseudokeijella*. In addition, several species previously referred to *Leguminocythereis* appear close to *Pseudokeijella* in outline and ornamentation (their internal features are mostly not known). Within this category I include *Leguminocythereis lokossaensis* Apostolescu, 1961, *Leguminocythereis frescoensis* Apostolescu, 1961, *?Leguminocythereis* cf. *L. lokossaensis* Apostolescu (Dingle 1976), *?Leguminocythereis* sp. 1 Dingle, 1976; *Leguminocythereis* cf. *L. exigua* (Apostolescu) (Frewin 1987); *Leguminocythereis* sp. 1507 Frewin, 1987.

Pseudokeijella lepralioides (Brady, 1880)

Figs 50A–F, 51E–F, 55E–F

Cythere lepralioides Brady, 1880: 94, pl. 19 (figs 5a–d). Puri & Hulings, 1976: 280–281, pl. 12 (figs 10–11).
Ruggieria lepralioides (Brady) Keeler, 1981: 173–175, pl. 10 (figs 1–3).
Leguminocythereis? sp. Boomer, 1985: 47–49, pl. 1 (figs 4–5).
Leguminocythereis sp. 1507 Frewin, 1987: 44–45, pl. 15A–D.

Illustrated material

SAM–PQ–MF–0557, LV, TBD 6824, 90 m
SAM–PQ–MF–0558, RV, TBD 6824, 90 m
SAM–PQ–MF–0559, RV, TBD 6836, 80 m
SAM–PQ–MF–0560, LV, TBD 6836, 80 m
SAM–PQ–MF–0561, carapace, TBD 6847, 94 m

Material

8 181 valves.

Remarks

The lectotype of Brady's (1880) species selected by Puri & Hulings (1976) is probably a penultimate instar, which has signs of physical wear. Our material shows that the ventral parts of the AM and PM are spinose, and that the eye spot is moderately well-developed, with two ribs running from it sub-parallel to the AM. The hinge is holamphidont with, in the RV, a prominent tooth at the posterior part of the ATE, an ovate smooth PTE, and a straight, denticulate ME. There is a deep internal ocular

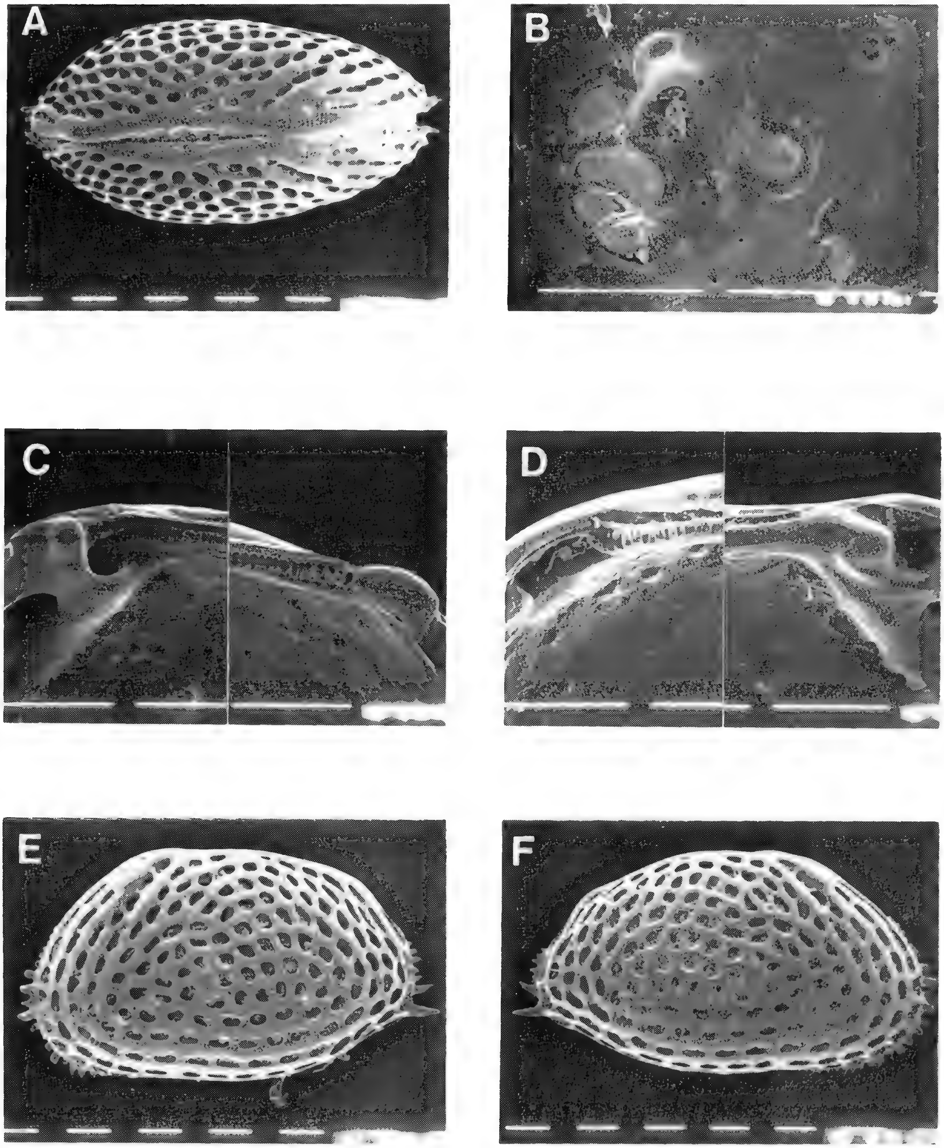

Fig. 50. A–F. *Pseudokeijella lepralioides* (Brady, 1880). A. SAM–PQ–MF0561, carapace, dorsal view, TBD 6847, 94 m, SEM 2389. B. SAM–PQ–MF0560, LV, MS, TBD 6836, 80 m, SEM 2381. C. SAM–PQ–MF0559, RV, hinge, TBD 6836, 80 m, SEM 2387–88. D. SAM–PQ–MF0560, LV, hinge, TBD 6836, 80 m, SEM 2382–83. E–F. TBD 6824, 90 m. E. SAM–PQ–MF0557, LV, SEM 2372. F. SAM–PQ–MF0558, RV, SEM 2377. Scale bars = 100 microns.

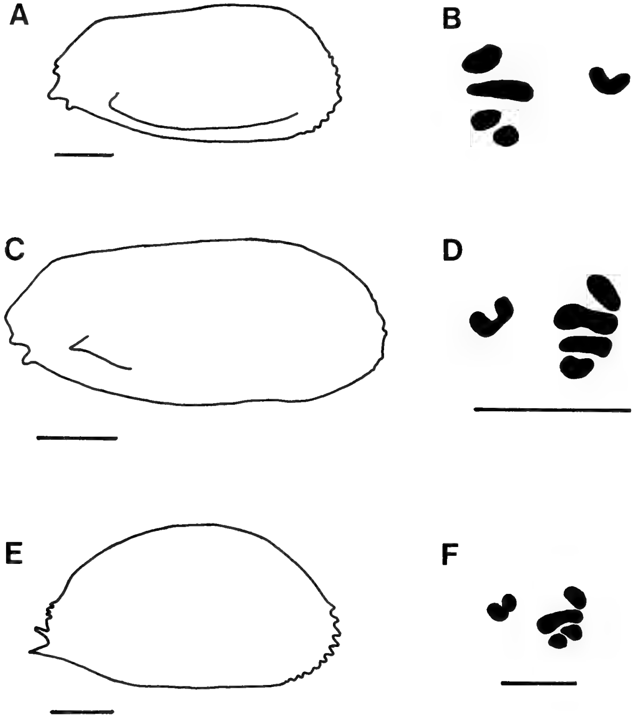

Fig. 51. Comparison of outline and MS of *Pseudokeijella* gen. nov. with *Ruggieria* Keij, 1957, and *Keijella* Ruggieri, 1967. A–B. *Ruggieria micheliniana* (Bosquet, 1852), type species of *Ruggieria* Keij, 1957. A. Specimen from Lower Miocene of Northern Germany (after Uffenorde 1981, pl. 6 (fig. 7)). B. Specimen from Lower Miocene of France (after Keij 1957, pl. 15 (fig. 5)). C–D. *Keijella hodgii* (Brady, 1866), type species of *Keijella* Ruggieri, 1967. C. Specimen from Upper Miocene of Turkey (after Doruk 1973, pl. 1:9:54 (1)). D. Specimen from Mio–Pliocene of San Marino (after Doruk 1973, pl. 1:9:56 (3)). E–F. *Pseudokeijella lepralioides* (Brady, 1880). E. SAM–PQ–MF0558, RV, TBD 6824, 90 m. F. SAM–PQ–MF0559, RV, TBD 6836, 80 m. Scale bars. A, C, E = 200 microns; D, F = 100 microns; B unknown.

sinus anterior to the anterior hinge elements. The MS pattern consists of four dissimilarly sized adductors, two small anterior spots that lie very close, or are partly fused to a flattened U-shape, and a prominent fulcral point. There is no noticeable MS depression, and consequently no STC on the outer lateral surface. In dorsal view, *P. lepralioides* is elliptical.

Distribution

Brady (1880) reported this species from two localities off south-western Africa: Station 140 in False Bay (30–40 m), and Station 142, south-west of the Cape of Good Hope (300 m).

Pseudokeijella lepralioides (combined modern and relict specimens) is overall the most abundant ostracod taxon on the south-western African continental shelf (32% of all specimens recorded in the present study, 39% of specimens in the samples con-

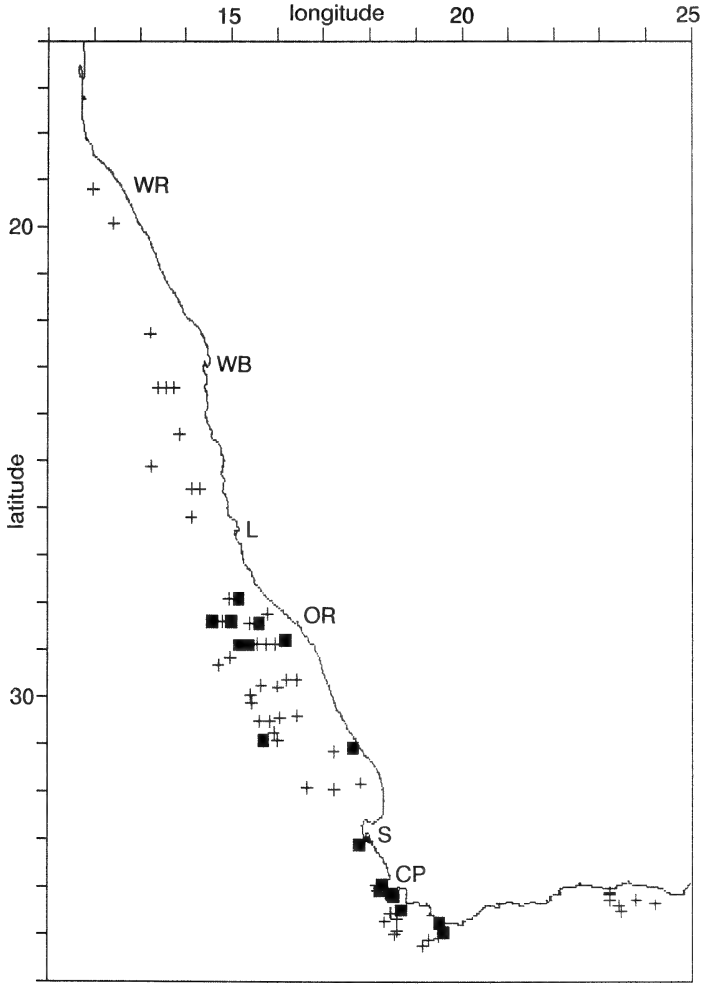

Fig. 52. Distribution of *Pseudokeijella lepralioides* (Brady, 1880). Crosses = relict sites, solid squares = modern sites. See Fig. 7 for abbreviations.

taining the dominant taxa of this paper), and Keeler (1981) recorded it as the most abundant species on the eastern Agulhas Bank (average 10% in 8 samples).

Modern specimens are concentrated in two areas (Figs 4, 52). On the Orange Shelf directly west of the Orange River (28–29°S), where UDL and LDL lie between 126 m and 183 m water depth, and between Cape Columbine (33°S) and Cape Agulhas where the species occurs between 40 m and 155 m. Two isolated occurrences off the Namaqualand coast in 88 m and 205 m.

The modern populations are most abundant on the Orange Shelf at *c.* 160 m, and off the south-western Cape at *c.* 100 m.

Relict specimens of *P. lepralioides* occur on the Walvis Ridge shelf (19°S) and the eastern Agulhas Bank (Figs 5, 52). The greatest abundance of relict specimens lies on

TABLE 5

Water depth distribution of *Pseudokeijella lepralioides*.

	UDL (m)	LDL (m)	Depth range (m)	Shift (m)
MODERN				
Orange	126	183	57	
Namaqualand	88	205	117	
South-western Cape	40	155	115	
RELICT				
Walvis	150	300	150	–
Orange	100	240	140	83
Namaqualand	88	310	222	105
South-western Cape	40	220	180	65

UDL – upper depth limit
LDL – lower depth limit
Shift – difference between relict and modern depth ranges

the Orange Shelf and, in contrast to the modern populations, the species is relatively poorly represented off the south-western Cape, although here relict specimens of *P. lepralioides* are an important secondary element. There is a southward decrease in the UDL from 150 m on the Walvis Shelf to 88 m off Namaqualand, and 40 m off the Cape Peninsula, and a corresponding, but less marked, decrease in LDL from *c.* 300 m on the Orange Shelf and areas farther north, to 220 m in the south.

Across-shelf abundances decrease in the northern area (18–32°S), with major changes at 160 m and 200 m, but in the south (32–36°S), there is a general increase to about 200 m, beyond which values decline.

Table 5 and Figure 53 summarize the depth range changes for the various *P. lepralioides* populations.

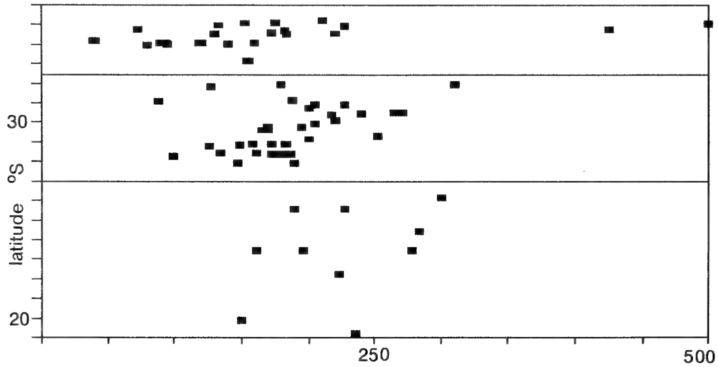

Fig. 53. Latitudinal water-depth distribution of sites with *Pseudokeijella lepralioides* (Brady, 1880).

Family **Xestoleberididae** Sars, 1928

Genus *Xestoleberis* Sars, 1866

Fourteen species of this genus have been recorded around southern and south-western Africa. Nine of these occur in the present study area: *Xestoleberis africana* Brady, 1880—west coast continental shelf to Agulhas Bank; *Xestoleberis hartmanni* sp. nov.—continental shelf west of the Cape Peninsula to Cape Agulhas; *Xestoleberis ramosa* Müller, 1908—coastal sites from Lüderitz to Simonstown harbour (False Bay); *Xestoleberis capensis* Müller, 1908—coastal sites from Simonstown harbour to Knysna Lagoon; *Xestoleberis crenulata* Klie, 1940—Lüderitz Bay; *Xestoleberis ferax* Klie, 1940— Lüderitz Bay; *Xestoleberis baja* Klie, 1940—Lüderitz Bay; *Xestoleberis humilis* Klie, 1940—Lüderitz Bay; and *Xestoleberis* aff. *X. rotunda* Hartmann, 1964 (Hartmann 1974)—coastal sites Cacuaco (Mozambique) to Lüderitz.

Xestoleberis africana Brady, 1880

Figs 54A–E, 56A–B

Xestoleberis africana Brady, 1880: 126, pl. 30 (figs 4a–c). Puri & Hulings 1976, 299, pl. 19 (figs 15–16).
?Xestoleberis sp. B Keeler, 1981: 182–183, pl. 10 (figs 14–15).
Xestoleberis spp. Boomer, 1985: 60–61, pl. 3 (figs 52–53).

Illustrated material

SAM–PQ–MF–0583, RV, TBD 6847, 94 m
SAM–PQ–MF–0584, LV, TBD 6847, 94 m
SAM–PQ–MF–0585, LV, TBD 6847, 94 m
SAM–PQ–MF–0586, RV, TBD 6847, 94 m
SAM–PQ–MF–0587, C, TBD, 6847, 94 m

Material

500 valves.

Remarks

This distinctively shaped, rather globular, thick-shelled species was re-illustrated by Puri & Hulings (1976). My SEM photographs show that the ME of the hinge in the RV and LV is locellate and denticulate, respectively, and not smooth as reported in the description of the lectotype. The small '*Xestoleberis*' spot is well illustrated in Figure 54D.

Distribution

Brady (1880) originally recorded this species only from 'Challenger' Station 140 in False Bay (15–20 fm (27–37 m)). The present study shows it to be the most widely distributed species of the genus on the continental shelf off south-western Africa (Fig. 57A).

Modern populations of *X. africana* are restricted to a narrow depth range off the Cape Peninsula (33,96–34,09°S; 80–95 m) and in False Bay (40 m) (Fig. 57B).

Relict specimens occur over a latitudinal range 22°S (Walvis Bay) to the eastern Agulhas Bank, and fall into three population groups. Two sites occur in the north

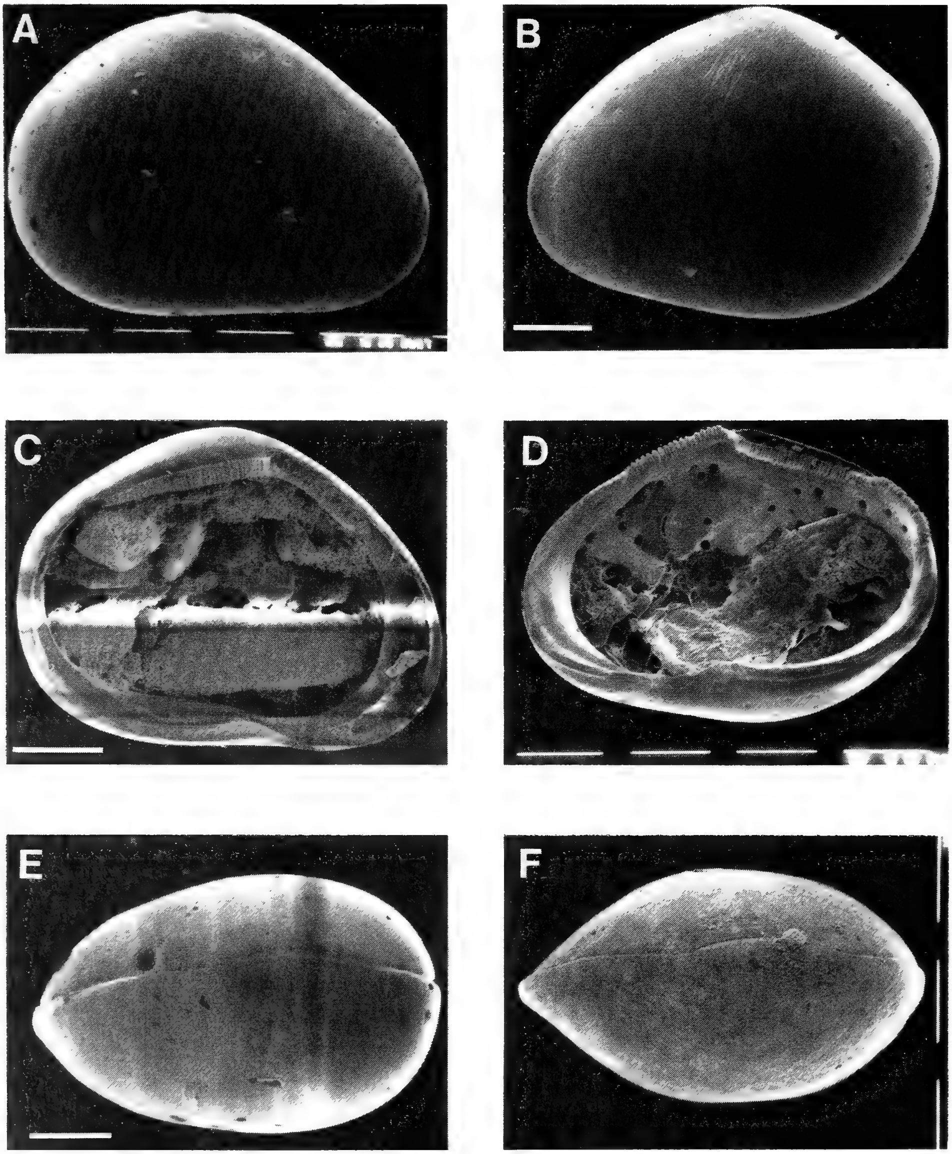

Fig. 54. A–E. *Xestoleberis africana* Brady, 1880, TBD 6847, 94 m. A. SAM–PQ–MF0583, RV, SEM 2657. B. SAM–PQ–MF0584, LV, SEM 2658. C. SAM–PQ–MF0585, LV, SEM 2663. D. SAM–PQ–MF0586, RV, SEM 2652. E. SAM–PQ–MF0587, carapace, dorsal view, SEM 2661. F. *Xestoleberis hartmanni* sp. nov. SAM–PQ–MF0579, carapace, dorsal view, TBD 6825, 160 m, SEM 2677. Scale bars = 100 microns.

(vicinity of Walvis Bay), a cluster of sites lies on the Orange–Namaqualand shelf between the Orange and Olifants rivers, and a third centre extends from the Cape Peninsula to the eastern Agulhas Bank. The upper depth limits of the sites north of 34°S all lie deeper than 173 m, whereas in the south relict specimens occur as shallow as 40 m in False Bay. With the exception of one isolated deep site, the lower depth limits along the whole shelf lie between 283 m and 290 m (Fig. 57C). The deep site (in 545 m) is relatively isolated from the main south-western Cape populations and contains a single, probably allochthonous valve.

Xestoleberis hartmanni sp. nov.

Figs 54F, 55A–D, 56G–H, S, 58

Derivation of name

The species is named for Professor G. Hartmann (University of Hamburg) for his important contribution to the study of modern marine ostracods around southern Africa.

Holotype

	length	height
SAM–PQ–MF–0578, LV, TBD 6825, 160 m	0,50 mm	0,38 mm

Paratypes

	length	height	width
SAM–PQ–MF–0579, C, TBD 6825, 160 m	0,51 mm	—	0,30 mm
SAM–PQ–MF–0580, RV, TBD 6825, 160 m	0,49 mm	0,30 mm	—
SAM–PQ–MF–0581, LV, TBD 6825, 160 m	0,51 mm	0,34 mm	—
SAM–PQ–MF–0582, RV, TBD 6825, 160 m	0,45 mm	0,29 mm	—

Material

20 valves.

Diagnosis

Species with an 'angular' aspect resulting from a strongly and asymmetrically arched DM, with the addition of a truncated posterodorsal margin in the RV. RV and LV hinge ME are locellate and denticulate, respectively.

Description

External features. LV and RV differ considerably in lateral outline. In both valves the narrow AM is asymmetrically rounded, ventrally directed and somewhat extended. In LV the PM is broadly rounded, with a continuous sweep over the posterodorsal area. In RV the PM is truncated, rounded ventrally, but angular across the posterodorsal area. The LV DM is strongly arched, with the rounded, highest point just behind mid-length. This contrasts with the RV DM, which is straight to the rounded highest point (lying just anterior of mid-length), whence the DM sweeps downward to the AM. In both valves the VM is slightly convex. In dorsal view the carapace is lemon-shaped: distinctly acuminate anteriorly, and more rounded, but

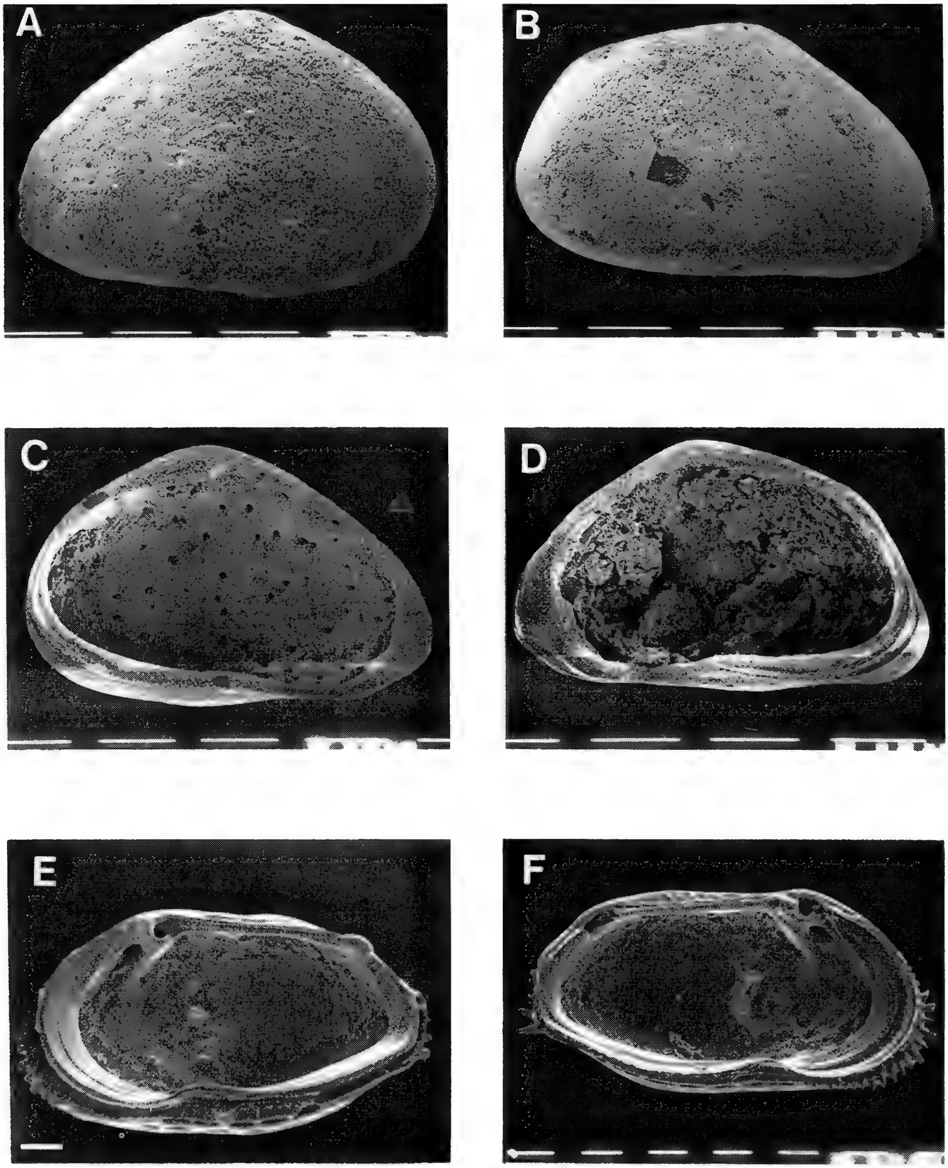

Fig. 55. A–D. *Xestoleberis hartmanni* sp. nov., TBD 6825, 160 m. A. SAM–PQ–MF0578, holotype, LV, SEM 2673. B. SAM–PQ–MF0580, RV, SEM 2674. C. SAM–PQ–MF0581, LV, SEM 2678. D. SAM–PQ–MF0582, RV, SEM 2681. E–F. *Pseudokeijella lepralioides* (Brady, 1880), TBD 6836, 80 m. E. SAM–PQ–MF0559, RV, SEM 2385. F. SAM–PQ–MF0560, LV, SEM 2380. Scale bars = 100 microns.

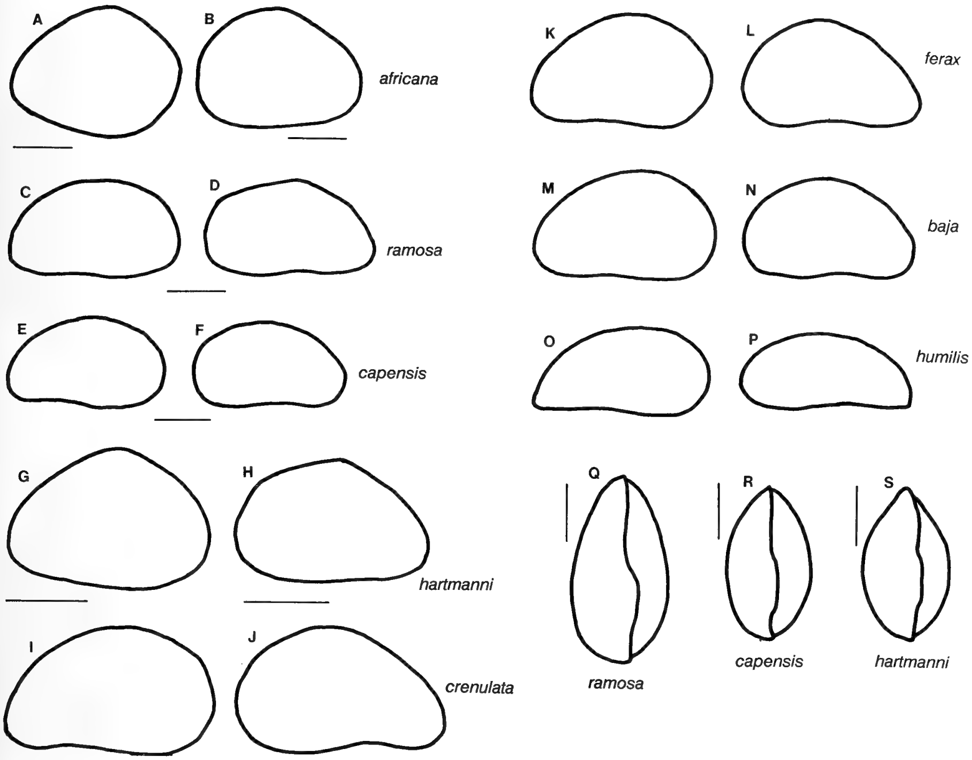

Fig. 56. Outlines of *Xestoleberis* species from southern Africa. A–B. *X. africana* (Brady, 1880), TBD 6847, 94 m. A. SAM–PQ–MF0574, LV. B. SAM–PQ–MF0573, RV. C–D, Q. *X. ramosa* Müller, Simonstown harbour, traced from Müller (1908: 129). C. LV. D. RV. Q. Carapace, dorsal view. E–F, R. *X. capensis* Müller, Simonstown harbour, traced from Müller (1908: 127). E. LV. F. RV. R. Carapace, dorsal view. G–H, S. *X. hartmanni* sp. nov., TBD 6825, 160 m. G. SAM–PQ–MF0578, holotype, LV. H. SAM–PQ–MF0580, RV. S. SAM–PQ–MF0579, carapace, dorsal view. I–J. *X. crenulata* Klie, Lüderitz Bay, traced from Klie (1940, figs 44–45). I. LV. J. RV. K–L. *X. ferax* Klie, Lüderitz Bay, traced from Klie (1940, figs 51–52). K. LV. L. RV. M–N. *X. baja* Klie, Lüderitz Bay, traced from Klie (1940, figs 57–58). M. LV. N. RV. O–P. *X. humilis* Klie, Lüderitz Bay, traced from Klie (1940, figs 61–62). O. LV. P. RV. Scale bars = 200 microns; other scales not known.

somewhat drawn out posteriorly. Valve surface is smooth, with numerous, distinct, but small normal pore openings.

Internal features. Marginal areas are relatively narrow, but in the material available details were not well preserved. The hinge is antimerodont, with relatively short terminal elements, with a locellate ME in the RV. No unambiguous views of the MS were obtained because of generally poor preservation, but the adductors consist of four elongate scars, with a small U- or V-shaped anterior scar and a further small ventrally adjacent scar (Fig. 58). The '*Xestoleberis*' spot is indistinct, dorsally situated and small. There is no well-developed eye socket.

Remarks

None of the other locally occurring species of *Xestoleberis* possesses a comparably 'angular' outline to *X. hartmanni* (Fig. 56). Although the outline of the RV of *X. ramosa* is similar, the DM outline of the LV of Müller's species is broadly

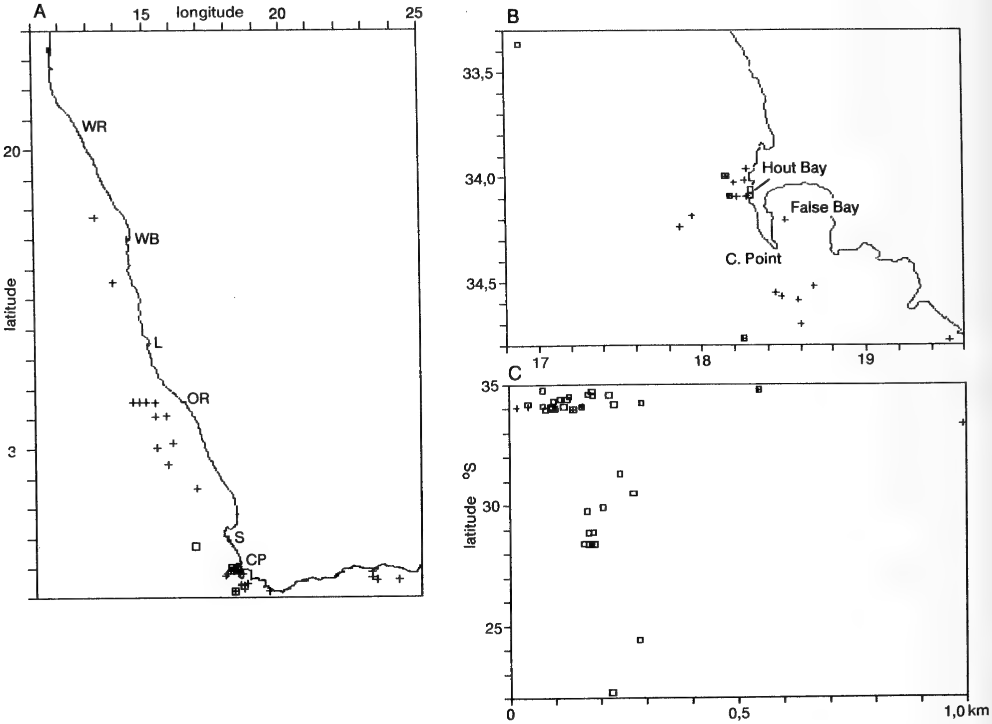

Fig. 57. A. Distribution of *Xestoleberis hartmanni* sp. nov. (squares) and *X. africana* Brady, 1880 (crosses). See Fig. 7 for abbreviations. B. Distribution of *X. hartmanni* sp. nov. (squares) and *X. africana* Brady, 1880 (crosses) off the south-western Cape. C. Latitudinal water-depth distribution of sites with *X. hartmanni* sp. nov. (crosses) and *X. africana* Brady, 1880 (squares).

rounded, and in dorsal view is more elliptical, with rounded extremities. The other continental shelf species, *X. africana*, has an overall rounded and inflated appearance and cannot be confused with *X. hartmanni*.

Distribution

Xestoleberis hartmanni is limited to the waters off the south-western Cape. One site only contains modern specimens (15 m in Hout Bay).

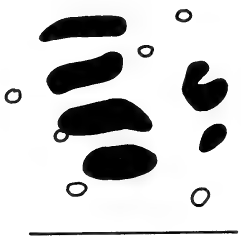

Fig. 58. *Xestoleberis hartmanni* sp. nov., SAM–PQ–MF0581, LV, MS, TBD 6825, 160 m. Scale bar = 100 microns.

Relict populations occur at three sites off the Cape Peninsula (42–160 m), and at two further isolated, much deeper locations: south-west of Saldanha (990 m), and south-west of Cape Point (545 m) (Fig. 57B). The species reaches a maximum abundance of 6 per cent total ostracod population in 160 m off the Cape Peninsula.

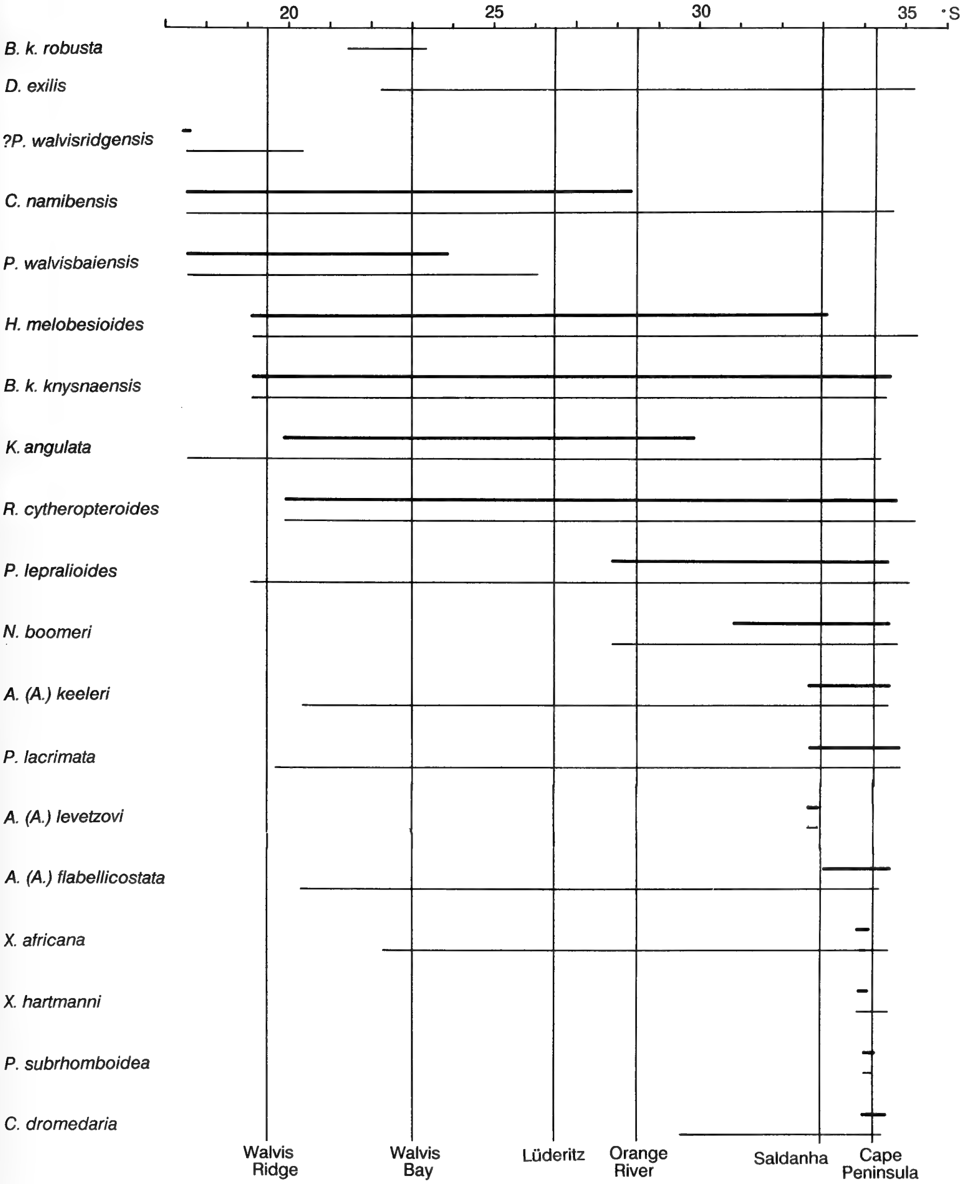

Fig. 59. Modern and relict latitudinal ranges of dominant ostracod taxa on the continental margin off south-western Africa. Thick lines = modern range, thin lines = relict range.

TABLE 6

Dominant taxa in shelf sectors.

		CAPE PENINSULA	CAPE PEN.– SALDANHA	SALDANHA– ORANGE R.	ORANGE R.– LÜDERITZ	LÜDERITZ– WALVIS BAY	WALVIS BAY– WALVIS RIDGE	N. WALVIS RIDGE
MODERN	Loxoconchidae					—	—	—
	Cytherella spp.							—
	Ruggieria cytheropteroides	—		—	—	—		
	Bensonia knysnaensis				—			
	Pseudokeijella lepralioides	—	—	—				
	Henryhowella melobesioides		—					
RELICT	Loxoconchidae						—	—
	Cytherella spp.					—	—	
	Ruggieria cytheropteroides	—	—	—	—			
	Bensonia knysnaensis					—		
	Pseudokeijella lepralioides			—	—			
	Henryhowella melobesioides	—	—					—

SUMMARY

Figures 4, 5 and 59 and Table 6 summarize the distribution of the dominant ostracod taxa on the continental margin of south-western Africa.

On a regional scale there is dominance by two groups, with an area of overlap in the Walvis Bay–Orange River zone: loxoconchids–*Cytherella–Bensonia* form a northern assemblage, and *R. cytheropteroides* and *P. lepralioides* dominate in the south. This regional pattern occurs in both relict and modern assemblages. *Henryhowella* is locally dominant in both northern and southern sectors.

A comprehensive discussion of the distribution of the ostracod taxa on the continental shelf off south-western Africa (both dominant and minor forms) will be given in Dingle (in press) and Dingle & Girandeau (in press).

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Names of new taxa, combinations, synonyms, etc., when used for the first time, must be followed by the appropriate Latin (not English) abbreviation, e.g. gen. nov., sp. nov., comb. nov., syn. nov., etc.

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Synonymy arrangement should be according to chronology of names, i.e. all published scientific names by which the species previously has been designated are listed in chronological order, with all references to that name following in chronological order, e.g.:

Family **Nuculanidae**

Nuculana (Lembulus) bicuspidata (Gould, 1845)

Figs 14–15A

Nucula (Leda) bicuspidata Gould, 1845: 37.
Leda plicifera A. Adams, 1856: 50.
Laeda bicuspidata Hanley, 1859: 118, pl. 228 (fig. 73). Sowerby, 1871: pl. 2 (fig. 8a–b).
Nucula largillierti Philippi, 1861: 87.
Leda bicuspidata: Nicklès, 1950: 163, fig. 301; 1955: 110. Barnard, 1964: 234, figs 8–9.

Note punctuation in the above example:
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Synonymy arrangement according to chronology of bibliographic references, whereby the year is placed in front of each entry, and the synonym repeated in full for each entry, is not acceptable.

In describing new species, one specimen must be designated as the holotype; other specimens mentioned in the original description are to be designated paratypes; additional material not regarded as paratypes should be listed separately. The complete data (registration number, depository, description of specimen, locality, collector, date) of the holotype and paratypes must be recorded, e.g.:

Holotype

SAM–A13535 in the South African Museum, Cape Town. Adult female from mid-tide region, King's Beach, Port Elizabeth (33°51′S 25°39′E), collected by A. Smith, 15 January 1973.

Note standard form of writing South African Museum registration numbers and date.

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Capital initial letters

(a) The Figures, Maps and Tables of the paper when referred to in the text
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e.g.Therocephalia, but therocephalian

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Specific name must not stand alone, but be preceded by the generic name or its abbreviation to initial capital letter, provided the same generic name is used consecutively. The generic name should not be abbreviated at the beginning of a sentence or paragraph.

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R. V. DINGLE

QUATERNARY OSTRACODS FROM THE CONTINENTAL MARGIN OFF SOUTH-WESTERN AFRICA
PART I. DOMINANT TAXA

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KOHN, A. J. 1960*b*. Spawning behaviour, egg masses and larval development in *Conus* from the Indian Ocean. *Bulletin of the Bingham Oceanographic Collection, Yale University* **17** (4): 1–51.
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TAXONOMIC REVISION OF AFRICAN CYPRIDINI. PART II. DESCRIPTION OF *RAMOTHA* GEN. NOV. (CRUSTACEA, OSTRACODA)

By

K. MARTENS

Cape Town Kaapstad

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TAXONOMIC REVISION OF AFRICAN CYPRIDINI PART II. DESCRIPTION OF *RAMOTHA* GEN. NOV. (CRUSTACEA, OSTRACODA)

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(With 17 figures and 1 table)

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ABSTRACT

Ramotha gen. nov. is described to accommodate a number of African species, previously assigned to *Cypris*, *Eucypris* and *Strandesia*. It belongs to the Cypridini and in this tribe is characterized by a T1 with a divided penultimate segment, by a RV with an inwardly displaced frontal selvage and by a LV without a frontal selvage but with a large inner list. The type species of the new genus is *R. hirta* (Sars) from the Western Cape. *Ramotha curtisae* sp. nov. is described from bisexual populations, originating from Namibia and Zimbabwe. Ten other species are also transferred to this genus and are redescribed. *Eucypris bouilloni* Kiss is furthermore placed in the synonymy of *R. crassa* (Klie). The males of *R. hirta* (Sars), *R. producta* (Sars) and of *R. trichota* (G. W. Müller), thus far unknown, are here described. Representatives of this new genus are found mainly in temporary bodies of water in East and southern Africa and all species have restricted geographical distributions.

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INTRODUCTION

Sars (1895) described *Cypris corpulenta* and *Cypris trigona* from a swamp near Knysna (South Africa, Cape Province). Later, Sars (1924) transferred these and the species meanwhile described by Müller (1908, 1914) to the genus *Eucypris*, and added three more taxa to the list. Related taxa were reported from East African water bodies by Lowndes (1931), Klie (1939, 1944), Lindroth (1957) and Löffler (1968). Upon re-investigation of the types of *Strandesia crassa* Klie, it was shown that this species does not belong in the Cypricercinae, but rather has characters shared by the above taxa.

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All these species are united by a number of features, which seem to place them between the genera *Cypris* and *Eucypris*, as interpreted in a classical sense, hence the confusion in the older literature. However, they do not belong in *Cypris* s.s., because they possess an inwardly displaced selvage in the RV only (in both valves in *Cypris*) and have the penultimate segment of the T1 divided (fused in *Cypris*). For the latter reason, Sars (1924) removed these taxa to *Eucypris*. It is here shown that they do not belong to this genus either, as they lack a 'c'-seta on the Mx2, which is typical of all Eucypridini (Martens 1989).

The genus *Ramotha* gen. nov. is here described to comprise all of the above species, as well as one new species, and is assigned to the Cypridini, because the hemipenis (in species where males are known), displays the '8'-shaped coils of the inner (post labyrinth) spermiductus, which is typical of this tribe. A re-assessment of the subfamily Cypridinae and its nominate tribe is presented in the first part of this revision (Martens 1990). Apart from *Ramotha* gen. nov., the Cypridini to date also comprise the genera *Cypris*, *Pseudocypris* and *Globocypris*.

The phyletic lineage analysed in the present paper constitutes a good example of the present chaos and confusion in African ostracod taxonomy and illustrates the difficulty of identifying African ostracods with the literature as it stands. The present genus has 12 nominal representatives (of which one is a synonym), originally described in no less than three different genera and subfamilies!

MATERIAL & METHODS

List of museums and collections

AM	Albany Museum, Grahamstown, RSA.
GW	Ernst-Moritz-Arndt-Universität, Greifswald, Germany.
KBIN	Koninklijk Belgisch Instituut voor Natuurwetenschappen, Brussels, Belgium.
MRAC	Koninklijk Museum voor Midden-Afrika, Tervuren, Belgium.
OSLO	Zoological Museum, Oslo, Norway.
UPPS	Uppsala Universitet, Zoologiska Muset, Uppsala, Sweden.
SAM	South African Museum, Cape Town, RSA.
SMN	State Museum of Namibia, Windhoek, Namibia.
ZIZM	Zoologisches Institut und Zoologisches Museum, Hamburg, Germany.

Abbreviations used in text and figures

A1 = antennula; A2 = antenna; bc = bursa copulatrix in hemipenis; Cp = carapace; db = dorsal branch of furcal attachment; di = distal end of unbranched furcal attachment; H = height of valves; il = inner list; im = inner margin; L = length of valves; lc = line of concrescence; ls = lateral shield of hemipenis; LV = left valve; Md = mandibula; ms = medial shield of hemipenis; Mx1 = maxillula; Mx2 = maxilla; pr = proximal end of furcal attachment; R = Rome organ; RV = right valve; sl = selvage; T1 = first thoracopod; T2 = second thoracopod; vb = ventral branch of furcal attachment; vm = valve margin; W = width of valves.

Chaetotaxy of the limbs follows the model proposed by Broodbakker & Danielopol (1982), and revised for the A2 by Martens (1987).

TAXONOMIC DESCRIPTIONS

Class OSTRACODA Latreille, 1806
Subclass PODOCOPA G. W. Müller, 1894
Order PODOCOPIDA Sars, 1866
Family **Cyprididae** Baird, 1845
Subfamily Cypridinae Baird, 1845
Tribe Cypridini Baird, 1845

Genus *Ramotha* gen. nov.

Derivation of name

The new genus is named after Ramoth, last remaining golden queen dragon at Benden Weyr on the planet Pern. This is, of course, a tribute to her creator, Miss Anne McCaffrey. Gender of the new genus is feminine.

Type species. *Eucypris hirta* Sars, 1924.

Diagnosis

A cypridinid genus, with mostly large (2–3 mm) and globular species. RV with frontal and caudal selvage inwardly displaced over a large distance, but with anterior valve margin ventrally not with lip-like extension. LV without inwardly displaced selvage, but with a large inner list, situated in the centre of a wide anterior calcified inner lamella and on the posterior inner margin; ventrally with a conspicuous outer list. T1 with penultimate segment divided and with seta d_1 2–3 times as long as seta d_2.

Additional generic features

Caudal valve margin of the RV crenulated. A1 with Rome organ small. A2 with natatory setae extending well beyond tips of claws; in males with a sexual dimorphic chaetotaxy of apical claws and setae, showing a supplementary reduction of claw G_1. Gamma seta on Md palp long, relatively slender and hirsute. Mx1 palp with terminal segment elongated. Mx2 without 'c'-seta. T2 with distal segments pincer-shaped. Furca and furcal attachment well developed.

Other species

Ramotha capensis (G. W. Müller, 1908), *R. corpulenta* (Sars, 1895), *R. crassa* (Klie) (syn.: *R. bouilloni* (Kiss) syn. nov.), *R. curtisae* sp. nov., *R. kenyensis* (Lindroth), *R. montana* (Lindroth), *R. producta* (Sars, 1924), *R. purcelli* (Sars, 1924), *R. trichota* (G. W. Müller, 1908), and *R. trigona* (Sars, 1924).

Taxonomic position

The genus belongs to the Cypridini, because of the presence of the '8'-shaped loops of the inner spermiductus in the hemipenis. It differs from *Cypris* s.s. and from *Pseudocypris* because it has the penultimate segment of the T1 divided; it furthermore lacks an inwardly displaced selvage on the LV, whereas the selvage on the RV has a different shape. *Pseudocypris* furthermore has a marginal selvage on both valves, and

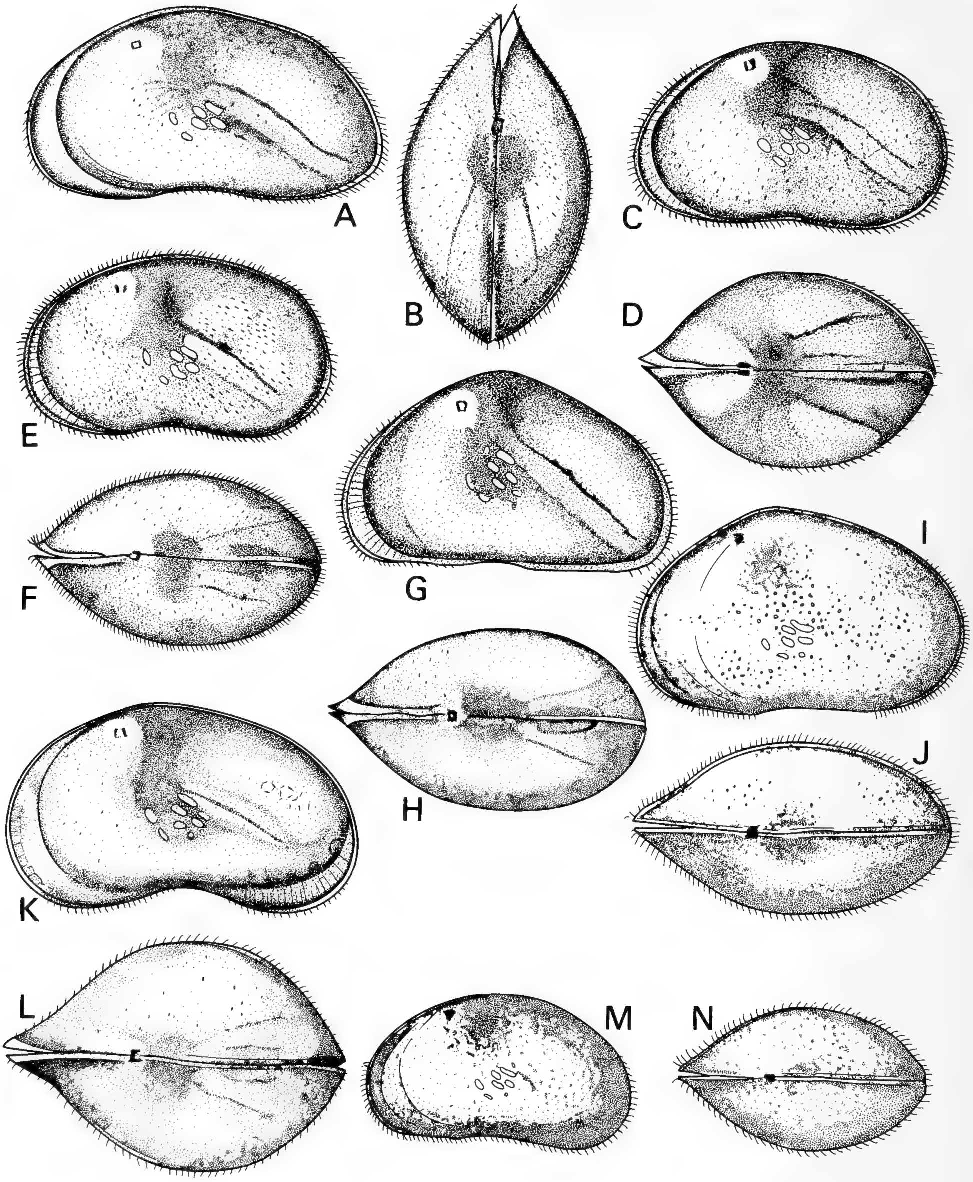


Fig. 1. Original illustrations of some South African species of *Ramotha* (all redrawn after Sars 1924—*Annals of the South African Museum*). A–B. *R. producta* (L = 2,40 mm). C–D. *R. corpulenta* (L = 2,10 mm). E–F. *R. hirta* (L = 1,90 mm). G–H. *R. trigona* (L = 1,75 mm). I–J. *R. trichota* (L = 3,30 mm). K–L. *R. capensis* (L = 1,80 mm). M–N. *R. purcelli* (L = 2,30 mm). A, C, E, G, I, K, M: Cps in left lateral view. B, D, F, H, J, L, N: Cps in dorsal view.

most species of this genus display large lateral ala on the valves. *Globocypris* also has a large frontal selvage on the LV.

Ramotha hirta (Sars, 1924)

Figs 1E–F, 14H–L, 16H (parthenogenetic populations)
Figs 2–4, 5A–H (bisexual populations)

Cypris corpulenta G. W. Müller, 1908: 150–151, figs 1–6 (*non* Sars, 1895).
Eucypris hirta Sars, 1924: 110–111, pl. 3 (figs 5–6).
non *Eucypris hirta* Lowndes, 1931: 1292 (= *R. crassa* (Klie)).
non *Eucypris hirta* Klie, 1944: 17–18 (= *R. montana* (Lindroth)).
Ramotha elephantina Martens, 1990: 159 (*nomen nudum*).

Type locality

Pond on Green Point Common, near Cape Town (South Africa).

Type material

SAM–A11116: *c.* 20 good ♀ from the above locality (tube labelled 'Cape of Good Hope'); these specimens are here considered the syntypes of this species. Lectotype (here designated): a ♀, selected from the above syntypes, with soft parts dissected in glycerine on a sealed slide and with valves stored dry (SAM–A40043); all other syntypes become paralectotypes.

Other material investigated

Parthenogenetic populations. SAM–A11115, 1 dissected ♀ from Cape of Good Hope. SAM–A11119, 1 ♀ from Cape of Good Hope. SAM–A11283, 2 ♀, labelled 'SAM EE'. SAM–A11284, 2 ♀ from Cape Flats. SAM–A11285, 1 ♀, no locality given. (All identified by G. O. Sars.)

Bisexual populations. 18 ♀ and 2 ♂ raised from dried mud, collected from small pools in granite on Olifantsberg near Leopoldsville (approx. 32°12′S 18°25′E), Western Cape Province, Republic of South Africa. Mud collected by Dr J. A. Day (original collections '02', 'C4' and 'SWT2') between June 1980 and July 1981. Deposition: 1 dissected ♂ (SAM–A40038), 1 dissected ♀ (SAM–A40039), 1 ♂ and 1 ♀ (both dissected) (KBIN OC1489–1490), 1 ♂ and 2 ♀ stored dry (after use for SEM illustration—MRAC.56779–56780), the remaining specimens *in toto* in spirit (KBIN OC1491).

Diagnosis (parthenogenetic populations)

An easily recognizable species with valves densely set with long hairs. Cp in dorsal view (Fig. 14L) with anterior edge beak-like and asymmetrically pointed to the right side. Valves in lateral view (Fig. 14H–J) relatively high and short. Mx2 palp in some specimens with an additional lateral seta (Fig. 16H). Furcal attachment distally branched.

Measurements (in μm, mean ± S.D., n = 5)

L = 1 472 ± 40; H = 931 ± 24; W = 896 ± 27; W/L = 0,59–0,63.

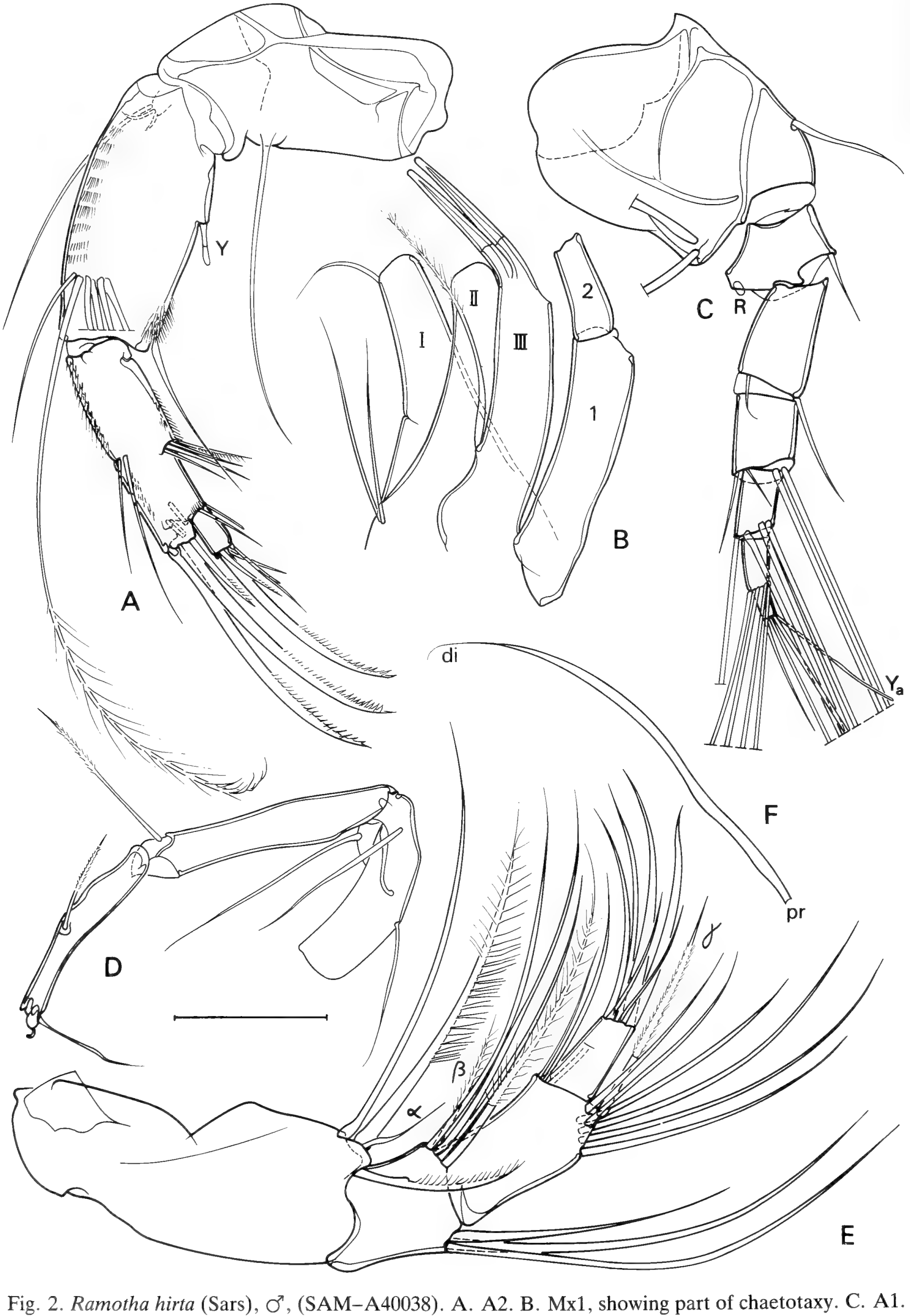


Fig. 2. *Ramotha hirta* (Sars), ♂, (SAM–A40038). A. A2. B. Mx1, showing part of chaetotaxy. C. A1. D. T2. E. Md palp. F. furcal attachment. Scale: 156 μm for A, C, D, F; 81 μm for B, E.

Diagnosis (bisexual populations)

Medium-sized species, with ventral margin (including inner list and selvage) conspicuously produced in the first third (especially in the ♀). Cp in dorsal view with greatest width (*c.* one-half of the length) situated in the first third of the length, anterior tip concavely and asymmetrically produced and posterior margin bluntly pointed. Furcal attachment in both sexes without dorsal branch. Prehensile palps asymmetrical, the right one being the largest. Hemipenis with lateral shield protruding towards the ventral side.

Measurements (in μm, mean ± S.D.)

♂: L = 1 724; H = 1 034; W = 1 000 (n = 1).
♀: L = 1 755 ± 104; H = 1 083 ± 66; W = 1 069 ± 35; W/L = 0,61–0,66 (n = 5).

Additional description of ♂

RV (Fig. 5B) with anterior margin more broadly rounded than posterior one; dorsal margin weakly curving and sloping towards the caudal side, merging with that margin without an obvious angle; towards the frontal side weakly indented at about one-third from the front; ventral margin nearly straight, apart from the conspicuous curve of the selvage and valve margin in the anterior third. Calcified part of the inner lamella relatively narrow, on both anterior and posterior sides with traces of a blunt inner list; valve margin on both posterior and anterior sides set with a series of short ridges (Fig. 5G). Central muscle scars with mandibular scars large and with scar pattern of adductor muscles conforming to that of the subfamily.

LV (Fig. 5A) with anterior margin more broadly rounded than posterior one; dorsal margin weakly curving and passing into the caudal margin with a blunt angle, no anterior indentation; ventral margin somewhat more sinuous than in the RV and with matching curves of valve margin and inner list. Caudal calcified inner lamella somewhat wider than in the RV and with a large inner list positioned near the inner margin. No ridges on the valve margin.

Cp in ventral view with RV reaching beyond LV anteriorly and with LV overlapping RV on the ventral side. Greatest width situated in the anterior third of the Cp. Surface densely pitted and set with short setae.

A1 (Fig. 2C) seven-segmented and typical of the subfamily. Terminal segment *c.* 1,5 times as long as its greatest width, all natatory setae long.

A2 (Fig. 2A) with natatory setae reaching well beyond tip of terminal claws; aesthetasc Y short. Apical chaetotaxy (Fig. 3A) with typical sexual dimorphic characters (see Martens 1987), but with claw G_1 short; seta of y_3 longer than the aesthetasc.

Md with coxa elongated (Fig. 3H). Md palp (Fig. 2E) four-segmented. First segment with large respiratory plate (exopodite—not shown in the figure) and a group of four apical setae: one long and smooth, one short, narrow and smooth (alpha-seta), the latter flanked by one large 's'-seta, set with a double row of setulae, and by one short 's'-seta. Second segment with two groups of apical setae—an internal group consisting of a short and hirsute beta-seta, three long and smooth and one long and barbulated setae; external group consisting of two long and one shorter setae. Penultimate segment with six subapical external setae (three long and three shorter) and one narrow and hirsute gamma-seta of intermediate length, as well as three subequal

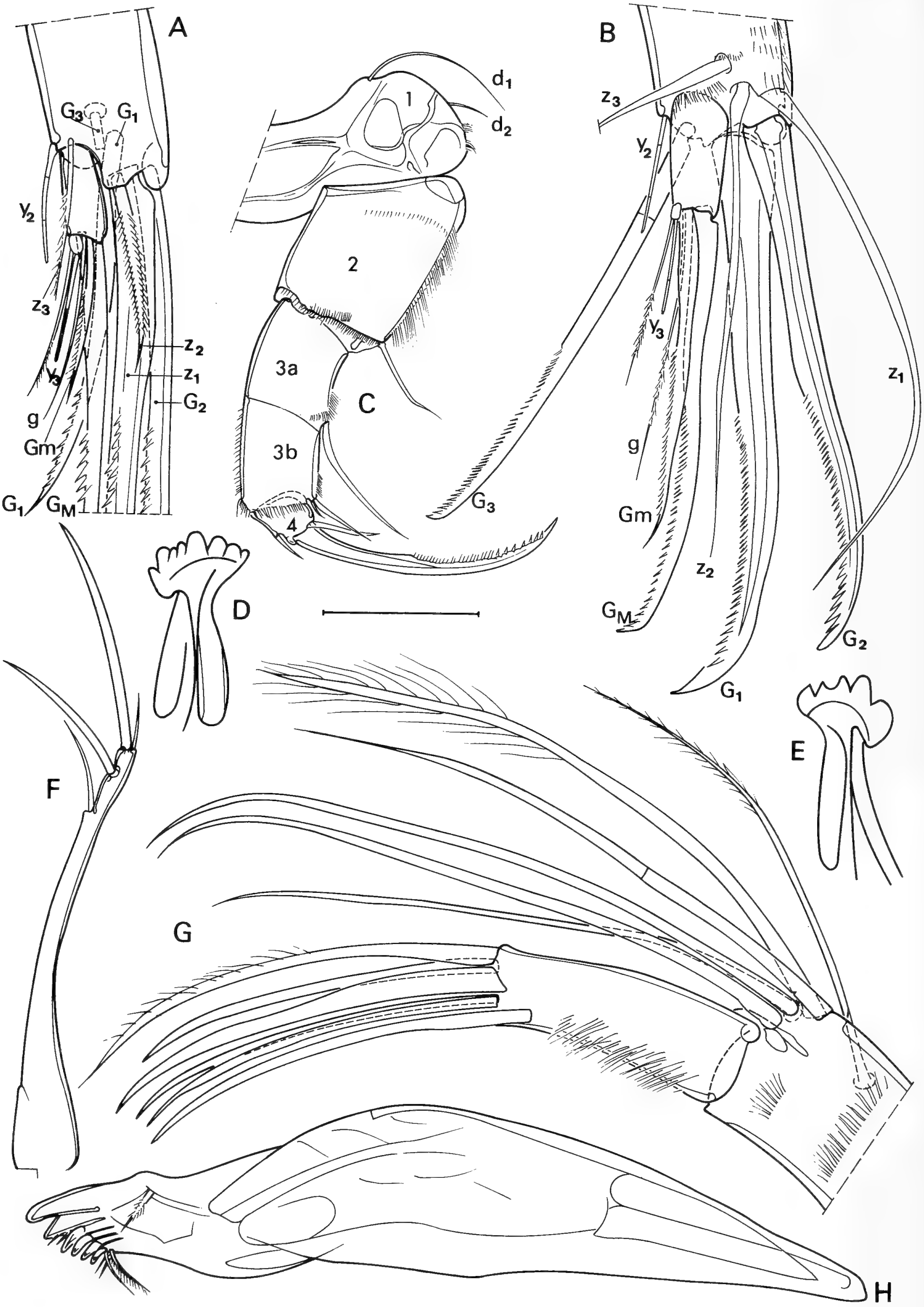


Fig. 3. *Ramotha hirta* (Sars). A. ♂, A2, detail of distal chaetotaxy (SAM–A40038). B. ♀, A2, detail of distal chaetotaxy (SAM–A40039). C. ♂, T1 (SAM–A40038). D-E. ♂, rake-like organ (SAM–A40038). F. ♂, furca (SAM–A40038). G. ♂, Mx1 palp, detail of chaetotaxy (SAM–A40038). H. ♂, Md-coxa (SAM–A40038). Scale: 156 μm for B, F, G; 81 μm for A, C–E; 33 μm for H.

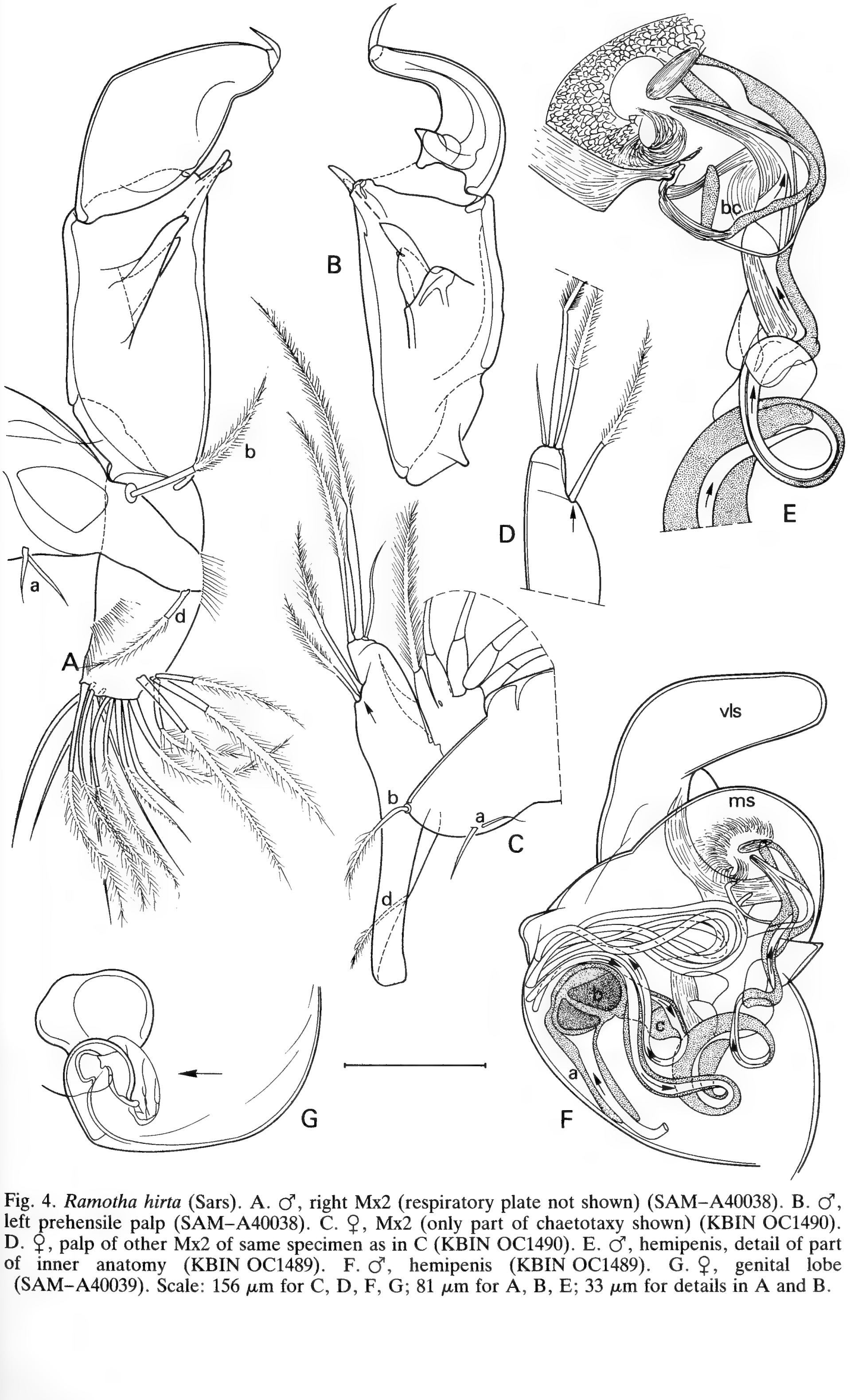
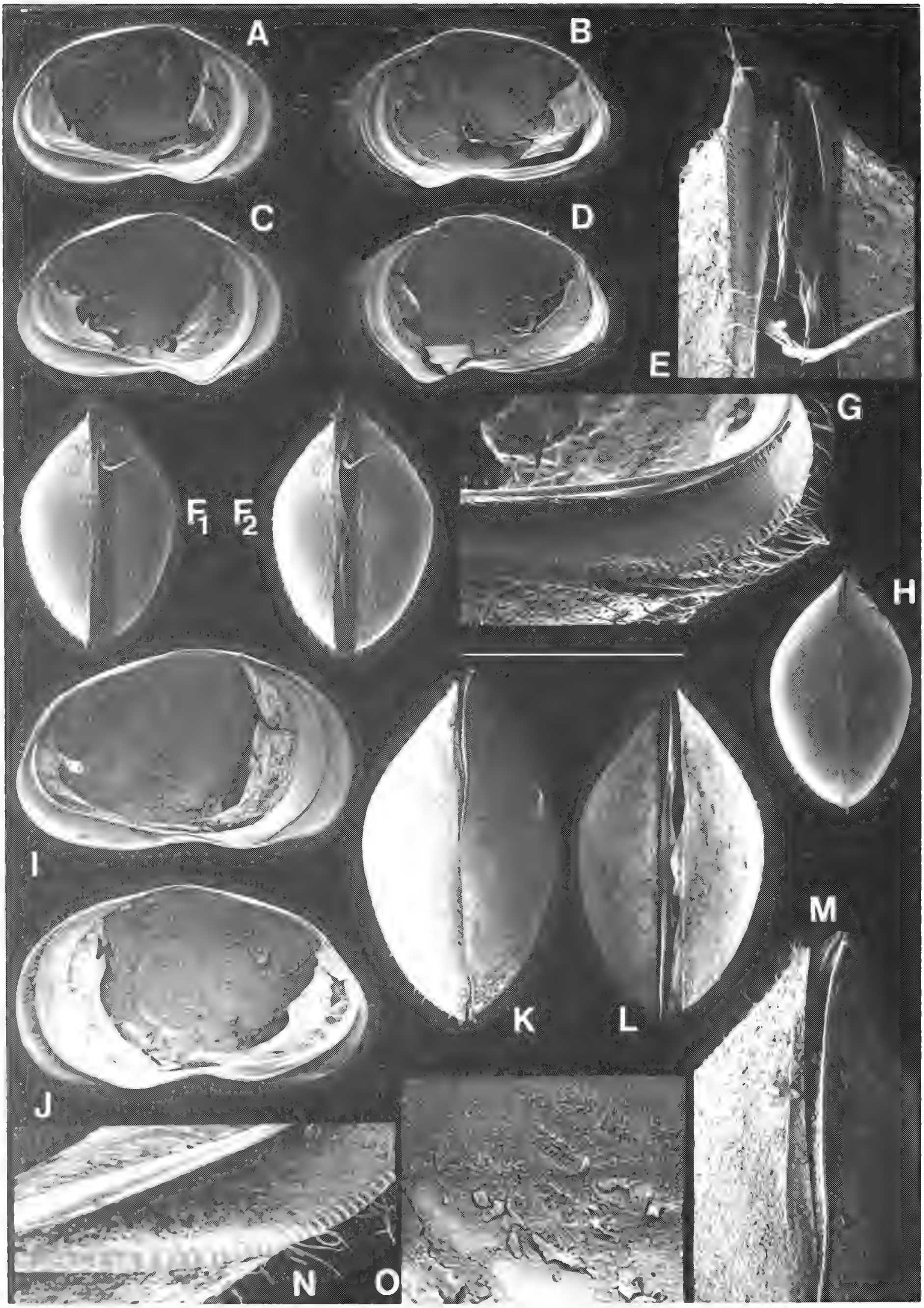


Fig. 4. *Ramotha hirta* (Sars). A. ♂, right Mx2 (respiratory plate not shown) (SAM–A40038). B. ♂, left prehensile palp (SAM–A40038). C. ♀, Mx2 (only part of chaetotaxy shown) (KBIN OC1490). D. ♀, palp of other Mx2 of same specimen as in C (KBIN OC1490). E. ♂, hemipenis, detail of part of inner anatomy (KBIN OC1489). F. ♂, hemipenis (KBIN OC1489). G. ♀, genital lobe (SAM–A40039). Scale: 156 μm for C, D, F, G; 81 μm for A, B, E; 33 μm for details in A and B.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apical setae on the internal side. Terminal segment with four claw-like and with two or three short and slender setae, all apically inserted.

Mx1 with three endites, a two-segmented palp (Fig. 2B) and a large respiratory plate. Third endite with two smooth apical claws and with a long and stout lateral seta, apart from the normal apical setae. First segment of palp (Fig. 3G) with six subapical and subequal setae; terminal segment elongated, 2,5–3 times as long as its basal width, carrying six apical claw-like setae.

Mx2 with asymmetrical palps, a large endopodite with typical chaetotaxy conforming to the subfamily and a respiratory plate (exopodite) with six plumous rays (five long and one short—not shown in the figures). Endopodite (Fig. 4A) elongated, carrying two short 'a'-setae, one larger, central 'b'-seta and one lateral 'd'-seta, 'c'-seta absent. Apical chaetotaxy consisting of *c.* 15 setae of different size and shape.

Right prehensile palp (Fig. 4A) with elongated basal segment, carrying two apical sensory outgrowths; terminal segment three-dimensionally curved; when flattened on a slide broad, with a narrow apex and with distal margin showing a wide, blunt angle, apically with one broad sensory organ.

Left prehensile palp (Fig. 4B) with basal segment similar to that of the right palp; terminal segment narrower, with a proximal blunt tooth, this segment gradually narrowing towards the tip, the latter bearing a single sensory organ.

T1 (Fig. 3C) with seta d_1 more than three times as long as d_2; all segments short, wide and hairy; penultimate segment divided; apical claw stout and only in its distal half set with a double row of spines. Second segment with one apical seta. Segment 3A with one subapical seta; segment 3B with one large and one minute apical setae. Fourth segment with one lateral seta and, apart from the apical claw, with one other apical claw-like seta.

T2 (Fig. 2D) a cleaning limb with an apical pincer and without further special features.

Furca (Fig. 3F) with ramus narrow and curved, carrying two claws and two setae and with ventral margin serrated with minute setulae. Furcal ramus (Fig. 2F) in this species consisting of a single ramus, not distally split into a dorsal and a ventral branch.

Rake-like organs (Fig. 3D–E) T-shaped, but with apical part swollen, carrying few blunt teeth.

Hemipenis (Fig. 4F) with a broadly rounded medial shield, asymmetrically expanded towards the ventral side and a pointed, protruding lateral shield, the latter boot-like and with the tip pointing in ventral direction. Internal anatomy with the normal labyrinth, consisting of the elongated parts 'a' and 'c' and the rounded hinge-

Fig. 5 (*see opposite*). A–H. *Ramotha hirta* (Sars). A. ♂, LV, internal view (KBIN OC1489). B. ♂, RV internal view (KBIN OC1489). C. ♀, LV, internal view (KBIN OC1490). D. ♀, RV, internal view (KBIN OC1490). E. ♀, Cp, ventral view, detail of anterior edge (MRAC.56779). F. ♀, Cp, ventral view (stereo-pair, MRAC.56779). G. ♂, tilted RV, internal view, detail of posterior margin (KBIN OC1489). H. ♀, Cp, dorsal view (MRAC.56779). I–O. *Ramotha purcelli* (Sars), paralectotypes. I. ♀, LV, internal view (SAM–A40046). J. ♀, RV, internal view (SAM–A40046). K. ♀, Cp, dorsal view (SAM–A40048). L. ♀, Cp, ventral view (SAM–A40048). M. ♀, Cp, dorsal view, detail of anterior edge (SAM–A40048). N. ♀, tilted RV, internal view, detail of posterior edge (SAM–A40046). O. ♀, RV, internal view, detail of central muscle scars (SAM–A40046). Scale: 1 563 μm for A–D, F, H; 1 320 μm for I–L.

joint 'b', followed by the 3–5 '8'-shaped coils of the inner spermiductus, situated distally from the labyrinth, the sclerotized semi-circular loop and the various hollow trabeculae leading to the bursa copulatrix (Fig. 4E).

Four pairs of testical tubes present.

Additional description of ♀

All valve features (Fig. 5C–D) basically as in the male, but valves generally slightly larger; ventral outgrowth even more pronounced than in the male and caudal inner list in the LV situated more towards the interior.

Cp in dorsal and ventral view (Fig. 5E–H) with greatest width situated in the anterior third; RV frontally reaching beyond LV.

A2 (Fig. 3B) basically as in the male, apart from the normal sexual dimorphism in the apical chaetotaxy.

Mx2 (Fig. 4C–D) with palp undivided, carrying the normal unequal three apical setae, but also 1–2 supplementary lateral setae.

T1 somewhat plumper and heavier than in the male.

Genital lobe (Fig. 4G) undivided and without specific characteristics.

Ovaria on both sides curved upwards.

Discussion

The shape and the hairy aspect of the valves allow an easy identification of this species within the genus. Nevertheless, confusion exists in the older literature. G. W. Müller (1908) erroneously reported specimens of this species as *Cypris corpulenta* (see p. 105). Lowndes (1931) and Klie (1944) both reported this taxon from East African inland waters. The material of the latter author was available for re-examination (ZIZM, Hamburg) and, although heavily decalcified, could still be identified as belonging to *R. montana* (Lindroth) (see p. 113).

Lowndes (1931) mentioned that he had only a few specimens in bad condition and therefore no attempt was made to obtain his material. Relying on the locality from which his material originated (Elgon), it is very likely that he was actually dealing with *R. crassa*, reported from this area by Klie (1939) and Kiss (1959), and his specimens are here tentatively referred to the latter species.

Remarks

It is noteworthy that the masticatory processes of both mandibular coxae are always situated in the space created by the ventral bulges in both valves. Undoubtedly, these ventral bulges are adaptations to the species' feeding strategy and behaviour, which unfortunately remain unknown to date.

Ramotha capensis (G. W. Müller, 1908)

Figs 1K–L, 6E–J, 7A–F

Cypris capensis G. W. Müller, 1908: 153–154, figs 1–6; 1914: 70.
Eucypris capensis Sars, 1924: 112, pl. 3 (figs 9–10).

Type locality

Zeekoevlei, Plumstead, near Simonstown (South Africa).

Type material

GW II 24627(4): *c.* 80 ♀ in spirit in a tube, labelled '*Cypris capensis*, Gaus Expedition (paratypus)'. Lectotype (here designated): a ♀, with soft parts dissected in glycerine on a sealed slide and with valves stored dry (no. GW.24627b, c), selected from the above syntypes; all other syntypes become paralectotypes.

Other material investigated

GW II 25131(70): *c.* 50 ♀ in spirit in a tube, labelled 'Süd-Afrika, Deutsche Südpolar Exp.' (det. G. W. Müller). SAM–A11288: 16 ♀ in spirit in a tube, labelled 'SAM EE' (det. G. O. Sars) (used for descriptions: SAM–A40051–40052). SAM–A11927: various ♀ in spirit in a tube labelled 'Valkenberg vlei, coll. 15 July 1922 by Stephensen' (det. D. H. Eccles—these specimens smaller). KBIN OC1492 (G501/18): 1 ♀ in spirit from Wiesdrif, Western Cape Province (approx. 34°40′12″S 19°54′47″E) (coll. Dr J. King, 11 May 1989) (det. K. Martens).

Diagnosis

In lateral view (Fig. 7A–B), rather elongated and with a sinuous ventral margin. In dorsal view (Fig. 7E–F) with greatest width (*c.* two-thirds of length) situated in the middle, with both anterior and posterior edges with strong beak-like extension. Ventral outer list on LV strong (Fig. 7C–D); anterior, ventral and posterior valve margins of RV set with internal ridges. Valve surface densely pitted; 'poren-warzen' present.

Mx2 palp in some specimens with an additional lateral seta (Fig. 6I); furcal attachment distally branched (Fig. 6F).

Measurements (in μm, mean ± S.D., n = 5)

L = 1 791 ± 25; H = 1 014 ± 19; W = 1 179 ± 26; W/L = 0,65–0,68.

Discussion

This species is easily recognizable and can be distinguished from its congeners by the shape of the valves in lateral view, but especially by the morphology of the carapace in dorsal and ventral views. *Ramotha capensis* appears to be restricted to the Western Cape Province.

Ramotha corpulenta (Sars, 1895)

Figs 1C–D, 6A–D, 7G–J

Cypris corpulenta Sars, 1895: 30–32, pl. 5 (figs 2a–c).
Eucypris corpulenta Sars, 1924: 110, pl. 3 (figs 3–4).

Type locality

Swamp near Knysna, east of Cape of Good Hope (South Africa).

Type material

SAM–A11114: *c.* 20 ♀ raised from dried mud, collected from the type locality. Lectotype (here designated): a ♀, selected from the above syntypes, with soft parts

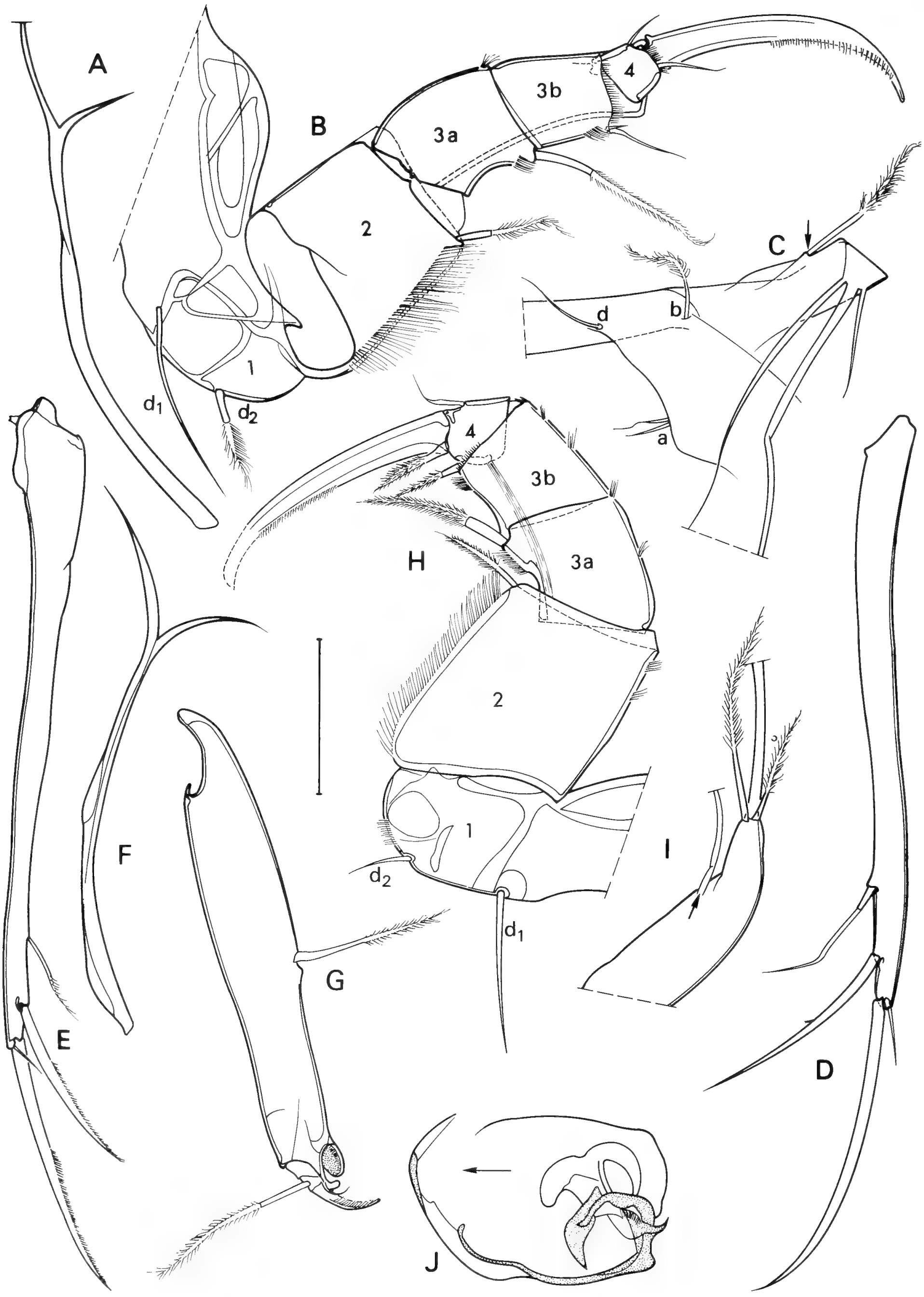


Fig. 6. A–D. *Ramotha corpulenta* (Sars), ♀, (SAM–A40049). A. Furcal attachment. B. T1. C. Mx2. D. Furca. E–J. *Ramotha capensis* (G. W. Müller), ♀, (SAM–A40051). E. Furca. F. Furcal attachment. G. Distal segment of T2. H. T1. I. Mx2 palp. J. Genital lobe. Scale: 156 μm for A–F, H–J; 81 μm for G.

dissected in glycerine on a sealed slide and with valves stored dry (SAM–A40049); all other syntypes become paralectotypes.

Diagnosis

Large and semi-globular species, with dorsum highly arched in lateral view (Fig. 7G–H) and with ventral margin only weakly sinuous. RV caudally produced, with few ridges on the caudal valve margin only. Cp in ventral view (Fig. 7J) with anterior end beak-like, but less so than in *R. capensis*; posterior edge convex; greatest width about two-thirds of length and situated at about one-third from the front. Valve surface pitted, but less so and with shallower pits than in *R. capensis*; 'poren-warzen' present. Ventral outer list on LV strongly produced. Mx2 palp in some specimens with an additional lateral seta (Fig. 6C); furcal attachment distally branched (Fig. 6A).

Measurements (in μm, mean ± S.D., n = 5)

L = 1 924 ± 109; H = 1 141 ± 55; W = 1 162 ± 86; W/L = 0,58–0,62.

Discussion

Sars' (1924) illustrations of this species were somewhat inaccurate, as he failed to show the caudally produced RV and illustrated the carapace too globular and wide.

G. W. Müller (1908) identified some specimens from Zeekoevlei as *Cypris corpulenta* and provided illustrations. Relying on the shape and the size of the carapace (1,9–2,0 mm), we can unequivocally refer these specimens to *Ramotha hirta* (redescribed above). This species was at that stage still unknown, which makes Müller's error understandable. *Ramotha hirta* is furthermore a typical Western Cape species, whereas *R. corpulenta* is only known from the vicinity of Knysna (Southern Cape region).

Ramotha crassa (Klie, 1939)

Fig. 8A–G

?Eucypris hirta Lowndes, 1931: 1292 (*non* Sars, 1924).
Strandesia crassa Klie, 1939: 132–134, figs 44–47.
Eucypris bouilloni Kiss, 1959: 5–7, fig. 2 (1–10) syn. nov.

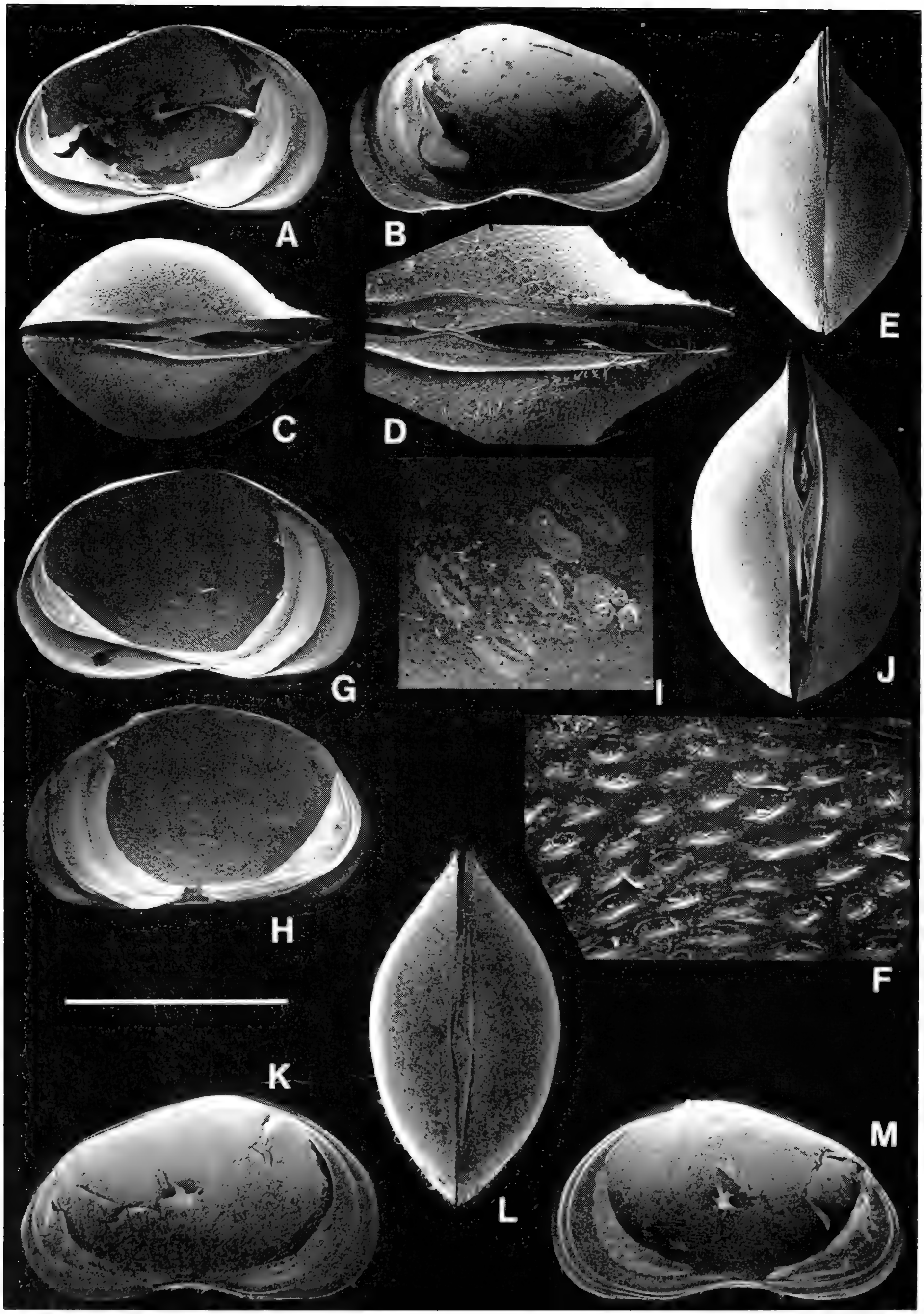
Type locality

Small lake near camp 4 of Elgon; small lake of Cladera near Elgon (Kenya).

Type material

Ramotha crassa: ZIZM 871: *c.* 20 ♀ in glycerine in a tube, labelled '*Strandesia crassa* n. sp., Omo Exp. Calderasee des Elgon 7 Januar 1933 coll. Chappuis'. These specimens are generally recognizable, but all carapaces are completely decalcified (hence no SEM micrographs could be provided) and crushed. Lectotype (here designated): a ♀, selected from the above syntypes, with soft parts dissected in glycerine on a sealed slide and with valves stored dry (ZIZM/CR.871a/1); all other syntypes become paralectotypes.

Ramotha bouilloni: MRAC 47352–47359: 5 decalcified ♀ in a tube, labelled 'Mt. Elgon, 2e lac, alt. 3 780 m, coll. Dr J. Bouillon—14.12.1953', belonging to at least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two different genera. As *R. bouilloni* is here synonymized with *R. crassa*, no lectotype is here designated for this nominal species.

Diagnosis

Valves short and high, greatest height situated at about one-third from the front, dorsal margin straight, sloping towards the caudal side and passing into the caudal margin with a blunt angle on the LV (Fig. 8A–B). In dorsal view (Fig. 8C), frontal edge pointed, with LV reaching beyond RV, greatest width (*c.* four-sevenths of length) situated just in front of the middle. The 'a'-setae on Mx2 sometimes fused at their base (Fig. 8F–G).

Measurements

Klie (1939: 134) gave the following measurements: L = 1,6 mm; H = 0,96 mm; W = 0,92 mm. New measurements (in μm, mean ± S.D., n = 5): L = 1 528 ± 36; H = 917 ± 19.

Discussion

This species is closely related to *R. montana*, but is much smaller and has relatively higher valves. It was originally described from Mount Elgon (Klie 1939). From the same region, Kiss (1959) described two other species: *Eucypris montelgoni* and *E. bouilloni*. The type material of both nominal taxa is curated by the MRAC (Tervuren); in both cases, it consists of very few, damaged and decalcified specimens.

The tube labelled '*E. bouilloni*' contained 5 ♀, three of which belong to a species of *Eucypris* s.s. (no selvage in RV, no inner list in LV, 'c'-seta on Mx2), possibly *E. virens*; the remaining two specimens belong to *R. bouilloni*. Upon comparison with the type material of *R. crassa*, it was decided that the species were synonymous. Their similarity was evident from the figures of both nominal taxa. We here formally synonymize *R. bouilloni* with *R. crassa*.

A more difficult case is the position of *Eucypris montelgoni*. The tube thus labelled (MRAC 47350) contained one crushed ♀, similar in appearance to *R. crassa* and of approximately the same size, but definitely not referable to what was described as *E. montelgoni*. Kiss (1959: 7–8) indeed cited the length of *E. bouilloni* as 1,7 mm, but only 0,7 mm for *E. montelgoni*. We cannot consider the latter to be the larvae of *R. bouilloni* (hence *R. crassa*), because the A2 was illustrated with 5+1 natatory setae (A-1 larvae—the 8th instar—of Cyprididae have only five natatory setae, A-2 larvae have four setae, etc.—see below). We are therefore, at present, unable to place *E. montelgoni* conveniently and this will remain impossible until new material of this species becomes available.

Fig. 7 (*see opposite*). A–F. *Ramotha capensis* (G. W. Müller), ♀. A. LV, internal view (GW.24627b, c). B. RV, internal view (GW.24627b, c). C. Cp, ventral view (GW.24627d). D. Cp, ventral view, detail anterior (GW.24627d). E. Cp, dorsal view (GW.24627d). F. Cp, dorsal view, detail of surface structure (GW.24627d). G–J. *Ramotha corpulenta* (Sars), ♀. G. LV, internal view (SAM–A40050). H. RV, internal view (SAM–A40050). I. RV, internal view, detail of central muscle scars (SAM–A40050). J. Cp, ventral view (KM.1167—lost). K–M. *Ramotha producta* (Sars), ♀ (8th larval instar). K. LV, internal view (KBIN OC1499). L. Cp, ventral view (KBIN OC1500). M. RV, internal view (KBIN OC1499). Scale: 1 316 μm for A–C, E, G, H, J; 980 μm for K–M; 714 μm for D; 373 μm for I; 82 μm for F.

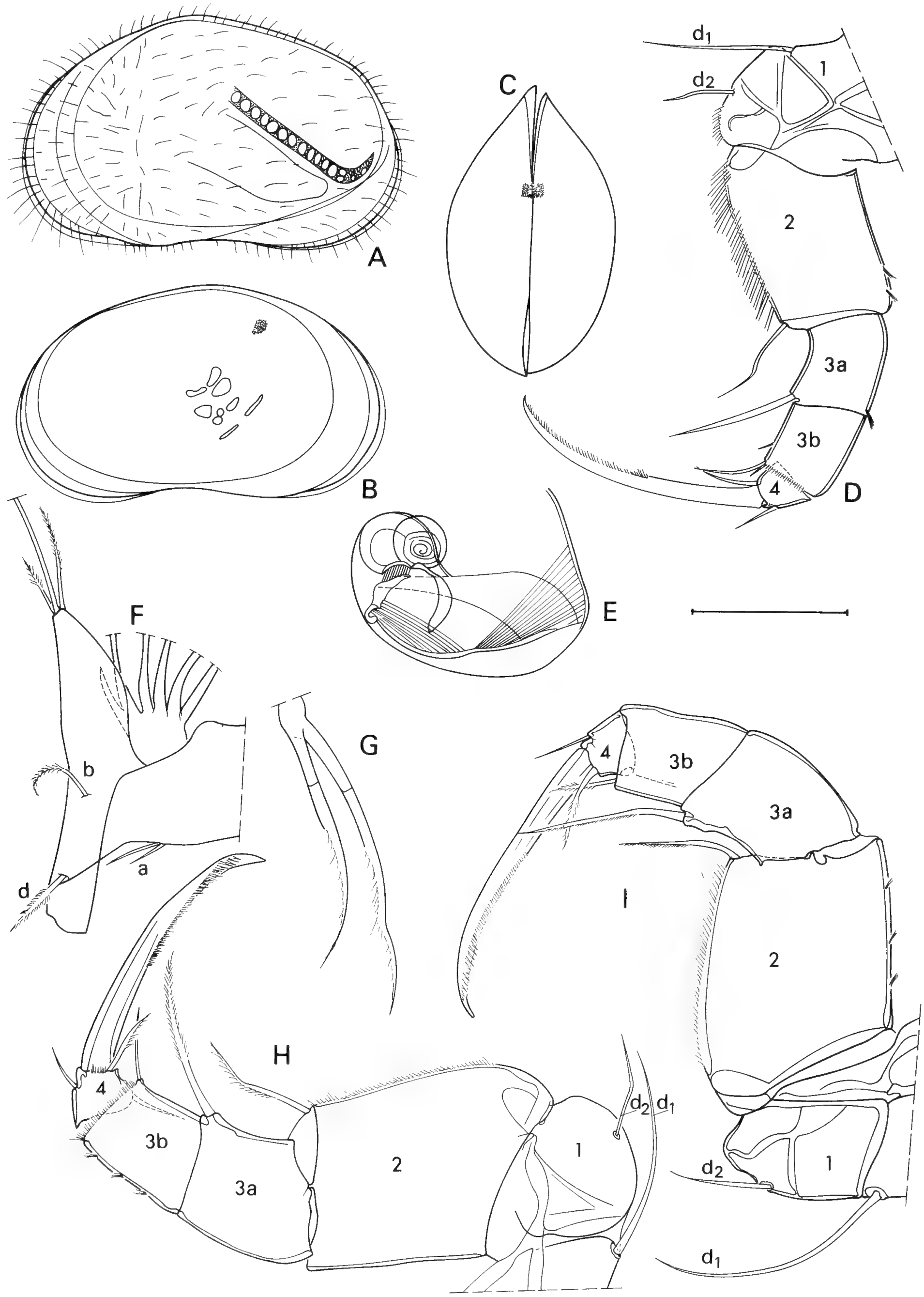


Fig. 8. A–G. *Ramotha crassa* (Klie), ♀ (A–C redrawn after Klie (1939), D–G original from lectotype specimen no: ZIZM/CR.871a/1). A. LV, external view. B. RV, external view. C. Cp, dorsal view. D. T1. E. Genital lobe. F. Mx2, showing part of chaetotaxy. G. Mx2, detail of fused 'a'-setae. H. *Ramotha montana* (Lindroth), ♀ (UPPS.228(g.1–2)), T1. I. *Ramotha kenyensis* (Lindroth), ♀ (UPPS.601(n.1–2)), T1. Scale: *c.* 840 μm for C; *c.* 670 μm for A, B; 156 μm for D–F, H, I; 33 μm for G.

Ramotha curtisae sp. nov.

Figs 9, 10A–M, 11A–H

Derivation of name

This species is named after Miss Barbara Curtis (Windhoek), curator of freshwater invertebrates at the State Museum, Windhoek, Namibia, who has generously supplied me with Namibian ostracods over the past years.

Type locality

A small farm dam at Joyec (plot 198), Gobabis district, Namibia (approx. 21°52′32″S 18°18′2″E).

Type material

SMN 51250: *c.* 20 good ♂ and ♀, collected from the above locality by B. A. Curtis on 24 June 1986. Holotype: ♂, stored *in toto* in spirit (SMN 51513).

Allotype: ♀, with soft parts dissected and with valves stored dry (SMN 51514). Paratypes: 2 ♂ dissected and stored as the allotype (KBIN OC1493 and SMN 51515), 2 ♀ stored dry *in toto* (after use for SEM—SMN 51516); the bulk of the paratypes remains in spirit, stored under the same number as the original sample. Deposition: one dissected ♂ is lodged in the collection of the KBIN (Brussels), the other paratypes, as well as the holotype and the allotype, are returned to the SMN (Windhoek, Namibia).

Other material investigated

SMN 50921: 1 LV + soft parts of a ♀, collected on 26 February 1986 by B. A. Curtis from a farm dam at Biesiepan (plot 971) at the border of the Grootfontein and the Otjiwarongo districts (approx. co-ordinates: 20°S 17°E). Accompanying ostracod fauna: *Heterocypris ovularis*.

10 000s of good ♂ and ♀ in 3 samples from Shopi Pan in Hwange Nature Park, Zimbabwe (approx. 18°S 24°E), collected on 4 September 1948 (AM/SED.91), 5 September 1948 (AM/SED.98) and 11 September 1948 (AM/SED.36) by Mr and Mrs Omer-Cooper. Accompanying ostracod fauna in these samples: *Pseudocypris circularis*, *Cypricercus* sp. nov., *Parastenocypris junodi* and *Afrocypris barnardi*.

Diagnosis

Valves (Fig. 10A–F) highly arched and sub-triangular, in lateral view with anterior margin more broadly rounded than posterior one, the latter rather pointed. Cp in dorsal view with both anterior and posterior edge convexly rounded and with greatest width situated in the middle. LV with anterior inner list crenulated.

Hemipenis with lateral shield boot-like (Fig. 9E–F), but with tip less elongated than in *R. hirta*; medial shield far more pronounced than in the latter species. Prehensile palps asymmetrical; right palp (Fig. 9C) with penultimate segment with a dorsal angle of *c.* 90° (this angle greater in the type species).

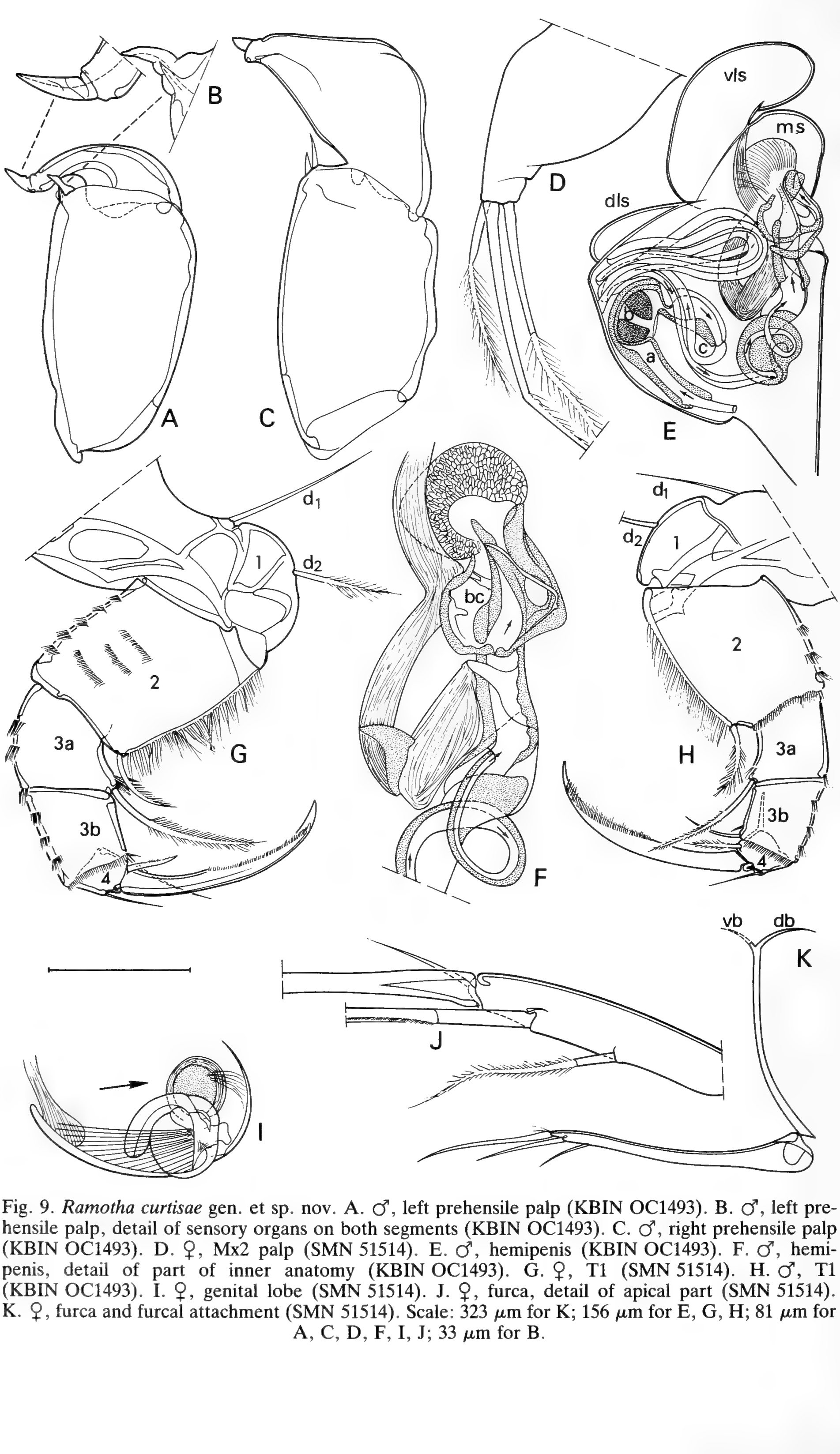


Fig. 9. *Ramotha curtisae* gen. et sp. nov. A. ♂, left prehensile palp (KBIN OC1493). B. ♂, left prehensile palp, detail of sensory organs on both segments (KBIN OC1493). C. ♂, right prehensile palp (KBIN OC1493). D. ♀, Mx2 palp (SMN 51514). E. ♂, hemipenis (KBIN OC1493). F. ♂, hemipenis, detail of part of inner anatomy (KBIN OC1493). G. ♀, T1 (SMN 51514). H. ♂, T1 (KBIN OC1493). I. ♀, genital lobe (SMN 51514). J. ♀, furca, detail of apical part (SMN 51514). K. ♀, furca and furcal attachment (SMN 51514). Scale: 323 μm for K; 156 μm for E, G, H; 81 μm for A, C, D, F, I, J; 33 μm for B.

Remarks

Specimens from the Hwange Nature Park (Figs 10G–M, 11A–H) are somewhat smaller than those from Namibia and have a significantly larger H/L ratio (see measurements below). The right prehensile palp has a terminal segment that is somewhat narrower and more elongated than in the Namibian specimens, whereas the left palp has a more elongated penultimate segment. These differences, however, seem to fall in the range of a reasonable variability and no taxonomic value is as yet attached to them.

Measurements (in μm, mean ± S.D., n = 5)

Namibia (SMN 51250). ♂: L = 1 576 ± 38; H = 1 007 ± 15; W = 910 ± 33; W/L = 0,55–0,63; H/L = 0,63–0,64. ♀: L = 1 645 ± 63; H = 1 045 ± 38; W = 957 ± 43; W/L = 0,56–0,60; H/L = 0,63–0,65.

Zimbabwe (AM/SED.36). ♂: L = 1 452 ± 39; H = 993 ± 33; W = 907 ± 20; W/L = 0,62–0,64; H/L = 0,67–0,70. ♀: L = 1 489 ± 26; H = 1 034 ± 21; W = 955 ± 9; W/L = 0,64–0,65; H/L = 0,68–0,70.

Discussion

Ramotha curtisae sp. nov. has a somewhat isolated position in the genus and differs markedly from all congeners except *R. trigona* by its sub-triangular shape in lateral view. It differs from the latter species by the convex anterior edge in dorsal view (beak-like in *R. trigona*). There can, however, be no doubt that these two taxa (*R. trigona* and *R. curtisae*) belong to the same phyletic lineage within the genus, *R. trigona* thus being the most southern representative of this species-group.

Ramotha kenyensis (Lindroth, 1957)

Figs 8I, 12A–F, 14A–D

Eucypris kenyensis Lindroth, 1957: 53–56, figs 1–6. Löffler, 1968: 153–156.

Type locality

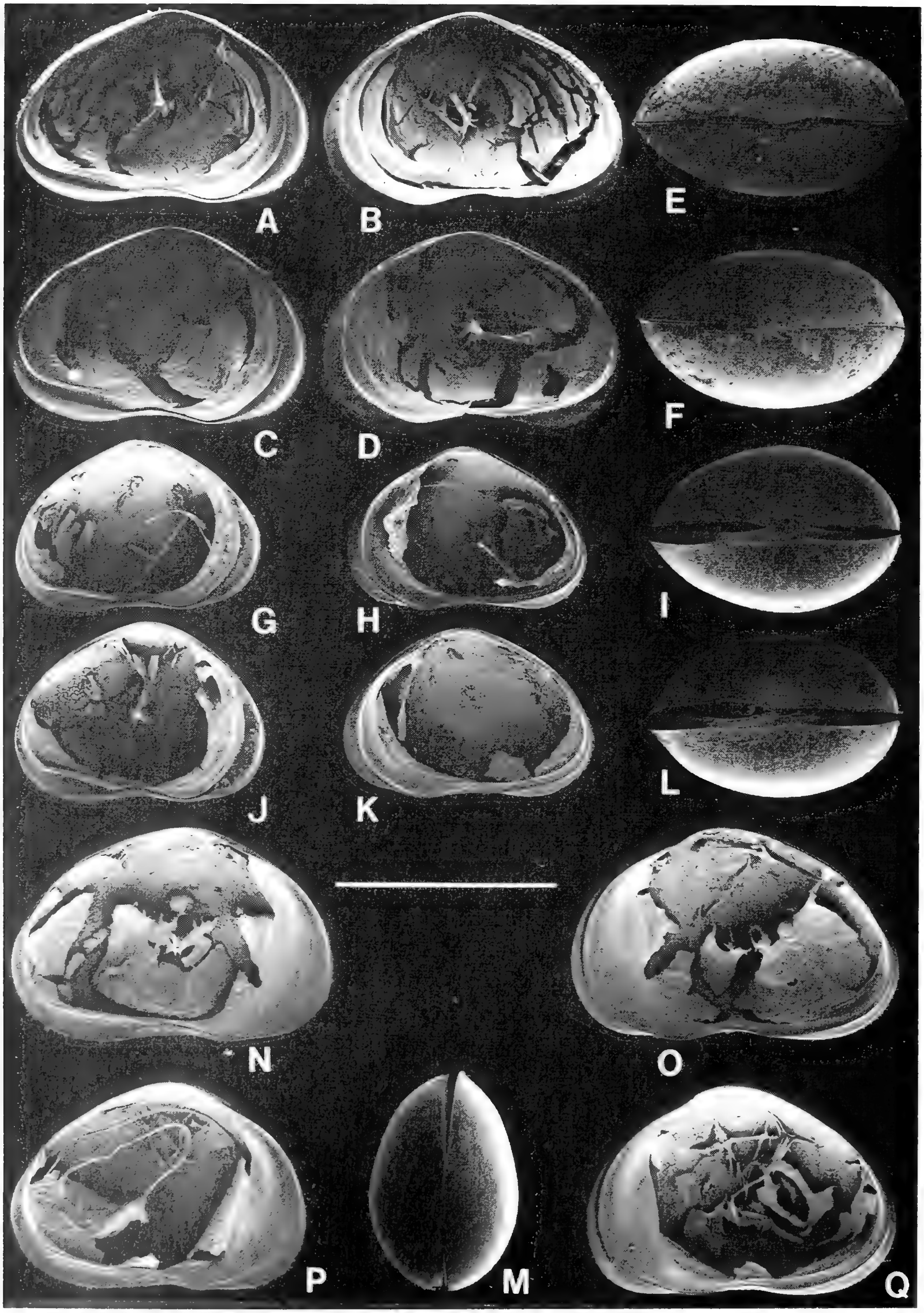
Shallow lake in Teleki Valley on Mount Kenya (altitude 4 230 m).

Type material

UPPS (type 601n): 31 Ad ♀ (3 used for SEM, 1 dissected and 2 stored *in toto*—UPPS.601(n.1–3), 1 (A–1) ♀, 16 (A–2) ♀, 5 (A–3) ♀ in spirit in a tube. Lectotype (here designated): ♀, selected from the above syntypes, with soft parts dissected in glycerine on a sealed slide and with valves stored dry (UPPS.601(n.1–2)); all other syntypes become paralectotypes.

Diagnosis

Valves elongated (Figs 12A–B, 14A–B), with posterior margin produced in lateral view, anterior margin very broadly rounded, smoothly passing into the dorsal margin, almost without an ascending part and dorsal margin, thus not showing an anterior blunt angle. In dorsal view (Figs 12C, 14C), anterior edge pointed, greatest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width (*c.* one-half of length) situated near the middle. Soft parts without special features.

Measurements

Lindroth (1957) (in mm): L = 1,96–2,15 (n = 4); H = 1,10–1,18 (n = 4); W = 1,07 (n = 1). New measurements (in μm, mean ± S.D., n = 5): L = 2 038 ± 59; H = 1 162 ± 46; W = 1 183 ± 38; W/L = 0,57–0,60.

Discussion

Ramotha kenyensis differs from its geographically closest congeners, *R. montana* and *R. crassa*, in the shape of the anterior margins in lateral view, which are far more broadly rounded than in the two other taxa. In this, *R. kenyensis* agrees well with the South African *R. purcelli*, to which it is indeed closely related. *Ramotha purcelli*, however, has its greatest width in dorsal view situated at about one-third from the front (in the middle in *R. kenyensis*).

Ramotha montana (Lindroth, 1957)

Figs 8H, 12G–M, 14E–G

Eucypris hirta Klie, 1944: 17–18 (*non* Sars, 1924).
Eucypris montana Lindroth, 1957: 56–59, figs 7–13. Löffler, 1968: 153–156.

Type locality

Shallow temporary water on Mount Meru (altitude 2 250 m).

Type material

UPPS (type 228g) 92B: 7 Ad ♀ (two used for SEM of which one dissected—UPPS.228(g.1–3)), 15 (A–1) ♀, 4 (A–2) ♀, 2 (A–4) ♀, and 4 (A–5) ♀ in spirit. Lectotype (here designated): ♀, selected from the above syntypes, with soft parts dissected in glycerine on a sealed slide and with valves stored dry (UPPS.228(g.1–2)); all other syntypes become paralectotypes.

Other material investigated

ZIZM 837: *c.* 10 ♀ *in toto* in glycerine (with Cps completely decalcified, but with shape recognizable) in a tube, labelled '*Eucypris hirta* G. O. Sars, Belg. Congo: Albert Nat. Park. no. 51, 11 März 1935, coll. H. Damas'.

Fig. 10 (*see opposite*). A–M. *Ramotha curtisae* gen. et sp. nov. A–F. From Namibia. A. ♂, LV, internal view (KBIN OC1493). B. ♂, RV, internal view (KBIN OC1493). C. ♀, LV, internal view (SMN 51514). D. ♀, RV, internal view (SMN 51514). E. ♀, Cp, ventral view (SMN 51516). F. ♀, Cp, dorsal view (SMN 51516). G–M. From Zimbabwe. G. ♂, LV, internal view (KBIN OC1508). H. ♂, RV, internal view (KBIN OC1508). I. ♂, Cp, ventral view (AM/SED.36A). J. ♀, LV, internal view (KBIN OC1509). K. ♀, RV, internal view (KBIN OC1509). L. ♀, Cp, ventral view (AM/SED.36B). M. ♂, Cp, dorsal view (AM/SED.36A). N–Q. *Ramotha trichota* (G. W. Müller). N. ♀, LV, internal view (KBIN OC1505). O. ♀, RV, internal view (KBIN OC1505). P. ♂, LV, internal view (KBIN OC1506). Q. ♂, RV, internal view (KBIN OC1506). Scale: 1 333 μm for A–M; 1 587 μm for N–Q.

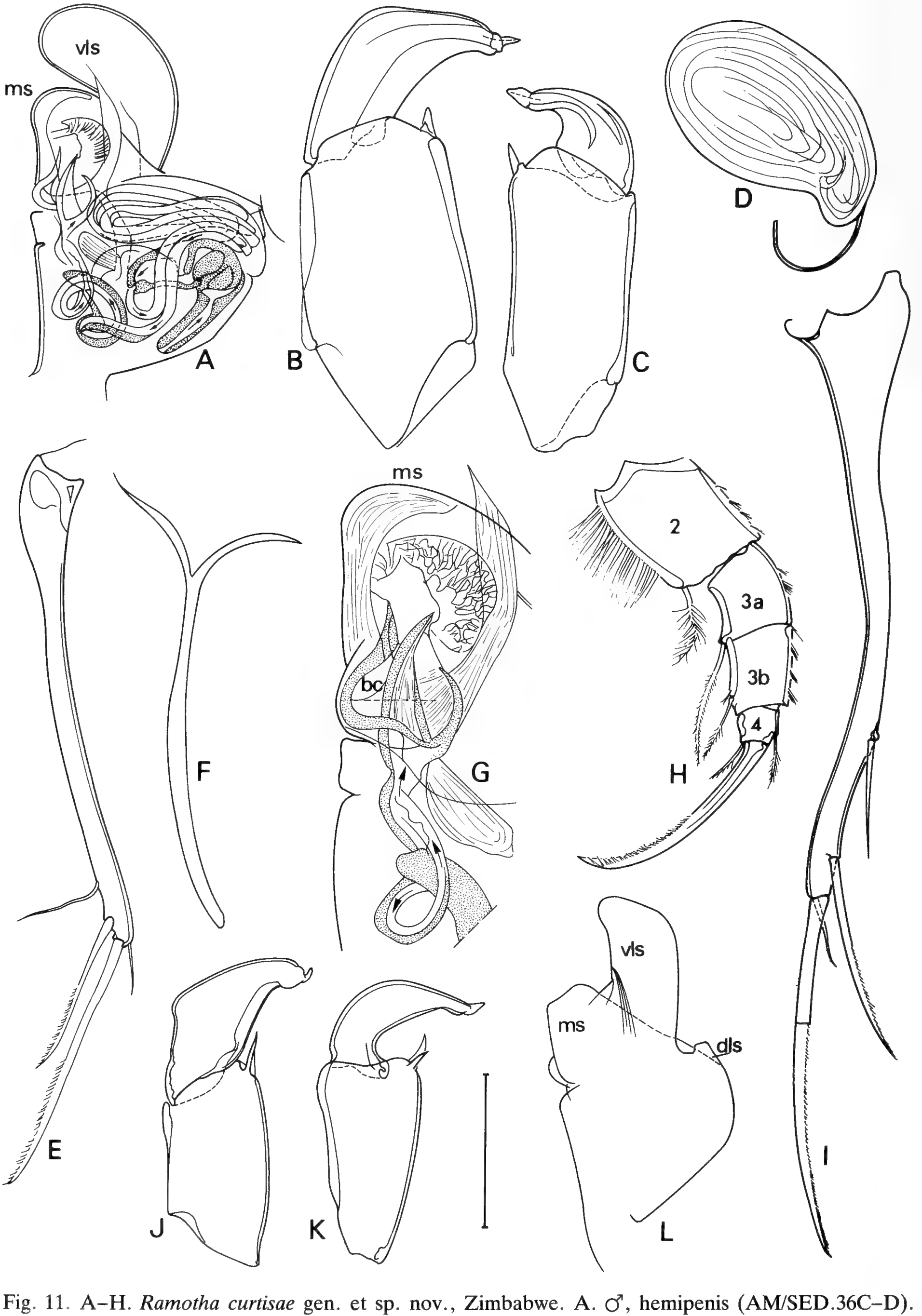


Fig. 11. A–H. *Ramotha curtisae* gen. et sp. nov., Zimbabwe. A. ♂, hemipenis (AM/SED.36C–D). B. ♂, right prehensile palp (AM/SED.36C–D). C. ♂, left prehensile palp (KBIN OC1508). D. ♀, flattened seminal receptacle (KBIN OC1509). E. ♂, furca (AM/SED.36C–D). F. ♂, furcal attachment (AM/SED.36C–D). G. ♂, hemipenis, detail of inner anatomy (AM/SED.36C–D). H. ♂, T1 (AM/SED.36C–D). I–L. *Ramotha trichota* (G. W. Müller), ♂ (KBIN OC1506). I. Furca. J. Right prehensile palp. K. Left prehensile palp. L. Outline of hemipenis. Scale: 323 μm for L; 156 μm for A, D, H–K; 81 μm for B, C, E–G.

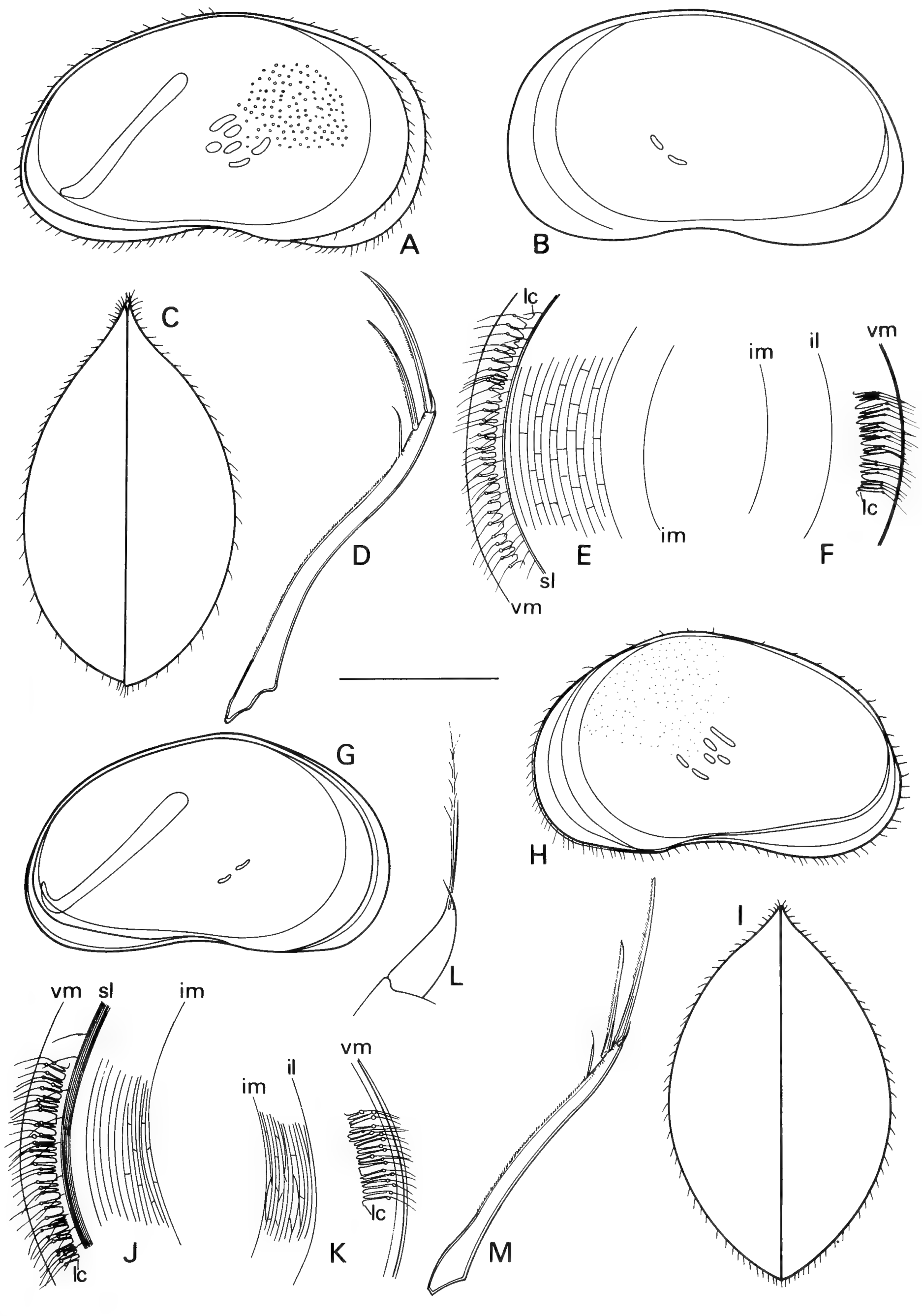
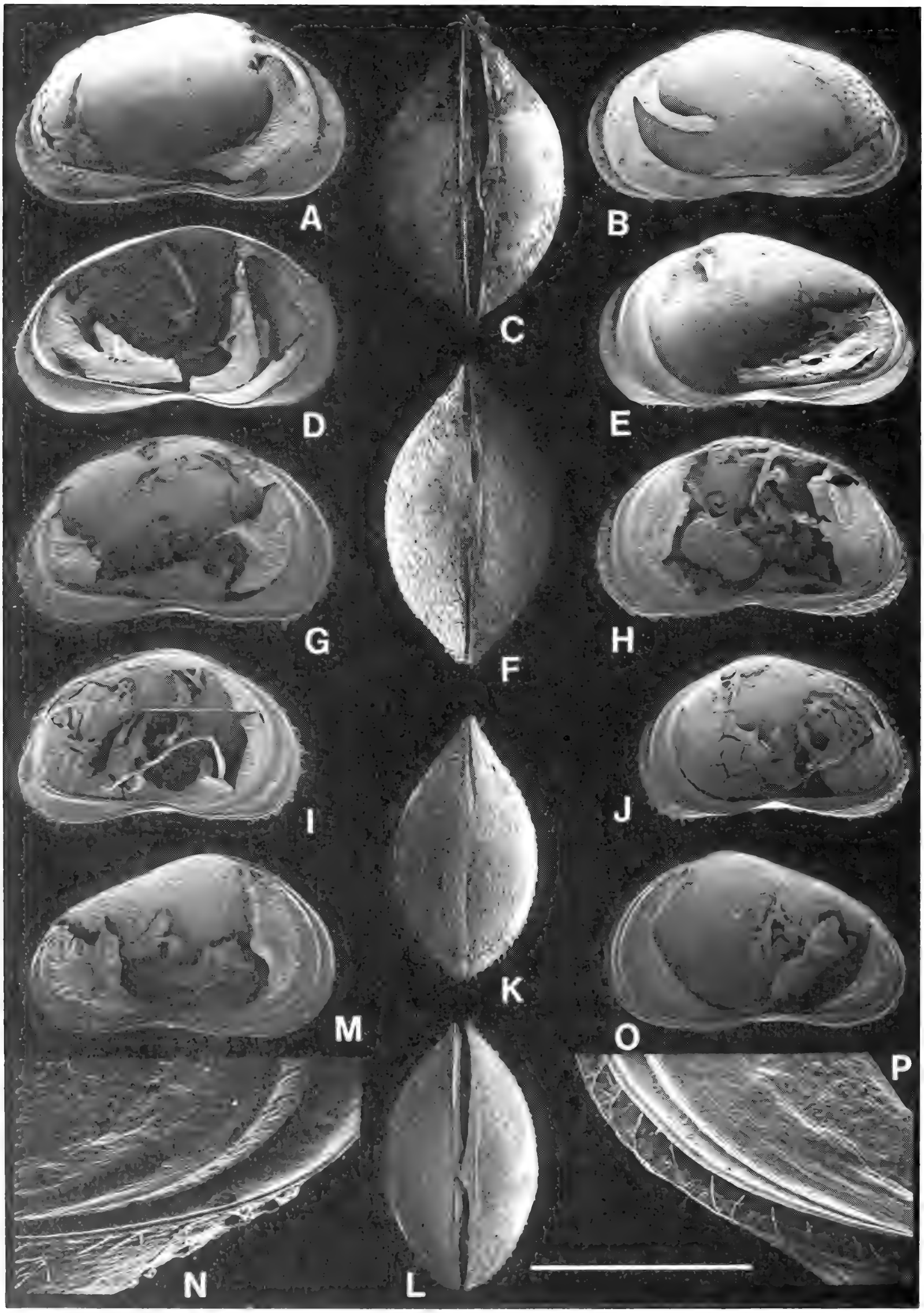


Fig. 12. A–F. *Ramotha kenyensis* (Lindroth), all redrawn after Lindroth (1957). A. RV, external view. B. LV, external view. C. Cp, dorsal view. D. Furca. E. RV, internal view, detail of anterior margin. F. LV, internal view, detail of anterior margin. G–M. *Ramotha montana* (Lindroth), all redrawn after Lindroth (1957). G. RV, external view. H. LV, external view. I. Cp, dorsal view. J. RV, internal view, detail of anterior margin. K. LV, internal view, detail of anterior margin. L. Mx2, detail of palp. M. Furca. Scale: *c.* 800 μm for A–C, G–I; *c.* 300 μm for D–F, J–M.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Diagnosis

Valves (Figs 12G–H, 14E–G) higher than in the preceding species, with anterior margin in lateral view less broadly rounded and more pointed, passing into the dorsal margin after a long ascending part with a blunt angle; LV posteriorly evenly rounded. Cp in dorsal view (Figs 12I, 14L) wider than in the preceding species, but with greatest width also situated in the middle; anterior edge pointed, but less so than in *R. producta*, and posterior edge convexly rounded. Soft parts without special features.

Measurements

Lindroth (1957) (in mm, n = 2): L = 1,94–1,98; H = 1,14–1,16; W = 1,13–1,17. New measurements (in μm, mean ± S.D., n = 5): L = 1 914 ± 57; H = 1 141 ± 45; W = 1 148 ± 55; W/L = 0,58–0,62.

Discussion

See under the following species.

Ramotha producta (Sars, 1924) comb. nov.

Figs 1A–B, 7K–M, 13, 15E–K, 16A–G

Eucypris producta Sars, 1924: 109–110, pl. 3 (figs 1–2).

Type locality

Vlei near Port Elizabeth (South Africa).

Type material

SAM–A11312: 5 ♀ from the above locality (labelled '*Eucypris propinqua* G. O. Sars'—MS-name) in spirit (2 ♀ used for SEM, nos SAM–A40040–1171, the former dissected). Lectotype (here designated): the dissected ♀ with soft parts dissected in glycerine on a sealed slide and with valves stored dry (SAM–A40040); the other syntypes become paralectotypes.

Other material investigated

A slightly aberrant form of this species was collected from various temporary water bodies in the vicinity of Grahamstown, Eastern Cape Province (KBIN/IG.27549–GR/12–15); in some of these localities, bisexual populations occurred (KBIN/IG.27549–GR/17–19). The specimens from the parthenogenetic populations are slightly more elongated and have carapaces that are narrower and show a

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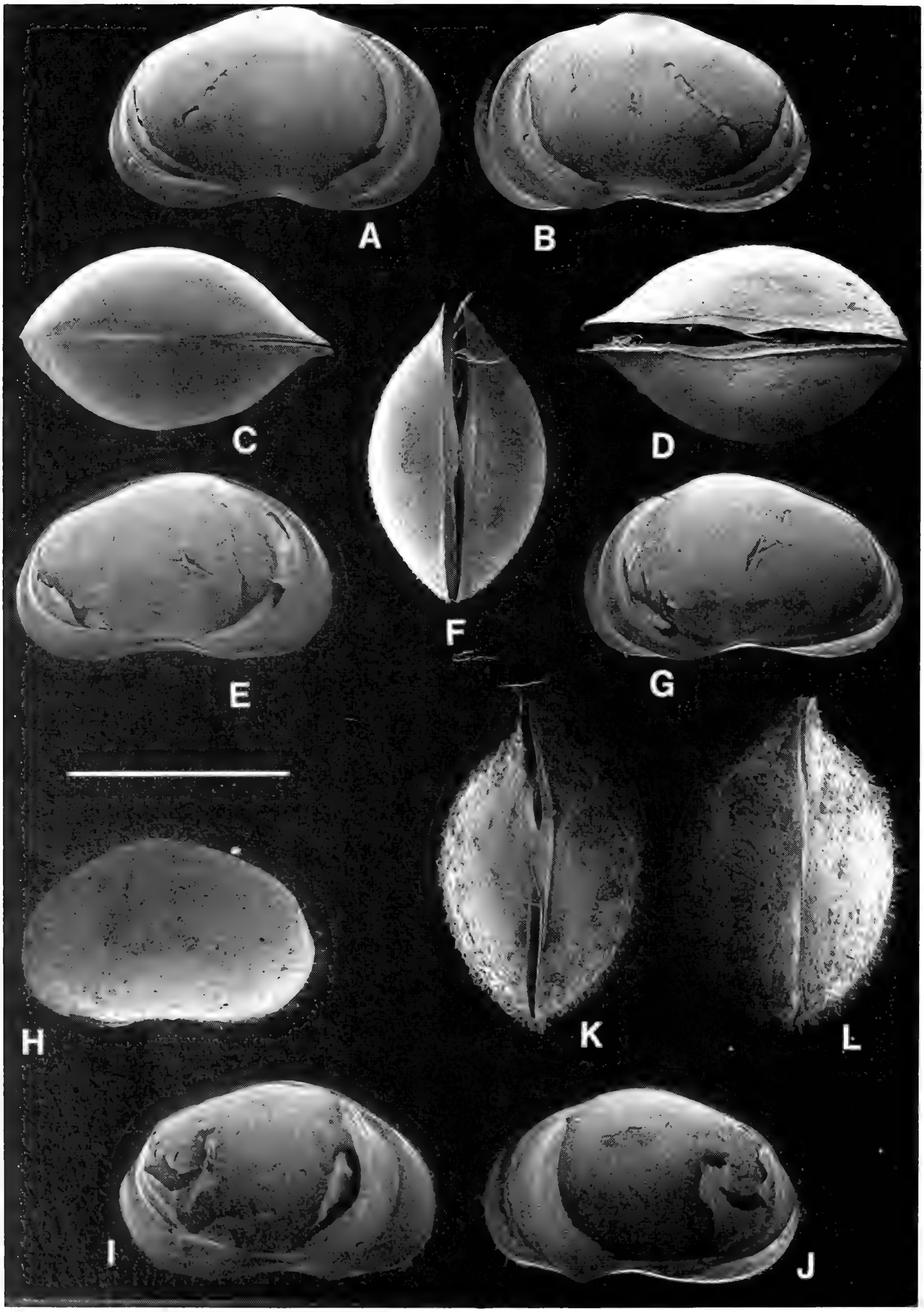
Fig. 13 (*see opposite*). *Ramotha producta* (Sars). A–B. Lectotype, ♀ (SAM–A40040). A. LV, internal view. B. RV, internal view. C. Paralectotype (SAM–A40041), ♀, Cp, ventral view. D–F. Parthenogenetic ♀ from Grahamstown. D. LV, internal view (KBIN OC1502). E. RV, internal view (KBIN OC1502). F. Cp, ventral view (KM.1173—lost). G–L. Males and females from a bisexual population, Grahamstown. G. ♀, LV, internal view (KBIN OC1497). H. ♀, RV, internal view (KBIN OC1497). I. ♂, LV, internal view (KBIN OC1494). J. ♂, RV, internal view (KBIN OC1494). K. ♂, Cp, dorsal view (KBIN OC1496). L. ♂, Cp, ventral view (KBIN OC1495). M–P. 7th larval instar ♀ from a parthenogenetic population near Grahamstown. M–N. LV (KBIN OC1501). M. Internal view. N. Anterior detail. O–P. RV (KBIN OC1501). O. Internal view. P. Anterior detail. Scale: 1 587 μm for A–L; 781 μm for M, O; 145 μm for P; 133 μm for N.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cavely pointed posterior end. The ♂ and some of the ♀ from the bisexual populations generally have a significantly larger height/length ratio (see measurements). Other females from the same populations have the same shape as the parthenogenetic specimens. Both types of ♀ were found to contain spermatozoids, although less commonly in the more elongated specimens. Intermediate forms, although rare, were present, which is why no taxonomic importance is attached to these morphological differences.

All this material was collected by K. Martens (with H. Barber and F. C. de Moor) in November 1989.

Diagnosis

♀ *(parthenogenetic populations)*. Valves (Fig. 13A–B, D–E) elongated and caudally produced, anterior margin in lateral view not broadly rounded, and passing into the dorsal margin after a relatively long ascending part, with a blunt angle; the latter angle situated considerably more towards the front than in the preceding species. LV posteriorly not evenly rounded, showing a weak and blunt angle. Cp (Fig. 13C, F) wide in dorsal view, but with greatest width situated slightly anterior to the middle; anterior edge pointed, more so than in the preceding species; lateral sides mostly running straight and parallel to each other over about one-third of the total length.

♀ *(bisexual populations)*. As in the former, but with valves considerably higher (Fig. 13G, H); in dorsal view, most carapaces with evenly rounded lateral sides.

♂ *(first description)*. Valves (Fig. 13I, J) considerably shorter and higher than those of the parthenogenetic ♀. Cp in dorsal view (Fig. 13K, L) with rounded lateral sides. Hemipenis with lateral shield broadly rounded, medial shield asymmetrically produced towards the ventral side, bluntly pointed (Fig. 16A, D). Left prehensile palp (Fig. 16B, E) with distal segment tapering, evenly rounded, proximal segment with two medium-sized subapical sensory organs. Right prehensile palps (Fig. 16C, F) with distal segment sub-triangular, with three nearly straight margins; proximal segment with 2 larger sensory organs. A2 with normal sexual dimorphism in the apical chaetotaxy. T1 with distal claw somewhat longer than in the ♀ (Fig. 14E). Furca with ramus straight. Other soft parts as in the ♀.

Measurements

See Table 1.

Discussion

Ramotha montana and *R. producta* are closely related and could indeed constitute geographically isolated subspecies of the same species. The differences cited in the above diagnosis of *R. producta*, however, seem sufficient to maintain the specific

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Fig. 14 (*see opposite*). A–D. *Ramotha kenyensis* (Lindroth). A–B. Lectotype, ♀ (UPPS.601(n.1–2)). A. LV, internal view. B. RV, internal view. C–D. Paralectotype, ♀ (UPPS.601(n.3)). C. Cp, dorsal view. D. Cp, ventral view. E–G. *Ramotha montana* (Lindroth). E. Lectotype, ♀, LV, internal view (UPPS.228(g.1–2)). F. Paralectotype, ♀, Cp, ventral view (UPPS.228(g.3)). G. Lectotype, ♀, RV, internal view (UPPS.228(g.1–2)). H–L. *Ramotha hirta* (Sars). H. Paralectotype, ♀, LV, external view (SAM–A40044). I–J. Lectotype, ♀ (SAM–A40043). I. RV, internal view. J. LV, internal view. K. Cp, ventral view (KM.1229). L. Cp, dorsal view (KM.1228). Scale: 1 389 μm for A–G; 1 111 μm for H–L.

TABLE 1

Measurements of different populations of *Ramotha producta* (in μm, mean ± S.D.).

Population	L	H	W	H/L	W/L
GR/12 (n = 5)					
parthenogenetic ♀	2161±38	1162±38	1193±41	0,52–0,55	0,54–0,57
GR/17 (n = 5)					
parthenogenetic? ♀	2321±46	1241±44	1255±31	0,52–0,55	0,53–0,57
bisexual ♀	2155±37	1231±34	1179±23	0,56–0,59	0,54–0,57
♂	1954±54	1161±27	1092±36	0,58–0,61	0,54–0,59
Lectotype RV	2241	1276	—	0,57	—
Lectotype LV	2276	1310	—	0,58	—

status of both taxa. Future finds of intermediate populations will reveal whether this decision can be corroborated.

Ontogeny

As larval morphology can be most illuminating when attempting to reveal phylogenetic relationships, aspects of the morphology of the larval stages that were available are presented.

8th larval stage of ♀. RV (Fig. 7M) with approximately the same shape as in the adult, but with anatomy of the valve margin substantially different: both anteriorly and posteriorly with selvage inwardly displaced over a short distance only and with a long and conspicuous inner list (absent in adults).

LV (Fig. 7K) on both sides with an inner list only (as in the adults), but situated closer to the valve margin than in the adult stage. Shape of Cp in dorsal view (Fig. 7C) as in the adult.

A1 with 2+5 segments, all segments relatively shorter and wider than in the adult; Rome organ relatively larger; distal segment with Ya long and narrow and with one of the setae shorter, approximately two-thirds of the length of Ya.

A2 with five long natatory setae; z_1 with base about twice as wide as in z_2 and z_3, i.e. rather claw-like; G_2 short and incompletely developed; terminal segment with y_3 bifurcated; penultimate segment with three lateral 't'-setae.

Md palp with seta alpha narrower, beta subequal to the one in the adult and gamma-seta flanked by two instead of three setae.

Mx1 palp with terminal segment *c.* 2,5 times as long as basal width, third endite with two smooth claws.

Mx2 with two subequal 'a'-setae, one 'b'- and one 'd'-seta; respiratory plate carrying four long and one short ray; palp with three apical setae.

T1 (Fig. 15F) with penultimate segment divided; claw relatively short, but with two rows of teeth; seta d_2 = *c.* 1,5 times the length of seta d_1.

Basal segment of T2 with three setae; apically with fourth segment somewhat more separated from third segment than in the adult, but still forming a cleaning pincer.

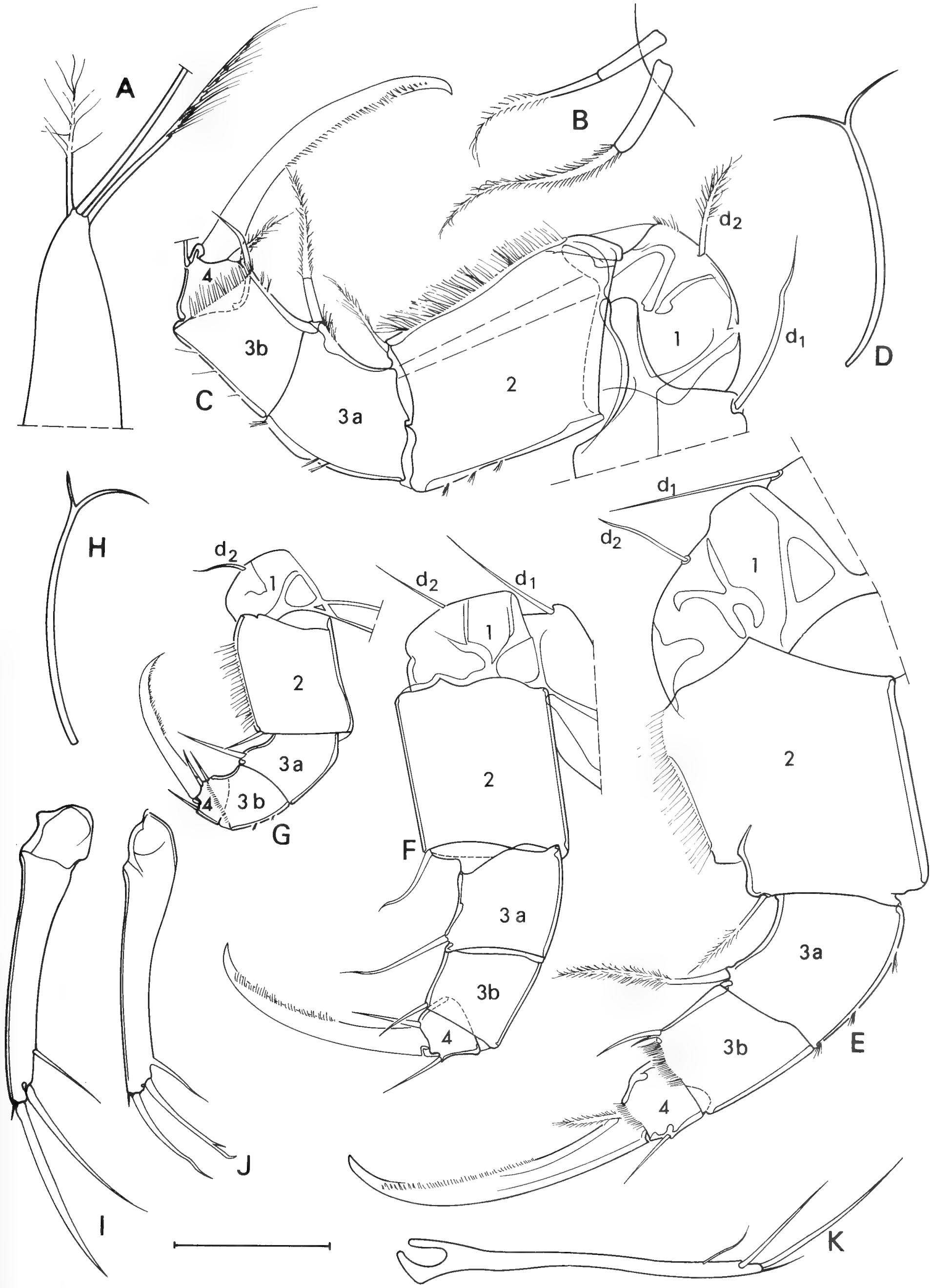

Fig. 15. A–D. *Ramotha purcelli* (Sars), ♀(SAM–A40046). A. Mx2, detail of palp. B. Mx2, detail of 'a'-setae. C. T1. D. Furcal attachment. E–K. *Ramotha producta* (Sars). E. ♀ (Ad), T1 (KBIN OC1502). F. ♀ (8th larval instar), T1 (KBIN OC1499). G. ♀ (7th larval instar), T1 (KBIN OC1501). H. ♀ (7th larval instar), furcal attachment (KBIN OC1501). I. ♀ (7th larval instar), furca (KBIN OC1501). J. ♀ (7th larval instar), other furca of same specimen (KBIN OC1501). K. ♀ (Ad), furca (KBIN OC1502). Scale: 323 μm for D, K; 156 μm for A, C, E–J; 33 μm for B.

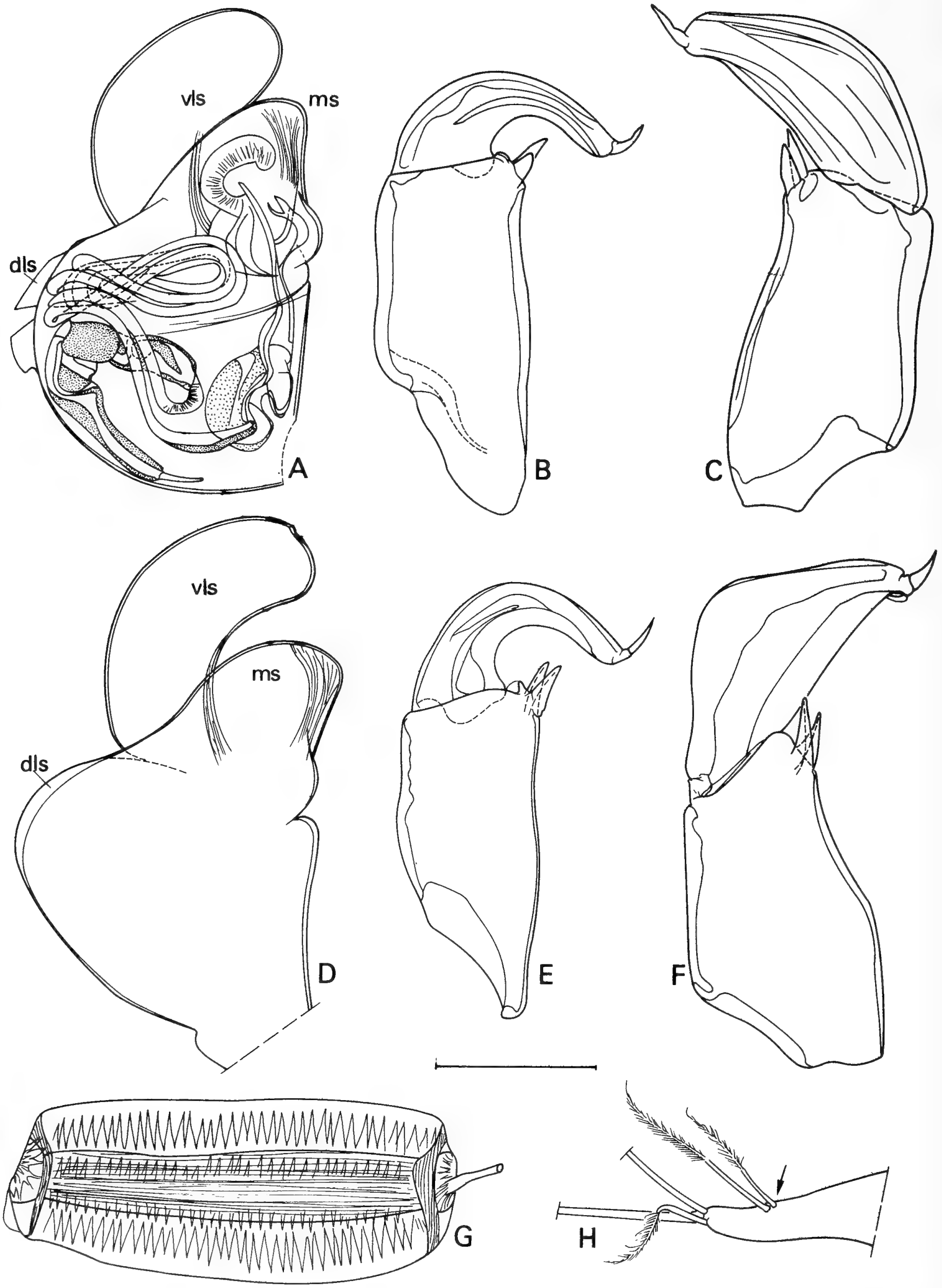

Fig. 16. A–G. *Ramotha producta* (Sars), ♂. A. Hemipenis (AM/LEN.17A). B. Left prehensile palp (AM/LEN.17A). C. Right prehensile palp, insufficiently flattened (AM/LEN.17A). D. Hemipenis outline (KBIN OC1494). E. Left prehensile palp (KBIN OC1494). F. Right prehensile palp (KBIN OC1494). G. Zenker's organ (KBIN OC1494). H. *Ramotha hirta* (Sars), ♀ (SAM–A40043), Mx2 palp. Scale: 156 μm for A, D, G, H; 81 μm for B, C, E, F.

Furca with rami shorter and wider, (sub-)apically still with two claws and setae. Furcal attachment bifurcated. Rake-like organs as in the adult.

7th larval stage of ♀. Shape of both valves more elongated, with greatest height situated more towards the front; ventral sinuous indentation more caudally situated and caudal margin more pointed than in the previous larval instar (Fig. 13M, O). Marginal anatomy similar to the 8th larval stage, but with selvage in RV and inner list in LV situated even closer to the valve margins (Fig. 13N, P).

A1 with Rome organ still visible.

A2 with four long natatory setae; apical segment with claws GM and Gm, seta 'g' and aesthetasc y_3 penultimate segment with two subapical z-setae, claw G_2 short and only two lateral 't'-setae.

Md palp normal alpha-seta, beta-setae somewhat wider and gamma-setae more smooth.

Mx1 with second palp segment approximately three times as long as the basal width, two claws on third endite smooth.

Mx2 with only one 'a'-seta and one 'b'- and 'd'-seta; respiratory plate with three long and one short ray; palp apically with one long, one medium-sized and one minute seta.

T1 with setae d_1 and d_2 subequal, penultimate segment divided and apical claw set with two rows of teeth (Fig. 15G).

T2 as in the former larval stage, but with all segments relatively wider and shorter.

Furca with ramus short (sometimes both rami significantly different—see Fig. 15I, J). Furcal attachment (Fig. 15H) bifurcated.

Ramotha purcelli (Sars, 1924)

Figs 1M–N, 5I–O, 15A–D

Eucypris purcelli Sars, 1924: 108–109, pl. 2 (figs 12–15).

Type locality

Pond at Ashton, Robertson Division (South Africa).

Type material

SAM–A11287: syntypes, *c.* 100 good ♀ and larvae, collected from the above locality (SAM–A40047–A40049 used for illustrations and stored separately).

Lectotype (here designated): ♀, selected from the above syntypes, with soft parts dissected in glycerine on a sealed slide and with valves stored dry (SAM–A40046); all other syntypes become paralectotypes.

Diagnosis

Both valves elongate in lateral view (Fig. 5I, J), with frontal margin broadly rounded, passing into the dorsal margin almost without an angle, the latter margin passing into the caudal margin with a blunt angle; caudal margin not evenly rounded but showing an additional blunt angle; ventral margin weakly sinuous. Greatest height situated slightly in front of the middle. Ventral outer list on LV weak (Fig. 5L); dorsal outer list on this valve prominent (Fig. 5M). Cp in dorsal view with RV anteriorly clearly reaching beyond LV, and with greatest width situated at about one-third from the front (Fig. 5K). Soft parts without special features.

Measurements (in μm; mean ± S.D., n = 5)

L = 2 089 ± 129; H = 1 172 ± 53; W = 1 169 ± 56; W/L = 0,55–0,58.

Discussion

The differences between *R. purcelli* and *R. producta* are similar to those between *R. kenyensis* and *R. montana*. *Ramotha purcelli* is thus similar to *R. kenyensis*, but is sufficiently different in its morphology to merit separate specific status (see discussion under *R. kenyensis*).

Ramotha trichota (G. W. Müller, 1908)

Figs 1I–J, 10N–Q, 11I–L

Cypris trichota G. W. Müller, 1908: 152–153, figs 1–5.
Eucypris trichota Sars, 1924: 108, pl. 2 (figs 1–11).

Type locality

Zeekoevlei, Plumstead, near Simonstown (South Africa).

Material investigated

GW no. 25133(7g): 1 ♀ ('Südafrika—Südpolar Exp.'). (Note: this is probably one of the specimens used by G. W. Müller for the original description of the species. However, this author mentioned that he had 9 ♀ from Zeekoevlei. As we do not know the whereabouts of the other specimens, a lectotype will not be designated here. The specimen was left undissected.)

SAM–A11926: *c.* 20 ♀ (with soft parts in bad condition) from Valkenbergvlei, collected on 15 July 1922 by E. M. Stephensen (?det. D. H. Eccles).

SAM–A11286: 5 ♀ and numerous valves from 'SAM EE' (?) (identified as *Eucypris producta* by G. O. Sars, as *R. trichota* by K. Martens).

KBIN OC1507 (G501/18): 1 ♀ from Wiesdrif, Western Cape Province (approx. co-ordinates: 34°40′12″S 19°54′47″E), collected by Dr J. King (UCT, Cape Town) on 11 May 1989 (det. K. Martens).

KBIN OC1505–1506 (G501/19): 1 ♀ and 1 ♂ from Soetendalsvlei Ditch, Western Cape Province (34°44′42″S 19°58′33″E), collected by Dr J. King (UCT, Cape Town) on 11 May 1989 (det. K. Martens).

Diagnosis (♀)

By far the largest of all *Ramotha* species, with high valves (Fig. 10N, O), greatest height situated at about one-third from the front, with dorsal margin sloping towards the caudal side and passing into the caudal margin without an angle; anterior margin in lateral view more broadly rounded than posterior one. Cp in dorsal view with anterior edge beak-like (concavely produced) and posterior edge rounded; greatest width situated slightly anterior to the middle. Soft parts without special features.

First description of ♂

Valves (Fig. 10P, Q) shorter and considerably higher than in the ♀, in lateral view with a sub-triangular appearance; anatomy of the valve margin identical to that of ♀. Both prehensile palps with surprisingly small penultimate segment, in right palp only slightly longer than the terminal segment (Fig. 11J). The latter in the right palp furthermore with a wide base and an irregular outline. Terminal segment of left palp (Fig. 11K) sickle-shaped and rather more elongated than in the other species of *Ramotha*. Hemipenis (Fig. 11L) with an elongated lateral shield, with straight and parallel lateral margins and a nearly straight distal margin.

Remark

The inner part of the hemipenis was not yet fully developed and sclerotized in the only ♂ specimen available for examination.

Measurements (in μm)

Type specimen (GW.25133/7g): L = 2 862; H = 1 724; W = 1 551; W/L = 0,54. Soetendalsvlei Ditch, ♀ (KBIN OC1505): RV: L = 2 724; H = 1 758. LV: L = 2 655; H = 1 758. ♂ (KBIN OC1506): RV: L = 2 224; H = 1 483. LV: L = 2 155; H = 1 534.

Relationships

This species can at once be distinguished from all congeners by the superior size of the ♀: almost 1 mm longer than the second largest species, *R. producta*.

Remarks

The MRAC (Tervuren) holds two slides (RG.38570) identified as *Eucypris trichota* by R. Kiss, the specimen originating from Bogarama in East Africa (coll. Marlier 1949). This specimen, however, is in such a bad condition that it became completely unidentifiable and this record is therefore disregarded here.

Ramotha trigona (Sars, 1895)

Fig. 1G–H

Cypris trigona Sars, 1895: 32–34, pl. 5 (fig. 3a–c).
Eucypris trigona Sars, 1924: 111–112, pl. 3 (figs 7–8).

Type locality

Swamp near Knysna, east of the Cape of Good Hope (South Africa).

Type material

OSLO F4339: 7 decalcified ♀ and several empty, decalcified valves. As permission was not obtained to dissect specimens, a lectotype has not been designated here.

Diagnosis

Valves in lateral view sub-triangular (Fig. 1G–H), with greatest height situated towards the front; both anterior and posterior margins bluntly pointed in lateral view, but the latter more so; ventral margin nearly straight. Cp in dorsal view with greatest width situated at or slightly posterior to the middle; anterior edge with concave beak-like extension. Both valves anteriorly with a wide fused zone, posteriorly with fused zone and flange wide.

Morphology of soft parts unknown.

Measurements

According to Sars (1924), the ♀ of this species is 1,75 mm long. New measurements (in μm, mean ± S.D., n = 3): L = 1 649 ± 105; H = 948 ± 69; W = 862 ± 17; W/L = 0,50–0,53.

KEY TO THE SPECIES

1A. Length of ♀ more than 2,5 mm (W. Cape) . . . . *R. trichota*
1B. Length of ♀ less than 2,5 mm 2

2A. Ventral margin (including selvage in RV and inner list in LV) conspicuously produced in the first third (Fig. 5C, D), especially in the ♀; carapace very hairy (W. Cape) . . . . *R. hirta*
2B. Carapace less hairy, ventral margin not conspicuously produced in the first third 3

3A. W/L ratio >2/3, in dorsal view anterior conspicuously beak-like 4
3B. W/L ratio <1/2, in dorsal view anterior less produced 5

4A. Valves in lateral view with a nearly evenly rounded dorsal margin, a nearly straight ventral margin and with anterior and posterior margins nearly evenly rounded (W. Cape) . . . . *R. corpulenta*
4B. Valves in lateral view more elongated, with curved ventral margin and with anterior margin more broadly rounded than posterior one (W. Cape) . . . . *R. capensis*

5A. Valves sub-triangular 6
5B. Valves elongated, not sub-triangular 7

6A. Carapace in dorsal view with concavely produced beak (W. Cape) . . . *R. trigona*
6B. Carapace in dorsal view anteriorly and posteriorly convexly rounded (Namibia and Zimbabwe) . . . . *R. curtisae*

7A. L = *c.* 1,75 mm (East Africa) . . . . *R. crassa*
7B. L = *c.* 2 mm (East and South Africa) 8

8A. Anterior margins of isolated valves broadly rounded, passing into the dorsal margin almost without an angle 9
8B. Anterior margin of isolated valves less broadly rounded, more pointed, and with a conspicuous angle between anterior and dorsal margin 10

9A. Carapace in dorsal view with greatest width situated almost at mid-length (East Africa) . . . . *R. kenyensis*
9B. Carapace in dorsal view with greatest width situated at about one-third from the front (South Africa) . . . . *R. purcelli*

10A. Carapace in dorsal view with posterior margin convexly rounded (East Africa) . . . . *R. montana*

10B. Carapace in dorsal view with posterior margin concavely pointed (South Africa) .... *R. producta*

Note. To distinguish between the latter four species, check all figures carefully, especially when dealing with material from localities between East and southern African regions.

DISCUSSION

TAXONOMY AND ZOOGEOGRAPHY

Ramotha gen. nov. belongs to the tribe Cypridini in the Cypridinae, because of the presence of the '8'-shaped loops of the inner spermiductus in the hemipenis. Its affinities with the Eucypridini are thus limited. For a further discussion on the validity of these higher taxa and their mutual affinities, see the first part of this revision (Martens 1990). Within *Ramotha* gen. nov., we can distinguish different phyletic lineages:

Ramotha trichota is quite distinct within the genus and constitutes a separate lineage.

Ramotha capensis, *R. corpulenta* and *R. hirta* constitute another lineage, characterized by a wide carapace with a pointed, beak-like frontal edge. This group forms part of the Cape fauna.

Ramotha trigona and *R. curtisae* sp. nov. form another group within the genus; both taxa have sub-triangular valves. They occur in most of southern Africa.

The final lineage is formed by the remaining five species: the small *R. crassa*, the larger *R. kenyensis* and *R. montana* (all from East Africa), and the South African species *R. purcelli* and *R. producta*. We expect this group to have representatives also in the intermediate territories, e.g. in Zambia, Mozambique, etc.

Nevertheless, the genus forms one closely related group, quite distinct from the other Cypridini, as is shown by the very uniform shape of the hemipenis. The genus is furthermore well characterized by a T1 with a divided penultimate segment (fused in *Cypris* and *Pseudocypris*) and by the anatomy of the valve margins. The latter feature deserves some further elaboration. The closing mechanism of the anterior part of the valves in *Ramotha* is formed by a large, inwardly displaced selvage in the RV, which locks into a conspicuous inner list in the LV. In *Cypris*, the closing mechanism is formed by two inwardly displaced selvages, one on each valve. Such a system also exists in, for example, *Chlamydotheca* and in nearly all Megalocypridinae. On the other hand, a similar system to that in *Ramotha* was described for *Trajancypris* (Martens, 1989), a genus belonging to the Eucypridini. In spite of this, *Cypris* and *Ramotha* are much more closely related to each other than to the groups cited above. It is thus concluded that supra-generic affinities should not be based on such functionally relevant aspects of valve anatomy but rather on non-functional relicts of the morphology, e.g. the presence or absence of a 'c'-seta on the Mx2.

Another, superficially similar genus is the Australian *Alboa* De Deckker, 1981. Thanks to the kindness of Dr De Deckker, I was able to re-investigate a number of paratypes. It appeared that *Alboa* does not belong in the Cypridini, as it lacks '8'-shaped loops of the inner spermiductus in the hemipenis, apart from other features that are different. Its original allocation to the Cyprinotinae still seems the most plausible to date.

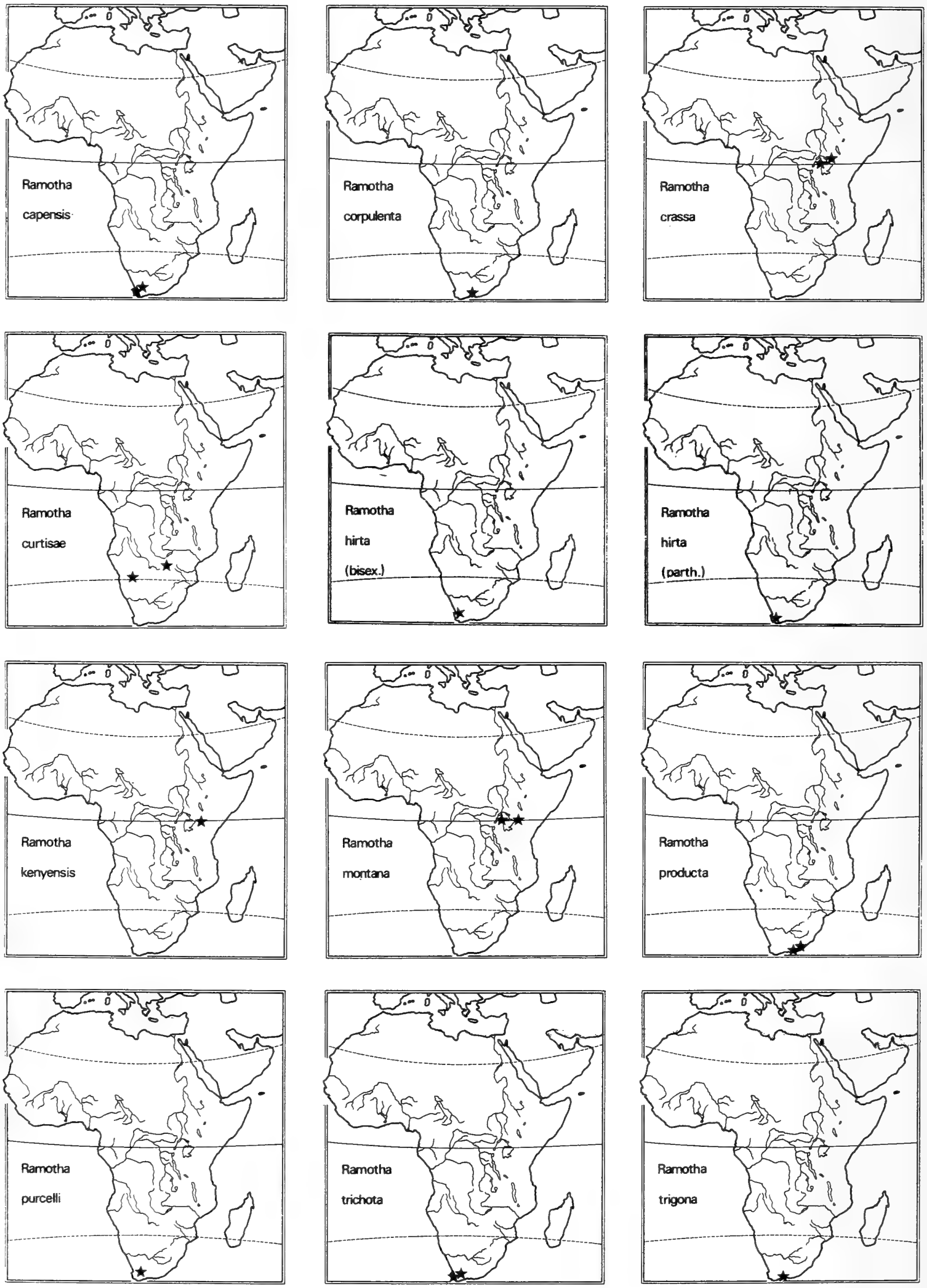

Fig. 17. Distribution of African species of *Ramotha* gen. nov.

The distribution of *Ramotha* is similar to that found in the genus *Sclerocypris* (see Martens 1986, 1988). There are, however, a number of differences. Firstly, *Sclerocypris* also has Indian representatives. Only African species are here assigned to *Ramotha* gen. nov., but it is unlikely that this genus has an exclusively African distribution and representatives of this genus can be expected in India. Secondly, there is at least one species of *Sclerocypris*, *S. bicornis* (G. W. Müller), which is widespread in most of Africa, and also in the northern part of the continent. Contrary to this, all *Ramotha* species have restricted geographical distributions (Fig. 17).

ECOLOGY

Thus far, species of *Ramotha* were mostly found in temporary habitats. They are reported from a number of small to medium-sized, permanent water bodies (Lake Elgol in East Africa and Zeekoevlei in South Africa), but never from the larger ancient East African lakes.

No fewer than three species of *Ramotha* occurred sympatrically in Zeekoevlei at the beginning of this century. Such coexistence of congeners, although not unique in ostracods, is of interest. Recent sampling in Zeekoevlei (December 1989) revealed that eutrophication has destroyed most of the original fauna of this vlei and not one representative of *Ramotha* was found.

All *Ramotha* species were thus far collected from fresh or slightly saline waters only. Most species are furthermore exclusively known from parthenogenetic populations. A fairly thorough survey of temporary waters in the vicinity of Grahamstown (Eastern Cape), revealed that *R. producta* occurs in both parthenogenetic and bisexual populations in virtually adjacent vleis. Nothing is known about the life history of these species, other than that their complete life cycle takes three weeks or less (at temperatures between 10° and 30°C); this is the time between the first rains and the collection of adults.

ACKNOWLEDGEMENTS

Mrs C. Behen and Mr J. Cillis offered technical assistance with the illustrations. Mr M. Cartois patiently sorted the collections from Namibia and the Cape Province. Material from various museums and collections was obtained through the efforts of the following people: Miss B. Curtis (Windhoek), Dr P. De Deckker (Canberra), Dr F. de Moor and Miss H. Barber (Grahamstown), Miss L. Hoenson and Mrs M. van der Merwe (Cape Town), Dr R. Jocqué (Tervuren), Mr N. Langeland (Oslo), Dr G. Müller (Greifswald), Mr H. Petersen (Hamburg) and Dr L. Wallin (Uppsala). Dr D. Danielopol (Mondsee) and an anonymous referee read the manuscript and suggested improvements. I would furthermore like to take this opportunity to thank the people who, by their warm hospitality, their active co-operation and enthusiastic support made my trips to Namibia and South Africa such rewarding experiences. They are: Miss B. Curtis (Windhoek), Dr J. A. Day, Dr B. Davies, Miss E. Louw, Miss K. Jagoe, Mrs M. van der Merwe and Miss L. Hoenson (Cape Town), Dr F. C. de Moor, Miss H. Barber and Miss N. Kohly (Grahamstown). To all of the above and to the many I might have forgotten, my sincere gratitude!

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6. SYSTEMATIC papers must conform to the *International code of zoological nomenclature* (particularly Articles 22 and 51).

Names of new taxa, combinations, synonyms, etc., when used for the first time, must be followed by the appropriate Latin (not English) abbreviation, e.g. gen. nov., sp. nov., comb. nov., syn. nov., etc.

An author's name when cited must follow the name of the taxon without intervening punctuation and not be abbreviated; if the year is added, a comma must separate author's name and year. The author's name (and date, if cited) must be placed in parentheses if a species or subspecies is transferred from its original genus. The name of a subsequent user of a scientific name must be separated from the scientific name by a colon.

Synonymy arrangement should be according to chronology of names, i.e. all published scientific names by which the species previously has been designated are listed in chronological order, with all references to that name following in chronological order, e.g.:

Family **Nuculanidae**

Nuculana (Lembulus) bicuspidata (Gould, 1845)

Figs 14–15A

Nucula (Leda) bicuspidata Gould, 1845: 37.
Leda plicifera A. Adams, 1856: 50.
Laeda bicuspidata Hanley, 1859: 118, pl. 228 (fig. 73). Sowerby, 1871: pl. 2 (fig. 8a–b).
Nucula largillierti Philippi, 1861: 87.
Leda bicuspidata: Nicklès, 1950: 163, fig. 301; 1955: 110. Barnard, 1964: 234, figs 8–9.

Note punctuation in the above example:
comma separates author's name and year
semicolon separates more than one reference by the same author
full stop separates references by different authors
figures of plates are enclosed in parentheses to distinguish them from text-figures
dash, not comma, separates consecutive numbers.

Synonymy arrangement according to chronology of bibliographic references, whereby the year is placed in front of each entry, and the synonym repeated in full for each entry, is not acceptable.

In describing new species, one specimen must be designated as the holotype; other specimens mentioned in the original description are to be designated paratypes; additional material not regarded as paratypes should be listed separately. The complete data (registration number, depository, description of specimen, locality, collector, date) of the holotype and paratypes must be recorded, e.g.:

Holotype

SAM–A13535 in the South African Museum, Cape Town. Adult female from mid-tide region, King's Beach, Port Elizabeth (33°51'S 25°39'E), collected by A. Smith, 15 January 1973.

Note standard form of writing South African Museum registration numbers and date.

7. SPECIAL HOUSE RULES

Capital initial letters

(a) The Figures, Maps and Tables of the paper when referred to in the text
e.g. '. . . the Figure depicting *C. namacolus* . . .': '. . . in *C. namacolus* (Fig. 10) . . .'
(b) The prefixes of prefixed surnames in all languages, when used in the text, if not preceded by initials or full names
e.g. Du Toit but A. L. du Toit; Von Huene but F. von Huene
(c) Scientific names, but not their vernacular derivatives
e.g. Therocephalia, but therocephalian

Punctuation should be loose, omitting all not strictly necessary

Reference to the author should preferably be expressed in the third person

Roman numerals should be converted to arabic, except when forming part of the title of a book or article, such as
'Revision of the Crustacea. Part VIII. The Amphipoda.'

Specific name must not stand alone, but be preceded by the generic name or its abbreviation to initial capital letter, provided the same generic name is used consecutively. The generic name should not be abbreviated at the beginning of a sentence or paragraph.

Name of new genus or species is not to be included in the title; it should be included in the abstract, counter to Recommendation 23 of the Code, to meet the requirements of Biological Abstracts.

K. MARTENS

TAXONOMIC REVISION OF AFRICAN CYPRIDINI. PART II. DESCRIPTION OF *RAMOTHA* GEN. NOV. (CRUSTACEA, OSTRACODA)

VOLUME 102 PART 3 OCTOBER 1992 ISSN 0303–2515

ANNALS
OF THE SOUTH AFRICAN MUSEUM

CAPE TOWN

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   (a) *Centred masthead to consist of*
   Title: informative but concise, without abbreviations and not including the names of new genera or species
   Author's(s') name(s)
   Address(es) of author(s) (institution where work was carried out)
   Number of illustrations (figures, enumerated maps and tables, in this order)
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   (c) *Table of contents* giving hierarchy of headings and subheadings
   (d) *Introduction*
   (e) *Subject-matter* of the paper, divided into sections to correspond with those given in table of contents
   (f) *Summary*, if paper is lengthy
   (g) *Acknowledgements*
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   (i) *Abbreviations*, where these are numerous.

3. MANUSCRIPT, to be submitted in triplicate, should be typewritten and neat, double spaced with 3 cm margins all round. First lines of paragraphs should be indented. Tables and a list of captions for illustrations should be typed separately, their positions indicated in the text. All pages should be numbered consecutively.

Major headings of the paper are centred capitals; first subheadings are shouldered small capitals; second subheadings are shouldered italics; third subheadings are indented, shouldered italics. Further subdivisions should be avoided, as also enumeration (never roman numerals) of headings and abbreviations.

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Only generic and specific names should be underlined to indicate italics; all other marking up should be left to editor and publisher.

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The number of the figure should be lightly marked in pencil on the back of each illustration.

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'Smith (1969) describes . . .'
'Smith (1969: 36, fig. 16) describes . . .'
'As described (Smith 1969*a*, 1969*b*; Jones 1971)'
'As described (Haughton & Broom 1927) . . .'
'As described (Haughton *et al.* 1927) . . .'

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For books give title in italics, edition, volume number, place of publication, publisher.
For journal article give title of article, title of journal in italics (according to the *World list of scientific periodicals*. 4th ed. London: Butterworths, 1963), series in parentheses, volume number, part number in parentheses, pagination (first and last pages of article).

Examples (note capitalization and punctuation)

BULLOUGH, W. S. 1960. *Practical invertebrate anatomy*. 2nd ed. London: Macmillan.

FISCHER, P. H. 1948. Données sur la résistance et de la vitalité des mollusques. *Journal de conchyliologie* **88** (3): 100–140.

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(continued inside back cover)

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ADDITIONS AND REVISIONS TO THE LIST OF SPECIMENS OF THE EXTINCT BLUE ANTELOPE (*HIPPOTRAGUS LEUCOPHAEUS*)

By

L. C. ROOKMAAKER

Cape Town Kaapstad

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(With 6 figures)

[*MS accepted 29 April 1991*]

ABSTRACT

Very little material of the extinct blue antelope (*Hippotragus leucophaeus*) is known to exist. Until now, four mounted skins, two pairs of horns and one skull have been documented and their history is summarized. Three further specimens are now added: a hitherto unknown pair of horns discovered in Cape Town; a skull in the Zoological Museum of Amsterdam; and a now unavailable skin brought to Holland in 1805 by J. A. Uytenhage de Mist. This specimen was donated to the museum of the Hollandsche Maatschappij der Wetenschappen in Haarlem; it is supposedly the second blue antelope skin once present in this collection.

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INTRODUCTION

The blue antelope, *Hippotragus leucophaeus* (Pallas, 1766), became extinct as early as the year 1800. The only evidence regarding its existence consists of a few short descriptions written in the seventeenth and eighteenth centuries, four mounted specimens in museums, as well as some horns and skulls, and three drawings. The available information was comprehensively treated by Mohr (1967) in her classic monograph on the species. Some additional material was reported by Klein (1974, 1987).

The blue antelope was a close relative of both the sable, *Hippotragus niger* (Harris, 1838) and the roan, *Hippotragus equinus* (Desmarest, 1804). It has been stated that the species was mentioned for the first time in 1719 in the book on the Cape of Good Hope by Peter Kolb. Earlier, however, its name appeared in a list of South African animals by Johann Schreyer (1681): 'Auch lauffen auff den hohen Bergen von vielerley Arten der wilden Böcke, und Ziegen, als Gems-Böcke, *blaue Böcke*, bundte Böcke, Rehe-Böcke, Klippsteiger, Steinböcke, wilde Böcke' [italics added]. The blue antelope, with its assumed shoulder height of 1–1,2 m, was some-

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what smaller than the sable and the roan; its teeth too were smaller and the horn cores more compressed on the sides. It had a faint blue to grey colour, whitish underparts, a brown forehead and top of the muzzle, and a lighter coloured patch in front of the eyes. The blue antelope was a grazer that lived in groups of up to 20 animals. In historic times, it was recorded only from a small region in the south-western Cape Province, roughly between Caledon and Swellendam. Rookmaaker (1989) gave details of the three known drawings of the blue antelope made during the eighteenth century, i.e. one by Robert Jacob Gordon presently in the Rijksmuseum, Amsterdam, and two almost identical drawings connected with the work of François Levaillant preserved in the Library of Parliament, Cape Town, and in the Library of the University of Leiden (Fig. 1).

LIST OF KNOWN SPECIMENS OF THE BLUE ANTELOPE

Mohr (1967) gave a reliable and detailed list of the known specimens of the blue antelope. She enumerated four mounted skins, two pairs of horns, and four skulls. The history of these specimens will be summarized here, with the addition of a few historical points discovered since 1967. In this paper, I give some additional remarks about three specimens: a pair of horns recently discovered in the South African Museum in Cape Town; a skull found in the Zoological Museum of Amsterdam; and a missing mounted skin in the (former) Museum of the Dutch Society of Sciences in Haarlem.

The identification of the skulls has been debated. Mohr's list (1967: 44) included two skulls in the Zoological Museum in Berlin, but she concluded that these were incorrectly referred to *Hippotragus leucophaeus*. Another skull in her list had been reported in the museum of the Royal College of Surgeons in London, but it was destroyed in an air attack in 1941. Although it had been attributed to the blue antelope by Renshaw (1921), Mohr showed that this skull also more probably belonged to a roan. The identity of the fourth skull is still inconclusive (see no. 7 below).

Mohr (1967: 43) mentioned uncertain evidence concerning a pair of horns in the Albany Museum in Grahamstown. This refers to a note in that museum's annual report for 1901, where director S. Schönland (1902: 3) stated that he 'came across a pair of horns, which I take to be identical with a pair of horns identified in one of our old catalogues as belonging to the Blaauwbok (*Hippotragus leucophaeus*).' It was suggested that this specimen was destroyed in a fire in the early 1940s, an opinion that is confirmed by W. H. Holleman, deputy director of the Albany Museum (in litt. 18 March 1991); he informed me that the only pair of horns in that museum which could fit the description was recently identified as belonging to *Hippotragus equinus*.

We can thus confine our list to the four mounted specimens, the horns and one skull.

1. The Zoological Museum in Stockholm has a mounted skin of a young male. Its provenance is not known, except that it was in the private collection of Adolf Ulrich Grill (1752–1797) before its accession in the museum in 1829.
2. The Zoological Museum in Vienna preserves the mounted skin of an adult female. Nothing is known about the history of the specimen. It was first recorded in Vienna by Kohl (1886: 84).

Fig. 1. The blue antelope in a collection made by François Levaillant around 1780, preserved in the library of the University of Leiden (UBL 13 in Rookmaaker 1989).

3. The Rijksmuseum van Natuurlijke Historie in Leiden has the mounted skin of an adult male, now the lectotype of *Hippotragus leucophaeus* (Pallas, 1766). The specimen was discovered by J. C. Klöckner in a shop in Amsterdam before 1776. Klöckner mounted it and then gave (or sold) it to Jacob Cornelis Sylvius van Lennep (1746–1776). On Van Lennep's death, his entire collection, including the blue antelope skin, was bequeathed to the Hollandsche Maatschappij der Wetenschappen

(Dutch Society of Sciences) in Haarlem, Holland. It was listed in the Society's catalogue of 1803 (Van Marum 1803: x). In 1842, the Society moved its collection from one building to another and decided to sell a number of its mammals and exotic birds. As detailed by Husson & Holthuis (1969: 150–151), these specimens were auctioned on 15 April 1842 by A. Engesmet in Haarlem, including 'a very large and clean specimen of *Antilope Strepsicheros* (the kudu), a similar one of *Antilope leucophas* (the blaauwbok)', etc. (No other antelopes are mentioned.) This blue antelope was bought by H. Schlegel for the museum in Leiden.

4. The Muséum National d'Histoire Naturelle in Paris has the mounted skin of an adult male. Mohr (1967: 37–40) suggested that this skin was transferred in 1795 from the collection of Willem V in The Hague, Holland. She recognized a certain similarity between the mounted skin and the animal shown on a drawing made in South Africa by Robert Jacob Gordon (1743–1795). Mohr did not know that Gordon had sent a blue antelope specimen to Holland. J. N. S. Allamand (1778) wrote about the 'tzeiran' (the blue antelope) without any indication that he had received one from South Africa. However, in the next volume of this Holland edition of Buffon's *Histoire Naturelle*, Allamand (1781: 38) added a footnote to the article about the bontebok with information concerning the 'pasan' [= *Oryx gazella*] and the 'tzeiran': 'M. Gordon m'a envoié les peaux de l'un & de l'autre, qu'il a tués au Cap de Bonne Esperance'. This short passage corroborates Mohr's suggestion that the Paris blue antelope came from Holland, and it is likely that it was forwarded from the Cape of Good Hope by R. J. Gordon (Rookmaaker 1989: 301).

5. The Zoological Museum in Uppsala has a pair of horns that are the only remainder of a complete mounted skin. Although C. P. Thunberg did not carry it from the Cape of Good Hope, he received one in 1781 through the assistance of D. F. Immelman (Rookmaaker 1989: 161, 300). The skin was present in 1846, but it seems probable that it was destroyed later in the nineteenth century.

6. The Natural History Museum in London has a pair of horns of unknown provenance. It has been suggested that these horns might have been bought by Thomas Pennant in Amsterdam before 1781 (*cf.* Mohr 1967: 43). I would also like to record here that there is the following item in the catalogue of the auction of Bullock's Museum in London, 10th day's sale, Friday, May 14, 1819: '89 Blue Antelope, *A. Leucophaea*.' William Bullock (*fl.* 1795–1840) was the owner of a large Museum of Natural Curiosities, started in Sheffield around 1795, moved to Liverpool in 1801, to London in 1809, and exhibited from 1812 onwards in the Egyptian Temple on Piccadilly (Sweet 1970). The entire collection was auctioned between 29 April and 11 June 1819. The sale was attended by representatives from the major British and continental museums, such as Walter Adam from Edinburgh, Coenraad Jacob Temminck from Leiden, and Heinrich Lichtenstein from Berlin. There is an annotated copy of the sales catalogue in the Natural History Museum, London, which shows that the blue antelope mentioned above was bought by Dr Leach for £1–1–0. William Elford Leach (1790–1836) bought animals for the British Museum, where he was in charge of the zoological collections from 1813 to 1822. It is debatable whether the animal sold was in fact a blue antelope if one considers its rather low price and the fact that people like Lichtenstein apparently showed no interest in what they would have known to be a rare exhibit. It is possible that the specimen was in a poor state.

7. The Hunterian Museum in Glasgow preserves a complete skull with horns attached. It is not known how the specimen came to Glasgow. Klein (1974: 110) suggested that it was, in fact, a skull of a sable antelope, *Hippotragus niger*.

ADDITIONS TO THE LIST OF SPECIMENS

HORNS IN CAPE TOWN

Ozinsky (1989) reported that a pair of horns was donated to the South African Museum in Cape Town. It came from the family collection of Mr J. Piek of Observatory in Cape Town, but the earlier history is not known. It is likely that the horns belonged to the blue antelope. The horns are registered as catalogue number SAM–ZM40759 (Fig. 2). The distance from tip to tip has been measured as 150 mm, and the front length over the curvature of the right hand side is 611 mm (D. Drinkrow, Collection Manager, South African Museum, in litt. November 1990).

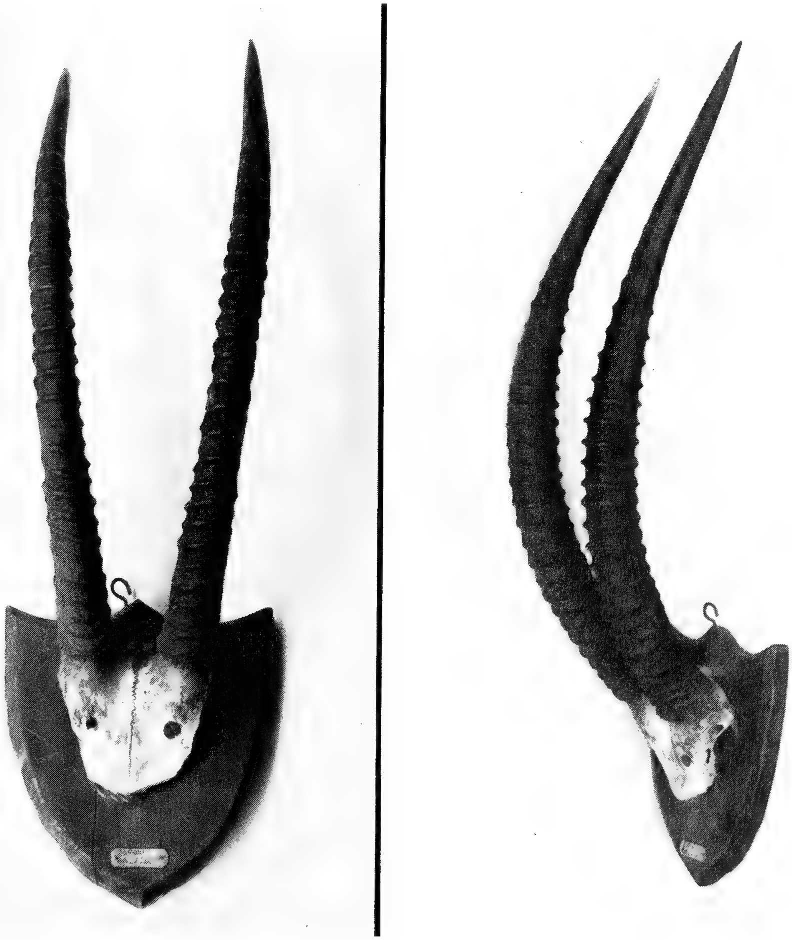

Fig. 2. Two views of the horns recently acquired by the South African Museum, Cape Town (SAM–ZM40759). Length 611 mm.

A SKULL IN AMSTERDAM

During a recent review of the collections of the Zoological Museum of Amsterdam, Holland, Dr P. J. H. van Bree, Curator of Mammals, found a hippotragine skull with attached horns without data (ZMA 18.623). The specimen was examined in detail by Erdbrink (1988: 144–146, pls 10–12) and cautiously identified as '*Hippotragus* cf. *leucophaeus* (Pallas, 1766); (?) ♂, ad.' (Figs 3–6). The caution is necessary, because there are no other recent skulls of the blue antelope with which it could be compared. The right horn is 505 mm long over the curvature and has 31 rings, the left horn measures 495 mm and has 29–30 rings. The skull's width over the orbit is 154 mm, the left lower premolar row is 44 mm, the left lower molar row 72 mm (see Erdbrink 1988 for these and other measurements).

It is rather disconcerting that there is no information about the provenance of this specimen. One possibility is that the skull was among other unidentified specimens from the Haarlem Cabinet in 1866 (see below), and that the skin has since been discarded, leaving the skull, which has remained unattended ever since. If, in fact, the specimen does belong to the blue antelope, which seems likely, it would be difficult to establish an alternative source.

EVIDENCE OF A SKIN ONCE IN HAARLEM

On 23 July 1805, Martinus van Marum (1750–1836), supervisor of the collections of the Hollandsche Maatschappij der Wetenschappen in Haarlem, wrote a letter to

Fig. 3. Blue antelope skull in the Zoological Museum in Amsterdam, Holland (ZMA 18.623): right lateral aspect.

J. A. de Mist acknowledging receipt of a small collection of Cape specimens: ‘I was pleasantly surprised to-day by some items of natural history, consisting of six bottles of snakes in spirit, a box with planks of African woods and the skin, together with the horns, of the Blue Buck, which your Honour sent to me for the Natural History Cabinet of our Society’ (translated by Lefebvre & De Bruyn 1976: 239).

Jacob Abraham Uytenhage de Mist (1749–1823) was one of three secretaries of the Dutch town Kampen from 1766, and was elected a member of the National Convention in 1796. In 1802, he was sent as Commissioner General to the Cape of Good Hope. He stayed three years in the southern part of Africa. From 9 October to the end of November 1803 he travelled northwards from the Cape into the interior, accompanied by a large group of people. Among them was Martin Heinrich Carl Lichtenstein (1780–1853), from 1813 director of the Zoological Museum in Berlin, who published an account of his stay in South Africa in 1811–1812. Lichtenstein kept the journal of De Mist’s expedition, which included only a few zoological details and nothing about the blue antelope (as summarized by Molsbergen 1922: 167–189).

Fig. 4. Blue antelope skull in the Zoological Museum in Amsterdam, Holland (ZMA 18.623): frontal aspect. Width over the orbit 154 mm.

When De Mist returned to Holland, he took with him a small collection of natural history specimens and some ethnographical material. Van Marum (1812) gave a report on these specimens, the preparation of which was delayed because he had hoped to receive their descriptions from Lichtenstein. De Mist's gift consisted of 333 species of insects (put in order by Lichtenstein in South Africa), and besides it included: 'De Huiden van een Leeuw, van een Tyger, en van een Blaauwe Bok (*Antilope Leucophaea*), alsmede de Horens van verscheidene soorten van Antilopen en van een Rhinoceros' (Van Marum 1812: 166). [Translated: The skins of a lion, a leopard, and a blue antelope (*Antilope Leucophaea*), as well as the horns of several species of antelopes and those of a rhinoceros.]

One wonders how much Lichtenstein knew about the specimen brought home by De Mist. Considering his understanding of the blue antelope's extinction in South Africa and his personal acquaintance with De Mist, it is almost impossible that he would not have heard about it, and may even have examined it. In his travel book, Lichtenstein (1811: 265) said that 'Im Jahre 1800 war noch einer geschossen, dessen Fell jetzt in Leyden aufbewahrt wird; seitdem aber hat man keine mehr gesehen.' In a paper about antelopes written just a few years later, Lichtenstein (1814: 160) clearly described a skin of the blue antelope that he had examined personally: 'Das Fell, nach welchem ich beschreibe, war leider das letzte das gesehen worden ist. Man hat seit 1799, wo dieses Thier geschossen ward, keine wieder eingetroffen.' He did not say where he saw the animal. However, it is very tempting to assume that Lichtenstein was talking about De Mist's specimen of the blue antelope. Why did Lichtenstein write, in 1811, that the animal was 'now in Leiden'? He returned to Europe in June 1806 and he may have heard that De Mist took his specimen to Holland. Still, Leiden does not fit the facts, because the collection was given to Haarlem in 1805 and De Mist is not known to have lived in Leiden. Maybe further research can clarify these statements.

Considering the above references, I suggest the following history for De Mist's blue antelope. The specimen probably was killed just before 1800, since which time it

Fig. 5. Blue antelope skull in the Zoological Museum in Amsterdam, Holland (ZMA 18.623): ventral aspect with upper tooth row.

was kept in a private collection or in a shop of natural history specimens; it was given to De Mist or he may have bought it. He took the skin to Holland arriving on 8 July 1805, after which he donated it to the society in Haarlem. From 1812 onwards, the history of the skin becomes obscure.

We need to consider the possibility that the animal was a roan (*Hippotragus equinus*) rather than a blue antelope. In the absence of any evidence, it is useless to speculate. However, since it is likely that Lichtenstein's description was drawn up after De Mist's specimen, it is almost certain that it was in fact a blue antelope and not a roan. If this conclusion is correct, it appears that the Dutch Society of Sciences in Haarlem possessed two mounted skins of this rare species from 1805 onwards, i.e. specimen number 3 mentioned in the list of known specimens (see p. 133) and the one brought by De Mist. Tuijn (1971) mentioned both animals in passing, without giving further details. As stated above, the Haarlem society auctioned one blue antelope in April 1842 and that one passed to the Rijksmuseum van Natuurlijke Historie in Leiden.

It is, of course, important to establish which specimen of the blue antelope was bought by the Leiden Museum: the one bequeathed by Van Lennep or the one received in 1805. It is probable that Mohr (1967: 35) gave the correct clue when she said that the specimen still in the Leiden Museum 'hat mit dem ursprünglichen Bild bei Buffon [= Allamand] 1778—und *nur* mit diesem—derart viele Ähnlichkeiten, daß sie sich gegenseitig beeinflußt haben mussen.' This can be safely followed and justifies the conclusion of Husson & Holthuis (1969) that the Leiden blue antelope was one of the syntypes of *Antilope leucophaea* Pallas, 1766.

Surprisingly, the second Haarlem blue antelope, the one donated by De Mist, has disappeared from the records. In fact, there is not a single clue as to what happened to

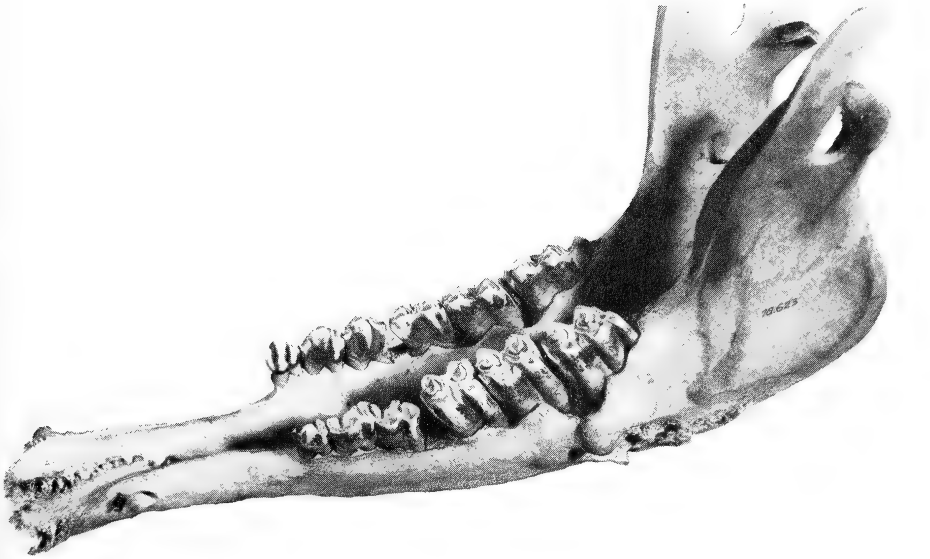

Fig. 6. Blue antelope skull in the Zoological Museum in Amsterdam, Holland (ZMA 18.623): mandible. Left premolar row 44 mm, molar row 72 mm.

this skin with horns; a skeleton or skull were never mentioned. One reason for this must be that interest in the Cabinet of the Society in Haarlem dwindled after the death of Van Marum. The history of the Society and the Cabinet, written by Bierens de Haan (1941, 1952), shows that Van Marum's successors, J. G. S. van Breda (secretary 1838–1864) and E. H. von Baumhauer (secretary 1864–1885) did not care properly for the zoological specimens of the museum. In 1866, a committee of investigation reported that a large part of the collection had lost its value due to age and lack of maintenance. Obviously, nobody was interested in keeping records about the collection. In November 1866, the largest part of the Haarlem Cabinet was transferred to the Museum of the Zoological Gardens in Amsterdam; much was bought by the Amsterdam Zoo but some of the more valuable specimens were only given on loan, like the Duchassaing & Michelotti collection of sponges (Wiedenmayer 1977: 252). An inventory was made at that time, but it only included 'all sorts of lower animals' (Smit 1986: 108) and birds or mammals were not mentioned during the transactions (Bierens de Haan 1952: 266). It is unlikely that a complete stuffed blue antelope was included.

ACKNOWLEDGEMENTS

I am grateful to Dr P. J. H. van Bree for sharing the information of his discovery of the blue antelope skull in the Zoological Museum of Amsterdam and for general encouragement. Dr D. P. Bosscha Erdbrink kindly helped by supplying photographs of the skull in Amsterdam. An earlier version of this paper was read by Dr C. Smeenk, Dr L. B. Holthuis, Dr R. G. Klein and Mr R. Rau and I am thankful for their comments. Mr W. H. Holleman provided information about the horns in the Albany Museum.

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6. SYSTEMATIC papers must conform to the *International code of zoological nomenclature* (particularly Articles 22 and 51).

Names of new taxa, combinations, synonyms, etc., when used for the first time, must be followed by the appropriate Latin (not English) abbreviation, e.g. gen. nov., sp. nov., comb. nov., syn. nov., etc.

An author's name when cited must follow the name of the taxon without intervening punctuation and not be abbreviated; if the year is added, a comma must separate author's name and year. The author's name (and date, if cited) must be placed in parentheses if a species or subspecies is transferred from its original genus. The name of a subsequent user of a scientific name must be separated from the scientific name by a colon.

Synonymy arrangement should be according to chronology of names, i.e. all published scientific names by which the species previously has been designated are listed in chronological order, with all references to that name following in chronological order, e.g.:

Family **Nuculanidae**

Nuculana (Lembulus) bicuspidata (Gould, 1845)

Figs 14–15A

Nucula (Leda) bicuspidata Gould, 1845: 37.
Leda plicifera A. Adams, 1856: 50.
Laeda bicuspidata Hanley, 1859: 118, pl. 228 (fig. 73). Sowerby, 1871: pl. 2 (fig. 8a–b).
Nucula largillierti Philippi, 1861: 87.
Leda bicuspidata: Nicklès, 1950: 163, fig. 301; 1955: 110. Barnard, 1964: 234, figs 8–9.

Note punctuation in the above example:
comma separates author's name and year
semicolon separates more than one reference by the same author
full stop separates references by different authors
figures of plates are enclosed in parentheses to distinguish them from text-figures
dash, not comma, separates consecutive numbers.

Synonymy arrangement according to chronology of bibliographic references, whereby the year is placed in front of each entry, and the synonym repeated in full for each entry, is not acceptable.

In describing new species, one specimen must be designated as the holotype; other specimens mentioned in the original description are to be designated paratypes; additional material not regarded as paratypes should be listed separately. The complete data (registration number, depository, description of specimen, locality, collector, date) of the holotype and paratypes must be recorded, e.g.:

Holotype

SAM–A13535 in the South African Museum, Cape Town. Adult female from mid-tide region, King's Beach, Port Elizabeth (33°51'S 25°39'E), collected by A. Smith, 15 January 1973.

Note standard form of writing South African Museum registration numbers and date.

7. SPECIAL HOUSE RULES

Capital initial letters

(a) The Figures, Maps and Tables of the paper when referred to in the text
e.g. '. . . the Figure depicting *C. namacolus* . . .': '. . . in *C. namacolus* (Fig. 10) . . .'
(b) The prefixes of prefixed surnames in all languages, when used in the text, if not preceded by initials or full names
e.g. Du Toit but A. L. du Toit; Von Huene but F. von Huene
(c) Scientific names, but not their vernacular derivatives
e.g.Therocephalia, but therocephalian

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Specific name must not stand alone, but be preceded by the generic name or its abbreviation to initial capital letter, provided the same generic name is used consecutively. The generic name should not be abbreviated at the beginning of a sentence or paragraph.

Name of new genus or species is not to be included in the title; it should be included in the abstract, counter to Recommendation 23 of the Code, to meet the requirements of Biological Abstracts.

L. C. ROOKMAAKER

ADDITIONS AND REVISIONS TO THE LIST OF SPECIMENS OF THE EXTINCT BLUE ANTELOPE (*HIPPOTRAGUS LEUCOPHAEUS*)

VOLUME 102 PART 4 NOVEMBER 1992 ISSN 0303-2515

ANNALS
OF THE SOUTH AFRICAN MUSEUM

CAPE TOWN

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(b) *Abstract* of not more than 200 words, intelligible to the reader without reference to the text
(c) *Table of contents* giving hierarchy of headings and subheadings
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Major headings of the paper are centred capitals; first subheadings are shouldered small capitals; second subheadings are shouldered italics; third subheadings are indented, shouldered italics. Further subdivisions should be avoided, as also enumeration (never roman numerals) of headings and abbreviations.

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Bullough, W. S. 1960. *Practical invertebrate anatomy*. 2nd ed. London: Macmillan.
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Fischer, P. H., Duval, M. & Raffy, A. 1933. Études sur les échanges respiratoires des littorines. *Archives de zoologie expérimentale et générale* **74** (33): 627–634.
Kohn, A. J. 1960*a*. Ecological notes on *Conus* (Mollusca: Gastropoda) in the Trincomalee region of Ceylon. *Annals and Magazine of Natural History* (13) **2** (17): 309–320.
Kohn, A. J. 1960*b*. Spawning behaviour, egg masses and larval development in *Conus* from the Indian Ocean. *Bulletin of the Bingham Oceanographic Collection, Yale University* **17** (4): 1–51.
Thiele, J. 1910. Mollusca. B. Polyplacophora, Gastropoda marina, Bivalvia. *In:* Schultze, L. *Zoologische und anthropologische Ergebnisse einer Forschungsreise im westlichen und zentralen Süd-Afrika ausgeführt in den Jahren 1903–1905* **4** (15). *Denkschriften der medizinisch-naturwissenschaftlichen Gesellschaft zu Jena* **16**: 269–270.

(continued inside back cover)

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TWO NEW SPECIES OF OIL-COLLECTING BEES OF THE GENUS *REDIVIVA* FROM THE SUMMER RAINFALL REGION OF SOUTH AFRICA (HYMENOPTERA, APOIDEA, MELITTIDAE)

By

V. B. WHITEHEAD
&
K. E. STEINER

Cape Town Kaapstad

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TWO NEW SPECIES OF OIL-COLLECTING BEES OF THE GENUS *REDIVIVA* FROM THE SUMMER RAINFALL REGION OF SOUTH AFRICA (HYMENOPTERA, APOIDEA, MELITTIDAE)

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(With 9 figures and 4 tables)

[*MS accepted 25 May 1992*]

ABSTRACT

Two species of oil-collecting bees of the genus *Rediviva* are described from the summer rainfall region of southern Africa. *Rediviva pallidula* is a high-altitude bee that closely resembles *R. neliana* Cockerell, but is distinguished by its paler pubescence on the leg extremities and metasomal terga and by differences in the shape of sternum seven and genital capsule among males. Females collect oil from six *Diascia* species (Scrophulariaceae) and two species of terrestrial orchids. *Rediviva saetigera* is the only oil-collecting bee in the summer rainfall area with short tarsomeres 2, 3 and 4 on the front legs of the female, and with modified hairs for collecting oil on the front basitarsus and tibia only. There are also distinctive long pollen-collecting hairs on the frons of females. The oil hosts of *R. saetigera* are two species of shrubby trees, *Bowkeria cymosa* MacOwan and *Anastrabe integerrima* E. Meyer ex Benth. (Scrophulariaceae), the former occurring on the eastern Transvaal escarpment and the mountains of Swaziland and the latter in coastal forests from East London to northern Natal and Moçambique.

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INTRODUCTION

We have been investigating the relationships between oil-collecting bees of the genus *Rediviva* and their oil and nectar host plants in southern Africa (Whitehead *et*

Ann. S. Afr. Mus. **102** (4), 1992: 143–164, 9 figs, 4 tables.

al. 1984; Whitehead & Steiner 1985; Steiner & Whitehead 1988, 1990, 1991). *Rediviva* bees can be conveniently grouped according to their occurrence in the summer and autumn rainfall regions of the eastern Cape and eastern Transvaal, and the winter rainfall areas of the western Cape. Bees from these two regions do not overlap either temporally or geographically.

In the winter rainfall region there are four described species—*R. peringueyi* (Friese), *R. intermixta* (Cockerell), *R. longimanus* Michener, and *R. emdeorum* Vogel & Michener (Michener 1981; Vogel & Michener 1985), and 10 undescribed species (Whitehead & Steiner in prep). The summer rainfall group is also made up of four described species, *R. neliana* Cockerell, *R. politissima* (Cockerell), *R. rufocincta* (Cockerell) and *R. colorata* Michener (Michener 1981). *Rediviva neliana* and *R. politissima* do not differ in male genitalia nor on non-meristic characters, except colour of pubescence. At present, these two species are considered to constitute part of a single highly variable species, which may, with more detailed study, result in the recognition of one or more additional species. Two other *Rediviva* species that are readily distinguishable are described below. Although detailed morphological studies have only recently started, it would appear from data available at present that the species from these two areas form a monophyletic group. A phylogenetic analysis of the group will be included with the revision of the genus.

METHODS

Measurements were made with a calibrated eye-piece graticule, using a dissecting microscope. Forelegs were removed and mounted on card and each segment measured separately (Steiner & Whitehead 1990, 1991). Wing length is the distance from the outer edge of the tegula to the wing tip. Body length was measured from the anterior ocellus to the tip of the abdomen and, although there was some variability due to the position of the abdomen, this measurement was found to be a good estimate of body size (Steiner & Whitehead 1990). Male genitalia and the associated sterna were extracted with a bent needle after the bee had been relaxed. The genital capsule with associated sterna were macerated in cold 10 per cent KOH overnight, rinsed with water, acidified with acetic acid, rinsed again and then stored in glycerine. All dissected parts were placed in microvials attached to the relevant insect. Mouthparts were removed after treating the whole head as outlined above. Both mouthparts and genitalia were drawn in glycerine using a drawing tube attached to a dissecting microscope. When drawing the mouth-parts, pressure had to be applied to the coverslip to flatten some of the structures.

The terms used for the various structures are those of Michener (1981) and for the description of surface sculpture those of Eady (1968). For leg orientation we have used the terminology of Roberts & Brooks (1987), whereby the leg is considered to be a cylindrical lateral projection at right angles to the long axis of the body. The symbols S and T with the appropriate numeral are used to indicate the sterna and terga of the metasoma; S1, for example, refers to the first sternum of the metasoma.

DESCRIPTIONS

Rediviva pallidula sp. nov.

Figs 1–5

Rediviva politissima Manning & Brothers, 1986: 108–111 (*part.*—Sani Flats specimens only).

Diagnosis

Integument black, females with brown pubescence on dorsal areas of mesosoma, on rest of the body pubescence white to pale straw-coloured. Male pubescence similar but paler. Malar space relatively long, one-quarter to one-fifth as long as wide. In areas of overlap with *R. neliana*, *R. pallidula* females can be distinguished by the presence of white pubescence on the discs of metasomal terga two, three and four; in *R. neliana* females, the pubescence on the disc of metasomal tergum four is always black. The hairs on the leg extremities of *R. pallidula* are white to pale yellow in contrast to the dark brown to black hairs of *R. neliana*. Males of the two species can be separated by the shape of sternum seven as well as differences in the genital capsule.

Type locality

Natal, Sani Pass, 2 490 m, 2929CB, collected on flowers of *Diascia integerrima* Benth. (Scrophulariaceae).

Etymology

Pallidus, Latin for somewhat paler, referring to the paler colour of the pubescence in contrast to that of *R. neliana* with which it may be confused.

Material examined

Type material. Holotype: SAM–HYMB0001, female, Natal, Sani Pass, 2 490 m, 2929CB, V. B. Whitehead, 16 Feb. 1986. *Allotype*: SAM–HYMB0002, male, Lesotho, Sani Top, 2 740 m, 2929CB, V. B. Whitehead, 15 Feb. 1986. *Paratypes* (46 ♀♀, 25 ♂♂)—*Cape Province*: 1 ♀, Lady Grey, Joubert's Pass, 2 140 m, 3027CB, K. E. Steiner, 13 Jan. 1985; 1 ♀, Lady Grey, Joubert's Pass, 3027CB, K. E. Steiner, 8 Jan. 1986; 1 ♀, Lady Grey, Joubert's Pass summit, 3027CB, V. B. Whitehead, 8 Jan. 1984; 3 ♀♀, 1 ♂, Ben Macdhui, 3027DB, K. E. Steiner, 12 Jan. 1984; 1 ♀, Naudesnek, 3028CA, 2 240 m, K. E. Steiner, 28 Jan. 1986; 1 ♀, Naudesnek, 3028CA, 2 370 m, K. E. Steiner, 29 Jan. 1986; 1 ♀, Naudesnek, 2 170 m, 3028CA, K. E. Steiner, 31 Jan. 1986; 1 ♂, Naudesnek, 2 280 m, 3028CA, K. E. Steiner, 19 Jan. 1989; 1 ♂, Naudesnek, 2 300 m, 3028CA, K. E. Steiner, 19 Jan. 1989; 1 ♀, 1 ♂, Naudesnek, 3028CA, V. B. Whitehead, 11 Jan. 1985; 1 ♀, 1 ♂, Naudesnek, 3028CA, V. B. Whitehead, 12 Jan. 1985; 1 ♀, Naudesnek, 2 370 m, 3028CA, V. B. Whitehead, 28 Jan. 1986; 1 ♀, Naudesnek, 3028CA, V. B. Whitehead, 19 Jan. 1989; 1 ♀, 2 ♂♂, Naudesnek, 2 480 m, 3028CA, V. B. Whitehead, 19 Jan. 1989; *Lesotho*: 1 ♂, Blue Mountain Pass, 2928AC, V. B. Whitehead, 7 Jan. 1985; 1 ♀, 1 ♂, Blue Mountain Pass, 2928AC, V. B. Whitehead, 24 Jan. 1985; 1 ♀, 4 ♂♂, Blue Mountain Pass, 2928AC, V. B. Whitehead, 25 Jan. 1985; 1 ♀, Lebelonyane Pass, 3028AA, K. E. Steiner, 14 Jan. 1985; 1 ♀, Lebelonyane Pass, 2 400 m, 3028AA, K. E. Steiner, 27 Feb. 1990; 1 ♀, 1 ♂, Lebelonyane Pass, 3028AA, V. B. Whitehead, 14 Jan. 1985;

1 ♀, Lebelonyane Pass, 3028AA, V. B. Whitehead, 27 Feb. 1990; 4 ♀♀, 1 ♂, Mapholaneng, 2828BB, K. E. Steiner, 13 Feb. 1986; 1 ♂, Mapholaneng, 2828BB, V. B. Whitehead, 13 Feb. 1986; 1 ♀, Oxbow, 2828DC, K. E. Steiner, 23 Jan 1985; 2 ♀♀, Oxbow, 2828DC, V. B. Whitehead, 23 Jan. 1985; 1 ♂, Sani Pass, 2 720 m, 2929CB, K. E. Steiner, 14 Feb. 1986; 4 ♀♀, Sani Pass, 2 720 m, 2929CB, K. E. Steiner, 15 Feb. 1986; 1 ♀, Sani Pass, 2 720 m, 2929CB, V. B. Whitehead, 14 Feb. 1986; 1 ♂, Sani Pass, 2 750 m, 2929CB, V. B. Whitehead, 14 Feb. 1986; 1 ♂, Sani Pass, 2 720 m, 2929CB, V. B. Whitehead, 15 Feb. 1986; *Natal*: 4 ♂♂, Sani Pass, 2 080 m, 2929CB, K. E. Steiner, 21 Jan. 1985; 1 ♀, Sani Pass, 2 250 m, 2929CB, K. E. Steiner, 16 Feb. 1986; 1 ♀, Sani Pass, 2 290 m, 2929CB, K. E. Steiner, 16 Feb. 1986; 1 ♀, Sani Pass, 2 440 m, 2929CB, V. B. Whitehead, 15 Feb. 1986; 1 ♀, 2 ♂♂, Sani Pass, 2 350 m, 2929CB, V. B. Whitehead, 16 Feb. 1986; 2 ♀♀, Sani Pass, 2 490 m, V. B. Whitehead, 16 Feb. 1986.

Other material (112 ♀♀, 9 ♂♂)—*Cape Province*: 4 ♀♀, Carlisle's Hoek, 3027DD; 35 ♀♀, Naudesnek, 3028CA; *Lesotho*: 6 ♀♀, 1 ♂, Blue Mountain Pass, 2928AC; 1 ♀, Lebelonyane Pass, 3028AA; 1 ♂, Makapung Dip, 2929AC; 5 ♀♀, Mapholaneng, 2828BB; 4♀♀, 2♂♂, Moteng Pass, 2828DA; 21 ♀♀ Sani Pass, 2929CB; *Natal*: 36 ♀♀, Sani Pass, 2929CD.

Description

Female

Measurement and ratios. Holotype: body 11,7 mm, forewing 10,7 mm. Other material: means given in Table 1 for 15 specimens selected at random from six different localities where possible, otherwise all specimens at particular locality used.

Integumental colour. Black, except apical one-fourth of mandibles and flagellar segments 3–10 brown; wings lightly tinted with brown; stigma and costa light brown, other veins dark brown to black; apical margins of metasomal terga T2 to T4 light brown, apical margins of sterna S1 to S4 light brown becoming translucent.

Structure. Head wider than long, 3,8:2,9 mm (type); means of head measurements from sample of the paratypes from various collection localities presented in

TABLE 1

Mean lengths (±SD) of forelegs, body, foreleg/body ratios and forewings of females (n = 67) and males (n = 27) of *R. pallidula* from all localities.

	Females		Males	
	Length (mm)	Range (mm)	Length (mm)	Range (mm)
Foreleg	12,2±0,49	10,3–13,3	08,9±0,25	08,8–09,3
Body	10,8±0,26	09,8–12,5	09,9±0,34	09,9–10,1
Foreleg/body	01,1±0,03	00,9–01,3	00,9±0,03	00,8–01,0
Forewing	08,8±0,15	08,2–09,3	08,2±0,24	07,9–08,5

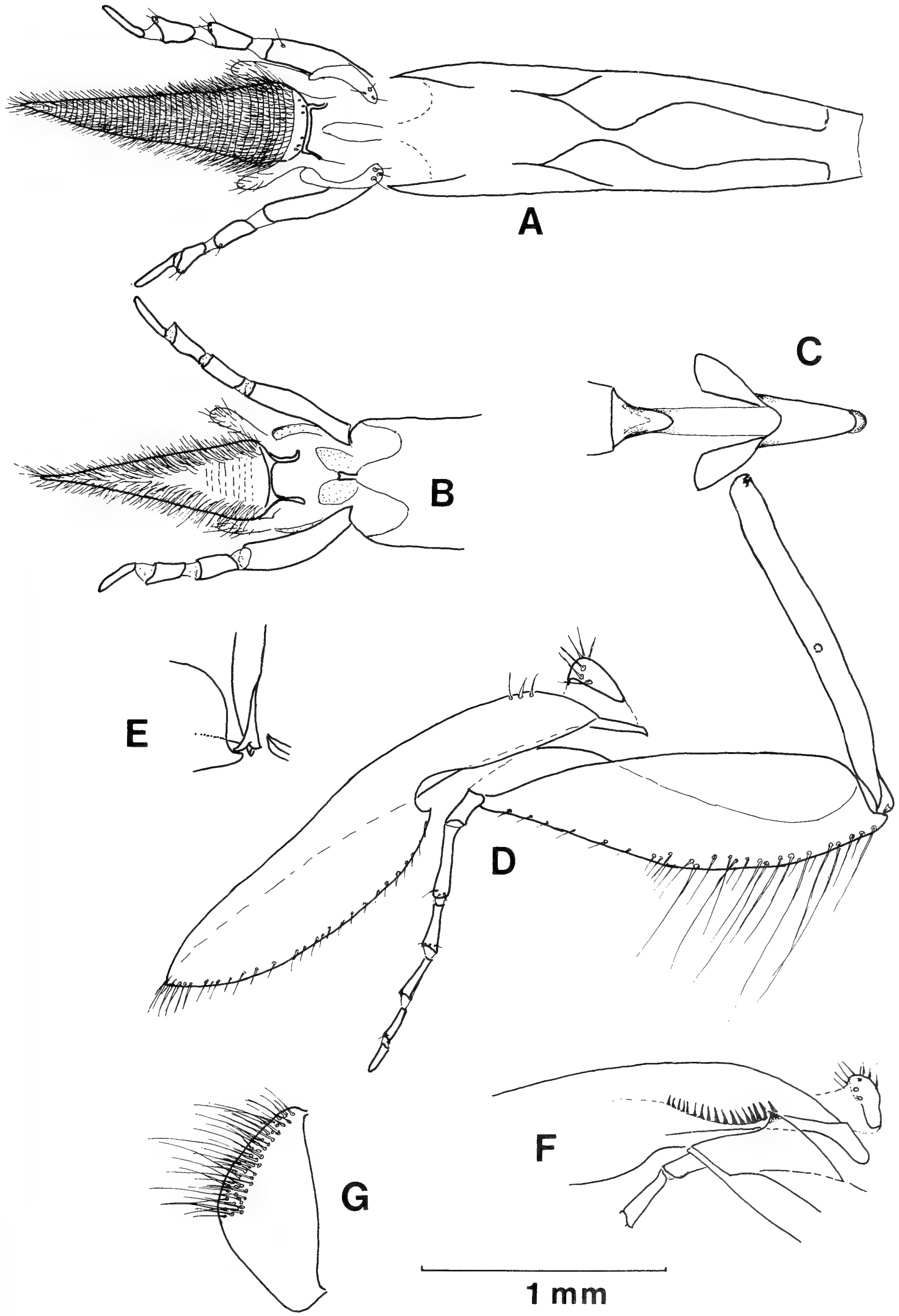


Fig. 1. *Rediviva pallidula* sp. nov. Female, mouth-parts. A. Labium, anterior view. B. Distal part of labium, posterior view. C. Fragmentum of prementum, mentum and lorum, anterior view. D. Maxilla, outer view. E. Basistipital process of maxilla. F. Inner view of maxilla to show galeal comb. G. Labrum.

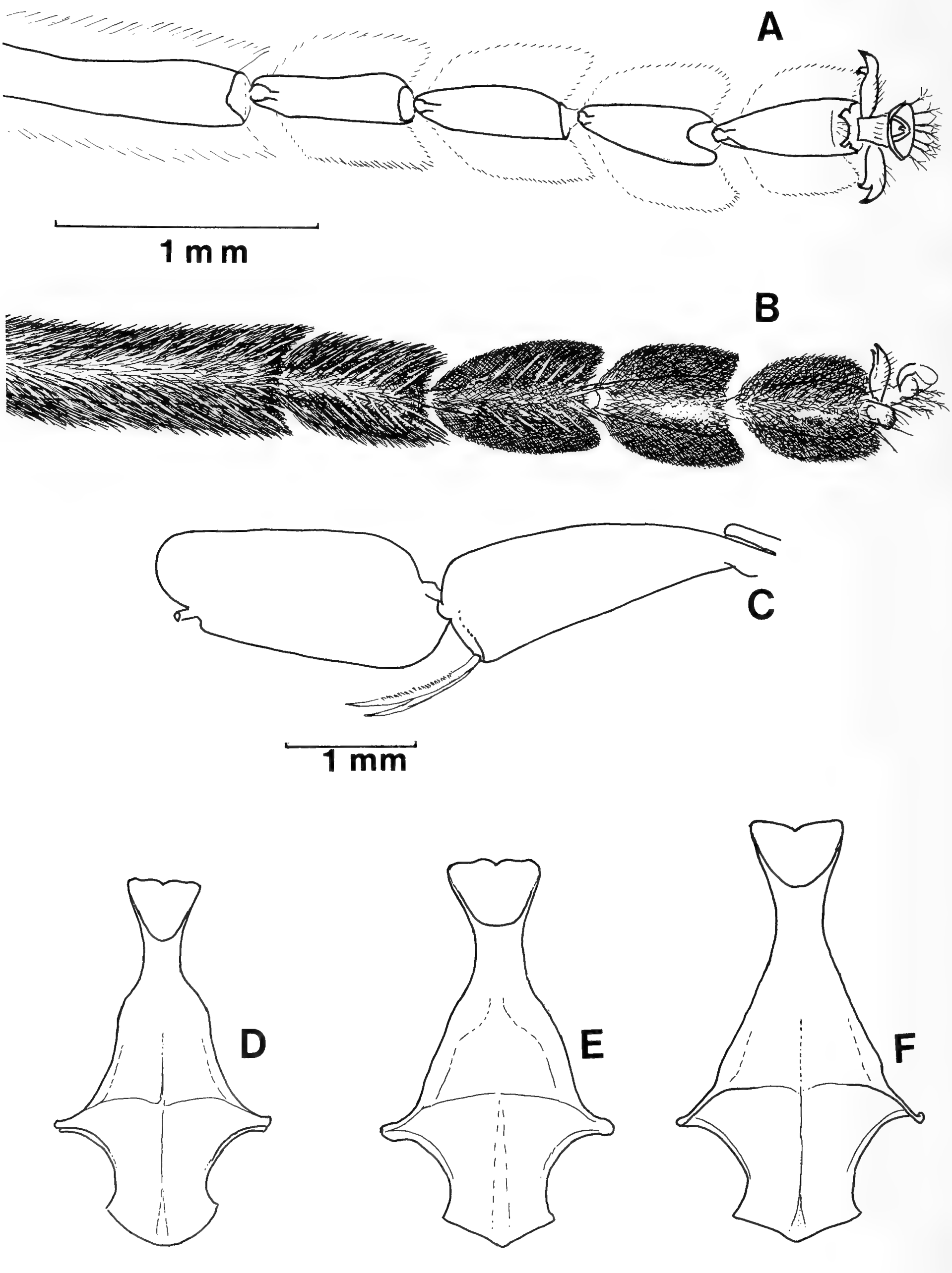


Fig. 2. *Rediviva pallidula* sp. nov. A. Ventral and B. Dorsal views of oil-collecting segments of female fore tarsus. C. Hind tibia and basitarsus of female (hairs removed). D–F. Dorsal view of S8 of males to show variation. D. S8 of male from Naudesnek. E. S8 of male from Sani Pass. F. S8 of male from Blue Mountain Pass.

Table 2; inner orbits converging above, distance between eyes greater than length of eyes, 2,5:2,3 mm (holotype), with mean of 2,5:2,2 mm (n = 33) for paratypes (Table 2); inner distance between lateral ocelli slightly greater than ocellocular distance (0,6 mm); malar space one-quarter to one-fifth as long as wide (holotype L:W = 0,24); mean L:W for populations from all the collection areas in Table 2. Mouth-parts: glossa triangular, one-half as long as prementum, extending beyond labial palps; paraglossae extending one-quarter length of glossa; labial palps nearly reaching tip of glossa, basal segment one-third length of palp, terminal segment slender, well sclerotized (Fig. 1A–B); ligular arms occupying basal two-thirds of prementum (Fig. 1A); premental fragmentum, mentum and lorum as in Figure 1C; subligular process and basiglossal sclerite (Fig. 1B); cardo slightly shorter than stipes, stipes 3,5 times as long as wide, lateral margin with scattered hairs, extremely long posteriorly (Fig. 1D); basistipital process short (Fig. 1E); maxillary palp not extending beyond tip of galea, six-segmented, segments longer than wide; galea with broadly pointed apex, short hairs along apical and lateral margins (Fig. 1D), galeal comb distinct with 17 teeth (Fig. 1F); mandibles curved, strong preapical and apical tooth (Fig. 4B); labrum triangular, twice as wide as long, with dense long hairs on margin (Fig. 1G). Antennae with first flagellar segment about three-quarters length of scape and longer than segments 2 plus 3, segments 4 to 9 subequal and almost as long as broad, segment 10 twice as long as broad terminating in a shiny, oblique, slightly convex surface. Front legs long, varying from 10,3 mm to 13,3 mm, depending on collection locality (Table 1), tarsus making up about one-third of the leg length; tarsomeres 2–4 with dense, finely branched hairs on dorsal and lateral surfaces, spatulate hairs on sides of segment 2 but only at apex of segments 3 and 4 and isolated on segment 5; four terminal segments constitute oil-collecting apparatus in this species; basitarsus bearing stout unbranched hairs (Fig. 2A–B). Hind legs with tibia nearly as wide as basitarsus; basitarsus roughly ovoid, distal dorsal angle rounded, spurs pale brown, finely dentate (Fig. 2C); wings (Fig. 4A) with second submarginal cell slightly broader than long (1:0,8), receiving first recurrent vein beyond middle (20:11), third submarginal one-and-a-half times as broad as long, receiving second recurrent vein beyond middle (27:20), basal vein nearly three times as long as first abscissa of RS, meeting Cu at junction of Cu–V; jugal lobe of hind wing less than half length of vanal lobe (12:32); hamuli 11–12. Propodeal triangle small, nearly parallel-sided at apical

TABLE 2

Mean measurements (±SD) of head width (HW), head length (HL), interocular distance (IOD), eye length (EL) and the length/width ratio of the malar space (MS–L/W) of *R. pallidula* females (n = 33) and males (n = 21) from all localities.

	HW (mm)	HL (mm)	IOD (mm)	EL (mm)	MS–L/W
Females	3,7±0,04	3.0±0,04	2,5±0.07	2.2±0,03	0,2±0,01
Range	3,4–3,7	2,9–3,0	2,4–2,6	2,2–2,3	
Males	3,5±0,01	2,8±0,11	2,2±0,12	2,0±0,89	0,2±0,02
Range	3,4–3,6	2,7–3,0	2,1–2,4	2,0–2,1	

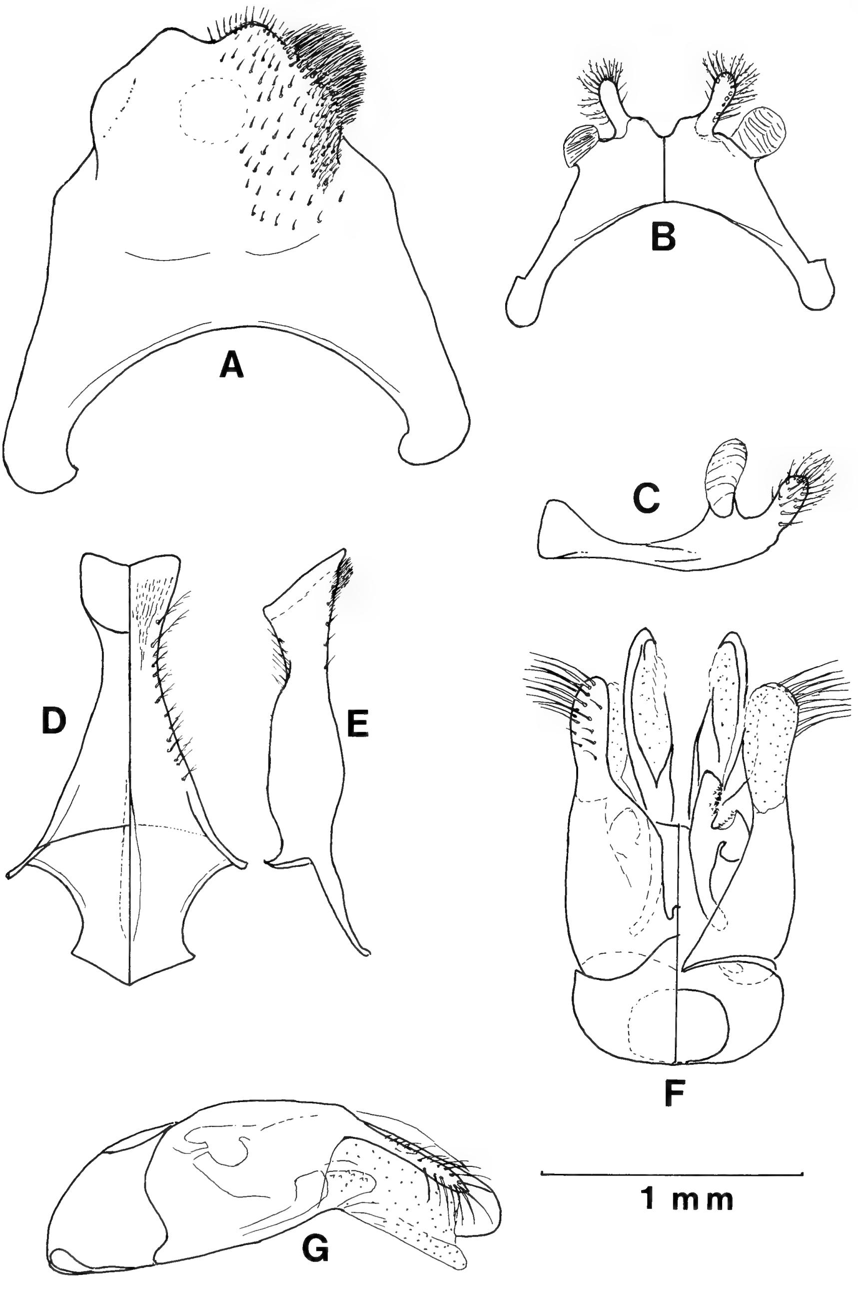


Fig. 3. *Rediviva pallidula* sp. nov. Male genitalia and terminal sterna. A. S6, ventral view. B. S7, dorsal (left) and ventral (right) view. C. S7, side view. D. Dorsal and ventral view of S8. E. S8, side view. F. Genital capsule, dorsal view (left) and ventral view (right). G. Genital capsule, side view.

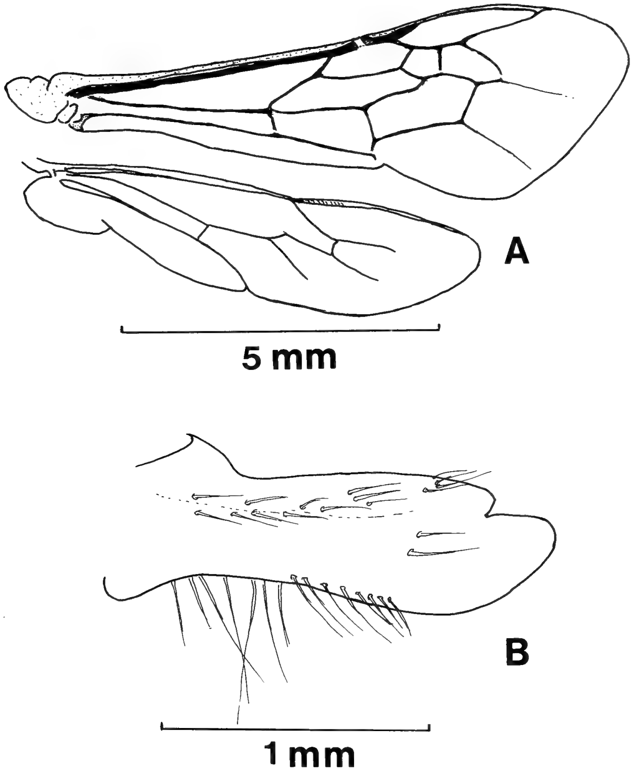


Fig. 4. *Rediviva pallidula* sp. nov. Female. A. Right wings. B. Right mandible, outer view.

two-thirds, broadening slightly at base, shiny and finely rugose; rest of propodeal surface shiny but coarsely rugose. Apical margins of metasomal S2 to S4 concave, as is gradulus of S2. Pygideal plate dull, faintly rugose with some coarse punctures basally.

Sculpture. Head: clypeus with basal area coarsely punctate, surface between punctures shiny, punctures becoming finer and less dense towards apex, apical margin practically impunctate and finely reticulate; frons coarsely punctate either side of frontal ridge, becoming more finely punctate in para-ocular areas and towards anterior ocellus, area between ocelli and preoccipital ridge coarsely punctate; small triangular area between lateral ocelli and preoccipital ridge shiny and impunctate or with scattered fine punctures. Mesosoma: scutum finely punctate on disc, punctures coarser lateral to parapsidal line; median line distinct, extending one-third length of segment; scutellum finely punctured, coarser posteriorly and laterally; metanotum finely punctured; propodeum finely rugose, triangle shiny and faintly strigose. Metasoma: T1 shiny with fine scattered punctures on apical margin; T2, T3 and T4 shiny with denser fine punctures, T5 with coarse punctures, surface between punctures finely rugose; S2 to S5 finely punctured, areas between punctures finely reticulate, apical margins impunctate.

Vestiture. Head: brush of pale yellow hairs at centre of ridge on anterior margin of clypeus, rest of clypeus covered with strong white hairs, long unbranched pale yellow hairs on median area with a few scattered black hairs; supraclypeal and para-ocular areas with white, finely branched hairs, scattered black hairs on para-ocular areas; scattered dark hairs on vertex; genal area with long white plumose hairs. Meso-

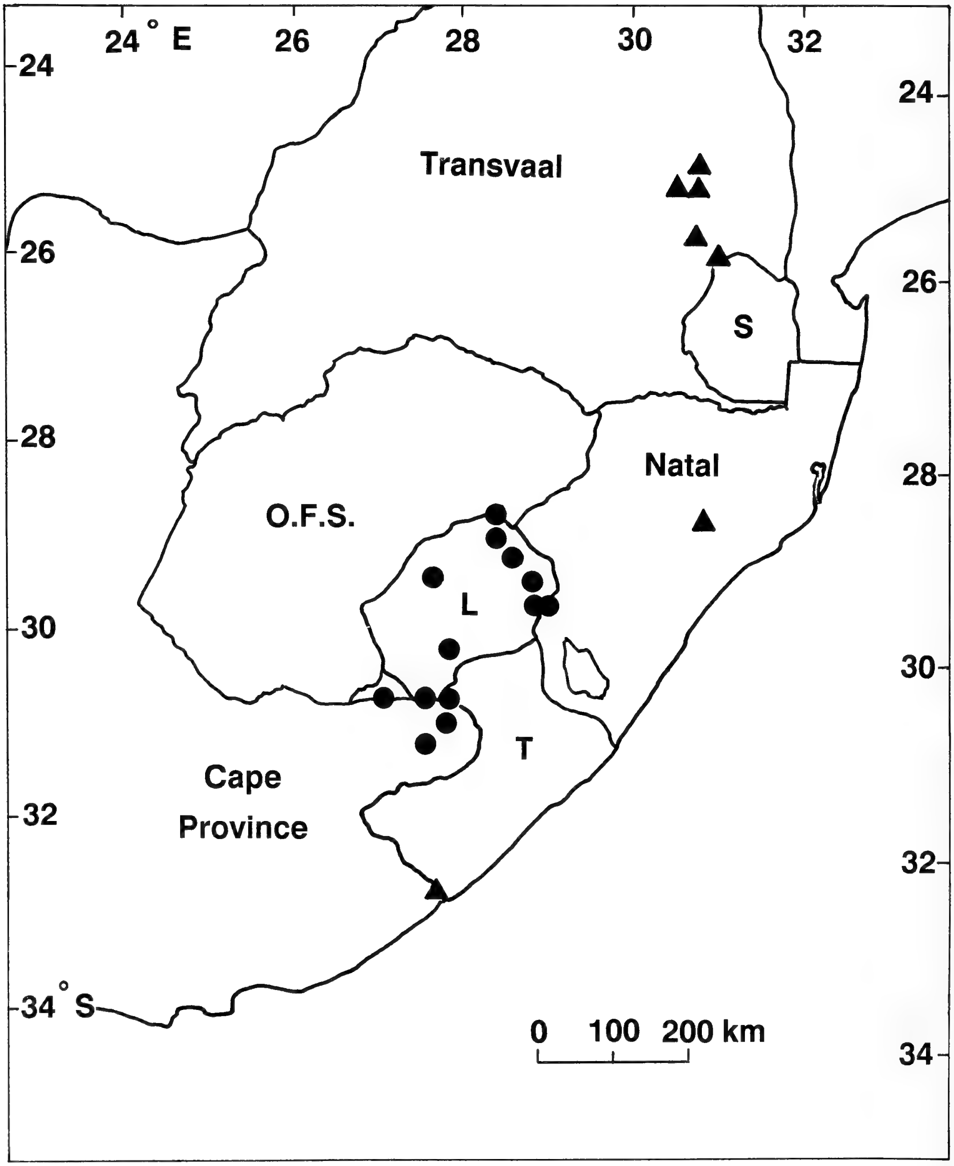


Fig. 5. Known distribution of *R. pallidula* (●) and *R. saetigera* (▲). L = Lesotho, O.F.S. = Orange Free State, S = Swaziland, T = Transkei.

soma: margins of scutum, scutellum and metanotum densely covered with light brown hair, interspersed with some dark hairs; hair shorter and more scattered on disc of scutum and scutellum; finer and more branched on propodeum except triangle which is bare; episternum and sternum covered in dense white hair; hairs on tibiae and tarsae light brown, tarsal segments 2–5 of front legs with finely branched oil-collecting hairs on dorsal and lateral areas, bare underneath; hairs on anterior area of middle legs paler with a dark patch at apex of tibia; anterior face of hind tibia and basitarsus with a finely branched mat of pale hairs through which strong pale unbranched hairs protrude; posterior face with strong unbranched pale brown hairs only; penicillum of light brown hair on distal margin of basitarsus. Metasoma: white apical hair bands on S1 to S4, fimbrium on T4 black dorsally, white laterally; white decumbent hairs basally on T2, T3 and T4, with some scattered black hairs in this area on T4; subapical band of long erect hairs on S2 to S5.

Male

Measurement and ratios. Allotype male, body 9,8 mm, forewing 8,7 mm. Means for various localities are given in Table 1.

Integumental colour. Black, except tip of mandibles, under-side of antennae, posterior surface of hind tibia, leg extremities, lateral area of T1, tegulae, costal vein, and bases of other veins piceous to dark brown.

Structure. Head: wider than long, 3,4:2,6 mm; distance between eyes 2,1 mm, eye length 1,9 mm (allotype). Means for males in Table 2. Ocellocular distance equal to distance between lateral ocelli; malar space one-quarter to one-fifth as long as wide, mean L:W = 0,2 mm; first flagellar segment more than two-thirds length of scape (27:39), slightly shorter than length of flagellar segments 2 plus 3 (27:31), segment 2 shorter than 3, segments 3–10 subequal, segment 11 slightly longer, terminating in convex, shiny oblique area. Mesosoma: forelegs not obviously lengthened, equal to or shorter than body, FL:B = 0,8–1,0 (n = 27) (Table 1); hind tibia nearly twice as wide as basitarsus (45:24); tibial spurs pale, finely serrated, basitibial plate covered with fine white hairs; prominent dorsal spur at distal end of fore tibia. Wing venation as in female, jugal lobe more than one-third length of vanal lobe (29:80). Metasoma: S2 to S5 with apical margins straight or shallowly concave at middle; S6 with disc concave, shiny, covered with short white hairs, lateral lobes with dense tufts of white hairs, apical margin emarginate, with short white hairs (Fig. 3A); short apical lobes of S7 with long hairs on apical and lateral margins; lateral lobes striated, translucent, ovate, projecting upwards (Fig. 3B–C); S8 with margin of sloping tip variable (Figs 2D–F, 3D–E). Genitalia (Fig. 3F–G): gonostyli slightly shorter than penis valves, narrow with large translucent membranous area below, apical setae straight, projecting at right angles; volsellae large with distinct teeth on opposing surfaces of digitis and cuspis, opening posterolaterally.

Sculpture. As in female on head and mesosoma, punctures coarser on sterna and terga of metasoma.

Vestiture. Head: labrum with white to straw-coloured hairs on anterior margin; longer unbranched hairs on outer and inner margins of mandibles; tufts of branched hairs on anterior ridge of clypeus, dense long white hairs on rest of clypeus, paraocular areas, frons and genal area; shorter sparser dark hairs on vertex, scattered dark hairs along inner eye margins. Mesosoma: scutum covered with finely branched straw-coloured hairs, shorter on disc with scattered black hairs; scutellum and metanotum with long straw-coloured branched hairs; episternal areas and three basal segments of legs covered in long white branched hairs; hairs on under-side of tibia and tarsus of forelegs light brown. Metasoma: dense apical white hair bands on T1 to T6, fimbrium on T7 light brown; erect shorter and sparser white hairs basally on disc of T2 to T5, some black hairs mixed with white on disc of T3 to T5, becoming progressively denser towards apex of metasoma; sparser preapical hair bands on S1 and S3 to S6, S7 with tufts of pale brown hairs on lateral lobes; long white hairs on under-side of S8 projecting beyond the spatulate tip.

Variations

There is some variation in intensity of coloration of the brown hairs on the scutum, scutellum and metanotum in both sexes. The greatest variation is, however, in the length of the forelegs of females from the various localities and is correlated with the spur lengths of the oil-secreting *Diascia* species at a particular locality (Steiner & Whitehead 1991).

Host flower records

Nectar is not produced by oil-secreting host plants, so bees must obtain it from other plants. Both males and females take nectar from the same source, and males also patrol nectar plants in search of receptive females. Although it is the females that mainly visit the oil-producing flowers, males have occasionally been collected patrolling them, presumably in search of females. *Rediviva pallidula* females collect oil from six species of *Diascia* (Scrophulariaceae), which include *D. anastrepta* Hilliard & Burtt, *D. barberae* Hook f., *D. cordata* N. E. Brown, *D. fecaniensis* Hilliard & Burtt, *D. integerrima* Benth., and *D. stricta* Hilliard & Burtt. They also collect oil from the terrestrial orchids *Pterygodium cooperi* Rolfe and a species of *Corycium*. Nectar plants are *Lobelia preslii* A. DC., *Wahlenbergia cuspidata* v. Brehm (Campanulaceae), *Phacocapnos pruinosis* (E. Mey.) Bernh. (Fumariaceae), *Geranium multisectum* N. E. Brown (Geraniaceae), and *Stachys sessilis* Guerke (Lamiaceae).

Distribution (Fig. 5)

Rediviva pallidula is a high-altitude bee occurring from 1 830 m to 2 720 m. In the north-eastern Cape, it has been collected on Joubert's Pass at Lady Grey, and at Carlisle's Hoek, Naudesnek and Ben Macdhui in the Rhodes district and at Bottlenek Pass, Barkly East. In Natal, the species has been found just below the escarpment at Garden Castle State Forest and at the top of Sani Pass. It is widely distributed in Lesotho from Lebelonyane Pass in the south, east to the top of Sani Pass, north to Oxbow and Moteng Pass, and west to Blue Mountain Pass. Manning & Brothers (1986) reported *R. politissima* (= *R. neliana*) visiting several *Diascia* species on Sani Pass, including *D. barberae* on the Sani Flats in Lesotho. We have examined this material and found that they had a mixed sample, the specimens from Sani Flats being the new species, *R. pallidula*. At lower altitudes, 1 800 m to 2 400 m, this species is sympatric with *R. neliana* and shares the same oil and nectar plants.

Rediviva saetigera sp. nov.

Figs 5–9

Diagnosis

Integument black with light to dark brown pubescence, except on episternum and sternum where pubescence is white to cream. Female with long straight unbranched dark hairs with bent or curled tips on clypeus, frons and vertex, parted on a line with bases of antennae. Hairs on dorsal areas of front and middle tibiae and tarsae dark brown to black. Front legs short with no elongation of tarsomeres 2 to 4, long dense oil-collecting hairs on basitarsus and distal area of tibia. Glossa short, circular. This is the only *Rediviva* known in the summer rainfall area with short front tarsomeres and with oil-collecting hairs on the front basitarsus and tibia only.

Type locality

Transvaal, road to Lydenburg, 11,6 km south-west of Sabie, 2530BB, collected on flowers of *Bowkeria cymosa* (Scrophulariaceae).

Etymology

Saetiger, Latin for 'bearing bristles', which refers to the pollen-collecting hairs on the clypeus, frons and vertex of females.

Material examined

Type material. Holotype: SAM–HYMB0003, female, 11,6 km south-west of Sabie, 2530BB, V. B. Whitehead, 30 Jan. 1988. *Allotype*: SAM–HYMB0004, male, Graskop, God's Window, 2430DD, V. B. Whitehead, 2 Mar. 1990. *Paratypes* (46 ♀♀, 13 ♂♂)—*Cape Province*: 1 ♀, Ocean View Farm, East London, 3228CA, K. E. Steiner, 19 Jan. 1986; *Natal, Kwazulu*: 1 ♀, 52,6 km north-west of Eshowe, 2831CA, V. B. Whitehead, 13 Jan. 1989; 2 ♀♀, Nkandla Forest, 56,9 km north-west of Eshowe, 2831CA, V. B. Whitehead, 13 Jan. 1989; 1 ♀, Nkandla Forest, 66,8 km north-west of Eshowe, 2831CA, V. B. Whitehead, 14 Jan. 1989; 1 ♀, road to Nkandla, km 38, 2831CA, K. E. Steiner, 13 Jan. 1989; 3 ♀♀, Road to Nkandla, km 38, 2831CA, K. E. Steiner, 14 Jan. 1989; 2 ♀♀, road to Nkandla, km 38, 2831CA, K. E. Steiner, 1989; *Transvaal*: 2 ♀♀, Barberton, 25,5 km east of Road 38 on road to Havelock, 2531CB, V. B. Whitehead, 4 Mar. 1990; 1 ♀, Barberton, 9,3 km east off Road 38 on road to Havelock, 2531CB, K. E. Steiner, 4 Mar. 1990; 1 ♀, Barberton, 19,3 km, east off Road 38 on road to Havelock, 1 270 m, 2531CD, V. B. Whitehead, 4 Mar. 1990; 1 ♀, Barberton, 31,8 km east off Road 38 on road to Havelock, 2531CB, K. E. Steiner, 4 Mar. 1990; 5 ♀♀, Graskop, God's Window, 1 710 m, 2430DD, V. B. Whitehead, 2 Mar. 1990; 1 ♂, Kaapsehoop, Berlin State Forest, 2530DA, V. B. Whitehead, 31 Jan. 1988; 2 ♀♀, Long Tom Pass, 1 690 m, V. B. Whitehead, 14 Feb. 1987; 1 ♀, Long Tom Pass, 1 590 m, V. B. Whitehead, 16 Feb. 1987; 1 ♂, Pilgrim's Rest, Vaalhoek Road, 1 280 m, 2530DD, V. B. Whitehead, 2 Mar. 1990; 4 ♀♀, 0,5 km west of turn off to Pilgrim's Rest on Sabie Road, 2530DD, K. E. Steiner, 4 Mar. 1986; 7 ♀♀, 10,7 km west of Sabie, 1 350 m, 2530BA, K. E. Steiner, 3 Mar. 1986; 4 ♀♀, 11,6 km west of Sabie, 1 350 m, 2530BA, K. E. Steiner, 5 Mar. 1986; 4 ♀♀, 11,6 km west of Sabie, 1 500 m, 2530BA,

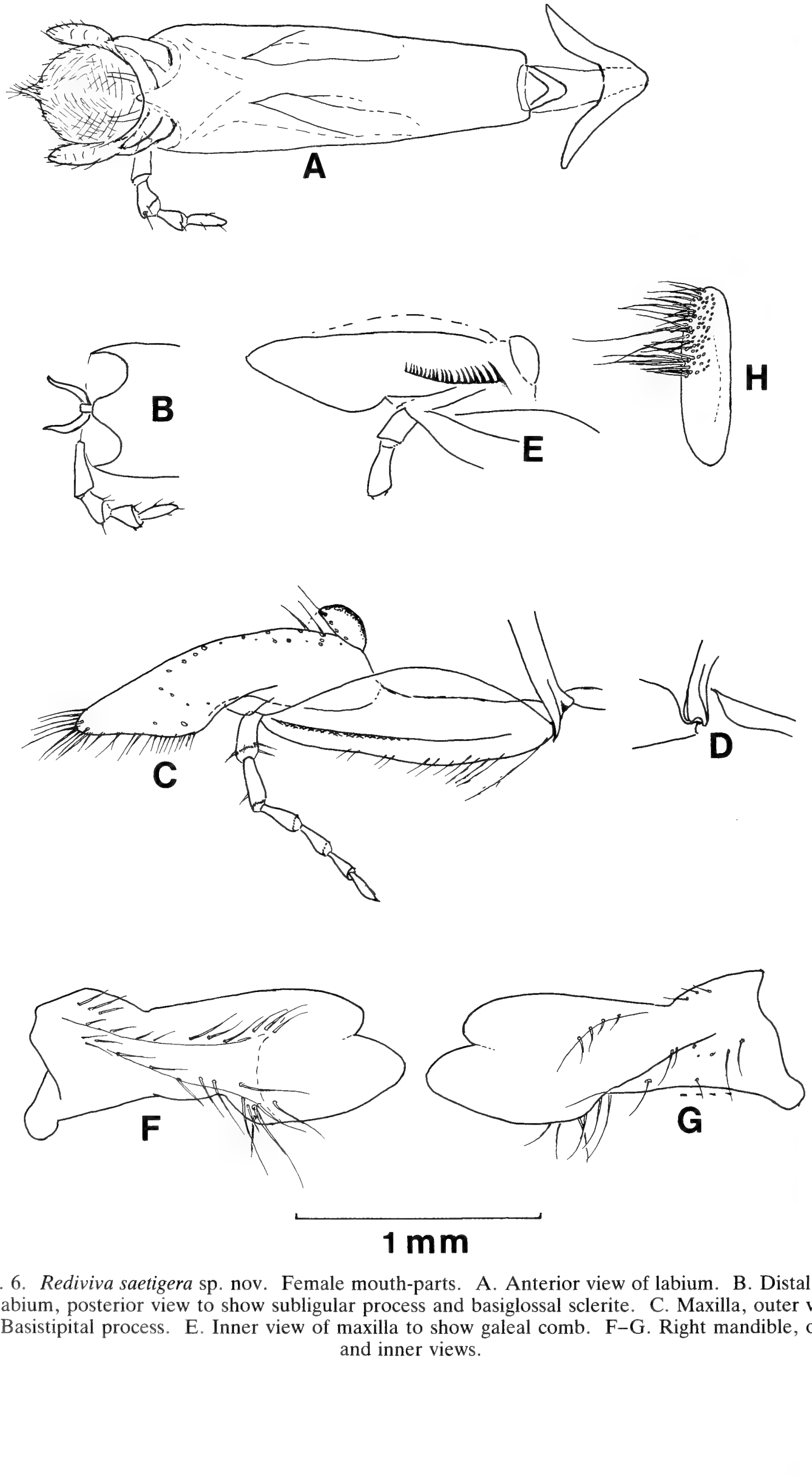


Fig. 6. *Rediviva saetigera* sp. nov. Female mouth-parts. A. Anterior view of labium. B. Distal part of labium, posterior view to show subligular process and basiglossal sclerite. C. Maxilla, outer view. D. Basistipital process. E. Inner view of maxilla to show galeal comb. F–G. Right mandible, outer and inner views.

K. E. Steiner, 30 Jan. 1988; 1 ♀, 11,7 km west of Sabie, 1 500 m, 2530BA, K. E. Steiner, 15 Feb. 1987.

Other material. (68 ♀♀)—*Natal, Kwazulu*: 21 ♀♀, Nkandla, 2831CA; *Transvaal*: 5 ♀♀, Barberton, 2531CD; 7 ♀♀, Graskop, 2430DD; 2 ♀♀, Kaapsehoop, 2530DA; 5 ♀♀, Pilgrim's Rest, 2430DD; 28 ♀♀, Sabie, 2530BA.

Description

Female

Measurement and ratios. Holotype, body 10,0 mm, forewing 9,5 mm; other material in Table 3.

Integumental colour. Black, mouth-parts, scape and first flagellar segment black with dark brown extremities, rest of flagellum dark brown, lighter on under-side; front tarsae, middle and hind tibiae dark brown; tegulae light brown; wings lightly tinted with brown, stigma and veins brown except R and M+Cu which are black.

Structure. Head wider than long, holotype 3,6:3,25 mm, other material 3,6 : 3,0 mm (n = 20) (Table 4); inner orbits of eyes converging above and below, interocular distance greater than length, holotype 3,3:2,9 mm; interior distance between the lateral ocelli greater than ocellocular distance; malar space narrow, length one-eighth of width (holotype), other material in Table 4; mouth-parts

TABLE 3

Mean lengths (±SD) of forelegs, body, foreleg/body ratios and forewings of females (n = 25) and males (n = 8) of *R. saetigera* from the eastern Transvaal and Nkandla, Natal.

Eastern Transvaal

	Females		Males	
	Length (mm)	Range (mm)	Length (mm)	Range (mm)
Foreleg	08,3±0,17	07,9–08,6	07,8±0,28	07,5–08,5
Body	10,9±0.70	09,7–12,5	09,0±0,35	08,5–09,7
Foreleg/body	0,76±0,04	0,66–0,81	0,87±0,28	0,80–0,90
Forewing	09,1±0,22	08,8–09,5	08,8±0,19	08,5–09,0

Nkandla

	Females	
	Length (mm)	Range (mm)
Foreleg	08,2±0,12	08,0–08,4
Body	10,3±0,37	10,0–11,2
Foreleg/body	0,80±0,04	0,73–0,85
Forewing	08,9±0,26	08,3–09,2

TABLE 4

Mean measurements (±SD) of head width (HW), head length (HL), interocular distance (IOD), eye length (EL), and the length/width ratio of the malar space (MS–L/W) of *R. saetigera* females (n = 20) and males (n = 8) from all areas.

	HW (mm)	HL (mm)	IOD (mm)	EL (mm)	MS–L/W
Females	3,6±0,08	3,0±0,09	2,5±0,06	2,2±0,07	0,11±0,02
Range	3,4–3,8	2,8–3,1	2,3–2,6	2,1–2,3	0,07–0,20
Males	3,4±0,09	2,7±0,10	2,3±0,07	2,1±0,09	0,12±0,02
Range	3,3–3,6	2,6–2,9	2,2–2,4	2,0–2,3	0,08–0,15

(Fig. 6A), glossa short, circular with short apical projection, paraglossae short not extending beyond glossal extremity; labial palps extending beyond apex of glossa, segments 2 and 3 broader at apex; ligular arms occupying middle third of prementum; premental fragmentum, proximal part of mentum and lorum sclerotized, posterior ligular process and basiglossal sclerite as in Figure 6B; cardo slightly shorter than stipes, stipes 3,5 times as long as wide, posterior margin with scattered long plumose hairs (Fig. 6C); basistipital process short (Fig. 6D); maxillary palps extending beyond galea, first two segments subcylindrical, following three broader distally; galea with rounded apex, with hairs along apical and posterior margins, galeal comb large with 19 teeth (Fig. 6E); mandibles (Fig. 6F–G) strongly curved, stout preapical and apical tooth, cap of rutellum occupying about one-third of mandible; labrum narrow, about 3,5 times as wide as long, rounded laterally with dense long hairs on anterior half, hairs shortening posteriorly (Fig. 6H); antennae with first flagellar segment less than half length of scape (excluding pedicellus), approximately as long as segments 2 plus 3, segments 4–9 subequal and as long as broad, segment 10 one-and-a-half times longer than broad. Front legs short, not attenuate, sum of tarsomeres 2, 3 and 4 less than one-quarter of leg length, similar in shape to tarsomeres of middle and hind legs (Fig. 7A–B); hind legs with basitarsus trapezoidal in outline (Fig. 7C); tibial spurs light brown, finely dentate. Wings (Fig. 8A) with second submarginal cell one-and-a-half times broader than long, receiving first recurrent vein beyond middle (19:10), third submarginal cell more than twice as broad as long, receiving second recurrent vein beyond middle (22:17), basal vein more than twice as long as first abscissa of Rs, joining Cu slightly distal to Cu–V; jugal lobe of hind wings slightly more than half length of vanal lobe (34:62); ten hamuli. Propodeal triangle small, shiny, devoid of hairs, distinguishable from adjacent propodeal surface which is coarsely punctate reticulate, small area at base of triangle finely rugose. Apical margins of S2, S3 and S4 produced to a point in midline giving the margin a biconcave appearance; gradulus on S2 bisinuate (Fig. 7D). Pygideal plate punctate, dull.

Sculpture. Head: clypeus and frons coarsely punctate, area between punctures less than diameter of punctures, surface area between punctures finely reticulate, small area adjacent to lateral ocelli, shiny, impunctate or with isolated punctures, finely reticulate towards occipital ridge. Mesosoma: large shallow punctures on scutum

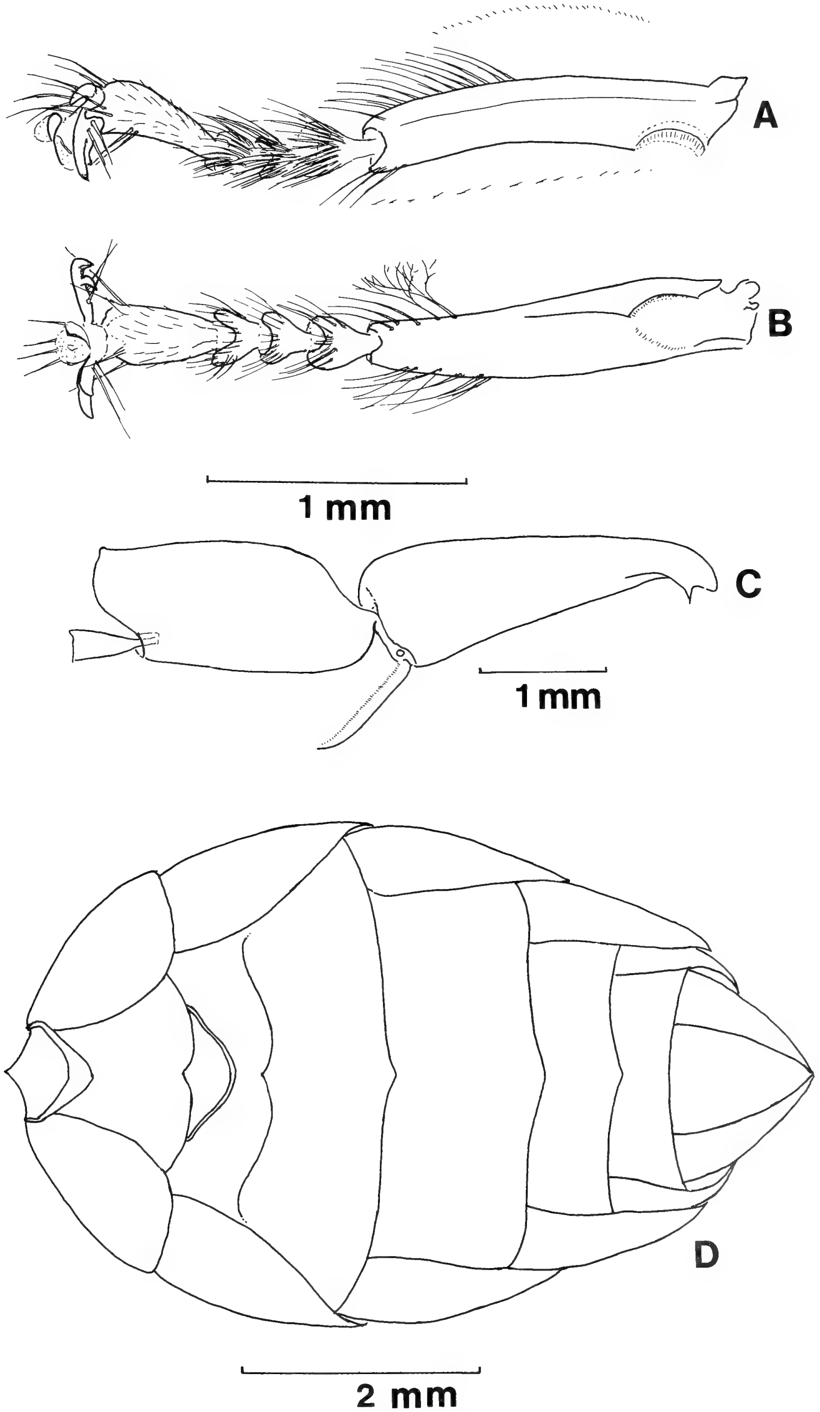
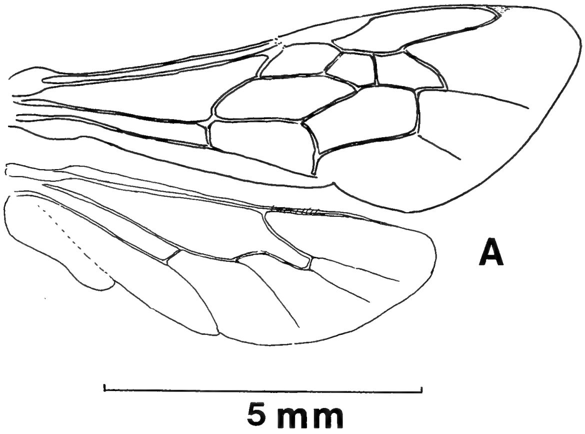


Fig. 7. *Rediviva saetigera* sp. nov. Female. A. Foreleg, lateral view. B. Foreleg, ventral view. C. Hind tibia and basitarsus (hairs removed). D. Ventral view of metasoma.



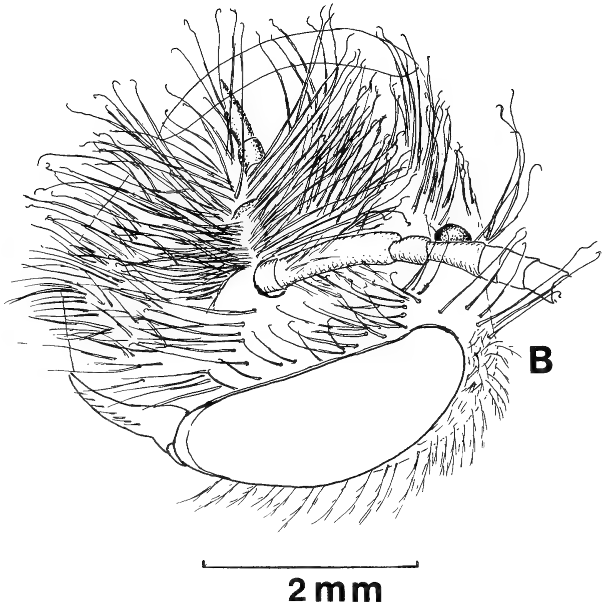


Fig. 8. *Rediviva saetigera* sp. nov. Female. A. Right wings. B. Head, to show long unbranched pollen-collecting hairs.

with whole surface finely granulate; punctures coalescing on scutellum becoming scaly-reticulate; punctures finer on metanotum with areas between punctures shiny; punctures on mesepisternum elongate, tending to coalesce, surface finely granulate. Metasoma: T1 shiny, sparsely punctured, T2 to T4 punctate, areas between punctures finely granulate, apical margins impunctate; S2 to S4 more coarsely punctured, apical margins impunctate, shiny.

Vestiture. Head: long, unbranched stout black hairs between bases of antennae, on supraclypeal area and down to just before anterior clypeal margin, shortening anteriorly, parting at bases of antennae, hairs below antennal bases point forward and above point backward (Fig. 8B), similar hairs on occiput between lateral ocelli and in ocellocular area point forward, ends of hairs taper finely to a sinuate or curved point; finely branched white hairs at base of scape; hairs on mandibles and labrum reddish-brown, on under-side of head long, white and plumose. Mesosoma: margins of scutum and scutellum densely covered in light brown hairs mingled with sparse black hairs, disc of both areas with fine decumbent hairs; metanotum covered with light brown hairs, paler on margins; propodeum (except triangle), episternum and sternum densely covered with finely branched pale brown to white hairs; fore- and middle legs with black hairs on basitarsus, tibia and anterior part of femur, dark brown ventrally, hairs on front legs longer on both tibia and basitarsus, where unmodified hairs have an under-storey of finely branched oil-collecting hairs; hind legs with dark hairs on base of tibia and apex of basitarsus, sparse black and numerous long brown hairs protruding through mat of fine brown hairs on anterior face of tibia and basitarsus, posterior surface covered in stout brown hairs, hairs on distal margin of basitarsus parted to form a penicillum. Metasoma: decumbent light brown hairs on apical two thirds of T2, T3 and T4, basal hairs paler, short on disc, longer laterally, isolated erect black hairs basally on T4; T5 and T6 with long black hairs on apical margins; long pale hairs on apical margins of S2, S3 and S4, black on S5.

Male

Measurement and ratios. Allotype, body 9,0 mm, forewing 8,7 mm; other material in Tables 3–4.

Integumental colour. Black, except extremities of mouth-parts, under-side of antennal flagellum, tarsae, tibial apices, tibial spurs and tegulae, which are brown; stigma and veins brown except R and M+Cu, which are black.

Structure. Head wider than long (3,4 : 2,7 mm); inner orbits as in female, distance between eyes greater than length of eye (2,3 : 2,1), ocellocular distance equal to inner distance between lateral ocelli; malar space short (L : W = 3 : 28); first flagellar segment of antenna short, less than half length of scape, shorter than successive flagellar segments. Forelegs not modified, hind tibia slightly wider than basitarsus (15 : 12), tibial spurs brown, finely serrated, basitibial plate small, twice as long as wide, basal three-quarters covered with hairs. Wings with whole surface papillate, venation, jugal and anal lobes as in female. Propodeal triangle as in female. Apical margins of S3, S4 and S5 pointed in middle giving margin a biconcave outline, concavities deepest on S5; S6 (Fig. 9A) shiny on disc with scattered black hairs, apical and lateral lobes small, lateral lobes with dense black hairs; apical lobes on S7 short with sparse hairs on distal margins, lateral lobes large, crescent-shaped in lateral view, papillate, particularly on lower part (Fig. 9B–C); tip of S8, viewed from above, shiny, oval with a single emargination (Fig. 9D–F). Genitalia (Fig. 9G–H) with gonostyli narrow and keeled below, with large translucent flange on upper surface basally; volsellae distinct with teeth on opposing surfaces, opening lateroventrally.

Sculpture. As in female.

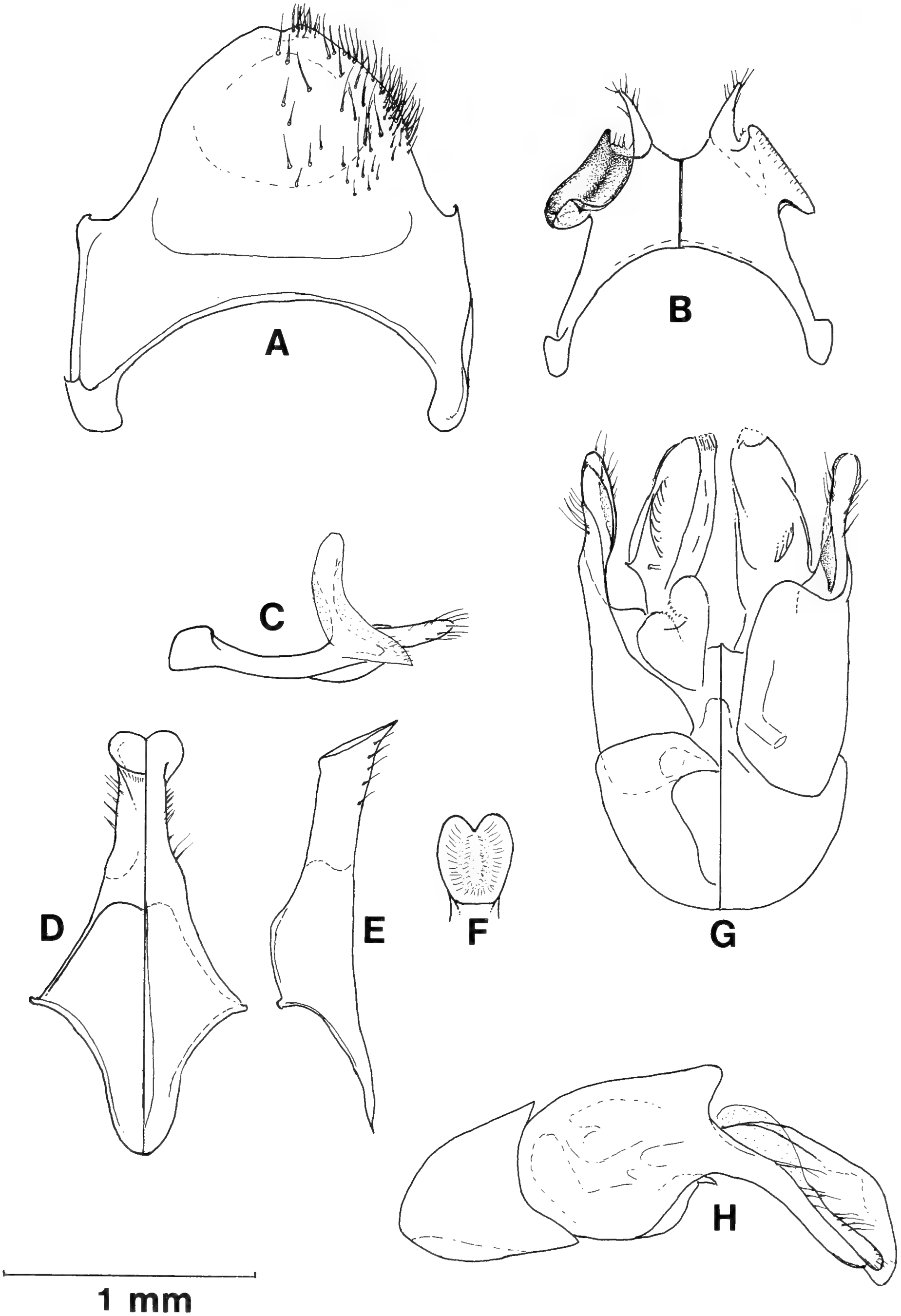


Fig. 9. *Rediviva saetigera* sp. nov. Male genitalia and associated sterna. A. S6. B. S7, dorsal view (left), ventral view (right). C. S7, side view. D. Dorsal and ventral view of S8. E. S8, lateral view. F. Tip of S8, dorsal view. G. Genital capsule, ventral (left) dorsal (right). H. Genital capsule, lateral view.

Vestiture. Head: stout brown unbranched hairs on lower part of labrum, lighter and shorter branched hairs on upper surface; mixture of long white and black branched hairs on clypeus, supraclypeal area and frons; long branched black hairs on vertex towards occipital ridge. Mesosoma: as in female. Metasoma: hair bands on apical margins of T2, T3 and T4 brown (mixture of brown and black or all black on T4 in some specimens), black on T5, light brown on T6 and T7; basal hairs on T2 pale, on base of T3 and T4 predominantly black with some pale hairs laterally, on T5 black; hairs on apical margins of S2, S3 and S4 long, paler than on tergum, on S5 black, hairs longer and more dense laterally. Forelegs with light brown hairs on tarsomeres 2–5, under-side of basitarsus and distal part of tibia; hairs on dorsal surface of basitarsus, dorsal and posterior areas of tibia black; mixture of long black and long white plumose hairs on the ventral side of femora; middle legs similar to forelegs but with some dark hairs on tarsi; hind legs with more black hairs on tarsi and tibiae; hairs on ventral surface of femora, tibiae and basitarsus light brown; tibial spurs light brown.

Variations

The brown and reddish-brown hairs on females of the eastern Transvaal populations are richer in colour than those from Natal and the eastern Cape. Males from the eastern Transvaal also have a rich reddish-brown on the mesosomal dorsum and, although no males have been collected from the coastal regions of Kwazulu or the eastern Cape, it is probable that they will also have the dull colour of the females. Males collected in the eastern Transvaal also have some variation in the amount of brown hair in the band on the posterior margin of T4, which can be mostly brown to all black.

Host flower records

Only two host plants have been recorded for this species: one, *Bowkeria cymosa*, is a shrubby tree that occurs in the cooler higher rainfall areas of the eastern Transvaal, in forest edge, stream and roadside situations. The other, *Anastrabe integerrima*, is a shrub to medium-sized tree that occurs primarily in warmer coastal areas; it too grows along forest edges or streams. Female *R. saetigera* bees collect pollen and oil from both host plants. Males have been found to patrol the oil-producing flowers of *B. cymosa* early in the season, presumably in search of females. No bees of this species have as yet been found visiting nectar plants.

Distribution (Fig. 5)

Rediviva saetigera is associated with *B. cymosa* on the eastern Transvaal escarpment from Pilgrim's Rest to Kaapsehoop, and further south from the hills of Barberton to the Swaziland border. Large populations occur in the Eshowe–Nkandla area of Kwazulu, and one specimen has been collected near the eastern Cape coast between Komga and Kei Mouth. The host plant at these sites, *Anastrabe integerrima*, occurs in the coastal forests of Transkei and southern Natal but, despite searching in several locations in these areas, we have been unable to find additional localities for *R. saetigera*.

ACKNOWLEDGEMENTS

We thank Dr Nigel Fergusson and Mr George Else of the Natural History Museum, London, for use of facilities and their assistance in locating the material described by Cockerell, and Professor Denis Brothers, University of Natal, Pietermaritzburg, for the loan of material. The National Parks Board and the Natal Parks Board are thanked for permission to work in their respective areas and, in particular, Messrs E. Fourie of the Mountain Zebra National Park, G. Groenewald of the Golden Gate Highlands National Park, H. Braack of the Karoo National Park, and K. Riggien of the Department of Forestry, for assistance with transport and accommodation. The constructive comments of two referees are much appreciated.

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Steiner, K. E. & Whitehead, V. B. 1988. Association between oil-producing flowers and oil-collecting bees in the Drakensberg of southern Africa. *Monographs in Systematic Botany from the Missouri Botanical Garden* **25**: 259–277.

Steiner, K. E. & Whitehead, V. B. 1990. Pollinator adaption to oil-secreting flowers—*Rediviva* and *Diascia*. *Evolution* **44** (6): 1701–1707.

Steiner K. E. & Whitehead, V. B. 1991. Oil flowers and oil bees: further evidence for pollinator adaption. *Evolution* **45** (6): 1493–1501.

Vogel, S. & Michener, C. D. 1985. Long bee legs and oil-producing flower spurs, and a new *Rediviva* (Hymenoptera, Melittidae; Scrophulariaceae). *Journal of the Kansas Entomological Society* **58**: 359–364.

Whitehead, V. B., Schelpe, E. A. C. L. E. & Anthony, N. C. 1984. The bee *Rediviva longimanus* Michener (Apoiodea: Melittidae), collecting pollen and oil from *Diascia longicornis* (Thunb.) Druce (Scrophulariaceae). *South African Journal of Science* **80** (6): 286.

Whitehead, V. B. & Steiner, K. E. 1985. Oil-collecting bees in South Africa. *African Wildlife* **39** (4): 144–147.

6. SYSTEMATIC papers must conform to the *International code of zoological nomenclature* (particularly Articles 22 and 51).

Names of new taxa, combinations, synonyms, etc., when used for the first time, must be followed by the appropriate Latin (not English) abbreviation, e.g. gen. nov., sp. nov., comb. nov., syn. nov., etc.

An author's name when cited must follow the name of the taxon without intervening punctuation and not be abbreviated; if the year is added, a comma must separate author's name and year. The author's name (and date, if cited) must be placed in parentheses if a species or subspecies is transferred from its original genus. The name of a subsequent user of a scientific name must be separated from the scientific name by a colon.

Synonymy arrangement should be according to chronology of names, i.e. all published scientific names by which the species previously has been designated are listed in chronological order, with all references to that name following in chronological order, e.g.:

Family **Nuculanidae**

Nuculana (Lembulus) bicuspidata (Gould, 1845)

Figs 14–15A

Nucula (Leda) bicuspidata Gould, 1845: 37.
Leda plicifera A. Adams, 1856: 50.
Laeda bicuspidata Hanley, 1859: 118, pl. 228 (fig. 73). Sowerby, 1871: pl. 2 (fig. 8a–b).
Nucula largillierti Philippi, 1861: 87.
Leda bicuspidata: Nicklès, 1950: 163, fig. 301; 1955: 110. Barnard, 1964: 234, figs 8–9.

Note punctuation in the above example:
comma separates author's name and year
semicolon separates more than one reference by the same author
full stop separates references by different authors
figures of plates are enclosed in parentheses to distinguish them from text-figures
dash, not comma, separates consecutive numbers.

Synonymy arrangement according to chronology of bibliographic references, whereby the year is placed in front of each entry, and the synonym repeated in full for each entry, is not acceptable.

In describing new species, one specimen must be designated as the holotype; other specimens mentioned in the original description are to be designated paratypes; additional material not regarded as paratypes should be listed separately. The complete data (registration number, depository, description of specimen, locality, collector, date) of the holotype and paratypes must be recorded, e.g.:

Holotype

SAM–A13535 in the South African Museum, Cape Town. Adult female from mid-tide region, King's Beach, Port Elizabeth (33°51′S 25°39′E), collected by A. Smith, 15 January 1973.

Note standard form of writing South African Museum registration numbers and date.

7. SPECIAL HOUSE RULES

Capital initial letters

(a) The Figures, Maps and Tables of the paper when referred to in the text
e.g. '. . . the Figure depicting *C. namacolus* . . .': '. . . in *C. namacolus* (Fig. 10) . . .'

(b) The prefixes of prefixed surnames in all languages, when used in the text, if not preceded by initials or full names
e.g. Du Toit but A. L. du Toit; Von Huene but F. von Huene

(c) Scientific names, but not their vernacular derivatives
e.g.Therocephalia, but therocephalian

Punctuation should be loose, omitting all not strictly necessary

Reference to the author should preferably be expressed in the third person

Roman numerals should be converted to arabic, except when forming part of the title of a book or article, such as
'Revision of the Crustacea. Part VIII. The Amphipoda.'

Specific name must not stand alone, but be preceded by the generic name or its abbreviation to initial capital letter, provided the same generic name is used consecutively. The generic name should not be abbreviated at the beginning of a sentence or paragraph.

Name of new genus or species is not to be included in the title; it should be included in the abstract, counter to Recommendation 23 of the Code, to meet the requirements of Biological Abstracts.

V. B. WHITEHEAD
&
K. E. STEINER

TWO NEW SPECIES OF OIL-COLLECTING BEES OF THE GENUS *REDIVIVA* FROM THE SUMMER RAINFALL REGION OF SOUTH AFRICA (HYMENOPTERA, APOIDEA, MELITTIDAE)

VOLUME 102 PART 5 FEBRUARY 1993 ISSN 0303-2515

ANNALS OF THE SOUTH AFRICAN MUSEUM

CAPE TOWN

INSTRUCTIONS TO AUTHORS

1. MATERIAL should be original and not published elsewhere, in whole or in part.

2. LAYOUT should be as follows:

- (a) *Centred masthead to consist of*
  Title: informative but concise, without abbreviations and not including the names of new genera or species
  Author's(s') name(s)
  Address(es) of author(s) (institution where work was carried out)
  Number of illustrations (figures, enumerated maps and tables, in this order)
- (b) *Abstract* of not more than 200 words, intelligible to the reader without reference to the text
- (c) *Table of contents* giving hierarchy of headings and subheadings
- (d) *Introduction*
- (e) *Subject-matter* of the paper, divided into sections to correspond with those given in table of contents
- (f) *Summary*, if paper is lengthy
- (g) *Acknowledgements*
- (h) *References*
- (i) *Abbreviations*, where these are numerous.

3. MANUSCRIPT, to be submitted in triplicate, should be typewritten and neat, double spaced with 3 cm margins all round. First lines of paragraphs should be indented. Tables and a list of captions for illustrations should be typed separately, their positions indicated in the text. All pages should be numbered consecutively.

Major headings of the paper are centred capitals; first subheadings are shouldered small capitals; second subheadings are shouldered italics; third subheadings are indented, shouldered italics. Further subdivisions should be avoided, as also enumeration (never roman numerals) of headings and abbreviations.

Footnotes should be avoided unless they are short and essential.

Only generic and specific names should be underlined to indicate italics; all other marking up should be left to editor and publisher.

4. ILLUSTRATIONS should be reducible to a size not exceeding 12 × 18 cm (19 cm including caption); the reduction or enlargement required should be indicated (and preferably uniform); originals larger than 35 × 47 cm should not be submitted; photographs should be rectangular in shape and final size. A metric scale should appear with all illustrations, otherwise magnification or reduction should be given in the caption; if the latter, then the final reduction or enlargement should be taken into consideration.

All illustrations, whether line drawings or photographs, should be termed figures (plates are not printed; half-tones will appear in their proper place in the text) and numbered in a single series. Items of composite figures should be designated by capital letters; lettering of figures is not set in type and should be in lower-case letters. If Letraset is used authors are requested to use Helvetica-style lettering, if possible.

The number of the figure should be lightly marked in pencil on the back of each illustration.

5. REFERENCES cited in text and synonymies should all be included in the list at the end of the paper, using the Harvard System (*ibid., idem, loc. cit., op. cit.* are not acceptable):

(a) Author's name and year of publication given in text, e.g.:

'Smith (1969) describes . . .'
'Smith (1969: 36, fig. 16) describes . . .'
'As described (Smith 1969*a*, 1969*b*; Jones 1971)'
'As described (Haughton & Broom 1927) . . .'
'As described (Haughton *et al.* 1927) . . .'

Note: no comma separating name and year
pagination indicated by colon, not p.
names of joint authors connected by ampersand
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(b) Full references at the end of the paper, arranged alphabetically by names, chronologically within each name, with suffixes *a*, *b*, etc., to the year for more than one paper by the same author in that year, e.g. Smith (1969*a*, 1969*b*) and not Smith (1969, 1969*a*).

For books give title in italics, edition, volume number, place of publication, publisher.
For journal article give title of article, title of journal in italics (according to the *World list of scientific periodicals*. 4th ed. London: Butterworths, 1963), series in parentheses, volume number, part number in parentheses, pagination (first and last pages of article).

Examples (note capitalization and punctuation)

BULLOUGH, W. S. 1960. *Practical invertebrate anatomy*. 2nd ed. London: Macmillan.
FISCHER, P. H. 1948. Données sur la résistance et de la vitalité des mollusques. *Journal de conchyliologie* **88** (3): 100–140.
FISCHER, P. H., DUVAL, M. & RAFFY, A. 1933. Études sur les échanges respiratoires des littorines. *Archives de zoologie expérimentale et générale* **74** (33): 627–634.
KOHN, A. J. 1960*a*. Ecological notes on *Conus* (Mollusca: Gastropoda) in the Trincomalee region of Ceylon. *Annals and Magazine of Natural History* (13) **2** (17): 309–320.
KOHN, A. J. 1960*b*. Spawning behaviour, egg masses and larval development in *Conus* from the Indian Ocean. *Bulletin of the Bingham Oceanographic Collection, Yale University* **17** (4): 1–51.
THIELE, J. 1910. Mollusca. B. Polyplacophora, Gastropoda marina, Bivalvia. *In:* SCHULTZE, L. *Zoologische und anthropologische Ergebnisse einer Forschungsreise im westlichen und zentralen Süd-Afrika ausgeführt in den Jahren 1903–1905* **4** (15). *Denkschriften der medizinisch-naturwissenschaftlichen Gesellschaft zu Jena* **16**: 269–270.

(continued inside back cover)

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HUMAN SUBJECTS AS MUSEUM OBJECTS. A PROJECT TO MAKE LIFE-CASTS OF 'BUSHMEN' AND 'HOTTENTOTS', 1907–1924

By

PATRICIA DAVISON

Cape Town Kaapstad

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HUMAN SUBJECTS AS MUSEUM OBJECTS. A PROJECT TO MAKE LIFE-CASTS OF 'BUSHMEN' AND 'HOTTENTOTS', 1907–1924

By

PATRICIA DAVISON

African Studies & Anthropology, South African Museum, Cape Town

(With 8 figures and 1 table)

[*MS accepted 18 August 1992*]

ABSTRACT

In 1906 the Director of the South African Museum initiated a project to make life-casts of 'aboriginals of the Bush and Hottentot Races', believed at the time to be near extinction. The project was thus regarded as having anthropological importance. Between 1907 and 1924 over 60 casts were made, and although intended primarily as a scientific collection, many of the casts were placed on exhibition as examples of a primitive race. This paper demonstrates how museum practice reduced the people who were cast to specimens for public viewing. In this process human subjects became museum objects.

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INTRODUCTION

During the past decade, anthropologists have become critically aware of the methodological and epistemological assumptions of their discipline (Fabian 1983; Clifford & Marcus 1986; Clifford 1988; Kuper 1988). If, as is now widely acknowledged, the discipline as a whole was originally premised on treating people of other cultures as objects of study, anthropology as practised in museums provides one of the clearest examples of this process. The casting project undertaken at the South African Museum (SAM) between 1907 and 1924 can be regarded as a tangible manifestation of a general conceptual position that underpinned the emerging discipline of academic anthropology. By adopting a historical perspective and focusing attention on a collection of life-casts of subjects deemed to be pure 'Bushmen' and 'Hottentots', I hope to elucidate the way in which museum practice operated to reify these people in terms of race, to objectify them as physical specimens, and to perpetuate unproven anthropological notions regarding racial primitiveness.

Although it could be argued that this paper further dehumanizes the people who were cast, my intention has been to situate the casting project historically and to increase awareness of an inherent problem in anthropological practice, past and present.

Ann S. Afr. Mus. **102** (5), 1993: 165–183, 8 figs, 1 table.

HISTORICAL BACKGROUND

Since its inception in 1825, the South African Museum has been associated with an anthropological interest in the people widely known as 'Bushmen' and 'Hottentots'. (Although San and Khoikhoi are the preferred current terms, the use of the former terms in this paper reflects historical usage.) Dr Andrew Smith, founder of the SAM, published an early paper on the origin and history of the Bushmen and Hottentots (Smith 1830), and on his 1834–1836 expedition to the interior he collected a range of ethnographic artefacts, including '9 Sets of Bosjesman Bows and Arrows' (Lye 1975). In the Museum accession registers that date back to 1855, when the Museum was reconstituted under the Directorship of Edgar Layard, Khoikhoi and San artefacts appear intermittently in the Miscellaneous Collections, categorized under various sub-headings such as 'Work of Uncivilized Races', 'Native implements' or 'Work of native races'. An early interest in displaying modelled figures is suggested in the diary of Lieutenant T. Duthie, who recorded in 1832 that he and Dr Murray of the South African Institution had gone to the Museum 'to see the [modelled] Hottentot woman of Smith's' (Kirby 1965: 116). Although no further reference to this exhibit has been found, it attests an early concern for a subject that was later to be pursued more scientifically at the Museum.

As an army surgeon, Andrew Smith had been trained in anatomy in Edinburgh, graduating in 1819, a few years after Robert Knox, who later became a vociferous advocate of polygenism. During the first half of the nineteenth century, the debate between polygenists and monogenists was the most contentious issue within anthropological discourse (Harris 1969). Polygenists, who generally also opposed the abolition of slavery, were emboldened by the taxonomic work of Linnaeus in their attempts to differentiate the human species (Haddon 1934). Although there is no evidence to suggest that Smith was a polygenist (Kirby 1965), he was doubtless a participant in the controversial debates on racial and cultural evolution. It is of interest that he presented the cranium of a 'notorious Bushman murderer' to the Anatomical Museum of the Royal Army Medical Corps in Chatham where, after returning to England, he served as Principal Medical Officer from 1837 to 1845 (Morris 1987: 14). In being concerned with questions of racial origins and classification, Smith was a man of his time. He was a meticulous scientist and recorder of ethnographic data but he did not dispute the widely held nineteenth-century belief that both Hottentots and Bushmen were among the low orders of humanity.

General explanations for this conviction included the influence of climatic factors, a presumed low position of Bushmen and Hottentots in the Great Chain of Being, and the possibility of their being biologically different from other races. The latter polygenist view gave rise to a scientific discourse on race that attempted to establish racial distinctiveness on morphological criteria. Among these the cranial index (length : breadth ratio of the skull) was believed to be of taxonomic significance in classifying racial types, and was also thought to be linked to intellectual capacity (Stocking 1987). Phrenologists used skull dimensions as evidence to support theories on unequal intellectual capability among different races, and there was a widespread popular belief in the correlation of race and physiognomic features with moral disposition. The amassing of morphological data on people of different races was considered an essential prerequisite to solving current anthropological problems, both before and after the publication of Darwin's work on the origin of species (Duckworth 1904).

During the nineteenth and early twentieth centuries, hundreds of skulls of people believed to be Bushmen found their way into European collections and were used in morphological studies.

> These osteological remains were considered to be part of the native fauna of distant lands and no natural history collection could be considered complete unless it contained a representative quantity of human skulls (Morris 1987: 12).

That skulls of Bushmen were regarded as faunal collections is telling, if not surprising, considering that an evolutionary paradigm taken from natural history had a strong influence on the emerging ethnological sciences. In 1847, when ethnology was included in the British Association for the Advancement of Science, it was grouped with 'Zoology and Botany' (Altick 1978). Historical time-depth and the principles of stratigraphy, demonstrated scientifically in the earth sciences, were increasingly drawn on to explain human variation. In order to treat people as specimens, as objects of study, it was necessary to distance them in concept both temporally and spatially. Accordingly, Bushmen and other 'primitive' people could be treated as living fossils—specimens to be appropriated for the advancement of science.

From 1859 onwards Darwin's theory of evolution provided, by analogy, a range of biological explanations for human cultural differences. The language of biology was transferred as a metaphor to the discourse of the social sciences. Social evolutionists, however, misused Darwin's theory of natural selection in the promotion of selective breeding or eugenics, and they also misinterpreted his concept of time by linking it to the idea of cultural progress (Ingold 1986). Throughout the nineteenth and early twentieth centuries, racial typology and the relationship between race and culture remained subjects of intense public interest and academic investigation. As the authority of the scientific disciplines of biology, natural history and ethnology grew, the 'primitive' or 'lower' races were increasingly regarded as anthropological specimens.

By the mid-nineteenth century, the Enlightenment idea of the 'noble savage' had been eclipsed by confidence in European superiority, a conviction that was confirmed by successive exhibitions in London of aboriginal inhabitants of Africa and America. One particular exhibition that had a notable impact on the popular image of the Bushmen was held in 1847 at the Egyptian Hall in Piccadilly. To give an aura of scientific respectability to the venture, it was preceded by a lecture delivered at the Exeter Hall by the anatomist, Robert Knox. The lecture was publicized as addressing, among other things, 'the great question of race' (Altick 1978: 280). Appealing to a more popular audience, the exhibition poster advertised: 'Bosjesmans . . . The most singular specimens of that decreasing race of human beings . . . that from their wild habits could never before be induced to visit a place of civilization.' The Times described the Bushmen as 'little above the monkey tribe, and scarcely better than the mere brutes of the field' (cited in Altick 1978: 281). Not only were the Bushmen objects of curiosity, they were also a source of gratification for the Victorian public whose self-esteem was enhanced relative to the spectacle they observed so avidly.

In the context of southern African settler society, a distorted stereotype of the indigenous population served a more insidious purpose than simply affirming the superiority of the settlers. It justified the violence and dispossession inflicted on the Khoikhoi and San people (Guenther 1980). Throughout southern Africa, the resistance of the aboriginal population was eventually quelled and, by the second half of the nineteenth century, their numbers had been greatly reduced. Those who survived in the Cape Colony were no longer living as hunter-gatherers but as labourers and squatters on farms. By this time they had ceased to be a threat to the settlers, but remnant groups were becoming of increasing interest to philologists and ethnologists as living examples of a low order of the human species.

Scientists working in South Africa aligned themselves with a cosmopolitan scientific fraternity and were strongly influenced by the ideas of overseas specialists. This was apparent in 1905 when the British and South African Associations for the Advancement of Science held a joint meeting in South Africa. A. C. Haddon, president of the Anthropological section, concluded his address by stressing the importance of investigating the Bushmen and Hottentots, who represented 'very primitive varieties of mankind', and who were 'rapidly diminishing' in number (Haddon 1906: 525). At the same meeting Professor F. von Luschan, Director of the Museum für Völkerkunde in Berlin, recommended that casts from the living subject should be made of the few extant full-blooded aboriginals of the Bush and Hottentot races.

THE CASTING PROJECT, 1907–1924

With the impetus of international scientific interest in the question of racial origins, Dr Louis Péringuey, who had become Director of the South African Museum in 1906, initiated a project that was aimed at making an accurate physical record of members of the few remaining groups of 'pure-bred' Bushmen and Hottentots.

Hoping to enlist the official support of the Cape Government in locating suitable subjects, Péringuey wrote to the Under Colonial Secretary of the Cape as follows in 1907:

> *Modelling from life aboriginals of the Bush and Hottentot Races*
>
> Sir,
>
> Owing to the rapid disappearance by reasons which I need not mention here, of the pure specimens of the Hottentot and Bushman races the Trustees of the Museum are endeavouring to obtain models from the living flesh which would enable the exact physical reproduction of the survivors of these nearly extinguished races.
>
> I have of late endeavoured to locate pure types of both sexes, but not as successfully as I would have expected. Moreover some of these live at distances so great that the expenditure of travelling to such parts greatly militates against the successful result of my endeavours.
>
> But the Cape Government would greatly assist the Trustees of the Museum in securing the last vestiges of these people,
>
> 1. by asking the Civil Commissioners to inquire of their respective jurisdictions as to the presence there of *true* Bushmen and Bushwomen, Nama Hottentots and Korannas and to report to you.
> 2. by obtaining similar informations from the Superintendent of Prisons, or jails in the country.
> 3. by authorizing us in the case of men and women in jail to have the casts and necessary photographs and measurements taken by experts. The process is not a long one; it is very simple and absolutely painless.

> The importance of securing these physical reproductions, while we still can do it, is so great that I doubt not that you will grant my respectful request for the information and instructions mentioned herein.
>
> (SAM letterbook, 31 July 1907)

The project received the support of the Colonial Office, and assistance was duly requested from the Secretary for Native Affairs, as well as Convict Stations and Magistrates in the northern districts of the Colony and in the Bechuanaland Protectorate. In most cases those responding to Péringuey's request showed willingness to assist but, not surprisingly, expressed some difficulty in locating 'pure aboriginals'. The reply of the Superintendent of the Convict Station in Kimberley to the circular sent out by the Under Colonial Secretary exemplifies this uncertainty:

> Sir,
>
> . . . I have the honour to state that we have a number of Bushmen, Hottentots, and Koranna convicts stationed here. Amongst them are fairly good specimens of their race, but I might point out that it is most difficult nowadays to find a pure-blooded specimen.
>
> . . . might I ask whether the Director of the S. A. Museum is not in a position to suggest someone who could confer with me at this Station any Sunday morning between 9.15 and 10.15 a.m. It could then be decided whether the types we have are *pure enough* for their models to be taken . . . .
>
> (My emphasis; SAM letterbook, 19 September 1907)

The reference to 'a pure-blooded specimen' draws attention to the fact that the project was premised on the notion of racial purity, and furthermore that, for scientific purposes, people could be reduced or dehumanized to objects of study, to 'specimens of their race'. Péringuey (1911) was explicit about the most notable physical characteristics of 'pure bred' members of the Bush race—women would have steatopygia and elongated labia minora, and men would have semi-erect penises. He noted that he had been informed by 'old Colonists' that 'the purity of the race was denoted by the angle at which the penis stood normally' (Péringuey 1911: 201). In his instructions to the Museum modeller (see p. 175), Péringuey also stressed the importance of skin colour and facial features. Subjects to be cast were measured according to predetermined morphological criteria, and photographed from a number of different angles to show their height as well as the above features.

Considering that it is a general practice for convicts to be de-personalized and made to conform to disciplinary procedures, it can be assumed that suitable 'specimens' in convict stations were not given the right to refuse being photographed naked, measured in minute detail and cast 'from the living flesh'. However, it would seem that those who were not in prison required some persuasion. Dorothea Bleek commented in a letter written to Péringuey from Prieska: 'It is exceedingly difficult to get photos of the natives without clothes on. Perhaps your modeller will be more fortunate than we were' (SAM correspondence, 6 August 1911). In practice the project depended on the unequal relations between the people who were cast and those who captured their likeness in plaster and on film. The reduction of the human subject to specimen for observation is clearly revealed in photographs that were taken at the time (Fig. 1A, B).

Fig. 1. Photographic studies of an anonymous Khoikhoi woman, Caledon, *c*. 1912. A. Clothed in everyday attire. B. Unclothed for scrutiny by Museum scientists. (South African Museum Photographic Collection.)

Although very little is known about the interaction between Museum modeller and the people who were cast, there is some evidence of reticence on the part of proposed subjects. An example of an unwilling subject is recorded in a letter from Péringuey to the Secretary for Native Affairs in the Transvaal (SAM letterbook, 14 September 1907). A Bushwoman, whose physical attributes had been examined previously by members of the Anthropological Committee of the Association for the Advancement of Science, refused to be cast and would not be persuaded to reconsider her decision. In the face of this disappointment, Péringuey was hoping to enlist official support in persuading the woman to submit to being measured and photographed 'under different aspects' so that an accurate model of her could be made. There is no record of this having been accomplished. The woman's refusal to comply seems especially poignant considering that Péringuey had relied on the power of officialdom to further his project. I am not suggesting that physical coercion was used but that bureaucratic power would have been exerted. Elsewhere Péringuey states explicitly that Bushmen were likely to acquiesce to being modelled 'if

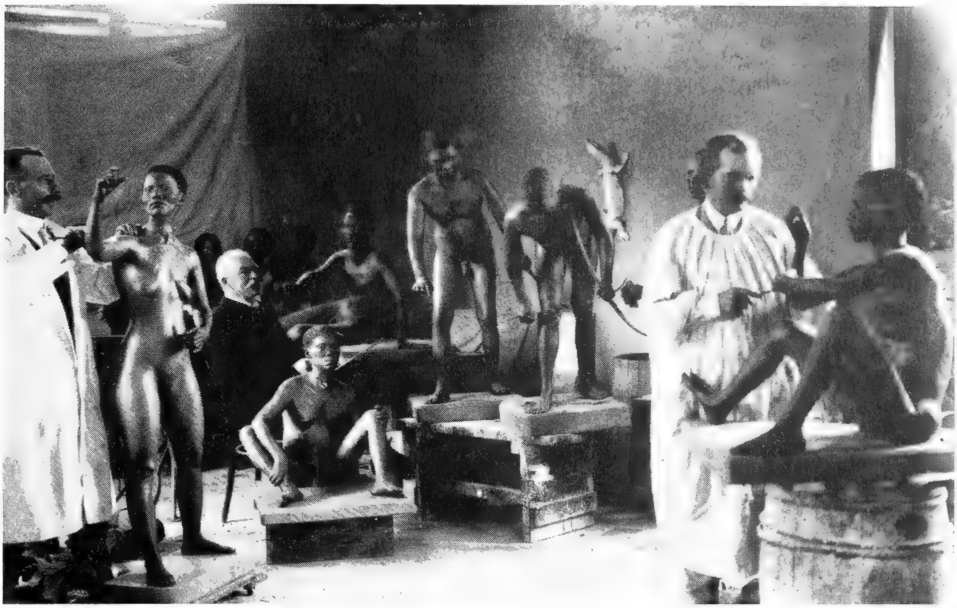

Fig. 2. James Drury (left) working on the casts in the Museum studio. Dr Péringuey is seated in the centre. (South African Museum Photographic Collection.)

the request comes from someone in authority' (Péringuey to Colonial Office, SAM letterbook, 25 March 1908). Repeated appeals through the Colonial Secretary for the co-operation of Magistrates, Constables, Chiefs and Missionaries were justified in terms of the perceived urgency and scientific importance of the casting project. Thus the authority of science was linked to that of the state to give the project official status and credibility.

Between 1907 and 1924 the Museum modeller, James Drury, photographed, measured and made field-moulds of 'thoroughbred' San and Khoikhoi wherever suitable subjects were to be found. Plaster casts from these moulds were made and painted in the Museum studio (Fig. 2). Drury cast people living in Prieska, Carnarvon and other villages in the Northern Cape; Grootfontein and Sandfontein in South West Africa; Kanye in the Bechuanaland Protectorate; and the Lake Chrissie area of the eastern Transvaal. He also cast convicts in Cape Town, Kimberley, Windhoek and Gaborone, if they conformed to the assumed 'pure' physical type. During this time Drury made body-casts of 68 people (including 14 convicts) whom he also photographed and measured in anatomical detail. The registered casts are listed in Table 1. In addition to the figures that Drury cast, he made field-moulds of at least another 20 people. These moulds remained unused for some 60 years. In the 1980s casts were eventually made from the moulds (SAM–AP6186 to SAM–AP6205).

On his expedition to Kanye in 1908, Drury was given specific instructions by Péringuey. The memorandum is cited in full as it gives insight into the casting project as a whole:

For Drury—Memorandum about the Modelling

I would like to have first, a group of five or six, men, women and children photographed in the position they naturally assume, either in sitting down, or as if they were on the march: the man carrying his few arms and chattels; the woman carrying what they generally carry, the youngsters probably carry nothing.

But apart from these two groups, and I think that Mr Harvey will be from his knowledge of statuary quite able to make them assume positions that will not make the models appear *too stiff*, you may have to take single people somewhat like the figures we have. Try also to place them in such a position that would not prove too fatiguing, in order to avoid also stiffness in the reproduction.

Do not chose [sic] the two decrepit specimens. But I would far prefer however to have those with all the wrinkles of the body, especially the belly, than to have them as well fed as our previous specimens.

Pay special attention to the hairs [sic] in your note of the specimens, of the colour or expression of the eye, of the shape of the ear, and above all copy the colour of the skin, and verify your slab a couple of days after you have painted it in order to make *quite sure* of the genuine colour.

Of course photographs of the full face, the quarter and side views will be taken of each. If you run short either send for more at Mafeking, or reduce the three views of the face to two.

You must not forget however that we are not likely for some time to come.to have such an opportunity and *any* photograph, provided it is a good one will prove of great value to us.

Men are of course desirable; women still more so. You will be very careful to take all their peculiarities, including the ‘apron’. A special moulding of the same to be added to the statue is very much wanted. You will endeavour to find out more or less the age of the young ones. Could you take a woman with her little one on the back, wraps and all, it would indeed look very natural.

But to resume avoid any stiffness in the attitude you will take the models in.

If for reasons unavoidable you were leaving Kanye without finishing the models in hand, it is understood that Harvey will remain a few days longer. You would then take down with you such parts as have already been taken, Harvey bringing down the rest.

As to the remuneration to the Chief you are authorized to give him from 5 to 10 pounds provided he gives you all facility for taking the casts. You would however not make him the present until you have ascertained from some person in authority or the Missionary whether you should give him the full sum or the other.

As to the Bush people you will probably get at the stores the shirts and petticoats suitable for them. The knives you have. If need be you might get more on the spot.

As to the Graphophone. Read carefully the instructions. If you have no time to attend to that part of the undertaking, ask the Missionary there to be kind enough to do so, while you are proceeding with the modelling. If need be I could send more cylinders.

> Endeavour to buy the garments of these Bush people in order to clothe the reproductions with if you can, provided their garments or arms are not manchester or [? Birmingham] goods.
>
> If any native curio other than Bush was procurable you may buy if not dear.
>
> You will let me know of your arrival and how you are getting on. It may be that I take a run up that way, but I am afraid that Finances will not permit.
>
> I should not like you to lose some useful opportunities for the sake of a few shillings, but I am compelled to recommend a careful handling of the fifty pounds you take to cover expenses.
>
> I am enclosing all correspondences with the Resident Commissioner's office. In case of need you should apply to him.
>
> (Péringuey to Drury, SAM letterbook, 1908: 718–720)

This memorandum clearly conveys some of the assumptions and emphases of the project. The stress on accurate recording of physical attributes, notably exact skin colour (skin pigmentation remains one of the most manifest signifiers of race), facial features and genital characteristics underlines the fact that questions about race motivated the project. Indeed the project was regarded as adding evidence to the debate on the classification of the racial stocks of Africa which, as Dubow (1989: 5) has commented, was accompanied by 'hairsplitting distinctions with respect to sub-races and the relationship between races'. The frequent reference to 'specimens' confirms that the human subjects referred to by Péringuey had been objectivized conceptually before they were literally objectivized as casts. Indeed, I contend that this was a necessary precondition for the project.

Genital features were considered to be of special interest as they were differentiating characters in taxonomic classification (Gilman 1986). Despite the fact that polygenism was easily disproved by ample evidence of inter-racial breeding and that support for polygenist arguments declined in the second half of the nineteenth century, interest in the genital features of Bush and Hottentot people persisted. Female genital morphology was of particular interest and, in accordance with Péringuey's instructions, Drury made special mouldings of female genitalia (SAM–AP6205 to SAM–AP6209). During the nineteenth century, both popular and academic attention had been drawn to the physical characteristics of Hottentot women, following the London exhibition in 1810 of Saartjie Baartman ('The Hottentot Venus'), and the dissection of her genitalia by Cuvier, after her death in Paris in 1815 (Kirby 1954; Altick 1978; Gould 1982). In the early decades of the twentieth century, the significance of the so-called 'tablier Hottentot' was still the subject of speculation, and continued to attract scientific interest (Péringuey 1911; Drury & Drennan 1926).

The memorandum also reveals an emphasis on 'traditional' artefacts that was characteristic of museum collecting-practice at the time, and has continued to the present. Although purchased shirts, petticoats and knives were suggested as gifts for the people who were cast, Drury was explicitly instructed not to acquire garments of trade-cloth for the Museum. No interest was shown in documenting the actual material culture of the people to be cast. If garments were to be acquired for the Museum, they should be of the type that would allow casts of 'pure' racial types to be dressed in specimens of true 'traditional' attire. Both of these notions were idealized constructs and yet, ironically, Péringuey was concerned that the casts should appear natural. This was a quest for simulated naturalness to be achieved by completely artificial means.

That people having features assumed in advance to be typically Bushman were selectively cast is evident from much of Péringuey's correspondence. For example, when asked by the Resident Magistrate in Kanye which kind of Bushmen from Ngamiland he wished to cast, since they varied in size, being 'diminutive, medium or large', Péringuey replied, 'By nature the real Bushman is small . . . It would thus seem that if the Masarwa Bush are large, one can assume that they are not of pure blood, and the diminutive kind would therefore be preferable' (SAM letterbook, 20 June 1915). Thus, if the casts showed features presumed to be 'typically Bushman', it was because those people who were cast had been pre-selected to show such features—the results of the project simply provided a tautologous reinforcement of an existing idea. Those people who did not conform to a preconceived stereotype were excluded from the project or regarded as 'half-breeds'.

For museum purposes the casts were registered as specimens in the physical anthropology collections (see Table 1), together with the human skeletal collections. Although some personal details of Drury's subjects were kept on record, the plaster-casts were essentially museum objects, 'specimens' identified primarily by registration number, and by those details recorded in the accession register—racial type, sex and locality. It is instructive to consider briefly some of the information that was omitted from the accession records. Perhaps the most telling omission is the subject's personal name. For example, in 1911 at Prieska, three members of the Bosman family—Stuurman, Piet and Klein Piet—were cast, as were Anna Zwartbooi, Willem Toonies and Willem Jooi, among others, but from the accession records it is not possible to identify the casts of these people. Although in many cases Drury noted the names of the individuals whom he cast, they were never included in the accession register, which lists the casts only as numbered specimens. The omission of personal names is a clear illustration of the dehumanizing nature of the project.

The emphasis on physical type also precluded any serious attention being given to social context. In most cases living conditions, social setting and material culture were not recorded for museum purposes, but the records on some of Drury's subjects who were cast in prison give an indication of their clothing and other personal effects. The listed possessions of 17-year-old Augeniet Booysen (SAM–AP3897, identified as a 'half-breed'), cast in 1908 at the House of Correction in Cape Town, where she was serving six months hard-labour for stock-theft, include a skirt, blouse, two petticoats, chemise, three handkerchiefs, bodice, lace collar, shoes and a ring. As she is represented in the Museum, however, Augeniet is without any personalizing cultural attributes. This accords with the scientific interest in the casts primarily as examples of a physical type. Ethnographic details of dress and local setting were not relevant to the project and were deliberately overlooked in the way the casts were presented to the public, even though the Museum had access to photographs showing the socio-cultural environment of Drury's subjects.

Photographs taken by Dorothea Bleek at Prieska in 1911 show aspects of the living conditions that pertained when Drury cast a remnant group of /Xam Bushmen (Figs 3–5). Although these people were then living in a semi-permanent squatter camp on the outskirts of Prieska village, their racial 'purity' had been affirmed on 'philological grounds',

Fig. 3. Group of /Xam Bushmen, some of whom were cast by Drury, Prieska, 1911. (Photograph: D. Bleek, South African Museum Photographic Collection.)

Fig. 4. /Xam family group outside their home. The two adult women were Dorothea Bleek's informants and were cast by Drury, Prieska, 1911. (Photograph: D. Bleek, South African Museum Photographic Collection.)

TABLE 1

Body casts made by James Drury, 1907–1924, registered with the Physical Anthropology collections of the South African Museum.

SAM NO.	SEX	GROUP	DESCRIPTION	LOCALITY
AP3391	♂	Sarwa	Boy with bow and arrow	Kanye, Botswana
AP3392	♂	Sarwa	Sitting	Gaborone, Botswana
AP3393	♂	Sarwa	Looking at spoor	Gaborone
AP3394	♂	Sarwa	Pointing to spoor	Gaborone
AP3395	♂	River Bushman	Standing	Gaborone
AP3396	♀	Sarwa	Standing, holding baby	Kanye
AP3397	♀	Sarwa	Sitting	Kanye
AP3398	♀	!Kung	Old woman standing	Nuragas
AP3399	♀	!Kung	Sitting with son	Nuragas
AP3400	♂	!Kung	Sitting with mother	Nuragas
AP3401	♂	'Bushman'	Bust only	Otjito
AP3402	♂	'Bushman'	Bust only	Otjito
AP3403	♂	Nama	Standing	Grootfontein
AP3404	♂	'Bushman'	Holding a hare	Lake Chrissie, Transvaal
AP3405	♂	'Bushman'	Lifting arms	Lake Chrissie
AP3406	♂	'Bushman'	Holding a stick	Lake Chrissie
AP3407	♂	'Bushman'	Dancing	Lake Chrissie
AP3408	♂	'Bushman'	Sitting, pounding a bone	Lake Chrissie
AP3409	♂	'Bushman'	Boy standing, arms folded	Lake Chrissie
AP3410	♀	'Bushman'	Carrying a pot	Lake Chrissie
AP3411	♀	'Bushman'	Sitting	Lake Chrissie
AP3412	♀	'Bushman'	Sitting, stirring food	Lake Chrissie
AP3413	♀	'Bushman'	Bending forward	Lake Chrissie
AP3414	♀	'Bushman'	Standing	Lake Chrissie
AP3415	♂	Damara/Topnaar	Standing, with stick	Possession Is.
AP3416	♂	'Hottentot'	Half-reclining	Possession Is.
AP3417	♀	'Hottentot'	Standing, right arm raised	Possession Is.
AP3878	♀	Topnaar	Sitting	Possession Is.
AP3879	♀	/Xam	Walking, stick over shoulder	Prieska, Cape
AP3880	♂	/Xam	Bow in hand	Prieska
AP3881	♂	/Xam	Drawing bow	Prieska
AP3882	♂	/Xam	Sitting cross-legged	Prieska
AP3883	♀	/Xam	With digging-stick	Carnavon
AP3884	♀	/Xam	Sitting, digging	Prieska

AP3887	♀	/Xam	Pounding snuff	Prieska
AP3888	♂	/Xam	Bending forward	Prieska
AP3889	♂	/Xam	Squatting as if using fire-sticks	Prieska
AP3890	♂	/Xam	Standing, arm out-stretched	Prieska
AP3891	♂	/Xam	Crouching	Carnarvon
AP3892	♂		Crouching, arm out-stretched	Carnarvon
AP3893	♂	Nama	Boy sitting	Vosburg
AP3894	♂	/Xam	Boy playing musical instrument (gorah)	Upington (cast at Tokai reformatory)
AP3895	♀	/Xam	Reclining	Prieska
AP3896	♀	/Xam mother, Cape coloured father	Standing, right arm on hip	Victoria West
AP3897	♀	'Hottentot' mother, Xhosa father	Standing, arms extended	Britstown (cast in House of Correction, Cape Town)
AP3898	♀	? Hottentot or Bushman mother, Hottentot father	Standing	Britstown (cast in House of Correction, Cape Town)
AP3899	♂	Korana	Standing	Cast at Kimberley prison
AP3900	♂	Kgalagadi	Sitting, one knee raised	Kanye
AP3901	♀	Kgalagadi	Standing, carrying pot on head	Kanye
AP3902	♀	Kgalagadi	Kneeling, using pestle and mortar	Kanye
AP3903	♂	'Makua'	Standing, body cicatrized	Cast in Johannesburg
AP3904	♀	'Hottentot'	Head only	Bethany (cast in Windhoek prison)
AP3905	♂	Nama	Standing	Windhoek prison
AP3906	♂	Bondelswart	Head only	Bethany (cast in Windhoek prison)
AP3907	♂	Korana	Standing	De Beers Compound, Kimberley
AP3908	♂	Cape Hottentot	Boy standing, arm outstretched	De Beers Compound, Kimberley
AP3909	♂	Griqua	Standing as if in trance	De Beers Compound, Kimberley
AP3910	♂	Topnaar	Standing	Walvis Bay
AP3911	♂	Kgalagadi	Sitting, with outstretched legs	Gaborone prison
AP3912	♀	/Xam	Sitting on rock	Carnarvon
AP3913	♀	Auen	Sitting as if making ostrich egg-shell beads	Sandfontein
AP3914	♀	Auen	Sitting as if drilling bore in beads	Sandfontein
AP3915	♀	Naron	Standing, clapping	Sandfontein
AP3916	♀	Naron	Dancing	Sandfontein
AP4608	♀	Heikom	Standing, clapping	Grootfontein
AP4609	♂	Auen	Sitting as if making string	Sandfontein
AP4610	♂	? Bush	Walking	De Beers Compound, Kimberley

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AP3884	♀	/Xam	Sitting, digging	Prieska
AP3885	♀	/Xam	Standing with hands on hips	Prieska
AP3886	♀	/Xam	Standing, resting on stick	Prieska
AP3887	♀	/Xam	Pounding snuff	Prieska
AP3888	♂	/Xam	Bending forward	Prieska
AP3889	♂	/Xam	Squatting as if using fire-sticks	Prieska
AP3890	♂	/Xam	Standing, arm out-stretched	Prieska
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AP4610	♂	? Bush	Walking	De Beers Compound, Kimberley

Fig. 5. Three young men at the /Xam encampment, Prieska, 1911. (Photograph: D. Bleek, South African Museum Photographic Collection.)

supported by the presence of 'physical characters that could not be ignored' (SAM Annual Report for 1911: 22). Social and cultural information relating to particular individuals, such as old Guiman Toonies who, in his youth, had been a hunter of gemsbok, eland and kudu, was not considered as important as his physical attributes. Later in 1911, when the casts were put on exhibition at the South African Museum, these physical characters became the primary focus of public interest.

EXHIBITING THE CASTS

The exhibited figures were not intended to evoke a presence of the social beings who had been cast at a particular time and place, but instead were presented as generalized examples of a racial type. Separated from their social and historical context, the people who were cast were literally objectivized and reduced to scientific specimens. People, who in actual life were living as farm labourers or domestic servants, having survived a long period of conflict with the Cape Government, became no more than examples of a physical type (Fig. 6). Janikie Achterdam (Fig. 7), an informant of Dorothea Bleek, was one of the people from Prieska who was cast by Drury. In sharp contrast to the wealth of cultural knowledge of /Xam life that the Bleek records reveal, in the Museum the cast of Janikie was displayed as a numbered specimen, bereft of all cultural and social context (Fig. 8).

The main label in the exhibition (Fig. 6) of a group of casts taken at Prieska in 1911 read as follows:

> CAPE BUSHMEN: The Bushmen of the Cape appear to have been the purest-blooded representatives of the Bushman stock, much purer than those of the Kalahari

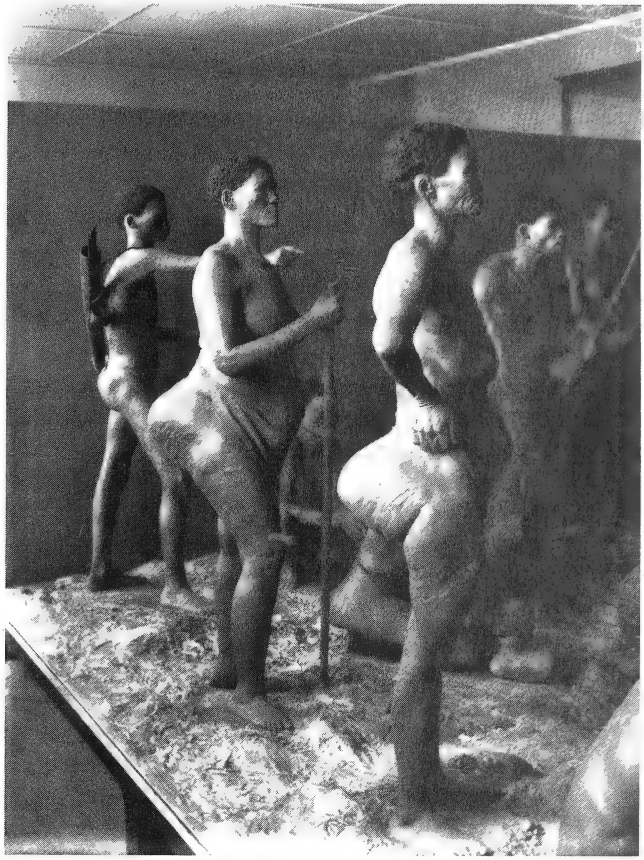

Fig. 6. The casts on display in the South African Museum, *c.* 1915. (South African Museum Photographic Collection.)

> and other more northerly districts. They are now practically extinct. They were light in colour and of small or medium height; the prominent posterior development (steatopygy) of the women was a characteristic feature of the race.
>
> To anthropologists the Bushmen are one of the most interesting races in the world. There are strong grounds for suspecting that they are of the same stock as the remote Upper Palaeolithic period. This cannot yet be definitely asserted but recent discoveries in North and East Africa have tended to strengthen the probability considerably.

(A key to the figures followed, giving approximate age of the subject and locality in which the cast was made.)

It is noteworthy that, while drawing attention in this label to purity of stock, in the same year Péringuey published the results of Dr F. C. Shrubsall's craniological analysis of some 162 skulls, which showed no discernible difference between San and Khoikhoi (Péringuey 1911). He stated 'I have given up, now, distinguishing between a so-called Bushman or a so-called Hottentot' (Péringuey 1911: 197). These findings were

Fig. 7. Janikie Achterdam, Prieska, 1911. (Photograph: D. Bleek, South African Museum Photographic Collection.)

Fig. 8. Cast of Janikie Achterdam (SAM–AP3895) on display in the South African Museum, *c.* 1912. (South African Museum Photographic Collection.)

communicated to a wider public in 1913 in a series of articles by Péringuey in the Cape Argus. Furthermore, while stating in the Museum label that the Cape Bushmen as a physical type were practically extinct, he commented in the newspaper that a surprising number of people speaking a Bushman language were still to be found in the Northern Cape. Considering that the purity of the /Xam had been attested in part on linguistic criteria, this must have been confusing evidence for Péringuey. Even in his own terms, the Museum label was contradictory to the known evidence.

The prominence accorded to the casts of /Xam and other Khoisan people was quite out of proportion to any proven anthropological importance. According to Péringuey's own assessment in 1918, 'The results of the examination of the large and representative [collection of] material of the 'San' Race accumulated at such great cost and difficulties by this Museum has not, I regret to say, materialized much' (SAM Annual Report for 1918). No later academic research contradicted this point of view, but the exhibition of casts none the less remained unchanged until 1932, when the casts were given even greater prominence by being placed in the centre of a new Ethnology Gallery (Davison 1991).

DISCUSSION

In retrospect, the casting project, undertaken between 1907 and 1924, provides a clear example of the way in which museum practice reduced people of another culture to objects of study. Through the project, San and Khoikhoi people were classified and reified as racial Others, a stereotype that was perpetuated in the way the casts were labelled and exhibited in the Museum. For decades after Péringuey's death in 1924 countless visitors, including thousands of school-children each year, viewed exhibits that gave credibility to a flawed anthropological notion of racial typology.

Although it was not only in South Africa that an evolutionary paradigm remained the most prevalent model in ethnographic museums long after its rejection by academic anthropology (Coombes 1988), in the socio-political context of South Africa this would have reinforced and added credibility to a pervasive ideology of essential racial difference and inequality. Moreover, the power of this ideology would have been made all the more effective through being endorsed by an institution that claimed a position of scientific neutrality. That the presentation of the casts was perceived as being value-free is confirmed in a press report on Drury and his modelling skills (Cape Times, 7 February 1925):

> The value of the plaster casts lies in their absolute impartiality, their pure, unadulterated 'objectivity'. They are the Bushmen themselves without the gloss of 'interpretation' or extraneous adornment . . . every shade of facial expression is caught. Every expression, indeed, that the mind projects through the physical organism is recorded.

However, as shown above in Péringuey's memorandum to Drury, the casting project was not impartial, nor was the presentation of the casts neutral, even if they appeared so life-like and natural that viewers tended not to question the implicit assumptions underlying their exhibition. It was less politically contentious to represent 'the Bushmen' as an endangered anthropological type, and therefore of scientific interest, than to confront social issues of colonial dispossession, racial conflict and integration. The emphasis was on an idealized, hypothetical, 'traditional' past. No attempt was made to represent the actual living conditions of the remnant San communities, among whom Drury found his subjects. It was the 'pure' physical type beneath the European dresses, jackets and trousers that was deemed to be of scientific interest. In pursuing this interest, the people who were cast were distanced and denied the sensibilities of the observer.

Ironically, however, if viewers had looked closely at the casts on display, they could have seen in Drury's accurate rendering of the skin pigmentation of his subjects pale and darker tones that correspond to the clothed parts of the body and those that were exposed to the sun. This minutely observed detail, fulfilling Péringuey's instructions to a fault, bears subtle testimony to the ideas that informed the casting project. Abstracted from the social and cultural context of their human subjects, the casts on display reveal Péringuey's scientific interests, Drury's casting expertise and the unequal power relations inherent in the execution of the project. In brief, the casts are authentic artefacts of scientific attitudes and museum practice in the early twentieth century.

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6. SYSTEMATIC papers must conform to the *International code of zoological nomenclature* (particularly Articles 22 and 51).

Names of new taxa, combinations, synonyms, etc., when used for the first time, must be followed by the appropriate Latin (not English) abbreviation, e.g. gen. nov., sp. nov., comb. nov., syn. nov., etc.

An author's name when cited must follow the name of the taxon without intervening punctuation and not be abbreviated; if the year is added, a comma must separate author's name and year. The author's name (and date, if cited) must be placed in parentheses if a species or subspecies is transferred from its original genus. The name of a subsequent user of a scientific name must be separated from the scientific name by a colon.

Synonymy arrangement should be according to chronology of names, i.e. all published scientific names by which the species previously has been designated are listed in chronological order, with all references to that name following in chronological order, e.g.:

Family **Nuculanidae**

Nuculana (Lembulus) bicuspidata (Gould, 1845)

Figs 14–15A

Nucula (Leda) bicuspidata Gould, 1845: 37.
Leda plicifera A. Adams, 1856: 50.
Laeda bicuspidata Hanley, 1859: 118, pl. 228 (fig. 73). Sowerby, 1871: pl. 2 (fig. 8a–b).
Nucula largillierti Philippi, 1861: 87.
Leda bicuspidata: Nicklès, 1950: 163, fig. 301; 1955: 110. Barnard, 1964: 234, figs 8–9.

Note punctuation in the above example:
comma separates author's name and year
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full stop separates references by different authors
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In describing new species, one specimen must be designated as the holotype; other specimens mentioned in the original description are to be designated paratypes; additional material not regarded as paratypes should be listed separately. The complete data (registration number, depository, description of specimen, locality, collector, date) of the holotype and paratypes must be recorded, e.g.:

Holotype

SAM–A13535 in the South African Museum, Cape Town. Adult female from mid-tide region, King's Beach, Port Elizabeth (33°51′S 25°39′E), collected by A. Smith, 15 January 1973.

Note standard form of writing South African Museum registration numbers and date.

7. SPECIAL HOUSE RULES

Capital initial letters

(a) The Figures, Maps and Tables of the paper when referred to in the text
e.g. '. . . the Figure depicting *C. namacolus* . . .': '. . . in *C. namacolus* (Fig. 10) . . .'
(b) The prefixes of prefixed surnames in all languages, when used in the text, if not preceded by initials or full names
e.g. Du Toit but A. L. du Toit; Von Huene but F. von Huene
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Punctuation should be loose, omitting all not strictly necessary

Reference to the author should preferably be expressed in the third person

Roman numerals should be converted to arabic, except when forming part of the title of a book or article, such as
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Specific name must not stand alone, but be preceded by the generic name or its abbreviation to initial capital letter, provided the same generic name is used consecutively. The generic name should not be abbreviated at the beginning of a sentence or paragraph.

Name of new genus or species is not to be included in the title; it should be included in the abstract, counter to Recommendation 23 of the Code, to meet the requirements of Biological Abstracts.

PATRICIA DAVISON

HUMAN SUBJECTS AS MUSEUM OBJECTS. A PROJECT TO MAKE LIFE-CASTS OF 'BUSHMEN' AND 'HOTTENTOTS', 1907–1924

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ANNALS
OF THE SOUTH AFRICAN MUSEUM

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CAPE TOWN

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1. MATERIAL should be original and not published elsewhere, in whole or in part.

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Title: informative but concise, without abbreviations and not including the names of new genera or species
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(c) *Table of contents* giving hierarchy of headings and subheadings
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Major headings of the paper are centred capitals; first subheadings are shouldered small capitals; second subheadings are shouldered italics; third subheadings are indented, shouldered italics. Further subdivisions should be avoided, as also enumeration (never roman numerals) of headings and abbreviations.

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Only generic and specific names should be underlined to indicate italics; all other marking up should be left to editor and publisher.

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FISCHER, P. H. 1948. Données sur la résistance et de la vitalité des mollusques. *Journal de conchyliologie* **88** (3): 100–140.
FISCHER, P. H., DUVAL, M. & RAFFY, A. 1933. Études sur les échanges respiratoires des littorines. *Archives de zoologie expérimentale et générale* **74** (33): 627–634.
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(continued inside back cover)

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CRETACEOUS FAUNAS FROM ZULULAND AND NATAL, SOUTH AFRICA. THE HETEROMORPH AMMONITE GENUS *EUBACULITES* SPATH, 1926

By

HERBERT CHRISTIAN KLINGER
&
WILLIAM JAMES KENNEDY

Cape Town Kaapstad

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CRETACEOUS FAUNAS FROM ZULULAND AND NATAL, SOUTH AFRICA. THE HETEROMORPH AMMONITE GENUS *EUBACULITES* SPATH, 1926

By

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Geological Collections, University Museum, Oxford

(With 57 figures)

[*MS accepted 27 May 1991*]

ABSTRACT

The taxonomy of the heteromorph ammonite genus *Eubaculites* Spath, 1926 (family Baculitidae), is reviewed and the five most important species, *Eubaculites carinatus* (Morton, 1834), *E. labyrinthicus* (Morton, 1834), *E. vagina* (Forbes, 1846), *E. simplex* (Kossmat, 1895) and *E. latecarinatus* (Brunnschweiler, 1966), are described.

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INTRODUCTION

The genus *Eubaculites* Spath, 1926, is a prominent member of the ammonite fauna of the Zululand Maastrichtian, and is the dominant ammonite in terms of both biomass and numbers of individuals at certain levels in both the Lower and Upper Maastrichtian in parts of Zululand, Chile, Western Australia, and the U. S. Gulf Coast region. Although unknown in Antarctica, the U. S. Western Interior, North and West Africa, Greenland, Asia, Japan, and the Middle East, its otherwise wide distribution shows it to have been one of the most important Maastrichtian heteromorphs. The five best known species,

Ann. S. Afr. Mus. **102** (6), 1993: 185–264, 57 figs.

Eubaculites carinatus (Morton, 1834), *Eubaculites labyrinthicus* (Morton, 1834), *Eubaculites vagina* (Forbes, 1846), *Eubaculites simplex* (Kossmat, 1895), and *Eubaculites latecarinatus* (Brunnschweiler, 1966), are described and discussed below.

LOCATION OF SPECIMENS

The following abbreviations are used to indicate the location of specimens mentioned in the text:

AMNH	American Museum of Natural History, New York
ANSP	Academy of Natural Sciences, Philadelphia
BMNH	Natural History Museum, London
GSI	Geological Survey of India, Calcutta
OUM	Oxford University Museum
SAM	South African Museum, Cape Town
SAS	South African Geological Survey, Pretoria.

FIELD LOCALITIES

Details of field localities are given by Kennedy & Klinger (1975); further descriptions of these localities are deposited in the Department of Palaeontology, Natural History Museum, London, Geological Survey of South Africa, Pretoria, and Department of Invertebrate Palaeontology, South African Museum, Cape Town.

DIMENSIONS OF SPECIMENS

All dimensions are given in millimetres. Wb = whorl breadth; Wh = whorl height. The term 'rib index' means the number of ribs present in a distance equal to the whorl height at the middle of the interval measured. Taper index is:

$$\frac{\text{Larger whorl height–smaller whorl height}}{\text{Distance between measurements}} \times 100$$

SUTURE TERMINOLOGY

The suture terminology of Wedekind (1916), reviewed by Kullmann & Wiedmann (1970), is followed here: I = internal lobe, U = umbilical lobe, L = lateral lobe, E = external lobe.

SYSTEMATIC PALAEONTOLOGY

Phylum MOLLUSCA Cuvier, 1797
Class CEPHALOPODA Cuvier, 1797
Order AMMONOIDEA Zittel, 1884
Suborder ANCYLOCERATINA Wiedmann, 1966
Superfamily TURRILITACEAE Gill, 1871

Family **Baculitidae** Gill, 1871

Genus *Eubaculites* Spath, 1926

(= *Giralites* Brunnschweiler, 1966; *Cardabites* Brunnschweiler, 1966;
Eubaculiceras Brunnschweiler, 1966)

Type species. Baculites vagina Forbes var. *ootacodensis* Stoliczka, 1866: 199, pl. 90 (fig. 14), by the original designation of Spath (1926: 80) (= *Baculites labyrinthicus* Morton, 1834: 44, pl. 13 (fig. 10)).

Diagnosis

Curved or straight baculitids with pyriform whorl section in adult stage; length may exceed 1 m. Dorsum flat to rounded, venter fastigiate or with a tabulate siphonal keel, the edges of which are predominantly sharp but subrounded in some. Siphonal keel smooth, ribbed or crenulated. In juveniles, the whorl section may be ovoid, lacking a tabulate or fastigiate venter. Venter generally changes from fastigiate to keeled, with subrounded to tabulate top during ontogeny; in some it remains fastigiate throughout. Development of flank ornament variable; growth lines only, crescentic ribs, or up to two distinct rows of tubercles. Ribs may extend to dorsolateral or ventrolateral region. Aperture apparently simple, with ventral rostrum and sinuous lateral indentation. Suture with plump, finely incised saddles and lobes and phylloid elements in some saddles.

Discussion

The genus *Eubaculites* was introduced in characteristically brief fashion by Spath (1926: 80) as: '*Eubaculites* gen. nov. for the carinate forms of the group of *E. vagina* (Forbes) and *E. otacodensis* Stoliczka sp. (Kossmat, 'Unters. Südind. Kreideform. *Beitr. Pal. Österr.-Ung.*, vol. ix, 1895, p. 157, pl. xix, figs 15a, b genotype).' Wright (1957: L218) was the first to provide a diagnosis of *Eubaculites*: 'Section pear-shaped, with flat venter; ribs normally faint towards venter but on inner part form prominent long curved bullae; row of lower lateral tubercles may be present. Suture with plump, minutely frilled elements.'

Matsumoto (1959) described a limited *Eubaculites* fauna from California, and essentially followed Wright (1957) in his interpretation of the genus; however, he used the term 'tabulate ventral keel' instead of 'flat venter', because he believed *Eubaculites* could be derived from keeled baculitid species such as *Baculites occidentalis.*

Subsequent descriptions of eubaculitid faunas from various regions, e.g. Western Australia (Brunnschweiler 1966), Zululand, South Africa (Klinger 1976), Argentina (Riccardi 1974), Chile (Hünicken & Covacevich 1975; Stinnesbeck 1986), the Netherlands (Kennedy 1986*c*), Austria (Kennedy & Summesberger 1986), and southern France (Kennedy 1986*a*), have differed considerably in their interpretation of the genus—to the extent that Brunnschweiler placed it in a separate subfamily, Eubaculitinae, in which he recognized four genera.

It is necessary to look at the genus in terms of the type species. Kennedy (1986*c*: 193) pointed out that Spath's 'genotype' (type species) is a species and not an individual. *Eubaculites ootacodensis* is thus the type species of *Eubaculites*. The lectotype of *E. ootacodensis* by subsequent designation of Kennedy (1986*c*: 193) is the original of Stoliczka (1866, pl. 90 (fig. 14)) from the Maastrichtian Arrialoor Group of

South India, whereas (as shown below) *E. ootacodensis* is a synonym of *Eubaculites labyrinthicus* (Morton, 1834).

Because Spath (1926) did not provide a diagnosis of *Eubaculites*, it is possible to decide on the limit of his generic concept only on the basis of species he referred to it. That he included *Eubaculites vagina* of Forbes (1846*a*), the type material of which was available to him for study, shows that the distinctive feature of this species—a broad tabulate venter and bituberculate ribbed flanks—were encompassed. That he cited plate 19 (fig 15) of Kossmat (1895) as a reference to the species, rather than the original figure, is unfortunate, as this figure is of an incomplete specimen, lacking the critical features of the venter (Fig. 7F–H). It is, however, a topotype of the species, likely to be conspecific with *E. ootacodensis* of Stoliczka (= *Eubaculites labyrinthicus* (Morton, 1834)) and thus characterized by binodose, ribbed flanks and a fastigiate venter.

In describing the Maastrichtian faunas from Western Australia, Spath (1940: 49) referred Kossmat's *Baculites vagina* var. *simplex* (1895: 156(60), pl. 19(5) (figs 13a–b, 14a–cb)) to *Eubaculites*, but nevertheless separated it from *Eubaculites vagina* '. . . because it is a passage-form between *Eubaculites* and *Baculites* s.s'—thus including forms with both tabulate and fastigiate venters in *Eubaculites*. Later (1953: 20), he seemed to regard possession of a tabulate venter as an essential feature: 'The true *Eubaculites vagina* (Forbes) which I discussed recently (1940, p. 48) has a perfectly tabulate, not a sharpened, venter already at 10 mm (long diameter) . . . so that *Baculites cazadorianus* is neither a *Eubaculites* nor a variety of *E. vagina*.' In the same article (1953: 46), he also referred to *Baculites vagina* var. *simplex* Kossmat as *E.(?) simplex*. Both Wright (1957: L218) and Matsumoto (1959: 166) emphasized the tabulate shape of the venter of *Eubaculites*. Klinger (1976: 90) noted that Stoliczka's figure of *E. ootacodensis* showed a fastigiate venter, although his description may have been based in part on specimens with tabulate venters ('. . . the siphuncle often lies nearer to one edge than to the other; this, however, is not constant in all specimens'—Stoliczka 1866: 199).

Brunnschweiler (1966) described (amongst other heteromorphs) a eubaculitid assemblage of about 200 specimens from the Miria Marl of Western Australia—until then the most extensive collection of the genus described. This included forms with tabulate and fastigiate venter, ribbed and smooth forms, and inflated and compressed forms. These he referred to a new subfamily Eubaculitinae and four genera. This subfamily was distinguished from Baculitinae (Brunnschweiler 1966: 24) for those forms 'with a ventral keel which appears in very early growth stages. The keel is either acute or tabulate, never rounded.'

Brunnschweiler's criteria for recognition of the four genera he referred to the subfamily Eubaculitinae were as follows:

Genus *Eubaculites*, type species *E. ootacodensis* (Stoliczka). This genus was restricted to those costate forms that are truly similar to the type species in cross-section and shape of the keel.

Genus *Giralites* Brunnschweiler, 1966, type species *Giralites latecarinatus* Brunnschweiler, 1966. The genus included non-costate species in which the Wh : Wb ratio is less than 1,8 : 1.

Genus *Eubaculiceras*, type species *Eubaculiceras compressum* Brunnschweiler, 1966. This included ribbed species with a very compressed whorl section and a Wh : Wb ratio of 2 : 1 or more.

Genus *Cardabites* Brunnschweiler, 1966, type species *Cardabites tabulatus* Brunnschweiler, 1966. This is a non-costate genus with a very compressed whorl section with a Wh : Wb ratio of 2 : 1 or more.

Klinger (1976: 83–84) regarded all these as synonyms of *Eubaculites* and, for stratigraphic purposes, recognized four species groups based primarily on lateral ornament and secondarily on compression of the whorl section, although admitting that the divisions were arbitrary and that the groups were connected by transitions:

1. *Eubaculites* gr. ex. *vagina* (Forbes) with pyriform whorl shape, Wh : Wb less than 2 : 1, ornament consists of tubercles at mid-flank and at dorsolateral edge.
2. *Eubaculites* gr. ex. *ootacodensis* (Stoliczka). Whorl section as in *E. vagina*; lateral ornament consisting of strong crescentic ribs. Venter tabulate or fastigiate.
3. *Eubaculites* gr. ex. *latecarinatus* (Brunnschweiler). Whorl section as above, but flanks devoid of all ornament.
4. *Eubaculites* gr. ex. *compressum* (Brunnschweiler). Whorl section strongly compressed; Wh : Wb, 2 : 1 or more. Lateral ornament, if present, very weak. Venter fastigiate or tabulate.

Kennedy (1986*a*: 1015; 1986*c*: 194) and Kennedy & Summesberger (1986: 197) accepted Klinger's (1976) species groups with some modifications, but considered the shape of the ventral keel to be of major significance. Kennedy (1986*a*: 1015, 1986*c*: 194) recognized three species groups:

1. Species with fastigiate venter and flattened dorsum, ribbed or smooth, e.g. *Baculites ootacodensis* Stoliczka, 1866, *Baculites vagina* var. *simplex* Kossmat, 1895, *Baculites rioturbioensis* Hünicken, 1965, *Eubaculiceras fastigiatum* Brunnschweiler, 1966, *Cardabites scimitar* Brunnschweiler, 1966, and *Baculites argentinicus* Weaver, 1927—the last named a *nomen dubium* and possibly a corroded fragment of *B. rioturbioensis*.
2. Species with tabulate venter, flattened dorsum, dorsolateral and dorsal tubercles, some individuals smooth, e.g. *Baculites vagina* Forbes, 1846, and *Baculites ornatus* d'Orbigny, 1847.
3. Species with tabulate venter and flattened dorsum generally ornamented by flank ribs, some individuals may be smooth, e.g. *Baculites lyelli* d'Orbigny, 1847, *Eubaculites kossmati* Brunnschweiler, 1966, *Eubaculites multicostatus* Brunnschweiler, 1966, *Giralites latecarinatus* Brunnschweiler, 1966, *Giralites quadrisulcatus* Brunnschweiler, 1966, *Eubaculiceras compressum* Brunnschweiler, 1966, and *Cardabites tabulatus* Brunnschweiler, 1966.

Stinnesbeck (1986) discussed *Eubaculites lyelli* from Quiriquina, Chile, on the basis of several hundred specimens; he concluded that transitions to *E. latecarinatus*, *E. compressum* and *E. ootacodensis* occur in his material (of *E. lyelli*) but these cannot, as yet, be used for stratigraphic purposes. As far as we can ascertain, no typical examples of *E. latecarinatus*, *E. compressum* or *E. ootacodensis* occur at Quiriquina.

A subsequent unpublished revision of North American *Eubaculites* by Kennedy & Cobban (in preparation) revealed that the prior name for *Baculites lyelli* of d'Orbigny (1847) was *Baculites carinatus* (Morton, 1834), and that for *Baculites vagina* var. *ootacodensis* of Stoliczka (1866) was *Baculites labyrinthicus* of Morton (1834), as described below.

Henderson *et al.* (1992) revised the *Eubaculites* of the Miria Formation and underlying phosphate horizon at the top of the Korojong Calcarenite in the Carnarvon Basin, Western Australia. They recognized *Eubaculites latecarinatus* (with *Giralites quadrisulcatus* Brunnschweiler (1966) and *Eubaculites ambindensis* of Collignon (1971) as synonyms) as the oldest species, present only in the phosphatic nodule bed at the top of the Korojong Calcarenite. The overlying Miria Formation yielded two species: *Eubaculites carinatus* (of which *Eubaculites ootacodensis* of Brunnschweiler (1966, *non* Kossmat), *E. vagina* of Brunnschweiler (1966, *non* Forbes), and *E. kossmati* and *E. multicostatus* are synonyms) and *E. simplex* (of which *Eubaculiceras compressum*, *E. fastigiatum*, *Cardabites tabulatus* and *C. scimitar* are synonyms). They also showed *E. simplex* to include individuals with both tabulate and fastigiate venter through ontogeny, as well as those with an initially fastigiate venter that develop a tabulate venter subsequently.

Baculites occidentalis Meek, 1862 (see e.g. Usher 1952: 98, pl. 28 (fig. 1), pl. 31 (fig. 19), text-fig. 4; Matsumoto 1959: 150, pl. 35 (figs 2a–d, 3a–d), pl. 36 (fig. 1a–d), pl. 41 (fig. 1a–d), pl. 42 (fig. 1a–c, 2a–c), text-figs 64, 65a–b, 66, 67–71; Obata & Matsumoto *in* Matsumoto & Obata 1963: 82, pl. 23 (fig. 3), pl. 25 (fig. 1), pl. 26 (figs 1–3), pl. 27 (figs 2–5, 8), text-figs 172–186), has an indistinct siphonal keel with rounded edges, and was regarded by Matsumoto (1959: 154) as an intermediate stage between *Baculites* and *Eubaculites*. We here tentatively regard it as an early form of *Eubaculites*.

Baculites regina Obata & Matsumoto (*in* Matsumoto & Obata 1963: 85, pl. 22 (figs 3–6), pl. 23 (figs 1–2), pl. 24 (figs 1–5), pl. 25 (figs 3–5), pl. 27 (figs 1, 6–7, 9), text-figs 191–196, 200–214) from the Campanian of Honshu, was compared to *Eubaculites* by Obata & Matsumoto (*in* Matsumoto & Obata 1963: 90), because of its flattened dorsum, subangular dorsal edges and differentiation of lateral ornament. However, it lacks a tabulate siphonal keel and is better regarded as a lateral offshoot of *Eubaculites occidentalis* rather than in the main line of descent to *Eubaculites*, according to Obata & Matsumoto (*in* Matsumoto & Obata 1963: 91).

Baculites lomaensis Anderson (1958: 191, pl. 48 (figs 5–6)) was regarded as being related to *Eubaculites vagina* by Anderson, but it appears that this opinion was based mainly on stratigraphic grounds. *Baculites lomaensis* lacks a tabulate siphonal keel and has a suture line similar to early true *Baculites*.

We here recognize the following species of *Eubaculites*, synonyms of the most important which are given below: *Eubaculites carinatus* (Morton, 1834), *Eubaculites labyrinthicus* (Morton, 1834), *Eubaculites vagina* (Forbes, 1846), *Eubaculites latecarinatus* (Brunnschweiler, 1966), *Eubaculites simplex* (Kossmat, 1895), and *Eubaculites occidentalis* (Meek, 1862). *Baculites binodosus* Noetling, 1897, and *Baculites rioturbioensis*, Hünicken, 1965, may be further valid species.

Occurrence

Where well dated, *Eubaculites* is typically Maastrichtian, ranging throughout most of the stage; *Eubaculites occidentalis* may appear in the Upper Campanian (for the basis of a Campanian date, see Ward 1978*a*, 1978*b*). The evolutionary origin of the genus is not clear; it probably lies in the group of *Baculites chicoensis* Trask, 1856 (see Matsumoto 1959: 145, pl. 36 (fig. 2), pl. 37 (fig. 1), text-figs 59a–d, 60a–b, 61a–b, 62a–b, 63a–b), from the Lower Campanian of California and British Columbia, but similarities in ornament between *E. carinatus* and *E. labyrinthicus*, and *Baculites* sp. (nov.?) cf.

B. aquilaensis Reeside (*in* Collignon, 1970: 81, pl. 639 (fig. 8, 8a); see Fig. 57) from the Upper Campanian of Madagascar and *Baculites vanhoepeni* from the Campanian of Zululand, are striking. However, this probably is due to homoeomorphous development only. Unfortunately, the phylogeny of the genus is difficult to elucidate, mainly because of the very poor level of inter-regional correlation of the Maastrichtian at the present time, this difficulty also extending to the definition of the base of the stage (Birkelund *et al.* 1984) and division into substages. The present state of knowledge of *Eubaculites* in its main areas of occurrence is discussed below.

South Africa. Details of the distribution of *Eubaculites* in Zululand were given by Klinger (1976). These are emended here on the basis of new collections and the taxonomic revision given below. Specimens previously referred to *E. ootacodensis* are *E. carinatus*, as are some specimens previously referred to *E. vagina*.

Stratigraphic distribution is as follows: *Eubaculites labyrinthicus*—Maastrichtian II; *Eubaculites carinatus*—Maastrichtian a, Maastrichtian I–II; *Eubaculites latecarinatus*—Maastrichtian ?a, Maastrichtian I–?II; *Eubaculites simplex*—Maastrichtian I–II; *Eubaculites vagina* (*?*)—Maastrichtian I.

Eubaculites carinatus is most abundant in Maastrichtian I–II, but occurs as early as Maastrichtian a (*ex* Campanian IV of Kennedy & Klinger 1975). *Eubaculites latecarinatus* is very abundant in Maastrichtian I and possibly persists to Maastrichtian II. Offshore data (Klinger *et al.* 1980) suggested it may already occur as early as Maastrichtian a. *Eubaculites simplex* is known from Maastrichtian I–II. Typical binodose adult *E. vagina* are not known from Zululand—possible *E. vagina* (herein interpreted as *E. labyrinthicus*) are known from Maastrichtian I.

Mozambique. Material described by Crick (1924) is poorly preserved, but is here identified as follows: *Baculites sheringomensis* = *Eubaculites carinatus*; *Baculites vagina* var. *ootacodensis* = *Eubaculites carinatus*; and *Baculites vagina* var. *simplex* = *Eubaculites carinatus*.

Chile. The Quiriquina Formation has yielded only one species, *E. carinatus*, which is also the most common ammonite there (Fig. 37) (cf. Hünicken & Covacevich 1975; Stinnesbeck 1986). Stinnesbeck (1986: 207) claimed that transitions to *E. latecarinatus*, *E. compressum* and *E. ootacodensis* are present in his collections but stated that these do not, as yet, have any stratigraphic significance (*E. ornatus* d'Orbigny, 1847, is most probably a specimen of *E. vagina* from Pondicherry, India). Stinnesbeck (1986) dated the Zone of *Eubaculites lyelli* (= *E. carinatus*) as upper Lower Maastrichtian to Upper Maastrichtian.

Argentina. *Eubaculites carinatus* is relatively common in the Neuquén Basin of northern Patagonia. Riccardi (1974) dated it as Lower–Middle Maastrichtian.

Weaver (1927) described *Baculites argentinicus* from the Cerro Huantraico in Neuquén Province. This is based on two fragmentary specimens (see Olsson 1944: 105 (263)) and has generally been interpreted as a *nomen dubium* (cf. Riccardi 1974: 397; Kennedy 1986*a*: 1015; 1986*c*: 194). Camacho (1967) recorded this species from Paso del Sapo on the Chubut River, and regarded it as a *Eubaculites*. It belongs to the group of *E. simplex* in having a fastigiate venter. Camacho (1968: 328, pl. 3 (figs 5a–b, 6)) recorded a baculitid with a fastigiate venter, and a true *Eubaculites* with tabulate venter from this area. Subsequent work by M. Uliana (*in* Riccardi 1974: 396) has yielded *Baculites rioturbioensis*.

Baculites argentinicus and *B. rioturbioensis* appear to be synonyms, and are contemporaries of *Eubaculites*.

Baculites rioturbioensis was described from the 'Yacimiento Rio Turbio', Santa Cruz Province in the Austral Basin of Patagonia, near the boundary with Argentina and Chile. Hünicken (1965: 63) dated it as uppermost Campanian to basal Maastrichtian. *Baculites rioturbioensis* has a flat dorsum, fastigiate venter, and broad undulating lateral ribs; it belongs to the group of *E. simplex*. A ribbed specimen of *Eubaculites* was described from a borehole in Santa Cruz Province by Garcia & Camacho (1965: 72, pl. 1 (fig. 4)).

There may thus be an older *Eubaculites carinatus–Baculites rioturbioensis* assemblage and a younger one with *E. carinatus* alone.

Western Australia. Based on the work of Henderson & McNamara (1985) and Henderson *et al.* (1992), the following sequence can be recognized in the Carnarvon Basin. The oldest assemblage with *Eubaculites* comes from the nodule bed at the top of the Korojong Calcarenite (12–20 cm), with *Eubaculites latecarinatus*, *Nostoceras (N.) attenuatus* Brunnschweiler, 1966, *N. (N.) fischeri* Brunnschweiler, 1966, and *Gunnarites kalika* (Stoliczka, 1865). The lower part (75–150 cm thick) of the overlying Miria Formation yields *Eubaculites simplex* and rare non-heteromorphs, including *Phyllopachyceras forbesianum* (d'Orbigny, 1850), *Pachydiscus jacquoti australis* Henderson & McNamara, 1985, *Gunnarites kalika*, *Neophylloceras surya* (Forbes, 1846) and *Gaudryceras kayei* (Forbes, 1846). The upper part of the Miria Formation (45–50 cm) yields abundant *Eubaculites carinatus*, common *Diplomoceras cylindracum* (Defrance, 1816) and *Glyptoxoceras rugatum* (Forbes, 1846), rare *Baculites lechitides* Brunnschweiler, 1966, and 22 species of non-heteromorphs described by Henderson & McNamara (1985). The succeeding Palaeocene Boongarooda Greensand yields reworked *Eubaculites carinatus*.

South India. The oldest occurrence of *Eubaculites* in South India is that of *Eubaculites labyrinthicus* (as *E. vagina* var. *ootacodensis*) and *E. simplex* in the white sandstone of the Arrialoor Group north of Ootacod, near Arrialoor, which also yielded *Pachydiscus tweenianus* (Stoliczka, 1865) and *Anapachydiscus arrialoorensis* (Stoliczka, 1865), and is said to yield *Hauericeras gardeni* (Baily, 1955). (*Pachydiscus preegertoni* Collignon, 1952, was also illustrated from an unspecified horizon near Arrialoor as *Ammonites egertonianus* Forbes of Stoliczka 1865, pl. 5 (figs 1, 1a); *fide* Matsumoto *et al.* 1986: 5.)

Much younger are records from the Valudavur Formation of Pondicherry. *Eubaculites vagina* comes from the *Anisoceras* beds of various authors and is probably from a horizon equivalent to the lower part of the Upper Maastrichtian *Abathomphalus mayaroensis* (planktonic foraminiferan) Zone (Rajagoplan 1965; Govindan 1972). *Eubaculites lyelli* probably occurs at an even higher horizon, the lower part of the *Trigonarca* Beds of Kossmat, horizon D of Warth (1895) (e.g. *Baculites vagina* var. *ootacodensis* Stoliczka of Kossmat 1895, pl. 19(5) (fig. 16)).

Madagascar. The records from Madagascar (Collignon 1971) indicate the presence of *E. vagina*, *E. labyrinthicus* (as *E. ootacodensis*), *E. simplex* and *E. latecarinatus* (as *Baculites occidentalis* and *E. ambindensis*) at the following localities (horizons): *E. vagina*—localities 504, 671; *E. simplex*—localities 503, 666; *E. latecarinatus*—localities 504, 665–7; and *E. labyrinthicus*—localities 503, 504.

We are unable to place these localities in sequence, but note that *E. vagina*, *E. latecarinatus* and *E. labyrinthicus* co-occur at locality (horizon) 504.

Japan. No typical *Eubaculites* has been recorded, but for doubtful *Baculites occidentalis* and *B. regina* Obata & Matsumoto from uncertain Upper Campanian to lower Maastrichtian of south-west Japan (*in* Matsumoto & Obata 1963).

United States. The oldest recorded *Eubaculites* is *E. occidentalis*, which occurs in the Upper Campanian–Lower Maastrichtian of California and British Columbia (Matsumoto 1959; Ward 1978*a*, 1978*b*). *Eubaculites carinatus* from the presumed Maastrichtian of California was recorded as misidentified *Baculites chicoensis* Gabb (1864 pars) and *Eubaculites ootacodensis* by Matsumoto (1959). In the Gulf Coast region, the Corsicana Formation of north-east Texas yields *Eubaculites carinatus* and is equivalent to the mid-Maastrichtian *Globotruncana gansseri* (planktonic foraminiferan) Zone (Kennedy & Cobban unpublished). The Owl Creek Formation of Missouri and Mississippi yields common *E. carinatus* (Conrad 1858; Stephenson 1955) and is referred to the upper part of the *G. gansseri* zone by C. C. Smith (pers. comm. 1990). The Maastrichtian Prairie Bluff Chalk in Alabama is the source of the type material of *E. carinatus* and *E. labyrinthicus*, but these occurrences are difficult to date precisely as they are from phosphatic layers that include elements from more than one horizon in the Maastrichtian, at least in some places.

In New Jersey, *E. labyrinthicus* occurs in the Maastrichtian middle part of Navesink Formation, and *E. carinatus* has been found reworked into the base of the succeeding Palaeocene.

Europe. There is a well-substantiated belemnite zonation from the White Chalk of north-west Europe, into which the scattered occurrences of *Eubaculites carinatus* can be placed. This zonation is:

	ZONE
Upper Maastrichtian	*Belemnella casimirovensis*
	Belemnitella junior
Lower Maastrichtian	*Belemnella occidentalis*
	Belemnella lanceolata

Eubaculites carinatus first appears at Neuberg, Steiermark, Austria, at a horizon equivalent to the lower part of the *Belemnella occidentalis* Zone (Kennedy & Summesberger 1986: 200), that is to say, somewhere in the *Globotruncana gansseri* (planktonic foram) Zone. The last appearance of *E. carinatus* is in the Petites-Pyrénées of south-eastern France (Kennedy *et al.* 1986), where the species occurs with forms of *Hoploscaphites constrictus* that indicate the *Belemnella casimirovensis* Zone, and foraminifera indicating the upper part of the *Abathomphalus mayaroensis* (planktonic foraminiferan) Zone. There is also a mass occurrence of this species in the *A. mayaroensis* Zone, approximately 40 m below the base of the Palaeocene at Hendaye (Pyrénées Atlantiques), France. A specimen from the Maastricht area (Kennedy 1986*c*: 195, pl. 27 (figs 5–8)) is from either the upper part of the *B. junior* Zone or the lower part of the *B. casimirovensis* Zone.

It is difficult to determine absolute ranges for *Eubaculites* species from these data, because of difficulties in long-distance correlation. Using Upper and Lower Maastrichtian in a north-west European sense, *E. carinatus* is seen to be long-ranging, from middle Lower to upper Upper Maastrichtian. *Eubaculites vagina* is probably lower Upper Maastrichtian, overlapping with *E. carinatus*, but not occurring with it in the Valudavur Formation in South India.

Evidence from Western Australia suggests *E. simplex* to be Upper Maastrichtian; that it is older than *E. vagina* in South India might suggest lower Upper Maastrichtian. *Eubaculites latecarinatus* is older than *E. simplex* in Western Australia, whereas *E. labyrinthicus* occurs with *E. carinatus* and *E. latecarinatus* in Maastrichtian II in Zululand.

The succession of *Eubaculites* may thus be:

E. carinatus (youngest)
E. carinatus, *E. vagina*
E. carinatus, *E. simplex* (?plus *E. labyrinthicus*)
E. carinatus, *E. labyrinthicus*, *E. latecarinatus*
E. carinatus
E. occidentalis (oldest).

Eubaculites labyrinthicus (Morton, 1834)

Figs 1–6, 7F–H, 36A–D, 52A–C

Baculites labyrinthicus Morton, 1834: 44, pl. 13 (fig. 10).
Baculites vagina Forbes var. *Ootacodensis* Stoliczka, 1866: 199, pl. 90 (fig. 14) (*non* fig. 15).
Baculites vagina var. *Otacodensis* Stoliczka: Kossmat, 1895: 157, pl. 19(5) (?fig. 15) (*non* fig. 16 = *E. carinatus*). Cottreau, 1922: 180(72), pl. 9(17) (fig. 11–11b). Diener, 1925: 63 (pars).
Baculites vagina Forbes: Spengler, 1923: 54, pl. 4 (fig. 9). Besairié, 1930: 222, pl. 26 (figs 12–13).
non *Eubaculites otacodensis* (Stoliczka): Spath, 1940: 49, pl. 1 (fig. 3), text-fig. 1b (= *E. carinatus*).
non *Eubaculites ootacodensis* (Stoliczka): Wright, 1957: L218, text-figs 245, 246a–c (= *E. carinatus*).
non *Eubaculites ootacodensis* (Stoliczka): Matsumoto, 1959: 166, pl. 43 (fig. 6), pl. 44 (figs 1–3), text-figs 84–85 (= *E. carinatus*).
non *Eubaculites ootacodensis* (Stoliczka): Brunnschweiler, 1966: 27, pl. 1 (figs 9–14), text-figs 9–11 (= *E. carinatus*).
?Eubaculites sp. Leanza, 1967: 55, pl. 1 (figs 6–7).
Baculites simplex Kossmat: Collignon, 1971: 15, pl. 645 (figs 2388–2389).
non *Eubaculites otacodensis* Stol.: Collignon, 1971: 18, pl. 646 (fig. 2395) (? = *E. carinatus*).
non *Eubaculites ootacodensis* (Stoliczka): Riccardi, 1974: 388, pl. 1 (figs 1–7), pl. 2 (figs 1–4, 6), pl. 3 (figs 1–6), pl. 4 (figs 1–7), text-fig. 2 (= *E. carinatus*).
Eubaculites ootacodensis (Stoliczka): Klinger, 1976: 90 (pars) pl. 39 (fig. 3 only) (*non* fig. 1); *non* pl. 41 (figs 1–2), pl. 42 (figs 3, 8), text-fig. 11c (= *E. carinatus*). Kennedy, 1986*c*: 194 (pars).
Eubaculites labyrinthicus (Morton): Kennedy & Henderson, 1992: 716, text-fig. 5D–K.

Types

There are two syntypes (Fig. 1). The original of Morton (1834, pl. 13 (fig. 10)) is ANSP 72868; the second specimen is ANSP 72869. Both are from the Prairie Bluff Chalk of Alabama. The lectotype of *Baculites ootacodensis* is the original of Stoliczka (1866, pl. 90 (fig. 14a–c)) (Fig. 5), GSI 406 and GSI 407 in the Collections of the Geological Survey of India, from 'the white gritty sandstone north of Ootacod, near Arrialoor'.

Material

SAM–PCZ8652 from Bed 3(C) and OUM–KX1828–1833, from Bed 7 (G) at locality 20, Zululand, St Lucia Formation, Maastrichtian I–II.

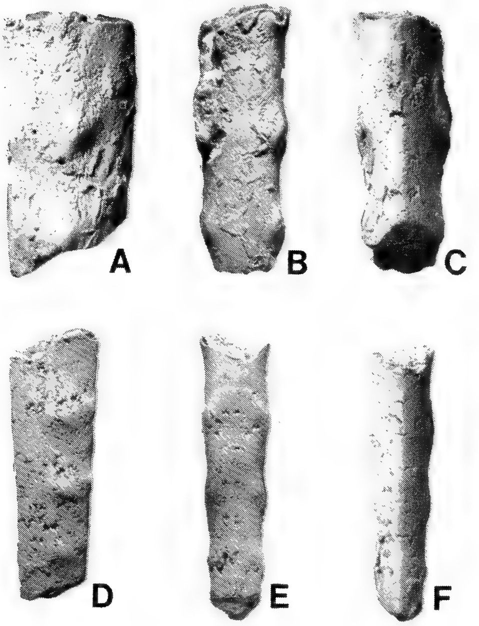

Fig. 1. *Eubaculites labyrinthicus* (Morton, 1834). A–C. Syntype, ANSP 72868. D–F. Syntype, ANSP 72869. Both from the Prairie Bluff Chalk of Alabama. Collection of the Academy of Natural Sciences of Philadelphia. × 1.

Diagnosis

Whorl section cuneiform, with flattened dorsum and fastigiate venter, lacking siphonal, tabulate keel; lateral ornament consists of two rows of tubercles, linked by ribs of variable strength.

Description

This is a rare species. In addition to the types, we have seen four other fragments from the Prairie Bluff Chalk. All are phosphatic internal moulds; they range from 8,0 mm to 17,5 mm in whorl height. The largest specimen (syntype ANSP 72868), figured by Morton (1834, pl. 13 (fig. 10)), is wholly septate throughout (Fig. 1A–C). The expansion rate is moderate, the whorl section compressed, with intercostal whorl breadth to height ratio 0,58. The dorsum is flattened and barely convex. The dorsolateral margin is narrowly rounded, the dorsal flanks flattened, mid-flank region broadly rounded, ventral flanks flattened and convergent, and the venter fastigiate. Strong nodes, elongated parallel to the length of the shell, perch on the dorsalmost flank, two occurring in a distance equal to the whorl height. A low, broad rib connects the node to a similarly elongated but slightly obliquely aligned mid-lateral tubercle. The mid-lateral tubercles give rise to delicate riblets and striae, also present on the interspaces, and projected forwards to intersect

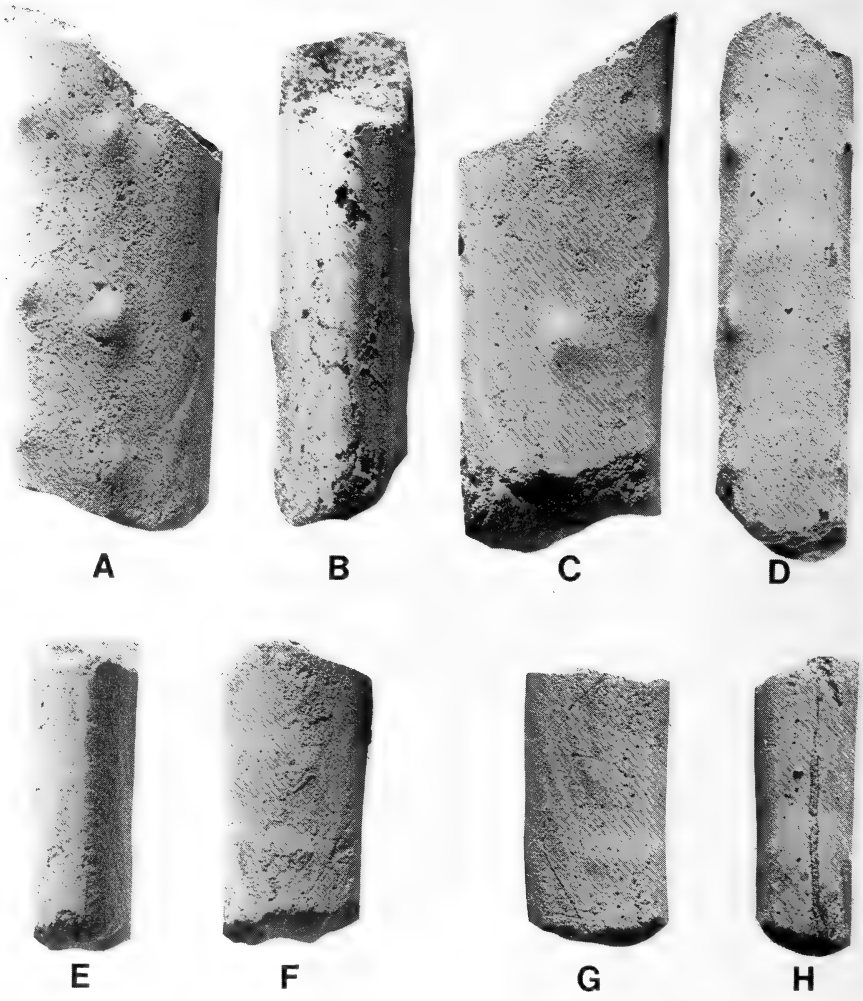

Fig. 2. *Eubaculites labyrinthicus* (Morton, 1834). A–D. OUM KX1831. E–H. OUM KX1832. Both from Bed 7 (G), locality 20, Zululand, St Lucia Formation, Maastrichtian II. Both × 2.

the siphonal line of the mid-venter at an acute angle. The dorsum is decorated by feebly convex ribs and striae. The suture has broad, bifid, rectangular saddles, L/U with variable degree of incision, E/L narrow and bifid, and U broad and bifid.

A cast of the lectotype of *Baculites ootacodensis*, here considered a junior synonym of *E. labyrinthicus*, shows it to be a wholly septate internal mould, 56 mm long (GSI 406, Fig. 5), with a maximum preserved whorl height of 15,5 mm. The intercostal whorl breadth to height ratio is 0,62, the dorsum broad and very feebly convex to flat. The dorsolateral margin is narrowly rounded, the dorsal flanks flattened in intercostal section, the mid-flank region broadly rounded, the ventral flanks flattened, converging to a bluntly

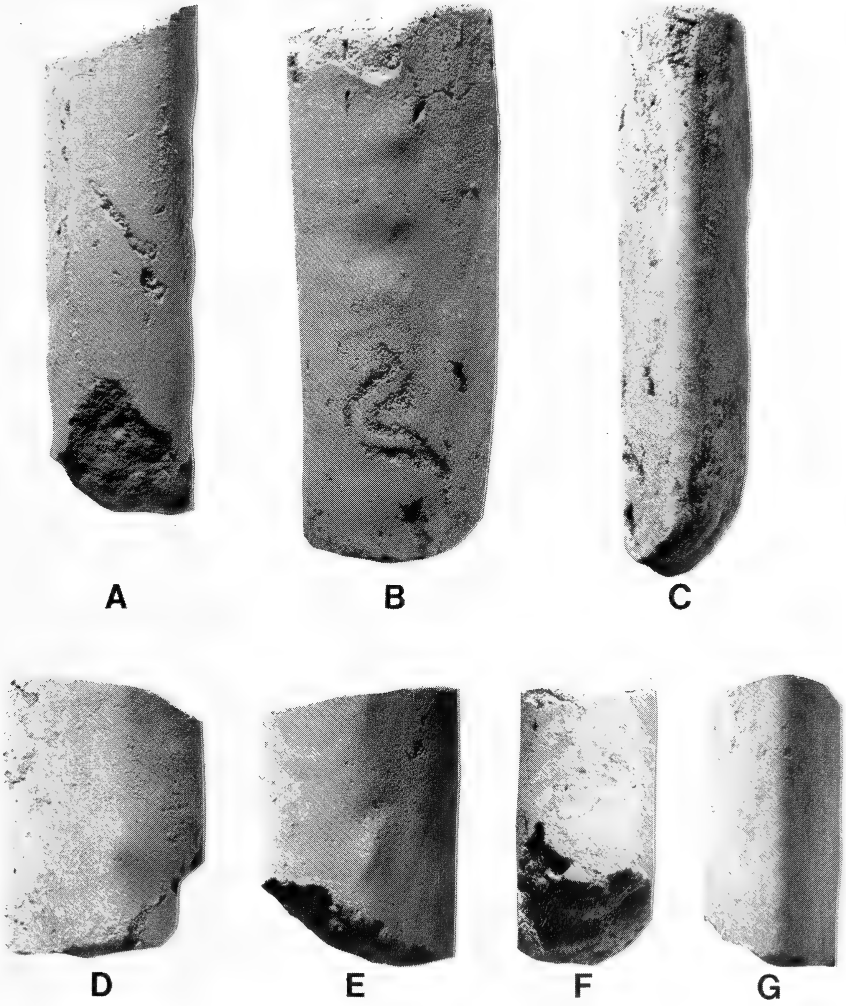

Fig. 3. *Eubaculites labyrinthicus* (Morton, 1834). A–C. OUM KX1830. D–G. OUM KX1829. Both from Bed 7 (G), locality 20, Zululand, St Lucia Formation, Maastrichtian II. Both × 2.

fastigiate venter. There are two ribs in a distance equal to the whorl height, parts of four ribs being preserved on the specimen. They begin at small dorsolateral nodes, perched on the dorsolateral margin, are elongated parallel to the length of the shell, and are coarse, transverse and feebly prosiradiate on the inner flank, strengthening into a mid-lateral tubercle that is elongated in a slightly prorsiradiate direction. These tubercles give rise to a progressively weakening prorsiradiate rib that sweeps forwards and declines before reaching the venter. The flanks are otherwise smooth, but the mid-venter is distinctly crenulated.

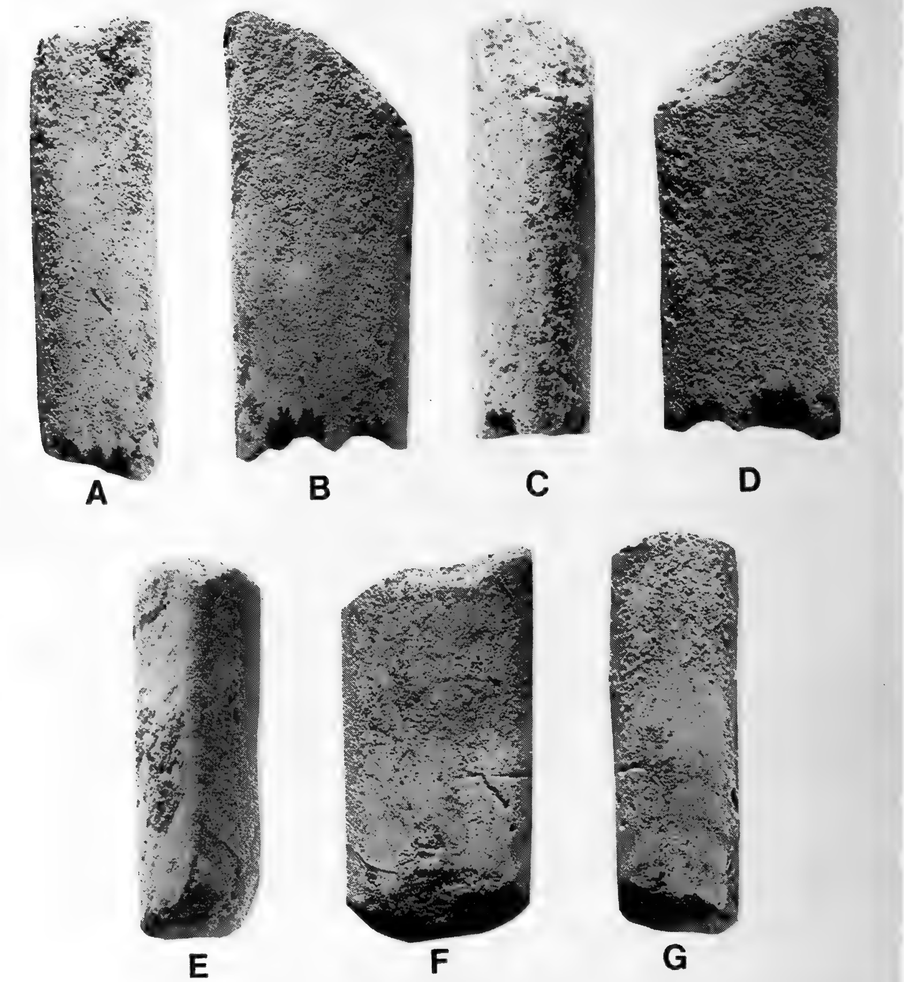

Fig. 4. *Eubaculites labyrinthicus* (Morton, 1834). Smooth variants with fastigiate venter, probably of *E. labyrinthicus*. A–D. OUM KX1828. E–G. OUM KX1833. Both from Bed 7 (G) at locality 20, Zululand, St Lucia Formation, Maastrichtian II. Both × 2.

The Zululand specimens referred to the species (Figs 2–4, 52A–C) are all rather small body chambers, with a maximum preserved whorl height of 14,5 mm, and a whorl breadth to height ratio of 0,65. They have weaker ornament than the types of both *Eubaculites labyrinthicus* and *E. ootacodensis*, rather matching specimens from the Prairie Bluff Chalk, such as those shown in Figure 1; in fact, some specimens are nearly smooth (Figs 3–4). Material from Madagascar, here referred to *E. labyrinthicus*, includes specimens larger than any known from the Prairie Bluff Chalk or the Valudavur Formation (e.g. Collignon 1971: 15, pl. 645, (fig. 2388), as *Baculites simplex*—herein Fig. 6; Cottreau, 1922: 180, pl. 9 (fig. 11), as *Baculites vagina* var. *otacodensis*). In these, lateral

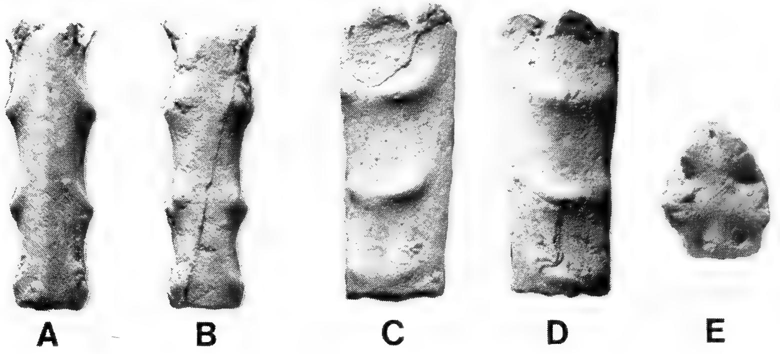

Fig. 5. *Eubaculites labyrinthicus* (Morton, 1834). Cast of lectotype of *E. ootacodensis* (Stoliczka, 1866), the original of Stoliczka, 1866, pl. 90 (fig. 14), from Ootacod. Collection of the Geological Survey of India, no. 406 × 1.

ornament consists predominantly of prominent crescentic ribs, with little or no sign of development of tubercles. We assume these to be adults of forms with bituberculate ornament in the juvenile stage. Given more material, it may be possible to separate those forms with lateral ribbing only and fastigiate venter from those with lateral ribbing, two rows of tubercles and fastigiate venter. The relationship of these predominantly ribbed to ribbed and bituberculate forms may be analogous to that of *E. carinatus* to *E. vagina*.

Discussion

Eubaculites labyrinthicus has been a neglected species, but comparison of the type and other material from the Prairie Bluff Chalk with the lectotype of *E. ootacodensis* and the Zululand and Madagascan material referred to the species, show this to be a distinctive form, the combination of predominantly binodose flanks and a fastigiate venter distinguishing it from all other species referred to the genus. *Eubaculites vagina* (Forbes, 1846) (Figs 8–20) has binodose flanks, but the type population shows it to have a broad, flat tabulate venter at a size where *E. labyrinthicus* is fastigiate. Some variants of *E. carinatus* develop an incipient binodose condition (e.g. Brunnschweiler 1966, text-fig. 11), but the broad, tabulate ventral keel is immediately distinctive.

Eubaculites ootacodensis has been widely misinterpreted. In his original account, Stoliczka (1866: 199) referred to this species as differing from *E. vagina* in that 'lateral tubercles in this variety begin to grow at a much earlier stage, and the dorsal edge is somewhat narrower than in many Pondicherry specimens; further, the siphuncle often lies nearer to one edge than to the other; this, however, is not constant in all specimens'. The last statement is difficult to reconcile with a fastigiate venter. Kossmat (1895: 157 (61), pl. 19(5) (figs 15, 16)) figured, as *Baculites vagina* var. *ootacodensis*, a specimen from Otacod, and one from Rautankupam (Pondicherry). The latter is a large *Eubaculites carinatus*. The former is distinctly binodose but is damaged and lacks the venter (Fig. 7F–H); we presume it to be a near-adult *E. labyrinthicus* but it could be a variant of *E. carinatus*. Most subsequent authors took Kossmat's figures to represent the species, assuming it to have a tabulate venter. As indicated in the synonymy, most of these citations refer to *Eubaculites carinatus*.

Spengler (1923) described three baculitid species from Assam. The first, *Baculites vagina* (Spengler 1923: 54, pl. 4 (fig. 9)) from Tharia Ghat, is a typical representative of *E. labyrinthicus*. The second species from Assam (below Maomluh), described and figured by Spengler (1923: 54–55, pl. 4 (fig. 2a–b)) as *Baculites* sp. (cf. *vagina* Forbes var. *simplex* Kossmat), has perfectly smooth flanks, a compressed whorl section, and a narrowly rounded venter. This is similar to the lectotype of *Eubaculites simplex*, but for the shape of the venter. We are not sure if this is a *Eubaculites* at all; it may be a *Baculites* sensu stricto. The third species of Spengler (1923: 55, pl. 4 (fig. 8)) from Tharia Ghat, described and figured as *Baculites* cf. *B. anceps* Lamarck, has an inflated whorl section, but Spengler noted that 'The siphonal side is keel-shaped'. Again, we are not sure if it indeed is a *Eubaculites* at all—if it is, it might be a smooth variant of *E. vagina* or some other species.

Baculites rioturbioensis Hünicken, 1965 (p. 58, pl. 2 (figs 1–2), pl. 3 (figs 7–8), pl. 7 (fig. 1), pl. 8 (figs 6–8)) is from Santa Cruz Province, where Hünicken tentatively dated it as uppermost Campanian or basal Maastrichtian. *Baculites rioturbioensis* has a trigonal whorl section with a flattened dorsum and fastigiate venter as in *E. labyrinthicus*. In some specimens of *B. rioturbioensis*, Hünicken (1965: 59) noted signs of depressions on either side of the siphuncle—possibly indications of an incipient ventral keel. Major differences between *B. rioturbioensis* and *E. labyrinthicus* are the lateral ornament. In *B. rioturbioensis* the flanks are ornamented by low, broad folds, in contrast to the generally well-defined, crescentic binodose flank ribs of *E. labyrinthicus*.

Baculites argentinicus Weaver (1927: 429, fig. 2) is probably a senior synonym of *B. rioturbioensis*, but is based on poorly preserved material and best regarded as a *nomen dubium*. Hünicken & Covacevich (1975: 146, pl. 2 (figs 1–3), text-fig. 5a–b) described, as *Baculites?* sp. B, a form with a fastigiate venter and low ribs from Bahia Las Tablas, Quiriquina Island. This looks very much like *E. labyrinthicus*. It occurs at the same stratigraphic level (Nivel 12) as *E. carinatus* (= *B. lyelli*).

The lectotype of *Eubaculites vagina* var. *simplex* Kossmat (1895, pl. 19(5) (fig. 13)) (Fig. 7I–K), by subsequent designation of Kennedy (1986*c*: 195), has a fastigiate venter like that of the lectotype of *E. labyrinthicus*, but lateral ornament is very faint, and the whorl section is not as inflated as that of typical *E. ootacodensis*. Kennedy (1986*c*: 194) regarded it as a synonym of *E. ootacodensis* (= *E. labyrinthicus* herein), but subsequent work on Australian faunas (Henderson *et al.* 1992) showed *E. simplex* to be a distinct, very compressed species (whorl breadth to height ratio 0,46–0,70) with a tear-shaped to pyriform whorl section, with or without a distinct keel, the venter being fastigiate or narrowly tabulate. Smooth variants of *E. labyrinthicus* (e.g. Fig. 4), differ from *E. simplex* mainly in having a more inflated whorl section, but juvenile specimens are difficult to separate satisfactorily. The other specimen referred to *E. simplex* by Kossmat (1895, pl. 19(5) (fig. 14)) has an inflated whorl section, prominent lateral ribbing and indications of a tabulate keel; it is best referred to *E. carinatus*, as suggested by Kennedy (1986*c*: 196). *Eubaculites simplex* has a more compressed whorl section and smooth flanks.

Fig. 6. *Eubaculites labyrinthicus* (Morton, 1834). The original of Collignon's (1971, pl. 645 (fig. 2388)) *E. simplex* from locality 666, Antsoha (Belo sur Tsiribihina), Madagascar. This specimen shows prominent development of *'E. ootacodensis'* type of ribbed ornament on flanks in lieu of bituberculate as in typical *E. labyrinthicus*. × 1.

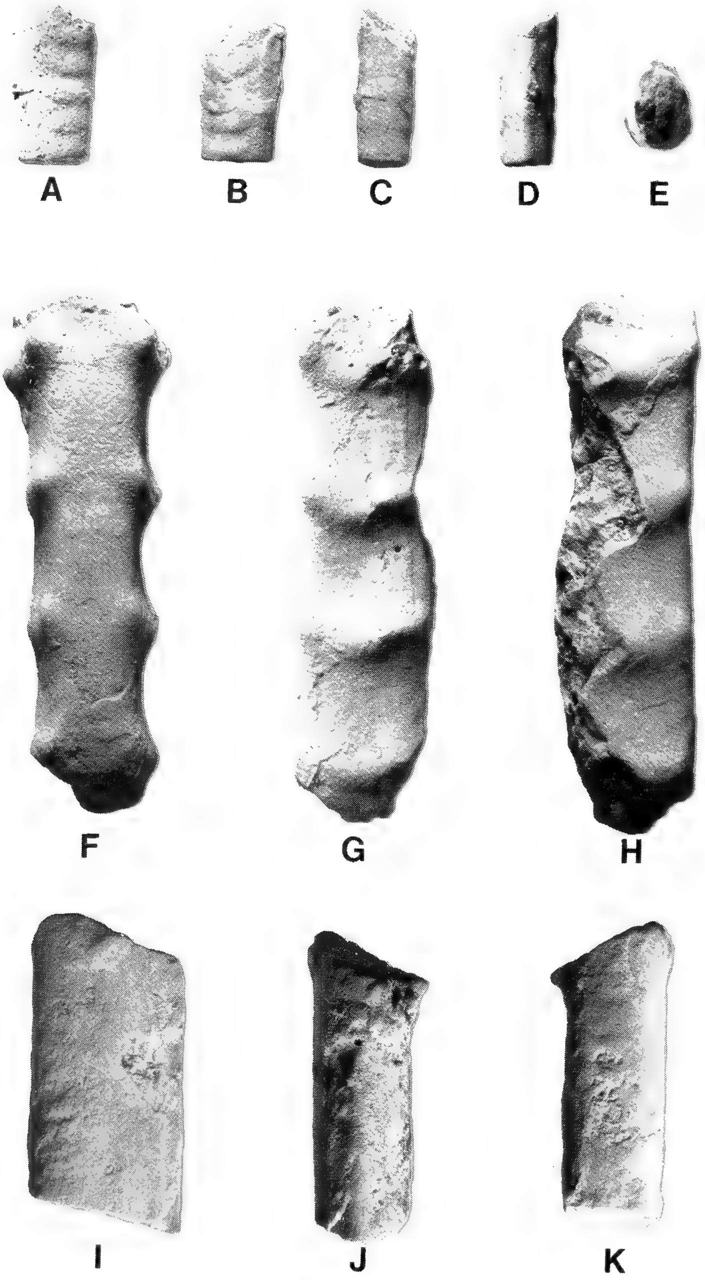

Fig. 7. A–E. *Eubaculites carinatus* (Morton, 1834). Paralectotype of *Eubaculites simplex* (Kossmat, 1895) the original of Kossmat, 1895, pl. 19 (5) (fig. 14) from Ootacod. GSI 14820. F–H. *Eubaculites labyrinthicus* (Morton, 1834). Cast of original of Kossmat, 1895, pl. 19 (5) (fig. 15) from Ootacod. GSI 14821. I–K. *Eubaculites simplex* (Kossmat, 1895). Cast of lectotype, the original of Kossmat, 1895, pl. 19(5) (fig. 13), from Arrialoor; GSI 14819. All specimens in the collections of the Geological Survey of India. All × 1.

Occurrence

Maastrichtian, Prairie Bluff Chalk in Alabama, Navesink Formation in New Jersey, U. S. A. Maastrichtian near Ootacod, South India. Locality 20 of Kennedy & Klinger (1975: 283), Beds 3 (C) and 7 (G) of Klinger (1976, fig. 13), St Lucia Formation, Maastrichtian II, Zululand. Lower Maastrichtian, zone of *Pachydiscus gollevillensis* and *P. neubergicus* of Madagascar (as *Baculites simplex*).

Eubaculites vagina (Forbes, 1846)

Figs 8–20

Baculites vagina Forbes, 1846*a*: 144, pl. 10 (fig. 4a–c). D'Orbigny, 1850: 215. Stoliczka, 1866: 198 (pars), pl. 91 (figs 1–6), *non* pl. 90 (fig. 14) (= *E. labyrinthicus*); *non* pl. 90 (fig. 15) (= *E. carinatus*). Crick, 1898: 78, pl. 17 (fig. 5). Diener, 1925: 63 (pars).

Baculites ornatus d'Orbigny, 1847: pl. 3 (figs 3–6).

Baculites vagina Forbes. a) Typische Form Kossmat, 1895: 155 (50), pl. 19 (5) (fig. 17).

non *Baculites vagina* Forbes. Forbes *in* Darwin, 1846*b*: 126, pl. 5 (fig. 3) (= *E. carinatus*).

non *Baculites vagina* Forbes. Kossmat, 1895: pl. 19(5) (fig. 14) (= *E. carinatus*).

non *Baculites vagina* var. *Cazadorana* Paulcke, 1907: 11, pl. 16 (fig. 5–5b). (= *Baculites* sp.).

non *Baculites vagina* Forbes. Boule, Lemoine & Thévenin, 1907: 45(65), pl. 8(15) (fig. 3) (= *Baculites* sp.).

non *Baculites* sp. cf. *vagina* Forbes. Woods, 1917: 36, pl. 20 (fig. 5a–d) (= *?B. rectus*).

non *Baculites vagina* Forbes. Spengler, 1923: 54, pl. 4 (fig. 9) (= *E. labyrinthicus*).

non *Baculites* cf. *vagina* var. *otacodensis* Stoliczka. Crick, 1924: 140, pl. 9 (figs 4–5) (= *?E. carinatus*).

non *Baculites* cf. *vagina* var. *simplex* Kossmat. Crick, 1924: 140, pl. 9 (figs 6–7) (= *?E. carinatus*).

non *Baculites vagina* Forbes. Crick, 1924: 139, pl. 9 (figs 1–3) (= *E. carinatus*).

non *Baculites vagina* Forbes. Spath, 1926: 80.

non *Baculites vagina* Forbes. Wetzel, 1930: 90, pl. 10 (figs 3–4) (= *E. carinatus*).

non *Baculites vagina* Forbes. Basse, 1931: 20, pl. 2 (figs 6–10) (= *?Baculites* sp.).

non *Baculites vagina* Forbes var. *Van Hoepeni* Venzo, 1936: 116(58), pl. 10(6) (figs 11–12) (= *Baculites vanhoepeni*).

non *Eubaculites vagina* (Forbes). Spath, 1940: 49, text-fig. 1a (= *E. carinatus*).

non *Eubaculites vagina* (Forbes): Brunnschweiler, 1966: 29, pl. 1 (fig. 7), pl. 2 (figs 1–14), text-figs 12–14 (= *E. carinatus*).

Eubaculites vagina (Forbes): Collignon, 1971: 15, pl. 645 (fig. 2391), p. 18, pl. 646 (fig. 2394). Klinger, 1976: 87, pl. 35 (figs 1–4), pl. 36 (figs 1–4), pl. 37 (figs 1–5), pl. 38 (figs 1–3, ?fig. 4), pl. 39 (fig. 2), pl. 42 (fig. 1, ?fig. 4), pl. 43 (figs 5–12). Kennedy, 1977, text-fig. 31 (1–2). Klinger & Kennedy, 1980: 299, fig. 5a–c. Kennedy 1986*c*: 194. Kennedy & Henderson, 1992: 712, pl. 5 (figs 10–13), pl. 7 (figs 1–18), pl. 8 (figs 1–12), pl. 9 (figs 1–13), pl. 10 (figs 1–3), text-fig. 1C, F.

Eubaculites Kennedy, 1989, fig. 17i–j.

Type

The lectotype of *E. vagina* is the original of Forbes (1846*a*, pl. 10 (fig. 4)) from the Valudavur Beds of Southern India, BMNH C49762 (herein Fig. 8), designated by Kennedy & Henderson (1992: 713). Klinger (1976: 88) referred to it as 'holotype'—this is not considered a valid lectotype designation.

Diagnosis

Eubaculites with tabulate siphonal keel and bituberculate lateral ornament; some rare variants may be smooth.

Fig. 8. *Eubaculites vagina* (Forbes, 1846). A–C. BMNH C49762, the lectotype, the original of Forbes (1846, pl. 10 (fig. 4)); Geological Society Collection R10488. From the Valudavur Formation of southern India. × 1.

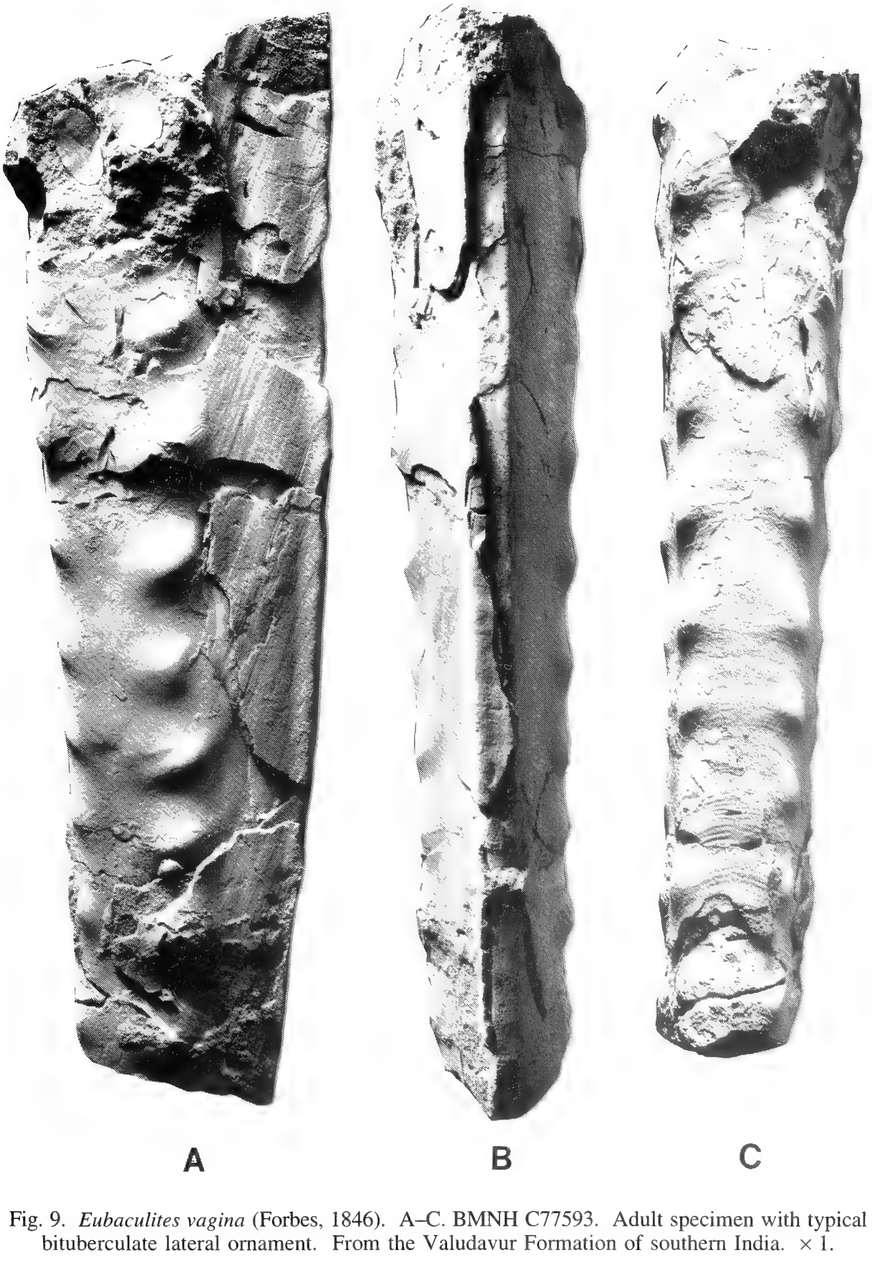

Fig. 9. *Eubaculites vagina* (Forbes, 1846). A–C. BMNH C77593. Adult specimen with typical bituberculate lateral ornament. From the Valudavur Formation of southern India. × 1.

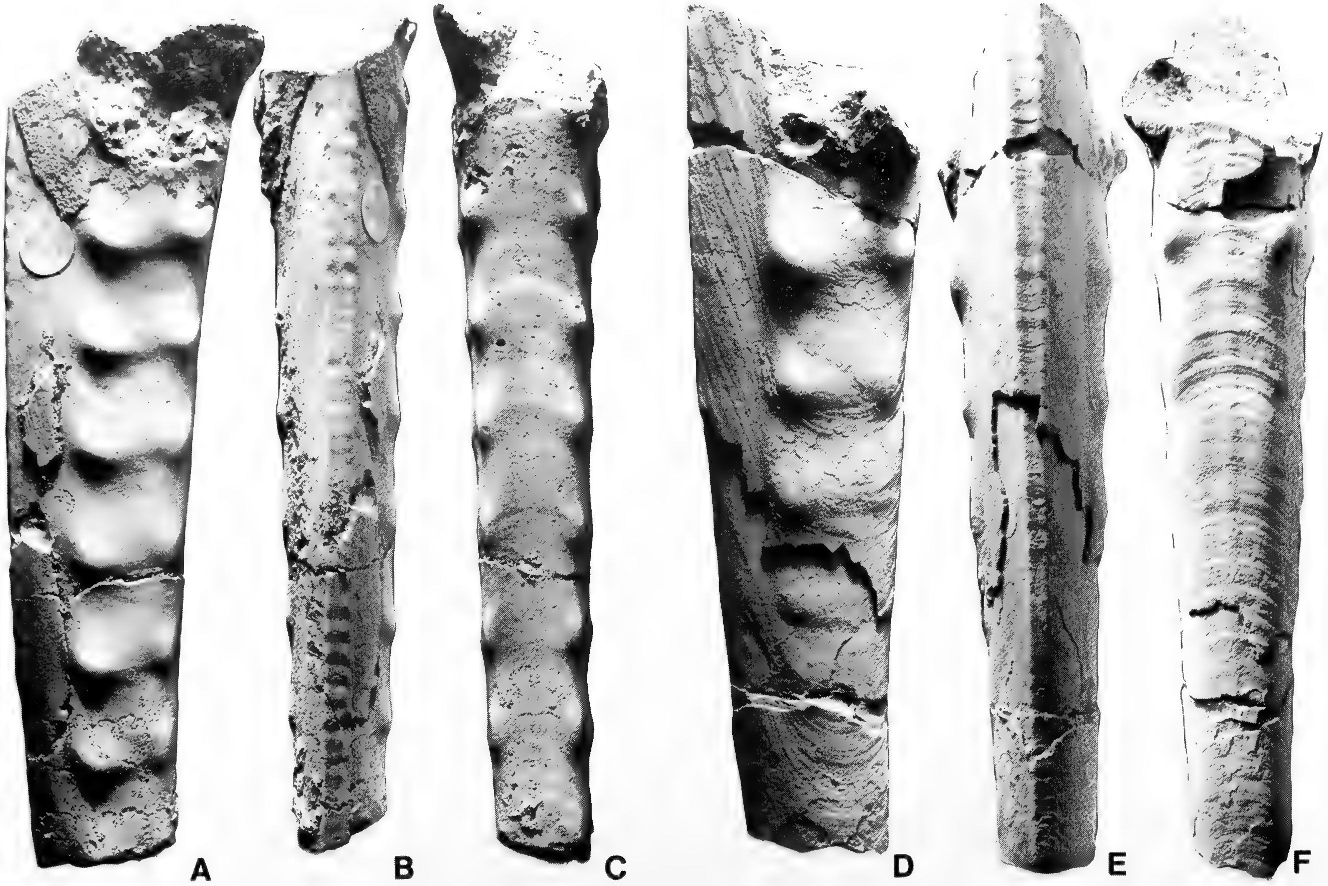

Fig. 10. *Eubaculites vagina* (Forbes, 1846). A–C. BMNH C51143. D–F. BMNH C51141. Two specimens showing typical bituberculate lateral ornament. Both specimens are from the Valudavur Formation of southern India. × 1.

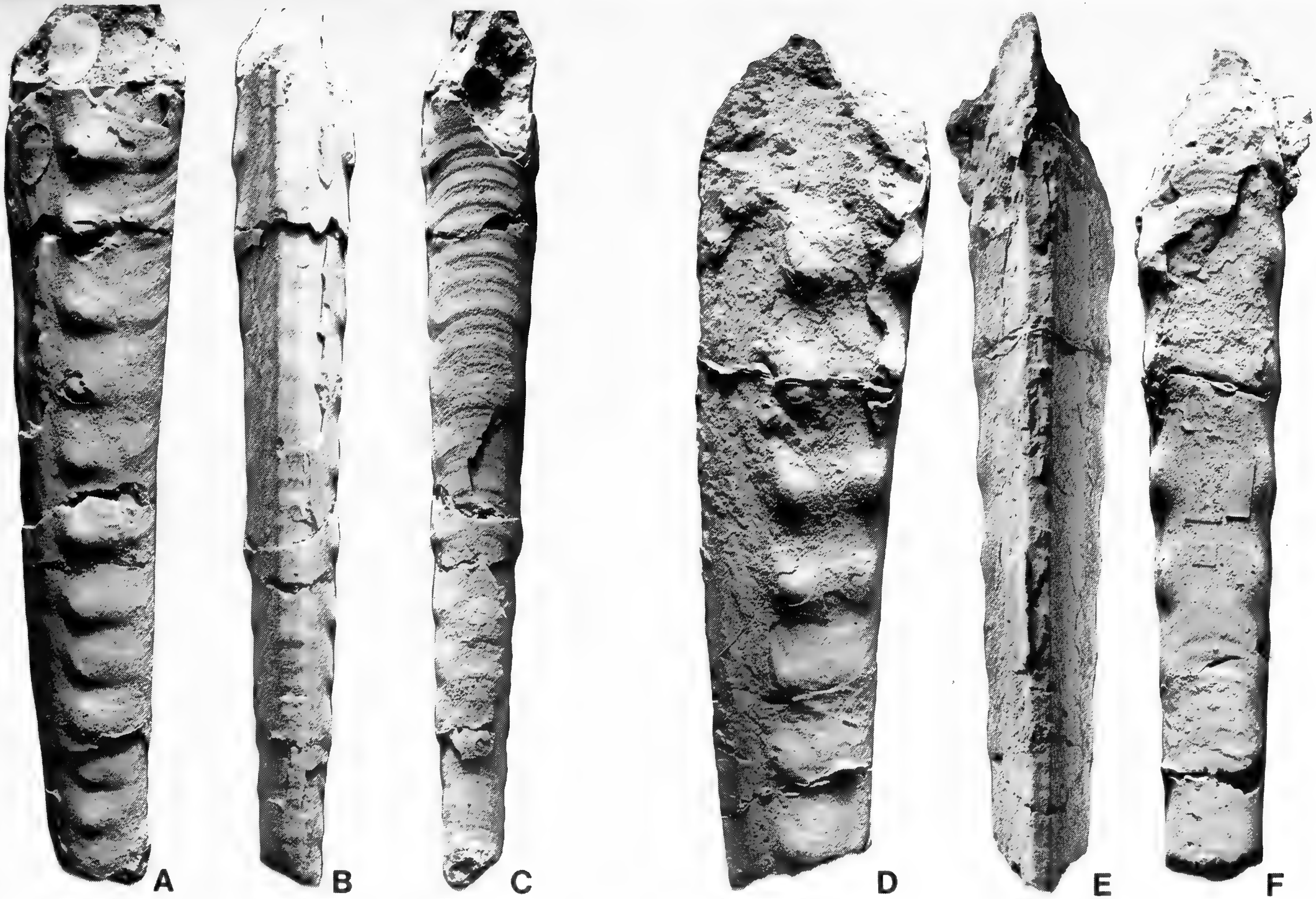

Fig. 11. *Eubaculites vagina* (Forbes, 1846). A–C. BMNH C77594. D–F. BMNH C2583, specimens showing typical bituberculate lateral ornament. Both specimens are from the Valudavur Formation of southern India. × 1.

Description

Full descriptions of the species are given by Klinger (1976) and Kennedy & Henderson (1992) and need not be repeated. As yet, no adult specimens of *E. vagina* have been found in Zululand, and, in retrospect, we suspect that the juvenile specimens referred to this species by Klinger (1976, pl. 42 (fig. 4)) (herein Fig. 52A–C) are better referred to *E. labyrinthicus*.

Discussion

One of us (Klinger 1976) previously described and figured syn- and topotype material from South India, and described the variation shown by this species. Due to unforeseen circumstances, the original figures were reduced so as to be practically unrecognizable. These specimens are here refigured (Figs 8–15).

Eubaculites vagina is unique in the genus *Eubaculites*, in having two rows of lateral tubercles combined with a tabulate ventral keel. Specimens with distinct bituberculate ornament, here regarded as being typical of *E. vagina*, include BMNH C77593 (Fig. 9), C51141 (Fig. 10D–F) and C51143 (Fig. 10A–C), C77594 (11A–C), and C2583 (Fig. 11D–F). Some specimens are nearly smooth, with no lateral ornament, e.g. C51142 (Fig. 15A–C), C51145 (Fig. 15I–J)) and the specimen figured by Stoliczka (1866, pl. 91 (figs 1–2)) (herein Fig. 16). We are not quite sure if these are, in fact, smooth *E. vagina*, or *Eubaculites latecarinatus*; we think *E. vagina*, as they occur with typical representatives of that species. Also, typical populations of *E. latecarinatus* are, as yet, unknown from South India. BMNH C51140 (Fig. 13) and the specimen figured by Stoliczka (1866, pl. 91 (fig. 4)) (herein Fig. 19) differ from other specimens of *E. vagina* in their denser and more oblique, though weaker lateral tuberculation. This may possibly be a feature of the adult body chamber. The differences in size between these specimens and the lectotype, which also appears to be adult, may be an indication of dimorphism. However, the largest known specimens of *E. vagina* are all significantly smaller than the largest *E. carinatus* and *E. latecarinatus*. We are not sure if this is a consistent feature or only due to the relatively small number of adult *E. vagina* known.

Until now, unequivocal adult bituberculate shells of *E. vagina* have only been found in South India and in Madagascar—the doubtful Zululand specimens reported by Klinger (e.g. 1976, pl. 42 (fig. 4)) are juveniles and better referred to *E. labyrinthicus*. Collignon (1971: 15, pl. 645 (fig. 2391), p. 18, pl. 646 (fig. 2394)) (herein Fig. 20) recorded *E. vagina* from the 'Lower' Maastrichtian of Madagascar, Zone à *Pachydiscus gollevillensis* et *P. neubergicus*. This is true *E. vagina*, unlike the totally incorrect interpretation of the species by Boule *et al.* (1907: 65, pl. 8(15) (fig. 3)) and Basse (1931: 20) (*fide* Spath 1953: 46). These Madagascan specimens appear to be true *Baculites*. The Australian specimens referred to *E. vagina* by Brunnschweiler (1966: 29, pl. 1 (fig. 7), pl. 2 (figs 1–14), text-figs 12–14) are all typical representatives of *E. carinatus*.

The specimen figured by D'Orbigny (1847, pl. 3 (fig. 3)) as *Baculites ornatus* is a composite synthetograph. Nevertheless, it clearly shows typical *E. vagina* bituberculate lateral ornament. Stoliczka (1866: 199) commented that '*B. ornatus* . . . probably is from Pondicherry itself'. The fact that the vast collections from the Quiriquina Formation of Stinnesbeck (1986: 207) yielded only *E. lyelli* but no *E. vagina (ornatus)* confirms Stoliczka's suspicions. Hünicken & Covacevich (1975: 159–160) discussed the

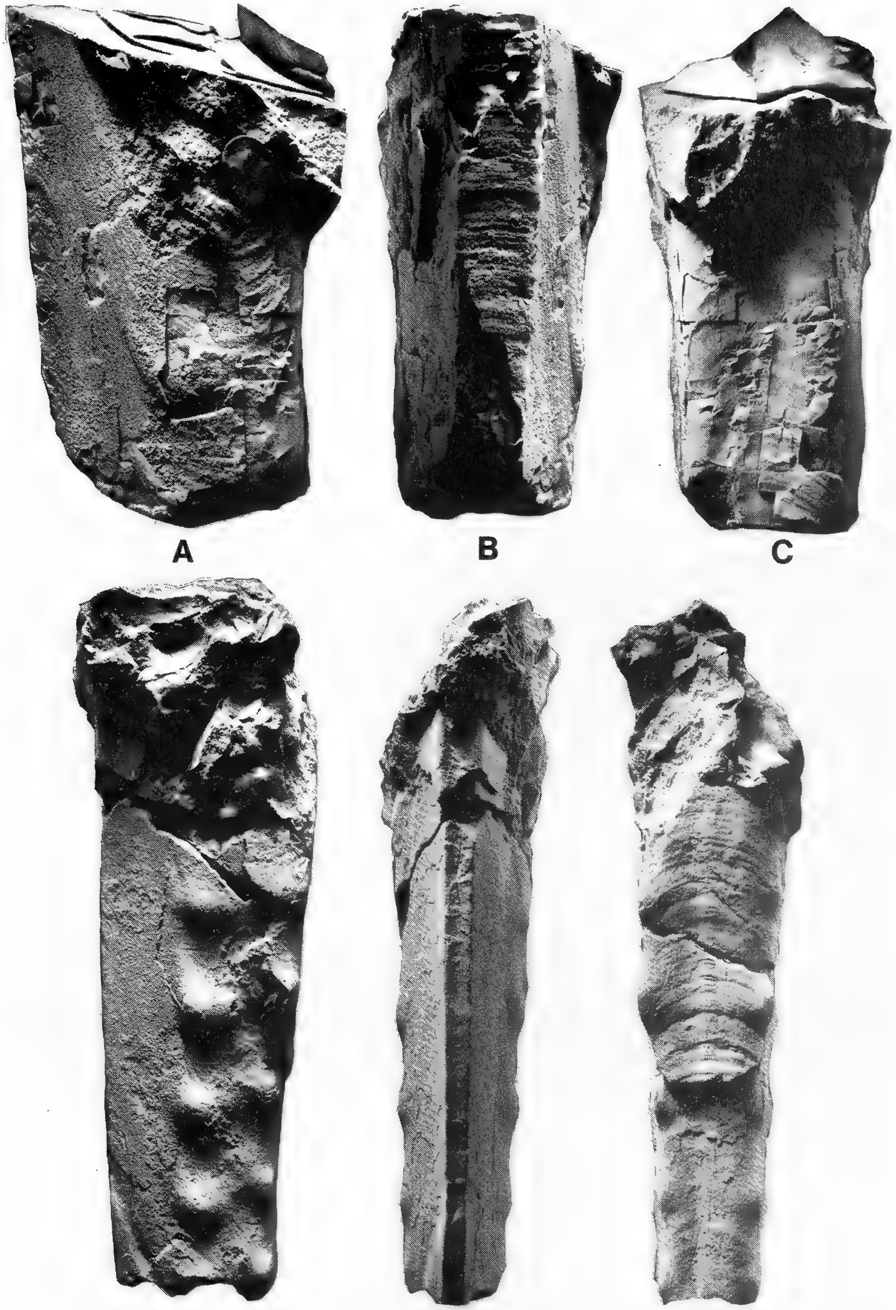

Fig. 12. *Eubaculites vagina* (Forbes, 1846). A–C. BMNH C51146. Body chamber fragment with part of the aperture preserved. D–F. BMNH C51147. Specimen with prominent bituberculate ornament. Both specimens from the Valudavur Formation of southern India. Both × 1.

Fig. 13. *Eubaculites vagina* (Forbes, 1846). A–C. BMNH C51140, part of body chamber, from the Valudavur Formation of Pondicherry, southern India. × 0,75.

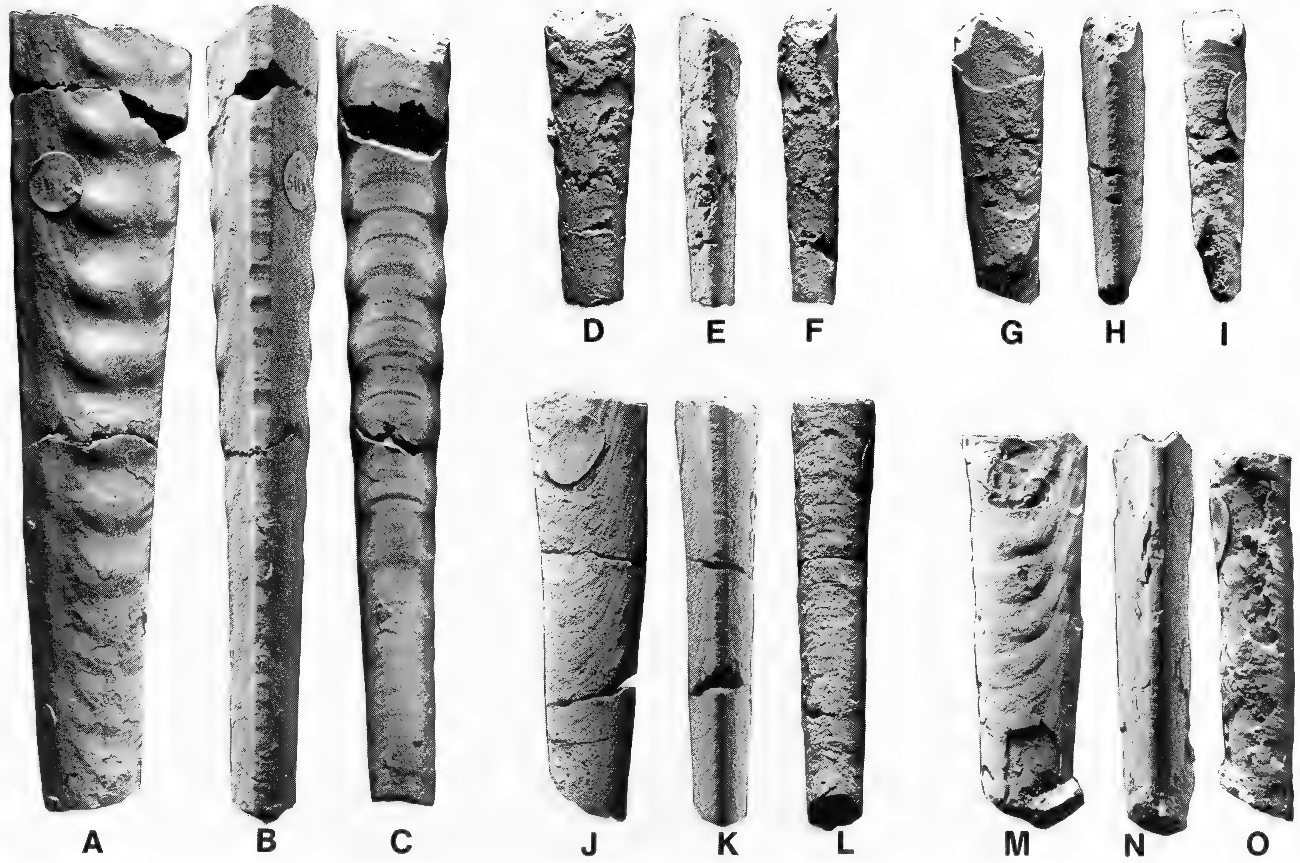

Fig. 14. *Eubaculites vagina* (Forbes, 1846). A–C. BMNH C51149. D–F. BMNH C51144. G–I. BMNH C73569. J–L. BMNH C51145. M–O. BMNH C73569. A series of specimens illustrating range of ontogenetic and intraspecific variation. All specimens are from the Valudavur Formation of southern India. All × 1.

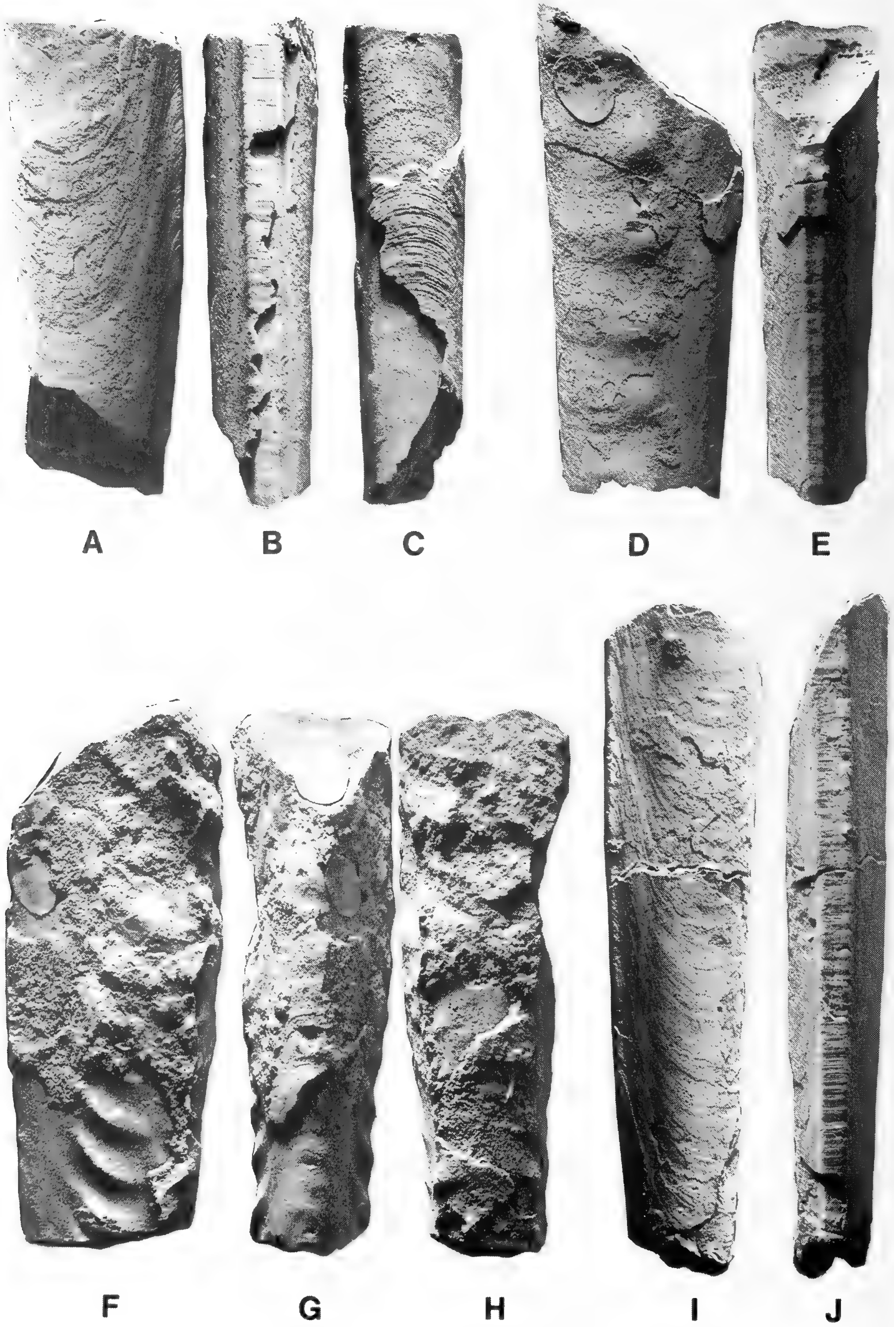

Fig. 15. *Eubaculites vagina* (Forbes, 1846). A–C. BMNH C51142, a smooth form of *E. vagina* showing fine striae on shell and smooth surface on internal mould. D–E. BMNH C51150. F–H. BMNH C77599, a body chamber fragment with crowded ornamentation. I–J. BMNH C51145, another smooth form. All specimens are from the Valudavur Formation of southern India. All × 1.

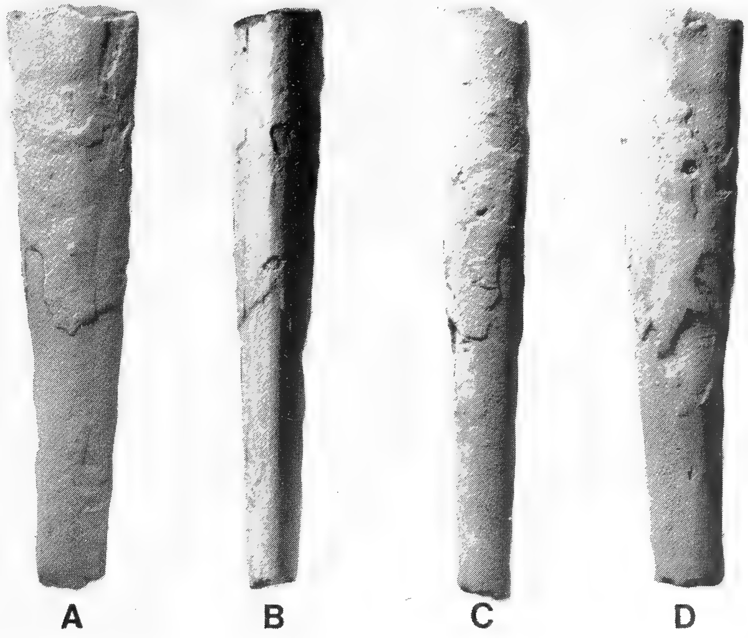

Fig. 16. *Eubaculites vagina* (Forbes, 1846). A smooth, non-ornate variety of the species. Cast of the original of Stoliczka, 1866, pl. 91 (fig. 2), from Pondicherry. Collection of the Geological Survey of India, GSI 408. × 1.

systematic position of *B. ornatus*, stating that the type of *B. ornatus* could not be found in the D'Orbigny collections, but concluded that (1975: 160) it was a synonym of *E. vagina*.

Eubaculites vagina has been reported from the Ukrainian SSR (see Kennedy 1986*a*: 1015; 1986*c*: 194) on the basis of a crushed baculitid from the Maastrichtian flysch described and figured by Wisniowski (1907: 199, pl. 17 (fig. 9)) as *Baculites anceps*. Admittedly, the specimen does show bituberculate lateral ornament, but this is due to a longitudinal fracture and subsequent displacement of ribbing ('. . . dargestellten Gehäuse, welches leider in der Längsrichtung zerbrochen ist und infolgedessen eine kleine Verschiebung beider Teile erlitt'—Wisniowski 1907: 199).

Baculites labyrinthicus Morton (1834: 44, pl. 13 (fig. 10); see above) also has bituberculate flank ornament but a fastigiate rather than tabulate venter. *Baculites binodosus* Noetling, 1897 (p. 77, pl. 23 (fig. 3)) (herein Fig. 56) is based on a single fragment; it has a single feeble row of dorsolateral tubercles and a feebly tabulate venter. It may represent a further distinct species of *Eubaculites*, probably close to *E. simplex*.

Occurrence

Maastrichtian of South India and Madagascar; only dubious juveniles, best referred to *E. labyrinthicus*, are known in Zululand.

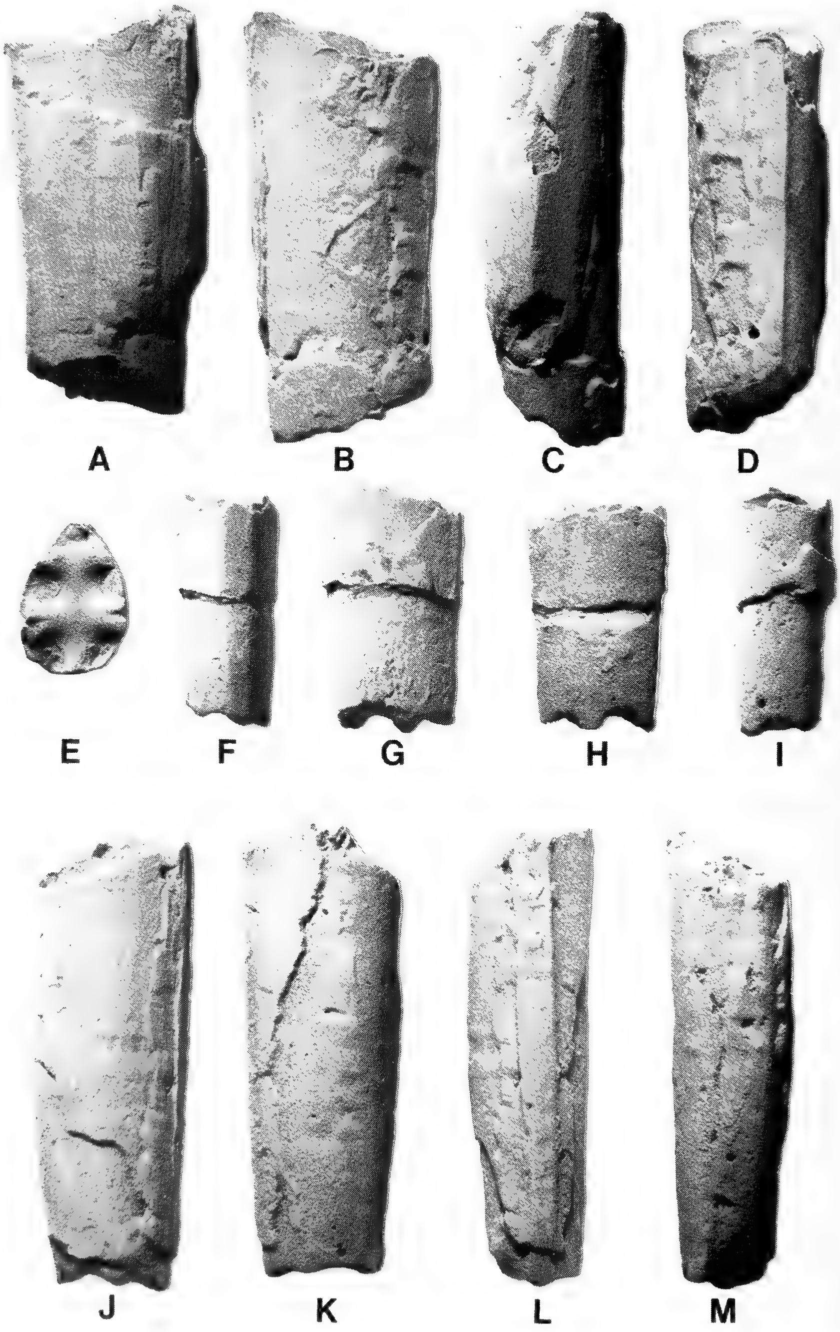

Fig. 17. *Eubaculites vagina* (Forbes, 1846). A–D. Cast of original of Stoliczka, 1866, pl. 91 (fig. 1), part, GSI 408. E–I. Cast of original of Stoliczka, 1866, pl. 91 (fig. 3). GSI 410. J–M. Cast of original of Stoliczka, 1866, pl. 91 (fig. 1), part, GSI 408. All from Pondicherry, Collection of the Geological Survey of India. × 1.

Fig. 18. *Eubaculites vagina* (Forbes, 1846). A–C. Cast of original of Stoliczka, 1866, pl. 91 (fig. 5) from Pondicherry; GSI 412. D. Cast of original of Stoliczka, 1866, pl. 91 (fig. 4) from Pondicherry; GSI 411. Both in the collections of the Geological Survey of India. × 1.

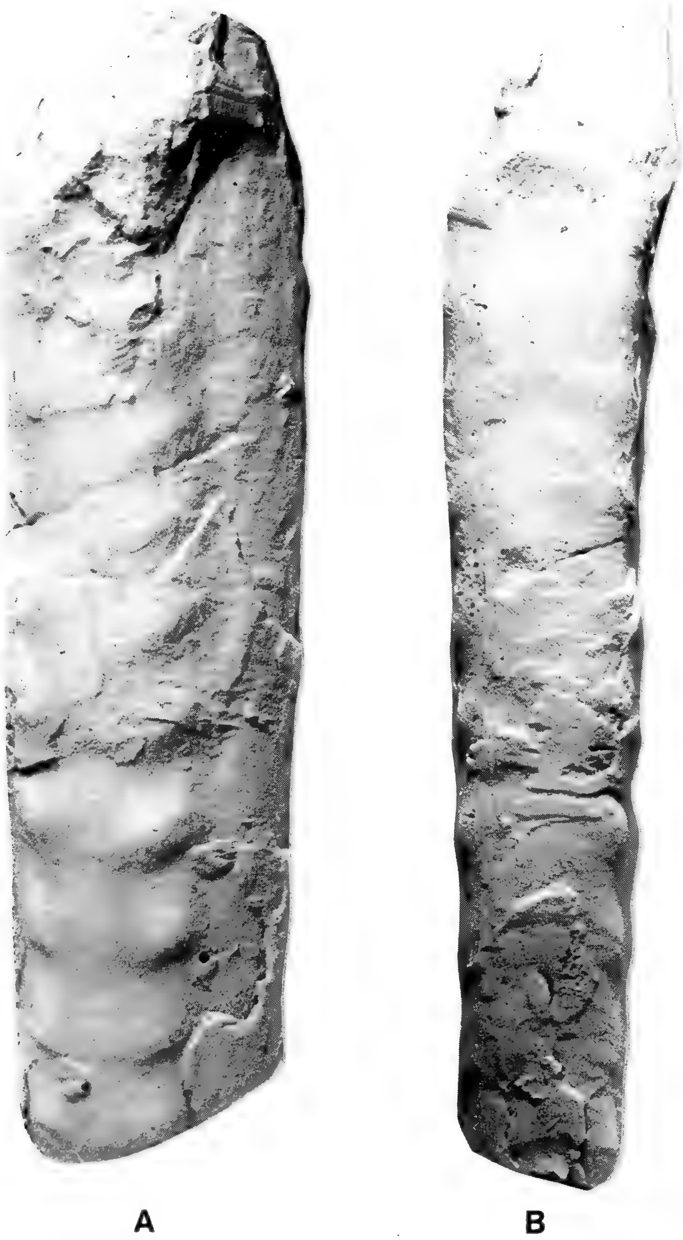

Fig. 19. *Eubaculites vagina* (Forbes, 1846). Cast of original of Stoliczka, 1866, pl. 91 (fig. 4) from Pondicherry. Collections of the Geological Survey of India, GSI 411. × 1.

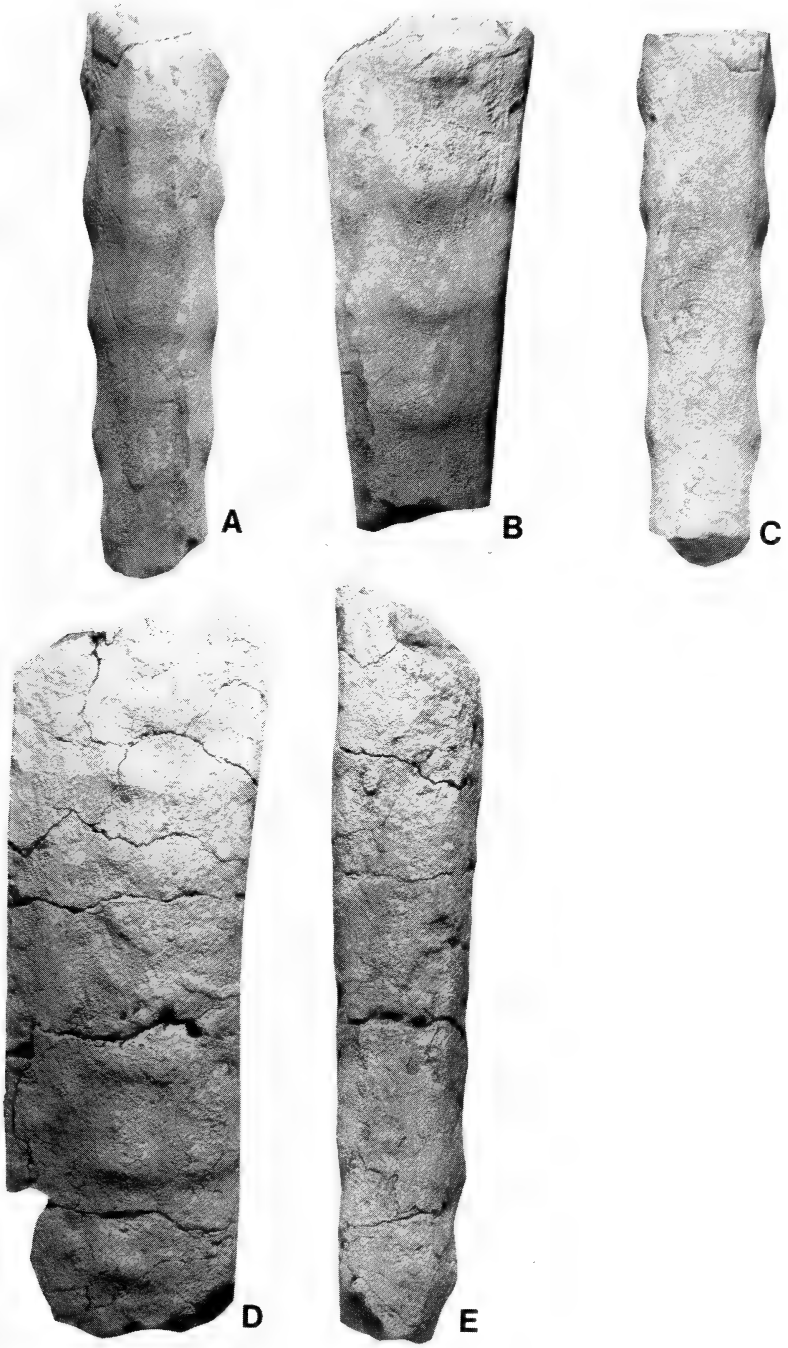

Fig. 20. *Eubaculites vagina* (Forbes, 1846). A–C. The original of Collignon (1971, pl. 645 (fig. 2391)) from locality 504, Mont Ambinda-Mikoboka (Manera), Madagascar. D–E. The original of Collignon (1971, pl. 646 (fig. 2394)) from locality 671, Antsoha (Bela Sur Tsiribihina), Madagascar. All × 1.

Eubaculites carinatus (Morton, 1834)

Figs 7A–E, 21–30, 31A–G, 32–35, 36E–F, 37–38, 42A, 52G–H

Baculites carinatus Morton, 1834: 44, pl. 13 (fig. 1). Stephenson, 1955: 134, pl. 24 (figs 5–9).
Baculites vagina Forbes: Darwin, 1846: 126. Forbes *in* Darwin, 1846*b*; pl. 5 (fig. 3). Steinmann, 1895: 89, pl. 6 (fig. 4), text-figs 8–10. Kossmat, 1897*b*, pl. 6 (fig. 4). Wilckens, 1904: 188. Diener, 1925: 63 (pars). Wetzel, 1930: 90, pl. 10 (figs 3–4). Hoffstetter *et al.*, 1957: 300, 302.
Baculites Lyelli d'Orbigny, 1847, pl. 1 (figs 3–7); 1850: 215. Olsson, 1944: 104, pl. 16 (figs 3–5), text-fig. 1.
Baculites tippaensis Conrad, 1858: 334, pl. 35 (fig. 27).
Baculites spillmani Conrad, 1858: 335, pl. 35 (fig. 24).
Baculites anceps Lamarck. Binckhorst, 1861: 42, pl. 5d (fig. 3a–d).
Baculites chicoensis Gabb, 1864: 80 (pars), pl. 14 (fig. 29, 29a); *non* pl. 17 (fig. 27, 27a), *non* pl. 14 (fig. 27b).
Baculites vagina var. *Otacodensis* Stol.: Kossmat, 1895: 157(61) (pars), pl. 19(5) (fig. 16), (?*non* fig. 15 = ?*E. labyrinthicus*).
Baculites vagina var. *simplex* Kossmat, 1895: 156(60) (pars), pl. 19(5) (fig. 14 only).
non *Baculites vagina* var. nov. *cazadorianus* Paulcke, 1907: 11, pl. 16 (fig. 5–5b) (= *Baculites* sp.).
non *Baculites vagina* var. *cazadoriana* Paulcke: Diener, 1925: 63.
Baculites sheringomensis Crick, 1924: 139, pl. 9 (figs 1–3).
Baculites cf. *vagina* var. *otacodensis* Stoliczka: Crick, 1924: 140, pl. 9 (figs 4–5).
Baculites cf. *vagina* var. *simplex* Kossmat: Crick, 1924: 140, pl. 9 (figs 6–7).
Eubaculites otacodensis Stoliczka. Spath, 1940: 49, pl. 1 (fig. 3), text-fig. 1b. Wright, 1957: L218, figs 245, 246a–c. Collignon, 1971: 18, pl. 646 (fig. 2395).
?*Baculites anceps* (Lamarck) d'Orbigny: Haas, 1943: 13 (figs 16–17 only).
Eubaculites lyelli (d'Orbigny): Matsumoto & Obata, 1963: 97. Hünicken & Covacevich, 1975: 149, pl. 1 (figs 5–12), pl. 2 (figs 4–9), pl. 3 (figs 1–8), pl. 4 (figs 1–8), pl. 5 (figs 1–4), text-figs 6–28. Stinnesbeck, 1986: 207, pl. 9 (figs 6–8), text-fig. 24D, d. Kennedy & Summesberger, 1986: 197, pl. 14 (figs 1–5, 9–14). Kennedy, 1986*a*: 1016, pl. 1 (figs 1–3), pl. 2 (figs 3–8), pl. 3 (figs 2–8, 13–21). Kennedy, 1986*b*, fig. 10c, d. Kennedy, 1986*c*: 195, pl. 27 (figs 5–8), pl. 32 (figs 13–14). Immel, 1987: 129.
Eubaculites argentinicus (Weaver): Leanza, 1964: 95, pl. 1 (figs 1–5), text-fig. 1.
Eubaculites sp. Garcia & Camacho, 1965: 72, pl. 1 (fig. 4).
Eubaculites vagina (Forbes): Brunnschweiler, 1966: 29, pl. 1 (fig. 7), pl. 2 (figs 1–14), text-figs 12–14.
Eubaculites ootacodensis (Stoliczka): Brunnschweiler, 1966: 27, pl. 1 (figs 9–14), text-figs 9–11. Matsumoto, 1959: 166, pl. 43 (fig. 6), pl. 44 (figs 1–3), text-figs 84a–b, 85a–b. Riccardi, 1974: 388, pl. 1 (figs 1–7), pl. 2 (figs 1–4, 6), pl. 3 (figs 1–6), pl. 4 (figs 1–7), text-fig. 2; 1980: 11–14, figs 1–2. Klinger, 1976: 90 (pars), pl. 39 (fig. 1, *non* fig. 3), pl. 41 (figs 1–2), pl. 42 (figs 3, 8), *non* pl. 43 (fig. 1), text-fig. 11c.
Eubaculites kossmati Brunnschweiler, 1966: 31, pl. 2 (figs 15–17), pl. 3 (figs 1–7), text-fig. 15.
Eubaculites multicostatus Brunnschweiler, 1966: 32, pl. 3 (figs 8–12), text-fig. 16.
Eubaculites carinatus (Morton, 1834): Henderson *et al.*, 1992: 150, figs 6F–G, 14–16, 17A–C, G–J, 18–20. Kennedy & Henderson, 1992: 716, text-fig. 5A–C.

Type

Holotype, by monotypy, is ANSP 72866 in the collections of the Academy of Natural Sciences, Philadelphia, the original of Morton (1834, pl. 13 (fig. 1)), from the Prairie Bluff Chalk of Alabama (Fig. 21). The lectotype of *Baculites lyelli* d'Orbigny, 1847, by subsequent designation by Kennedy (1986*a*: 1016) is MNHP R1020a (refigured by Kennedy 1986*a*, pl. 1 (figs 1–3)) (herein Fig. 22F–G); paralectotypes are MNHP R1020b–c (formerly D'Orbigny collection no. 7206) (herein Fig. 22D–E). These specimens are presumably the basis of D'Orbigny's highly idealized figures (1847, pl. 1 (figs 3–7)). The locality is given as 'Conception', but it is more likely Quiriquina Island, as also later stated by D'Orbigny's (1850: 715) Prodrôme entry.

Material

We have numerous specimens, including SAS H54/11 from locality 132, degraded cliff and foreshore platform 300 m north-north-east of the northern jetty at Charter's Creek Rest Camp, St Lucia Formation, Maastrichtian I; SAM–PCZ7070, PCZ7073, PCZ7427, PCZ7442, PCZ7429, PCZ7788, PCZ8317–8330, SAS H54/11, SAS Z2204 from locality 134, cliffs and foreshore section 1,2 km south of Charter's Creek Rest Camp, St Lucia Formation, Maastrichtian I; SAM–PCZ7047, PCZ8651, SAS H63/12, H63/1, H61/20, OUM KX1835–1838, SAS Z2204 from an unspecified horizon at locality 133; H60F/2, SAS H60F/14, H60H/17, Bed F; SAS H60H/17, Bed H, locality 133, cliff section and beach platform below Charter's Creek Rest Camp, St Lucia Formation, Maastrichtian I; PCZ8831 from locality 125, foreshore platform north of Fanies Island, eastern shores of the southern peninsula, Maastrichtian a (ex Campanian IV); SAM–PCZ8647, PCZ8650, SAS H48/1, SAS L97a–b from locality 131, low cliffs and foreshore sections 3, 1 km north of Charter's Creek Rest Camp, St Lucia Formation, Maastrichtian II; SAM–PCZ8311, PCZ8648, loose at locality 20; SAS H163C/4, Bed 3 (C); H163D/1, OUM KX1834, Bed 4 (D); SAS H20/5, H163E/5, Bed 5 (E); SAS H163G, OUM KX1825, KX1827, KX1839–1840, Bed 7(G) at locality 20, section at junction of old course of the Mfolozi River, the present course and the unnamed stream draining south from Lake Mfuthululu, St Lucia Formation, Maastrichtian I–II.

Dimensions

Specimen	*Wb*	*Wh*	*Wb/Wh*	*Tapering*
SAS Z2204a	8	14	0,57	—
SAS H163D/1	10	16	0,62	—
	11	20	0,55	11,4 (D = 35)
SAM–PCZ7442	10	19	0,53	—
SAM–PCZ8320	9	17	0.53	—
	12	20	0,60	7,3 (D = 55)
SAM–PCZ8322	12	19	0,63	—
	10	14	0,71	12,5 (D = 40)
SAM–PCZ8323	11	17	0.65	—
	10	14	0,71	8,8 (D = 34)
SAM–PCZ8328	10	16	0,62	—
	9	13	0,69	
	7	10	0,70	12,0 (D = 25)
SAM–PCZ8330	9	13	0,69	—
SAM–PCZ8319	11	16	0,69	—
	9	13	0,69	10 (D = 30)
SAM–PCZ8326	9	13	0,69	
	7	10	0,70	13,0 (D = 23)
SAM–PCZ8329	9	13	0,69	
	8	11	0,72	11,8 (D = 17)
SAM–PCZ8327	9	13	0,69	
	7	9,5	0,74	13,5 (D = 26)

SAM–PCZ8321	9	14	0,64	—
SAS H63/1	21	42	0,50	—
	24	47	0,51	4,9 (D = 102)
SAM–PCZ7047	24	43	0,59	—
	19	34	0,56	10,6 (D = 85)
SAM–PCZ7427	20	34	0,56	—
	14	25	0,56	8,1 (D = 94)
SAS 97	—	44	—	—
	—	34	—	9,0 (D = 111)
SAS H60H/17	8	31	0,58	—

Diagnosis

Eubaculites with tabulate siphonal keel and lateral ornament consisting of ribbing only.

Description

The holotype of *Eubaculites carinatus* (Fig. 21) is a phosphatic internal mould of a body chamber and parts of two camerae, 47,5 mm long, with a whorl breadth to height ratio of 0,74. The whorl section is pyriform, with a flattened dorsum, narrowly rounded dorsolateral margin and broadly rounded flanks, with greatest breadth below mid-flank. The outer flanks are convergent, and separated by a narrow longitudinal groove from narrowly rounded ventrolateral shoulders; the venter is narrow and bears a tabulate keel. The rib index is 2,5. The ribs are broad, strong and concave, as wide as the interspaces, extending from the dorsolateral margin to the middle third of the flank. On the ventral third of the flank the ribs weaken, break down into riblets and striae and project strongly forwards to the ventrolateral margin, where they flex back and are feebly convex. They strengthen markedly at the ventrolateral shoulder and are coarse and distant on the venter, which is markedly serrate in profile; ventral ribs are approximately twice as numerous as those on the flank.

Typical Zululand representatives of this species are easily identified by the pyriform whorl section, tabulate venter and the crescentic flank ribs. There is, however, considerable variation in the strength of the flank ribs, rib index, and whorl breadth to height ratio.

The shell may grow to a great size (e.g. Figs 25, 26C, 36F)—the maximum whorl height measured is 80 mm. At the smallest diameter available (PCZ8318) (Fig. 28B), the whorl section is tear-shaped, with a narrow, rounded venter. Flattening of the keel only takes place at whorl heights varying between 15 mm and 20 mm; development of the typical tabulate keel takes place even later. Tapering is rapid in small specimens; large specimens have essentially parallel ventral and dorsal sides and a very slow rate of taper as can be seen in the list of dimensions.

Flank ornament typically consists of crescentic ribs, arising, and protruding above the dorsal edge, most prominent at mid-flank, and, in adult specimens, disappearing near the ventrolateral furrows demarcating the keel. The stage of appearance, strength and density of ribbing is extremely variable as can be seen from the figured specimens. Prominent flank ornament is best shown in PCZ7047 (Fig. 24A–C), whereas PCZ8651 (ex H63/1) (Fig. 27) merely shows lateral undulations, and is morphologically transitional to *E. simplex*.

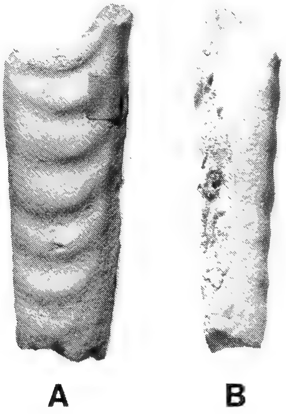

Fig. 21. *Eubaculites carinatus* (Morton, 1834). The holotype, ANSP 72866, from the Prairie Bluff Chalk of Alabama. × 1.

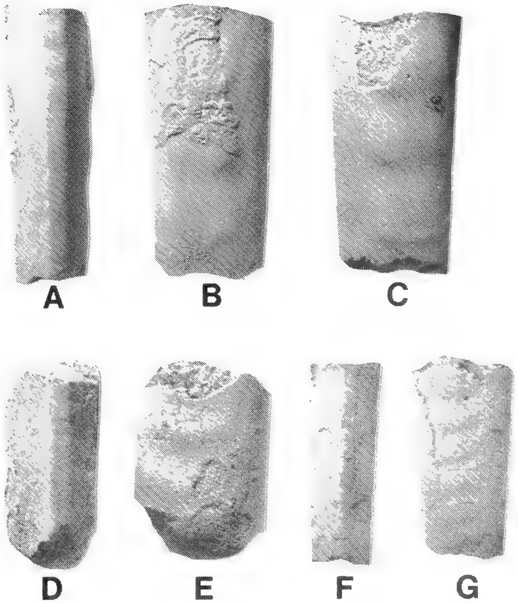

Fig. 22. *Eubaculites carinatus* (Morton, 1834). A–C. Unnumbered specimen, presumably from India. D–E. Paralectotype of *Baculites lyelli* d'Orbigny, 1847, from Quiriquina Island, Chile; MNHP R1020b–c. F–G. Lectotype of *Baculites lyelli* d'Orbigny, 1847, from Quiriquina Island, Chile; MNHP R1020a. All specimens housed in the collections of the Muséum National d'Histoire Naturelle, Paris. × 1.

Fig. 23. *Eubaculites carinatus* (Morton, 1834). SAM–PCZ8647 from locality 131, Zululand, St Lucia Fm, Maastrichtian II. × 0,75.

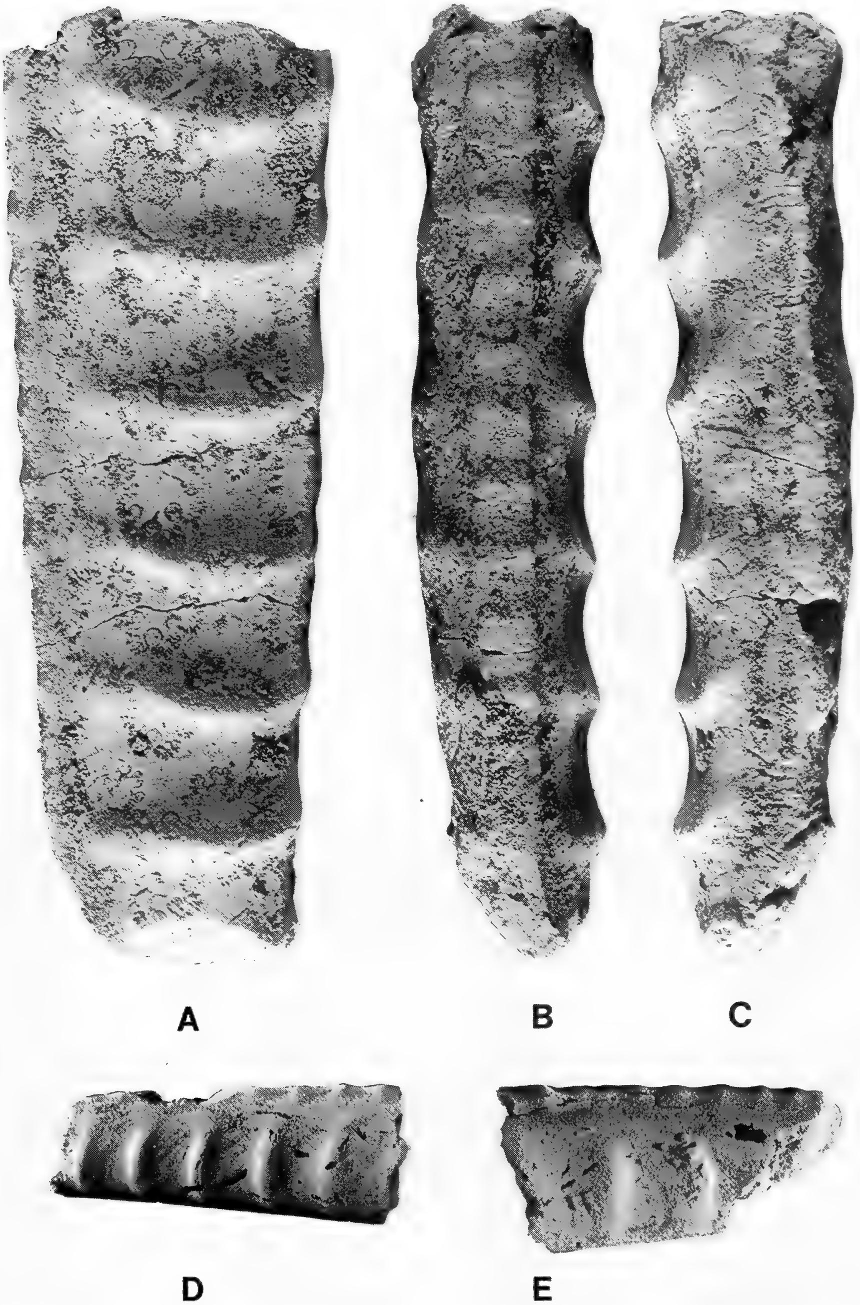

Fig. 24. *Eubaculites carinatus* (Morton, 1834). A–C. SAM–PCZ7047 from locality 133, Zululand, St Lucia Fm, Maastrichtian I. D. SAM–PCZ8322. E. SAM–PCZ8648. Both loose from the top of the section at locality 20, Zululand, St Lucia Fm, Maastrichtian II.

Fig. 25. *Eubaculites carinatus* (Morton, 1834). A. SAM-PCZ8649 from locality 134, Zululand, St Lucia Fm, Maastrichtian I. B. SAM-PCZ8331 from locality 125, Zululand, St Lucia Fm, Maastrichtian a. Both × 1.

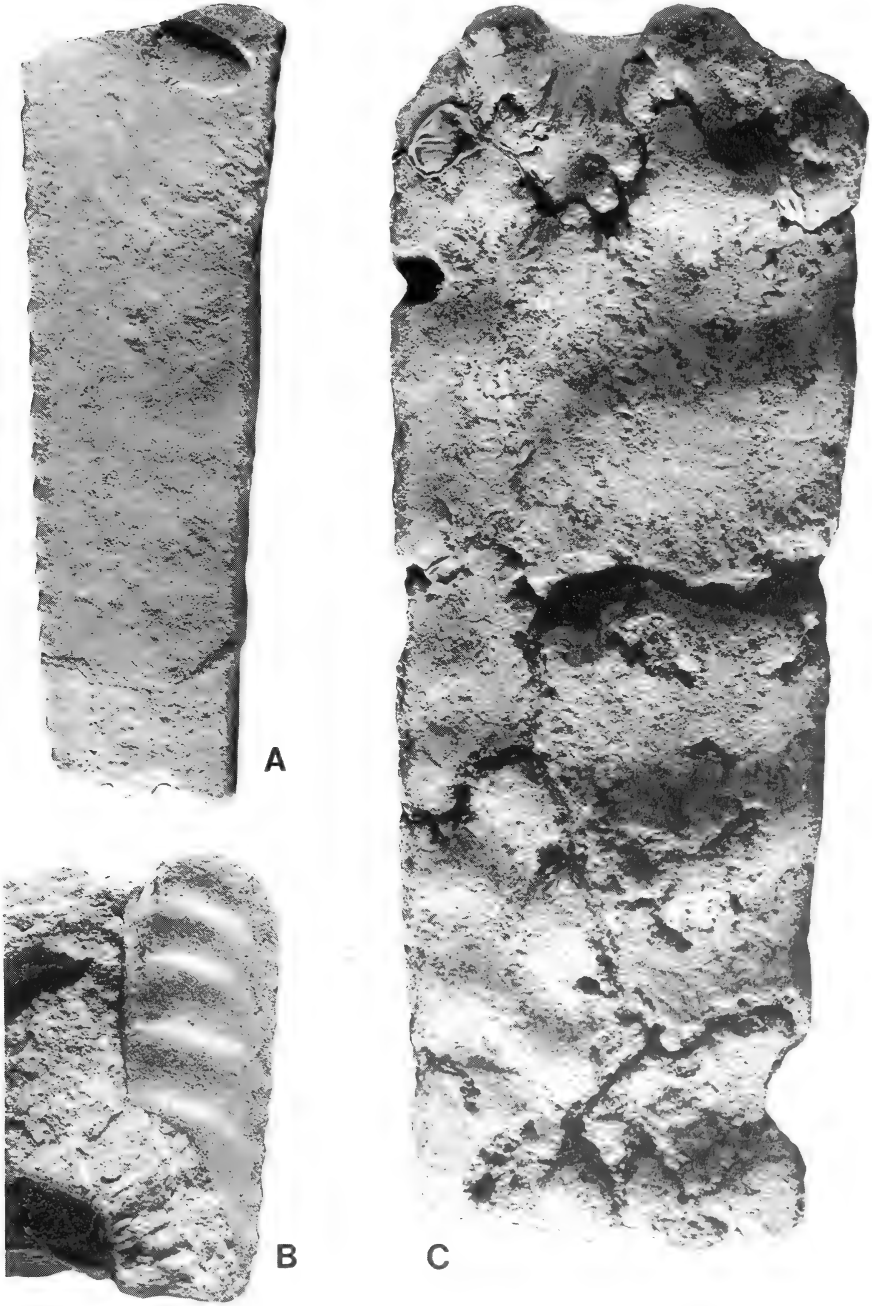

Fig. 26. *Eubaculites carinatus* (Morton, 1834). A. SAM–PCZ7427, specimen with very weak lateral ornament, transitional to *E. latecarinatus*, from locality 134, Zululand, St Lucia Fm, Maastrichtian I. B. SAM–PCZ7073 from locality 134. C. SAM–PCZ8650 from locality 131, Zululand, St Lucia Fm, Maastrichtian II. All × 1.

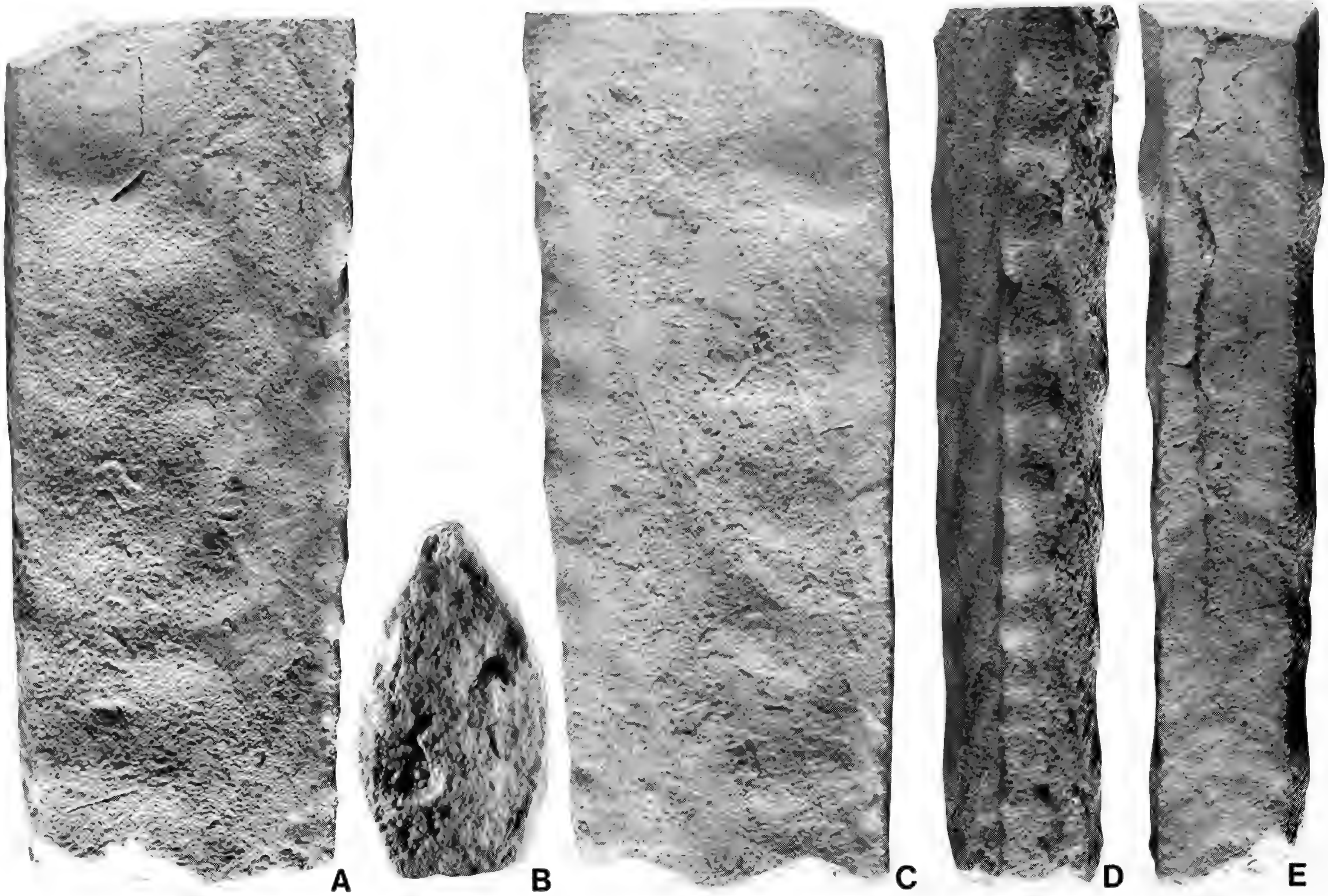

Fig. 27. *Eubaculites carinatus* (Morton, 1834), SAM–PCZ8651 (ex H63/1) weakly ornamented form, morphologically transitional to *E. latecarinatus*. From locality 133, Zululand, St Lucia Fm, Maastrichtian I. × 1.

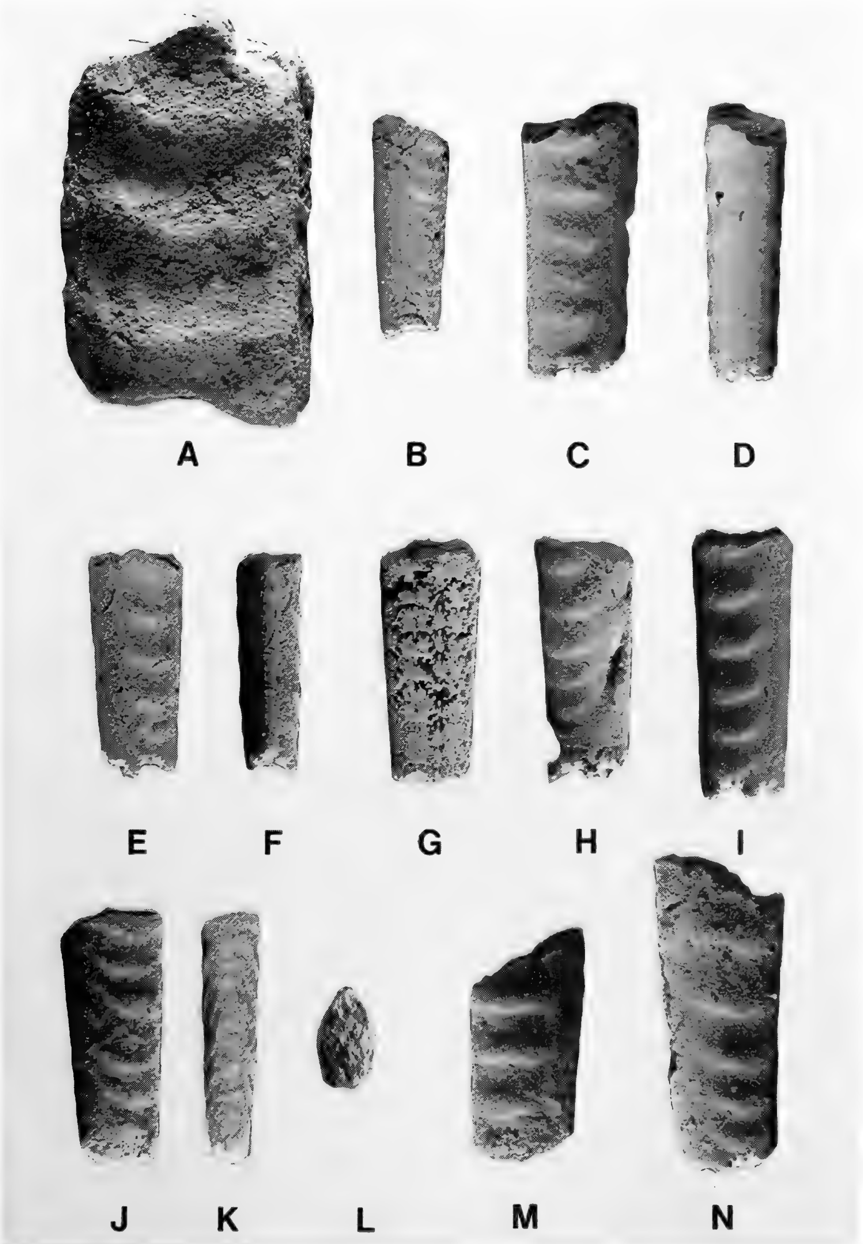

Fig. 28. *Eubaculites carinatus* (Morton, 1834). A. SAS H48/1 from locality 131, Zululand, St Lucia Fm, Maastrichtian II. B. SAM–PCZ8318. C–D. SAM–PCZ8319. E–F. SAM–PCZ8326. G. SAM–PCZ8324. H. SAM–PCZ8329, all from locality 134, Zululand, St Lucia Fm, Maastrichtian II. I. SAS H163G from Bed 7 (G) at locality 20. J–L. SAS Z2204a, specimen transitional to *E. simplex* from locality 133, Zululand, St Lucia Fm, Maastrichtian I. M. SAM–PCZ8320 from locality 134, Zululand, St Lucia Fm, Maastrichtian I. N. SAM–PCZ8323, from locality 134. All × 1.

Parts of the suture line (from PCZ7047) are shown in Figure 38 and illustrated photographically in Figure 24A–C.

Discussion

The ribbed Zululand *Eubaculites* were originally identified by Kennedy & Klinger (1975: 281) and described as *E. ootacodensis* by Klinger (1976). However, as discussed above, this is a synonym of *E. labyrinthicus*, which has binodose flanks and a fastigiate venter at small diameter. In large specimens the lateral ornament of *E. labyrinthicus* and some of *E. carinatus* is virtually identical, and they can only be distinguished by their distinct fastigiate venter and tabulate ventral keels, respectively (compare e.g. Fig. 36A–D and Fig. 35, specimens from Madagascar). In typical specimens, *E. carinatus* is easily identified in the adult stage by the conspicuous crescentic flank ribbing. *Eubaculites vagina* has a similar, sometimes more angular whorl section, but ornament typically consists of two distinct rows of tubercles—one at mid-flank and the other near the dorsolateral edge. *Eubaculites latecarinatus* differs from *E. carinatus*, typically having smooth flanks. However, smooth specimens of *E. carinatus* do occur (see Kennedy & Summesberger 1986, pl. 14 (figs 6–8)). Individually these are indistinguishable from *E. latecarinatus*, and smooth variants of *E. vagina*, but populations are distinct enough.

We have a number of small specimens that are weakly ribbed to smooth but with compressed whorl section, with Wb : Wh ratio of 0,4–0,5. Klinger (1976) referred these compressed specimens to *E. compressum* Brunnschweiler, 1966. *Eubaculites compressum*, as interpreted by Klinger (1976), included Brunnschweiler's (1966) *Eubaculiceras* and *Cardabites* species. This is a rather mixed bag containing costate (*Eubaculiceras*) and non-costate (*Cardabites*) forms, some with tabulate venter, e.g. *Eubaculiceras compressum* (sensu Brunnschweiler 1966), *Cardabites tabulatus*, and others with fastigiate venter, e.g. *Eubaculiceras fastigiatum* and *Cardabites scimitar*. SAS H60F/2 (Klinger 1976, pl. 43 (fig. 13)) shows the transition from a fastigiate venter at one end to tabulate at the other. They all have in common a compressed whorl section with Wb : Wh ratio of less than 0,5. Henderson *et al.* (1992) restudied the Australian material, and also regarded all of these species as synonyms (plus *Baculites* sp. of Hünicken 1965: 64, pl. 2 (figs 3–4), pl. 3 (figs 5–6), pl. 5 (fig. 5), pl. 6 (figs 6–7), pl. 8 (figs 2–5) and *Eubaculites simplex* Kossmat of Collignon (1971: 15, pl. 645 (figs 2388–2389)), for which they used the name *Eubaculites simplex* Kossmat, 1895 (*pars*, p. 156, pl. 19 (fig. 13 *non* 14)). The lectotype is shown in Figure 7I–K. The Australian material is very compressed, smooth or with faint dorsal undulations and a narrowly fastigiate to narrowly tabulate venter.

Of all the species of *Eubaculites* recognized, *E. carinatus* has the longest stratigraphic range, through much of the Lower and Upper Maastrichtian. Assemblages of *E. carinatus* from different geographic regions and different stratigraphic levels all show a very wide range of variation. The excellent illustrations by Hünicken & Covacevich (1975) of the Quiriquina material (Fig. 37) and West Australian material, described and figured by Brunnschweiler (1966) and Henderson *et al.* (1992), show the wide variation in density and strength of ribbing of *E. carinatus*. Brunnschweiler (1966: 32, pl. 3 (figs 8–12), text-fig. 16) named the more densely ribbed forms *E. multicostatus*. Kennedy & Summesberger (1986: 197, pl. 14 (figs 6–8)) figured an almost smooth individual of *E. carinatus* (as *E. lyelli*) from the Maastrichtian of Neuberg, Steiermark, Austria.

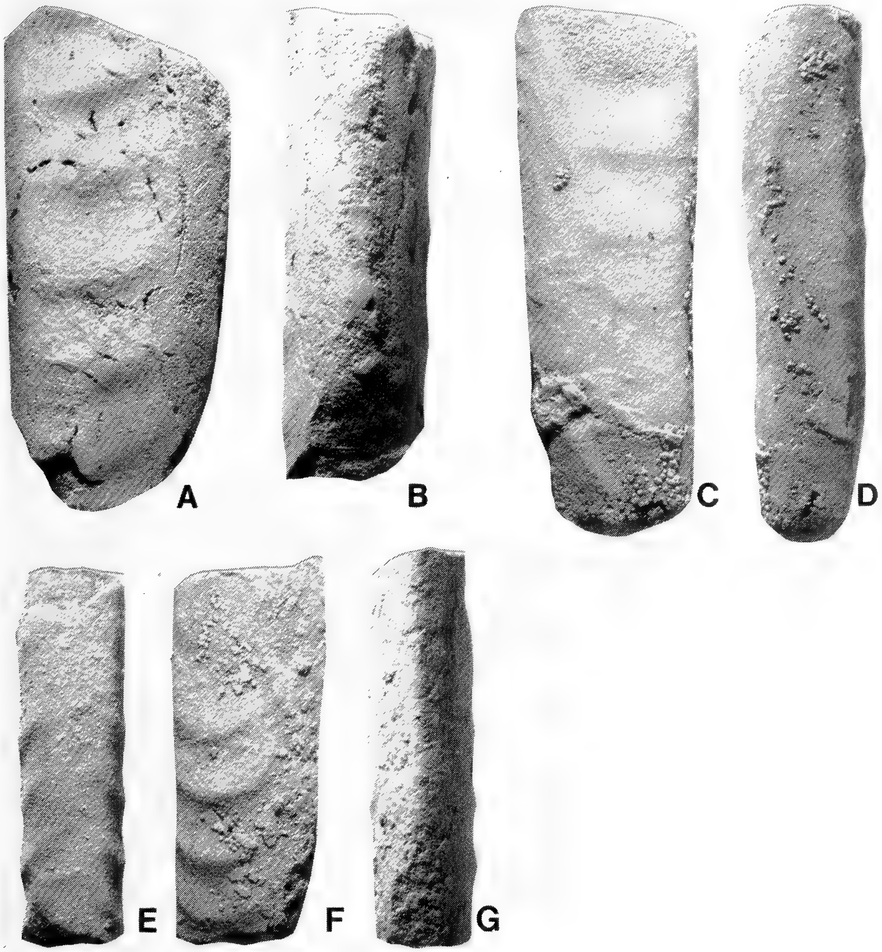

Fig. 29. *Eubaculites carinatus* (Morton, 1834). A–B. OUM KX1836. C–D. OUM KX1837. E–G. OUM KX1835. All from locality 133, Zululand, St Lucia Fm, Maastrichtian I. All × 2.

Kossmat (1897*b*: 73) noticed that 'The Chilean *Baculites vagina* is recognizable by the fact that the swellings of the ribs are a little nearer to the siphonal part of the shell than in the Indian type, for this reason the section appears to be more oval.' We do not know if Kossmat had Indian *Eubaculites carinatus* or *E. ootacodensis* in mind when making this statement. Both Indian *E. ootacodensis* figured by Stoliczka (1866, pl. 90 (fig. 14)) and *E. carinatus* figured by Kossmat (1895, pl. 19(5) (fig. 16)) do show the ribs to be most strongly developed near the dorsal edge, but we do not know if this is a constant feature of Indian *E. carinatus*, for there are not enough illustrations of Indian material to substantiate this view.

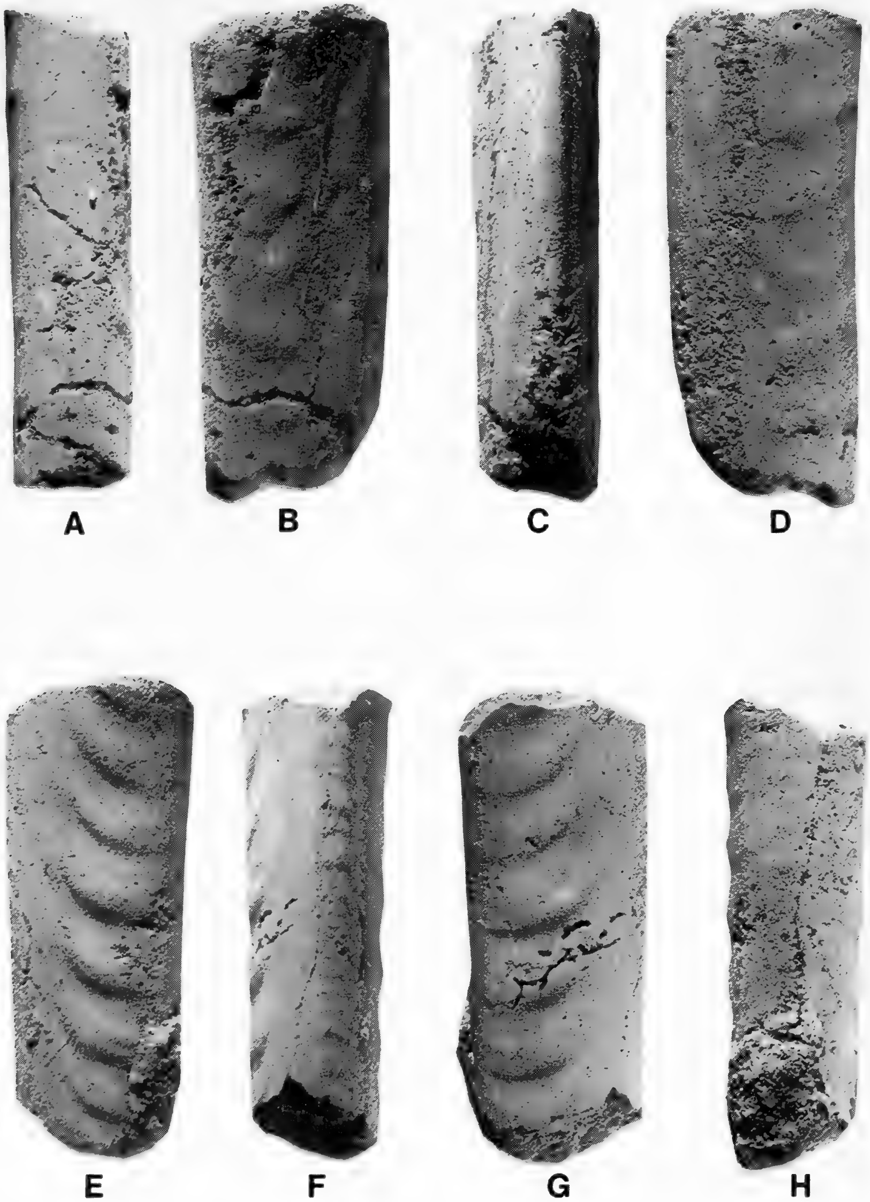

Fig. 30. *Eubaculites carinatus* (Morton, 1834). A–D. OUM KX1839. E–H. OUM KX1840. Both from Bed 7 (G), locality 20, Zululand, St Lucia Fm, Maastrichtian II. Both × 2.

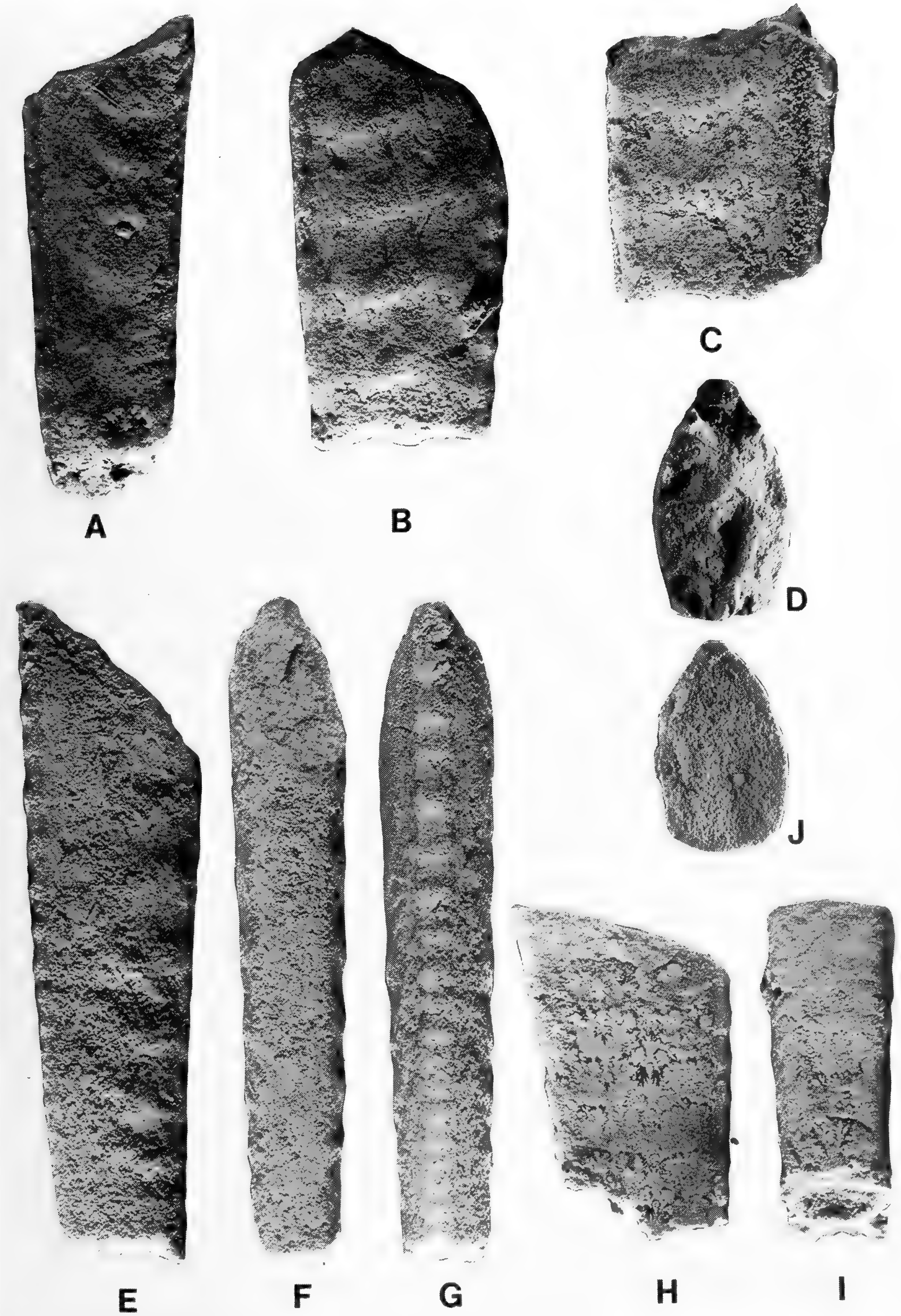

Fig. 31. A–G. *Eubaculites carinatus* (Morton, 1834). A. SAS H20/5 from Bed 5 (E) at locality 20, Zululand, St Lucia Fm, Maastrichtian II. B. SAS H63/12 from locality 133, Zululand, St Lucia Fm, Maastrichtian I. C–D. SAS H60H/17 from Bed H at locality 133. E–G. SAS H54/11 from locality 132, Zululand, St Lucia Fm, Maastrichtian I. H–J. *Eubaculites latecarinatus* (Brunnschweiler, 1966), SAS H61/13 from locality 133. All × 1.

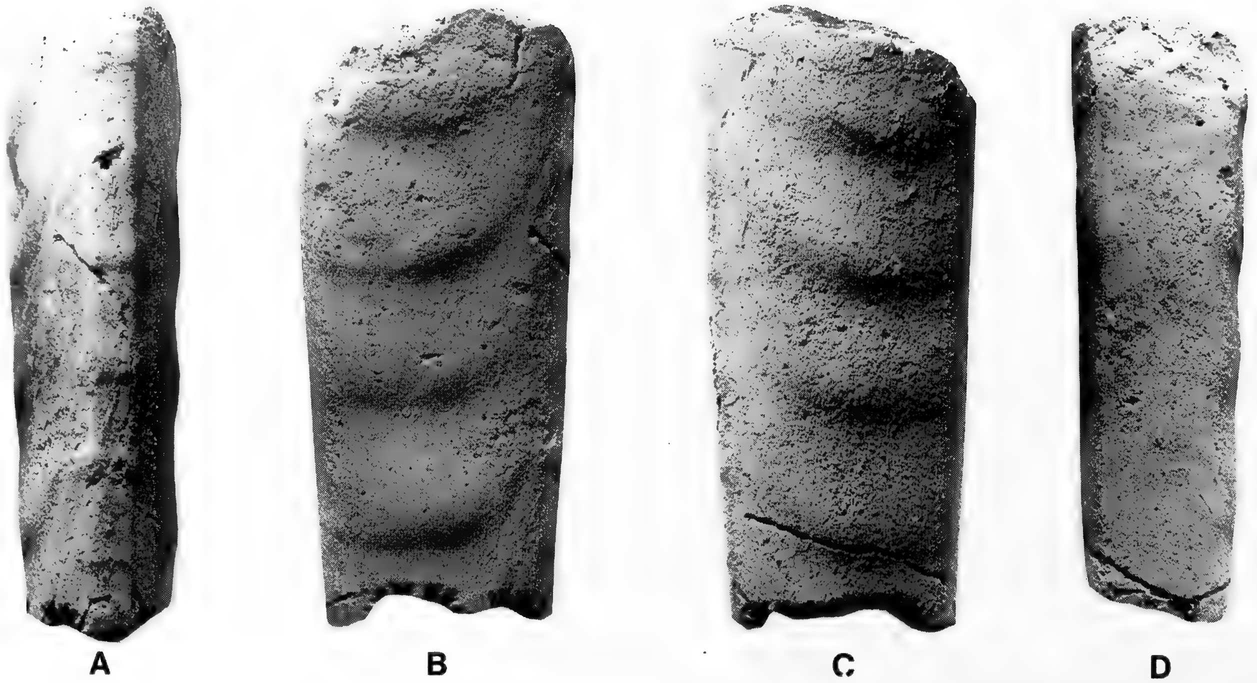

Fig. 32. *Eubaculites carinatus* (Morton, 1834). A–D. OUM KX1827 from Bed 7 (G), locality 20, Zululand, St Lucia Fm, Maastrichtian II. × 2.

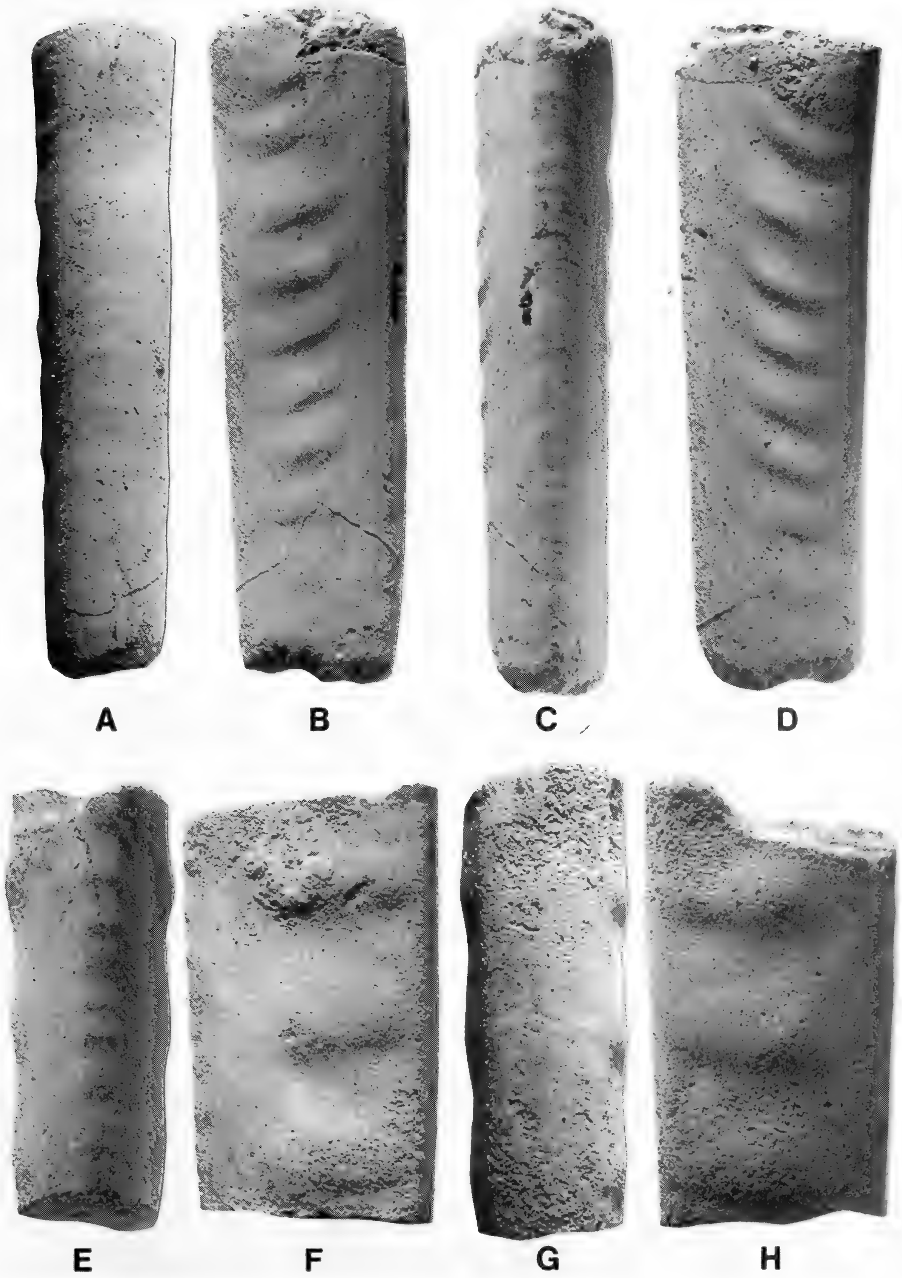

Fig. 33. *Eubaculites carinatus* (Morton, 1834). A–D. OUM KX1826. E–H. OUM KX1825. Both from Bed 7 (G), locality 20, Zululand, St Lucia Fm, Maastrichtian II. Both × 2.

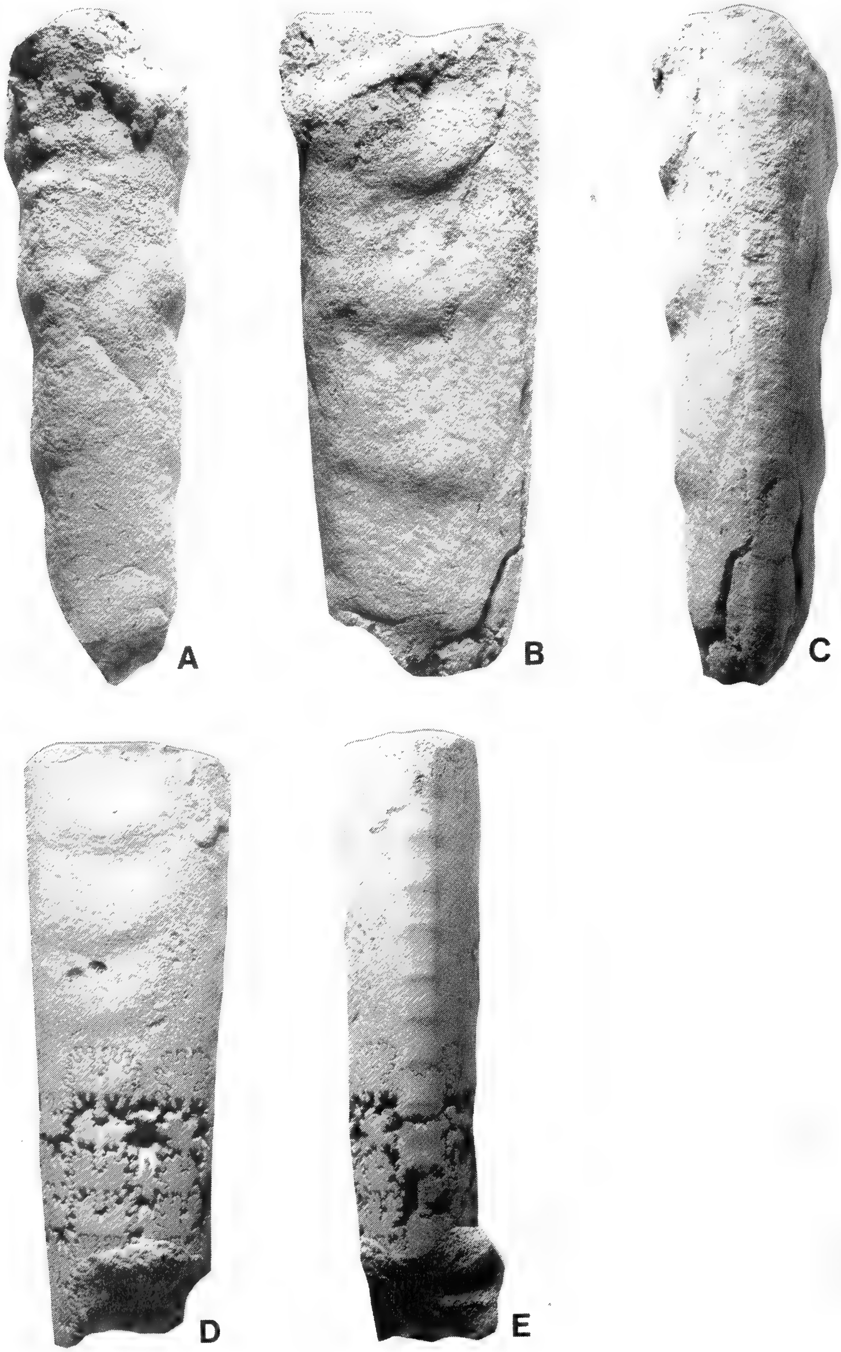

Fig. 34. *Eubaculites carinatus* (Morton, 1834). A–C. OUM KX1834 from Bed 4, locality 20, Zululand, St Lucia Fm, Maastrichtian I–II. D–E. OUM KX1838, from locality 133, Zululand, St Lucia Fm, Maastrichtian I. All × 2.

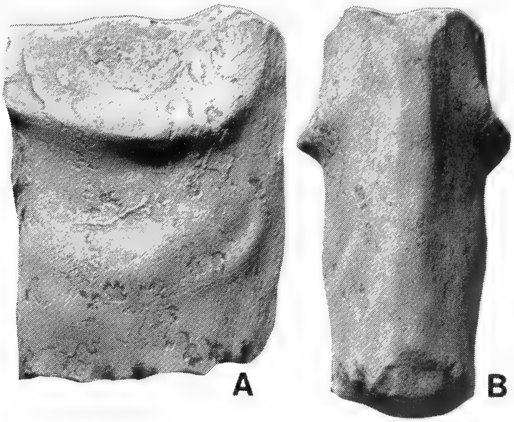

Fig. 35. *Eubaculites carinatus* (Morton, 1834). The original of Collignon's (1971, pl. 646 (fig. 2395)) *Eubaculites otacodensis* from locality 503–504, Soatana-Mikoboka (Manera), Madagascar. Note similarity of lateral ornament to that of large *E. labyrinthicus*, also from Madagascar in Figure 36A–D.

As in *E. latecarinatus*, there is great variation in the absolute size of *E. carinatus*. Some of the Argentinian specimens before us (Fig. 36F) are as large as the largest *E. latecarinatus* we have seen.

The specimens from Mozambique identified by Crick (in Teale 1924: 139) as belonging to the group of *Baculites vagina* include ribbed forms that probably belong to the present species.

Eubaculites carinatus has not been previously recorded from Madagascar, but the original of Collignon's (1971) *E. otacodensis* in part belongs to the present species (Fig. 35).

Occurrence

Of the known species of *Eubaculites*, *E. carinatus* has the widest geographic distribution and is a good indicator for the Maastrichtian Stage. It first occurs in Zululand in Maastrichtian a, associated with typical Lower Maastrichtian *Pachydiscus neubergicus*—as it also does at Neuberg, Steiermark in Austria—and ranges to Maastrichtian II in Zululand, and the upper Upper Maastrichtian in the Petites-Pyrénées in southern France, as well as in coastal sections in the Biscay region. *Eubaculites carinatus* is abundant in the Southern Hemisphere in the South Gondwanid Province, where it has been recorded from South India, Western Australia, Zululand, Mozambique, Madagascar, possibly Angola (Fig. 55F–H), Chile and Argentina. In the Northern Hemisphere it is common in the Owl Creek, Prairie Bluff and Corsicana Formations in Missouri, Mississippi, Alabama, and Texas, and is rare as remanié fossils at the base of the Palaeocene in New Jersey. It also occurs, albeit not in such great numbers, in California, the Netherlands, south-east France, northern Spain and Austria.

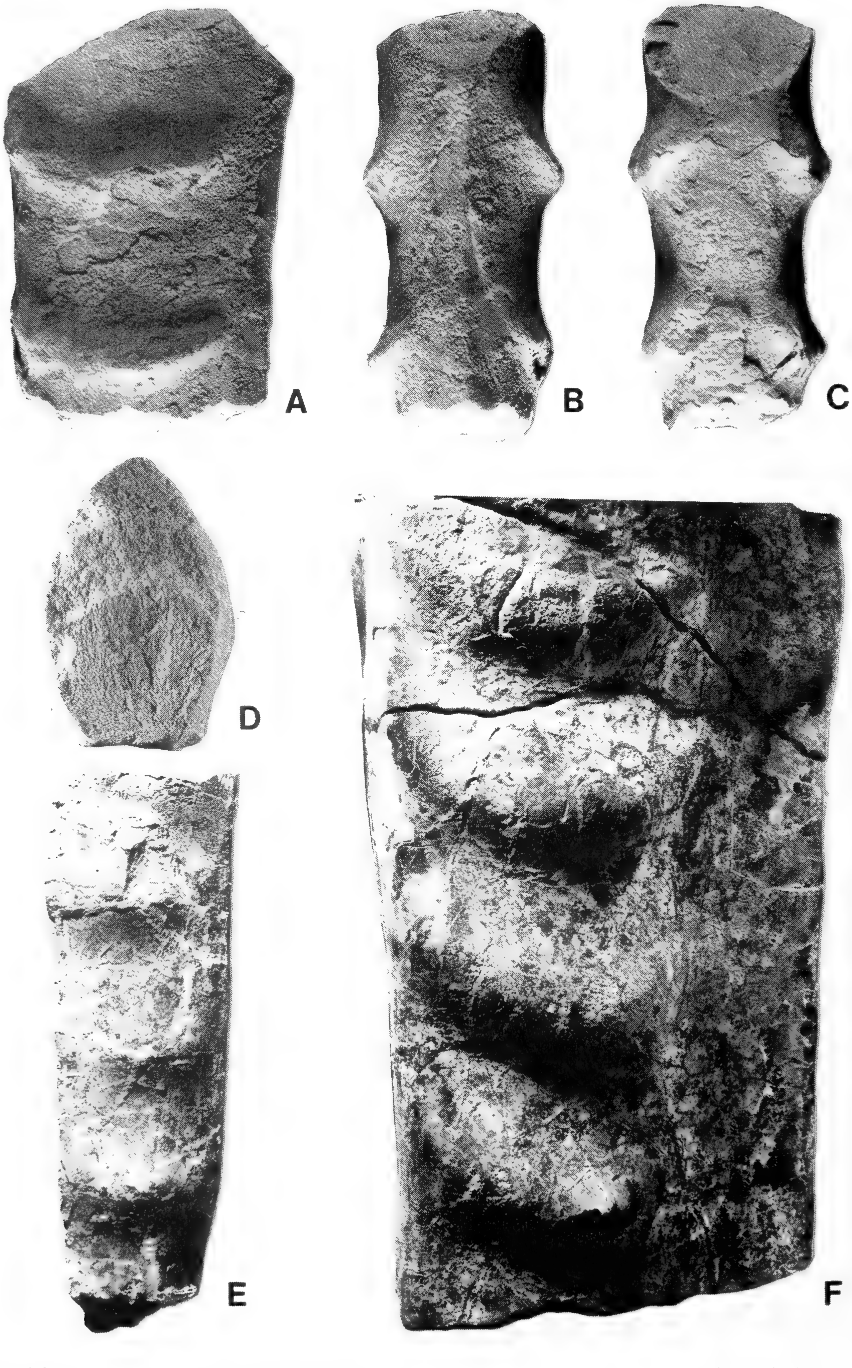

Fig. 36. A–D. *Eubaculites labyrinthicus* (Morton, 1834). Specimen from locality 503, Soatana-Mikoboka (Manera), Madagascar, donated by the late Gen. M. Collignon. E–F. *Eubaculites carinatus* (Morton, 1834). Two specimens from Neuquén Basin, Argentina. Collections of the División Paleozoologia de Invertebrados, Museo de Ciencias Naturales, Universidad Nacional de la Plata, Argentina; courtesy Dr A. C. Riccardi. All × 1.

Fig. 37. *Eubaculites carinatus* (Morton, 1834). Block of specimens from Quiriquina Island, Chile. Collection of Museum für Naturkunde, Berlin. × 1.

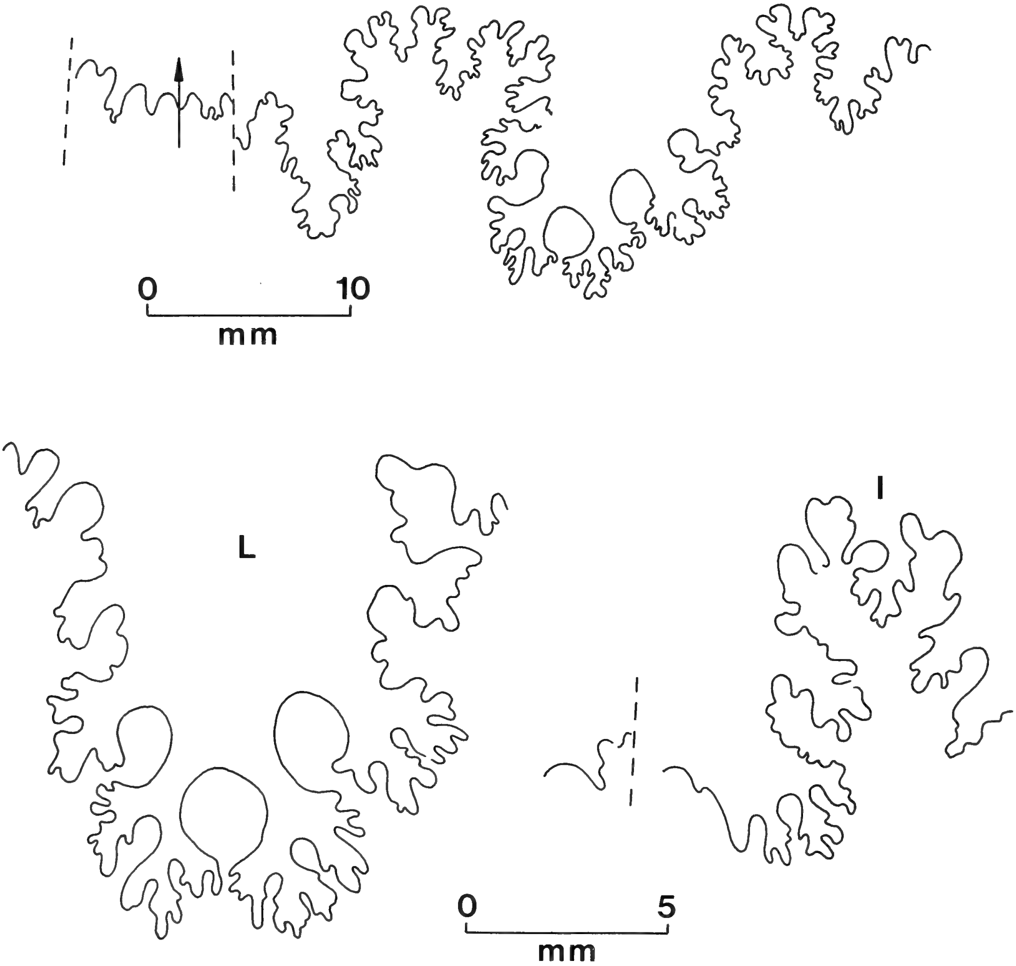

Fig. 38. *Eubaculites carinatus* (Morton, 1834). Part of suture line of SAM–PCZ7047.

Eubaculites latecarinatus (Brunnschweiler, 1966)

Figs 26A, 39–41, 42B–C, 43–49, 50A, 53A

Eubaculites otacodensis (Stoliczka): Spath, 1940: 49 (*pars*), text-fig. 1c.
Giralites latecarinatus Brunnschweiler, 1966: 33, pl. 3 (figs 13–14), pl. 4 (figs 1–5), text-figs 17–18.
Giralites quadrisulcatus Brunnschweiler, 1966: 35, pl. 4 (figs 11–14), text-fig. 20.
Eubaculites ambindensis Collignon, 1971: 18, pl. 646 (fig. 2393).
Baculites occidentalis Meek: Collignon, 1971: 15, pl. 645 (fig. 2390).
Eubaculites latecarinatus (Brunnschweiler): Klinger, 1976: 91, pl. 40 (figs 1–2), pl. 41 (fig. 3), pl. 42 (figs 2, 6), pl. 43 (figs 3–4), text-fig. 11d–e. Klinger & Kennedy, 1980: 296, figs 2–4, 5D. Henderson *et al.*, 1992: 159, figs 22L–N, 23N–P.

Type

Holotype is the original of Brunnschweiler (1966, pl. 4 (figs 2–4)), CPC 2718 from the nodule bed at the top of the Korojong Calcarenite; Western Australia.

Material

Numerous specimens, including SAS H163D, Bed 4 (D), SAM–PCZ7938, Bed 7 (G) at locality 20, section at junction of old course of the Mfolozi River, the present course and the unnamed stream draining south from Lake Mfuthululu, St Lucia Formation, Maastrichtian I–II; SAM–PCZ7029, PCZ7041–7045, PCZ7048–7056, PCZ7064, PCZ7072, PCZ7074, PCZ7172–7176, PCZ7291–7298, PCZ7975, PCZ7979, SAS H60, H60/1.2, H61/6, H61/13, H62/5, all from locality 133; SAS H60F/11 from Bed F at locality 133; SAS H60H, H60H/1, H60H/4, Bed H at locality 133, cliff section and beach platform below Charter's Creek Rest Camp, Lake St Lucia, Zululand, St Lucia Formation, Maastrichtian I; SAM–PCZ7038, PCZ7058–7059, PCZ7061, SAS H54B/15, Bed B, from locality 132, degraded cliff and foreshore platform 300 m north-east of northern jetty at Charter's Creek Rest Camp, Lake St Lucia, Zululand, St Lucia Formation, Maastrichtian I; SAM–PCZ7065–7066, PCZ7068–7069, PCZ7075, PCZ7429, PCZ7432, PCZ7709, PCZ7980, PCZ8320–8330, PCZ8457–8458, SAS Z2204 from locality 134, cliffs and foreshore section, 1,2 km south of Charters Creek Rest Camp, St Lucia Formation, Maastrichtian I; SAS L97 from locality 131, low cliff and foreshore section 4,6 km north of Charter's Creek Rest Camp, St Lucia Formation, Maastrichtian II; SAM–PCO5908–5914, all from locality C in the Alphard Group, offshore, Cape Province, Maastrichtian ?a.

Dimensions

Specimen	*Wb*	*Wh*	*Wb/Wh*	*Tapering*
SAS Z2204	19	28	0,68	—
SAS H60F/11	12,5	19	0,66	—
	10	16	0,62	9,7 (D = 13)
SAS H61/6	18	25	0,7	—
SAS H61/13	17	27	0,63	—
	14	23	0,61	16 (D = 25)
SAS H62/5	18	26	0,69	—
	13	19	0,68	14,2 (D = 49)
SAS H60/1.2	—	52	—	
		41		5,2 (D = 210)
SAM–PCZ7068	27	44	0,61	—
SAM–PCZ7069	29	49	0,59	
	24	44	0,54	6,5 (D = 77)
SAS H54B/15	46	72	0,64	
	40	65	0,61	6,0 (D = 117)
SAM–PCZ7269	—	65	—	
		64		0,41 (D = 240)
SAM–PCZ7066	—	68	—	
		66		2,3 (D = 88)
SAM–PCZ7980	—	90	—	
		82		4,6 (D = 172)
SAS H163D	28	44	0,63	
	19	28	0,69	12,6 (D = 125)

SAS H60	—	68	—	
		77		3,1 (D = 290)
SAM–PCZ7298	—	88	—	
		57		3,9 (D = 800)

Diagnosis

Eubaculites with tabulate ventral keel; no lateral ornament. May grow to a large size.

Description

Tapering in the early stages is rapid, but decreases with growth, such that large specimens have venter and dorsum essentially parallel in side view. The whorl section in the adult stage is distinctly pyriform with a broad, flat dorsum and a serrated, tabulate keel. The flanks are slightly inflated and nearly parallel. Maximum width is at, or just ventral of, mid-flank. A distinct longitudinal ridge at the middle of the dorsum is present in some specimens. The flanks are completely smooth. The suture is minutely frilled with phylloid foliole elements in the saddles.

Discussion

This species is characterized by its tabulate venter and smooth flanks. It is the commonest *Eubaculites* in Zululand, and is conspicuous by virtue of its large size—the estimated length of some specimens was in excess of 2 metres.

Specimens reach maturity at large and small whorl heights, indicating size-related dimorphism—compare, e.g. Figures 39, 40 and 41. Unfortunately, complete apertures are very rare in the available material; part of one is preserved in H60H/1 (Fig. 46).

Smooth individuals of *E. vagina* (e.g. Stoliczka 1866, pl. 90 (fig. 1); herein Figs 15A–C, I–J, 16) and of *E. carinatus* (Kennedy & Summesberger 1986, pl. 14 (figs 6–8)) occur and are inseparable from *E. latecarinatus*, apart perhaps from details in whorl section. Populations of the species are easily distinguished, as discussed above.

The specimen figured by Collignon (1971: 15, pl. 645, (fig. 2390)) as *Baculites occidentalis* Meek seems to be a juvenile specimen of *Eubaculites simplex* or *E. latecarinatus* (Fig. 55A–B).

We have been inclined to regard smooth and compressed *Eubaculites*, described by Klinger (1976: 92, pl. 43 (fig. 2)), as *E. compressum* as variants of the present species, but revision of the Australian material (Henderson *et al.* 1992) has shown *E. latecarinatus* and these compressed forms, for which the earliest available name is *E. simplex* (Kossmat, 1895), to be morphologically and stratigraphically separated. *Eubaculites simplex* is much more compressed than *E. latecarinatus*, may have feeble flank undulations or be smooth, and has a fastigiate to narrowly tabulate ventral keel.

Occurrence

Eubaculites latecarinatus is most abundant in Maastrichtian I of Zululand, but onshore extends into Maastrichtian II. It is imprecisely located in the Maastrichtian of the offshore Alphard Group, but may appear as early as Maastrichtian a (ex Campanian IV). In Madagascar it occurs in the Lower Maastrichtian Zone of *Pachydiscus neubergicus* and *P. gollevillensis*. The occurrences in Western Australia can be dated no more precisely than Maastrichtian.

Fig. 39. *Eubaculites latecarinatus* (Brunnschweiler, 1966). A–C. SAS H163D from Bed 4 (D) at locality 20, Zululand, St Lucia Fm, Maastrichtian I–II. × 1.

Fig. 40. *Eubaculites latecarinatus* (Brunnschweiler, 1966). A–B. SAS H60H/4 from Bed H, locality 133, Zululand, St Lucia Fm, Maastrichtian I. × 0,75.

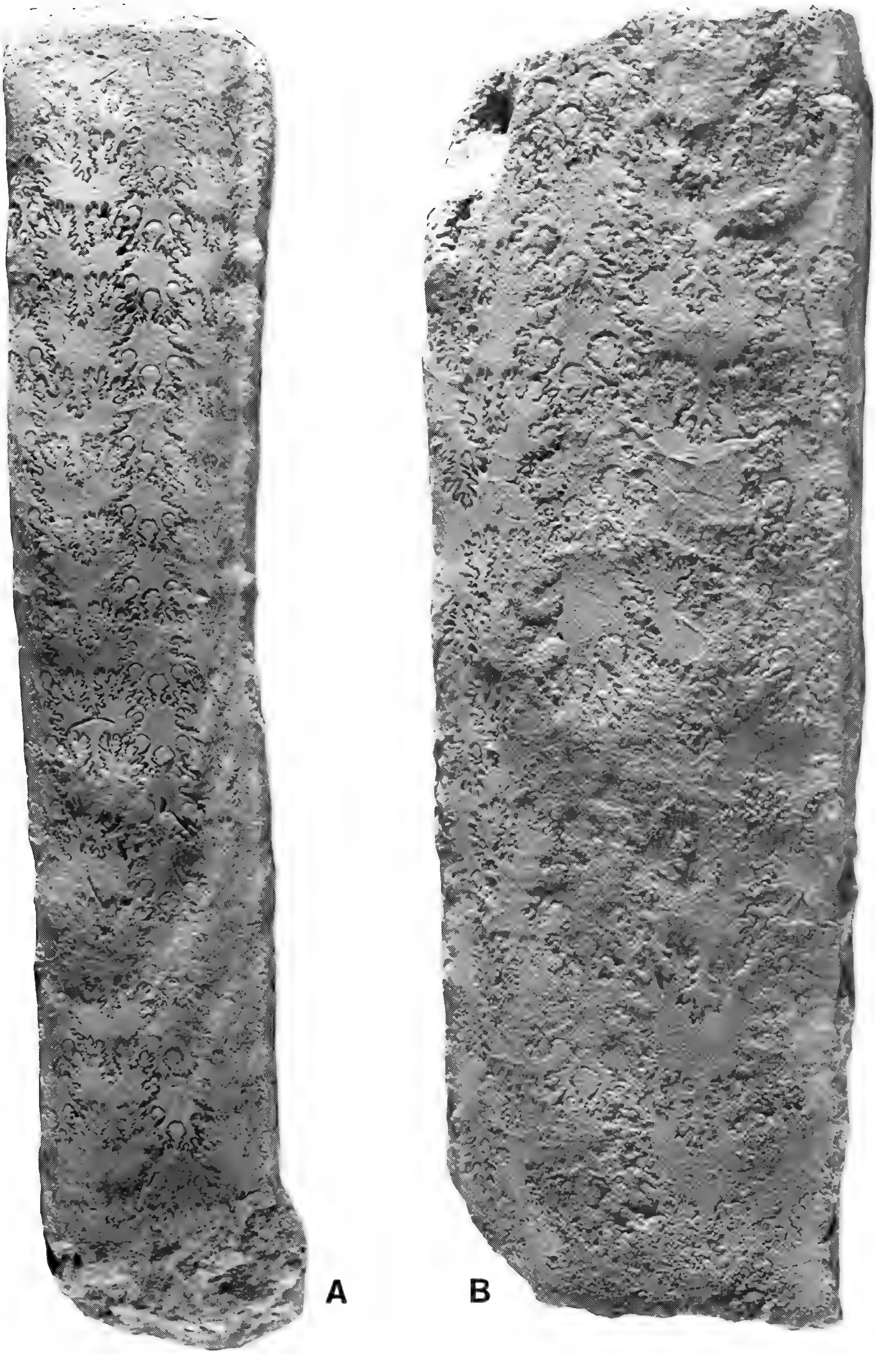

Fig. 41. *Eubaculites latecarinatus* (Brunnschweiler, 1966). A. SAS H60H from locality 133, Zululand, St Lucia Fm, Maastrichtian I. B. SAS H54B/15 from Bed B at locality 132, Zululand, St Lucia Fm, Maastrichtian I. A × 0,40; B × 0,85.

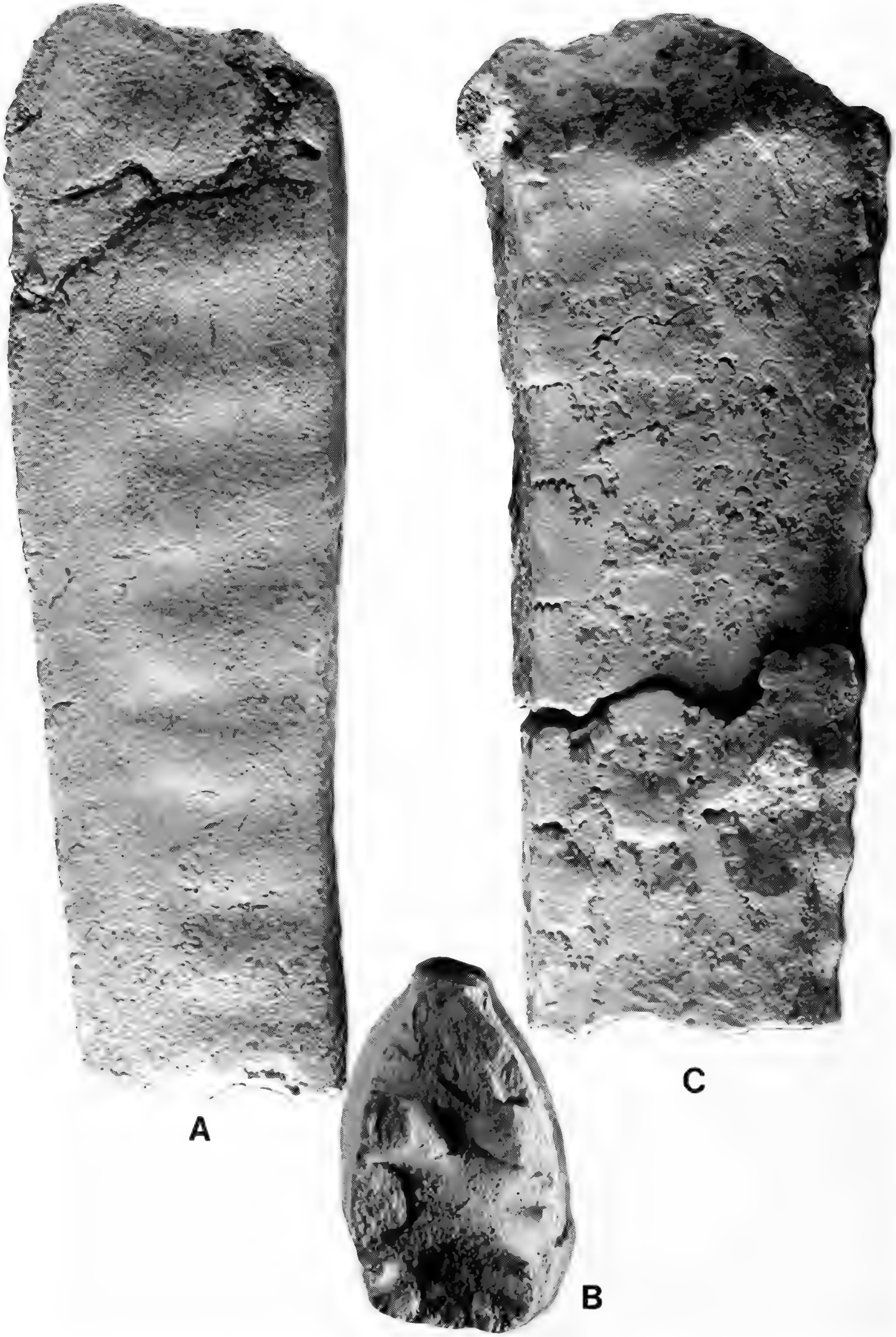

Fig. 42. A. *Eubaculites carinatus* (Morton, 1834). SAS L97, specimen with weak lateral ornament, transitional to *E. latecarinatus*, from locality 131, Zululand, St Lucia Fm, Maastrichtian II. B–C. *Eubaculites latecarinatus* (Brunnschweiler, 1966). SAM–PCZ7432 from locality 134, Zululand, St Lucia Fm, Maastrichtian I. Both × 1.

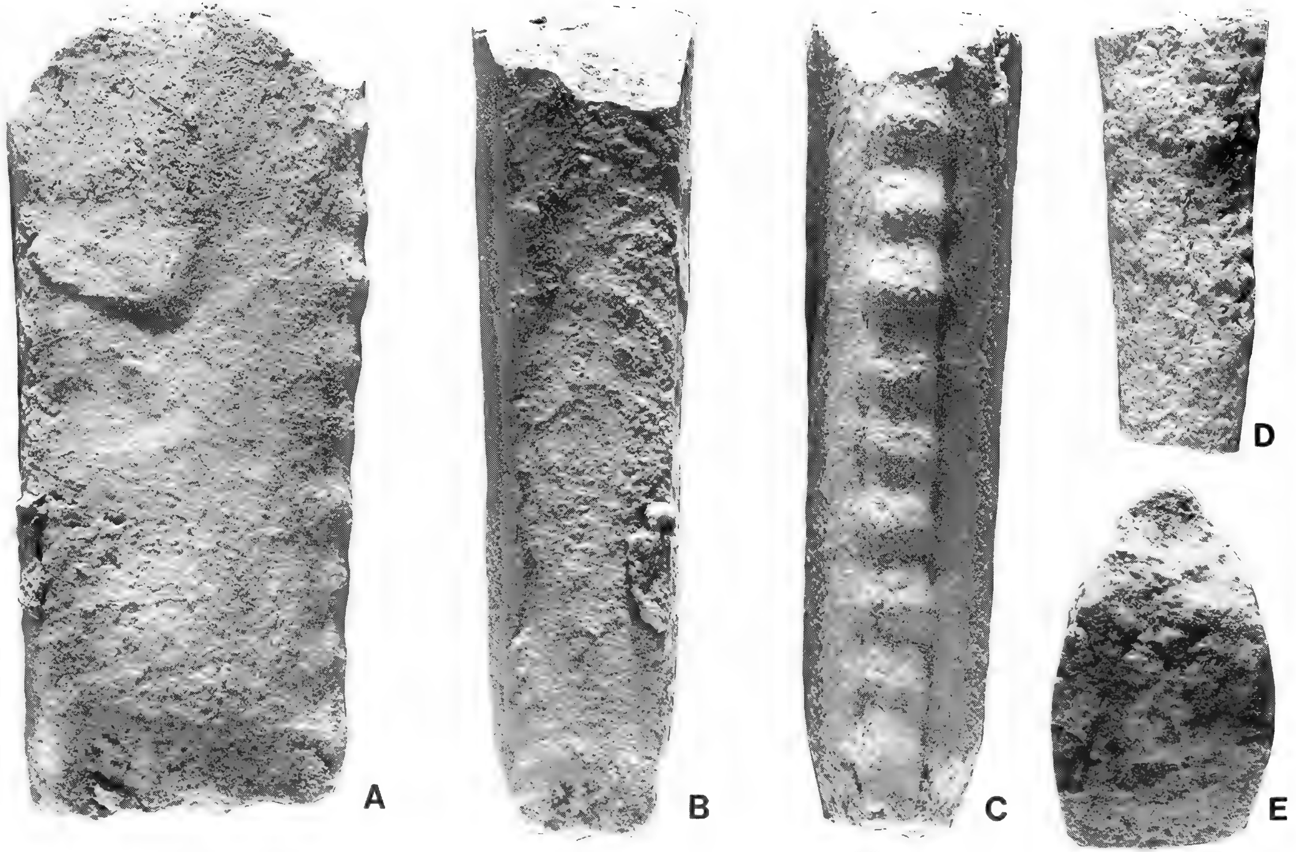

Fig. 43. *Eubaculites latecarinatus* (Brunnschweiler, 1966). A–C, E. SAM–PCZ7069. D. SAM–PCZ8457. Both from locality 134, Zululand, St Lucia Fm, Maastrichtian I. Both × 1.

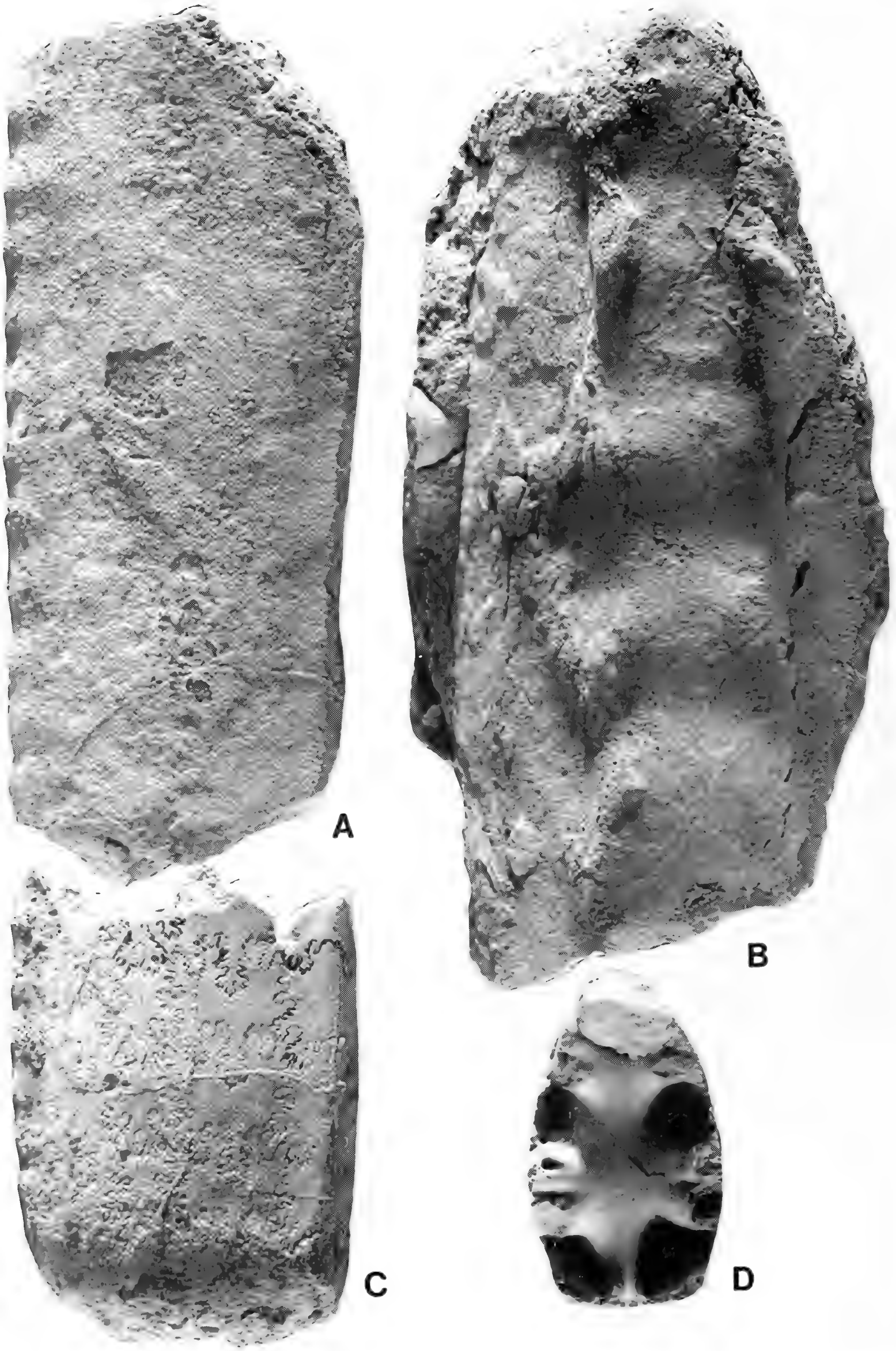

Fig. 44. *Eubaculites latecarinatus* (Brunnschweiler, 1966). A. SAM–PCZ7068. B. SAM–PCZ8458, the largest known specimen, slightly deformed, viewed from the venter to show the size of the crenulate, tabulate venter. A–B. From locality 134, Zululand, St Lucia Fm, Maastrichtian I. C–D. SAM–PCZ7938; from Bed 7 (G) at locality 20, Zululand, St Lucia Fm, Maastrichtian I–II. All × 1.

Fig. 45. *Eubaculites latecarinatus* (Brunnschweiler, 1966). A–B. SAM–PCZ7975 from locality 133. C. SAS H54B/15 from Bed B at locality 132. Both from Zululand, St Lucia Fm, Maastrichtian I. A–B × 1; C × 0,85.

Fig. 46. *Eubaculites latecarinatus* (Brunnschweiler, 1966). SAS H60H/1. Adult specimen with part of aperture preserved. Bed H, locality 133, Zululand, St Lucia Fm, Maastrichtian I. × 1.

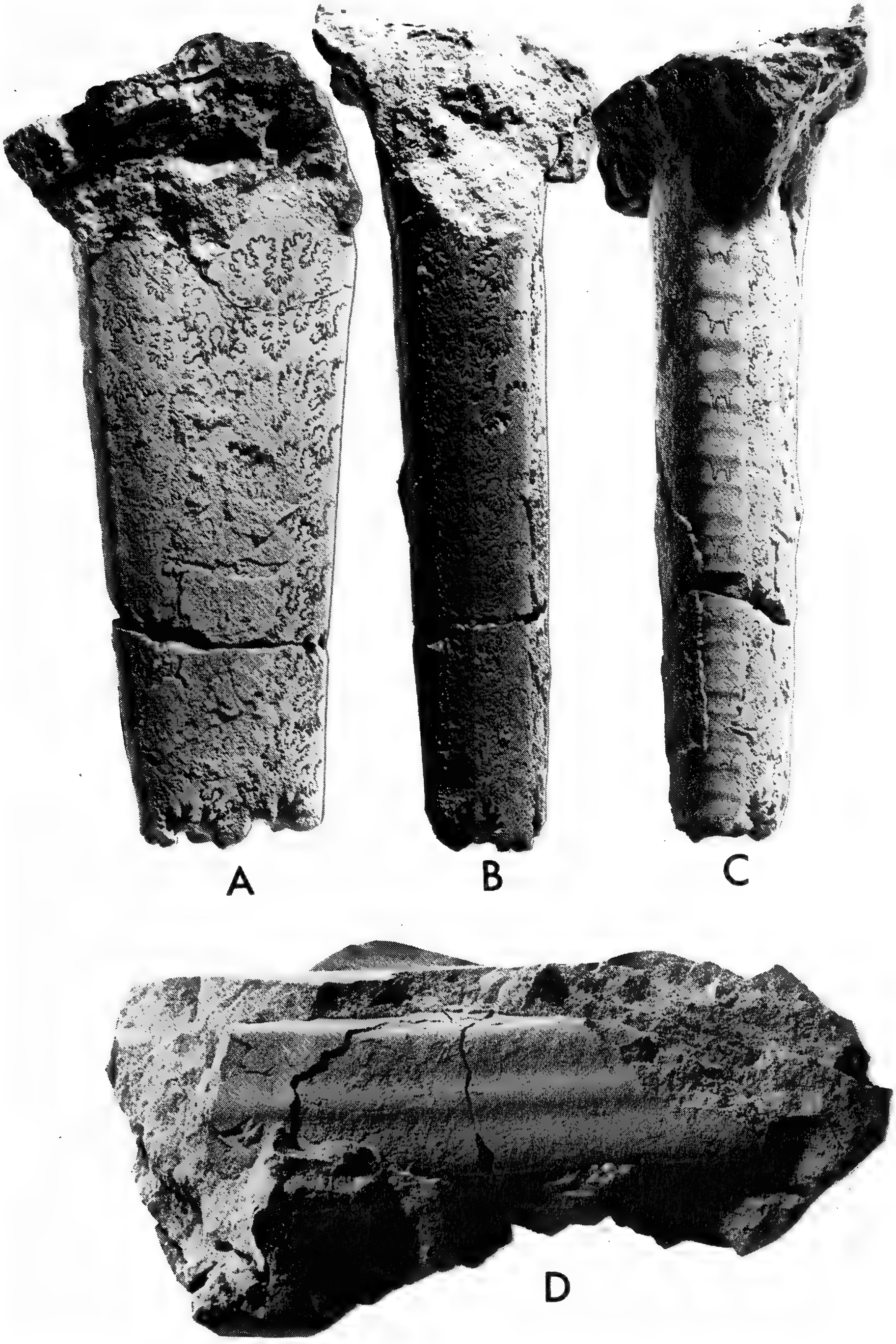

Fig. 47. *Eubaculites latecarinatus* (Brunnschweiler, 1966). A–C. SAM–PCO5909. D. SAM–PCO5908; note the prominent median ridge on dorsal side. Both from locality C (TBD 1336) on the offshore Alphard Group, southern Cape, South Africa. × 1.

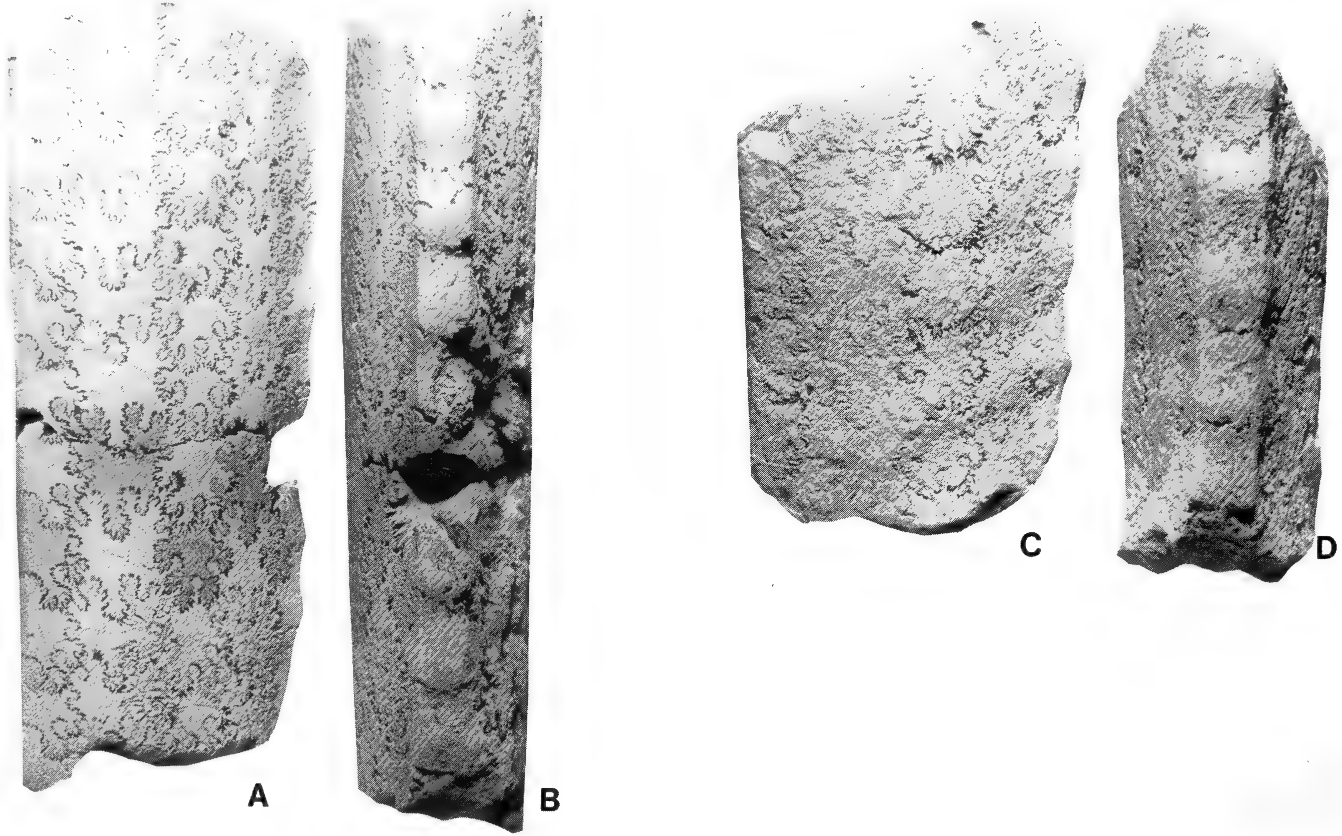

Fig. 48. *Eubaculites latecarinatus* (Brunnschweiler, 1966). A–B. The original of Collignon's (1971, pl. 646 (fig. 2393) *Eubaculites ambindensis* from locality 504, Mont Ambinda-Mikoboka (Manera), Madagascar. C–D. An unfigured syntype of Collignon's *Eubaculites ambindensis*. All × 1.

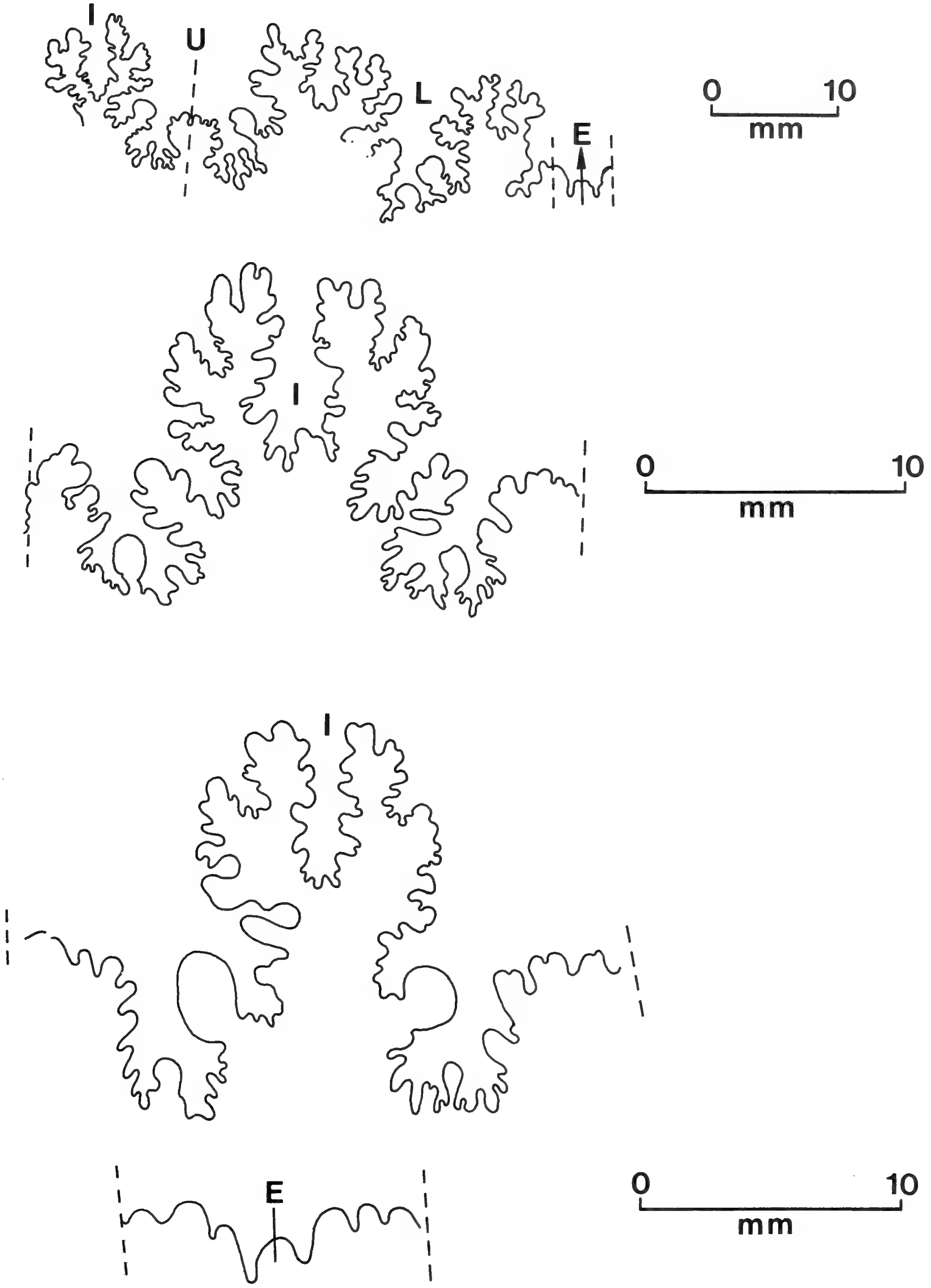

Fig. 49. *Eubaculites latecarinatus* (Brunnschweiler, 1966). Parts of the suture line.

Eubaculites simplex (Kossmat, 1895)

Figs 7I–K, 50B, 51, 52D–F, I–N, 53B, 54–55

Baculites vagina Forbes n. var. *simplex* Kossmat, 1895: 156, pl. 19(5) (figs 13a–b) (*non* figs 14a–c) (= *E. carinatus*).
Baculites sp. Hünicken, 1965: 64, pl. 2 (figs 3–4), pl. 3 (figs 5–6), pl. 5 (fig. 5), pl. 6 (figs 6–7), pl. 8 (figs 2–5).
Giralites simplex (Kossmat): Brunnschweiler, 1966: 34, pl. 4 (figs 6–10), text-fig. 19.
Eubaculiceras compressum Brunnschweiler, 1966: 36, pl. 4 (figs 15–17), pl. 5 (figs 1–3), text-fig. 21.
Eubaculiceras fastigiatum Brunnschweiler, 1966: 37, pl. 5 (figs 7–9), text-fig. 22.
Cardabites tabulatus Brunnschweiler, 1966: 38, pl. 5 (figs 12–15), text-fig. 23.
Cardabites scimitar Brunnschweiler, 1966: 38, pl. 5 (figs 16–21), text-fig. 24.
Eubaculites compressum (Brunnschweiler): Klinger, 1976: 92, pl. 42 (fig. 10a–b), pl. 43 (figs 2a–c, 13a–c, 14a–c).
Eubaculites simplex (Kossmat): Henderson *et al.*, 1992: 153, 21, 22A–K, O–P, 23A–F, K–M, 24-25. Kennedy & Henderson, 1992: 717, text-fig. 6D–F.

Types

Lectotype, designated by Kennedy (1986*c*: 195), is the original of Kossmat (1895, pl. 19 (figs 13a–b)), Geological Survey of India Type Collection, GSI 14819 (Fig. 7I–K). The original of Kossmat (1895, pl. 19 (figs 14a–c)) is GSI 14820 in the same collections, and is a *Eubaculites carinatus*. Both are from the Arrialoor Group of Otacod, South India.

Material

SAS H163C/3 (Bed C), H163D/3 (Bed D), H163F/2 (Bed F), and SAM–PCZ7939 and PCZ7912 (Bed G) at locality 20, section at junction of the old course of the Mfolozi River, the present course, and the unnamed stream draining south from Lake Mfuthululu, St Lucia Formation, Maastrichtian I–II; SAS H66/2, H66/3, from locality 135, foreshore

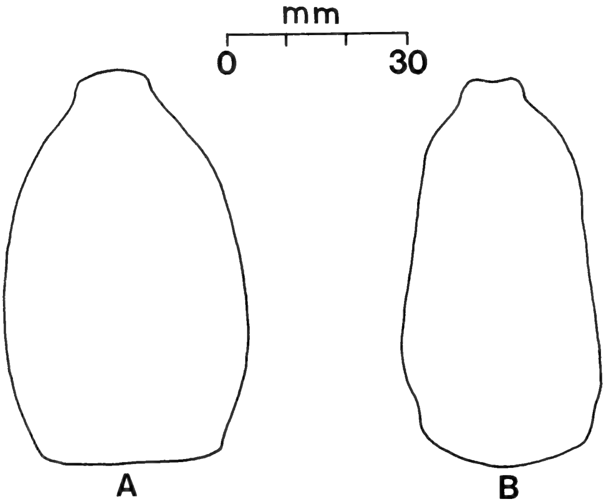

Fig. 50. Comparison of whorl sections of large examples of *Eubaculites latecarinatus* and *E. simplex*. A. *Eubaculites latecarinatus* (Brunnschweiler, 1966), SAM–PCZ7979. B. *Eubaculites simplex* (Kossmat, 1895), SAM–PCZ7939. Both × 1.

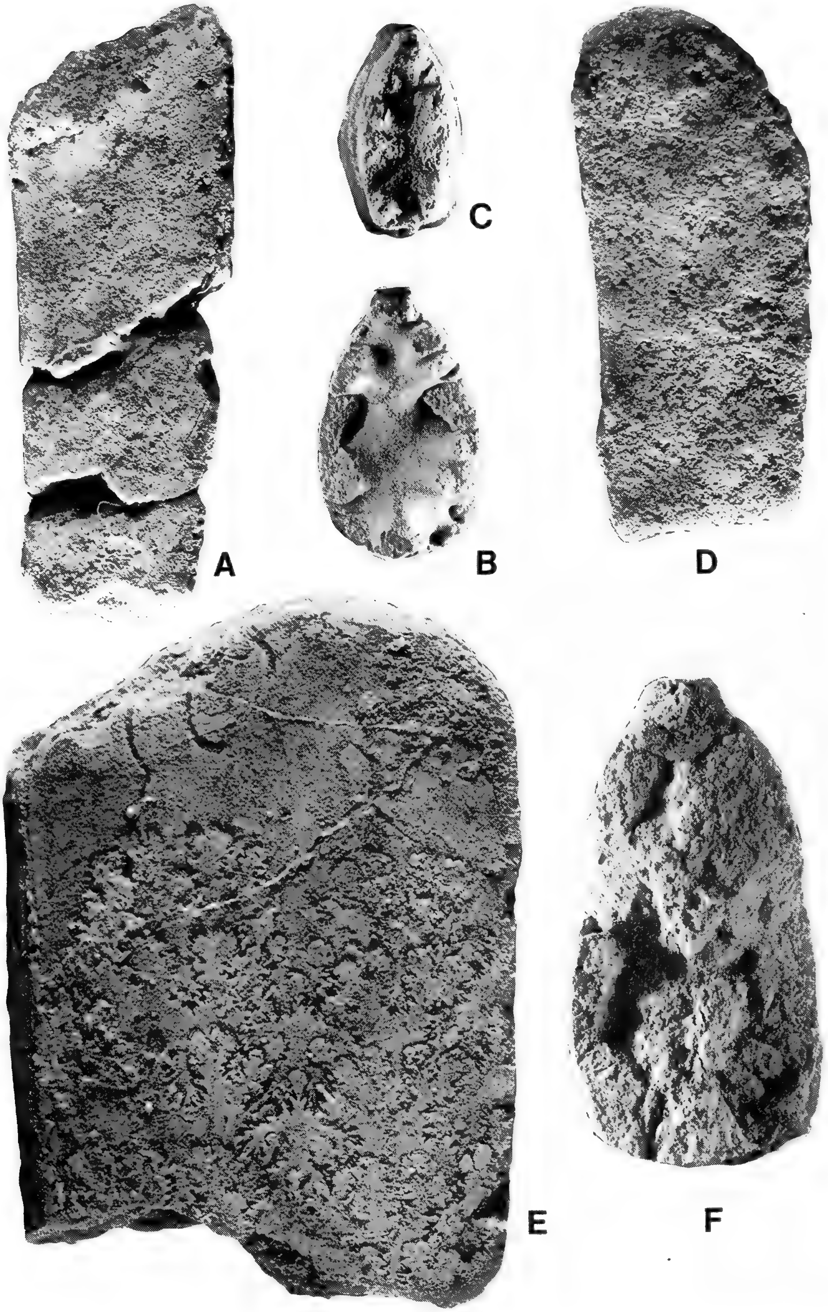

Fig. 51. *Eubaculites simplex* (Kossmat, 1895). A. SAS H163D/3 from Bed 4 (D). B. SAS Z2204m. C–D. SAS H163C/4 from Bed 3 (C). E–F. SAM–PCZ7939 from Bed 7 (G). All from locality 20, Zululand, St Lucia Fm, Maastrichtian I–II. All × 1.

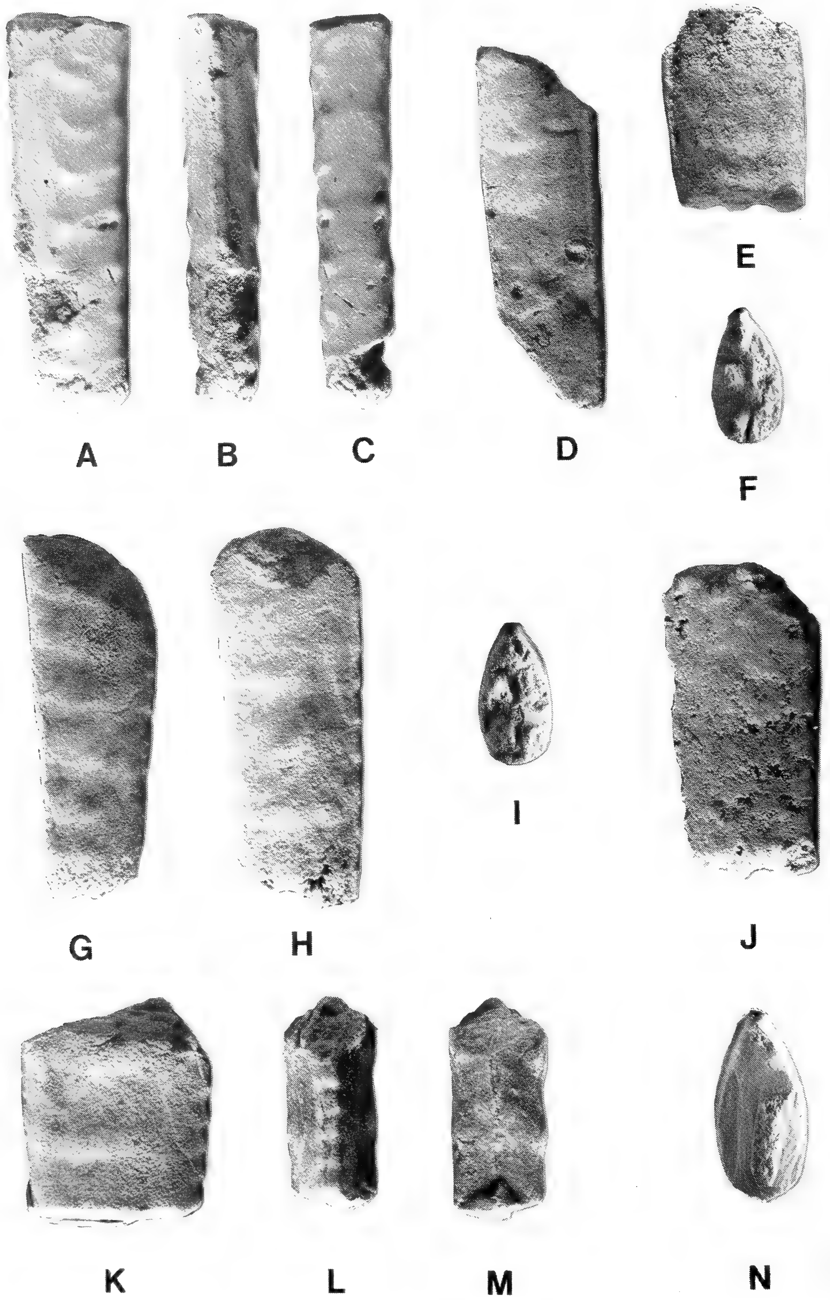

Fig. 52. A–C. *Eubaculites labyrinthicus* (Morton, 1834). SAS H163G/7 from Bed 3 (C) at locality 20, Zululand, St Lucia Fm, Maastrichtian I–II. D–F, I–N. *Eubaculites simplex* (Kossmat, 1895). D. SAS H66/2 from locality 135, Zululand, St Lucia Fm, Maastrichtian I. E–F. SAS H60F/12 from Bed F at locality 133, Zululand, St Lucia Fm, Maastrichtian I. I–J. SAS 163F/2 from Bed 6 (F) at locality 20. K–N. SAS Z2204c from locality 133. G–H. *Eubaculites carinatus* (Morton, 1834). G. SAM–PCZ8311, loose from locality 20. H. SAS H163D/1 from Bed 4 (D) at locality 20. All × 1.

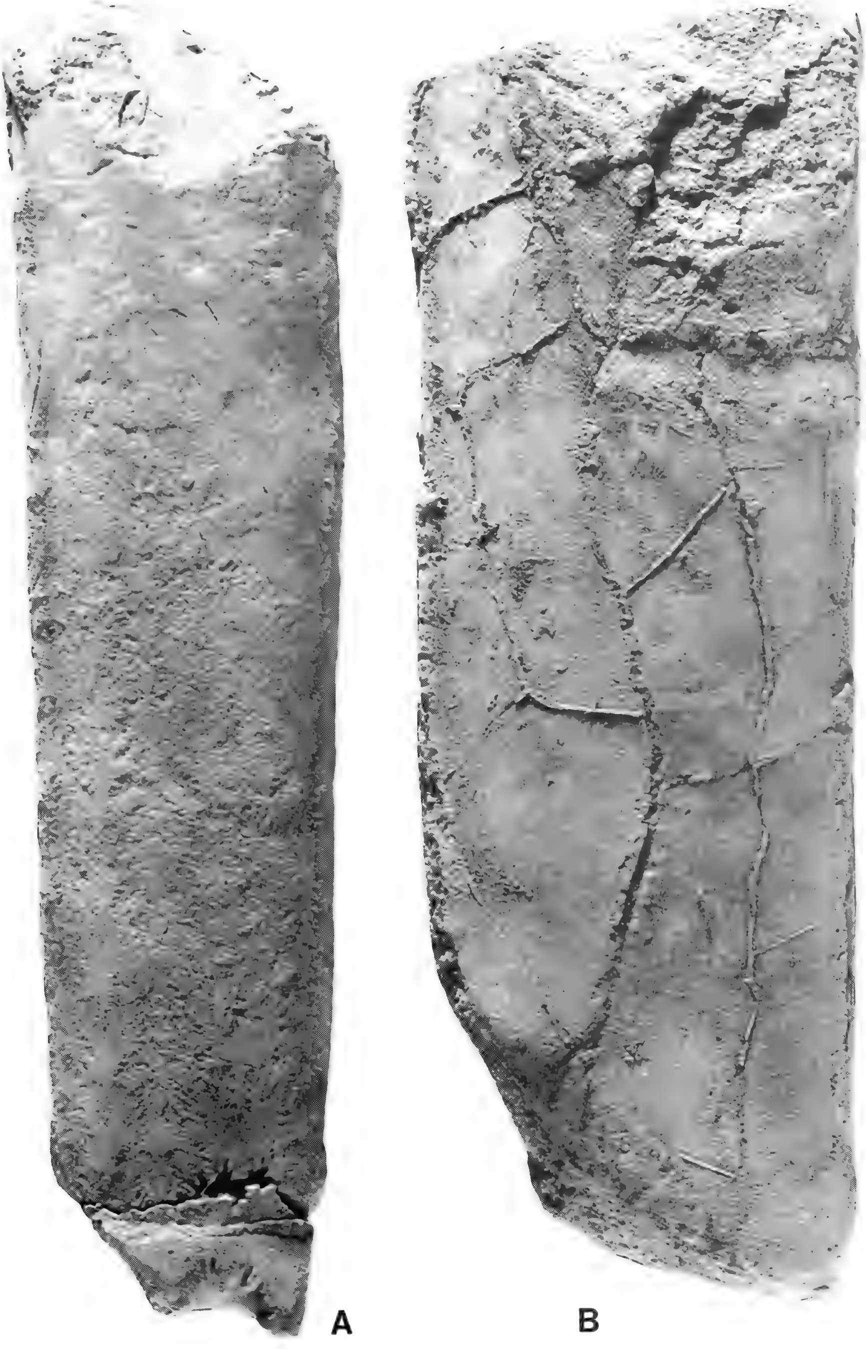

Fig. 53. A. *Eubaculites latecarinatus* (Brunnschweiler, 1966). SAM–PCZ7980 from locality 134, Zululand, St Lucia Fm, Maastrichtian I. B. *Eubaculites simplex* (Kossmat, 1895), SAM–PCZ7980, a body chamber fragment with part of the aperture preserved; from Bed 7 (G) at locality 20, Zululand, St Lucia Fm, Maastrichtian I–II. A. × 0,45; B. × 0,70.

Fig. 54. *Eubaculites simplex* (Kossmat, 1895). A. Large specimen, SAM–PCZ7980 (see also Fig. 53B) showing details of aperture, from Bed 7 (G) at locality 20, St Lucia Fm, Maastrichtian II.

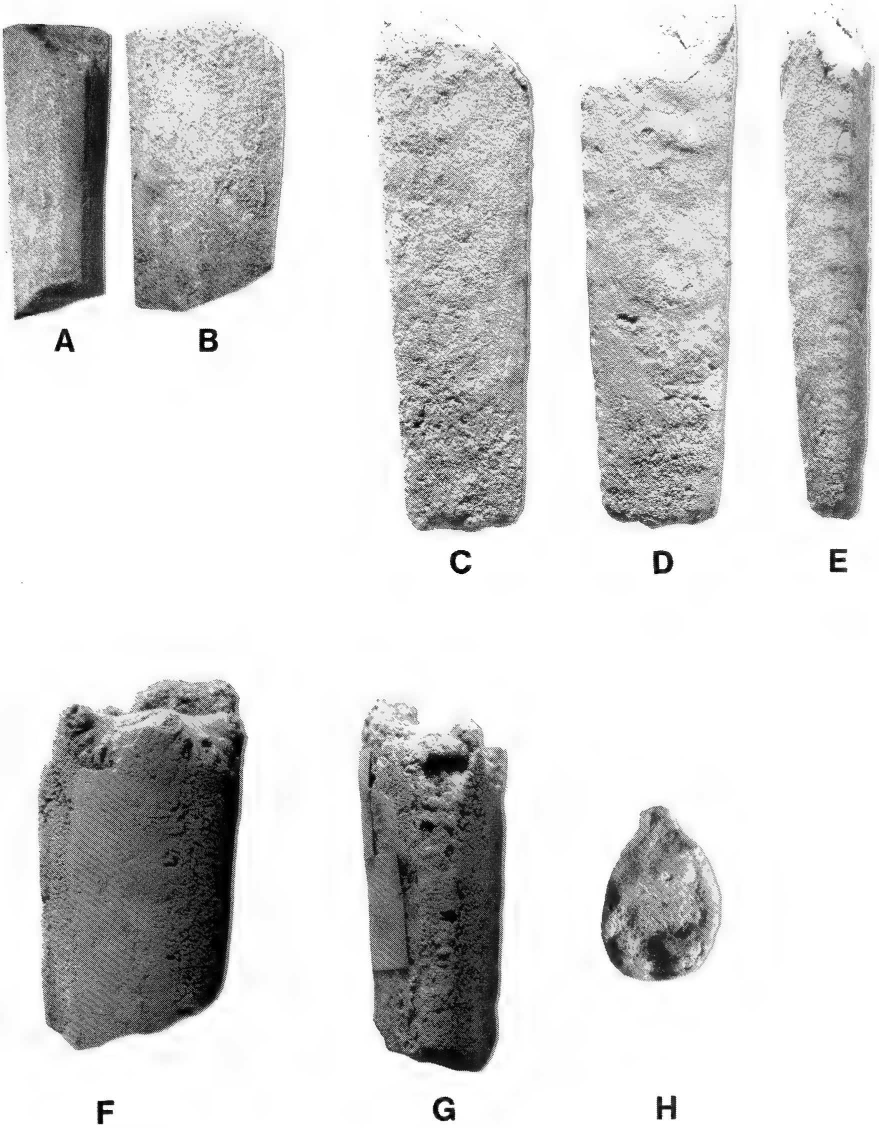

Fig. 55. A–E. *Eubaculites simplex* (Kossmat, 1895). The original of Collignon's (1971, pl. 645 (fig. 2390)) *Baculites occidentalis* from locality 665–7, Route Antsoha-Andranomana (Ambavaloza) (Belo sur Tsiribihina), Madagascar. × 1. C–E. SAS H60A/21, specimen showing transition from fastigiate to tabulate venter from locality 133, St Lucia Formation, Maastrichtian II. F–H. *Eubaculites?* sp., specimen from Angola figured by Haas (1943, fig. 16) as *Baculites anceps*. Collections of the American Museum of Natural History, courtesy of Dr N. Eldredge.

Fig. 56. *Eubaculites? binodosus* (Noetling, 1897). Cast of holotype, GSI 3097, of *Baculites binodosus*, the original of Noetling (1897, pl. 23 (fig. 3)) from Dés Valley, Baluchistan.

outcrops in Makakatana Bay, east of the settlement, St Lucia Formation, Maastrichtian I; SAS H60F/5, H60/2, H66F/15, H60F/21, all from Bed F at locality 133; SAS H60A/21 from Bed A; and SAS Z2204 from an unspecified horizon at locality 133; SAS Z2204c and SAS H60HA/21, Bed A, locality 133, cliff section and beach platforms below Charter's Creek Rest Camp, Lake St Lucia, Zululand, St Lucia Formation, Maastrichtian I.

Dimensions

Specimen	*Wb*	*Wh*	*Wb/Wh*	*Tapering*
SAS H60F/12	9	17	0,53	—
SAS H60/2	9	16	0,56	—
SAS H60F/21	7	16	0,44	—
	12	20	0,60	7,3 (D = 55)
SAS H60F/5	11	24	0,46	—
SAS H163F/2	10	18	0,56	—
SAM–PCZ7939	34	67	0,50	—
SAM–PCZ7912	43	80	0,53	—

Fig. 57. *Baculites* sp. (nov.?) *aquilaensis* Reeside. The original of Collignon (1970, pl. 639 (fig. 2358)) from the Upper Campanian of locality 227–2, Mokotibe (Antsalova) Madagascar. × 1.

Diagnosis

Compressed *Eubaculites* (Wb/Wh 0,46–0,70) with flanks that are smooth or with broad, faint dorsal undulations. Whorl section tear-shaped to pyriform, with or without a distinct keel, and venter fastigiate or narrowly tabulate.

Description

The lectotype (Fig. 7I–K) as represented by a cast, is 39 m long, with a maximum preserved whorl height of 19,5 mm and a whorl breadth to height ratio of 0,64. It retains recrystallized shell, and appears to be a fragment of body chamber; venter and dorsum are parallel when viewed in profile. The dorsum is broad and very feebly convex. The dorsolateral margin is narrowly rounded, the dorsal two-thirds of the flank very broadly rounded, the ventral third converging to a fastigiate venter, demarcated from the flanks by a marked longitudinal depression. There is no ornament. Zululand material referred to this species consists predominantly of fragmentary juvenile specimens. These all show the very compressed whorl section, and have generally no, or extremely weak flank ornament. H60F/21 (Fig. 55C–E) shows the transition from a fastigiate venter at the smaller end to tabulate at the larger. In all the other specimens, the venter is narrowly tabulate both with and without crenulations.

Two large specimens, PCZ7939 (Fig. 51E–F)—part of the phragmocone—and PCZ7980 (Figs 53B, 54A)—part of a body chamber with the aperture preserved, with compressed whorl section—are possibly adults of the species. These indicate that *E. simplex* may reach maximum sizes comparable to those of *E. latecarinatus* and *E. carinatus*.

Discussion

Henderson *et al.* (1992) referred an assemblage of 132 specimens from the Miria Formation of Western Australia to this species. They described the shell as straight or with a slight endogastric curvature, and a very low expansion rate. The whorl section is fairly to very much compressed, with a whorl breadth to height ratio of 0,46–0,7, the shell surface smooth or with broad, weak undulations on the dorsal part of the flanks, 2–4 in a distance equal to the whorl height. Dorsum and venter are completely smooth. The whorl section is tear-shaped to weakly pyriform, the flanks broadly convex, dorsum feebly convex, and venter fastigiate or with a tabulate keel which may be bordered on either side by a longitudinal groove in some specimens. A collection of 27 specimens from a single locality included eight with a clearly tabulate venter and eight with a rounded to fastigiate venter that is narrowly arched in some but blade-like in others. Two specimens showed a change from fastigiate to tabulate with growth. Shape of venter is not a function of growth stage, as both large (whorl height in excess of 20 mm) and small specimens (whorl height less than 20 mm) may have either tabulate or fastigiate venter.

Patagonian material described by Hünicken (1965) as *Baculites* sp. and possessing a keeled, fastigiate venter, is referred here to *E. simplex*. *Baculites vagina* var. *cazadorianus* Paulcke (1907: 11, pl. 16 (figs 5, 5a, 5b)) may perhaps be conspecific, but its range of variation is not known and the sole illustrated specimen is more like *B. anceps* in whorl profile than *E. simplex*.

The lack of significant flank ornament, very compressed whorls, and fastigiate to very narrowly tabulate venter separates populations of *E. simplex* from *E. vagina*, *E. carinatus* and *E. labyrinthicus*, described above. Smooth variants of *E. carinatus* and *E. labyrinthicus* may be difficult to separate, as individuals, from smooth *E. simplex* with tabulate venter, other than by their wider venters. Populations of *E. simplex* and *E. latecarinatus* can be separated by the presence of individuals with fastigiate venters in the former at a size where *E. latecarinatus* always has a tabulate venter, whereas this species has a much wider venter than morphs of *E. simplex* with a tabulate venter. Differences in whorl section in large specimens of *E. simplex* and *E. latecarinatus* are shown in Figure 50.

Occurrence

Maastrichtian of South India, Western Australia, Patagonia, and Zululand (South Africa). This species does not extend into the highest Maastrichtian.

ACKNOWLEDGEMENTS

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Names of new taxa, combinations, synonyms, etc., when used for the first time, must be followed by the appropriate Latin (not English) abbreviation, e.g. gen. nov., sp. nov., comb. nov., syn. nov., etc.

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Synonymy arrangement should be according to chronology of names, i.e. all published scientific names by which the species previously has been designated are listed in chronological order, with all references to that name following in chronological order, e.g.:

Family **Nuculanidae**

Nuculana (Lembulus) bicuspidata (Gould, 1845)

Figs 14–15A

Nucula (Leda) bicuspidata Gould, 1845: 37.
Leda plicifera A. Adams, 1856: 50.
Laeda bicuspidata Hanley, 1859: 118, pl. 228 (fig. 73). Sowerby, 1871: pl. 2 (fig. 8a–b).
Nucula largillierti Philippi, 1861: 87.
Leda bicuspidata: Nicklès, 1950: 163, fig. 301; 1955: 110. Barnard, 1964: 234, figs 8–9.

Note punctuation in the above example:
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In describing new species, one specimen must be designated as the holotype; other specimens mentioned in the original description are to be designated paratypes; additional material not regarded as paratypes should be listed separately. The complete data (registration number, depository, description of specimen, locality, collector, date) of the holotype and paratypes must be recorded, e.g.:

Holotype

SAM–A13535 in the South African Museum, Cape Town. Adult female from mid-tide region, King's Beach, Port Elizabeth (33°51′S 25°39′E), collected by A. Smith, 15 January 1973.

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Name of new genus or species is not to be included in the title; it should be included in the abstract, counter to Recommendation 23 of the Code, to meet the requirements of Biological Abstracts.

HERBERT CHRISTIAN KLINGER
&
WILLIAM JAMES KENNEDY

CRETACEOUS FAUNAS FROM ZULULAND AND NATAL, SOUTH AFRICA. THE HETEROMORPH AMMONITE GENUS *EUBACULITES* SPATH, 1926

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CAPE TOWN

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(continued inside back cover)

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By

WILLIAM JAMES KENNEDY
&
HERBERT CHRISTIAN KLINGER

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ON THE AFFINITIES OF *COBBANOSCAPHITES* COLLIGNON, 1969 (CRETACEOUS AMMONOIDEA)

By

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(With 2 figures)

[*MS accepted 25 May 1992*]

ABSTRACT

The genus *Cobbanoscaphites* Collignon, 1969, from the Lower Campanian of Madagascar, is not a heteromorph ammonite of the superfamily Scaphitaceae, as originally described, but a pachydiscid microconch and a synonym of *Menuites* Spath, 1922.

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INTRODUCTION

In the course of a revision of the South African representatives of the heteromorph ammonite superfamily Scaphitaceae Gill, 1871, the authors recently examined the Madagascan representatives of the group described by Collignon (1963–1971), and currently housed in the Département des Sciences de la Terre, Dijon. The most distinctive form referred to the scaphites by Collignon was the genus *Cobbanoscaphites* Collignon, 1969, originally described and diagnosed as follows:

> *COBBANOSCAPHITES MENABENSIS* nov. gen. nov. sp. G. T. (1) D: 0,080.–H: 0,043. (0,52).–E: 0,055. (0,69).–O: 0,023. (0,59) (?).
>
> Ce *Scaphites* (unique exemplaire) paraît représenter un nouveau genre, défini par un ensemble de caractères empruntés à différents autres genres.
>
> Ammonites massive, épaisse, subsphérique, à flancs plats fortement convexes et région externe un peu plus large que ceux-ci. Section largement semi-lunaire. Ombilic difficile à apprécier (probablement peu large) parce que, l'exemplaire étant creux, l'enlèvement de ce qui subsiste de la gangue ferait tomber les tours internes

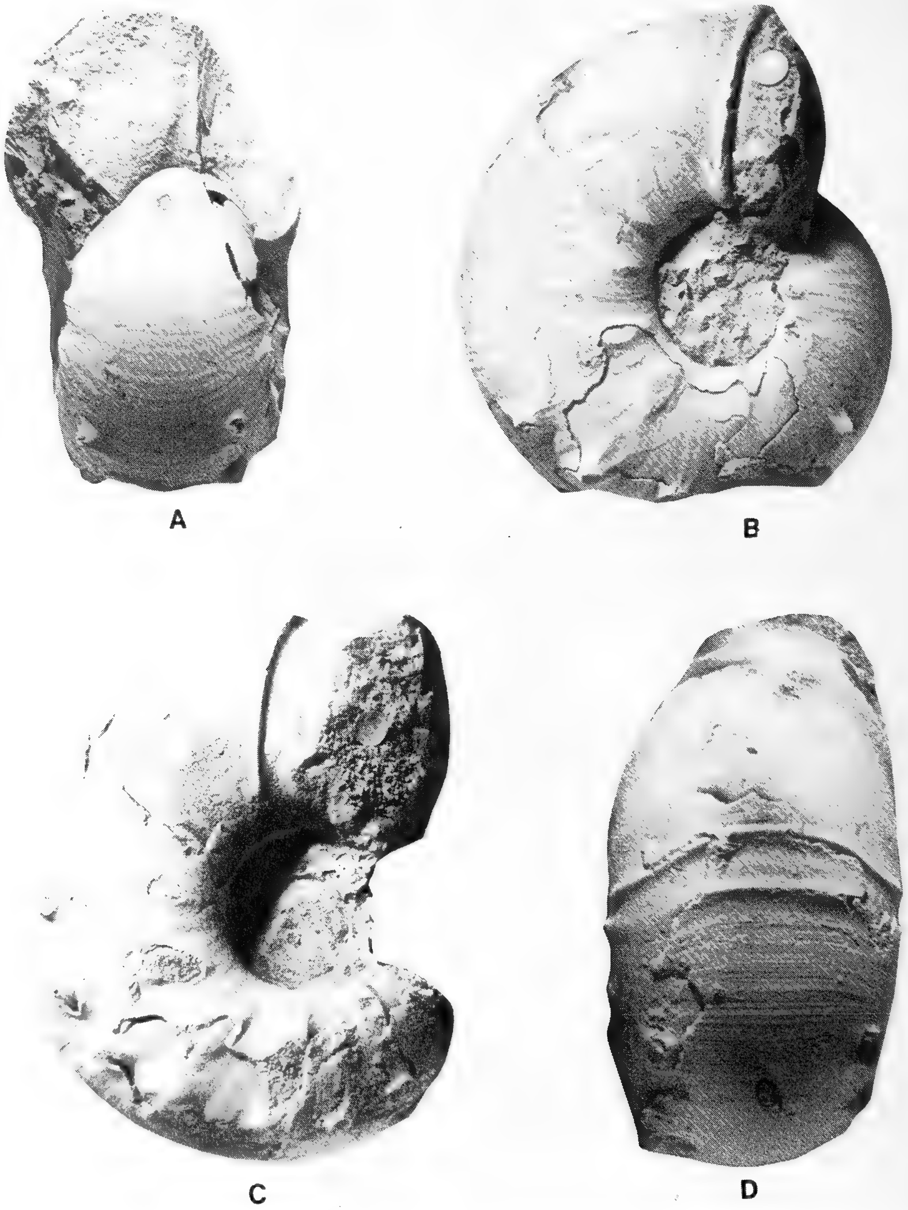

Fig. 1. Menuites menu (Forbes, 1846). A–B. Paralectotype, BMNH C47599. C–D. Lectotype, BMNH C51048, from Pondicherry, South India. All figures are × 1.

retenus par celle-ci; mais il est éminemment infundibuliforme (voir la Fig. de face). Ornementation de côtes basses, espacées, prenant librement naissance au sommet de la fosse ombilicale, et aboutissant, sur la chambre d'habitation seulement, à six très gros tubercules externes (qui n'existent pas sur la partie cloisonnée). Cloisons à premier lobe latéral trifide; deuxième lobe étroit; selles hautes et étalées.

Rapports et Différences.–L'ornementation de côtes est celle de *Desmoscaphites* (cf. Reeside, Eagle Sandstone. Pl. 22, Fig. 8), tandis que les très gros tubercules externes sont exactement ceux de Acanthoscaphites (cf. Nowak, Reeside, Cobban); mais ils n'existent que sur la chambre d'habitation. La cloison à le premier lobe de *Desmo-scaphites,* tandis que l'ensemble rappelle celle de *Clioscaphites* (cf. Cobban. Scaphitoid Cephalopods of the Colorado Group. Pl. 20–21).

Zone à *Karapadites karapadensis.* Sous-Zone à *Maorites Aemilii.* Gisement 191 de la Coupe de Berere II (Belo sur Tsiribihina). Coll. M. Collignon, 1954.

(1) Le Genre est dédié à Mr. W. A. Cobban, Paléontologiste Américain, auteur de nombreux Travaux sur le Genre *Scaphites.* (Collignon 1969: 51, pl. 533 (fig. 2097)).

Examination of the holotype, and only known specimen, showed that, rather than being a distinctive scaphite, it is an adult microconch pachydiscid, referable to the genus *Menuites* Spath, 1922, as is discussed below.

CONVENTIONS

All dimensions given below are in millimetres; D = diameter, Wb = whorl breadth, Wh = whorl height, U = umbilical diameter.

Figures in parentheses are dimensions as a percentage of the total diameter.

The suture terminology is that of Wedekind (1916), as reviewed by Kullmann & Wiedmann (1970), E = external lobe, L = lateral lobe, U = umbilical lobe, I = internal lobe.

SYSTEMATIC PALAEONTOLOGY

Class CEPHALOPODA
Order AMMONOIDEA Zittel, 1884
Suborder AMMONITINA Hyatt, 1889
Superfamily DESMOCERATACEAE Zittel, 1884
Family **Pachydiscidae** Spath, 1922

Genus *Menuites* Spath, 1922

[= *Neopachydiscus* Yabe & Shimizu, 1926; *Anapachydiscus* Yabe & Shimizu, 1926; *Besairieites* Collignon, 1931; *Cobbanoscaphites* Collignon, 1969]

Type species. Ammonites menu Forbes, 1846 (p. 111, pl. 10 (fig. 1)), by original designation of Spath (1922: 123).

Discussion

The type species of *Menuites, M. menu,* is based on a lectotype and six paralectotypes from the Upper Maastrichtian Valudavur Formation of Pondicherry, South India, and has been revised by Kennedy & Henderson (1992: 430, pl. 14 (figs 1–15), text-fig. 12c; see Fig. 1A–D herein). It is a small form reaching a maximum known diameter of 70 mm (Kennedy & Henderson 1992, pl. 14 (figs 10–15)). The phragmocone has a depressed reniform whorl section, and an ornament of umbilical bullae from a diameter of 15mm onwards, that give rise to groups of fine, crowded irregular ribs and growth lines, while additional ribs intercalate between. Strong ventrolateral tubercles that alternate on either side of the venter appear on the last part of the phragmocone at a diameter of 40 mm, and persist on to the adapical part of the body chamber. Ribbing weakens on the body chamber, which is densely lirate, whereas ventrolateral tubercles are absent on the last 90°–120° sector. There are two constrictions on the lectotype, one 45° before, and one immediately preceding the aperture (Fig. 1C–D). A single constriction precedes the aperture in a paratype (Fig. 1A–B).

Similar tuberculate pachydiscids referred to *Menuites* are known from the Lower Campanian to Upper Maastrichtian and, in a number of cases, occur with much larger pachydiscids referred to the genus *Anapachydiscus* Yabe & Shimizu, 1926. These co-occurring pairs have identical early developmental stages, and constitute dimorphic pairs, as demonstrated by Cobban & Kennedy (in press) for Campanian species from the U.S. Western Interior. In northern Hokkaido in Japan, a distinctive *Menuites*, described by Matsumoto (1984: 17, pl. 5 (fig. 1), text-fig. 5) as *M. sanadai,* occurs in Upper Campanian rocks associated with typical large specimens of the type species of *Anapachydiscus, A. fascicostatus* (Yabe 1921) (*in* Yabe & Shimizu 1921: 57, pl. 8 (fig. 5), pl. 9 (figs 2–5); see Matsumoto 1984: 14, pl. 4 (figs 1–2), pl. 5 (fig. 2), pl. 8 (fig. 7), text-fig. 4). These co-occurring *Menuites* and *Anapachydiscus* have similar early developmental stages and are clearly dimorphs, so that *Anapachydiscus* is a junior synonym of *Menuites.* That small, tuberculate pachydiscids are microconchs of larger non-tuberculate forms was demonstrated by Kennedy & Summesberger (1984) and discussed by Kennedy (1986); current work on South African pachydiscids shows it to be present in *Pachydiscus (Neodesmoceras)* Matsumoto, 1938.

Menuites menabensis (Collignon, 1969)

FIG. 2A–D

Cobbanoscaphites menabensis Collignon, 1969: 51, pl. 533 (fig. 2097).

Type

Holotype, by monotypy, is the original of Collignon, 1969: 51, pl. 533 (fig. 2097), from the Upper Campanian *Maorites aemilii* [sic] Subzone of the *Karapadites karapadensis* Zone, Gisement 191 de la Coupe de Berere II (Belo sur Tsiribihina), Madagascar.

Dimensions

	D	*Wb*	*Wh*	*Wb : W*	*U*
Holotype	80,0 (100)	51,5 (64,3)	35,0 (43,8)	1,47	24,5 (30,6)

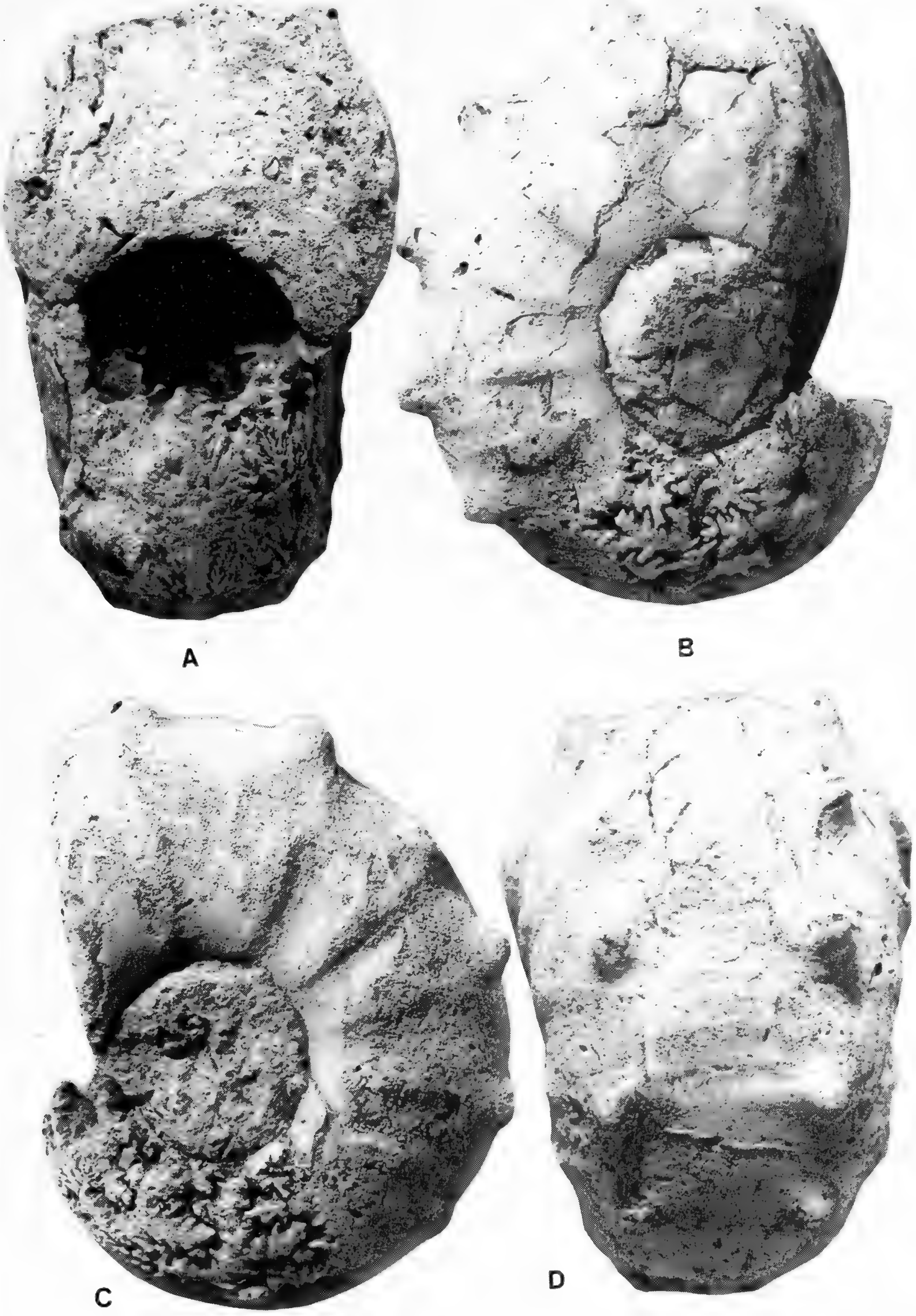

Fig. 2. *Menuites menabensis* (Collignon, 1969). The holotype, the original of Collignon (1969, pl. 533 (fig. 2097)), from the Lower Campanian of Belo sur Tsiribihina, Madagascar. All figures are × 1.

Description

The holotype is a slightly distorted internal mould, two-thirds of the last whorl is body chamber, and a short section of the adapertural phragmocone is also preserved. Coiling is moderate involute, the umbilicus comprising an estimated 30 per cent of the diameter, with a broadly rounded wall and shoulder. On the phragmocone, the whorl section is very depressed, reniform, with a whorl breadth to height ratio greater than two (the specimen is defective); the only detectable ornament is distant, blunt umbilical bullae. The body chamber is much better preserved, with a depressed, reniform whorl section, and whorl breadth to height ratio of 1,47 at the adapertural end. Six low, broad, straight prorsiradiate ribs arise on the umbilical wall, and strengthen into long umbilicolateral bullae. The bullae give rise to single narrow, straight ribs that link to very strong, blunt conical ventrolateral tubercles. A pair of delicate ribs loops between these tubercles, which are opposite rather than alternate. The interspaces between the ribs are decorated by delicate, distant, prorsiradiate riblets, straight and prorsiradiate on the flank, and feebly convex across the venter. They become increasingly prominent on the adapertural end of the specimen, where there is an incipient constriction flanked by two of these riblets.

The suture is imperfectly preserved but there is a large ventral lobe, a deeply incised E/L, and L/U_2 with narrow stems, and deeply incised L.

Discussion

A comparison of Figures 1A–D and 2A–D demonstrates the striking resemblance between *Cobbanoscaphites menabensis* and *Menuites menu.* Any doubts that *Cobbanoscaphites* might not be a pachydiscid, rather than a scaphite, are removed by a consideration of the suture. Although imperfectly preserved (Fig. 2), the degree and nature of the incisions are typically pachydiscid, as is the very narrow stem of the saddles.

Because the inner whorls of the holotype are so poorly preserved, it is not possible to link *Menuites menabensis* with its corresponding macroconch.

Occurrence

As for the type.

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Names of new taxa, combinations, synonyms, etc., when used for the first time, must be followed by the appropriate Latin (not English) abbreviation, e.g. gen. nov., sp. nov., comb. nov., syn. nov., etc.

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Synonymy arrangement should be according to chronology of names, i.e. all published scientific names by which the species previously has been designated are listed in chronological order, with all references to that name following in chronological order, e.g.:

Family **Nuculanidae**

Nuculana (Lembulus) bicuspidata (Gould, 1845)

Figs 14–15A

Nucula (Leda) bicuspidata Gould, 1845: 37.
Leda plicifera A. Adams, 1856: 50.
Laeda bicuspidata Hanley, 1859: 118, pl. 228 (fig. 73). Sowerby, 1871: pl. 2 (fig. 8a–b).
Nucula largillierti Philippi, 1861: 87.
Leda bicuspidata: Nicklès, 1950: 163, fig. 301; 1955: 110. Barnard, 1964: 234, figs 8–9.

Note punctuation in the above example:
comma separates author's name and year
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In describing new species, one specimen must be designated as the holotype; other specimens mentioned in the original description are to be designated paratypes; additional material not regarded as paratypes should be listed separately. The complete data (registration number, depository, description of specimen, locality, collector, date) of the holotype and paratypes must be recorded, e.g.:

Holotype

SAM–A13535 in the South African Museum, Cape Town. Adult female from mid-tide region, King's Beach, Port Elizabeth (33°51′S 25°39′E), collected by A. Smith, 15 January 1973.

Note standard form of writing South African Museum registration numbers and date.

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(a) The Figures, Maps and Tables of the paper when referred to in the text
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Specific name must not stand alone, but be preceded by the generic name or its abbreviation to initial capital letter, provided the same generic name is used consecutively. The generic name should not be abbreviated at the beginning of a sentence or paragraph.

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WILLIAM JAMES KENNEDY
&
HERBERT CHRISTIAN KLINGER

ON THE AFFINITIES OF *COBBANOSCAPHITES* COLLIGNON, 1969 (CRETACEOUS AMMONOIDEA)

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(continued inside back cover)

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THE BASKETWORK OF SOUTHERN AFRICA. PART 2. BASKETWORK OF THE KHOISAN AND THE DAMA

By

E. M. SHAW

Cape Town Kaapstad

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THE BASKETWORK OF SOUTHERN AFRICA.

PART 2.

BASKETWORK OF THE KHOISAN AND THE DAMA

By

E. M. SHAW

African Studies and Anthropology, South African Museum, Cape Town

(With 18 figures)

[*MS accepted 9 December 1991*]

ABSTRACT

In Part 1 of this study, the techniques and materials used in southern African basketwork were described. Part 2 describes the objects made, their uses, and the techniques and materials used by the Khoisan and the Dama. The study is based on the few extant museum specimens and on the literature. Virtually no fieldwork was undertaken; this part is intended merely to gather what evidence remains.

It might be expected that basketwork, because of its comparative lightness, would have featured prominently in the material culture of people constantly on the move. With three notable exceptions, however—mats, traps and sieves—it did not.

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INTRODUCTION

The people whom early anthropologists designated Khoisan embraced two major cultural divisions—the San (Bushmen), who were semi-nomadic hunters and food-gatherers, and the Khoikhoi (Hottentots), who were herders and moved about following the grazing for their cattle, sheep and goats.

Formerly, San hunter-gatherers seem to have been spread, doubtless in small groups,

Ann S. Afr. Mus. **102** (8), 1993: 273–301, 18 figs.

over the whole of southern Africa, but it is only in the Kalahari and adjacent areas that some remain as distinct groups today.

By early historic times, the Khoikhoi were living mainly in the coastal area below the escarpment, from the Swakop River in the north to the Great Fish River in the east. While some of them still recognize their original affiliations, none live in a tribal situation today.

People who are constantly on the move tend not to have an elaborate material culture, particularly if, like the San, they have no means of transport other than themselves. Because of its comparative lightness, one would expect basketwork to have featured more in the culture, but with three notable exceptions—mats, traps and sieves—it evidently did not.

The Dama of Namibia, formerly called Bergdama or Bergdamara, are people about whose origins very little is known. All that is known for certain is that for many generations they were associated often, but not always, as serfs or slaves, with the Nama, whose language they speak. Whether this association took place before or after their entry into Namibia is not known. In Namibia their form of subsistence was hunting and gathering veld foods. Later, when the Herero entered the country, they too enslaved groups of Dama. One would have expected, therefore, that the material culture of the Dama would have been strongly influenced by those with whom they came in contact, neither of whom had specialized in basketwork. Very little basketwork has been recorded from the Dama.

The text is arranged under headings of class of object, and the sources are arranged in date order of sojourn of the author, or of the museum acquisition, where known. Date of publication follows in square brackets, and it stands alone if the date of sojourn is not known. Sources are grouped as: 'Early'—up to 1899, and 'Recent'—from 1900. Because so many of even the quite early sources are quotations from even earlier sources, eye-witness accounts only are quoted as far as can be judged. As far as possible, the place where the author was when he saw the object described is noted. The localities follow, therefore, the travel routes of the respective authors. This arrangement does not, of course, imply that the objects described by them occurred in that particular place only. In figure captions and text, numbers in italics refer to technique numbers allocated in Shaw (1992).

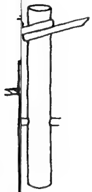
SAN

MATS

Roofing mats were made of sedge stems, in the straight-sewn technique. Generally, one or two mats were used for each dwelling, which, as Daniell (1820, pl. 26) depicts (Fig. 2), was little more than a windscreen. One mat would be placed on the side from which the wind was coming, in a semicircle supported by two or three sticks; the other might form a roof. When the group moved on, the mats could be rolled up with the sticks and carried. This type of shelter is also described by Le Vaillant (1803) from just north of the Orange River.

The mats seem to have been identical with those of the Khoikhoi. Judging by the frequency with which they are mentioned in the folk tales and in the records of early travellers, the mats were in common use by the southern San who lived away from mountains, and it should not therefore be considered that those who used them were

A



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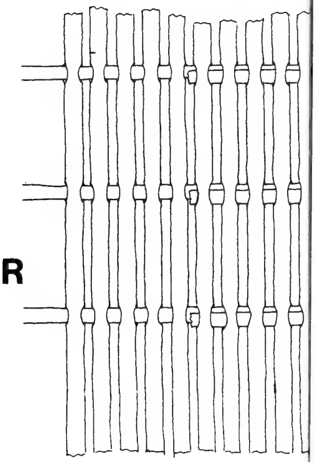

Fig. 1. A. Straight sewing, sin
single lattice wrap, *5c*. D. Wick
4a. F. Wefts taken back diago
next row, loop at edge, *85e*. H.
taut at edge, *85d*. J. Wrapping–
oversewing over one, multiple f
foundation, *17a*. M. Beginning
work: closed ring, *38a*. O. Dia
in colour; coiled work, *151c*. Q
S. Straight-sewn work: decora
work: simple oversewing ov

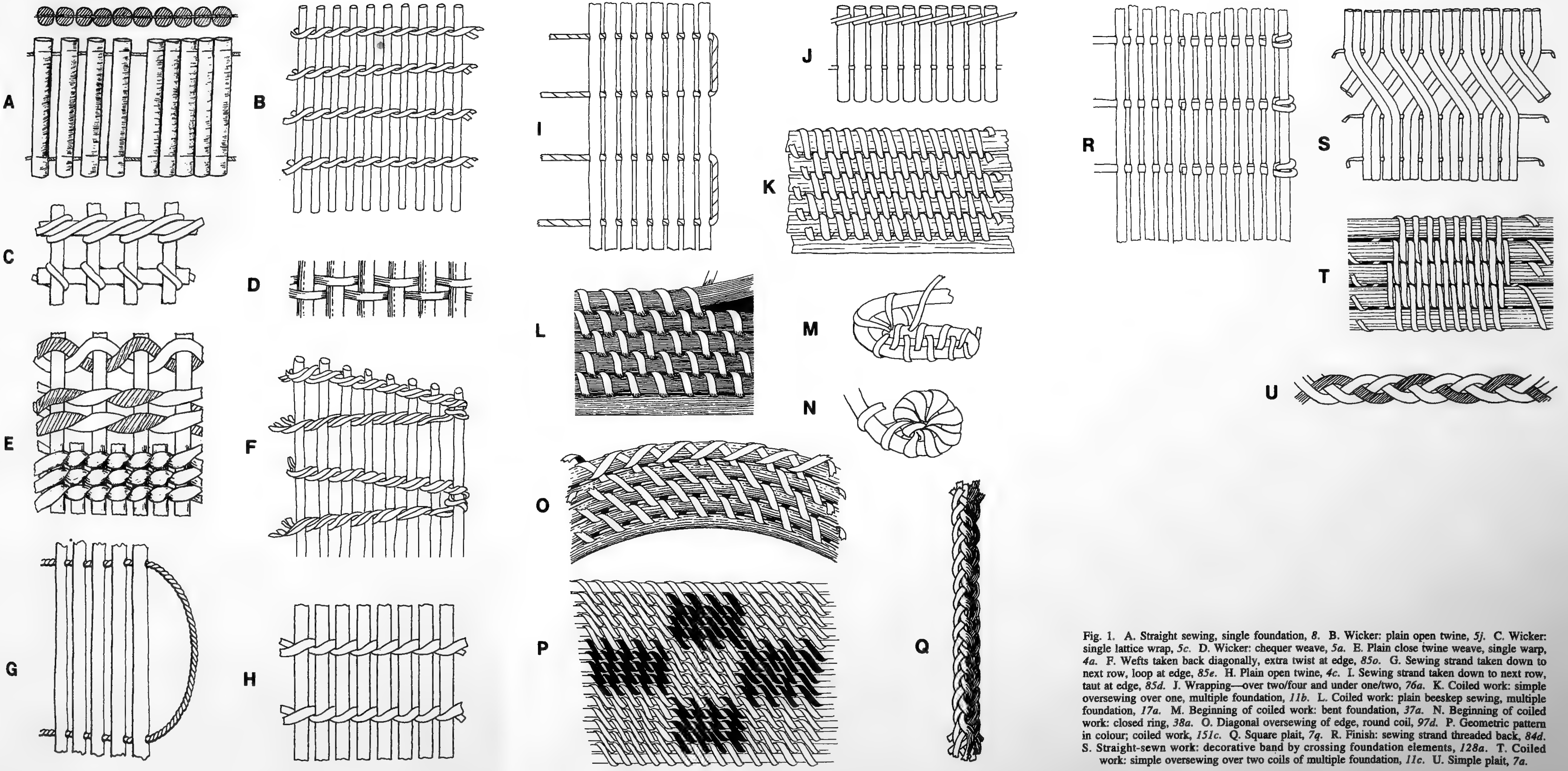

Fig. 1. A. Straight sewing, single foundation, *8*. B. Wicker: plain open twine, *5j*. C. Wicker: single lattice wrap, *5c*. D. Wicker: chequer weave, *5a*. E. Plain close twine weave, single warp, *4a*. F. Wefts taken back diagonally, extra twist at edge, *85o*. G. Sewing strand taken down to next row, loop at edge, *85e*. H. Plain open twine, *4c*. I. Sewing strand taken down to next row, taut at edge, *85d*. J. Wrapping—over two/four and under one/two, *76a*. K. Coiled work: simple oversewing over one, multiple foundation, *11b*. L. Coiled work: plain beeskep sewing, multiple foundation, *17a*. M. Beginning of coiled work: bent foundation, *37a*. N. Beginning of coiled work: closed ring, *38a*. O. Diagonal oversewing of edge, round coil, *97d*. P. Geometric pattern in colour; coiled work, *151c*. Q. Square plait, *7q*. R. Finish: sewing strand threaded back, *84d*. S. Straight-sewn work: decorative band by crossing foundation elements, *128a*. T. Coiled work: simple oversewing over two coils of multiple foundation, *11c*. U. Simple plait, *7a*.

Fig. 2. San windscreen, Daniell (1820, pl. 26), 1804, near Prieska.

impoverished Khoikhoi. In fact, Burchell illustrates from south of the Orange River, an apparently far from impoverished settlement, with full, if small, huts with withy domes, covered with mats (Burchell 1822). According to Burchell, some San immediately south of the Orange River painted their mats lengthwise with stripes of red ochre.

Mats, presumably the same as those above, were used in the Lake Ngami and Wankie areas for roofing, and in the Okavango area for roofing or as windscreens. According to Seiner (1910), those in the Okavango area were obtained from the Mbukushu, but no other author reports this and the hut depicted is of Khoikhoi style, and the mats are straight-sewn.

Techniques

Fabric—straight-sewn, single foundation (Fig. 1A, *8*).
Ornamentation—painting of mats by some southern San.
No further information.

Tools

A bone awl.

Materials

Foundation—sedge (*Cyperus* sp.).
Sewing—cord of inner bark or other plant fibre; antelope sinew.

Makers

Women.

Records

Early: Gordon 1777 [1988: 132], near Steynsburg. Le Vaillant 1783–1784 [1803: 167], just north of Orange River near Fish River in Namibia. Barrow 1797 [1804: 272, 275], Colesberg. Daniell 1802 [1820, pl. 26], near Prieska. Burchell 1811–1813 [1822*b*: frontispiece, p. 141], between De Aar and Orange River. Campbell 1813 [1822*a*: 105], near Kuruman. Backhouse 1839 [1844: 203], Shiloh, eastern Cape. Arbousset & Daumas [1846: 249, 358], near Morija. Bleek & Lloyd *c.* 1873 [1911: 183, 185, 203, 205], Katkop, north Cape. Stow before 1880 [1905: 43–44], 'plains'.

Recent: Seiner [1910: 342, 345, 359], Okavango. Dornan [1925: 90], Ngami, Wankie. Hirschberg [1933: 128], general.

San huts or shelters, as described in the literature, did not have formal frames, but Lebzelter (1934, pl. 4:4) shows a !Kung hut frame on which side lattices are attached by single wrapping. A similar use of lattice wrapping was seen among the !Kung of Nama Pan in 1975.

No further information.

Records

Early: nil.

Recent: Lebzelter 1926–1928 [1934, pl. 4:4], northern Namibia.

Field survey: 1975, Tsumkwe.

SIEVES

In the south, sieves were used for sifting small bulbs, seeds, ants' larvae and roots. According to Burchell, they were about 900 mm by 600 mm and were made in the same way as roofing mats 'except that the rushes are not so close together', and that they were 'extended by a stick tied along each side and by others fastened to them transversally'. In areas where there were a lot of small bulbs and roots, the earth was sifted through the sieves so as to obtain the roots quickly. No other author reported this, but among the *//n/ke* of Gordonia, D. F. Bleek collected sieves that, except in size and the fact that the warps are thin reeds, fit this description (Fig. 3).

In the south-western Kalahari, sieves were used for sorting white ants' larvae or melon seeds, and for sifting them from the ashes after roasting or, according to Kling (1925 correspondence), for laying out and cooling cooked meat. In that area they were made of thin reeds, in a flexible style without the supporting sticks, so that they could be rolled like a mat. According to Steyn (1971: 284) they are made, in the Ghanzi area, exclusively for sifting roasted melon seeds.

The flexible sieves (Fig. 4) are said to have been used in the central Kalahari also, for sifting roasted larvae of termites or roasted grass seeds. No sieves were seen among the !Kung of Tsumkwe in 1975, nor did Marshall record their use among the !Kung of Nyae Nyae, or Lee record having seen them among the !Kung of Dobe.

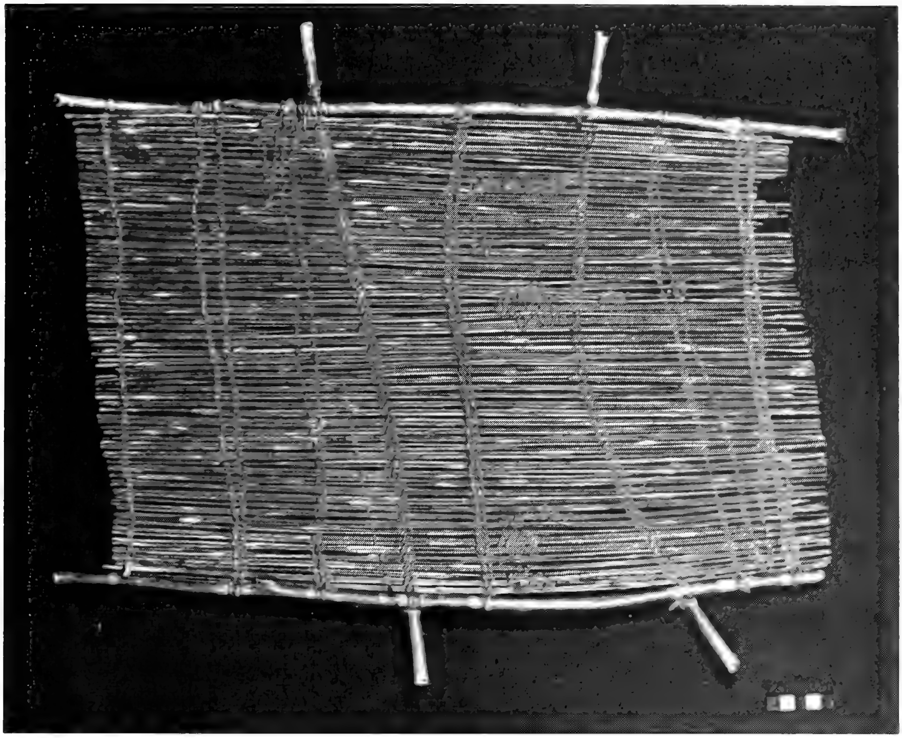

Fig. 3. San wicker sieve, SAM–1552, Gordonia, 1911. Width 380 mm, length 500 mm.

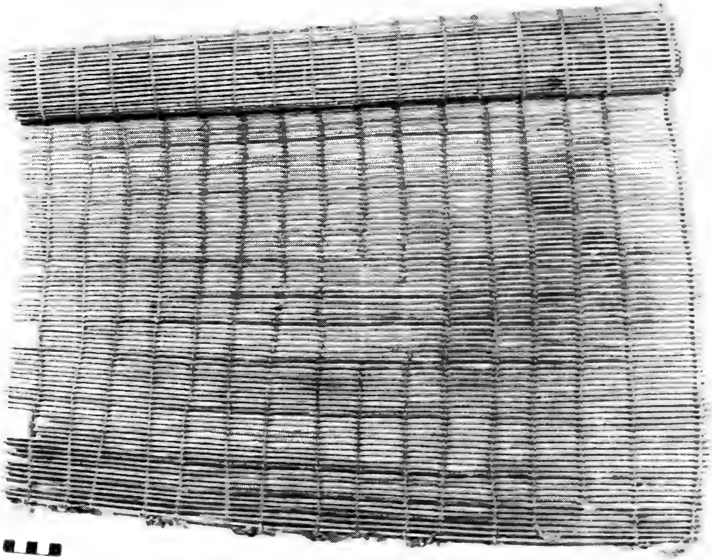

Fig. 4. San flexible sieve, SAM–3769, Sandfontein, 1921. Width 610 mm, length 980 mm.

Techniques

(a) *Fabric:* open twine wicker (Fig. 1B, *5j*); one strand open lattice wrap (Fig. 1C, *5c*) with lattices in three places, over four and under two; two rows chequer (Fig. 1D, *5a*).
Method of work: not described.
Beginning: knotted wefts.
Shaping: natural increase or decrease of warps.
Shape: roughly rectangular.
Edges: warp—none; several rows of close twine (Fig. 1E, *4a*); weft—one weft strand wound round last warp which may be reinforced, then back diagonally (Fig. 1F, *85o*); weft twined round last warp for short distance; one edge knotted and cut, other taken down with loop (Fig. 1G, *85e*).

(b) *Fabric:* open twine (Fig. 1H, *4c*).
Method of work: not described.
Beginning: knotted weft.
Shaping: none.
Shape: rectangular.
Edges: warp—several rows of close twine (Fig. 1E, *4a*); weft—at one edge weft taken down to next row, with (Fig. 1G, *85e*) or without (Fig. 1I, *85d*) a loop, and returned, once only; at other edge knotted.
Finishings: ends knotted together.
Decoration: none.
Ornamentation: none.

(c) *Fabric:* straight-sewn (Fig. 1A, *8*).
Method of work: not described.
Beginning: knotted sewing strand.
Shaping: none.
Shape: rectangular.
Edges: sewing: sewing strand carried down straight (Fig. 1I, *85d*) or with a loop (Fig. 1G, *85e*) and then back, continuously; foundation: sewing strand wrapped once over two and under one foundation strand (Fig. 1J, *76a*).
Finishings: a knot.
Decoration: none.
Ornamentation: none.

Tools

Not known.

Materials

Warp—thin reed stems; thin withies; weft—thin thongs, thin bark-fibre cord; sinew.

Makers

Not known.

Records

Early: Burchell 1811–1813 [1822*b*: 20], near Prieska. Bleek & Lloyd 1873 [1911: 85], Katkop, N. Cape. Stow before 1880 [1905: 59], Koesberg, N. Cape.

Recent: SAM–1552, 1911, Gordonia. Wit. Univ. 2441, no date, Gemsbok Park. Drury 1921 [1935: 94], Sandfontein. SAM–3679, 1921, Nharo, Sandfontein. SAM–4284, 1925, Kalahari. Dornan [1925, facing p. 48], Kalahari. Kling 1925, correspondence, east of Gochas. Fourie [1928: 102], Namibia. Hirschberg [1933: 128], Oas, Rietfontein, Sudonibsaup. SAM–7551, 1936, N. E. Kalahari. Maccrone 1937: 252, pls 97, 98; near Auob and Nossop Rivers. Afr. Mus. 43/165, 1943, Gobabis. Marshall 1951–1961 [1976], Nyae Nyae, Namibia. Lee 1963–1965 [1965], Dobe, northern Namibia. SAM–9141, 1965, Nharo, Ghanzi. SAM–9333, 1966, Nharo, Ghanzi. Steyn 1968 [1971: 284–285], Ghanzi. SAM–9621, 1969, Nharo, Kalkfontein.

Field survey: 1975, Tsumkwe.

FISH-TRAPS

Basketwork fish-traps were used by people who lived along the Orange River and the Fish River in Namibia and probably near other rivers and marshes. They are described by early travellers as neatly made funnel-shaped or pointed baskets, about 183 cm long and 45–61 cm at the greatest diameter. The warps of those seen by Barrow (1801) near the Orange River were alternately of 'reeds' and twigs of *taaibos* (*Rhus* sp.), light and dark respectively, and 'gave a pretty effect'. Other descriptions were that they were made of 'stick grass' (this often meant sedge) and that they resembled the eel-baskets of Europe (Fig. 5). No authors, however, describe the inner valve, which is visible in the eel-baskets, and is common in other African fish-traps (Fig. 6). According to Barrow (1801), they were used either individually by men standing in the river, or were placed mouth forwards, in gaps in stone walls or reed fences, across or at the edge of the water. Alexander (1838) saw men sitting in deep water holding the traps, while other men chased the fish into them. These two original sources have been quoted by several other authors.

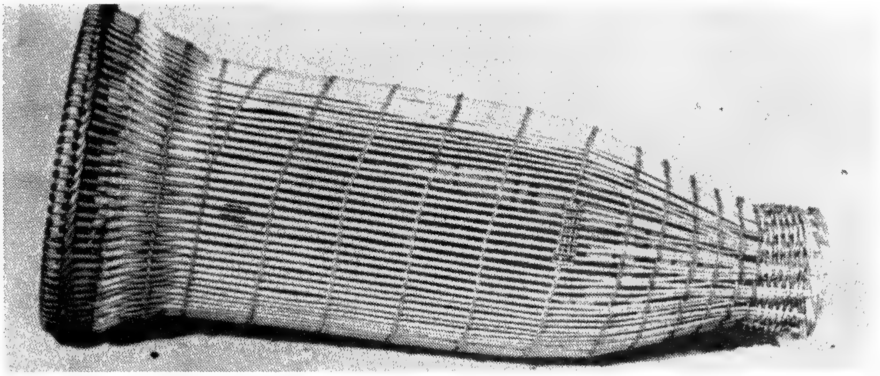

Fig. 5. Eel-pot, England, *c.* 1860. Photo: A. Heseltine, Shire Publications Album 92; copyright Institute of Agricultural History, University of Reading.

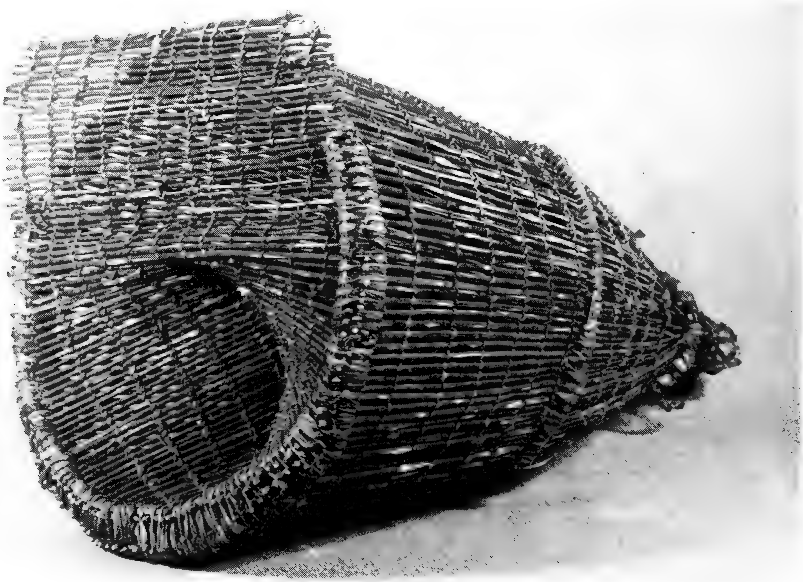

Fig. 6. Ambo fish-trap, SAM–6124, Oshikango, 1940, typical for southern Africa. Diameter of mouth 465 mm.

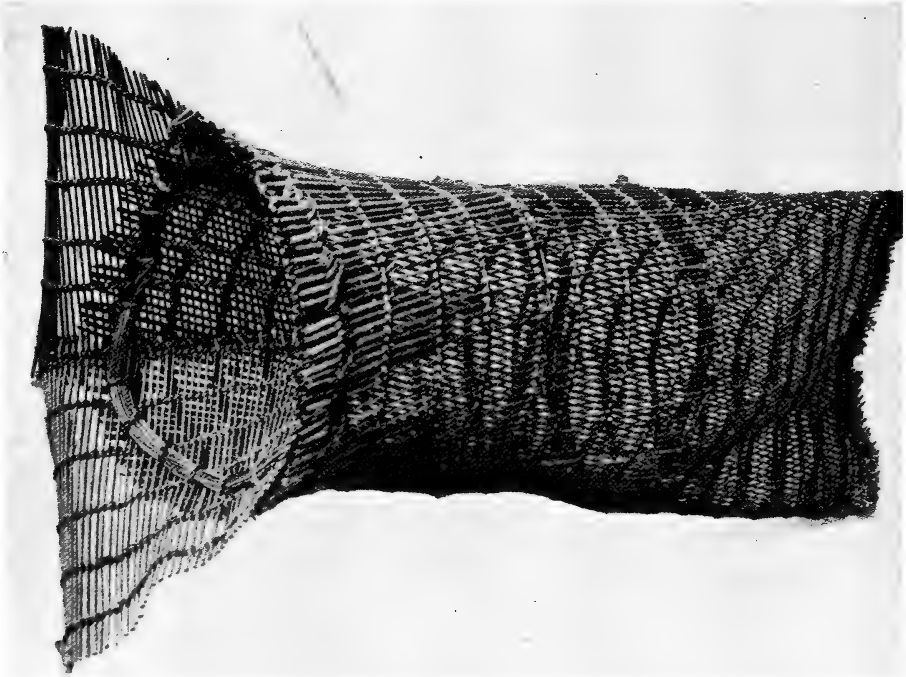

Fig. 7. Drawing of a San fish-trap. Van Rippen 1918, fig. 24.

According to Dornan (1925), he saw the same type of funnel-shaped basketwork fish-traps used by San people in the north-east, along the Botletle River, placed in gaps in stone weirs, and facing upstream. Sometimes a group of men would sit in a row holding the traps, while others went upstream and chased the fish into the traps. This description does resemble that of Alexander, but there is nearly a century between them.

In 1917, Van Rippen (1918) had a fish-trap made for him by a 42-year-old San man, who claimed that his people used to make such traps (see Fig. 7). Van Rippen does not state where he travelled, nor where he was at the time. As far as can be seen, the technique is open lattice wrap wicker (Fig. 1C), and the trap is said to have been made of 'taai boschje'. The valve is clearly visible. Van Rippen questions whether this is of 'pure Bushman origin'.

Techniques

Fabric: 'woven'; lattice wrap (or twine) wicker.

Shape: 'pointed' or 'funnel-shaped'; a cone flattened at the narrow end. No further information.

Tools

No information.

Materials

Warps—'reeds' and twigs of *taaibos* (*Rhus* sp.); *taaibos* alone; 'stick grass'; *Aristida* sp.: wefts—cord made of 'bruised rushes' or of the inner bark of mimosa (*Acacia* sp.).

Makers

Men (according to Van Rippen).

Records

Early: Barrow 1797–1798 [1804: 290], general, [p. 300], Orange River west of Philippolis. Lichtenstein 1803–1806 [1930: 55], Orange River. Alexander 1835 [1838*a*: 237, 238], Fish River (Namibia). Moffat 1817–1818 [1842: 55], Namaqualand. Hahn [1870: 103], Orange and Zuga Rivers, partly quoting Barrow. Stow before 1880 [1905: 93], general, quoting Barrow.

Recent: Seiner [1910: 345], Okavango River. Van Rippen 1917 [1918: 92, 93], no locality. Dornan [1925: 51, 106], Botletle River.

MISCELLANEOUS

BASKETS

No distinctive basketry containers have been recorded as used by the San. The only actual baskets seen among them were Tswana-style garden baskets made by Sarwa near Serowe in 1962, for sale to Tswana. At the temporary camp where these were seen, they were also in use. The technique and the materials were those used by the local Tswana. They were made by women and the tool used was an awl.

In addition to those made near Serowe, Ebert (1978) recorded a flourishing industry in Tswana-style baskets among the Sarwa along the Nata River, north-west of Francistown—again for use at home as well as for sale. Four types are made, three by women

—the garden basket, a beer storage vessel and a basket with lid and handle, and one by men—a winnowing basket or tray.

Stow (1905) stated that ants' eggs, after they had been sieved and sorted, were put into a small grass basket or a skin bag. He does not mention where or among whom he saw this and no confirmation of it has been found.

Records

Early: Stow before 1880 [1905: 59].
Recent: Ebert 1977 [1978: 69–83], Nata River.
Field survey: 1962, Serowe.

STORAGE BINS

According to Lee (1965), each !Kung family in the Dobe area made a storage bin of 'branches and palm fronds woven together in the crotch of a young tree', in which to keep foods. The bin is not further described and may not be basketwork. Bins were not seen among the !Kung of Tsumkwe in 1975.

No further information.

Records

Early: nil.
Recent: Lee 1963–1965 [1965: 180].
Field survey: 1975, Tsumkwe.

HATS

Some people in the north-east made and wore hats (Fig. 8). These were rather roughly made in an eighteenth century 'sailor' shape. Hats are said to have been worn by !Kung women and other San in Namibia.

Techniques

Fabric: simple or beeskep oversewing (Fig. 1K, *11b*, L, *17a*) over multiple or simple coil foundation.

Method of work: not seen.

Beginning: bent foundation (Fig. 1M, *37a*); closed ring (Fig. 1N, *38a*).

Shaping: placing of coil.

Shape: 'sailor'.

Edge: diagonal oversewing around coil in opposite direction (Fig. 1O); leather binding.

Finishing: ends worked in.

Decoration: sewing: geometric patterns in different coloured material (Fig. 1P, *149f*) .

Ornamentation: nil.

Tools

Not seen.

Materials

Foundation: grass; reed.
Sewing: strands of bark; palm leaf.

Makers

Generally not known, but among the !Kung, men.

Fig. 8. San hat, SAM–7089, northern Kalahari, *c.* 1936. Diameter of crown 175 mm.

Records

Early: Alexander 1835 [1838: 236], Namibia.

Recent: Lebzelter 1926–1928 [1934: 36, pl. 7: 5, 6], northern Namibia. SAM–7089, 1936, north-east Kalahari.

ORNAMENTS

Plaited grass ornaments are mentioned by Smith (1836 [1975]). A bangle from Lake Chrissie is an eight-strand square plait of *Digitaria* grass, but may have been a borrowing from the Swazi.

The Nharo made necklets and bangles of *Scirpus nodosus* and *Kyllinga alba* (Bleek 1928). According to Passarge (1907), those in the Ghanzi area were 'woven spirally' by children. According to Hirschberg (1933), at Rietfontein, ornaments were made from the lengths between the nodes of a grass stem, split in two and 'interlaced'.

Grass ornaments are common throughout southern Africa.

Techniques

Fabric: eight-strand square plait (Fig. 1Q, *7q*); spiral plait; 'interlaced'.

Finishing: oversewn.

Materials

Flowering stems of *Digitaria* sp., *Scirpus nodosus* Rottb., *Kyllinga alba* Nees, etc.

Records

Early: Smith 1834–1836 [1975: 147], Riet River near Philippolis. Passarge 1896 [1907: 90–91], Ghanzi.

Recent: Schultze 1903–1905 [1907: 657–658], southern Botswana. Bleek 1921 [1928: 67], Sandfontein. SAM–1795, 1922, Lake Chrissie. Hirschberg [1933: 3], Oas, Rietfontein, Sudonibsaup.

PLAITED ROPE

There is an isolated report of a plaited grass rope used as a hand-hold on a ladder by San honey-gatherers in southern Lesotho.

Technique

'Plaited'.

Material

'Grass'.

Records

Early: nil.
Recent: Walton [1956: 15–16].

KHOIKHOI

The material culture of the Khoikhoi was not uniform throughout the three large areas where the major groups of Khoikhoi lived—that is, east of the Gamtoos River, between the Gamtoos and the Olifants Rivers, and north of the Olifants River. It seems best in this discussion to group the people of the first two areas together, and to separate those of the north, the Nama. One item in particular, however, was common to all—their type of dwelling, which was a framework hut of beehive shape, roofed with the long mats that were their main item of basketwork. The great advantage of the mats was that in wet weather the sedge stems, of which they were made, swelled and made the cover watertight, while in dry weather the slight gaps between the stems allowed the air to circulate.

MATS

Gonaqua, Cape Khoikhoi, Korana, Griqua

The only articles of basketwork that all Khoikhoi appear to have made and used were mats made of the long inflorescence stems of sedges (Fig. 9). Their main and universal purpose was for roofing the huts (Figs 10, 11, 12). The huts, some large, some small, consisted of a framework of previously bent poles, planted in a circle and tied where they crossed. Mats of various sizes, according to their position, were laid over the frame and tied on to it. The order in which the mats were disposed was not the same everywhere. A single small mat was tied above the lintel of each of the doorways, back and front, and rolled up or let down to open or close the doorway. When the owner moved, the hut was dismantled and poles and mats were transported, tied to each side of a pack-ox (Fig. 13).

The sedge stems were prepared by drying in the sun and damping for use if necessary. To make the mats, the stems were laid side by side and joined by straight-sewing. Holes were pierced in the stems a short distance apart and a thin cord of sedge, of the inner bark of an acacia species, sinew, or—as early as 1772—of European pack-thread, was threaded through the holes.

Fig. 9. Sedge, *Cyperus textilis*, Montagu area. Photo: W. van Rijssen.

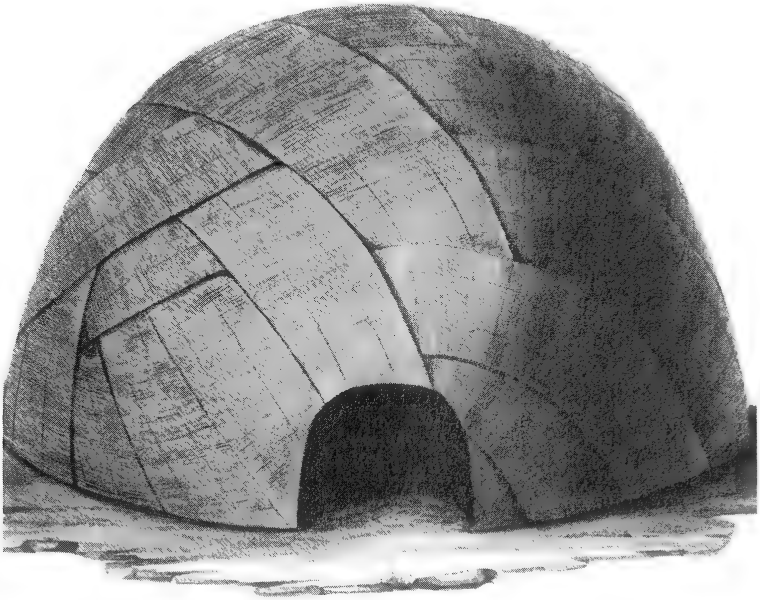

Fig. 10. Le Vaillant's drawing of the arrangement of mats on a Khoi hut near Great Fish River, 1780–1803 [1973, pl. 58].

Fig. 11. Korana hut, Daniell 1820, pl. 1B, Read's Drift, Orange River near Prieska, 1804.

Fig. 12. Gonaqua village, Le Vaillant 1790, pl. 12, west of Great Fish River, 1780–1785.

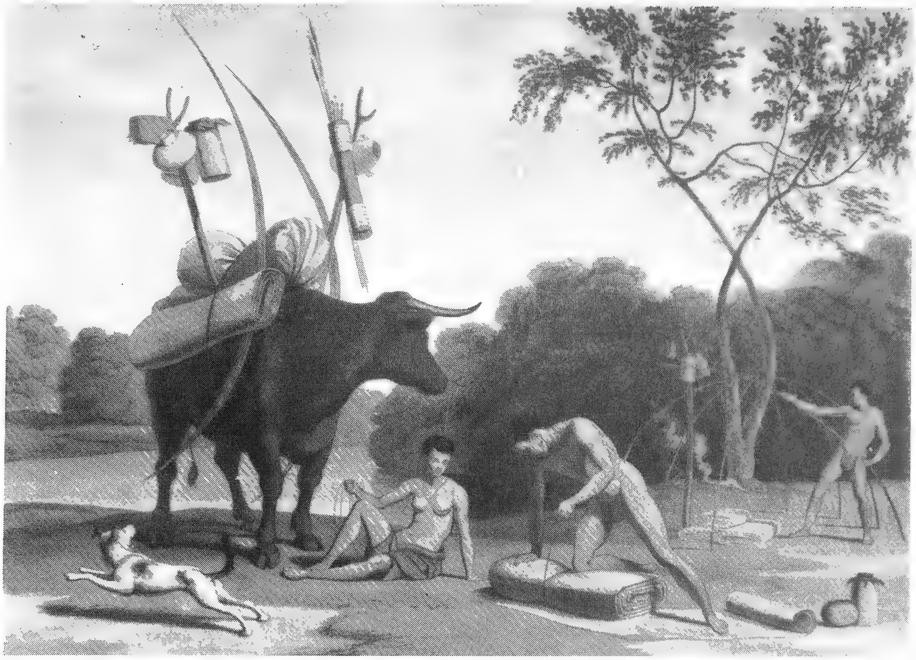

Fig. 13. Korana preparing to move house, Daniell 1820, pl. 20, banks of Orange River, 1804.

According to Burchell (1822), the women of Genadendal made mats for sale as well as for their own use.

Remains in a cave on the Bredasdorp coast (Grobbelaar & Goodwin 1952) suggest that the mats were also used as sleeping mats. For adults skins were more generally used, but children slept on mats (Engelbrecht 1936).

Techniques

Fabric: straight-sewn (Fig. 1A, *8*).

Method of work: foundation elements laid side by side and joined by sewing through holes pierced at short intervals. The sewing ran lengthwise and the full length of the mat was sewn before the next row was commenced.

Beginning: not recorded.

Shape: rectangular.

Shaping: none.

Edge: top and bottom: a single or double row of twine (Fig. 1E, *4a*); sides: sewing carried down to next row taut (Fig. 1I, *85d*) or leaving a loop for tying (Fig. 1G, *85e*).

Finishing: loose ends knotted at edge.

Decoration: none.

Ornamentation: none.

Tools

An awl of bone or wood; a needle of ostrich bone or wood.

Materials

Foundation: stems of *Cyperus textilis* at Genadendal, or *Scirpus inanis* near Fraserburg, and other sedges elsewhere. The Korana used a less durable material for mats for children to sleep on.

Sewing: two-ply twisted cord of crushed sedge stems, the inner bark of *Acacia capensis* or *Acacia karroo*, a soft outer bark, sinew, or pack-thread.

Makers

Women made both mats and sewing strand.

Records

Early: Dapper 1668 [1933: 57, 59], Cape. Schreyer 1679 [1965: 93], Cape. Graevenbroeck 1695 [1933: 251], Cape. Kolben 1705–1713 [1738: 220–221, 236], Cape. Thunberg 1773 [1986: 206], Cogmans Kloof; [p. 238], Van Stadens River. Sparrman 1772–1776 [1785*a*: 207–209], near Swellendam. Le Vaillant 1780–1785 [1790*a*: 159–160], near Mossel Bay; [1790*b*: 39], near Great Fish River. Somerville 1801 [1979]: 89, south of Griquatown. Daniell 1804–1805 [1820, pl. 20], Orange River, south of Griquatown. Burchell 1811–1813 1822*a*: 83, Genadendal; 186–187, Riet River; 228–229, pl. 5, north bank of Orange River, east of Prieska; [pp. 279, 281–282], Vaal River, east of junction with Orange; [1822*b*: 88], Seekoe River, north of Sneeuwberg. Pitt Rivers Museum: A: M. 645–651, 1822, Genadendal, Fraserburg. Campbell 1820 [1822*b*: 346], east of Kuruman. Thompson 1823–1824 [1827*a*: 120, 122], east of junction Vaal and Orange; [1827*b*: 46–47], near Aughrabies Falls. Smith 1834*a* [1839: 80], Riet River, east of Philippolis. Backhouse 1838–1840 [1844: 433], Griquatown. Mackenzie [1871: 499], general. Stow before 1880 [1905: 240, general: 276], near junction Vaal and Orange.

Recent: Engelbrecht 1927 [1936: 93–96], Bloemhof. Afr. Mus. M48/53, 1948, Bloemhof. Grobbelaar & Goodwin 1952: 102–103, Skipskop Cave, Bredasdorp. Wells 1965: 81, Gamtoos Valley.

Nama

Mats (Fig. 14) of the same type as described above were made for the roofing of huts. At least 15 to 20 were required for a single covering, and the making took a long time. Some Nama dyed the sedge stems to part of their length by wrapping them in bundles with old damp kraal manure. The stems could then be arranged in the mats to make patterns with the dyed portions (Fig. 15). Mats were also made for babies to sleep on, or were sometimes used as a floor covering. The roofing mats, with the hut framework, could be dismantled and moved. They were said to last about 10 to 15 years but the original and the dyed colour faded before that. Ollp (1884) noted that women made enough to replace worn examples and also to sell. Their making and use have been described fully by several authors (see particularly Haake 1982). By the end of the nineteenth century they were becoming rare because the sedges were difficult to obtain. Substitute coverings had to be used, such as rough mats of *Aristida* grass, skins or sacking.

According to Thompson (1827), rough mats were also used for fishing. (See p. 292.)

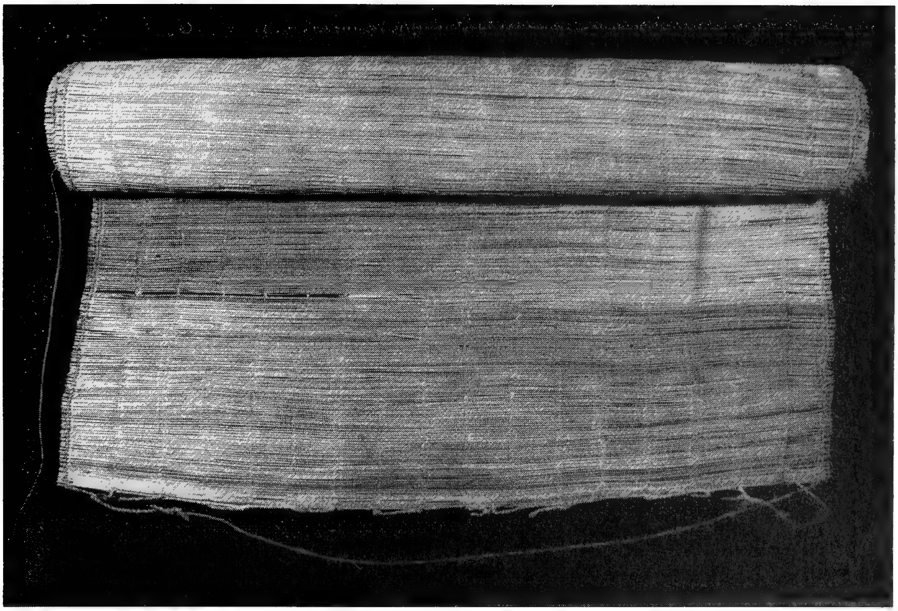

Fig. 14. Nama mat, SAMUCT–23/131, Fransfontein, 1923.

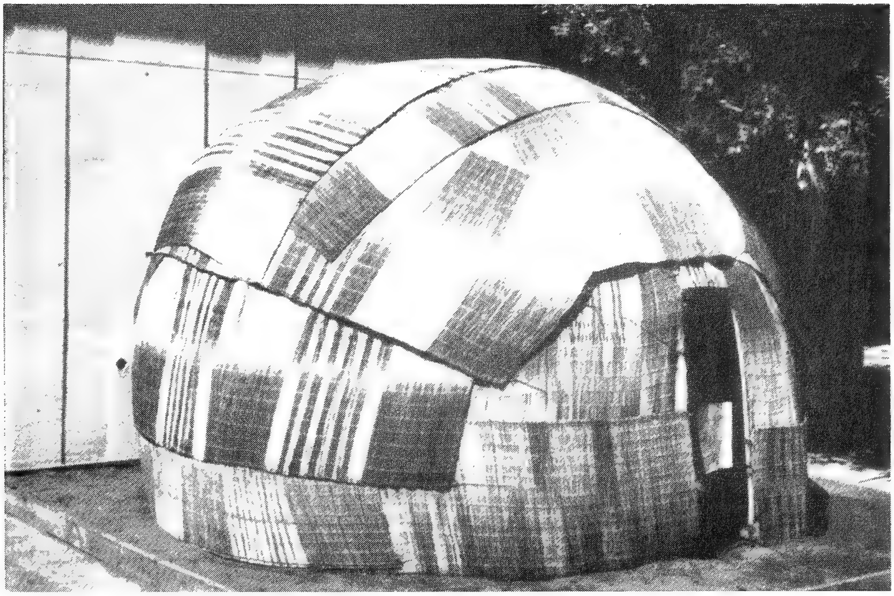

Fig. 15. Nama hut, made for exhibition, Windhoek, 1980. Photo: E. M. Shaw.

Techniques

Fabric: straight-sewn (Fig. 1A, *8*).

Method of work: sedge gathered green, allowed to dry, trimmed, and soaked overnight when about to be used. Stems are pierced at 50–70 mm intervals with a flat awl (Fig. 16A) which is turned on its side from time to time to let the needle (Fig. 16C) with the sewing thread (Fig. 16B) go through easily. The Nama south of the Orange River are said to have taken the stems one or even up to four at a time, while those north of the river took about 20. The awl moves away from the worker and the needle towards. Finally, the ridges are tidied with the wooden handle of an awl and emphasized with a special grooved tool (Fig. 17).

Beginning: the foundation strands are laid on the ground in a row and holes for the thread are made at intervals. The work may commence at the centre of the width of the mat, with a knotted loop.

Shaping: none.

Shape: rectangular.

Edges: foundation: single or double row of plain twine (Fig. 1E, *4a*), in twos or threes.

Sewing: carried down with loops (Fig. 1G, *85e*).

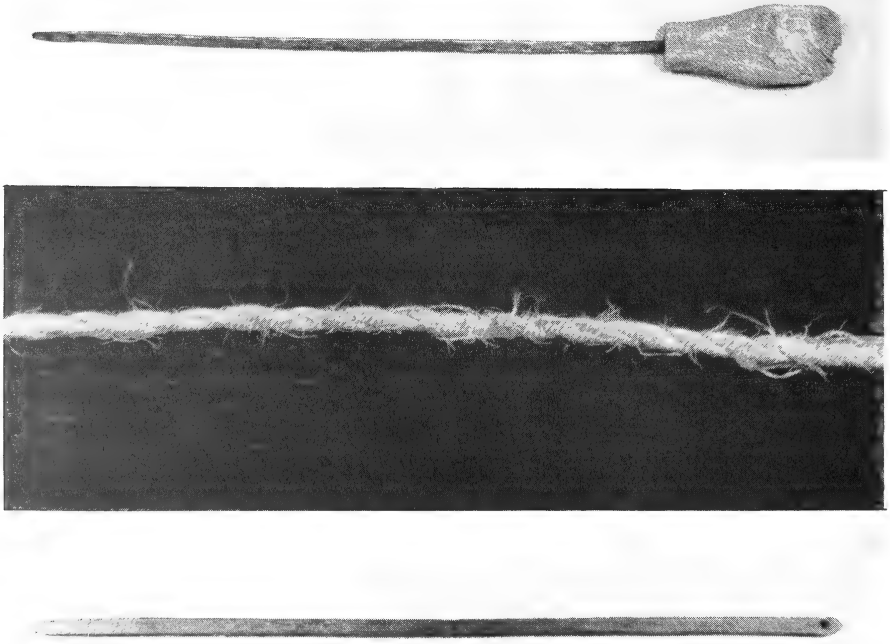

Fig. 16. A. Nama awl for making mats, SAMUCT–23/137, Fransfontein, 1923. Length 210 mm. B. Nama string for sewing mats, SAMUCT–23/137, Fransfontein, 1923. Thickness 4 mm. C. Nama needle for sewing mats, SAMUCT–23/138, Fransfontein, 1923. Length 210 mm.

Finishing: foundation strands cut off about 15 mm from the twining; sewing strands knotted at beginning and threaded back (Fig. 1R, *84d*) at end.

Decoration: crossed foundation strands (Fig. 1S, *126a*); arrangement of same material dyed.

Ornamentation: none.

Tools

A long thin awl (Fig. 16A) made from the shin bone of giraffe, or latterly of iron, together with a needle made of the leg bone of an ostrich; an iron needle (Fig. 16C); a thorn or piece of sedge to which the thread has been attached; a knife for cutting; a tool for smoothing ridges (Fig. 17).

Fig. 17. Nama tool for emphasizing ridges of mat, SAMUCT–23/152, Fransfontein, 1923. Width across flat head 70 mm.

Materials

Foundation: sedge—*Cyperus* sp., *Juncus* sp., *Scirpus* sp.

Sewing thread: inner bark of *Acacia polyacantha*, *A. karroo* or other spp.; flexible stems of *Salix capensis* (willow); *Asclepius fruticosus*; grain-bag string, to obtain which the bags may be bought especially. The fibre for the thread is soaked in water or milk, then chewed, to soften it, then twisted on the leg into two- or more ply thread (Fig. 15B).

Dye: old kraal manure.

Makers

Women.

Records

Early: Barrow 1797–1798 [1804: 389–390], Kamiesberg. Thompson 1822–1824 [1827*b*: 56, 59, 63, 64–65], Pella, Gams, general south of the Orange. Alexander 1835–1837 [1838*a*: 98], between Kleinsee and Orange River mouth; [pp. 171, 194], Warmbad.

Shaw 1815–1837 [1840: 23], Kamiesberg (Lily Fountain) and general south of Orange River. Ridsdale 1844–1847 [1883: 87], Nisbetts Bath (Warmbad). Andersson 1854 [1856: 326], Great Namaqualand. Hahn 1867: 306, general Namibia. Ollp 1865–1876 [1884: 28], Gross-Namaland. Stow before 1880 [1905: 253], near Pella. Schinz 1884–1887 [1891: 86], Keetmanshoop. Von Francois 1889–1893 [1896: 209], general.

Recent: Schultze 1903–1905 [1907: 227–231, 241–242], 'Great Namaqualand'. Hoernlé 1913 [1987: 71–74], Walvis Bay. Hoernlé 1922 [1987: 127, 128], Fransfontein. Hoernlé 1913–1922 [1923: 24], Namaqualand. SAMUCT–23/131, 1923, Fransfontein. Vedder [1928: 125], general Namibia; [1934: 51–52], general Namibia. Ferreira 1974: 1–6, general. SAM–9389, 1977, Leliefontein (Kamiesberg). Du Pisani 1981 [1983: 9, 11, 15], Kuisib River. Haake 1982: 80–84, general Nama. Van der Merwe 1984: 1–4, Leliefontein.

STRAINERS

Nama

The only record of the use of a strainer was by the Topnaars of Walvis Bay for straining boiled *nara* fruit (*Acanthosicyos horrida*) in the process of making *nara* cakes. It appears from Schultze's figure to be a deep bowl-shaped basket of open twine with a thick coil once round the top and continuing to make a handle. It is very roughly made. The coil is oversewn and the handle bound round with a two-ply twisted cord of the same material. This strainer is also mentioned in Hoernlé's 1913 diary.

Techniques

Fabric: open twine (Fig. 1H, *4c*).
Edge: thick coil and handle, oversewn two-ply twisted cord.

Materials

Sedge.
No further information.

Records

Early: nil.

Recent: Schultze 1903–1905 [1907: 198–199], figure, Walvis Bay. Hoernlé 1913 [1987: 71], Walvis Bay.

FISH-TRAPS

Nama

There is no record of the use of traps by any Khoi other than Nama.

Basket traps, according to Wikar and Hoernlé, or 'rush mats', according to Thompson, were used by Nama for fishing in shallow streams and in the Orange River. They were placed across the stream with men standing behind them while other men drove the fish towards the traps. Nama who lived away from the rivers, claimed, when talking to Alexander, that they did not eat fish.

Materials

Acacia karroo; Rhus sp.
No further information.

Records

Early: Gordon 1779 [1988: 326], an island in the Orange River. Wikar 1779 [1935: 115], near Aughrabies Falls. Thompson 1821–1824 [1827*b*: 64–65], near Orange River mouth. Alexander 1835–1837 [1838*b*: 64], near Orange River mouth. Von Francois 1889–1893 [1896: 211], general Namibia.

Recent: Schultze 1903–1905 [1907: 198–199], probably Orange River. Hoernlé 1923 [1923: 25], Namibia. Du Pisani 1981 [1983: 4], Kuisib River and general.

MISCELLANEOUS

BASKETS

Gonaqua

The Gonaqua did not themselves make baskets but obtained them from the Xhosa. They were used as containers for milk and as pails for milking. Two such baskets, one globular and lidded (Stockholm, 626), one flanging to a wide mouth (Stockholm 1799.2.101) are preserved in the State Ethnographic Museum in Stockholm, presented respectively by Thunberg and Sparrman. There is no record of the use of baskets by Cape Khoikhoi or Griqua.

Records

Early: Thunberg 1772 [1793: 102–103, 238], Gamtoos River. Sparrman 1772–1776 [1785*a*, pl. 1.1; 1785*b*: 34, 35], Little Sundays River. Stockholm: 626, 1799, Gamtoos River; Stockholm: 1799.2.101, 1799, ? Little Sundays River. Le Vaillant 1782–1783 [1790*a*: 375–376; 1790*b*: 4, 22], Great Fish River.

Korana

The Korana, similarly, obtained baskets from the Tswana. They did, however, fit a basketwork neck onto containers of skin (Fig. 18).

Techniques

Fabric: multiple foundation, simple oversewing over two (Fig. 1T, *11c*).
Method of work: not seen.
Beginning: start sewing into the skin, then add foundation.
Shaping: placing of coil.
Shape: circular band.
Edge: none.
Finishing: just end.
Decoration: none.
Ornamentation: none.

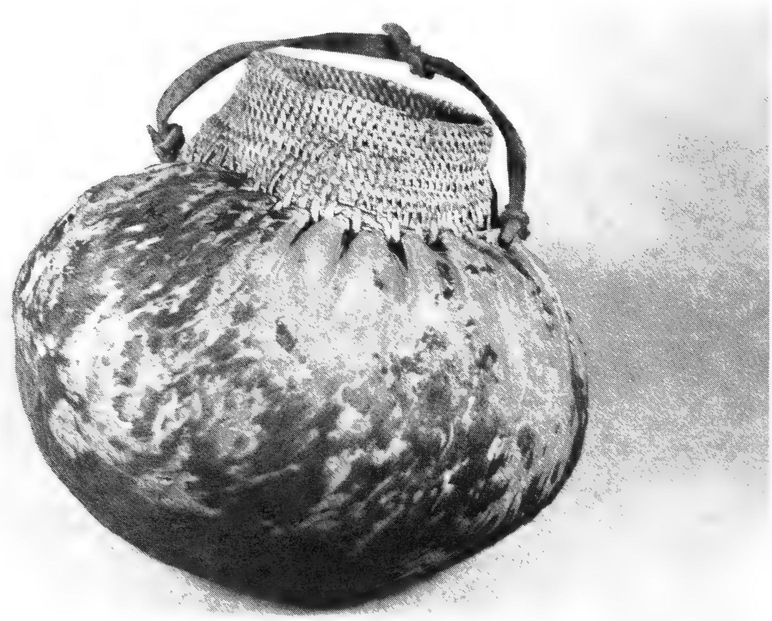

Fig. 18. Korana flask for butter fat, SAM–4450, Barkly West, 1926. Diameter of bowl 240 mm, mouth 113 mm.

Tools

Not known.

Materials

Foundation: split root of *katbos* (?*Lycium hirsutum*) or 'rushes' or thin withies.

Sewing: split root of *katbos*, or 'rushes' or latterly sedge and string.

Makers

Not recorded but surely men.

Records

Early: nil.

Recent: SAM–4450, 1926, Barkly West. Engelbrecht 1927 [1936: 101, pl. 8], Bloemhof.

Nama

According to Vedder, baskets were made of 'suitably flexible roots and twigs', but there is no information regarding their making or use.

Records

Early: nil.

Recent: Vedder 1928: 126–127.

HATS

Korana

Hats were worn by both men and women. They had circular or conical crowns and flat brims. Narrow leather straps were sewn at the sides to tie under the chin.

Techniques

No information, but judging from the description and materials, coiled sewn on a multiple foundation (Fig. 1K, *11b*).

Materials

Foundation: grass.
Sewing: rosyntjiebos (*Grewia flava*).

Makers

Men.

Records

Early: nil.
Recent: Engelbrecht 1927 [1936: 106], Bloemhof. Smith 1966: 403.

ROPE

Korana

There is no record of other branches of the Khoikhoi using plaited ropes, but it is unlikely that they did not do so. Twined string, which is much used, is not interlaced and therefore does not come under the definition of basketwork.

Plaited rope of wildebeest tail hair was made by the Korana for tying over the mats of a hut. Later, horsehair was used.

Technique

Simple plait (Fig. 1U, *7a*).

Materials

Wildebeest hair; horsehair.
No further information.

Records

Early: nil.
Recent: Engelbrecht 1927 [1936: 94–95], Bloemhof.

DAMA

BASKETS

1. A special narrow-mouthed basket in which locust meal is stamped and stored. It is hung in a tree and lasts for one or two years. This may or may not be the ‘little bag’ mentioned by Hahn (1984).

Techniques

No information.

Tools

No information.

Materials

Grass; *Cyperus marginatus*; *Stipagrostis namaquensis*.

Makers

No information.

Records

Early: Hahn 1846–1851 [1984: 386], Central Namibia.

Recent: Lebzelter 1926–1928 [1934: 131], Okambahe, Namibia. Steyn & Du Pisani 1985: 44–45, Ugab River Valley, Namibia.

2. A flat basket for which no purpose is given.

Techniques

'Woven', 'made tight with bast'.

Tools

No information.

Materials

Acacia bast and thin sticks split in half; *Stipagrostis namaquensis*.

Makers

Men.

Record

Early: nil.

Recent: Lebzelter 1926–1928 [1934: 178], general.

SIEVES

A shallow 'woven' basket through which ants' eggs are sifted out of the sand for food.

No further information.

Records

Early: nil.

Recent: Schwarz [1928: 201].

The lack of further information about Dama techniques makes it hard to judge whether there is any item of basketwork that could be considered truly Dama.

SUMMARY

There is no doubt that basketwork was not a major feature of Khoisan or Dama culture, with the exception of the mat which was universal among the Khoikhoi and used by some San but not by the Dama. The technique of the mats was straight, flat sewing with single foundation strands. The twined technique was known and was used for traps along the rivers, for sieves, especially for flexible sieves, and occasionally for the edging of mats. Apart from the latter, edges and finishings were merely the most practical way of dealing with a problem. The only decoration recorded is the Nama dyeing of sedge stems, to make a chequered pattern on the finished hut. For ornamentation, there is Burchell's (1822) statement that the San south of the Orange used red ochre to paint longitudinal stripes on their roofing mats, but there is no confirmation of this.

A bone awl was used throughout for making holes for the sewing strands to go through the sedge stems of the mats. The bone used was said to have been that of the ostrich or the giraffe. No other tool is recorded among the San, but the Khoikhoi used a needle for the actual sewing, and the Nama used a stone to smooth and sharpen the needles and a wooden tool for smoothing and emphasizing the ridges made by the sewing. By the eighteenth century, when most of the records began, iron awls with wooden handles, and later, iron needles, were in use.

The material of importance beyond all others was the sedge—*Cyperus* and *Scirpus* spp. The long smooth stems formed the foundation for the mats and for some sieves north of the Orange River. They were sometimes twisted into a cord for binding or sewing. So important were the sedges that it is possible that their availability may have been a factor, additional to grazing, in directing the semi-nomadic movements of the Khoikhoi. Burchell (1822: 279) notes an occasion when he was taken further than he wished to go to camp, so that his people could gather the 'mat rush'. It is also possible that the people in drier areas may have obtained the material through trade.

Today, sedge continues to flourish in the south because circumstances have brought about the disappearance of the mat-house. In Namaland, however, where the domed hut has remained in use until recent times, the sedges have become scarce with over-exploitation, and sacking and other materials have replaced sedge mats.

Throughout, Khoisan women seem to have been the manufacturers, except that the men did the rare coiled sewn work and the twilled winnowing baskets, which appear to have been a foreign borrowing.

Information for the Dama in earlier times is scant, and as the situation is now, it would be hard to find any more information about basketwork that could be considered truly Dama. Although the Dama settlement plan is similar to that of the Nama (G. Lindhardt, pers. comm. 1989), they did not share the Khoikhoi type of mat-covered dwelling, nor apparently did they use mats for any other purpose.

CONCLUSION

The country in which most of the Khoisan and the Dama lived was certainly not lacking in material suitable for basketwork. But hunter-gatherers and pastoralists have access to animal skins for carrying and for storing food and do not, therefore, need baskets as containers. The use throughout of sewn mats for roofing by the Khoikhoi, and their more limited use by the San, must be considered a particular cultural trait, as indeed were the huts themselves. The non-existence of the mat hut, or the mats, among the Dama is equally significant. The sieves and traps, while important, are more localized, as are the occasional borrowings from Bantu-speakers.

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ABBREVIATIONS

Afr. Mus.	Africana Museum, Johannesburg
SAM	South African Museum, Cape Town
SAMUCT	UCT collection now in South African Museum, Cape Town
Stockholm	Folkens Museum, Stockholm
UCT	University of Cape Town
Wit. Univ.	Witwatersrand University, Johannesburg

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6. SYSTEMATIC papers must conform to the *International code of zoological nomenclature* (particularly Articles 22 and 51).

Names of new taxa, combinations, synonyms, etc., when used for the first time, must be followed by the appropriate Latin (not English) abbreviation, e.g. gen. nov., sp. nov., comb. nov., syn. nov., etc.

An author's name when cited must follow the name of the taxon without intervening punctuation and not be abbreviated; if the year is added, a comma must separate author's name and year. The author's name (and date, if cited) must be placed in parentheses if a species or subspecies is transferred from its original genus. The name of a subsequent user of a scientific name must be separated from the scientific name by a colon.

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Family **Nuculanidae**

Nuculana (Lembulus) bicuspidata (Gould, 1845)

Figs 14–15A

Nucula (Leda) bicuspidata Gould, 1845: 37.
Leda plicifera A. Adams, 1856: 50.
Laeda bicuspidata Hanley, 1859: 118, pl. 228 (fig. 73). Sowerby, 1871: pl. 2 (fig. 8a–b).
Nucula largillierti Philippi, 1861: 87.
Leda bicuspidata: Nicklès, 1950: 163, fig. 301; 1955: 110. Barnard, 1964: 234, figs 8–9.

Note punctuation in the above example:
comma separates author's name and year
semicolon separates more than one reference by the same author
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figures of plates are enclosed in parentheses to distinguish them from text-figures
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In describing new species, one specimen must be designated as the holotype; other specimens mentioned in the original description are to be designated paratypes; additional material not regarded as paratypes should be listed separately. The complete data (registration number, depository, description of specimen, locality, collector, date) of the holotype and paratypes must be recorded, e.g.:

Holotype

SAM–A13535 in the South African Museum, Cape Town. Adult female from mid-tide region, King's Beach, Port Elizabeth (33°51′S 25°39′E), collected by A. Smith, 15 January 1973.

Note standard form of writing South African Museum registration numbers and date.

7. SPECIAL HOUSE RULES

Capital initial letters

(a) The Figures, Maps and Tables of the paper when referred to in the text
e.g. '. . . the Figure depicting *C. namacolus* . . .': '. . . in *C. namacolus* (Fig. 10) . . .'
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e.g.Therocephalia, but therocephalian

Punctuation should be loose, omitting all not strictly necessary

Reference to the author should preferably be expressed in the third person

Roman numerals should be converted to arabic, except when forming part of the title of a book or article, such as
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Specific name must not stand alone, but be preceded by the generic name or its abbreviation to initial capital letter, provided the same generic name is used consecutively. The generic name should not be abbreviated at the beginning of a sentence or paragraph.

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E. M. SHAW

THE BASKETWORK OF SOUTHERN AFRICA.
PART 2.
BASKETWORK OF THE KHOISAN AND THE DAMA

7X

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ANNALS
OF THE SOUTH AFRICAN MUSEUM

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CAPE TOWN

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1. MATERIAL should be original and not published elsewhere, in whole or in part.

2. LAYOUT should be as follows:

- (a) *Centred masthead to consist of*
  Title: informative but concise, without abbreviations and not including the names of new genera or species
  Author's(s') name(s)
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  Number of illustrations (figures, enumerated maps and tables, in this order)
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- (c) *Table of contents* giving hierarchy of headings and subheadings
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- (e) *Subject-matter* of the paper, divided into sections to correspond with those given in table of contents
- (f) *Summary*, if paper is lengthy
- (g) *Acknowledgements*
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3. MANUSCRIPT, to be submitted in triplicate, should be typewritten and neat, double spaced with 3 cm margins all round. First lines of paragraphs should be indented. Tables and a list of captions for illustrations should be typed separately, their positions indicated in the text. All pages should be numbered consecutively.

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Footnotes should be avoided unless they are short and essential.

Only generic and specific names should be underlined to indicate italics; all other marking up should be left to editor and publisher.

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FISCHER, P. H., DUVAL, M. & RAFFY, A. 1933. Études sur les échanges respiratoires des littorines. *Archives de zoologie expérimentale et générale* **74** (33): 627–634.

KOHN, A. J. 1960*a*. Ecological notes on *Conus* (Mollusca: Gastropoda) in the Trincomalee region of Ceylon. *Annals and Magazine of Natural History* (13) **2** (17): 309–320.

KOHN, A. J. 1960*b*. Spawning behaviour, egg masses and larval development in *Conus* from the Indian Ocean. *Bulletin of the Bingham Oceanographic Collection, Yale University* **17** (4): 1–51.

THIELE, J. 1910. Mollusca. B. Polyplacophora, Gastropoda marina, Bivalvia. *In:* SCHULTZE, L. *Zoologische und anthropologische Ergebnisse einer Forschungsreise im westlichen und zentralen Süd-Afrika ausgeführt in den Jahren 1903–1905* **4** (15). *Denkschriften der medizinisch-naturwissenschaftlichen Gesellschaft zu Jena* **16**: 269–270.

(continued inside back cover)

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HOW MANY SPECIES OF *DIICTODON* WERE THERE?

By

GILLIAN M. KING

Cape Town Kaapstad

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HOW MANY SPECIES OF *DIICTODON* WERE THERE?

By

GILLIAN M. KING

Department of Karoo Palaeontology, South African Museum, Cape Town

(With 3 figures and 1 table)

[*MS accepted 26 October 1992*]

ABSTRACT

Twenty species of the dicynodont genus *Diictodon* have been described. Although the genus is distinguishable by reliable characters, the validity of the species-level taxonomy is questionable. The present work re-evaluates the existing species and concludes that previous authors have not been able to produce convincing species-level characters. A sample of well-preserved and well-prepared skulls in the South African Museum is used to search for any other possible species-specific characters, but none is found.

It is concluded that only one species of the genus, *Diictodon galeops*, is justifiable. The specific longevity of this dicynodont is noted.

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INTRODUCTION

The dicynodont genus *Diictodon* is distinctive and well-characterized. Descriptions of the genus have been given by Cluver & Hotton (1981), Cluver & King (1983) and King (1988). The most distinctive feature of the skull is the prominent maxillary caniniform process that is clearly demarcated from the anterior palatal rim by a deep notch (Figs 1, 2B). This feature is found in conjunction with small palatines that do not meet the premaxilla on the palatal surface, a narrow intertemporal region in which the postorbitals tend to cover the parietals (Fig. 2), prominent dentary tables of which the medial edge stands proud as a ridge, and a weakly-developed lateral dentary shelf (Fig. 3). This suite of characters permits easy identification of members of the genus.

Diictodon seems to have been a common element in the Karoo palaeoenvironment. Many specimens of the genus are known (Smith 1980), together with trackways and burrows that are probably attributable to this form (Smith 1987). Excellent postcranial material is also available. Despite this, no detailed functional study of the genus has been made, nor has a species-level revision of the taxonomy of the genus been carried out.

Ann S. Afr. Mus. **102** (9), 1993: 303–325, 3 figs, 1 table.

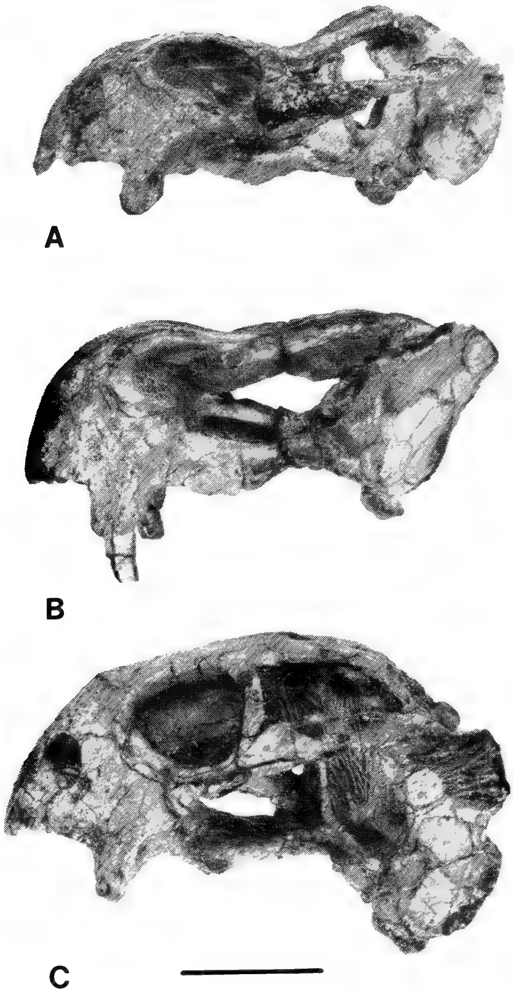

Fig. 1. Three specimens of *Diictodon* in lateral view to show the distinctive square-cut caniniform process. A. SAM–10086. B. SAM–K5105. C. SAM–K7730. Scale = 30 mm.

Owing to the wealth of material available, *Diictodon* offers an opportunity to examine the effects of intraspecific variation in a fossil species and detailed studies of this aspect of the genus are in progress (King in prep.). Stratigraphic information for specimens from the South African Karoo Basin is also available and becoming increasingly refined (Kitching 1977; Keyser & Smith 1978; Rubidge in press), so the genus also offers the possibility of studying changes in osteological morphology in time and space.

However, a prerequisite of such studies is an understanding of the species-level taxonomy of the genus. Here the existing species are reviewed and their validity, based

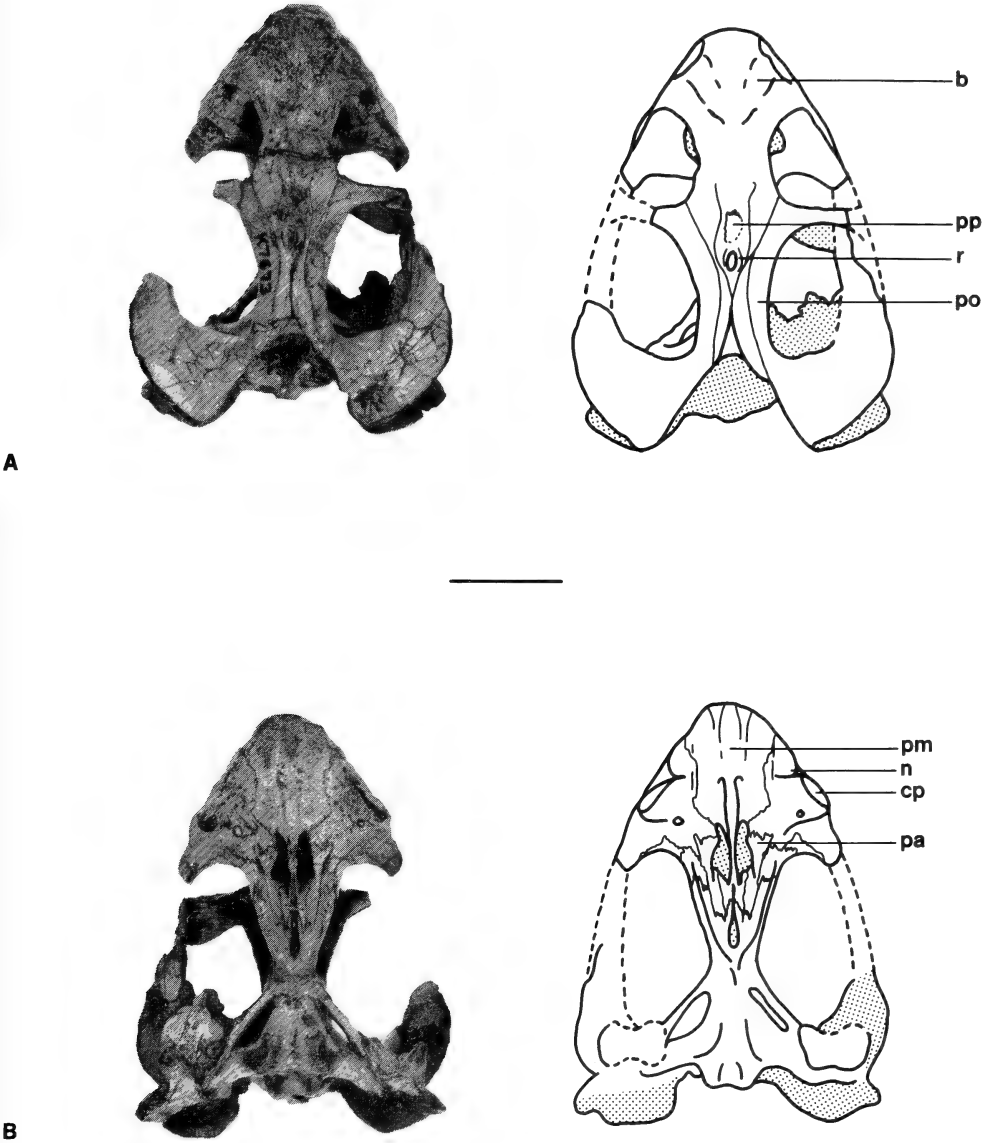

Fig. 2. *Diictodon galeops* SAM–K7673. A. Skull in dorsal view. B. Skull in palatal view. Stipple indicates area of matrix. Scale = 30 mm.

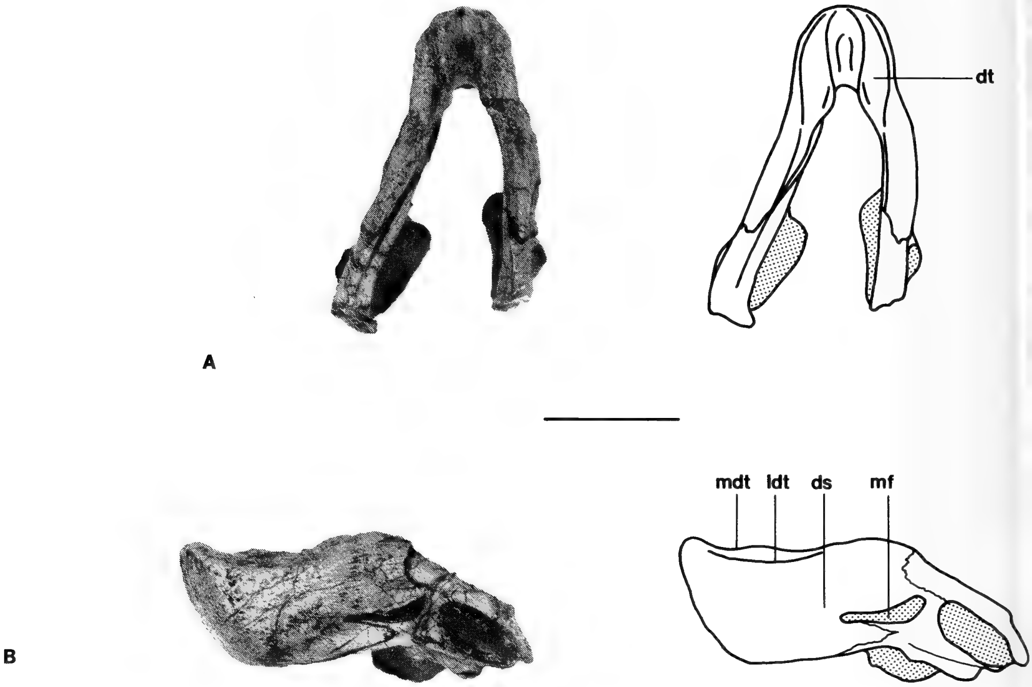

Fig. 3. *Diictodon galeops* SAM–K7730. A. Lower jaw in dorsal view. B. Lower jaw in lateral view. Stipple indicates area of matrix. Scale = 30 mm.

TABLE 1

Biostratigraphic schemes for the Karoo Sequence.

A. After Kitching (1977).

Triassic	*Cynognathus* bio-zone
	Lystrosaurus bio-zone
Permian	*Daptocephalus* bio-zone
	Cistecephalus bio-zone
	Tapinocephalus bio-zone

B. After Rubidge (in press).

Triassic	*Cynognathus–Diademodon* assemblage zone
	Lystrosaurus–Procolophon assemblage zone
Permian	*Dicynodon–Theriognathus* assemblage zone
	Cistecephalus–Aulacephalodon assemblage zone
	Tropidostoma–Endothiodon assemblage zone
	Pristerognathus–Diictodon assemblage zone
	Tapinocephalus–Bradysaurus assemblage zone
	Eodicynodon–Tapinocaninus assemblage zone

on the characters used by the naming authors, is assessed. In addition, a collection of well-preserved and well-prepared skulls in the South African Museum is used to investigate whether there are any species-specific characters that have been missed by previous authors, and to facilitate a revision of the existing species.

Since it was hoped to draw some conclusions concerning the stratigraphic distribution of *Diictodon* species, the most refined biostratigraphic scheme for the Beaufort Sequence (Rubidge in press) has been used to assign the South African Museum sample skulls to biostratigraphic assemblage zones (see Table 1). (I am extremely grateful for the help of Dr R. M. H. Smith, South African Museum, in this regard.) However, the available locality information for the existing type specimens does not always allow assignment of those specimens to an assemblage zone in Rubidge's scheme, and their assignments to bio-zones in the previous stratigraphic scheme, as published in Kitching (1977), have been retained.

SPECIES OF *DIICTODON*

King (1988) gave a list of 20 species of the genus. Although it is clear that these forms all belong within the genus (possessing the distinctive maxillary notch and other features noted above), the validity of the species involved requires re-assessment.

The type species is *Diictodon galeops*, described by Broom (1913).

Diictodon galeops Broom, 1913

Diictodon galeops Broom, 1913: 453, fig. 15.

The type, AMNH 5308, is a skull from Slachtersnek, Somerset East District, Cape Province, South Africa. This locality is recorded as being in the *Cistecephalus* bio-zone of the Teekloof Formation, Karoo Sequence by Kitching (1977).

The feature which Broom (1913) felt distinguished this genus from the otherwise similar *Dicynodon* was the large size and peculiar shape of the preparietal. This bone surrounds the pineal opening in *Diictodon galeops*, whereas Broom considered that the usual state in *Dicynodon* was for the preparietal to lie in front of the pineal. On this basis he transferred the *Dicynodon* species *D. kolbei* and *D. alticeps* to *Diictodon*, and noted that this might also be warranted for *Dicynodon tigriceps*. However, the former two species are now regarded as belonging in the genus *Oudenodon*, and the latter in *Aulacephalodon* (King 1988).

Toerien (1953) discussed variation in the shape and position of the preparietal in *Diictodon* (*Dicynodon*) *grimbeeki* and *Diictodon sollasi*. He concluded that sutural pattern should be used as a generic or specific character only with caution, since in a sample of otherwise similar skulls from one locality, continuous variation in pattern and size of the preparietal was seen. However, Cluver & Hotton (1981) gave a revised diagnosis of the genus based on more reliable characteristics also present in the type of *Diictodon galeops*.

Of the remaining 19 species, only one, *Diictodon sesoma* Watson, 1960, was originally described as *Diictodon*, the others having been previously included in the genera *Dicynodon*, *Oudenodon* and *Emydorhynchus*.

Diictodon sesoma Watson, 1960

Diictodon sesoma Watson, 1960: 142, fig. 2.

The holotype of this species is a skull, lower jaw and postcranial skeleton from Buffel's River, Orange Free State, South Africa (UMZC R314). Watson (1960) included it in the genus *Diictodon*, because the pineal opening is surrounded by the preparietal, but he felt that the material warranted allocation to a new species, owing to its shorter and broader skull, wider occiput, relatively wider intertemporal region, and large canine.

The intertemporal region, as illustrated by Watson, is rather wide for *Diictodon* (based on the sample of specimens in the South African Museum), although this appearance can result when the skull roof is weathered and the postorbitals obliterated. The specimen does appear to have a maxillary notch, however, although the maxillary rim in front of the tusk appears to be broken. The pineal is slightly raised above the skull roof, another feature also seen in some specimens attributed to *Diictodon*.

Diictodon feliceps (Owen, 1876)

Dicynodon feliceps Owen, 1876: 45, pl. 43.
Rhachiocephalodon feliceps (Owen, 1876) Seeley, 1898: 108.
Diictodon feliceps (Owen, 1876) Cluver & Hotton, 1981: 125.

The holotype, BMNH 47052, is from Fort Beaufort, Cape Province, South Africa (*Cistecephalus* bio-zone, Kitching 1977).

Owen (1876) felt that there was no difficulty in accommodating this specimen in the genus *Dicynodon* as then known but considered that a new species was warranted, based on skull proportion, suture pattern and curvature of the canine tusk. Owen (1876, pl. 43 (fig. 1)) showed a clear notch in front of the caniniform tusk, a characteristic indicating that the specimen can be accommodated within the genus *Diictodon*. The pinched-in nature of the temporal region, with postorbitals approaching each other over the parietals, is also typical of *Diictodon*.

Diictodon jouberti (Broom, 1905)

Dicynodon jouberti Broom, 1905: 331.
Sintocephalus jouberti (Broom, 1905) van Hoepen, 1934: 93.
Diictodon jouberti (Broom, 1905) Cluver & Hotton, 1981: 127.

The holotype skull (SAM–695) is from Gouph (Koup) Tract, Beaufort West District, South Africa. The locality is in a low to middle horizon of the *Tapinocephalus* bio-zone (Kitching 1977).

Broom (1905) considered that the noteworthy features of the skull were that the parietal, frontal and upper part of the nasal are practically in one plane; the interparietal portion is about equal in breadth to the interorbital; and the jugal arch is unusually deep in the region of the postorbital bar.

Broom (1905) described a series of skulls, some with large and others with smaller canines. He considered this to be a sexual difference, since the two forms do not differ consistently in size.

The type has a distinctly notched maxilla in front of the tusk typical of *Diictodon*.

Diictodon psittacops (Broom, 1912)

Dicynodon psittacops Broom, 1912: 869, pl. 92.
Diictodon psittacops (Broom, 1912) Cluver & Hotton, 1981: 129.

The holotype skull and skeleton (AMNH 5534) are from the Beaufort West commonage, Cape Province, South Africa. This locality is in the *Cistecephalus* bio-zone according to Kitching (1977).

Broom (1912) considered the distinguishing features of this new species to be the narrow nasals, thickened upper part of the nasals, elevated prefrontal region of the orbital margin, broad and flat frontal region, pineal foramen that is situated on an elevated preparietal, postorbitals that approach each other behind the pineal opening and form a ridge, small downwardly and forwardly directed tusk, broad and deep front portion of the lower jaw, and the very small intramandibular foramen.

Diictodon ictidops (Broom, 1913)

Dicynodon ictidops Broom, 1913: 466, figs 5–6.
Pylaecephalus ictidops (Broom, 1913) van Hoepen, 1934: 93.
Diictodon ictidops (Broom, 1913) Cluver & Hotton, 1981: 130.

The holotype, AMNH 55110, is a skull from Beaufort West commonage, Cape Province, South Africa (*Cistecephalus* bio-zone according to Kitching 1977).

Broom (1913) described a number of small skulls from the same locality as being narrow with large, rounded nostrils. He noted that the septomaxilla does not show on the side of the skull and that the tusks are variably expressed, being absent in at least one specimen. The zygomatic arch beneath the postorbital bar was described as being very deep. Broom noted that the preparietal does not surround the pineal foramen.

Diictodon palustris (Broom, 1913)

Emydorhynchus palustris Broom, 1913: 456, fig. 19.
Diictodon palustris (Broom, 1913) Cluver & Hotton, 1981: 130.

The holotype (AMNH 5512) is a skull from New Bethesda, Graaff-Reinet District, Cape Province, South Africa. This is in the *Daptocephalus* bio-zone (Kitching 1977).

Broom (1913) noted the short preorbital part of the skull, the absence of tusks, the apparent absence of the septomaxilla (or its reduction), the large preparietal, and the large postorbital, which was considered to be unusual in that it was broad in front and narrow posteriorly.

Diictodon testudirostris (Broom & Haughton, 1913)

Dicynodon testudirostris Broom & Haughton, 1913: 36.
Pylaecephalus testudirostris (Broom & Haughton, 1913) van Hoepen, 1934: 93.
Diictodon testudirostris (Broom & Haughton, 1936) Cluver & Hotton, 1981: 130, figs 22–26.

The holotype, SAM–2354, is a skull from Dunedin, Beaufort West District, Cape Province, South Africa, a locality in the *Cistecephalus* bio-zone (Kitching 1977).

Distinguishing characters noted by Broom & Haughton (1913) are the very short beak, the maxilla which almost reaches the orbit, the apparent absence of the septomaxilla, the reduced lachrymal and prefrontal, the large postorbitals that meet in the midline, the large preparietal almost entirely in front of the pineal opening, the quadratojugal that is not ankylosed to the quadrate.

Diictodon sollasi (Broom, 1921)

Dicynodon sollasi Broom, 1921: 648, figs 28–29.
Pylaecephalus sollasi (Broom, 1921) van Hoepen, 1934: 93.
Diictodon sollasi (Broom, 1921) Cluver & Hotton, 1981: 132.

The holotype (SAM–7420) is from Biejiespoort, Victoria West District, Cape Province, South Africa, in the *Cistecephalus* bio-zone according to Kitching (1977).

Broom's (1921) description was based on many skulls from the same locality. He noted that immediately behind the plane of the nostrils there is a thickening of the bones, which forms a low, round, button-like boss in the midline. Other features to which attention was drawn were the canine that had a thickened ridge above and behind it, and the small preparietal. Broom (1921) distinguished *Dicynodon sollasi* from other species on the basis of such characters as the delicate build of the skull, the feebler tusk, the degree to which the postorbitals overlap the parietals, and the size of the preparietal.

Diictodon haughtonianus (von Huene, 1931)

Dicynodon haughtonianus von Huene, 1931: 30, fig. 25.
Diictodon haughtonianus (von Huene, 1931) King, 1988: 121.

The holotype (UT Von Huene 1931 Abb 25) is a skull and anterior part of lower jaw from Bloukrans, Prince Albert, South Africa, in the *Tapinocephalus* bio-zone (Kitching 1977).

Von Huene (1931) distinguished this species from others by its smaller nasal opening which lies further from the maxillary rim, the caniniform process which is more backwardly directed, the delicate postorbital bar, the shorter and wider postfrontal, and the shape of the preparietal.

Diictodon rubidgei (Broom, 1932)

Dicynodon rubidgei Broom, 1932: 189, fig. 62.
Pylaecephalus rubidgei (Broom, 1932) van Hoepen, 1934: 93.
Diictodon rubidgei (Broom, 1932) Cluver & Hotton, 1981: 133.

The holotype (BMNH 47081) is a skull from the Graaff-Reinet commonage, Cape Province, South Africa. This is in the *Cistecephalus* bio-zone (Kitching 1977).

Broom (1932) did not specifically allude to any distinguishing characters, but he mentioned the large preparietal and small pineal opening, and the large postfrontal. He noted that the postorbital is moderately large but its junction with the squamosal is not as far back as in most species of *Dicynodon*.

Diictodon grimbeeki (Broom, 1935)

Dicynodon grimbeeki Broom, 1935: 7, figs 6–7.
Diictodon grimbeeki (Broom, 1935) Cluver & Hotton, 1981: 133.

The holotype (TM 253) is a skull from Leeuwpoort, Beaufort West District, Cape Province, South Africa. The locality is in the *Cistecephalus* bio-zone (Kitching 1977).

Broom (1935) described a sample of 19 skulls from the locality and noted that the morphology of the preparietal varies within the sample. A small boss behind the pineal foramen was noted, as was the smooth rounded median boss on the snout formed by the nasals and the premaxilla. Broom distinguished male and female skulls, noting that the male skulls are bigger than those of the females, due to the much larger snouts of the former. The males were considered to have tusks; the females no or rudimentary tusks.

Diictodon nanus (Broom, 1936)

Dicynodon nanus Broom, 1936: 379, fig. 25A.
Diictodon nanus (Broom, 1936) Cluver & Hotton, 1981: 133.

The holotype (TM 268) is a skull from Houd Constant, Graaff-Reinet District, Cape Province, South Africa, in the *Cistecephalus* bio-zone (Kitching 1977).

Broom considered this to be a juvenile form. He noted the complete absence of postfrontals, that the postorbitals do not meet over the parietals, and that a developing canine (or possibly postcanine) is present behind the feebly developed caniniform processes.

Diictodon huenei (Broili & Schröder, 1937)

Dicynodon huenei Broili & Schröder, 1937: 130, figs 1–4 (preoccupied).
Dicynodon broilii (Broili & Schröder, 1937) Boonstra, 1948: 57.
Oudenodon huenei (Broili & Schröder, 1937) Toerien, 1953: 97.
Anomodon huenei (Broili & Schröder, 1937) Keyser, 1975: 74, fig. 28.

The holotype (BSP 1934 VIII 46) is a skull from La-de-da, Beaufort West District, Cape Province. The locality is in a high horizon of the *Tapinocephalus* bio-zone (Kitching 1977).

The main distinguishing features of this form mentioned by Broili & Schröder (1937) are its small size (total skull length 75 mm), the broad intertemporal and interorbital regions, the low bosses over the nostrils, the flat skull roof, the well-developed postfrontals, the large preparietal, the postorbital incompletely covering the parietals, and the beak-like dentary symphysis.

Diictodon broomi (Broili & Schröder, 1937)

Dicynodon broomi Broili & Schröder, 1937: 132, figs 5–13.
Diictodon broomi (Broili & Schröder, 1937) Cluver & Hotton, 1981: 134.

The holotype (BSP 1934 VIII 47a and b) comprises two skulls, one tusked, one tuskless from La-de-da, Beaufort West District, Cape Province. The locality is in a high horizon of the *Tapinocephalus* bio-zone (Kitching 1977).

The main distinguishing features of the species mentioned by Broili & Schröder (1937) are the skull (length 91 mm), which is slightly larger than that of the other specimens described in the same paper, the strongly developed preorbital region of the skull with a median boss between the nasal openings, the interorbital distance which is slightly broader than that of the intertemporal, the flat skull roof, the pineal foramen surrounded by a ring of bone, the large tusk, and the postorbitals which converge behind the pineal opening, covering the parietals.

Diictodon grossarthi (Broili & Schröder, 1937)

Dicynodon grossarthi Broili & Schröder, 1937: 161, figs 14–18.
Diictodon grossarthi (Broili & Schröder, 1937) Cluver & Hotton, 1981: 134.

The holotype (BSP 1934 VIII 48) is a skull from La-de-da, Beaufort West District, Cape Province, in a high horizon of the *Tapinocephalus* bio-zone (Kitching 1977).

The main distinguishing features mentioned by Broili & Schröder (1937) are the delicate snout, the convex skull roof, the absence of tusks, the low median boss over the nostrils, the delicate postorbital bar, the palatine which reaches relatively far forward on the palate, and the oval depression at the junction of the ectopterygoid, jugal and palatine.

The skull length is approximately 100 mm.

Diictodon anneae (Broom, 1940)

Dicynodon anneae Broom, 1940: 181, fig. 23.
Dicynodon whitsonae Toerien, 1954: 937.
Diictodon whitsonae (Toerien, 1954) Cluver & Hotton, 1981: 134.
Diictodon anneae (Broom, 1940) comb. nov.

It should be noted that Toerien (1954: 937) renamed this species *Dicynodon whitsonae*, believing that *Dicynodon anneae* was preoccupied by the Russian form described by Amalitsky (1922) as *Dicynodon annae*. Cluver & Hotton (1981: 134) followed Toerien's species reassignment and, in addition, referred *Dicynodon whitsonae* to *Diictodon*. King (1988) also accepted *Diictodon whitsonae* as the valid species. However, these authors failed to notice that the spelling of Broom's original species, *anneae*, was distinct from that of the Russian form, *annae*. The original species name given by Broom (1940) is therefore valid. It is here referred to the genus *Diictodon* as *Diictodon anneae*.

The holotype (RC 42) is a skull from Wellwood, Graaff-Reinet District, Cape Province, South Africa. The locality is in the *Cistecephalus* bio-zone (Kitching 1977).

The only noteworthy feature of this small tusked specimen from Broom's (1940) description is the fact that the postorbitals are well developed, but the posterior processes are shorter than in most species.

Diictodon pseudojouberti (Boonstra, 1948)

Dicynodon pseudojouberti Boonstra, 1948: 60.
Diictodon pseudojouberti (Boonstra, 1948) Cluver & Hotton, 1981: 134.

The holotype (SAM–774) is a skull from Prince Albert Road, Cape Province, South Africa, in the *Tapinocephalus* bio-zone (Kitching 1977).

From Boonstra's (1948) description, the points of distinction of this species appear to be the relatively high and fairly broad skull, the fairly weak snout, the interorbital width being approximately equal to the intertemporal, the convex intertemporal and interorbital regions, the large and roughly oval preparietal, the well-developed postfrontal, and the postorbitals that are large and overlap the parietals.

Diictodon vanderhorsti (Toerien, 1953)

Dicynodon vanderhorsti Toerien, 1953: 91, fig. 60.
Diictodon vanderhorsti (Toerien, 1953) Cluver & Hotton, 1981: 135.

The holotype (BPI 175) is a skull from Antjiesfontein, Prince Albert District, South Africa, in a low horizon of the *Tapinocephalus* bio-zone (Kitching 1977).

Toerien (1953) noted that a low boss is present over the nostrils, and a low bony ring surrounds the pineal foramen. He discussed variation within dicynodonts and suggested that replacement canines are only found in young individuals, that nasal bosses increase with the size of the individual, and that the pineal boss is characteristic of old males.

Diictodon tienshanensis (Sun, 1973)

Dicynodon tienshanensis Sun, 1973: 56, figs 1–6.
Diictodon tienshanensis (Sun, 1973) Cluver & Hotton, 1977: 179, pls 73–74.

The holotype (IVPP V.3260) is a skull from the north foot of the Tienshan mountains, XinJiang Province, China. This is in the Upper Jijicao Group, perhaps equivalent to either the *Cistecephalus* or *Daptocephalus* bio-zone (King 1992).

Sun (1973) did not note any features of the skull that might distinguish this species from any other, apart from in the palate. Here the large interpterygoid fossa and long, narrow interpterygoid foramen are specified. In addition, Sun noted that the palatine forms a nodule at the anterior end, which projects internally and constricts the anterior end of the internal nares, and a small boss also projects at the inner posterior side of the maxillary process.

ASSESSMENT OF CHARACTERS

The features that previous authors have felt to be important in terms of recognizing the above species can be categorized as follows:

Features of the pineal and preparietal

1.1 Pineal foramen surrounded by a ring of bone
1.2 Pineal foramen situated on an elevated preparietal
1.3 Size and shape of the preparietal
1.4 Position of the preparietal relative to the pineal opening

General skull features

2.1 Skull roof flat, concave or convex
2.2 Height of skull
2.3 Breadth of skull
2.4 Narrowness of skull
2.5 Length of skull
2.6 Whether skull is robust or delicate
2.7 Width of occiput
2.8 Width of intertemporal region relative to skull length
2.9 Width of intertemporal region relative to interorbital
2.10 Length of preorbital part of the skull
2.11 Whether snout is delicate or robust

Features relating to the nasals and nostrils

3.1 Width of nasals
3.2 Size and shape of nostrils
3.3 Position of nostril relative to maxillary rim

Features of the postorbital bones

4.1 Whether and how far the postorbitals approach each other behind the pineal opening
4.2 Shape of the postorbital

Features of the caniniform process and tusks

5.1 Direction of the caniniform process or tusk
5.2 Presence and size of canine tusks

Features relating to skull bosses

6.1 Whether a boss is present behind the pineal foramen
6.2 Whether separate nasal bosses are present
6.3 Whether median boss over the nostrils is present

Features of the lower jaw

7.1 Whether the dentary symphysis is beak-like
7.2 Whether front part of lower jaw is broad and deep
7.3 Size of intramandibular foramen

Features relating to individual bones or specific areas of the skull

8.1 The septomaxilla does not show on the side of the skull
8.2 Presence, absence or reduction of the septomaxilla
8.3 Depth of the jugal arch
8.4 The prefrontal region of orbital margin is elevated
8.5 The frontal region is broad and flat
8.6 Maxilla almost reaches the orbit
8.7 The prefrontal is reduced
8.8 Quadrato-jugal not ankylosed to the quadrate
8.9 Whether the postorbital bar is delicate
8.10 Size and shape of the postfrontal

Features of the palate

9.1 The palatine reaches relatively far forward on the palate
9.2 Presence of an oval depression at the junction of the ectopterygoid, jugal and palatine
9.3 Size of interpterygoid fossa
9.4 Length and breadth of interpterygoid foramen
9.5 Whether a nodule is present on the anterior end of the palatine
9.6 Whether a small boss is present on the inner posterior side of the maxillary process

Several of these features may be dismissed at once, since it is now known that they do not constitute valid specific characters, either because they vary within otherwise similar forms, or because they are widespread among many different forms, or are likely to have been produced by distortion or bad preservation.

The size and shape of the preparietal and its position with respect to the pineal opening (1.3, 1.4) are examples of known variation within a group (Toerien 1953) and may be dismissed.

Features 2.1–2.5, 2.7, 2.8, 3.2, 5.1, 9.3, and 9.4 may all be affected by distortion and are therefore unreliable.

Features 8.1, 8.5, 8.6 and 8.7 occur in all specimens of *Diictodon* investigated. Feature 8.8 (quadratojugal not ankylosed to the quadrate) is now known to be the case in the majority of dicynodonts (see King 1981).

Feature 4.1 (whether and how far the postorbitals approach each other behind the pineal opening) varies within the group of species discussed above. The postorbitals usually approach each other in the midline but they do not always cover the parietals completely. Nevertheless, the 'pinched-in' appearance of the intertemporal bar seems to be a typical feature of *Diictodon*, as noted by Cluver & Hotton (1981).

Some features (2.6, 2.11, 8.9) are based on subjective non-quantitative assessments, e.g. the suggestion that the skull is delicate. Broom (1921) used this feature to distinguish between *Diictodon feliceps* and *Diictodon sollasi* but, in any case, the two skulls are of different sizes and it might be expected that the larger would be less delicate. I will not use these more subjective features further in the discussion.

The remaining features are discussed further below. I have used a sample of well-preserved and well-prepared specimens in the South African Museum (Appendix 1) to investigate the states of the features given above: to determine whether the features are identifiable consistently, how often they occur, and how much variation they exhibit.

Of the 37 skulls and jaws in this sample, two are from the *Tapinocephalus–Bradysaurus* assemblage zone, four from the *Pristerognathus–Diictodon*, three from the *Cistecephalus–Aulacephalodon*, two from the *Dicynodon–Theriognathus*, and the remainder from the *Tropidostoma–Endothiodon* assemblage zone. These numbers do not represent the abundance of specimens per stratigraphic zone in the field, nor probably in life, but reflect the composition of the collections available for study.

Pineal foramen surrounded by a ring of bone (1.1); and pineal foramen situated on an elevated preparietal (1.2)

Out of the South African Museum sample of 37 skulls, 15 specimens show some indication of a ring-like structure or bulbous area around the pineal foramen. (The latter seems to be what is meant by elevated preparietal in previous authors' descriptions of *Diictodon sesoma* and *Diictodon psittacops*.) The two conditions do not seem to be independent. In larger specimens the ring around the pineal opening becomes swollen, giving the bulbous or elevated structure.

It is possible that, in two specimens where the skull roof is slightly weathered, the ring may have been lost if it had been present but very slightly developed in the first place.

The presence of this structure does not correlate with any particular assemblage zone, the 16 specimens coming from the *Tapinocephalus–Bradysaurus* assemblage zone (1), the *Pristerognathus–Diictodon* assemblage zone (2), and *Tropidostoma–Endothiodon* assemblage zone (13). Specimens without the feature are also known from the *Tapinocephalus–Bradysaurus* and *Tropidostoma–Endothiodon* zones.

The feature correlates in some way with size, since the seven largest specimens (approximately 90–120 mm skull length) in the sample all have it, but in smaller specimens the feature may or may not be present. The smallest skull in the sample (skull length 47 mm) does not have the feature. The ring or bulbous area tends to be better developed in the larger specimens. Both tusked and tuskless specimens have the feature. Since this is a feature that may well be correlated with size of skull (as Toerien (1953) also pointed out), it is not a useful feature for delineating species.

Width of intertemporal region relative to interorbital (2.9)

Comments on the relative intertemporal and interorbital widths are made by previous authors for several species. This feature is dependent on the measurement of the intertemporal width, which is in turn dependent on how much the postorbitals overlie the parietals. This may be affected by distortion in two ways. The intertemporal region may be pinched together, forcing the postorbitals to approach each other more closely, forming ridges above the surface of the parietals. Secondly, it may be possible for post-mortem compression to cause the postorbitals to slide over the parietals, presumably either medially or laterally, reducing or increasing the intertemporal distance, respectively. The evidence for this is that some specimens in the South African Museum sample have a layer of matrix between the postorbitals and parietals, indicating that there must be space between the two bones. Because of this it is difficult to measure the true intertemporal width and use of this ratio as a specific character is not advisable, as Keyser (1975) pointed out.

Length of preorbital part of the skull (2.10)

There are two problems with using this feature for taxonomic purposes. The first is that it is not known how the preorbital part of the skull would be affected by distortion and whether it would react in the same way to compressive or tensional forces as the rest of the skull. If, for example, it were more resistant to compression, then preorbital/skull length ratios would be unreliable.

Secondly, Toerien (1953) gave evidence that the snout length increases relatively more quickly with increasing skull length, and so this may be another feature attributable to age difference.

Width of nasals (3.1)

Broom (1912) suggested that the nasals of *Diictodon psittacops* are so narrow that the nostrils face almost directly upwards. However, this is an unreliable character, since dorso-ventral flattening of the skull due to distortion would produce more upwardly-directed nostrils, and also the antero-dorsal margin of the nostril is very thin and may be worn away, making the nasals narrower.

Position of nostril relative to maxillary rim (3.3)

This feature will be affected by distortion and preservation. If the skull is subject to antero-posterior compression, the snout becomes flattened posteriorly and the nostril appears to lie nearer the anterior surface of the skull. If the maxillary rim of the snout is worn away, the nostril will appear to be nearer the ventral maxillary rim. Wearing away of the maxillary rim is not always obvious, since the rim is thin and the bone has an unfinished appearance and does not always show a break cleanly.

Whether and how far the postorbitals approach each other behind the pineal opening (4.1)

The tendency for the postorbitals to approach each other in the dorsal midline, covering the parietals in the intertemporal region has been used as a diagnostic character for *Diictodon* (Cluver & Hotton 1981; Cluver & King 1983). Although this tendency is present, the degree to which the postorbitals cover the parietals is variable. As mentioned under 2.9, the intertemporal region may be affected by distortion such that the configuration of the postorbitals changes. Because of this the degree to which the postorbitals meet each other over the parietals should not be given undue emphasis.

Shape of the postorbital (4.2)

Broom (1913) noted that the postorbital in *Diictodon palustris* differs in shape from anything known in dicynodonts, being so broad in front as to roof over part of the temporal fenestra, but narrowing rapidly behind. This condition is seen in other specimens (SAM–K7673, SAM–K7674), where it would appear that the thinner medial part of the postorbital behind the pineal opening has broken off on both sides. This gives the appearance of the postorbital narrowing posteriorly.

Presence and size of canine tusks (5.2)

Various conditions of the caniniform tusks have been noted by previous authors (Broom 1905, 1913, 1921, 1935; Broili & Schroder 1937; Toerien 1953). They have been reported to be large or small, always present, always absent, or variably present within the same alleged species. In the latter case authors have explained this by sexual dimorphism and/or ontogenetic variation.

The question of sexual dimorphism in dicynodonts, as evidenced by presence or absence of tusks, is a long-standing one. It was reviewed by Cluver (1971), but it was not then possible to draw any conclusions. As far as *Diictodon* is concerned, data given by Smith (1989) are highly suggestive that sexual dimorphism is present in this genus, one sex being tusked, the other tuskless. In a collection of skulls from one locality (Dunedin, Beaufort West), Smith noted that 94 specimens were tusked, 84 tuskless and the condition of 18 could not be deduced from the material at that stage.

If several *Diictodon* skulls were to be reported from one locality and horizon all either with or without tusks, then presence and absence of tusks could be used as a valid feature of a species. However, this is not true for any of the hitherto recognized species of *Diictodon*. It is far more likely that the condition of the tusks is a sexually dimorphic or ontogenetic feature and, therefore, it should not be used to distinguish different species.

Whether a boss is present behind the pineal foramen (6.1)

Only one species, *Diictodon grimbeeki*, is reported to have a boss behind the pineal region. In his description of the species, Broom (1935) mentioned 19 'fairly good skulls', but does not say how many of them have a post-pineal boss.

The feature occurs in one specimen in the South African Museum sample, SAM–K7132. The latter specimen is tusked, approximately 115 mm in skull length (the largest in the collection), and is from the locality Leeukloof in the *Tropidostoma–Endothiodon* assemblage zone of South Africa. The type of *Diictodon grimbeeki* is from the same locality. Both tusked and tuskless forms were reported by Broom (1935). The type skull is 120 mm in length.

Several other *Diictodon* specimens in the South African Museum sample are known from this locality, but none has a post-pineal boss. These specimens are otherwise indistinguishable from the specimen with the post-pineal boss. There is evidence that other kinds of dicynodont skull bosses (nasal, frontal, pineal) are correlated with size or sexual dimorphism (Toerien 1953; Tollman *et al.* 1981) and it is most likely that the occasional occurrence of a post-pineal boss also falls within the category of intraspecific variation of some kind.

Whether separate nasal bosses are present (6.2); and whether a median boss over the nostrils is present (6.3)

Separate nasal bosses are present in *Diictodon heunei* and a single median boss in various other species. All specimens in the South African Museum sample have nasal bosses of some description, but it is often difficult to say whether they are separate or confluent. For example, they may be separated from each other medially, but confluent posteriorly. Separation also depends to some extent on how well developed the bosses are, and on distortion of the snout.

Whether the dentary symphysis is beak-like (7.1)

The degree to which the dentary symphysis appears beak-like depends on how well the front end of the lower jaw is preserved, and is an unreliable character.

Whether the front part of lower jaw is broad and deep (7.2)

In order to be applicable to other specimens, this feature needs quantifying: the breadth and depth in question need to be related to some other aspect of jaw size, such as length. However, such measurements are prone to distortion and affected by incomplete preservation. Therefore in many cases they would simply be estimates, so the feature is likely to be unreliable.

Size of intramandibular foramen (7.3)

This feature is affected by distortion. The fenestra may appear to be closed-up if the spur of the dentary, which runs dorsal to the fenestra, is pushed downwards over it. The fenestra may appear to be of very different sizes on the opposite sides of a single jaw (e.g. SAM–K7738) if distortion has affected them differently.

Presence, absence or reduction of the septomaxilla (8.2)

It has been suggested that the septomaxilla may be absent or reduced in two species, *Diictodon palustris* (Broom 1913) and *Diictodon testudirostris* (Broom & Haughton 1913). Broom (1913) stated that, 'There does not appear to be a septomaxillary. If one is present it is very small and does not show on the face.' Broom & Haughton (1913) were similarly unsure, 'There is no evidence of a septomaxillary, at least on the outer side of the skull. Whether there may be one hidden underneath it is impossible to say without damaging the skulls. We incline, however, to think that the septomaxillary is absent.'

The septomaxilla is a small, fairly loosely-articulated bone, which is probably easily lost from the skull, as noted by Cluver & Hotton (1981) in *Diictodon galeops*. Its absence in the fossil does not necessarily mean it was absent in life. Well-preserved and well-prepared specimens in the South African Museum sample invariably show a septomaxilla, although it is often broken and never appears on the face.

Depth of the jugal arch (8.3)

Both *Diictodon ictidops* and *Diictodon jouberti* are noted as having a very deep zygomatic arch beneath the postorbital bars. However, this is a feature that may be produced by deformation of the skull. Two skulls in the South African Museum sample illustrate this. SAM–K7738 has been dorso-ventrally compressed and the zygoma lies more horizontally than usual. In side view this gives the impression of a shallow zygoma. SAM–K7281 has been laterally compressed and the zygoma lies almost vertically and appears very deep. The type of *Diictodon jouberti* is damaged in the zygomatic region but the skull has been compressed laterally and there is a break between zygoma and post-orbital bar. The type of *Diictodon ictidops* is described as narrow so there is also the possibility that it has been laterally compressed.

This is clearly an unreliable feature on which to base specific distinction.

The prefrontal region of orbital margin is elevated (8.4)

Broom (1912) noted this feature in *Diictodon psittacops*, referring to thickening of the antero-dorsal margin of the orbit. A swelling in this position is present in many specimens and is particularly well developed in SAM–K7643, one of the largest individuals known. It is probably size related and unhelpful as a specific character.

Size and shape of the postfrontal (8.10)

Various sizes and shapes of the postfrontal have been described in type specimens. The bone was said to be short and wide in *Diictodon haughtonianus*, absent in *Diictodon nanus* and *Diictodon galeops* and fairly well-developed in *Diictodon pseudojouberti*, large in *Diictodon rubidgei*, and clearly present in *Diictodon huenei*. The South African Museum sample also shows that the bone is very variable both in size and shape. It may be a fairly well-developed triangular bone that reaches the orbital border, or a mere sliver of bone confined to the skull roof. Conditions in between these extremes can be seen. It seems unwise to use this character to separate species because of its great variability.

The palatine reaches relatively far forward on the palate (9.1)

Although there is some variability in the sutural pattern in *Diictodon*, the typical pattern (as seen in the South African Museum sample specimens) is for the maxilla to separate palatine and premaxilla (see Fig. 2). The palatine bone does not usually run anteriorly to contact the premaxilla as it does in *Diictodon grossarthi*. This seems then to be a distinctive feature of *Diictodon grossarthi*. The type is from the locality La-de-da in the *Pristerognathus–Diictodon* assemblage zone, as are the types of *Diictodon heunei* and *Diictodon broomi*, which are otherwise very similar but do not exhibit this particular condition of the premaxilla. SAM–K7643 from La-de-da also shows a sutural pattern within the normal range of variation for other *Diictodon* specimens.

In the South African Museum sample, the degree to which the palatine approaches the premaxilla is variable but nothing like the condition illustrated in *Diictodon grossarthi* occurs. Although it is possible that this might represent a real difference between *Diictodon grossarthi* and other specimens, in view of its occurrence in only one known specimen, and the variability of the sutural pattern in other specimens, it should not be regarded as a reliable specific character.

Presence of an oval depression at the junction of the ectopterygoid, jugal and palatine (9.2)

This feature was noted in *Diictodon grossarthi* by Broili & Schröder (1937). It occurs in many, but not all, of the specimens of the South African Museum sample, although its size is variable. It does not seem to be helpful in distinguishing separate species, because of its wide variability.

Whether a nodule is present on the anterior end of the palatine (9.5)

This feature is noted by Sun (1973) in *Diictodon tienshanensis*, a tuskless specimen. It is present also in specimens of the South African Museum sample, both tusked and tuskless, where preservation of the palatine is good. It is probably a constant feature of the genus and not of use in delineation of species.

Whether a small boss is present on the inner posterior side of the maxillary process (9.6)

This is another feature noted by Sun (1973) in *Diictodon tienshanensis*. Most specimens of the South African Museum sample have a small tubercle behind the canine tusk or flange, although in some cases this is very indistinct. A similar tubercle was noted by Cluver (1970) in *Diictodon testudirostris*. Again this feature is probably present throughout the genus and not of help in delineation of species.

SUMMARY

None of the various features used by previous authors seems acceptable as characters on which to base specific differences. However, with a sample of fossils that are adequately preserved and prepared, it might prove possible to find other features not noted by previous authors owing to indifferent specimens or incomplete preparation. The South African Museum sample was studied from this point of view, but no obvious candidates were found. Although there is variability in the sample in features such as preparietal suture, premaxilla suture, bosses, and canine tusks, none of these is useful for delimiting species, as discussed above.

CONCLUSION

Since no reliable specific characters can be found, it is not possible to justify the 20 different species of *Diictodon* that exist in the literature. There is no reason why all *Diictodon* specimens should not be referred to *Diictodon galeops*.

Diictodon galeops is distinguished by the generic features of *Diictodon*: dicynodonts that are tusked or tuskless, have a narrow intertemporal region with the postorbitals tending to cover the parietals behind the pineal foramen, although this covering is not always complete. The pineal foramen is often surrounded by a bony ring or boss, especially in larger specimens. The intertemporal region is approximately the width of the interorbital region. There are bosses over the nostrils, which are sometimes confluent in the midline. The caniniform process (whether bearing a tusk or not) is set obliquely to the ventral maxillary rim, leaving a sharp-edged notch. The premaxilla and palatine are separated by the maxilla on the palatal surface. The palatine bears a small boss on its antero-medial corner. The maxilla bears a small tubercle postero-medial to the caniniform process. The anterior rami of the pterygoid are straight and built up into strong keels midway along their length. There are two anterior palatal ridges that meet the anterior premaxillary margin, a single median premaxillary ridge, and low ridges running along the maxilla–premaxillary suture.

The lower jaw has distinctive dentary tables that are excavated into shallow troughs and whose medial edge is higher than the lateral. The postero-medial corner of the dentary table is drawn out into a distinct angle overhanging the edge of the jaw ramus. The lateral dentary shelf is not prominent.

As far as can be ascertained from specimens available for study, the genus *Diictodon* appears to contain only one justifiable species, *Diictodon galeops*. This species is thus known from the *Tapinocephalus–Bradysaurus* assemblage zone through to the *Dicynodon–Theriognathus* zone of the Late Permian Karoo sediments of South Africa. The genus is also known from Zambia (Gale 1988), China (Sun 1973), and Russia (pers. obs.). Although the precise correlation with the South African stratigraphic scheme is uncertain at present, the non-South African specimens of *Diictodon* are from rocks probably equivalent to *Cistecephalus–Aulacephalodon* or *Dicynodon–Theriognathus* assemblage zones, (King 1992), and they therefore fall within the known range of the genus in South African rocks.

One qualification about this range should be noted. Specimens of *Diictodon* from the *Tapinocephalus–Bradysaurus* assemblage zone are rare in museum collections, and often very poorly preserved. (Several specimens in the South African Museum collections which were prepared in the hope that they were *Diictodon* in fact proved to be *Robertia* (King & Rubidge in press). It is possible that *Robertia* may well be the relatively common dicynodont in the *Tapinocephalus–Bradysaurus* assemblage zone, rather than *Diictodon*.) Therefore, while this study has attempted to use well-preserved and well-prepared specimens, this has been possible only to a lesser degree with *Tapinocephalus–Bradysaurus* assemblage zone specimens. However, specimens at my disposal, even when poorly preserved, show no difference in the general suite of characters used to define the genus, and exhibit no characters which might be used to delineate a species other than *Diictodon galeops*.

If *Diictodon* can be considered to span all but the lowest of the Late Permian assemblage zones of the Karoo, this would give it a species longevity of between five and ten million years, since Rubidge (in press) considers the *Tapinocephalus–Bradysaurus* assemblage zone to be between 258 Ma and 253 Ma and the *Dicynodon–Theriognathus* assemblage zone to be Upper Tatarian (up to 248 Ma).

It appears that the one species, *Diictodon galeops*, is both long-lived and widespread. Since few specific revisions of mammal-like reptiles have been carried out so far, few measurements of specific longevity are available and this information on *Diictodon* will therefore make a useful contribution to discussions of species longevity and diversity in the Late Palaeozoic.

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I would like to thank Drs Michael Cluver and Margaret Avery (South African Museum) for useful discussion and Bruce Rubidge and Roger Smith for providing stratigraphic information. I am grateful to Clive Booth for photography and to Janet Goodall and Sheena Kaal for carrying out the extensive preparation of fossils which this project necessitated.

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ABBREVIATIONS

Morphology

b	nasal boss
cp	caniniform process
ds	dentary shelf
dt	dentary table
ldt	lateral edge of dentary table
mdt	medial edge of dentary table
mf	mandibular fenestra
n	notch in maxillary rim
pa	palatine
pm	premaxilla
po	postorbital
pp	preparietal
r	ring of bone around pineal foramen

Institutions

AMNH	American Museum of Natural History, New York, USA
BMNH	Natural History Museum, London, UK
BPI	Bernard Price Institute for Palaeontological Research, Johannesburg, RSA
BSP	Bayerische Staatssammlung für Paläontologie und historische Geologie, Munich, Germany
IVPP	Institute for Vertebrate Paleontology and Paleoanthropology, Beijing, China
RC	Rubidge Collection, Wellwood, Graaff-Reinet, RSA
SAM	South African Museum, Cape Town, RSA
TM	Transvaal Museum, Pretoria, RSA
UMZC	University Museum of Zoology, Cambridge, UK
UT	Universität Tübingen Museum und Institut für Geologie und Paläontologie, Germany

APPENDIX

Diictodon specimens in the South African Museum used in this study:

SAM–2354: Skull from Dunedin (Quaggafontein 82, Beaufort West District). *Tropidostoma–Endothiodon* assemblage zone. Type of *Dicynodon testudirostris*.

SAM–K6654: Skull (with anterior part of snout missing) and lower jaw, from Willowdene (Beato 238, Beaufort West District). *Tropidostoma–Endothiodon* assemblage zone.

SAM–K6929: Skull and lower jaw, and skeleton from Oukloof Pass (Wilgerboschkloof 449, Fraserburg District). *Tropidostoma–Endothiodon* assemblage zone.

SAM–K6724: Skull and lower jaw, from Amandelboom (Ryers Valley 401, Fraserburg District). *Tropidostoma–Endothiodon* assemblage zone.

SAM–K6588: Skull and lower jaw, from Amandelboom (Ryers Valley 401, Fraserburg District). *Tropidostoma–Endothiodon* assemblage zone.

SAM–K5189: Skull and lower jaw, from Dunedin (Quaggafontein 82, Beaufort West District). *Tropidostoma–Endothiodon* assemblage zone.

SAM–K7084: Skull and lower jaw, from Leeu Kloof 43, Beaufort West District. *Tropidostoma–Endothiodon* assemblage zone.

SAM–10394: Anterior part of skull, and lower jaw, from Highlands (Matjesfontein 220, Victoria West District). *Tropidostoma–Endothiodon* assemblage zone.

SAM–K5990: Skull and lower jaw, from Dunedin (Quaggafontein 82, Beaufort West District). *Tropidostoma–Endothiodon* assemblage zone.

SAM–10394: Anterior part of skull, and lower jaw, from Highlands (Matjesfontein 220, Victoria West District). *Tropidostoma–Endothiodon* assemblage zone.

SAM–K5990: Skull and lower jaw, from Dunedin (Quaggafontein 82, Beaufort West District). *Tropidostoma–Endothiodon* assemblage zone.

SAM–K7281: Skull, from Karreebosch (Karree Bosch 63, Murraysburg District). *Tropidostoma–Endothiodon* assemblage zone.

SAM–K5105: Skull and lower jaw, from Dunedin (Quaggafontein 82, Beaufort West District). *Tropidostoma–Endothiodon* assemblage zone.

SAM–K6017: Skull and lower jaw, for Dunedin (Quaggafontein 82, Beaufort West District). *Tropidostoma–Endothiodon* assemblage zone.

SAM–10078: Skull (with right squamosal, and occipital condyle absent) and lower jaw, from Dunedin (Quaggafontein 82, Beaufort West District). *Tropidostoma–Endothiodon* assemblage zone.

SAM–10377: Skull in two parts, from Noblesfontein (Nobelsfontein 248, Victoria West District). *Cistecephalus–Aulacephalodon* assemblage zone.

SAM–10341: Skull, from Noblesfontein (Nobelsfontein 248, Victoria West District). *Cistecephalus–Aulacephalodon* assemblage zone.

SAM–K5204: Skull, from Hoeksplaas (Hoeksplaas 159, Murraysburg District). *Cistecephalus–Aulacephalodon* assemblage zone.

SAM–K6991: Skull and lower jaw, from Doornplaats (Rust 126, Graaff-Reinet District). *Dicynodon–Theriognathus* assemblage zone.

SAM–K7795: Skull and lower jaw, and some post-crania, including complete fore-limb and hand, from Meltonwold (Melton Wold 158, Victoria West District). *Pristerognathus–Diictodon* assemblage zone.

SAM–K6873: Skull and lower jaw, from Waterval (Brandewyns Gat 214, Beaufort West District). *Tropidostoma–Endothiodon* assemblage zone.

SAM–10086: Skull and lower jaw, from Dunedin (Quaggafontein 82, Beaufort West District). *Tropidostoma–Endothiodon* assemblage zone.

SAM–K6827: Skull and lower jaw, from Willowdene (Beato 238, Beaufort West District). *Tropidostoma–Endothiodon* assemblage zone.

SAM–K6668: Skull (with right side of snout absent) and lower jaw, from Willowdene (Beato 238, Beaufort West District). *Tropidostoma–Endothiodon* assemblage zone.

SAM–K7036: Skull and lower jaw, from Leeuwe Kloof 402, Fraserburg District. Hoedemaker M., *Tropidostoma–Endothiodon* assemblage zone.

SAM–K6921: Skull and lower jaw, from Oukloof Pass (Wilgerboschkloof 449, Fraserburg District). *Tropidostoma–Endothiodon* assemblage zone.

SAM–K6009: Skull and lower jaw, from Dunedin (Quaggafontein 82, Beaufort West District). *Tropidostoma–Endothiodon* assemblage zone.

SAM–11851: Skull and lower jaw, from Perdewater (Veldmans River 9, Prince Albert District). *Pristerognathus–Diictodon* assemblage zone.

SAM–K7603: Skull and lower jaw, from Leeurivier (Rietfontein 306, Beaufort West District). *Pristerognathus–Diictodon* assemblage zone.

SAM–K7132: Skull and lower jaw, from Leeukloof (Leeu Kloof 43, Beaufort West District). *Tropidostoma–Endothiodon* assemblage zone.

SAM–K7673: Skull and lower jaw, from Leeukloof (Leeu Kloof 43, Beaufort West District). *Tropidostoma–Endothiodon* assemblage zone.

SAM–K7674: Skull and lower jaw, from Leeukloof (Leeu Kloof 43, Beaufort West District). *Tropidostoma–Endothiodon* assemblage zone.

SAM–K7738: Skull and lower jaw, from Leeukloof (Leeu Kloof 43, Beaufort West District). *Tropidostoma–Endothiodon* assemblage zone.

SAM–K6979: Skull and lower jaw, from Doornplaats (Rust 126, Graaff-Reinet District). *Dicynodon–Theriognathus* assemblage zone.

SAM–K7675: Skull and lower jaw, from Leeukloof (Leeu Kloof 43, Beaufort West District). *Tropidostoma–Endothiodon* assemblage zone.

SAM–K7730: Skull and lower jaw, from Leeukloof (Leeu Kloof 43, Beaufort West District). *Tropidostoma–Endothiodon* assemblage zone.

SAM–K7643: Skull and lower jaw, from La-de-da (La-de-da 178, Beaufort West District). *Pristerognathus–Diictodon* assemblage zone.

SAM–11563: Skull and lower jaw, from Kroonplaas (Honing Kaps Fontein 321, Beaufort West District). *Tapinocephalus–Bradysaurus* assemblage zone.

SAM–11589: Skull, from Koedoeskop (Leeuwkraal 309, Beaufort West District). *Tapinocephalus–Bradysaurus* assemblage zone.

6. SYSTEMATIC papers must conform to the *International code of zoological nomenclature* (particularly Articles 22 and 51).

Names of new taxa, combinations, synonyms, etc., when used for the first time, must be followed by the appropriate Latin (not English) abbreviation, e.g. gen. nov., sp. nov., comb. nov., syn. nov., etc.

An author's name when cited must follow the name of the taxon without intervening punctuation and not be abbreviated; if the year is added, a comma must separate author's name and year. The author's name (and date, if cited) must be placed in parentheses if a species or subspecies is transferred from its original genus. The name of a subsequent user of a scientific name must be separated from the scientific name by a colon.

Synonymy arrangement should be according to chronology of names, i.e. all published scientific names by which the species previously has been designated are listed in chronological order, with all references to that name following in chronological order, e.g.:

Family **Nuculanidae**

Nuculana (Lembulus) bicuspidata (Gould, 1845)

Figs 14–15A

Nucula (Leda) bicuspidata Gould, 1845: 37.
Leda plicifera A. Adams, 1856: 50.
Laeda bicuspidata Hanley, 1859: 118, pl. 228 (fig. 73). Sowerby, 1871: pl. 2 (fig. 8a–b).
Nucula largillierti Philippi, 1861: 87.
Leda bicuspidata: Nicklès, 1950: 163, fig. 301; 1955: 110. Barnard, 1964: 234, figs 8–9.

Note punctuation in the above example:
comma separates author's name and year
semicolon separates more than one reference by the same author
full stop separates references by different authors
figures of plates are enclosed in parentheses to distinguish them from text-figures
dash, not comma, separates consecutive numbers.

Synonymy arrangement according to chronology of bibliographic references, whereby the year is placed in front of each entry, and the synonym repeated in full for each entry, is not acceptable.

In describing new species, one specimen must be designated as the holotype; other specimens mentioned in the original description are to be designated paratypes; additional material not regarded as paratypes should be listed separately. The complete data (registration number, depository, description of specimen, locality, collector, date) of the holotype and paratypes must be recorded, e.g.:

Holotype

SAM–A13535 in the South African Museum, Cape Town. Adult female from mid-tide region, King's Beach, Port Elizabeth (33°51′S 25°39′E), collected by A. Smith, 15 January 1973.

Note standard form of writing South African Museum registration numbers and date.

7. SPECIAL HOUSE RULES

Capital initial letters

(a) The Figures, Maps and Tables of the paper when referred to in the text
e.g. '. . . the Figure depicting *C. namacolus* . . .': '. . . in *C. namacolus* (Fig. 10) . . .'

(b) The prefixes of prefixed surnames in all languages, when used in the text, if not preceded by initials or full names
e.g. Du Toit but A. L. du Toit; Von Huene but F. von Huene

(c) Scientific names, but not their vernacular derivatives
e.g.Therocephalia, but therocephalian

Punctuation should be loose, omitting all not strictly necessary

Reference to the author should preferably be expressed in the third person

Roman numerals should be converted to arabic, except when forming part of the title of a book or article, such as
'Revision of the Crustacea. Part VIII. The Amphipoda.'

Specific name must not stand alone, but be preceded by the generic name or its abbreviation to initial capital letter, provided the same generic name is used consecutively. The generic name should not be abbreviated at the beginning of a sentence or paragraph.

Name of new genus or species is not to be included in the title; it should be included in the abstract, counter to Recommendation 23 of the Code, to meet the requirements of Biological Abstracts.

GILIAN M. KING

HOW MANY SPECIES OF *DIICTODON* WERE THERE?

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INSTRUCTIONS TO AUTHORS

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Title: informative but concise, without abbreviations and not including the names of new genera or species
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Only generic and specific names should be underlined to indicate italics; all other marking up should be left to editor and publisher.

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Bullough, W. S. 1960. *Practical invertebrate anatomy*. 2nd ed. London: Macmillan.
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ANNOTATED CATALOGUE OF THE AVES TYPE SPECIMENS IN THE SOUTH AFRICAN MUSEUM

By

R. K. BROOKE

Cape Town Kaapstad

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ANNOTATED CATALOGUE OF THE AVES TYPE SPECIMENS IN THE SOUTH AFRICAN MUSEUM

By

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Percy FitzPatrick Institute of African Ornithology, University of Cape Town,
and *South African Museum*

[*MS accepted 12 November 1991*]

ABSTRACT

There is type material of 50 avian nominal taxa (of which 12 are fossil) in the South African Museum, as well as those of two further names that were not published. These are listed with comments, including nomenclatural, as appropriate. Particular attention is paid to where the specimens were obtained. It is suggested that the type locality of *Pterocles gutturalis* Smith should be clarified by selection of a lectotype. The type locality of *Agapornis nigrigenis* Sclater is established for the first time. The type locality of *Parisoma layardi* Hartlaub is corrected. Two synonyms in *Pachyptila* Illiger are clarified. *Barbatula extoni* Layard is shown to be based on two syntypes. The date of publication of Winterbottom's proposed names in *Chersomanes albofasciata* is established. Smith's proposal of a timaliid *jardineii* is clarified. It is argued that *Laniarius maraisi* Sclater is a colour phase of *Telophorus olivaceus* (Shaw) and not just the juvenile plumage.

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INTRODUCTION

The South African Museum has already published lists of types in the following taxa: decapod Crustacea (Kensley 1974), Hydroida (Coelenterata) (Millard 1979), Dinocephalia (Therapsida) (Van den Heever & Grine 1981), and marine Mollusca other than Cephalopoda (Giles & Gosliner 1983); Carabidae (Coleoptera) (Cochrane in press) is to be published shortly. The avian nominal taxa are listed below, following the sequence proposed by Wetmore (1960). It is accepted that Wetmore's system will soon be replaced, perhaps by that of Sibley & Ahlquist (1990) and Sibley & Monroe (1990), or perhaps by another that has yet to be published. In the meantime, clarity is best served by using Wetmore's system.

Under ordinal and family names, type specimens are listed first under the name proposed, with bibliographic reference. In the case of fossil species, this is preceded by a '†'. Details of type specimens are then given, with particular reference to where each specimen was obtained. Dr J. M. Winterbottom did not usually put his name as collector on specimens labelled in his handwriting. In some cases, the describer of a taxon has stated that J. M. W. was the collector and it has been assumed that he was the collector of specimens labelled by him and collected in the 1950s and 1960s. Under 'Remarks',

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comments are made on the state of specimens, historical and nomenclatural points, and any other pertinent matters, including the meaning of the epithet chosen by the proposer. The current name is then given, usually following Clancey (1980).

In searching for type specimens, I have been guided by the names of ornithologists who have worked at the South African Museum: in historical order, Edgar Leopold Layard, Roland Trimen (better known as an entomologist), William Lutley Sclater, Edwin Leonard Gill, and John Miall Winterbottom (Summers 1975). However, Dr Gill did not describe any birds as new. If I could not find the type of a taxon proposed by any of the remaining four workers, I ascertained that the type was said to be in another museum and searched no further. In addition, Dr Winterbottom used to annotate in red the card index to the bird skin collection in respect of type specimens and this has been of great assistance.

Appreciation of ornithologists at the South African Museum by their contemporaries and successors has never been brought together and is, in any case, very scattered through the literature. However, it seems desirable to mention the principal appreciations: Layard (Liversidge 1957); Trimen (Sclater 1916); Sclater (Grant 1945); Gill (Broekhuysen 1956; Winterbottom 1957*a*); and Winterbottom (Clancey 1984; Brooke & Siegfried 1985).

LIST OF TYPE SPECIMENS

Order SPHENISCIFORMES Sharpe

Family **Spheniscidae** Bonaparte

† ***Spheniscus predemersus*** Simpson, 1971: 1145.

Holotype SAM–PQL12887A, left humerus from the late Pliocene, at E Quarry, Langebaanweg, 32°58′S 18°09′E, south-western Cape Province, South Africa.

Remarks

In fact, the type comes from the Quartzose Sand Member, Varswater Formation, early Pliocene (Hendey 1981). The epithet indicates that the taxon was the predecessor of *S. demersus*, at least in time, if not phylogenetically. Subsequently, Simpson (1975) proposed a new monotypic genus *Inguza* for this taxon. Now known as *Spheniscus predemersus* Simpson (Clancey *et al.* 1987), following the preliminary advice of Dr S. L. Olson (in litt. 1985) on the spheniscid taxa proposed by the late Dr George Gaylord Simpson.

† ***?Palaeospheniscus huxleyorum*** Simpson, 1973: 343.

Holotype SAM–PQ1882, right humerus with both ends incomplete from the Miocene, at Ysterplaats airforce base, 33°55′S 18°29′E, Cape Town, Cape Province, South Africa.

Remarks

The deposits at Ysterplaats are now thought to date from the early Pliocene (Olson 1983, 1985*b*). Named in honour of Thomas Huxley and his grandson, Sir Julian Huxley, for their contributions to vertebrate systematics and evolutionary theory. Now known as *Spheniscus huxleyorum* (Simpson) (Clancey *et al.* 1987).

† ***Dege hendeyi*** Simpson, 1979*a*: 6.

Holotype SAM–PQL28455, left tarsometatarsus with most of metatarsals II and III (metatarsal IV found and attached later) and proximal articulation from the Quartzose Sand Member, Varswater Formation, early Pliocene, at E Quarry, Langebaanweg, 32°58′S 18°09′E, south-western Cape Province, South Africa.

Remarks

Named in honour of Dr Quentin Brett Hendey, then Curator of Tertiary Palaeontology at the South African Museum, who devoted many years to the collection of material at Langebaanweg and to the study of the mammals represented therein. He is currently Director of the Durban Natural Science Museum. The palaeoecology of the Langebaanweg fossil deposits is set out in Hendey (1981). Now known as *Spheniscus hendeyi* (Simpson) (Clancey *et al.* 1987).

† ***Nucleornis insolitus*** Simpson, 1979*b*: 4.

Holotype SAM–MBD4, right tarsometatarsal lacking the distal ends of the second and third metatarsals, from ?Miocene deposits, at Koeberg Nuclear Power Station, Duinefontein, 33°39′S 18°27′E, south-western Cape Province, South Africa.

Remarks

The deposits at Duinefontein are now thought to date from the early Pliocene (Olson 1983, 1985*b*). The epithet means unusual and is a reference to the presence of a single medial intermetatarsal foramen. Now known as *Spheniscus insolitus* (Simpson) (Clancey *et al.* 1987).

Order PROCELLARIIFORMES Fürbringer

Family **Procellariidae** Leach

† ***Pachyptila salax*** Olson, 1985*a*: 130.

Holotype SAM–PQL25187, left humerus, complete, from the Quartzose Sand Member, Varswater Formation, early Pliocene, at E Quarry, Langebaanweg, 32°58′S 18°09′E, south-western Cape Province, South Africa.

Remarks

The epithet means a sieve and refers to the filtering apparatus in the upper mandibles of living members of the genus. Now known as *Pachyptila salax* Olson (Clancey *et al.* 1987).

Heteroprion desolata peringueyi Mathews, 1912: 223.

Holotype SAM–6792, adult female from Port St Johns, 31°38′S 29°32′E, Transkei, collected by Mr Guy C. Shortridge from the beach on 4 September 1902.

Remarks

In fair to good condition. Named in honour of Dr Louis Albert Péringuey, then Director of the South African Museum and a noted coleopterist. Captain Guy C. Shortridge (as he later became, and still later Director of the Kaffrarian Museum, King William's Town) is better known for his work on southern African mammals, particularly those of Namibia. Curiously, the type specimen is not mentioned in Shortridge & Sclater (1904), although its date of collection falls within their purview. Jouanin & Mougin (1979) place *H. peringueyi* as a synonym of *Pachyptila desolata banksi* Smith but this taxon is not admitted by either Cox (1980) or Bretagnolle *et al.* (1990) who all synonymize it with the nominate race. The type specimen measures in mm: length of exposed culmen 28,0, maximum width of culmen 12,4, wing > 175, tarsus 30,6. It is in active moult of the primaries (primary score 30) and the unguis at the tip of the upper mandible is pale, the rest being black. I place *H. peringueyi* as a junior synonym of *P. desolata desolata* (Gmelin). The taxonomy of the genus *Pachyptila* Illiger is still strongly disputed. I have followed Bretagnolle *et al.* (1990) without believing that they have said the last word.

Prion vittata keyteli Mathews, 1912: 212.

Holotype SAM–10316, unsexed adult from Tristan da Cunha, South Atlantic, collected by Mr P. C. Keytel on an unstated date.

Remarks

In poor condition. Named in honour of Mr P. C. Keytel, the collector, who visited Tristan da Cunha and Inaccessible Islands in 1908 and 1909 (Phillips 1913; Winterbottom 1976) for somewhat less than one year. Mathews (1932) added that the type was collected with its egg on Inaccessible Island, 37°19′S 12°44′W, on 17 September 1908. The type specimen measures in mm: length of exposed culmen 32,1, maximum width of culmen 21,4, wing length 200, tarsus 36,2. There is no moult of the primaries and the bill is wholly black. Jouanin & Mougin (1979) place *Prion keyteli* as a synonym of *Pachyptila vittata vittata* (Forster). The status of *Prion keyteli* was studied by Clancey (1981) who also found that *P. keyteli* is a junior synonym of *Pachyptila v. vittata* (Forster).

Family **Hydrobatidae** Mathews

† ***Oceanites zaloscarthmus*** Olson, 1985*a*: 126.

Holotype SAM–PQL25214, right humerus, complete, from the Quartzose Sand Member, Varswater Formation, early Pliocene, at E Quarry, Langebaanweg, south-western Cape Province, South Africa.

Remarks

The epithet means skipping over the surging sea, a common foraging behaviour pattern in the living members of the family. I have used the family-group name Hydrobatidae Mathews (1912), which he created as a replacement name for Thalassidromidae Müller—*Thalassidroma* Vigors being a junior synonym of *Hydrobates* Boie—instead of Oceanitidae Forbes as used by Clancey (1980) and other authors listed by Olson (1987). In this I follow Prof. Walter J. Bock MS of an application to the International Commission on Zoological Nomenclature seeking a general ruling conserving all family-group names currently widely used in the Aves. This will probably be accepted in due course, despite the trenchant objections of Olson (1987), and therefore I use the name in the interests of long-term clarity. Now known as *Oceanites zaloscarthmus* Olson (Clancey *et al.* 1987).

Family **Pelecanoididae** Gray

† ***Pelecanoides cymatotrypetes*** Olson, 1985*a*: 139.

Holotype SAM–PQL14564, left humerus, complete, from the Quartzose Sand Member, Varswater Formation, early Pliocene, at E Quarry, Langebaanweg, south-western Cape Province, South Africa.

Remarks

The epithet means a wave-borer, from the habit of living members of the family of flying straight through the crests of waves. The family Pelecanoididae is not known from South African waters, even as vagrants, in the historical period (Clancey 1980). However, this taxon was a breeding species on offshore islands near Langebaanweg (Olson 1985*a*). Now known as *Pelecanoides cymatotrypetes* Olson (Clancey *et al.* 1987).

Order CICONIIFORMES Bonaparte

Family **Ciconiidae** Sundevall

† ***Ciconia kahli*** Haarhoff, 1988: 300.

Holotype SAM–PQL22164, partial associated skeleton from the Quartzose Sand Member, Varswater Formation, early Pliocene, at E Quarry, Langebaanweg, south-western Cape Province, South Africa.

Remarks

Named in honour of Dr Marvin Philip Kahl who has written extensively on the systematics and behaviour of ciconiiform birds (e.g. Kahl 1979).

Family **Scopidae** Bonaparte

† ***Scopus xenopus*** Olson, 1984*b*: 737.

Holotype SAM–PQL43396, distal end of left tarsometatarsus with posterior parts of inner and outer trochleae abraded from the Quartzose Sand Member, Varswater Formation, early Pliocene, at E Quarry, Langebaanweg, south-western Cape Province, South Africa.

Remarks

The epithet means strange foot and is a reference to the unusual morphology of the tarsometatarsus. *Xenopus* Wagler is also the generic name of some toads which the living member of the family captures and eats. Now known as *Scopus xenopus* Olson (Clancey *et al.* 1987).

Family **Threskiornithidae** Poche

† ***Geronticus apelex*** Olson, 1985*c*: 59.

Holotype SAM–PQL20692, partial associated skeleton from the Quartzose Sand Member, Varswater Formation, early Pliocene, at E Quarry, Langebaanweg, south-western Cape Province, South Africa.

Remarks

The epithet means lacking a helmet and is an allusion to the lack of an expanded bony occipital crest found in the two living species of this genus. The family name used is that recommended by Prof. Walter J. Bock—see under *Oceanites zaloscarthmus* above. Now known as *Geronticus apelex* Olson (Clancey *et al.* 1987).

Order GALLIFORMES Temminck

Family **Phasianidae** Horsfield

Scleroptila jugularis cunenensis Roberts, 1932: 22.

Holotype SAM–16508a, adult male from the Cunene River, Namibia, collected by Mr Archibald Gerald White, on 14 March 1923.

Remarks

In good condition. The epithet refers to the type locality, subsequently elucidated as Otjimbombe (Macdonald 1953). The site may now be covered by the waters of the Rua Cana Dam (see map in Tarboton (1967) and discussion of *Lamprotornis mevesii violacior* below). The label contains an MS note in Austin Roberts's handwriting that he intended to name this subspecies *S. j. gilli* in honour of Dr E. L. Gill but he did not do so, preferring to convey that honour by way of *Pternistis swainsoni gilli* (see below). The collector, Mr White, was then the junior taxidermist at the South African Museum. He soon moved to the post of taxidermist at the Transvaal Museum, Pretoria. Now known as *Francolinus levaillantoides jugularis* Büttikofer (Clancey 1980).

Pternistis afer cunenensis Roberts, 1932: 22.

Holotype SAM–16511c, adult male from the Cunene River, Namibia, collected by Mr A. G. White on 15 March 1923.

Remarks

In very good condition. The epithet refers to the type locality. For notice of the type locality and collector see the preceding taxon. Now known as *Francolinus afer afer* Statius Müller (Clancey 1980).

Since *S. j. cunenensis* and *P. a. cunenensis* are both now placed in *Francolinus*, a minor problem in homonymy arises. Both names were proposed by Roberts (1932) on p. 22 and *Scleroptila jugularis cunenensis* has line priority. The matter is of little consequence unless the proposed subspecies are later thought worthy of recognition (unlikely). White (1958) proposed *Francolinus afer palliditectus* as a replacement name for *Pternistis afer cunenensis* Roberts.

Pternistis swainsoni gilli Roberts, 1932: 23.

Holotype SAM–16532, adult male from Ondonga (more correctly Ondangwa), 17°58′S 16°01′E, collected by Mr A. G. White on 22 February 1923.

Remarks

In very good condition. Named in honour of Dr Edwin Leonard Gill, then Director of the South African Museum. Now known as *Francolinus swainsonii gilli* (Roberts) (Clancey 1980).

Order CHARADRIIFORMES Huxley

Family **Rostratulidae** Mathews

† ***Rostratula minator*** Olson & Eller, 1989: 118.

Holotype SAM–PQL25552, nearly complete left humerus from the Quartzose Sand Member, Varswater Formation, early Pliocene, at E Quarry, Langebaanweg, 32°58′S 18°09′E, south-western Cape Province, South Africa.

Remarks

Type not seen: on loan to Dr Storrs L. Olson in September 1991. The epithet means one who threatens and is an allusion to the distinctive threat display of the living old world member of this family.

Order PTEROCLEIFORMES Boucard

Family **Pterocleidae** Bonaparte

Pterocles burchelli delabati Winterbottom, 1964: 30.

Holotype SAM–54727a, adult male from Onguma, 18°44′S 17°03′E, Namutoni, Etosha National Park, Namibia, collected by Mr P. J. Buys on 27 August 1963.

Remarks

In fair condition though the head is in poor condition. Named in honour of Mr Bernabé de la Bat, Chief Game Warden, Game Department of South West Africa (now Namibia). For Mr Buys see *Campethera bennettii buysi* below. Now known as *Pterocles burchelli burchelli* Sclater (Clancey 1980).

The spelling of the family and ordinal names based on the genus *Pterocles* is variable, depending on estimates of the stem of Greek nouns ending in KLES: some have stems KL-, some KLE- and some KLED-. Prof. Walter J. Bock in MS recommends Pteroclidae and, by implication, Pterocliformes. However, after discussion with Dr M. R. Mezzabotta of the Classics Department of the University of Cape Town, it appears that the correct view is that the stem of *Pterocles* is KLE-, giving Pterocleidae and Pterocleiformes, as used here, cf. KLEOPATRA (= Cleopatra).

Pterocles gutturalis Smith, 1836: 56.

Syntype SAM–20890, adult female, labelled Latakoo [= Kuruman, 27°28′S 23°26′E] in which case it would have been collected in 1835 (Kirby 1965).

Remarks

Formerly mounted; in good condition. Presented to the Museum in 1855 by the South African Literary and Scientific Institution. Mr W. L. Sclater in MS on the label suggested that it is one of Andrew Smith's syntypes, apparently correctly. The type locality is Kurrichane, 25°21′S 26°11′E, near Zeerust in the western Transvaal, following Smith (1836). The British Museum (Natural History) has a male syntype from 80 miles east of Latakoo as well as a female syntype (Warren 1966). It appears from the map in Kirby (1965) that Smith was never due east of Latakoo but that his route took him north-east of there. This means that the place of collection of the male syntype is just west of Vryburg, 26°57′S 24°44′E. Since Smith (1836) only described the male, the male syntype could be declared the lectotype, requiring an adjustment of the type locality. This might be desirable since Smith (1836) gave the vague 'Inhabits the country north and south of Kurrichaine'. The epithet refers to the more distinctive throat pattern found in this species compared with other southern African sandgrouse. Now known as *Pterocles gutturalis gutturalis* Smith (Clancey 1980).

Order PSITTACIFORMES Wagler

Family **Psittacidae** Rafinesque

Agapornis nigrigenis W. L. Sclater, 1906: 61.

Holotype SAM–8485, ?adult male from the Muguazi River some 25 km above its confluence with the Zambezi River, Southern Province, Zambia, collected by Dr A. H. B. Kirkman in September 1904.

Remarks

A poor specimen not properly stuffed or sewn up afterwards. The Muguazi River is not a known name (Benson *et al.* 1971) but I think it is a misspelling of the name of the Ngwezi River shown on map A of Pitman (1934) and map 210 of the 1984 *Reader's Digest Atlas of Southern Africa* and which joins the Zambezi at 17°40′S 25°06′E, about where the Muguazi would (Benson *et al.* 1971). The collector, Dr Kirkman, made two game-hunting trips into southern Zambia (Sclater 1906) and subsequently practised in Queenstown, eastern Cape Province (deduced from specimen material in the South African Museum). The epithet refers to the most distinctive feature (blackish cheeks and throat but not black on the crown as in *A. personata*) distinguishing this species from other members of the genus. *Agapornis nigrigenis* is treated as a full species by Clancey (1980) but it seems to be an isolated melanistic population of *A. lilianae* Shelley and should be referred to as *A. l. nigrigenis* as White (1965) and Benson *et al.* (1971) have done.

Order COLIIFORMES Murie

Family **Coliidae** Sundevall

† ***Colius hendeyi*** Rich & Haarhoff, 1985: 23.

Holotype SAM–PQL28858, left tarsometatarsus from the Quartzose Sand Member, Varswater Formation, early Pliocene, at E Quarry, Langebaanweg, 32°58′S 18°09′E, south-western Cape Province, South Africa.

Remarks

Named in honour of Dr Q. B. Hendey: see *Dege hendeyi* above. Now known as *Colius hendeyi* Rich & Haarhoff (Clancey *et al.* 1987).

Order CORACIIFORMES Forbes

Family **Coraciidae** Rafinesque

Coracias spatulata Trimen, 1880*a*: 31.

Holotype SAM–20898, adult male from Leshumo Valley, 17°50′S 25°15′E, near the Victoria Falls, Zimbabwe, collected by Dr Benjamin Frederick Bradshaw on 23 May 1878.

Remarks

Formerly mounted; in very good condition. Dr Bradshaw was a police surgeon when he died in 1883 (Sharpe 1884; Oates 1889). Dr Bradshaw's bird collections were never written up and the specimens were dispersed to various public and private collections, often by sale (Tabler 1966). The epithet describes the unusual shape of the outermost rectrix. The genitive of the Greek noun *Coracias* is KORAKIADIS and in the Latin alphabet the stem would be CORACIAD-, giving Coraciadidae and Coraciadiformes. However, the *International Commission on Zoological Nomenclature* has placed the family name Coraciidae on the Official List of Family-Group Names in Zoology (Direction 58 of 20 December 1956) and it would be unbearably pedantic then to spell the ordinal name as Coraciadiformes. Now known as *Coracias spatulata spatulata* Trimen (Clancey 1980).

Order PICIFORMES Meyer & Wolf

Family **Capitonidae** Bonaparte

Barbatula extoni Layard, 1871: 226.

Syntype SAM–19684, adult female from Kanye, 24°59′S 25°21′E, Botswana, presumably collected by Dr Hugh Exton on an unknown date, presumably in 1869 (Roberts 1935).

Remarks

Formerly mounted (still mounted in 1934 (Roberts 1935)); in good condition. Named in honour of Dr Hugh Exton, a medical practitioner, whose ornithological work was noticed by Roberts (1935), including a short biography. The status of this specimen is uncertain though it is marked as the type by Mr W. L. Sclater. Roberts (1935) regarded the type as being held in the British Museum (Natural History), then in London, now at Tring. This is supported by Warren (1966) who stated that that museum holds the male holotype. However, Layard (1871) did not nominate a type nor indicate which sex it might be in this sexually monomorphic species. I believe that the species is based on two syntypes, the male in the B. M. (N. H.) and the female in the South African Museum. Exton in Roberts (1935) added that he obtained male specimens at Kanye in September and October 1869. Now known as *Pogoniulus chrysoconus extoni* (Layard) (Clancey 1980).

Family **Picidae** Leach

Dendrobates striatus Layard, 1871: 227.

Syntypes SAM–21162a and SAM–21162b, adult male and female (the latter by plumage), respectively, the male from Kanye, 24°59′S 25°21′E, Botswana, and the female from Bechuanaland (presumably near Kanye), both collected by Dr Hugh Exton.

Remarks

Both formerly mounted; in fair to good condition. The epithet refers to the heavily streaked underparts. For Dr Exton see the preceding entry. *Dendrobates striatus* was proposed provisionally and does not appear to have been used since, though it is listed as a synonym by Reichenow (1902). Now known as *Campethera abingoni abingoni* Smith (Clancey 1980).

Campethera bennettii buysi Winterbottom, 1966: 39.

Holotype SAM–55390, adult male from Swartboois Drift, 17°20′S 13°52′E, Cunene River, Namibia, collected by Mr Pieter J. Buys of the State Museum, Windhoek, on 21 October 1965.

Remarks

In good condition. Named in honour of the collector, a technical officer of the State Museum of Namibia, Windhoek. Now known as *Campethera bennettii buysi* Winterbottom (Clancey 1980).

Order PASSERIFORMES Linnaeus

Family **Alaudidae** Vigors

Mirafra apiata marjoriae Winterbottom, 1956: 156.

Holotype SAM–19594, adult male from Soetendalsvlei, 34°43′S 19°59′E, near Bredasdorp, western Cape Province, South Africa, collected by Dr Austin Roberts on 27 October 1940.

Remarks

In good condition. Named in honour of his wife, Marjorie G. Winterbottom. Now known as *Mirafra apiata marjoriae* Winterbottom (Clancey 1980).

Certhilauda albofasciata macdonaldi Winterbottom, 1958*a*: 59.

Holotype SAM–20340, adult male from 36 km north-east of Karoopoort, 33°15′S 19°43′E, western Cape Province, South Africa, collected by Dr J. M. Winterbottom on 23 May 1956.

Remarks

In fair to good condition. Named in honour of Mr James David Macdonald, then head of the Bird Department at the B. M. (N. H.), London, who led an expedition to collect and study the birds of western southern Africa (Macdonald 1957). The date of publication of the name is May 1958. Some copies were issued with the date October 1957 and some with an overprinted sticker giving the date as May 1958. The latter is correct: the South African Museum Library's copy was receipted on 30 May 1958 and a copy in the South African Library was receipted on 9 June. The date of publication also affects the status of the name *C. a. bathoeni* Winterbottom, proposed on p. 64 of the same issue, and attributed by Winterbottom to R. H. N. Smithers and M. L. Paterson in press. The name was subsequently reproposed by Paterson alone (1958: 125) issued in October 1958, not January as stated by Clancey (1980). The type locality given by Paterson (1958) is *c.* 90 km east of Kakia, 24°16′S 23°24′E, Botswana. Now known as *Chersomanes albofasciata macdonaldi* (Winterbottom) and *Chersomanes albofasciata bathoeni* (Winterbottom) (Clancey 1980).

Anacorys africanoides omaruru Roberts, 1936: 263.

Holotype SAM–21005, adult male from Omaruru, 21°26′S 15°56′E, Namibia, apparently collected by Mr A. W. Eriksson on 5 December 1878.

Remarks

In good condition. The earliest writing on the label is in Mr A. W. Eriksson's handwriting: see *Cinnyris erikssoni* below, p. 343. The label is endorsed in Dr Austin Roberts's handwriting that he intended to name the taxon *'namibensis'*. The epithet is, in fact, the name of the type locality. Now known as *Mirafra africanoides omaruru* (Roberts) (Clancey 1980).

Calandrella sclateri capensis Ogilvie-Grant, 1913: 41.

Syntypes SAM–11635a and SAM–11635b, adult male and female respectively from Philipstown, 30°26′S 24°28′E, Cape Province, collected by Mr H. Leighton Hare on unknown dates.

Remarks

In fair to good condition, though the abdomens are not sewn up. Named for the Cape Province as opposed to Namibia, the type locality of the species. Now known as *Spizocorys sclateri capensis* (Ogilvie-Grant) (Clancey *et al.* 1987).

Calandrella hamiltoni W. L. Sclater unpublished.

Syntypes SAM–5873 and SAM–5874, adult male and female respectively from Christiania (correctly Christiana, 27°55′S 25°10′E) District, south-western Transvaal, collected by Captain B. Hamilton on 29 and 30 July 1903.

Remarks

The male specimen is in fair to good condition and the female specimen in good condition. Mr Sclater intended to name a new species after the collector, a British Army officer, but realized, before publication, that the species had been described by Shelley (1902) as *Calandrella starki* on material from Namibia. However, the specimens are labelled in red with his intention to describe them. Now known as *Eremalauda starki gregaria* (Clancey) (Clancey *et al.* 1991).

Family **Remizidae** Olphe-Galliard

Anthoscopus minutus gigi Winterbottom, 1959*b*: 152.

Holotype SAM–20323a, adult male from Oudtshoorn, 33°35′S 22°12′E, Little Karoo, Cape Province, South Africa, collected by Dr J. M. Winterbottom on 10 April 1956.

Remarks

In poor condition. Named in honour of Mr Gerald Graham (known as G-G) Smith, Chairman of the Board of the East London Museum, a museum that had built up a large collection of Cape Province specimens under his guidance. Now known as *Anthoscopus minutus gigi* Winterbottom (Clancey 1980).

Family **Timaliidae** Vigors & Horsfield

Cratopus jardineii Smith, 1836: 45.

Syntypes SAM–58324 and SAM–58325, without locality or sex.

Remarks

Formerly mounted; in good condition. The labels are endorsed by Mr W. L. Sclater as syntypes, probably correctly. There are no syntypes in the British Museum (Natural History) (Warren & Harrison 1971) where the majority of Dr Andrew Smith's type material eventually ended up. However, there was formerly a syntype in the Royal Scottish Museum, Edinburgh (Stenhouse 1930). The generic name *Cratopus* used by Smith in the Willughby Society reprint of his (1836) report, as well as in the original, appears to be a lapsus for *Crateropus* Swainson. Named in honour of Sir William Jardine Bt, a distinguished Scottish naturalist who wrote on birds and arranged for the publication of books on birds and other major taxa. The type locality is 'banks of rivers beyond Kurrichaine' (Smith 1836), i.e. near Zeerust, 25°32′S 26°05′E, in the western Transvaal. Now known as *Turdoides jardineii jardineii* (Smith) (Clancey 1980).

Chaetops aurantius Layard, 1867: 126.

Syntypes SAM–15071a and SAM–15071b, adult male and female respectively from near Graaff-Reinet, 32°15′S 24°33′E, eastern Cape Province, South Africa, collected by Mr A. O'Reilly on unknown dates.

Remarks

Formerly mounted; in good condition. The collector is named as A. O'Reilly on the label but as Mr J. J. O'Reilly by Layard (1867) who added that Mr O'Reilly was a magistrate stationed at various towns in the eastern Cape Province. The epithet refers to the orange, not deep red colour of the abdomen. Described by Layard in the Turdidae but now believed to be a member of the Timaliidae (Olson 1984*a*; Clancey *et al.* 1987). Irrespective of its family allocation, the taxon is still known as *Chaetops aurantius* Layard (Clancey 1980), though some consider that it is a subspecies of *C. frenatus* (Temminck).

Family **Pycnonotidae** Gray

Xenocichla debilis W. L. Sclater, 1899*b*: 284.

Holotype SAM–3116, adult male from north of Inhambane, Inhambane Province, Mozambique, collected by Mr H. F. Francis on 10 October 1898.

Remarks

In fair to good condition. The epithet refers to the slender build of the species compared with its close relative *Phyllastrephus flavostriatus* Sharpe. For the Francis brothers, see *Erythrocercus francisi* below. Sclater (1899*b*) gave the type locality as 'about twenty miles north of the Bay of Inhambane, near the coast'. This would place it close to Massinga, 23°20′S 35°22′E, as noted by Clancey (1971, 1980). Now known as *Phyllastrephus debilis debilis* (Sclater) (Clancey 1980).

Family **Turdidae** Rafinesque

Saxicola spectabilis Hartlaub, 1865*a*: 428.

Syntypes SAM–15115a and SAM–15115b, adult male and female respectively from Windvogelberg, 32°18′S 27°04′E, Cathcart, eastern Cape Province, South Africa, collected by Captain George Ernest Bulger on unknown dates.

Remarks

Formerly mounted; the male is in good condition and the female in fair condition. The epithet refers to the strikingly patterned plumage, unlike that of so many species from South Africa that Dr K. J. Gustav Hartlaub of the Bremen Museum had to deal with. Captain Bulger, whose botanical and military careers are briefly summarized in Gunn & Codd (1981), was clearly interested in chats, since he published on the behaviour of *Myrmecocichla formicivora* Vieillot (Bulger 1869*a*) and noted that *S. spectabilis* had been synonymized with *S. bifasciata* Temminck (Bulger 1869*b*). Layard (1865) provided data on the breeding and behaviour of the 'new' species. Now known as *Oenanthe bifasciata* (Temminck) (Clancey 1980). Subsequently, Tye (1989) argued that it was better placed in *Saxicola* Bechstein, and Clancey (1990) recommended resuscitating the genus *Campicoloides* Roberts of which it is the genotype, in the combination *Campicoloides bifasciatus* (Temminck).

Saxicola pollux Hartlaub, 1865*b*: 747.

Holotype SAM–15134, unsexed bird from the Traka Karoo collected by Mr W. Atmore on an unknown date.

Remarks

Formerly mounted; in good condition but somewhat foxed from exposure in the public galleries. The epithets *castor* (see the next taxon) and *pollux* were the names of the heavenly twins, whose sister was Helen of Troy, and refer to the similarity of the two types. The Traka River is a right bank affluent of the Olifants River, which itself runs into the Gourits River. Most of the course of the Traka River lies in the Great Karoo. Curiously, neither this nor the next taxon is included in Layard's (1867) book. Now known as *Cercomela schlegelii pollux* (Hartlaub) (Clancey 1980).

Saxicola castor Hartlaub, 1865*b*: 747.

Syntypes SAM–15125a and SAM–15125b, unsexed birds (males by plumage) from the Karoo collected by Mr W. Atmore on unknown date/s.

Remarks

Formerly mounted; in good condition. Both syntypes belong to the morph with least white in the plumage. The epithet is explained above in discussing *S. pollux*. Now known as *Oenanthe monticola monticola* Vieillot (Clancey 1980).

Myrmecocichla stoehri W. L. Sclater, unpublished.

Holotype SAM–9272, adult female (male by plumage: the opinion also of Mr Sclater in Stoehr & Sclater 1906) from Lavushi, 12°23′S 30°52′E, Mpika District, Northern Province, Zambia, collected by Dr Frederick Otto Stöhr in early September 1905.

Remarks

In fair condition. Named in honour of the collector who was primarily a botanist (Brooke 1970; Crook 1970) but was medical officer and naturalist to a geodetic survey at the time (Benson *et al.* 1970). Now known as *Myrmecocichla nigra* Vieillot (Benson *et al.* 1971).

Family **Sylviidae** Leach

Parisoma layardi Hartlaub, 1862: 147.

Holotype SAM–21623, adult unsexed from Clanwilliam, 32°11′S 18°54′E, western Cape Province, South Africa, collected by Mr J. Russouw.

Remarks

Formerly mounted; in fair condition but somewhat foxed from exposure in the public galleries. Named in honour of Mr Edgar Leopold Layard, then Curator of the South African Museum, who sent the specimen to Dr K. J. G. Hartlaub for study as a possibly new taxon. The collection locality given on the label does not correspond with that which Hartlaub (1862) quoted from Layard's letter accompanying the specimen, viz. 'received from Zwartland, in the Malmesbury [33°27′S 18°44′E] division'. Layard (1867) reiterated these data in his book. Winterbottom (1957*b*) drew attention to the conflict without resolving it but obviously considered that the Swartland was where the specimen came from since Winterbottom (1968, map 27) believed that Clanwilliam birds were *aridicola* (see the next taxon below). However, Clancey (1963, 1980) placed the Cedarberg Mountains, against which Clanwilliam lies, within the range of the nominate race. Hockey *et al.* (1989) in their Atlas showed that in the 1980s Clanwilliam quarter-degree square (3218 BB) was one of the few places where the species was regularly reported. They also show that it is now scarce to absent in the Swartland and that the only place where it occurs regularly is on the Piketberg massif, 32°42′S 18°33′E, largely in Moravia quarter-degree square (3218 DC). Of course, one does not know by how much further the grainlands of the Swartland have been transformed since 1860. Nonetheless, I believe that Clanwilliam is the real type locality. The type shows most of the characters laid down by Clancey (1963) for the nominate subspecies. Dr P. A. Clancey has examined both types of this species for me and advises that no change in nomenclature is required, even if the type locality is accepted as Clanwilliam. Now known as *Parisoma layardi layardi* Hartlaub (Clancey 1980).

Parisoma layardi aridicola Winterbottom, 1958*b*: 148.

Holotype SAM–21565, adult male from Noisabis, 28°27′S 17°11′E, Richtersveld, north-western Cape Province, South Africa, collected by Dr J. M. Winterbottom on 25 March 1958.

Remarks

In good condition. The epithet refers to the aridity of the Richtersveld where the type was collected. Now known as *Parisoma layardi aridicola* Winterbottom (Clancey 1980).

Calamoherpe gracilirostris Hartlaub in Gurney, 1864: 348.

Holotype SAM–15093, unsexed adult from the Liesbeeck River, 33°56′S 18°28′E, Cape Town, Cape Province, South Africa, collected by Mr E. L. Layard or his son (Layard 1867) on an unknown date.

Remarks

Formerly mounted; in good condition. The epithet draws attention to the slender bill *vis-à-vis* that of other species then placed in *Calamoherpe*. Now known as *Acrocephalus gracilirostris gracilirostris* (Hartlaub) (Clancey 1980).

Prinia pectoralis etoshae Winterbottom, 1964: 59.

Holotype SAM–54841, adult male from Leeubron, 19°04′S 15°50′E, Okaukuejo, Etosha National Park, Namibia, collected by Mr Miles Berkeley Markus on 20 August 1963.

Remarks

In good condition. The epithet refers to the Etosha National Park, where the type was collected. Dr Markus is now a professor of zoology at the University of the Witwatersrand. The species is not a *Prinia* (Maclean 1974; Brooke & Dean 1990). Now known as *Malcorus pectoralis etoshae* (Winterbottom) (Clancey 1980).

Family **Muscicapidae** Fleming

Erythrocercus francisi W. L. Sclater, 1898: 60.

Holotype SAM–2077, adult female (no locality given) collected by Mr H. F. Francis on 18 November 1897.

Remarks

In good condition. Named in honour of the collector who sent his Mozambican and eastern Transvaal bird specimens to the South African Museum. Some of the Mozambican specimens were obtained by his brother, Mr W. Francis. The specimen came from near Inhambane, 23°52′S 35°23′E, Inhambane Province, Mozambique (Sclater 1899*a*). Now known as *Erythrocercus livingstonei francisi* Sclater (Clancey 1980).

Family **Malaconotidae** Swainson

Laniarius atrocroceus Trimen, 1880*b*: 623.

Holotype SAM–58323, adult unsexed from the Crocodile [= Limpopo] River in the north-western Transvaal, South Africa, collected by Dr B. F. Bradshaw on 25 November 1879.

Remarks

Formerly mounted; in very good condition. The specimen was collected at Stockpoort, 23°24′S 27°20′E, on the Limpopo River where the Tropic of Capricorn crosses it. This is 100 km more or less south-east of Shoshong, 22°57′S 26°29′E, Botswana, as stated by Trimen (1880*b*). The epithet (black and yellow) parallels that of *L. atrococcineus* (Burchell) (black and red) of which it is an aberrant specimen with the deep red replaced by rich yellow (Stark & Sclater 1901), as Trimen (1880*b*) suspected. A similar yellow aberration in the normally red *L. barbarus* (Linnaeus) has recently been reported from Senegal (Ndao 1989). For Dr Bradshaw see *Coracias spatulata* above (p. 334). Now known as *Laniarius atrococcineus* (Burchell) (Clancey 1980).

Laniarius maraisi W. L. Sclater, 1901: 183.

Syntypes SAM–4866, adult male from Craddock's Bush collected on 3 November 1898, and SAM–4867, adult female from Salt River, 34°02′S 23°02′E, collected on 14 May 1898, both by Johann van Oosterzee Marais.

Remarks

The male is in good condition but in worn plumage. The female is in fair to good condition but in fresh plumage. Both localities are near Knysna, 34°02′S 23°02′E, southern Cape Province, South Africa. Named in honour of the collector, then in the Forestry Department of the Cape Colony (Anon. 1905). Curiously, Sclater (1930) did not mention *Laniarius maraisi* in his Afrotropical bird list.

Sclater (1901) pointed out that some birds shot in *Laniarius maraisi* plumage were in breeding condition. The state of wear of the primaries of both syntypes is consistent with their being adults which moult after breeding, as do nearly all passerines. *Laniarius maraisi* is now held to be the juvenile/immature plumage of *Telophorus olivaceus olivaceus* (Shaw) (Clancey 1980). It would appear that in *Telophorus olivaceus* reproductive maturity does not correlate with plumage maturity, as Harris (1988) has remarked in respect of females, and that a juvenile-type plumage may be retained for a long time, perhaps throughout life. It is a pity that Hall *et al.* (1966) did not consider *L. maraisi* in their study of plumage polymorphism in this and related bush-shrikes. I believe that *L. maraisi* is yet another colour phase in this polymorphic species. Whichever view is correct, *L. maraisi* Sclater is not a zoological taxon.

Laniarius maraisi is found around Knysna. Extreme southern and south-eastern Africa is the base for a number of geographically restricted polymorphisms in plumage: *Accipiter melanoleucus melanoleucus* Smith (Accipitridae) (melanistic morphs) (Malan 1988; A. J. van Zyl, pers. comm. on the Tarkastad District); *Clamator jacobinus serratus* (Sparrman) (Cuculidae) (melanistic morph) (Rowan 1983); *Alcedo semitorquata semitorquata* Swainson (Alcedinidae) (whitish belly morph) (Clancey 1978); *Hirundo paludicola paludicola* (Vieillot) (Hirundinidae) (brown belly morph) (Maclean 1985; pers. obs.); *Campephaga flava* (Vieillot) (Campephagidae) (yellow shoulder morph) (Maclean 1985); *Telophorus olivaceus olivaceus* (olive-yellow and 'immature' or *maraisi* morphs) (Hall *et al.* 1966; Clancey 1967, 1969); and perhaps others. All these appear to be subspecies in the throes of being absorbed by more northerly ones with larger ranges.

The morphs probably originated as subspecies during Pleistocene glaciations, when the fall in sea-level markedly extended the land area of the extreme south of Africa (Dingle & Rogers 1972, particularly their figs 3a and 4a). Much of the exposed land was grassland (Avery 1982) but forests would have extended southwards along the major rivers, many of which had exceedingly shallow gradients leading to extensive marshy conditions (Dingle & Rogers 1972). It will be noted that the species listed above as showing geographically limited polymorphism are mostly species of forest and forest edge, or marshland in the case of *R. paludicola*. There is so little natural grassland left in the southern Cape Province that subspecific taxa that developed on the grassland areas to the south of the present coastline, if any, have probably become extinct without leaving a trace, unlike the grazing antelope *Hippotragus leucophaeus* (Pallas) (Klein 1974).

Family **Sturnidae** Rafinesque

Lamprotornis mevesii violacior Clancey, 1973: 279.

Holotype SAM–16308a, adult male from Otjibombe (= Otjumbumbe), Nankwale Rapids on the Cunene River between Rua Cana and Eriksson's Drift, Namibia, collected by Mr A. G. White on 23 March 1923.

Remarks

In very good condition. Otjumbumbe lies at 17°24′S 14°25′E (cf. Tarboton 1967). The site is probably covered by the waters of the Rua Cana Dam. The epithet indicates the more purplish tinge on the foreparts compared with the nominate race. Now known as *Lamprotornis mevesii violacior* Clancey (Clancey 1980).

Family **Nectariniidae** Vigors

Cinnyris erikssoni Trimen, 1882: 451.

Syntypes SAM–22045a, SAM–22045c and SAM–22045d, adult male and two females, respectively, from Shella, Angola, collected by Axel Wilhelm Eriksson in 1883, obviously 1882 as stated by Trimen (1882).

Remarks

SAM–22045c was formerly mounted; all syntypes in good condition. Unlike the other two syntypes, the former mount is stated to have been collected in 1882. Shella is an anglicized spelling of Chela, an escarpment lying west of Lubango and separating the plateau from the coastal lowlands. It is also the boundary between the Huila and Namibe Provinces of Angola in that sector. Named in honour of the collector who did much to make the ornithology of Namibia and adjacent countries known. Rudebeck (1955) gave a detailed account of Eriksson's ornithological activities but noted that there was no data for the period 1881 to 1883. This was the period of his residence in south-western Angola when he sent some, at least, of his material to the South African Museum. He had moved to Angola to avoid the troubles created by the Second Nama–Herero War (Tabler 1973) and to open a new route for driving cattle and other produce to the sea at Moçamedes (now Namibe) (Brinck 1955). Now known as *Nectarinia ludovicensis ludovicensis* du Bocage (Clancey & Irwin 1978).

Family **Ploceidae** Sundevall

Hyphantornis nigriceps Layard, 1867: 180.

Holotype SAM–1968, adult male in nuptial plumage from Kuruman, 27°28′S 23°26′E, northern Cape Province, South Africa, collected by Rev. Robert Moffat at an unknown date.

Remarks

Formerly mounted; in fair condition but lacking a tail. Grant & Mackworth-Praed (1957) corrected the type locality to Bulawayo, 20°10′S 28°43′E, Zimbabwe, on the adequate grounds that *H. nigriceps* is not known from anywhere near Kuruman, Rev. Moffat's missionary base from which he travelled widely, including to Bulawayo. Named for its black as opposed to yellow crown. Now known as *Ploceus cucullatus nigriceps* (Layard) (Clancey 1980).

Ploceus velatus inustus Clancey, 1959: 173.

Holotype SAM–20427, adult male in nuptial plumage from Lokenburg, 31°41′S 19°11′E, western Cape Province, South Africa, collected by Dr J. M. Winterbottom on 21 October 1956.

Remarks

In good condition. The epithet refers to the relative absence of the pectoral fiery reddish brown wash in the nuptial plumage of this subspecies. Now known as *Ploceus velatus velatus* Vieillot (Clancey 1980; Brooke 1985).

Euplectes orix turgida Clancey, 1958: 96.

Holotype SAM–20218, adult male in nuptial plumage from Citrusdal, 32°35′S 19°01′E, western Cape Province, South Africa, collected by Dr J. M. Winterbottom on 20 October 1955.

Remarks

In good condition. The epithet refers to the increased size of this extra-tropical subspecies compared with tropical ones. Now known as *Euplectes orix turgidus* Clancey (Clancey 1980).

Family **Carduelidae** Vigors

Serinus flaviventris quintoni Winterbottom, 1959*a*: 318.

Holotype SAM–20188, adult male from Hillmore Farm, 32°30′S 22°49′E, Beaufort West, Great Karoo, South Africa, collected by Dr J. M. Winterbottom on 22 September 1955.

Remarks

In fair to good condition. Named in honour of Mr William F. Quinton, a local ornithologist and owner of the farm on which the type was collected (cf. Quinton & Winterbottom 1968). Now known as *Serinus flaviventris quintoni* Winterbottom (Clancey 1980).

Serinus atrogularis lwenarum White, 1944: 40.

Holotype SAM–20098, adult male from Balovale, 13°33′S 23°07′E, North-western Province, Zambia, collected presumably by Mr Charles Matthew Newton White, on 27 May 1943.

Remarks

In good condition. The epithet refers to the Lwena people in whose territory the type was collected. Now known as *Serinus atrogularis lwenarum* White (Benson *et al.* 1971).

Family **Emberizidae** Vigors

Fringillaria tahapisi nivenorum Winterbottom, 1964: 73.

Holotype SAM–54934a, adult male from Otjivasando (correctly Otjovasandu), 19°09′S 14°30′E, Kaokoveld, north-western Namibia, collected by Dr J. M. Winterbottom on 9 September 1963.

Remarks

In poor condition. Named in honour of the Niven family of Amanzi in the eastern Cape Province and chiefly in honour of Mr and Mrs J. P. Mackie Niven. Mrs Cecily Kathleen (J. P. M.) Niven, daughter of Sir Percy FitzPatrick, founded the Percy FitzPatrick Institute of African Ornithology, which started work in 1960 and of which Dr Winterbottom was the first Director. Now known as *Emberiza tahapisi nivenorum* (Winterbottom) (Clancey 1980).

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6. SYSTEMATIC papers must conform to the *International code of zoological nomenclature* (particularly Articles 22 and 51).

Names of new taxa, combinations, synonyms, etc., when used for the first time, must be followed by the appropriate Latin (not English) abbreviation, e.g. gen. nov., sp. nov., comb. nov., syn. nov., etc.

An author's name when cited must follow the name of the taxon without intervening punctuation and not be abbreviated; if the year is added, a comma must separate author's name and year. The author's name (and date, if cited) must be placed in parentheses if a species or subspecies is transferred from its original genus. The name of a subsequent user of a scientific name must be separated from the scientific name by a colon.

Synonymy arrangement should be according to chronology of names, i.e. all published scientific names by which the species previously has been designated are listed in chronological order, with all references to that name following in chronological order, e.g.:

Family **Nuculanidae**

Nuculana (Lembulus) bicuspidata (Gould, 1845)

Figs 14–15A

Nucula (Leda) bicuspidata Gould, 1845: 37.
Leda plicifera A. Adams, 1856: 50.
Laeda bicuspidata Hanley, 1859: 118, pl. 228 (fig. 73). Sowerby, 1871: pl. 2 (fig. 8a–b).
Nucula largillierti Philippi, 1861: 87.
Leda bicuspidata: Nicklès, 1950: 163, fig. 301; 1955: 110. Barnard, 1964: 234, figs 8–9.

Note punctuation in the above example:
comma separates author's name and year
semicolon separates more than one reference by the same author
full stop separates references by different authors
figures of plates are enclosed in parentheses to distinguish them from text-figures
dash, not comma, separates consecutive numbers.

Synonymy arrangement according to chronology of bibliographic references, whereby the year is placed in front of each entry, and the synonym repeated in full for each entry, is not acceptable.

In describing new species, one specimen must be designated as the holotype; other specimens mentioned in the original description are to be designated paratypes; additional material not regarded as paratypes should be listed separately. The complete data (registration number, depository, description of specimen, locality, collector, date) of the holotype and paratypes must be recorded, e.g.:

Holotype

SAM–A13535 in the South African Museum, Cape Town. Adult female from mid-tide region, King's Beach, Port Elizabeth (33°51′S 25°39′E), collected by A. Smith, 15 January 1973.

Note standard form of writing South African Museum registration numbers and date.

7. SPECIAL HOUSE RULES

Capital initial letters

(a) The Figures, Maps and Tables of the paper when referred to in the text
e.g. '. . . the Figure depicting *C. namacolus* . . .': '. . . in *C. namacolus* (Fig. 10) . . .'

(b) The prefixes of prefixed surnames in all languages, when used in the text, if not preceded by initials or full names
e.g. Du Toit but A. L. du Toit; Von Huene but F. von Huene

(c) Scientific names, but not their vernacular derivatives
e.g.Therocephalia, but therocephalian

Punctuation should be loose, omitting all not strictly necessary

Reference to the author should preferably be expressed in the third person

Roman numerals should be converted to arabic, except when forming part of the title of a book or article, such as
'Revision of the Crustacea. Part VIII. The Amphipoda.'

Specific name must not stand alone, but be preceded by the generic name or its abbreviation to initial capital letter, provided the same generic name is used consecutively. The generic name should not be abbreviated at the beginning of a sentence or paragraph.

Name of new genus or species is not to be included in the title; it should be included in the abstract, counter to Recommendation 23 of the Code, to meet the requirements of Biological Abstracts.

R. K. BROOKE

ANNOTATED CATALOGUE OF THE AVES TYPE SPECIMENS IN THE SOUTH AFRICAN MUSEUM