ANNALS OF THE SOUTH AFRICAN MUSEUM

ANNALE VAN DIE SUID-AFRIKAANSE MUSEUM

VOLUME 98

BAND 98

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

VOLUME 98 BAND

THE TRUSTEES OF THE
SOUTH AFRICAN MUSEUM
CAPE TOWN

DIE TRUSTEES VAN DIE
SUID-AFRIKAANSE MUSEUM
KAAPSTAD

1987–1989

SET, PRINTED AND BOUND IN THE REPUBLIC OF SOUTH AFRICA
BY THE RUSTICA PRESS (PTY) LTD, NDABENI, CAPE

D2109

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ME 98 PART 1 OCTOBER 1987 ISSN 0303-2515

ANNALS
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(continued inside back cover)

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Volume 98 Part 1 DINGLE, R.V. *ET AL.*

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ANNALE VAN DIE SUID-AFRIKAANSE MUSEUM

Volume **98** Band
October **1987** October
Part **1** Deel

DEEP-SEA SEDIMENTARY ENVIRONMENTS AROUND SOUTHERN AFRICA (SOUTH-EAST ATLANTIC AND SOUTH-WEST INDIAN OCEANS)

By

R. V. DINGLE, G. F. BIRCH, J. M. BREMNER, R. H. DE DECKER, A. DU PLESSIS, J. C. ENGELBRECHT, M. J. FINCHAM, T. FITTON, B. W. FLEMMING, R. I. GENTLE, S. W. GOODLAD, A. K. MARTIN, E. G. MILLS, G. J. MOIR, R. J. PARKER, S. H. ROBSON, J. ROGERS, D. A. SALMON, W. G. SIESSER, E. S. W. SIMPSON, C. P. SUMMERHAYES, F. WESTALL, A. WINTER & M. W. WOODBORNE.

Cape Town Kaapstad

The ANNALS OF THE SOUTH AFRICAN MUSEUM

are issued in parts at irregular intervals as material
becomes available

Obtainable from the South African Museum, P.O. Box 61, Cape Town 8000

Die ANNALE VAN DIE SUID-AFRIKAANSE MUSEUM

word uitgegee in dele op ongereelde tye na gelang van die
beskikbaarheid van stof

Verkrygbaar van die Suid-Afrikaanse Museum, Posbus 61, Kaapstad 8000

OUT OF PRINT/UIT DRUK

1, 2(1–3, 5–8), 3(1–2, 4–5, 8, t.–p.i.), 5(1–3, 5, 7–9),
6(1, t.–p.i.), 7(1–4), 8, 9(1–2, 7), 10(1–3),
11(1–2, 5, 7, t.–p.i.), 14(1–2), 15(4–5), 24(2), 27, 31(1–3), 32(5), 33, 36(2), 45(1)

ISBN 0 86813 090 7

Printed in South Africa by
The Rustica Press, Pty., Ltd.,
Court Road, Wynberg, Cape

In Suid-Afrika gedruk deur
Die Rustica-pers, Edms., Bpk.,
Courtweg, Wynberg, Kaap

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By

R. V. DINGLE[1*], G. F. BIRCH[2], J. M. BREMNER[1], R. H. DE DECKER[1], A. DU PLESSIS[3], J. C. ENGELBRECHT[4], M. J. FINCHAM[5], T. FITTON[6], B. W. FLEMMING[7], R. I. GENTLE[8], S. W. GOODLAD[9], A. K. MARTIN[9], E. G. MILLS[1], G. J. MOIR[10], R. J. PARKER[11], S. H. ROBSON[9], J. ROGERS[1], D. A. SALMON[12], W. G. SIESSER[13], E. S. W. SIMPSON[†], C. P. SUMMERHAYES[14], F. WESTALL[15], A. WINTER[1] & M. W. WOODBORNE[1]

(With 7 figures and 3 tables)

[*MS accepted 30 April 1987*]

ABSTRACT

Continental shelf sediment provenances, deep ocean basin sediment patterns, tectonosedimentary features, and the bathymetry of approximately four million square kilometres of the SE Atlantic and SW Indian oceans are summarized in two charts at a scale of 1 : 3 200 000. Contrasting modern deep-sea sedimentary environments around southern Africa are explained in terms of regional oceanography and terrigenous sediment supply, and their spatial development is traced through Cenozoic time. The linkage of major changes in oceanic circulation to sediment production, injection, and dispersal is emphasized, including the case for a direct relationship between Neogene Antarctic Bottom Water scour and large-scale allochthonism along the west-coast continental margin.

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Ann. S. Afr. Mus. **98** (1), 1987: 1–27, 7 figs, 3 tables.

INTRODUCTION

Since mid-Cenozoic time (Oligocene), sedimentation in the deep ocean basins around southern Africa has been effected by three major processes: (a) episodic injection of allochthonous material from the basin margins by a combination of tectono-sedimentary mass movements and benthic currents; (b) steady-state benthic accretion and erosion; and (c) steady-state pelagic accretion (Table 1). This contribution describes the main ocean basin sedimentary features around southern Africa, and interprets their distribution and development in the context of these processes.

TABLE 1

Sedimentary processes, environments, and features

PROCESSES	SEDIMENTARY ENVIRONMENTS	ASSOCIATED FEATURES
Episodic		
slope wasting and continental rise and ocean basin accretion	(a) proximal basin: slope and rise allochthonous structures and feeders	slumps, canyons, chutes, lobes, fans
	(b) distal basin: fill	abyssal plains
Steady-state benthic		
targeted accretion and erosion (incl. authigenic mineralization)	distal basin: zones of drift and scour	drifts, waves, billows, omission surfaces, Mn pavement, basement outcrops
Steady-state pelagic		
accretion (incl. ice rafting)	low energy proximal and distal pelagic regions, especially on ridges and plateaux	drapes, billows

Figure 1 summarizes the sedimentary environments of the deep-sea basins around southern Africa and has been compiled from numerous studies, but particularly the regional surveys of Emery *et al.* (1975), Kolla *et al.* (1980), and Tucholke & Embley (1984), more local accounts (e.g. Bornhold & Summerhayes 1977; Dingle *et al.* 1978; Summerhayes *et al.* 1979; Dingle & Camden-Smith 1979; Embley & Morley 1980; Westall 1984; Martin 1984; Goodlad 1986), and the continental shelf sediment maps produced by Birch *et al.* (in press) and Bremner

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Fig. 1 *(see accompanying map)*. Deep-sea sedimentary environments around southern Africa (south-east Atlantic and south-west Indian oceans). Compiled from published and unpublished data: Bang (1968); Birch (1975, 1980); Birch *et al.* (in press); Bornhold & Summerhayes (1977); Bremner (1978); Bremner *et al.* (in press); Dingle (1977, 1980); Dingle & Camden-Smith (1979); Dingle *et al.* (1978); Dingle & Robson (1985); Embley & Morley (1980); Emery *et al.* (1975); Flemming (1978, 1981); Goodlad (1986); Kolla *et al.* (1980); Martin (1984); Robson & Dingle (1986); Rogers (1977, 1986); Shannon (1985); Summerhayes *et al.* (1979); Tucholke & Carpenter (1977); Tucholke & Embley (1984); Westall (1984).

et al. (in press). There are strong contrasts in the nature and style of sediments between the south-east Atlantic and south-west Indian oceans, which result primarily from a combination of two phenomena: climate (terrestrial and oceanographic), and ocean basin physiography. Climate dictates the quantity and relative proportions of terrigenous, biogenic, and authigenic material potentially available for injection into the deep basins, and is controlled by the two quasi-resident high-pressure atmospheric circulation cells (anticyclones) that lie on either side of southern Africa. One over the south-west Indian Ocean and the south-eastern seaboard of Africa supports a high-energy, relatively low-productivity western boundary surface current (Agulhas Current) adjacent to the

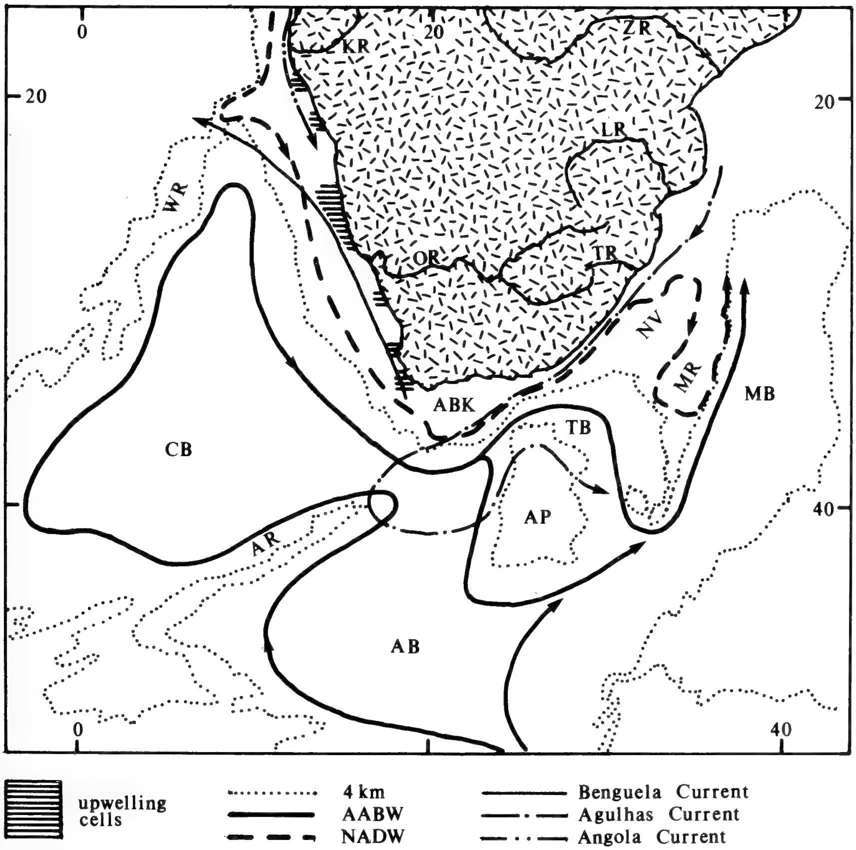


Fig. 2. Oceanographic setting of southern Africa. Water-mass flow paths are schematic, and based on numerous authors cited in the text. Coastal upwelling sites are after Shannon (1985). Abbreviations: rivers—KR = Kunene, LR = Limpopo, OR = Orange, TR = Tugela, ZR = Zambezi; physiographic features—AB = Agulhas Basin, ABK = Agulhas Bank, AP = Agulhas Plateau, AR = Agulhas Ridge, CB = Cape Basin, MB = Mozambique Basin, MR = Mozambique Ridge, NV = Natal Valley, TB = Transkei Basin, WR = Walvis Ridge.

humid hinterland of south-east Africa, while the other over the south-east Atlantic is associated with a low-velocity, high-productivity eastern boundary surface current (Benguela Current) adjacent to the arid hinterland of south-west Africa (Fig. 2). The former sustains shelf sedimentary environments characterized by high terrigenous input and high-energy benthic boundary conditions; the latter sustains low terrigenous input, low-energy benthic boundary conditions.

Complex sea-floor morphology in the south-west Indian Ocean has its origins in a more complicated plate tectonic history than the less cluttered south-east Atlantic Ocean. This, coupled with a high sediment accumulation rate results in physiographic differences between the two basins that lead to the partitioning, at about 34,5°S in the Natal Valley, of the two deep current regimes that effect the dispersal and/or erosion of bottom sediments in the area (Antarctic Bottom Water, AABW; and North Atlantic Deep Water, NADW: Figs 2, 3). The results are gradients in sediment thickness and sea-floor current velocity, which are generally high in the south-west Indian and low in the south-east Atlantic basins.

Finally, it will be suggested that the foregoing pattern of deep-sea sedimentary environments has persisted at least for most of late Cenozoic time (i.e. Neogene and Quaternary, 24,6 m.y.), although the effectiveness of the various processes controlling sedimentation has fluctuated.

DISCUSSION

SEDIMENT SOURCES

The single most significant factor in understanding the differences shown in Figure 1 between the eastern Cape–northern Agulhas basins and the Natal Valley–Transkei Basin is an appreciation of the amount of terrigenous sediment that they receive. The former area is sediment-starved, whereas the latter is not (Embley & Morley 1980; Tucholke & Embley 1984), and the reason for this is vividly illustrated by considering the proportion of modern terrigenous input supplied to the southern African continental shelves via rivers: west coast, 4,1 per cent; south coast, 17,9 per cent; east coast, 78,0 per cent (Table 2a, Fig. 4). These figures become even more skewed when the fate of the detritus is considered. On the west coast (south of 22°S) only three rivers are perennial and contribute to the shelf sediment flux (Orange, Olifants and Berg), and it is suspected that only a small proportion of their load crosses the shelf. Large quantities of mud are trapped in a nearshore strip (Fig. 1) (Birch 1975; Rogers 1977; Bremner 1978), although small quantities of clay-sized detritus are entrained in the Benguela Current and carried from the Orange River at least as far north as the eastern end of the Walvis Ridge (Diester-Haass & Rothe 1987).

Fig. 3 *(see accompanying map)*. Bathymetry around southern Africa (south-east Atlantic and south-west Indian oceans). Compiled from: Dingle (1977, 1980, 1986); Dingle *et al.* (1977, 1978); Dingle & Camden-Smith (1979); Kolla *et al.* (1980); Rabinowitz *et al.* (1980); Simpson (1982); Tucholke & Embley (1984).

Table 2

Terrigenous sediment input

(a) MODERN RIVER INPUT (× 10^6 m^3/yr)

	Input	*Percentage*	*End point*
west coast: Orange,	6,5[@]	4,1	Cape Basin
Olifants, Berg	0,5[c]		
south coast (to Cape Padrone)	30,59[$]	17,9	Transkei Basin, Agulhas Basin
east coast (C. Padrone to Limpopo)	133,0[″]	78,0	Natal Valley
Total	170,59		

(b) AEOLIAN INPUT

West coast (18–30°S)—perhaps as much as 6,5 × 10^6 m^3 per large katabatic event ('berg wind') (see Shannon & Anderson 1982; Chapman & Shannon 1985).

(c) CENOZOIC ACCUMULATION RATES (means for 65 m.y., based on areas>0,5 km sediment cover)

	Vol[#] (km^3)	Area[#] (km^2)	Rate[^]	Rate/area[*]
Orange Basin[#]	15	14	2,3	16
Natal Valley[c]	32	21	4,9	23

[#] = × 10^4; [^] = 10^6 m^3/yr; [*] = m^3/km^2/yr

[@] = Milliman & Meade (1983) [c] = recalculated from Dingle *et al.* (1983)
[″] = Flemming & Hay (1983) [#] = Dingle & Hendey (1984)
[$] = A. K. Martin (personal data)

Sand-sized particles (mostly from the Orange, which contributes 93% of the total sediment input) move northwards by longshore drift and are blown onshore into the Namib Desert (Rogers 1977). In a similar fashion, along the south coast, muds are trapped in nearshore belts and some sand at least is moved along shore and incorporated into small coastal dune fields (Birch 1980).

In addition to fluvial input, extensive aerosol plumes of fine sediment are periodically swept off the continental interior and injected for up to 200 km across the west-coast continental shelf (Figs 1, 4). These are generated by strong katabatic winds (up to 15 m/sec) from high-pressure systems over southern Africa, which force hot, dry air across the arid coastal plains ('berg winds': Shannon & Anderson 1982; Shannon 1985; Chapman & Shannon 1985). There are no quantitative data on the volumes of sediment transported during—nor on the frequency of—these berg winds, but Shannon & Anderson (1982) have suggested that one large katabatic event operating between 18° and 28°S may involve as much particulate material as the annual sediment input from the Orange River. South of 23°S there are three zones in which large south-westerly trending plumes have been consistently identified: the largest is centred on the Orange River valley; the second between 10 and 20 km north of Lüderitz; and the third in the vicinity of Walvis Bay. These zones are thought to coincide with topographic depressions that focus the winds (Shannon & Anderson 1982). Deposition appears to be confined to the continental shelf and, in comparison with fluvial input, is well dispersed, fine grained, and unlikely to be lost to the

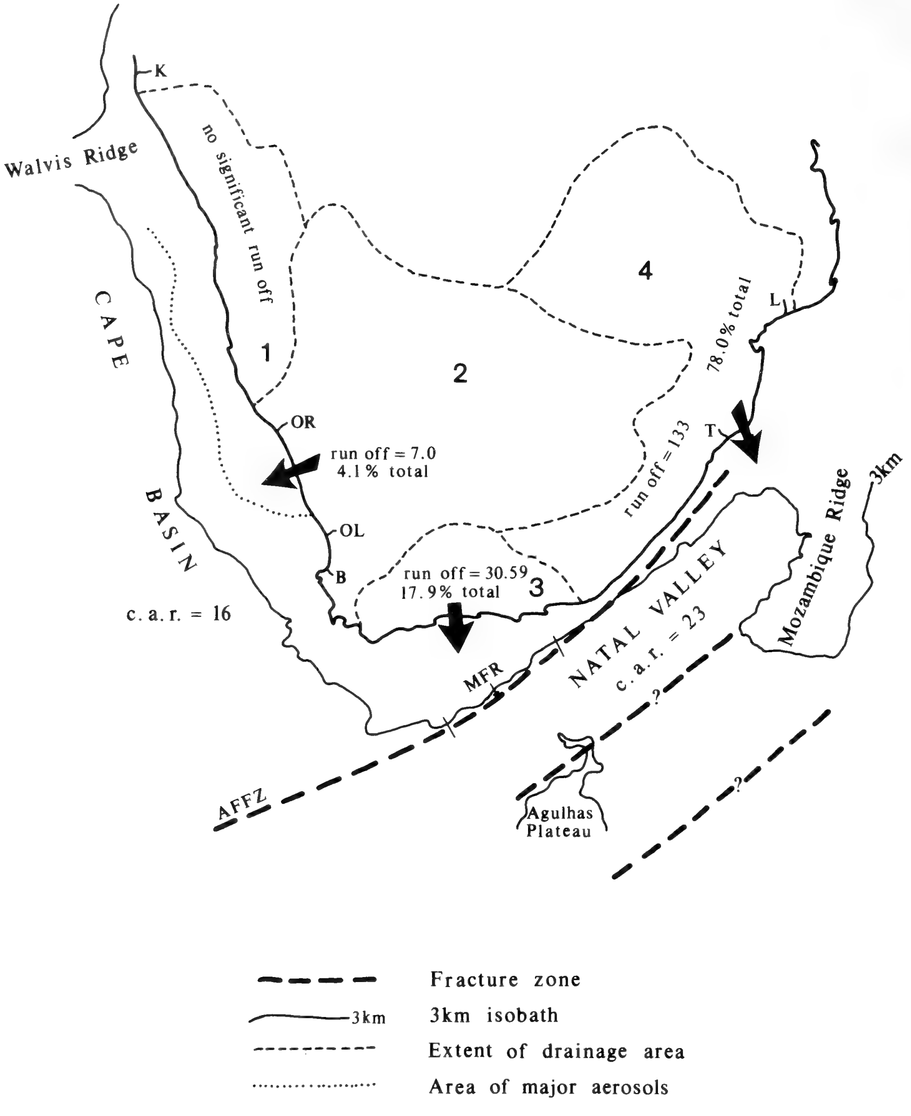


Fig. 4. Drainage areas and fluvial sediment yields in southern Africa.
1 = between Kunene and Orange rivers—no significant runoff; 2 = west coast: Orange, Olifants and Berg rivers; 3 = southern Cape; 4 = east coast, including Tugela and Limpopo rivers. Runoff yield is in × 10^6 m^3/yr.
Abbreviations: c.a.r. = Cenozoic sediment accumulation rate/area within the 0,5 km isopachyte in $m^3/km^2/yr$; AFFZ = Agulhas–Falkland Fracture Zone; MFR = marginal fracture ridge. Rivers—K = Kunene, OR = Orange, OL = Olifants, B = Berg, T = Tugela, L = Limpopo.

marine environment by transport back onshore (although entry into food and chemical cycles will reduce the flux to the sea-floor). Depending on the frequency of these winds (and the veracity of Shannon & Anderson's 1982 suggestion), the total annual terrigenous supply to the west-coast shelf is realistically likely to fluctuate from 7,0 × 10^6 m^3 (no katabatic events) to 20,0 × 10^6 m^3 (two events).

Diester-Haass *et al.* (1986) and Diester-Haass & Rothe (1987) have shown that during Neogene glacial, low sea-level episodes, there were increases of between two and six times the non-glacial rates in the terrigenous sediment flux to the eastern Walvis Ridge. This was probably achieved through a combination of aeolian and Benguela Current activity, and included the injection of shelf-derived glauconite and phosphorite grains.

The foregoing situations are in strong contrast to those off the east coast, where the very much greater fluvial terrigenous input is available for injection into the Natal Valley. Sands are entrained in the Agulhas Current (which reaches velocities above 250 cm/sec—Flemming 1978; Flemming & Hay in press), and together with relict Pleistocene carbonate gravel lags, form large underwater dunes that leave the shelf via at least four canyon-head complexes (Flemming 1981; Hay 1984; Dingle & Robson 1985). The precise fate of the east-coast mud is not known, but little or none resides on the shelf (Fig. 1). Presumably it all passes into the deep-sea environment (probably via the canyon systems), but the route appears to involve an initial phase in surface waters in the inshore shear zone of the Agulhas Current before the muds cross the shelf (Walters & Schumann 1985). Modern terrigenous supply is grossly inflated by agricultural malpractices (e.g. Dingle *et al.* 1983; Dingle & Hendey 1984), and may distort predictions of regional trends, but calculations based on sediment basin volumes indicate a mean Cenozoic accumulation ratio for east coast : west coast of 2 : 1, at rates/area of 23 and 16 $m^3/km^2/yr$, respectively (Table 2c, Fig. 4).

These figures raise the question of possible variations in either rate of sediment supply, or provenance during Cenozoic time, because they contrast strongly with the ratio of modern terrigenous input for the east coast : west coast of at least 10 : 1 (depending on the frequency of west-coast berg winds). If the east-coast terrigenous supply remained constant through Cenozoic time, then alternative sources of sediment must have made up the shortfall. Candidates include large increases in authigenic (i.e. phosphatic, ferro-manganese, glauconitic minerals) and biogenic (carbonates and opaline silicia) components, and possibly ice-rafted detritus. With our present data, which are essentially two-dimensional, it is not possible to assess the volumes of these individual components, but we suspect that the problem of a significant shortfall may be more apparent than real. Dingle & Hendey (1984) briefly addressed the problem of variation in mean annual sediment input rates off the west coast (off area 2 in Fig. 4), and concluded that there has been a drastic reduction from Upper Cretaceous, through Palaeogene to Neogene (excluding modern) time: 16 : 3 : 0,5 × 10^6 m^3. We do not have similar figures for the east coast area, but if Neogene rates there are similar to the mean Cenozoic rates (there was no comparable increase in the aridity in this region), then the Neogene east : west coast ratios of rates/area would be of the order of 7 : 1. Clearly, this is an aspect of the regional sediment budget that warrants further study.

These terrigenous supply rates reflect arid hinterlands for the west-coast rivers, and humid hinterlands along the south- and east-coast mountain ranges, which in turn are sustained by the atmospheric and oceanic circulation adjacent to the coasts (Fig. 2). Along most of the west coast intense upwelling of cold, nutrient-rich water is associated with the Benguela Current system (see Shannon 1985; Chapman & Shannon 1985; Shannon & Pillar 1986, for extensive reviews of physical, chemical, and biological aspects of the Benguela Current). This has been a feature of the oceanic climate since at least Upper Miocene times (Siesser 1978; Diester-Haass & Rothe 1987) and, coupled with the low terrigenous dilution rate, has promoted extensive production of authigenic sediment (glauconite and carbonate apatite), pelagic carbonate sands, and more locally diatomaceous muds (Fig. 1). Although evidence for modern production of phosphatic sediments is limited to the Walvis Bay area (e.g. Bremner 1980), Mio–Plio–Pleistocene deposits occur as far south as 37°S and across the Agulhas Bank to the southern part of the east-coast sand stream (28°E). Pleistocene sediments on most of the Agulhas Bank consist of relict quartz and benthic carbonate sands (Birch *et al.* in press).

A recently described feature of modern sedimentation on the south and east coasts is the development of prograding 'submerged spit-bars' (Martin & Flemming 1986). Along the east coast these form where the large transverse Agulhas Current and counter-current-driven dunes converge with littoral drift paths, whereas off the south coast similar structures form where swell-driven littoral sediments moving eastward cannot bypass capes. Large volumes of sand have been incorporated in these structures (for example, individual submerged spit-bars on the south coast contain up to 5 km^3), which themselves may form the boundaries of inshore sediment traps.

ALLOCHTHONOUS ENVIRONMENTS AND FEEDERS

Episodic injection of sediment into the deep ocean basins around southern Africa has occurred on a massive scale during later Cenozoic time, and Table 3 summarizes the main sediment types available for injection into the ocean basins from the shelf source areas. On the west coast this has primarily been in the form of slumps and slides, whereas off the east coast a wide variety of mass-wasting and accretionary mechanisms and processes has operated—e.g. slumps, slides, debris flows, and turbidity currents. These differences are a direct result of the contrasts in the low energy-low terrigenous input versus high energy-high terrigenous input shelf regimes of the two coasts, respectively.

Eight discrete allochthonous masses have been identified between the Walvis Ridge and the southern tip of the Agulhas Bank (Summerhayes *et al.* 1979; Dingle 1980, 1983). These affect an area of about 260 000 km^2, and fall into three categories: north of 27°S; peripheral to the main Orange Shelf depocentre; and south of the Cape Canyon.

TABLE 3

Shelf sediment types and minerals available for injection into adjacent ocean basins

	Sediments/minerals	*Potential destination*
West coast	glauconite phosphorite pelagic carbonate sand opal fine terrigenous debris	CAPE BASIN
South coast	glauconite phosphorite relict quartz and carbonate sand (including oncolites)	N. AGULHAS BASIN AGULHAS PASSAGE TRANSKEI BASIN EXTREME S. NATAL VALLEY
East coast	terrigenous sands terrigenous muds relict carbonate sands (including oncolites)	NATAL VALLEY TRANSKEI BASIN

(a) Three thin (up to 75 m) slides lie off the Walvis shelf. In this region the slope is smooth, regular and canyon-free. The slides' head regions lie in about 1 900 m water depths.

(b) A major slump (up to 720 m thick) lies on the north-west face of the Orange Shelf (Chamais Slump). There is an extensive fissured head zone (lying between 200–1 500 m water depth) and locally irregular sea-floor, but no evidence of canyons. The Orange River probably debouched directly into this region during Neogene and Quaternary low sea-levels (Dingle & Hendey 1984), and the slump head structures locally intersect the zone of authigenic sediments on the outer shelf. At least two, thinner, and tectonically less-complex slides lie south of the Tripp Seamount on the south-east lower face of the Orange Shelf. These occur along a smooth, regular continental slope with no evidence of canyons. Their head regions lie deeper than 2 km water depth, but there is a wide, sub-parallel fissured zone that extends shallower than 1 km in the vicinity of Childs Bank, where it may intersect the outer edge of the shelf authigenic sediment zone.

(c) South of 34°S the nature of the outer margin slumps changes. They lie on a steep, rugged (probably canyoned) slope adjacent to a relatively narrow continental slope. The slumps are thick (up to 720 m) but relatively narrow and tectonically complex. Large glide-plane scars incise the slope, and are deflected across the margin when they intersect the Cape Canyon, whose thalweg is littered with detached blocks where it crosses the lower slope (Dingle 1986). The head region of the canyon and associated glide planes intersect a major shelf zone of authigenic sediments west of Cape Town. Tucholke & Embley (1984) show that the outer edge of this slumped sector has been scoured by Cape Basin AABW flow.

All the west-coast allochthonous zones (with the exception of the southernmost part of the Cape Town sector) have wide distal lobes that are thought to represent more mobile debris-like deposits associated with the main slide activity. None (with the notable exception of the Cape Canyon) appear to have feeders or chutes, presumably because there is either insufficient sediment, or no mechanism to divert significant quantities of shelf sediment on to the continental slope. Significant slope wasting processes probably operated south of the Cape Canyon immediately following slumping (creating the relatively rugged slope topography), and may reactivate during low sea-levels when the small rivers in the south-western corner of the continent discharge directly on to the outer shelf.

In summary, on a regional scale, the heads of all the west-coast allochthonous masses lie in zones of outer shelf–upper slope biogenic carbonate sands and muds, and locally intersect areas of authigenic-rich sediments.

East-coast allochthonous features present a more complex picture than their west-coast counterparts because they formed along a margin with a large, steady-state sediment supply that has allowed them to progress to maturity (in terms of slope wasting), and locally, to have produced large-scale continental rise accretion. There are three sectors, each with distinctive structures: the south-eastern side of the Agulhas Bank; 26°E to Durban; Tugela to Limpopo cones (submarine fans).

(a) The whole south-eastern side of the Agulhas Bank, to water depths as shallow as 200 m, has been involved in a long slump that causes a distinct concavity in the bathymetry (Agulhas Slump: Dingle 1977). Its head region contains a fissured zone and several large glide-plane scars that intersect Pliocene limestones and outer-shelf patches of authigenic sediments.

Downslope movement was impeded by the Marginal Fracture Ridge (MFR) that crops out intermittently along the outer margin (e.g. Robson & Dingle 1986), so that the toe region of the slide failed to penetrate into the Agulhas Passage. The 'fresh' state of sea-floor microtopography suggests that scour by the Agulhas Current has prevented Holocene sedimentation over the slumped zone.

(b) The MFR can be traced to 35°S 26°E, north-east of which it did not form a dam to downslope mass movement. Between this point and 31°S (just south of Durban) the shelf is very narrow (*c.* 20 km) and locally rugged. (Flemming 1981 identified 85 canyon-like features along this sector.) For this area Figure 1 has been compiled from Flemming (1981), Birch (1981), Dingle & Robson (1985), and Robson & Dingle (1986), and shows that slope canyons are concentrated in two complexes: in the north between Port Shepstone and Port St Johns, and in the south between Kei River and Cape Padrone. Both these regions are loci of slumping and large-scale mass wasting of the slope (Dingle & Robson 1985), and are centres through which large quantities of detritus are siphoned from the shelf and injected into the Natal Valley. Flemming (1981) recognized their role as exits via which the Agulhas Current-driven shelf dune fields passed on to the slope, and Dingle & Robson (1985) compared the sequence of slumping, canyon formation, slope wasting and thalweg incision with that described by Farre *et al.* (1983) from the New England slope. Large coalescing continental rise lobes emanate from these two centres, and are crossed by canyon extensions and debris flow chutes that spread aprons of allochthonous material over much of the southern Natal Valley floor. In the extreme south, the canyon/glide-plane heads intersect authigenic mineral-rich sediments as far north as the Fish River (*c.* 33°30′S), but otherwise the bulk of the injected shelf debris is derived from the river-borne terrigenous input and the carbonate lag gravels on the outer shelf (Flemming 1978, 1981; Hay 1984; Flemming & Hay in press). The southern edge of the main apron is dammed against the east–west trending Agulhas Drift that forms the northern edge of the Transkei Basin. However, the distal lithofacies of this allochthonous input probably penetrates into the Transkei Basin, where it forms small abyssal plains and infilled channels floored by turbidites (Westall 1984).

(c) Two of the largest east-coast terrigenous inputs are the Tugela and Limpopo rivers, whose modern contributions are 5,9 and 65,0 × 10^6 m^3/yr, respectively (53,3% total east-coast supply—Flemming & Hay 1983). Both rivers have constructed large submarine fans that prograde across the continental shelf into deep water and, although each has a history that extends into the Cretaceous, they were both active in Neogene and Quaternary time (Dingle *et al.* 1978; Martin 1984; Goodlad 1986). This has been achieved through the sheer volume of supply, and the fact that both rivers discharge south-west of coastal offsets that create semi-permanent clockwise gyres inshore of the Agulhas Current (Flemming 1981). Small pockets of muddy sediment occur in these gyres (e.g. Martin 1984; Felhaber 1985). It is significant that other east-coast rivers that have large modern sediment yields have not constructed similar submarine fans (e.g. Fish: 13,5; Kei: 9,2; and Mzimvubu: 5,6 × 10^6 m^3/yr—Flemming & Hay 1983). This must be attributed either to unsuitable coastal geometry (which permits the Agulhas Current to disperse sediment rapidly), or to the fact that the high yields merely reflect modern agricultural practice. A further constructional feature lies to the east of the Limpopo Cone, where localized upwelling of the Agulhas Current has generated a small area of authigenic sediments on the Inharrime Terrace (Dingle *et al.* 1978).

Canyons are known from two areas: the Tugela Cone and the Zululand coast. The two large canyons on the Tugela Cone probably represent alternative pathways for Tugela River and shelf sediments to the Natal Valley (Goodlad 1986), and are comparable in size to the Cape Canyon, although neither appears to be structurally controlled. The southernmost (Tugela Canyon) debouches on to the deep sea-floor on the southern flank of the cone, and may generate a chute system that connects with that emanating from the Port St Johns canyons, whereas the Goodlad Canyon runs north-east and links with a system tapping the Zululand shelf. Several small deep canyons cross this very narrow (less than 5 km) shelf and head almost to the modern coast (Bang 1968; Flemming 1981; Martin 1984), where they were presumably linked to rivers of the Zululand coastal plain during low sea-level stands. Flemming (1981) reported submarine dunes on this narrow shelf, which acts as a zone of bedload parting related to the shelf gyre off Maputo. He postulated that the canyons siphon off the shelf load, which must ultimately move down the broad valley on the western side of the Central Terrace and link with the northern Tugela Cone input.

Martin (1984) has described a slump complex along the steep Zululand slope, which in the north appears to have encroached on to the Central Terrace. Its relationship with the southern end of the Limpopo Cone is unclear. Other smaller slumps have been partially mapped off Maputo, and the Inharrime and Central terraces (Martin 1984). Also in the northern part of the Natal Valley, the distal edge of the Limpopo Cone coincides with the Almirante Leite Ridge and the western pathway of the Agulhas Current scour zone. There are two main branches to the current in this area (Fig. 1) (Martin 1981, 1984; Martin *et al.* 1982), which between them have kept the Central Terrace a region of low or zero sedimentation through most of Neogene time.

STEADY-STATE ACCRETION AND EROSION

Terrigenous and hemipelagic

Dynamic, steady-state sedimentation on the ocean floors around southern Africa is principally effected by two surface currents (Benguela and Agulhas), and two deep-water masses (AABW and NADW) (Fig. 2). Of these, the Benguela plays a major role as a sediment generator but, in areas south of the Walvis Ridge, a minimal role in sediment movement, because surface velocities are generally not greater than 30 cm/sec at 25°S and 50 cm/sec at 33°S (Stander 1964; see Shannon 1985, fig. 17, for summary), and 5–10 cm/sec at 200–300 m depth (Moroshkin *et al.* 1970; see Shannon 1985, fig. 18, for trajectories). In contrast, there is abundant documentation (cited below) that the other three currents are major vehicles in transporting suspensate, and that during the course of late Cenozoic time they have targeted erosion and deposition on a large scale.

Antarctic Bottom Water probably enters the area across sills in the Atlantic–Indian mid-ocean ridge between 20° and 30°E before circulating clockwise in the eastern and western parts of the Agulhas Basin (e.g. Tucholke & Embley 1984). Because it is confined to water depths below about 4 km, its effects are restricted to the Cape Basin, Agulhas Passage, perimeter of the Agulhas Plateau, and Transkei and Mozambique basins. Tucholke & Embley (1984) have predicted a clockwise circulation in the Cape Basin, with AABW entering through the seamount province at the north-east end of the Agulhas Ridge (Figs 1–3). Evidence of bottom sediment scour along the foot of the northern Agulhas Ridge and the eastern Walvis Ridge, and the lower continental rise off south-western Africa, has been provided by numerous workers (e.g. Connary 1972; Emery *et al.* 1975; Bornhold & Summerhayes 1977; Embley & Morley 1980; Emery & Uchupi 1984; Siesser *et al.* in press) that supports the hypothesis of Tucholke & Embley (1984) of a scour zone under the core of the AABW mass. Data on benthic velocities are sparse, but some values have been predicted from photographic, sedimentologic and oceanographic evidence: less than 10 cm/sec (Wust 1955; Bornhold & Summerhayes 1977); 15 cm/sec

(Connary 1972). These are lower than required to erode semi-consolidated fine-grained sediments (40–100 cm/sec—Flemming 1977), so that the existence of a benthic nepheloid layer up to 1 km thick (Connary 1972) indicates that they are not representative of episodic bursting velocities.

The scour zone associated with the AABW circulation is shown in Figure 1 along the lower part of the west-coast continental rise. It generally lies between 4 and 4,5 km, and whilst Tucholke & Embley (1984) suggest that it probably is not actively eroding the sea-floor at present, the widespread phenomenon of truncated bedding—as seen on seismic records—is unequivocal evidence for large-scale erosion in the upper Cenozoic (e.g. Emery *et al.* 1975; Tucholke & Embley 1984). Palaeogene sediments have been proved at the sea-floor in two deep-water areas: at DSDP site 361 (4 549 m) within the scour zone south-west of Cape Town they are over-compacted early Eocene chalks and oozes (Bolli *et al.* 1978); and in the scour moat on the northern side of the Agulhas Ridge (4 943 m) they are muddy, glauconitic Oligocene sands (Siesser *et al.* in press). Tucholke & Embley (1984) suggest that a short episode of intense erosion occurred in the late Miocene, and that since then the ability of the AABW to sweep most of the new input away from the core zone has maintained a dynamic equilibrium, with very low sediment accumulation rates (0,4 m/m.y.—Embley & Morley 1980). If this is the case, then the area shown on Figure 1 must represent the site of late Miocene to Holocene omission surfaces (condensed sequences or hardgrounds; e.g. Neogene to Quaternary ferro-manganese nodule pavements—Rogers 1986). In fact, evidence suggests that, at least in the region off Cape Town, there has been a later erosional event because the distal parts of the slumps in this area have been eroded (Tucholke & Embley 1984). It follows from a dating of the slumps that this younger AABW erosive episode was not older than Pliocene, and is possibly as young as Pleistocene (Dingle 1980).

In the extreme south-east of the Cape Basin, Tucholke & Embley (1984) predict that the AABW pathway leads through the seamount province at the southern tip of Africa and into the Agulhas Passage. There have been numerous reports of ferro-manganese nodules from this area (e.g. Tucholke & Embley 1984), and a recent photographic and sampling survey by Rogers (1986) shows examples of fused nodule pavements, as well as partly buried nodule fields and ripples in glauconitic sand. The latter observation suggests allochthonous input from the adjacent shelf where feeders (e.g. Cape Canyon) have tapped the authigenic shelf sediments.

AABW routes east of 20°E cannot be readily identified directly from geological evidence because of the complex sea-floor morphology. Dingle & Camden-Smith (1979) suggested that steady-state, relatively strong, westward-flowing bottom currents were responsible for a narrow moat in the sediments along the northern foot of the Agulhas Plateau. This developed across a strongly asymmetric velocity gradient during late Cenozoic time (rather than by erosion), but in the most recent phase of sedimentation the moat has been partially filled with turbidites (Westall 1984). We link the latter event to the youngest period of slope wasting and allochthonous injection from the margin of south-east Africa. Tucholke & Embley (1984) suggest that modern AABW continues to follow a similar path: entering along the northern side of the Agulhas Passage, circulating clockwise in the Transkei Basin, and leaving along the southern side of the Agulhas Passage. In contrast, Westall (1984) predicts that AABW moves north-east into the Passage, but that it passes eastwards out of the Transkei Basin. In support of this hypothesis, she cites evidence from sediment bedforms, and current-meter data from the central and northern flanks of the passage (Dingle & Camden-Smith 1979; Camden-Smith *et al.* 1981; Westall 1984). The current-meter data of Camden-Smith *et al.* (1981), which indicated an average south-west velocity of 22 cm/sec at a site close to the foot of the Agulhas Plateau, Westall (1984) interprets as recording large eddies from the main AABW north-east flow. Although there may be a small, irregular return flow of AABW along the southern Agulhas Passage, we prefer Westall's overall model, because the data do not indicate a steady south-west current out of the passage, as required by Tucholke & Embley's (1984) interpretation. Erosional features along the western flanks of the Agulhas Plateau (e.g. Tucholke & Carpenter 1977) can be attributed to the most southerly portions of the AABW mass that do not enter the Agulhas Passage but peel off southwards (Tucholke & Embley 1984). It is probable, therefore, that a return AABW flowed along the northern Agulhas Plateau–southern Agulhas Passage in late Tertiary and perhaps Pleistocene time, but current-meter evidence does not suggest a similar modern regime.

Drapes of thin Quaternary sediment over Eocene and Miocene strata (Salmon 1979), together with billows and elongate sediment drift, and numerous basement outcrops attest to long-term, steady-state targeted erosion and deposition in the Agulhas Passage. This is particularly so along its northern side, where AABW velocities with a range 2–49 cm/sec and a north-north-east progressive velocity vector have been measured at one site at the foot of the continental slope (at 4 590 m—Camden-Smith *et al.* 1981). Along the northern side of the Transkei Basin bathymetric contours shallower than 4,6 km swing sharply east–west and partition the two deep-water masses that move through the Agulhas Passage (Westall 1984); AABW is forced to its right, whilst the NADW continues north-eastwards. The sudden change in direction of AABW, where it encounters a rising sea-floor formed by the terrigenous apron from the east-coast slumps and canyon feeders, originally targeted deposition along a narrow zone and resulted in the formation of the 480 km long Agulhas Drift (Figs 1, 5) ('E–W Ridge' of Westall 1984). Truncated bedding planes along its southern flank suggest that modern AABW may be eroding the Agulhas Drift (Dingle & Camden-Smith 1979).

A model for steady-state targeted sedimentation under the influence of the NADW is presented in Figure 5. Bottom-water potential temperatures (Kolla *et al.* 1980, fig. 7) indicate that along the continental slope and rise off south-east Africa, NADW flows north-east beneath the south-west flowing Agulhas Current. After eastward deflection around the southern face of the Tugela Cone

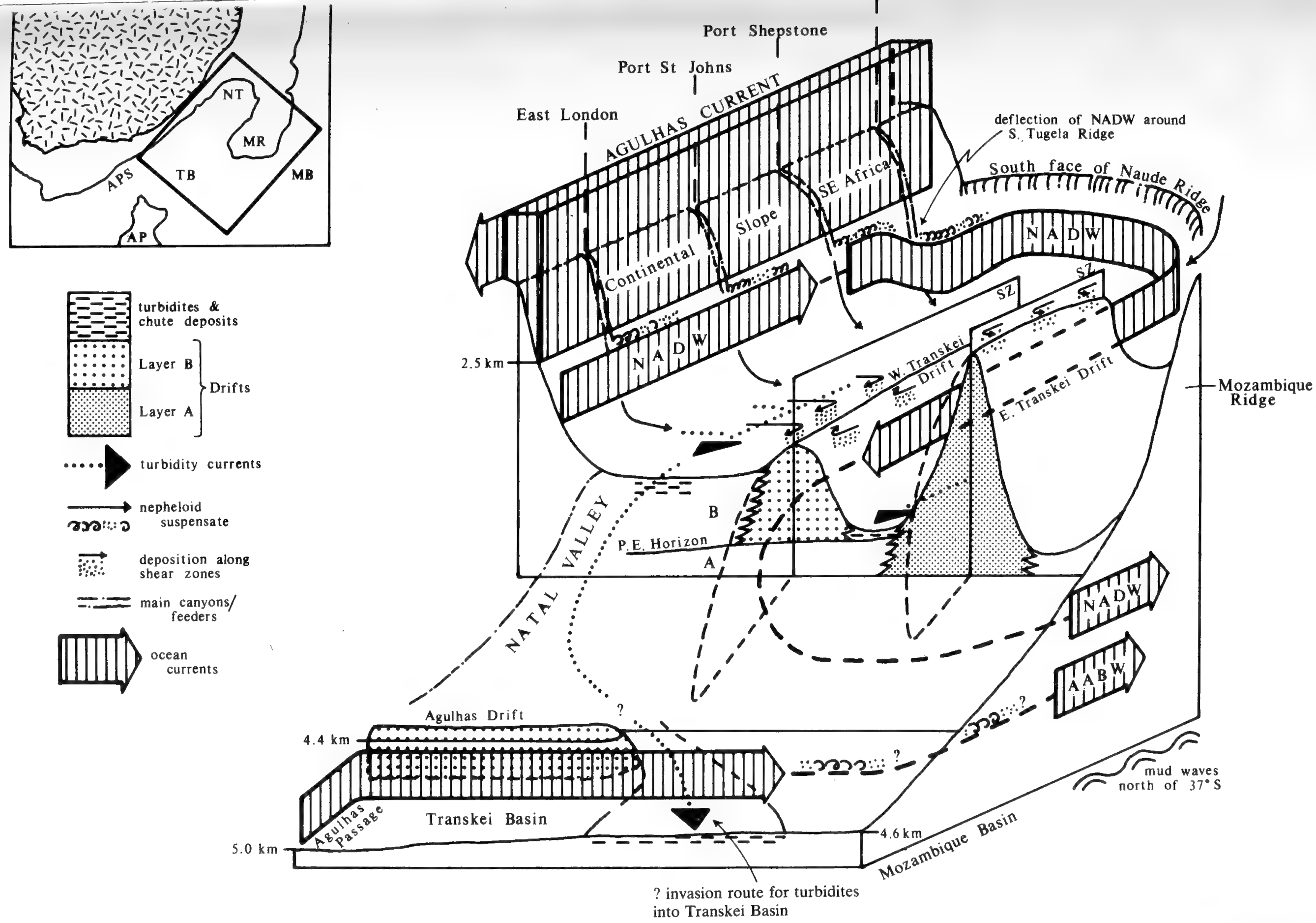


Fig. 5. Schematic and partly speculative model for the construction of various sedimentary features in the southern part of the Natal Valley and Transkei Basin. View is from the south-east corner of the area shown in the insert. The shear zones (SZ) that determine the loci of deposition along the East and West Transkei drifts occur along the periphery of the return NADW. They result in the settling-out of the following suspensates: those carried by the NADW; those continent-derived sea-floor loads that move transversely across the western Natal Valley (W. Transkei Drift); and material from the Mozambique Ridge (E. Transkei Drift). A possible route for the introduction of turbidites from the Natal Valley into the Transkei Basin is indicated. Note that at present the Agulhas Drift is probably not accreting, or is being eroded by AABW. Based primarily on data and ideas published by Dingle & Camden-Smith (1979); Dingle & Robson (1985); Goodlad (1986); Kolla *et al.* (1980); Tucholke & Embley (1984); and Westall (1984). Abbreviations in insert: AP = Agulhas Plateau, APS = Agulhas Passage, MB = Mozambique Basin, MR = Mozambique Ridge, NT = Natal Valley, TB = Transkei Basin.

(which here is banked behind the buried South Tugela Ridge), further northward progress of the NADW is stopped by the southern face of the Naude Ridge (Goodlad 1986). This barrier rises from 2,5 to 1,8 km water depth, and deflects the water mass southward down the eastern side of the Natal Valley along the western flank of the Mozambique Ridge, at the southern end of which the AABW and NADW masses reunite and flow eastwards and then northwards into the Mozambique Basin (Kolla *et al.* 1980). Two long (at least 300 km) sediment drifts occur in the eastern Natal Valley adjacent to the Mozambique Ridge, and both indicate long-term, steady-state, targeted deposition (Dingle & Robson 1985). We postulate that the East Transkei Drift forms from fine suspensate that has circulated round the Natal Valley (much of it probably acquired from the canyon feeders off East London, Port St Johns, Port Shepstone and the Tugela), with deposition along the locus of the shear zone between the NADW core and eddies developed against the irregular steep walls of the Mozambique Ridge. Fine suspensate, carried eastwards across the Natal Valley by eddies peeling off from the NADW and by turbidity currents discharging directly via the canyon feeders on to the rise prism, are deposited along a second shear zone. This is located where eastward moving bottom water interferes with the NADW moving down the eastern Natal Valley. The locus of convergence of these suspensate-carrying water masses coincides with the West Transkei Drift. Dingle & Robson (1985) show that the initiation of the East Transkei Drift (in Layer A sediments) predates the West Transkei Drift (Layer B: Fig. 6). Southward-travelling turbidites accumulate in the depression between the two drifts, with those in the east probably having a Mozambique Ridge provenance.

A further consequence of the passage of NADW along the lower continental margin of south-east Africa, together with the periodic eastward flushing of channelled and sheet-flow suspensates, is seen in low (or negative) sedimentation rates in the western part of the Natal Valley south of 31°S. Here, coccolith and stable isotope data indicate sub-Recent sediments at the sea-floor, which were deposited at water temperatures lower than those obtaining today (relatively low percentage of *Emeliania huxleyi* at less than 20,5 °C—Fincham & Winter 1986).

The West Transkei and Agulhas drifts can be traced to within 70 km of each other, and it is possible that they join. Because the southern end of the former is buried, however, it seems more likely that they both shrink in size and that the region between them is the main pathway for Natal Valley turbidity currents into the Transkei Basin.

Exit routes for AABW and NADW from the Natal Valley have not yet been identified, but a narrow 'barren erosional zone' that has been mapped for at least 700 km between 4 and 5 km water depth along the foot of the Mozambique Ridge, and the large sediment wave field adjacent to it have been attributed to north-east flowing AABW (Kolla *et al.* 1980; Tucholke & Embley 1984). Bottom water entering the Mozambique Basin from the Agulhas Basin is estimated to contain about 10 μgm/litre of suspensate (Kolla *et al.* 1980) and, with the ensuing low sediment accumulation rates, manganese nodules and thin sediment veneers cover the sea-floor. North of 37°S resuspension of muds from Quaternary (probably mostly Pleistocene) turbidites raises the suspensate concentration to around 20 μgm/litre and a long 200–20 km wide zone of mud waves has formed. The waves are northward migrating, 35–100 m high, and have a wavelength of 5 km. Kolla *et al.* (1980) estimate, from sea-floor photography, the AABW velocity at 8–10 cm/sec. The ultimate provenance of the detritus is thought to be the Zambezi River, and runoff from Madagascar.

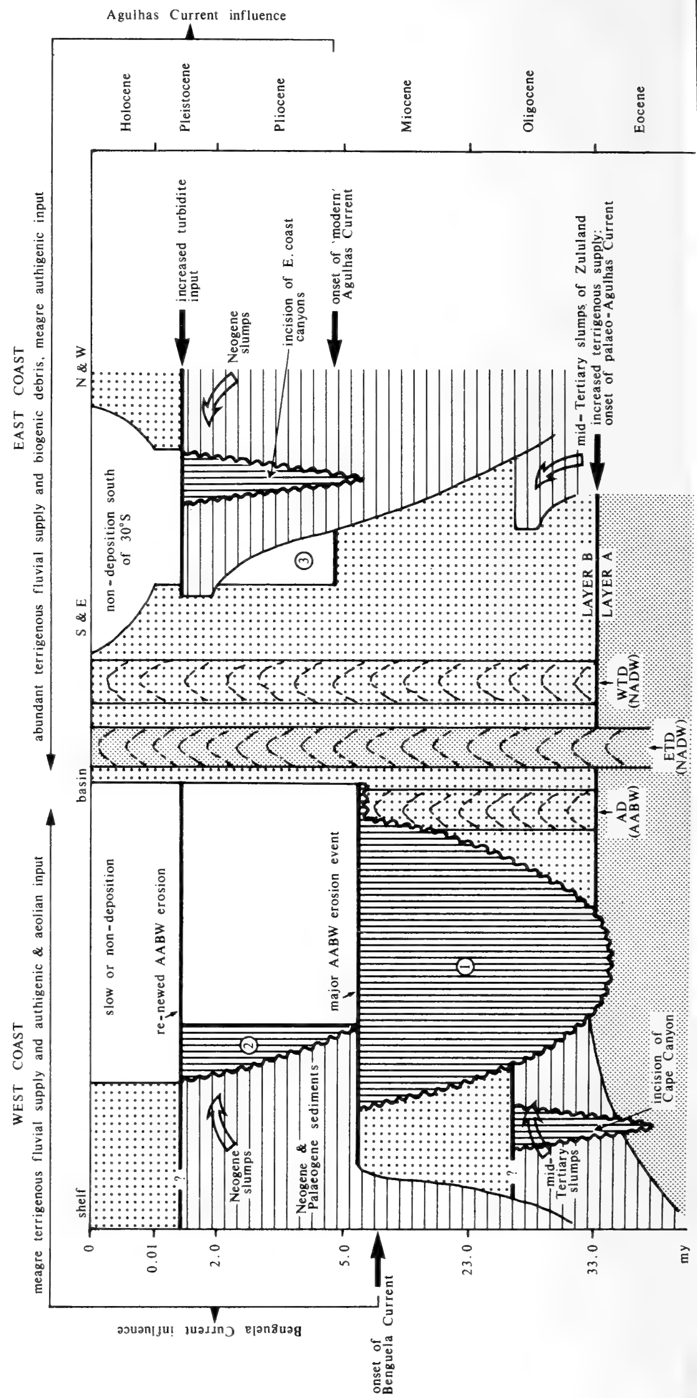
Pelagic carbonates and authigenic sediments

Extensive areas of modern deep-sea pelagic carbonates are confined to the crests of the Agulhas Plateau and the Mozambique Ridge. Both are topographically isolated from significant terrigenous input, and lie above the carbonate lysocline. The Mozambique Ridge is covered by sands that have a carbonate content that is generally greater than 75 per cent (Kolla *et al.* 1980) and are composed of planktonic foraminifera, with smaller areas of pteropods (Vincent 1972; UCT unpublished data). Current control of this deposition is indicated by large-scale billow-like bed forms, locally coarse grain textures, and manganese nodules and encrustations that have been reported from the Ridge's crest and flanks south of 35°S (Vincent 1972; Summerhayes & Willis 1975; Tucholke & Embley 1984; Robson 1985, pers. comm. 1985). Similarly, high carbonate values have been reported from the northern Agulhas Plateau (66%—Westall 1984), where large erosional and depositional bedforms have been identified from seismic records (Emery *et al.* 1975; Tucholke & Carpenter 1977; Dingle & Camden-Smith 1979; Westall 1984), and manganese nodules and encrustations have been widely reported (Summerhayes & Willis 1975; Tucholke & Embley 1984).

Rogers (1986) has shown that in the south-east Cape Basin, in the vicinity of the Agulhas Ridge, ferro-manganese nodule pavements are locally draped with modern sediment. In addition, the outer layers of nodules in the area have a relatively high content of terrigenous detritus (including ice-rafted debris). This evidence suggests that since some time in the Pleistocene, nodule growth has been smothered by increased sediment supply caused by a combination of reduced AABW scour and influx of ice-rafted detritus (Rogers 1986).

SYNOPSIS

Regional patterns of sedimentation during Neogene time in the south-east Atlantic and south-west Indian oceans were, and are, controlled by the complex interaction of large-scale allochthonous and synsedimentary processes, and steady-state water-mass circulation. Fluctuations in their relative importance have resulted in significant spatial and temporal changes in the Neogene sedimentary record, so that, for instance, some features at present are either dormant or relict (e.g. some ferro-manganese nodule fields, the Cape Canyon,


Agulhas Current influence
Holocene
Pleistocene
Pliocene
Miocene
Oligocene
Eocene
EAST COAST
abundant terrigenous fluvial supply and biogenic debris, meagre authigenic input
WEST COAST
meagre terrigenous fluvial supply and authigenic & aeolian input
Benguela Current influence
onset of Benguela Current
shelf
basin
S & E
N & W
0
0.01
2.0
5.0
23.0
33.0
my
slow or non-deposition
re-newed AABW erosion
major AABW erosion event
non-deposition south of 30°S
increased turbidite input
Neogene slumps
incision of E. coast canyons
onset of 'modern' Agulhas Current
mid-Tertiary slumps of Zululand
increased terrigenous supply; onset of palaeo-Agulhas Current
LAYER B
LAYER A
WTD (NADW)
ETD (NADW)
AD (AABW)
1
2
3
Neogene slumps
Neogene & Palaeogene sediments
?
?
mid-Tertiary slumps
incision of Cape Canyon

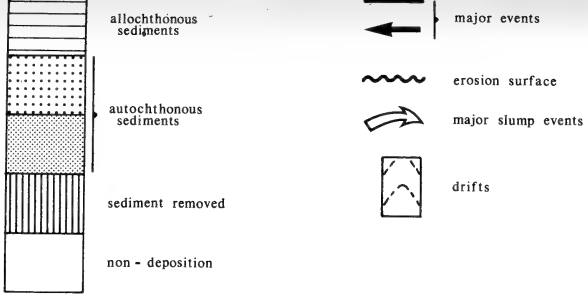
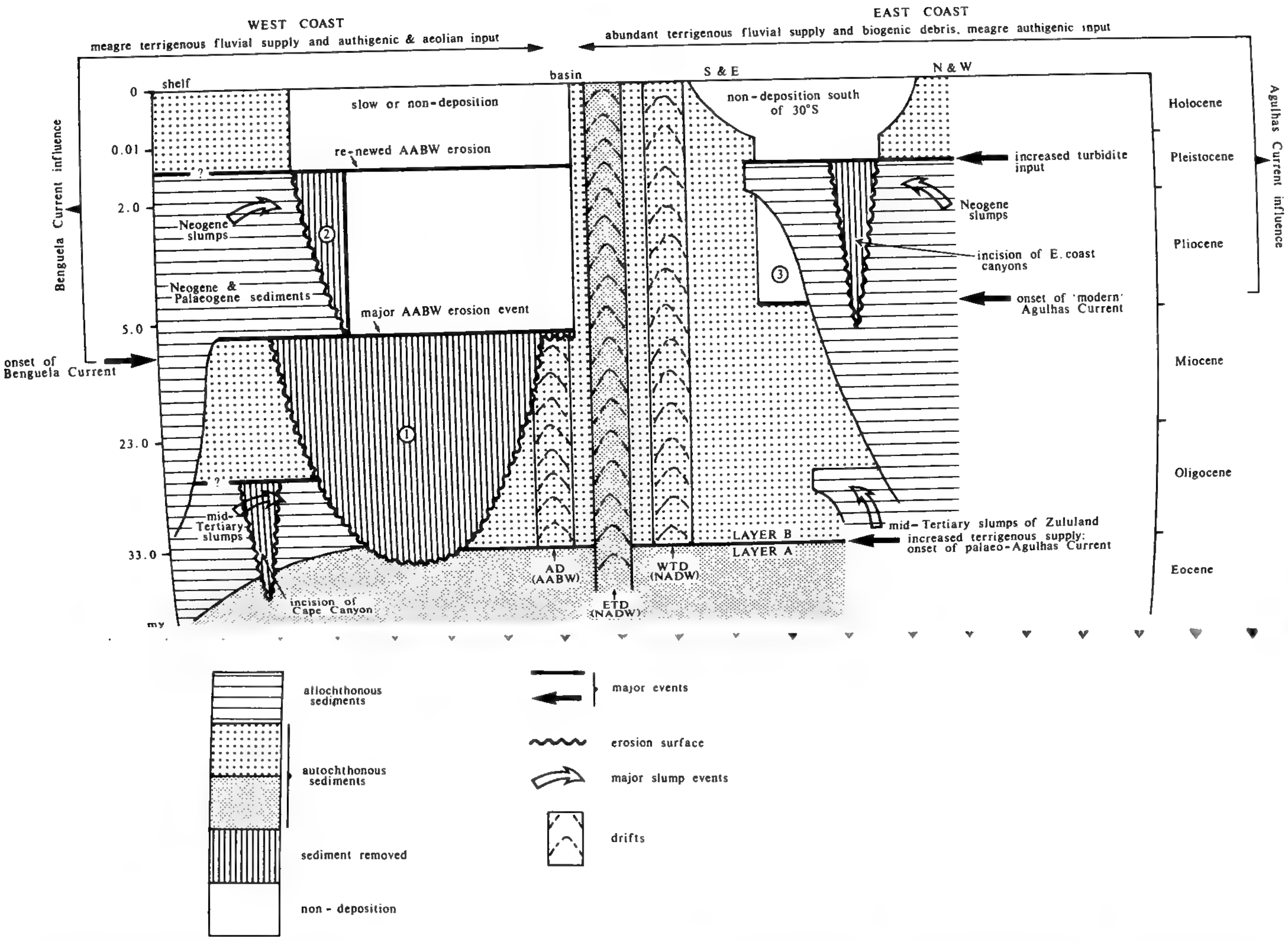


Fig. 6. Schematic stratigraphic relationships of principal mid-Tertiary to modern sedimentary sequences in the ocean basins around southern Africa. The diagram is in two parts: (a) the 'West Coast' (which includes features as far east as the Agulhas Drift) shows a shelf-to-basin profile in which the Benguela Current and AABW have dominated sedimentary events; (b) the 'East Coast' shows features in a transect down the Natal Valley to the Transkei Basin, where the Agulhas Current and NADW have dominated sedimentary events. Major erosion events commence at horizons marked by a thick line, whereas the material removed by them (outlined by wavy lines) extends down in time, truncating earlier surfaces and features.

1 = material removed by late Miocene AABW erosion, 2 = material removed by Pleistocene AABW erosion, 3 = non-deposition under the Agulhas Current, especially on the Central Terrace. AD = Agulhas Drift, ETD = East Transkei Drift, WTD = West Transkei Drift. See text for explanation and data citations.



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west-coast slumps and slides, and the Agulhas Drift). Figure 6 is an attempt to identify and date these changes and to relate them to environmental phenomena. The key factor, which switches other processes on and off, appears to be alterations in oceanic circulation.

Local mid-Tertiary glaciation of Antarctica was probably triggered by the isolation of the continent at shallow water levels (Haq 1981). This resulted in the creation of steady-state, cold, corrosive, bottom currents in the world ocean, and the establishment of AABW pathways by earliest Oligocene time (33 m.y .— Shackleton & Kennett 1975). Tucholke & Embley (1984) recognized an early Oligocene erosion surface in the Cape Basin and on the flanks of the Agulhas Plateau, and related this to AABW penetration into the south-east Atlantic. Martin *et al.* (1982) and Martin (1984) date the initiation of the palaeo-Agulhas Current to this period, and link the two phenomena. Martin & Flemming (in press) argue that the establishment of this major surface current would have had a significant effect on the climate of the hinterland, and it follows that the deep-water sedimentary environments in the southern part of the Natal Valley would reflect the change. The major lithologic change identified on seismic records occurs between Layers A and B (Dingle & Camden-Smith 1979; Dingle & Robson 1985). Westall (1984) dated this event (P.E. Horizon: Fig. 5) as Palaeocene by analogy (but not direct correlation) with Horizon D in the south-east Atlantic (Emery *et al.* 1975; Bolli *et al.* 1978), but in the absence of more substantive evidence, the younger early Oligocene date suggested by the reasoning of Martin & Flemming (in press) fits the available data more comfortably. Consequently, Figure 6 shows earliest Oligocene sediments recording the commencement of two sediment drifts: the Agulhas Drift (AABW), and the West Transkei Drift (NADW or equivalent), which are related to the initiation of the Agulhas Current and resultant increase in terrigenous input from south-east Africa. The East Transkei Drift is older (Layer A), and we postulate

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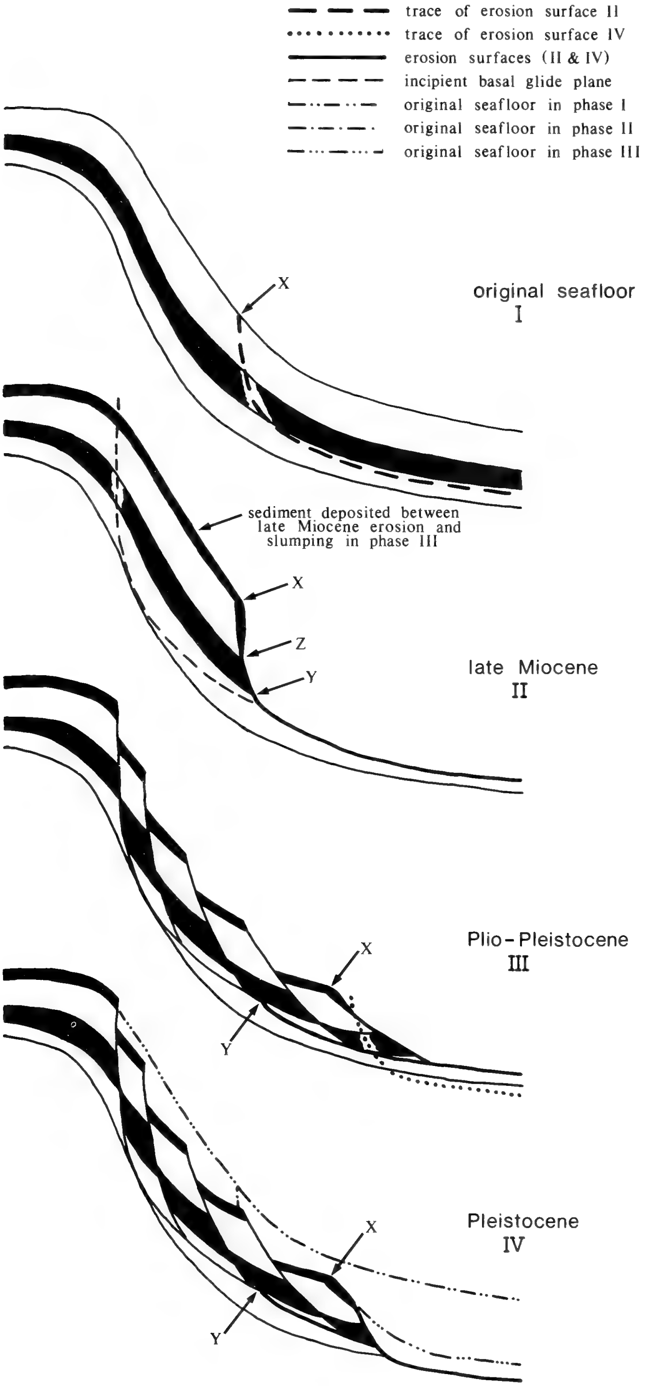
Fig. 7 *(see facing page)*. Development of west coast allochthonous structures.
Key: X = intersection of erosion surface II and depositional surface I. Y = intersection of erosion surface II and basal glide plane. Z = intersection of sea-floor and upper level of effective scour (i.e. its shallowest depth) of the post-'late Miocene' AABW. I: Structures prior to the 'late Miocene' erosion event. Sediment wedge to be removed by 'late Miocene' AABW erosion is enveloped by the heavy dashed line. Arbitrary stratigraphic horizons (one is blacked) are used in subsequent sketches to illustrate the developing structural and erosional relationships. II: Lower slope support for outer margin sediments has been removed by 'late Miocene' AABW erosion. X is the shallowest depth to which erosion operated. Erosion surface II (i.e. new sea-floor) is marked by a heavy line. Sediment wedge to slump in phase III is enveloped by light dashed line. This line is the incipient basal glide plane. Following erosion, the shallowest depth of effective AABW scour is Z, upslope of which post-'late Miocene' sediment continues to accumulate (upper thin blacked layer). III: Plio–Pleistocene slumping has translated slope sediments into deeper water as rotated blocks. Point X over-rides point Y. Sediment wedge to be removed by 'Pleistocene' AABW erosion is enveloped by the heavy dotted line. IV: The outer edge of the distal slump block is trimmed by 'Pleistocene' AABW erosion. Previous sea-floor configurations are shown for comparison by light dot-dash lines.


trace of erosion surface II
trace of erosion surface IV
erosion surfaces (II & IV)
incipient basal glide plane
original seafloor in phase I
original seafloor in phase II
original seafloor in phase III
X
original seafloor
I
sediment deposited between late Miocene erosion and slumping in phase III
X
Z
Y
late Miocene
II
X
Y
Plio-Pleistocene
III
X
Y
Pleistocene
IV

that it was sustained by detritus carried clockwise around the Natal Valley (in contrast to predominantly across it: see Fig. 5).

Tucholke & Embley (1984) detected no major regional Upper Oligocene to Upper Miocene hiatuses in the south-east Atlantic, but dated the initiation of the modern deep-sea scour zones to massive 'late Miocene' erosion by AABW. There is a certain amount of ambiguity in their dating (Tucholke & Embley 1984, fig. 10), and it is unclear whether this is a composite erosional event covering NH5–NH7 (planktonic foram zones N16 to N18; late Miocene to earliest Pliocene) or relates to one Neogene hiatus in particular. Keller & Barron (1983) dated the three events as: NH5—9 m.y.; NH6—7 m.y.; and NH7—5 m.y.; the youngest of which has recently been correlated with widespread AABW erosion in the Atlantic sector of the Southern Ocean (Ledbetter & Ciesielski 1986). This event (or events) stripped at least 500 m of middle and late Tertiary cover from the continental rise and basin floor along the eastern Cape Basin (Bolli *et al.* 1978; Tucholke & Embley 1984; Siesser *et al.* in press). In the Southern Ocean, widespread AABW erosion also occurred at 3,5–4 m.y. and 1,0–2,5 m.y. but, according to Tucholke & Embley (1984), active erosion in the Cape Basin did not persist significantly beyond Miocene time, since when it has maintained a wide swathe of very slow sedimentation or non-deposition (Fig. 1). Off the east coast, the late Miocene surge in AABW activity may have a slightly delayed action analogue, where Martin *et al.* (1982) and Martin (1984) recognized the establishment of the modern flow path of the Agulhas Current just after 5 m.y. (i.e. earliest Pliocene). This resulted in active scouring of the Central Terrace, and must have enhanced the Agulhas Current's ability to transport detritus. One effect of the invigorated AABW flow was to start to dismantle the Agulhas Drift, which it had been constructing since early Oligocene time (Fig. 6).

At present we do not have an accurate timetable for the formation of the massive allochthonous structures that occur on the outer continental margin around southern Africa, but there does seem to be a synchroneity between east and west coasts (Fig. 6). The youngest phase has been dated as Pleistocene and/or Pliocene by Summerhayes *et al.* (1979), and by Dingle (1980) on the west coast, and post-5 m.y. (i.e. Pliocene or younger) by Dingle (1977), Martin (1984), and Dingle & Robson (1985) on the south and east coasts. In addition, 'mid-Tertiary' episodes have been postulated for the west coast (Dingle 1980), and off Zululand (Martin 1984).

Because the outer edges of the allochthonous masses have been eroded by the Cape Basin scour core (see seismic profiles in Tucholke & Embley 1984), it follows that in this region at least, the slumps pre-date the youngest episode of scouring. Tucholke & Embley (1984) consider this scouring to be 'late Miocene', which is older than geological evidence suggests for the youngest slumping. Figure 7 attempts to reconcile these dates and to incorporate the phenomenon of scouring into a genetic model for the allochthonous masses. Stage I is pre-'late Miocene' and shows the deep-water slab that the pulse of corrosive AABW removed in 'late Miocene' time. In Stage II, support for mid-slope sediments has been weakened by removal of this slab, whilst sedimentation continued into Pliocene time in water depths shallower than point 'Y' (which represents a retreat from the high point of erosion at 'X' following the cessation of active AABW erosion). This additional loading during Stage II eventually triggered down-slope rotation of blocks in Plio–Pleistocene time (Stage III). A post-Stage III (?Pleistocene) episode of erosion by AABW is indicated by the trimmed outer edges of some of the allochthonous units south-west of Cape Town (Stage IV). This event may correlate with part of the 1,0–2,5 m.y. (Matuyama Chron) AABW erosion event identified by Ledbetter & Ciesielski (1986) in the Southern Ocean. Ancillary processes, which may have precipitated or facilitated allochthonism, but whose relative effects cannot be assessed at this stage, possibly include: base of slope sapping by ground water during periods of low sea-levels (Oligocene, early Pliocene, and Pleistocene) (Robb 1984); seismic shocks; high interstitial methane content in sediments (particularly along the west coast—Emery *et al.* 1975; Summerhayes *et al.* 1979).

The ruggedness of the west-coast continental slope south of 34°S can probably be attributed to small canyon and gulley formation on the slump-affected slope that was accentuated by the discharge of rivers from the mountainous Cape Town–Agulhas hinterland across the narrow coastal plain during Pleistocene sea-level lows. This is a direct analogue to the narrow East London margin and contrasts strongly with the non-dissected continental slope farther north (where the coastal plains were much wider). Dingle & Hendey (1984) date the initial cutting of the Cape Canyon as 'mid-Tertiary', when the Oligocene Orange River discharged through the modern Olifants estuary. The presence of a deep incision across the slope may explain the 'focusing' of Plio–Pleistocene slump glide planes along its lower eastern wall.

ACKNOWLEDGEMENTS

This compilation is based on work carried out in the Marine Geoscience Unit at the University of Cape Town since 1967. Sea-time and research facilities were funded by the University of Cape Town, Geological Survey of South Africa, South African National Committee for Oceanographic Research, National Research Institute for Oceanology, Sea Fisheries Research Institute, and the Foundation for Research Development. Over the years, the officers and crew of the University of Cape Town research vessel *Thomas B. Davie* bore the brunt of the work at sea and we gratefully acknowledge their skill, dedication and comradeship. We thank Judy Woodford for doing the cartography and also the editorial staff of the South African Museum for guidance with the coloured maps. Publication costs were generously met by the South African Museum, Foundation for Research Development, and the Editorial Board of the University of Cape Town.

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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:
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figures of plates are enclosed in parentheses to distinguish them from text-figures
dash, not comma, separates consecutive numbers.

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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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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. 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
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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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& M. W. WOODBORNE.

DEEP-SEA SEDIMENTARY ENVIRONMENTS AROUND SOUTHERN AFRICA (SOUTH-EAST ATLANTIC AND SOUTH-WEST INDIAN OCEANS)

VOLUME 98 PART 2 MAY 1988 ISSN 0303-2515

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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.

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

'Smith (1969) describes . . .'
'Smith (1969: 36, fig. 16) describes . . .'
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'As described (Haughton *et al.* 1927) . . .'

Note: no comma separating name and year
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names of joint authors connected by ampersand
et al. in text for more than two joint authors, but names of all authors given in list of references.

(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)

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

Volume **98** Band
May **1988** Mei
Part **2** Deel

OCHETOSTOMA (ECHIURA) FROM SOUTHERN AFRICA WITH A DESCRIPTION OF A NEW SPECIES

By

R. BISESWAR

Cape Town Kaapstad

The ANNALS OF THE SOUTH AFRICAN MUSEUM

are issued in parts at irregular intervals as material
becomes available

Obtainable from the South African Museum, P.O. Box 61, Cape Town 8000

Die ANNALE VAN DIE SUID-AFRIKAANSE MUSEUM

word uitgegee in dele op ongereelde tye na gelang van die
beskikbaarheid van stof

Verkrygbaar van die Suid-Afrikaanse Museum, Posbus 61, Kaapstad 8000

OUT OF PRINT/UIT DRUK

1, 2(1–3, 5–8), 3(1–2, 4–5, 8, t.–p.i.), 5(1–3, 5, 7–9),
6(1, t.–p.i.), 7(1–4), 8, 9(1–2, 7), 10(1–3),
11(1–2, 5, 7, t.–p.i.), 14(1–2), 15(4–5), 24(2), 27, 31(1–3), 32(5), 33, 36(2), 45(1)

ISBN 0 86813 092 3

Printed in South Africa by
The Rustica Press, Pty., Ltd.,
Court Road, Wynberg, Cape

In Suid-Afrika gedruk deur
Die Rustica-pers, Edms., Bpk.,
Courtweg, Wynberg, Kaap

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By

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(With 23 figures and 1 table)

[*MS accepted 17 August 1987*]

ABSTRACT

In southern Africa, the genus *Ochetostoma* is currently represented by ten species: *Ochetostoma natalense* is described as new; *O. baronii*, *O. kempi*, *O. palense*, *O. decameron* and *O. formosulum* are redescribed and figured (the first four are new records for the region); *O. capense* and *O. arkati* are briefly diagnosed; *O. caudex* and *O. erythrogrammon*, recorded from several localities, are fairly well known. The status of one species from Park Rynie Beach, on the Natal coast, remains to be resolved. A key for the identification of all the species in the genus is provided, and the distribution of the southern African forms is briefly discussed.

CONTENTS

INTRODUCTION

At present, knowledge of the southern African echiuran fauna is rather scanty. This is the fourth in a series of papers on the systematics and distribution of the echiurans of Africa south of 20°S (Biseswar 1983, 1984, 1985). Biseswar (1985) dealt with the genera and species of echiurans from southern Africa and mapped their distribution, partly from the published works and partly from surveys made along the coast.

The present paper is a comprehensive report on the species of *Ochetostoma* from these waters. In their monograph, Stephen & Edmonds (1972) have outlined some of the taxonomic problems encountered in the group. It is evident from the literature that many of the species listed in this genus need re-examination and redescription.

Collecting trips, specifically in search of echiuroids, were undertaken to several localities along the Natal and Cape coasts. Most of the shallow-water

Ann. S. Afr. Mus. **98** (2), 1988: 29–75, 23 figs, 1 table.

material used in this study was, however, obtained from the rocky shores of the Natal coast. Some species were also obtained as a result of requests made to several universities and institutions in South Africa. Unless otherwise stated in the text specimens were collected by the author. Abbreviations used in the figures are explained on p. 75.

Living specimens were photographed and then narcotized by adding small quantities of magnesium sulphate to sea-water. Measurements of the proboscis and trunk were taken after preservation in 10 per cent formalin. All the specimens were subsequently dissected and, where possible, variations were noted. Gross morphology was studied with the aid of a camera lucida.

DESCRIPTIONS

Ochetostoma Leuckart & Rüppell, 1828

Type-species: *Ochetostoma erythrogrammon* Leuckart & Rüppell, 1828.

Diagnosis

Longitudinal muscle layer of body gathered into distinct bundles. Inner oblique muscles between the longitudinal bands form fascicles. No anal or posterior setae. Gonoducts are paired, ranging from one to seven pairs. Gonostomal lips elongate and usually coiled.

Remarks

The genus is the largest of all the echiuran genera and comprises 24 species. It was only after the publications of Spengel (1912) and Wharton (1913) that the taxonomic importance of the condition of the oblique muscles was realized (Stephen & Edmonds 1972). Unfortunately, some of the earlier descriptions contain no information about the oblique muscles and hence the generic position of a number of species that have been assigned to the genus *Ochetostoma* is doubtful. They may belong to the genus *Listriolobus*. More detailed redescriptions of some of the species, based on additional material, are required before their taxonomic positions can be satisfactorily resolved.

Distribution

The genus *Ochetostoma* is very widely distributed in tropical and subtropical waters of the Indian, Atlantic and Pacific oceans. The majority of the species is confined to shallow waters of the intertidal zone but a few have been reported from considerable depths. In their monograph Stephen & Edmonds (1972) gave the distribution range of each species.

KEY TO THE SPECIES OF THE GENUS *OCHETOSTOMA*

The keys provided by Datta Gupta & Menon (1971) and Stephen & Edmonds (1972) for the species of *Ochetostoma* have been modified to accommodate *O. natalense* sp. nov. An attempt has been made to update the existing keys in the light of additional information obtained from the redescriptions of some of the species. In the present key, additional less rigorous characters have been included to assist in the identification of single individuals. A discussion of the structure and terminology of the group is included in a previous paper (Biseswar 1983).

1. Gonoducts 7 pairs ... 2
— Gonoducts 5 pairs or less ... 3
2. First pair of gonoducts presetal; 12 longitudinal muscle bands ... *O. zanzibarense* Stephen & Robertson, 1952
— All gonoducts postsetal; 7 longitudinal muscle bands ... *O. senegalense* Stephen, 1960
3. Gonoducts 5 pairs ... 4
— Gonoducts 4 or fewer pairs ... 5
4. First 3 pairs of gonoducts presetal; 19 longitudinal muscle bands ... *O. hornelli* (Prashad, 1921)
— First 2 pairs of gonoducts presetal; 10–11 longitudinal muscle bands ... *O. bombayense* (Prashad & Awati, 1929)
5. Gonoducts 4 pairs, with first pair presetal ... 6
— Gonoducts 3 or fewer pairs ... 7
6. 10 longitudinal muscle bands ... *O. decameron* (Lanchester, 1905)
— 17–20 longitudinal muscle bands ... *O. kempi* (Prashad, 1919)
7. Gonoducts 3 pairs; only first pair presetal ... 8
— Gonoducts 2 pairs ... 12
8. Proboscis slightly bifurcated with ventral and terminal rims crenated; 18 longitudinal muscle bands; colour of trunk pink ... *O. indosinense* Wesenberg-Lund, 1939
— Proboscis not bifurcated, margins smooth ... 9
9. Small flat papillae confined to anterior and posterior surfaces of trunk; living specimens red in colour; usually 12–13 longitudinal muscle bands, occasionally 11–14 ... *O. australiense* Edmonds, 1960
— Papillae distributed over entire surface of trunk, much larger posteriorly .. 10
10. Alimentary canal short, about three times trunk length; 15 longitudinal muscle bands; bright green in life ... *O. palense* Ikeda, 1924
— Alimentary canal long, about five times trunk length ... 11
11. Integument thin and transparent in middle region of trunk; 12–18 longitudinal muscle bands ... *O. erythrogrammon* Leuckart & Rüppell, 1828
— Integument thick and opaque throughout; usually 16–22 longitudinal muscle bands, very occasionally 14–16 ... *O. caudex* (Lampert, 1883)
12. Interbasal muscle absent ... 13
— Interbasal muscle present ... 20
13. Lateral edges of proboscis modified ... 14
— Lateral edges of proboscis not modified ... 17
14. Gill-like processes along basal edges of proboscis; 8 longitudinal muscle bands ... *O. arkati* (Prashad, 1935)
— Proboscis without gill-like structures ... 15

15. Proboscis with dendritic outgrowths; 7 longitudinal muscle bands .... *O. septemyotum* Datta Gupta, Menon & Johnson, 1963
— Proboscis without dendritic outgrowths but proximal border with processes with scalloped edges 16
16. Oesophageal diverticulum present; 13 longitudinal muscle bands; trunk with 30–35 rings of large oblong papillae ... *O. mercator* Wesenberg-Lund, 1954
— Oesophageal diverticulum absent; 12–13 longitudinal muscle bands; skin smooth with only a few rings of papillae at posterior end of trunk .... *O. glaucum* (Wesenberg-Lund, 1957)
17. 8 longitudinal muscle bands; proboscis one-third trunk length; integument translucent .... *O. octomyotum* Fisher, 1946
— Muscle bands 10 or more 18
18. Trunk yellow in colour, covered with small uniformly distributed papillae; 10–11 muscle bands......................... *O. hupferi* (Fischer, 1895)
— Trunk not yellow, papillae more densely packed at posterior end 19
19. Trunk light green to bluish in colour, up to 25 mm long and transparent in middle region; 13 longitudinal muscle bands .. *O. pellucidum* (Fischer, 1895)
— Trunk reddish-purple, up to 94 mm in length; integument thick and opaque; 17–20 longitudinal muscle bands.................... *O. natalense* sp. nov.
20. Muscle bands less than 10 21
— Muscle bands more than 10 22
21. Posterior end of trunk with a ring of elongate papillae; trunk up to 35 mm in length; 7–8 muscle bands .... *O. formosulum* (Lampert, 1883)
— Posterior end of trunk without elongate papillae; trunk up to 120 mm in length; 7–8 muscle bands .... *O. capense* Jones & Stephen, 1955
22. Interbasal muscle extends over pharynx; trunk greyish-green; 14 longitudinal muscle bands .... *O. manjuyodense* (Ikeda, 1905)
— Interbasal muscle passes below pharynx.............................. 23
23. Proboscis readily deciduous; oblique muscles between longitudinal bands well developed; 17–19 muscle bands .... *O. baronii* (Greeff, 1879)
— Proboscis not readily deciduous; oblique muscles between longitudinal bands weakly developed; 18–21 muscle bands .... *O. myersae* Edmonds, 1963

Ochetostoma natalense sp. nov.

Figs 1–4, Table 1

Material

Holotype, SAM–A21924, in the South African Museum, Cape Town. Adult male, Park Rynie Beach, Natal (31°19′S 30°44′E); collected by K. S. Ganga, 18 October 1982.

Paratypes, SAM–A21925, in the South African Museum, Cape Town. Seven specimens from Park Rynie Beach, Natal (31°19′S 30°44′E) and Isipingo Beach, Natal (29°05′S 30°56′E); collected 1983, 1984.

Habitat

The specimens from Park Rynie Beach occurred in coarse sand under a projecting ledge of rock facing the shore, while those from Isipingo Beach were found under loose rocks in a rock tunnel. At both localities, the specimens were found in the intertidal area, close to the high-water mark.

Description

Size. Trunk length (holotype) 80 mm, proboscis length 58 mm. Of the paratypes, five sexually mature since gametes present in gonoducts. Trunk length of sexually mature specimens ranges from 54 mm to 94 mm and proboscis from 30 mm to 58 mm (Table 1); hence proboscis ranges fron about one-third to three-quarters of trunk length.

TABLE 1

Measurements (in mm) of preserved specimens of *Ochetostoma natalense* sp. nov.

Specimen	*Total Length**	*Trunk length*	*Ratio proboscis:trunk*
+Holotype	138	80	0,73
+Paratype	126	94	0,34
+Paratype	120	85	0,41
+Paratype	111	71	0,56
+Paratype	110	69	0,59
Paratype	86	50	0,72
Paratype	82	47	0,74
+Paratype	69	54	0,56

* Trunk length and proboscis length
+ Gametes present in gonoducts

Colour. In living specimens, proboscis is pale yellow. Trunk with reddish-purple longitudinal stripes marking longitudinal muscle bands, interspaces bluish-grey. Posterior extremity of trunk white, tinged with green in a few specimens. In preserved specimens colour changes to pale pink.

External features

Proboscis. Proboscis fleshy, non-deciduous and of uniform diameter throughout (Fig. 1A). Spatula-shaped in live animals but in preserved specimens lateral edges curl inwards to form a tubular structure. Lateral margins of proboscis smooth and free at base.

Trunk. Trunk sausage-shaped, more or less of uniform diameter (Fig. 1A). Papillae minute, densely arranged over most of trunk except at posterior end where they are very prominent, round to ovoid in shape. Size and distribution of papillae uniform in all specimens. A white mucous cap encases posterior extremity of trunk in formalin-preserved specimens. Entire integument thick and opaque. Longitudinal muscle bands range from 17 to 20, inner oblique muscle layer between longitudinal bands forming distinct fascicles. Ventral setae one

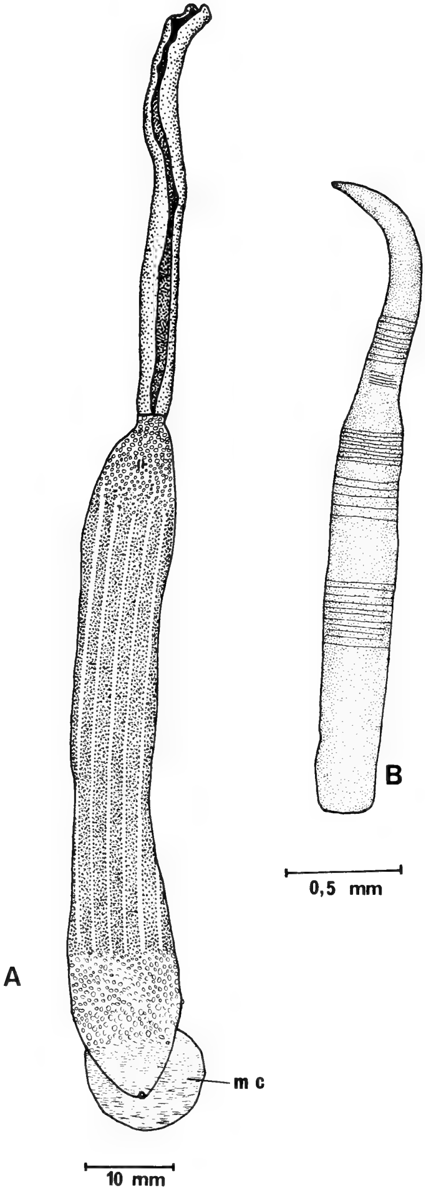

Fig. 1. *Ochetostoma natalense* sp. nov. A. Ventral aspect. B. Right functional seta.

pair, located at anterior end of trunk, close behind mouth. Genital pores two pairs, opening posterior to setae.

Setae. Each seta consists of a cylindrical shaft with curved terminal end tapering towards tip (Fig. 1B). Much narrower distal third of seta golden-yellow in colour while proximal two-thirds dark brown. Concentric markings present mainly on middle two-thirds of shaft. Each seta is invested in connective tissue and supported by radiating muscle strands as in other related species. There is no interbasal muscle between setae.

Internal anatomy

Alimentary canal. Alimentary canal is considerably longer than trunk and intricately coiled (Fig. 2). In holotype, numerous closely arranged mesenteric strands fasten gut to body wall (Fig. 2). Mesenteric strands fewer in paratypes and more sparsely arranged. Foregut comparatively small, terminating at ring vessel. After ring vessel, intestine pursues complicated course through body cavity, forming several ascending and descending limbs. A double sheet of mesentery fastens oesophagus to anterior part of body wall.

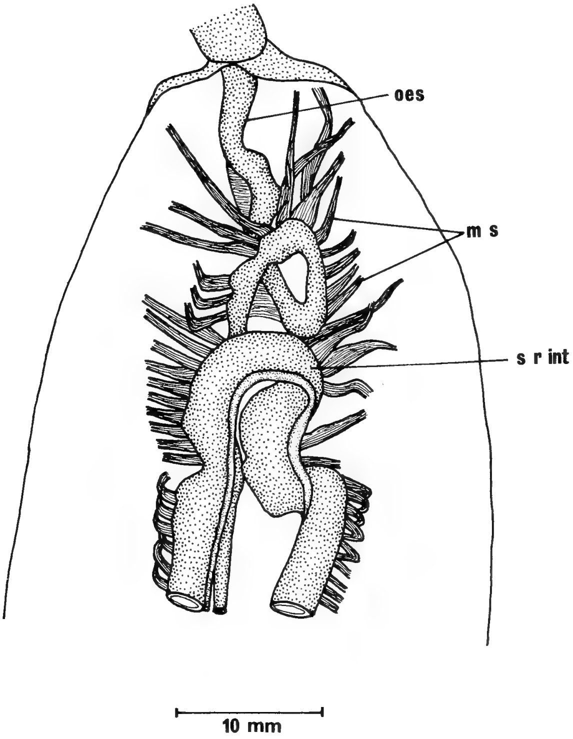

Fig. 2. *Ochetostoma natalense* sp. nov. Anterior part of the alimentary canal, showing the mesenteric strands.

Intestine proper commences soon after ring vessel and is differentiated into presiphonal, siphonal and postsiphonal regions. Presiphonal region marked by presence of ciliated groove, which in holotype is about 36 mm long. Intestine considerably dilated and extremely thin-walled in region of siphon, whereas in postsiphonal region it is narrow with fairly thick walls. Last part of intestine of uniform diameter, leading into more or less straight rectum. Small, spherical rectal caecum present in all specimens.

Anal vesicles. Anal vesicles elongate, distensible tubes lying in coelom and opening into rectum. In holotype, anal vesicles are abnormal (Fig. 3). Left anal vesicle about three-quarters length of trunk, while right one about one-fifth as long. In addition to these, a third anal vesicle present, which, instead of terminating blindly, forms a loop and reopens into rectum (Fig. 3). All three vesicles with numerous, tiny ciliated funnels. In paratypes, as in specimens of related species, anal vesicles are normal, and are almost equal to or longer than trunk. Numerous thin, mesenteric strands fasten proximal end of vesicle to body wall, whereas distally they loosely interweave through coils of intestine.

Gonoducts. Two pairs of elongate, tubular gonoducts are located behind setae; posterior pair much larger (Fig. 4A). In holotype, gonoducts are swollen at base. Gonostomal lips elongate and spirally coiled. Opening of gonostome basal in position. In sexually mature individuals, gonoducts considerably distended due to presence of gametes.

Blood system. Intestinal ring sinus is an incomplete vascular ring located at end of foregut (Fig. 4B). Neuro-intestinal vessel elongate, double for most of its length. Dorsal vessel, after arising from ring sinus, continues anteriorly, dorsal to oesophagus and pharynx, and enters proboscis.

Remarks

Distinctive features of the present species from southern Africa include the number and location of the gonoducts in relation to the setae, the presence of 17–20 longitudinal muscle bands, the nature of the integument, the characteristic shape and distribution of the dermal papillae, and the absence of an interbasal muscle. The interbasal muscle is a useful taxonomic character in echiurans. Other features of lesser significance are the colour and size of the animals and the ratio of the proboscis length to trunk length.

In the genus *Ochetostoma* there are 13 species that possess two pairs of gonoducts (see key p. 30).

The species *O. arkati*, described originally from Calcutta, India, differs from *O. natalense* in several respects. In the former species the longitudinal muscles are gathered into 7–8 bands and the proboscis is short, about a third to a quarter of the trunk length. However, the most important distinguishing feature of *O. arkati* is the presence of short, branched, gill-like processes along the edges of the posterior half of the proboscis.

The species *O. septemyotum* differs from other known echiurans in the genus in possessing a proboscis where the lateral margins are produced into a series of

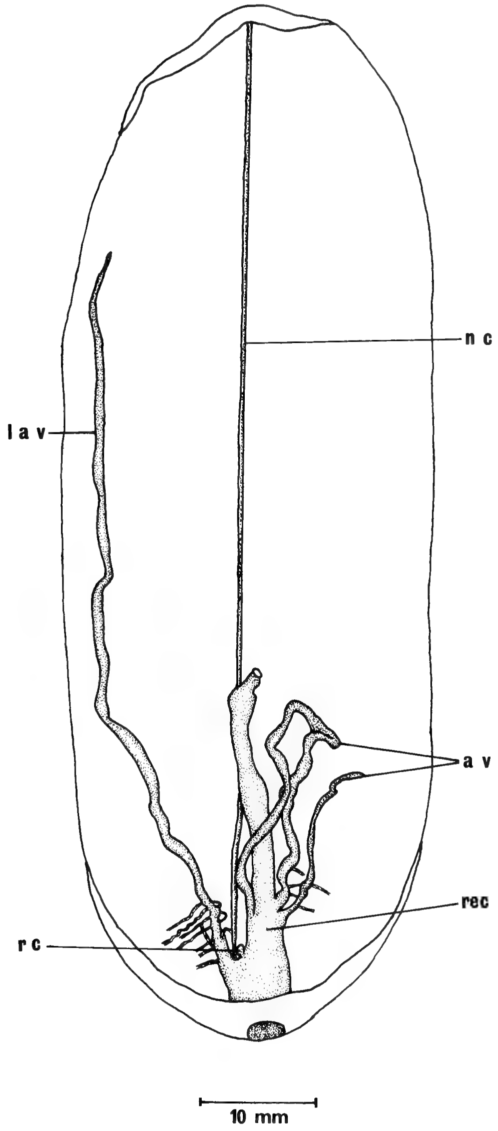

Fig. 3. *Ochetostoma natalense* sp. nov. Dorsal dissection of the trunk showing the abnormal anal vesicles of the holotype.

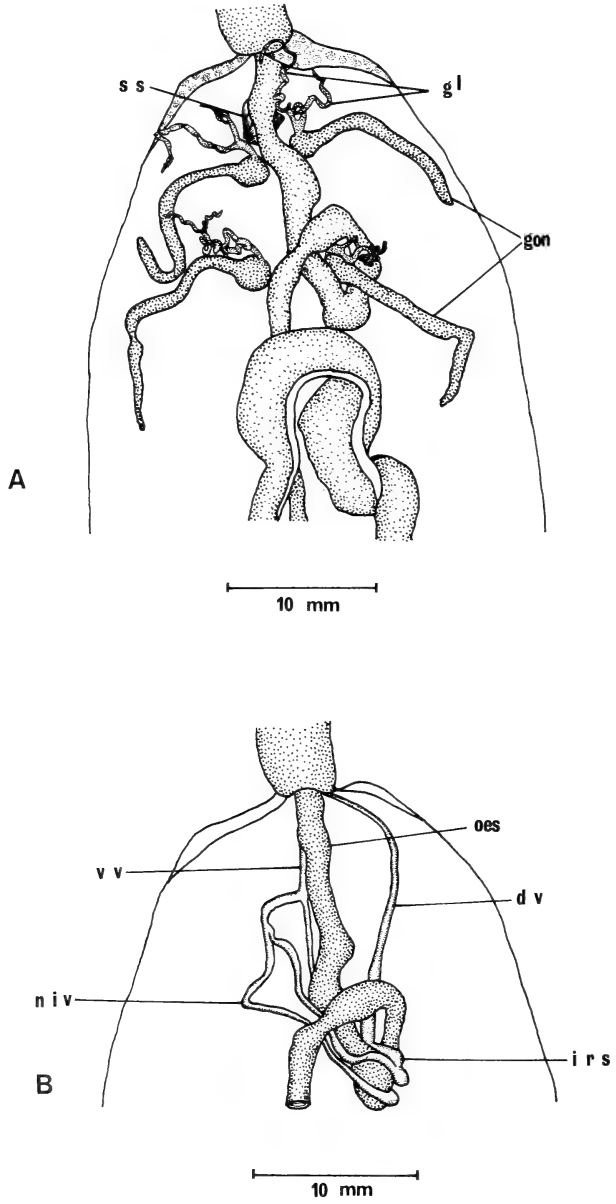

Fig. 4. *Ochetostoma natalense* sp. nov. Anterior end of the trunk cavity. A. Gonoducts. B. Blood vessels.

folds with dendritic outgrowths that are bent inwards into the proboscis groove.

Ochetostoma baronii, *O. capense*, *O. myersae* and *O. formosulum* are distinct from *O. natalense* in possessing an interbasal muscle that passes through a loop of the neuro-intestinal vessel. In addition, there are several other differences in the proboscis, integument and dermal papillae that separate the above species from *O. natalense*.

Ochetostoma hupferi from Nyango, West Africa, is based on a single damaged specimen recorded from a depth of 11 m. In this species, the trunk is small, light yellow in colour and covered with small, uniformly distributed papillae. The proboscis is 5 mm in length and the ventral setae are large, golden-yellow in colour. Fischer's description (1895) mentions that the longitudinal muscle layer is gathered into 10–11 bands. The most important differences between *O. hupferi* and *O. natalense* lie in the number of longitudinal muscle bands, in the size of the ventral setae and in the distribution of the dermal papillae. Differences are also present in size as well as in the colour of live animals.

The original description of *O. manjuyodense* is based on a single specimen from Manjuyodi, Philippines, in which the proboscis was missing. Fisher (1948) merely recorded this species from Hawaii. The trunk is 18 mm in length and has a greyish-green tint. The dermal papillae are minute, almost invisible to the naked eye, except at the posterior end where they are somewhat larger and arranged almost in circular rows. A very distinctive feature in this species is the interbasal muscle that extends over the pharynx. The longitudinal muscles are gathered into 14 broad bands. The anal vesicles are covered with numerous short-stalked funnels, which are visible to the naked eye. In addition to the interbasal muscle, important differences also occur in the size and distribution of the dermal papillae, in the number of muscle bands and in the colour of the animals.

Ochetostoma mercator, described by Wesenberg-Lund (1954), is known only from the holotype. In this species the trunk is 25 mm long and the proboscis, which is broad, fleshy and non-deciduous, is one-fifth its length. An important feature that distinguishes this species from *O. natalense* is the presence of 30–35 rings of large, oblong papillae on the trunk. Another difference lies in the longitudinal muscle layer, which in *O. mercator* is gathered into 13 bands. The proboscis of *O. mercator* is also much smaller in comparison with the length of the trunk.

Fisher (1946) erected the species *O. octomyotum* from several specimens collected from the Californian coast. His description mentions that the trunk of full-grown specimens is 110 mm long and the proboscis ranges from one-third to the full length of the body. The longitudinal muscle layer is gathered into eight bands, but in the posterior third of the trunk it forms a continuous sheet. The integument of *O. octomyotum* is translucent. Thus important differences between the two species lie mainly in the number of longitudinal muscle bands and in the nature of the integument. As in *O. natalense*, the ventral setae have no interbasal muscle.

Ochetostoma pellucidum was described originally from several specimens from the West African coast at depths of 10 m. In this species the trunk, which is light green to bluish in colour, is 25 mm long and the proboscis is about one-quarter its length. The longitudinal muscles are gathered into 13 bands. Fischer's (1895) description mentions that the integument is opaque anteriorly and posteriorly but transparent in the middle region. Hence differences exist between *O. pellucidum* and *O. natalense* in the number of longitudinal muscle bands and in the nature of the integument. Other differences are present in the colour and size of the specimens. Furthermore, the anal vesicles of *O. pellucidum* are only about one-quarter as long as the trunk and the ventral setae are large.

The species *O. glaucum* is known from two rather badly preserved specimens. According to the description provided by Wesenberg-Lund (1957), the trunk is about 22 mm in length and the proboscis is 6 mm long. An interesting feature in this species is the presence of two rows of processes on the proximal part of the proboscis. The outer row consists of rather long lobes with slightly scalloped edges. The integument is smooth with only a few rings of papillae on the posterior part of the trunk. There are 12–13 longitudinal muscle bands. This species differs significantly from *O. natalense* in the structure of the proboscis, in the distribution of the papillae and in the number of longitudinal muscle bands.

Thus it is evident that *O. natalense* differs significantly from the other known species of *Ochetostoma* that possess two pairs of gonoducts, thereby justifying the establishment of a new species.

Etymology

This species is named after the province of Natal, along which coast it was found.

Ochetostoma baronii (Greeff, 1879)

Figs 5–7

Thalassema baronii Greeff, 1879: 151, pl. 6 (figs 62–67). Selenka, 1885: 8. Shipley, 1899*a*: 55; 1899*b*: 336, 345, pl. 33 (figs 1, 7). Sluiter, 1902: 47. Augener, 1903: 348. Verrill, 1904: 40. Lanchester, 1905: 34. Fischer, 1922: 15. Hérubel, 1924: 108.

Thalassema kefersteini A. ten Broeke, 1925: 94.

Ochetostoma baronii Fisher, 1946: 241. Stephen, 1960: 513. Mackie, 1961: 247. Stephen & Edmonds, 1972: 429. Amor, 1976: 123.

Ochetostoma edax Fisher, 1946: 245, fig. 14.

Type-locality

Arrecife, Canary Islands (Atlantic Ocean).

Material

One sexually mature female, Pontá Torres, west coast of Inhaca Island; collected by Zoology Department, Witwatersrand University, period 1956–1963.

Two juvenile specimens, Park Rynie Beach, Natal; collected 28 May 1983 and 8 September 1983.

Distribution

Numerous localities in tropical and subtropical waters of the Indian, Atlantic and Pacific oceans (Stephen & Edmonds 1972).

Habitat

At both localities the specimens were found under rocks in the intertidal zone. While the specimen from Inhaca occurred in mud in a permanent pool, those from Park Rynie were found in relatively coarse sand.

Description

Size. Trunk of preserved specimen from Inhaca 66 mm long, greatest diameter 17 mm; proboscis 18 mm long, detached from specimen. Trunk length of Park Rynie specimens 21 mm and 30 mm and proboscis length 6 mm and 8 mm, respectively. Hence proboscis ranges from about a quarter to one-third trunk length.

Colour. In living specimen from Inhaca Island, trunk purple, proboscis pale yellow with fine green stripes. Colour of trunk and proboscis of Park Rynie specimens rich dark green; green coloration due to symbiotic algae. In preserved specimens, colour ranges from pale pink to dull greyish-brown.

External features

Proboscis. Proboscis markedly deciduous. In living specimens may exceed half length of trunk. Proboscis spatula-shaped in living specimens but tubular when preserved (Fig. 5A). Anterior and lateral margins smooth and free at base of proboscis. In smaller specimen from Park Rynie, proboscis detached during narcotization.

Trunk. Trunk sausage-shaped, more or less of uniform diameter in both specimens from Park Rynie. Trunk of Inhaca specimen broad anteriorly but tapering at posterior end (Fig. 5B).

Entire integument of trunk densely covered with minute, rounded papillae. Papillae irregularly distributed, more closely arranged at extremities of trunk and larger posteriorly. Much smaller papillae interspersed among larger ones.

Integument translucent, parts of alimentary canal and nerve cord visible. Longitudinal muscles gathered into 18–20 bands. Inner oblique muscles between longitudinal bands distinctly fasciculated.

Setae. Setae one pair, located on antero-ventral surface of trunk, just posterior to mouth (Fig. 5B). Genital pores two pairs, opening behind setae. Each seta consisting of a cylindrical shaft with curved terminal end (Fig. 5C). Distal bent end slightly flattened. Cylindrical part of shaft with faint concentric markings. Setae embedded in connective tissue and located in cone-shaped setal sacs as in other species. Cylindrical interbasal muscle present.

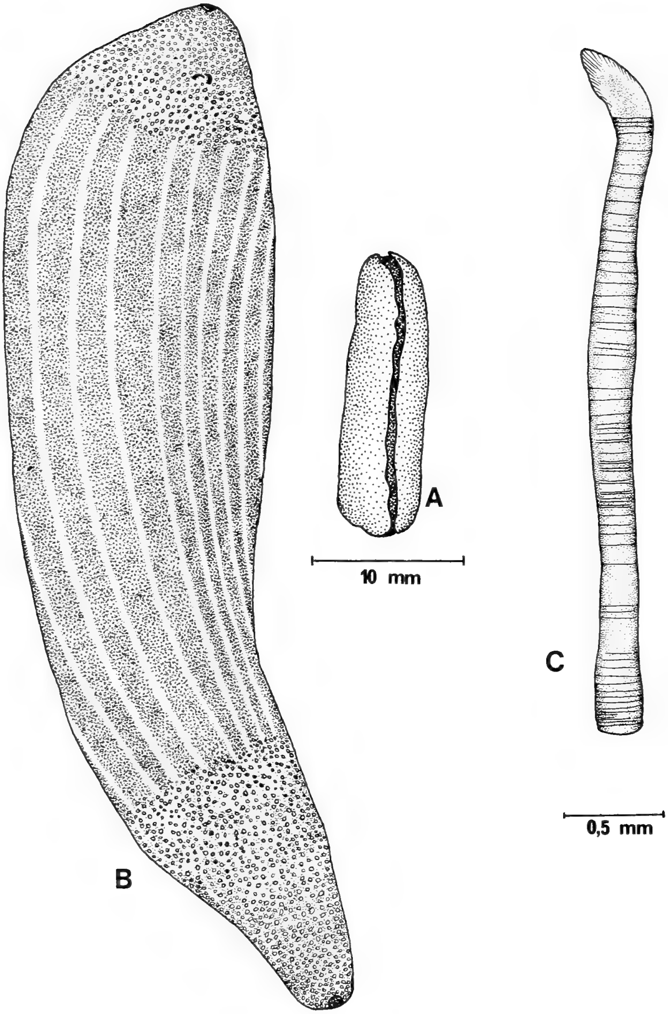

Fig. 5. *Ochetostoma baronii*. A. Detached proboscis. B. Ventral view of trunk. C. Left functional seta.

Internal anatomy

Alimentary canal. Alimentary canal long, coiled, about five times trunk length (Fig. 6). Foregut extremely small, ending at intestinal ring vessel. Gizzard and crop not distinguishable as no distinct boundaries present externally. Fine mesenteric strands fasten alimentary canal to body wall at several points. Numerous dilatations present in intestine due to presence of sand grains and shell fragments. Contents of intestine not in the form of pellets. Small precloacal caecum opening ventrally into rectum.

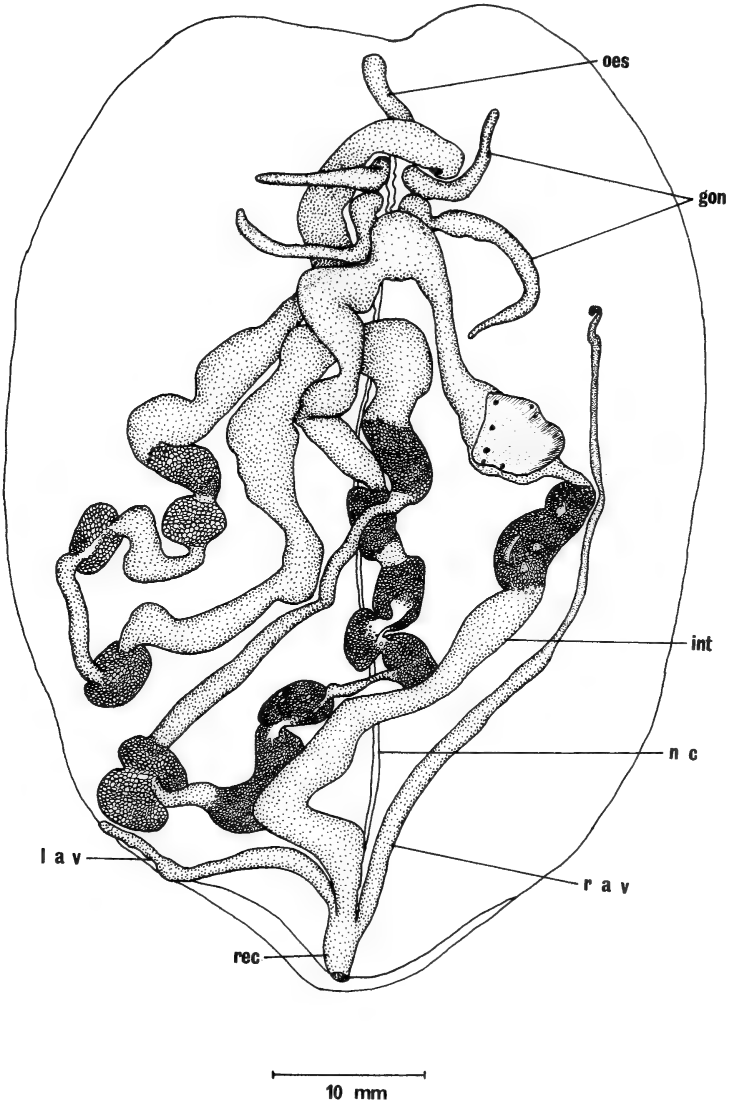

Fig. 6. *Ochetostoma baronii.* Dorsal dissection of the trunk, illustrating the alimentary canal and anal vesicles.

Anal vesicles. Anal vesicles thin-walled, unbranched, blind-ending tubes opening into rectum (Fig. 6). Right anal vesicle of Inhaca specimen two-thirds length of trunk, without ciliated funnels. Left vesicle approximately one-quarter length of trunk with tiny unstalked funnels on distal third. Right anal vesicle of smaller specimen from Park Rynie almost as long as trunk; left one less than one-third trunk length. Both vesicles in larger specimen almost equal to trunk length; ciliated funnels present on vesicles of both specimens.

Gonoducts. Gonoducts two pairs, located posterior to ventral setae (Fig. 7). Gonoducts of Inhaca specimen considerably distended due to presence of numerous ova. Gonostomal lips long, spirally coiled (Fig. 7). Openings of gonostomes basal in position. Both specimens from Park Rynie immature. Gonoducts oval in smaller specimen, somewhat elongate in larger one.

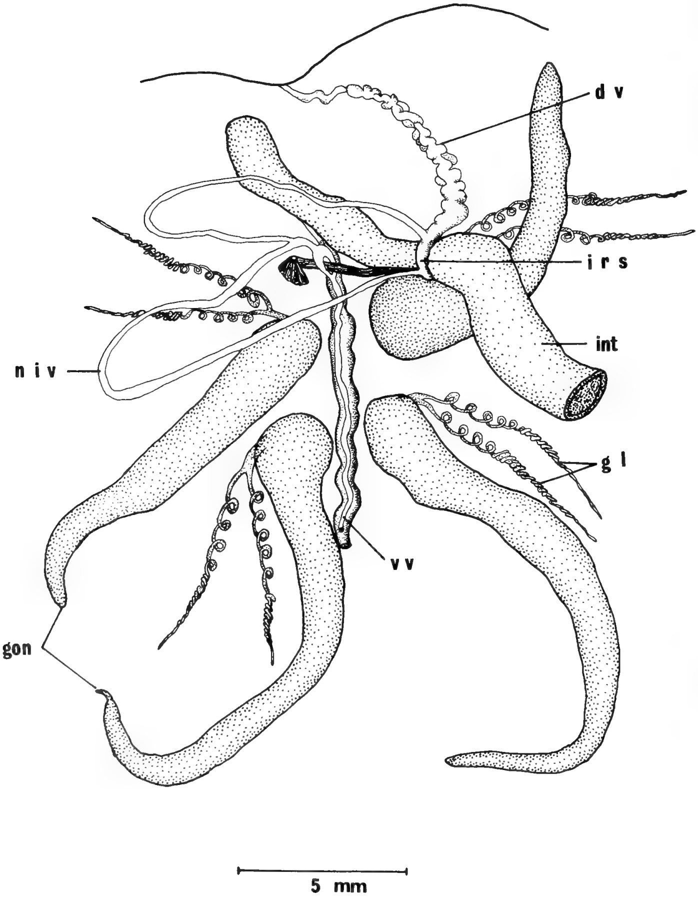

Fig. 7. *Ochetostoma baronii.* Anterior end of the trunk cavity, showing the blood system and gonoducts.

Blood system. Neuro-intestinal vessels paired, elongate, connecting dorsal and ventral vessels by means of intestinal ring sinus (Fig. 7). Ring sinus located at end of foregut. Interbasal muscle passes through loop of neuro-intestinal vessel. Dorsal vessel weakly coiled with numerous small dilatations, passes anteriorly and enters proboscis. Ventral vessel continues posteriorly, beside nerve cord, terminating in region of rectal caecum.

Remarks

The present specimens of *O. baronii* represent new records for the southern African region, extending the range of distribution southwards from the Zanzibar coast.

According to Greeff (1879), the trunk is up to 80 mm in length, dark green in colour with violet longitudinal muscle bands and white papillae scattered over the surface. The longitudinal muscle layer is gathered into 17–19 bands. Selenka's description (1885), however, mentioned the presence of 20–23 muscle bands. An interesting feature mentioned by Greeff (1879), Selenka (1885) and Shipley (1899*a*) is the presence of short branching outgrowths on the anal vesicles.

The present specimens of *O. baronii* from the east coast of southern Africa closely approach the description given by Greeff (1879), except for differences in the structure of the anal vesicles. All the specimens lack the branched outgrowths and conform with the descriptions provided by Fisher (1946), Lanchester (1905) and Amor (1976).

Furthermore, the specimens from southern Africa as well as those examined by Amor (1976) have a markedly deciduous proboscis, a feature that seems to have gone unnoticed by previous authors.

Amor (1976) examined the type specimens of *O. kefersteini* and *O. edax* and compared them with numerous specimens of *O. baronii* collected from the Canary Islands. From this investigation she concluded that both *O. edax* and *O. kefersteini* were synonymous with the species of Greeff. The present study supports Amor's conclusion.

The species of *O. myersae* Edmonds, 1963, based on four specimens from Long Reef, New South Wales, appears to be closely related to *O. baronii* and, according to Edmonds, the colour of living specimens is chlorophyll green. The length of the trunk ranges from 20 mm to 35 mm and the proboscis, which is not readily deciduous, is about a quarter to half the length of the trunk. The longitudinal muscles are gathered into 18–21 bands. An important difference between *O. myersae* and *O. baronii* lies in the oblique muscles, which in the former species are weakly developed. The integument is covered with soft, white, wart-like papillae, which are large and most conspicuous on the posterior third of the trunk. Edmonds (1963) reported the presence of two pairs of postsetal gonoducts in three of his specimens and only one pair in his largest specimen. As in *O. baronii*, an interbasal muscle is present that passes through a loop of the neuro-intestinal vessel. The anal vesicles are thin, elongate tubes that lack branched outgrowths. The ciliated funnels are borne on very short stalks. Hence differences between *O. baronii* and *O. myersae* are apparent in the integument, the proboscis and in the size and arrangement of the dermal papillae. The differences appear to be sufficiently distinctive to retain these as two separate species.

Ochetostoma formosulum (Lampert, 1883)

Figs 8–10

Thalassema formosulum Lampert, 1883: 339. Shipley, 1899*b*: 348. Sluiter, 1902: 48, fig. 13. Wharton, 1913: 248. Prashad, 1921: 35.

Ochetostoma formosulum Fisher, 1946: 241. Wesenberg-Lund, 1963: 140. Datta Gupta *et al.*, 1963: 57, figs 1a–c. Stephen & Edmonds, 1972: 433.

Type-locality

Manila, Philippines.

Material

Two specimens, one sexually mature, from Durban Bay; collected by University of Cape Town Ecological Survey, 1963. One of these specimens (dissected) was described by Wesenberg-Lund (1963).

Distribution

Indo-West-Pacific, from Japan, the Philippines and Indonesia, and the Natal coast.

Habitat

Both specimens occurred in sand at a depth of 8–9 m.

Description

Size. Trunk of intact sexually mature specimen 22 mm long, greatest diameter 11 mm. Proboscis 5 mm long, less than one-quarter trunk length.

Colour. Dissected specimen cream, intact specimen pinkish-brown.

External features

Proboscis. Proboscis fleshy, highly contracted, non-deciduous and more or less spherical in outline (Fig. 8A). A series of tight ridges on lateral edges, margins frilled. Dorsal surface with small, scattered papillae. Proboscis with broad incision at anterior end. Lateral margins fused posteriorly, forming a narrow lower lip.

Trunk. Trunk broad at anterior end, tapering posteriorly (Fig. 8A). White papillae sparsely distributed over middle two-thirds or more of trunk, more closely arranged at extremities. Papillae arranged in rings at posterior end (Fig. 8A). Anus at tip of small, smooth conical projection. A ring of large, elongate papillae around base of conical projection about 3 mm away from posterior tip of trunk. Integument very thin and transparent, somewhat thicker

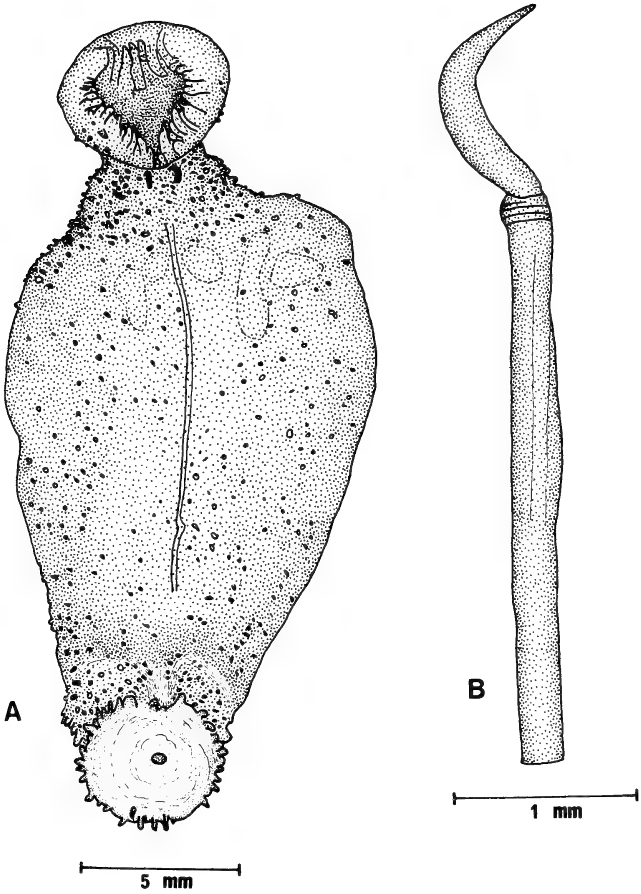

Fig. 8. *Ochetostoma formosulum*. A. Ventral aspect. B. Left functional seta.

and opaque posteriorly. Nerve cord, gonoducts and parts of alimentary canal visible through transparent body wall. Genital pores two pairs, postsetal. Muscle layers continuous over most of trunk. Longitudinal muscle bands indistinct except in posterior third of trunk where narrow bands faintly discernible. Inner oblique muscle layer fasciculated, visible only in posterior end of trunk.

Setae. Setae large, golden-brown in colour, hook-like, about 4 mm long (Fig. 8B). Terminal bent end flattened and clearly demarcated from straight, cylindrical part of shaft by a conspicuous ridge. Both setae located in special sacs, supported by numerous radiating muscle strands. Interbasal muscle cylindrical, passing through small loop of neuro-intestinal vessel.

Internal anatomy

Alimentary system. Alimentary canal long, highly coiled tube, fastened to body wall at several points by thin mesenteric strands. Pharynx club-shaped with

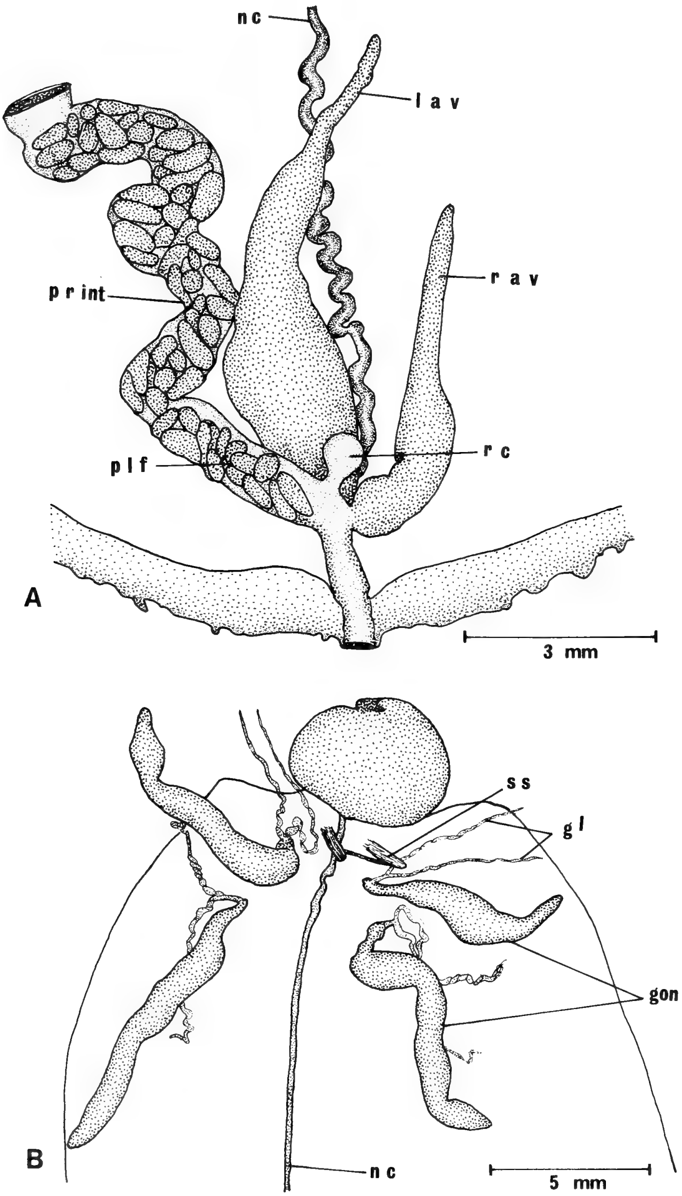

Fig. 9. *Ochetostoma formosulum*. A. Posterior end of trunk cavity, showing the anal vesicles and posterior part of the alimentary canal. B. Anterior part of the trunk cavity, showing the gonoducts.

thick muscular walls. Oesophagus narrow, more or less of uniform diameter. Foregut long, terminating at intestinal ring sinus. Presiphonal region of intestine with a ciliated groove. Intestine considerably dilated, extremely thin-walled and transparent in region of siphon. Entire intestine compactly filled with small, sausage-shaped faecal pellets consisting of fine sand particles (Fig. 9A). Rectal caecum small, spherical.

Anal vesicles. Anal vesicles small, about one-third trunk length, unbranched and transparent (Fig. 9A). Narrow anteriorly but considerably dilated and sac-like posteriorly. Ciliated funnels minute, stalked, sparsely distributed over surface of both vesicles.

Gonoducts. Gonoducts two pairs (Fig. 9B), posterior to ventral setae, oval in juvenile specimen but elongate, tubular and considerably distended in sexually mature individual due to presence of numerous ova. Gonostomal lips thin, spirally coiled; gonostomal openings basal in position.

Blood system. Intestinal ring sinus is an incomplete vascular ring at posterior end of foregut (Fig. 10). Dorsal vessel prominent, continuing anteriorly and entering proboscis. Paired neuro-intestinal vessels short, stout, forming small loop around interbasal muscle (Fig. 10). Heart conspicuous at posterior end of dorsal vessel. Ventral vessel terminating posteriorly in rectal caecum.

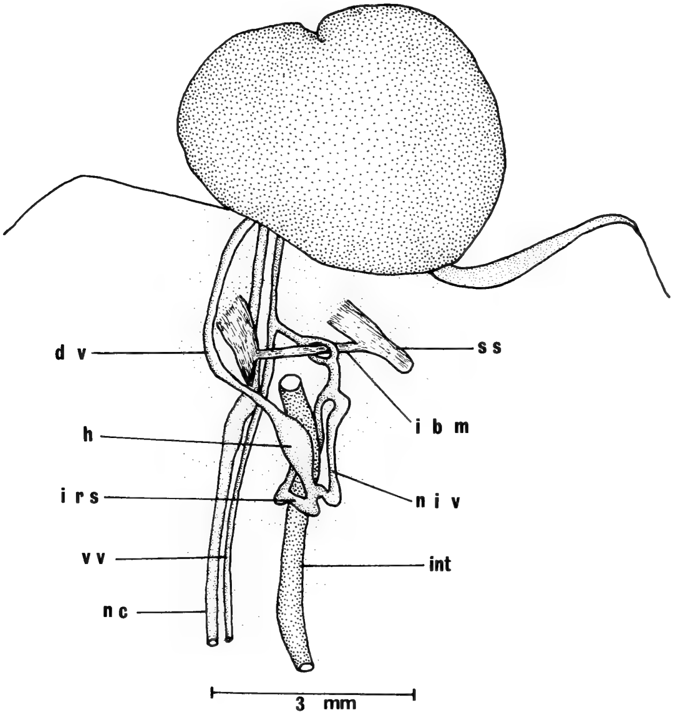

Fig. 10. *Ochetostoma formosulum*. Anterior part of the trunk cavity, showing the blood vessels.

Remarks

Ochetostoma formosulum (Lampert, 1883) was described from a single specimen from Manila, Philippines. This species was later recorded and described from several other localities in the Indo-West-Pacific Ocean. Wesenberg-Lund (1963) recorded and described a single specimen collected from a central sandbank in Durban Bay. Although this species is fairly well known, some features require further discussion.

The most important distinguishing features of *O. formosulum* are the presence of two pairs of postsetal gonoducts with spirally coiled gonostomal lips, a very thin and transparent integument, 6–8 longitudinal muscle bands and an interbasal muscle that passes through a loop of the neuro-intestinal vessel. Other taxonomic features include the proboscis which is less than one-quarter of the trunk length, the frilled lateral margins of the proboscis, and the characteristic shape and distribution of the dermal papillae.

It is rather surprising to note that, with the exception of Wharton (1913), none of the other authors mentioned the presence of an interbasal muscle in this species. In their key to species of *Ochetostoma*, Datta Gupta & Menon (1971) were incorrect in including *O. formosulum* with those species that lack an interbasal muscle.

The description provided by Lampert (1883) mentioned a trunk length of 30 mm and proboscis length of 8 mm. With the exception of the dermal papillae, the present specimens from Durban Bay closely correspond with Lampert's description. According to Lampert (1883) and Wharton (1913), the papillae are not arranged in transverse or longitudinal rows on any part of the trunk.

Sluiter's description (1902) was based on 21 well-preserved specimens from Siboga. The trunk ranged from 15 mm to 23 mm in length and the proboscis from 4 mm to 6 mm. Sluiter also mentioned the presence of a conical projection and a ring of large papillae at the posterior extremity of the trunk.

Wharton's description (1913) was based on a single individual from Samar. The trunk is 35 mm long and the proboscis is less than one-third its length.

The trunk of the single specimen described by Wesenberg-Lund (1963) is 17 mm long and the proboscis 6 mm. Hence from the description provided by the above authors, it is apparent that the proboscis ranges from a quarter to one-third the trunk length. Regarding the dermal papillae, Wesenberg-Lund (1963: 140) stated: 'The dermal organs show a slight tendency to an annular arrangement; they are nowhere especially crowded, and a small area round the posterior end seems almost smooth.'

The anal vesicles are broad and sac-like in the intact specimen from Durban Bay and hence similar to those described by Lampert (1883), Wharton (1913) and Datta Gupta *et al.* (1963). Wesenberg-Lund (1963), however, described these organs as white, transparent tubes.

Ochetostoma formosulum appears to be related to *O. septemyotum* and *O. arkati* in possessing two pairs of gonoducts and 7–8 longitudinal muscle bands. The latter two species, however, besides lacking an interbasal muscle, also differ significantly in the structure of their proboscises. In *O. septemyotum* the lateral margins of the proboscis are produced into a series of folds with dendritic outgrowths; in *O. arkati* gill-like structures are present along the basal edge of the proboscis.

Ochetostoma decameron (Lanchester, 1905)

Figs 11–13

Thalassema decameron Lanchester, 1905: 35, pl. 1 (fig. 5).
Ochetostoma decameron Fisher, 1946: 241. Stephen & Edmonds, 1972: 432.

Holotype

From Ohwaka Bay, Zanzibar; deposited by Lanchester in the British Museum (Natural History).

Material

One sexually mature specimen, Park Rynie Beach (31°19′S 30°44′E), Natal coast; collected 8 September 1983.

Distribution

Ohwaka Bay, Zanzibar, and Natal coast, South Africa.

Habitat

The Park Rynie specimen occurred in sand, under rocks in the intertidal area, close to the high-water mark.

Description

Size. Trunk of preserved specimen 18 mm long, greatest diameter 6 mm. Proboscis half trunk length.

Colour. In living specimen, proboscis pale yellow, trunk reddish-purple. Colour of preserved specimen pale pink.

External features

Proboscis. Proboscis fleshy, non-deciduous, spatula-shaped in living specimens but in preserved condition lateral margins roll inwards forming a tube (Fig. 11A). Anterior and lateral margins smooth. Small, rounded papillae visible on dorsal surface under dissecting microscope. Lateral margins of proboscis united at base, forming a narrow lower lip ventral to mouth.

Trunk. Trunk broad in middle region, tapering more towards posterior end (Fig. 11A). Integument thin and transparent. Small, rounded papillae irregularly distributed over entire surface of trunk, more closely arranged at extremities. Trunk papillae larger than those on proboscis and not of uniform size. Much smaller papillae interspersed among larger ones.

Longitudinal muscle bands not visible from external surface but, under dissecting microscope, 10 inconspicuous bands apparent only in middle region of trunk. Longitudinal and inner oblique muscles form a continuous sheet in mid-dorsal region of trunk. Oblique muscles weakly developed, arranged in fascicles between longitudinal bands.

Setae. Setae one pair, golden-yellow, located about 3 mm away from anterior end of trunk (Fig. 11A). Each seta consisting of a cylindrical shaft with a curved terminal end tapering in a sharp point (Fig. 11B). Distal third of seta much narrower. Interbasal muscle absent.

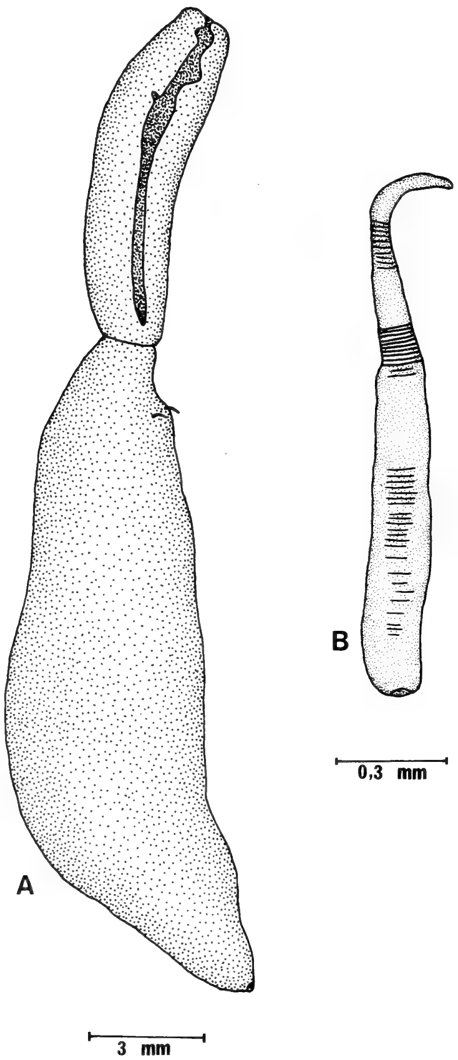

Fig. 11. *Ochetostoma decameron*. A. Ventral aspect. B. Left functional seta.

Internal anatomy

Alimentary canal. Alimentary canal comparatively short, consisting of a few irregular coils (Fig. 12A). Foregut short, narrow tube of uniform diameter, terminating at ring sinus. Thin-walled presiphonal and siphonal regions of intestine compactly filled with coarse sand grains and shell fragments. Intestinal contents not in the form of pellets. Few thin mesenteric strands fastening alimentary canal to body wall. A small spherical rectal caecum present.

Anal vesicles. Anal vesicles thin-walled transparent tubes, about half length of trunk (Fig. 12A). Ciliated funnels few, unstalked over surface of both vesicles.

Gonoducts. Gonoducts four pairs, white in colour; first pair anterior to ventral setae while remaining three pairs postsetal in position (Fig. 12B). Presetal gonoducts smallest of all, situated just anterior to cone-shaped setal sacs and partially obscured by muscle strands radiating from base of setae. Gonoducts spherical to oval and equidistant from each other. Postsetal gonoducts distended due to presence of gametes. Gonostomal lips broad, weakly coiled and large in comparison to size of gonoducts (Fig. 12C). Gonostomal openings basal in position.

Blood system. Neuro-intestinal vessels short, connecting dorsal and ventral vessels by means of intestinal ring sinus. Paired neuro-intestinals unite anteriorly before opening into ventral vessel (Fig. 13). Dorsal vessel prominent, passing anteriorly and entering proboscis. Ventral vessel continuing posteriorly, alongside nerve cord and terminating in rectal caecum.

Remarks

Ochetostoma decameron is based on a single specimen from Zanzibar, in which the proboscis was missing. Its discovery at Park Rynie is a new record for southern Africa. Lanchester's (1905) description was extremely brief and, according to Stephen & Edmonds (1972), the taxonomic position of this species is still uncertain. Nothing is known about the size of the specimen, the structure of the proboscis, the disposition of the oblique muscles, and the distribution of the dermal papillae. Lanchester mentioned the presence of four pairs of gonoducts, with the first two pairs presetal in position. The body wall is extremely thin and the longitudinal muscles are aggregated into 10 fairly broad but inconspicuous bands. According to Stephen & Edmonds (1972), the holotype in the British Museum (Natural History) is damaged and the muscle systems are not clearly evident.

Important distinguishing features of the present specimen from Park Rynie include the four pairs of gonoducts, 10 longitudinal muscle bands, a thin and transparent integument, the narrow lower lip of the proboscis and the characteristic shape and arrangement of the dermal papillae. Other features of lesser taxonomic importance are the colour and size of the specimen.

The present specimen closely approaches Lanchester's (1905) description in the number of gonoducts and longitudinal muscle bands, as well as in the nature

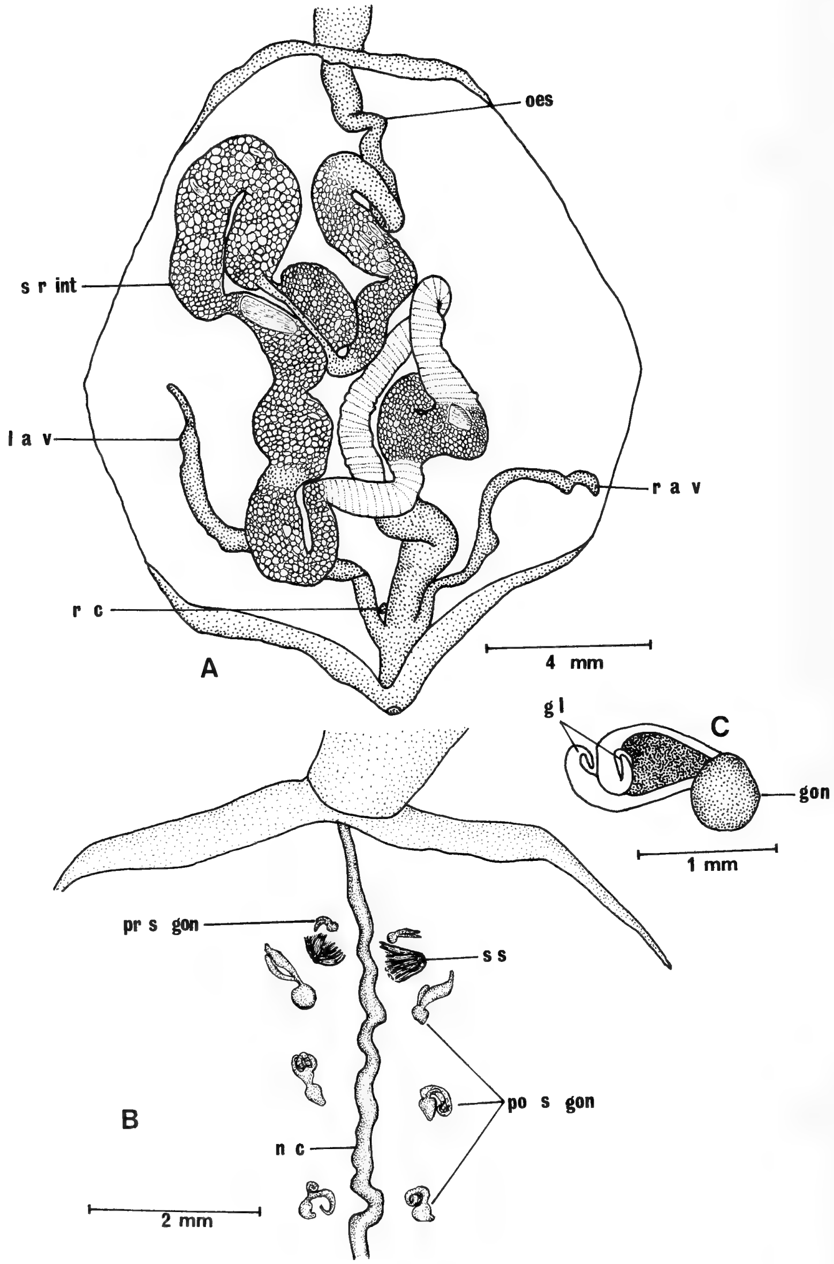

Fig. 12. *Ochetostoma decameron*. A. Dorsal dissection of the trunk, showing the alimentary system and anal vesicles. B. Anterior part of the trunk cavity showing the gonoducts. C. First postsetal gonoduct from left.

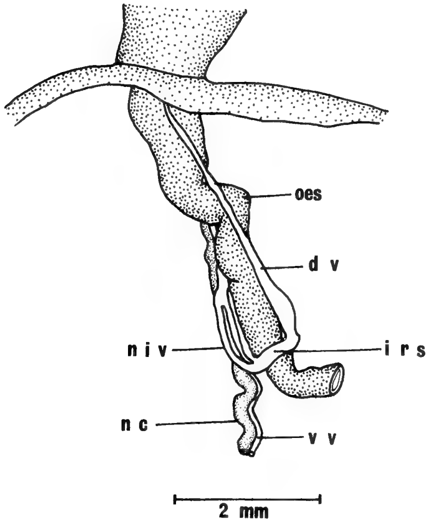

Fig. 13. *Ochetostoma decameron*. Anterior part of trunk cavity, showing blood vessels.

of the integument. An important difference, however, lies in the location of the gonoducts in relation to the ventral setae.

Ochetostoma decameron appears to be related to *O. kempi* in possessing four pairs of gonoducts. According to Prashad (1919), the trunk of *O. kempi* is 77 mm long and the longitudinal muscles are gathered into 20 bands. The integument of the latter species is thick and opaque. Hence, significant differences are present in the size of the animals, in the number of longitudinal muscle bands, and in the nature of the integument. Another distinguishing feature lies in the oblique muscles, which in *O. decameron* are weakly developed.

Additional material in the future will give a better understanding of the variations within *O. decameron* and its taxonomic position.

Ochetostoma kempi (Prashad, 1919)

Figs 14–16B

Thalassema kempi Prashad, 1919: 336, fig. 2; 1935: 41.
Ochetostoma kempi Fisher, 1946: 241. Datta Gupta & Menon, 1971: 176, fig. 2. Stephen & Edmonds, 1972: 437.

Holotype

From the Andaman Islands; deposited by Prashad in the Indian Museum, Calcutta (cat. no. W194/4).

Material

One specimen, Isipingo Beach (29°05′S 30°56′E), Natal coast; collected 12 May 1983.

Distribution

Andaman Islands and Natal coast, South Africa.

Habitat

The specimen from Isipingo Beach occurred in sand under rocks in a rock tunnel, in the intertidal zone close to the high-water mark.

Description

Size. Trunk of preserved specimen 69 mm in length, greatest diameter 16 mm. Proboscis 39 mm long, slightly exceeding half length of trunk.

Colour. In live animal, proboscis pale yellow, trunk with reddish-purple stripes marking longitudinal muscle bands. Interspaces narrow, bluish-grey in colour. In preserved condition the colour changed to light brown.

External features

Proboscis. Proboscis fleshy, non-deciduous, slightly truncated at anterior end. Spatula-shaped in live specimen but in preserved state lateral margins curl inwards forming a narrow tube (Fig. 14A). Lateral margins of proboscis smooth and free at base.

Trunk. Trunk sausage-shaped, tapering posteriorly (Fig. 14A). Small, rounded papillae irregularly distributed over entire surface of integument. Papillae minute on anterior two-thirds or more of trunk but larger posteriorly. Entire integument thick and opaque. Longitudinal muscle layer gathered into 17–19 bands; inner oblique muscles between longitudinal bands distinctly fasciculated. A pair of golden-yellow setae located about 8 mm away from anterior end of trunk.

Setae. Each seta consisting of a cylindrical shaft with curved terminal end, tapering in a pointed tip (Fig. 14B). Proximal end of shaft slightly bent. Non-functional or replacement seta small, in close association with right functional one (Fig. 14C). Fine concentric ridges on surface of both setae. Interbasal muscle absent.

Internal anatomy

Alimentary canal. Alimentary canal slightly coiled, several times length of trunk. Intestine attached to body wall at several points by very thin and elongate mesenteric strands. Ventral sheet of mesentery attaching oesophagus to body wall. Foregut small, ending at ring sinus. Intestine subdivided into presiphonal, siphonal and postsiphonal regions as in related species. Presiphonal region with ciliated groove. Intestine considerably dilated and extremely thin-walled in region of siphon. Gut compactly filled with fine sand grains and shell fragments, not moulded into pellets. Rectal caecum large and spherical (Fig. 15).

Anal vesicles. Paired anal vesicles long, slender tubes exceeding length of trunk (Fig. 15). Numerous, tiny, unstalked ciliated funnels on surface of both vesicles.

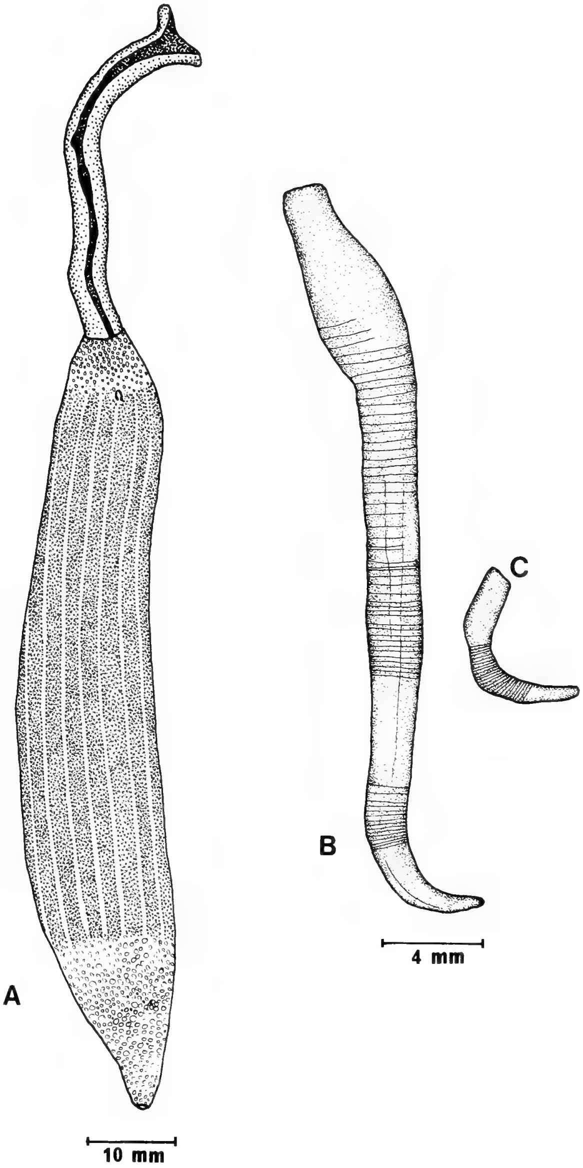

Fig. 14. *Ochetostoma kempi*. A. Ventral aspect. B. Right functional seta. C. Much smaller, non-functional seta.

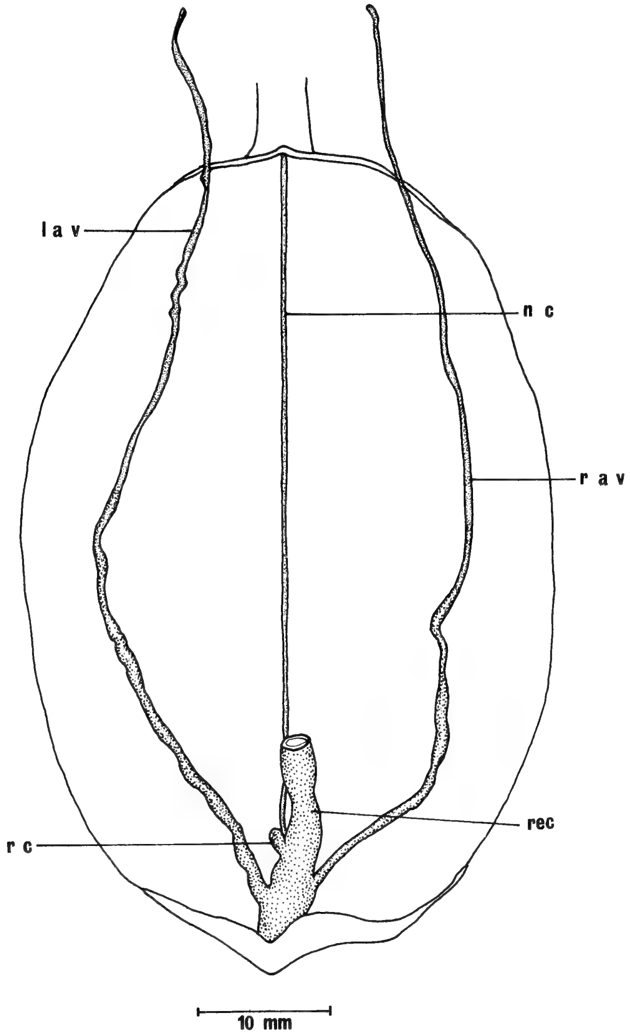

Fig. 15. *Ochetostoma kempi*. Dorsal dissection of the trunk, showing the anal vesicles.

Gonoducts. Gonoducts four pairs, first pair presetal (Fig. 16A). Arrangement of gonoducts asymmetrical; right presetal gonoduct slightly anterior to corresponding one on left. Second and third pairs on both sides located very close to each other, with second pair anterolateral in position to third pair. First and second pairs of gonoducts small, more or less oval while fourth pair elongate, tubular and largest of all (Fig. 16A). Gonostomal lips small, spirally coiled, opening into base of gonoduct.

Blood system. Ring sinus at end of foregut is an incomplete vascular ring (Fig. 16B). Paired neuro-intestinal vessels unite prior to opening into ventral

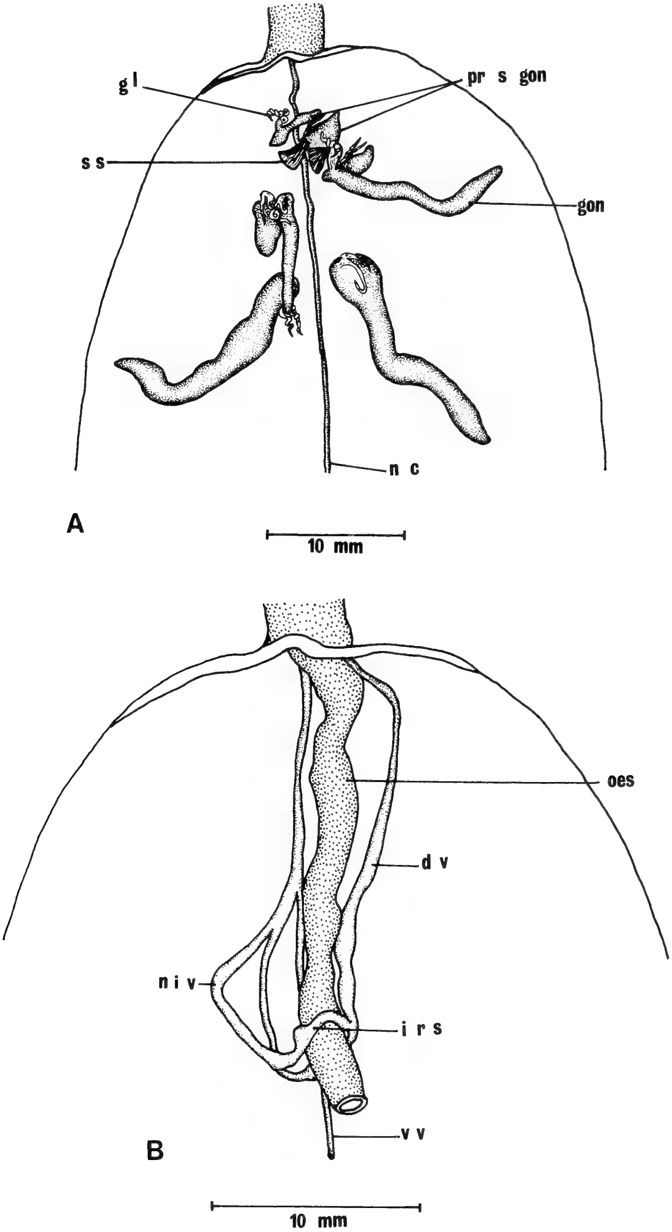

Fig. 16. *Ochetostoma kempi*. Anterior part of trunk cavity. A. Gonoducts. B. Blood vessels.

vessel. Dorsal vessel prominent, arising from ring sinus and passing anteriorly into proboscis. Ventral vessel terminating near rectal caecum.

Remarks

The discovery of *O. kempi* from Isipingo is a new record for southern Africa. However, it is not unexpected for this species to be found as far west as the east coast of southern Africa.

According to Prashad (1919), the trunk, which is 77 mm in length, is wider in the middle region but gradually tapers at both ends. The proboscis is short and stumpy and slightly truncated at the anterior end. It is 17 mm long and hence less than a quarter the trunk length. Prashad stated that both the proboscis and trunk are covered with papillae. On the proboscis, the papillae are minute and just visible, while on the trunk they are small anteriorly but gradually increase in size at the posterior end. A few large papillae are also scattered among the smaller ones over the whole surface. The longitudinal muscle layer is gathered into 20 bands. According to Prashad (1919), there are four pairs of gonoducts located posterior to the ventral setae. The first two pairs are poorly developed but the fourth pair is the best developed of all. The anal vesicles are very much contracted and about one-third the length of the trunk. Prashad (1935), however, re-examined the holotype of *O. kempi* and found that the first two pairs of gonoducts were presetal in position.

The present specimen from Isipingo differs from the type specimen in several respects. The most important differences lie in the position of the gonoducts in relation to the ventral setae, the size and arrangement of the dermal papillae, and the length of the anal vesicles. The papillae on the anterior two-thirds of the trunk are small and evenly distributed and are not interrupted by larger papillae. The differences in the size of the proboscis and anal vesicles could be due to different degrees of contraction of these organs during narcotization and fixation. It is very likely that Prashad's (1919) description was based on a specimen that was highly contracted.

Datta Gupta & Menon (1971) identified a specimen, also collected from the Andaman Islands, as *O. kempi*. According to these authors, the proboscis is nearly tubular with the lateral margins slightly indented. The body is covered with rounded papillae that are prominent towards the posterior end. An interesting feature about their specimen is that the extreme posterior end of the trunk is devoid of papillae and is made up of concentric fleshy rings. The longitudinal muscle layer is gathered into 20 bands. These authors also mentioned the presence of four pairs of gonoducts, with the first pair presetal in position. Hence the arrangement of the gonoducts, in relation to the ventral setae, conforms with that of the specimen from Isipingo. The size and distribution of the dermal papillae and the anatomy of the blood system are also very similar. The specimen described by Datta Gupta & Menon (1971), however, differs in lacking a rectal caecum. The posterior end of the trunk of their specimen also appears to be rather unusual. Unfortunately, these authors did not give any details regarding the size of their specimen. However, from their illustration it is apparent that the proboscis is about half the length of the trunk.

The specimen from Isipingo is ascribed to *O. kempi* on the basis of the number of gonoducts and longitudinal muscle bands. According to Datta Gupta (1976) and Saxena (1983), the number of gonoducts is constant within a species and is an important taxonomic character in echiurans.

Ochetostoma kempi appears to be related to *O. decameron* in possessing four pairs of gonoducts. Significant differences, however, occur in the size of the animals, in the number of longitudinal muscle bands and in the nature of their integuments. Additional material in the future should give a better understanding of the variations within *O. kempi*.

Ochetostoma palense (Ikeda, 1924)

Figs 17–19B

Thalassema palense Ikeda, 1924: 39, figs 13–15.
Ochetostoma palense Stephen & Edmonds, 1972: 440.

Material

One specimen, Isipingo Beach (29°05′S 30°56′E), Natal coast; collected 13 June 1983.

Distribution

Known only from the holotype from Palau Islands, Japan, and Natal coast, South Africa.

Habitat

The Isipingo specimen occurred in coarse sand under rocks in a rock tunnel, in the intertidal area, close to the high-water mark.

Description

Size. Trunk of preserved specimen 22 mm long, greatest diameter of trunk 7 mm. Proboscis 7 mm long, about one-third trunk length.

Colour. In living specimen, proboscis pale yellow, trunk reddish-purple. Preserved specimen white.

External features

Proboscis. Proboscis spatulate, non-deciduous; lateral margins smooth and free at base. When preserved, lateral edges of proboscis curl inwards forming a tube (Fig. 17A).

Trunk. Trunk cylindrical, tapering gradually towards posterior end (Fig. 17A). Anus at tip of small conical projection. Papillae small, rounded, irregularly distributed over entire surface of trunk, more closely arranged at posterior end. Integument extremely thin and transparent. Nerve cord and other internal organs visible through transparent body wall. Longitudinal muscle bands

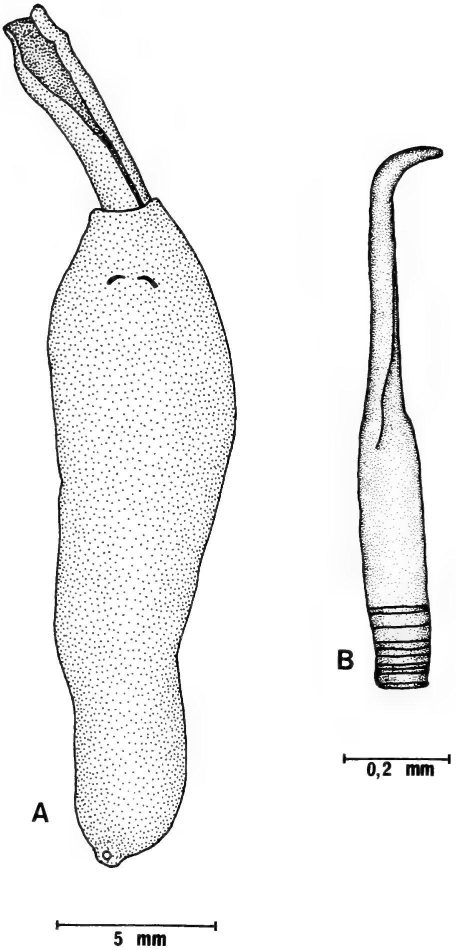

Fig. 17. *Ochetostoma palense*. A. Ventral aspect. B. Right functional seta.

not visible externally. In dissected specimen, 15 inconspicuous muscle bands apparent only in posterior half of trunk. Interspaces narrow. In anterior half of trunk longitudinal and oblique muscles form a continuous sheet. Oblique muscles between longitudinal bands weakly fasciculated.

Setae. Setae minute, golden-yellow, about 3 mm away from anterior end of trunk. When dissected out and viewed under compound microscope, each seta consists of a straight shaft with a curved terminal end (Fig. 17B). Proximal half of shaft broader with a few concentric markings at base. Interbasal muscle absent.

Internal anatomy

Alimentary canal. Alimentary canal comparatively short, about three times trunk length and with relatively few coils (Fig. 18). Intestine attached to body wall by a few thin mesenteric strands. Foregut is a narrow tube, about 4 mm long, ending at ring sinus. Presiphonal region of intestine 6 mm in length, marked by presence of a ciliated groove. Ciliated groove commences soon after ring sinus and leads into intestinal siphon. Siphonal region of intestine considerably dilated and extremely thin-walled. Intestine narrows in postsiphonal region and leads into more or less straight rectum. A small, spherical rectal caecum present.

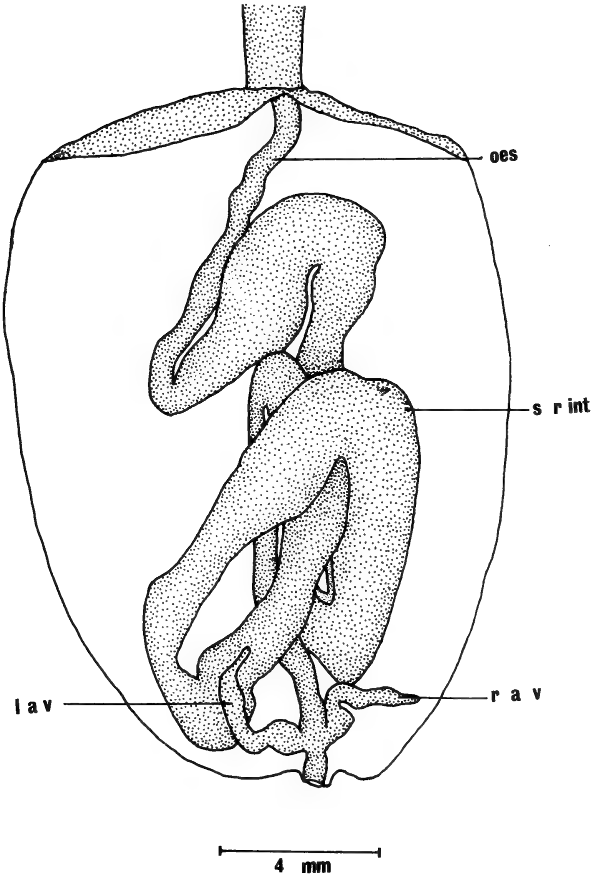

Fig. 18. *Ochetostoma palense*. Dorsal dissection of the trunk, showing the alimentary canal.

Anal vesicles. Anal vesicles (Fig. 18) small, less than one-quarter trunk length. Ciliated funnels minute, unstalked, on surface of both vesicles.

Gonoducts. Gonoducts three pairs, spherical to somewhat oval in shape with weakly coiled gonostomal lips (Fig. 19A). First pair of gonoducts presetal. Gonostomal lips broad, unlike condition in several other species of *Ochetostoma*. Second and third pairs of gonoducts much larger than first pair.

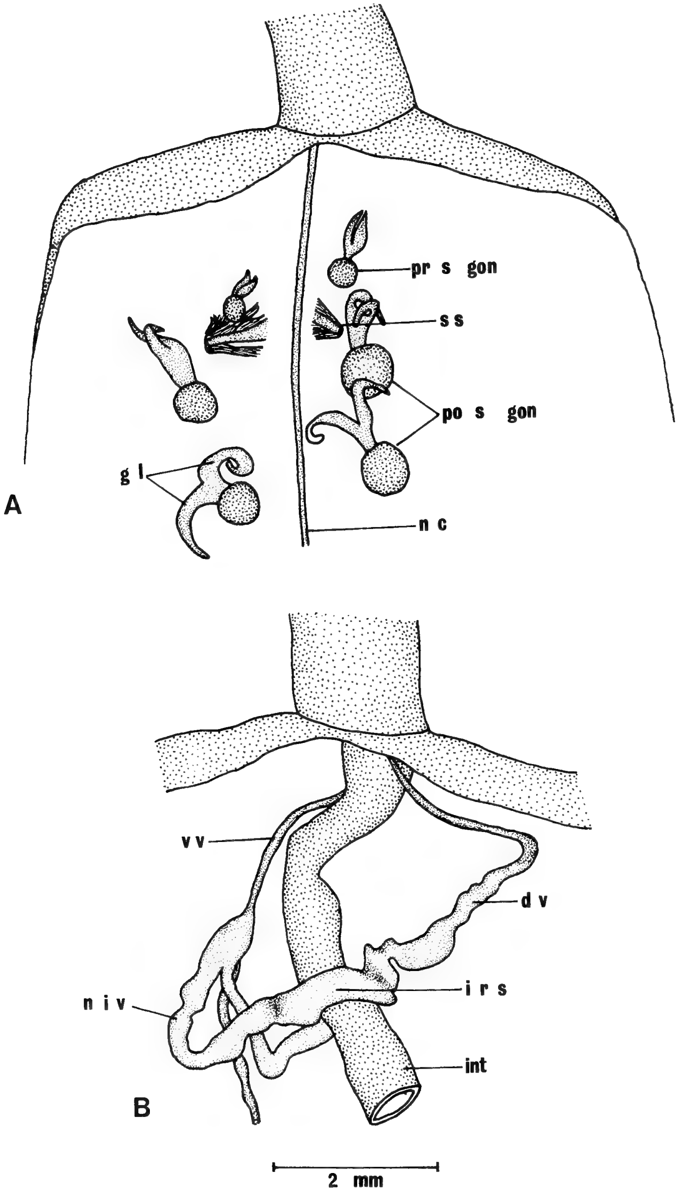

Fig. 19. *Ochetostoma palense*. Anterior part of the trunk cavity. A. Gonoducts. B. Blood vessels.

Blood system. Intestinal ring sinus is an incomplete vascular ring at end of foregut (Fig. 19B). Paired neuro-intestinal vessels unite before opening into ventral vessel. Dorsal vessel prominent, arising from ring sinus and entering proboscis.

Remarks

Ochetostoma palense (Ikeda, 1924) is based on a single specimen from Palau Islands, Japan. The holotype is small, about 22 mm in its entire length, of which about one-quarter belongs to the proboscis. The pear-shaped trunk is 8 mm at its widest part. Ikeda mentioned that the animal is uniformly bright green in life. The thin and transparent integument is covered with minute papillae, which are larger and more closely arranged at the extremities of the trunk. The longitudinal muscles are gathered into 15 bands that are apparent only on a small portion of the anterior part of the trunk. An interbasal muscle is absent. There are three pairs of spherical gonoducts with slightly coiled gonostomal lips. The first pair of gonoducts are presetal. The anal vesicles are thin-walled tubes, over half the length of the trunk, with few unstalked funnels. A rectal caecum is absent. According to Ikeda (1924) the alimentary canal is short as compared with the size of the animal, with a few irregular coils.

The present specimen from Isipingo is similar to the Japanese specimen in size, distribution of the dermal papillae, the nature of the integument, as well as in the number of gonoducts and longitudinal muscle bands. In both specimens the gonostomal lips are weakly coiled. The specimen from Isipingo, however, differs in possessing a rectal caecum. Differences are also present in the colour of the animals as well as in the lengths of the anal vesicles.

Ochetostoma palense appears to be closely related to *O. erythrogrammon* Leuckart & Rüppell, 1828, and Wesenberg-Lund (1939) considered the species to be synonymous. However, there are several features that tend to separate the two species. An interesting feature of the specimen from Isipingo is that the alimentary canal is comparatively short, about three times the trunk length. In *O. erythrogrammon* it is long and highly coiled, and measurements made in a few specimens have shown that it is five times as long as the trunk. The gonostomal lips of *O. palense*, unlike those of *O. erythrogrammon*, are not thread-like and are only weakly coiled. Another distinguishing feature is that the longitudinal muscle bands of *O. palense* are not conspicuous throughout the trunk. Furthermore, the oblique muscles between the longitudinal bands are very weakly developed.

Stephen & Edmonds (1972) refrained from placing *O. palense* in the synonymy of *O. erythrogrammon* mainly because of the differences in the dimensions of the alimentary canal and in the disposition of the gonostomal lips. In view of the above differences, it has been decided to retain *O. palense* as a species distinct from *O. erythrogrammon*. Any further decisions will have to await the collection of more, preferably adult, material.

Ochetostoma arkati (Prashad, 1935)

Thalassema arkati Prashad, 1935: 41, figs 1–4.
Ochetostoma arkati: Wesenberg-Lund, 1959: 203, figs 13–14; 1963: 141.

Type-locality

Sandheads off the mouth of the River Hooghly, Ganges Delta, Calcutta.

Diagnosis

Proboscis short and stumpy, a third to a quarter of total length of animal; edges of posterior half form short, branched, gill-like processes. Ventral margins of proboscis free at base. Dorsal surface of proboscis smooth; ventral side trough-shaped, deepest at proximal end. Trunk oval, up to 38 mm in length, covered with minute, round to oval papillae, which are very sparse or absent in middle region. Borders of anus deeply crenulated and scalloped. Area around anus smooth, thin-skinned and devoid of papillae. Longitudinal muscle layer gathered into 7–8 bands, separated by broad interspaces. Two pairs of postsetal, tubular gonoducts almost as long as trunk; gonostomal lips elongate and spirally coiled. Anal vesicles yellowish, very thin and about one-third length of animal.

Distribution

Calcutta, India (Prashad 1935); African coast, Nigeria and Cape Town (Wesenberg-Lund 1959), and Port Elizabeth (Wesenberg-Lund 1963). It is very likely that this species is widely distributed through the western part of the Indo-Pacific, and the southern part of the eastern Atlantic.

Remarks

Wesenberg-Lund's (1959, 1963) material agreed with Prashad's (1935) description, except that the number of longitudinal muscle bands was 7–8 instead of eight. *Ochetostoma arkati* is adequately described and is distinct from all the other species in the genus in possessing branched, gill-like processes along the edges of the posterior half of the proboscis.

Ochetostoma capense Jones & Stephen, 1955

Ochetostoma capensis Jones & Stephen, 1955: 273, figs 1–3. Wesenberg-Lund, 1963: 142.

Diagnosis

Proboscis small, in preserved specimens about one-eighth of trunk length and in living specimens one-twelfth to one-third; ventral edges crenate when proboscis is extended, but thrown into a series of tight ridges when contracted. Colour varies from cream, through different shades of cream-yellow, to light orange. Trunk up to 120 mm when fully extended, thickly covered with papillae on anterior ventral surface but fewer at posterior end. Papillae dispersed in rows in middle region of trunk. Colour of trunk variable, ranging from dark grey-brown to purple-brown. Trunk cylindrical or sausage-shaped and typically widest at posterior end. Longitudinal muscles gathered into seven main bands, most conspicuous at ends of trunk. A few weakly developed bands occur in between the main bands. Two pairs of tubular, postsetal gonoducts, usually half to three-quarters as long as trunk, but sometimes quite short. Gonostomal lips extended into long spiral filaments. Interbasal muscle present, passes through a loop of neuro-intestinal vessel. Anal vesicles long, thin, brown tubes of variable length, from one- to three-quarters of trunk length and bearing minute, ciliated funnels, which are most numerous towards the free ends of the vesicles. Rectal caecum present.

Distribution

Zwartkops River, Langebaan Lagoon and Durban Bay (Jones & Stephen 1955).

Remarks

Ochetostoma capense is based on a large number of specimens. It is the only estuarine species recorded from southern Africa, and is probably endemic. This species appears to be related to *O. septemyotum* Datta Gupta, Menon & Johnson, 1963, but differs significantly in the structure of the proboscis. This species has been illustrated and fully described (Jones & Stephen 1955).

Ochetostoma sp.

Figs 20–23

Material

One sexually mature female, Park Rynie Beach, Natal; collected 7 June 1982.

Habitat

The specimen occurred in the intertidal zone in relatively coarse sand under a projecting ledge of rock facing the shore.

Description

Size. Trunk of preserved specimen 40 mm in length, greatest diameter 8 mm. Proboscis 11 mm, about one-quarter as long as trunk.

Colour. Proboscis pale yellow in living specimen. Longitudinal stripes marking longitudinal muscle bands dark red, interspaces bluish-grey. Colour of preserved specimen pale pink.

External features

Proboscis. Proboscis non-deciduous, shovel-shaped with smooth lateral and terminal margins (Fig. 20). Lateral margins of proboscis fuse at base forming a narrow lower lip ventral to mouth. Ventral groove of proboscis smooth but dorsal surface covered with minute, densely arranged, rounded papillae.

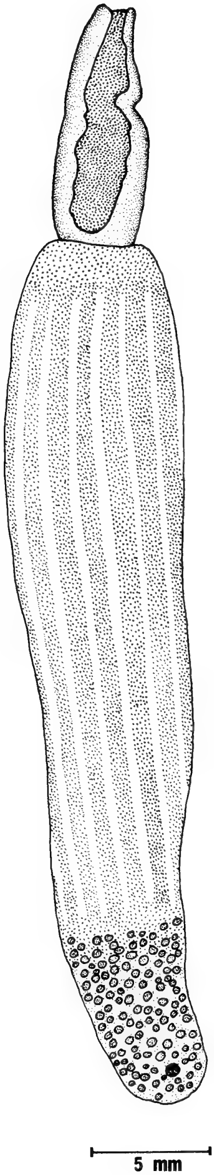

Fig. 20. *Ochetostoma* sp. Ventral aspect.

Trunk. Trunk sausage-shaped, tapering more towards posterior end (Fig. 20). Entire integument densely covered with small, rounded papillae. Papillae much larger and white in colour at posterior end of trunk. Longitudinal muscles aggregated into 20 bands; inner oblique muscles between longitudinal bands distinctly fasciculated. Entire integument thick and opaque. Ventral setae missing. Two tiny scars on integument indicate that setae have fallen off. Interbasal muscle absent.

Internal anatomy

Alimentary canal. Alimentary canal long, consisting of several ascending and descending limbs. An interesting feature is the presence of numerous, closely arranged, white mesenteric strands along entire length of gut (Fig. 21). Oesophagus comparatively short, terminating at ring sinus. A ventral sheet of mesentery fastens oesophagus to body wall. Intestine shows usual divisions into presiphonal, siphonal and postsiphonal regions. Presiphonal region of intestine with a ciliated groove commencing soon after ring vessel. In region of siphon, intestine considerably dilated and thin-walled. A small, spherical rectal caecum present.

Anal vesicles. Anal vesicles paired distensible tubes exceeding length of trunk (Fig. 21). Both vesicles covered with tiny, unstalked ciliated funnels. Funnels more numerous at distal ends of vesicles.

Gonoducts. Gonoducts three pairs, tubular, light brown in colour. First pair smallest, located anterior to ventral setae (Fig. 22A). Gonostomal lips small, weakly coiled (Fig. 22B), unlike condition in several other species of *Ochetostoma*. Gonostomes robust, and not thread-like in appearance. Proximal end of gonostome broad and sac-like. All gonoducts compactly filled with eggs, visible through transparent wall.

Blood system. Ring sinus is an incomplete vascular ring located at end of foregut (Fig. 23). Paired neuro-intestinal vessels unite before opening into ventral vessel. As in other species, dorsal vessel passes anteriorly and enters proboscis.

Remarks

Important features of the present specimen include: the presence of an unusually large number of mesenteric strands attaching the gut to the body wall, the structure of the gonostomes, and the 1 : 4 ratio of the proboscis to the trunk length. Another distinguishing feature seems to be the small size of the sexually mature specimen.

Ochetostoma erythrogrammon, *O. caudex*, *O. palense*, *O. australiense* and *O. indosinense* possess three pairs of gonoducts and 12–22 longitudinal muscle bands and hence appear to be related to this specimen from Park Rynie.

The trunk length of sexually mature specimens of *O. caudex* ranges from 72 mm to 105 mm (Biseswar 1983), and in *O. erythrogrammon* from 80 mm to 160 mm (Stephen & Edmonds 1972). In both these species, the proboscis is one-third to three-quarters as long as the trunk. This sexually mature specimen of

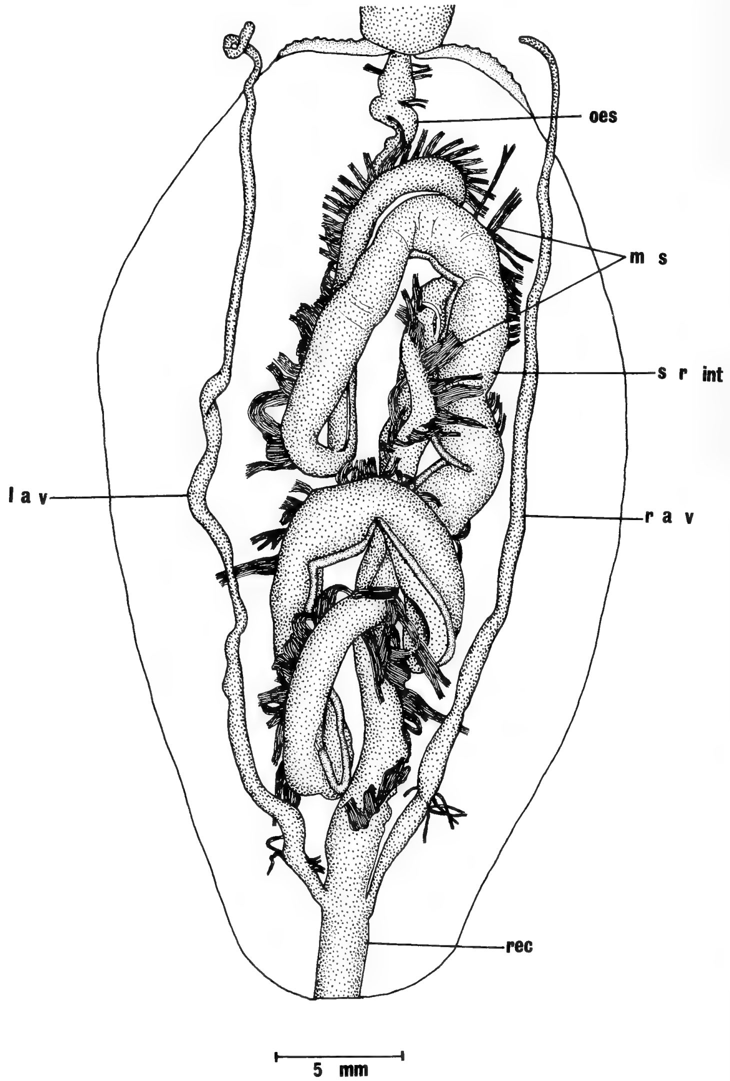

Fig. 21. *Ochetostoma* sp. Dorsal dissection of the trunk, showing the alimentary system and anal vesicles.

Ochetostoma sp., however, is small, with a trunk length of only 40 mm and the proboscis is about one-quarter as long.

In addition, this specimen has a proboscis in which the lateral margins unite posteriorly to form a narrow lower lip.

Another distinguishing feature of the present specimen lies in the structure of the gonostomes. The gonostomal lips, unlike those of *O. caudex* and *O. erythrogrammon*, are comparatively small and are not spirally coiled. Furthermore, in

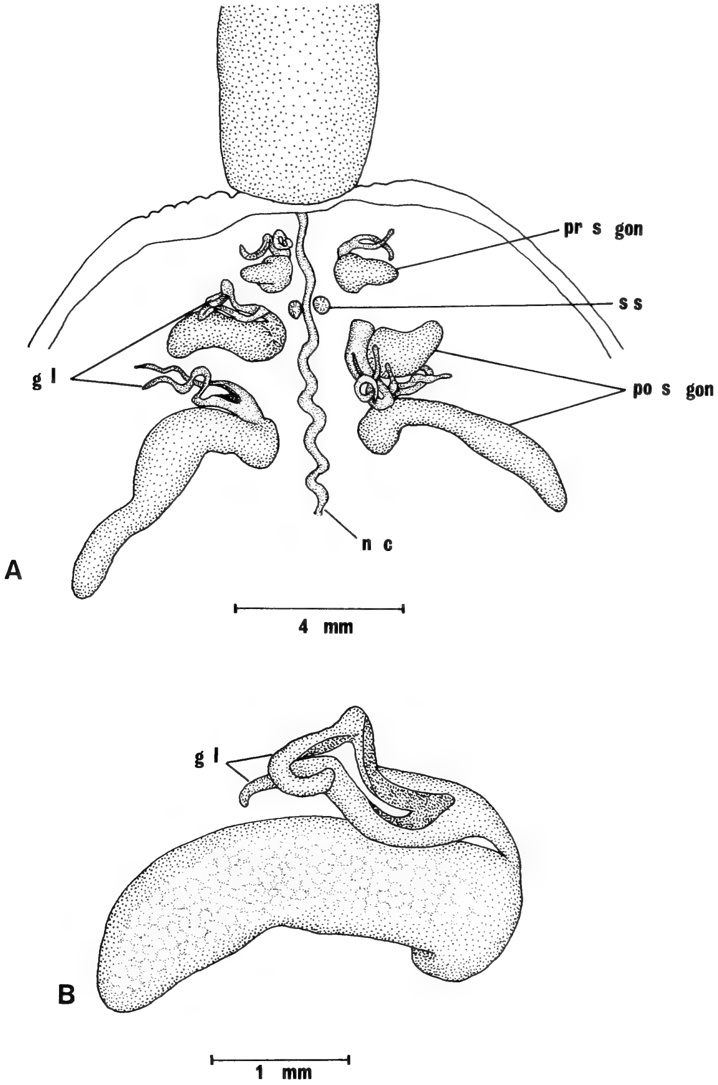

Fig. 22. *Ochetostoma* sp. A. Anterior part of trunk cavity, showing the gonoducts. B. First postsetal gonoduct.

the latter two species, the mesenteric strands that fasten the gut to the body wall are relatively few.

In *O. palense* the trunk is 22 mm long and the integument is thin and transparent. Furthermore, the longitudinal muscle layer is gathered into 15 bands, which are apparent only on a small portion of the anterior part of the trunk. Hence *O. palense* differs from the present specimen in size as well as in the nature of the integument. Another important feature that distinguishes

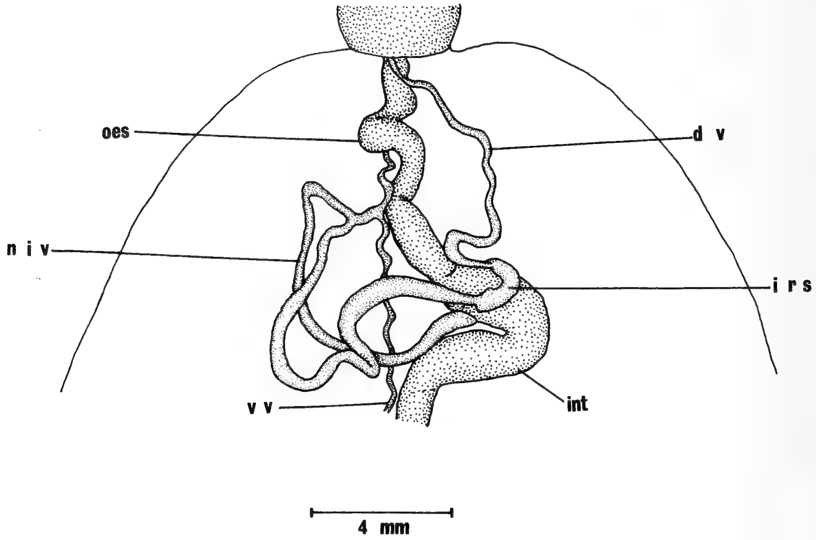

Fig. 23. *Ochetostoma* sp. Anterior part of the trunk cavity, showing blood vessels.

O. palense is the presence of a comparatively short alimentary canal with a few irregular coils. Ikeda (1924) also mentioned the absence of a rectal caecum.

In *O. australiense* the proboscis is up to 41 mm long and the trunk is up to 102 mm in length. The Australian specimens usually have 12–13 longitudinal muscle bands, very occasionally 11–14. The gonostomal lips are long and spirally coiled. According to Edmonds (1960), the anterior and posterior surfaces of the trunk bear small flat papillae. Differences between *O. australiense* and the present specimen are evident in the size of the animals, the number of longitudinal muscle bands, the structure of the gonostomal lips and in the nature and distribution of the dermal papillae.

Ochetostoma indosinense Wesenberg-Lund, 1939, from South Annam, is known only from the holotype. In this species, the proboscis is 9 mm long and the trunk length is 50 mm. According to Wesenberg-Lund (1939) the proboscis is slightly bifurcated with the ventral and terminal rims crenated. The proboscis is light green in life and the trunk is pink. There are 18 longitudinal muscle bands with narrow interspaces. The gonostomal lips are long but not coiled. *Ochetostoma indosinense* differs from the present specimen in several respects. The proboscis of *O. indosinense* is not typical of *Ochetostoma*. Furthermore, the inner oblique muscle layer is very thin and continuous. *Ochetostoma indosinense* also differs in lacking a rectal caecum. Differences are also present in the colour of live animals.

There seems little doubt, therefore, that this specimen from Park Rynie differs in several respects from other known species of *Ochetostoma* that possess three pairs of gonoducts. A closer study of additional specimens in the future may well indicate that the present specimen represents an undescribed species.

ACKNOWLEDGEMENTS

I wish to thank Dr Jennifer A. Day of the Department of Zoology, University of Cape Town, for her constructive criticism of the manuscript. Financial support for this research was provided by the Council for Scientific and Industrial Research. Thanks are also due to the University of Durban-Westville for contributing to publication costs and for facilities. The assistance given by my colleagues, Messrs K. S. Ganga and G. K. Moodley, during collecting trips is gratefully acknowledged.

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ABBREVIATIONS

a v	anal vesicle	n i v	neuro-intestinal vessel
d v	dorsal vessel	oes	oesophagus
g l	gonostomal lip	p l f	pellet-like faeces
gon	gonoduct	p r int	postsiphonal region of intestine
h	heart	po s gon	postsetal gonoduct
i b m	interbasal muscle	pr s gon	presetal gonoduct
int	intestine	r a v	right anal vesicle
i r s	intestinal ring sinus	r c	rectal caecum
l a v	left anal vesicle	rec	rectum
m c	mucous cap	s s	setal sac
m s	mesenteric strand	s r int	siphonal region of intestine
n c	nerve cord	v v	ventral vessel

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. BISESWAR

OCHETOSTOMA (ECHIURA) FROM SOUTHERN AFRICA WITH A DESCRIPTION OF A NEW SPECIES

VOLUME 98 PART 3 MAY 1988 ISSN 0303-2515

ANNALS OF THE SOUTH AFRICAN MUSEUM

CAPE TOWN

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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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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)

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

Volume **98** Band
May **1988** Mei
Part **3** Deel

SOUTH AFRICAN SPECIES OF THE GENUS *GERYON* (CRUSTACEA, DECAPODA, GERYONIDAE)

By

RAYMOND B. MANNING

&

L. B. HOLTHUIS

Cape Town Kaapstad

The ANNALS OF THE SOUTH AFRICAN MUSEUM

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Obtainable from the South African Museum, P.O. Box 61, Cape Town 8000

Die ANNALE VAN DIE SUID-AFRIKAANSE MUSEUM

word uitgegee in dele op ongereelde tye na gelang van die
beskikbaarheid van stof

Verkrygbaar van die Suid-Afrikaanse Museum, Posbus 61, Kaapstad 8000

OUT OF PRINT/UIT DRUK

1, 2(1–3, 5–8), 3(1–2, 4–5, 8, t.–p.i.), 5(1–3, 5, 7–9),
6(1, t.–p.i.), 7(1–4), 8, 9(1–2, 7), 10(1–3),
11(1–2, 5, 7, t.–p.i.), 14(1–2), 15(4–5), 24(2), 27, 31(1–3), 32(5), 33, 36(2), 45(1)

ISBN 0 86813 093 1

Printed in South Africa by
The Rustica Press, Pty., Ltd.,
Court Road, Wynberg, Cape

In Suid-Afrika gedruk deur
Die Rustica-pers, Edms., Bpk.,
Courtweg, Wynberg, Kaap

SOUTH AFRICAN SPECIES OF THE GENUS *GERYON* (CRUSTACEA, DECAPODA, GERYONIDAE)

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(With 6 figures)

[*MS accepted 2 July 1987*]

ABSTRACT

Three species of *Geryon* are recorded from South West Africa–Namibia and South Africa: *G. chuni* Macpherson, *G. macphersoni* sp. nov., and *G. maritae* Manning & Holthuis. *Geryon ischurodous* Stebbing is shown to be a species of *Carcinoplax*.

CONTENTS

INTRODUCTION

Until recently, three species of *Geryon* had been reported from South African waters, *Geryon quinquedens* Smith (1879: 35), *G. ischurodous* Stebbing (1923: 2), and *G. maritae* Manning & Holthuis (1981: 112), with most authors identifying material from South Africa with the American *G. quinquedens*. Also until relatively recently, many authors had identified material of *Geryon* from a wide variety of localities with either *G. affinis* A. Milne Edwards & Bouvier, 1894, originally named from the north-eastern Atlantic, or *G. quinquedens* Smith, described from the north-western Atlantic. In spite of the fact that A. Milne Edwards & Bouvier (1894: 41–45) and Chace (1940: 38–40) showed that *G. affinis* differed from *G. quinquedens* in having the dactyli of the walking legs laterally compressed rather than dorso-ventrally depressed, some authors, including Barnard (1950), considered the two species to be conspecific. Even those who recognized the differences in the structure of the dactyl considered

Ann. S. Afr. Mus. **98** (3), 1988: 77–92, 6 figs.

G. affinis to be widely distributed around the world. Thus *G. affinis* has been recorded from the western Atlantic (Chace 1940), Japan (Sakai 1978), Australia (Griffin & Brown 1976), and East Africa and the Valdivia Bank (Doflein 1904).

Manning & Holthuis (1981), in a review of the West African crabs, described *G. maritae*, the first of six species of *Geryon* to be recognized in this decade. The others are: *G. chuni* Macpherson (1983: 23), from South West Africa–Namibia; *G. fenneri* Manning & Holthuis (1984: 666), from localities off Florida, U.S.A.; *G. erytheiae* Macpherson (1984: 86), from the Valdivia Bank; *G. gordonae* Ingle (1985: 90), from the north-eastern Atlantic; and *G. inghami* Manning & Holthuis (1986: 366), from Bermuda.

As part of a long-term study of the genus *Geryon*, material of this genus in the collections of the South African Museum was examined. The results of that study are presented here.

The following abbreviations are used in the text: cb—carapace breadth; cl—carapace length; fm—fathom; m—metre; mm—millimetre. Repositories have been identified by the following abbreviations: BM—British Museum (Natural History), London; ICM—Instituto de Ciencias del Mar, Barcelona; MNHP—Muséum national d'Histoire naturelle, Paris; RMNH—Rijksmuseum van Natuurlijke Historie, Leiden; SAM—South African Museum, Cape Town; USNM—National Museum of Natural History, Smithsonian Institution, Washington; ZMC—Zoological Museum, Copenhagen.

Co-ordinates in the text given in square brackets have been taken from gazetteers of the United States Board on Geographic Names.

THE STATUS OF *GERYON ISCHURODOUS* STEBBING, 1923

Geryon ischurodous was described by Stebbing (1923: 2) from a single specimen, cl 16 mm, cb 26 mm, taken from coral washed up on a beach at Durban. No additional material identified with this species has been recorded in the literature since then, and its status has remained uncertain. Barnard (1950: 293) commented on similarities between Stebbing's species and *Geryon trispinosus* (Herbst). He concluded that 'There seems to be little doubt that *ischurodous* should become a synonym of *trispinosus*'.

Among the material of *Geryon* examined from the collections of the South African Museum was a single small specimen taken off Natal in 700–680 m and reported by Kensley (1977: 163) as *Geryon* sp. It proved to be identifiable with *Geryon ischurodous* Stebbing.

In our opinion, Stebbing's species did not belong in the genus *Geryon*. In seeking to place it in another genus, we looked through a variety of accounts of deep-sea crabs in the literature. Among these sources was the recent account by Guinot & Richer de Forges (1981*a*, 1981*b*) of deep-sea crabs from the Indo-Pacific. The similarity between the South African material of *Geryon ischurodous* and a species taken in 600 m off the New Hebrides and described by Guinot & Richer de Forges as *Carcinoplax eurysternum* was immediately recognized.

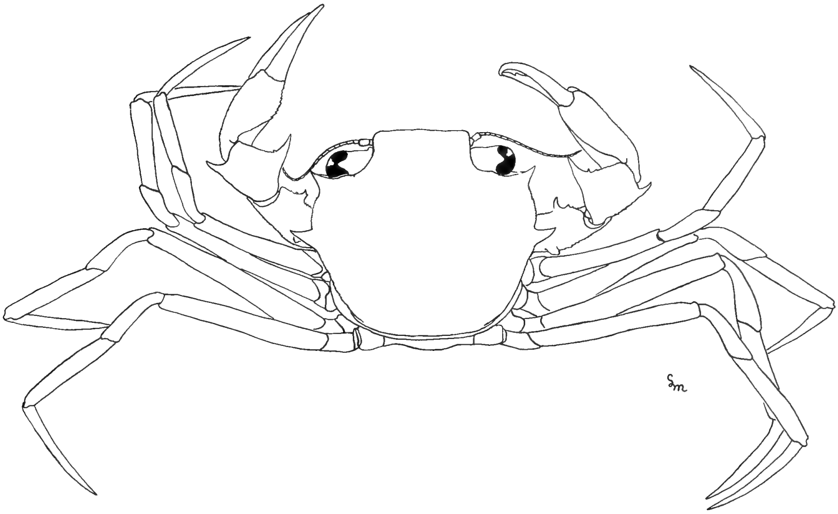

Fig. 1. *Carcinoplax ischurodous* (Stebbing), Natal. Male, cl 4,1 mm.

Guinot & Richer de Forges (1981*b*: 251) pointed out that few species of *Carcinoplax* have only two teeth on the anterolateral margin of the carapace, and that few species have one of these teeth as an exorbital spine. *Geryon ischurodous* has but two anterolateral teeth on the carapace, and one of these is a well-developed exorbital tooth (Fig. 1). Further, the figures of *C. eurysternum* provided by Guinot & Richer de Forges show a species with an inner spine on the merus of the cheliped and an inner and outer spine on the carpus of the cheliped, with the inner carpal spine bifurcate. The southern African specimens are similarly spined and, although the smaller lacks the secondary spine on the inner carpal spine, it is clearly shown on the type by Stebbing (1923, pl. 11). However, the gonopods of the two species are slightly different—compare Stebbing's figure (1923, pl. 11, plp.2) with that of Guinot & Richer de Forges (1981*b*, fig. 10H), and the shape of the carapace is somewhat different in the two nominal species, being broader in *C. eurysternum*.

Comparison of the specimen from off Natal and the type of *Geryon ischurodous* with the original account of *Carcinoplax eurysternum* convinces us that these three specimens are very closely related and that *Carcinoplax eurysternum* Guinot & Richer de Forges, 1981, may prove to be a junior synonym of *Geryon ischurodous* Stebbing, 1923. The correct name for Stebbing's species is *Carcinoplax ischurodous* (Stebbing, 1923).

We have examined the following specimens of *Carcinoplax ischurodous* from South African waters:

BM 1928.12.1.104: Durban [29°51'S 31°01'E]; on a coral washed up, leg. Mr H. W. Bell Marley; 3/20, Stebbing collection; 1 male, cl 16 mm, cb 26 mm; holotype of *Geryon ischurodous* Stebbing.

SAM–A15289: off Natal, 27°14′S 32°54′E, 700–680 m, Agassiz trawl, 20 May 1976, R.V. *Meiring Naude* station SM 67; 1 male, cl 4,1 mm, cb 5,9 mm.

Synonymy of *Carcinoplax ischurodous*:

Geryon ischurodous Stebbing, 1923: 2, pl. 11. Barnard, 1950: 292, fig. 54k. Guinot, 1967: 276 [no record].
Geryon sp.: Kensley, 1977: 163.

THE SOUTH AFRICAN SPECIES OF *GERYON* SENSU STRICTO

Geryon chuni Macpherson, 1983

Figs 2, 3, 6C

Geryon quinquedens: Stebbing, 1905: 36; 1910: 313. Barnard, 1950: 291, fig. 54f–i [*part.*].
Geryon affinis: Takeda, 1976: 64, fig. S. Afr.–69 [colour]. [Non *G. affinis* A. Milne Edwards & Bouvier, 1894.]
Geryon chuni Macpherson, 1983: 23, figs 10–15, 17a–c.

Material

South West Africa–Namibia

RMNH (no number): off South West Africa–Namibia, 23°50′S 13°03,6′E, 761–768 m, mud, 30 May 1982, *Valdivia* I, station P–26; 1 male, 1 female.

South Africa

USNM 205337: Cape Columbine [32°49′S 17°51′E] region; 1 female. SAM–A19513: WNW of Dasseneiland [= Dassen Island, 33°26′S 18°05′E], 160–180 fms (293–329 m), 25 February 1965, collected by S. Kannemeyer; 1 female. SAM–A12073: off Dasseneiland, 165 fms (302 m); 1 male, 1 ovigerous female. SAM–A12207: west of Slangkop [= Slang Kop Point, 34°09′S 18°19′E], 200 fms (366 m), 24 February 1965, collected by S. Kannemeyer: 1 male, 3 females. BM 1928.12.1: Cape Point Lighthouse [Cape Point = 34°21′S 18°29′E], 470 fms (860 m), Stebbing collection; 1 male, 1 female, 3 juveniles. SAM–A836, A837, A1626: off Cape Point (three lots with different bearings combined), 345, 500, and 760 fms (631, 915, and 1 391 m); 6 juveniles. SAM–A675, A6075: off Cape Point Lighthouse (two lots with different bearings combined), 360 and 470 fms (659 and 860 m), S.S. *Pieter Faure*, stations P.F. 6004, 16655; 2 males, 2 females (1 ovigerous). SAM–A15385: west of Cape Point, 250 fms (458 m); 2 males, 1 female. USNM 228311: 34°49′S 18°17′E, 515 m, 1985, R.V. *Africana*, collected by R. Melville-Smith; 1 male, 1 female. SAM–A676, A681: off Table Mountain [33°58′S 18°25′E], 250 fms (458 m) and 39°49′S 21°14′E, 560 fms (1 025 m) (two different lots combined); 5 females (1 ovigerous). ZMC (no number): Agulhas Bank [35°30′S 21°00′E]; exchange from South African Museum; 2 males.

Description

A large *Geryon*, cl to 95 mm, cb to 114 mm in adults, with five anterolateral teeth on the carapace and laterally compressed dactyli on the walking legs. Carapace about 1,2 times broader than long. Median pair of frontal teeth

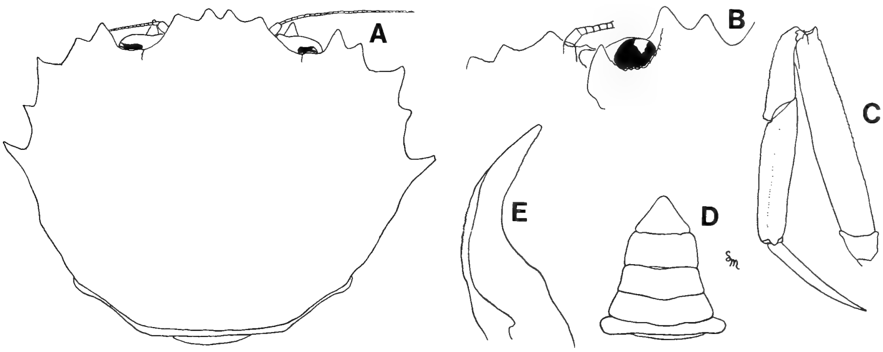

Fig. 2. *Geryon chuni* Macpherson, Agulhas Bank. A–D. Male, cl 24 mm. A. Carapace. B. Orbit, ventral view. C. Fifth leg. D. Abdomen. E. Male, cl 53 mm. Gonopod.

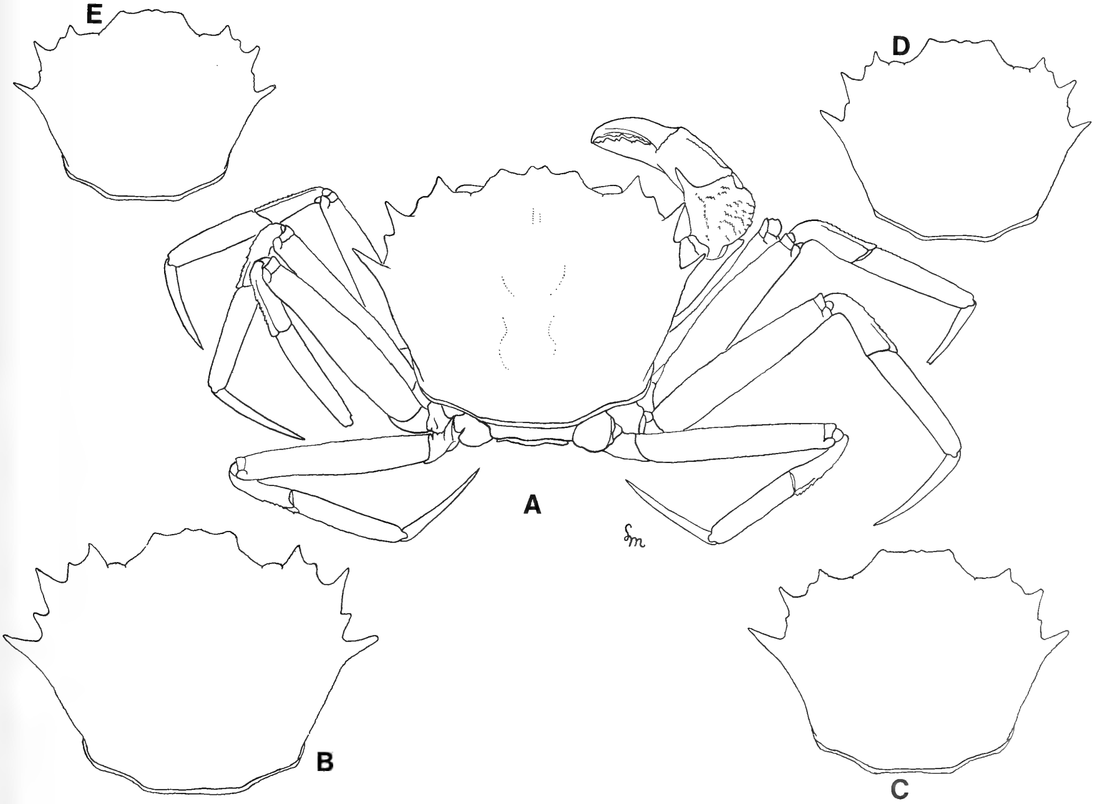

Fig. 3. Juveniles of *Geryon chuni* Macpherson, off Cape Point. A. cl 19,5 mm, dorsal view. B–E. Outline of carapace. B. cl 13 mm. C. cl 11 mm. D. cl 10 mm. E. cl 9 mm.

separated by deep V-shaped sinus. Distance between submedian frontal teeth less than distance between them and lateral frontal teeth. Second and fourth anterolateral teeth often obsolete in adults, fourth smallest of all; distance from first to third tooth less than that from third to fifth tooth. Carapace lacking distinct raised ridge mesial to fifth anterolateral tooth, granular posterolaterally, smooth dorsally. Suborbital tooth well developed, extending to level of lateral frontal teeth. Cheliped with sharp tooth subdistally on upper margin and with distal dorsal tooth or lobe on merus; carpus roughened dorsally, with distal outer spine or angled lobe, anterior margin smooth; propodus with at most distal angled projection. Meri of walking legs usually with distal, dorsal tooth or projection. Dactyli of walking legs compressed, height at midlength greater than width. Fifth leg: merus about 4,5 (range 3,8–5,2) times longer than high, length about half carapace width; carpus with line of denticles or low spinules dorsally; propodus length about four times height, subequal to dactylus in length (longer in some, shorter in others).

Size

Carapace lengths of males 24 to 92 mm, of non-ovigerous females 47 to 69 mm, of ovigerous females 54 to 65 mm, of juveniles 8,5 to 19,5 mm. Carapace widths of males 32 to *c.* 100 mm, of non-ovigerous females 62 to 87 mm, of ovigerous females *c.* 68 to 85 mm, of juveniles 12 to 26 mm. Macpherson (1983) reported the following range of measurements in his material: males, cl 51 to 114 mm, cb 61 to 95 mm; females, cl 56 to 73 mm, cb 68 to 86 mm; ovigerous female, cb 86 mm.

Depth range

The specimens were taken in depths ranging between 302 m and 1 391 m. Three records were from about 300 m, two from about 400 m, one from 500 m, two from 600 m, one from 700 m, three from about 900 m, one from about 1 000 m, and one from 1 391 m. All of the juveniles, cl 19,5 mm or less, came from depths in excess of 600 m.

Remarks

Adults of *G. chuni* can be distinguished at once from both *G. maritae* and *G. macphersoni* by the laterally compressed dactyli on the walking legs and by the larger suborbital spine. This species further differs from *G. maritae* in having a distinct dorsal spine on the meri of the walking legs, especially the posterior two pairs, it is a smaller species than either *G. maritae* or *G. macphersoni*, and it is a much smoother species than the latter.

At smaller sizes, differences in the shape of the dactyli of the walking legs become less clear. The series of juveniles from SAM–A836 all lack distal spines on the meri of the walking legs. The three juveniles from the lot of five specimens from the collection of the British Museum all lack distal spines on the meri of the walking legs as well as erect spinules on the carpi of the walking legs; the meral spines are present, at least on the last legs, in the two larger specimens in the same lot.

The configuration of the carapace spines in several specimens from lot SAM–A836 are shown in Figure 3.

The specimens reported by Stebbing (1905, 1910) and Barnard (1950) were examined. Part of the material reported by Barnard, at least the specimens from off Cape Point, are identifiable with this species; his figure 54f–h probably is based on the juveniles from lot SAM–A836. His material from East London is referred below to *G. macphersoni* sp. nov. As Barnard did not list individual lots, it is not possible to determine exactly which specimens that he might have studied actually belong here, although it is likely that he saw all of the early specimens in the collection.

The range of *G. chuni* overlaps with that of *G. maritae* off South West Africa–Namibia and with that of *G. macphersoni* sp. nov. off South Africa. In the material examined, *G. chuni* was found together with *G. macphersoni* sp. nov. in the lots from off Dasseneiland in 293–329 m, that taken by the R.V. *Africana* in 515 m, that from off Slangkop in 366 m, and at Cape Columbine. According to R. Melville-Smith (in litt. August 1985), this species and *G. macphersoni* were taken together off Cape Columbine at 32°25'S 16°29'E, in 496 m.

The species reported from South Africa by Takeda (1976) probably is this species. His colour figure shows a reddish-tan crab with blunt anterolateral teeth and distal spines on the meri of the walking legs, and the dactyli of the walking legs appear to be compressed.

Distribution

Off south-western coast of Africa, from 23°50'S, off South West Africa–Namibia, to Agulhas Bank, South Africa.

Geryon macphersoni sp. nov.

Figs 4, 5, 6A–B

Geryon quinquedens: Barnard, 1950: 291, fig. 54f–i [*part.*]. Kensley, 1977: 163. Paula e Silva, 1985: 8 [p.p.]. [Non *Geryon quinquedens* Smith, 1879.]
Geryon sp.: Kensley, 1981*a*: 61; 1981*b*: 41 [no records].

Material

South Africa

SAM–A12206: holotype, WNW of Dasseneiland [= Dassen Island, 33°26'S 18°05'E], 160–180 fms (293–329 m), 25 February 1965, collected by S. Kannemeyer; 1 male.

USNM 221699: paratype, ?off Cape Columbine [32°49'S 17°51'E], *c.* 500 m; 1 male. SAM–A19514: paratype, W of Slangkop [= Slang Kop Point, 34°09'S 18°19'E], 200 fms (366 m), 24 February 1965, collected by S. Kannemeyer;

1 male. USNM 228316: paratypes, 34°49′S 18°17′E, 515 m, 1985, R.V. *Africana* (R. Melville-Smith); 1 male, 1 female. ICM (no number): paratypes, 3 males, 1 female (data as for USNM 228316). SAM–A19515: paratype, off Table Mountain [33°58′S 18°25′E], 250 fms (458 m) and 39°49′S 21°14′E, 560 fms (1 025 m) (two different lots combined); 1 male. RMNH no. Crust.D.36594: paratype, off Cape Town, R. Melville-Smith; 1 male. SAM–A680: paratype, off Bashee River Beacon [Bashee River = 32°15′S 28°54′E], 300 fms (549 m), S.S. *Pieter Faure*, station P.F. 12650; 1 female (dry). SAM–A16773: paratypes, 32°15′S 29°09′E, 580 m, D.B. trawl, R.V. *Meiring Naude* station SM 233, 25 June 1979; 2 males, 2 females. SAM–A15890: paratype, 30°32′S 30°52′E, 900–625 m, beam trawl, R.V. *Meiring Naude*, station SM 121, 10 May 1977; 1 female. SAM–A15282: paratypes, off Natal, 28°21′S 32°34′E, 775–825 m, R.V. *Meiring Naude* station SM 38, 28 May 1975; 3 males, 1 female. ZMC (no number): paratypes, off Natal, 25°20′S 35°17′E, 680–730 m, sand bottom, *Galathea*, station 203, 21 February 1951; 1 male, 1 female.

Mozambique

RMNH no.Crust.D.36593: paratype, off Mozambique, P–51, I. Riera; 1 female.

Description

A large *Geryon*, cl to 105 mm, cb to 126 mm in adults, with five anterolateral teeth on the carapace and dorso-ventrally depressed dactyli on the walking legs. Carapace about 1,2 times broader than long. Median pair of frontal teeth separated by shallow sinus. Distance between submedian frontal teeth less than distance between submedian and lateral frontal teeth. Second and fourth anterolateral teeth reduced, fourth often completely obsolete, distance from first to third tooth subequal to distance from third to fifth. Carapace with distinct raised ridge mesial to fifth anterolateral tooth, and with strong granulation on branchial, cardiac, and protogastric regions, especially in males. Suborbital teeth low, falling short of level of lateral frontal teeth. Cheliped rough, surface with sharp, erect granules; upper margin of merus with sharp subdistal spine; carpus rough, anterior margin, lateral to inner spine, lined with sharp granules; propodus rough dorsally, unarmed distally, with an outer granulate ridge. Meri of walking legs usually with distal, dorsal spine. Dactyli of walking legs dorso-ventrally depressed, width near midlength greater than height. Fifth leg: merus 3,9 (range 3,6–5,0) times longer than high, with distal dorsal spine, length 0,5–0,6 carapace width; propodus with line of erect spinules dorsally, length about 3,5 times height, slightly longer than dactylus.

Size

Carapace lengths of males 23 to 105 mm, of females 30 to 83 mm; carapace widths of males 34 to 126 mm, of females 40 to 100 mm. Paula e Silva (1985) reported females with cb 105 mm and males with cb more than 120 mm from the population off Mozambique.

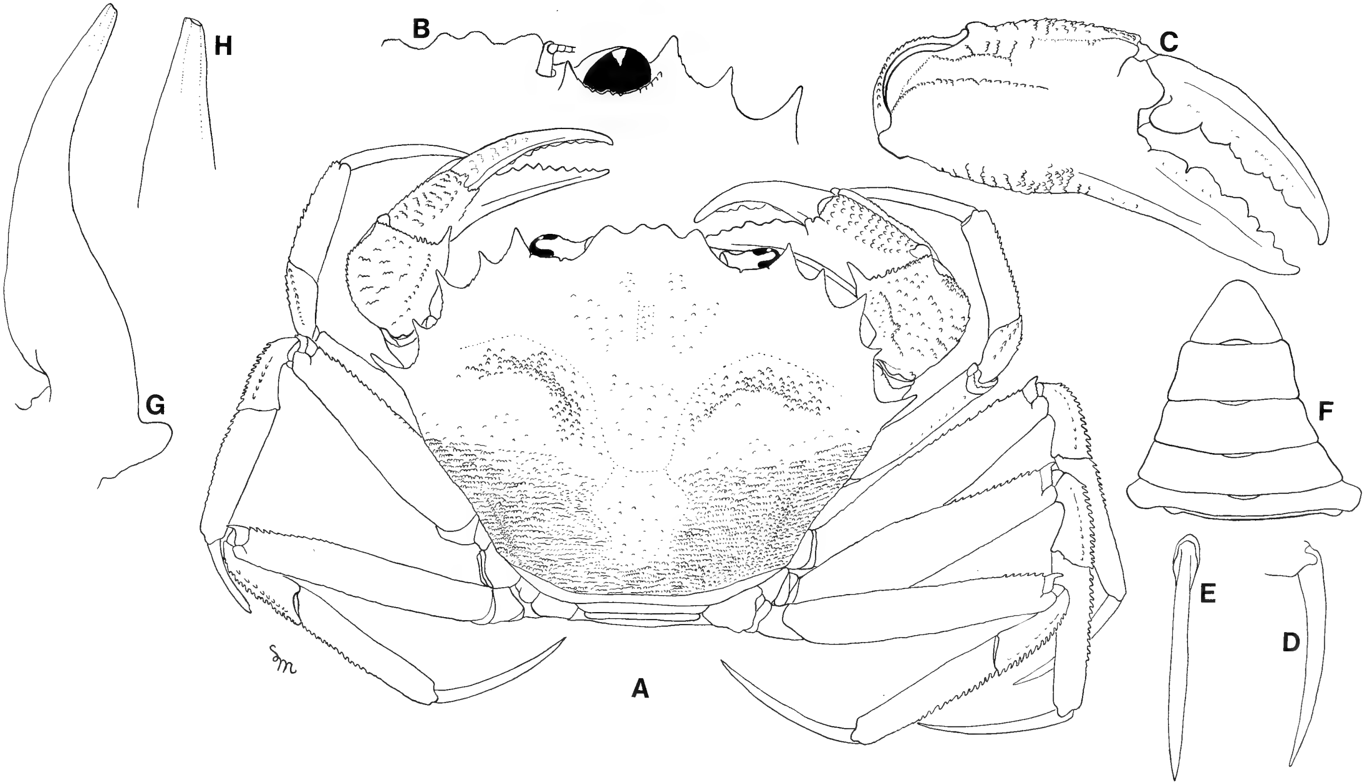

Fig. 4. *Geryon macphersoni* sp. nov. Off Natal. Male, paratype, cl 27 mm. A. Dorsal view. B. Orbit, ventral view. C. Chela. D. Dactylus of fifth leg, posterior view. E. Dactylus of fifth leg, dorsal view. F. Abdomen. G. Gonopod. H. Apex of gonopod.

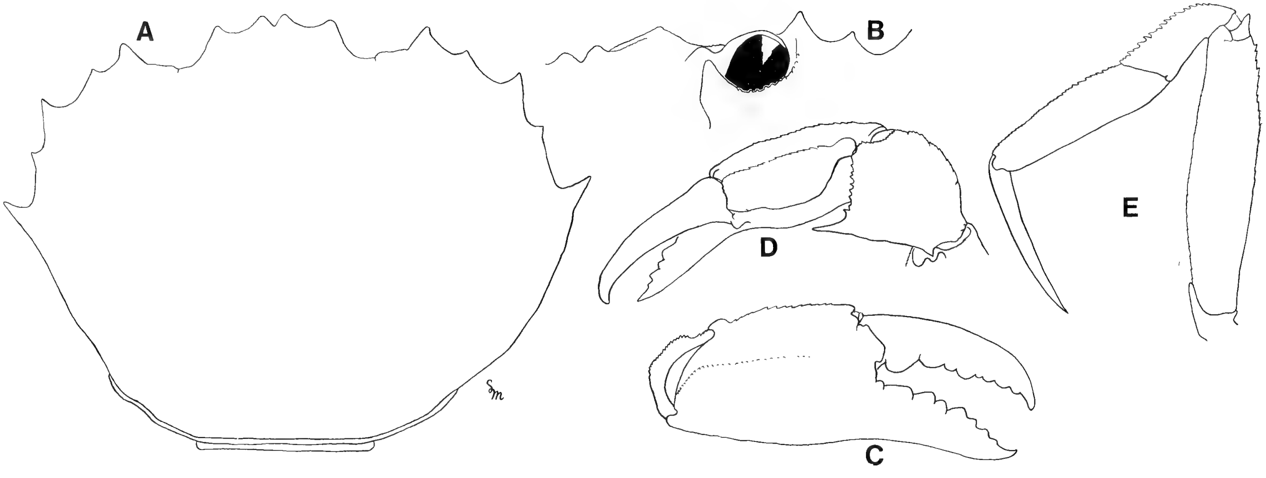

Fig. 5. *Geryon macphersoni* sp. nov. Off Natal. Female, paratype, cl 30 mm. A. Carapace. B. Orbit, ventral view. C. Chela. D. Cheliped. E. Fifth leg.

Depth range

The specimens were taken in depths of 293–329 m to 900–625 m; intermediate depths included 366 m, 458 m, *c.* 500 m, 549 m, 580 m, 680–730 m, and 775–825 m. The smallest specimens were taken in depths of 900–625 m and 775–825 m. Paula e Silva (1985) reported that this species was taken in 250–850 m off southern Mozambique.

Remarks

This species can be distinguished from both *G. chuni* and *G. maritae* by the extent of granulation on the carapace, chelipeds, and dorsal margins of the walking legs. The smallest specimen of *G. macphersoni* examined is much rougher dorsally than the largest specimen we have seen of *G. chuni*. *Geryon macphersoni* resembles *G. maritae* and differs from *G. chuni* in having dorsoventrally depressed dactyli on the walking legs. It further differs from *G. maritae* in having a distal spine on the meri of the walking leg, a distinct line of erect spinules on the carpus of the walking legs, and tubercles or denticles on the anterior margin of the carpus of the cheliped.

In roughness of the carapace, this species resembles *G. granulatus* Sakai (1978: 11) from Japan, and the Japanese species also has depressed dactyli on the walking legs. *Geryon granulatus*, however, lacks the distal spines on the meri of the walking legs and those legs are much smoother dorsally, and the carapace has a much more rounded shape and is more inflated dorsally as well.

Barnard (1950: 291) considered *G. paulensis* Chun (1903: 531), taken in 2 068 m, north of St. Paul and New Amsterdam, Indian Ocean, to be the juvenile of his *G. quinquedens*. That species, however, known only from the type, has compressed dactyli on the walking legs, which are very long and slender, and has very long first, third, and fifth anterolateral spines on the carapace. *Geryon paulensis* appears to be distinct from any of the species known from southern African waters.

The specimen recorded by Barnard (1950) from off East London [33°02′S 27°55′E] in 300 fms (549 m) is probably the specimen recorded here from off the Bashee River. The specimens reported by Kensley (1977, 1981*a*) were also examined and both are referable to this species.

This species apparently occurs together with *G. chuni* in the area around the Cape but has a much greater eastward distribution than *G. chuni*, which has not been taken from east of Agulhas Bank.

The specimen shown in Figure 5 has a branchial parasite on its right side. The male from off Cape Town carries small lepadid barnacles on the mesial side of the legs and the base of the carapace. The female from Mozambique shows two balanid barnacles on the right cheliped.

Etymology

We are pleased to dedicate this species to our colleague Enrique Macpherson of the Instituto de Ciencias del Mar, Barcelona, whose careful work has recently revealed the existence of two previously undescribed species of *Geryon*, *G. chuni* and *G. erytheiae*.

Distribution

Southern Africa, from off Cape Columbine to 35°17′E, off Natal, and off Mozambique.

Geryon maritae Manning & Holthuis, 1981

Fig. 6D

Geryon quinquedens Beyers & Wilke, 1980: 9 [non *G. quinquedens* Smith, 1879].

Geryon maritae Manning & Holthuis, 1981: 112, figs 24a, 25, 26 [*part.*, not references to Doflein 1903, 1904 = *Geryon erytheiae* Macpherson, 1984]. Macpherson, 1983: 22, figs 16–17d. Melville-Smith, 1983: 123, figs 2, 3; 1985: 55, fig. 2 (left); 1986: 257, figs 1–3; 1987: 143 [p.p.].

Material

South West Africa–Namibia

MNHP (no number): off South West Africa–Namibia, 18°41,5′S 11°24,5′E, 480 m, 27 June 1971, 'Walda'–0067–CMO3; 1 male. USNM 205342: ?off South West Africa–Namibia, 19°30′S, 400 m; 1 ovigerous female. SAM (no number): just north of Lüderitz [26°39′S 15°09′E], 600 m; 1 male.

Description

A very large *Geryon*, adults with cl of up to 140 mm, cb to more than 160 mm, with five anterolateral teeth on the carapace and dorso-ventrally depressed dactyli on the walking legs. Carapace about 1,1 times broader than long. Median pair of frontal teeth separated by wide sinus, base of sinus at about level of lateral frontal teeth, submedian frontal teeth distinctly over-reaching lateral frontal teeth. Distance between submedian frontal teeth less than distance from each to lateral frontal tooth. Second and fourth anterolateral teeth greatly reduced, fourth often completely obsolete, distance between first and third tooth less than distance between third and fifth tooth. Carapace with short, oblique ridge on each side mesial to fifth anterolateral tooth. Surface of carapace variably granular, granulations particularly well developed on branchial regions. Suborbital spine very short. Cheliped with blunt subdistal lobe on upper margin of merus, but lacking distal projection there, carpus lacking outer spine, propodus lacking distal dorsal spine. Meri of walking legs with no trace of distal dorsal spine. Dactyli of walking legs dorso-ventrally depressed, width at midlength greater than height. Fifth leg: merus about four (3,8–4,3) times as long as high, length about two-thirds carapace width; carpus with irregularly tuberculate dorsal ridge, lacking line of erect tubercles; propodus length about four times height, shorter than dactylus.

Size

Carapace length of males 85 and 112 mm, of ovigerous female 82 mm. Carapace widths of males 97 and 131 mm, of ovigerous female 97 mm. Manning

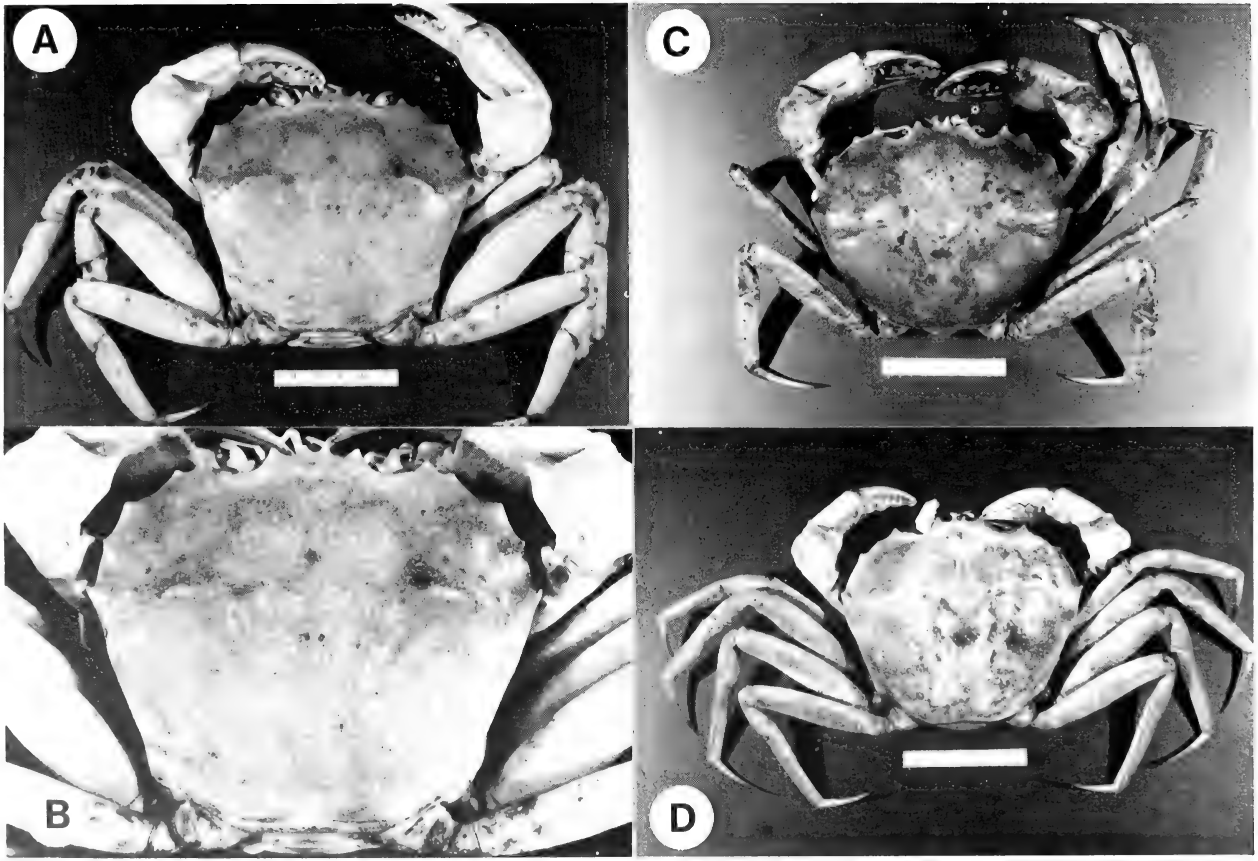

Fig. 6. A–B. *Geryon macphersoni* sp. nov., male, cl 98 mm. ?Off Cape Columbine. C. *Geryon chuni* Macpherson, male, cl 53 mm, Agulhas Bank. D. *G. maritae* Manning & Holthuis, ovigerous female, cl 82 mm, off South West Africa–Namibia.

& Holthuis (1981) recorded males as large as cl 140 mm, cb 160 mm, and females as large as cl 89 mm, cb 95 mm. Beyers & Wilke (1980) reported males as large as cb 172 mm. Macpherson (1983) reported males with cl 63 to 155 mm, females with cl 54 to 86 mm.

Depth range

The specimens were taken in 400, 480, and 600 m. Manning & Holthuis (1981) reported that the species had been recorded from depths between 100 and 936 m. Beyers & Wilke (1980) surveyed the fishery for this crab off South West Africa–Namibia in depths between 295 and 849 m. Macpherson (1983) studied material that had been collected between 270 and 615 m.

Remarks

Geryon maritae agrees with *G. macphersoni* and differs from *G. chuni* in having the dactyli of the walking legs strongly depressed dorso-ventrally, wider than high. In *G. chuni*, which is a smaller species, the dactyli of the walking legs are distinctly compressed, higher than wide. *Geryon chuni* further differs from *G. maritae* in having a distinct dorsal spine distally on the merus of each walking leg. Differences between this species and *G. macphersoni* are discussed under the account of that species.

In the southern extreme of its range, off southern South West Africa–Namibia, the distribution of *G. maritae* overlaps that of *G. chuni*, which is known to occur off southern South West Africa–Namibia and off South Africa.

In the fisheries literature, this species is known as the 'deep-sea red crab', the common name now in use for *G. quinquedens* proper. This name probably is in use because *G. quinquedens* was believed to occur in South African waters. New common names should be coined for all three species of *Geryon* from South Africa.

Distribution

Atlantic coast of western Africa, from numerous localities between South Morocco to the north and South West Africa–Namibia to the south. Beyers & Wilke (1980) and Melville-Smith (1983, 1985, 1986, 1987) reported on aspects of the fisheries for this species off South West Africa–Namibia, and Macpherson (1983) provided additional records from off South West Africa–Namibia.

ACKNOWLEDGEMENTS

We thank our colleagues at the museums in Copenhagen, London, and Paris for allowing us to work with their material. E. Macpherson, Instituto de Ciencias del Mar, Barcelona, provided us with valuable comparative material. R. Melville-Smith, Sea Fisheries Research Institute, Cape Town, gave us information on South African *Geryon* and references, including some that we might not otherwise have seen. We thank Brian Kensley, Smithsonian Institution, and Enrique Macpherson, for their comments on a draft of the manuscript. We appreciate the help and patience of Mrs M. G. van der Merwe, South African Museum, who made that collection available to us. Roy Kropp, University of Maryland, took the photographs for us, and all of the figures were prepared by Lilly King Manning. Our work on *Geryon* has been supported in part by FAO, Rome.

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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.

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comma separates author's name and year
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RAYMOND B. MANNING & L. B. HOLTHUIS

SOUTH AFRICAN SPECIES OF THE GENUS *GERYON* (CRUSTACEA, DECAPODA, GERYONIDAE)

VOLUME 98 PART 4 MAY 1988 ISSN 0303-2515

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A NEW SPECIES OF *MYSIDOPSIS* (MYSIDACEA) FROM COASTAL WATERS OF SOUTHERN AFRICA AND A KEY TO THE KNOWN SPECIES FROM THE SUBCONTINENT

By

T. H. WOOLDRIDGE

Cape Town Kaapstad

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1, 2(1–3, 5–8), 3(1–2, 4–5, 8, t.–p.i.), 5(1–3, 5, 7–9),
6(1, t.–p.i.), 7(1–4), 8, 9(1–2, 7), 10(1–3),
11(1–2, 5, 7, t.–p.i.), 14(1–2), 15(4–5), 24(2), 27, 31(1–3), 32(5), 33, 36(2), 45(1)

ISBN 0 86813 094 X

Printed in South Africa by
The Rustica Press, Pty., Ltd.,
Court Road, Wynberg, Cape

In Suid-Afrika gedruk deur
Die Rustica-pers, Edms., Bpk.,
Courtweg, Wynberg, Kaap

A NEW SPECIES OF *MYSIDOPSIS* (MYSIDACEA) FROM COASTAL WATERS OF SOUTHERN AFRICA AND A KEY TO THE KNOWN SPECIES FROM THE SUBCONTINENT

By

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(With 5 figures)

[*MS accepted 1 September 1987*]

ABSTRACT

A new species of *Mysidopsis* was collected from warm temperate coastal waters on the east coast of southern Africa. Morphological features distinctive to *M. buffaloensis* sp. nov. include the narrowly triangular and apically acute rostrum and the armament along the inner margin of the uropod, these spines on the endopod extending only to the midlength of the segment. The lateral margins of the telson are also partly unarmed and the segment is posteriorly narrowed and tapering, terminating in two long spines. A key to the known species of *Mysidopsis* in southern Africa is given.

CONTENTS

INTRODUCTION

Bentho-pelagic mysid shrimps are an important subtidal component of sandy beaches in southern Africa (Wooldridge 1983). Beach mysids are usually represented by the genus *Gastrosaccus*, with other genera sometimes present. Such multigeneric assemblages usually occur when beaches are interrupted by other substrata or are influenced by estuaries.

Dredging in the shallow surf (1,5 m depth) adjacent to a concrete harbour pier bordering Orient Beach, East London, revealed the presence of an undescribed species of *Mysidopsis*. Underwater observations showed them to be present in large numbers on the surface of the sand and up to 25 m from the pier. Associated with these mysids were relatively low numbers of *Gastrosaccus psammodytes*, a species common along the beaches on the west and south coasts of southern Africa (Brown & Talbot 1972; Wooldridge 1983). Further distant from the pier *G. psammodytes* was the principal species, with *G. bispinosa* (unpublished pers. obs.) occasionally recorded.

Ann. S. Afr. Mus. **98** (4), 1988: 93–103, 5 figs.

DESCRIPTION

Mysidopsis buffaloensis sp. nov.

Figs 1–5

Holotype

SAM–A39552, South African Museum, Cape Town. Adult female from Orient Beach, East London (33°01′S). Collected on 9 March 1985 by T. Wooldridge.

Paratypes

SAM–A39553, South African Museum, Cape Town. Numerous adult males and adult females. Collection data as for holotype.

Etymology

The name refers to the robust nature of the body of this mysid and the proximity of the Orient Beach to the Buffalo River harbour, East London.

Description

General form robust. Total length of adult females 10,3–14,0 mm (mean of 25 specimens: 12,1 mm); adult males 9,0–11,5 mm (mean of 20 specimens: 10,5 mm).

Rostrum acutely pointed, extending to base of third segment of antennular peduncle, or further in large specimens (Fig. 1A). Anterolateral carapace margins rounded; posterior border emarginate leaving last two thoracic segments exposed in dorsal view. Antennular peduncle (Figs 1A, B) extending barely beyond eyes, first segment equal in length to second and third combined. Male lobe large and hirsute, typical for the genus.

Antennal sympod (Fig. 1C) with a strong spine on outer distal margin. Margins of scale setose, about four times as long as greatest width. Outer margin of scale straight, inner margin convex. A small suture present in distal one-twentieth.

Mandible (Fig. 2A) with incisor process and lacinia mobilis well developed. Molar process reduced. Palp three-segmented, second segment large and expanded, producing a distinct 'heel' along outer margin of segment. Maximum width about half the segment length. Terminal segment two and one half times as long as wide, armed at apex with a strong barbed spine. A row of about seven smaller barbed spines on inner margin on distal half of segment. Setation of palp as shown.

Maxilla (Fig. 2B) with long, slender exopod armed along outer margin with about 13 graduated setae. Second endopod segment truncate, two and one-half times as long as wide. Armament of endopod and endites as illustrated.

Maxillule (Fig. 2C) with three setae on inner lobe. Outer lobe with about nine barbed spines at distal end. First thoracic limb (Fig. 3A) typical for the genus, endopod robust with second and third joints fused. Dactylus small, slightly

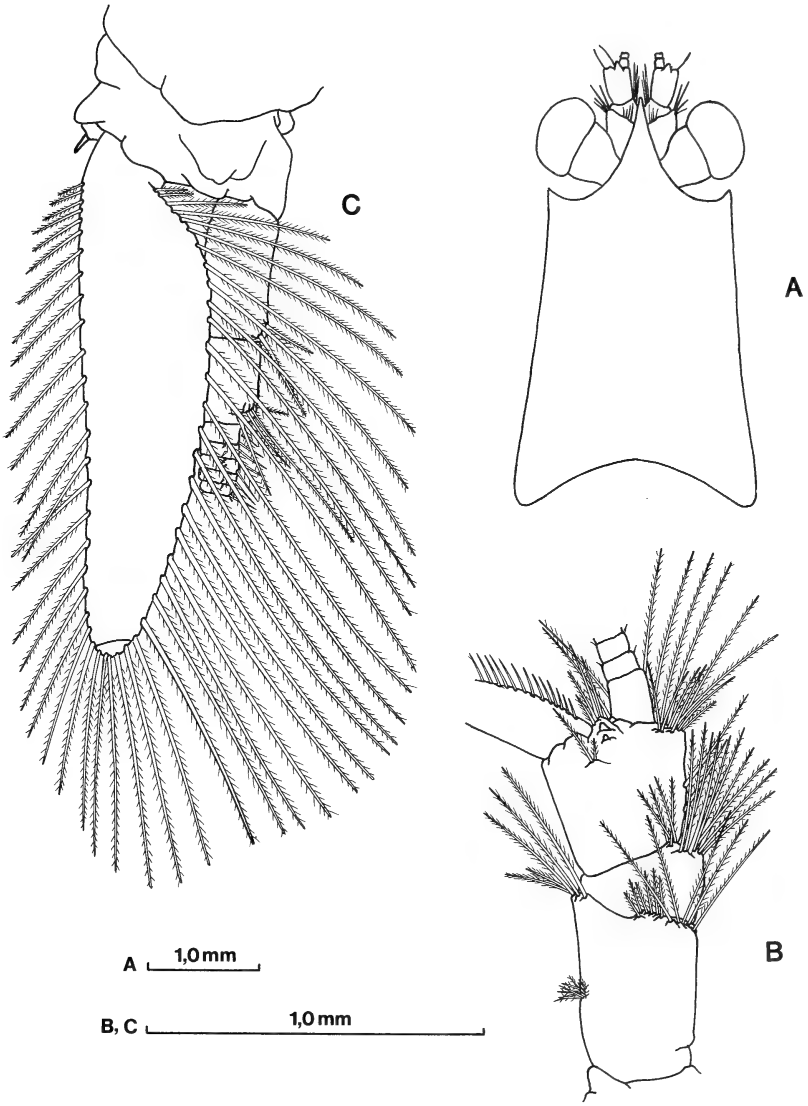

Fig. 1. *Mysidopsis buffaloensis* sp. nov. A. Carapace in dorsal view. B. Antennule. C. Antenna.

wider than long, and armed with long claw three times length of segment. Exopod with first joint expanded, outer distal angle approximately 90 degrees. Setation of segments as illustrated (Fig. 3A).

Second thoracic limb (Fig. 3B) with endopod more slender than in first thoracic limb. Merus three times as long as wide, carpo-propodus shorter and more robust than merus. Dactylus slightly longer than wide, with claw equal in length to segment.

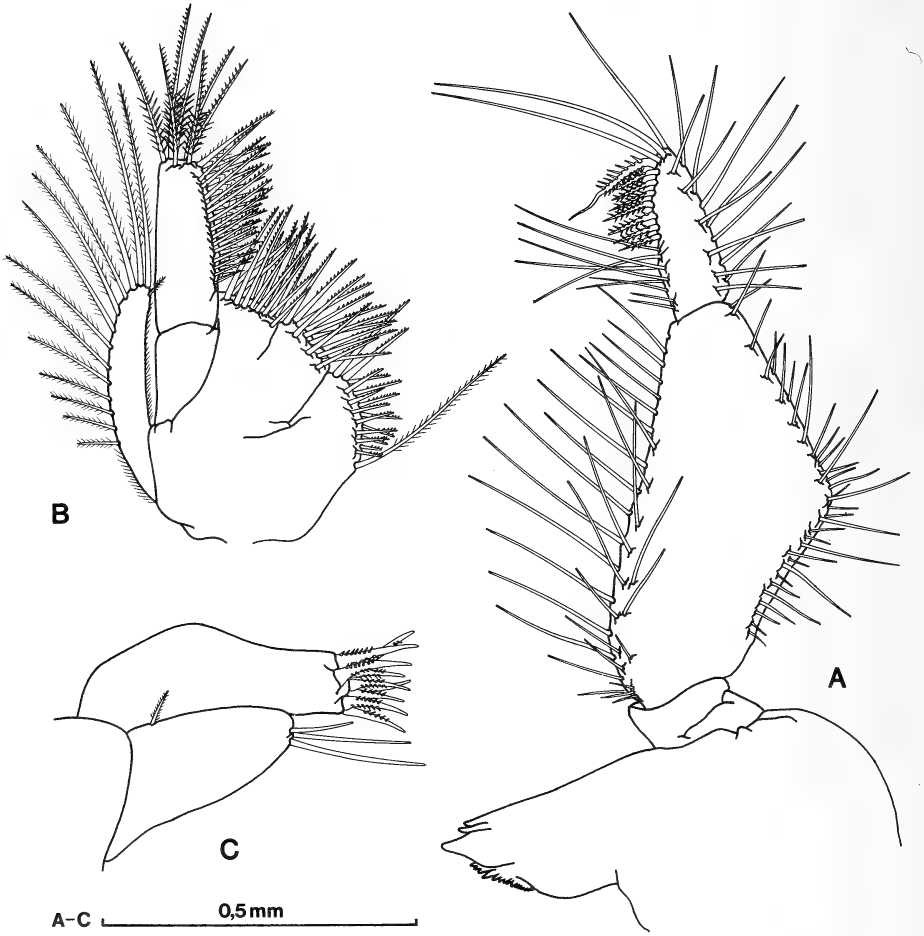

Fig. 2. *Mysidopsis buffaloensis* sp. nov. A. Mandible. B. Maxilla. C. Maxillule.

Remaining thoracic appendages slender, subequal. Carpo-propodus of three subsegments, third shorter in length than first and second combined. Dactylus small, nail long and slender (Fig. 4A).

Pleopod 1 and remaining pleopods in female (Fig. 3C) simple setose plates, which become progressively longer posteriorly.

Pleopod 1 in male (Fig. 3D) with sympod sub-rectangular. Endopod one-third length of exopod, bearing a distinct lobe at base. Lobe with five small terminal spines. Second male pleopod with rectangular sympod (Fig. 4B). Rami seven-segmented, endopod subequal in length to exopod. Basal lobe on endopod expanded in distal half and bearing five small terminal setae. Fourth male pleopod (Fig. 4C) similar in general form to pleopod 2, terminal exopod segment bearing a long, curved modified seta (Figs 4C, 5A) barbed along distal half.

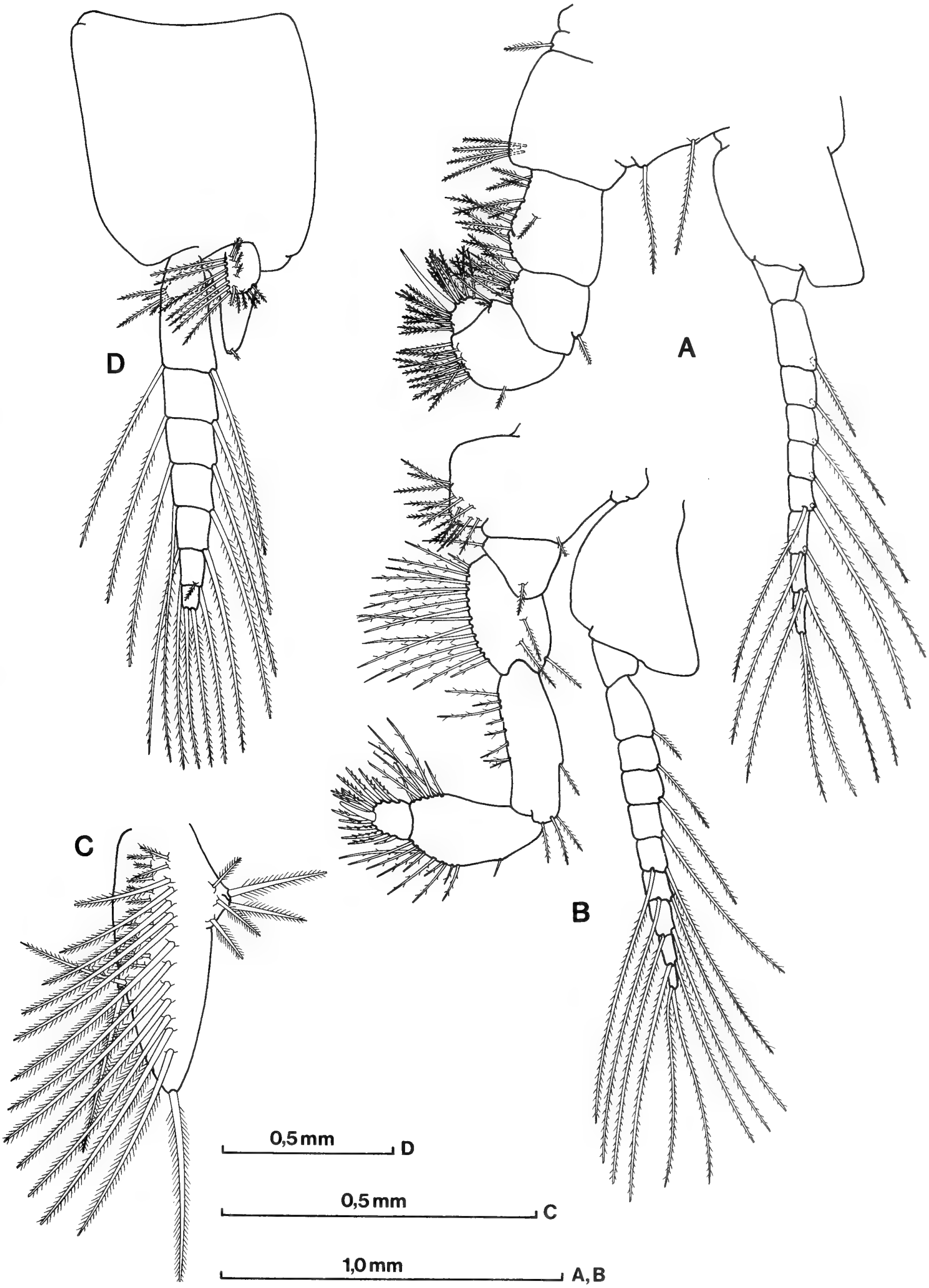

Fig. 3. *Mysidopsis buffaloensis* sp. nov. A. First thoracic appendage. B. Second thoracic appendage. C. First pleopod of female. D. First pleopod of male.

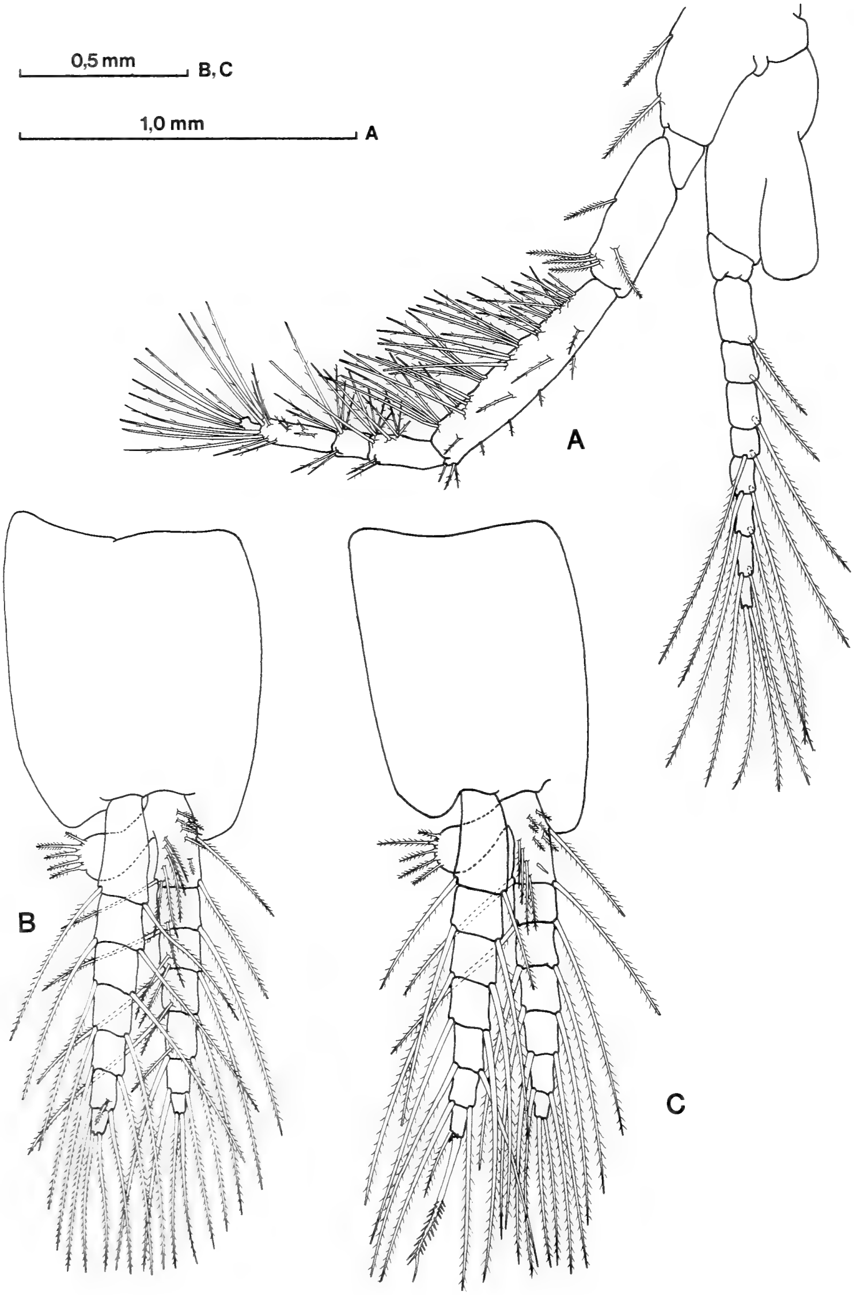

Fig. 4. *Mysidopsis buffaloensis* sp. nov. A. Eighth thoracic appendage. B. Second pleopod of male. C. Fourth pleopod of male.

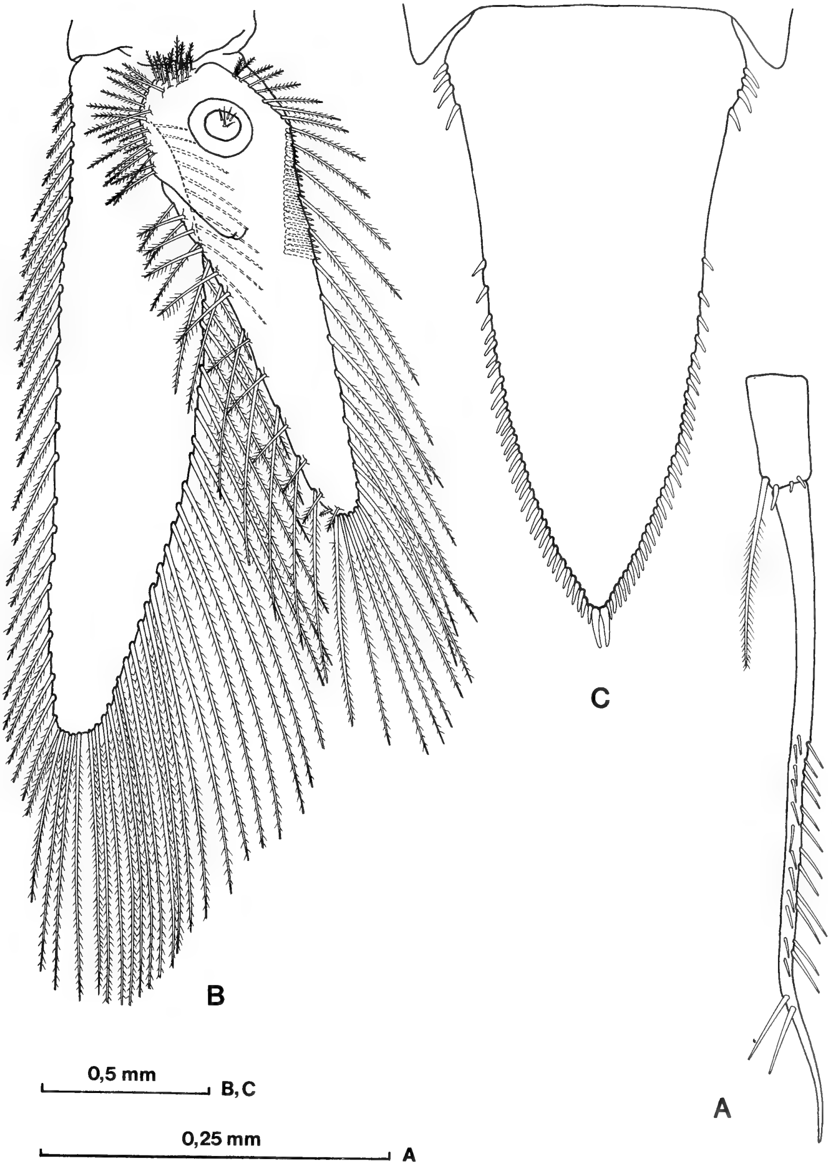

Fig. 5. *Mysidopsis buffaloensis* sp. nov. A. Terminal exopod segment of fourth pleopod of male. B. Uropod. C. Telson.

Subterminal barbs nearly twice as long as others. A second seta also present on seventh exopod segment (Fig. 5A), not reaching midpoint of barbed seta. Three minute spinules near base of barbed seta. Remaining setation as illustrated.

Uropod (Fig. 5B) with exopod having entire margin setose; outer margin straight, the inner convex. Endopod as wide as exopod and about two-thirds as long. Inner endopod margin armed with row of 25–30 closely-set graduated spines, the smallest opposite statocyst. Spine row extending to mid-region of segment, proximal spines about one-quarter the length of those more distal. Outer endopod margin with a dense patch of setae proximally, distal two-thirds of this margin with about 12 relatively short setae set dorso-laterally to the longer marginal setae.

Telson (Fig. 5C) triangular, almost twice as long as basal width. Armament along lateral margins discontinuous in anterior half, unarmed part about one-quarter length of telson. Lateral margins slightly concave in mid-region, becoming convex towards the pointed apex. Four lateral spines anterior to unarmed part of telson, slightly longer than posterior spines, which number about forty. Terminal pair of spines at least twice as long as those adjacent to them.

REMARKS

Mysidopsis buffaloensis sp. nov. represents the eighth species of the genus currently known from coastal waters around southern Africa. Previously described are *M. major* (Zimmer, 1912), *M. schultzei* (Zimmer, 1912) and *M. similis* (Zimmer, 1912), from Lüderitz Bay. Their range extends southwards (Tattersall 1955) and along the south-east coast as far as Algoa Bay (Wooldridge 1983). *Mysidopsis camelina* Tattersall, 1955, is recorded from False Bay only, while *M. eremita* Tattersall, 1962, is represented by one ovigerous female collected on the west coast.

Mysidopsis bispinosa Tattersall, 1969, and *M. suedafrikana* Tattersall, 1969, were each described from a single damaged specimen and had originally been reported by him (Tattersall 1958) as *Mysidopsis* species A and *Mysidopsis* species B, respectively. The current known range of *M. bispinosa* extends from Table Bay (Tattersall 1969) eastward to Algoa Bay (Wooldridge 1983), while *M. suedafrikana* is recorded from Langebaan Bay and False Bay (Tattersall 1969).

Species of *Mysidopsis* presently known from southern Africa are readily distinguishable from *Mysidopsis buffaloensis* sp. nov.; the key features separating them are recorded below.

KEY TO THE SOUTHERN AFRICAN SPECIES OF *MYSIDOPSIS*

A key to the known species of adult *Mysidopsis* recorded from coastal waters around southern Africa is presented. Characteristics included are based on published descriptions, so that in some cases data refer to relatively few specimens or even single animals.

1. One or two distinct nodules along mid-dorsal line of carapace 2

— Carapace without nodules along mid-dorsal line 3

2. Two protuberances along dorsal midline of carapace. First abdominal somite produced posteriorly into a broad plate, which covers dorsal surface of second somite. Apex of telson truncate, the entire border along each side armed with nine or ten spines. Apical spines are not markedly longer than remaining spines on telson .... *M. camelina* O. Tattersall, 1955

— A single protuberance on dorsal surface of carapace. First abdominal somite not produced along mid-dorsal line. Apex of telson rounded, the apical spines markedly longer than the evenly spaced lateral spines, which number 19 or 20 on each side .... *M. eremita* O. Tattersall, 1962

3. Lateral margins of telson without spines 4

— Lateral margins of telson at least partially armed with spines 5

4. Telson with lateral margins straight, converging to a narrow apex that is armed with two long spines .... *M. bispinosa* O. Tattersall, 1969

— Telson with lateral margins straight, converging towards a blunt, almost truncate apex that is armed with three pairs of spines. Outermost pair small, almost lateral. Inner pair longer than those adjacent to them .... *M. suedafrikana* O. Tattersall, 1969

5. Spines along lateral margins of telson continuous, without a gap in the armament 6

— Spines along lateral margins of telson discontinuous. Telson distinctly pointed, the two apical spines about three times the length of the spines adjacent to them. Lateral margins of telson with four spines on each side near the base, proximal to an unarmed section that is equal to one-quarter the length of the telson. Endopod of uropod with a graduated row of spines along inner margin, extending almost to midlength of endopod. Rostrum long and acutely pointed, reaching base of the third segment of antennular peduncle ... . ***M. buffaloensis*** sp. nov.

6. Apex of telson rounded 7

— Apex of telson distinctly pointed, the two apical spines markedly longer than those immediately adjacent to them. Spines along inner margin of endopod of uropod graduated, extending only a short distance beyond statocyst .... *M. similis* (Zimmer, 1912)

7. Apex of telson broadly rounded, marginal spines around apex increasing evenly in length towards the median line. Armature along inner margins of endopod of uropod graduated, the more distal spines not markedly longer than the others. These spines closely set and extending about three-quarters the length of the endopod .... *M. major* (Zimmer, 1912)

— Telson tapering posteriorly, apex smoothly rounded with marginal spines increasing evenly in length towards the median line. Spines along inner margin of endopod or uropod distinctly graduated, those more distal long and slender. Spines extend along entire length of endopod .... *M. schultzei* (Zimmer, 1912)

Diagnostic features described for *Mysidopsis buffaloensis* also allow for clear separation from the remaining 36 described forms. The most diacritical is the discontinuity in the armament along the lateral margins of the telson. Only *M. hellvillensis* Nouvel, 1964, *M. taironana* Brattegard, 1973, and *M. tortonesei* Bačescu, 1968, have a comparable arrangement of spines on the telson. In *M. tortonesei* the apex of the antennal scale is sharply pointed, the spines arming the inner margin of the uropod extending along the entire length of the segment. In the proximal half these spines are thick and robust. The telson is apically rounded and the marginal spines increase evenly in length towards the apex. Apical spines are therefore not distinctly longer than those immediately adjacent to them (Bačescu 1968; Brattegard 1969, 1973).

In *M. taironana* the antennal scale lacks the distal segment and the inner margin of the uropod is armed with only 2–4 spines, just distal to the statocyst. The telson is triangular, apically rounded and about 1,2 times as long as the basal width. Unarmed sections along the lateral margins of the telson are not always distinct and there are two pairs of long, slender apical spines (Brattegard 1973).

Mysidopsis hellvillensis was described by Nouvel (1964) from Madagascar and is clearly distinguishable from *M. buffaloensis*. In the former species the spines along the inner margin of the endopod of the uropod extend along the entire length of the segment. The rostrum is obtund and there are only two spines on each side of the telson near the base. Posterior to these spines, the unarmed portion is followed by a single spine and a further discontinuity in the spinal arrangement along each side. In *M. hellvillensis* the apex of the telson is obtund with two pairs of terminal spines subequal in length.

An indistinct discontinuation of marginal spines on the telson is sometimes apparent in *M. coralicola* (Bačescu, 1975). This species was described by Bačescu from Tanzanian coastal waters (Bačescu 1975), but it is more closely allied to *M. similis* from southern Africa than to *M. buffaloensis*.

ACKNOWLEDGEMENTS

Financial assistance from the Department of Environment Affairs is acknowledged.

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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.

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.

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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.

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.

T. H. WOOLDRIDGE

A NEW SPECIES OF *MYSIDOPSIS* (MYSIDACEA) FROM COASTAL WATERS OF SOUTHERN AFRICA AND A KEY TO THE KNOWN SPECIES FROM THE SUBCONTINENT

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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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Volume **98** Band
July **1988** Julie
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A REDESCRIPTION OF *AFROCHILTONIA CAPENSIS* (K. H. BARNARD, 1916) WITH A REVIEW OF THE GENERA OF THE FAMILY CEINIDAE (CRUSTACEA, AMPHIPODA)

By

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1, 2(1–3, 5–8), 3(1–2, 4–5, 8, t.–p.i.), 5(1–3, 5, 7–9),
6(1, t.–p.i.), 7(1–4), 8, 9(1–2, 7), 10(1–3),
11(1–2, 5, 7, t.–p.i.), 14(1–2), 15(4–5), 24(2), 27, 31(1–3), 32(5), 33, 36(2), 45(1)

ISBN 0 86813 096 6

Printed in South Africa by
The Rustica Press, Pty., Ltd.,
Court Road, Wynberg, Cape

In Suid-Afrika gedruk deur
Die Rustica-pers, Edms., Bpk.,
Courtweg, Wynberg, Kaap

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(With 4 figures)

[*MS accepted 2 February 1988*]

ABSTRACT

Afrochiltonia capensis (Barnard, 1916) is redescribed and figured, including the first description of the male, and a lectotype is selected. In the light of this redescription it is concluded that *A. capensis* is sufficiently different from currently recognized Australian congeners to warrant generic recognition. The genera of Ceinidae are reviewed briefly and *Austrochiltonia* Hurley, 1959, is resurrected for the Australian species with *Afrochiltonia* K. H. Barnard, 1955, being restricted to *A. capensis* from South Africa. A key to the genera of Ceinidae is provided.

CONTENTS

INTRODUCTION

Afrochiltonia capensis (Barnard, 1916) has never been adequately figured. The male was not correctly recognized until Griffiths (1976*b*) and has never been described, although Rühe (1914), referring to six young females (as *Chiltonia subtenuis*), illustrated the second gnathopod of what is clearly a male.

Earlier confusion of non-ovigerous females with males led to a misleading generic diagnosis, which has never been resolved satisfactorily. Barnard (1916) suggested widening the diagnosis of *Chiltonia* to accommodate what he thought was a species with gnathopod one and two alike in both sexes. Later Hurley (1954) noted an unusual modification of the first pleopod in the male of New Zealand species of *Chiltonia*, where the inner ramus forms 1–3 dorsally directed whip-like lashes. This feature was thought to be of generic significance and led to

Ann. S. Afr. Mus. **98** (5), 1988: 105–119, 4 figs.

the erection of *Afrochiltonia* Barnard, 1955, for the South African species and *Austrochiltonia* Hurley, 1959, for the Australian species, with the New Zealand species remaining in *Chiltonia* Stebbing, 1899. Thus *Afrochiltonia* was distinguished from *Austrochiltonia* by the condition of the male second gnathopod. There the matter remained until Griffiths (1976*b*) discovered some males with the characteristically enlarged second gnathopod. He consequently synonymized *Afrochiltonia* with *Austrochiltonia* and furthermore *Afrochiltonia capensis* with *Austrochiltonia subtenuis*. However, *Afrochiltonia* has priority over *Austrochiltonia*, as noted and corrected by Barnard & Karaman (1982). Despite all of these systematic changes the South African species remained poorly known and the male was still not described or figured.

Barnard's (1916) description is considered inadequate by today's standards and is insufficient for comparisons with similar fauna in New Zealand and Australia. Because 'Chiltonias' are very common and widespread in the freshwaters of southern Australia, with several undescribed species, it is important to establish clearly the systematic status of the South African species.

It is the purpose of this paper to redescribe *Afrochiltonia capensis* (Barnard, 1916), including the first description of the male, and to clarify the status of the genera of Ceinidae, particularly *Afrochiltonia* and *Austrochiltonia*.

MATERIALS AND METHODS

Barnard's (1916) type specimens of *Afrochiltonia capensis* were borrowed from the South African Museum and examined in detail. As no other material of *A. capensis* was available from the South African Museum, additional specimens were collected at my request, from Milnerton Lagoon (see 'Material examined') by Dr C. L. Griffiths. These specimens are deposited in the South Australian Museum, except for the male described herein, which has been transferred to the South African Museum. Specimens of *Austrochiltonia* in the collections of the South Australian Museum were also examined for comparison.

Specimen length was measured along a lateral parabolic line drawn from the anterior extremity of the head through the middle of the body to the posterior limit of the telson. Barnard's type material was not used for size comparisons between males and females as his sample may have been biased towards larger specimens.

The thoracic limbs are referred to as gnathopod 1 and 2 followed by pereopods 3–7 to avoid confusion. Size comparisons of gnathopods exclude the coxa and dactyl and of the pereopods the coxa, with articles being measured down the middle.

Unless indicated otherwise dissected appendages were taken from the left hand side of the animal. The mouthparts of the lectotype and the mouthparts and appendages from the male, described herein, are mounted in poly-vinyl lactophenol on microscope slides. All other appendages, remains of dissected specimens, and other specimens are preserved in 75 per cent alcohol.

SYSTEMATICS

Family **Ceinidae** J. L. Barnard, 1972

Afrochiltonia capensis (Barnard, 1916)

Figs 1–4

Chiltonia subtenuis Rühe, 1914: 35, figs 13, 14a–c [*non* Sayce, 1902].
Chiltonia capensis Barnard, 1916: 224, pl. 27 (figs 38–40).
Afrochiltonia capensis Barnard, 1955: 93. Griffiths, 1974*a*: 253; 1974*b*: 327; 1975: 168; 1976*a*: 75, fig. 47.
Austrochiltonia subtenuis Griffiths, 1976*b*: 30.

Type locality

Salt River, Cape Town, South Africa, by present designation of lectotype.

Material examined

Type material. K. H. Barnard's syntypes consist of two lots.

SAM–A2885 labelled 'Type Specms' from Salt River, Cape Town, collected by Dr W. F. Purcell, October 1898, consisting of 8 females in alcohol, one of which has been selected as lectotype; the remainder have been designated paralectotypes and have been transferred to SAM–A39685.

SAM–A2886 from Milnerton near Cape Town, collected by K. H. Barnard, 25 October 1913, consisting of 20 females (some damaged) in alcohol and a microscope slide of the appendages of at least three specimens. All of this material has been designated paralectotypes. The slide material, although labelled 'Type', could not be used as the lectotype as it did not consist of a single specimen and the mountant had become crazed with age, thus obscuring the finer detail of the mounted appendages.

Other material. South Australian Museum No. C4165: 30 females and 6 males from Milnerton Lagoon, Cape Town, collected by C. L. Griffiths, 20 January 1987. SAM–A39686: male (the specimen described and illustrated herein), collection data as for C4165 but transferred to the South African Museum. South Australian Museum No. C4166: 40 females and 69 males from mouth of Milnerton Lagoon, near Cape Town, collected by C. L. Griffiths, June 1987.

Description

Female

Lectotype, 3,7 mm, non-ovigerous, SAM–A2885. Coxal gills present from G2 to P6. Oostegites, dorsally folded, present from G2 to P5.

Head as long as deep, length equivalent to first 1,5 pereonites; eyes black (in alcohol), ovato-circulate with some ommatidia diffuse dorsally.

Antenna 1 short, about twice head length or equivalent to 0,2 times body length; article 1 of peduncle almost twice as long as wide and 1,5 times length of article 2; article 3 slightly shorter than 2; flagellum slightly longer than peduncle, of six articles with a ventral aesthetasc at the base of each of the last two articles.

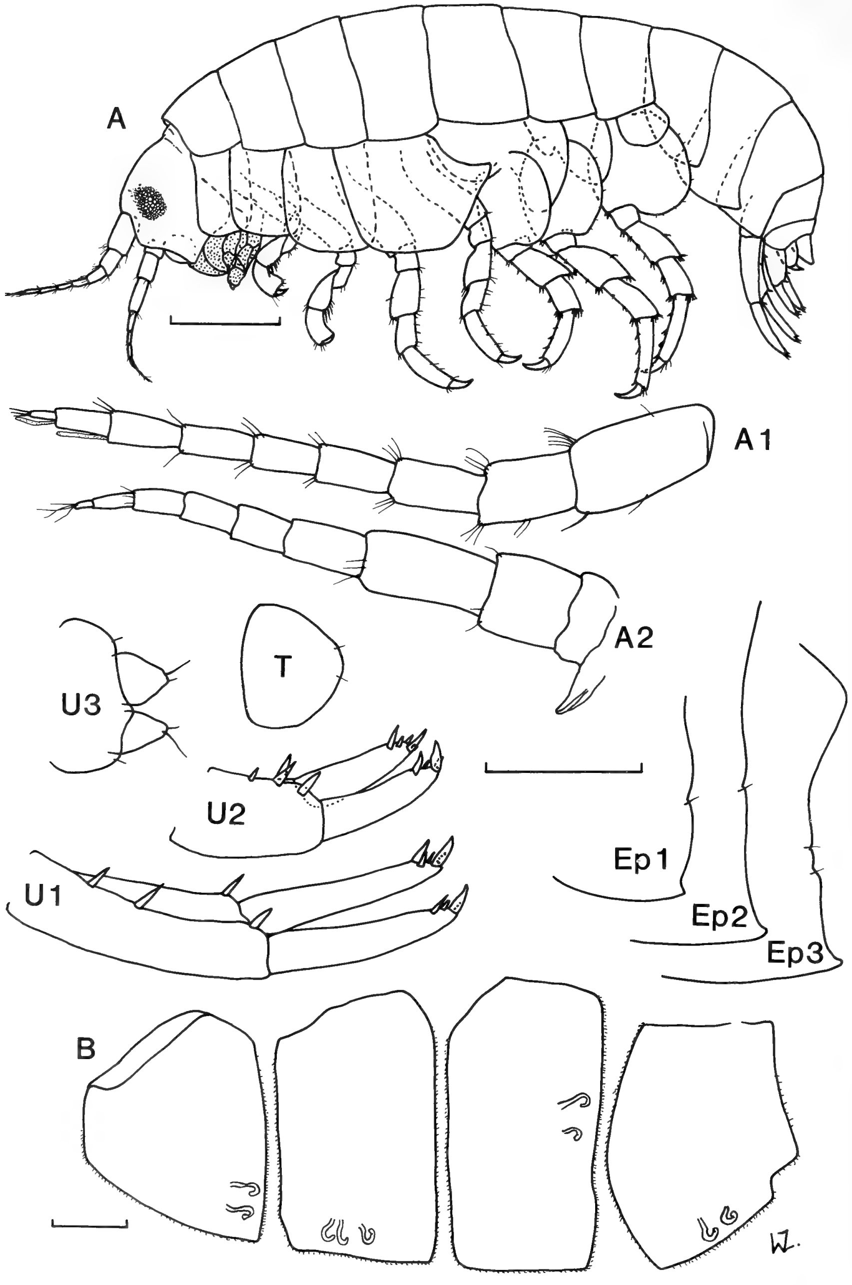

Fig. 1. *Afrochiltonia capensis* (Barnard). A. Lectotype female, 3,7 mm (SAM–A2885) (gills, oostegites and pleopods not shown). Scale bar = 0,5 mm. B. Oostegites from paralectotype specimen (SAM–A39685), shown in order from G2–P5. Scale bar = 0,2 mm. Other appendages from lectotype. Scale bar = 0,2 mm.

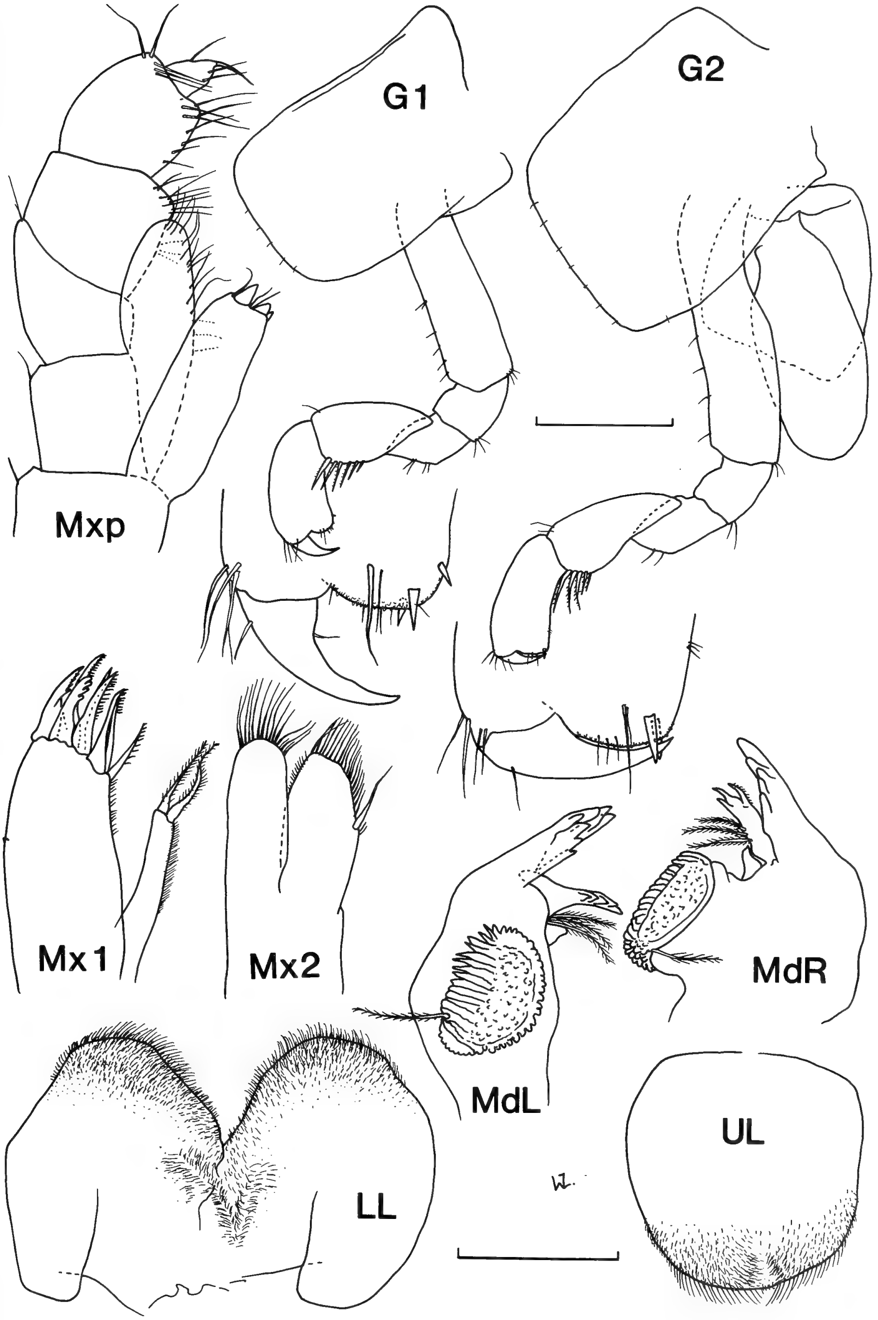

Fig. 2. *Afrochiltonia capensis* (Barnard). Lectotype female, 3,7 mm, gnathopods and mouthparts. Scale bars = 0,2 mm and 0,1 mm, respectively.

Antenna 2 little more than 0,75 length A1, gland cone pressed firmly against head—not visible laterally; article 1 of peduncle twice as wide as long; article 2 as wide as long, twice length article 1 and slightly less than half length of article 3; flagellum only slightly longer than peduncle, of six articles.

Upper lip as wide as long, apically rounded, bearing numerous short setae distally.

Lower lip without inner lobes; outer lobes subovate with setose distal and inner margins.

Mandibles without palp: left with incisor of seven teeth, lacina mobilis of five teeth, spine row of three feathered spines and triturative molar with one long feathered seta; right with incisor of five teeth, lacina mobilis of three teeth, spine row of three feathered spines and molar like left.

Maxilla 1: outer plate without palp but notched at palp's normal position, with eight comb-like spines apically; inner plate very narrow with only two feathered spines apically.

Maxilla 2: outer plate slightly longer than inner, about 0,75 times as wide; both apically setose; inner plate with one large seta on inner margin at end of setal row.

Maxilliped: inner plate reaching extremity of article 1 of palp, rectangular, about three times as long as broad, with three stout spines apically, the inner one very small; outer plate reaching 0,75 along article 2 of palp, ovate, about as wide as inner plate bearing several setae apically and along inner margin; palp article 1 with oblique distal margin, length outer margin about 2,5 times inner; palp article 2 slightly broader than long and slightly shorter than outer margin of article 1, bearing a few setae on inner distal corner and distal half of inner margin; palp article 3 about as long as broad and as long as article 2, with sparse long setae on distal and inner margins; palp article 4 small, conical, slightly longer than wide, about half length of article 3; dactylus sharp, as long as article 4.

Gnathopod 1: coxa length about 1,5 times width, longer than article 2 with antero-dorsal corner slightly produced; article 5 length twice maximum width, postero-distal lobe not produced, with row of six stout pectinate spines; article 6 as long as article 5, about twice as long as wide, postero-distal corner rounded, distal face with spine on either side of dactyl and two long medial setae, antero-distal corner with four long setae, posterior margin with small spine near postero-distal corner; dactyl as long as width of palm and fitting neatly against palm.

Gnathopod 2: similar to G1 but 1,25 times as long; coxal gill sac-like, more than twice as long as wide, as long as article 2; coxa slightly longer than wide, as long as article 2; article 5 with slightly produced postero-distal lobe with row of five stout pectinate spines; article 6 without small spine on posterior margin, otherwise as in G1.

Pereopod 3: length 1,35 times G2; coxal gill like that of G2; coxa like that of G2 but slightly larger, slightly longer than article 2; article 4 broad, about

0,7 times length; article 5 like 4 but not as broad and only 0,75 times as long; article 6 length 1,6 times article 5, about three times as long as wide; dactyl length 0,4 times article 6; all articles sparsely setose as illustrated.

Pereopod 4 identical to P3 except for coxa. Coxa with shallow antero-dorsal excavation, maximum width 1,5 times length, slightly longer than article 2, posterior margin oblique so that width at distal margin is only about half maximum width.

Pereopod 5: smallest pereopod, length about 0,9 times P4; coxal gill similar to P4 but a little wider; coxa width almost twice width article 2, length of anterior lobe about half maximum width coxa, length of posterior lobe about 0,7 maximum width coxa or as long as article 2; article 2 slightly longer than wide with typical expanded posterior margin and postero-distal lobe overlapping and almost reaching to distal margin of article 3; article 4 length 1,2 times width, with postero-distal corner produced; article 5 length about 1,2 times article 4 and of similar shape except postero-distal corner is not as produced; article 6 length 1,6 times article 5, about three times as long as wide; dactyl length 0,4 times article 6; all articles sparsely spinose as illustrated.

Pereopod 6 longest pereopod, length 1,25 times P5; like P5 except articles 3–6 somewhat longer in proportion to their width; coxa as wide as article 2, anterior lobe small, length about half width coxa, posterior lobe as long as coxa width.

Pereopod 7 a little shorter than P6; coxa semi-circular, slightly wider than long; article 2 as wide as long, postero-distal lobe extending beyond article 3, posterior margin slightly serrate and minutely spined with acute proximal corner; otherwise similar to P6.

Pleonal epimera with very small postero-ventral tooth.

Uropod 1 longer than U2; rami subequal, about 0,8 times as long as peduncle, outer ramus with two large and two small spines at tip, inner ramus with two large and three small spines at tip; peduncle with large spine on inner and outer-distal corner and two more on dorsal outer margin.

Uropod 2: rami subequal, a little more than 0,8 times as long as peduncle; peduncle and rami with spines as in U1 except outer ramus also has a spine on middle of inner margin (only on right in lectotype).

Uropod 3 one-articulate, half length of telson, conical in shape with one long outer and one short inner seta at tip.

Telson entire, hemispherical, slightly wider than long.

Oostegites from paralectotype (SAM–A39685), ovigerous, most eggs released. All with curled margins and numerous small hooks forming a tight marsupium. First is pentagonal with long distal and posterior margins, almost as wide as deep; second is rectangular, length 1,8 times width; third is also rectangular, length a little more than 1,8 times width and is longest oostegite, about 0,6 times length of P4; fourth is sub-rectangular with oblique distal margin and excavate postero-distal corner, maximum length 1,3 times maximum width.

Male

Hypotype 2,5 mm (SAM–A39686), generally like female but differs as follows.

Coxal gills relatively smaller.

Antenna 1 flagellum a little shorter than peduncle, consisting of only five articles.

Antenna 2 only slightly shorter than A1.

Mandibles: only right molar with long feathered seta.

Gnathopods and pereopods with articles not so stout.

Gnathopod 1: coxa narrower distally, about 0,7 times dorsal width, without antero-dorsal corner produced; article 6 slightly longer than article 5 with two spines on distal face in addition to those on either side of the dactyl.

Gnathopod 2 with enlarged article 6, unlike G1; length about 1,4 times G1; coxa length 1,2 times width, only 0,9 times length article 2; article 4 with right-angled bend; article 5 small, without pectinate spines; article 6 a little longer than article 2, maximum length 1,6 times maximum width, postero-proximal corner forming distinct lobe for almost 0,4 length article, palm oblique with several small spines on either side of 'cutting edge' followed proximally by small groove for tip of dactyl; dactyl claw-like, length 0,8 times maximum length article 6.

Pereopod 3: length 1,1 times G2; coxa like that of G2 only slightly longer.

Pereopod 4: coxa maximum width a little more than length, only slightly more narrow distally—posterior corner of excavation not produced as in female.

Pereopod 5 as long as P4; coxa width 1,5 times width article 2, length anterior lobe slightly less than half maximum width coxa; length posterior lobe less than 0,6 times maximum width coxa or only 0,7 times length article 2.

Pereopod 6: coxa, length anterior lobe 0,3 times width coxa, length posterior lobe a little less than coxa width.

P7, U1–U3 and telson like female.

Pleopods all of normal structure (not modified as in *Chiltonia*).

Variations

Females ranged in size from 1,0 to 4,1 mm with a mean of 3,2 ± 0,2 mm (± 95 % c.l.; n = 70). Males ranged in size from 1,5 to 2,6 mm with a mean of 2,2 ± 0,06 mm (± 95 % c.l.; n = 76). Males are thus significantly smaller than females ($P << 0,01$). No specimens were as large as 4,5 mm as recorded by Barnard (1916) and one must assume this measurement included the antennae or to be an error.

All of the specimens examined varied little from the above descriptions. In some specimens the ommatidia of the eyes were more diffuse at the edges and almost confluent dorsally. Antenna 1 and 2 usually had a flagellum of six articles, increasing to seven in some females, or decreasing to five in some males but rarely in females. The antennae were almost equal in length in some specimens and varied from 0,2 to 0,25 times the body length. The condition of the mandible with a feathered seta on the molar usually occurred only on the right, rarely on

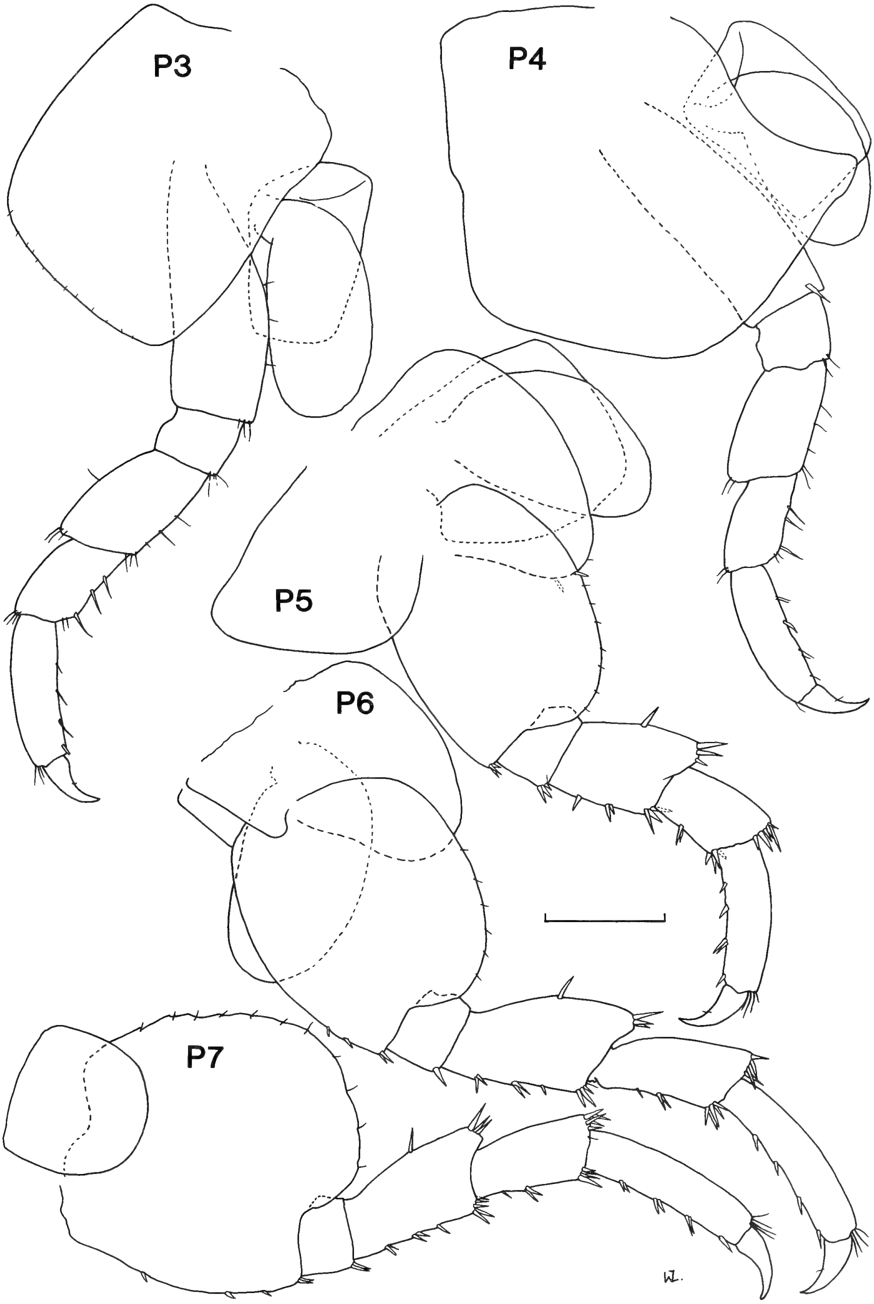

Fig. 3. *Afrochiltonia capensis* (Barnard). Lectotype female, 3,7 mm, pereopods 1–7. Scale bar = 0,2 mm.

the left as in the lectotype. The rami of U1 were sometimes as short as 0,6 times peduncle, particularly in males. The inner ramus of U2 without a medial spine was rare. Oostegites of females varied considerably in size but were expanded and as illustrated in ovigerous specimens.

Remarks

Griffiths (1976*b*) synonymized *Afrochiltonia capensis* with *Austrochiltonia subtenuis* on the basis that the male G2 was enlarged and U3 was one-articulate. However, apart from a number of minor differences, *Afrochiltonia capensis* is clearly distinguished from *Austrochiltonia subtenuis* by: (1) the shape of coxa 4; (2) the relative lengths of the antennae; (3) the stout nature of the pereopods, particularly in the female; (4) the lack of marginal spines on the rami of U1 and U2; (5) the gland cone on A2 is not visible laterally; and (6) P7 is shorter than P6. The synonymy proposed by Griffiths (1976*b*) is thus considered invalid.

The earlier confusion on non-ovigerous females with males might be explained by the fact that the males are considerably smaller than the females and may have been overlooked when sorting samples or confused with juveniles of other common species (e.g. *Melita zeylanica*). There is also a likely seasonal variation in the number of males present in the population, as is evidenced by the two random samples collected in January and June 1987, which contained 6/36 and 69/109 males, respectively. It is therefore possible that, when Barnard's samples were collected in October, few males were present in the natural population and were thus not represented in his samples. Further evidence of a seasonal breeding cycle is provided by the fact that in January 15/30 females were ovigerous as compared to only 9/40 in June. However, a more detailed study of the life cycle of this species is required to determine breeding seasons and seasonal variations in the male/female ratio.

Now that the male has been described it is possible to re-evaluate the systematic position of this species with that of similar taxa in New Zealand and Australia. In particular, I recommend retaining the genus *Austrochiltonia* Hurley, 1959, for the Australian species and reserving *Afrochiltonia* Barnard, 1955, for the single South African species.

Distribution

Kosi Bay, Zululand, to Olifants River, western Cape, in brackish–estuarine environments (endemic).

REVIEW OF THE FAMILY CEINIDAE J. L. BARNARD, 1972

The family Ceinidae is divided into two subfamilies, the Ceininae—consisting of marine forms with cleft telsons—and the Chiltoniinae—consisting of freshwater–brackish forms with uncleft telsons (Barnard 1972*b*). It is generally distinguished from the Hyalidae (= Talitridae) by the form of U3 (e.g. Barnard 1972*b*), which is diagnosed by Barnard (1972*a*) as 'composed only of peduncle

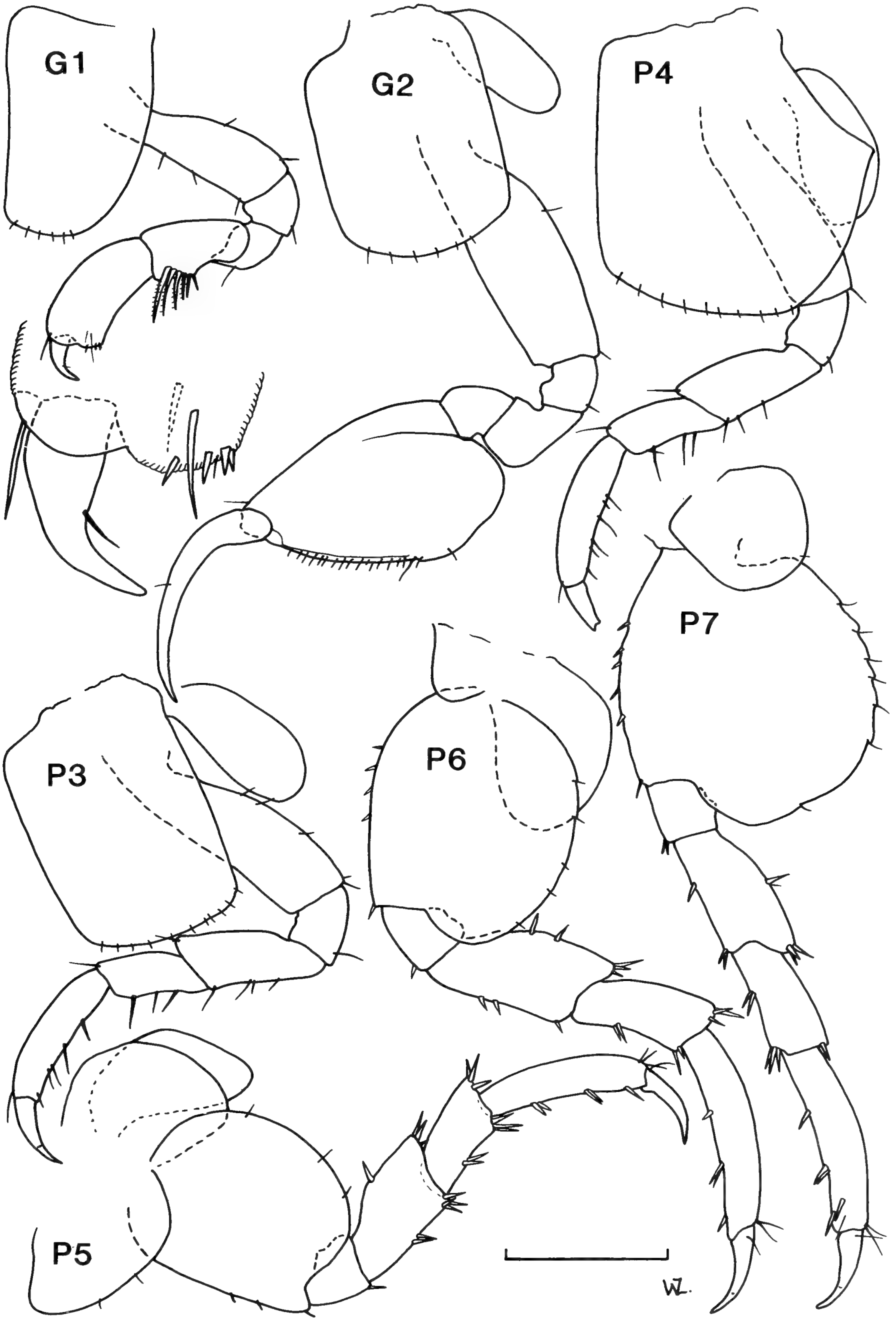

Fig. 4. *Afrochiltonia capensis* (Barnard). Male, 2,5 mm (SAM–A39686), pereopods 1–7. Scale bar = 0,2 mm.

. . . .' This diagnosis needs to be amended as the Australian species *Austrochiltonia australis* (Sayce, 1901) has a third uropod consisting of two articles, a feature used to distinguish it from the only other described Australian species *A. subtenuis* (Sayce, 1902) (Williams 1962). In addition, I have recently discovered some undescribed Australian species that also have a third uropod consisting of a peduncle and a small ramus. The family diagnosis therefore needs amending as follows: 'third uropod usually composed of peduncle only, some freshwater species (Australian) with additional small article'.

The problem now remains to determine a more satisfactory way to distinguish this family from the Hyalidae.

The subfamily Ceininae J. L. Barnard, 1972, consists of entirely marine species placed in the three genera, *Ceina* Della Valle, 1893, *Taihape* J. L. Barnard, 1972, and *Waitomo* J. L. Barnard, 1972. These genera have been adequately diagnosed by Barnard (1972*b*) and they will not be discussed further here.

The subfamily Chiltoniinae J. L. Barnard, 1972, consists of brackish–freshwater species currently placed in only two genera, *Chiltonia* Stebbing, 1899, and *Afrochiltonia* K. H. Barnard, 1955.

Chiltonia, endemic to New Zealand, is readily distinguished from the other Chiltoniinae by the unusual character of the first male pleopod, in which the inner ramus is modified to form 1–3 dorsally directed whip-like lashes. The three species concerned are adequately dealt with by Hurley (1954), who also provided a satisfactory generic diagnosis.

Afrochiltonia was erected by Barnard (1955) for the South African species *A. capensis*, based on the mistaken belief that the gnathopods were alike in both sexes, a feature used to distinguish it from *Austrochiltonia*, erected by Hurley (1959) for the Australian species. When males of *Afrochiltonia capensis* were eventually recognized correctly and found to have an enlarged G2 (Griffiths 1976*b*), the distinction between the two genera was considered invalid and Griffiths (1976*b*) promptly synonymized *Afrochiltonia* with *Austrochiltonia*. However, *Afrochiltonia* has priority over *Austrochiltonia* as was noted and corrected by Barnard & Karaman (1982). This synonymy came about without an examination of the Australian species and in the absence of an adequate description *Afrochiltonia capensis*. Having examined both the South African and Australian species I find this synonymy unsatisfactory, as *A. capensis* is considered sufficiently different from Australian species (including known undescribed ones) to warrant the resurrection of *Austrochiltonia*. *Afrochiltonia* is thus restricted to *A. capensis* from South Africa and is diagnosed as follows.

Afrochiltonia K. H. Barnard, 1955

Males only about two-thirds size of females. Eyes ovato-circulate, occasionally with diffuse ommatidia at edges. Antenna 1 and 2 subequal in length, only about 0,2 times body length. Antenna 1 with ventral aesthetasc at base of last two flagella articles. Gland cone of A2 not visible laterally. Maxilla 1 without palp, notched at palp's normal position. Coxae 1–4 deep. Coxa 4 with large, shallow posterior excavation, maximum width more than length (up to 1,5 times in female). Gnathopods 1 and 2 subchelate in both sexes; article 6 of G2 enlarged in male. Pereopods stout, particularly in female; P7 shorter than P6. Pleopod 1 not modified in male. Uropod 3 one-articulate. Telson entire, hemispherical, with evenly rounded distal margin.

Austrochiltonia is here resurrected for the Australian species *A. subtenuis* (Sayce, 1901), *A. australis* (Sayce, 1902) and several undescribed species, and is diagnosed as follows.

Austrochiltonia Hurley, 1959

Males of similar size or only marginally smaller than females. Eyes ovato-circulate without diffuse edges. Antenna 1 longer than antenna 2, more than 0,3 times body length. Antenna 1 with ventral aesthetasc at base of distal four or more flagella articles. Gland cone of A2 large, visible laterally. Maxilla 1 without palp, notched at palp's normal position. Coxae 1–4 deep. Coxa 4 with shallow or deep posterior excavation, maximum width equal to, or less than, length. Gnathopods 1 and 2 subchelate in both sexes; article 6 of G2 enlarged in male. Pereopods slender, P7 longer than P6. Pleopod 1 not modified in male. Uropod 3 with single ramus or ramus absent. Telson entire, subrectangular to slightly concave.

Although *Afrochiltonia* superficially resembles *Austrochiltonia* there are several differences that collectively are considered of generic significance. In particular the large coxa 4 of *Afrochiltonia capensis* is most unusual and is unlike any species of *Austrochiltonia* or *Chiltonia*. The small size of the male relative to the female is also unusual. In his revision of *Austrochiltonia*, Williams (1962) noted that the largest specimens were males but, in a more detailed study of *A. australis*, Smith & Williams (1983) found that the largest male was about 0,8 times as long as the largest female. In the present study of *Afrochiltonia capensis*, in which 76 males and 70 females were measured, the largest male was 2,6 mm and the largest female was 4,1 mm, a ratio of only slightly more than 0,6!

Other distinguishing characters of *Afrochiltonia*, apart from those given in the diagnosis and other minor differences, are the lack of marginal spines on the rami of uropod 1 and uropod 2 (except for one on the inner ramus) and the relatively few pectinate spines on article 5 of gnathopod 1 and gnathopod 2 (female).

Also of possible significance is that *Afrochiltonia* is only found in estuarine habitats, while *Austrochiltonia*—although found in brackish–freshwater habitats throughtout the southern half of Australia—has not been recorded from an estuarine environment.

In view of the above, the genera of Ceinidae may now be distinguished according to the following key.

KEY TO THE GENERA OF THE FAMILY CEINIDAE

1. Telson slightly cleft, marine (Ceininae) 2
— Telson entire, freshwater–brackish (Chiltoniinae) 4
2. Pereopod 3 with numerous long setae on anterior margins of articles 2–4 .... *Taihape*
— Pereopod 3 lacking long setae on articles 2–4 3
3. Head attached to body in underslung fashion, mandibular molar forming long smooth thorn .... *Ceina*
— Head attached normally to body, mandibular molar large and heavily triturative .... *Waitomo*
4. Pleopod 1 of male with inner ramus modified to form 1–3 dorsally directed whip-like lashes (New Zealand) .... *Chiltonia*
— Pleopod 1 of male of normal structure 5
5. Coxa 4 maximum width 1,5 times length in female, only marginally wider than long in male; estuarine (South Africa) .... *Afrochiltonia*
— Coxa 4 maximum width equal to or marginally less than length in both sexes; brackish–freshwater, non-estuarine (Australia) .... *Austrochiltonia*

ACKNOWLEDGEMENTS

I thank Mrs M. G. van der Merwe, South African Museum, for the loan of Barnard's syntypes and for checking Museum records for more material. I am particularly grateful to Dr C. L. Griffiths, Zoology Department, University of Cape Town, for collecting and sending me more specimens on two separate occasions, thus making this study possible. Mrs K. L. Gowlett-Holmes is thanked for typing the manuscript.

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ABBREVIATIONS

A1	antenna 1	G1	gnathopod 1
A2	antenna 2	G2	gnathopod 2
Mxp	maxilliped	P3–P7	pereopod 3 to pereopod 7
Mx1	maxilla 1	U1–U3	uropod 1 to uropod 3
Mx2	maxilla 2	T	telson
Md	mandible	Ep1–Ep3	first to third pleonal epimeron
UL	upper lip	R	right
LL	lower lip	L	left

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.

WOLFGANG ZEIDLER

A REDESCRIPTION OF *AFROCHILTONIA CAPENSIS* (K. H. BARNARD, 1916) WITH A REVIEW OF THE GENERA OF THE FAMILY CEINIDAE (CRUSTACEA, AMPHIPODA)

VOLUME 98 PART 6 DECEMBER 1988 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.

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

'Smith (1969) describes . . .'
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'As described (Haughton *et al.* 1927) . . .'

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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*).

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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)

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

Volume **98** Band
December **1988** Desember
Part **6** Deel

THE SOUTH AFRICAN MUSEUM'S *MEIRING NAUDE* CRUISES
PART 17. PYCNOGONIDA

By

FRANÇOISE ARNAUD
&
C. ALLAN CHILD

Cape Town Kaapstad

The ANNALS OF THE SOUTH AFRICAN MUSEUM

are issued in parts at irregular intervals as material
becomes available

Obtainable from the South African Museum, P.O. Box 61, Cape Town 8000

Die ANNALE VAN DIE SUID-AFRIKAANSE MUSEUM

word uitgegee in dele op ongereelde tye na gelang van die
beskikbaarheid van stof

Verkrygbaar van die Suid-Afrikaanse Museum, Posbus 61, Kaapstad 8000

OUT OF PRINT/UIT DRUK

1, 2(1–3, 5–8), 3(1–2, 4–5, 8, t.–p.i.), 5(1–3, 5, 7–9),
6(1, t.–p.i.), 7(1–4), 8, 9(1–2, 7), 10(1–3),
11(1–2, 5, 7, t.–p.i.), 14(1–2), 15(4–5), 24(2), 27, 31(1–3), 32(5), 33, 36(2), 45(1)

ISBN 0 86813 098 2

Printed in South Africa by
The Rustica Press, Pty., Ltd.,
Court Road, Wynberg, Cape

In Suid-Afrika gedruk deur
Die Rustica-pers, Edms., Bpk.,
Courtweg, Wynberg, Kaap

THE SOUTH AFRICAN MUSEUM'S *MEIRING NAUDE* CRUISES

PART 17. PYCNOGONIDA

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(With 14 figures)

[*MS accepted 27 May 1987*]

ABSTRACT

Thirty-nine species of Pycnogonida collected off the east coast of South Africa are recorded. One new genus, *Safropallene* (family Callipallenidae) and the following 13 new species are described: *Pantopipetta armata*, *Pantopipetta bilobata*, *Callipallene africana*, *Parapallene invertichelata*, *Safropallene longimana*, *Hedgpethia magnirostris*, *Nymphon barnardi*, *Nymphon bicornum*, *Nymphon granulatum*, *Nymphon obesum*, *Nymphon paralobatum*, *Nymphon pedunculatum*, and *Nymphon serratidentatum*.

A brief discussion of the distribution and zoogeography of the pycnogonids collected by the R.V. *Meiring Naude* indicates the presence of a considerable endemic pycnogonid fauna on the continental shelf and slope of the east coast of South Africa.

CONTENTS

INTRODUCTION

The paper deals with the pycnogonids taken during four cruises by the South African Museum on R.V. *Meiring Naude* in 1976, 1977, 1978 and 1979. No pycnogonids have come to light from the 1975 cruise. The specimens

Ann. S. Afr. Mus. **98** (6), 1988: 121–187, 14 figs.

originate from continental shelf and slope localities from just south of the Mozambique–South African border to the East London area and from depths of 80 to 1 300 m. For full station data as well as background information on the cruises the reader is referred to Louw (1977, 1980).

All specimens are deposited in the South African Museum, Cape Town, under SAM–A catalogue numbers, except for a few surplus or duplicate lots of material deposited in the U.S. National Museum of Natural History (USNM), Washington, and the Museum National d'Histoire Naturelle (MNHN), Paris.

SPECIES LIST

Material unidentified at species level is either damaged or immature.

	SM Station no.	ovig. ♂♂	♂♂	gravid ♀♀	♀♀	juv.
Family **Ammotheidae**						
Ammothella setacea (Helfer)	86	—	4	—	6	4
	103	—	3	—	1	—
	129		(93 ♂♂, ♀♀, juvs.)			
	151	—	—	—	1	—
	163	—	3	—	1	1
	226		(110 ♂♂, ♀♀, juvs.)			
	232	—	14	—	3	1
	236	—	4	—	1	—
	250	—	—	—	1	—
Ascorhynchus ornatum (Helfer)	163	—	—	—	1	—
Boehmia tuberosa Möbius	233	—	1	—	—	—
Cilunculus sewelli Calman	185	—	—	—	—	3
	226	—	—	—	—	1
Tanystylum thermophilum (Barnard)	250	—	2	—	—	—
Family **Phoxichilidiidae**						
Anoplodactylus typhlops Sars	123	—	1	—	—	—
Family **Austrodecidae**						
Pantopipetta armata sp. nov.	103	—	4	—	1	—
	109	—	—	—	1	—
Pantopipetta bilobata sp. nov.	86	—	1	—	1	—
	163	1	—	—	4	—
	164	—	—	—	1	—
	250	—	1	—	5	—
Family **Callipallenidae**						
Callipallene phantoma (Dohrn)	129	1	—	—	—	—
Callipallene africana sp. nov.	226	—	3	—	—	—
	250	—	—	—	1	—
Callipallene sp.	163	1	—	—	—	—
	185	—	—	—	1	—
Pallenopsis capensis Barnard	185	—	1	—	1	—
Pallenopsis longirostris Wilson	107	—	1	—	1	—
Pallenoides sp.	185	—	—	—	—	1
Parapallene algoae Barnard	86	—	—	—	1	—
Parapallene invertichelata sp. nov.	86	1	—	—	2	3
Pseudopallene gilchristi Flynn	226	1	—	—	—	—
Safropallene longimana gen. et sp. nov.	129		(21 ♂♂, ♀♀)			
	226	—	12	—	15	2

	SM Station no.	ovig. ♂♂	♂♂	gravid ♀♀	♀♀	juv.
Family **Pycnogonidae**						
Pycnogonum (Nulloviger) africanum Calman	162	—	1	—	—	—
	232	—	—	—	1	—
Pycnogonum crassirostrum Sars	232	—	1	—	—	—
Pycnogonum forte Flynn	185	—	—	—	1	—
	226	—	—	—	1	1
Pycnogonum nodulosum Dohrn	86	—	—	—	2	—
	250	—	—	—	3	—
Family **Colossendeidae**						
Hedgpethia magnirostris sp. nov.	103	—	1	1	—	—
Hedgpethia sp.	226	—	—	—	—	1
Rhopalorhynchus gracillimus Carpenter	164	—	—	—	1	—
Family **Nymphonidae**						
Nymphon barnardi sp. nov.	250	—	—	—	2	—
Nymphon bicornum sp. nov.	60	—	1	—	—	—
	129	—	—	—	2	2*
Nymphon comes Flynn	179	—	—	—	1	—
	233	—	1	—	—	—
Nymphon crenatiunguis Barnard	179	—	1	—	—	—
	250	—	—	—	1	—
Nymphon distensum Möbius	86	—	2	—	2	—
	179	1	—	—	1	—
	185	1	—	1	1	3
	232	—	1	—	—	—
Nymphon granulatum sp. nov.	129	—	—	—	1	—
	162	—	3	—	1	—
	226	—	1	—	3	—
	232	—	—	—	1	3
	236	—	—	—	1	1
Nymphon microctenatus Barnard	237	—	—	1	—	—
Nymphon modestum Stock	86	1	1	—	—	—
	239	—	—	1	—	—
	250	—	3	—	1	7
Nymphon obesum sp. nov.	179	—	—	—	1	—
Nymphon paralobatum sp. nov.	226	—	—	—	1	—
Nymphon pedunculatum sp. nov.	163	2	1	—	—	1
	164	—	—	—	3	—
Nymphon phasmatodes Böhm	180	—	—	—	1	—
	185	—	—	—	1	1
Nymphon pilosum Möbius	86	6	3	—	4	5
	103	2	1	4	—	3
	129	—	1	—	—	—
	226	—	—	—	1	—
	250	—	1	—	2	—
Nymphon serratidentatum sp. nov.	226	—	1	—	1	1
Nymphon sp.	185	—	—	—	—	1
	250	—	—	—	—	1

SYSTEMATIC ACCOUNT

Family **Ammotheidae** Dohrn, 1881

Ammothella Verrill, 1900

Ammothella setacea (Helfer, 1938)

Fig. 1

Kyphomia setacea Helfer, 1938: 179–181, fig. 9A–C. Barnard, 1954: 144, fig. 28A.
Ammothella setacea Stock, 1953*a*: 41; 1954: 118 (text), 120 (key).

Material

Transkei area. Neotype, SAM–A10221, SM 226, 32°28,6′S 28°58,8′E, 710–775 m, 1 ovigerous ♂. Paraneotype, SAM–A10220, SM 226, 1 gravid ♀. SAM–A10240, SM 226, 104 ♂♂, ♀♀. USNM 216758, SM 226, 2 ♂♂, 2 ♀♀. MNHN–Py 593, SM 226, 1 ♂, 1 ♀. SAM–A10241, SM 232, 620–560 m, 14 ♂♂, 3 ♀♀, 1 juv. SAM–A10222, SM 236, 670–660 m, 4 ♂♂, 1 ♀. SAM–A10242, SM 250, 150–200 m, 1 ♀.

Zululand area. SAM–A10236, SM 86, 550 m, 4 ♂♂, 6 ♀♀, 4 juv. SAM–A10219, SM 103, 680 m, 3 ♂♂, 1 ♀.

Durban area. SAM–A10237, SM 129, 850 m, 93 ♂♂, ♀♀. SAM–A10238, SM 151, 900 m, 1 ♀.

East London area. SAM–A10239, SM 163, 90 m, 2 ♂♂, 1 ♀, 1 juv. F. Arnaud's collection, 1 ♂, SM 163.

Redescription

Male. Trunk fairly slender, first anterior segmentation line present, second usually absent, third lacking. Lateral processes long, separated by their diameters or slightly less proximally, armed with three long dorsodistal slender tubercles, except for the posterior pair which have two, and two laterodistal long spines. The longest tubercle measures over twice diameter of lateral process. Trunk armed with single anterolateral slender tubercle as long as chelifore basal diameter. Ocular tubercle very long, slender, eyes at distal swollen tip, slightly pigmented; tubercle armed with one, two, or three posterior pointing slender tubercles of varying lengths, but some specimens without posterior tubercles. Proboscis moderately inflated, without constrictions, lips almost flat. Abdomen typical of genus, long, with ventral bend in posterior half, armed with set of extremely variable dorsal tubercles consisting of from two to six single or double slender tubercles equal to and in varying lengths as the lateral process tubercles, and a pair of distal setae.

Chelifore slender, flaring distally, not as long as proboscis, the first segment armed with slender distal tubercle, the longer second segment with variable number (4–7) of similar dorsal tubercles and several long and short distal setae. Chela vestigial, without fingers, sometimes everted, sometimes extended beyond chelifore distal cup. Chela armed with single seta.

Palp typical of genus, distal five segments subequal, armed with many ventral and lateral setae slightly longer than each segment diameter.

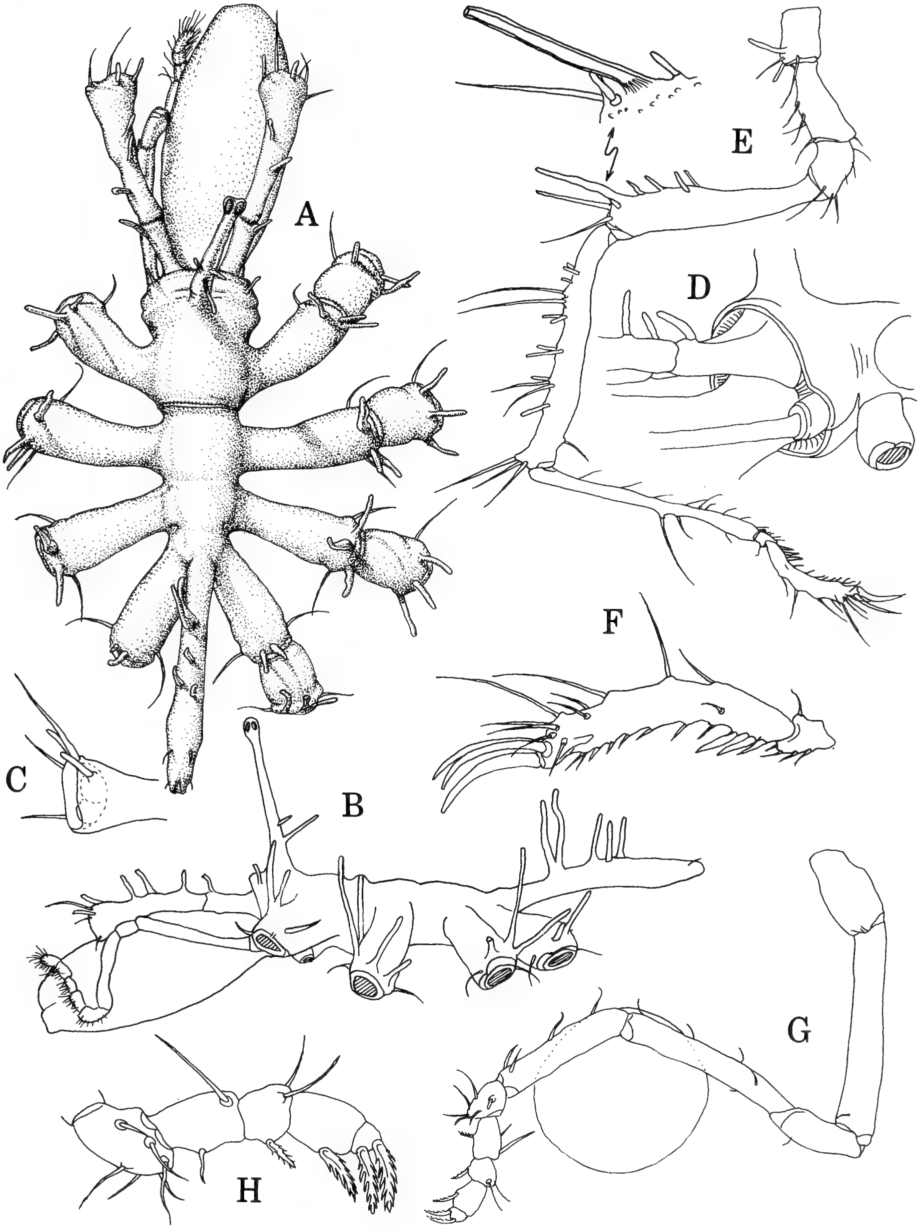

Fig. 1. *Ammothella setacea* (Helfer), male. A. Trunk, dorsal view. B. Trunk, lateral view. C. Chelifore tip. D. Trunk anterior, oblique lateral view. E. Third leg, with enlargement of cement-gland tube. F. Distal segments of third leg. G. Oviger with egg attached. H. Strigilis segments of oviger.

Oviger also typical, with second segment longest. Distal four segments each armed with one denticulate spine, except terminal segment with two. Spines with five or six serrations per side. Egg larger than for others of genus, equal in diameter to length of fourth segment.

Leg very slender, armed with long dorsal and lateral spines equal to or longer than segment diameters and dorsal blunt spines equal to or shorter than segments. Femoral cement-gland tube very long, dorsodistal, carried at low angle. Tarsus extremely short, propodus long, slender, armed with few long dorsal setae, three slender heel spines, and from seven to ten short sole spines. Claw slender, less than half propodal length, auxiliaries very slender, almost as long as main claw.

Proboscis, chelifores and palps originating in an anterior trunk concavity, slightly similar to that found in the genus *Cilunculus*.

Female. Slightly larger in all measurements except for oviger, which is reduced in size with a fourth segment of reduced length. Posterior trunk segmentation lines present or absent. Tubercles on chelifore and on lateral trunk shorter, as are those of lateral processes and abdomen.

Previous record

Agulhas Bank, 126 m.

Remarks

This species was described from a single female specimen and the above records apparently constitute only the second time this species has been taken. The type specimen was evidently lost during wartime (Stock 1953*a*: 41), so we have designated a neotype and a paraneotype from this large collection. This heretofore enigmatic species appears to have some characters of the closely related genus *Cilunculus*. The accompanying figures reveal several characters not illustrated by Helfer (1938). The proboscis, chelifore and palpi originate in a cephalic segment 'hood' typical of *Cilunculus* species, but this species has the longer chelifores of two segments, long tubular spines and general habitus of the genus *Ammothella*. The differences cited in the literature for *Cilunculus* are this cephalic hood, shorter chelifores of one or two segments, usually long pointed spines on the appendages, and a femoral gland showing as a long conical outgrowth of the femur. The genus *Ammothella* usually lacks the cephalic hood, has chelifores usually as long as the proboscis, long hollow clubbed or tubular spines, and an articulated distal tube as the emergent part of the femoral gland. These characters are mixed in *A. setacea*. Among the known species of both genera there are exceptions to every character used to diagnose the two. *Cilunculus* has usually been characterized by short chelifores but one species, *C. acanthus*, has two-segmented chelifores almost as long as the proboscis. On the other hand, several species of *Ammothella* (*A. tubicen*, *A. thetidis*, and others) display an ocular segment anterior extension suggestive of a hood, and two other genera, *Boehmia* and *Oorhynchus*, have projecting cephalic collars or hoods over the chelifore insertion. The number of scape segments is not diagnostic for *Cilunculus*, but all known *Ammothella* species have long two-segmented scapes. *Cilunculus* has eight known species with two-segmented scapes and seven with a single segment. The cement glands of *Ammothella* species are characterized as tubes that are sometimes articulated, but at least two species (again *A. tubicen* and *A. thetidis*) have what appear to be long conical gland tubes, which have no articulation with the femur. The cement glands of *Cilunculus* are not known to be articulated but appear similar to those *Ammothella* species mentioned. This leaves the long tubular spines of *Ammothella* as a character not known to be shared by *Cilunculus*. If all *Ammothella* species had tubular blunt spines, the character might serve as diagnostic for the genus, but less than half of the known species have these spines. The remainder have long (sometimes only short) pointed spines, to all appearances the same as those on species of *Cilunculus*. Therefore, spine type cannot be a valid diagnostic character of *Ammothella*. At least one other genus, *Eurycyde*, has species with similar hollow blunt spines.

Cilunculus is known for its deep-water species and indeed, most are found in waters deeper than 100 m. There are exceptions to this aspect also. *Cilunculus australiensis* has a known depth range of 40–70 m and *C. cactoides* has been taken in as little as 38 m (unpublished National Museum of Natural History specimens). *Cilunculus* species have never been found in the littoral, whereas *Ammothella* is usually a littoral genus, but *A. profunda* was taken in over 1 000 m. This species was found to have a cephalic hood and was recently moved to *Cilunculus* (Nakamura & Child 1983: 32).

We believe, in spite of the evidence presented here, that the two genera should be kept separate for now. The differences remain, even with exceptions, and those of the tubular blunt spines, shallow- versus deeper-water habitats, predominantly short chelifores, and hooded cephalic segment continue to be sufficient evidence, in our opinion, to arrange the species in two separate genera.

Distribution

Extended considerably from Agulhas Bank to Transkei coast, in depths from 90 to 900 m.

Genus *Ascorhynchus* Sars, 1877

Ascorhynchus ornatum (Helfer, 1938)

Ainigma ornatum Helfer, 1938: 181, fig. 10a–f. Barnard, 1954: 144, fig. 28B.
Ascorhynchus ornatum Stock, 1953*a*: 41, 43–44, fig. 6; 1953*b*: 304 [key].

Material

East London area. SAM–A19597, SM 163, 90 m, 1 ♀.

Remarks

This is apparently only the fourth specimen and second capture recorded for this species. The types consist of a male and two females from the Agulhas

Bank, and the sexual characters of the male have not been described. From an unreported male collected south-west of the Cape of Good Hope in 708 m in the National Museum of Natural History collections, the following sexual characters are noted. The cement-gland pores appear to be a series of 6–8 tiny cups in a single row along the dorsal surface of the femur. The cement gland itself is not discernible in this young male Cape specimen. The ovigers are very similar in both sexes with the major segments of the male not much longer than those of the female. The strigilis terminal claw is slender, with no serrations, and is longer than the terminal segment. Sexual pores are very indistinct on the fourth legs, second coxae of the male. Stock (1953*a*: 41) is correct in stating that this is a highly characteristic, easily recognizable species. It should be noted that, in the two specimens examined, neither has eyes on the tall blunt ocular tubercle.

Distribution

This is an apparently endemic South African species and the Cape of Good Hope specimen is from the deepest known locality.

Genus *Boehmia* Hoek, 1881

Boehmia tuberosa Möbius, 1902

Fig. 3H

Böhmia tuberosa Möbius, 1902: 189–190, pl. 28 (figs 13, 14). Schimkewitsch, 1909: 3–4, figs 1B, D. Barnard, 1954: 136–137, fig. 23.
Böhmia spinosa Möbius, 1902: 190 [*lapsus calami*].
Boehmia tuberosa: Stock, 1957: 96 [text]; 1962: 278.

Material

Transkei area. USNM 216759, SM 233, 540–580 m, 1 ♂.

Remarks

This species had been described as smaller than *Boehmia chelata*, but both species should be on hand for this comparison to be relevant. It is easier to differentiate between the males of the two species than to identify isolated females. The male cement-gland area of *B. tuberosa* consists of a smooth or slick patch in an otherwise papillose and setose femur dorsum, and contains two rows of tiny transverse slits (Barnard 1954, fig. 23). The gland area covers the proximal half or two-thirds of the femur. The gland area of *B. chelata* is shorter, broader and has an uneven row of tiny circular pores in place of the slits present in *B. tuberosa*.

The palps of the three known species of this endemic genus have seven or eight segments. *Boehmia longirostris* (known only from a female) has seven palp segments, while *B. chelata* and *B. tuberosa* have eight—the short basal segment of these having been unnoticed by previous authors. A figure of the palp of *B. tuberosa* is provided (Fig. 3H). The terminal segment is shorter than the penultimate segment, and in the single specimen on hand, the two terminal segments measure only half or a little less than the length of the fifth segment. Barnard (1954: 133) lists two other differences in his key. In *B. chelata* the femur is shorter, measuring only three or four times longer than its width, and the cephalic segment is parallel-sided or widens anteriorly. In *B. tuberosa* (the *Meiring Naude* specimen), the femur is slightly longer, being 4,2 times the width, and the cephalic segment narrows anteriorly. The cephalic segment anterior in *B. longirostris* is more or less parallel-sided, but the leg is not figured, nor are measurements given. The proboscis of the latter species is a longer tube than in the other two species and its lateral processes are spaced further apart.

Distribution

Of the few collecting records for *B. tuberosa*, the depth ranges from 11 m to 550 m, and it has been taken from off Cape Town and the Agulhas Bank to the East London area and now the Transkei area.

Through the courtesy of Dr G. Räck (Zoologisches Institut und Zoologisches Museum, Hamburg), we have been permitted to examine the holotype of *B. longirostris*. This is a smaller species than the two others of the genus. It is similar in habitus to *B. chelata*, but the following differences are evident: the legs decrease in length from anterior to posterior on the trunk; the three coxae are subequal in length with the second swollen with genital pores; the femur is about 1,5 times its width and bears many acute conical tubercles, each bearing a seta; the tibiae are shorter with tibia 2 slightly longer than tibia 1; the proboscis reaches 0,6 as long as the ventral trunk, while that of *B. chelata* is only half as long as the trunk; and the abdomen is articulated, carried ventrally and is square tipped. The following key is presented to help separate the three known species. There is controversy as to whether or not *B. dubia* Hedgpeth, known from a larva, is actually a member of this genus, and it is omitted from the key.

1. Legs about four times as long as body; cephalic segment narrow anteriorly; femur (♂) 4–5 times longer than broad .... *B. tuberosa*

— Legs not more than twice as long as body; cephalic segment parallel-sided or widened anteriorly; femur little more than twice as long as broad 2

2. Palp 7-segmented; proboscis length equals 0,6 of ventral trunk length .... *B. longirostris*

— Palp 8-segmented; proboscis length equals half of ventral trunk length .... *B. chelata*

Genus *Cilunculus* Loman, 1908

Cilunculus sewelli Calman, 1938

Cilunculus sewelli Calman, 1938: 161–163, figs 8–9. Clark, 1963: 75. Stock, 1968: 13.
Ammothella gigas Fage, 1956: 173–175, figs 9–14.

Material

East London area. SAM–A19607, SM 185, 90 m, 3 juvs.
Transkei area. SAM–A19608, SM 226, 710–775 m, 1 juv.

Remarks and distribution

There is nothing remarkable about the two sets of juveniles except for the great difference in their depths of capture. The 90 m at SM 185 marks the shallowest this species has ever been taken, but its wide depth range of 183–1 789 m easily permits the addition of shallower or deeper depths to the record. This species has been taken off the Natal coast, Zanzibar, and as far east as New Zealand.

Genus *Tanystylum* Miers, 1879

Tanystylum thermophilum (Barnard, 1946)

Austroraptus thermophilus Barnard, 1946: 62; 1954: 146–148, figs 29–30.
Tanystylum thermophilum Stock, 1956: 92–93; 1957: 94–95, fig. 12; 1962: 277. Clark, 1977: 336.

Material

Transkei area. SAM–A19596, SM 250, 150–200 m, 2 ♂♂.

Remarks

These are typical males as figured by Barnard (1954, figs 29–30). The species has a six-segmented palp and a curved bottle-shaped proboscis, which makes it easy to distinguish.

Distribution

The maximum depth at this station off Transkei is the deepest at which this species has been taken (previously recorded from 11 m to a little over 100 m).

Family **Phoxichilidiidae** Sars, 1891

Genus *Anoplodactylus* Wilson, 1878

Anoplodactylus typhlops Sars, 1888

Anoplodactylus typhlops Sars, 1888: 341–342; 1891: 29, pl. 2 (fig. 3a–e). Hedgpeth, 1948: 228, 229, fig. 29a–c [literature]. Child, 1982*a*: 21.
Anoplodactylus neglectus Hoek, 1898: 293–295, figs 7–10.
Anoplodactylus pelagicus Flynn, 1928: 25–27, fig. 14a–b. Barnard, 1954: 128, fig. 19a–g.
non Anoplodactylus pelagicus Stock, 1981: 463–464, fig. 6.

Material

Durban area. SAM–A10223, SM 123, 690 m, 1 ♂.

Remarks

This male specimen closely resembles both *A. pelagicus* Flynn and *A. typhlops* Sars. The blind flattened ocular tubercle, the large gaping chelifores, the legs on which the cement-gland tube rises distally at 0,7 of the femur length, and the general habitus all conform to both descriptions. We believe they are inseparable and have little hesitation in synonymizing Flynn's species with Sars'.

We do not believe that Stock's nine specimens reported (as *A. pelagicus*) from campaign 'Walvis 1', station 75, 32°18,2′S 13°15,9′E, in 3 550 m, are this species. Stock (1981: 464, fig. 6a) illustrated three different acutely pointed ocular tubercles for Flynn's species, while the original description and figure stated 'the ocular tubercle is vey low and flattened on top' (Flynn 1928: 25, fig. 14b). The oviger and legs of Stock's specimens are very close to this species, but the tall ocular tubercle is so unlike that of Flynn's and Sars' species descriptions that we believe the Walvis specimens may be another or new species.

There is a curious anomaly present in the *Meiring Naude* male. The cement-gland tubes are found only on the anterior three pairs of legs and not on the posterior pair. This specimen must be an adult as the sex pores appear ventrally on the second coxae of the posterior pair of legs. Perhaps the posterior legs were lost and then regenerated. The cement-gland duct joins the femur at a more obtuse angle (135°) than those shown by Flynn (1928, fig. 14a).

Distribution

This species, under its various names, is a deep-water blind species of wide distribution. It is known from the North and South Atlantic and its range extends into the Indian Ocean in the sub-Antarctic zone of Prince Edward and Crozet islands, and it has been taken in the Gulf of Alaska. Its depth range extends to over 3 600 m.

Family **Austrodecidae** Stock, 1954

Genus *Pantopipetta* Stock, 1963

Key to the genus *Pantopipetta*

1. Auxiliary claws present; eyes present 2
— Auxiliary claws lacking; eyes present, lacking, or not evident 3
2. With very tall spurs on lateral processes; auxiliary claws from 0,3 to 0,4 of main claw length .... *P. auxiliata*
— Without spurs or tubercles on lateral processes; auxiliary claws less than 0,3 main claw length .... *P. oculata*
3. Lateral processes without distal spurs or tubercles; palps with 4 distal segments; first coxae without spur; eyes lacking or not evident 4
— Lateral processes with tall or short spurs or low tubercles; palps with 3 or 4 distal segments; first coxae with or without spurs; eyes present, lacking, or not evident 6
4. Tarsus very short; tarsus–propodus length ratio 1 : 7; propodal claw without serrations .... *P. australis*
— Tarsus longer, tarsus–propodus length ratio from 1 : 1,5 to 1 : 2,5; propodal claw with or without serrations 5
5. Tarsus–propodus length ratio 1 : 2,5; palp segment 5 equal to terminal segment; propodal claw smooth (including *P. brevicauda*) .... *P. longituberculata*

— Tarsus–propodus length ratio 1 : 1,5; palp segment 5 distinctly longer than terminal segment; propodal claw endally serrate . . . . *P. weberi*

6. Palp with 3 short distal segments; eyes present or lacking 7

— Palp with 4 short distal segments; eyes lacking or not evident 10

7. Lateral processes with low rounded tubercles, not taller than wide; first coxae with 2 low slender tubercles; eyes lacking . . . . *P. aconae*

— Lateral processes with tall spurs or tubercles; first coxae with or without spurs or tubercles; eyes present or lacking 8

8. Lateral processes with low tubercle on first pair, tall spur on posterior 3 pairs; first coxae and femorae with broad rounded dorsal tubercles; eyes present . . . . *P. bilobata* sp. nov.

— All lateral processes with tall spurs; first coxae with or without tubercles or spurs; eyes lacking or not evident 9

9. First coxae with tall dorsal spur and shorter ventral spur, matching those of lateral processes . . . . *P. armata* sp. nov.

— First coxae without spurs or tubercles . . . . *P. armoricana*

10. Lateral processes with tall spurs on posterior 3 pairs only; propodal claws slightly serrate . . . . *P. capensis*

— Lateral processes with low inconspicuous tubercles; propodal claw smooth 11

11. Femur with large dorsodistal tubercle almost as long as segment diameter; tarsus–propodus length ratio 1 : 2,6; propodal claw shorter than tarsus . . . . *P. angusta*

— Femur with very low dorsodistal tubercle less than half segment diameter; tarsus–propodus length ratio 1 : 3,1; propodal claw longer than tarsus . . . . *P. lata*

Pantopipetta armata sp. nov.

Fig. 2

Material

Holotype, SAM–A19574, SM 103, 28°31,7′S 32°34,0′E, 680 m, 1 ♂. Paratypes, SAM–A19575, 1 ♂, 1 ♀. Paratype, USNM 228131, SM 103, 1 ♂. Paratype, MNHN–Py 591, SM 103, 1 ♂. Paratype, SAM–A19576, SM 109, 28°41,0′S 32°36,8′E, 1 300 m, 1 ♀.

Description

Male. Trunk completely segmented, including segmentation line at base of abdomen. Lateral processes long, widely separated, armed with long slender spur on first pair, slender spurs twice length of first pair on posterior three pairs, and shorter slender spurs on ventrodistal lateral processes. Abdomen reaching to midlength of coxa 2 of fourth pair of legs, slender, cylindrical, glabrous. Proboscis slightly swollen proximally, tubular and annulated in distal two-thirds, almost as long as trunk, curved slightly ventrally. Palps seven-segmented, second segment longest, fourth segment 0,6 of second segment length. Terminal three segments armed with ventral short setae, sixth segment twice length of fifth, seventh only a tiny knob.

Ocular tubercle a tall erect cone tapering to small distal bulb, without eyes.

Oviger 10-segmented, typical of genus. Strigilis segments increasingly smaller, armed with short broad denticulate spines in formula 3 : 2 : 2 : 3, with terminal claw only slightly larger than spines.

Legs long, slender, armed with few distal setae and long dorsodistal seta longer than segment diameter on major segments. First coxae with tall dorsodistal spur and short ventrodistal spur, third coxae with matching dorsodistal

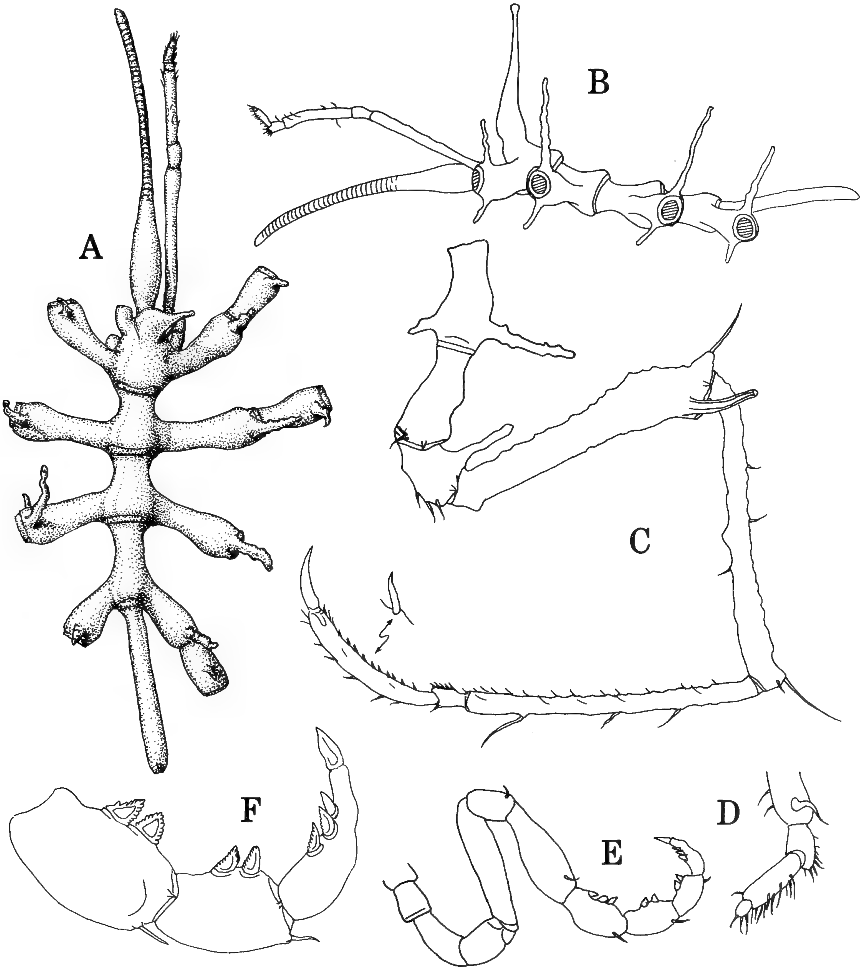

Fig. 2. *Pantopipetta armata* sp. nov. Holotype, male. A. Trunk, dorsal view. B. Trunk, lateral view. C. Third leg, with enlargement of sole spine. D. Distal segments of palp. E. Oviger. F. Distal segments of oviger.

spur. Cement-gland tube tapered, longer than femur diameter, placed distally on anterolateral or posterolateral surface and extending beyond flexed first tibia. Anterior or posterior gland placement random, without apparent pattern. Tarsus short, about 0,25 propodal length, both segments armed with row of short sole spines, few ectal setae. Claw 0,4 propodal length, auxiliary claws lacking. Femur and tibia 2 equal in length, tibia 1 slightly longer.

Female. Only slightly larger than male, except for oviger which is smaller, with fewer denticulate spines.

Measurements (holotype, in mm)

Trunk length, 1,66; trunk width (across 2nd lateral processes), 1,3; proboscis length, 1,54; abdomen, 0,84; third leg, coxa 1, 0,36; coxa 2, 0,35; coxa 3, 0,24; femur, 0,94; tibia 1, 0,98; tibia 2, 0,94; tarsus, 0,12; propodus, 0,49; claw, 0,2.

Remarks

Of the 12 known species of *Pantopipetta*, none has the slender spurs on both the dorsal and ventral surfaces of the lateral processes and first coxae. At least one other species (*P. capensis*) has reduced spurs on the first pair of lateral processes; others have no spurs but instead low tubercles (as in *P. bilobata*), but the presence of ventral spurs is sufficient to make this a new species.

Distribution

The stations at which these specimens were taken are on the Natal coast, between the St Lucia Estuary and Richards Bay, and this blind deep-water species was taken in 680 m and 1 300 m.

Etymology

The specific name '*armata*' refers to the unusual lateral process and first coxa armament of dorsal and ventral spurs.

Pantopipetta bilobata sp. nov.

Fig. 3A–G

Material

Transkei area. Holotype, SAM–A10256, SM 250, 31°59,3′S 29°22,5′E, 150–200 m, 1 ♂. Paratypes, SAM–A10260, SM 250, 4 ♀♀. Paratype, MNHN–Py 592, SM 250, 1 ♀.

Zululand area. Paratypes, SAM–A10259, SM 86, 27°59,5′S 32°40,8′E, 550 m, 1 ♂, 1 ♀.

East London area. Paratypes, SAM–A10257, SM 163, 33°04,6′S 28°06,6′E, 90 m, 3 ♀♀. Paratypes, USNM 228132, SM 163, 1 ♂, 1 ♀. Paratype, SAM–A10258, SM 164, 33°04,6′S 28°06,6′E, 90 m, 1 ♀.

Description

Male. Trunk completely segmented including abdomen base. Lateral processes moderately long, about twice their maximum diameter, separated by approximately their own diameters, armed with tiny low single or double tubercles on first pair, and very tall slender spurs on others. Without ventral armament. Tall slender spurs may be present only on posterior two pairs of lateral processes or only on posterior pair. Ocular tubercle tall, erect, tapering

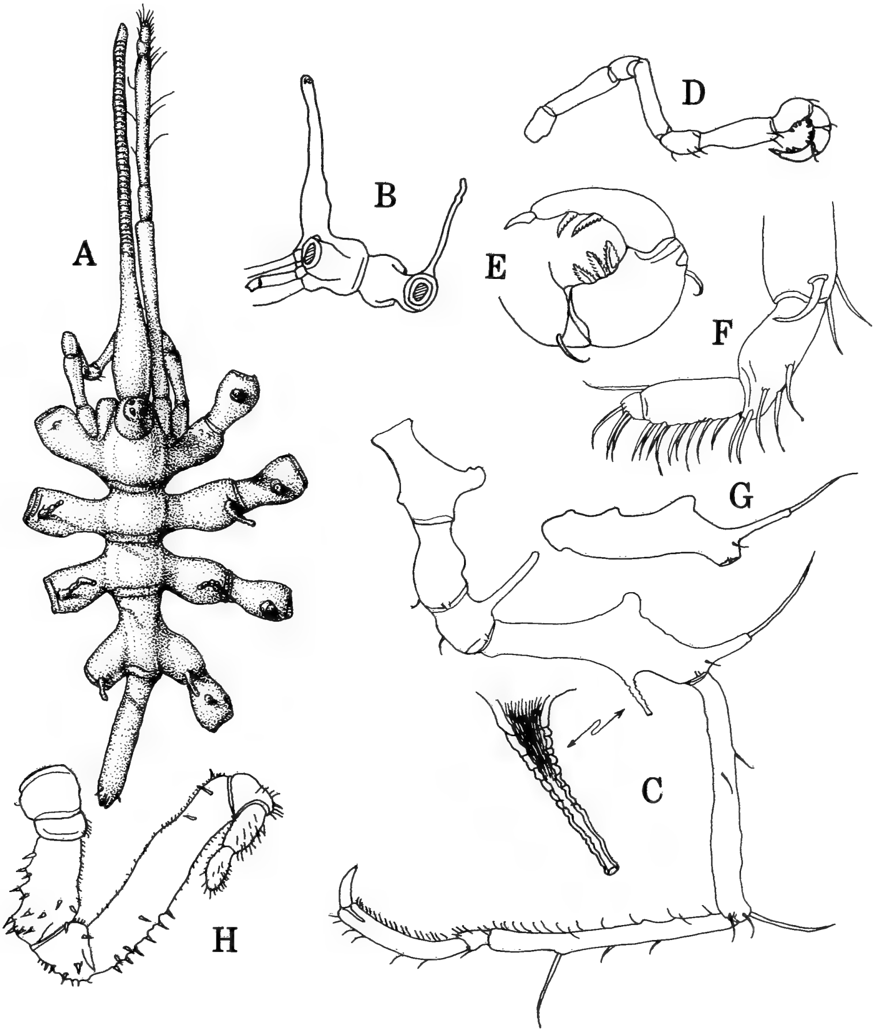

Fig. 3. A–G. *Pantopipetta bilobata* sp. nov. A–F. Holotype, male. A. Trunk, dorsal view. B. Trunk anterior, lateral view. C. Third leg, with enlargement of cement-gland tube. D. Oviger. E. Oviger distal segments. F. Distal palp segments. G. Paratype, female. Femur. H. *Boehmia tuberosa* Möbius. Palp.

to tiny eyes at tip. Proboscis typical of genus, swollen proximally, tubular and annulated distally, 0,25 longer than trunk length, down-curved distally. Abdomen moderately robust, cylindrical, extending to distal end of second coxae of fourth legs, armed with pair of short distal setae.

Palp seven-segmented, second longest, fourth 0,6 as long as second. Terminal three segments heavily setose ventrally, setae longer than segment diameters. Sixth segment slightly longer than fifth, seventh only a knob.

Oviger of typical recurved shape; second, fourth and sixth segments subequal. Strigilis segments of increasingly reduced size distally, armed with an ectal seta and endal denticulate spines in the formula 3 : 3 : 3 : 2, with terminal claw the same size as spines. Spines slender, margins closely serrate.

Legs long, slender, armed with few short setae and a very long spine dorsodistally on a femur tubercle as long as femur diameter and on single dorsodistal swellings on both tibiae. Femur with conical cement-gland tube ventrally along 0,6 of its length and large broad-based tubercle dorsally just opposite cement-gland tube. First coxae with large broad-based dorsodistal tubercle and tiny hint of a low tubercle on ventral side. Third coxae with tall slender dorsal tubercle or spur. Tarsus short, slightly over 0,2 propodal length, armed with few ventrodistal setae. Propodus slender, well curved, with few ectal setae and row of short sole spines. Claw robust, short, only slightly longer than tarsus, without serrations.

Female. Entire animal slightly larger than male except for oviger which is typically smaller. Femur distinctive from that of male. Dorsal surface with two broad low tubercles, the distal tubercle larger than the proximal one and dorsodistal slender tubercle bearing spine longer than in male, measuring 1,5 the segment diameter. Dorsal broad tubercles only on posterior four legs and absent from anterior two pairs.

Measurements (holotype, in mm)

Trunk length, 1,5; trunk width (2nd lateral processes), 1,25; proboscis length, 2,1; abdomen, 0,71; third leg, coxa 1, 0,41; coxa 2, 0,36; coxa 3, 0,21; femur, 0,96; tibia 1, 1,11; tibia 2, 1,06; tarsus, 0,12; propodus, 0,53; claw, 0,15.

Remarks

This species is characterized by the presence of eyes, lack of auxiliary claws, and by the curious variability of the tall lateral-process spurs occurring on the posterior six, or four, or only on the last pair of lateral processes. This latter character is not exactly unique among species of *Pantopipetta*, where at least two species lack tall spurs on the anterior pair of lateral processes, but no other species appears to have this 'diminishing' of spurs toward the anterior in some, but not all, specimens examined. Perhaps this is a sexual character related to maturity of the gonads, but many more specimens would have to be examined, including ovigerous specimens, in order to confirm this conjecture. This character of 'gain' or 'loss' of tall spurs appears sufficient in our opinion to propose this as another new species of *Pantopipetta*.

In the twelve species of *Pantopipetta*, including the two new species described herein, there are only three with eyes (a few others are described in which the eyes are not evident and supposedly are lacking), while the majority (10) lack auxiliary claws. Besides this species, *P. auxiliata* and *P. oculata* have eyes, but the latter two have auxiliary claws whereas the new species lacks them. The majority of species have four short distal palp segments, except for four species—including *P. bilobata*—that have three segments. The other species with three short segments are *P. aconae*, *P. armoricana*, and *P. armata* (described herein, see pp. 132–134). *Pantopipetta bilobata* differs from *P. aconae*, which has low pointed lateral-process tubercles, paired tubercles on the first coxae, and other morphological differences. The other two species bear long slender tubercles of varying lengths on all eight lateral processes, have other tubercles where *P. bilobata* has none, and also lack eyes.

Distribution

This new species appears to be a typical element of the eastern warmer-water pycnogonid fauna of South Africa and has a rather wide geographic and bathymetric distribution from Zululand to East London in 90–550 m.

Etymology

This species name refers to the bilobed appearance of both the male femur, with a dorsal tubercle and opposed ventral cement-gland tube, and the female femur, with its twin dorsal tubercles.

Family **Callipallenidae** Hilton, 1942

Genus *Callipallene* Flynn, 1929

Callipallene phantoma (Dohrn, 1881)

Pallene phantoma Dohrn, 1881: 196–197, pl. 14 (figs 1–9).
Callipallene phantoma Child, 1982*a*: 26–27 [literature]. Arnaud, 1987: 49.

Material

Durban area. SAM–A10225, SM 129, 850 m, 1 ♂ with larvae.

Remarks

This specimen possesses the typical habitus of the species, the long neck, long legs with few spines, and straight propodus without a heel, but with long auxiliary claws measuring over half the main claw. The auxiliaries of this specimen have basal denticulation like those figured for *C. panamensis* Child, 1979 (fig. 14e), and the proboscis is less angular than that of Mediterranean specimens.

Measurements (in mm) of the third right leg of this specimen are: coxa 1, 0,16; coxa 2, 1,23; coxa 3, 0,26; femur, 1,95; tibia 1, 1,77; tibia 2, 2,43; tarsus, 0,05; propodus, 0,51; claw, 0,34; auxiliaries, 0,25.

Distribution

This species is distributed from the Mediterranean to New England, Florida, the Bahamas and Japan. It is a new record for the Indian Ocean off South Africa and was taken at a surprising depth of 850 m. Other known collecting depths are much shallower (3 m from *Sargassum linifolium*—Krapp-Schickel & Krapp 1975, and from 10 to 35 m in Marseille Gulf, from *Posidonia oceanica* blades—Arnaud 1987: 49).

Callipallene africana sp. nov.

Fig. 4

Material

Transkei area. Holotype, SAM–A10226, SM 226, 32°28,6′S 28°58,8′E, 710–775 m, 1 ♂ (incomplete). Paratypes, SAM–A10217, SM 226, 710–775 m, 2 ♂♂ (damaged, without legs). Paratype, SAM–A10227, SM 250, 31°59,3′S 29°22,5′E, 150–200 m, 1 ♀ (damaged, 1 complete leg only).

Description

Male. Size moderately small, leg span 24,3 mm. Trunk completely segmented, lateral processes short, 1,5 times longer than their diameters or less, separated by slightly less than their diameters, glabrous. Neck moderately long, posterior parallel-sided part as long as anterior expanded part, or 'crop'. Oviger implantation well in front of first lateral processes, against posterior extremity of neck. Ocular tubercle low, blunt, as tall as diameter, with slender tubercle at apex not as tall as ocular tubercle itself. Eyes present, slightly pigmented. Abdomen short, blunt, semi-erect, glabrous. Proboscis short, not as long as neck, blunt, broad, without ventrodistal bulges, lips flat.

Chelifores massive, curved against proboscis anterior. Scape not as long as proboscis, slightly curved inward, armed with few lateral and distal setae. Chela broad, semiglobular, armed with fringe of setae before fingers. Fingers straight except at curved tips, armed with row of low crenulations.

Ovigers typical, third segment slightly elongate, fourth about 0,74 length of fifth, which has distal apophysis and row of six or seven ectal setae. Strigilis segments increasingly shorter distally, armed with monomorphic denticulate spines in the formula 12 : 11 : 11 : 12. Spines bear one or two broad proximolateral teeth and finely serrate distolateral edges. Distal spines longer than proximal spines. Legs missing.

Female. Trunk and appendages slightly larger than male, oviger fifth segment shorter, without distal apophysis.

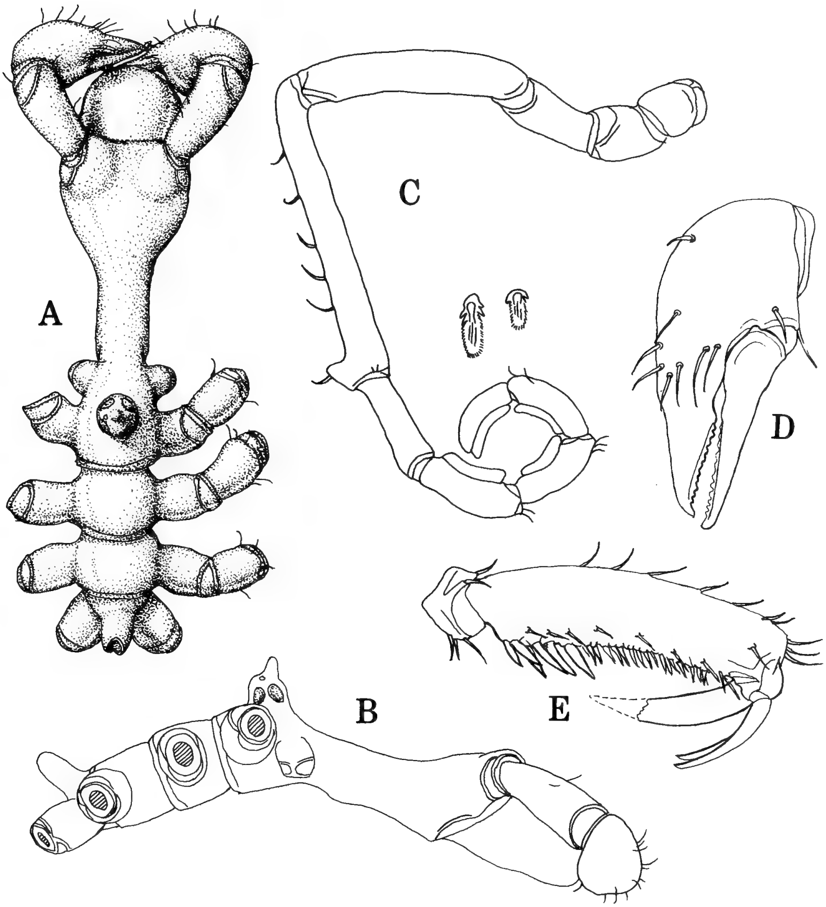

Fig. 4. *Callipallene africana* sp. nov. A–D. Holotype, male. A. Trunk, dorsal view. B. Trunk, lateral view. C. Oviger, with enlargements of proximal and distal denticulate spines. D. Chela. E. Paratype, female. Third leg, distal segments.

Legs elongate, armed with very few setae not as long as segment diameters. Femur and first tibia equal in length, second tibia about 0,2 longer. Propodus very slightly curved, without heel, armed with five or six heel spines arranged in two rows, many shorter sole spines flanked by row of short lateral setae. Claw moderately slender, slightly curved, auxiliaries about 0,6 main claw length.

Measurements (in mm)

Holotype, male: trunk length 2,22; trunk width, 0,92; proboscis length, 0,7; abdomen length, 0,23.

Paratype, female: leg—coxa 1, 0,32; coxa 2, 1,37; coxa 3, 0,46; femur, 2,76; tibia 1, 2,75; tibia 2, 3,37; tarsus, 0,12; propodus, 0,54; claw, broken.

Remarks

There are no long-necked species of the genus *Callipallene* known in southern African waters. We hesitate to describe this as a new species for lack of suitable undamaged material, but it is unlike anything known from the region. There are two species known from South Africa, *Callipallene vexator* Stock, 1956, and *Callipallene* sp. Barnard, 1954, each with sufficient differences as to prevent confusion with this new species.

The taxonomy of this genus is in a state of confusion and there also seems to be some evidence that neck length is a function of age (Stock 1952: 10, figs 25–27). *Callipallene phantoma* (Dohrn) and its controversial subspecies appear to be the nearest relatives of the new species, but they have longer necks, many more setae, different leg length ratios, and other characters that differ from this new species. They are also separated from the new species by vast geographical distances and, although this is never sufficient reason to name a new species, this is a contributing factor, in addition to the morphological differences, in naming this new species.

The combination of moderately long neck, five or six heel spines in two rows, lack of significant setae and spines on the legs, presence of chela finger serrations, and the compact trunk segments are sufficient, we believe, to describe this as a new species.

Distribution

Known only from the type locality, the Transkei area, in 710–775 m, and slightly to the north-east in 150–200 m.

Etymology

The specific name for this species is derived from the African continent, its place of origin.

Callipallene sp.

Material

East London area. SAM–A10228, SM 163, 90 m, 1 ♂ with eggs. SAM–A10247, SM 185, 90 m, 1 ♀.

Remarks

These damaged specimens may represent a new species, but they share many characters with known species and are sufficiently damaged that we refrain from designating them either as known or new.

The trunk is either completely segmented or lacks the posterior suture between third and fourth segments. The lateral processes are compact, separated by less than their diameters and only slightly longer than their maximum diameters. The neck is short and the chelifores are robust and short. The palm has many ectal setae and the fingers, about as long as the palm, have serrate teeth. The abdomen and proboscis are quite short and the proboscis has ventrodistal bulges.

The oviger is typical, with a large fifth segment apophysis in the male. The strigilis spines are alike and have the formula 10 : 8 : 8 : 10. The legs are robust, with few setae, the femur is subequal to tibia 1, and tibia 2 is longest. The propodus is very setose lateral to two distinct rows of sole and heel spines. There are four to six heel spines. The claw is short and the auxiliaries are over 0,7 as long as the claw. Both auxiliaries have endal rugosities or patches of tiny blunt spines numbering from five to eight.

These specimens share characters of *Callipallene belizae* Child, *C. pectinata* (Calman), *C. californiensis* Hall, and *C. emaciata* (Dohrn). The pectinate or rugose auxiliary claws do not appear on all specimens of the species bearing them (*C. pectinata*, *C. panamensis*, and possibly others). Therefore, it is not always a reliable taxonomic character in the genus.

This unnamed species is closest to *C. pectinata*, also its closest geographical associate. Although *C. pectinata* has much larger rugosities (even teeth) endally on the auxiliary claws, the leg and propodus are similar except for having fewer lateral propodal setae and a longer main claw. The neck and general trunk habitus are the same in both species, as are the ovigers and chelifores. It is possible that when more specimens of this species are taken from South African waters, it will be found that they conform more closely with *C. pectinata* and can be assigned to that species with more confidence.

Of the other species near these *Meiring Naude* specimens, *C. emaciata* and *C. belizae* have shorter propodi with less curvature and fewer lateral setae. Also, *C. belizae* lacks chelifore teeth and ventrodistal proboscis bulges. *Callipallene panamensis* has a much longer propodus with fewer setae and spines, while the propodus of *C. californiensis* has fewer lateral setae and auxiliary claw rugosities that appear more like tiny setae than the blunt spines of *Callipallene* sp.

These specimens are, of course, quite different from the two known South African species, *C. vexator* Stock, 1956, and *Callipallene* sp. Barnard, 1954.

Genus *Pallenopsis* Wilson, 1881

Pallenopsis capensis Barnard, 1946

Pallenopsis capensis Barnard, 1946: 62; 1954: 116 [key], 118–119. Stock, 1956: 83–84, fig. 7a; 1962: 285; 1983: 34.

Material

East London area. SAM–A10216, SM 185, 90 m, 1 ♂, 1 ♀.

Remarks

These two specimens agree well with *P. capensis* as described. They have the long auxiliaries, a few long spines, and a club-shaped sixth oviger segment densely covered with minute spines or setae. The male of this species has a very short cement-gland tube opening ventrally, slightly proximal to the middle of each femur. The second left leg of the male measures 73 mm, whereas that of the female is smaller.

Distribution

This is a typical South African species, known from the Cape to East London area in 51–342 m.

Pallenopsis longirostris Wilson, 1881

Pallenopsis longirostris Wilson, 1881: 252–253, pl. 4 (figs 19–22), pl. 5 (figs 24–25). Hedgpeth, 1948: 210–211, fig. 21a–b [literature]. Arnaud, 1973: 150. Stock, 1981: 463, fig. 5a–f.
Pallenopsis oscitans: Barnard, 1954: 122, fig. 17.

Material

Zululand area. SAM–A10215, SM 107, 1 200–1 000 m, 1 ♂, 1 ♀.

Remarks

This is a large handsome species with well-pigmented eyes.

Distribution

It has a wide distribution, predominantly in the North Atlantic, but this appears to be the first record of it in the Indian Ocean. Barnard (1954: 122) recorded it from off Cape Point, so it is not surprising to find it off the coast of Zululand. It has a depth range of 135–3 065 m.

Genus *Pallenoides* Stock, 1951

Pallenoides sp. nr *amazonica* Stock

Compare:
Pallenoides amazonica Stock, 1975: 1012–1015, figs 23–24.

Material

East London area. SAM–A10218, SM 185, 90 m, 1 larva.

Remarks

Despite its young stage of development (its fourth legs are only pointed knobs), this specimen shares the main characters of an adult of *P. amazonica* as originally described. It has three trunk suture lines, a short proboscis with ventrodistal bulges, stout scapes and chelae with smooth movable fingers and very small crenulations on the immovable finger, a low conical ocular tubercle, a short angular abdomen, and robust legs. The anterior four legs are completely developed, whereas the posterior four are less developed to undeveloped. The eyes are not visible and the curved propodus has a heel with only two basal spines and five shorter sole spines. The auxiliary claws are as long on the anterior legs as in the type of *P. amazonica*.

The larva measures 1,44 mm in trunk length and 0,63 mm across the second lateral processes.

It is possible that this specimen is either *P. proboscideum* Barnard, or *P. magnicollis* Stock, both known from the South African area (Algoa Bay and Lüderitz Bay respectively). However, it lacks the median trunk, lateral process and chelifore tubercles of *P. proboscideum*, and lacks the distal trunk setae and has a different shaped proboscis than *P. magnicollis*. It agrees more in the trunk, proboscis and leg characters with *P. amazonica* than with the two South African species. Stock's type was taken in northern Brazil, and although this *Meiring Naude* record is certainly questionable, it would not be the first time a pycnogonid species has such disparate distribution.

Genus *Parapallene* Carpenter, 1892

Parapallene algoae Barnard, 1946

Parapallene algoae Barnard, 1946: 61; 1954: 111–112, fig. 12a–c. Stock, 1956: 81–82, fig. 5a–e; 1962: 284.

Material

Zululand area. SAM–A10252, SM 86, 550 m, 1 ♀.

Remarks

This is a large, handsome, long-necked species and this specimen bears several orange or white ova in its distended femorae. The trunk length, from the base of the chelifores to the abdomen base, is 10,3 mm.

Distribution

This is apparently an endemic South African species, known from the south and east coasts in 55–159 m. This record extends the known range well into the Indian Ocean and, at 550 m, is from much deeper water.

Parapallene invertichelata sp. nov.

Fig. 5

Material

Zululand area. Holotype, SAM–A19572, SM 86, 27°59,5′S 32°40,8′E, 550 m, 1 larvigerous ♂. Paratypes, SAM–A19573, SM 86, 550 m, 2 ♀♀ (1 without legs), 1 juv., 2 larvae.

Description

Male. Size fairly small, leg span slightly greater than 21 mm. Slender species with long appendages. Trunk completely segmented, neck moderately

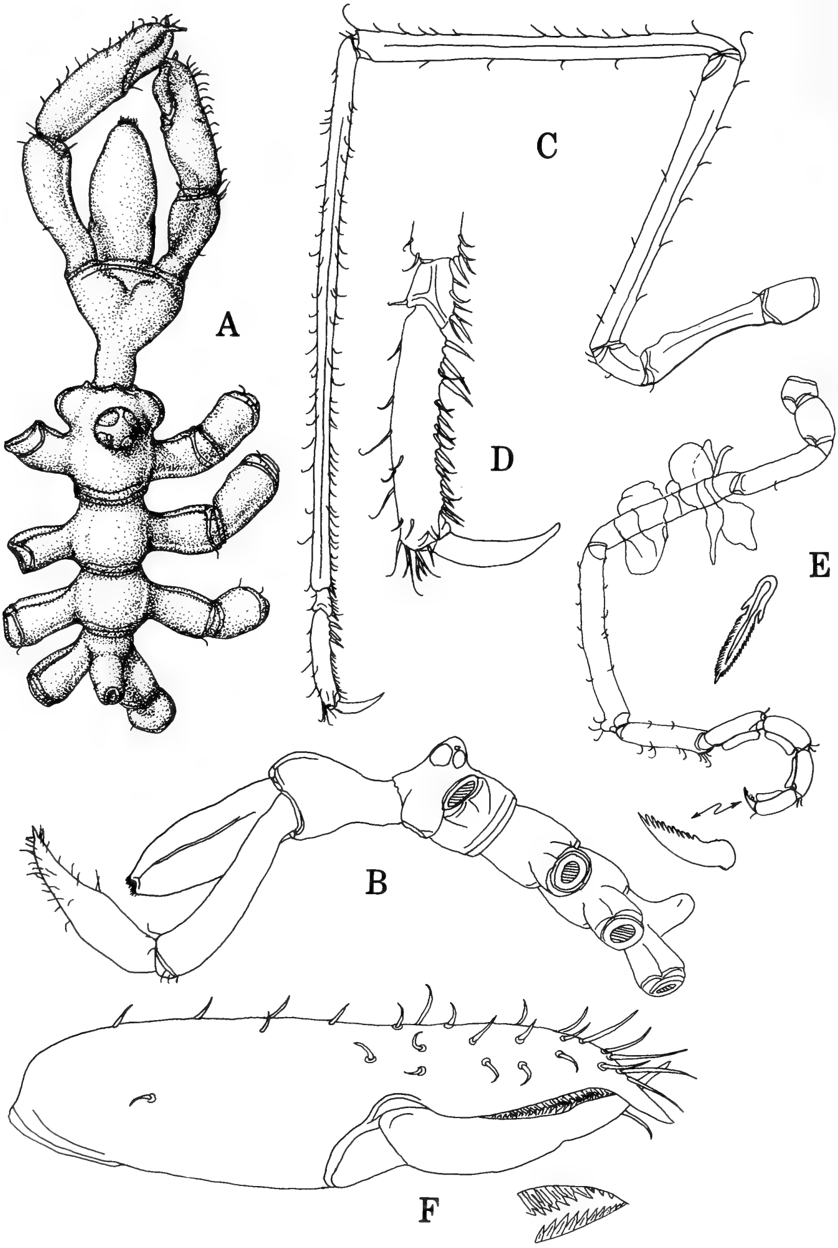

Fig. 5. *Parapallene invertichelata* sp. nov. Holotype, male. A. Trunk, dorsal view. B. Trunk, lateral view. C. Third leg. D. Distal segments of leg. E. Oviger, with enlargements of denticulate spine and terminal claw. F. Chela, with enlargement of teeth.

short, lateral processes separated by their own diameter or little more, as long as 1,5 times their maximum diameter, armed with short posterodistal seta on second and third pairs. Ocular tubercle short, not as tall as its diameter; eyes large, anterior pair larger than posterior pair, slightly pigmented. Abdomen short, erect, armed with pair of short distal setae. Proboscis slender, constricted in midregion, tapering distally to very small mouth bearing tightly packed fringe of oral setae.

Chelifores large, carried in inverted or inferior position, arching ventral to proboscis. Scape large, equal in length to proboscis, armed with several distal setae. Chela long, fingers shorter than palm. Fingers swollen for most of length, tapering to slender tips that cross when fingers close. Armed with many short setae on immovable finger only, and row of coalesced teeth similar to propodal lamina on both fingers.

Oviger moderately long, slender, third segment slightly longer than combined length of first two, fifth longest, 0,2 longer than fourth, armed with several lateral setae and low distal apophysis bearing three setae. Sixth through tenth segments progressively shorter, armed with few lateral and distal setae. Strigilis armed with denticulate spines in formula 16 : 15 : 14 : 13, spines slender, with pair of large basal serrations and many tiny serrations distally. Terminal claw short, about half length of terminal segment, well curved, armed with eleven short endal teeth.

Legs long, very slender, armed with short setae increasing in numbers distally. Second coxa slightly longer than first and third combined. Second tibia longest with first tibia and femur progressively shorter. Tarsus very short, armed with several ventral setae and single spine equal to ventrodistal spine on second tibia. Propodus very slightly curved, without heel, armed with three heel spines of equal length and row of eight or nine sole spines, which are flanked by rows of short lateral setae. Claw robust, moderately curved, half length of propodus. Auxiliary claws absent. Cement glands not evident.

Female. Sexual pores dilated on all second coxae, femorae with few ova. Trunk size almost matching male, equally or slightly less setose. Oviger segments four and five equal, fifth without setose distal apophysis.

Measurements (holotype, in mm)

Trunk length, 1,97; trunk width (2nd lateral processes), 0,93; proboscis length, 0,76; abdomen, 0,2; third leg—coxa 1, 0,29; coxa 2, 0,78; coxa 3, 0,36; femur, 2,0; tibia 1, 2,23; tibia 2, 3,37; tarsus, 0,16; propodus, 0,6; claw, 0,3.

Remarks

This new species shares characters of both *Parapallene* and *Pseudopallene* and, indeed, there is little to differentiate the two genera (Stock 1953*b*: 296–297; 1954: 50). Without wishing to undertake an analysis of both genera, we propose this new species as belonging to *Parapallene*. Its proboscis is very much like that of *Pseudopallene hospitalis* (Loman) (formerly *Parapallene* *hospitalis*). One of the few differences between the two genera has been the configuration of the lips and whether or not they have a corona of setae. This means of differentiation has apparently been abandoned, as there are species in both genera with differing lip configurations and with or without lip setae. The presence or absence of chela finger teeth has been used as a differentiating character, but there are known species in both genera with and without chelae teeth. We have placed this new species under *Parapallene* because, in our opinion, it shares more characters with that genus than it does with *Pseudopallene*, according to Stock's (1954: 50, 61) definitions of these genera.

The inverted flexure of the chelifores in this new species is very rare among pycnogonids and is unique among the species of *Parapallene* (and *Pseudopallene*).

The adults of this new species have an apparent wrinkle artifact anterior to the oviger implantation on the neck.

Distribution

Known only from the type locality, off Zululand in 550 m.

Etymology

The specific name '*invertichelata*' refers to the inverted flexion of the chelifores present in all specimens examined.

Genus *Pseudopallene* Wilson, 1878

Pseudopallene gilchristi Flynn, 1928

Pseudopallene gilchristi Flynn, 1928: 23–25, fig. 13a–c. Barnard, 1954: 107. Stock, 1968: 39, fig. 14e–g.

Material

Transkei area. SAM–A10254, SM 226, 710–775 m, 1 larvigerous ♂.

Remarks

This male specimen agrees well with the original description and figure 13b of Flynn's male, in regard to the proboscis shape and lip fringe, the chelae, legs and ovigers. The few small differences involve the expected variation in oviger spine counts and differences in measurement of various long segments. The claw measures 0,7 of the propodus length and there are no auxiliaries present. Despite the depth at which this specimen was dredged, the low, rounded ocular tubercle bears well-pigmented eyes.

Distribution

This record apparently marks only the third capture of this species and its range, from so few records, is restricted to the Indian Ocean from Transkei and Port Natal to Lourenço Marques, from 'tow net' depth to the present record of 710–775 m.

Safropallene gen. nov.

Diagnosis

Trunk elongate, completely segmented. Neck present, with oviger implantation at midlength. Lateral processes well separated, without adornment. Chelifores extremely elongate, scape one-segmented, chelae with many teeth. Palps lacking entirely. Proboscis straight, cylindrical, without protruding lips. Oviger long, slender, 10-segmented, strigilis with denticulate spines and serrate terminal claw. Legs very slender, elongate, with few very long spines. Cement-gland pore(s) not evident. Propodus without heel or long sole spines, claw long, without auxiliaries.

Type species: *Safropallene longimana* sp. nov.

Etymology

The name is an anagram derived from the area of origin, southern Africa, and '*pallene*', the suffix used for most genera of this family. Gender feminine.

Remarks

This new genus joins 22 others in this broad-based but fairly homogeneous family. In the latest key to the family (Child 1982*a*: 24–25), *Safropallene* can be traced to couplet 14, where it joins *Seguapallene* in the list of characters. This latter genus differs from *Safropallene* in its much shorter, more normal appearing trunk and appendage lengths, and in the presence of auxiliary claws on the two known species.

Safropallene longimana sp. nov.

Fig. 6

Material

Transkei area. Holotype, SAM–A10243, SM 226, 32°28,6′S 28°58,8′E, 710–775 m, 1 ♂. Paratypes, SAM–A10244, 5 ♀♀; SAM–A10245, 4 ♂♂, SAM–A10229, 15 specimens, all SM 226, 710–775 m. Paratypes, USNM 216760, SM 226, 710–775 m, 2 ♂♂, 2 ♀♀.

Durban area. Paratypes, SAM–A10246, SM 129, 30°53,4′S 30°31,7′E, 850 m, 18 ♂♂, ♀♀. Paratypes, MNHN–Py 599, SM 129, 850 m, 2 ♂♂, 2 ♀♀.

Description

Male. Moderately small, extremely tenuous, leg span 12,3 mm. Trunk fully segmented, slender, with moderately long neck bearing oviger implantation bulges at midlength, armed with two small anterolateral knobs at chelifore insertion. Lateral processes separated by more than twice their diameters, about twice their diameters in length, without adornment. Ocular tubercle low, broad-based, with small unpigmented eyes, situated at anterior of cephalic segment.

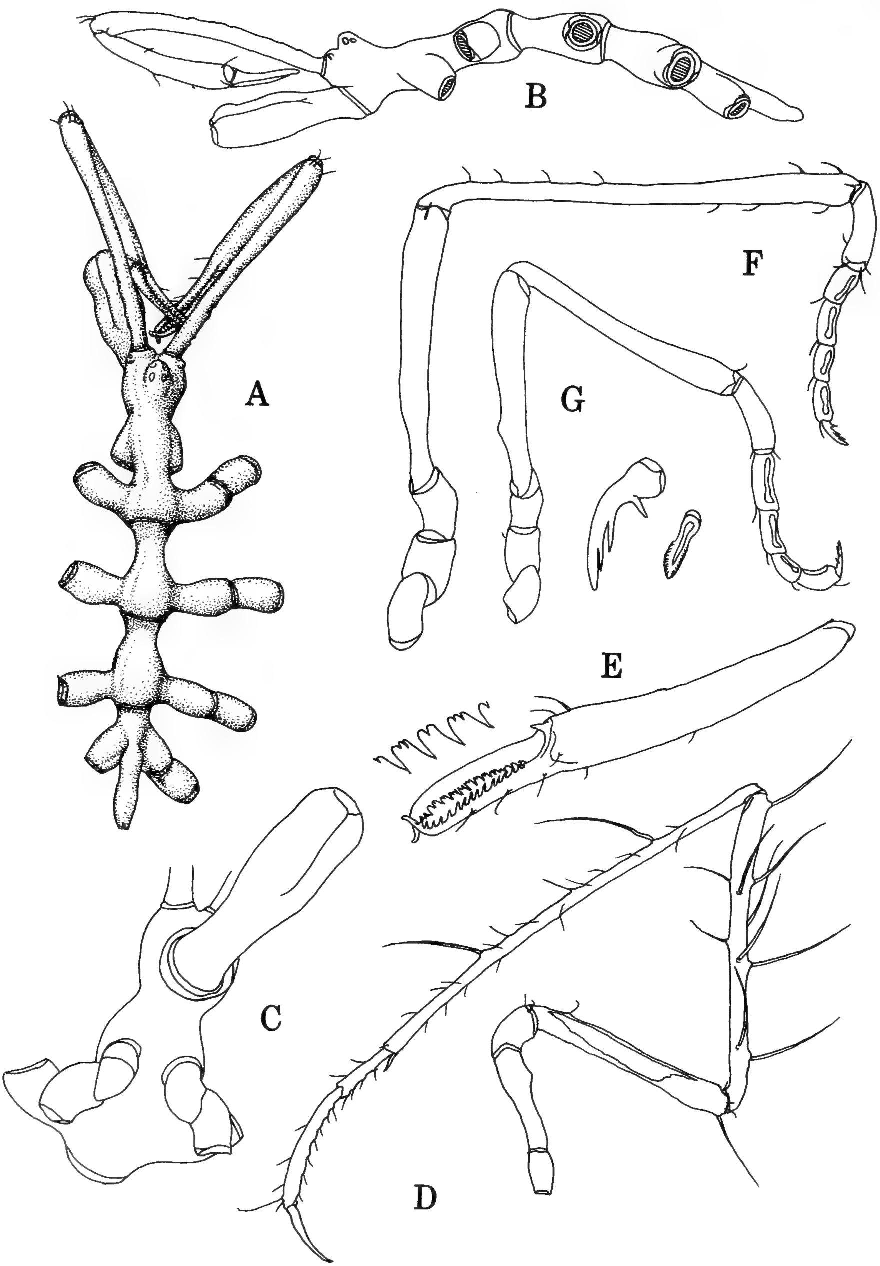

Fig. 6. *Safropallene longimana* gen. et sp. nov. A–F. Holotype, male. A. Trunk, dorsal view. B. Trunk, lateral view. C. Trunk anterior, ventral view. D. Third leg. E. Chela, with enlargement of teeth. F. Oviger. G. Paratype, female. Oviger with enlargements of denticulate spine and terminal claw.

Proboscis fairly short, cylindrical, slightly swollen distally, lips rounded. Abdomen moderately long, sausage-shaped, glabrous, extending to distal rim of first coxae of fourth legs.

Chelifores scapes almost twice proboscis length, armed with few distal setae not longer than scape diameter. Chelae as long as scapes, carried folded inward above proboscis, cylindrical, slightly curved. Fingers 0,3 of chela length, crossing at tips, armed with 15 large teeth on immovable finger and 12–13 on movable finger, teeth separated by gaps holding one or two very small teeth in each. Chela armed at insertion of movable finger with small slender tubercle and few setae mostly distally and ectally on immovable finger.

Palps entirely lacking.

Oviger very long, slender, fifth segment over 14 times longer than maximum diameter, fourth segment measuring 0,6 length of fifth. Sixth segment short, curved; it and fifth armed with few setae. Strigilis segments subequal, each armed with ectal seta and endal denticulate spines in the formula 8 : 6 : 5 : 6. Spines with smooth proximal edges, distal edges closely serrate. Terminal claw shorter than tenth segment, well curved, armed with three large endal teeth.

Legs very slender, long, major segments armed with few very long spines, some over five times segment diameter. Femoral cement gland a long dark mass 0,6 as long as segment length, pores or tubes not evident. Tarsus slender, 0,6 propodal length, armed with few dorsal and ventral setae. Propodus slightly curved, without heel, armed with few dorsal setae, a very long dorsodistal spine, seven or eight short sole spines. Claw almost 0,5 propodal length, well curved, auxiliaries lacking.

Female. Oviger fourth and fifth segments much shorter, almost equal in length. Strigilis segments with denticulate spines in the formula 8 : 6 : 4 : 7, with three teeth on the claw. Femur dilated only proximally in gravid specimens.

Measurements (holotype, in mm)

Trunk length, 1,57; trunk width (2nd lateral processes), 0,59; proboscis length, 0,6; abdomen, 0,36; third leg—coxa 1, 0,18; coxa 2, 0,5; coxa 3, 0,24; femur, 0,91; tibia 1, 1,25; tibia 2, 1,7; tarsus, 0,28; propodus, 0,54; claw, 0,24.

Remarks

This new species has several attributes found in the genus *Nymphon*, such as the generally slender habitus, the oviger implantation, the heavily armed chelae, and the long slender legs without auxiliary claws, but the total lack of palps removes it from consideration in that genus. There is, to our knowledge, no other known pycnogonid with such long chelifores that, when extended, measure over four times the length of the proboscis.

Distribution

Known from Transkei and Durban areas with a bathymetric range of 710–850 m.

Etymology

The specific name *longimana* alludes to the very long characteristic chelifores.

Family **Pycnogonidae** Wilson, 1878

Genus *Pycnogonum* Brünnich, 1764

Pycnogonum (Nulloviger) africanum Calman, 1938

Pycnogonum africanum Calman, 1938: 163–165, fig. 10A–C.
Pycnogonum (Nulloviger) africanum Stock, 1968: 61, fig. 22A–B.

Material

East London area. SAM–A10250, SM 162, 630 m, 1 ♂.
Transkei area. SAM–A10251, SM 232, 620–560 m, 1 ♀.

Remarks

Stock (1968: 61) created the subgenus *Nulloviger* to accomodate *P. africanum* and several other species without ovigers in the male, and this is confirmed by the *Meiring Naude* male. This specimen (SAM–A10250), while lacking ovigers, is a male due to the placement of the sex pores, but fits Calman's (1938) female paratype better than his female holotype. It has lateral processes devoid of the three tubercles, having only a single large conical one, and the ocular tubercle is produced into a tall acute spine with four distinct but unpigmented eyes. The three median pointed tubercles have some sparse short spines. First coxae of each leg have two low posterior tubercles, second coxae with only an integument of large granules, and third coxae devoid of ornamentation. The male femur is distally produced into a shorter anterior and a longer posterior tubercle, the first tibia has two subequal prominences, and the second tibia has a brush of equal and very short spines over its ventrodistal third, which is continued over the sole of the tarsus and propodus. The reticulation is usually inconspicuous, as stated by Calman, but the integument is granular with one short spine on some of the granules.

Some measurements (in mm) of the *Meiring Naude* male are: trunk from anterior of cephalic segment to base of abdomen, 5,22; proboscis, 3,44; and abdomen, 1,46.

The female from station SM 232 is much larger than the male of SM 162. Some of the female's measurements (in mm) are: trunk, 4,59; proboscis, 6,31; and abdomen, 1,15. The proboscis in the female is long and styliform and is 0,33 longer than the trunk. The female specimen is also more tuberculate with three stout anterior-projecting median trunk tubercles which, like most of the integument, are granular, of an uneven size, and bear a few short setae or spines.

The male sexual pore is quite visible on the posteroventral face of the second coxae on the fourth legs. The female legs are slightly larger than those of the male, but are otherwise similar. The differences between characters of the male and female, as noticed by Stock (1968) are confirmed by these two specimens.

Distribution

This species was known from off Zanzibar and Lourenço Marques in 183–1 228 m, and the above records extend its distribution further south in the Indian Ocean.

Pycnogonum crassirostrum Sars, 1888

Pycnogonum crassirostre Sars, 1888: 340; 1891: 12, pl. 1 (fig. 1A–H). Hedgpeth, 1948: 279, fig. 52B [literature]. Stock, 1966: 402 [key].
Pycnogonum crassirostrum: Stock, 1975: 1086–1087, fig. 59e.

Material

Transkei area. SAM–A10255, SM 232, 620–560 m, 1 ♂ juv.

Remarks

This small subadult specimen agrees more closely with *Pycnogonum crassirostrum* than with the similar *P. guyanae* Stock. It has the small rounded median dorsal tubercle on the fourth trunk segment, the median dorsal trunk tubercles are smooth (but granular), tibia 2 is slender, and the tarsus and propodus have a dense ventral cover of spinules, bifurcate at their tips. The oviger has eight segments although it is not fully formed (the ultimate segment is a knob without the claw) in this juvenile, the ocular tubercle is short, broad, and has four well-pigmented eyes, and it is shorter than the three anterior median trunk tubercles. Stock (1975: 1086–1087) remarked on the resemblances or similarities between these *P. crassirostrum* and *P. guyanae*, but the differences appear to be sufficient to keep the two separate.

Distribution

This species has been taken from water ranging from 100–400 m deep off Iceland, Greenland, Norway, and eastern North America, and is thus a moderately deep, cold-water form. It is surprising to find it in South African waters, but less so if the cold capture depth is considered.

Pycnogonum forte Flynn, 1928

Pycnogonum forte Flynn, 1928: 31–33, figs 18, 19. Barnard, 1954: 152–153, fig. 31C–D. Stock, 1966: 402 [key].

Material

East London area. SAM–A10249, SM 185, 90 m, 1 ♀.
Transkei area. SAM–A10248, SM 226, 710–775 m, 1 ♀, 1 juv.

Remarks

Neither the females nor the juvenile specimen shed any light on the question of relationship between this species and *Pycnogonum cataphractum* Möbius (1902: 194, pl. 30 (fig. 11)). The specimen figured by Möbius is a male, for which he indicated the absence of ovigers despite its bearing eggs. Flynn (1928) figured a female of *P. forte*, as did Barnard with a second specimen. The above three specimens appear from the scant literature to be the third and fourth captures of this species, but still the male is either unknown or is the more tuberculate *P. cataphractum* as figured by Möbius. The male in many genera of pycnogonids is the more spinose, tubercular or setose of the two sexes, so the more tubercular male specimen figured by Möbius may possibly be the male of this species. However, some *Pycnogonum* species—such as *P. africanum*, *P. anovigerum*, *P. cataphractum*, and possibly others known from females only—lack ovigers in the male, so we cannot be sure until a male with eggs is taken. The female status of these two adult specimens was confirmed by finding a barely distinguishable genital pore on the posterior surface of the second coxae of the fourth legs in both specimens (none on the second coxae of the other legs), and groups of tiny eggs in a dissected leg of the specimen from SM 226. Therefore, the presence or absence of an oviger in the male of this species remains unknown.

The mid-dorsal trunk tubercles are apparently variable. Both Flynn (1928) and Barnard (1954) illustrated a rather pronounced tubercle between the ocular tubercle and the posterior tubercle of the cephalic segment. The corresponding tubercle on the females of this collection is a low mound composed of many papillae arranged on bumps all over the mound. The distal ends of all tubercles on the trunk and legs are very papillose. The propodal sole has only a few short pointed spines and none of the blunt bifurcate spines found on some *Pycnogonum* species.

Distribution

This species has been collected previously off the Gneka River near Port Elizabeth and off Great Fish Point. Only one depth, 90 m (49 fathoms), has been recorded in the literature, so the above records greatly extend the known depth range to 775 m, and confirm that it is an endemic South Africa species.

Pycnogonum nodulosum Dohrn, 1881

Pycnogonum nodulosum Dohrn, 1881: 203–207, pl. 16 (figs 1–3). Loman, 1928: 62, 64. Fage, 1953: 381 [list]. Barnard, 1955: 106. Stock, 1958*a*: 5; 1966: 401 [key]. Arnaud, 1987: 50, table 1.

Material

Zululand area. SAM–A10253, SM 86, 550 m, 2 ♀♀.
Transkei area. SAM–A10224, SM 250, 150–200 m, 3 ♀♀.

Remarks

These five females are fully adult with sexual pores opening on the posterolateral side of fourth leg, second coxae. Their length ranges from 3,5 mm to 3,97 mm and width across the second lateral processes from 1,03 mm to 1,15 mm, sizes comparable with the Mediterranean specimens (Arnaud 1987: 50). The largest female (SM 86) is 3,97 mm long and bears three strong almost columnar dorsal tubercles, larger than in the specimens from SM 250.

Distribution

This species was previously recorded from South Africa by Barnard (1955: 106), who listed a specimen from Algoa Bay in 9 m. It has also been found occasionally in places between its type locality in the Mediterranean and Morocco (Loman 1928), occidental Africa (Fage 1953) and South Africa. Its above occurrence off the Zululand and Transkei coasts is in deeper waters than previous records, which are as shallow as 9 m. Another female specimen was taken by the University of Cape Town Ecological Survey in Saldanha Bay, at station SB306T (33°03,7′S 17°58,5′) in 20 m, on 30 April 1963, on fine sand.

Family **Colossendeidae** Hoek, 1881

Genus *Hedgpethia* Turpaeva, 1973

Hedgpethia magnirostris sp. nov.

Fig. 7

Material

Zululand area. Holotype, SAM–19579, SM 103, 28°31,7′S 32°34,0′E, 680 m, 1 ♂. Paratype, SAM–A19580, SM 103, 680 m, 1 ♀.

Description

Male. Size small for this genus, leg span about 34 mm. Trunk completely segmented, with suture or separation lines crossing each segment. Each segment posteriorly flaring, decreasing in size towards posterior. Lateral processes extremely short, not as long as their diameters, separated by slightly less than their diameters, armed with one dorsodistal seta or glabrous. Cephalic segment narrow anteriorly, with small dorsolateral knob above palp insertion. Ocular tubercle low, conical, as tall as basal diameter, eyes indistinct, unpigmented. Abdomen extremely short, reaching to just beyond posterior lateral processes, carried obliquely ventrally, glabrous.

Proboscis extremely large, 1,7 times length of trunk, proximally slender, inflating gradually to very swollen midpoint, tapering less gradually to slender distal portion and small lips. Curved slightly downward in lateral view.

Palp third segment longest, slender, curved, fourth segment short, fifth almost 0,6 length of third, sixth shortest, distal four segments almost subequal, all armed with short setae, more numerous ventrodistally.

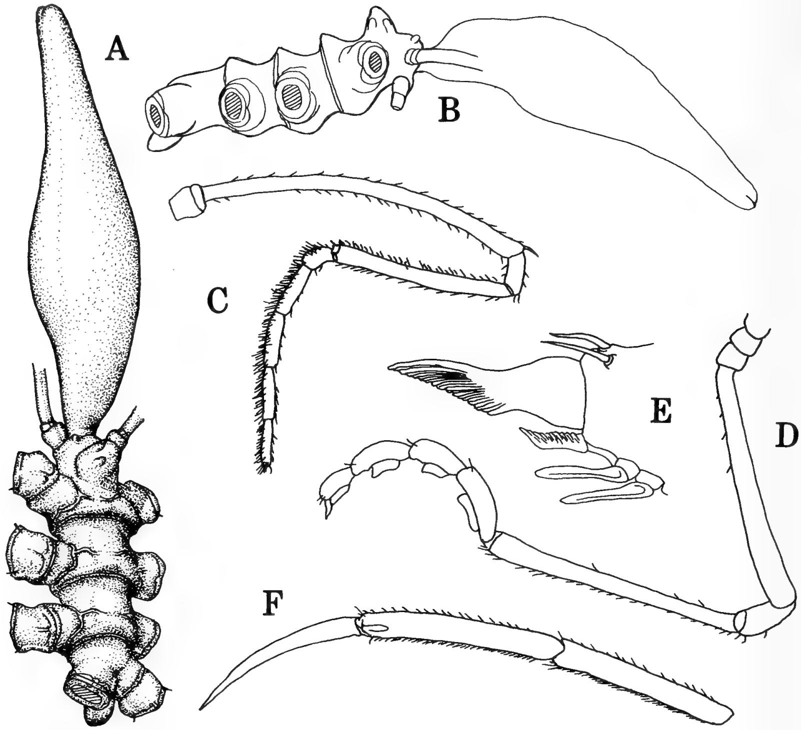

Fig. 7. *Hedgpethia magnirostris* sp. nov. Holotype, male. A. Trunk, dorsal view. B. Trunk, lateral view. C. Palp. D. Oviger. E. Oviger terminal segment and claw. F. Third leg, terminal segments.

Oviger fourth and sixth segments subequal, sixth armed with row of short ectal setae. Strigilis four segments, increasingly short, armed with single ecto-distal seta and row of spatulate endal spines. Terminal segment armed with comb-like terminal spine forming subchela with terminal claw. Claw broad, bottle-shaped with denticulate comb distally forming acute angle with tip.

Legs long, slender, armed with very short setae and few equally short spines growing more numerous distally. Femur curved proximally, straight distally. Tibia 2 only 0,64 length of tibia 1, femur 0,68 length of tibia 1. Tarsus slightly shorter than propodus, both armed with very short sole setae, fewer short ectal setae. Claw robust, well curved, equal in length to tarsus.

Female. Slightly larger in all measurements except for main oviger segments. Femorae slightly inflated proximally with ova.

Measurements (holotype, in mm)

Trunk length, 2,0; trunk width, 0,73; proboscis length, 3,36; third leg—coxa 1, 0,4; coxa 2, 0,5; coxa 3, 0,5; femur, 3,4; tibia 1, 5,0; tibia 2, 3,2; tarsus, 1,2; propodus, 1,3; claw, 1,2.

Remarks

For a genus hitherto containing only eight known species, *Hedgpethia* presents some problems to the taxonomist because the species are closely similar. This new species differs from the eight known species by having a proboscis much larger in proportion to the trunk than in any other species, and a shorter ocular tubercle with indistinct eyes.

This species is most closely related to *H. californica* (Hedgpeth, 1939), and *H. bicornis* (Turpaeva, 1958) (previously under the '*articulatus*-group' (Loman, 1908)—lacking a proboscis tooth—of the genus *Rhopalorhynchus*). It differs from these two in having a longer first tibia, thus making the leg segment ratios different. It has a femur measuring only 0,68 the length of tibia 1, whereas the femur is 0,82 of the first tibia in *H. californica* and is 0,8 in this ratio for *H. bicornis*. The tarsus is shorter than the propodus (T = 0,92 of P) in *H. magnirostris*, whereas it is equal to or longer than the propodus in *H. californica* and *H. bicornis*.

The main difference, besides greater proboscis size in the new species, is in the ocular tubercle, which is a low truncate cone without a pointed apex, whereas *H. californica* and *H. bicornis* both have a tall pointed ocular tubercle. The eyes of both species are large and well pigmented, whereas those of the new species are very indistinct and lack pigmentation. Both *Meiring Naude* specimens agree in this character.

The new species shares with *H. bicornis* two small anterolateral cephalic segment tubercles, which are not present in *H. californica*. But, *H. bicornis* has middorsal trunk tubercles, whereas the other two have cowls or ridges that lack these tubercles. The palps of *H. californica* have 'a few scattered setae on the terminal segments' (Hedgpeth 1939: 460), whereas the palps of the other two species are heavily setose on the terminal segments.

Distribution

Since the new species has been taken at a single station and depth, nothing can be deduced about its distribution.

Etymology

The specific name is from the Latin *magnus* and *rostrum*, meaning a large snout or beak, pertaining to the larger than usual proboscis of these specimens.

Hedgpethia sp. indet.

Material

Transkei area. SAM–A19585, SM 226, 710–775 m, 1 juv.

Remarks

This specimen has similarities with the species described above, but is too juvenile for positive identification.

Genus *Rhopalorhynchus* Wood-Mason, 1873

Rhopalorhynchus gracillimus Carpenter, 1907

Rhopalorhynchus gracillimus Carpenter, 1907: 99–100, pl. 13 (figs 25–32) [all except Saya de Malha record].
Rhopalorhynchus kröyeri: Loman, 1908: 26–27 [only Siboga sta. 310 specimen]. Calman, 1923: 268–270 [part]. Barnard, 1954: 88–89, fig. 2.
Rhopalorhynchus gracillimum: Stock, 1958*b*: 128–132, figs 39–56.

Material

East London area. SAM–A19598, SM 164, 90 m, 1 ♀.

Remarks

This longitarsal specimen agrees in most characters with Carpenter's (1907) description and particularly with Stock's (1958*b*) figures 52–56. The ratio of tarsus–propodus–claw to tibia 2 length is 0,72 to 1, well within the lower end of Stock's ratio figures of 0,7 : 1 to 1 : 1. The claw is slightly shorter than half the propodal length.

The one character of the present material not in keeping with the previous descriptions of this species is the form of the distal palp. The palp segments of this female are notably shorter than in any figures of the palp given for the species, and much shorter than those of the type specimen. The distal four segments are only slightly longer than their diameters, whereas the sixth segment is about twice as long as its diameter. The shortness of the distal segments on both palps may be due to regeneration or some other factor, and we feel that other specimens from this locality should be examined before deciding whether or not this character is variable in the species or if the East London material is attributable to another species.

Distribution

This specimen adds nothing new to the known distribution of the species, which has been recorded from the East Indies and Maldive Islands to the east coast of South Africa, in depths from 0 m to 156 m.

Family **Nymphonidae** Wilson, 1878

Genus *Nymphon* J. C. Fabricius, 1794

Nymphon barnardi sp. nov.

Fig. 8

Material

Transkei area. Holotype, SAM–A10261, SM 250, 31°59,3′S 29°22,5′E, 150–200 m, 1 ♀. Paratype, SAM–A10262, SM 250, 150–200 m, 1 ♀.

Description

Female. Moderately small size, leg span 26,3 mm. Trunk completely segmented, glabrous, without tubercles. Lateral processes short, hardly longer than their diameter, separated by half or slightly more of their diameters, glabrous. Neck short, oviger implantation bulges touching first lateral processes. Ocular tubercle not taller than wide, sides bulging, with tiny apical papilla, eyes large, slightly pigmented. Proboscis moderately short, cylindrical, inflated slightly at midlength, lips rounded. Abdomen cylindrical, tapering distally, reaching slightly beyond posterior lateral processes, glabrous.

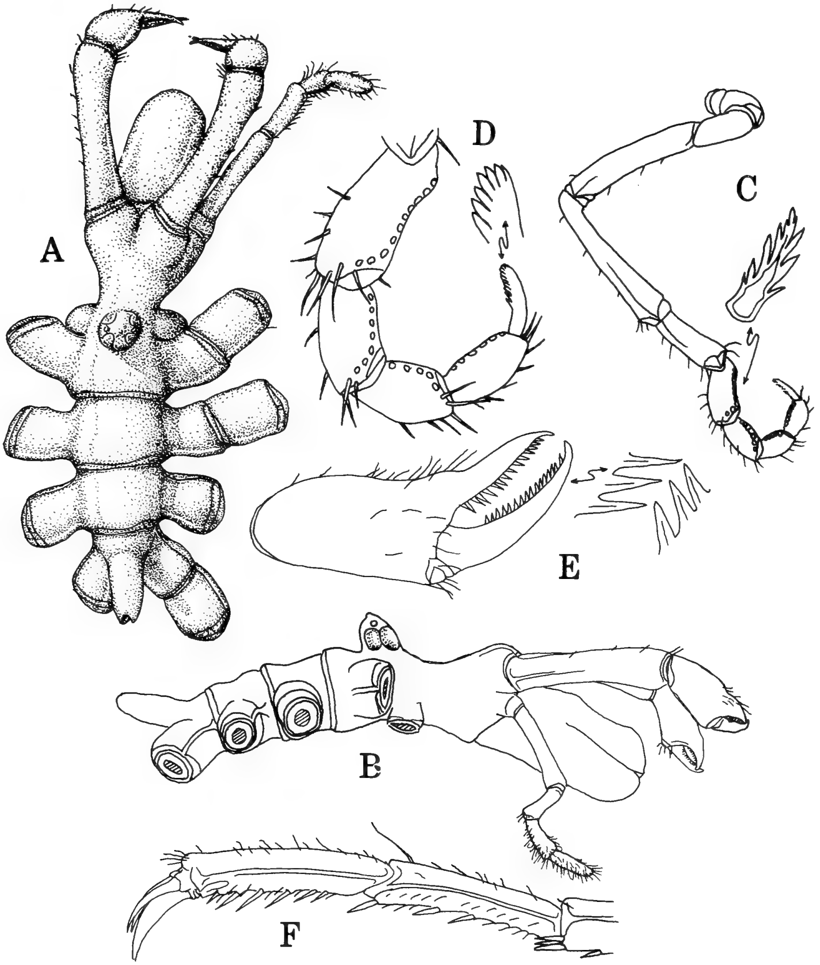

Fig. 8. *Nymphon barnardi* sp. nov. Holotype, female. A. Trunk, dorsal view. B. Trunk, lateral view. C. Oviger, with enlargement of denticulate spine. D. Strigilis, with enlargement of terminal claw. E. Chela, with enlargement of teeth. F. Third leg, terminal segments.

Chelifores typical, scapes as long as proboscis, armed with few lateral and distal setae. Chelae moderately short, palm slightly longer than fingers, armed with few short distal setae. Fingers slightly curved, overlapping at tips, armed with 15 equal-sized teeth on immovable finger and 16 similar or slightly smaller teeth on movable finger.

Palp segment 2 longest, third through fifth subequal, fairly short, armed with many short ventral and distal setae.

Oviger fairly short, third segment slightly shorter than fourth, both with few setae. Sixth segment half length of fifth, armed with few setae. Strigilis segments progressively smaller distally, armed with few ectal setae, and a row of denticulate spines in the formula 10 : 7 : 5 : 6; spines with four or five serrations per side. Terminal claw shorter than terminal segment, moderately curved, with row of eleven serrations extending around and forming part of the tip of claw.

Legs long, moderately slender, armed with short setae increasing in numbers distally. Tibia 2 the longest segment, followed by tibia 1, then the femur. Tarsus slightly longer than propodus on first pair of legs, slightly shorter than propodus on posterior three pairs of legs. Tarsus and propodus armed with few short dorsal setae, a row of lateral setae and several sole spines with short setae between each. Claw robust, moderately curved, about 0,4 length of propodus, auxiliaries about 0,85 length of main claw.

Measurements (holotype, in mm)

Trunk length, 2,56; trunk width (across 2nd lateral processes), 1,39; proboscis length, 1,15; abdomen, 0,44; third leg—coxa 1, 0,5; coxa 2, 0,72; coxa 3, 0,4; femur, 2,38; tibia 1, 2,78; tibia 2, 3,95; tarsus (first leg), 0,62; propodus (first leg), 0,58; tarsus (third leg), 0,7; propodus (third leg), 0,74; claw, 0,29.

Remarks

This new species is closest to another small South African endemic species, *N. crenatiunguis*. The general habitus of the two is very similar, but the differences are more than superficial. The chelae fingers are shorter and have more teeth in *N. crenatiunguis*, and the third palp segment is much longer than the short fourth and fifth segments. The ovigers of the two species are quite similar, including the claw serrations that continue around the tip in a fan shape, but the denticulate spines of *N. crenatiunguis* have three lateral lobes per side, whereas the new species has spines with four or five narrower lobes. The femur is slightly longer than the first tibia in *N. crenatiunguis* (femur shorter than tibia 1 in *N. barnardi*), and in *N. crenatiunguis* the tarsus and propodus have many more sole spines and shorter auxiliaries than in the new species. The tarsus is shorter than the propodus in all legs we examined in *N. crenatiunguis*, but is slightly longer than the propodus on the first pair of legs in the new species. We believe these differences are sufficient to warrant creation of a new species for these two females.

Distribution

This species is only known from one station, at a depth of 150–200 m.

Etymology

This species is named for Keppel H. Barnard (1887–1964) of the South African Museum, whose contributions to the literature have greatly enriched our knowledge of South African pycnogonids.

Nymphon bicornum sp. nov.

Fig. 9

Material

Zululand area. Holotype, SAM–A19577, SM 60, 27°09,6′S 32°58,2′E, 800–810 m, 1 ♂.

Durban area. Paratypes, SAM–A19578, SM 129, 30°53,4′S 30°31,7′E, 850 m, 2 ♀♀, 2 larvae.

Description

Of a small slender size, leg span 13,9 mm. Trunk long, slender, fully segmented, including base of abdomen. Lateral processes separated by 1,5 to twice their diameters, moderately short, slightly longer to 1,5 times as long as their diameters, glabrous. Neck long, semicylindrical, slightly inflated at midpoint with oviger bulges and ocular tubercle both well anterior to first lateral processes. Ocular tubercle a low anterior-pointing cone with two moderately large lateral sensory papillae, without trace of eyes. Proboscis of moderate size, cylindrical, constricted just behind anterior tip, lips rounded. Abdomen short, cylindrical, constricted distally, with two distal setae.

Chelifores robust, scape slightly longer than proboscis, with a dorsodistal seta. Chela longer than scape, slender, palm shorter than fingers, glabrous. Fingers straight to gently curving distally and overlapping, armed with 40 small curved teeth on immovable finger and 41 similar teeth on movable finger. The immovable finger also bears several short setae.

Palp second segment longest, third 0,75 length of second, fourth half length of third, fifth slightly longer than fourth, terminal three segments armed with distal and ventral setae, some slightly longer than segment diameter.

Oviger fourth segment with ectal bulge proximally, segment 0,75 as long as fifth, which is armed with ectal and endal rows of short setae. Sixth segment slightly curved, half as long as fourth, armed with ectal and endal setae same as fifth segment. Strigilis segments subequal in length, armed with two or three ectal setae, endal denticulate spines in the formula 6 : 4 : 3 : 5, spines with spatulate centre lobe flanked by two serrations per side. Terminal claw shorter

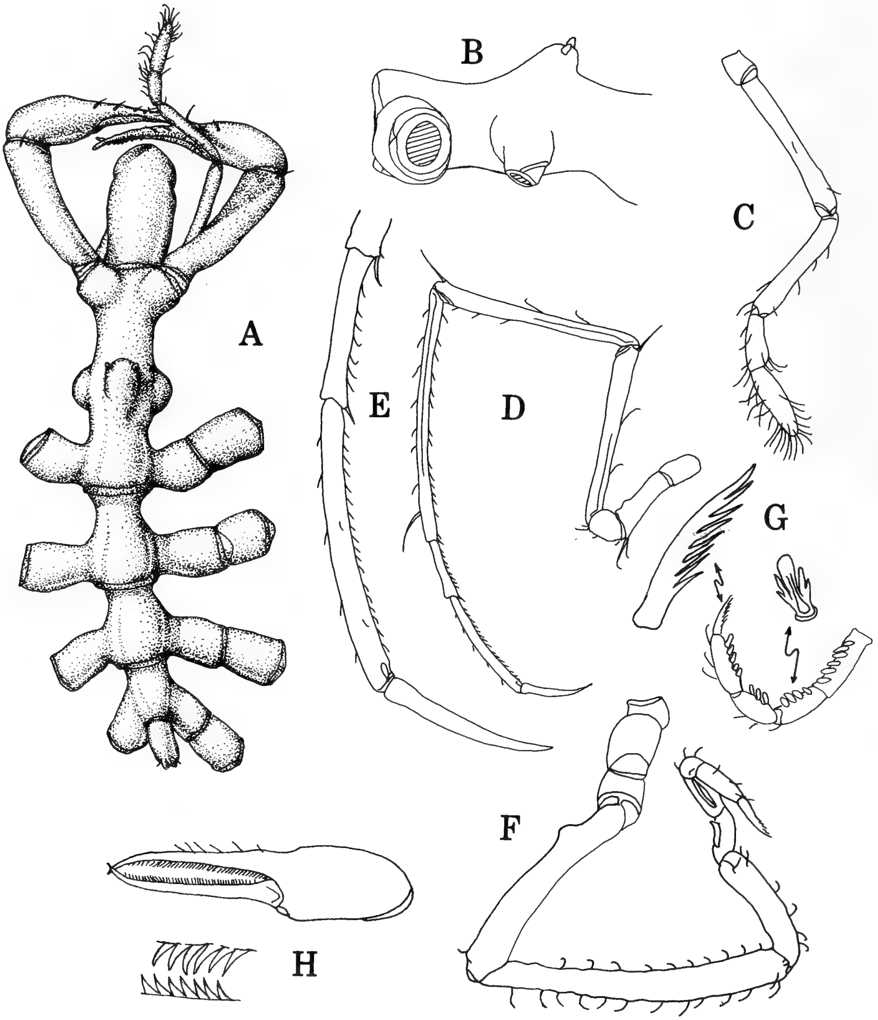

Fig. 9. *Nymphon bicornum* sp. nov. Holotype, male. A. Trunk, dorsal view. B. Part of anterior trunk segment, lateral view. C. Palp. D. Third leg. E. Distal segments of third leg. F. Oviger. G. Strigilis, with enlargements of denticulate spine and terminal claw. H. Chela, with enlargement of teeth.

than ultimate segment, slightly curved, armed with seven endal serrations not including pointed tip.

Legs slender, tibia 2 the longest segment, major segments each armed with few short dorsal and ventral setae and single long dorsodistal seta. Tarsus slightly over half propodus length, both armed with row of short sole spines and propodus with few lateral and dorsal setae. Claw robust, slightly curved, 0,6 as long as propodus, auxiliaries lacking.

Measurements (holotype, in mm)

Trunk length, 1,82; trunk width (across 2nd lateral processes), 0,78; proboscis length, 0,6; third leg—coxa 1, 0,26; coxa 2, 0,48; coxa 3, 0,24; femur, 1,14; tibia 1, 1,3; tibia 2, 1,58; tarsus, 0,4; propodus, 0,73; claw, 0,43.

Remarks

This new species appears to be most closely related to a deeper-water species found in both the North and South Atlantic and Pacific oceans, *N. procerum* Hoek, 1881. Both have a long neck with the ocular tubercle and oviger bases implanted well forward of the first lateral processes, and have a similar long tenuous appearance. Both lack auxiliary claws and have long chelae fingers with 40 or more teeth in each. The differences are in the longer neck, much longer palp segments, longer chelae fingers with longer teeth, longer proboscis and abdomen, and longer setae on the legs of *N. procerum*. The legs and ovigers of the two species are very much alike, except that the oviger of *N. procerum* has a terminal claw with about 20 fine teeth, instead of the seven or eight found in the new species.

Distribution

The new species is known only from Natal and Zululand in 800–810 m and 850 m depths, whereas the depths known for *N. procerum* are much deeper, including specimens from a trawl in over 6 000 m.

Etymology

The species name *bicornum* means two-lobed or two-horned and refers to the two fairly large sensory papillae found on the ocular tubercle.

Nymphon comes Flynn, 1928

Nymphon comes Flynn, 1928: 14–16, figs 4–6. Barnard, 1954: 92–93, figs 3, 5C. Stock, 1956: 78–79, fig. 3; 1962: 282; 1965: 21–23 [list, text].
Nymphon affinis Stock, 1951: 5–7, figs 1–6. Barnard, 1954: 94.
Nymphon affine: Stock, 1965: 21–23 [list, text].

Material

East London area. SAM–A19612, SM 179, 80 m, 1 ♀.
Transkei area. SAM–A19611, SM 233, 540–580 m, 1 ♂.

Remarks

Both of these fairly large specimens agree in most characters with descriptions of both *Nymphon comes* and *N. affine*. Their differences lie in appendage segment lengths, numbers of chela finger teeth, and oviger spine counts, all of which can be attributed to variation within the species. The character that separated the two species, prior to our decision to unite them under *N. comes*, was the presence or absence of alternating small and large teeth on the chelae fingers. Both of these specimens have alternating large and small teeth, sometimes with two short teeth instead of one between two successive long teeth, in agreement with Barnard's (1954) figure 5c of specimens he listed as *N. comes*. Since these have the alternating teeth and *N. affine* shares this character (Stock 1951: 6, fig. 3), we have united the two species under the senior synonym. Flynn's type specimen is not located at the South African Museum and is unavailable at the moment for examination.

Distribution

This handsome species is another that has been found only along the South African coasts and, although it has been taken in as shallow as 15 m (Stock's type specimen), the specimen from SM 233 was taken in 540–580 m, giving it a rather wide depth range on the shelf and slope.

Nymphon crenatiunguis Barnard, 1946

Nymphon crenatiunguis Barnard, 1946: 60; 1954: 101–102, fig. 7.

Material

East London area. Syntypes SAM–A10137, *Pieter Faure*, P.F. 907, 85 fm (155 m), 1 ♂, 1 ♀. SAM–A19609, *Meiring Naude*, SM 179, 80 m, 1 ♂.

Transkei area. SAM–A19610, SM 250, 150–200 m, 1 ♀.

Remarks

This apparently rare species is recorded in new material here only for the second time. Barnard (1946, 1954) treated the same specimens—the types and one other doubtful specimen. Through the courtesy of the South African Museum, we have been permitted to examine the type series deposited in that Museum.

There are several slight differences between the *Meiring Naude* material and the type specimens. There are several more finger teeth on the SM 179 male chelae (20 and 26), whereas the syntype male has 17 and 22, and both rows of teeth appear more like the pointed ovals figured in Barnard's (1954, fig. 7a) enlargement of the movable finger teeth. The strigilis spine count is 10 : 8 : 6 : 7 in the SM 179 male and there is a total of about five more spines on the female strigilis. The tarsus is slightly shorter than that of the syntypes and the sole spines on the propodus are fairly robust but of a single size. There are five cement-gland openings protruding as low knobs ventrally on the femorae, whereas the syntype male has either four or five per femur, the presence of which add to the ease of recognition in this species.

Distribution

Barnard's types were taken in 155 m, whereas the two *Meiring Naude* specimens are from 80 m and 150–200 m, respectively. The distribution of this species is extended north-east to Port St Johns in the Transkei area.

Nymphon distensum Möbius, 1902

Nymphon distensum Möbius, 1902: 179–180, pl. 25 (figs 1–6). Loman, 1923: 14 [key]. Flynn, 1928: 10–11. Gordon, 1932*a*: 105–106, fig. 6; 1932*b*: 28–29, [table], 35 [key]; 1944: 20 [key]. Barnard, 1954: 98–100, fig. 5b.

Material

East London area. SAM–A10026, *Pieter Faure*, P.F. 12840, 17 mi SSW of Buffalo River, trawled, 357 m, 2 ♂♂. SAM–A19600, *Meiring Naude*, SM 179, 80 m, 1 ovigerous ♂. SAM–A19601, SM 185, 90 m, 2 ♀♀, 3 juvs. MNHN–Py 594, SM 185, 1 ovig. ♂.

Zululand area. SAM–A19602, SM 86, 550 m, 1 ♂, 2 ♀♀. USNM 228135, SM 86, 550 m, 1 ♂.

Transkei area. SAM–A19599, SM 232, 620–560 m, 1 ♂.

Remarks

The male from SM 232 has 38 teeth on the immovable chela finger and about 50 teeth on the movable finger, whereas most specimens in the literature have from 60 to 70 and 30 to 33 teeth, respectively. The third leg tarsus is 0,85 as long as the propodus and the claw is 0,4 of that segment, differing slightly from published figures. The strigilis has somewhat fewer denticulate spines than in those described by Barnard (1954: 98). The formula is 12 : 8 : 8 : 8, with 9 spines on the claw. Other than for these slight differences, the specimen from SM 232 and the others, including the *Pieter Faure* specimens, differ very little from the type.

Distribution

Widely distributed from south of Cape Point to Zululand region, between 80 m and 560 m.

Nymphon granulatum sp. nov.

Fig. 10

Material

Transkei area. Holotype, SAM–A10230, SM 226, 32°28,6′S 28°58,8′E, 710–775 m, 1 ♂. Paratypes, SAM–A10232, SM 226, 710–775 m, 2 ♀♀. Paratype, MNHN–Py 597, SM 226, 710–775 m, 1 ♂. Paratypes, SAM–A10231, SM 232, 32°14,9′S 29°10,4′E, 620–560 m, 1 ♀, 3 larv. Paratypes, SAM–A10235, SM 236, 32°14,3′S 29°11,6′E, 670–660 m, 1 ♀, 1 larv.

Durban area. Paratype, SAM–A10233, SM 129, 30°53,4′S 30°31,7′E, 850 m, 1 ♀.

East London area. Paratypes, SAM–A10234, SM 162, 32°55,0′S 28°31,0′E, 630 m, 2 ♂♂. Paratypes, USNM 228133, SM 162, 630 m, 1 ♂, 1 ♀.

Description

Male. Moderately small, leg span 27,7 mm. Entire surface moderately papillose except proboscis, imparting granular appearance. Trunk anterior fully segmented,

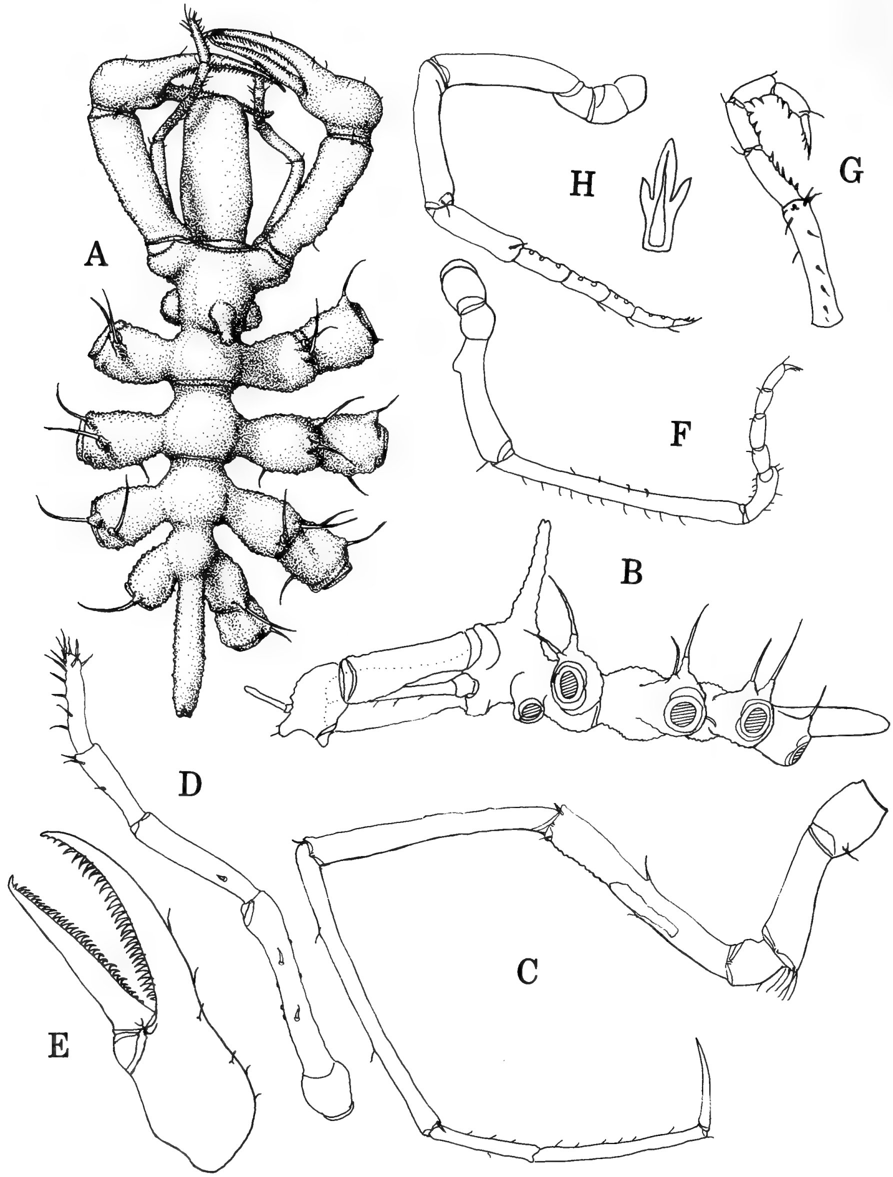

Fig. 10. *Nymphon granulatum* sp. nov. A–G. Holotype, male. A. Trunk, dorsal view. B. Trunk, lateral view. C. Third leg. D. Palp. E. Chela. F. Oviger. G. Strigilis. H. Paratype, female. Oviger, with enlargement of denticulate spine.

posterior third and fourth segmentation line incomplete. Lateral processes robust, separated by about half their diameters, as long as twice their diameters, armed with dorsodistal and slightly laterodistal slender tubercles not as long as segment diameter, capped with slender spine longer than segment diameter. Neck short, expanded anteriorly to oblique angular chelifore insertions. Oviger implantation well anterior to first lateral processes, ocular tubercle implanted directly dorsal to ovigers, very tall, columnar, with two tiny papillae at apex, without eyes. Proboscis cylindrical, slightly constricted proximally, lips almost flat. Abdomen long, extending to distal rim of second coxae, fourth legs, glabrous.

Chelifores large, scapes almost as long as proboscis, distal diameter almost equal to proboscis base, armed with one or two lateral and distal setae. Chelae longer than scapes, palm ovoid, shorter than fingers. Immovable finger moderately curved, armed with slightly curved teeth of a similar size. Movable finger straight except for curved tip overlapping immovable finger, armed with 33 smaller curved teeth only half size of those on immovable finger, of slightly different sizes.

Palp moderately slender, second segment longest, third 0,6 as long as second, both armed with few short lateral setae. Fifth segment slightly longer than fourth, combined length only equal to second segment, both distal segments armed with few ventral and distal setae increasing in numbers distally, none longer than segment diameter.

Oviger fourth segment with large ectal mound proximally, fifth longest, straight, armed with ectal and endal rows of few setae, without distal apophysis or setae. Sixth segment well curved, armed with few lateral setae. Strigilis segments slender, progressively shorter, armed with ectal seta distally and small denticulate spines in the formula 5 : 3 : 2 : 3; spines broad with single lateral lobes. Claw almost as long as terminal segment, armed with three endal teeth.

Legs slender, long, armed with very few setae or spines. Second coxae with ventrodistal tuft of setae as long as segment diameter. Femoral cement gland a small sac at midpoint of segment, pore(s) not evident. Tibia 2 the longest segment with tibia 1 and femur each slightly shorter than the last. Tibia 2 armed with stout ventrodistal spine. Tarsus 0,6 as long as propodus, both armed with very few tiny sole spines. Claw slightly less than half propodal length, almost straight, auxiliaries lacking.

Female. Slightly larger overall than male. Oviger segments four and five subequal, glabrous. Strigilis armed with fewer denticulate spines in the formula 3 : 2 : 2 : 2, with three endal teeth on the terminal claw of both female and male. Sexual pores on coxa 2 ventrally on only posterior four legs.

Measurements (holotype in mm)

Trunk length, 3,24; trunk width (across 2nd lateral processes), 2,08; proboscis length, 1,21; abdomen, 1,14; third leg—coxa 1, 0,58; coxa 2, 1,18; coxa 3, 0,54; femur, 2,09; tibia 1, 2,28; tibia 2, 2,86; tarsus, 0,98; propodus, 1,57; claw, 0,74.

Remarks

This new species appears to be most closely related to the West African species *N. mauritanicum* and *N. prolatum*, each having tall columnar ocular tubercles, long abdomens and no auxiliary claws. This species differs from *N. mauritanicum* in its slender lateral-process tubercles bearing long spines instead of broad tubercles bearing many short setae, its longer palps and proboscis, its glabrous abdomen, and the legs that have far fewer setae. The chelifores and ovigers are quite different in the two species.

It differs from *N. prolatum* in its much more robust and crowded general habitus, shorter lateral processes, abdomen and neck, in having tubercles with spines on the lateral processes, and in the chelae finger teeth that are more or less the same size on any one finger instead of being at least two different sizes. The legs, palps, proboscis, and ovigers are very similar in the two species except that the fifth segment of the oviger has a distal apophysis with setae in *N. prolatum*. Eyes are lacking in the new species, whereas both of the West African species have clearly defined eyes.

Distribution

Well established along the east coast of southern Africa, between 620 m and 850 m.

Etymology

The new species name, *granulatum*, refers to the overall granular appearance of the integument.

Nymphon microctenatus Barnard, 1946

Nymphon microctenatus Barnard, 1946: 60; 1954: 95–96, fig. 4. Stock, 1965: 22–23 [list, key].

Material

East London area. Holotype, SAM–A10100, *Pieter Faure*, P.F. 12840, 17 mi SSW of Buffalo River, trawled in 357 m, 23 April 1901, 1 ♀.

Transkei area. SAM–A19594, *Meiring Naude*, SM 237, 600–650 m, 1 gravid ♀.

Remarks

This is apparently only the second specimen of this large and very distinctive species to be recorded. The specimen from SM 237 is from about 100 miles north-east of where the type was taken and is from deeper water.

The chelae teeth are quite distinctive and make this an easily recognized species. They number over 300 on each chela and appear similar to a fine-toothed comb or much like the large propodal lamina found on many species of the genus *Anoplodactylus*. The finger tips cross in the new specimen and may have been broken off in Barnard's type. The terminal palp segment appears even more slender but no more curved than that of Barnard's (1954: 95, fig. 4c) type, and both the fourth and fifth segments are slightly longer in this specimen. The terminal leg segments appear tiny in comparison to the very long major leg segments. The sole spines of the tarsus and propodus are all of a single size and in a single row. The oviger strigilis has the denticulate spine formula 15 : 11 : 10 : 11, with 16 small teeth on the slender terminal claw. The spines have 5–6 fine serrations on each side.

Nymphon modestum Stock, 1959

Nymphon modestum Stock, 1959: 556–558, fig. 3.

Material

Zululand area. SAM–A19595, SM 86, 550 m, 1 ♂ with eggs. USNM 228136, SM 86, 550 m, 1 ♂.

Transkei area. SAM–A19603, SM 239, 90 m, 1 gravid ♀. SAM–A19604, SM 250, 150–200 m, 2 ♂♂, 1 ♀, 7 juv. and larv. MNHN–Py 596, SM 250, 150–200 m, 1 ♂.

Remarks

We believe these specimens are *N. modestum*, although the variation displayed among these seven adults does not quite agree with the description of the female type. Some differences seem superficial but others assume greater importance among closely related species in the genus *Nymphon*.

The palp third segment is described as being about as long as segment 5 in the type, whereas that of these specimens is variously 0,3 to 0,6 times longer than segment 5. The abdomen varies from shorter than the fourth lateral processes to as long as the distal end of coxa 1. The curved chelae of these specimens are distinctly shorter than the scapes that, in turn, are equal to the proboscis, whereas in the type the chelae are longer than the scapes. The finger teeth vary in number from 17 to 21 on the immovable finger and from 21 to 24 on the movable finger, whereas those of the type number 23 and 27, respectively. Similarly, the oviger strigilis spines number from as many as eight to as few as five.

The tarsus and propodus of these specimens show the greatest differences from those of the type. The tarsus is fully 0,6 as long as the propodus and both are more slender than those of the type. There are usually more sole spines, the proximal heel spine is sometimes absent, and in the males from SM 250, the auxiliary claws are only about 0,4 times as long as the main claw. In most other characters, the variations are sufficiently small to suggest that these specimens are well within the limits described for the type.

The male oviger has not been described before as the type, and only previous record, is a female. The fifth segment is typically elongate, curved, laterally setose, and bears a small distal apophysis with six or seven setae as long as the segment diameter. The strigilis is also more setose and bears spines in the formula 8 : 6 : 5 : 7, with five teeth on the terminal claw. The distal palp segments are more setose ventrally. In summary, the principal differences are the greater length of the third palp segment and tarsus, and the shorter chelae in relation to the scape in these specimens.

Distribution

The range of this species is extended eastwards from Lambert's Bay in the South Atlantic to the Indian Ocean, from off Lake St Lucia to the Transkei coast, and the known depths are greatly extended from 23 m for the type to 90 m and 550 m by the present specimens.

Nymphon obesum sp. nov.

Fig 11

Material

East London area. Holotype, SAM–A10263, SM 179, 33°30,3′S 27°22,1′E, 80 m, 1 ♀.

Description

Moderately small, leg span 26,7 mm. General habitus robust, stout, appendages crowded. Trunk completely segmented, barrel-shaped. Lateral processes short, thick, only as long as their diameters, separated by very slight intervals to almost touching, glabrous. Neck short, oviger implantation against and below first lateral processes. Ocular tubercle directly above ovigers, short, slightly taller than wide, apex conical with small lateral papillae, eyes large, tear-shaped, slightly pigmented. Proboscis broad, shorter than twice its diameter, cylindrical, lips flat. Abdomen short, carried almost erect, tapering distally, glabrous.

Chelifores large, scape longer than proboscis, downcurved, armed with several dorsal and distal setae. Chela palm longer than fingers, subcylindrical, with few distal setae. Fingers well curved, overlapping at tips, armed with three widely separated teeth on the immovable finger and four like teeth on the movable finger.

Palps small, slender, second segment longest, third slightly shorter, both armed with several setae, mostly distal. Fourth segment slightly shorter than fifth, both with short ventral and distal setae not longer than segment diameter.

Oviger fourth and fifth segments subequal, glabrous, sixth shorter than seventh, with several distal setae. Strigilis segments progressively shorter, armed with several short ectal setae and denticulate spines in the formula 11 : 6 : 5 : 5; with eight small blunt teeth on the short almost straight terminal claw. Spines with three lobes per side.

Leg robust proximally, more slender distally. Main segments with few setae, tibia 2 the longest segment, with tibia 1 and femur progressively shorter. Tarsus very short, 0,33 the length of propodus, armed with ventrodistal spine and few sole setae. Propodus slightly curved, armed with several short ectal setae and five or six sole spines interspersed with short setae. Claw robust,

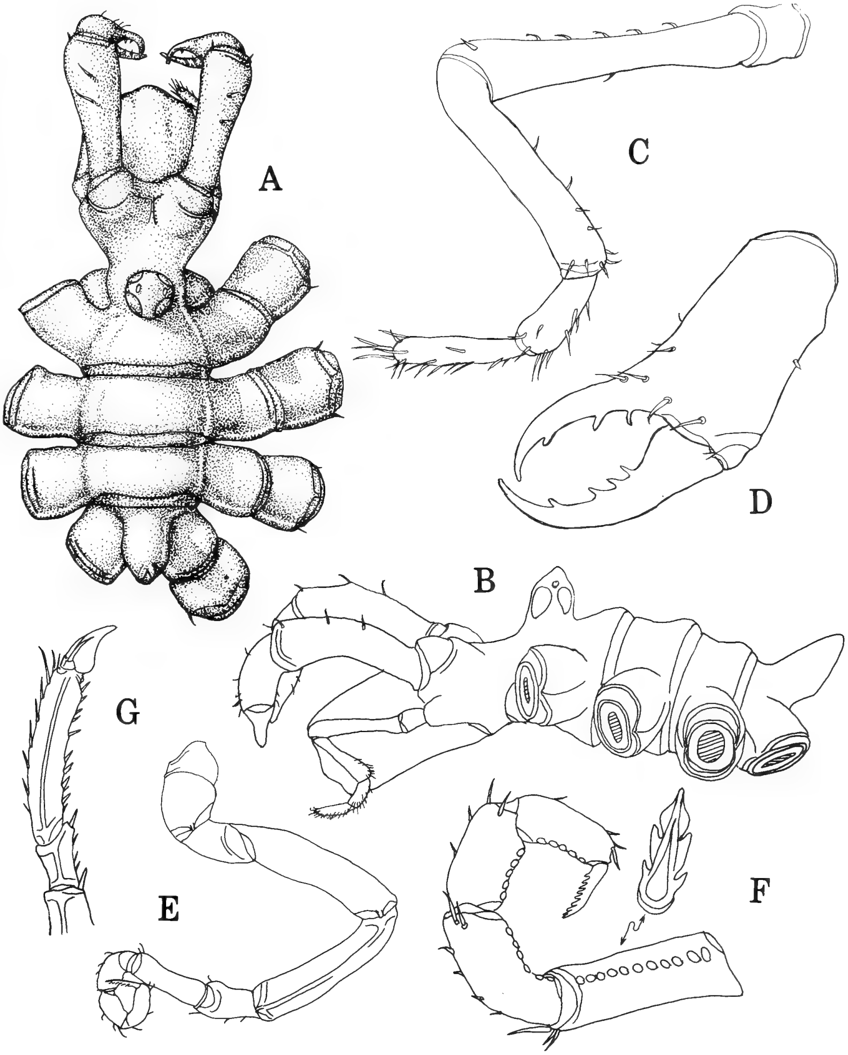

Fig. 11. *Nymphon obesum* sp. nov. Holotype, male. A. Trunk, dorsal view. B. Trunk, lateral view. C. Palp. D. Chela. E. Oviger. F. Strigilis, with enlargement of denticulate spine. G. Third leg, terminal segments.

short, about 0,3 the length of propodus, auxiliaries slender, about 0,6 as long as main claw.

Male unknown.

Measurements (holotype, in mm)

Trunk length, 2,94; trunk width (across 2nd lateral processes), 2,04; proboscis length, 1,32; abdomen, 0,66; third leg—coxa 1, 0,78; coxa 2, 0,88;

coxa 3, 0,76; femur, 2,4; tibia 1, 2,64; tibia 2, 2,92; tarsus, 0,4; propodus, 1,18; claw, 0,37.

Remarks

This new species shares the character of a remarkably 'fat' trunk and proboscis with a number of species previously named under the old junior synonym *Chaetonymphon*, erected by G. O. Sars (1888) to include 'thickset' setose species. Although we have found no closely related South African species at all like *N. obesum*, there are at least two similar North Atlantic species, *N. hirtum* Fabricius, 1794, and *N. hirtipes* Bell, 1853. The new species is probably closest to *N. hirtum* from the high Arctic, except that it is far less setose and has a bald appearance in comparison to *N. hirtum*. The chelae, legs and propodus are quite different in the new species.

Nymphon hirtipes is also a very setose species and, in spite of its similarities of short neck, thickset trunk and lateral processes, and large chelifores, its ovigers, legs, chelae, and palps are very different from those of *N. obesum*.

Distribution

Only known from the type locality, off East London, at 80 m.

Etymology

The species name *obesum* refers to the robust and thickset habitus of this unique specimen.

Nymphon paralobatum sp. nov.

Fig. 12

Material

Transkei area. Holotype, SAM–A19571, SM 226, 32°28,6′S 28°58,8′E, 710–775 m, 1 ♀.

Description

Moderately small, leg span 24,4 mm. Trunk completely segmented, rather slender, lateral processes short, little longer than their diameters, separated by about their diameters, glabrous. Neck short, oviger bases slightly anterior to first lateral processes; ocular tubercle between oviger bases and first lateral processes, short, not as tall as wide, with tiny apical papilla; eyes large, slightly pigmented; lateral papillae present, tiny. Proboscis moderately long, cylindrical, with constriction just proximal to flat lips. Abdomen extending half length of first coxae of fourth legs, tapering distally, armed with few dorsolateral setae.

Chelifores large, scape cylindrical, armed with few lateral and distal setae. Chelae only as long as scapes, palm semicylindrical, armed with scattered short

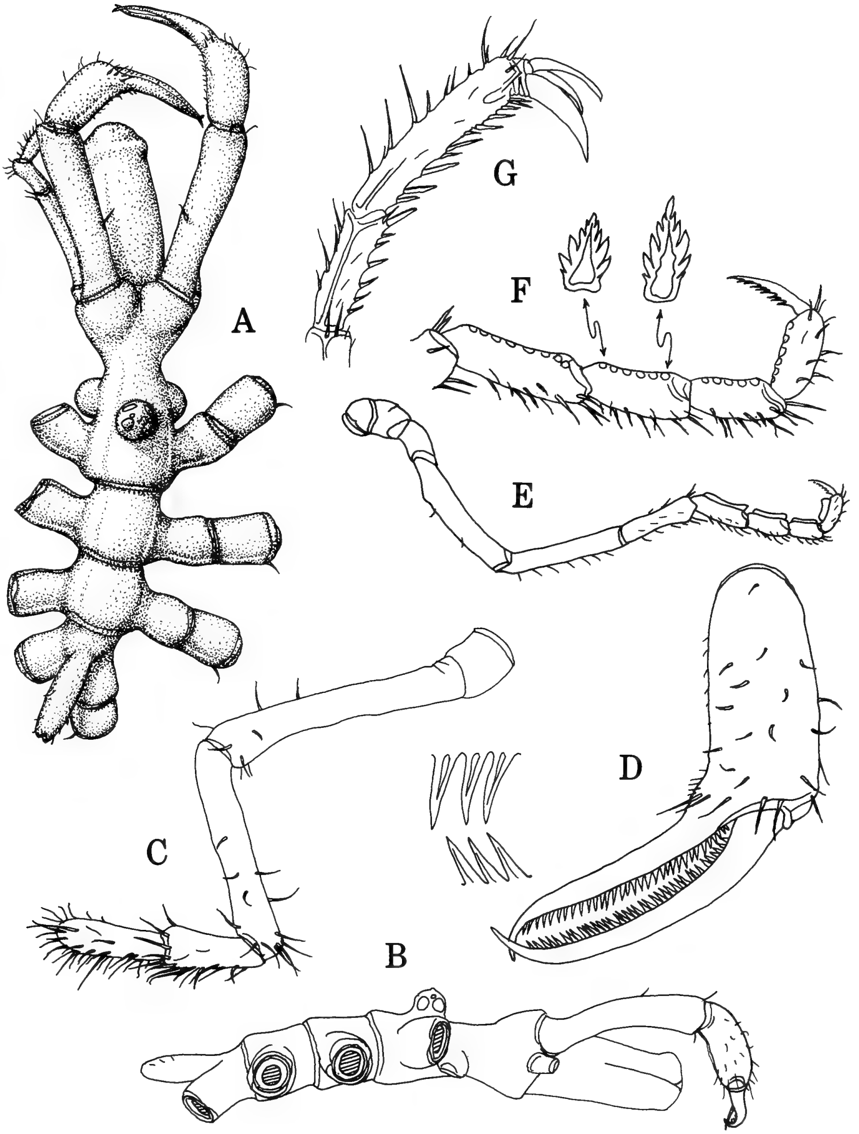

Fig. 12. *Nymphon paralobatum* sp. nov. Holotype, female. A. Trunk, dorsal view. B. Trunk, lateral view. C. Palp. D. Chela, with enlargement of teeth. E. Oviger. F. Strigilis, with enlargements of proximal and distal denticulate spines. G. Third leg, distal segments.

setae. Fingers slender, slightly longer than palm. Movable finger moderately curved, armed with 38 slender straight teeth; immovable finger almost straight, overlapping movable finger at tip, armed with 33 slightly longer straight teeth.

Palps fairly small, second segment only slightly longer than third, both armed with few distal setae. Terminal two segments subequal, together almost as long as third segment, armed with many ventral and distal setae, some longer than segment diameters.

Oviger fourth segment with small proximal bump, length about equal to fifth segment. Sixth segment straight, 0,6 as long as fifth, both armed with row of ectal setae and sixth with short lateral and ventral setae. Strigilis segments armed with few short ectal setae and denticulate spines endally in the formula 8 : 6 : 5 : 6, with eight short teeth on terminal claw as long as tenth segment. Denticulate spines shorter proximally than longer distal spines.

Legs moderately setose, major segments increasingly longer from femur to tibia 2. Tarsus 0,56 as long as propodus, armed with six or seven sole spines, several lateral and dorsal setae not as long as segment diameter. Propodus armed with 10 or 11 sole spines, few lateral setae, and several dorsal setae, some of which are longer than segment diameter. Claw about 0,45 as long as propodus, well curved, auxiliaries about 0,7 as long as main claw.

Male unknown.

Measurements (holotype, in mm)

Trunk length, 2,58; trunk width (across 2nd lateral processes), 1,28; proboscis length, 1,1: abdomen, 0,6; third leg—coxa 1, 0,43; coxa 2, 0,76; coxa 3, 0,38; femur, 1,75; tibia 1, 2,74; tibia 2, 3,84; tarsus, 0,46; propodus, 0,82; claw, 0,36.

Remarks

We hesitate to attribute this single female to a new species, particularly as it has no outstanding or unique characters, but its combination of characters, we feel, goes beyond the extremes of variation that might be found in its near-namesake, *N. lobatum* Stock, 1962. It is also sufficiently different from any other species in the genus to warrant being placed in a new species. This new species is closest to *N. lobatum* in its general trunk habitus, most chelifore characters, the palp, some oviger characters, and the legs in particular. It differs from *N. lobatum* in having a shorter neck, oviger bulges placed in advance of the first lateral processes, longer chelifores in relation to the scapes (about equal), a much shorter second coxa, and a slightly longer tarsus. *Nymphon lobatum* was described from a single male specimen and this new species is a single female, but the differences are mostly non-sexual and sufficiently numerous, we believe, to warrant designating a new species. Another major difference, although of little taxonomic importance, is the size of the two species. In most pycnogonids the female is usually a bit larger than the male in most measurements except the oviger, but this female specimen is smaller in the trunk measurements and has about half the leg span of *N. lobatum* (latter about 51 mm).

This new species also has characters in common with *N. signatum* Möbius, 1902, another presumably endemic South African species. In both the neck is moderately short, the lateral processes are separated by about half their diameters, the chela palm is approximately equal in length to the fingers that overlap at the tips, the palps are similar with the fourth segment being about 0,85 the length of the third, and the tarsus, propodus and claw length ratios are similar. The differences are that, in *N. signatum*, the oviger bases touch the first lateral processes, the ocular tubercle is taller than wide, there are almost twice as many teeth on the immovable finger as there are on the movable finger, and there is a maximum of 43 denticulate spines of the same size on the strigilis segments, whereas in the new species there are only 23 spines, of which the distal spines are taller.

Distribution

Only found at one station, off Transkei coast.

Etymology

The specific name is derived from the prefix *para* meaning a species beyond the designated nomina *Nymphon lobatum*, its closest relation.

Nymphon pedunculatum sp. nov.

Fig. 13

Material

East London area. Holotype, SAM–A19581, SM 163, 33°04,6′S 28°06,6′E, 90 m, 1 ♂ with eggs. Paratype, USNM 228134, SM 163, 90 m, 1 ♂. Paratypes, SAM–A19582, SM 163, 90 m, 2 ♀♀. Paratypes, MNHN–Py 598, SM 164, 1 ♀.

Description

Male. Size small, leg span about 21 mm. Trunk fully segmented, lateral processes 1,5 as long as their diameters, separated by half to less than half their diameters, glabrous. Neck very short, only as long as oviger bases. Ocular tubercle situated directly dorsal to oviger bases, slightly over twice as tall as diameter, arising from constricted base giving pedunculate appearance, eyes large, well pigmented, situated just below biconical apex. Proboscis slightly longer than cephalic segment, cylindrical, with slight constriction distal to midpoint, lips moderately inflated. Abdomen short, erect, extending just beyond distal rims of fourth lateral processes, glabrous.

Chelifores robust, scape almost as long as proboscis, armed with few lateral and distal setae. Chelae approximately as long as scapes, palms little shorter than fingers. Immovable finger only curved distally, overlapping movable finger, armed with fringe of proximal setae, 53 closely set teeth of equal size. Movable finger moderately curved except distally where sharply curved, armed with 56 closely set teeth of equal size, slightly smaller than teeth of immovable finger.

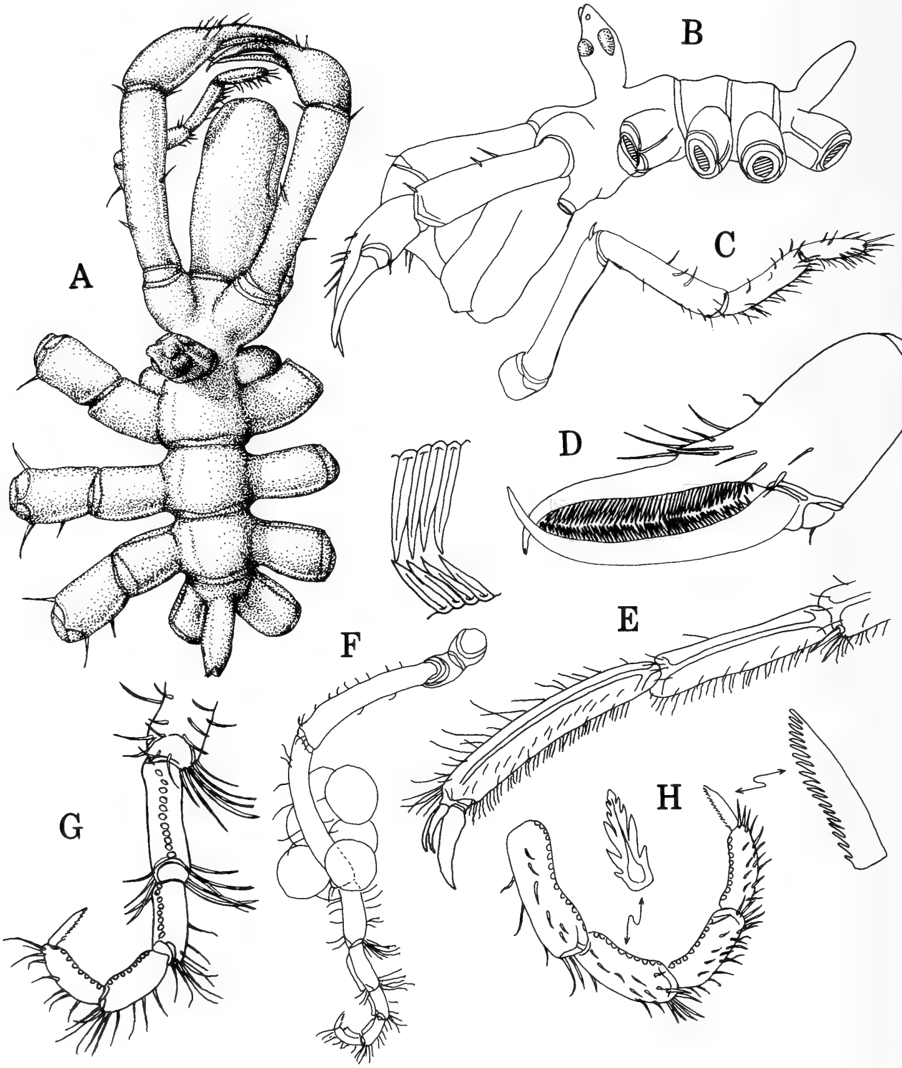

Fig. 13. *Nymphon pedunculatum* sp. nov. A–G. Holotype, male. A. Trunk, dorsal view. B. Trunk, lateral view. C. Palp. D. Chela, with enlargement of teeth. E. Third leg, distal segments. F. Oviger. G. Strigilis. H. Paratype, female. Strigilis, with enlargements of denticulate spine and terminal claw.

Palp segment three subequal to segment two, third armed with few distal setae. Segment five only 0,8 as long as segment four, combined length of both equal to second segment, terminal segments armed with many short lateral and ventral setae, some longer than segment diameter.

Oviger segments four and five subequal, both with row of lateral setae, short on fourth, longer on fifth. Sixth segment slightly curved, 0,3 as long as fifth, armed with lateral setae and tuft of long distal setae, longer than segment diameter. Strigilis segments progressively shorter in length, armed with ectal tuft of setae longer than segment diameter, and endal denticulate spines in the formula 12 : 8 : 7 : 7; spines slender, with four or five lateral serrations per side. Terminal claw slightly shorter than terminal segment, straight, armed with 17 lobe-like serrations extending to tip.

Major leg segments with few setae, tibia 2 longest with tibia 1 and femur each respectively shorter. Cement-gland pores not evident. Tarsus about 0,85 as long as propodus, both armed with few dorsal setae, numerous short lateral setae and many short sole spines of a single size. Claw 0,3 length of propodus, moderately curved, auxiliaries about 0,6 as long as main claw.

Female. Slightly larger than male except for oviger. Bifurcate ocular tubercle apex also pedunculate, as is base of tubercle. Oviger segments four and five subequal, strigilis segments with fewer setae and all shorter than those of male. Strigilis compound spines in the formula 13 : 10 : 8 : 9, with 18 blunt serrations on terminal claw.

Measurements (holotype, in mm)

Trunk length, 1,99; trunk width (across 2nd lateral processes), 1,16; proboscis length, 1,18; abdomen, 0,4; third leg—coxa 1, 0,41; coxa 2, 0,72; coxa 3, 0,58; femur, 1,91; tibia 1, 2,39; tibia 2, 2,64; tarsus, 0,49; propodus, 0,59; claw, 0,19.

Remarks

This new species is closest to *Nymphon pleodon* Stock, 1962, a South African species not encountered during this survey. It differs from *N. pleodon* in having a taller and pedunculate ocular tubercle, chelae with fingers showing less curvature and having more closely crowded teeth, the palp terminal segment shorter than the fourth, oviger segment six slightly longer than the seventh, terminal claw and denticulate spines of the oviger with a greater number of serrations, femur shorter than tibia 1, and auxiliaries longer than half the main claw length. The new species lacks the strong broad spines on oviger segments five and six of *N. pleodon*.

As stated by Stock (1962: 281), *N. pleodon* resembles *N. gruveli* Bouvier, 1910, as does the new species. The principal differences between the new species and *N. gruveli* are that the latter lacks the pedunculate ocular tubercle, has dorsodistal tubercles on tibia 2 (not found in the new species), and has much shorter auxiliary claws. Also, in Bouvier's species the terminal palp segment is longer than the fourth segment, whereas the opposite is true for the new species.

Distribution

Only found at one station, off East London.

Etymology

The specific name *pedunculatum* is derived from the Latin *pedis*, meaning a foot and refers to the ocular tubercle growing on a narrowed basal part that supports the larger part of the tubercle.

Nymphon phasmatodes Böhm, 1879

Nymphon phasmatodes Böhm, 1879: 173–174, pl. 1 (fig. 2). Flynn, 1928: 4. Loman, 1928: 67, figs 2, 6, 7. Stock, 1956: 76–78, fig. 2; 1959: 558; 1962: 283–284; 1965: 22–23 [key].
Nymphon capense Hodgson, 1908: 169–170, pl. 1 (figs 2, 2A). Gordon, 1932*a*: 117–120, figs 11–12; 1932*b*: 28, 32, 34, 62. Barnard, 1954: 91–92.

Material

East London area. SAM–A19605, SM 180, 80 m, 1 ♀. SAM–A19606, SM 185, 90 m, 1 ♀, 1 juv.

Remarks

There are few differences between these three specimens and the previous decriptions and illustrations of *N. phasmatodes*. We regard these differences to be only variation within the species, because most characters in the *Meiring Naude* specimens agree very well with the published figures. The differences are a slightly shorter tarsus for these specimens, the strigilis spine and claw count which vary by one or two spines per segment, and a similar variation in claw teeth, a slightly lower ocular tubercle having rather large lateral papillae, and a shorter tibia 2 which is nevertheless much longer than tibia 1 or the femur. Apparently, the chelifores of this species are carried usually in a distinctive erect position with the chelae extended vertically down to the sides of the mouth. In most *Nymphon* species the chelae are carried in a more horizontal or oblique position.

Distribution

This is another endemic South African species known from relatively shallow depths. Station 185, at 90 m, marks the deepest depth from which this species has been taken.

Nymphon pilosum Möbius, 1902

Nymphon pilosum Möbius, 1902: 179, pl. 24 (fig 8–12). Barnard, 1954: 100–101, fig. 6. Stock, 1956: 76; 1962: 278; 1968: 29.
Nymphon bipunctatum Flynn, 1928: 8–10, figs 1–2.

Material

Zululand area. SAM–A19591, SM 86, 550 m, 6 ♂♂ with eggs, 2 ♂♂, 3 ♀♀, 5 juvs. MNHN–Py 595, SM 86, 550 m, 1 ♂, 1 ♀. SAM–A19593, SM 103, 680 m, 2 ♂♂ with eggs, 1 ♂, 4 gravid ♀♀, 3 juvs. SAM–A19592, SM 129, 850 m, 1 ♂.

Transkei area. SAM–A19590, SM 226, 710–775 m, 1 ♀. SAM–A19589, SM 250, 150–200 m, 1 ♂, 2 ♀♀.

Remarks

This fairly common species is easily recognized among the many South African *Nymphon* species by its extremely long leg setae, some of which are up to five times longer than the segment diameter. As is true for all described *Nymphon* species examined for this report, the appendage measurements of this species vary and assume slightly different ratios among the segments, the oviger strigilis spines vary in number—some with as little as 18 spines, and the number of chelae finger teeth show a reduction in number in some of the above specimens, possibly due to age, but the specimens agree very well in most characters with the specimens previously figured. The cement-gland tube cones on the ventral surface of the femur vary in number from one male with two per leg to several specimens with four or five per femur. This, again, may be a function of age.

Distribution

As far as its distribution is known, this species is confined to South African waters, and was previously recorded over a rather wide depth range from 20 m to 366 m. The depths at which it was taken by the *Meiring Naude* increase the maximum known depth to 850 m.

Nymphon serratidentatum sp. nov.

Fig. 14

Material

Transkei area. Holotype, SAM–A19583, SM 226, 32°28,6′S 28°58,8′E, 710–775 m, 1 subadult ♀. Paratypes, SAM–A19584, SM 226, 710–775 m, 1 ♂ (damaged), 1 juv.

Description

Female. Size moderately small, leg span 27,8 mm. General habitus slender, tenuous. Trunk long, completely segmented, with lateral processes separated by twice their diameters, less than twice as long as their diameters, glabrous. Neck moderately long, triangular in dorsal profile anterior to ocular tubercle and oviger implantation, which are well anterior to first lateral processes in an inflation of the neck. Ocular tubercle low, rounded, wider than tall, eyes present, with little pigmentation. Proboscis slender, moderately short, with slight median inflation, lips rounded. Abdomen very short, not extending beyond distal fourth lateral processes, with few dorsodistal setae.

Chelifores large, scape 1,2 times longer than proboscis, glabrous. Chelae slightly longer than scapes, curved inward, palm less than half length of fingers, with few short distal setae. Fingers very slender, slightly curved, overlapping at

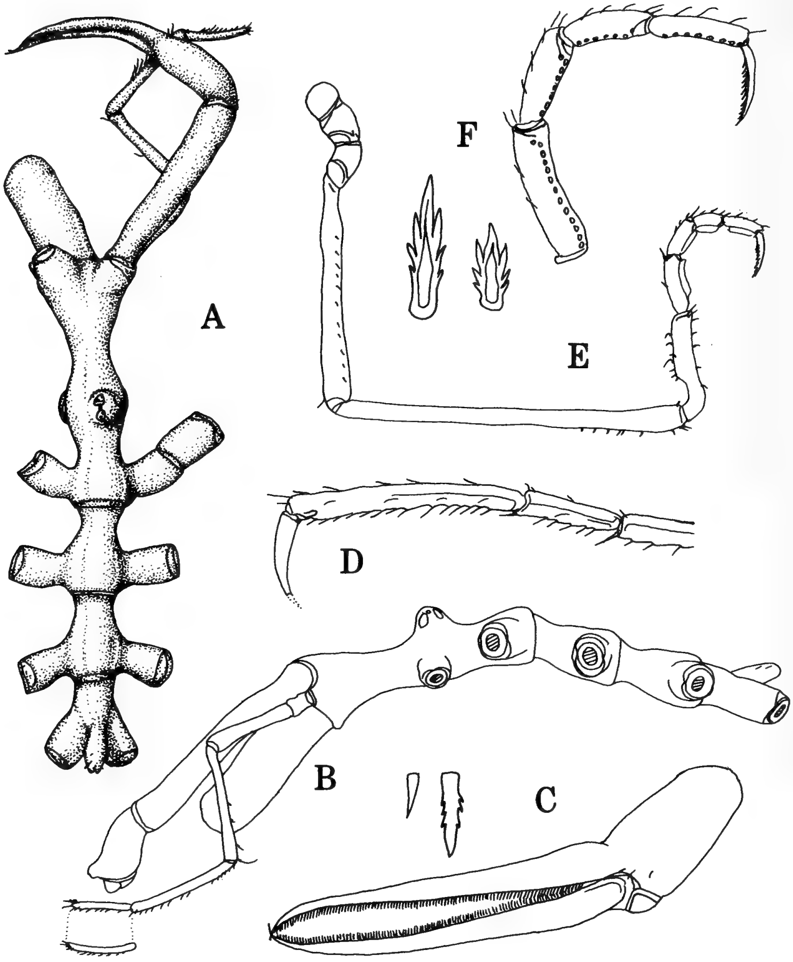

Fig. 14. *Nymphon serratidentatum* sp. nov. Holotype, female. A. Trunk, dorsal view. B. Trunk, lateral view. C. Chela, with enlargements of teeth. D. Third leg, terminal segments. E. Oviger. F. Strigilis, with enlargements of denticulate spines.

tips, armed with very many closely crowded narrow teeth, numbering 95 on immovable finger, 118 on movable finger. Some proximal teeth on movable finger with finely serrate edges with two to four tiny serrations per margin. No serrate teeth on immovable finger, plain spine-like teeth on both fingers distally. Finger tips slightly curled laterally.

Palps long, tenuous, third segment longest, 1,3 times longer than second, fourth almost as long as third, fifth segment shorter, half as long as third, with slight endal curve. Third to fifth segments armed with few very short ventral and distal setae.

Ovigers broken off and missing beyond second and fourth segments, respectively.

Legs long, slender, tibia 2 longest with first tibia 0,6 as long and femur 0,43 as long, armed with few short setae and long dorsodistal seta over three times longer than segment diameter of each segment. Tarsus slightly over 0,4 as long as propodus, both armed with few short dorsal and lateral setae, six equal sole spines on tarsus and 16 or 17 equal sole spines on propodus, none longer than segment diameter. Claw about 0,3 as long as propodus (claw tip broken off), auxiliary claws lacking.

Male. Slightly smaller in all measurements except oviger segments. Fifth oviger segment very long, slender, 1,5 times length of fourth, slightly swollen distally, both armed with few short lateral setae. Sixth segment about half as long as fourth, with strong proximal curve separated from distal straight section by small lateral tubercle, armed with lateral and distal setae. Strigilis segments progressively shorter in length, slender, armed with few ectal setae not as long as segment diameter and endal denticulate spines in single row in the formula 13 : 8 : 7 : 8, with slender terminal claw, slightly curved, not as long as terminal segment and armed with 13 short endal teeth. Denticulate spines shorter on proximal part of segments, longer on distal parts, with three slender serrations per side.

Palp segment lengths differ from female with fourth segment slightly longer than second, and third 0,87 as long as fourth. Terminal segment, presumably curved, missing.

Measurements (holotype, in mm)

Trunk length, 4,61; trunk width (across 2nd lateral processes), 1,62; proboscis length, 1,62; abdomen, 0,52; third leg—coxa 1, 0,38; coxa 2, 0,99; coxa 3, 0,42; femur, 2,11; tibia 1, 3,01; tibia 2, 4,99; tarsus, 0,38; propodus, 0,84; claw, 0,3 (? broken off).

Remarks

This new species is very like *Nymphon microctenatus* Barnard, 1946, in many characters. For purposes of comparison, the type of Barnard's species was examined and found, among other differences, to be about three times larger than these specimens. The major differences are in the chelae teeth, which number about 213 in the new species and over 300 in Barnard's species, the much longer neck, the anterior placement of the oviger bases and ocular tubercle in the new species, the much less stout trunk and lateral processes that are separated by much greater distances than in Barnard's species, the strongly curved chelae finger tips which overlap in the new species, and the tarsus which is much shorter than the propodus in the new species.

The striking similarities between the two species are the great number of chelae finger teeth, the extreme similarity of the palp segments in length, and the curve of the fifth or terminal segment, the separation of the oviger bases from the first lateral processes in both, and the relative measurements of leg, oviger and chelifore segments.

Unfortunately, the holotype female of the new species has only one complete leg and the adult male paratype is entirely without legs. We believe the differences between these specimens and Barnard's type of *N. microctenatus* go beyond variation within a species. However, if subsequent specimens are taken that are intermediate between these specimens and Barnard's type then, of course, the present specimens must be included in his species.

There are some similarities in the new species with *N. prolatum* Fage, 1942, a slender species found in West Africa. The general habitus of both species is similar, except for the ocular tubercle, abdomen and lateral process, which are very much longer than those of *N. serratidentatum*.

The presence of several serrate teeth among the otherwise simple curved teeth on the movable finger of these specimens is, so far we can discern from the literature, unique among the many species of *Nymphon*. The chelae teeth of *N. microctenatus* are very difficult to see separately in their crowded state, but none of the proximal teeth has any serrations in the type specimen.

Distribution

Species only found at one station off the Transkei coast at 710–775 m.

Etymology

The species name *serratidentatum* refers to the uniquely serrate chelae finger teeth of this new species.

Nymphon sp. indet.

Material

East London area. SAM–A19586, SM 185, 90 m, 1 juv.
Transkei area. SAM–A19587, SM 250, 150–200 m, 1 juv.

Remarks

Neither of these juveniles is sufficiently developed to describe or compare with other *Nymphon* species from the above two stations.

DISTRIBUTION AND ZOOGEOGRAPHY

The South African Museum's *Meiring Naude* cruises comprise a set of collections made between the southern Mozambique border and just south of East London, South Africa, and represent the only modern survey of deeper waters along this coast. Of the 92 benthic stations made during the annual cruises from 1975 through 1979, samples from only 21 (21,7%) of these stations contained pycnogonids. No pycnogonids were taken during the first cruise, but methods improved subsequently and greater numbers appeared in the samples as the cruises advanced. The number of specimens (455, of which 253 were of one species) and the small number of stations do not permit us to draw reliable conclusions concerning distribution.

A few brief comments can be made about the *Meiring Naude* collections with regard to the families represented, depth distribution, geographical boundaries, and associated fauna. The majority of pycnogonid species recorded in these collections belong in three families, while other families are represented by very few or even no specimens. This situation is different to a deeper-water collection reported on by Stock (1963) from South Africa, where the predominant family was the Colossendeidae with six species. Stock's (1981) deep Walvis Basin records again emphasized the Colossendeidae (3 species) and two other families also prevalent in the *Meiring Naude* material—Nymphonidae (4 species) and Austrodecidae (2 new species). The Nymphonidae dominate the *Meiring Naude* material with 14 species (7 new to science), and most of them are from the continental slope. Half the species of this family reported on herein occur in shelf depths of less than 100 m (with some distributions extending well beyond 100 m), whereas the remaining seven species are found between 100 m and 850 m; no specimens were taken between 850 m and 1 300 m.

Another very well-represented group in this material is the family Callipallendidae, with 10 species (3 new). It is also represented by the most genera (six), including the new genus *Safropallene*.

The family Ammotheidae is represented by five known species with one of them, *Boehmia tuberosa*, a relatively rare genus and species. A surprise is the appearance of new material of *Ammothella setacea*, taken only for the second time and redescribed here due to the loss of the type material. It is the most common pycnogonid taken in this survey, with captures at nine stations in continental shelf and slope depths of 90 m to 900 m. Indeed, the 253 specimens of *A. setacea* comprise over 55 per cent of the entire collection.

The family Pycnogonidae is represented here by four species, all from bathyal depths, but *Pycnogonum forte* and *P. nodulosum* are also known from shallower depths along the South African coast or in other parts of the Atlantic and Mediterranean.

There were only two *Meiring Naude* stations as deep as 1 000 m to 1 300 m, so the fact that no species of the genus *Colossendeis* (family Colossendeidae) was captured is inconclusive. There is evidence (Stock 1963) that these species live in deeper habitats off the South African coast. This family is represented in the collections by smaller-sized genera: *Rhopalorhynchus gracillimus* in relatively shallow depths, and *Hedgpethia magnirostris* in bathyal depths.

The genus *Pantopipetta* (family Austrodecidae) is represented by two new species, adding to the six species already known from southern African waters (including two from the Walvis Basin). Of the twelve known species, South Africa seems to be a point of speciation for this genus, although not all six South African species are endemic. The genus is a predominantly deep-water one, but at least two species (one South African) have been taken in depths as shallow as 66–69 m.

The family Phoxichilidiidae, a predominantly warm, shallow-water group, is represented here by only one species, *Anoplodactylus typhlops*, a true deep-water blind form. The genera *Endeis* and *Phoxichilidium* were not recorded at the depths sampled by the *Meiring Naude*, but at least two species of *Endeis* are known from shallower waters of the South African coast—*E. clipeatus* (Möbius, 1902) and *E. mollis* (Carpenter, 1894) (Barnard 1954: 129–132).

Tiny specimens of the genus *Rhynchothorax* (family Rhynchothoracidae) have yet to be found in South African waters.

We can distinguish three groups of species in the *Meiring Naude* material, according to their depth range. There is a continental shelf and slope component (*c.* 90 m to 200 m) composed of *Ascorhynchus ornatum*, *Tanystylum thermophilum*, *Rhopalorhynchus gracillimus*, *Nymphon barnardi*, *N. crenatiunguis*, *N. obesum*, *N. pedunculatum* and *N. phasmatodes*. A bathyal element, represented by four species, occurring below 500 m, includes *Nymphon granulatum*, *N. microctenatus*, *N. pilosum* and *N. serratidentatum*. A group of eurybathic species, which may be found at shallow as well as bathyal depths, includes *Ammothella setacea*, *Cilunculus sewelli*, *Pycnogonum nodulosum*, *Nymphon distensum* and *N. modestum*.

The major trends in geographical distribution of southern African littoral pycnogonids are sufficiently documented in the previous literature (Möbius 1902; Barnard 1954; Stock 1959, 1963), but the *Meiring Naude* material, obtained mostly from depths below 500 m, improves our knowledge of the deeper-water species. There are now approximately 100 species recognized from the entire area of southern Africa, south of 20°S (Arnaud & Bamber 1987: 71, table 14). Among the deep-water species of the *Meiring Naude* material, an Atlantic component of five species may be recognized: *Pallenopsis longirostris*, *Pycnogonum crassirostre*, *P. nodulosum*, *Callipallene phantoma*, and *Anoplodactylus typhlops*. There is also an Indo-Pacific element of four species: *Cilunculus sewelli*, *Pseudopallene gilchristi*, *Pycnogonum africanum* and *Rhopalorhynchus gracillimus*. *Pycnogonum forte*, *N. crenatiunguis* and *N. microctenatus* are among the large endemic element of southern Africa. Other endemics are: *Ammothella setacea*, *Ascorhynchus ornatum*, *Boehmia tuberosa*, *Tanystylum thermophilum*, *Pallenopsis capensis*, *Parapallene algoae*, *Nymphon distensum*, *N. modestum*, *N. phasmatodes*, *N. pilosum* and *N. signatum*.

There is a true deep-water component of apparently blind species, all of which are described as new in this report. These are: *Nymphon bicornum*, *N. granulatum*, *N. serratidentatum*, *N. paralobatum*, *Pantopipetta armata*, *Hedgpethia magnirostris* and *Safropallene longimana*.

There is an absence of any Antarctic component, even at bathyal depths of 1 000 m to 1 300 m, in the *Meiring Naude* material. Several boundaries between the different parts of the very long coasts of southern Africa have been recognized (Branch & Branch 1981). The cold Benguela Current delimits a cold-temperate zone on the west coast, from Cape Town at 33°56′S north to 20°S latitude. A warm-temperate zone occurs from Cape Point to East London (33°S 27°54′E), a subtropical east-coast zone north from East London to Inhambane (23°51′S 30°30′E), and a tropical east-coast zone from north of Inhambane to Beira (20°S 35°E). With the *Meiring Naude* specimens, the Atlantic component corresponds with the cold-temperate zone, the endemic component mostly agrees with the warm-temperate zone of the south coast, and the Indo-Pacific component corresponds with the subtropical east-coast zone.

Comparisons of the *Meiring Naude* material with that of other abyssal surveys along the South African coasts is, unfortunately, mostly inconclusive. The six abyssal stations studied by Stock (1963) between 2 700 m and 3 000 m reveal a very different type of pycnogonid fauna in these deeper waters of the west coast of South Africa (off Cape Town and the Cape Peninsula). He found 12 species (six of which were new) belonging to five genera. These were one *Nymphon*, one *Ascorhynchus*, six *Colossendeis*, one *Anoplodactylus* and three species of *Pantopipetta*. This fauna may not be considered as truly South African, but rather as a partly cosmopolitan fauna (Atlantic and Indo-Pacific) for the six *Colossendeis* species, and a partly deep-sea Atlantic fauna. This deep-water Atlantic and Cosmopolitan composition holds for Stock's (1981) paper on the pycnogonids from the Walvis (or Cape) Basin in 3 350 m to 5 040 m. There are no affinities with the *Meiring Naude* fauna at these depths and localities, but it does reveal that this Walvis Basin fauna is also partly abyssal cosmopolitan and partly of a deep-water Atlantic component.

Comparison of the *Meiring Naude* pycnogonid stations with stations recorded as having possible prey material in the same catch is somewhat more revealing. It is known that pynogonids prey on hydroids and there is some evidence that they may also feed on the soft parts of bryozoans (Arnaud & Bamber 1987: 45). We note that at almost all pycnogonid capture stations, hydroids (Millard 1977, 1980) and/or bryozoans (Hayward & Cook 1983) were among the associated fauna brought up at each station.

On the basis of hydroid faunas, Millard (1978) was able to recognize at least nine biogeographic elements but, with the relatively small number of stations containing pycnogonids, we cannot provide such conclusive distribution data, particularly because of the high number (32%) of new species and other rare or little known species.

An attempt was made to see whether or not pycnogonids show a tendency towards greater depths in warmer waters, as Millard (1978: 179) did for hydroids. For example, *Tanystylum thermophilum* was dredged on the west coast at 50–54 m (33°08,6′S 17°57,3′E, sta. WCD203Q, 29 April 1964, unpublished record), and at 17 m and 26–29 m in False Bay on the south coast, but at 150–200 m on the east coast (Transkei, *Meiring Naude*, SM 250). *Pycnogonum nodulosum* has been taken in only 20 m at Saldanha Bay on the west coast (sta. SB306T, 33°03,7′S 17°58,5′E, 30 April 1963, unpublished record), at 9 m on the south coast, but at 150–200 m on the Transkei and 500 m on the Zululand coasts (*Meiring Naude*, SM 250 and SM 86). Another species, *Nymphon phasmatodes*, is known from 48 m, 53 m and 79 m respectively on the west coast (sta. WCD184, 186 and 189, 33°07,6′E, unpublished records), at 40 m, 61 m and 66 m on the south coast (False Bay, sta. FAL601, 687 and 688, unpublished records), and at 80–90 m on the east coast (south-west of East London). *Nymphon comes* occurs in more shallow waters in False Bay than on the Transkei coast (*Meiring Naude*, SM 233, 540–580 m).

From these records it is apparent that at least the above listed species do have a tendency to occupy greater depths on the east coast than on the west coast, but the phenomenon does not hold true for other species where greater geographic distribution is known.

Considering the bryozoan fauna, Hayward & Cook (1983: 145, 147) stressed 'the accepted faunal similarity of eastern South Africa with the Indo-Pacific realm' and the 'increasing evidence of strong similarities with eastern Australian and northern New Zealand faunas'. These assumptions do not hold true for the pycnogonid fauna, as no known *Meiring Naude* pycnogonid species appears to have a common distribution with India or the Australian area (nor even with South America).

The same authors gave an analysis of sediments in relation to the number of living and dead bryozoan species identified from eleven stations. Pycnogonids were taken at nine of these stations and it is possible that they contributed to the number of dead colonies by predation. Hayward & Cook (1983) pointed out that there was a significant contribution to the sediment made by bryzoan skeletal remains at several stations (SM 129, SM 131, SM 151, SM 163/164 and SM 179). At station SM 163/164 (90 m) they found 43 living and 24 dead species, at SM 179 (80 m) 20 living and 4 dead species, SM 180 (80 m) 6 living and 21 dead species, and at SM 185 (90 m) 40 living and 15 dead species.

Both Millard (1978) and Hayward & Cook (1983) emphasized the high level of endemism in the region between Cape Agulhas and Durban. Considering the distribution of the *Meiring Naude* species, this endemism extends to the pycnogonid fauna, which in this report includes 14 endemic species from this area. The 13 new species described here are not included in this count but some may be found to be endemic when more is known of their distribution.

ACKNOWLEDGEMENTS

We wish to thank the Director and Trustees of the South African Museum for permission to work on the *Meiring Naude* collections presented here, and for the loan of important types and other rare material for comparative purposes. Our sincerest appreciation is extended to Miss Elizabeth Louw of the South African Museum for her assistance in providing data, station lists, and encouragement during our work on this report, and for her excellent editing of the manuscript for publication.

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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.

FRANÇOISE ARNAUD & C. ALLAN CHILD

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PART 17. PYCNOGONIDA