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DENTAL MICROWEAR IN RELATION TO DIET IN BLUE DUIKER AND COMMON DUIKER *(Cephalophinae, Bovidae, Mammalia)* IN SOUTH AFRICA

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ABSTRACT

The blue duiker (*Philantomba monticola* Thunberg, 1789) and grey or common duiker (*Sylvicapra grimmia* Linnaeus, 1758) represent two of the three duiker species occurring in southern Africa. Whilst some work has been published on the relationship between dental microwear and diet in a number of antelope species, nothing is documented for duikers.

Scanning electron microscopy (SEM) analysis was used to study dental microwear on the second lower molars of the blue duiker and common duiker specimens collected from the Eastern Cape Province of South Africa and housed in the Shortridge Mammal Collection at the Amathole Museum.

Although there were no significant differences in the dental microwear of the two duiker species, results confirmed that the two are browsing species with a high incidence of pits on their dental surfaces, an attribute due to the presence of fruit in their diet.

Keywords: Dental microwear, scanning electron microscopy (SEM), blue duiker, common duiker, *Philantomba monticola, Sylvicapra grimmia, Bovidae, Cephalophinae.*

INTRODUCTION

Variations in dental microwear have yielded insight into a number of oral processes such as, occlusal relationships and biomechanies of the jaw (Gordon, 1984a, 1984b; Wilkins & Cunningham, 1993), and dietary habits (Smith 1984; Teaford, 1986; Taylor & Hannam, 1987). Probably the most important aspect of microwear analysis is the possibility of using it to deduce the diet of extinct and fossil forms (Grine, 1981; Daegling & Grine, 1987; Waddle, 1988; Van Valkenburgh *et al.*, 1990; Lubell *et al.*, 1994).

Dental microwear analysis has focussed on a number of herbivorous taxa such as Primates and Hyracoidea (Walker *et al.*, 1978; Teaford & Robinson, 1989; Teaford & Runestad, 1992), while there have been a few studies on large antelopes such as waterbuck and kudu (Solounias & Hayek, 1993). No such study on duikers or any other species of small antelopes is documented.

Dental microwear analysis is facilitated by the use of casts and scanning electron microscopy (Murphy, 1982; Roomans, 1984). Analyses range from qualitative to quantitative, and from experimental studies using live animals to comparative studies of museum colleetions (Teaford, 1988). Teaford & Oyen (1989) state that the process of taking dental impressions from live animals is a difficult one and that it presents problems different from those encountered when working with museum material. However, Teaford & Runestad (1992) stress the importance of using museum specimens collected from the same area at the same time unless the effects of spatial and temporal variation are being investigated.

Several microwear features have been correlated with dietary variations (Covert & Kay, 1981; Teaford & Runestad, 1992; Lukacs & Pal, 1993). Gordon (1982) places these features into three categories, striations or scratches, pits, and gouges. The distinction between pits and scratches can be made through the use of a cut-off point in the range of length to width ratio (Teaford, 1985; Daegling & Grine, 1994) or, by subjective determination (Grine, 1986). Generally, scratches are linear depressions whose length is always greater than breadth (Gordon, 1982). Lengths and breadths of pits are approximately equal, and gouges are usually broader, strongly curved, and often S-shaped (Gordon, 1982).

Microwear features do not necessarily reflect specific food items, but rather the mechanical properties of the items or the constituents of the items (Grine, 1986; Teaford & Robinson, 1989). Therefore, foods with similar mechanical properties might be expected to produce similar microwear patterns (Daegling & Grine, 1994). Microwear patterns have been used to differentiate browsers from grazers (Walker *et al.*, 1978; Teaford, 1985; Mainland, 1998), and frugivores from folivores (Teaford & Walker, 1984; Teaford & Runestad, 1992).

The diet of the blue duiker varies throughout its range (Faurrie & Perrin, 1993) and comprises mainly fallen leaves and fruits (Bowland, 1990; Hanekon & Wilson, 1991). Whereas, Dubost (1984) found a high occurrence of fruit in its diet and described them as frugivorous, Bowland (1990) considered blue duiker to be folivorous on account of their diet comprising mainly leaves. In a recent dietary classification of African bovidae, Gagnon & Chew (2000) state that with the exception of common duiker, all duiker species are frugivorous.

The diet of common duiker consists mainly of forage of various dicots, twigs, flowers and some fruit (Wilson & Clarke, 1962; Boomker, 1983; Allen-Rowlandson, 1986, Skinner & Smithers, 1990).

The aim of this study was to determine if dental microwear is a sufficiently refined tool to detect the small differences in the diets of the blue duiker and common duiker. In addition, patterns of dental microwear could become a valuable taxonomic tool in identification of skulls, jawbones and loose teeth of the two species. Accurate identification of species is of fundamental importance in ecological monitoring, assessment, impact and conservation work as it often underpins the data from which subsequent analyses and interpretations are made.

MATERIALS AND METHODS

SAMPLING OF SPECIMENS

Eleven skulls from each of the two duiker species,

Figure 1. The skulls of blue duiker (left) and common duiker (right).

collected from two neighbouring districts in the Eastern Cape Province, and with the closest possible dates of collection, were used for the study. The specimens were obtained from the Amathole Museum

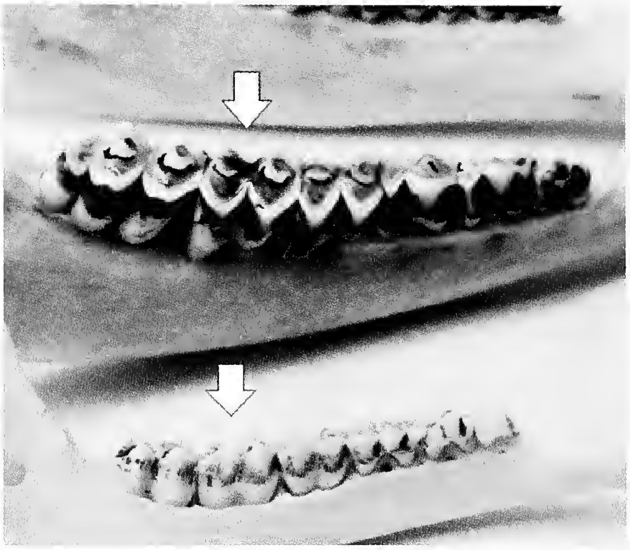


Figure 2. The lower jaws of blue duiker (foreground) and common duiker (background) showing the positioning of the second lower molar.

mammals collection (Appendix 1). This sample size is comparable to the ten used by Teaford (1985), and the eight of Gordon (1984 d).

The second lower molars (Skinner & Smithers, 1990) were selected for SEM analysis because they are placed between two other molars (Fig.2) and therefore the occlusal function is the same on both sides (Rensberger, 1973). They are also smaller in width than the upper molars and they occlude over the entire surface whereas the upper ones have only part of the crown occluded by all the lower ones as a result of the overlap (Butler, 1978).

PREPARATION OF DENTAL REPLICAS

With the use of cotton wool the teeth surfaces were cleaned with water, then ethanol and finally acetone (Rose, 1983). This frees the surface of any dirt, glue, loose matrix or grease (Rose, 1983). Vigorous scrubbing which may create artefactual scratches was avoided (Teaford & Oyen, 1989). After allowing the surface to air dry (Rose, 1983), a thin coating of acetic acid was applied to it, and a wall of Bostik Prestik sticky stuff (Genkem Ltd, England) was built around the tooth. Latex was then poured on top of the acid layer. The acetic acid facilitates rapid and proper setting of the impression material and together with the barrier prevent seepage of the latex (Ryan, 1979).

Preliminary SEM analysis indicated that latex did not pick up the dental impressions, and subsequently its use was abandoned. Molds of the teeth were then made with a mixture of an equal amount of Aquasil smart wetting impression material (S.W.I.M) "base" and Aquasil S.W.I.M " hardener catalyst" (Dentsply / Caulk, Milford DE, USA). As recommended by Rose

(1983) the impression material was applied to the teeth surfaces with disposable plastic syringes. Once the moulds were peeled off the teeth they were allowed to sit in a dust free environment at room temperature for about eight hours, in order to permit total degassing (Grine 1986). This is necessary in order to prevent any artefactual pitting (Gordon 1984 c). Initially epoxy-resin casts were made from the moulds as was the case in several studies (Gordon, 1984 d; Bullington, 1988; Teaford & Runestad, 1992). However, this was discontinued, as a result of failure of the casts to separate cleanly from the moulds, after setting. Rose (1983) states that clean separation is an important requirement for suitability of any casting material, which if not met may result into formation of artefacts. This led to a comparative examination of SEM images of teeth and images of their Aquasil S.W.I.M moulds. Based on the similarity of these images it was decided to use the original Aquasil moulds which once made and allowed time to degass were sputter-coated with gold prior to SEM analysis (Echlin, 1978).

SCANNING ELECTRON MICROSCOPY (SEM) ANALYSIS

Approximately two hours after coating the moulds they were carefully orientated in a particular angle, (long axes of moulds uniformly placed) and mounted on marked stubs. Care was taken to avoid any direct contact with the mould surfaces (Rose, 1983).

They were examined in a Jeol JSM 840 scanning electron microscope. Teeth were rotated in various positions to have an overview of features, and comparative micrographs were taken (Crompton & Kielan-Jaworowska, 1978). Sets of micrographs at magnifications of 130x and 450x were taken, but only the latter were used for analyses.

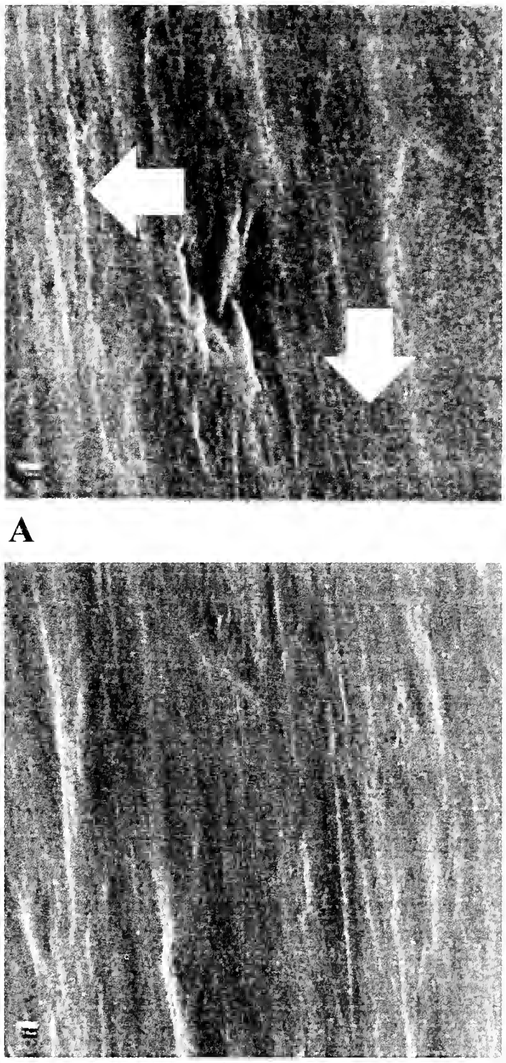
DATA COLLECTION AND ANALYSES

Data were collected from eleven micrographs for each of the two duiker species. These were a total of twenty-two micrographs taken from similar occlusal facets of the second lower molars. With the use of a B41420/3 illuminated magnifier all identifiable pits and scratches in an area of 16 cm^2 at the centre of each micrograph (of 450 X magnification) were counted and recorded. Gouges were subsumed as scratches (Grine, 1986). Pits and scratches were identified independently by subjective determination following the method of Gordon (1982), rather than by imposing an arbitrarily set length to width ratio on the features. In order to ensure that features are correctly categorised, only those which could clearly be identified were recorded. It has been stated (Gordon, 1982; Teaford and Walker, 1984) that, because of the overlap and large numbers of features per field it is not always possible to record every feature.

The number of microwear features per field of examination was compared between samples using the Mann-Whitney statistic or t- test. Chi-square analysis was used to test for interspecific differences in the proportions of pits and scratches (Zar, 1996).

RESULTS

Three types of features; scratches, pits and gouges were identified as occurring on all teeth of the blue duiker and common duiker. Representative images of casts from the teeth of the blue duiker and common duiker are shown in the micrographs (Figs. 3A and B).



A

B

Figure 3. Scanning electron micrographs taken from the occlusal surfaces of the second lower molars of common duiker (A) and blue duiker (B). The horizontal arrow indicates a scratch and the vertical arrow a pit. Magnification is 450X.

Table 1. Numbers, ratios, percentages and results of statistical comparisons of microwear features on teeth of blue and common duiker.

Dental microwear features	Blue duiker (n =11)	Common duiker (n =11)	Statistical results
Mean number of scratches per 16 cm^2	79 (15%)	84 (14.9%)	
Mean number of pits per 16 cm^2	449 (85%)	481 (85.1%)	
Ratio of Pits : Scratches	5.7 : 1	5.5 : 1	Insignificant Interspecific diff. (Chi-Square; p = 0.96)

The total number and percentages of pits and scratches recorded on the teeth of the blue duiker and common duiker were similar and for both species there were more pits than scratches on the dental surfaces (Table 1).

The chi-square analysis showed no significant interspecifie differences in the proportions of pits and scratches between duiker teeth (p = 0.96).

Interspecific comparison of the mean number of features per field indicated no significant differences (p = 0.53, Mann-Whitney). Intriguingly however, significant intraspecific differences were shown to exist between the number of pits and scratches per field in both the blue duiker (P < 0.0001, t-test) and common duiker (P < 0.0001, t-test).

The lowest recorded number of features in a 16 cm square field (from a micrograph of 450 X) on common duiker teeth was 21 compared with 9 in a similar field on blue duiker teeth. The highest number recorded, in the same size of fields for common duiker and blue duiker were 94 and 97 respectively.

DISCUSSION

It is established that the diets of grazers and browsers result in different patterns of molar microwear (Walker *et al.*, 1978; Teaford, 1985; Solounias & Hayek, 1993; Mainland, 1998). Browsers are characterised by many pits and few scratches, while grazers have many scratches and few pits (Solounias & Hayek, 1993). A frugivorous diet results in teeth with a high density of pits (Teaford & Walker, 1984; Teaford & Runestad, 1992) and hard fruit eaters have wider pits than soft fruit eaters (Teaford, 1985; Teaford & Runestad, 1992). Blue duiker and common duiker have been described as browsers by Boomker (1981), Wilson (1966), Bowland (1990) and Bowland & Perrin (1998) and this is supported by the type of microwear exhibited on their dental surfaces. The molars of both species are predominantly pitted which is characteristic of browsers.

Covert & Kay, (1981) and Peters (1982) attribute the differential wear on teeth of grazers (many scratches and few pits) to the opaline phytoliths in grasses. Baker *et al.*, (1959) and Kay & Covert, (1983) demonstrated that wear caused by the opaline phytoliths and that of gritty diets are essentially similar. Blue duiker eat fallen leaves, fruit, and flower (Skinner & Smithers, 1990; Faurie & Perrin, 1993; Bowland & Perrin, 1998) which are ingested along with accompanying debris. As a result, it might be expected that blue duiker dental wear would be closer to that of grazers, but the results from the present study suggest that this is not the case. It is possible that utilisation of fruit by both duiker species explains this. Teaford & Walker, (1984) and Teaford & Runestad (1992) relate a high incidence of pits to a frugivorous diet. It is therefore likely that the dental effects of eating fruits in both duiker species overshadows any minor feeding habit differences.

The significant intraspecific differences (between similar sites on the molars of the same species) in the number of features per field is interesting. Although every effort was made to ensure that specimens for the study were collected from the same area at the same time, this was not entirely possible. All specimens had been collected from Peddie and King William's Town districts, which are neighbouring jurisdictional areas of the Eastern Cape province. At the time of collecting the specimens, both these districts were described as having similar vegetation types, which was a combination of valley bushveld and Eastern province thornveld (Comins, 1962; Acocks, 1975). All specimens were collected between 25 May 1948 and 5 April 1949. However, most specimens were collected during autumn and winter (Appendix 1). Despite the use of only adult specimens (of unknown ages) in the study, age was not fully controlled for, and therefore may also have been a variable determining the results. Although the factor of gender is not mentioned in the literature, in this study only three specimens were of unknown sex, and males and females were spread evenly throughout all categories (species and localities) (Appendix 1).

Gordon (1982) postulates that the recognised types of microscopic abrasion features are not intrinsically different, but rather manifestations of different degrees of shear and compression subjeeted to the agents which produce microwear. According to this view, pits and scratches are found at opposite ends of a continuum of surface wear phenomena, such that the decision about where to make the division is always arbitrary (Gordon 1988). Different cut-off points have been used. Daegling & Grine (1994) defined pits as those features with a length-width ratio of 4:1 or below, while Teaford & Walker (1984) and Teaford (1985) assigned to pits a ratio of 10:1 and anything above to seratches. Subsequent assessment of the features indicated that, those features recognised as pits in this study possessed length to width ratios of about 4:1 and below. In an analysis of feature dimension ratios, Solounias & Hayek (1993) concluded that the best diagnostic method of tooth microwear analysis utilizes the number of pits smaller than or equal to the ratio four (length over width), the number of scratches between four and one hundred in length to width ratio, and that of gouges greater than one hundred in length to width ratio.

The data for this study were from microwear counts. Microwear feature densities and relative abundance have widely been used to detect dietary differences among closely related species (Teaford & Walker, 1984; Teaford & Runestad, 1992; Solounias & Hayek, 1993) however, feature dimensions are also equally important (Gordon, 1982). Robson & Young, (1990) state that microwear feature dimensions rather than feature densities and relative abundances, may be the most suited for investigating diet differences of closely related species. On the other hand, Teaford & Runestad (1992) describe scratch widths as poor indicators of dietary differences.

In conclusion, dental microwear cannot be used to separate the blue duiker and common duiker. However, the abundance of pits on the occlusal surfaces supports the observation that both are browsers, with fruit as part of their diets.

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APPENDIX 1

Information accompanying the blue and common duiker museum specimens whose molars were used in the dental microwear analyses.

Specimen	Catalogue Number	Sex	District of origin	Date collected
Blue duiker	KM 15056	M	King William's Town	25 April 1948
Blue duiker	KM 15060	?	King William's Town	25 May 1948
Blue duiker	KM 15082	F	King William's Town	30 July 1948
Blue duiker	KM 15037	M	King William's Town	27 June 1949
Blue duiker	KM 15055	M	King William's Town	06 May 1948
Blue duiker	KM 15558	?	King William's Town	08 May 1949
Blue duiker	KM 15559	?	King William's Town	27 June 1949
Blue duiker	KM 15052	M	Peddie	04 July 1948
Blue duiker	KM 15053	M	Peddie	01 July 1948
Blue duiker	KM 15062	M	Peddie	04 July 1948
Blue duiker	KM 15081	M	Peddie	19 July 1948
Common duiker	KM 15098	F	King William's Town	02 March 1949
Common duiker	KM 15099	F	King William's Town	05 April 1949
Common duiker	KM 15100	F	King William's Town	07 April 1949
Common duiker	KM 15101	F	King William's Town	17 January 1949
Common duiker	KM 15102	M	King William's Town	17 January 1949
Common duiker	KM 15103	M	King William's Town	09 July 1948
Common duiker	KM 15129	M	King William's Town	16 May 1948
Common duiker	KM 15138	M	Peddie	28 August 1948
Common duiker	KM 15162	M	Peddie	02 August 1948
Common duiker	KM 15163	M	Peddie	08 August 1948
Common duiker	KM 15164	F	Peddie	08 August 1948

KEY

KM Amathole Museum (Formerly Kaffrarian museum)

? Not given

F Female

M Male

King William's Town (3327 CD) and Peddie (3327 AA) districts are in the Eastern Cape Province of South Africa.

CHIRONOMIDAE (DIPTERA) IN THE ALBANY MUSEUM PART 1

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ABSTRACT

Four new species of Chironomidae from South Africa are described: *Metriocnemus capensis* sp. nov., *Polypedilum (Pentapedilum) chutteri* sp. nov., *Polypedilum (Polypedilum) hastaferum* sp. nov., and *Skusella freemani* sp. nov., also a possible new species of *Pagastiella*. *Paralauterborniella nigrohalteralis* Malloch is reported for the first time from Subsaharan Africa and the aberrant *Kribiothauma pulchellum* Kieffer is redescribed in detail with its putative larva.

Keywords: New species, *Chironomidae, Orthocladiinae, Chironomini*, South Africa, Namibia

INTRODUCTION

The Albany Museum, Grahamstown, Eastern Cape Province, South Africa, is the repository of large collections of aquatic invertebrates. These have come from the National Institute of Water Research (now Watertech) the Freshwater Research Unit, Zoology Department, University of Cape Town, and from extensive river studies carried out by the professional staff of the museum. The study of these collections has greatly increased the knowledge of the biodiversity of the freshwater fauna of southern Africa. The Chironomidae are very well represented in these collections and many new species have been discovered. Some are of ecological importance in South African river communities and these and rarer forms are of taxonomic interest. Harrison (2000) deals with four of these and this paper describes four new species, records the finding of two previously considered Holarctic genera, *Pagastiella* and *Paralauterborniella,* in the Subsaharan (Afrotropical) region of Africa and redescribes the aberrant *Kribiothauma pulchellum* Kieffer.

METHODS

Pinned specimens were treated as follows: the wings were removed first from the dried specimen and mounted directly in Canada balsam, then the rest of the specimen was macerated in 5% potassium hydroxide at room temperature for 24 hours; the KOH was removed by placing it in 70% ethanol for about 10 minutes, and then into 96% ethanol, it was dissected and mounted in Canada balsam dissolved in cellosolve on the same slide as the wings. Specimens preserved in alcohol were dissected and mounted in the same type of balsam. Drawings were made by means of a drawing tube on a compound microscope.

Measurements were made with an eyepiece micrometer in the compound microscope. Morphological terminology is aceording to Sæther (1980) and the description of the males follows the style of Cranston, Oliver and Sæther (1989) and Cranston, Pinder, Dillon and Reiss (1989), using their generic definitions. The description of females follows the style of Sæther (1977).

The holotypes and paratypes of all the species described here and other material used in the descriptions have been deposited in the Albany Museum, Grahamstown, 6140, Eastern Cape Province, South Africa. Representatives of the material collected in Namibia and listed under the KUN catalogue are deposited in the collections of the State Museum, Windhoek. The catalogue numbers of the specimens are given in the text.

Abbreviations used in this paper are:

AR *antennal ratio. Ratio of length of apical flagellomere to combined length of basal flagellomeres.*

LR *leg ratio. Ratio of length of tarsomere 1 to length of tibia.*

SV *'Schenkel-Schiene Verhältnis'. Ratio of femur plus tibia to tarsomere 1.*

BV *'Beinverhältnisse'. Combined length of femur, tibia and tarsomere 1 divided by length of tarsomeres 2 to 5.*

ADH *A D Harrison (Collector).*

TAXONOMIC DESCRIPTIONS

ORTHOCLADIINAE

Metriocnemus capensis sp. nov. (Figs 1-5)

The male of this species falls within the definition of Cranston, Oliver and Sæther (1989) and is of interest as it is the only one found so far in South Africa south of Pretoria. One specimen of *Metriocnemus wittei* Freeman was captured near there in 1954 and could have come from a tree hole (Freeman, 1956). The reason for this apparent absence of this genus is probably that chironomids of tree holes and mossy streams have not been studied in Southern Africa. Cranston and Judd (1987) show that this genus has a very wide ecological diversity.

ADULT MALE (N = 3, 2 mounted)

As per generic definition in Cranston, Oliver and Sæther (1989)

Body length. 4.1 mm

Wing length. 2.4 mm

Colour. Head and antennae brown; thorax: background light brown, scutal stripes separate and dark brown, preepisternum and postnotum dark brown, scutellum brown, legs light brown: abdomen: tergites dark brown, II to IV somewhat paler distally, hypopygium dark brown.

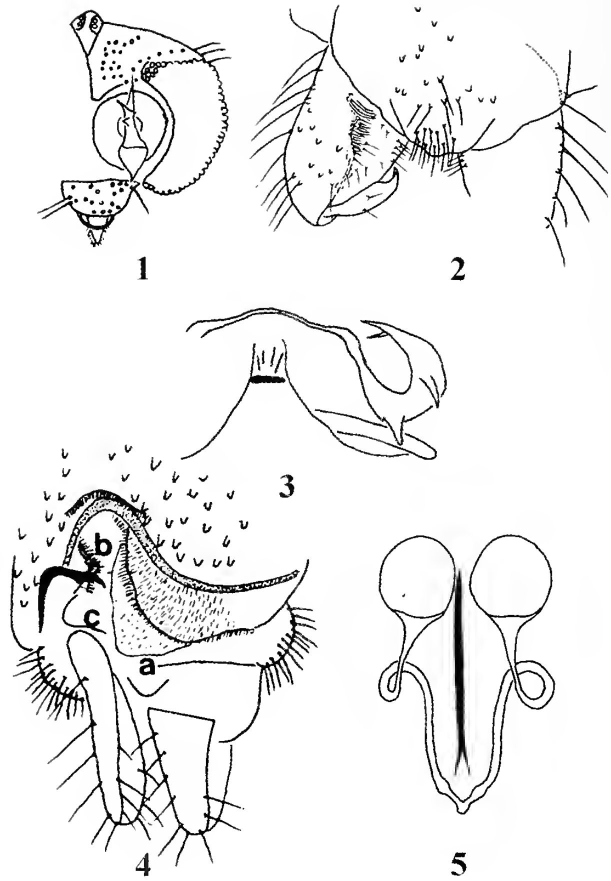
Head (Fig. 1). AR O.97. 13 flagellomeres, plume dense, one large preapieal seta on end flagellomere, groove beginning at flagellomere 4, flagellomeres without sensilla chaetica except for few at the tip of 13. Eyes bare with short, wedge-shaped dorsomedial extension; tentorium as in Fig. 1. Length of palp segments (there was variation between the two specimens) 36, 45, 180 and 198, 150 and 153, 210 µm; no subterminal sensillae on segment 3.

Thorax. Setation: lateral antepronotals 14, dorsocentrals about 50, biserial, posterior prealars 40, largely biserial, scutellars 18 per side, partly biserial. Acrostichals beginning near antepronotum.

Wings. Anal lobe weak, similar in shape to that of *M. knabi* Coquillett (Cranston, Oliver and Sæther, 1989), membrane densely covered with setae.and with fine punctation. Vein setation: all veins densely setose. Squama with about 32 setae.

Legs. LR fore 0.70 and 0.73, mid 0.43, hind 0.35 and 0.36. SV fore 0.38 and 0.40, BV fore 2.6 and 2.7. No sensilla chaetica on tarsomeres. Pseudospurs present: midleg, on tarsomeres 1, 2 (one specimen on 3), hind leg on tarsomeres 1 and 2. No pulvilli.

Hypopygium (Fig. 2). Numerous anal tergite setae, anal point absent, virga weak spines appear to be fused, gonocoxite with strongly reduced inferior volsella, the region is strongly chitinized with irregular ridges, small, roughly rectangular chitinized plate between gonocoxite bases. Gonostylus slender, crista dorsalis absent, megaseta of moderate length. Fig. 3 shows the apodemes and also the virga and plate between bases of gonocoxites, sternapodeme narrow, oral projections weak.



Figures 1 - 5. *Metriocnemus capensis*. Adult male: 1. head; 2. hypopygium; 3. apodemes. Adult female: 4. genitalia; 5. seminal capsules and ducts.

ADULT FEMALE (N = 1 mounted)

Close to generic definition of Sæther (1977).

Body length. 2.mm.

Wing length. 2.5mm

Colour. Similar to male except for abdomen tergite I light, tergites II VI anterior half dark brown, posterior light, giving a striped effect.

Head. AR 0.3, 5 flagellomeres, last with large terminal seta, no frontal tubercles; eyes similar to male, setation similar to male. Length of palp segments 36, 42, 186, 180, 270 µm. No subapical sensillae on segment 3.

Thorax. Setation: lateral antepronotals 18, dorsocentrals 70, mostly biserial, posterior prealars 37, biserial, scutellars 15. Acrostichals beginning near antepronotum.

Wings. Similar to male but extended costa reaches almost to the wing tip.

Legs. LR fore 0.70, mid 0.40, hind 0.36. No sensilla ehaetiea on tarsomeres.

Genitalia (Figs. 4, 5). Gonopophysis VIII, ventrolateral lobes large and rounded (a), dorsomedial lobes (b) small and pointed; a small apodeme lobe without setae (c) appears to be present, gonocoxapodemes light, narrow and joined. Gonocoxite IX large with about 18 setae, coxasternapodemes, dark, narrow and curved, segment X without setae, postgenital plate somewhat triangular, cerci large, 144µm, pediform. Seminal capsules (Fig. 5) brown in oral ¾ with neck, 78 µm without neck, ducts looped, narrow at neck but widening at start of loop to a long glandular portion, distinct bulbs before common opening.

SPECIMENS EXAMINED. 3♂ and 1♀ from small waterfall, tributary of Silvermine River, Cape Peninsula, 34.05S, 18.25E, 26 xi 1995. Holotype ♂ cat. SAC18A and paratype ♂ cat.SAC19A, paratype ♀ eat. SAC 35E. Collector ADH.

COMMENTS. The male is somewhat atypical for the genus because of its reduced inferior volsella, but according to Cranston, Oliver and Sæther. (1989) this also occurs in some other species.

ETYMOLOGY. *capensis* Latin, referring to the Cape Of Good Hope.

ECOLOGY. The adults were emerging from moss-covered rock within a small waterfall.

DISTRIBUTION. Known only from the Cape Peninsula, Western Cape Province.

CHIRONOMINI

Kribiothauma pulchellum Kieffer 1921 **(Figs 6-10)**

Kribiothauma pulchellum, Freeman 1958.

The adult male studied by Freeman had been pinned and had suffered some distortion. A male preserved in alcohol is described here, as well as a female and a probable larva. The male conforms to Freeman's (1958) generie definition, including the antenna without long plume setae.

ADULT MALE (N=2 mounted)

Body length. 1.7 - 1.9 mm

Wing length. 0.9 mm

Colour. whole body dark brown when mounted, almost black in alcohol.

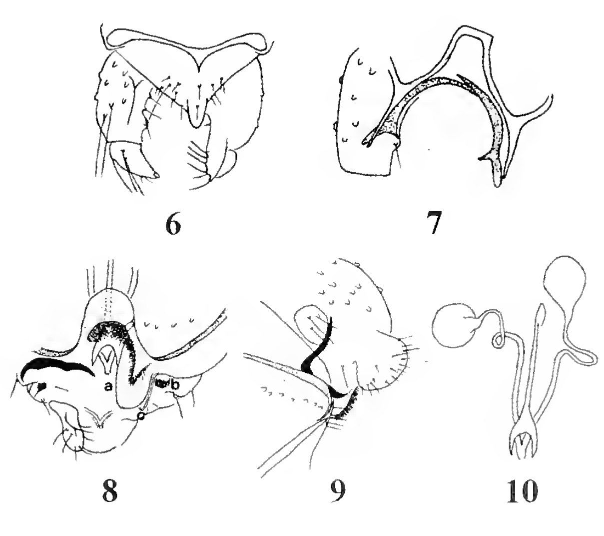
Head. AR 0.2. 13 flagcllomeres, plume setae short. Eyes bare. Frontal tubercles very small. Length of palp segments 24, 27, 33, 63, 114 µm. No subapical sensilla on segment 3.

Thorax. Antepronotum small and short, not visible from above. No scutal tubercle. Setation: lateral antepronotals nil, acroctichals 5, dorsocentrals 12, posterior prealars 3, scutellars 4 per side.

Wings. Colour as in Freeman (1958, photograph Plate 2r), most of wing dark with light spots in cells, 2 in r_{4+5}, 3 in m_{1+2}, 2 in m_{3+4}, and irregular spot in anal cell. Setation: brachiolum 1, R 10, R_1 5, R_{4+5}9, squama 3.

Legs. Foretibia with no scale but with long, curved spur with basal half with mierotrichia, other tibia with separate combs, one with spur. Pulvillae small. LR fore 1.0, mid 0.45, hind 0.56. SV fore 2.1, BV fore 2.5.

Hypopygium (Fig 6, 7). Anal tergite bands transverse and joined; numerous anal tergite setae; anal point broad and rounded with one dorsal seta; no superior volsella but it may be represented by a process on the gonocoxite with one seta, near a spur of the phallapodeme (Fig 7); inferior volsella large with 5 setae (Fig. 6 right) ; gonostylus short and pointed (Fig. 6 left); apodemes as in Fig. 7.



Figures 6 - 10. *Kribiothauma pulchellum*. Adult male: 6. hypopygium; 7. apodemes. Adult female: 8. genitalia, ventral; 9. genitalia, lateral; 10. seminal capsules and ducts.

ADULT FEMALE (N = 4-mounted)

Three specimens were preserved in alcohol and were used mainly for this description.

Body length. 2.45 - 2.8 mm

Wing length. 1.5 mm

Colour. Similar to male.

Head. AR 0.54; 6 flagellomeres. No frontal tubercles. Length of palp segments 27, 30, 42, 54, 120 µm. No subapical sensilla on segment 3.

Thorax. Similar to male. Setation: lateral antepronotals nil, acrostichals 6, dorsocentrals 11, posterior prealars 3, scutellars 2 per side.

Wings. Pattern similar to male. Setation: brachiolum 1, R 10, R_1 5, R_{4+5} 12, squama 3.

Legs. Spurs and pulvilli like male. LR fore 1.15, mid 0.5, hind 0.66. No sensilla chaetica on tarsi.

Genitalia. (Figs 8, 9, 10). Gonopophysis VIII divided into a large dorsomedial lobe (Fig. 8 a) and smaller ventrolateral (b) and apodeme lobes (c); gonocoxapodemes dark and joined; coxosternapodemes prominent and bent only at lateral tip; gonocoxite small with three setae (Fig. 9); segment X with one seta per side, postgenital plate pointed, cerci small. Seminal capsules spherical with necks (Fig. 10), colourless, spermathecal ducts convoluted with common opening.

SPECIMENS EXAMINED. 1♂ Great Usutu River near Amsterdam, 26.30S, 30.45E, 15 ix 1954 (cat. GEN14), 1♂ & 1♀ Lower Sabie River, Kruger National Park, 25.01S, 31.59E, 30 ix 1960 (cat. GEN 585AM and AN), collected ADH. 3♀ Klein Mooi River, 29. 18S, 29. 58E, 15 iii 1995 (cat. MOI 32AF v, vi, vii), 1♂ Klein Mooi River, 29.13S, 29.53E, KwaZulu-Natal 4 iv 1995 (cat. MOI 65CA), collectors F C de Moor and team.

COMMENTS. The gonostylus illustrated here (Fig. 8) differs markedly in shape from that in Freeman (1958) (cat. GEN14), but his specimen was originally pinned and not properly relaxed; another pinned specimen, GEN 585AM, still shows the same distortion after treatment with NaOH. There is no superior volsella but a small process half-way down the gonocoxite in the vicinity of a spur on the phallodeme, may be a rudiment . In the female there is no reduction of the genitalia that are like those of other species with single tibial spurs such as *Polypedilum* (Sæther 1977, Harrison 1996).

ECOLOGY. All the South African specimens were collected alongside rivers, those from KwaZulu-Natal in light traps.

DISTRIBUTION. Kribi in Cameroons; South Africa: Mpumalanga, KwaZulu-Natal.

Putative ***Kribiothauma* sp.** larva **(Figs 11-14)**

The larvae described here came from large samples taken from the Klein Mooi River on the same date (15 iii 1995) and place where adults of *Kribiothauma pulchellum* were caught in a light trap. These were the only chironomid larvae found in the river that did not belong to known genera and that approximated to *K. pulchellum* in size.

Colour: Head capsule pale yellow, body darkly pigmented, claws dark, procercus dark with light cerci.

Body length. 4.0 mm

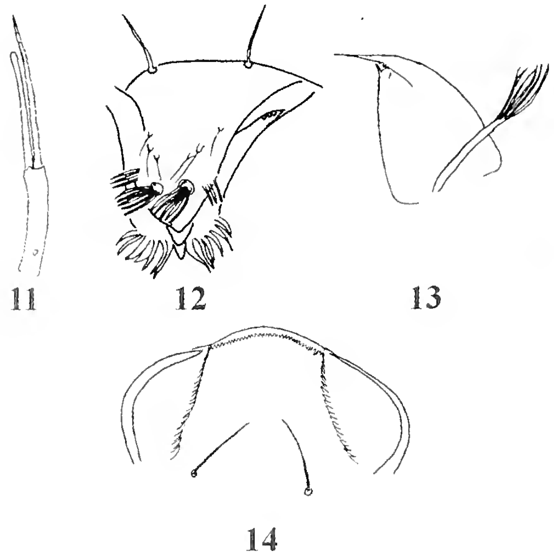
Head capsule length. 264 µm

Antenna. (Fig. 11) 56 µm, AR 1.25; 5-segmented, segment 2 membranous, blade reaching tip of segment 2, Lauterborn organs and style could not be detected.

Labrum. (Fig. 12) SI with 5 branches, remaining S setae simple, labral lamella small and simple, pecten epipharyngis a simple scale, premandible with one apical tooth.

Mandible. (Fig. 13) apical tooth long and needle-like, three small, pointed accessory teeth, basal tooth pointed, seta subdentalis not detectable, seta interna large.

Mentum. (Fig. 14) very characteristic, teeth light and very numerous, lateral teeth fairly large but continuous with a row of very small central teeth, ventromental plates lying lateral to main mentum and contiguous with it, no striations.



Figures 11 - 14. *K. pulchellum* probable larva: 11. antenna: 12. labrum; 13. mandible; 14. mentum.

Maxilla. the maxillary palp is reduced but the lacinal chaetae are well-developed.

Body. Parapods normal, procercus about as long as wide with 6 long setae, claws simple, no body setae, anal tubules short and pointed much shorter than parapod.

SPECIMENS EXAMINED. 3 from Klein Mooi River, 29.13S, 29.53E, 15 iii 1995 (cat. MOI 34M), one from Namibia, side channel alongside Kunene River, sediment on stones. 17.13S, 13.38E, 28 xi 1998 (cat. KUN 146D), collectors F C de Moor and team.

COMMENTS. The structure of the labrum places the larvae with those not belonging to the *Harnischia*-group but the highly aberrant mentum makes it impossible to relate them to any other larva described so far.

It would not be surprising if it turns out to be the larva of *Kribiothauma pulchellum* as this is an aberrant species.

***Pagastiella* sp. A (Figs 15-16)**

MALE (N=1 mounted)

Minute midge originally pinned.

Close to generic definition by Cranston, Pinder, Dillon and Reiss (1989).

Colour. Body uniform dark brown, legs and hypopygium lighter.

Wing length. 0.96 mm

Body length. 1.4 mm.

Head. AR 0.7. Frontal tubercles not apparent. Length of palp segments 22, 22, 47, 62, µm. Two subapical sensilla on segment 3.

Thorax. Antepronotal lobes tapering, dorsally separate, well overreached by scutum, very small scutal tubercle. Setation: Lateral antepronotals nil, dorsocentrals 4, posterior prealars 2, scutellars 1.

Wing. Damaged, costa not extended, anal lobe weak, squama with one long seta.

Legs. foretibia damaged, mid and hind tibia with short separate combs, inner comb only with short straight spur. Legs too twisted to measure LR. No sensilla chaetica on mid and hind tarsomeres. Simple pulvilli present.

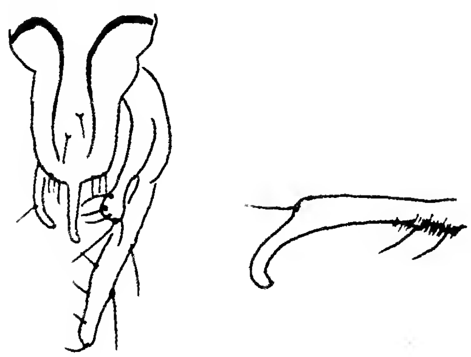
Hypopygium (Figs 15 & 16) anal tergite bands strong, dark and separate enclosing 2 long median anal tergite setae, few apical setae. Anal point distally broadened, apically pointed and downturned. Superior volsella (Fig.16, lateral view) digitiform, downturned, one long distal seta, two basal setae and basal microtrichia. Inferior volsella distally club-shaped with a few curved setae and one straight apieo-ventral seta. Gonostylus long and narrow, apically rounded.

SPECIMEN EXAMINED. 1♂, originally pinned, from Ndumu Game Reserve, KwaZulu-Natal, 26.53S, 32.18E, 19 xi 1959, netted (cat. GEN265Y), collector ADH.

COMMENTS. Fits into the rather broad generic definition and falls into the species group with only inner combs with spurs on the mid and hind tibia and with squamal setae. Its very small size was probably due to the fact it was bred in very warm, subtropical conditions. This one incomplete specimen was insufficient for creating a new species.

ECOLOGY. The region had small shallow ponds and slow-flowing streams. It is situated at low altitude in the sub-tropics.

DISTRIBUTION. Known only from this locality.



15 16

Figures 15 & 16. *Pagastiella sp. A.* Adult male: 15. hypopygium; 16. superior volsella, lateral.

Paralauterborniella nigrohalteralis
(Malloch 1915)

Three male specimens recognised as belonging to this genus were collected from the Wilge River, Free State, one in December 1958 and two in February 1959. They were all mounted on pins but two were mounted on slides in 1995. Eight male specimens were collected from the Kunene River, Namibia, and preserved in alcohol. The genus *Paralauterborniella* has not been found previously on the African continent, nevertheless, this species seems to be indistinguishable from *nigrohalteralis*.

SPECIMENS EXAMINED. 3♂ from the Wilge River, Swinburne, Free State, Vaal River Catchment, 28.20S, 29.16E, netted, 12 ix 1958 (cat. VAL 486H and 526C, H, K), collector ADH. 15♂ from light traps alongside the Kunene River, Namibia from the following sites: Site 9 Oonjana, at a large isolated pool next to river (no flow), 17.00S, 13.25E, 17 xi 1997 (cat. KUN65N.), Site 11, at camp site above Epupa Falls, wide deep slow-flowing water, 17.00S, 13.15E , 18 xi 1997 (cat. KUN74AQ), Site about 800m upstream from Site 11 wide slow-flowing section of river where boat crosses to Angola, 17.00S, 13.15E, 19 xi 1997 (cat. KUN.84K), Hoanib River at communal Ongongo camp site, limestone bedrock in swift current with *Chara,* other algae and leaf detritus 19.08S, 13.49E, 22 xi 1998 (cat. KUN105E, 105J), Ficus campsite Site 6, upstream of rapids along side pools with grassy verge and little or no flow, 17.13S 13.29E, 29 xi 1998 (cat. KUN147F), collectors F C de Moor and team.

COMMENTS. These specimens were very much darker than the "light brown" of Cranston *et al.* (1989), but otherwise fit well into their generic diagnosis. There is nothing to distinguish them from the Holarctic *P. nigrohalteralis* (Malloch) (Cranston, Dillon, Pinder and Reiss 1989, Pinder 1978).

ECOLOGY. According to Cranston, Dillon, Pinder and Reiss (1989) the larvae are found in littoral soft sediments of lakes. These midges could have come from a slow-flowing section of the Wilge River but the river tends to be fast-flowing at Swinburne as it is near it source in the mountains. The Kunene River specimens were caught in light traps alongside the river but, although larval samples were taken, no larvae of this genus were found.

DISTRIBUTION. These are the only records from Africa for this Holarctic species.

Polypedilum (Pentapedilum) chutteri **sp.nov.**

Figs 17-20

All specimens were pinned originally.

ADULT MALE (N = 3 mounted, 5 pinned)

As per generic definition by Cranston, Dillon, Pinder and Reiss (1989)

Body length. 3.5 mm

Wing length. 2.3 mm

Colour. Head, thorax, legs abdomen and hypopygium uniform dark brown, halteres brown, and no rings on abdomen.

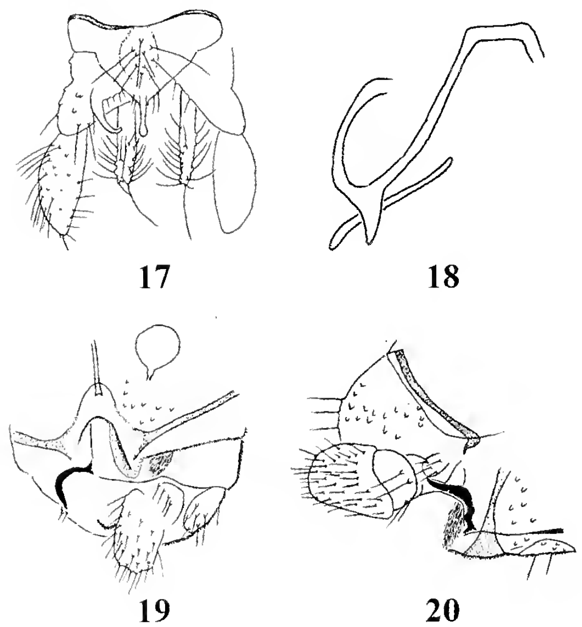
Head. AR 0.7 - 0.73. No frontal tubercles; vertical setae 11. Length of palp segments 45, 45, 123, 105, 132 μm. Two subapical sensilla on segment 3.

Thorax. Setation: lateral antepronotals nil, acrostichals 14, dorsocentrals 26 uniserial, posterior prealars 7, scutellars 6 uniserial.

Wings. No anal lobe; macrotrichia on wing membrane, r_{4+5} over whole cell but reduced to a single row in proximal third, m_{1+2} over whole cell distal to fork but reduced to one row proximally, m_{3+4} over whole distal half but reduced to one row proximally, anal eell with one row alongside anal vein and a row along outer edge. Vein setation: brachiolum 1, R 24, R_1 24, R_{4+5} 16, numerous setae on other veins, squama 6.

Legs. Fore tibia with scale with long spur; mid and hind tibiae with one spur; pulvilli short; LR fore 1.3, mid 0.4 - 0.5, hind 0.6; SV fore 1.9, BV fore 1.4; no sensilla chaetica on tarsi.

Hypopygium (Figs. 17, 18). Anal bands fused basal to median anal tergite setae which are in a well delimited oval area, few small anal tergite setae lateral to anal point which is long with rounded point; superior volsella with 4 basal setae and one on curved digitiform extension; gonostylus broad. Apodemes in Fig. 18.



Figures 17 - 20. *Polypedilum (Pent.) chutteri*. Adult male: 17. hypopygium; 18. apodemes. Adult female: 19. genitalia, ventral; 20. genitalia lateral.

ADULT FEMALE (N = 2 mounted, 2 pinned)

The structure of the genitalia fits in well with Sæther's (1977) definition.

Body length. 3.1 mm.

Wing length. 2.3 mm.

Colour. Similar to male

Head. AR 0.5, 6 flagellomeres ; no frontal tubercles. Length of palp segments 40, 40, 111, 90, 150 μm. No subapical sensilla on segment 3.

Thorax. Setation: lateral antepronotals nil, acrostichals 9, dorsocentrals 26 uniserial, posterior prealars 6, scutellars 6 uniserial

Wings. no anal lobe. Macrotrichia on membrane similar to male. Vein setation: brachiolum 1, R 25, R_1 24, R_{4+5} 32, numerous setae on other veins.

Legs. Scale and spur on fore tibia and other tibial spurs similar to male. LR fore 1.3, mid 0.4, hind 0.6. No sensilla chaetica on tarsi.

Genitalia (Figs 19, 20) Gonocoxite VIII divided into a dorsomesal lobe and small ventrolateral lobe, apodeme lobe not discernible; gonocoxapodemes light in colour, branching onto dorsomesal lobes, the other branches joined anteriorally; coxosternapodemes dark and curved; gonocoxite IX with 4-6 setae; segment X with 4 setae per side; postgenital plate broadly triangular; labia not discernible. Seminal capsules small and spherical; the ducts were destroyed by the NaOH.

SPECIMENS EXAMINED. 8♂ and 4♀ netted by Dr F.M.Chutter near Lindique's Drift, Vaal River, 26.44S, 27.36E, 24 iv 1958 (cat. VAL383AN, AP, AS-AW, AY-BE). Holotype ♂ VAL383AU, paratype ♂ VAL383AV, AY; paratype ♀ VAL383BA.

COMMENTS. The male of this species keys to *Polypedilum (Pentapedilum) wittei* on Freeman's (1958) key but it differs as follows (*wittei* in brackets): colour uniform dark brown (yellowish or reddish with darker thoracic markings and dark bands at the apices of the abdominal segments), AR 0.7-0.73 (2.0), LR fore leg 1.3 (2.0).

ETYMOLOGY . Named in honour of Dr F M Chutter.

ECOLOGY. The collecting site suggests that the larvae would have been living in the river.

DISTRIBUTION. Known only from the collecting site on the Vaal River

Polypedilum (Polypedilum) hastaferum sp. nov.

ADULT MALE (N=3 mounted)

As per generic definition by Cranston, Dillon, Pinder and Reiss (1989)

Body length. 2.1 - 2.6 mm

Wing length. 1.5 mm

Colour. Light brown, vittae dark brown.

Head. AR 0.3. Small frontal tubercles. Length of palp segments: 24, 36, 105, 123, 195 μm. Three subterminal sensilla on segment 3.

Thorax. Setation: lateral antepronotals nil, dorsocentrals 30-32 partly biserial, posterior prealars 8, scutellars 4.

Wings. No anal lobe. Setation: brachiolum 1, R 21, R_1 20, R_{4+5} 50. squama 4.

Legs. Foretibia with scale and small spur, mid and hind tibia with one long spur curved at tip. LR. fore 1.3, mid 0.6, hind tarsi missing. Sensilla chaetica on tarsomere 1, midleg 2, hindleg all tarsi missing.

Hypopygium. (Figs 21, 22). Anal tergite bands long, almost reaching anal point, enclosing anal setae, but not joined, anal point broad, shaped like a broad spear and notched on both sides, superior volsella curved and pointed with 2 setae on base and 1 subapical seta; inferior volsella parallel-sided with strong apical setae; gonostylus narrow.

21 22

Figures 21 & 22. *Polypedilum (Poly.) hastaferum sp. nov.* Adult male: 21. genitalia; 22. apodemes.

Apodemes in Fig. 22 phallapodemes curved and pointed and meeting centrally.

SPECIMENS EXAMINED. 2♂ from Mooi River (KZN) at Retreat Farm from light trap, 29.27S, 29.97E, 01 v 1996 (cat. MOI 54CT), 1♂ Mooi River (North East Cape), Riverside, 31.05S, 18.00E, from light trap 21-22 iii 1991 (cat. ECR 54AA 5). Holotype ♂ MOI 54CW, paratype ♂ MOI 54 CT, collectors F. C. de Moor and team.

COMMENTS. Bjørlo et al. (2000) state that "the subgenus *Tripodura* is characterised by having a trifid anal point or at least shoulders to each side of the anal point and/or a superior volsella without apical extensions"; the trifid appearance is produced by lateral projections on tergite IX. Some *Tripodura* spp., such as the Nearctic *P.(T.) simulans* Townes and *P.(T.) digitifer* Townes, also have notches towards the tip of the anal point. *P. hastaferum* has the notches but not the lateral projections or shoulders so it cannot be placed in the subgenus *Tripodura.*

ETYMOLOGY: from Latin *hasta,* a spear, *fero*, I bear.

ECOLOGY. It appears that, from the collecting sites, the larvae live in rivers.

DISTRIBUTION. Known only from the foothills of the Drakensberg Mountains from the North East Cape to KwaZulu-Natal.

***Skusella freemani* sp. nov. (Figs 23-29)**

ADULT MALE (N=2 mounted)

As per generic definition (Freeman 1961).

Body length. 5.1 mm

Wing length. 2.7 mm

Colour. Head and antennae brown, thoracic stripes, preepisternum and postnotum brown on a lighter background, legs yellowish, all femora with dark brown distal rings, tibiae of fore and mid leg with proximal third markedly darker and dark at tips, tibia of hind leg with proximal third faintly darker and darker at the tip; abdomen: tergite I light brown, tergites II & III light brown with narrow dark stripe anally, tergites IV-VIII light brown but VI-VIII somewhat darker, hypopygium dark brown.

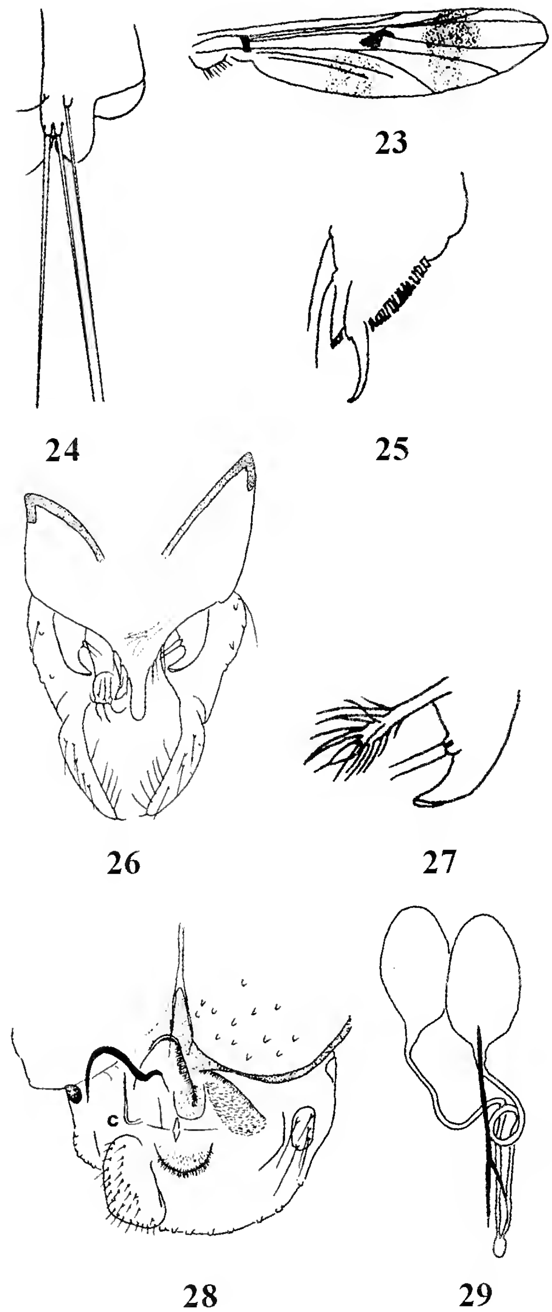
Head. Antenna with 13 flagellomeres. AR 1.5; eyes with parallel-sided dorsal extension separated by width of extension. Length of palp segments 60, 45, 189, 201, 330 µm. No apical sensilla on segment 3.

Thorax. Antepronotum not reaching front of notum. Setation: lateral antepronotals 1, dorsocentrals 11 uniserial, posterior prealars 3, scutellars 6 uniserial.

Wings (Fig. 23). With dark markings, small spot in base of cell r_{4+5} and larger spots in m and cu forming a band, another more distal band from costa through r_{2+3} , r_{4+5}, m_{1+2} and m_{3+4}. Costa not extended. Setation: brachiolum 2, R 26, R_1 25, R_{4+5} 34, squama 10.

Legs (Figs 24, 25). Fore tibia with scale and no spur (Fig. 24), mid and hind tibiae with combs fused, with one spur (Fig. 25), pulvilli small; LR fore 1.8, SV fore 1.4, BV fore 1.8, other tarsi missing.

Hypopygium (Figs 26, 27). Anal tergite bands strong, well separated, ending far from base of anal point; no median anal setae, a few setae on either side of anal point, anal point of holotype rounded at tip (Fig. 26) but more pointed on paratype; superior volsella hooked with 2 setae on broad base, median volsella (Fig. 27) cylindrical with tuft of setae, inferior volsella shorter than



Figures 23 - 29. *Skusella freemani*. Adult male: 23. wing; 24. fore tibia, scale; 25. hind tibia, combs; 26. hypopygium; 27. median volsella. Adult female: 28 genitalia, ventral; 29. seminal capsules and ducts.

anal point, club-shaped with strong curved setae; gonostylus moderately narrow.

ADULT FEMALE (N=1 mounted)

Body length. 4.4 mm

Wing length. 2.6 mm

Colour. Paler than male without darker thoracic stripes, preepisternum, postnotum and legs yellowish with no dark markings.

Head. Six flagellomeres. AR 0.44. Eyes similar to male. Length of palp segments 60, 45, 192, 207, 315 µm. No subterminal sensilla on segment 3.

Thorax. Antepronotum not reaching to front of notum. Setation: lateral antepronotals 1, dorsocentrals 15 uniserial, posterior prealars 3, scutellars 10 unserial.

Wings. Shape and pattern similar to male with spot at base of cell r_{4+5}. Setation: brachiolum 2, R 26, R_1 27, R_{4+5} 52, squama 6.

Legs. Structure of foretibia similar to male; combs and spurs on other tibia similar to male. All tarsi missing.

Genitalia (Figs 28, 29). Gonopophysis VIII divided into dorsomesal lobe, large ventrolateral lobe and small apodeme lobe without setae (Fig 28c); gonocoxapodemes light in colour and appear to be joined; coxosternapodemes dark and bent; gonocoxite IX small with 5 setae; segment X without setae, postgenital plate rounded, cerci small. Seminal capsule (Fig 29) ovoid and colourless with short necks, spermathecal ducts narrow and convoluted with common opening.

SPECIMENS EXAMINED. 1♂ and 1♀ Molopo Oog perennial spring, light trap, 25.53S, 26.01E, 4 xi 1993 (cat. TDW 46K(4) both), and 1♂ Malmani Oog alkaline spring, light trap, 25.49S, 26. 04E, 4 xi 1993 (cat. TDW 61D(2)), Northern Province, South Africa. Holotype ♂ TDW 46K(4), and paratype ♂ TDW61D(2), paratype ♀ TDW.46K(4) . Collectors F.C. de Moor and team.

COMMENTS. Freeman (1961) created *Skusella* for the Australian species *subvittatus* and states: "At first sight, this genus is very similar to *Lauterborniella*, but the absence of anterior tibial spur and the presence of a appendage 2a, combined with the presence of a reduced squamal fringe in the type species (that is only 2 setae) suggests a different genus". Appendage 2a is the median volsella. He also placed the African *Kribiomimus pallidipes* Kieffer into this genus in spite of its bare squamus. *S. freemani* differs from *pallidipes* that has a similar wing pattern, as follows (males): (*pallidipes* in brackets): wing pattern dark (wing pattern light grey), squama with setae (squama bare), femora with dark patterns (femora without markings).

There are three genera of Chironomini with median volsellae found in Africa south of the Sahara: *Paratendipes*, *Skusella* and *Conochironomus* (Cranston and Hare 1995). *Conochironomus* is distinguishable from the other two species by its obvious median tubercle on the scutum. The main differences between the others are (*Skusella* in brackets): foretibia with no scale (with scale) with spur (no spur); mid and hind tibia, both combs with spur (one comb with spur). These three genera differ from *Lauterborniella*, *Stelechomyia* and *Zavrelliella* as the combs on mid and post tibia of the latter three are widely separated and they lack median volsellae. Dr P. A. Cranston, who has worked on species of the genus *Skusella* from Africa and Australia, informs me (personal communication) that this definition of the genus is close to his.

The female of *S. freemani* differs from those of *Paratendipes albimanus* (Meigen) (Sæther 1977) and *P. striatus* Kieffer (Harrison 1996) in that these have a simple gonopophysis VIII.

ETYMOLOGY. This species is named in honour of Dr Paul Freeman who established the genus.

ECOLOGY. All adults were caught in a light trap in the vicinity of permanent alkaline springs or riffles running out of them.

DISTRIBUTION. Known only from the Northern Province, South Africa.

ACKNOWLEDGEMENTS

The author thanks Dr Ferdy de Moor, Curator, Freshwater Invertebrates, Albany Museum, Grahamstown, for access to much of the material described in this paper, and for a continuous supply of slides, coverslips and slide boxes that made the work possible.

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THE RE-EXCAVATION OF SPOEGRIVIER CAVE ON THE WEST COAST OF SOUTH AFRICA

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ABSTRACT

Further excavations at Spoegrivier Cave on the west coast of South Africa in 1994, show that the site was occupied *c.* 3500 BP, again *c.* 2400 BP and between *c.* 1900 and 1300 BP. Most significantly, confirmation has been obtained for the introduction of domestic sheep to the west coast *c.* 1900 BP. While the introduction of sheep was accompanied by an increase in the external diameter of ostrich eggshell beads and a decrease in the volume of faunal remains, the stone tool technology does not support the arrival of a new group of people. Further, there is no conclusive evidence that pottery was introduced together with sheep as a `pastoralist package' around 1900 BP. The debate regarding the migration of pastoralists groups versus the diffusion of pastoralist traits to hunter-gatherer groups cannot be resolved on the basis of the evidence from the site.

Keywords: archaeology, pastoralism, sheep.

INTRODUCTION

The Spoegrivier is a perennial river which flows into the Atlantic Ocean some 30 km south of Hondeklipbaai (Fig. 1). There is a sandbar at the mouth of the river, which is only broached during periods of extreme flooding such as in 1994. The ECRU (Grindley & Heydorn 1981) survey indicated low salinity measurements for the lagoon due to groundwater seepage but salinity measurements have been shown to vary with rainfall and during a large part of the year the water in the lagoon is quite unpalatable. A substantial body of water is maintained in the lagoon even in dry periods, allowing a wide diversity of plant and animal life to be supported. The eave (30°17'S: 17°16'E) itself is located in a granite outerop on the southern banks of the river, some 2 km from the mouth, and overlooks the estuary (Fig. 1). The cave, which measures 12 m by 6 m, faces directly northward into the wind and rain experieneed during the winter months of June to September. Rainfall varies between 25 and 50 mm per annum.

The vegetation in the vicinity of the site is Strandveld Proper (Acocks 1975) or semi-succulent scrub. Very little is known of the fauna of the area, but the ECRU survey (Grindley & Heydorn 1981) recorded Cape Fur Seal, porcupine, steenbok, grey duiker, bat-eared fox, water mongoose, red meerkat and various rodents in the vicinity of the estuary.

Excavations were undertaken at the cave between 7 June and 5 July 1994. The aim of these investigations was to collect a larger sample of sheep bones from the

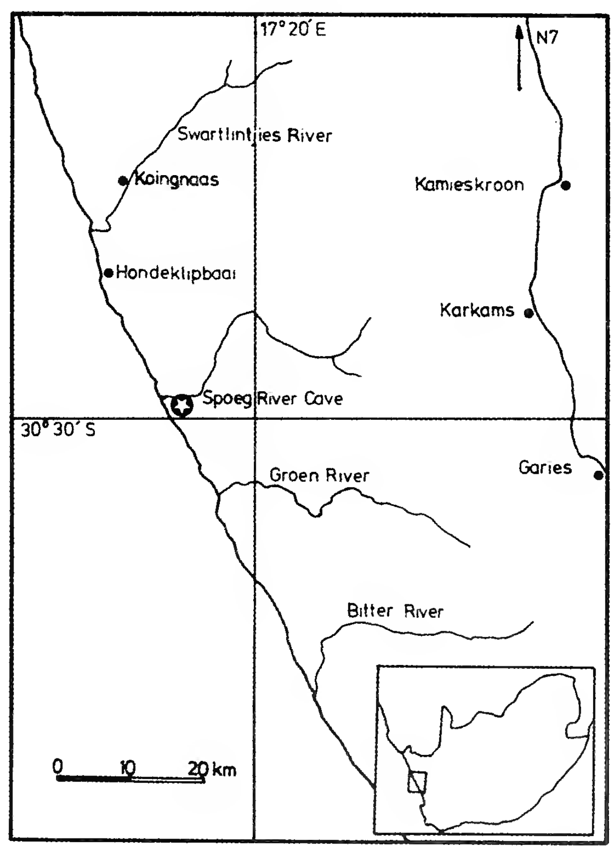

Figure 1. Location of Spoegrivier Cave at the mouth of the Spoegrivier, Namaqualand, Northern Cape.

lower units in order to substantiate the very early accelerator radiocarbon date (2105±65 BP) obtained for a single sheep phalange (Sealy & Yates 1994) recovered during the 1987 excavations (Webley 1992).

EXCAVATIONS

A total of 6 square metres (squares C4 - C6 and D4 - D6) was excavated (Fig. 2) close to the original 1987 excavations (squares B8, C9 and a small shellfish sample column from D9) but slightly more to the front (Webley 1992). Although some 4 weeks was spent in the field, we were unable to excavate D6 and D4 to bedrock. Nevertheless, the new excavation produced some interesting new results and suggested a considerably more complex stratigraphic sequence than originally suspected. Excavations proceeded stratigraphically and thin occupation lenses were combined into Layers, back at the museum, for ease of comparison (Table 1). Bulk samples were collected of the plant rich lenses in order that some quantification could be undertaken of the various plant species. Two columns (measuring 20 cm by 50 cm wide) were removed from squares B5 and E5, sieved, and removed in bulk to the museum for shell species analysis. A standard 3,5 mm sieve mesh was used and sorting took place on site. Microfauna was initially collected from all squares and stratigraphic lenses, but this procedure proved too time consuming on site and it was decided that the material from the bulk samples would be sufficient. After the preliminary analysis was completed, the faunal remains were sent to Dr I Plug (previously of the Northern Flagship Museums) for identification. Detailed analysis of the fauna will be presented as a separate paper.

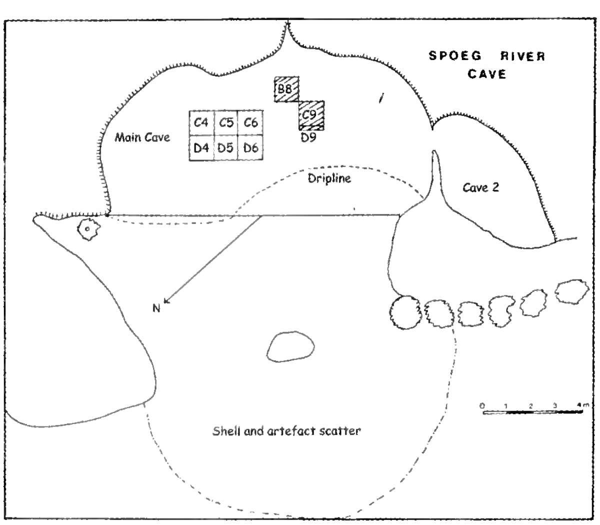

Figure 2. Site plan of the excavations with the hatched areas indicating the 1987 excavations.

STRATIGRAPHY

The surface lenses are not included in the discussion below because the cave is often used by overnight campers and the surface lenses have been badly disturbed. A total of six Layers containing pottery was identified. These layers contain the stratigraphic lenses referred to as Twiggy 1-6 because they are very rich in plant remains, most particularly grasses and reeds (Table 1). These vegetation-rich lenses tend to slope down to the back of the cave. Thin lenses of brown soil and numerous hearths inter-digitate within the Twiggy lenses (Fig. 3).

POTTERY LAYERS

Layer 1: This comprises Twiggy and Twiggy 2 lenses which appear to represent bedding hollows. CDT (compacted dung and twigs) was only found in the C squares. There are a number of small hearths which have been numbered consecutively. Only Hearth 1 is of any significant size.

Layer 2: This consists predominantly of Twiggy 3 as well as BS (brown soil) and a number of small hearths and ash features. CBS refers to compacted brown soil (Fig. 4) and CA to cream ash. The compacted shell lenses (SL) occur in the front squares, namely D4, D5 and D6 (Fig. 5). The dense shell layer in D6 lies partially on the drip-line and this explains its dark colour and its density - the fine soil seems to have been washed out. The centre of square D5 contained a circular area of soft soil which later turned out to be a recent pit probably excavated by poachers as it contained a complete steenbok skeleton and some beer caps. It extended down some 30 cm. This second layer contained a number of wooden 'pegs' many standing upright in the deposit.

Layer 3: This consists mainly of Twiggy 4 as well as its equivalent under Hearth 1, namely CT (carbonised twiggy) (Fig. 4). A fine soil lens seems to separate Twiggy 4 from Twiggy 5. The brown soil parting is called BS2, there are several hearths, while the shell lenses continue in the front squares.

Layer 4: Twiggy 5 occurs in a narrow band in C6 but then broadens into C5, C4 and D4 (Fig. 3). Twiggy 5 was divided into a number of subdivisions, such as 5 and 5a in Layer 4, since they are fairly thin and divided from each other by fine sand partings. Equivalent to Twiggy 5 are CST (crushed shell and twigs), TCS (twiggy with crushed shell) and CSL (crayfish and shell lens) (Fig. 5). They contain less plant material and more shell and crayfish. Furthermore, a complete grooved stone and two associated upper grindstones were recovered from

Table 1. The grouping of stratigraphic lenses into layers to facilitate analysis. H refers to Hearths and AF to Ash Features. Vol. refers to buckets of deposit.

Layer	D4	D5	D6	C4	C5	C6	Vol
1	Hearth 1	Hearth 2	Hearth 2	Twiggy	Twiggy 1 & 2	Twiggy 2	32
	Twiggy 2	Hearth 3	Hearth 3	Twiggy 2	CDT	CDT	
	Grey Ash			Grey Ash	Grey Ash, H3	H2 & H3	
2	Twiggy 3	Twiggy 3	BS, H5	Twiggy 3	Twiggy 3	Twiggy 3	56
	BS, H4	BS, H5, CA	Shell Lense	BS, H4,	H4, BS,	BS, AF2, H5, SL,	
	AF, CA, CBS	BST,		CBS, AF	H5, AF	Ashy Crust	
		Shell Lense					
3	Twiggy 4	Twiggy 4	Twiggy 4	Twiggy 4	Twiggy 4	Twiggy 4	53
	CT, BS2	BS2, H6	S Lense2,		CT, H6	H7	
			BS2, H6		AF3, H7, H9		
4	Twiggy 5a	Twiggy 5	CST	Twiggy 5a	Twiggy 5a	CSL, CST	56
	H16, H18	CST, H13		H16	CST CAT	Twiggy 5a	
					H12, H15 H10	H8, H14, H10	
5	Twig 5b& c	Twiggy 5c	Twiggy 5c	Twiggy 5b	Twiggy 5c	Twiggy 5c	61
	SL2 & 3	SL2 & 3	SL3	Twiggy 5c	H19	SL2	
	H17	Ash lense		H17		H19	
6 a	H21			H20 H21 H22	H20	Twig 5 d	30,3
				Twig 5 c L	Twig 5 c L	MH	
				Twig 5 d	Twig 5 d		
				GP			
6 b				Twig 5 e &	Twig 6	Twig 6	23,3
				base		H23	
				Twig 6			
				AF 6 H23			
7	YBS, GAS	YBS, GAS	YBS, GAS	YBS, GBS	YBS, GAS	YBS, GAS	85
				GAS H24			
8	LGAS	SL4	LGAS, SL4			LGAS	38
	H24	LGAS	DGAS, AF4				
9	SGAS, H25	SGAS, AF5		SGAS, H28	SGAS, AF8	SGAS	61
	GAS 2	GAS 2		GAS 2, AF7	GAS2, H28	GAS2	
				SGAS2, AF8, H25	SGAS2		
10	GAS3	GAS3		GAS3, H27	GAS3, H27	GAS3	60
				BVS, SAS	BVS, H26	MOS	
					MOS, SAS, AF10	AF10	
11		SAS2, BSS		H29 SVL, H30	SAS2, SVL	SAS2, H35	80
				SAS3, H31	BSA, BSS FDS	BSS=DAS	
				H32	SAS3, DAS	AF11, FDS	
						BSAS	
12		BSB BSB2	LGAS2		H34 ext	LGAS2	16
		LGAS2			LGAS2	H34 ext	
13		BSB3, LGAS3			LGAS4	LGAS4	31
		LGAS4			H34, MA, SB	H34	
14		BS b H34			BS bel H34	BS bel H34	26
		BSB4 & 5			BSB4	BSB4	
15		HCS1&2		AF9	WA1 & 2	HCS 1&2	26
		CA WA H33		H33	CA H33	CA WA	
16		DGS & pit		GMS MBS	MGS GMS	MGS, WA2	45
		WA2		MDBS FBS	MDBS	OGS	

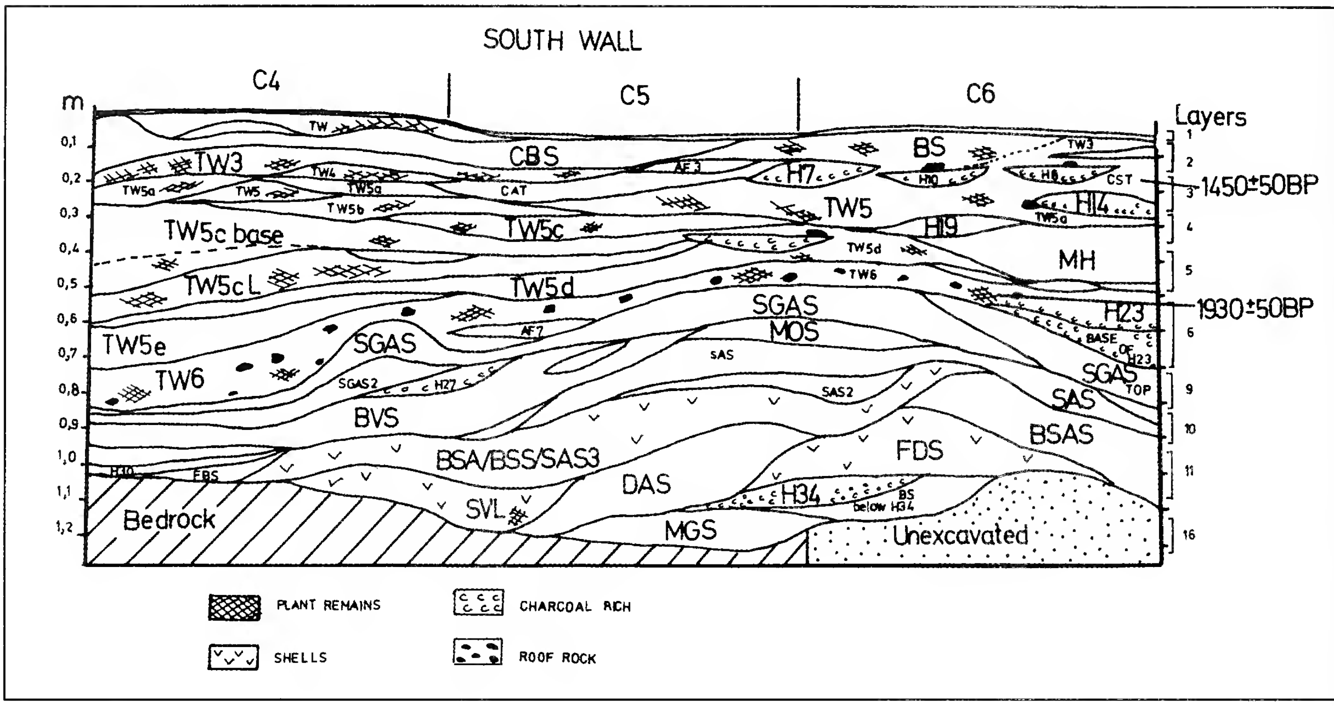

Figure 3. Section drawings of the south wall of C4-C5-C6. Note that the scale for these sections are different from Figs. 4-7.

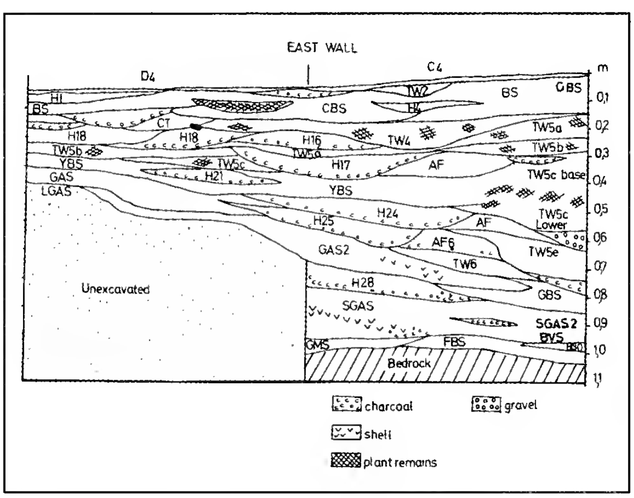

Figure 4. Section drawings of the east wall of D4-C4.

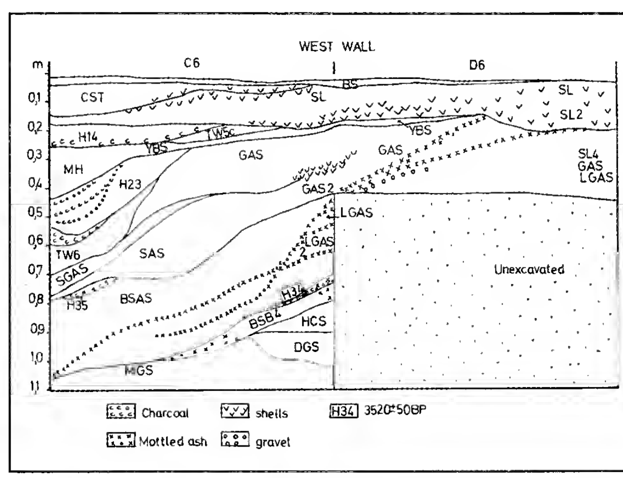

Figure 5. Section drawings of the west wall of D6-C6.

this lens. The CST lens was dated to 1450±50 BP (Pta-6750). CST immediately overlies a yellow brown soil with fine decomposed plant remains called YBS (yellow brown soil) to the front of squares C5 and C6.

Layer 5: Consists of Twiggy 5b and 5c while the front of the D squares contains shell lenses 2 and 3 (Figs. 3 & 4). Twiggy 5c is of variable thickness and in C5 dips down steeply to Twiggy 5c base. These lenses occur only in the C squares and dip down considerably to the back of the cave (Figs. 3 & 5). The slope is such that it seems unlikely that people could have lived at such an angle.

Layer 6a: Layer 6 has been divided into Layer 6a and Layer 6b for purposes of analysis because of the possibility that Layer 6a is more closely associated with Layer 5. Twiggy 5c Lower is very hard, consisting of compacted sticks and appears almost sterile - it may be a period of non-occupation. Twiggy 5d, which is mainly concentrated in the C4 square however, is full of bone and crayfish. Equivalent to Twiggy 5d is MH (microfauna hollow) which is concentrated in C6 (Fig. 3). It is situated beneath the roosting patch of the cave and relates to a period of non-occupation. This layer also contains gravel patch (GP), a thick gravel parting some 15 cm thick It is suggested elsewhere, that the cave may have been abandoned at this period.

Layer 6b: The lower lenses in Layer 6, comprising Layer 6b, appear Square C4 contains Twiggy 5e and Twiggy 5e base (Fig. 3). The bone from Twiggy 5e is encrusted with salt crystals. Finally, the last lens of this layer, Twiggy 6, lies along a narrow margin along the back of the C squares and clearly extends to the baek of the cave. It is a loose ashy soil with crayfish earapace and fragments of roof spalls. It has been dated to 1930±50 BP (Pta-6749). Twiggy 6 is the last of the pottery units. Isolated potsherds still occur in YBS but these, as well as the sheep bones (dated by accelerator radiocarbon methods) are probably intrusive as is discussed elsewhere.

PRE-POTTERY LAYERS

The pottery Layers in squares C4-C5-C6 (described above) were substantial and seemed to thin out to the front of the site (that in squares D4-D5-D6). The front squares contained substantial pre-pottery Layers dating to between 2400 BP and 3500 BP but probably also pre-dating 3500 BP. Excavations to the front of the cave revealed stratigraphie layers not identified during the 1987 exeavations.

A total of 10 pre-pottery Layers have been identified. Those immediately below the pottery layers are very ashy and contain little plant materials. Most significant was a single large hearth in Layer 13 covering four square metres which was dated to 3520±50 BP (Pta-6754). Layers 14-16 contain weathered ash units with poor bone preservation suggesting an earlier (wetter?) phase.

Layer 7: YBS (yellow brown soil) contains microfauna and fragmented roof spalls (Figs. 4 & 5) and this suggests a period of non-occupation which links with some of the Twiggy 5c Lower lenses in Layer 6a. The pottery and sheep bones in this unit appear to be intrusive from the upper layers. YBS overlies GAS (grey ash and shell) which is a fine grey ash soil with fragmented shell. GAS is denser and contains more shells to the front of the site where it merges with shell lens 4 (SL4) and becomes more ashy in the C squares (Figs. 4, 5 & 6). Because of its thickness it was removed in spits of 5 cm. Both GAS and SL4 contain many large land snails. GBS (gritty brown with shell) which only occurs in C4 under Twiggy 5 e base, is very hard, with roof spalls and salt crystals on the bones (Fig. 4). This suggests that part of Layer 7 may belong to Layer 6.

Layer 8: Shell lens 4 was removed as Layer 8 although it merges with GAS (Figs. 5 & 6). It is a loose, mottled brown soil with concentrations of limpet,

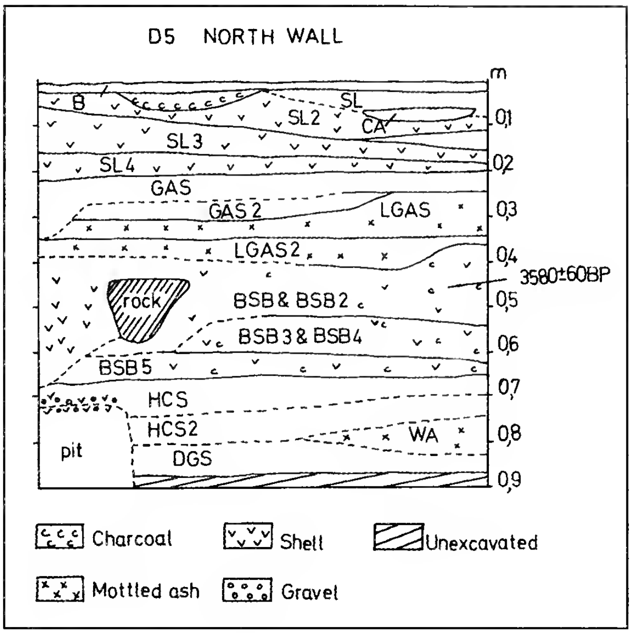

Figure 6. Section drawings of the north wall of D5.

microfauna and bone. SL4 and GAS overlie DGAS (dark grey ashy shell) in D6. This square, which lies within the dripline, is dark in colour, with little soil matrix and contains large shells. Merging with DGAS and extending into D5, D4 and C6 is LGAS (lower GAS). It is lighter in colour (yellow-brown), more gravelly, contains lots of bone and speckles of white ash. Its position, to the front of the excavation, and much higher although older, than lenses to the back, means that its exact position with relation to other units could not be exactly determined (Figs. 5 & 6). It slopes down dramatically from D5 to C5 and even seems to overlie Hearth 34 (Layer 13) in places.

Layer 9: GAS overlies SGAS (soft grey ashy shell) toward the back of the C squares (Figs. 3 & 5). It is light brown in colour, very soft and very ashy with fragmented shell. GAS 2 continues in this layer. SGAS 2 consists of only two buckets and is very similar to SGAS. In the northeast corner of square C4 is Hearth 28 (Fig. 4).

Layer 10: GAS 2 is separated from GAS 3 by a very thin soil parting. . GAS 3 is very soft with fragmented vegetation remains. MOS (Fig. 3) relates to a mottled orange soil which is very thin (1-2 em) and peels off onto a soft grey surface called SAS or soft ashy soil (Figs. 4 & 5). This latter unit contains large shells and seem to merge into GAS3. A grooved stone, coated in red ochre, was found in SAS in square C6 at a depth of 60 cm. BVS or brown vegetated soil (Figs. 3 & 4) also seems to relate to GAS 3 and slopes down from west to east. BVS is a vegetated soft ashy soil and contains pockets of bone and large limpets.

Layer 11: SAS 2 is a densely packed lens of roof rock (some as large as 10 by 20 cm) and an increasing number of shell (Fig. 5). SAS 3 is a soft ashy brown soil with large limpets, bone and pockets of vegetation. The SVL (soft vegetated lens) underlies SAS 3. BSS (brown soil and shell) and BSA (brown soil and ash) refer to the same lens. BSS/BSA seem to overlie DAS (dark ashy soil) (Fig. 3). Below SAS is square C6 is BSAS, an undifferentiated brown soil (Fig. 3). It overlies a fine dark brown soil, with patches of shell, bone and crayfish called FDS (fine dark soil). It is probably related to the FBS (fine brown soil) lens in square C4 which is wedged between Hearth 30 and bedrock (Fig. 4). Under FDS is a small ashy feature called AF11.

Layer 12: LGAS 2 overlies BSB in D5 (Fig. 6) although in other squares they appear to interleave. LGAS 2 wedges in underneath both BSAS and FDS in square C6 (Fig. 5). BSB (brown soil and bone) consists of a pale brown soil containing many steenbok mandibles. BSB and BSB2 were excavated in spits as there was no natural break in the deposit (Fig. 6). BSB 2 has been dated to 3580±60 BP (Pta-6987).

Layer 13: The SB (shell and bone) lens which was found on the edge of C5, was subsequently named MA (mottled ash) but then it became apparent that it formed the edge of LGAS 4. It has several large quartzite stones located in square D5 which may have been hearth stones although they did not form a circle. LGAS 4 eventually merged into Hearth 34 which extended over most of D5, D6, C6 and part of C5. It consisted of crushed, burnt mussel shell, stone artefacts and bone. The soil was very mottled, with creamy ash merging into a green colour. The base of this hearth consisted of a thick charcoal lens. It also contained patches of yellow and white beach soil. This hearth was dated to 3520±50 BP (Pta-6754).

Layer 14: BSB 4 formed an extensive lens beneath H34 in D5 and was also in C5 (Figs. 5 & 6). BS below Hearth 34 is a black soil with white mottled ash which may be the underburn of H34 or another hearth (Fig. 3). BSB 5 consisted of only 3 buckets of deposit and is not visible in the section drawings except for Figure 6.

Layer 15: Below BSB 5 is a speckled white ash complex (WA) whieh becomes quite hard and complex (Figs. 6). This WA merges with H33 and a lens of CA (camel ash). They overlie HCS (hard crusted shell) which had to be broken out in large lumps - it is a brown soil with fragmented mussel, ash and charcoal (Figs. 5 & 6). HCS 2 is a darker grey ash with fragmented shell. Both these units appear very damp.

Layer 16: The back squares such as C4 do not have the intervening LGAS and BSB units recovered in the front and SAS 3 (whieh is in Layer 11) overlies a thin ashy lens (AF9 in Layer 15) and a lens of mottled dark brown soil (MDBS) in Layer 16. On removing the latter, the soil is a mottled blend of grey, yellow, orange and dark brown with white ash specks - this basal unit in C4 was termed gritty mottled soil (GMS) because of fragments of decomposing bedrock (Fig. 4). In square D5, HCS 2 overlies DGS (a dark grey soil) containing charcoal and fragmented bone (Figs. 5, 6). This square has a large pit which was found to contain a long bone awl (Fig. 6). DGS is replaced by WA2 and lenses of GMS (gritty mottled ash) and MDBS (mottled dark brown soil) were also recovered in D5. There is another basal lens in C6 called OGS (orange gritty soil) which was only partially removed.

In summary, the slope of the various stratigraphic lenses (SL, LGAS and BSB) confirm that the early ceramic-using inhabitants of the site appear to have removed older deposits from the back area to create a living space, possible depositing these remains on the talus slope.

DATING

A total number of eight radiocarbon and six accelerator radiocarbon dates have been obtained for the site. This includes the three radiocarbon dates obtained during the 1987 excavations (Webley 1992), and the one accelerator date on a sheep phalange from the same excavation (Sealy and Yates 1994).

RADIOCARBON DATING

The radiocarbon dates for the 1994 excavation are presented below:

1. 1450±50 BP (Pta-6750) Charcoal from Square C6 Lens CST at a depth of 12-15 cm, associated with a grooved stone, upper grindstones, pottery and informal stone tools.
2. 1930±50 BP (Pta-6749) Charcoal from Square C6, Lens Twiggy 6, at a depth of 40-50 cm, associated with the last of the bedding, as well as pottery and

sheep.

3. 2400±25 BP (Pta-7200) Charcoal from Square C6 Lens SAS, at a depth of 60-67 cm, in association with a large grooved stone coated in red ochre.
4. 3520±50 BP (Pta-6754) Charcoal from Square D5, Hearth 34, at a depth of 60-100 cm, associated with tortoise and steenbok remains and formal stone tools.
5. 3580±60 BP (Pta-6987) Charcoal from Square D5 in Lens BSB2, at a depth of 50 cm, associated with steenbuck remains, scrapers and segments.

The radiocarbon dating on associated charcoals indicates that the 1994 excavations have identified older deposits not recovered during the 1987 fieldwork. Further, the isolated sheep remains recovered from the pre-1900 BP deposits suggested initially that sheep could possibly pre-date pottery at the site (Vogel *et al.* 1997). Four sheep fragments were recovered from a deposit dated to 2400 BP. This discovery, as well as the earlier accelerator radiocarbon date of 2100 BP on a sheep phalange, showed the necessity of undertaking further accelerator radiocarbon dating on sheep remains from the site. Funding was obtained and five sheep bones were submitted to the Groningen Laboratory in the Netherlands for accelerator dating.

ACCELERATOR RADIOCARBON DATING

1. 1260±50 BP (GrA-9027) sheep bone from Square C5 Lens YBS (Layer 7). The calibrated date is 769(798)883 AD.
2. 1490±50 BP (GrA-9030) sheep bone from Square D6 Lens YBS (Layer 7). The calibrated date is 588(628)652 AD.
3. 1890±50 BP (GrA-9029) sheep bone from Square C4 Lens GAS 2 (Layer 9). The calibrated date is 111(160)238 AD.
4. 1900±50 BP (GrA-9032) sheep bone from Square C6 Lens GAS 2 (Layer 9). The calibrated date is 100(144)233 AD.
5. 1900±50 BP (GrA-9028) sheep bone from Square C6 Lens SAS (Layer 10). The calibrated date is 100(144)233 AD.

The two dates above of 1260BP and 1490BP from YBS (Layer 7) are very late and do not match with the radiocarbon date of 1930 BP for Layer 6b. In the discussion on the stratigraphy, mention was made of the fact that YBS immediately underlies Twiggy 5b and 5c as well as SL (Figs. 4 & 5), suggesting that there may have been a movement of sheep bones from Layer 5 to Layer 7.

The accelerator radioearbon dates of 1890 and 1900 BP for Layers 9 and 10 more closely match the radiocarbon date of 1930 BP for Layer 6b and are within two standard deviations of the accelerator date of 2100 from Oxford (P. Pettitt, Oxford Radiocarbon Accelerator Unit, pers comm.). Sheep bones from Layer 6 seem to have moved down to Layers 9 and 10.

According to Pettitt (pers. comm.) the differences between the Oxford and Groningen Accelerator dates "should not arise through measurement as both laboratories participate in the TIRI lab inter-comparisons". They have measured over 150 known age samples in the past year and have found the average error between the two laboratories to be less than 10 years.

LINKING THE 1987 & 1994 EXCAVATIONS

In order to link the stratigraphy of the first excavation (1987) with the later one (1994) we need to remember that the initial excavations were located further back (i.e. squares B and C) while the 1994 excavations sampled squares C and D. The excavation walls for the C squares were deliberately **not** aligned as this would have meant excavating without a section wall (Fig. 2). However, this meant that it was difficult to link specific stratigraphic lenses. This is in addition to the usual problems posed by excavating shell lenses which seem to merge and then disappear without a trace. The radiocarbon dates indicate that the 1994 excavations sampled units not recovered in the initial excavations.

The 1994 excavations suggest that a re-interpretation of the earlier (1987) excavations needs to be undertaken. In the 1987 excavations, three phases of occupation were distinguished (Webley 1992). The basal Phase 1 included units FBS, Shelly Patch and Brown. Hearth 12, which is located above FBS and Shelly Patch (and perhaps associated or even above Brown) has a radioearbon date of 1920±40 BP (Pta-4745), while a single sheep phalange from FBS has an accelerator radiocarbon date of 2105±65 BP (OxA-3862). Phase 2 is represented by units Ashly Brown, Shelly Brown, Ashy Soil and Patella. Well preserved crayfish mantle from Patella produced a radiocarbon date of 2020±60BP (Pta-6334); however, when 400 years is subtracted as a correction for the marine reservoir affect, then the actual date is 1620 BP for purposes of comparison with dates on charcoal. Phase 3 includes units Coprolite, Brown Soil, Twiggy, Unit 1 and Surface. Hearth 3 in Twiggy was radiocarbon dated to 1390±50 BP (Pta-4753).

The dates for Phases 2 & 3 (1987 excavations) appear to match the radiocarbon date of 1450 BP for CST (Layer 4) as well as the accelerator radiocarbon dates on sheep bones from YBS (Layer 7) of 1260 BP and 1490 BP. YBS lies beneath Twiggy 5b, Twiggy 5c and SL and the sheep remains are likely to have been introduced from these units. The 1987 excavations uncovered a substantial lens of hyaena coprolite and twigs (suggesting a lair) below Twiggy and above Patella in square B8. Furthermore, a patch of gravel and a dense lens of microfauna supported the view that the site had been abandoned for a period between 1400 BP and 1900 BP. Although the Coprolite lens (1987 excavations) was not found further to the front in the 1994 excavations, scattered coprolites and thick twigs in Twiggy 5e as well as gravel patches (GP) and microfauna (MH) confirm a period of non-occupation between Twiggy 5e and Twiggy 6 (which is the base of the pottery levels). Further, many of the stones and bones from the Twiggy 5e and Twiggy 6 lens were covered in thick salt crystals. This may well signal a change in climatic conditions at this period such as, for example, increased precipitation (see observations on climate).

Initially (Webley 1992) it was thought that all three Phases dated to the last 2000 years. However, other indicators such as the percentage of mussels versus limpets, the stone tool numbers, the frequency of formal stone tools and the diameter of ostrich eggshell beads suggest that Phase 1 pre-dates 1900 BP and that the isolated potsherds and fragmentary sheep remains are probably intrusive. Phases 2 and 3 date to around 1400/1600 BP. If one compares this to the 1994 excavation results, then clearly both excavations uncovered so-called Twiggy or `bedding' patches with a range of dates around 1400 BP and 1900 BP. It is difficult to isolate and cross-correlate clearly defined layers as patches of bedding are wedged between thin soil layers and large hearths. However, these top 50 cm form a coherent horizon quite different from the lower ashy and shell-rich layers. The lower half of the 1987 stratigraphic sequence (particularly in square C9) comprised a series of ashy soils and brown shelly lenses (Webley 1992). Lenses such as Brown, Shelly Patch and FBS may well relate to Layers 7 to 11/12 in the 1994 excavations (i.e. to lenses GAS, SGAS, SAS, BSS, BSAS etc.). A radiocarbon date of 2400±25 BP (Pta-7200) was obtained from SAS (Layer 10). The accelerator radiocarbon dates on two sheep bones from GAS2 (Layer 9) and SAS (Layer 10) date to 1890 BP and 1900 BP. The section wall of C6-D6 (Fig. 5) shows the steep angle at which Twiggy 6 is lying; it appears to truncate GAS and this may well be an explanation for the sheep bones found in Layers 7-10 More discussion on these sheep bones in the pre-ceramic Layers will follow later.

The lower layers in the 1994 excavations (i.e. Layers 13-16) which were not recovered in the 1987 excavations, relate to the occupation of the site ca. 3500 BP. Further dating will be required to determine whether there was a hiatus between 2400 BP and 3500 BP or whether the site saw intermittent occupation throughout this period. The basal layers (15 & 16) are as yet undated, but may date to the early Holocene. Some particularly large scrapers were recovered from these lower leached ash units which may well relate to the Albany period. This would tie in which excavations at Wolfkraal (Webley 1984).

STONE ARTEFACTS

According to the lithic artefact inventory for the pottery layers (Table 2), formal tool percentages vary between 0,8% and 3,7%. There is a slightly higher pereentage of formal tools in Layers 5 and 6. Interestingly, these percentages are also higher than for the underlying pre-pottery layers. There are no formal, retouched scrapers in the pottery layers with the exception of a single example from Hearth 23 (Fig. 7), which is at the base of the pottery-bearing layers and may have intruded from below. The pottery from Layer 7 and sheep down to Layer 10 does indicate a certain degree of vertical displacement.

The most common formal tool type is backed flakes (Fig.7). Miscellaneous retouch pieces occur less frequently while only a single segment and two adzes were recovered. Adzes are surprisingly rare in view of the wooden artefacts and the clear evidence for the manufacture of wooden items on site in the form of wood shavings suggests tools other than standard adzes were being used.

The absence of formally retouched scrapers would seem to be related to the single *//khom* stone which was recovered from the bulk shell sample (B5 Twiggy 4 or Layer 3). This particular stone is of the same size and shape as contemporary ethnographic `scrapers' from rural areas in Namaqualand (Webley 1990: figure 2) and one surface is coated in fat and hair (Fig. 8). The significance of this find is that it clearly suggests that these *//khom* stones were also used in pre-colonial times (in this case some 1300 years ago). If herder groups were using *//khom* stones at this period then this would explain the absence of formally retouched scrapers at the site.

With regard to the utilized stone artefact category, a single grooved stone and two upper grindstones were found in association in C6 CST (Layer 4). The grooved stone is of granite and its dimensions are 300 mm by 180 mm. The groove itself measures 190 mm by 40 mm. The striations are clearly visible in the groove and a faint smear of ochre can still be discerned (Fig. 9). The associated two upper grindstones are of quartzite, one has two grinding surfaces and evidence of hammer-stone damage while the other is broken and also has two grinding surfaces. In addition, a number of fragments of broken grooved stones (Fig. 7) and grinding stone (mainly of quartzite and granite) were also recovered (Table 2). They suggest that the

Table 2. Lithic artefact inventory for the pottery layers (# 1 complete grooved stone).

	L1	L2	L3	L4	L5	L6a	L6b
Chips	58	89	60	22	44	46	
Chunks	18	21	25	19	29	14	10
Flakes	59	75	77	40	93	47	54
Cores	33	41	41	28	34	34	29
Bladelets	-	-	-	-	-	1	-
Pesquillees	-	-	-	-	1	1	-
Lithic manuports	1	6	16	9	25	3	2
Subtotal-Waste	169	232	219	118	226	146	112
Utilised flakes	1	2	-	1	6	3	-
UG fragments	1*	3	4	4	-	1	-
Groovedstone frags	-	1	1	1#	-	-	-
Hammerstone	-	-	1	-	-	-	-
Subtotal Utlised	2	6	6	6	6	4	-
Scrapers	-	-	-	-	-	-	1
Segments	-	-	-	-	1	-	-
Adzes	-	1	-	-	1	-	-
Backed flakes	2	4	2	1	3	3	1
Backed points	-	-	-	-	1	-	-
Borer	-	-	-	-	-	-	-
MRP	-	1	-	-	3	1	2
Subtotal Formal	2	6	2	1	9	4	4
Total	173	244	227	125	241	154	116

grinding of ochre and specularite, and perhaps other, as yet unidentified substances, was taking place on site.

With regard to the raw material composition of the pottery layers (Table 3), the majority of artefacts are made on quartz (roughly 80%) and formal tools are also most frequently manufactured on this material. Quartzite was generally used for grindstone implements and varies around 10%. Silcrete and chalcedony artefacts are not common. Specularite only occurs in small quantities and only in the pottery layers while ochre is very rare. Layer 5 contained pieces of red ochre but these are not lumps of raw ochre. They have been processed and appear to contain a fine, friable white ash (i.e. Layer 5 or C4 Twiggy 5c contained 2 red

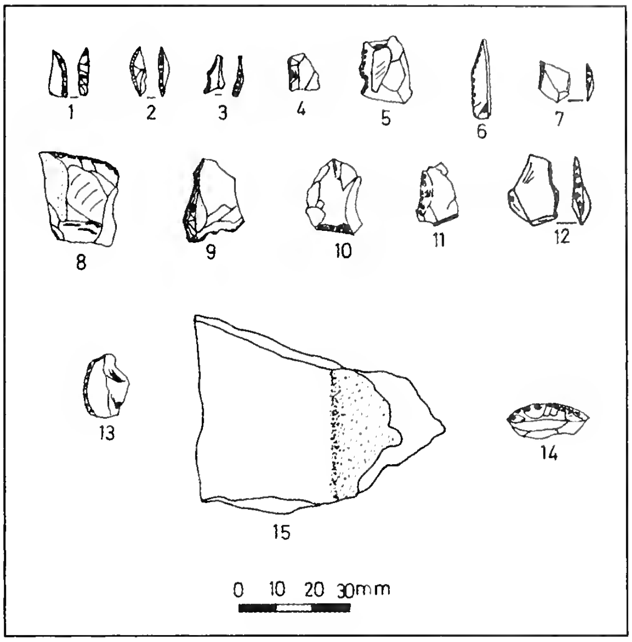

Figure 7. Lithic artefacts from the pottery layers: 1 - D5 BS, 2 - C4 BS, 3 - C4 Twiggy 3 (1-3 are quartz backed flakes), 4 - D4 Twiggy 5c, 5 - D5 SL3, 6 - C4 Twiggy 5c (4-6 are quartz miscellaneous retouch pieces), 7 - C4 Twiggy 5e (chalcedony heavily utilized piece), 8 - C5 Twiggy 5c, 9 - D6 SL (8 & 9 are chalcedony adzes), 10 - C4 Twiggy 5e (chalcedony broken flakes), 11 - C4 Twiggy 5e (quartz miscellaneous retouch piece), 12 - C5 Twiggy 5d (quartz backed flake), 13 - C6 Twiggy 6 (quartz miscellaneous retouch piece), 14 - C6 H23 base (silcrete scraper), 15 - C4 Twiggy 3 (broken granite grooved piece).

Figure 8. Photograph of the //khom stone from Layer 3 (B5 Twiggy 4) on the right, and the ethnographic example on the left.

Figure 9. Photograph of the grooved stone from Layer 4 (C6 CST).

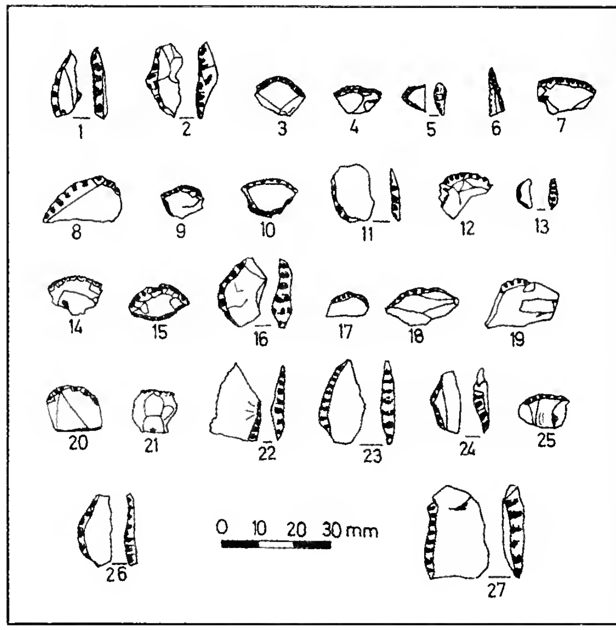

Figure 10. Lithic artefacts from the pre-pottery lithic layers: 1 - D4 GAS (silcrete backed point), 2 - D5 YBS (chalcedony segment), 3 & 4 - D6 GAS (chalcedony scraper), 5 - D6 GAS (quartz segment), 6 - D4 YBS (chalcedony drill), 7 - C6 GAS (quartz scraper), 8 - D5 SL4 (chalcedony scraper), 9 & 10 - D5 LGAS (9 is a silcrete scraper, 10 is a chalcedony backed scraper), 11 - D6 LGAS (quartz backed flake), 12 - C5 GAS 2 (chalcedony scraper), 13 - C4 GAS 2 (quartz segment), 14 - 16 are D4 GAS2 (14 is a chalcedony scraper, 15 is a silcrete backed scraper and 16 is a quartz segment), 17 & 18 are chalcedony scrapers (17 is from C4 BVS, 18 from C5 SAS), 19 - C5 BSS (quartz miscellaneous retouch piece), 20 - 22 are from D 6 LGAS2 (20 is a chalcedony scraper, 21 is a quartz scraper and 22 is a chalcedony backed flake), 23 - C6 LGAS2 (quartz backed flake), 24 - D5 LGAS3 (chalcedony segment), 25 - C6 H34 (silcrete scraper), 26 & 27 are from D5 H34 (26 is a chalcedony segment, 27 a quartz miscellaneous retouch piece).

ochre lumps which appear to contain white ash). This is similar to examples from Jakkalsberg in the Richtersveld (Webley 1997)

There is a greater density of lithic artefacts in the pre-pottery layers (Table 4), but formal tool percentages do not exceed 2,9% of the total assemblage. However, the composition of the formal tool component does differ from the pottery-bearing units with scrapers and segments more common (Fig. 10). A small number of backed scrapers are found.

The dimensions of the formal, retouched scrapers are presented in Table 5 and width ratios calculated. With regard to Layers 6b to 14, scrapers are small, generally on fine-grained raw material (although examples on quartz do occur) and have a fairly standardized plan form. However, scrapers in Layers 15 and 16 are considerably larger (Fig. 11), and mainly manufactured on quartz. The size of the scrapers may suggest an early Holocene date for these layers, however the lithic technological sequence for the early Holocene in Namaqualand has yet to be determined and it would be premature to speculate on this.

Adzes remain rare and unstandardized, while backed flakes and miscellaneous retouch pieces continue to occur (Fig. 10). Although utilized pieces decline relative to the pottery layers, they are still recovered from the lower layers. A single grooved stone was found in C6 SAS (Layer 10). It was found upside down, and well coated in red ochre. It measures 230 mm by 190 mm and the groove is 140 mm by 30 mm (Fig. 12). Clearly, the grinding on red ochre preceded the first appearance of pottery and is not linked exclusively to the later groups with pottery and livestock.

With regard to the raw material composition of the pre-pottery layers (Table 6), artefacts continue to be made primarily on quartz (80% and more), but there is an increase in both silcrete and chalcedony artefacts, especially between Layers 8 and 14. There is an increase in quartz implements to 90% in Layers 15 and 16. This together with the presence of the large scrapers in the basal units suggest that they predate the upper layers by some considerable time period. Specularite is only found in Layer 7 and ochre is only found in Layers 8 & 9. Large flakes of mica (possibly from the granite bedrock) were found in Layers 6-10. Quartz crystals are rare in both pottery and pre-pottery layers.

Table 3. Raw materials in the pottery lithic assemblage.

	L1	%	L2	%	L3	%	L4	%	L5	%	L6a	%	L6b	%
Quartz	153	88,9	199	81,8	172	77,1	91	72,8	183	80.6	138	89,6	101	87.0
Silcrete	-		1	0,4	3	1,3	1	0,8	2	0,8	1	0.6	4	3.4
Chalcendony	-		2	0,8	4	1,7	2	1,6	10	4,4	6	3,8	6	5,1
Quartzite	17	9,8	30	12,3	26	11,6	28	22,4	26	11,4	2	1,3	1	0,8
Granite	2	1,1	9	3,7	9	4,0	3	2,4	4	1,7	-		-	
Specularite	1	0,5	-		4	1,7	-		10	4,4	-		-	
Ochre	-		1	0,4	-		-		4	1,7	-		-	
Mica	-		-		-		-		-		-		-	
Crystal	-		-		-		-		-		-		-	
Other	-		2	0,8	9	4,0	-		2	0,8	2	1,3	-	
Total	173		244		227		125		241		154		116	

Table 4. Lithic artefact inventory of pre-pottery layers.

	L7	L8	L9	L10	L11	L12	L13	L14	L15	L16
Chips	183	98	63	64	67	32	101	49	65	137
Chunks	34	14	25	20	36	11	10	23	25	46
Flakes	299	246	142	193	186	123	220	156	172	330
Cores	164	142	104	119	144	64	135	79	145	255
Bladelet	-	-	-	-	-	-	-	1	1	-
P esquillees	-	1	1	-	1	-	-	-	-	-
Lithic Man.	12	3	3	8	12	1	3	2	5	2
Sub Waste	692	504	338	404	446	231	469	310	413	771
Utilized flakes	2	4	2	1	5	2	7	1	5	2
Grind. frag.	1	-	1	-	1	-	-	2	1	-
Hammerstone	1	-	-	-	-	-	-	-	-	-
Grooved stone	-	-	-	1	1	-	1	1	-	-
Sub Utilized	4	4	3	2	7	2	8	4	6	2
Scraper	8	2	1	2	1	2	1	3	4	6
Backed scraper	-	1	3	-	-	1	-	-	-	1
Adze	-	-	-	-	1	-	-	1	-	1
Segment	4	-	3	-	1	-	2	-		-
Backed flake	3	1	1	-	1	1	2	-		1
Backed point	1		-	-	-	-	-			-
Drill	1	-	-	-	-	-	-			1
MRP	2	4	2	2	5	3	7	1		-
Sub Formal	19 2.6%	8 1,5%	10 2.8%	4 0,9%	7 1,5%	7 2,9%	12 2,4%	5 1,5%	4 0,9%	10 1,2%
Total	715	516	351	410	460	240	489	319	423	783

Table 5. Scraper dimensions.

	Raw material	width mm	length mm	W/L ratio	Position of retouch
C6 H23 base (L6)	silcrete	21	11	190	9
D6 GAS (L7)	chalcedony	15	11	136	6
D6 GAS (L7)	chalcedony	13	9	144	6
D5 GAS (L7)	chalcedony	12	8	150	6
C4 YBS (L7)	quartz	12	10	120	6
C6 GAS (L7)	chalcedony	13	8	162	6
C6 GAS (L7)	quartz	16	13	123	9
C6 GAS (L7)	quartz	12	11	109	6
D5 SI 4 (L8)	chalcedony	22	14	157	10
*D5 LGAS (L8)	chalcedony	16	11	145	6
D5 LGAS (L8)	chalcedony	12	10	120	6
C5 GAS2 (L9)	chalcendony	15	9	166	6
D4 GAS 2 (L9)	chalcedony	14	13	107	3
*D4GAS2 (L9)	chalcedony	17	10	170	10
*D4GAS2 (L9)	chalcedony	15	8	187	10
C5 SAS (L10)	chalcedony	20	11	181	9
C4 BVS (L10)	chalcedony	12	8	150	7
C4 FBS (L11)	chalcedony	14	13	107	6
D6 LGAS2 (L12)	chalcedony	14	13	107	7
D6 LGAS2 (L12)	quartz	12	12	100	6
C6 H34 (L13)	silcrete	14	10	140	6
C5 BSB4 (L14)	chalcedony	14	14	100	7
D5 HCS2 (L15)	quartz	37	38	97	7
D5 HCS2 (L15)	quartz	33	26	126	7
D5 DGS (L16)	quartzite	36	40	90	6
D5 DGS (L16)	quartz	44	54	81	6
D5 WA (L16)	silcrete	42	37	113	7
D5 WA (L16)	silcrete	50	46	108	7
D5 WA (L16)	quartz	22	22	100	7
D5 WA (L16)	chalcedony	14	17	82	6
D5 WA (L16)	silcrete	12	23	52	6

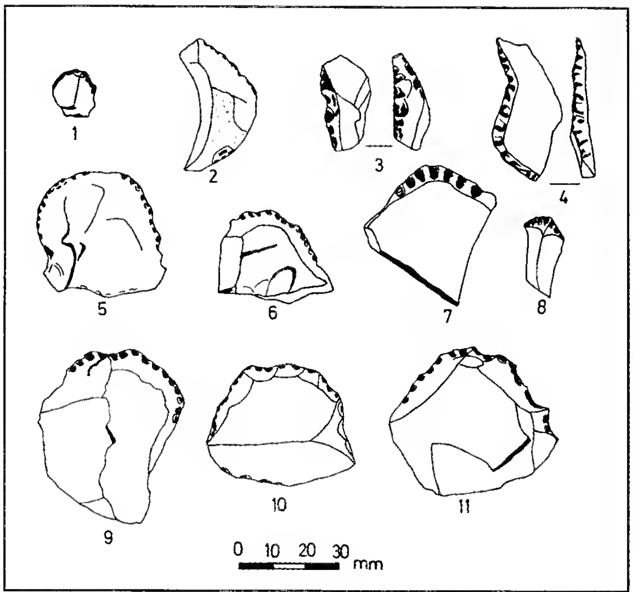

Figure 11. Lithic artefacts from the pre-pottery layers cntd: 1 - C5 BSB4 (chalcedony scraper), 2 - D5 DGS (silcrete heavily utilized flake), 3 - D5 DGS (chalcedony adze), 4 - D5 WA (quartz backed flake), 5 & 6 - D5 HCS2 (quartz scrapers), 7 - D5 DGS (quartzite scraper), 8 - D5 WA (silcrete scraper), 9 - D5 DGS (quartz scraper), 10 & 11 - D5 WA (silcrete scrapers).

Figure 12. Photograph of the grooved stone from Layer 10 (C6 SAS) covered in red ochre powder.

POTTERY

A total of 366 potsherds was recovered from the top six Layers (Table 7) of the deposit and a further five from Layer 7 (it is suggested that these have intruded from Layer 6). The highest concentration of sherds is found in Layer 3, more particularly in Twiggy 4 and Shell Lens 2. Very few of the sherds are decorated (Fig. 13) and the only motif is incised horizontal lines. A single sherd was recovered with incised cross-hatching on the rim. Incised punctations, which are common on potsherds from Namaqualand, do not occur. The percentage frequency of decorated potsherds amounts to 2,9% The neck of a typical Type C vessel (Rudner 1968) was recovered from Layer 2 (Fig. 13). No lugs or bosses were recovered from the excavations. Potsherd rims are rounded, squared, flat and one is slightly everted. A total of six decorated potsherds were recovered from the 1994, and four decorated potsherds from the 1987 excavations. These decorated sherds occur most frequently in the upper part of the ceramic sequence and no decorated sherds were recovered from Layer 6. However, decorated potsherd numbers are so low that no significant conclusions can be drawn from their distribution.

Mean sherd thickness varies between 4,8 mm and 6,1 mm (Table 7), with the sherds in Layers 6 and 7

Table 6. Raw materials used in the pre-pottery lithic assemblage.

	L7	%	L8	%	L9	%	L10	%	L11	%	L12	%	L13	%	L14	%	L15	%	L16	%
Quartz	577	80.6	438	84.8	299	85,1	330	80,4	382	83,0	196	81,6	413	84.6	260	81,5	381	90	705	90
Silcrete	37	5.1	26	5,0	13	3,7	14	3,4	23	5,0	8	3,3	19	2,8	14	4,3	21	4,9	38	4,8
Chalcedony	58	8.1	41	7,9	23	6,5	22	5,3	18	3,9	29	12,0	53	10,8	37 1	1,5	13	3	33	4,2
Quartzite	31	4,3	7	1,3	10	2,8	34	8,2	26	5,6	6	2.5	3	0,6	7	2,1	2	0,4	4	0,5
Granite	5	0,6	1	0,1	3	0,8	6	1,4	7	1,5	-		1		1	0,3	5	1,2	1	0,1
Specularite	1	0,1	-		-		-		-		-		-		-		-		-	
Ochre	-		1	0,1	-		1	0,2	-		-		-		-		-		-	
Mica	2	0,4	1	0,1	-		1	0,2	-		-		-		-		-		-	
Q. crystal	-	1	0,1		-		-		-		-		-		-		-		-	
Other	4	0,5	-	3	0,8	2	0,4	4	0,8	1	0,4		-		-		-		-	
Total	715		516		351		410		460		240		489		319		423		783	

Table 7. The distribution of pottery, indicating decorated fragments, rims and mean thickness.

Layers	Total	Decorated Rims	Rims	Decorated pieces	Mean thickness in mm	% Pottery of total	Sherds per cubic metre
1	30	-	2	-	5,8 mm	8,0	61,9
2	57	-	1	-	5,1 mm	15,3	66,7
3	144	2	1	1	5,5 mm	38,8	178,9
4	65	2	-	4	6,1 mm	17,5	76,4
5	53	1	-	1	6,1 mm	14,2	56,7
6 a	11	-	-	-	4,8 mm	0,2	23,5
6 b	6	-	-	-	4,7 mm	1,6	16,7
7	5	-	-	-	4,9 mm	1,3	3,8

noticeably thinner that the sherds in the upper Layers. Rim diameters could not be calculated because of the fragmentary nature of the sherds. Previous excavations had indicated that some of the vessels, particularly from the upper layers had not been fired properly and were disintegrating - these excavations confirmed that this applied to sherds from Layer 2. Some sherds from Layers 3 and 4 had a thick coating of carbonised material adhering to their outer surfaces. The temper of most of the sherds is fine-grained and outer surface is coloured black; red burnished sherds being uncommon.

The pottery index devised by Yates & Smith (1993) for the western Cape, was applied to Spoegrivier Cave

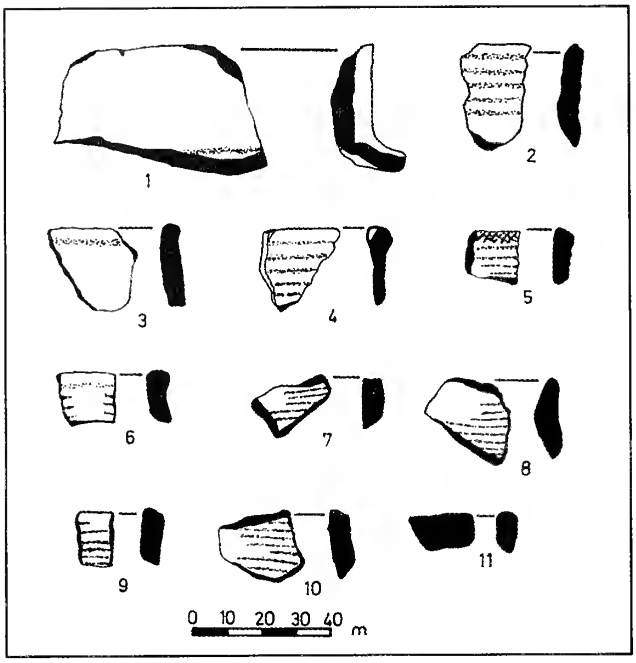

Figure 13. Potsherds: 1 - C4 Twiggy 3, 2 - D4 Twiggy 5b, 3 - D4 CT, 4 - D5 Twiggy 4, 5 - D4 H18, 6 - C5 Twiggy 4, 7 - D5 CST, 8 & 9 - D5 Twiggy 5, 10 - D4 Twiggy 5a, 11 - C4 GA.

Table 8. The Pottery Index (P.I.) for Spoegrivier Cave (after Yates & Smith1993).

Layer	Flaked Stone Tools	No of potsherds	P.I. index
1	172	30	0,17
2	238	57	0,23
3	211	144	0,68
4	116	65	0,56
5	216	53	0,2
7	703	5	0,007

(Table 8). These authors believe ceramic density to be a distinctive marker and according to their criteria, herders should have a P. I index exceeding 1. The highest values for Spoegrivier were obtained for Layers 3 and 4 and they are 0,68 and 0,56 respectively.The P.I. range for the site therefore falls within the range of their "post-pottery hunters".

The absence of pottery in Layers 8-10 is surprising given the association between pottery and sheep remains in Phase 1 of the 1987 excavations. However, the most plausible explanation for this is that potsherds may have been introduced to the lower levels of the 1987 excavations through the scuffling of hyaenas (there was considerable evidence for a hyaena lair at the back of the cave).

ARTEFACTS OF ORGANIC REMAINS

BONE

The total sum of worked bone (Table 9) is relatively small when compared with sites such as Kasteelberg (Smith & Poggenpoel 1988). Bone items comprised

Table 9. The distribution of bone artefacts.

Layer	Points	Awls	Beads	Worked	Total
1	-	-	-	-	-
2	-	-	-	1	1
3	-	-	-	1	1
4	-	-	-	1 1 Tort.	1
5	1	1	-	-	2
6 a	-	-	1	-	1
6 b	-	-	-	1 1 Tort.	1
7	1	3	1	-	5
8	-	1	-	2 1 Tort.	3
9	1	-	-	-	1
10	-	-	1	1 Tort.	1
11	1	-	-	1 Tort.	1
12	-	-	-	-	-
13	-	-	-	1 1 Tort.	-
14	-	-	-	1 Tort.	-
15	-	-	-	1 Tort.	-
16	-	1	-	-	1

* Tort. refers to tortoise shell fragments which have been worked on the edges suggesting that they had formed part of a bowl. These fragments are not included in the total presented above.

awls, points and beads. No complete bone linkshafts (Fig. 14) which would indicate hunting practices, were found at the site. Although some worked bone items were recovered in the upper layers, they seem to predominate in the pre-pottery layers. A single, very large bone awl was found in a pit in DGS, close to the base of the deposit. The bone beads (Fig. 14 nos 14 & 15) are very unusual as they are not made of hollow bird bone but are solid bone beads only slightly smaller than marbles (Fig. 14). Finally, a single incomplete bone pendant was also recovered.

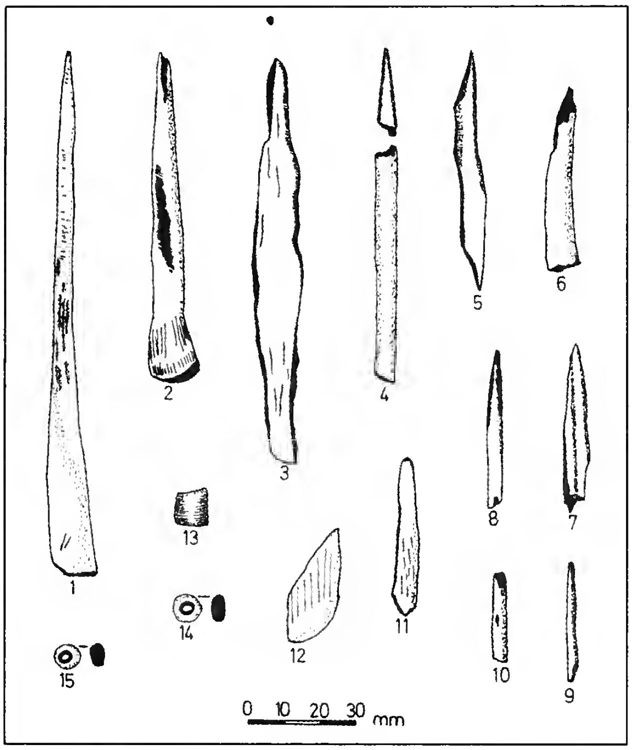

Figure 14. Bone artefacts: 1 - D5 DGS Pit (bone awl), 2 - D4 Twiggy 5c (broken bone awl), 3 - D5 Twiggy 5 (worked bone), 4 - D6 LGAS (broken bone awl), 5 - D5 GAS (worked bone), 6 - D5 LGAS (worked bone), 7 - D5 YBS (worked bone), 8 - C4 GAS (broken bone point), 9 - C4 SAS3 (broken bone point), 10 - C5 SGAS (broken bone point), 11 - D5 LGAS (worked bone), 12 - D4 Twiggy 4 (bone pendant?), 13 - C6 Twiggy 5d (broken bone tube bead), 14 - C4 SAS (bone bead), 15 - D6 GAS (bone bead).

WOOD, GRASS AND SEEDS

Artefacts made of wood, grass and seeds were recovered from Layers 1 to 10 (Table 10). Most commonly recovered were wood shavings which indicate wood-working on site. A broken wooden digging stick (Fig. 15) was found in Layer 2, and wooden pegs in Layer 4 and Layer 9. A wooden linkshaft was recovered from Layer 6 and a worked stick was found in Layer 5. A stick coated in red ochre was recovered from Layer 3. A total of four seed beads were recovered, from Layers 1, 4 and 5. The beads appear to be *Olea* sp. (perhaps *africanus*).

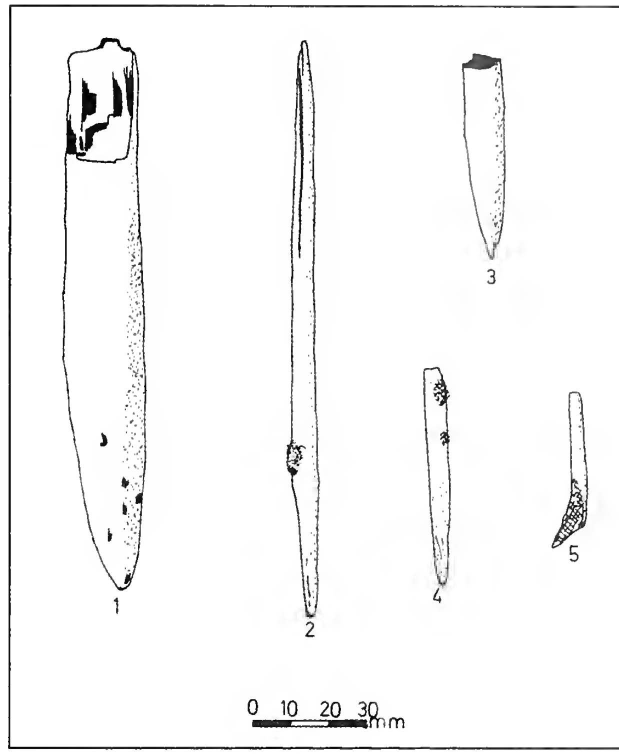

Figure 15. Wooden artefacts: 1 - C4 CBS (digging stick end), 2 - C5 Twiggy 6 (wooden linkshaft), 3 - C4 Twiggy 5a (wooden peg), 4 - C5 Twiggy 5c (worked wood), 5 - C4 Twiggy 4 (hatching indicates ochre coating).

FIBRE STRING

There were also numerous fragments of twine (Table 10), mostly of two strands and of varying thickness (Fig. 16). The string fragments was concentrated in Layers 4, 5 and 6. There were also a number of examples of knotted grass (Fig. 16). None of the knotted grass remains resembled netting nor were there any examples of string traps.

OSTRICH EGGSHELL

The mass of fragmented ostrich eggshell (OES) seems to be concentrated in Layers 1-8 which have more than 100 grammes per layer, the lower layers have approximately 50 grammes of OES per layer (Table 11). A total of eight decorated OES fragments were recovered in Layers 7 and 8 and also in Layers 11 and 13 (Table 11), i.e. the pre-pottery units. This contrasts with the 1987 excavations when none were recovered. The most common motifs are cross-hatching, horizontal and diagonal lines (Fig. 17). A

Table 10. Organic artefacts made of wood, grass and seeds.

Layer	Twine	Knotted grass	Wood artefacts	Wood shavings	Seed beads
1	1	-	-	5	1
2	1	2	1	10	-
3	-	1	1	7	-
4	2	1	1	7	1
5	4	-	1	4	2
6a	4	-	-	-	-
6b	1	-	1	1	-
7	-	-	-	-	-
8	-	-	-	-	-
9	-	-	2	-	-
10	1	-	-	-	-

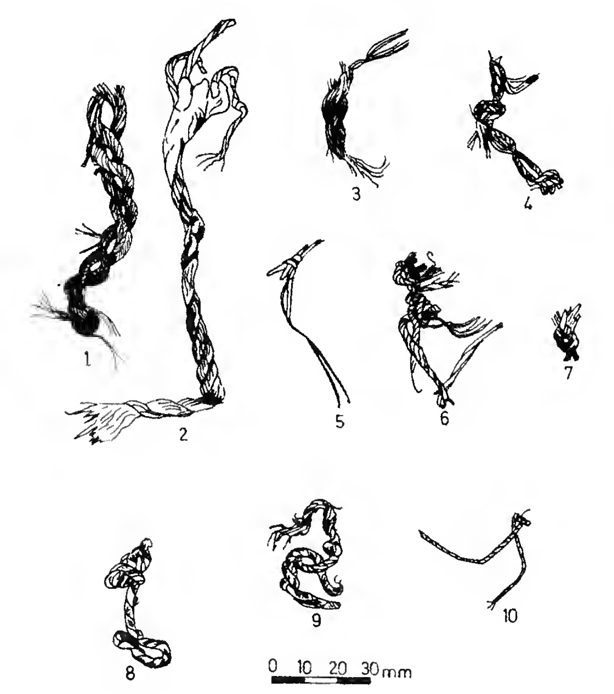

Figure 16. Fibre and/or grass string: 1 - B5 Twiggy 4, 2 - C5 CDT, 3 - D4 Twiggy 3, 4, 5 & 6 - C5 Twiggy 5, 7 - C4 Twiggy 4, 8 - C5 Twiggy 5, 9 - B5 Twiggy 6, 10 - C4 Twiggy 5c base.

total of four OES fragments had been fashioned into `scrapers' (Fig. 17), i.e. they have a roughly triangular shape and one of the margins of the reverse side has been retouched to form a concave edge. The function of these `scrapers' is unknown but they have also been

Table 11. The distribution of OES fragments, decorated OES and OES `scrapers' and flasks.

Layer	Mass (g)	Decorated	`Scrapers'	Flask mouth	% OES
1	106 g	-	-	-	6,7
2	304 g	-	2	-	19,3
3	195 g	-	-	-	12,4
4	150 g	-	-	2	9,5
5	86 g	-	1	-	5,4
6 a	30g	-	-	-	1,9
6 b	26g	-	-	-	1,6
7	117 g	4	-	3	7,4
8	121 g	1	1	1	7,7
9	69 g	-	-	1	4,3
10	39 g	-	-	-	2,4
11	66 g	2	-	-	4,2
12	57 g	-	-	1	3,6
13	48 g	2	-	1	3,0
14	45 g	-	-	-	3,0
15	60 g	-	-	-	3,8
16	51 g	-	-	1	3,2

identified at Frummel Bakkies in Bushmanland (Webley 1992) and at Jakkalsberg in the Richtersveld (Webley 1997). Finally, a total of 12 flask mouths were recovered, concentrated largely below Layer 6, but two were also found in layer 4 during the pottery period (Fig. 17). There is thus an inverse relationship between the mass of OES fragments and the flask mouths. The ostrich eggs which entered the site during the pre-pottery period may have been introduced as containers while in the pottery layers they may have been consumed as part of the diet.

With regard to the ostrich eggshell beads (Table 12), a total of 328 were recovered, with the highest concentrations in Layer 10, while Layers 4-14 tend to have similar numbers. Unfinished beads in particular are concentrated in Layers 12 and 13, but Layers 3, 4 and 5 also have large numbers confirming that bead manufacture was taking place in both pre and post-pottery periods. Ochre-stained beads were found in Layers 6 and 9. With regard to the external diameter measurements of the beads (Table 12), the mean sizes of beads in Layers 1 and 2 are higher than those for the 1987 excavation which amounted to 5,8 mm. The

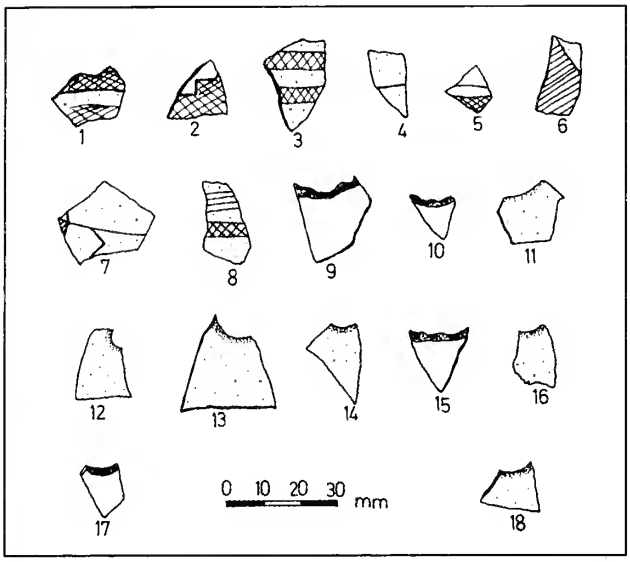

Figure 17. Modified ostrich eggshell fragments: Nos 1 to 8 are decorated fragments. 1 - D5 GAS, 2 & 3 - C4 GBS, 4 - C6 GAS, 5 - D5 LGAS, 6 - C5 SAS3, 7 & 8 - D5 BSB3. 9, 10, 15 & 17 are ostrich eggshell `scraper'. 9 - D4 BS, 10 - C5 BS, D6 AF4, 17 - D4 Twiggy 5c. 11-14, 16 & 18 are ostrich eggshell flask mouths. 11 - D5 CST, 12 - D6 GAS, 13 - C5 GAS, 14 - D6 AF4, 16 - C5 SGAS, 18 - D6 LGAS.

means for Layers 3 to 5 remain above 5 mm. Beads from Layer 6a have a mean diameter of 5,2 mm, while those from Layer 6b have a diameter of 4,9 mm. Thereafter there is a dramatic reduction to 4,2 mm in Layer 7. The mean sizes for these pre-pottery units varies between 4,2 mm and 4,4 mm.

One very unusual observation made during the more recent excavations is the presence of square OES beads, mainly from lenses below Layer 6. These beads are not unfinished, both the outer edges and the inner apertures showing clear signs of wear-polish.

MARINE SHELL ARTEFACTS

Two fragments of cowrie shells (species unidentified) from Layer 3 (D6 SL2) and Layer 4 (C4 Twiggy 5a) appear to have been introduced for non-dietary reasons. Further, one *Donax serra* appears to have polish (Layer 7) and one appears to have been used as a scraper (Layer 9). One fragment of artificially smoothed *Choromytilus meridionalis* was found in Layer 4 (D5 Twiggy 5). It is significant that no pendants or beads of marine shell were recovered despite the abundance of marine resources at the site.

Table 12. The distribution of ostrich eggshell beads. The total number of beads in the second column includes square beads and those broken beads which could be measured by means of a caliper but excludes the unfinished beads.

Layer	No.	Unfinished	Broken	Square	Mean	Beads per bucket
1	5	2	2	-	7,8 mm	0,16
2	13	3	6	-	6,2 mm	0,23
3	18	8	-	-	5,9 mm	0,34
4	22	9	3	1	5,7 mm	0,4
5	32	8	1	-	5,0 mm	0,5
6 a	19	-	1	1	5,2 mm	0,6
6 b	14	2	-	-	4,9 mm	0,6
7	35	4	3	8	4,2 mm	0,4
8	26	4	-	3	4,4 mm	0,6
9	34	3	-	-	4,2 mm	0,5
10	39	2	-	-	4,2 mm	0,36
11	36	4	-	2	4,3 mm	0,45
12	17	14	-	-	4,2 mm	1,08
13	19	19	-	2	4,4 mm	0,6
14	13	5	-	-	4,4 mm	0,5
15	2	-	-	-	4,4 mm	0,07
16	3	-	1	-	3,3	0,06

PLANT REMAINS

Plant remains are found throughout the deposit but occur in greatest quantities in the pottery layers. There is a reduction in grasses, sticks, etc. below Layer 6 which may indicate that the top pottery layers were deposited during drier period, and that preservation drops off below this because of moister conditions.

The Twiggy lenses which are found down to the base of Layer 6a refers to the fact that certain squares, most notably D4, C4 & C5 contain thick, grassy lenses. These `bedding patches' are rich in seeds, corm casings, reeds, flower heads and leaves. These various components from the Twiggy units have not been quantified but rough values are provided in Table 13.

The seeds most commonly recovered from the excavations were *Euclea racemosa* (amounting to 50% of the total), known locally as the `vlieebos' although it is also known in other areas as `sea guarri'. It ripens from February to May. The *Rhus* spp accounts for about 30% of the seeds present in the site. These bushes

Table 13. Plant remains recovered from various layers.

	L1	L2	L3	L4	L5	L6a	L6b	L7	L8	L9	L10	L11
Euclea sp.	x	x	x	x	x	x	x	x	x	x	x	x
Rhus sp.	x	x	x	x	x	x	x	x	x	x	x	-
Erythrophysa sp	21	37	7	13	6	-	-	1	-	1	-	-
Olea sp	2	3	1	4	12	-	-	1	-	-	-	-
Other seed	-	2	3	2	2	x	x	3	-	3	1	1
Grasses	x	x	x	x	x	-	-	-	-	-	-	-
Corm casings	x	x	x	x	x	x	x	x	-	x	-	x
Corm bases	1	6	7	5	6	1	-	-	-	-	-	-
Mesem sp. f	x	x	x	-	x	-	-	-	-	-	-	-
Seaweed	x	-	x	x	x	-	-	-	-	-	-	-
Carp sp f	-	-	-	10	4	-	-	-	-	-	-	-
Carp. sp. l	-	1	1	10	-	-	-	-	-	-	-	-
Boophane sp l	-	-	-	x	x	-	x	x	-	-	-	-
Diospyros sp	-	-	-	8	5	-	-	1	-	-	-	-
Cut reeds	-	-	x	x	-	x	x	-	-	-	-	-
Plant fibre	-	-	-	x	-	x	-	x	x	x	x	x
Sea bamboo	-	-	x	x	x	x	x	-	x	-	-	-
Helichrysum sp.	-	-	-	-	-	-	-	-	-	-	x	-

grow around the cave and estuary and seeds may be easily collected. The *Rhus* spp. may be *undulata* (Palgrave 1977:490), which has a fruit which ripens from March to June, or *horrida* which ripens from September to December. Their presence in the site could, however, be attributed to birds which nest on a projecting rock in the cave. A pit containing the seeds of *Erythrophysa alata* were found during the 1987 excavations. Although further pits were not located during the 1994 excavations, a number of these seeds (15%), commonly referred to as `kloe-kloekie' were recovered. They do not appear to be edible and inhabitants of the Leliefontein Reserve in Namaqualand were unable to identify a use for them. A fourth seed recognised from the excavations appears to be that of *Olea* spp (5%), it is possible that the seed beads recovered in certain units (Table 10) are of this genus.

Diospyros sp seeds occur in small quantities only in Layers 4 and 5. According to Palgrave (1977) the species is likely to be *austro-africana* which has a fruit which ripens from January. This plant is known as `kanobie' among Khoekhoen descendants and is known to be edible (Le Roux 1991; Wilson 1993). All the berries of *Diospyros* sp are known to be edible but not all are equally tasty (Archer 1982). In addition to the above seeds, small quantities of an unidentified seed, shaped like those of the genus *Cucurbitaceae* also occurs in Layers 2 to 7.

Corm casings and bases of underground bulbs were also recovered, most particularly from Layers 2 to 6. The quantities (Table 13) are very small and the variety has not been identified. There would appear to be two varieties present, one a very large bulb of a *Watsonia* sp type, another smaller, with a finer corm casing mesh. The only bulb which we were able to collect near the cave was *Antholyza plicata* (Le Roux & Schelpe 1981) which has red flowers and is not known to be edible. However, local farmers told us that about a `witlelie' which grows along the coast and is edible.

In addition to underground plant foods, well-preserved leaves and fruits of the sour fig or `hotnotsvy', *Carpobrotus edulis*, were found in Layers 4 and 5. The edible fruits of the sour fig ripen in summer, usually from January onwards. The flower heads of a small *mesembryanthemaceae* (tentatively identified as *Ruschia frutescens*) were found in several layers down to layer 5 and confirm that much of the occupation of the site during the pottery period took place in the summer months. Large samples of grasses, some of them flowering, as well as reeds were recovered from the bedding units but have not been identified - largely because of a lack of comparative botanical material from this part of the country. According to Dr E. February (Botany Department, University of Cape Town pers. comm.) Some of these grasses appear to be *Cynadon dactalon*. A number of the reeds recovered in the Twiggy layers appear to have been deliberately cut to a straight edge.

Fragments of *Boophane distichia*, or `gifbol', are found from Layers 4 to 7. The scales of the bulb of this plant are poisonous and they are frequently used as a dressing for wounds (Watt & Breyer-Brandwijk 1932). According to Thunberg (Forbes 1988), the Khoekhoen used this bulb for arrow poison. In addition, an as yet unidentified plant fibre occurs frequently in large lumps from Layers 6 to 13. Some of the flat leaves recovered may be that of *Trachyandra falcata* or `hotnotskool'. The young flowers of this plant is edible from July to September and is used today in stews (Archer 1982). Finally, large pieces of the kelp *Ecklonia maxima* were recovered from virtually all layers down to Layer 15.

FAUNAL REMAINS

INVERTEBRATE FAUNA

Bulk shell samples were obtained from squares B5 and E5 (Table 14 & 15). The abundant shellfish remains recovered from the site indicate that it formed a dietary staple. Limpets dominate the assemblage (Table 14 & 15) with the exception of Layer 7 which

Table 14. Percentage frequencies by MNI counts and weight of shellfish in excavation B5 at Spoegrivier Cave. Total weight of sample (w) is expressed in grammes.

LAYER	TOTAL		Patella argenvillei		Patella granatina		Patella granularis		Choromytilus meriodonalis		Aulacomya sp.		unid gastropod		unidentifiable	
	mni	w	%mni	%w	%mni	%w	%mni	%w	%mni	%w	%mni	%w	%mni	%w	%mni	%w
Layer 1	29	158	3,4	24,0	34,4	22,1	58,6	25,3	-	6,3	-	-	3,4	-	-	22.1
Layer 2	35	286	2,8	15,0	11,4	31,1	34,2	19,2	2,8	1,0	5.7	-	-	-	42.8	33.5
Layer 3	29	151	13,7	33,7	24,1	28,4	34,4	9,2	-	-	-	13,7	-	-	27.5	25.8
Layer 4	34	77	-	15,5	11,7	28.5	61.7	23,3	-	5,1	2,9	1.2	-	1,2	23.5	24.6
Layer 5	103	543	4,8	11,0	28,1	28,5	48,5	26,3	3,8	9,5	-	-	3,8	-	10,6	24.4
Layer 6	413	1870	8,7	17,3	19,8	16,6	54,9	16,4	7,5	24,8	0,7	1,1	2,6	3,4	5.5	20.0
Layer 7	11	54	9,0	5,5	-	25,9	-	48,1	-	7.4	-	-	-	1,8	90,9	11,1
layer 8																
Layer 9	21	197	4,7	32,4	19,0	12,6	23,8	13,7	-	12,6	4,7	2,0	9,5	4,5	38,0	21,8
Layer 10	234	1015	8,5	22,2	14,5	14,4	50,4	10,8	12,8	24,9	2,5	1,8	1,2	1,5	9,8	24,0
Layer 11	844	3541	14,4	20,1	13,7	6,5	41,4	12,1	20.2	33,9	3,0	2.4	1,5	3.3	5,4	21.4
Layer 12																
Layer 13																
Layer 14																
Layer 15																
Layer 16	21	79	-	8,8	28,5	34,1	61,9	15,1	-	17.7	-	-	9,5	11,3	-	12,6

Table 15. Percentage frequencies by MNI counts and weight of shellfish in excavation E5 at Spoegrivier Cave. Total weight of sample (w) is expressed in grammes.

LAYER	TOTAL		Patella argenvillei		Patella granatina		Patella granularis		Choromytilus meriodonalis		Aulacomya sp.		unid gastropod		unidentifiable	
	mni	w	%mni	%w	%mni	%w	%mni	%w	%mni	%w	%mni	%w	%mni	%w	%mni	%w
Layer 2 (Cream Ash)	138	451	0,7	11,9	3,6	39,9	90,5	4,8	-	1.5	-	-	-	1.1	5	40,5
Layer 2 (SL)	50	461	12	9,3	12	25,3	28	12,1	-	1,7	-	-	-	1	48	50,3
Layer 3 (SL2)	74	710	1,3	10.5	31	37	12,1	11.9	1.3	0.8	-	0,1	2.7	0.8	51,3	38,5
Layer 5 (SL3)	111	665	4,5	13	36	28,5	18	10,9	-	2,1	-	-	2,7	1,3	38,7	43,9
Layer 7 (GAS)	181	894	2,7	6,7	6,6	23,7	60,7	21,5	4.4	9.2	1,1	-	3,3	4,1	20,9	34,5
Layer 8 (LGAS)	269	865	3,7	7,8	10,4	16,9	72,1	20,2	3,7	12,8	-	1,2	0,7	7,6	9,2	33,1
Layer 8 (SL4)	119	799	3,3	12.7	25,2	32,6	24,3	13,3	3,3	2,7	-	0,1	-	1.3	43 6	36,9
Layer 12 (BSB1 & BSB2)	514	1554	8,7	11,3	16,7	23,5	59,5	27,1	2.1	6.8	-	-	1.7	6,2	11	24.9

contains a very high percentage (90%) of unidentifiable shell remains, which may be indicative of a high level of crushing and burning of the deposit. The most common limpet species is *Patella granularis*. However, below Layer 10 (which dates to 2400 BP), there is a noticeable increase in numbers of black mussel frequencies (Table 14 & 15).

According to Jerardino (1997:1033), *P. granatina* and *P. granularis* are found in the mid-intertidal which is "an area of easy access to humans". *P. argenvillei*, however, "usually inhabits the semi-vertical exposed rocks of the low-intertidal", while black mussels are found between the mid and low-intertidal depending on their size. The ribbed mussel too, is found in the low intertidal and sub-tidal zones. However, while the exposed rocks to the south of the estuary at Spoegrivier Cave today have substantial exposed stands of black mussels, limpets are sparse. This is not likely to be the result of over-exploitation of limpets by modern populations as visitors tend to harvest the mussels.

Limpets are disproportionally represented in the archaeological deposit during the period 1900 to 1300 BP. At this time sea levels along the west coast had already reached their present levels (Jerardino 1997). Mussels are more likely than limpets to become affected by toxic red tide conditions which are very common during the summer months on the South African west coast. The plant remains recovered from the site point to a later spring, early summer (October to February) occupation. Several authors have pointed to the high levels of limpet exploitation immediately prior to the colonial period (Robertshaw 1979; Jerardino 1997) which may support summer occupation along the length of the western Cape coast at this time.

As in the 1987 excavations, a significant number of crayfish (*Jasus lalandi*) are represented by their mandibles. A total MNI of 845 was obtained (Table 16). Peaks of crayfish utilisation occur in Layers 6,7,9,10 and 11. Mean mandible length varies between 11,0 mm and 13,0 mm and there is no indication of over-exploitation in certain layers leading to predation on smaller individuals.

VERTEBRATE FAUNA

The faunal analysis was undertaken by Dr I Plug (previously of the Northern Flagship Museum) and a full discussion is presented in Plug (in prep). The preservation of bone was very good and just over 34% were identified to species of size class (Table 17, 18& 21). The total sample consists of over 50 000 fragments. The primary purpose with the 1994 excavations was to enlarge the sheep sample. Sheep (*Ovis aries*) remains were found from Layers 1 to 10. Although the minimum number of individuals is small, Layers 5 and 6 contain large numbers of identifiable sheep fragments. The sheep remains for the pre-pottery

Table 16. Crayfish and Fish frequencies.

	Crayfish MNI	Mean mandible length	Fish vertebrae
Layer 1	23	13,0 mm	14
Layer 2	32	14.2 mm	30
Layer 3	45	13.2 mm	39
Layer 4	55	10,5 mm	48
Layer 5	48	12.2 mm	111
Layer 6 a	55	12.2 mm	78
Layer 6 b	44	12.1 mm	50
Layer 7	116	11.0 mm	356
Layer 8	43	11,6 mm	334
Layer 9	86	12,1 mm	73
Layer 10	108	11,3 mm	109
layer 11	115	11.5 mm	204
Layer 12	18	11.2 mm	41
Layer 13	25	12,6 mm	37
Layer 14	30	12.2 mm	54
Layer 15	2	6,1 mm	9
Layer 16	7	12.3 mm	52

phase is small, a total of eight individuals being recognised between Layers 7 and 10. While there is a radiocarbon date of *c.* 2400 BP for Layer 10, the accelerator radiocarbon dates on sheep bones of *c.*1900 BP confirm that these remains probably originated in Layers 5 and 6 and are intrusive into these lower layers.

It is the Cape Fur Seal and various limpets species, however, which contribute the most significant portion of the diet during the pottery period. This is similar to the pattern noted for Kasteelberg (Klein & Cruz-Uribe 1989) in the western Cape. Sheep are a rather minor source of protein and are less frequently consumed than steenbok or tortoise. Cape Fur Seal contributed significantly to the diet of the sites inhabitants, specifically during Layers 3 to 11. The preponderance of juveniles suggests that the site was occupied between October and December. Medium and large bovids are represented in small numbers by springbok, hartebeest, gemsbok and eland while small bovids such as steenbok, grysbok and the common duiker fluctuate in numbers between 9% and 22%. Fragments of the pangolin were found in Layers 8 and 13, just outside the normal distribution range of these animals. Tortoises are represented by *Chersina angulata* and by *Homopus signatus* and the former, in particular, is very common in Layer 3, as well as Layers 7-14.

There appears to be no specific preference with regard to skeletal part representation and skull, axial and abaxial elements are represented. Many of the bones are burnt. Human damage, in the form of cut

Table 17. The faunal species represented in the pottery layers at Spoegrivier Cave. NISP (Number of identified skeletal parts)/MNI (Minimum number of individuals). An asterisk (*) indicates that the MNI could not be determined.

Species	**S**	**1**	**2**	**3**	**4**	**5**	**6**
Vulpes chacma	-	1/1	-	2/1	4/1	12/2	6/2
Canis mesomelas	-	2/1	1/1	5/1	1/1	1/1	2/1
Arctocephalus pusillus	7/2	5/1	76/5	265/6	246/7	398/7	586/1[illegible]
Ictonyx striatus	-	1/1	-	-	-	-	2/1
Suricata suricata	-	-	-	-	-	1/1	-
Mongoose	-	-	-	2/1	1/1	3/1	-
Hyaena brunnea	-	-	-	-	1/1	-	1/1
Panthera pardus	-	-	-	1/1	2/2	-	2/2
Felis caracal	-	-	-	2/1	-	-	4/1
Felis cf. *Lybica*	-	-	-	-	-	1/1	-
Felidae sp. indet.	-	-	-	-	-	2/1	-
Carnivore medium	3/2	2/2	-	-	2/1	1/1	-
Carnivore large	-	-	-	1/1	-	-	3/2
Rhinocerus	-	-	-	-	-	-	1/1
Equus burchelli	1/1	-	-	-	-	-	-
Procavia capensis	-	2/1	13/3	45/4	27/5	33/4	26/3
Ovis aries	-	7/2	4/2	15/2	2/1	38/4	21/3
Alcelaphus buselaphus	1/1	-	-	-	-	2/1	-
Sylvicapra grimmia	1/1	3/1	1/1	4/2	7/2	-	-
Antidorcas marsupialis	-	6/2	1/1	-	2/2	8/1	8/4
Oreotragus oreotragus	-	-	-	-	-	2/1	-
Raphicerus campestris	4/1	6/1	32/2	114/5	60/5	117/3	46/6
Raphicerus melanotis	1/1	2/1	7/2	48/4	36/2	41/3	25/3
Raphicerus sp.	-	-	7/1	5/*	16/2	16/1	25/*
Oryx gazella	2/1	2/1	1/1	-	-	2/1	3/1
Taurotragus oryx	-	-	1/1	-	-	2/1	4/2
Bov 1	2/1	10/1	6/*	6/1	26/*	21/*	39/*
Bov 2 nondomestic	-	1/1	2/1	-	3/1	6/1	8/*
Bov 2 indet	1/1	1/*	-	2/*	4/1	3/*	4/*
Bov 3 nondomestic	2/1	2/1	-	1/1	2/1	8/1	8/2
Bov 4	-	1/1	-	-	-	-	-
Hystrix africaeaustralis	-	1/1	-	1/1	-	1/1	5/1
Lepus saxatilis	-	5/2	5/2	5/2	-	4/2	8/1
Lepus sp.	1/1	-	-	-	-	2/1	1/8
Lagomorph	-	7/1	-	-	2/2	3/8	14/1

Table 18. The faunal species represented in the pre-pottery layers. NISP (Number of identified skeletal parts)/MNI (Minimum number of individuals).

	7	8	9	10	11	12	13	14	15	16
Vulpes chacma	1/1	-	2/1	-	-	-	-	-	2/1	-
Canis mesomelas	4/2	2/1	2/1	5/1	7/1	2/1	2/1	3/1	-	4/1
Canidae sp. indet.	2/1	3/1	-	-	-	-	-	-	-	-
Otocyon megalotis	-	-	1/1	-	2/1	-	-	-	-	-
Arctocephalus pusillus	294/18	36/2	295/21	154/10	251/9	4/2	20/3	10/2	2/1	3/1
Suricata suricata	1/1	-	-	-	-	-	-	-	-	-
Mongoose	3/1	-	2/1	-	-	1/1	-	1/1	2/1	-
Hyaena brunnea	2/1	-	-	-	-	-	-	-	-	-
Panthera pardus	-	-	1/1	-	1/1	-	-	-	-	-
Felis caracal	1/1	-	1/1	2/1	-	-	1/1	-	-	2/1
Felis lybica	-	7/2	-	3/1	-	-	-	-	-	-
Felidae sp. indet	1/1	1/*	-	-	-	-	-	-	-	-
Carnivore med.	1/*	4/1	-	-	2/1	-	-	-	-	-
Carnivore large	-	-	-	1/1	-	-	-	-	-	-
Procavia capensis	20/6	12/4	9/2	13/3	28/3	-	4/1	19/2	8/2	6/3
Ovis aries	14/5	1/1	2/1	-	4/1	-	-	-	-	-
Alcelaphus buselaphus	-	-	-	1/1	-	-	-	-	-	6/1
Sylvicapra grimmia	7/7	2/1	10/2	4/1	15/2	14/1	7/1	33/2	5/1	13/3
Antidorcas marsupialis	4/2	2/1	8/2	1/1	9/1	-	6/1	3/1	-	-
Raphicerus campestris	155/6	330/7	76/5	47/3	175/8	168/6	199/8	177/4	40/3	21/2
Raphicerus melanotis	80/1	81/5	119/4	51/3	147/4	102/4	149/7	126/4	14/2	8/2
Raphicerus sp.	36/2	1/*	21/1	14/*	21/2	8/1	-	1/*	5/*	-
Oryx gazella	-	1/1	1/1	-	2/2	-	-	1/1	1/1	-
Taurotragus oryx	1/1	-	1/1	-	-	-	-	-	1/1	2/2
Bov I 25/1	29/2	17/*	14/1	36/1	6/2	54/2	19/2	3/2	2/1	-
Bov II nondomestic	6/1	11/1	2/1	2/1	4/1	2/1	11/2	8/1	-	3/1
Bov II indet	3/*	-	2/*	-	-	-	-	-	-	-
Bov III nondomestic	2/2	-	-	1/1	8/2	-	-	-	-	-
Manis temmincki	-	1/1	-	-	-	-	1/1	-	-	-
Hystrix africaeaustralis	5/1	-	-	-	1/1	-	-	1/1	-	-

Table 21. Tortoise, lizard and chameleon species represented. NISP (Number of identified skeletal parts)/MNI (Minimum number of individuals). An asterisk (*) indicates that MNI could not be determined.

Layer	Chameleon/ lizard	*Chersina angulata*	cf. *Homopus signatus*	Tortoise
1	-	56/3	-	-
2	-	144/8	-	-
3	3/1	534/29	-	-
4	4/2	148/8	-	-
5	5/2	179/6	16/3	2/*
6	-	204/18	18/3	16/*
7	2/1	850/26	4/1	-
8	2/2	1409/39	-	5/*
9	-	428/25	3/1	10/*
10	-	345/21	3/1	4/*
11	1/1	825/42	-	2/*
12	-	839/26	1/1	-
13	-	1174/27	-	-
14	-	1496/34	-	-
15	-	414/20	-	-
16	-	359/14	-	-

marks, is scarce. Carnivore damage occurs on some bones in almost all layers, it is obvious that carnivores used the shelter from time to time.

BIRDS

Bird remains occur in all layers (Tables 19 & 20). The variety is large, but consists predominantly of sea and estuarine species. Since jackass penguins and Cape gannets seldom "approach the shore unless sick, dying or washed up dead" (Avery & Underhill 1986: 341), the presence of large numbers in the archaeological deposit would suggest that coastal groups were collecting beached birds. Further, Avery and Underhill (1986) point out that 81% of jackass penguin, Cape gannet and Cape cormorant are beached between the months of October and April. They have also noted that the monthly density of beached birds is low, amounting to around 1,45 birds/km. Cape cormorant numbers are particularly high in the pre-pottery units (Layers 7-16), amounting to an MNI of 79 or 48% of the total assemblage. These figures may indicate that the occupants of the site had some method of snaring the birds. Fragments of the feet and wing bones of the ostrich show that not only were the eggs collected but the birds hunted as well.

If one compares the figures for bird remains from Spoegrivier with that of other archaeological sites in the Western Cape, such as Paternoster, Stofbergsfontein and Duiker Eiland (Avery & Underhill1986) it is clear the jackass penguins and Cape cormorant "are consistently the most common species in archaeological samples" (Avery & Underhill 1986: 351). At Mike Taylor's Midden (Jerardino & Yates 1997), the Cape cormorant also occurs in large numbers during the period 2000-2400 BP.

FISH

The fish sample is small and consists almost entirely of vertebrae which have not been identified. Greater numbers are found in Layers 6,7,8,10 and 11; i.e. coinciding with the crayfish peaks.

DENSITY VALUES

Apart from columns B5 and E5, which were taken to determine the shellfish frequencies for the site, a further random sample of eleven buckets of soil were taken from eleven different lenses.

The aim of establishing density values for the archaeological material from Spoegrivier Cave was to provide a framework for comparison with the figures Jerardino (1995) has generated for coastal sites from the Western Cape several hundred kilometres to the south. She has suggested that three parameters "area of settlement, rates of accumulation of unfinished ostrich eggshell beads and unfinished beads and pendants, as well as rates of accumulation of domestic debris" ... "can provide meaningful estimates of the relative size of visiting groups, time spent at the site and the intensity of site occupation" (Jerardino 1995:21).

At Spoegrivier Cave, the side and back walls of the cave determine the maximum dimensions of settlement while the spill-over of deposit down the talus slope to the front suggests that settlement has not always been constrained to the shelter itself. However, it is not possible to calculate the total area of each occupation layer unless each layer is systematically excavated and compared with horizons above and below it. Shell densities appear to more dense to the front of the site while deposits toward the back wall contain more sandy and plant-rich lenses. Evidence for bedding hollows and a hyaena lair at the back of the cave, and early deposits to the front of the site, suggest a complex accumulation process.

Density values were calculated in accordance with the formula used by Jerardino & Yates (1996).The highest density of unfinished ostrich eggshell beads (numbers per cubic metre) is in Layers 12 and 13 with

Table 19. The bird remains from the pottery layers at Spoegrivier Cave. NISP (Number of identified skeletal parts)/MNI (Minimum number of individuals.

Species	S	1	2	3	4	5	6
Struthio camelus ostrich	-	-	-	3/1	1/1	2/1	-
Sphenscus demersus penguin	-	-	1/1	6/1	1/1	-	3/1
Pelecanus onocrotalus pelican	-	-	-	2/1	-	2/1	4/2
Morus capensis Cape gannet	-	-	-	1/1	-	-	1/1
Phalacrocorax capensis Cape cormorant	-	-	1/1	2/1	2/1	-	1/1
Ciconia sp. stork	-	1/1	-	-	-	-	-
Phoenicopteres ruber flamingo	-	-	2/1	-	-	1/1	-
Anatidae sp. duck	-	1/1	-	-	-	-	-
Numida meleagris guinea fowl	-	-	2/1	1/1	-	-	1/1
Pterocles namaqua sandgrouse	-	-	-	3/1	-	-	-
Oena capensis Namaqua dove	-	1/1	-	-	-	-	-
Larus dominicanus kelp gull	-	-	-	-	-	-	1/1
Tyto alba barn owl	-	-	-	-	-	5/1	3/1
Corvus sp. crow	-	-	-	-	-	-	-
Columbidae	-	1/*	-	-	-	-	-
Aves gen. et sp. indet.	-	5/1	7/3	7/3	15/3	35/7	50/9

lesser peaks in Layers 3, 4, 5 and 14 (Fig. 18). The highest density of completed ostrich eggshell beads is also in Layer 12, with lower numbers in Layers 6, 8, 10 and 13 (Fig. 19). With regard to stone artefacts, the highest densities were recovered in Layers 12, 13, 15 and 16 with a smaller number in Layer 8 (Fig. 20).

Bone density was calculated in grammes per bucket and the highest values was realised in Layers 8, 12, 13 and 14 (Fig. 21). Densities of shell (in grammes per bucket) was considerably higher in Layer 11 with smaller amounts measured in Layers 9 and 6 (Fig. 22). Ostrich eggshell fragments densities (grammes per bucket) was highest in Layers 1, 2, 3 and 4, as well as Layers 8 and 12 (Fig. 23).

The period of most intensive (or prolonged) occupation at the site when measured in complete and unfinished beads, stone artefacts as well as domestic debris (bone and shell remains) appears to have been between Layers 8 to 12. High densities of stone in Layers 15 and 16 can be accounted for by the leaching of organic remains in these lower layers. The upper, pottery-bearing units are rich in plant remains and ostrich eggshell fragments which may suggest periodic or short-lived visits to the site after the aequisition of livestock.

ENVIRONMENTAL INFORMATION

According to Jerardino (1997) sea-levels along the Cape west coast had reached a maximum of 2-3 m above their present levels around 6000 BP and then again around 4000-3800 BP. There were regressions around 4200 BP and again between 3500 BP and 2800 BP when levels were close to those of today. While small fluctuations may have occurred between 2600 BP and 1800 BP, by the latter date sea levels had stabilized along the West coast. A 2 metre rise in sea levels around 4000 BP to 3800 BP would have covered the present mussel beds to the south of the Spoegrivier estuary.

A record of sea surface temperatures for the Late Holocene has been obtained for the south-western Cape from *P. granatina* shells found in archaeological

Table 20. The bird remains from the pre-pottery layers at Spoegrivier Cave. NISP (Number of identified skeletal parts)/MNI (Minimum number of individuals.

Species	7	8	9	10	11	12	13	14	15	16
Struthio camelus ostrich	1/1	-	1/1	1/1	-	-	1/1	-	-	-
Spheniscus demersus penguin	2/1	3/1	2/1	3/1	6/2	1/1	-	2/1	-	1/1
Pelecanus onocrotalus pelican	-	-	-	-	-	-	-	-	-	-
Morus capensis Cape gannet	2/1	2/1	-	-	1/1	2/1	-	2/2	-	-
Phalacrocorax capensis Cape cormorant	99/11	230/14	15/4	5/2	11/2	171/13	186/13	247/16	12/2	8/2
Ciconia sp. stork	-	-	-	-	-	-	-	-	-	-
Phoenicopteres ruber flamingo	-	4/1	-	1/1	-	-	1/1	-	-	-
Anatidae sp. duck	-	-	-	-	-	-	-	-	-	-
Numida meleagris guinea fowl	-	1/1	-	-	-	-	-	-	-	-
Pterocles namaqua sandgrouse	-	-	-	-	4/2	-	-	-	-	-
Oena capensis Namaqua dove	-	-	-	-	-	-	-	-	-	-
Larus dominicanus kelp gull	-	-	1/1	-	3/1	-	-	5/1	3/1	-
Tyto alba barn owl	-	-	2/1	1/1	1/1	-	-	-	-	1/1
Corvus sp. crow	-	-	1/1	-	-	-	-	-	-	-
Columbidae	-	-	-	-	-	-	-	-	-	-
Aves gen. et sp. indet.	34/8	11/2	28/4	27/9	80/12	12/2	6/4	8/2	14/4	9/4

shell middens (Cohen *et al.* 1992). "Lowest average sea surface temperatures are reached at *c.* 4200 BP, also from 3500 to 2300 BP, and again between 600 and 400 BP. Relatively warmer temperatures were established at 4330 and c. 750 BP" (Jerardino 1997:1034).

Oxygen isotope measurements of ostrich eggshell fragments from the 1987 excavations at Spoegrivier (by Dr J Lee-Thorp of the University of Cape), have been interpreted to reflect moisture (although some researchers believe that it reflects temperature) while the carbon values are believed to reflect vegetation. The carbon values indicates similar vegetation conditions throughout the period from 1300 BP to 2000 BP except for a tiny blip around 1850 BP toward more pure C3 vegetation. The oxygen isotope values indicate two relatively moister periods around 1400 BP and 1800 BP with a dry period in between around 1600 BP (Lee-Thorp pers.comm.) which may be equated with the Patella unit in the 1987 excavations.

Analysis of the micro-mammalian data from the 1987 excavations (Avery 1992: 116) show "relatively mild climatic conditions" *c.*1900 BP (AD 0-200). This may have been due to relatively cooler conditions at this time with possibly higher than average rainfall. The moderate amount of grass present in the vegetation surrounding the site, would have facilitated the introduction of sheep. A gradual reduction in the grass component by the time the site was abandoned (*c.*1300 BP) suggests a decline in rainfall and possible over-grazing. The oxygen isotope measurements and the micro-mammalian data do not support each other entirely and clearly further studies, particularly charcoal studies, may contribute to our knowledge of the environmental conditions in the north-western Cape during the late Holocene.

DISCUSSION

It is the period *c.*1900 to 1300 BP, represented by the upper units of Spoegrivier Cave, which are of particular interest to this study and are considered here in greater depth. During this period, sheep and pottery are present in small numbers. While there is a degree of continuity between the pre- and post-1900 BP period with regard certain aspects of the cultural remains, others show gradual changes. With the exception of a single accelerator date of *c.* 2100 BP, other accelerator dates for sheep fall in the period *c.*1900 BP and later.

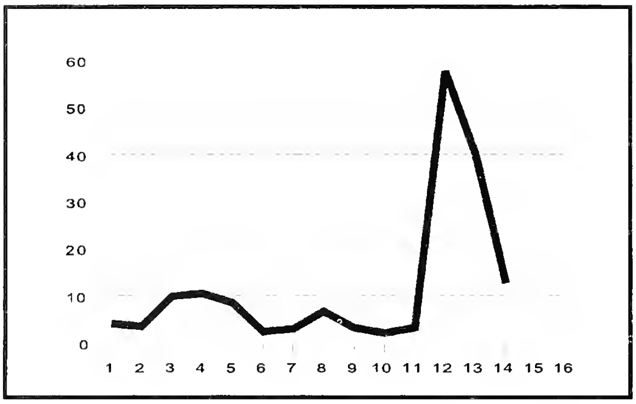

Figure 18. Number of unfinished ostrich eggshell beads per metre cubed.

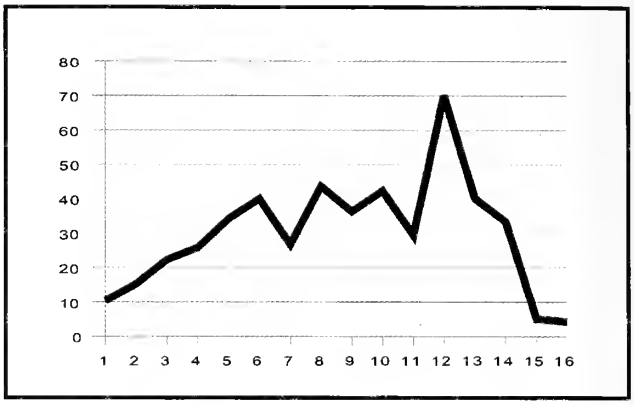

Figure 19. Number of completed ostrich eggshell beads per metre cubed.

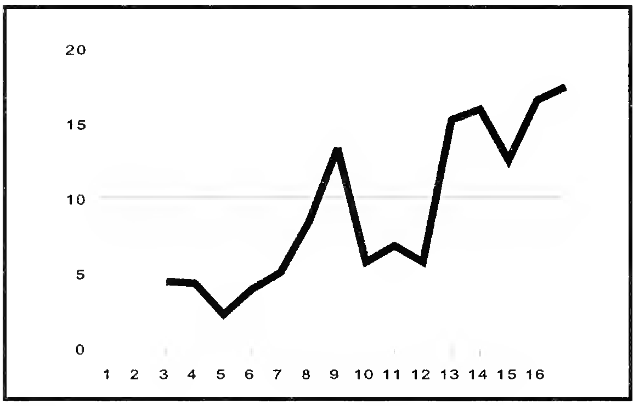

Figure 20. Number of stone artefacts per bucket.

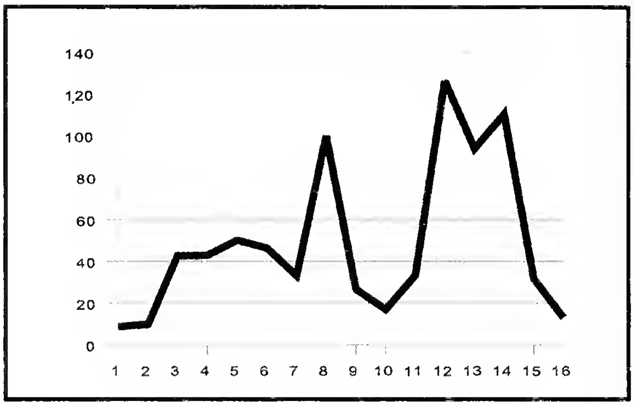

Figure 21. Grammes of bone fragments per bucket.

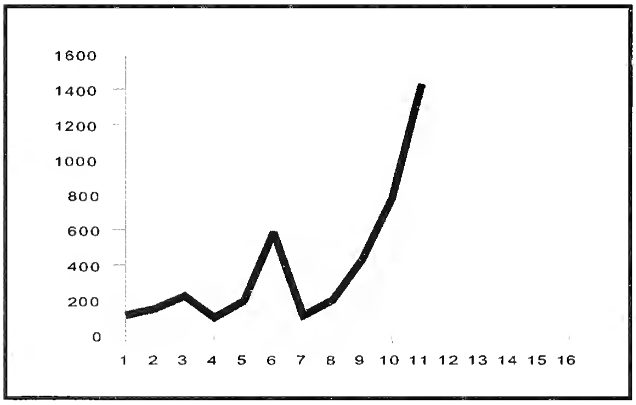

Figure 22. Grammes of shell per bucket

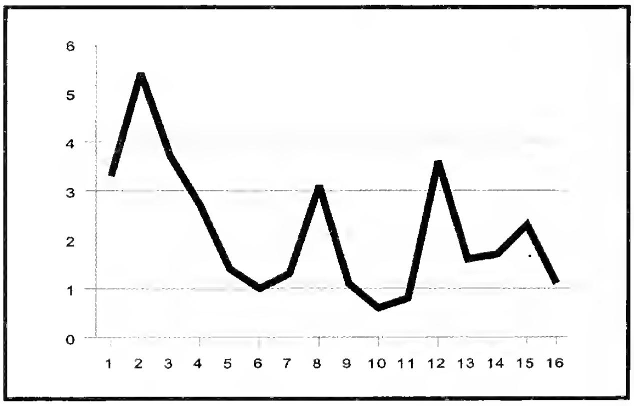

Figure 23. Grammes of ostrich eggshell fragments per bucket.

This accelerator date of 2100 BP may be anomalous (although it is within two standard deviations of the 1900 BP dates), but equally it is possible that it relates to an ephemeral occupation unit not distinguished during the excavations.

An examination of the distribution of sheep and pottery in these upper layers shows that sheep bones occur most frequently in Layer 5 while the largest number of potsherds occurs in Layer 3. It is not possible, with current dating methods, to suggest that they were introduced as a package. There is some evidence to suggest a hiatus between *c.*1400 BP and 1900 BP and that this disjuncture is located in Layer 6 itself. The obvious indicator for this hiatus is the roof spalls, microfauna, gravel partings, sticks and salt crystals observed in Twiggy 5c Base, Twiggy 5c Lower and Twiggy 5d (Layer 6a).

Neither sheep nor pottery occur in the bulk of the deposits of Layers 7 to 11 where they lie well away from the truncation. There is sufficient evidence to suggest that Layers 7 downwards predate *c.*2000BP and are pre-ceramic and pre-sheep. The *c.*1900 BP deposits appear to lie in a depression created by the site occupants and this begins with Twiggy 6. Isolated items may have found their way into the lower layers but the bulk of the material removed was probably deposited on the extensive talus slope.

The radiocarbon date of 2400 BP from SAS (Layer 10) may be a correct date and the sheep remains (with accelerator radiocarbon dating of 1890 BP and 1900 BP) may be intrusive, or the 2400 BP date itself may be wrong. It could be a mix of the *c.*3500 BP and *c.*1900 BP charcoals and the dates of the sheep could be correct. On the balance of the evidence, the former explanation seems more likely.

The broad spread in the age structure of the sheep remains (from neonatal to adult), suggests several possible scenarios for the Layers 1-6. One, hunter-gatherer groups were obtaining sheep from other early herding groups living nearby; two, they were herding sheep on a small scale; three, that the site functioned as a seasonal stockpost for early pastoralist groups in the area.

With regard the lithics, there is a substantial decline in the number of stone artefacts per bucket from Layer 7 to the surface. This could be ascribed to the change in the nature of the deposit, with the upper layers containing large amounts of plant remains. There is, however, little significant difference in the frequency of formal tools between the pottery layers and the pre-pottery layers immediately preceding them. Backed flakes and retouched pieces still occur and formal microlithic tools are not suddenly replaced by an informal assemblage. However, formal microlithic scrapers, which are found in the layers below Layer 6, are not found in the pottery layers at all. The absence of formal scrapers in the pottery layers can be linked to the recovery of a single *//khom* stone in Layer 3 which suggests that microlithic scrapers were being replaced by rough sandstone pebbles similar to those still used by Nama descendants in Namaqualand today (Webley 1990).

Quartz continues to dominate the lithic assemblage before and after the introduction of pottery with an average percentage of 80%. There is a small decline in the percentage of silcrete from 5% in Layers 7 & 8 to 1,8% in Layer 6. Quartzite numbers increase across the ceramic threshold and this increase (from 10% in the pre-pottery layers to 22% in Layer 4) can be ascribed to the larger numbers of flaked and fragmented pieces of ground stone from upper and lower grindstones. However, it is important to note that grooved stones stained with red ochre were found in both the pottery and pre-pottery layers. The lithics would suggest no significant difference in the technology practised between the early hunter-gatherer groups and later groups with domestic stock who were occupying the site. Similar observations regarding the absence of changes in lithic forms with the introduction of ceramics have also been made with respect to Falls Rock Shelter (Kinahan 1991) and Geduld (Smith & Jacobson 1996) in Namibia.

The 1994 excavations confirm a slightly thinner mean sherd thickness for pottery from Layers 6 and 7 as opposed to Layers 1-5. However, there is no evidence for changes in pottery style and decorative attributes between 1900 BP and 1300 BP. Bone artefacts, too, do not show an increase or decrease in numbers with the advent of pottery. There are, however, some differences in material culture between the pottery and pre-pottery period. Decorated ostrich eggshell fragments and square beads were recovered from the earlier period but are not found above Layer 7. Bead diameters increase in size across the ceramic threshold. They remain consistent between 4,2 mm and 4,4 mm from Layer 15 to Layer 7. However, in Layer 6b they increase to 4,9 mm, and again to 5,2 mm in Layer 6a. According to Yates (1995), mean diameters of between 4,1 mm and 4,8 mm have been measured for pre-pottery OES beads in Namibia and the Cape (for the period c.2300 - 2100 BP). While the "earliest post-pottery OES bead assemblages tend toward average diameters of 5,0 mm or more. Means of around 6,0 mm only commence in the Cape after *c.*1600 BP" (1995:17). Clearly, these more recent excavations at Spoegrivier confirm Yates' observations from elsewhere in Namibia and the Western Cape (Yates 1995:17).

Faunal remains (grammes of bone fragments per bucket) decrease sharply from Layer 7 to Layer 6, while ostrich eggshell fragments increase in the pottery layers. Apart from the invertebrate remains, the most common faunal remains are Cape Fur Seal. This marine mammal also predominates at Kasteelberg and at Duiker Eiland, confirming observations that it was of great importance in the diet of coastal dwellers during this period. With regard to the shellfish frequencies, Spoegrivier Cave may be contrasted with other West Coast shell middens dating to the mid- and late-Holocene. Mike Taylor's Midden at Elands Bay (Jerardino & Yates 1997), with 10 out of its 14 dates clustering in the period 2000 - 2400 BP, overlaps with Layers 7 to 10/11 at Spoegrivier Cave. The MTM invertebrate assemblage shows that shellfish gathering was focussed on the collecting of black mussels (80-90%) at this time, which is exactly the opposite of the pattern observed at Spoegrivier Cave where limpets predominate and amount to 80% of the total(Table 13).

Further south, in the Eland's Bay area, black mussels appear to be dominant before 1800 BP, after which limpets, barnacles and whelks become increasingly more common. Limpets dominate at the site of Duiker Eiland on Cape west coast, during the period 1900 - 1700 BP. Since, notes the excavator (Robertshaw 1979) black mussels are toxic during the summer months, their absence or low frequency at the site may suggest summer occupation.

CONCLUSIONS

The new excavations provide further evidence that Namaqualand was settled, albeit very sporadically, during the pre-2000 BP period (Jerardino *et al.* 1992). As a result of the 1987 excavations at the site, the occupation levels were divided into 3 `Phases'(Webley 1992). The new excavations support a re-assessment of this scheme. The archaeological evidence suggest four occupation phases at the site:

1. An initial occupation at the beginning of the Holocene;
2. An intensive occupation by hunter-gatherers *c.* 3500 BP;
3. A brief occupation by hunter-gatherers *c.* 2400 BP;
4. The emergence of a herding society around *c.*1900 BP - 1300 BP. The site is abandoned around 1300 BP for a variety of reasons which seem to include a change in the localised vegetation as a result of increasing aridity, as well as possible social factors.

First Phase

The large scrapers in the basal units of Spoegrivier suggests a possible `Albany' related industry although this clearly needs to be dated. Research further south, in the Eland's Bay and Lambert's Bay areas, indicates that there was an occupational hiatus between 7700 BP and 4400 BP (Jerardino & Yates 1996) and this seems to be supported by the exeavations at Spoegrivier.

Second Phase

Jerardino (1997) has shown that a 2 m rise in sea levels around 4000 BP to 3800 BP at Eland's Bay would have profoundly affected the shoreline. A 2 m rise in sea levels further up the coast at Spoegrivier Cave would have pushed the sea up into the estuary and much closer to the cave. Present mussel beds would have been inundated and this would have affected the availability of shellfish species. At any rate, there are no radiocarbon dates from Spoegrivier Cave to indicate that the site was occupied at this time. There are however, two dates of 3500 BP and in this respect the site resembles those further south at Eland's Bay. According to Jerardino (1997:1034) the "first signs of relatively fast accumulation of shell midden deposits and intensive shellfish consumption date to around 3500 BP". Further, the complex stratigraphy at Steenbokfontein at Lambert's Bay, south of Spoegrivier Cave, (Jerardino & Yates 1996) for the period 3600 BP to 2200 BP, which includes truncations of the deposit and infilling, is also mirrored in the lower levels at Spoegrivier.

During the period *c.*3000 BP to 2000 BP, according to Jerardino & Yates (1997:50), hunter-gatherer groups experienced "dramatic changes in subsistence and settlement choices....before the introduction of pastoralism in the western Cape". This is the period when "shellfish exploitation was greater than at any other time in the Holocene", when "enormous shell middens (named "megamiddens") containing tons of black mussel shells and few faunal and cultural remains accumulated immediately behind rocky platforms" (Jerardino 1997). The isotopic measurement on skeletons found on the West coast indicate that the hunter-gatherer diet between 3000 BP and 2000 BP was more marine than at any other period (Jerardino 1997). Excavations at Steenbokfontein Cave in the Lambert's Bay area have confirmed that hunter-gatherers during the period 3500 BP seem to have concentrated on exploiting marine resources in addition to snaring small animals rather than the hunting of large animals (Jerardino & Yates 1996). Shellfish densities at Spoegrivier are at their highest between Layers 14 and 6 (i.e. from 3500 BP to 1900 BP) which would support the results from the Eland's Bay area. There is also a substantial increase in marine birds such as Cape cormorant at this period, suggesting a more intensive exploitation of marine resources.

Third Phase

However, during the period 2000 BP "the scale of shellfish exploitation was dramatically reduced" with "the pre-colonial diet predominantly of terrestrial origin" (Jerardino 1997:1035). She has indicated that the changes in shellfish exploitation seems to have been the result of a "succession of different subsistence strategies and related changes in settlement patterns and population increase". This period is possibly represented by Layers 7 - 10 (2400 BP) at Spoegrivier and it would appear that shellfish densities are quite low although crayfish numbers are high and there is a dramatic increase in the utilisation of marine birds.

Fourth Phase

There are in fact very few sites along the coast which date to the first few centuries immediately after the introduction of pottery and domestic stock; Jerardino and Yates (1997:49) point out that Mike Taylor's Midden at Eland's Bay is one of only three sites in the area to span this time period. However, sites which do span this significant time period, seem to suggest changes in the variety/range of foodstuffs being utilized after 2000 BP. It has been suggested (Parkington *et al.* 1986) that increased population pressure with the arrival of pastoralist groups would have resulted in competition over resources, resulting in less desirable foodstuffs being exploited by hunter-gatherer groups.

The new accelerator dates for sheep from Spoegrivier Cave are important. They show that sheep are consistently archaeologically visible in the northern and western Cape *c.* 1900 BP (4 dates from Spoegrivier and 2 dates from Blombos).

However, were these people with domestic stock living at Spoegrivier during the period 1900 BP to 1300 BP pastoralists or, as Sadr (1998) would define them, hunter-herders? In his review, Sadr (1998) postulates 2 models, the one being a migration of Khoe-speakers with sheep and pottery around 1900 BP, the other being a diffusion of pottery and sheep to hunter-gatherer groups at least 1000 years before the migration of Khoe-speakers. According to the first model, sheep and pottery appear as a package. Initially, conventional radiocarbon dates suggested that sheep had been introduced to the site several hundred years <u>before</u> pottery (Vogel *et al.* 1997), the accelerator dates have now confirmed that they appear to have been introduced at approximately the same time. However, it is important to note that sheep occur most frequently *c.* 1990 BP and that pottery is only present in significant numbers after *c.*1400 BP. Discussions on pottery style are more difficult to critically review here because of the fragmented nature of the sample from Spoegrivier as well as the limited number of decorated sherds from the site. It is not possible to support either of Sadr's two models on the basis of the information presented above.

Arguments around migration versus diffusion *c.*1900 BP are difficult to resolve. A brief summary of the material culture from the site suggests that the evidence is not conclusive. The lithics do not support the arrival of a new group with a different stone tool technology; the grooved stones covered with red ochre point to a continuation of certain ritual/cosmetic activities after the introduction of pottery and sheep; the bone tool technology is not well developed and does not exhibit any changes. Variations in shell fish frequencies around *c.* 1900 BP appear to be slight. However, the introduction of sheep and pottery is accompanied by a increase in the size of ostrich eggshell beads and a decrease in the volume of faunal (including avian) remains. The large amount of plant remains in the upper, pottery bearing deposits may be related to the better preservation of these remains.

Sadr (1998) has argued that the earliest evidence for the actual migration of Khoe-speakers is related to a cultural disjunction which he recognises at Kasteelberg, and which dates to around 1200 - 900 BP. Spoegrivier was abandoned at 1300 BP, possibly due to increasing aridity at this time. However, it is also possible that there may have been a change in herding strategies at this critical period (see Webley 1992b), but a definitive answer awaits more substantial research and sites which span this period.

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