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Restoring context and identity to mummified human remains from South Africa: uncovering hidden information

Lucille Mary Pereira

A dissertation submitted to the Faculty of Science, University of the Witwatersrand, Johannesburg, in fulfilment of the requirements for the degree of Master of Science

Declaration

I declare that this dissertation is my own, unaided work. It is being submitted for the degree of Master of Science in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in any other University.

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_____ day of _____2008

Abstract

Mummified human remains are in effect cultural and biological museums, recording a wealth of information on the life and death of the individual as well as the socio-cultural beliefs of those involved in the collection and curation of the specimen. During the 1930's, the mummified remains of a single individual (TM PAL 92-136) and associated artefacts were donated to the Transvaal Museum. Detailed provenance data were not recorded. A multi-disciplinary approach is followed to restore context and identity to the remains.

TM PAL 92-136 was an adult female in her early to middle twenties who stood at 1.58 m when she died. The extraction and amplification of aDNA from a rib showed her ancestry to be Khoe-San, yet she lived at a time of contact between Iron Age pastoralists and traditional hunter-gatherers ~AD 1160. The extent to which she was immersed in either way of life cannot be gleaned from the data apart from to say that she was most probably associated with a semi-sedentary agricultural lifestyle. She appears to have died of natural causes as no pathologies are evident on the body. Perhaps frailty or malnutrition made her susceptible to illness although the absence of enamel hypoplasia suggests that she was exposed to little dietary stress during her life. Perhaps the cause of death was one that does not leave visible traces on skeletal remains. The body became covered in iron-oxide rich sediment from the Waterberg Group shortly after death resulting in natural mummification of the remains. Outer extremities became exposed some time later and were broken. The extremities are no longer mummified, have stepped fractures and were exposed to fire. In the 1930's the remains were discovered, possibly by people carrying candles in a dark environment

such as a cave or mineshaft, who spilled wax on the cranium. Dr Frederik Ludorf – a man in his thirties of German and missionary descent – donated the remains to the Transvaal Museum in Pretoria.

Human skeletal remains were highly sought after at the time as specimens in the study physical anthropology and presumably for display. Robert Broom accepted the remains applying a designation of 'Koranna' to it – despite later admitting that he'd 'made up' the classification. In order to fit into the display cabinet, the remains were deliberately broken and folded over at the knees. Following public disapproval about the display of human remains, the remains are now stored in the basement of the NCHM. 'Museum beetles' (*Dermestidae* sp.) have caused slight damage to the remains. The remains have been returned to the museum along with the results from this project.

To my parents,

Marjorie and Gabriel Pereira

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I have come to know the inside of the reading room at the National Archives in Pretoria intimately though this project. Thank-you Ludwig Döhne for the initial crash course on using the national archival resources. Thank-you Wanda Brown (neé Ludorf) and Norma Ludorf (and extended family) for your enthusiasm, information and cups of coffee. Jacqui Smilg is thanked for facilitating the CT-scanning at Johannesburg Hospital. Alan Cooper from the National Geographic Genographic Project was enthusiastic from the beginning and provided the ancient DNA analysis. Thank-you Himla Soodyall and Trefor Jenkins for guidance around ancient DNA.

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Presentations

This work has been presented at the following conference:

Pereira, LM. 2006. Preliminary report on restoring context and identity to mummified remains from South Africa. Palaeontological Society of South Africa. Grahamstown.

Abbreviations

aDNA:	Ancient DNA
amtDNA	Ancient mitochondrial DNA
ICLS	Interstrand cross-links
CAM	Crassulacean Acid Metabolism
CSIR	Council for Scientific and Industrial Research
mtDNA	mitochondrial DNA
NAAIRS	National Automated Archival Information Retrieval System
NCHM	National Cultural History Museum
PPRI	Plant Protection Research Council
PRECIS	Pretoria Computerised Information System
QUADRU	Quaternary Dating Research Unit
SACS	South African Committee for Stratigraphy
TM	Transvaal Museum
UP	University of Pretoria
Wits	University of the Witwatersrand

Miscellaneous

In this text, except in the quotations, modern terminology, which is less derogatory and more precise, will be used: 'San' instead of 'Bushman', 'Khoe' instead of 'Hottentot', '!ora' instead of 'korana' or 'Koranna', and [following Crawhall (2006)] Khoe-San instead of Khoi-San.

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Chapter 1 – Introduction

General Introduction

Mummified human remains are in effect cultural and biological museums, recording a wealth of information on the life and death of the mummified individual as well as the socio-cultural beliefs of those involved in the collection and curation of the specimen. Ancient human remains with some degree of soft tissue preservation are rare in South Africa. Haughton and Wells (1942) mention soft tissue preservation on human remains from a cave near Potchefstroom. More recently, mummified remains have been reported from Faroskop (Manhire, 1993), the Kouga Mountains (Binneman, 1999; Steyn *et al*., 2007), the Pakhuis Mountains (Sealy *et al*., 2000), Steenbokfontein (Jerardino *et al*., 2000), the Makapans Valley (Esterhuysen, 2006) and a naturally mummified brain has been studied from the Bushveld of South Africa (Eklektos *et al*., 2006). The majority of ancient human remains reported in the literature are however skeletonized, leaving only the bone available for observation. Mummified remains potentially contain a wealth of information on such diverse topics as sex, stature, genetic affiliation, palaeo-diet, mobility patterns, pathology, and ancient dermatological pathologies and disease.

Mummification refers to the state of arrested decay of a once living body of tissue (Aufderheide, 2003). This may result through intentional (anthropogenic) means which have cultural significance (such as most Egyptian mummies) or natural circumstances. The post-mortem interval in which decay is resisted can vary from a few months to 20 000 years or more – as is the case in some mammoths (Zimmerman and Tedford, 1976).

Immediately following death the enzymatic process of autolysis (self-destruction) begins. Enzymes enhance specific chemical reactions. During autolysis, the chemical reactions pertinent to the decay process are those that break down the large protein, fat and carbohydrate molecules composing the various body structures in ever smaller fragments. These final products of the progressive splitting of large molecules into smaller ones are mostly soluble in water or evolve as gas. At this stage of the tissue destruction, the end products are either ingested by living agents such as bacteria or other microbiota, insects or predators which use other enzymes to transform them into new compounds, the simple end products react with environmental substances such as soil, water and air (Aufderheide, 2003).

An arrested state of decay (mummification) occurs when the action of the chemicals involved in the enzyme-dominated decay process are retarded. Factors that influence enzyme activity include temperature, humidity, substrate specificity, acidity, types of micro-organisms, insects and carnivores present, time and the condition of the body. Mummification is the product of desiccation of soft tissue. Consistent hot and dry environmental conditions are optimal for mummification because rapid drying of soft tissues prevents putrefaction by enteric microorganisms, soil bacteria and other decay organisms (Aufderheide, 2003; Sledzik and Micozzi, 1997). Rate of mummification therefore varies across different environments, and can result in as little as 2 weeks (Mann *et al*., 1990).

During the 1930's, the mummified remains of a single anatomically modern individual (TM PAL 92-136) were donated to the Transvaal Museum and

subsequently relocated to the National Cultural History Museum (NCHM) in Pretoria. The acquisition papers (fig. 2.22) record simply that the specimen is “Koranna”, “[came] from a cave west of Bronkhorstspruit” and were “[d]onated by Dr F Ludorf”. Together with the skeletal remains in the museum display cabinet, eleven artefacts of floral material and one stone were found. For the purposes of this study, it is assumed that these artefacts were associated with the individual in life and not placed in association with the body at the whim of the curator post museum acquisition. As far as is known, the remains have not been studied previously.

Current ideological frameworks which recognise the sensitivity and value of human remains beg that the remains receive further attention. This is in line with the International Council of Museums (ICOM) Code of Ethics that urges that "all items accepted temporarily or permanently by [a] museum are properly and fully documented to facilitate provenance, identification, condition and treatment." (ICOM Code of Ethics for Museums, Section 6.2, available at http://icom.museum/ethics.html). Diligent research efforts towards determining the provenance of collected human remains and providing context is particularly pertinent in South Africa as they go some way towards redressing some of the appalling methods used to obtain some of the specimens (Morris and Jacobson, 2000). Indeed, Jacobson (1999 in Morris and Jacobson, 2000: 78) asks "whether we, as museums, or as a community of archaeologists or of anthropologists, can make use of this evidence without giving careful thought to the manner in which human remains were obtained."

The objective of the dissertation is to provide a fuller biological and historical context to TM PAL 92-136. The study is descriptive in nature and structured to address the following aims:

i. To establish the age, sex and stature of the individual
ii. To establish any occurrence of pathology
iii. To assess taphonomic signatures on the remains
iv. To establish the general diet of the individual
v. To date the remains
vi. To establish the cultural and ethnic affinity of the individual
vii. To establish the area whence the remains derive
viii. To offer possible scenarios surrounding death
ix. To establish the socio-historico-cultural context of the collection and acquisition of the remains

Techniques in the investigation of material remains from the past are constantly being developed and refined. Hence new research possibilities arise - the nature of which can seldom be predicted in advance. The key to providing context to ancient remains is to undertake a multi-disciplinary approach drawing on as many techniques as is allowed for by time and budget to illicit clues to that context. Perhaps the most famous research on mummified remains which drew on a multi-disciplinary approach is that of the naturally mummified 5 300 year old Ötzi Iceman from the Austrian-Italian border. Researchers were able to establish, *inter alia*, the stature, live weight, last meal, surrounding environment, tattoos, cause of death and genetic profile of the mummy (e.g. Bortenschklager and Oeggl, 2000; Muller *et al*., 2003; Murphy Jr *et al*., 2003; Ruff *et al*., 2006).

To fulfil the aims of the project, the dissertation is structured around the following sub-topics:

A. Skeletal Analysis
B. Bone Taphonomy

C. Ancient DNA

D. Stable Light Isotopes

E. Forensic Entomology

F. Floral Analysis

G. Geological Analysis

H. Dating

I. Cultural Artefacts

J. Ethnographic and Historical Analyses

It is hypothesised that

- The remains are of an adult female
- The individual died of natural causes
- The remains date from the last 200 years
- The remains are Iron Age Bantu remains
- The remains come from the Bronkhorstspruit area

Literature Review

A. SKELETAL ANALYSIS

The study of the skeletal elements of a single set of human remains allows for the determination of demographic characteristics such as age, sex and population affinity. Characterisitcs indicating sex and 'race' can be studied metrically and morphometrically. Because populations differ in size the metric standards in particular require that population specific standards be employed. Much of the literature on standard physical anthropological techniques available speaks to

Northern Hemisphere archaeological and recent remains. There is far less literature available describing developmental and chronological age in pre- proto- and historical African populations, although this situation is slowly being rectified. Various researchers have contributed towards the development of osteological standards for identification of South Africans, such as Washburn (1949), Keen (1950), De Villiers (1968a; 1968b), Macho (1990), Lundy and Feldesman (1987), Kieser *et al*. (1992), Loth (1996), Loth and Henneberg (1997), Steyn and İşcan (1997), İşcan and Steyn (1999), Asala (2001), Oettlé and Steyn (2000) and Patriquin *et al*. (2003). The dissertation draws on the most appropriate modern contributions in assigning biological delineation.

The assessment of ethnic origin remains one of the most difficult tasks in forensic osteology, as culturally or politically defined groups do not necessarily coincide with biological parameters. However, the biological basis of human variation is an important concept for both the evolutionary biologist and the physical anthropologist. It must be stressed that this modern view solely reflects on adaptive responses and is well removed from antiquated typological constructs. Thus, a current understanding of the variability of modern *Homo* always reflects genetic influences as well as factors of the natural and social environment (Steyn, 1995; Kemkes-Grottenthaler, 2001)

As Morris (2000) points out, with the exception of forensic sciences, typology as a method of exploration of human variation is dead. Questions of racial purity and appropriate type specimens are now rarely heard and the kind of collecting which drove early 20th century illicit activities is now gone. The measurements and statistical techniques applied today are chosen to aid in identifying population clusters as a means to establishing population affinity. It can be recognized that there are

recognizable genetically based (phenotypic) differences in the flesh and in the skeleton amongst *Homo* although the nature of race remains hotly debated (e.g. Patriquin *et al*., 2003). Significant metric and morphologic biological differences exist among the three major racial phenotypes, namely Caucasoid, Mongoloid and Negroid as well as at the population level.

Skeletal analyses further provide information on the stature at death of the individual and possible trauma during the individual's lifetime.

B. BONE TAPHONOMY

Taphonomy is the study of a decaying organism over time. The term taphonomy, (from the Greek *taphos* meaning burial, and *nomos* meaning law), was introduced by Efremov and describes the study of the transition of remains, parts, or products of organisms from the biosphere, to the lithosphere. The study of taphonomy stresses the recognition and evaluation of the extent to which fossil assemblages are biased records of ancient life (Behrensmeyer and Kidwell, 1985).

Properties of Bone

In taphonomy it is crucial to understand how bone's response to force affects process. Breaks in mineralised, peri-mineralised, fresh and dry bone all produce distinguishable patterns when failure occurs (Johnson, 1985). The composite nature of mammalian bone can be seen at the ultrastructural, microstructural and macrostructural levels. Typically, long bones consist of cancellous bone at the epiphyseal ends and compact bone at the diaphysis. The significance of this becomes apparent when looking at representation and completeness of recovered remains.

Compact bone consists of concentric cylinders (lamellae) of matrix called osteons (Haversian) systems each of which act as a weight-bearing pillar. Osteons are laid down around a central (Haversian) canal, containing the blood vessels that supply osteocytes (mature bone cells) with nutrients and oxygen. Bone matrix is maintained by osteocytes, which are found in lacunae (chambers) at the junctions of lamellae. On the ultrastructural level, an organic matrix of collagen fibres (protein), in which are embedded hydroxyapatite crystals, align with the fibre axis. Collagen fibres are either arranged randomly, or may be oriented in a predominant direction such as in lamellar bone. Lamellar bone is composed of lamellae in which orientation may differ from one lamella to the next (Johnson, 1985). Osteons are the mechanical unit of compact bone. It is the interaction of the organic collagen fibres and inorganic hydroxyapatite crystals that govern bones' response to external stimuli. On a microscopic level, compact bone fracturing is directly related to the amount and distribution of osteons, the distribution and orientation of collagen fibres, and the combined response to force of osteons and collagen fibres (Evans in Johnson,1985). Cancellous (spongy) bone is situated within compact bone and consists of an open network of plates and columns known as trabeculae that make it both light and strong.

Bone microstructure is the principle mechanical unit governing bone failure, however moisture content also plays a role. The resultant fracture pattern and bone response begins on the microlevel. The more fresh the bone, the more pliant its nature and *vice versa.* Green (fresh) bone is a visco-elastic and ductile material that is capable of withstanding great amounts of pressure and deformation before failure. After a certain limit is exceeded, microcracking represents the maximum strain to failure. To

understand bone breakage, agency and process should be reliably established. According to Johnson (1985), it boils down to the difference in how force is applied to bone, how the bone responds to that force, and the cortical damage resulting from manipulation of the bone.

Distinction between static and dynamic loading is necessary when inspecting assemblages. Large carnivores tend to employ static loading in which a constant compressive pressure is applied resulting in even distribution of force. Hominids tend to employ dynamic loading, which is a high velocity impact technique (Bonnichsen, 1979, Johnson, 1985). Under SEM, the dynamic fracture surfaces appear roughened and stepped as it was torn apart with extreme force (Shipman in Johnson, 1985). Johnson (1985), Shipman (1981) and Bonnichsen (1989) provide excellent guidelines on distinguishing fracture and failure morphologies in bone accumulations (fig. 1.1). Weathering, trampling, torsional loading (twisting), and others are distinguished by bone inspection.

Non-biotic agents of modification

Modification of bone can result from a number of physical and/or chemical processes. Non-biological agencies include weathering, root etching, sand and wind abrasion and burning (Lyman, 1996). Space does not permit a detailed discussion of each agency and instead weathering and burnt bone are focused on as examples. Different agencies of modification effect different diagnostic markings (table 1.3). There has been caution and criticism in the literature regarding the possibility of mis-identification based on 'mimicry' amongst cutmarks, percussion marks and carnivore tooth marks (e.g., Potts and Shipman (in Blumenschine *et al*, 1996). However,

Blumenschine *et al*. (1996) found a strong positive correlation in accuracy when conducting blind tests between several analysts.

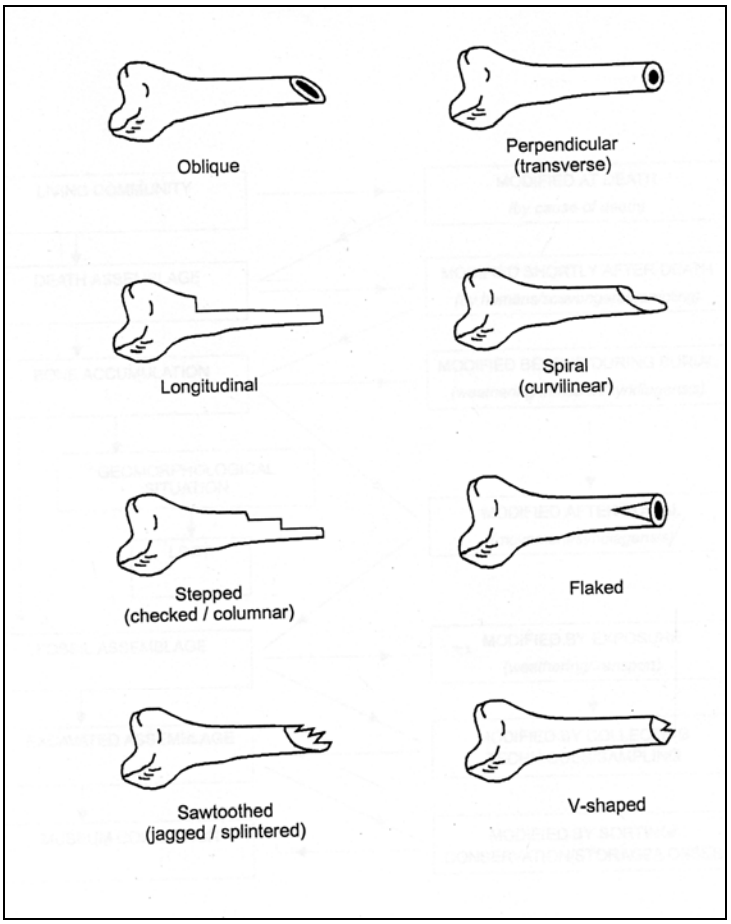


Figure 1 .1: Distinctive bone breakage patterns (after Shipman *et al*., 1989 and Marshall, 1989 in Backwell, 1999).

Weathering

The process by which the original inorganic and organic components of bone are separated from each other and destroyed is termed weathering (Behrensmeyer, 1978). Weathering results from either chemical or physical agents in the pre- or post-burial stage *(ibid*.) and varies according to macro- and micro- conditions (Behrensmeyer, 1978, 1982). On a single bone for example, weathering is usually more advanced on the upper (exposed) surface than the lower (ground contact) surface, except in highly

alkaline soils where this is reversed and salts crystallize on the bone surface (*ibid*.). In addition, micro- conditions favouring bacterial, fungal, or root growth may speed up the weathering process. Data from weathering intensity observed on bone can provide an estimate of the length of time an assemblage, or part thereof, remained exposed prior to burial.

Behrensmeyer (1978) developed a model for categorising six weathering stages (table 1.1). This table is particularly useful because it goes some way towards allowing for inter-analyst conformity in describing the state of weathering in their assemblage, even though there will always be some degree of subjectivity.

Table 1.1: Stages in bone weathering (after Behrensmeyer, 1978).

STAGE	CHARACTERISTICS
0	Bone surface shows no signs of cracking or flaking due to weathering. The bone is still usually still greasy; the marrow cavity contains tissue; and skin and muscle/ligament may cover part or all of the bone
1	Bone shows cracking, normally parallel to the fibre structure. Articular surfaces may show mosaic cracking of covering tissue as well as in the bone itself. Fat, skin and other tissue may or may not be present
2	Outermost concentric thin layers of bone show flaking, usually associated with cracks, in that the bone edges along the cracks tend to separate and flake first. Long thin flakes with one or more sides still attached to the bone are common in the initial part of Stage 2. Deeper and more extensive flaking follows, until most of the outermost bone is gone. Cracked edges are usually angular in cross-section. Remnants of ligaments, cartilage, and skin may be present.
3	Bone surface is characterised by patches of rough, homogeneously weathered bone, resulting in a fibrous texture. In these patches all the external, concentrically layered bone has been removed. Gradually the patches extend to cover the entire bone surface. Weathering does not penetrate deeper than 1 – 1.5 mm at this stage, and bone fibres are still firmly attached to each other. Cracked edges are usually rounded in cross-section, and tissue is rarely present at this stage.
4	The bone surface is coarsely fibrous and rough in texture. Large and small splinters occur and may be loose enough to fall away from the bone when it is moved. Weathering penetrates into inner cavities. Cracks are open and have splintered or rounded edges.
5	The bone is now fragile and easily broken if moved. It begins to fall apart in situ, and large splinters lie around what remains of the element. The original bone shape may be difficult to determine at this stage.

Burnt Bone

Descriptions of the characteristics of cremated bone have come from the anthropological and medicolegal communities. Colour change, shrinkage, fragment survival, fracture patterns, weight changes and histological changes have been described through a wide range of research techniques using various experiments when bone is exposed to various temperatures (e.g. Binford, 1963; Buikstra and Swegle 1989; Shipman *et al*., 1984). The range of colours which may be found on a single cremated bone fragment range from brown to gray-blue, black, gray-white and chalk-white. Mayne Correia (1997) provides a review of the literature on fire modification of bone. Table 1.2 is drawn from her work and describes reasons put forth in the literature for the different colours found on cremated bone.

Table 1.2: Reasons for the variability in colour of cremated bone evident in the archaeological record (after Mayne Correia, 1997).

Colour of cremated bone	Reason(s) for colour alteration	References
Brown	Associated with haemoglobin and/or soil discoloration	Gejvall, 1969; Lisowski, 1968
Black	Carbonization of bone burned in an oxygen-starved state	Herrmann, 1970
Gray-blue and gray	Result as the organic components of bone are pyrolized	Dokládal 1969, 1970; Shipman *et al*. 1984
White	The final stage of calcinations where the china-like texture of the bone represents a complete loss of organic portion and the fusion of bone salts	Shipman *et al*. 1984
Green	Presence of copper, bronze or iron the in surrounding environment	Dunlop, 1978; Gejvall, 1969 and Lisowski, 1968

More dense bone and those well embedded in muscle tissue are most likely to survive cremation. Spence (1967) found that the bones least likely to survive extremely high

temperatures are the zygomatics and frontal bone (13,6%), sacral vertebra, clavicles, and carpals (18,2%).

Table 1.3: Some characteristics and agents of bone collectors in caves. The table was compiled from: Brain (1981), Lam (1982), Skinner and Smithers (1991), De Ruiter (2001), De Ruiter and Berger (2000) and Marean and Cleghorn (2003).

COLLEC-TING AGENT	ORGANIC REMAINS COLLECTED	BEHAVIOUR
Hyaena	Scavenge whatever food is available including fish and tortoises. Regurgitate indigestible residues of recent meals. Overrepresentation of cranial remains. Hunt animals as large as adult waterbuck, eland and buffalo. May store food in water for future consumption. Variability in behaviour has been noticed.	Gnaw bones with incisors and canines, Crack bones with premolars. Characteristically get gnawed distal end and ragged margin at distal end.
Leopard	Carries or drags its prey some distance to feeding site, may store carcass in tree, however, when available, will preferentially utilise deep recesses of caves; are opportunistic	May find diagnostic puncture marks on crania.
Black eagle	Probably never enter caves: consume large numbers of dassies whose remains accumulate below their nests. If the nest or perch is within the catchment area of a cave mouth, black-eagle food remains will form part of the bone accumulation in the cave.	Food remains: mainly cranial parts, pelvises and larger limb bones. Eagles' sharp recurved bill frequently leaves characteristic round opening in the braincase.
Porcupines	Porcupines carry more bones to African caves than does any other species (Brain (1981). Shows little interest in fresh bone with meat on them. Gnaw bone to wear down the incisors. – may provide the porcupines with the mineral salts they require.	Typical gnawing marks on defatted and frequently weathered bones Importantly, porcupines do not gnaw on all of the bones that they take to the site.
Owls	The microfaunal dietary remains are good reflections of the habitat. Represent pellet accumulations	Accumulations of microfaunal remains.
Humans	Forage, scavenge and hunting strategies	Diagnostic surface markings as a result of butchery, preparation for cooking, bone tool manufacture and use and burning

Biotic agents of bone modification

The main biotic collecting agents relevant to southern African sites are listed in table 1.3. Animal and human colleting tendencies are reported, as well as diagnostic signature patterns seen on the faunal remains associated with the agent collecting and feeding strategies.

Bearing the above considerations in mind, a great deal of information about the history of a bone assemblage can be gleaned from knowledge of the kinds and frequencies of the bone represented and bone breakage patterns.

Selective representation of human remains

Selective representation results from differential sorting due to selective dispersal and/or transport of some elements to or away from the sampled locality and also to differential destruction due to structural properties and nutrient content of the bones themselves and to selective destruction of some elements and preservation of others during dispersal and transport (Marshall, 1989).

Differential destruction of bone elements results because different skeletal elements have distinct and regular durabilities in the face of any physical agent of attrition. The more dense the bone (dense bones include podials, astragali and phalanges), the higher its 'potential survival rating' because weaker , low density bones (ribs, vertebrae) are easily destroyed by postdepositional processes; comminuted by weathering, trampling, post-death breakage, scavenging and winnowing away by fluvial processes (Marshall, 1989).

C. ANCIENT DNA

DNA found in ancient remains yield new information about the origins, spread, interaction and culture of those individuals. Ancient mitochondrial DNA (amtDNA) has been used to determine biological distance by comparing variable DNA segments in samples from ancient skeletal populations or blood (e.g. Merriweather 1999 and Moraga *et al*., 2000). For example, hybridization of genomic DNA isolated from modern humans and that from the clavicular and parietal fossils on *Homo neanderthalensis* from Croatia and Germany respectively have revealed considerably more divergence than similar analyses using DNA from early *Homo sapiens* remains from Vogelherd Cave in Germany (Mitchell *et al.,* 2005). amtDNA from a 29 000-year-old specimen recovered from Mezmaiskaya Cave in Caucasus supported this finding as well as suggesting that modern human evolution was not multiregional (Ovchinnikov *et al.,* 2000). Infectious agents such as *Mycobacterium tuberculosis* (e.g. Nerlich *et al.*, 1997), leprosy (e.g. Rafi *et al*., 1994) and Chagas' disease (e.g. Madden *et al.*, 2001) have been identified in ancient specimens. Coprolite studies have identified the source (specific animal) of ingested meat (Aufderheide, 2002).

DNA is a relatively unstable biological molecule and damage can accumulate over extended periods of time. Paäbo (in Mitchell, 2005) extracted DNA from the dry remains of soft tissues ranging from 4 to 13 000 years old. The purified DNA was of low molecular weight and exhibited extensive damage including modified pyrimidines and sugar residues, abasic sites, interstrand cross-links (ICLs), and deamination products. While much of the damage probably results from spontaneous degradation, a significant portion may arise from environmental exposures such as

low level radiation of genotoxic chemicals. The rate of DNA degradation is very slow at temperatures <0˚C, but over extended time periods significant amounts of damage will occur (Mitchell *et al.*, 2005). However, Mitchell *et al.* (2005) found that DNA yields were relatively robust. Paäbo (*ibid*.) found no correlation between the degree of fragmentation and the age of the specimen, but suggested rather that desiccation might be an important factor in DNA degradation. Indeed it has been shown that 99% of DNA isolated from mummified tissue is depolymerised and chemically modified. To further complicate the issue, mummified tissues contain unidentified inhibitors that inhibit PCR reaction.

mtDNA in particular is important in evolutionary studies. mtDNA has characteristics such as a high copy number, lack of recombination, high substitution rate and inheritance on the matrilineal line (Ballard and Whitlock, 2004). Because mtDNA is maternally inherited, the only source of mutations separating two mtDNA types is a direct measure of the length of time since they shared a common ancestor. Because it evolves rapidly, it is useful for comparisons involving closely related populations (Stoneking, 2006). Studies have demonstrated that mtDNA is geographically structured and may be classified into groups of related haplotypes (Chen *et al*., 1995; 2000; Salas *et al*., 2002; 2004; Gonder *et al*., 2007). The main driver of population genetics affecting the proportions of haplotypes in a population is genetic drift i.e. random fluctuation caused by the sampling randomness of which members of the population happen to pass their DNA on to members of the next generation of the appropriate gender. As a result, the prevalence of a particular marker in a population continues to fluctuate until it either hits 100% or falls out of the population entirely. In large populations with efficient mixing the rate of genetic drift for common alleles

is extremely slow, however in small breeding populations the proportions may change more quickly. Therefore the marked geographical variations and concentrations of particular haplotypes and groups witness the distinctive effects of repeated population bottlenecks or founder events followed by population separations and increases. Lineages which can be traced back from the present do not reflect the full genetic variation of older populations. Genetic drift results in some of the variants dying out.

The time depth for mitochondrial DNA (mtDNA) lineages is more than 100 000 years in Africa (Oppenheimer, 2003). The most recent widespread demographic shift within the continent was most likely the Bantu dispersals which are dated both archaeologically and linguistically to between 3 000 and 4 000 years ago, originating in West Africa (Salas *et al.,* 2002). The distribution of Khoe-San languages before the Bantu diaspora may have extended to present-day Ethiopia and Sudan (Blench, 1993). The study of sub-Saharan African mtDNA variation is a daunting task because the time depth of lineages within the continent is vast. While all Eurasian mtDNA lineages coalesce on a single founder type at the root of haplogroup L3 at circa 80 000 (Watson *et al*., 1997), the coalescence time of African mtDNAs extends at least twice as far back (Salas *et al*., 2002). African mtDNA data sets comprise solely HVS-1 sequences which experience high levels of recurrent mutation at high time depths (*ibid.*). This allows for a greater chance of distinguishing between populations, and hence, in this case, uncovering the lineage of TM PAL 92-136.

D. STABLE LIGHT ISOTOPES

Biochemical palaeodietary tools based on stable isotope archives in the fossil and archaeological records have been used to test hypotheses about the diets of early

hominin and later anatomically modern humans. These include detecting the use of maize (Vogel and van der Merwe, 1977; van der Merwe and Vogel, 1978), pastoralism (Ambrose, 1986), marine food use (Tauber, 1981), wild C_4 plant foods (Peters and Vogel, 2005), trophic levels and dietary change (Schoeninger, 1979; Sillen, 1998; White *et al*., 1999) and seasonal mobility patterns (Sealy and van der Merwe, 1985; Balasse and Ambrose, 2002). The behaviour and ecology of all animals is influenced by their pursuit and consumption of food. Isotopic variability in plants is reflected in the bone collagen and tooth enamel of the animals who consume them (fig 1.3). Pertinent to this study is the extraction and interpretation of isotope ratios in bone collagen. It has been demonstrated that under the right conditions, bone collagen can survive for up to 200 000 years (Ambrose, 1998). Both carbon and nitrogen are used in this study to reflect diet of TM PAL 92-136.

Carbon ($\delta^{13}C$)

Carbon has two stable isotopes namely ^{12}C (98,99%) and ^{13}C (1, 11%) and one unstable isotope ^{14}C (Faure, 1986). ^{12}C and ^{13}C are fractionated by a variety of natural processes, the most pertinent here being photosynthesis and isotopic exchange reactions among carbon compounds. During photosynthesis, plants take in CO_2 and synthesise the carbon into simple sugars through a complex set of biochemical steps. Atmospheric carbon has a $\delta^{13}C$ value of -7‰ and is significantly enriched during photosynthesis (fig. 1.2). During photosynthesis, $^{13}CO_2$ is strongly discriminated against depending on the pathway (Smith and Epstein, 1971) and to a lesser extent on the environmental conditions (Lee-Thorp and Sponheimer, 2006). Plants which photosynthesise can be divided into three groups based on the particular chemical

pathway used during stage one of photosynthesis, namely C_3 plants, C_4 plants and Crassulacean Acid Metabolism (CAM) plants.

All trees, shrubs and herbs, and temperate or shade-adapted grasses follow the C_3 pathway and are strongly depleted in ^{13}C relative to atmospheric CO_2. Environmental factors such as the 'canopy effect' in dense forests may lead to further depletion (Vogel, 1978; van der Merwe and Medina, 1989) and aridity or temperature effects which may result in either an enrichment or depletion of ^{13}C (Lee-Thorp and Sponheimer, 2006). C_3 plants have a lower $\delta^{13}C$ value compared to C_4 plants.
The C4 pathway is a modification of the C3 pathway. C4 plants have a different cellular arrangement to C3 plants and are specialised to fix carbon in low CO_2 conditions (O'Leary, 1981). They are relatively modern plants and occur in more derived plant families, particularly monocotyledonous plants such as grasses and sedges. The different pathways result in differing degrees of fractionation of carbon within plant tissue, resulting in a significant difference in the $\delta^{13}C$ values of C_3 and C_4 plants. CAM plants effectively use both C_3 and C_4 pathways depending on whether they are 'obligate' CAM or not and depending on environmental conditions (Winter and Smith, 1996). CAM plants are rarely used for consumption by humans and include succulents such as euphorbias (Lee-Thorp and Sponheimer, 2006).

Nitrogen ($\delta^{15}N$)

Diet nitrogen isotope ratios ultimately depend on the $^{15}N/^{14}N$ ratios at the base of the food chain. By definition, air has a $\delta^{15}N$ value of 0‰ (fig. 1.2). Atmospheric N_2 is

the ultimate source of nitrogen in foodwebs. Air N_2 has a globally uniform isotopic composition and a low $\delta^{15}N$ value in comparison to most natural substances (Ambrose, 1991). Nitrogen enters the terrestrial foodweb via N_2-fixing bacteria in soils or plants to form nitrates or ammonium ions which are utilized by plants

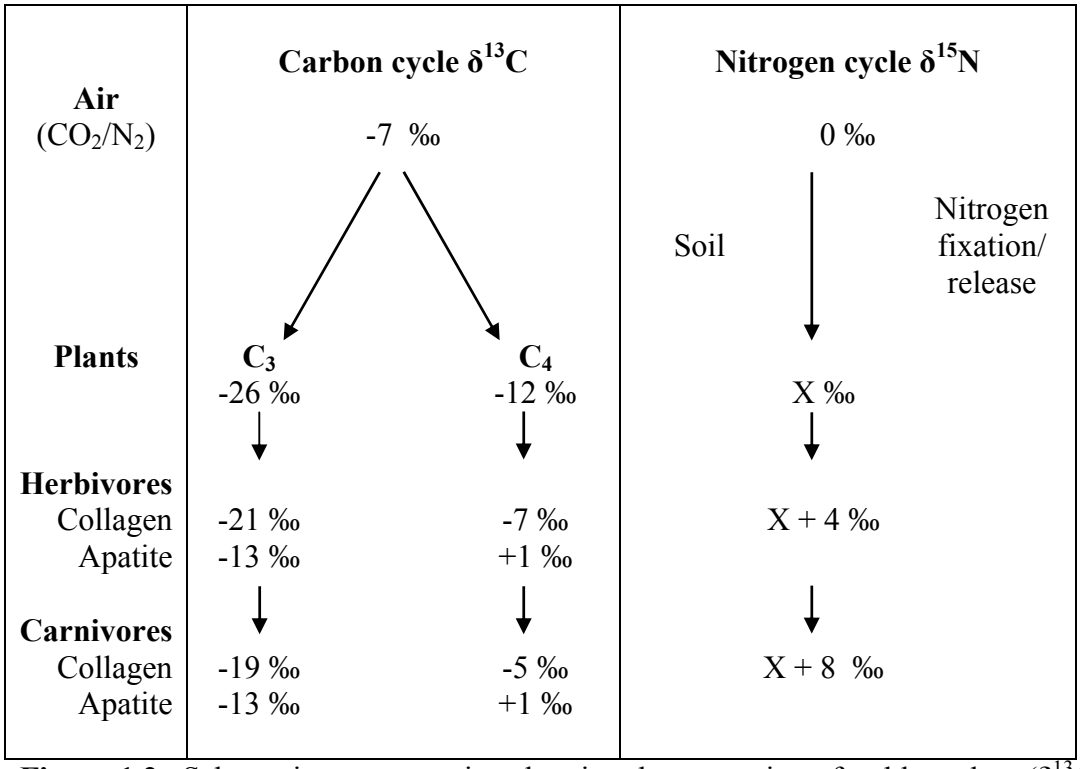


Figure 1.2. Schematic representation showing the patterning of stable carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) isotopes in typical foodwebs. Global mean $\delta^{13}C$ values are given for trophic steps in the carbon cycle (middle pane), while mean differences are given for steps in the nitrogen cycle (right panel). This is because soil $\delta^{15}N$ values depend on the balance of nitrogen fixation and denitrification, which is affected by a host of environmental factors. Two tissues (collagen and apatite) are shown for herbivores and carnivores (after Lee-Thorp and Sponheimer, 2006).

.A variety of biochemical and physical processes tend to cause enrichment or depletion in foodweb $\delta^{15}N$ values, resulting in variations in values within and between ecosystems (Ambrose, 1991).

Table 1.4: The $\delta^{15}N$ and $\delta^{13}C$ values of bone collagen from animals feeding exclusively on marine or terrestrial food sources (after Schoeninger *et al*., 1983)

	$\delta^{15}N$ (per mil)			$\delta^{13}C$ (per mil)		
Animal	**Mean**	**S.D.**	**Range**	**Mean**	**S.D.**	**Range**
			Terrestrial			
Mammals and Birds	-5.9	2.3	-1.9 -10.0	-18.6	3.1	-22.5 -11.9
Herbivores	-4.9	1.6	-1.9 -7.3	-19.3	3.1	-22.5 -11.9
Carnivores	-8.0	1.6	-5.9 -10.0	-18.4	2.1	-21.2 -15.8
			Marine			
Mammals	-15.6	2.2	-11.7 -22.9	-13.1	1.6	-16.1 -9.6
Fish eaters	-16.7	1.8	-14.3 -22.9	-12.8	1.1	-15.2 -11.0
Plankton, mollusc, arthropod eaters	-13.8	1.5	-11.7 -16.6	13.5	2.2	-16.1 -9.6
Birds	-13.0	2.8	-9.4 -17.9	-16.2	2.5	-19.6 -12.1
Fish eaters	-16.2	1.6	-14.2 -17.9	-15.2	2.3	-18.6 -13.6
Mollusc eaters	-10.9	1.3	-9.4 -13.0	-17.1	1.8	-19.0 -14.9
Fish	-13.8	1.6	-11.1 -16.0	-12.5	1.4	-14.4 -10.0

Stable isotopes in bone collagen

Collagen is the main organic component of bone. Isotope values measured from collagen tend to reflect long-term averages of 10 years or more (Lee-Thorp and Sponheimer, 2006). The difference between diet and collagen $\delta^{13}C$ is approximately +5‰. The relationship is primarily between dietary protein and collagen. This is because dietary amino acids are preferentially utilised for collagen tissue construction, while carbon from dietary carbohydrate and lipids makes a lesser contribution. It is widely recognised that there is a stepwise trophic shift of +3-5 ‰ in $\delta^{15}N$ from plants to herbivores, and from herbivores to carnivores in marine and terrestrial foodwebs (table 1.4). As a result, bone collagen is 'biased' towards the high protein component of an individual's diet. Animal foods are consequently overrepresented in bone collagen at the expense of low-protein (vegetable) foods (Lee-Thorp and Sponheimer, 2006).

E. FORENSIC ENTOMOLOGY

Insects are routinely used in police forensic studies in interpreting crime scenes. Insects may colonize the body throughout the process of decomposition from within the first few minutes after death until the bones approach the leached white stage. Diptera (flies) and Coleoptera (beetles) are the most frequent in numbers of species and individuals found in the body. Depending on the habitat, Hymenoptera (bees, wasps, ants), Dictyoptera (cockroaches, crickets, grasshoppers) and Arthropoda of the class Acari (mites) may also be found at various stages during the process of decomposition (Haskell *et al.*, 1997). Evaluation and interpretation of entomological evidence at crime scenes have been used to address questions such as time of death, season of death, geographic location of death, movement of storage of the remains following death, specific sites of trauma on the body, sexual molestation, use of drugs (Haskell *et al.*, 1997) and cause of death. To illustrate the last point, Williams and Villet (2006) relate a case where traditional healers were involved in murder through administering fatal concoctions of herbs and blister beetles. Forensic evidence has been called upon in recent high-profile crime cases such as in the Moses Sithole serial murder case and the Leigh Matthews murder trial (Mansell, *pers comm*.). Such evidence may include adult insect exoskeletal parts, larval cast skins (either Diptera or Coleoptera) and Diptera puparia. In mummy studies, insect studies have highlighted palaeo-environmental information as well as interval between death and burial. More than 35 species of insects were found on the body of the Iron Age Lindow Man in England. The peat environment had preserved midges (chironomids) and water fleas (Cladocera) in particular (Girling, 1986). The season of death and condition of

Bukkai, a 19th century mummy from Japan, were deduced from the pupal sloughs of the flies found on the body (Sakurai *et al*., 1998).

The greatest proportion of literature on insect behaviour relevant to forensic entomology is North America based. The geographic and seasonal distribution of insect species is well documented. Through insect remains, theories of body transfer and movement of remains are either supported or refuted. The preference of some species to oviposit in shade as opposed to direct sunlight, or built-up as opposed to rural settings is known. When dealing with some of the aquatic insect species, it is possible to identify a location of origin for a set of remains to within only a few kilometres (Haskell *et al.*, 1997). It is for this reason that the insect remains on TM-PAL 92-136 are studied.

Insect life cycles are used to establish the pattern of colonization and time interval between various events on remains. Families of Diptera, in particular the Calliphoridae (blow flies) are used. Their developmental rates have been previously established under differing temperature regimes in laboratory and field studies (Haskell *et al.* 1997). Flies are poikilothermic. Where adequate moisture is available and an area is protected from direct solar radiation, adult fly females lay eggs in close proximity to or on their food source. In the case of human remains, deposition sites are generally in the folds of clothing, in the hair line along the ground line or on the ground line where shelter and seclusion is created by the body's contours, in the nasal passages, inside the mouth or around open wounds. Dependent on ambient temperature and species, the eggs will hatch within a few hours. This gives rise to the first of three stages or instars of larvae. The larvae are less than 2mm in length and

dark in colour appearing as discolouration on the body. The second instar larvae are 4 to 6 mm in length and molt from the first instar larvae. The stage lasts for approximately 8 to 12 hours at moderate temperatures. Molting of the second instar larvae gives rise to third instar larvae which consume tremendous amounts of tissue in a relatively short period of time and are observed as a huge 'maggot mass'. Fat bodies of energy are stored and in time the larvae cease feeding and migrate away from the food source. This is known as the prepupae stage. The exoskeletons of the third stage larvae form the hard outer casing known as the puparia of the pupal stage. The puparia are initially white in colour and gradually darken in colour through reddish to maroon, to dark brown and finally almost black. Colour assessment is one method of aging puparia. The adult fly emerges after several days and in another 3 to 5 days has reached sexual maturity (Haskell *et al.,* 1997).

While the flies primarily feed on the carrion, beetles (order Coleoptera) are primarily predacious on the eggs and larvae of the flies. Some, however do predate on the decomposing carrion. These include silphids (carrion beetles), dermestids (hide beetles), nitidulid (sap beetles), and individual species of clerids (checker beetles). Beetles constitute some of the last species to colonize the body (Haskell *et al*., 1997). Where bodies are not exposed, colonization by insects is obviously affected. Few replicated entomological data on the insect fauna of buried bodies, or bodies submerged in water are available (Hall and Haskell, 1995).

Damage to bodies caused by insect activity may also be observed in the form of larval bore holes. Once decomposing skin begins to soften due to putrefaction, fly larvae have the opportunity to penetrate the skin at localized areas to reach the underlying

food source (Haskell *et al.*, 1997). A stringy material known as peritrophic membrane may be left by the beetle (Coleoptera) larvae of the family Dermestidae. Peritrophic membrane is the protective covering over faecal material as it passes through the gut of the beetle. Haskell *et al*. (1997: 434) report a case where it was "literally present by the cupful" associated with the soft tissue of two mummified bodies.

Artefacts on bodies which resemble antemortem wounds can also be postmortem artefacts from ant or cockroach feeding. Ant feeding is generally found on remains which are located outdoors and present as superficial markings oriented in a linear fashion. Cockroach feeding may be spread over a considerable portion of the body and while not limited to indoor environments, are usually found to occur inside (Haskell *et al.*, 1997).

F. FLORAL ANALYSES

Forensic botany includes traditional botanical classification of species, DNA, or materials evidence (trace and transfer evidence) and pertinent to this study, geosourcing. (Coyle *et al.*, 2005; Štambuk, 2007). Species identification is a typical first step in analyzing botanical evidence (Coyle *et al.*, 2001). In a forensic context, investigators could use plant material on a suspect or victim to establish the area from which the body came. Coyle *et al.* (2005) describe a case where a missing girl's jacket was found on the seat of a suspect's vehicle. The leaf litter represented Greenleaf manzanita, canyon live oak, interior live oak, ponderosa pine, black oak, and white fir. The growth requirements including sunlight, known geographic distributions, water and elevation were used to 'profile' where this combination of

tree and shrub species could be located, and five potential sites were selected to search for the missing girl.

G. GEOLOGICAL ANALYSIS

The allied disciplines of geology (mineralogy, sedimentology, microscopy), geophysics, soil science, microbiology, anthropology and geomorphology have been used as tools to aid in archaeological and forensic investigations. Pertinent to this study, is the use of geological tools in locating the provenance of the mummy. X-ray diffraction remains the best available technique for the identification of minerals in fine-grained materials such as soils, rock dust and rocks. The X-ray Diffraction (XRD) technique utilizes a focused X-ray beam ~20mm wide that is directed at varying angles onto the sample. The beam will be partly transmitted and partly diffracted dependant on the spacing of the molecules in the specimen (*d*-spacing). Using Bragg's law, the *d*-spacing of the crystal is calculated from the angles of the incident beams. A diffraction is recorded by the beam detector and recorded as a peak on a chart (XRD trace) of diffraction angle versus number of diffractions per angle (or part thereof) of beam incidence (Ruffel and Wiltshire, 2004). The XRD trace can be semi-quantitatively matched to known standards to give mineral or crystalline substance determinations to unknown specimens.

There are over 2200 known minerals (Murray and Tedrow, 1992), with some more common than others naturally. The XRD trace is useful is ascertaining provenance to a geological area only when rare geographically distinctive minerals are present.

H. DATING

In the 1940's, Libby, Anderson and Arnold discovered that as time passes, the ^{14}C in dead organic objects decays at a given and measurable rate (Aitken, 1990). As described in the stable isotope section of this literature review, the three principal isotopes of carbon that occur naturally are ^{12}C, ^{13}C (both stable isotopes) and ^{14}C (an unstable isotope). The isotopes are present in the following proportions: ^{12}C at 98,89%; ^{13}C at 1,11% and ^{14}C at 0.00000000010%. In other words, one ^{14}C atom exists in nature for every 1 000000000000 ^{12}C atoms in living material. Radiocarbon dating is based on the rate of decay of ^{14}C which forms in the upper atmosphere through the effect of cosmic ray neutrons upon ^{14}N such that

$$^{14}N + n \Rightarrow {}^{14}C + p$$

where n = neutron; p = proton

The carbon exchange reservoir (Aitken, 1990) describes the rapid oxidation of ^{14}C as it enters living pathways through photosynthesis and the food chain, entering the ocean through atmospheric exchange and as dissolved carbonate. Once a living organism dies, the metabolic function of carbon uptake ceases and there is decay rather than uptake of ^{14}C. Libby *et al.* (1949) measured the half-life of ^{14}C as 5568 ± 30 years – known as the 'Libby half-life'. Later experiments showed that the figure was *ca.* 3% too low and an amended, more accurate half-life was established to be 5730±40 years – known as the Cambridge half-life (Taylor, 1987). By measuring the C14 concentration or residual radioactivity of a sample of unknown age, it is possible to obtain the countrate per gram of carbon. By comparing this with modern (by

convention 1950 AD) concentrations, it becomes possible to calculate a date for the time of death of the organism.

I. CULTURAL ARTEFACTS

Surface Modification

Tattoos are intentional modifications of the body that have cultural significance. Alvrus *et al.* (2001) note that these modifications may be for medical purposes, similar to treatments such as branding and cauterizing, or they may be done to beautify the face or body.

Scarification and tattoos have been observed on mummified remains from several areas including Maori mummies from New Zealand (Aufderheide, 2003), Russia (Bogucki, 1996), Alaska (Zimmerman, 1998) and Greenland (Hart Hansen, 1998). The Ötzi Iceman was found with approximately 57 carbon tattoos consisting of simple dots and lines on his lower spine, on his right ankle and behind his left knee. Speculation is that the markings may be related to acupuncture, or might have been used to mark the passage from youth to adulthood (Murphy Jr *et al.*, 2003). Most traditional tattoos and scarification in Africa seems to represent group identity or rite of passage markings.

J. ETHNOGRAPHIC AND HISTORICAL ANALYSES

In order to provide a fuller understanding of how the remains came to be at the museum, and hence provide a fuller historical context, the historical processes of

collecting and interpretation that led to the current situation are explored. Recognising the 'culture' of physical anthropology during the early 20th century within which Robert Broom worked is crucial to providing an historical context in which the remains came to be presented to a museum. The nature of collecting human remains and racial stereotyping typical of that time provides the broader historical framework and context of TM PAL 92-136's acquistition. In particular, Robert Broom himself is known to have falsified provenance data in some cases in order to protect his specimens. His attitude towards the collection and study of human remains again provides important historical context pertinent to this study.

South African museums and universities house collections of human remains, ranging in age from recent to very ancient: from people who voluntarily donated their bodies to science; through the remains of individuals who died and whose identities could not be established, or whose relatives did not claim their bodies; to archaeological specimens hundreds of thousands of years old (Sealy, 2003). In the late 19th and early 20th century, when South African museum collections were being built up, some curators collected skeletons aggressively from any available source, at times in a manner that is morally unacceptable (Legassick and Rassool, 2000). Legassick and Rasool's paper underscores the fact that "'scientific' treatment of human remains cannot be separated from their social and political contexts." (Morris and Jacobson, 2000: 78). It is one of the consequences of this widespread digging up of 'Bushman' skeletons or parts thereof in the early twentieth century, that many of the human remains in collections lack important contextual information (Morris, 1992a). Indeed, some skeletons could not be included in the master catalogue of Holocene human skeletons (Morris, 1992a) because too little was known about them at the time of

compilation (Morris and Jacobson, 2000). Such is the case with TM PAL 92-136. The matter revolves on the history of scientific investigation – within its broader social and political context – and the prevailing attitudes as to acceptable scientific practice (Morris and Jacobson, 2000).

Many of these skeletons formed the basis of anthropological study. During the late nineteenth and early to middle twentieth centuries, physical anthropologists believed that measurements could prove racial purity and reflect the cultural soul underneath. Research was based on the typological approach and dominated the study of human variation. Typology was founded on essentialist philosophy. The idea of fixity and hence 'natural' delineation of races is inherent in typological classification. The aim was to classify humankind into races according to ideal 'types'. The construction of these types was to a large extent an arbitrary procedure. The 'type' was defined as an individual who possessed all of the characteristics deemed important of the race. Here the focus was only on those features which could differentiate between races and any features which might indicate unity of races were ignored. Variation was seen as impurity (Hall and Morris, 1983; Morris 2000; Štrkalj, 2000).

As a method of defining human variation, the compartamentalisation involved in the typological approach became unwieldy and more complex. It became almost impossible to incorporate the majority of remains into any of the racial types resulting in attempts at refining it – most often through the creation of more types. Fierce discussion and variation ensued with the multitude of resultant 'races', 'major races', smaller races', 'geographical races', 'sub-races', 'racial left-overs', 'human remnants or ilea' and so forth (Štrkalj, 2000).

Towards the middle of the twentieth century the typological approach to population classification had led to a situation where each distinctive craniological feature was interpreted as a sign of a specific genetic strain. Since the definition of a type required an assumption of morphological homogeneity in the 'pure stock', any sign of individual variation were assumed to represent the presence of alien genetic connections (Morris, 1986). Dart (1951, 1952) spoke of Armenioid, Mediterranean, and Mongolian influence in the morphology of the living Khoe, while Tobias (1955) was able to postulate seven separate genetic lines meeting and mingling to create the Khoe and the San.

The demise of typological thinking began after World War II when human biologists responded to various scientific as well as non-scientific stimuli. External factors such as the war, civil rights movements and changes in the education system played a role as did internal factors such as Mayr's (1963) species concept and recognition that a wide range of variation was a normal occurrence in any human population (Morris, 1986; Štrkalj, 2000).

There was, however, some reluctance to abandon typology. According to Morris (1986, 1987b), the main reason for this was that no one was certain which specimens were truly Khoe or San in ethnic terms. While the majority of accession registers recorded ethnic identity as 'Bushman' or 'Hottentot', there was no supporting documentation. Many of the specimens had been identified and catalogued by the typologists on morphological features alone (Morris, 1986). Hence as Morris (1986) points out, the inherent bias instilled by discoveries was emphasized or redirected by

the curators of the collections and it has become nearly impossible to rely on the accuracy of the catalogue identification from material collected in the early twentieth century.

Chapter 2 - Materials and Methods

A. SKELETAL ANALYSIS

One partially mummified anatomically modern human skeleton (TM PAL 92-136) and associated artefacts were used in this study. The specimen is currently housed at the National Cultural History Museum (NCHM) in Pretoria and is relatively complete. The skeleton was first viewed in a museum display cabinet at the NCHM. The skeleton lay on its back with the face turned towards the right side. The left arm is bent so that the hand touches the shoulder. The right arm is broken at the distal humerus. The feet are disarticulated. The knees had been broken to flex them and thus fit the body into the display cabinet. The following skeletal elements are absent: the right zygomatic, the proximal right ulna and radius, the sacrum, both patellae, the left third metacarpal, the left third proximal, middle and distal phalanges, the right talus, calcaneus, cuboid and third cuneiform, the right and left first metatarsals, the left second, third and fourth metatarsals, the right and left first proximal, middle and distal phalanges of the first toe, the left proximal, middle and distal phalanges of the second to fourth toes. Skin is preserved over much of the skeleton except the distal right humerus, feet and vertebrae. The underside (dorsal) surface has less well preserved skin. The remains were disturbed as little as possible during the study.

The skeleton was removed to the Department of Anatomy at UP and laid out (fig 2.1). Standard anthropometric and morphometric techniques were applied to the remains. The measurements and techniques applied were chosen to aid in identifying the sex, age and population clusters as a means to establish population affinity. The

measurements are recorded in millimetres and were initially taken using sliding and spreading callipers.

Sex determination

Sex determination was based mainly on the morphological characteristics of the pelvis, skull (Ferembach *et al*., 1980; Krogman and Ìşcan, 1986) and mandible (Loth and Henneberg, 1996). Studies have shown the usefulness of sexing based on other bones such as the radius and ulna (Mall *et al.,* 2001; Celbis and Agritmis, 2006) and the head of the femur (Asala, 2001). It was not deemed necessary to employ geometric morphometric analyses nor to analyse bones other than those of the skull and pelvis in determining sex as 90% to 95% accuracy can be achieved in sexing by using the pelvis alone (Brothwell, 1981) when complete. Following Krogman and İşcan (1986) and İşcan and Loth (2000), the pelvic bones were assessed on the general size and shape of the greater sciatic notch, the pubic bone, the acetabulum, the obturator foramen, the os pubis, the iliac crest, the iliac tuberosity, the degree of eversion of the ischio-pubic ramus, the degree of development of the pre-auricular sulcus, the height of the pubic symphysis, the angularity of the subpubis, the presence or absence of the preauricular sulcus and parturition scars. Apart from the presence of parturition scars, no one trait is a reliable indicator of sex. For example, Patriquin *et al.* (2003) looked at the shape of the greater sciatic notch in South African whites and blacks, they found that the traditional wide-in-females and narrow-in-males pattern held true for South Africa blacks, but not for South African whites. Sexual dimorphic traits of the pelvis are described in table 2.1.



Figure 2.1: TM PAL 92-136

Table 2.1: Sexual dimorphism traits in the pelvis (after Krogman and İşcan 1986 and İşcan and Loth 2000)

Sexual dimorphism in the pelvis		
Trait	*Male*	*Female*
Pelvis complete	Massive, rugged, marked muscle sites	Less massive, gracile, smoother
Pubic bone	Triangular	Rectangular
Pubic symphysis	Higher	Lower
Subpubic angle	Narrow, V-shaped	Wide, U-shaped,
Obturator foramen	Large, ovoid	Small, triangular
Acetabulum	Large, directed laterally	Small, directed antero-laterally
Greater sciatic notch	Small, close,deep	Larger, wider, shallower
Ischiopubic rami	Rough everted margin	Gracile, narrow near symphysis
Preauricular sulcus	Rarely present	Often present, well developed
Iliac tuberosity	Large, not pointed	Small, absent, pointed or varied
Sacrum	Longer, narrower, more evenly distributed curvature; often 5 or more segments	Shorter, broader, tendency for marked curvature at S1-S2 and S2-S5; 5 segments
Pelvic brim or inlet	Heart-shaped	Circular, elliptical

Cranial and mandibular indicators are less reliable than those of the pelvis. Morphological sex differences that were assessed in the skull are listed in table 2.2. These were observed on the CT-scanned images of the specimen (fig. 2.2) and the skeletal remains themselves.

Table 2.2: Sexual dimorphism traits in the skull (after Krogman and İşcan 1986 and İşcan and Loth, 2000)

Sexual dimorphism in the skull		
Trait	*Male*	*Female*
General size	Large, rugged	Small, smooth
Supraorbital torus	Large to medium	Small to absent
Supraorbital margins	Rounded	Sharp
Mastoid processes	Medium to large	Small to medium
Occipital area	Muscle lines with marked or hooked protuberance	Muscle lines and protuberance not distinct
Frontal eminences	Small	Large
Parietal eminences	Small	Large
Orbits	Rectangular	Rounded
Forehead	Sloped	Vertical
Mandibular ramus flexure	Ramus flexure	Straight ramus
Palate	Larger, broader, with a U-shape	Smaller with a parabola shape
Occipital condyles	Large	Small
Chin shape	Square	Round, pointed
Teeth	Larger, M1 usually has 5 cusps	Small, 4 cusps on the molar teeth



Figure 2.2 CT-scanned image of lateral view of TM PAL 92-136

Age determination

Skeletal age at death estimation parameters vary greatly within the successive developmental phases between infancy and old age. Following the cessation of the growth processes, aging is predominantly determined by a variety of environmental and biological factors. This results in a considerable gap between true chronological and estimated age which increases as age progresses. The best methodological approach to circumvent this dilemma is therefore to employ an array of age markers. Several techniques were used in age determination. Age estimate calculations pertinent to adult remains were employed as the third molar had erupted. Techniques employed included degeneration at the sternal ends of the ribs (Oettlé and Steyn, 2000; Steyn *et al.*, 2002), suture closure on the skull (Krogman and İşcan, 1986), and epiphyseal closure (McKern and Stewart, 1957 in White, 1991) (as the medial end of the clavicle can be open to age 30 years). According to Steyn *et al.* (2004), changes in the sternal ends of ribs are currently the most reliable and accurate method

available. The fifth rib was used in this study. The rib was compared to casts by Íşcan and Loth (1993) housed at the UP and compared to a descriptive table (table 2.3). General degeneration such as the presence or absence of osteophytes on vertebrae was investigated. Pubic symphysis was not assessed as the area could not be readily accessed.

Table 2.3. Female rib phase descriptions (after Iscan and Loth, 1993)

Female rib phase descriptions
Phase 0 (13 and younger). The articular surface is nearly flat with ridges or billowing. The outer surface of the sternal rib end is bordered by an epiphyseal ring. The rim is regular with rounded edges, and the bone itself is firm, smooth and very solid (F0)
Phase 1 (14-15). A beginning, amorphous indentation can be seen in the articular surface and the epiphyseal ring has disappeared. Ridges or billowing may still be present. The rim is rounded and regular with a little waviness in some cases. The bone remains solid, firm, and smooth (F1a, F1b)
Phase 2 (16-19). The pit is considerably deeper and has assumed a V-shape between the thick, smooth anterior and posterior walls. Some ridges or billowing may still remain inside the pit. The rim is wavy with some scallops to form at the rounded edge. The bone itself is firm and solid (F2a, F2b).
Phase 3 (20-24). There is only slight if any increase in pit depth, but the V-shape is wider, sometimes a narrow U as the walls become a bit thinner. The still rounded edges now show a pronounced, regular scalloping pattern. At this stage, the anterior or posterior walls may first start to exhibit a central, semicircular arc of the bone. The rib is firm and solid (F3a, F3b).
Phase 4 (24-32). There is a noticeable increase in the depth of the pit, which now has a wide V- or narrow U-shape with, at times, flared edges. The walls are thinner but the rim remains rounded. Some scalloping is still present, along with the central arc; however, the scallops are not as well defined and the edges look somewhat worn down. The quality of the bone is fairly good but there is some decrease in density and firmness (F4a, F4b).
Phase 5 (33-46). The depth of the pit stays about the same, but the thinning walls are flaring into a wider V- or U-shape. In most cases, a smooth, hard, plague-like deposit lines at least part of the pit. No regular scalloping pattern remains and the edge is beginning to sharpen. The rim is becoming more irregular, but the central arc is still the most prominent projection. Bone is noticeably lighter in weight, density and firmness. The texture is somewhat brittle (F5a, F5b, F5c).

Phase 6 (43-58). An increase in pit depth is again noted, and its V- or U-shape has widened again because of pronounced flaring at the end. The plague-like deposit may still appear but is rougher and more porous. The walls are quite thin with sharp edges and an irregular rim. The central arc is less obvious and, in many cases, sharp points project from the rim of the sternal extremity. The bone itself is fairly thin and brittle with some signs of deterioration (F6a, F6b, F6c).

Phase 7 (59-71). In this phase, the depth of the predominantly flared U-shaped pit not only shows no increase, but actually decreases slightly. Irregular bony growths are often seen extruding from the interior of the pit. The central arc is still present in most cases but is now accompanied by pointed projections, often at the superior and inferior borders, yet may be evidenced anywhere around the rim. The very thin walls have irregular rims with sharp edges. The bone is very light, thin, brittle, and fragile, with deterioration most noticeable inside the pit (F7a, F7b).

Phase 8 (70 and older). The floor of the U-shaped pit in this final phase is relatively shallow, badly deteriorated, or completely eroded. Sometimes it is filled with bony growths. The central arc is barely recognizable. The extremely thin, fragile walls have highly irregular rims with very sharp edges, and often fairly long projections of bone at the inferior and superior borders. "Windo" formation sometimes occurs in the walls. The bone itself is in poor condition – extremely thin, light in weight, brittle, and fragile (F8a, F8b, F8c).

Population affinity

Craniometrics

Choice of measurement and indices in this section were based on two considerations. Firstly, the need for substantial overlap with lists of measurements from previous studies which have considered comparative populations, and secondly the power of the feature chosen to discriminate among the comparative skeletal populations. There are two 'traditional' series of measurements – those of the Biometric School and those of the European standard (Martin and Saller, 1957). In this study, the Biometric School is followed because use is made of lists detailed by De Villiers (1968) and Morris (1992).

a) Definition of landmarks

The following landmarks were used (definitions after De Villiers, 1968; Knussman, 1988 and Buikstra and Ubelaker, 1994). They are illustrated in fig. 2.3.

ALARE **(al)**: the most lateral points on the nasal aperture in a transverse plane

ALVEOLON **(alv)**: the point on the hard palate where a line drawn through the most posterior points of the alveolar ridges crosses the midline

AURICULARE **(au)**: is defined as a point on the lateral aspect of the root of the zygomatic process at the deepest incurvature

BASION **(ba)**: the midline point on the anterior margin of the foramen magnum

BREGMA **(b)**: the ectocranial midline point where the coronal and sagittal sutures intersect

CONDYLION LATERALE **(cdl)**: the most lateral point on the mandibular condyle

DACRYON **(d)**: the point at the intersection of the lacrimo-maxillary suture and the frontal bone

ECTOCONCHION **(ec)**: the intersection of the most anterior surface of the lateral border of the orbit and a line bisecting the orbit along its long axis

ECTOMALARE **(ecm)**: the most lateral point on the outer surface of the alveolar borders of the maxilla

EURYON **(eu)**: the points on the opposite sides of the skull that form the termini of the line of greatest cranial breadth

FRONTOMALARE TEMPORALE **(fmt)**: the most laterally positioned point on the fronto-zygomatic suture

FRONTOTEMPORALE **(ft)**: the point where the temporal line reaches its most anteromedial position on the frontal

GLABELLA **(g)**: the most anterior midline point on the frontal bone

GNATHION **(gn)**: the most inferior midline point on the mandible

GONION **(go)**: a point along the rounded posteroinferior corner of the mandible between the ramus and the body

INFRADENTALE **(id)**: the midline point at the superior tip of the septum between the mandibular central incisors

LAMBDA **(l)**: the ectocranial midline point where the sagittal and lambdoidal sutures intersect

NASION **(n)**: the point of intersection between the frontonasal suture and the midsagittal plane

NASOSPINALE **(ns)**: the point where a line drawn between the inferior most points of the piriform aperture crosses the midsagittal plane

OPISTHION **(o)**: the midline point at the posterior margin of the foramen magnum

OPISTHOCRANION **(op)**: the most posterior point of the skull not located on the occipital protuberance

PROSTHION **(pr)**: the anterior most point in the midline on the alveolar processes of the maxillae

ZYGION **(zy)**: the most lateral point on the zygomatic arch

b) Definitions of cranial measurements

MAXIMUM CRANIAL LENGTH **(g-op)**: the distance between the glabella and opisthocranion

MAXIMUM CRANIAL BREADTH **(eu-eu)**: the maximum width of the skull perpendicular to the midsagittal plane

BIZYGOMATIC DIAMETER **(zy-zy)**: the direct distance between the zygions

BASION-BREGMA HEIGHT **(ba-b)**: the direct distance between the basion and the bregma

CRANIAL BASE LENGTH **(ba-n)**: direct distance from nasion to basion

BASION-PROSTHION LENGTH **(ba-pr)**: direct distance between basion and prosthion

MAXILLO-ALVEOLAR BREADTH **(ecm-ecm)**: the maximum breadth across the alveolar borders of the maxilla measured on the lateral surfaces at the location of the second maxillary molars

MAXILLO-ALVEOLAR LENGTH **(pr-alv)**: the direct distance between the prosthion and the alveolon

BIAURICULAR BREADTH **(au-au)**: the least exterior breadth across the roots of the zygomatic processes

UPPER FACIAL HEIGHT **(n-pr)**: the distance between the prosthion and the nasion

MINIMUM FRONTAL BREADTH **(ft-ft)**: the direct distance between the two frontotemporale

UPPER FACIAL BREADTH **(fmt-fmt)**: the direct distance between the two external points on the frontomalar suture

NASAL HEIGHT **(n-ns)**: the direct distance from the nasion to the midpoint of a line connecting the lowest points of the inferior margin of the nasal notches

NASAL BREADTH **(al-al)**: the masimum breadth of the nasal aperture

ORBITAL BREADTH **(d-ec)**: the laterally sloping distance from the dacryon to the ectoconchion

ORBITAL HEIGHT: the direct distance between the inferior and superior orbital margins

BIORBITAL BREADTH **(ec-ec)**: the direct distance between the left and right ectoconchion

INTERORBITAL BREADTH **(d-d)**: the direct distance between the right and left dacryon

FRONTAL CHORD **(n-b)**: the direct distance from the nasion to the bregma in the midsagittal plane

PARIETAL CHORD **(b-l)**: the direct distance from bregma to the lambda

OCCIPITAL CHORD **(l-o)**: the direct distance from the lambda to the opisthion in the midsagittal plane

FORAMEN MAGNUM LENGTH **(ba-o)**: the direct distance between the opisthion and the basion

FORAMEN MAGNUM BREADTH: the distance between the lateral margins of the foramen magnum at the points of maximum curvature

MASTOID LENGTH: the vertical projection of the mastoid process below and perpendicular to the Frankfort plane

CHIN HEIGHT **(id-gn)**: the direct distance from the infradentale to the gnathion

HEIGHT OF THE MANDIBULAR BODY: the direct distance from the alveolar process to the inferior border of the mandible perpendicular to the base – at the level of the foramen magnum

BREADTH OF THE MANDIBULAR BODY: the maximum breadth measured in the region of the mental foramen perpendicular to the long axis of the mandibular body

BIGONIAL WIDTH **(go-go)**: the direct distance between the right and left gonion

BICONDYLAR BREADTH **(cdl-cdl)**: the direct distance between the most lateral points of the two condyles

MINIMUM RAMUS BREADTH: the least breadth of the mandibular ramus measured perpendicular to the height of the ramus

MAXIMUM RAMUS BREADTH: the distance between the most anterior point on the mandibular ramus and a line connecting the most posterior point on the condyle and the angle of the jaw

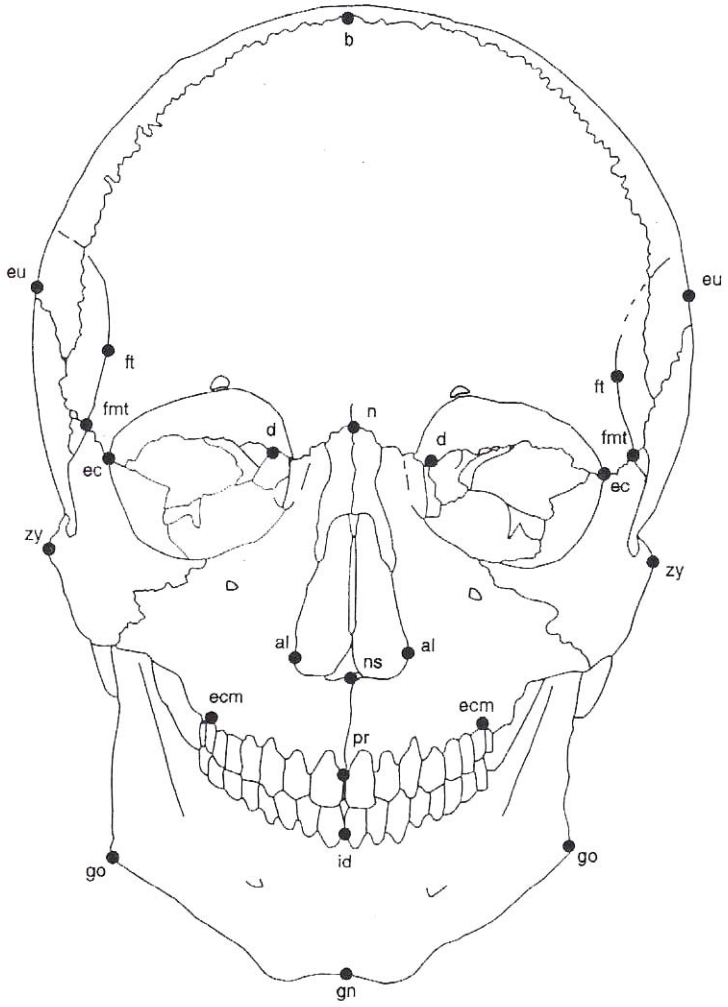
MAXIMUM RAMUS HEIGHT: the direct distance from the highest point on the mandibular condyle to gonion

MANDIBULAR LENGTH: the distance of the anterior margin of the chin from a centre point on the projected straight line placed along the posterior border of the two mandibular angles

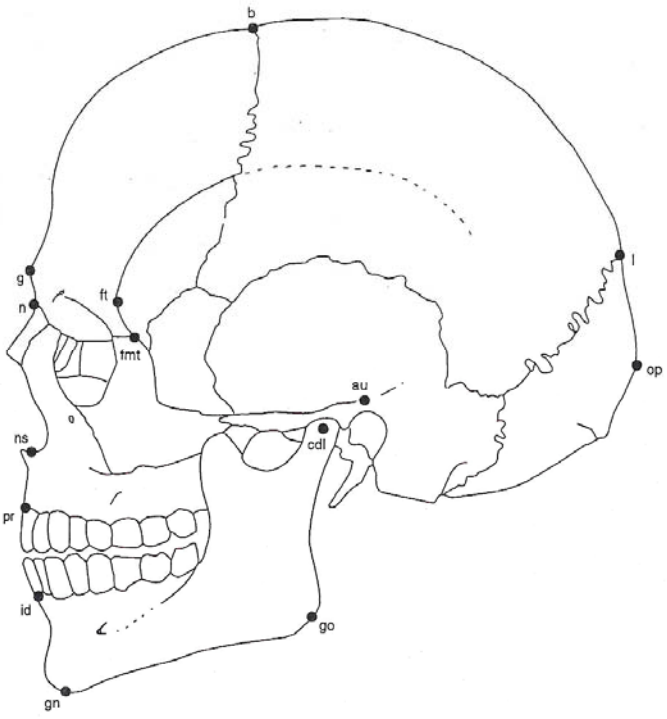
MANDIBULAR ANGLE: the angle formed by the inferior border of the corpus and the posterior border of the ramus

c) Definitions of indices

Indices (bivariate ratios) from cranial measurements accentuate differences in shape among specimens of variable size. Although allometric differences prevent the complete removal of the size effect, the use of indices for simple classificatory procedures is a valid exercise (Atchley *et al*., 1976 in Morris, 1992).


b
eu
eu
ft
ft
fmt
fmt
n
d
d
ec
ec
zy
zy
al
al
ns
ecm
ecm
pr
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b
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cdl
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id
go
gn

b

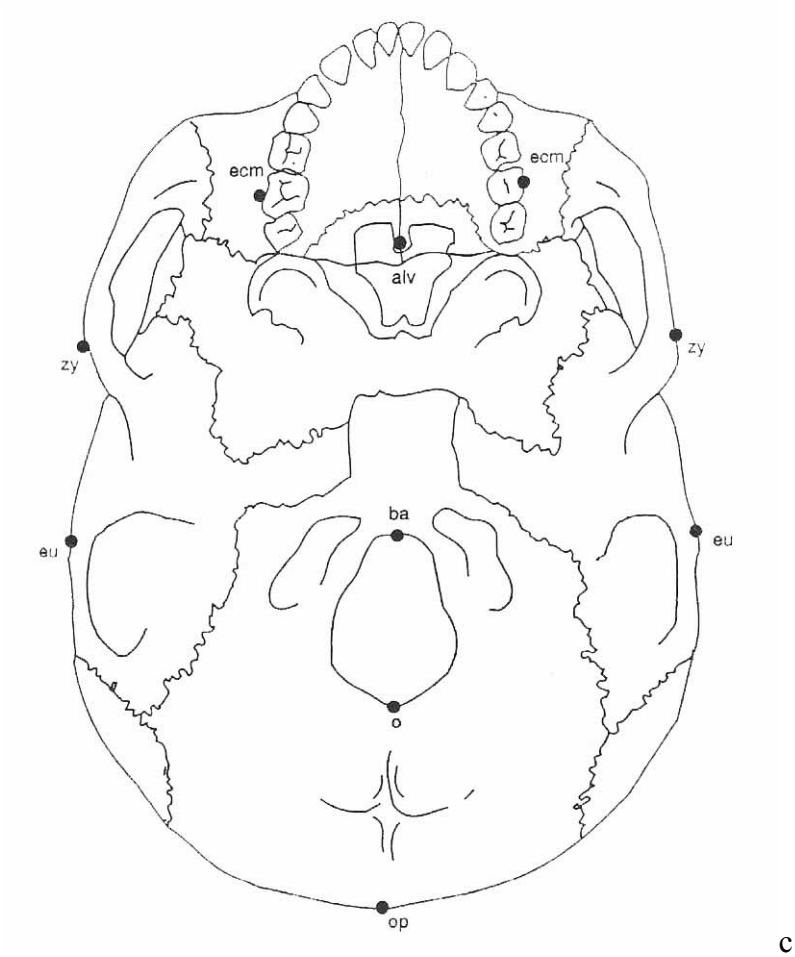


Figure 2.3. Anatomical landmarks of the skull in a) anterior, b) lateral and c) basilar view (after Buikstra and Ubelaker, 1994)

The following indices were calculated:

i. CRANIAL INDEX = 100 * (cranial breadth / cranial length)

ii. CRANIAL HEIGHT INDEX = 100 * (basibregmatic height / cranial length)

iii. VERTICAL INDEX = 100 * (basibregmatic height / maximum cranial breadth)

iv. TRANSVERSE FRONTOPARIETAL INDEX = 100 * (least frontal breadth/maximum cranial breadth)

v. FORAMEN MAGNUM INDEX = 100 * (foramen magnum breadth / length)

vi. GNATHIC INDEX = 100 * (prosthion-basion / nasion-basion)

vii. ZYGOMATICO-FRONTAL INDEX = 100 * (least frontal breadth / bizygomatic breadth)

viii. UPPER FACIAL INDEX = 100 * (upper facial height/bizygomatic breadth)

ix. ORBITAL INDEX = 100 * (orbital height / orbital breadth)

x. NASAL INDEX = 100 * (nasal breadth / nasal height)

Morphological characteristics of the skeleton

Discrete traits show familial inheritance and biological distance in *H. sapiens*. The most racially definitive skeletal element is the skull. Rephrase this and avoid the use of the word "race" altogether. Try "population affinity" or "ancestry" In the absence of the skull, metric assessment of the pelvis (Patriquin *et al.*, 2003) and the os coxae (Washburn, 1949) have been used to identify population affinity in southern Africa.

Discrete traits among Caucasoid, Negroid and Mongoloid populations are outlined in table 2.4 and are compared to CT-scanned imagery of TM PAL 92 136 (figure 2.2) and the skeletal remains themselves. The skulls of Negroids are commonly long and low as opposed to the rounder, broader heads of whites and Mongoloids (Patriquin *et al.*, 2003). The relative swelling of the temporal lobe of the brain was termed *mons temporosphenoidalis* and is considered a discrete Khoe-San trait (de Villiers, 1968). An inter-parietal groove and inferior frontal eminence represent further non-metric characteristics of Khoe-San people (de Villiers, 1968). Khoe-San also exhibit a more rounded forehead contour and less prognathic face than South African Bantu-speaking people (Franklin *et al.,* 2007).

Table 2.4: Cranial variation among Caucasoid, Negroid and Mongoloid races (Íşcan *et al.,* 2000 and modified from Krogman and Íşcan, 1986)

Cranial variation among Caucasoid, Negroid and Mongoloid races			
Characteristics	*Caucasoid*	*Negroid*	*Mongoloid*
General appearance	high, wide	long, low	rounded
Skull length	varied	Long	long
Skull breadth	varied (often broad)	Narrow	broad
Skull height	medium to high	Low	medium
Sagittal contour	round to arched	Flat	arched
Face breadth	narrow to wide	Narrow	very wide
Face height	medium to high	Low	high
Cheek	no projection	some lateral projection	anteriorly projected
Orbital opening	round to angular	Rectangular	rounded
Facial profile	orthognathic	Prognathic	medium to flat
Nasal opening	narrow to medium	Wide	narrow to wide
Lower nasal margin	sharp	smooth and/or gutted	sharp
Nasal profile	straight	downward slant	straight
Palate shape	narrow to wide	Wide	moderately wide

Due to the partial mummification of the specimen, several measurements could not be recorded because of the skin covering. In addition, the fragile nature of the remains prevented rotation of the body to enable measurements on the dorsal side. Degree of suture closure could also not be established where mummified skin covered the bone. For this reason, the remains were taken to the Johannesburg Hospital for CT-scanning. The skull was scanned at a thickness of 0.8mm with an increment of 0.4mm, while the post-cranial skeleton was scanned at a thickness of 1.5mm with an increment of 0.7mm. All measurements were taken on the left-hand side of the body in the case of bilateral measurements unless otherwise stated.

Stature

There are two main types of method for assessing adult stature estimation: 'mathematical' methods using regression formulae (or ratios) based on the correlation

of individual skeletal elements to living stature and 'anatomical' methods. The latter involves the addition of skeletal elements from the calcaneus to the skull. Long bone regressions produce the most accurate estimations amongst the mathematical methods as the long bones are the elements most highly correlated to total stature (Raxter *et al.*, 2006). Feldesman and Fountain (1996) investigated whether 'race'-specific ratios are more accurate than the simple generic femur/stature ratio amongst three quasi-geographic races (Blacks, Whites and Asians). They found that race-specific ratios slightly outperform the generic ratio when race is certain, but that the gains are small for the assumptions required. Further to this, they found that when race attribution is uncertain or unknown, as in palaeoanthropology, the wrong ratio (or the wrong regression equation) performs more poorly than the generic femur/stature ratio. For this reason, the generic femur/stature ratio was employed. Feldesman *et al.* (1990) demonstrated that femur length constitutes 26.74% of stature and that no assumptions about 'race', ethnicity or gender were required.

The femur/stature ratio is expressed as:

Stature (cm) = femur length (cm) * 100 / 26.74

Health status/ Pathology

Signs of disease and malnutrition were assessed on a macroscopic level as specific chronic diseases on bone may be recognized (Steinbock 1976; Ortner and Putschar, 1981; 2003). Aufderheide and Rodriguez-Martin 1998; Steyn and Íşcan, 2000). Subperiosteal bone growth is indicative of chronic infectious diseases manifesting as fresh lacework –like bone on the surface of the bone. Although usually non-specific, it may lead to a specific diagnosis (Steyn *et al.*, 2002). Chronic anaemia may be

indicated by cribra orbitalia which may also indicate the pathogen load that an individual has to cope with (Stuart-Macadam in Steyn *et al.*, 2002). Anaemia may result *inter alia* from intestinal parasites, chronic disease or malnutrition. In addition, the remains were assessed for potential signs of stress lesions such as lines of arrested growth present in long bones known as Harris lines (Ortner and Putschar, 2003) and signs of enamel hypoplasia. These usually manifest as horizontal pits or grooves on the tooth (*ibid*.). The remains are further observed for partrition scars which would indicate an obstetric history.

B. BONE TAPHONOMY

Burnt bone

Descriptions of the characteristics of cremated bone have come from the anthropological and medicolegal communities. Colour change, shrinkage, fragment survival, fracture patterns, weight changes and histological changes have been described through a wide range of research techniques using various experiments (Mayne Correia, 1997). However, as Mayne Correia (1997) points out, inconsistency in terminology and experimentation have tended to produce disparate and incomparable results. Further to this, the vast majority of research on cremated bone is based on northern and central European and North American samples. All of the remains were visually assessed for signs of burning, breakage and deformation.

C. ANCIENT DNA

Human cells contain a relatively short, circular chain of DNA in the cytoplasm's mitochondria (mtDNA), inherited on the matrilineal line. Each cell contains an

average of 1 000 mitochondria and the residuum of only 1% of this DNA is sufficient to be detectable (Aufderheide, 2002). This quantity is normally fragmented into segments of less than 200 nucleotides long (bases), many of which are rendered chemically unresponsive as a consequence of alterations by oxidation or deletion of the bases. Most laboratory methodology of DNA extraction has been designed for amounts of DNA normally found in living tissues. Small amounts of ancient DNA (aDNA) must be amplified before they can be manipulated chemically. South African DNA laboratories are not geared toward aDNA extraction. Previous attempts to extract aDNA from the 2000 year old Kouga mummy have proven unsuccessful in this country (Soodyall and Jenkins, *pers. comm*.).

The upper third left molar was extracted and sent to Alan Cooper (University of Adelaide) for DNA analysis.

The degree of contamination of the remains prior to museum acquisition and prior to this study is not known. A frequent source of contamination of aDNA is that of human DNA from ancient handlers, modern excavators or laboratory workers. From the outset of this study any potential (further) contamination was kept to a minimum. A Perspex™ container was manufactured which would house the remains during the study and subsequently donated to the museum. When the display cabinet was opened for the first time, full surgical gowns, gloves, masks and hats were worn. For the duration of the study, until the tooth had been extracted, masks and gloves were worn at all times when there was contact with the mummy. In a further attempt to limit any contamination, and at the suggestion of Alan Cooper (National Geographic Genographic Project, Head of Ancient DNA section), 'virgin' polystyrene was

purchased from a Johannesburg company, SAGEX (polystyrene manufacturers) and packed around the remains during transport.

D. STABLE LIGHT ISOTOPES

Carbon and nitrogen stable light isotope analyses were undertaken at the QUADRU facility (CSIR).

Sampling

Rib #10 on the right-hand side of TM-PAL 92-136 was used for the stable light isotope analysis and later for radio-carbon dating. Preparation of the bone collagen was undertaken by staff at the facility, subsequent to which the author ran the analysis. Ten samples were prepared and labelled TM-PAL 92-136/iso1 through to TP-PAL 92-136/iso10.

Standards

By convention, stable light isotope ratios are expressed as δ values relative to an international standard in parts per thousand (per mil), as illustrated in the expression for carbon isotopes:

$$\delta^{13}C\ (\%) = (R_{sample}/R_{standard} - 1)\ X\ 1,000$$

where $R = {}^{13}C/{}^{12}C$

the international standard is the Vienna Peedee Belemnite (VPDB)

For nitrogen isotopes, the international standard is atmospheric nitrogen (AIR). The expression for nitrogen isotopes is thus:

$$\delta^{15}N/^{14}N\ (\%) = R_{sample}/R_{standard} - 1)\ X\ 1,\ 000$$

where $R = {}^{15}N/{}^{14}N$

Analysis

Samples were analysed using the Thermo Flash Elemental Analyser 1112 Series integrated via the Thermo Finnigan Con-Flo 3 System with a Thermo Delta V-Plus Isotope Ratio Mass Spectrometer housed at the Quaternary Dating Research Unit (QUADRU) laboratory located at the Council for Scientific and Industrial Research (CSIR), Pretoria.

E. FORENSIC ENTOMOLOGY

Materials

Eighteen specimens were observed on TM PAL 92-136 and on the grass and wooden artefacts found in the original museum display cabinet. Specimens included pupae, insect bodies and cast skin (figures 2.5., 2.6 and 2.7). The position of the specimens on the body is illustrated in fig. 2.4

Analysis

Specimens were observed under magnification. A selection of five specimens were sent to the Department of Zoology and Entomology at Rhodes University for identification by Martin Villet. Discussions on the identification of specimens were also held with Mervyn Mansell (Biosystematics Division, PPRI, Agricultural Research Council) and Marcus Byrne (Department of Zoology, Wits).

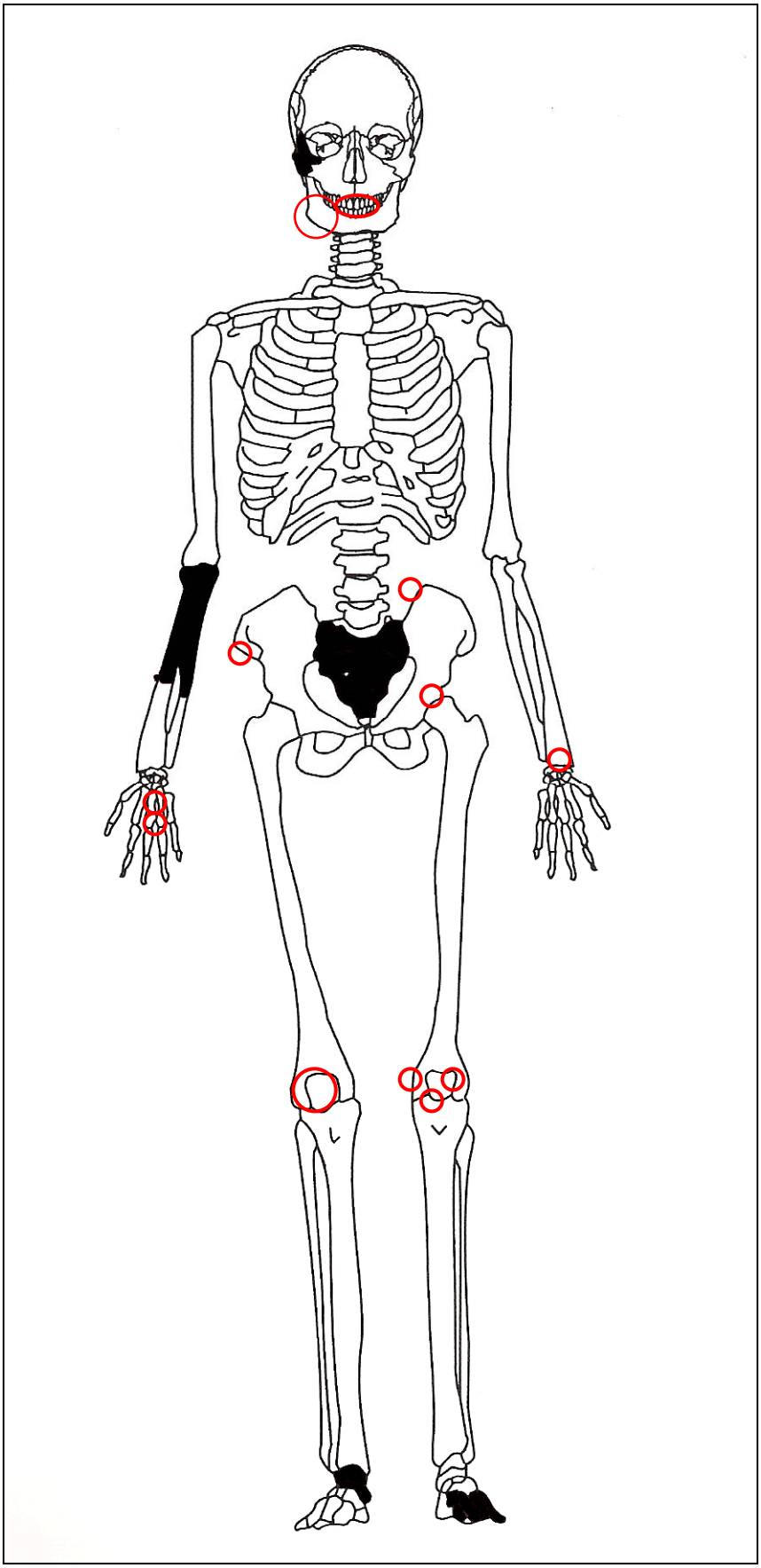


Figure 2.4: Position of entomological remains recovered from TM PAL 92-136

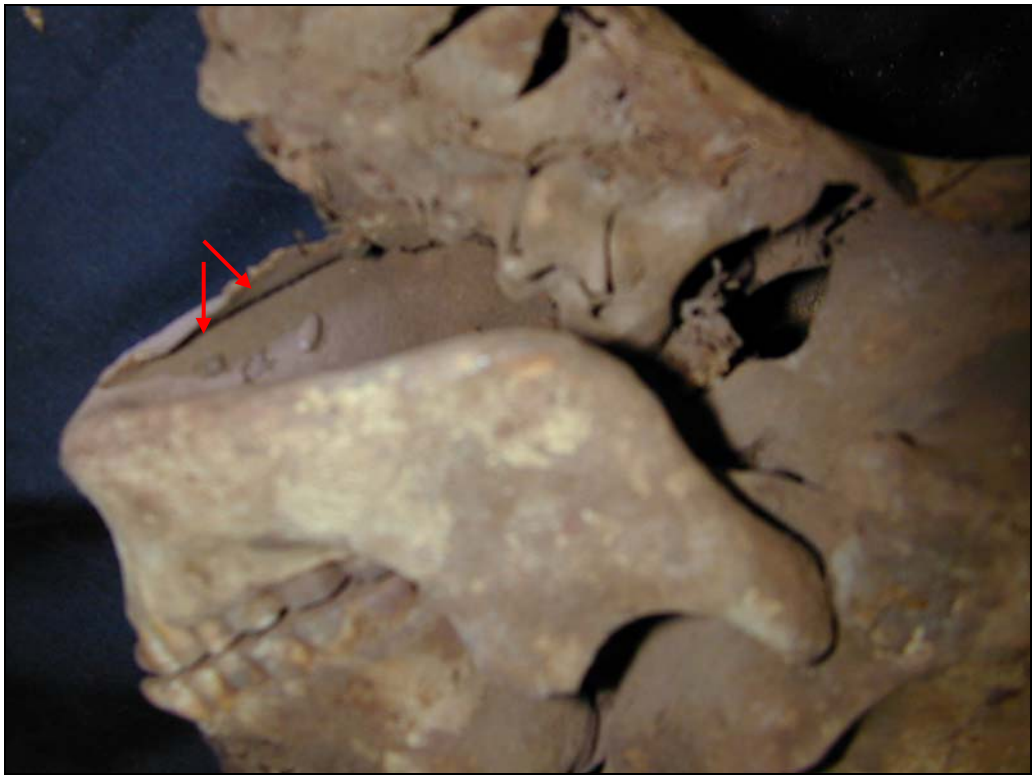


Figure 2.5: Pupae on TM PAL 92-136 mandible

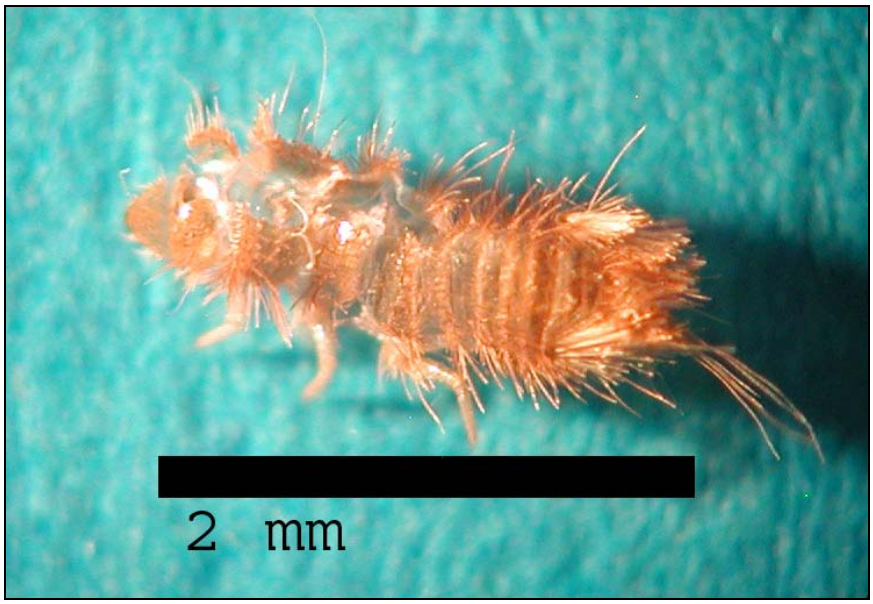


Figure 2.6: Dermestid remains recovered from body.



Figure 2.7: Cast skin on TM PAL 92-136/art9/flora9

F. FLORAL ANALYSIS

Several floral artefacts were found together with the human remains in the museum cabinet. It is hoped that identification of the plant species from which artefacts were made will provide a broad geographical area of provenance for the goods. The form and function of the artefacts were assessed through comparison with written records of archaeological records and through discussion. The plants species was identified through analysis of the inflorescence. The position of the body and artefacts as found in the display cabinet are illustrated in figure 2.16.

The accessioned materials are labelled and described as follows:

- TM PAL 92-136/art1/flora1 (fig. 2.8)

  A woven mat measuring approximately 215 by 223 mm. Stems of grass are matted together by plaited grass 'ropes'

- TM PAL 92-136/art2/flora2 (fig. 2.9)

An arc-shaped woven mat woven in the same manner at TM PAL 92-136/art1/flora1 and measuring approximately 250mm by 70mm.

- TM PAL 92-136/art3/flora3 (fig.2.10)

A length of flax-like fibrous floral material measuring 380mm in length embedded with patches of white fleecy/woolly hairs similar to the hairs in which are found seeds of the Kapok tree (*Ceiba pentandra*).

- TM PAL 92-136/art4/flora4 (fig.2.11)

A bundle of tightly-coiled grass stems.

- TM PAL 92-136/art5/flora5 (fig.2.12)

Two lengths of plaited grass measuring 494mm and 180mm.

- TM PAL 92-136/art6/flora6 (fig.2.13)

A crescent-shaped 'handle'-like artefact in which lengths of fine grass are held together by stems of thicker grass woven over at a perpendicular angle.

- TM PAL 92-136/art7/flora7 (fig 2.14)

A reed-like stick with small elliptical and oval holes – presumably from burrowing insects. The stick measures 131mm and there are parallel grooves/striations at one margin.

- TM PAL 92-136/art8/flora8 (fig 2.14)

A wooden stick measuring 159mm and manually tapered to form a point at one end.

- TM PAL 92-136/art9/flora9 (fig 2.15)

A shaped block of wood, approximately 220mm by 83mm by 33mm at its thickest. A parallel groove (approximately 10 mm wide and 10mm deep) has been carved into one surface.



Figure 2.8: TM PAL 92-136/art1/flora1

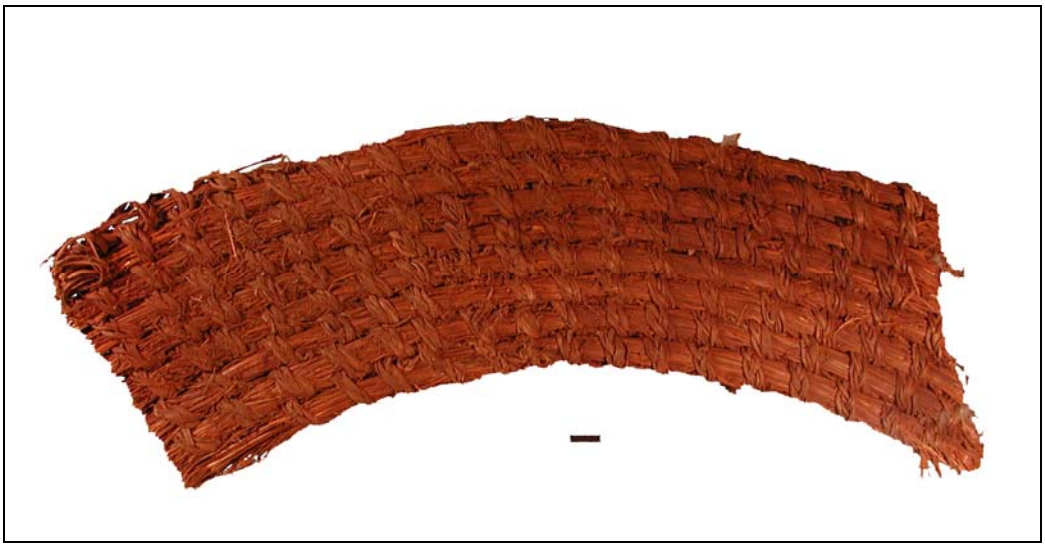


Figure 2.9: TM PAL 92-136/art2/flora2



Figure 2.10: TM PAL 92-136/art3/flora3



Figure 2.11: TM PAL 92-136/art4/flora4

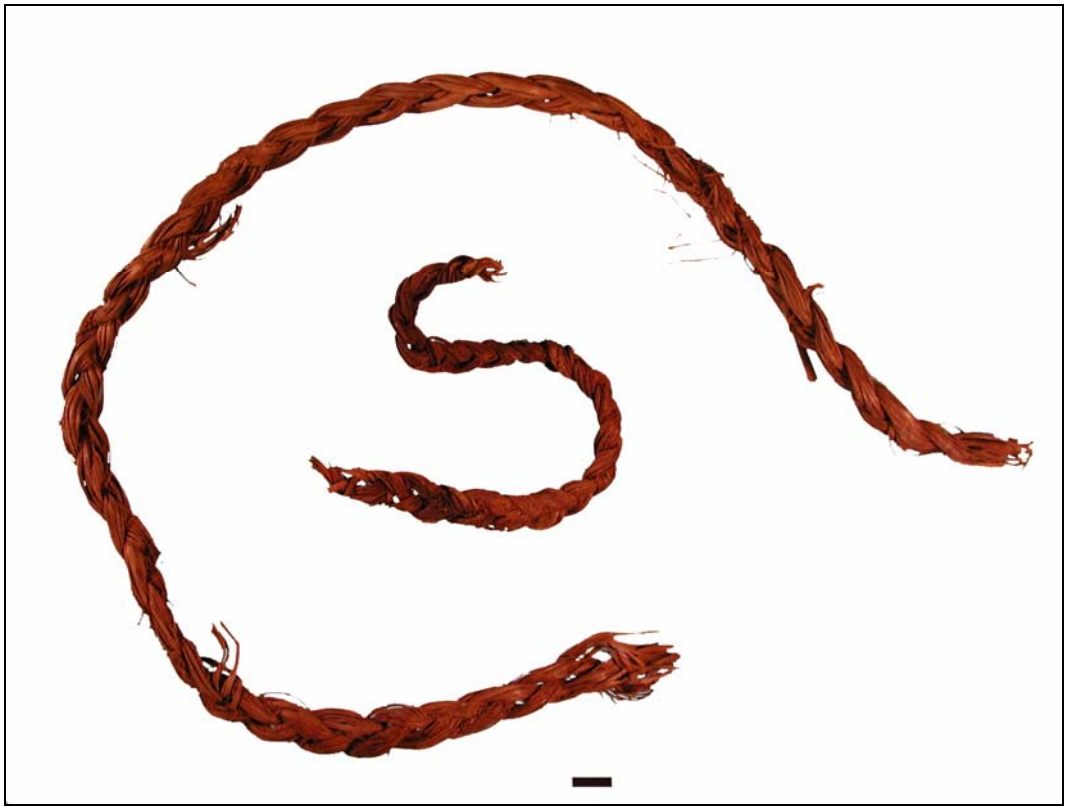


Figure 2.12: TM PAL 92-136/art5/flora5

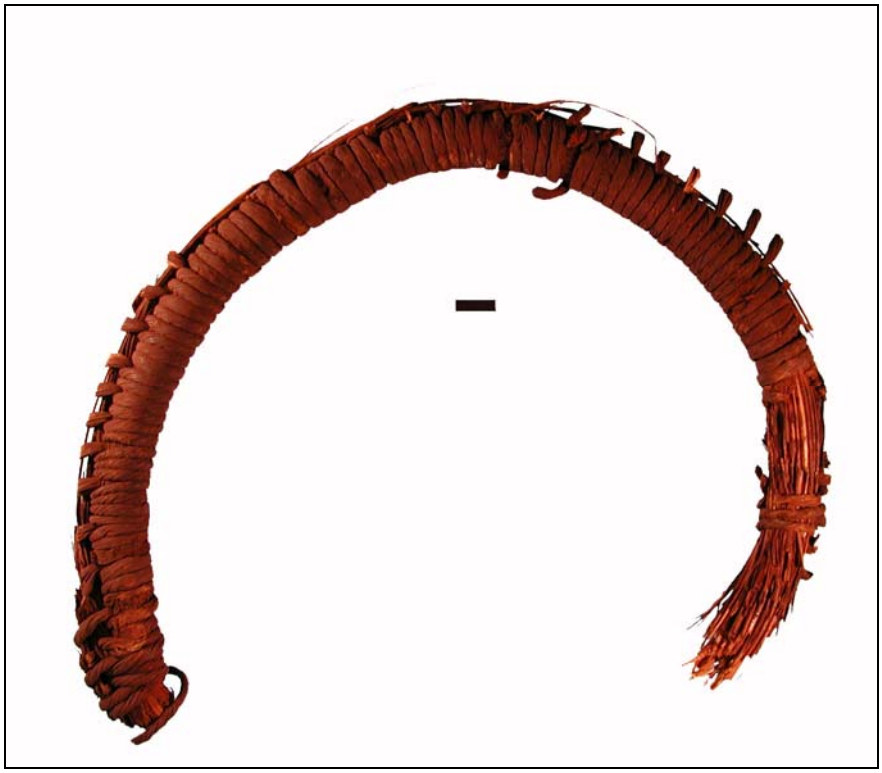


Figure 2.13: TM PAL 92-136/art6/flora6



Figure 2.14: TM PAL 92-136/art7/flora7 (below) and TM PAL 92-136/art8/flora8 (above)

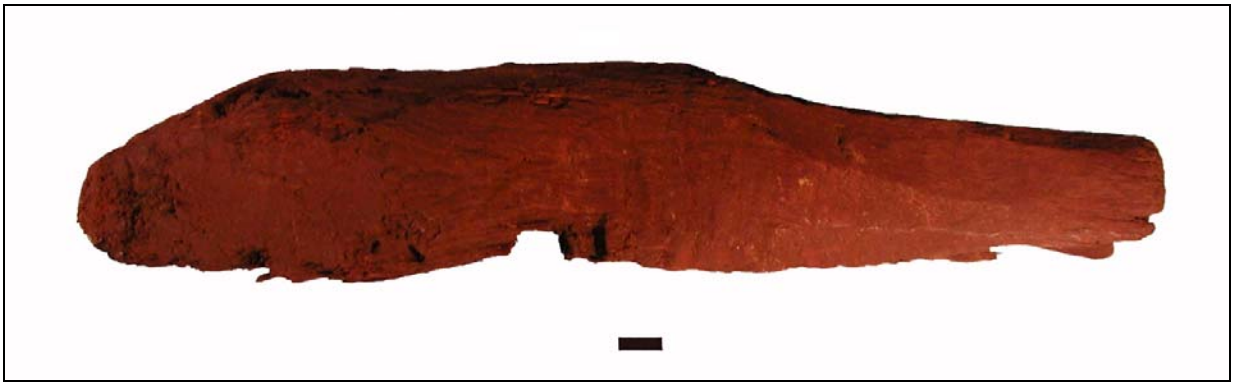


Figure 2.15: TM PAL 92-132/art9/flora9



Figure 2.16 Outline of position of human remains and relative position of floral remains as they were found in the museum display cabinet. Unfortunately, the photographs when taken were not aligned vertically, hence the panoramic reconstruction is distorted towards the centre.

G. GEOLOGICAL ANALYSIS

One small round stone (TM PAL 92-136/art10/stone) measuring approximately 1.5 x 1.5 cm was found among the skeletal remains in the cabinet (fig. 2.17)

TM 92-136/art10/stone was sent to the Police Forensic Laboratory in Pretoria for X-Ray Diffraction (XRD) to establish whether the minerals present could be matched to a location west of Bronkhorstspruit or alternatively eliminate the area. The XRD method is described in the literature review section of chapter 1.

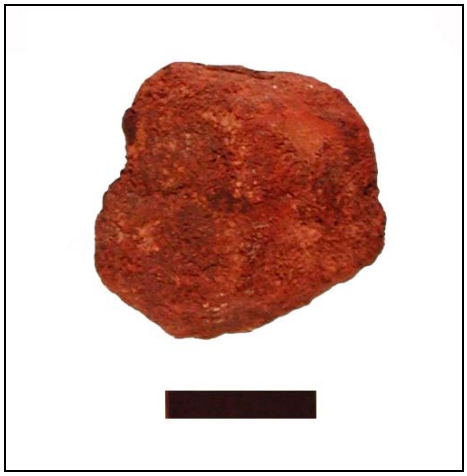


Figure 2.17: Stone (TM PAL 92-136/art10/stone) found in display cabinet amongst skeletal elements

H. DATING

The right 10th rib was removed and sent to QUADRU at the CSIR for radio-carbon dating. All preparation and analyses were conducted by QUADRU.

I. CULTURAL ARTEFACTS

TM PAL 92-136 was analysed twice under ultra-violet light at the University of Pretoria for any indications of scarification or tattoos which may aid in identifying cultural affinity. The remains were also observed under a hand-held magnifying lens to illicit any clues to its collection or affinity.

The floral artefacts were compared with those reported in the literature from many archaeological sites. As Smith and Ouzman (2004: 501) point out "Not all cultural materials are equally informative and not all material cultures are equally well – theorised". The artefacts found in the display cabinet along with the human remains can potentially provide clues to the cultural affinity of TM PAL 92-136.

J. ETHNO-HISTORICO-CULTURAL ANALYSES

Original museum catalogue

The original accession register (TM 92-136/art12/catalogue card) (fig. 2.18) is crucial in placing the remains into their historo-social context. TM 92-136/art12/catalogue card suggests four natural starting points to consider when restoring context and identity to the remains. The note reads:

> "Skeleton and skulls of *Korana* and *Korana Bush* from Cave *W. Bronkhorstspruit*. Presented by *Dr F. Ludorf*" (emphasis added).

Firstly, the entry was penned by Robert Broom who was Director of the museum in the mid- to late- 1930's. Secondly, the name of the person who donated the remains is known (Dr. F. Ludorf). Thirdly, Bronkhorstspruit is identified as the area from which the remains originate, and finally, Broom identifies the remains as those of 'Korana Bush [man].'

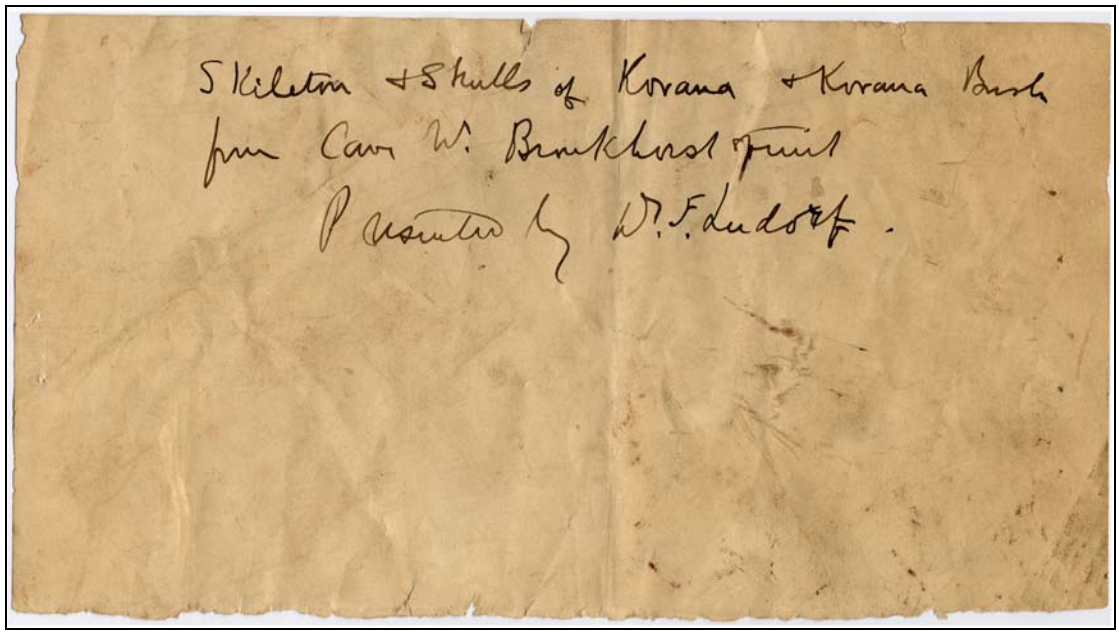


Figure 2.18 TM PAL 92-136/art12/catalogue card

Robert Broom and the historico-social setting of physical anthropology in the early 20th century.

As described in the Literature Review, recognising the 'culture' of physical anthropology during the early 20th century within which Robert Broom worked is crucial to providing an historical context in which the remains came to be presented to a museum. In order to illicit this context, an extensive literature review on the socio-historical state of physical anthropology and of the person of Robert Broom is presented. In addition, miscellaneous paraphernalia belonging to Broom (including his field notes) housed at the Transvaal Museum were analysed (with permission from

Francis Thackeray) to ascertain whether any mention of the mummified remains was recorded.

Dr F. Ludorf

Dr F. Ludorf presented the remains to the museum. Archival material at the National Archives in Pretoria was extensively researched to trace Dr Ludorf as was the National Automated Archival Information Retrieval System (NAAIRS). Aside from the archival research, telephone and personal discussions were held with his living relatives.

Bronkhorstspruit

As the remains are said to be from a cave west of Bronkhorstspruit, informal interviews were held with several local inhabitants from the area including the police inspector who has served in the town for the longest and the current magistrate who allowed access to the oldest entry books naming attorneys from the town (Dr F. Ludorf was an attorney). It was thought that the remains of an unknown body might have been recorded.

CHAPTER 3 - Results

A. SKELETAL ANALYSIS

Presence/absence of skeletal material.

Following outlines suggested by Buikstra and Ubelaker (1994), the presence and/or absence of cranial and postcranial bones are recorded in table 3.1. and illustrated in Fig 3.1. The skeleton is largely complete.

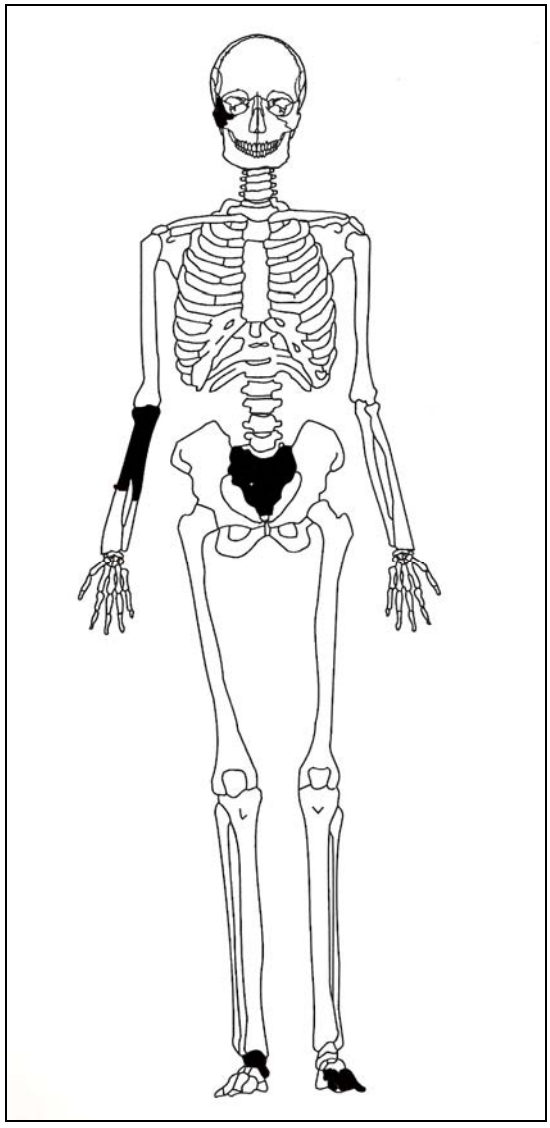


Figure 3.1: Schematic representation of skeletal elements present. Blackened areas represent skeletal element absence (base diagram after Buikstra and Ubelaker, 1994)

Table 3.1: Inventory recording form for TM PAL 92-136 where 0 = missing; 1 = >75% present or complete; 2 = 25% - 75% present and 3 = < 25% present (after Buikstra and Ubelaker, 1994).

CRANIAL BONES AND JOINT SURFACES

	L (left)	*R (right)*		*L (left)*	*R (right)*
Frontal	**1**	**1**	Sphenoid	**1**	**1**
Parietal	**1**	**1**	Zygomatic	**1**	**3**
Occipital	**1**	**1**	Maxilla	**1**	**1**
Temporal	**1**	**1**	Palatine	**1**	**1**
TMJ	**1**	**1**	Mandible	**1**	**1**

POSTCRANIAL BONES AND JOINT SURFACES

	L (left)	*R (right)*		*L (left)*	*R (right)*
Clavicle	**1**	**1**	Os Coxae	**1**	**1**
Scapula	**1**	**1**	Ilium	**1**	**1**
Body	**1**	**1**	Ischium	**1**	**1**
Glenoid f.	**1**	**1**	Pubis	**1**	**1**
Patella	**0**	**0**	Acetabulum	**1**	**1**
Sacrum	**0**	**0**	Auric. Surface	**1**	**1**

Vertebrae

Atlas	**1**
Axis	**1**
Cervical	**1**
Thoracic	**1**
Lumbar	**1**

Sternum:

Manubrium	**2**
Body	**2**

Long Bones

			Diaphysis		
	Proximal Epiphysis	*Proximal Third*	*Middle Third*	*Distal Third*	*Distal Epiphysis*
Left Humerus	**1**	**1**	**1**	**1**	**1**
Right Humerus	**1**	**1**	**1**	**2**	**2**
Left Radius	**1**	**1**	**1**	**1**	**1**
Right Radius	**0**	**0**	**2**	**1**	**1**
Left Ulna	**1**	**1**	**1**	**1**	**1**
Right Ulna	**0**	**0**	**2**	**1**	**1**
Left Femur	**1**	**1**	**1**	**1**	**1**
Right Femur	**1**	**1**	**1**	**1**	**1**
Left Tibia	**1**	**1**	**1**	**1**	**1**
Right Tibia	**1**	**1**	**1**	**1**	**1**
Left Fibula	**1**	**1**	**1**	**1**	**1**
Right Fibula	**1**	**1**	**1**	**1**	**1**

Hand

	Left	*Right*
Carpals	**1**	**1**
Scaphoid	**1**	**1**
Lunate	**1**	**1**
Triquetral	**1**	**1**
Pisiform	**1**	**1**
Trapezium	**1**	**1**
Trapezoid	**1**	**1**
Capitate	**1**	**1**
Hamate	**1**	**1**
Metacarpals		
MC1 (thumb)	**1**	**1**
MC2	**1**	**1**
MC3	**0**	**1**
MC4	**1**	**1**
MC5	**1**	**1**
Phalanges		
Proximal		
1	**1**	**1**
2	**1**	**1**
3	**0**	**1**
4	**1**	**1**
5	**1**	**1**
Middle		
1	**1**	**1**
2	**1**	**1**
3	**0**	**1**
4	**1**	**1**
Distal		
1	**1**	**1**
2	**1**	**1**
3	**0**	**1**
4	**1**	**1**
5	**1**	**1**

Foot

	Left	*Right*
Tarsals		
Talus	**1**	**0**
Calcaneus	**1**	**0**
First Cuneiform	**1**	**1**
Second Cuneiform	**1**	**1**
Third Cuneiform	**1**	**0**
Cuboid	**1**	**0**
Navicular	**1**	**1**
Metatarsals		
MT1	**0**	**0**

MT2	**0**	**1**
MT3	**0**	**1**
MT4	**0**	**1**
MT5	**1**	**1**
Phalanges		
Proximal		
1	**0**	**0**
2	**0**	**1**
3	**0**	**1**
4	**0**	**1**
5	**1**	**1**
Middle		
1	**0**	**0**
2	**0**	**1**
3	**0**	**1**
4	**0**	**1**
Distal		
1	**0**	**0**
2	**0**	**1**
3	**0**	**1**
4	**0**	**1**
5	**2-3**	**1**

Presence/absence of dental material

The upper right first incisor and lower left third molar are absent. The upper right canine, upper left first incisor and lower right first molar are chipped. The presence and or absence of the dentition are illustrated in figure 3.2.

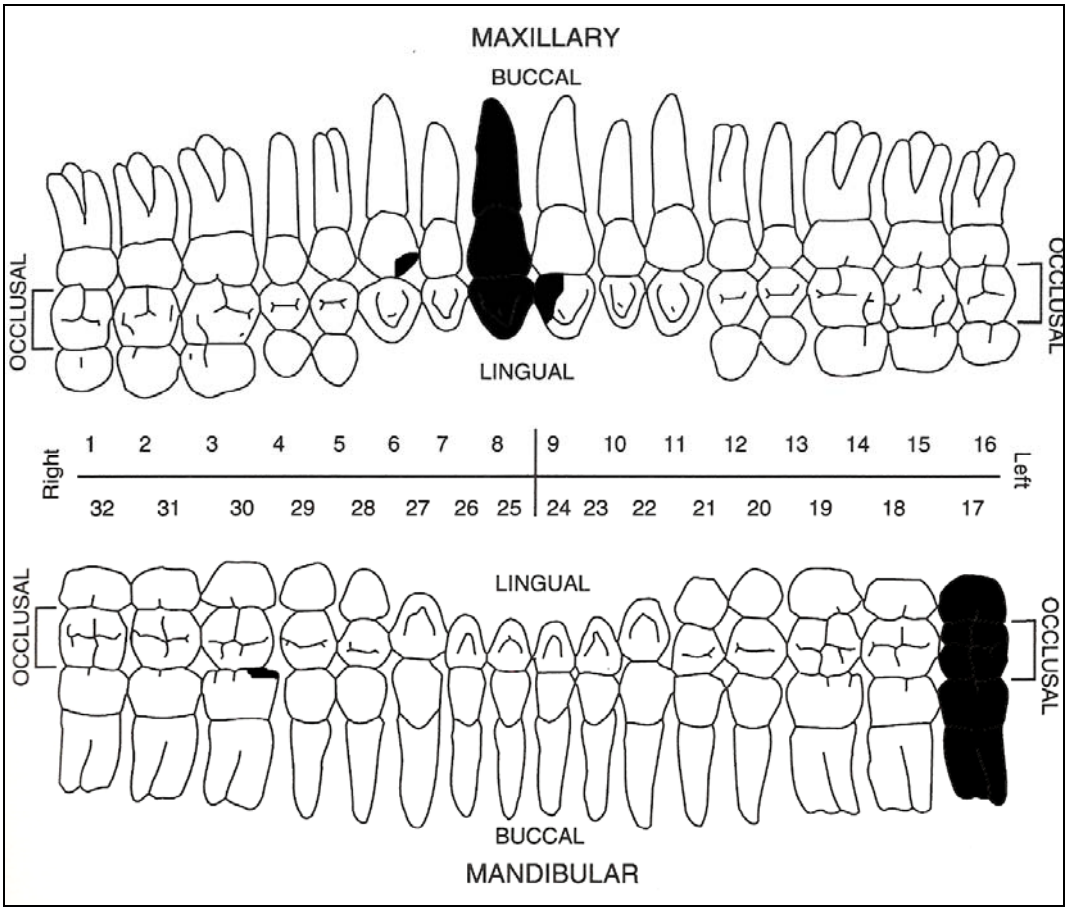


Figure 3.2: Dental inventory visual recording form. Blackened areas represent chipped or absent teeth. Base diagram from Buikstra and Ubelaker (1994).

Sex determination

TM PAL 92-136 is female. The specimen presented positive expressions of the ventral arc, the subpubic concavity and ischiopubic ramus ridge. The greater sciatic notch conformed most closely with scoring mark 2 following Buikstra and Ubelaker's (1994) guidelines for scoring sexual dimorphism where 1 represents typical female morphology and 5 typical male morphology (fig. 3.3). The preauricular sulcus expressed as more female than male (fig. 3.4).

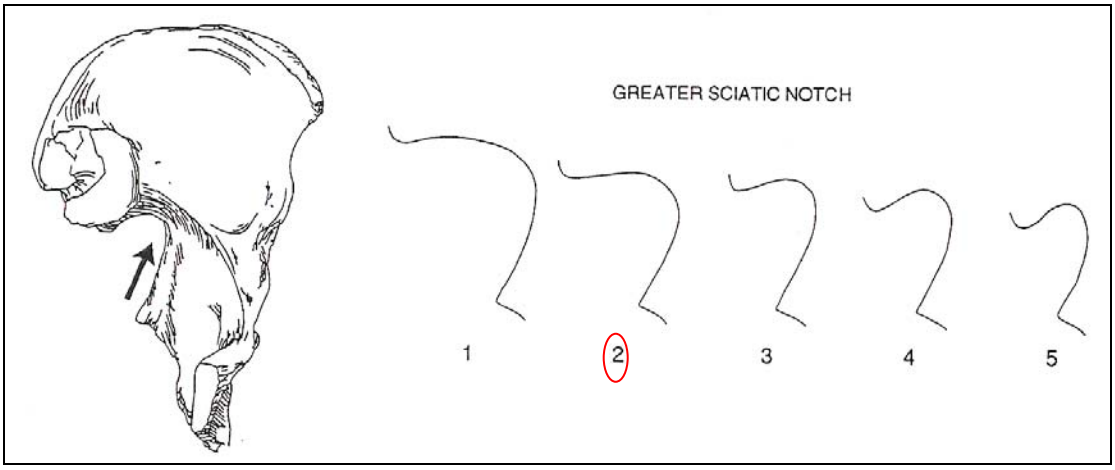


Figure 3.3: Sex differences in the greater sciatic notch. Illustration number 1 presents typical female morphology, while the higher numbers show masculine conformations. TM-PAL 92-136 most closely resembles 2 (marked in red) (drawing by P. Walker in Buikstra and Ubelaker, 1994).

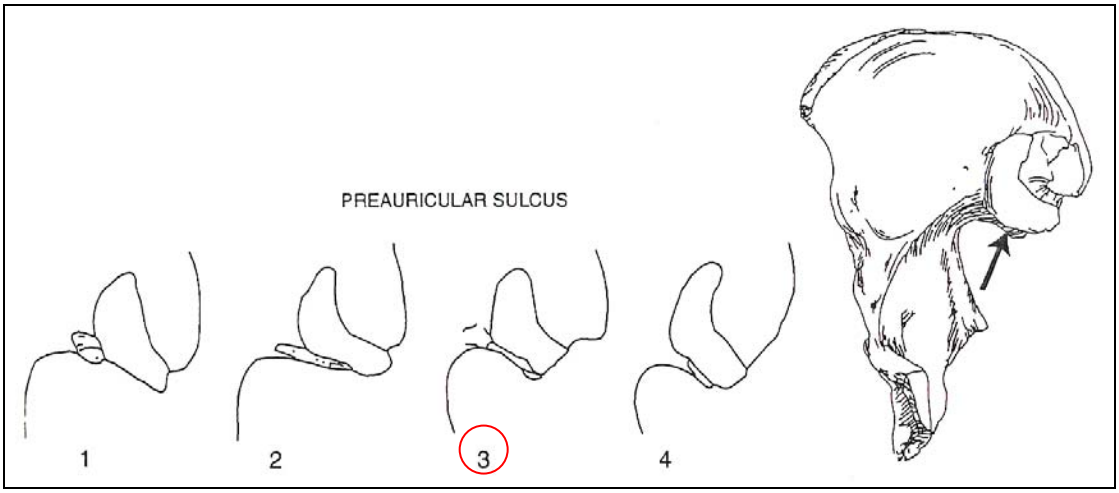


Figure 3.4: Scoring system used to identify the relative presence of absence of the preauricular sulcus. The preauricular sulcus appears more commonly in females than in males. It was adjudged to most closely resemble scoring 3 in TM PAL 92-136 (drawing by P. Walker in Buikstra and Ubelaker, 1994).

On the skull, the specimen expresses a fairly robust (masculine-like) nuchal crest. The mastoid process, mental eminence, and supramastoid crest are gracile (figure 3.5). The supra-orbital margin is sharp and glabella relatively flat. In addition, there are only weakly delineated muscle markings on the limb bones also expressing as female.

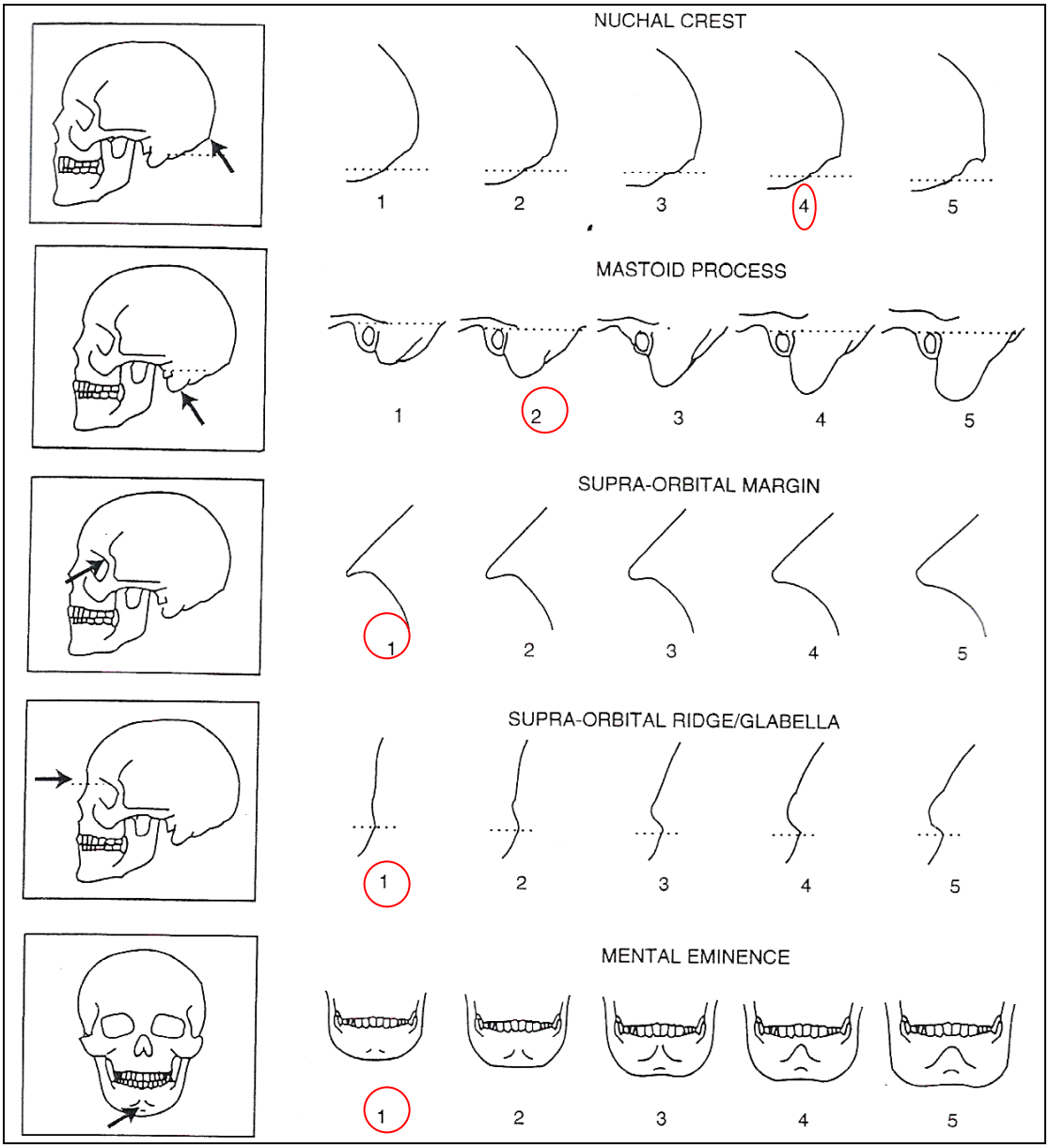


Figure 3.5: Scoring system for sexually dimorphic cranial features (after Acsadi and Nemeskeri in Buikstra and Ubelaker, 1994). Highlighted scores represent TM PAL 92-136.

Age determination

All long bone epiphyses are obliterated, with the exception of the medial end of the clavicle which is partly fused. The syndhondrosis spheno-occipitalis was almost completely obliterated and the permanent teeth had erupted. As it was established that the specimen was female, the sternal rib phase of rib 5 was compared to casts at the Department of Anatomy, University of Pretoria (Oettlé and Steyn, 2000) (table

2.3). The closest match was phase 3 for females, giving an age range of 22 – 24 years. TM PAL 92-136's age at death was therefore early- to mid- twenties.

Population affinity

Craniometrics

The results of the cranial measurements and cranial indices are presented in Tables 3.2 and 3.3 respectively. From this it can be seen that the skull is mesocephalic, with a wide nasal apertureand prognathic face.

Table 3.2. Cranial measurements for TM PAL 92-136

Cranial Measurements	
Measurement	*TM PAL 92-136*
Maximum cranial length	**178**
Maximum cranial breadth	**134**
Bizygomatic diameter	**118**
Basion-bregma height	**129**
Cranial base height	**89**
Basion-prosthion length	**92**
Minimum frontal breadth	**92**
Nasal height	**41**
Nasal breadth	**23**
Orbital breadth	**38**
Orbital height	**34**
Biorbital breadth	**101**
Interorbital breadth	**23**
Frontal chord	**108**
Parietal chord	**108**
Occipital chord	**96**
Foramen magnum length	**37**
Foramen magnum breadth	**29**
Mastoid length	**27**
Bigonial width	**85**
Minimum ramus breadth	**32**
Maximum ramus breadth	**44**
Maximum ramus height	**48**
Mandibular length	**99**
Mandibular angle	**123**

Table 3.3: Cranial indices calculated for TM-PAL 92-136

Cranial Indices	
Index	*Result*
Cranial	**75.3**
Cranial height	**72.5**
Vertical	**96.3**
Transverse Frontoparietal	**68.7**
Foramen Magnum	**78.3**
Gnathic Index	**103.4**
Zygomatico-Frontal	**78.0**
Upper Facial	**54.7**
Orbital	**89.5**
Nasal	**53.7**

Non metric (morphological and superficial) features of the skeleton

An inter-parietal groove was noted which is a Khoe-San feature (fig. 3.6). The relative swelling of the temporal area termed *mons temporosphenoidalis* which is a discrete Khoe-San feature was not visible, nor was an inferior frontal eminence. No metopic suture was visible. A pronounced over-bite is present. The orbits are rectangular in shape. The skull in general resembles a mixture of Negroid (prognathic, upper facial index category, shape of orbits) and Khoe-San (wide interparietal groove, mesocephalic cranial shape) features based on table 2.4. and demonstrates the difficulty of deducing unambiguous morphological affinities for a single individual.



Figure 3.6: Computed tomography image showing parietal depression

Stature

The maximum length of the femur is 422mm. The mean ratio of femur length to stature is 26.74%. Hence, the stature of TM PAL 92-136 is 15

Health Status/ Pathology

No signs of pathology (including cribra orbitalia, Harris lines or dental enamel hypoplasia) were observed on TM PAL 92-136..

B. TAPHONOMY

The right distal humerus and right calcaneus are partially cremated (fig 3.7). The bone breakage pattern on the humerus is stepped. The knees of TM PAL 92-136 were intentionally broken so as to 'fold the legs over' and fit the skeleton into the museum display cabinet (fig. 3.8). Postmortem insect boring damage is evident on the body (fig.3.9).

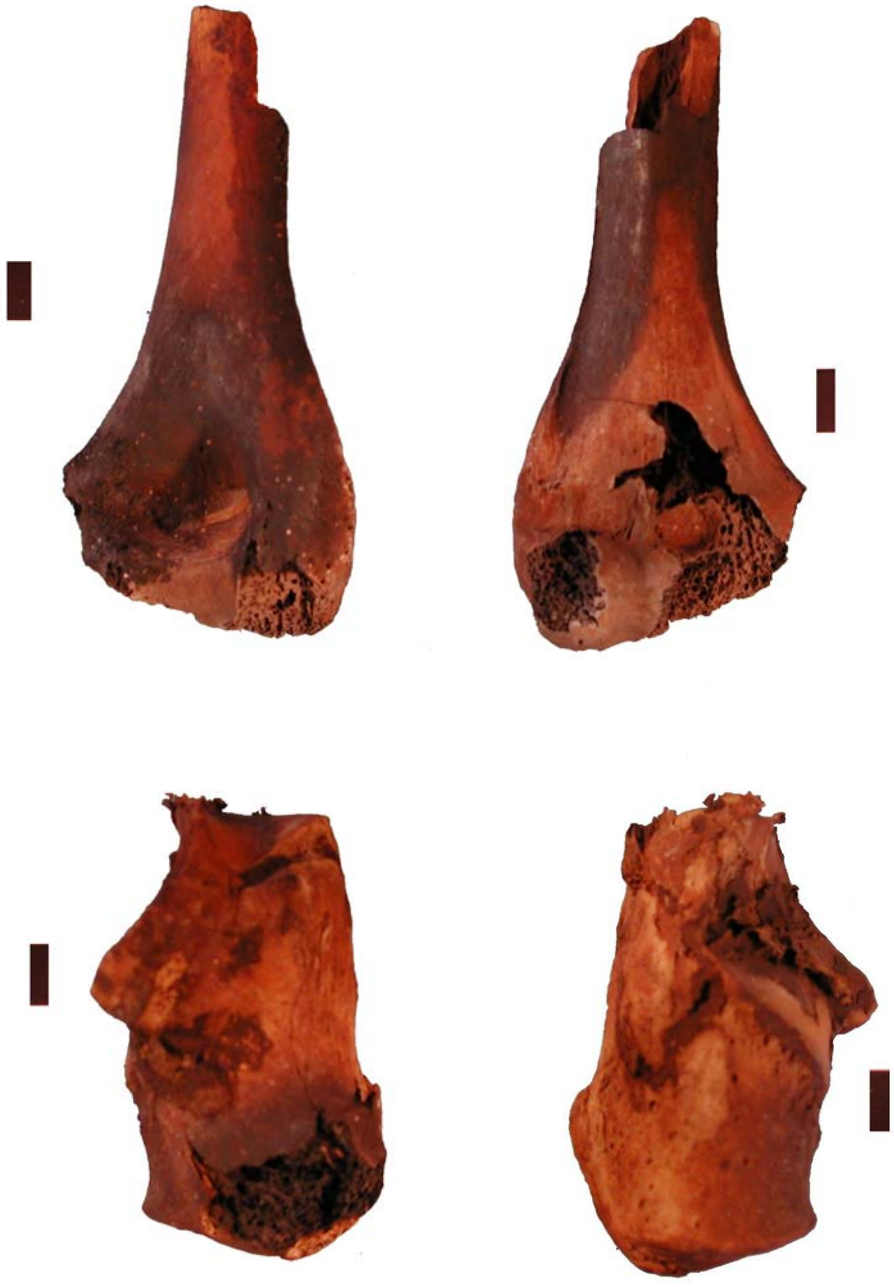


Figure 3.7: Burnt bone from TM PAL 92-136



Figure 3.8: Postmortem bone breakage on the knees of TM PAL 92-136



Figure 3.9: Insect bore hole damage to TM PAL 92-136

C. ANCIENT DNA

An almost complete HVS-1 sequence was obtained for the mummified remains. The majority sequence is:
16129A, 16152T, 16187T, 16189C, 16195T, 16122A, 16223T, 16230G, 16243C, 16311C, 16390A.

16129A, 16187T, 16189C, 16223T, 16230G, 16311C are motifs for Haplogoup L0d identifying the remains as coming from this group.

As described in the Literature Review section, the root of the human phylogenetic tree occurs in Africa. There are two main mtDNA lineages which originate here (namely haplogroups M and N) which were the progenitors of all non-African haplogroups. However, the macrohaplogroup L (including haplogroups L0 – L6) is primarily limited to sub-Saharan Africa (the Khoesan). Haplogroup L0 is divided into subhaplogroups L0a, L0d, L0f and L0k (Salas *et al*., 2002; 2004; Mishmar *et al*., 2004). Haplogroups lineages L0d and L0k have previously been found to occur almost exclusively among southern African "click-speakers" (the Khoesan) (Gonder *et al*., 2007). Recent research however, has detected L0d haplogroup in low frequencies of Tanzanian Sandawe and neighbouring Burunge (one individual) (Gonder, *et al*., 2007; Salas *et al.*, 2002; Tishkoff *et a*l., 2007). Common ancestry of the Sandawe and the southern African click-speakers dates back > 35 000 years (Tishkoff *et al.,* 2007). The presence of the L0d haplogroup in TM PAL 92-136 therefore identifies her lineage as Khoesan.

D. STABLE LIGHT ISOTOPES

Samples of bone collagen from TM-PAL 92-136 were analysed in order to better interpret the diet of the individual. The results for the carbon isotopes are summarized in table 3.4 and those for the nitrogen isotopes in table 3.5. The average $\delta^{13}C/^{14}C$ value is -8.2 (standard deviation 0.13) and the average $\delta^{15}N/^{14}N$ value is 9.4 (standard deviation 0.02). The standard deviations are a measure of the error on the samples and are low for all samples.

Table 3.4. $\delta^{13}C/^{14}C$ results for 5 samples from bone collagen from TM-PAL 92-136.

Sample	d $^{13}C/^{12}C$ [per mil] vs VPDB
TM-PAL 92-136/iso1	-9.313
C3 Standard	*-28.171*
C4 Standard	*-12.725*
TM-PAL 92-136/iso2	-7.819
TM-PAL 92-136/iso3	-7.999
TM-PAL 92-136/iso4	-8.095
TM-PAL 92-136/iso5	-7.836
C3 Standard	*-27.896*
C3 Standard	*-27.799*
C4 Standard	*-12.694*
C4 Standard	*-12.219*

Table 3.5. $\delta^{15}N/^{14}N$ results from 4 samples of bone collagen from TM-PAL 92-136.

Sample	d $^{15}N/^{14}N$ [per mil] vs Air N2
TM-PAL 92-136/iso6	9.065
Urea Standard	*-0.269*
Urea Standard	*-0.317*
TM-PAL 92-136/iso7	9.139
TM-PAL 92-136/iso8	9.088
TM-PAL 92-136/iso9	9.091
TM-PAL 92-136/iso10	9.106
Urea Standard	*-0.397*
Urea Standard	*-0.348*

E. FORENSIC ENTOMOLOGY

Several entomological specimens found on TM-PAL 9-136 or on the artefacts surrounding it have been identified.

- Pupae on the mandible are not fly pupae but more likely moths (M. Mansell, *pers comm.).*
- The adult insect remains on the mandible is a *Dermestes*, subgenus *Dermestinus*, probably *D. maculates* or possibly *D. frischii* or *D. gerstaeckeri*. *D. peruvianus* or *D. haemorrhoidalis* are ruled out. The larvae at most 3rd instar and at least one is 1st instar (Villet and Midgley, *pers. comm*.)
- Several insects on the post cranial skeleton and floral remains have been identified as dermestids (fig. 3.10) – but not *Dermestes* as they lack urogomphi (the horns on the tails). Villet and Midgley (*pers comm*.) submit that the desmestids are a species of *Attagenus*, most probably *A. verbasci* or *A. scrophulariae.* The chitin is relatively 'fresh-looking' leading Villet to believe that the insects died less than a year ago.



Figure 3.10: Dermestidae remains on TM PAL 92-136/art1/flora1

F. FLORAL ANALYSIS

Floral artefacts associated with TM-PAL 92-136 were identified where possible. The raw material from which TM-PAL 92-136/art4/flora4 (figure 2.11) was made was identified as *Cenchrus ciliaris.* The raw material from which TM-PAL 92-136/art1/flora1 (figure 2.8) and TM-PAL 92-136/art2/flora2 (figure 2.9) were made was identified as *Hyparrhenia hirta.* The distribution of the two species is illustrated in figures 3.12 and 3.14. TM-PAL 92-136/art7/flora7 (Figure 2.14) was identified as most likely sorghum (Huffman, *pers comm*.), possibly *Sorghum bicolor.*

Cenchrus ciliarus

Identification and description

Cenchrus ciliarus is a perennial grass often forming mats of tussocks (fig. 3.11). The culms reach heights 10 – 150 cm. They are wiry or sometimes woody. The panicle

measures 2-14cm. The panicle shape is long, cylindrical to ovoid with a grey, purple or straw colour. The involucre measures 6 – 16 cm and is connate only at the base forming a disk 0.5 – 1.5mm in diameter. The inner bristles are flexuous, often wavy and sparsely to densely ciliated below, while filiform above with one of them longer and stouter than the rest. The outer bristles are filiform. There are between one and four spikelets per bur, measuring 2 -5.5 mm long. The glumes are distinct and acute. The inferior glume from ¼ - ½ ; the superior from ½ to as long as the spikelet. The superior lemma is chartaceous (Clayton, 1989)



Figure 3.11: Photograph of *Cenchrus ciliarus*

Habitat

Cenchrus ciliaris is found in Savannah woodlands within the altitude range 0 – 1500m above sea level.

Range and Distribution

The range of *Cenchrus ciliaris* extends from tropical and southern Africa through the

hotter and drier parts of India and the Mediterranean region (http://www.kew.org; accessed 8/8/2006). The southern African distribution is illustrated in figure 312.

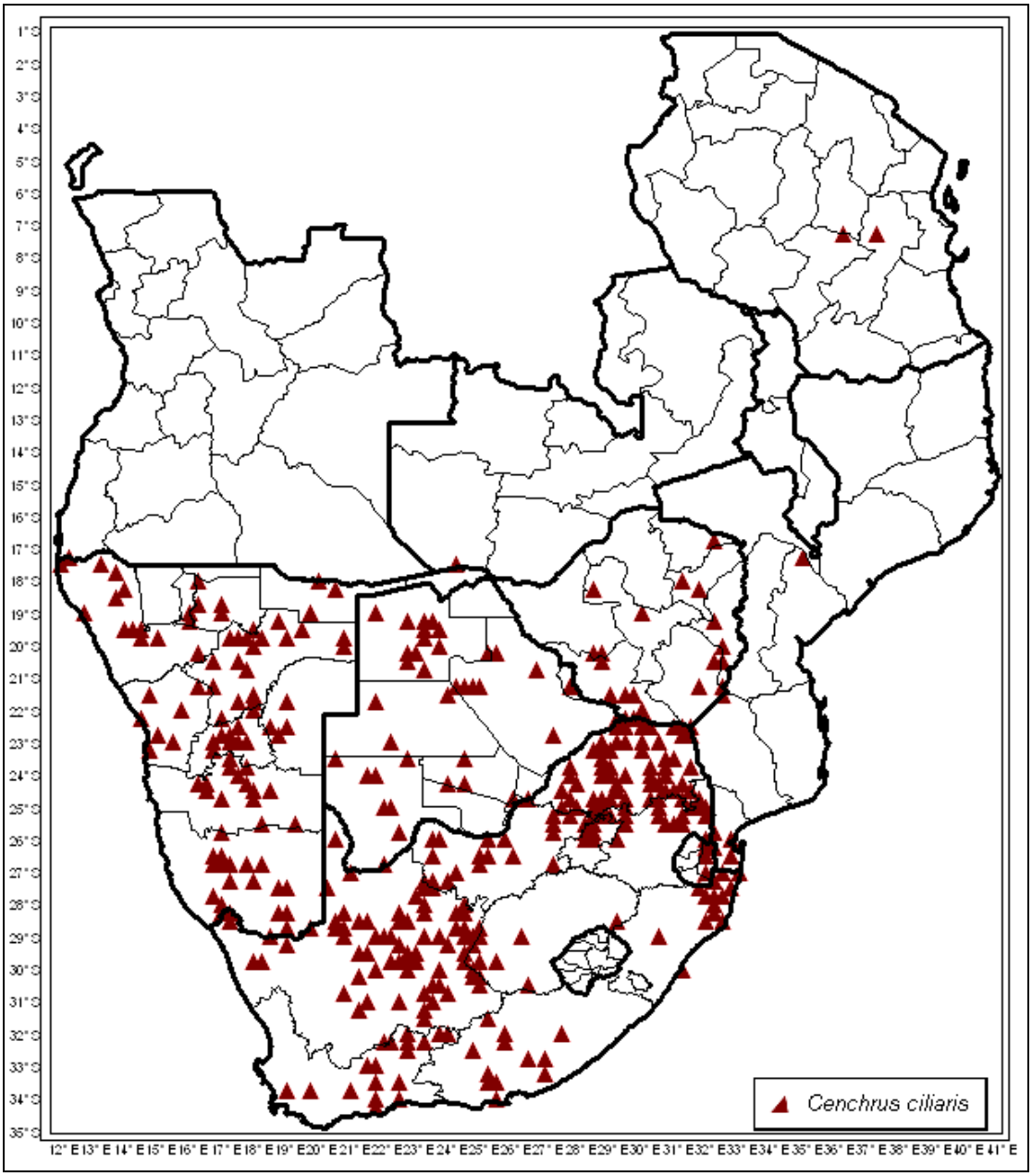


Figure 3.12: The distribution of *Cenchrus ciliaris* in southern Africa. The overall error level is estimated to be approximately 15% (PRECIS).

Hyparrhenia hirta

Identification and description

Hyparrhenia hirta (fig. 3.13) is a caespitose perennial arising from short rhizomes. The culms grow up to 60 cm high (growing to 1 m in exceptionally robust specimens). They are wiry and stand above a dense leafy tussock 10-20cm high. The leaf sheaths are compressed and keeled, glabrous or rarely obscurely puberulous. The leaf laminas are 2-15(30) cm long by 1-2(4) mm wide. They are narrowly linear to conduplicate and filiform, flexuous, glaucous and harshly scaberulous. The false panicle grows up to 30 cm long and is typically scanty with only 2-10 raceme-pairs but sometimes a little fuller with more raceme-pairs. The spatheoles are 3-8 cm long, linear-lanceolate. The peduncles are about as long as the spatheoles and glabrous or with white bulbous-based hairs above. Racemes are 2-4 cm long and 8-13(16)-awned per pair. They are white villous and terminally exserted, never deflexed. The raceme-bases are unequal, the superior being 2.5-5 mm long, filiform, glabrous or more usually pubescent to hirsute, either with or without a white beard at the foot. The homogamous spikelets are similar to the pedicelled, with a single pair at the base of the inferior or both racemes. Sessile spikelets are 4-6.5 mm long. The callus 0.5 – 1.5 mm long and subacute to acute. The inferior glume is linear-elliptic, yellowish-green to violet, white villous but occasionally the hairs are rather sparse. The awn is 10 – 35 mm long and puberulous with white hairs measuring 0.1 – 0.3 mm long. The pedicelled spikelets are 3 – 7 mm long and narrowly lanceolate, white villous, acute and muticous at the apex. The callus is absent. The pedicel-tooth is 0.2 – 1 mm long and subulate (Cope, 2002).

Habitat

H. hirta grows mostly in upland dambos within the altitude range of 1 200 to 1 700m

Range and Distribution

H. hirta occurs mainly in the Mediterranean region and north-east Africa, extending eastwards through Arabia and south-west Asia to Pakistan. It is absent from much of the rest of tropical Africa, except for isolated records from Niger and Angola, reappearing in South Africa (http://www.kew.org; accessed 8/8/2006). The southern African distribution is illustrated in figure 3.14.



Figure 3.13: Photograph of *Hyparrhenia hirta*

Sorghum bicolor

Sorghum bicolor is divided into subspecies *bicolor* to include all domesticated grain sorghums, subspecies *drummondii* (Steud.) de Wet comb. nov. to include stabilised derivatives of hybridization among grain sorghum and their closest wild relatives and subspecies *arundinaceum* (Desv.) de Wet et Harlan to include the wild progenitors of

grain sorghums. Four ecotypes of subspecies *arundinaceum* are recognized namely aethiopicum of the arid African Sahel, race virgatum of northeastern Africa, race arundinaceum of the African tropical forest, and race verticilliflorum of the African savannah (de Wet, 1978). The remains found with TM-PAL 92-136/art7/flora7 were not complete enough to distinguish between the species.

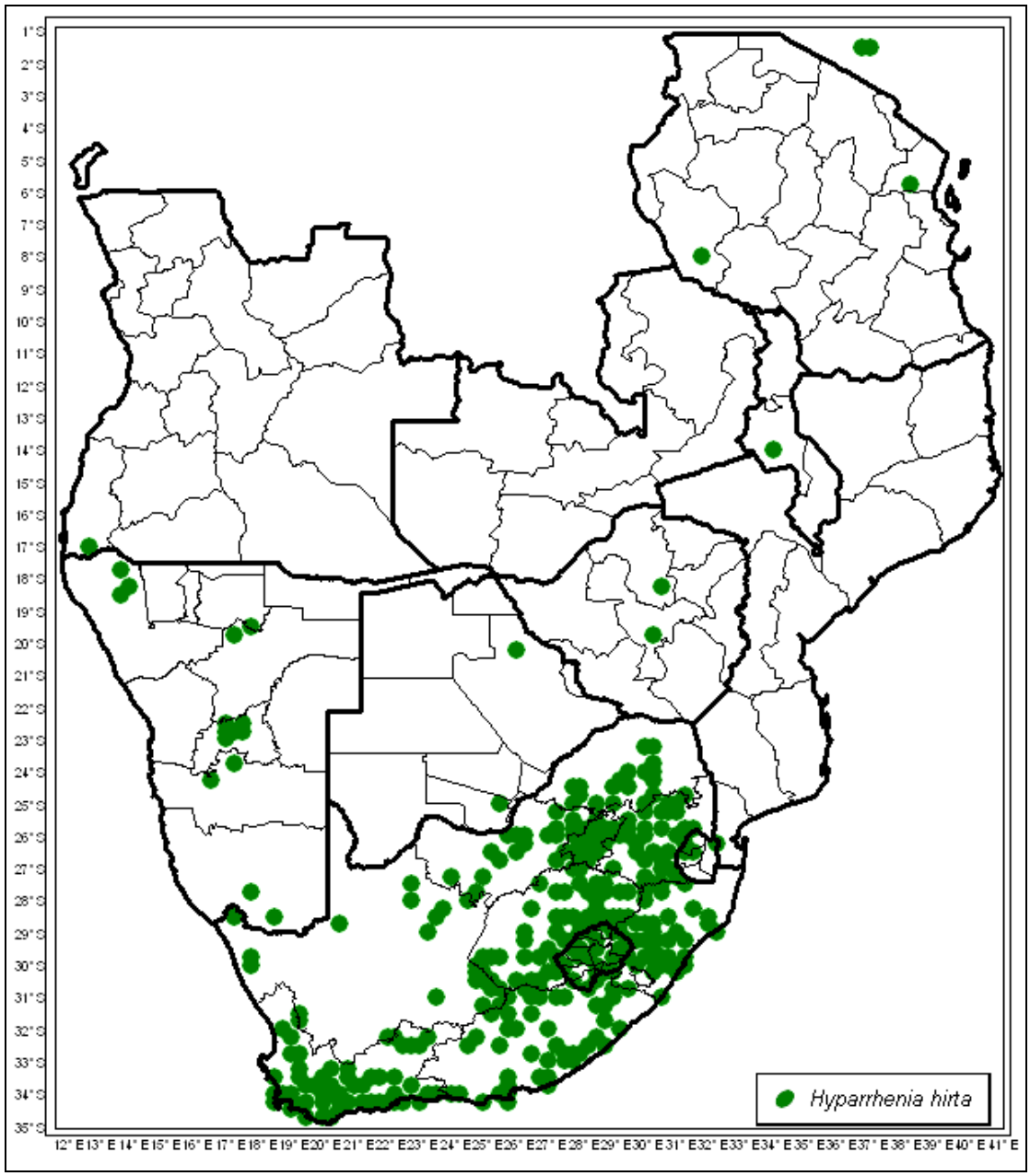


Figure 3.14: The distribution of *Hyparrhenia hirta* in southern Africa. The overall error level is estimated to be approximately 15% (PRECIS)

G. GEOLOGICAL ANAYSIS

The range of mineral types in soil may be upwards of tens to hundreds as there are over 2200 known natural minerals (Murray and Tedrow, 1992). A random sample cannot therefore be analysed and its provenance expected to match a map of soil distribution, as Ruffell and Wiltshire (2004) point out. However, its usefulness is that the XRD trace can be used if not to pin-point a particular area, then at least to disqualify others. XRD was carried out at the Police Forensics Laboratories in Pretoria by Roger Dixon. TM PAL 92-136/art10/stone is a highly weathered fine-grained sandstone. Minerals present include quartz, kaolinite and goethite which are a clay and fine-grained iron oxide respectively. The specimen is most likely from the Waterberg Group (Dixon, Senior superintendent, Police Forensic Laboratories, Pretoria, *pers comm*).

H. DATING

The results below (table 3.6) are reported using the convention of Stuiver and Polach (1977).

Table 3.6: Radiocarbon dating results from TM PAL 92-136 where [1]is percent modern carbon and is the radiocarbon content of the sample relative to the NBS standard; [2] is given in years Before Present (BP), i.e. before 1950 and dates are reported in conventional radiocarbon years using a half-life of 5568 years for C. Ages are corrected for isotope fractionation. [3] Age is calibrated after Talma and Vogel (1993).

Analysis No	Sample Name	$\delta^{13}C$ (‰PDB)	Percent Modern Carbon (PMC)[1]	Radiocarbon Age, yrs BP[2]	Calibrated Date[3]
Pta 9627	TM PAL 92-132	-9.2	92.6 +-0.7	870 +-70	AD 1162 (1217)1270

I. CULTURAL ANALYSIS

Analysis of TM PAL 92-136 under ultra-violet light (fig. 3.15) did not reveal any tattoos or scarification on the body. Areas of what appear to be candle wax were observed on the left side of the head (fig. 3.16 and 3.17). The entire body – whether covered by skin or not - was observed to have a reddish colouration.

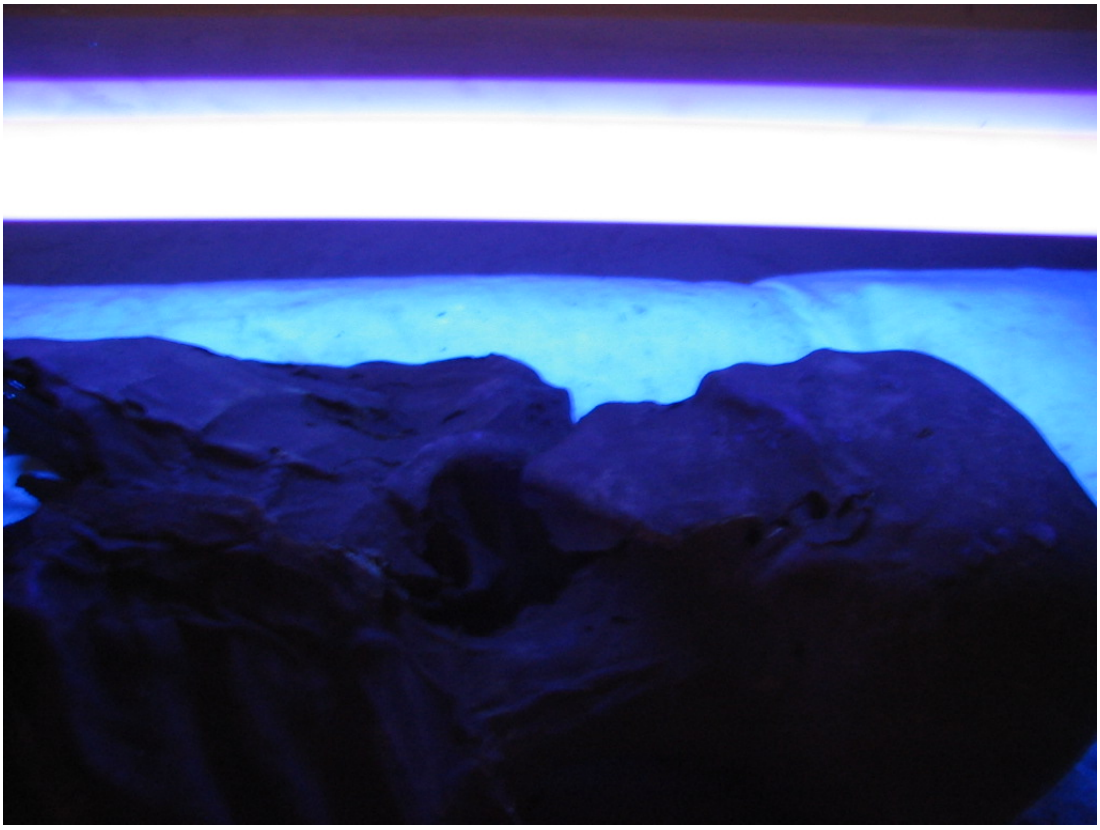


Fig. 3.15: TM PAL 92-136 under ultra violet light

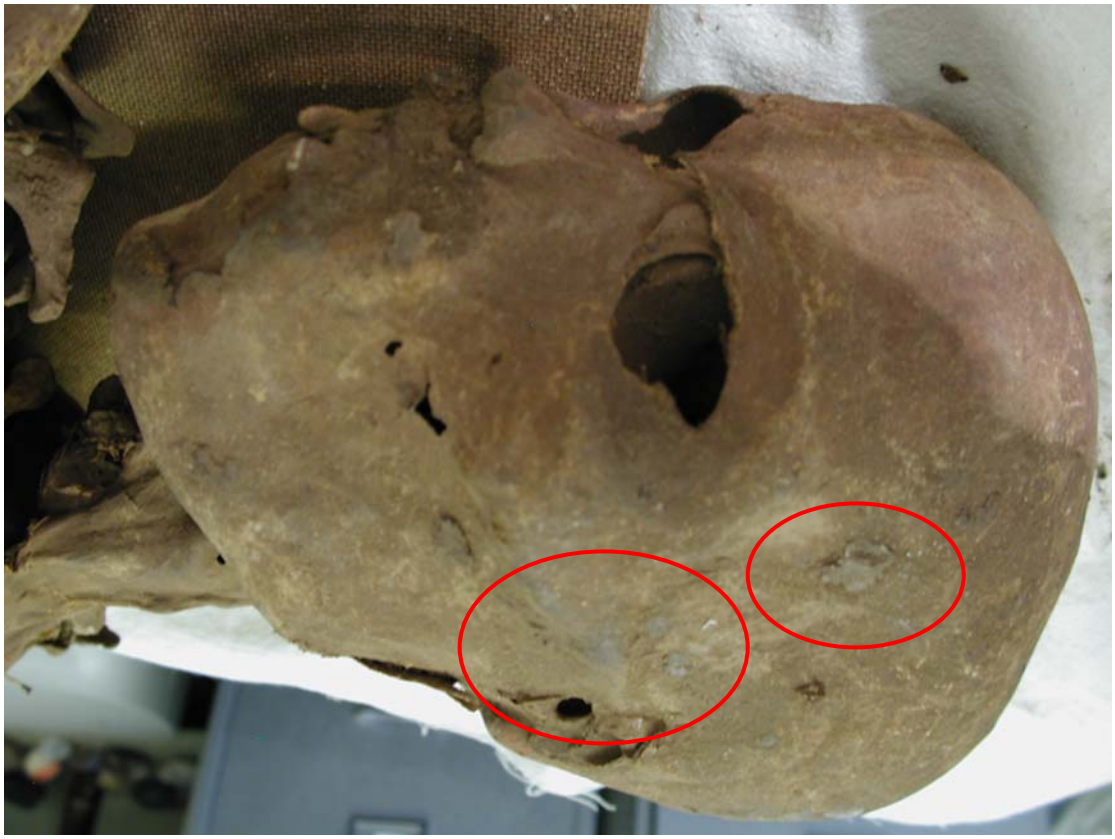


Fig. 3.16 "Candle wax" residue on the left cranium of TM PAL 92-136



Figure 3.17: "Candle wax" residue on the left cranium of TM PAL 92-136

The artefactual remains are fairly ubiquitous. TM PAL 92-136/art1/flora1 (fig.2.4) and TM PAL 92-136/art2/flora2 (fig. 2.5) most closely resemble known basketry from the Iron Age. Maggs (1976) describes Iron Age communities of the southern Highveld of the then Transvaal. In the text he provides a photograph and description of grain storage bins known as sesiu. TM PAL 92-136/art1/flora1 is juxtaposed with the photograph of the sesiu in fig.3.18. Maggs (1976:134) records: "[T]he traditional method of grain storage in our area was the sesiu, a large and approximately spherical basket, a metre or more in diameter. The method of manufacture [was] using loose coils of grass woven together with plaited grass ropes…The usual position of the sesiu in the historic settlements was 'around the huts of the natives, outside the fences' (Backhouse, 1844: 369)."

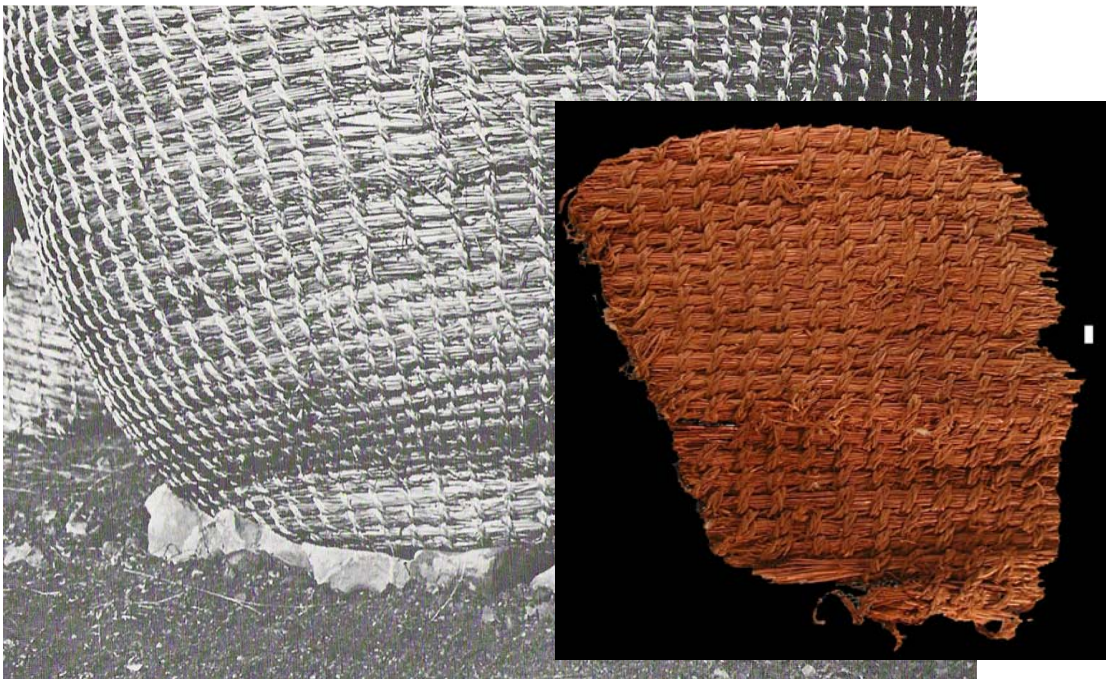


Figure 3.18: TM PAL 92-136/art1/flora1 (right) compared to photograph of sesiu grain storage basket (Maggs, 1976).

TM PAL 92-136/art8/flora8 (fig. 2.10) is a sharpened wooden stick resembling a peg which would have been used for example to stretch and peg animal skins to dry

(Huffman, *pers comm*.). TM PAL 92-136/art9/flora9 (fig 2.11) is an adze without its handle (*ibid*.).

J. ETHNOGRAPHIC AND HISTORICAL ANALYSES

Robert Broom and the historo-social setting of physical anthropology in the early 20th century.

TM PAL 92-136 was donated to the Transvaal Museum (TM) in the 1930's, according to the accession papers. Robert Broom was appointed Curator of Palaeontology at the TM from 1934 at the inducement of his friend and patron General Smuts and Raymond Dart (Štrkalj, 1996a).

It was a time when numerous biological studies were conducted on Khoe-San people and a time when Broom devoted much of his time pondering comparative anatomy. Beginning in the 1920's, he began to contribute significantly to the knowledge of living populations as well as to palaeoanthropology (Štrkalj, 2000). Broom was in part a product of his time and as described in the literature review section, anthropological research at this time was based on the now discredited typological approach.

Broom collected cadavers of the deceased and prepared the skulls. It seems that he was prepared to collect specimens from any source, be it prisons, graves or donations. It is also known that anthropologists of the time approached missionaries on occasion to request the donation of Khoe-San skeletal remains (Legassick and Rassool, 2000).

Findlay (1972: 72-73 quoted in Legassick and Rassool, 2000: 51-52) records a passage from one of Broom's letters in which he alludes to his collecting techniques:

> "Studying anthropology is not always a pleasant task. One day a very interesting native died and I wanted the skeleton rather badly so I had the body sent up to my garage for me to do a post mortem. It was in January, and the temperature was much above 100 degrees in the shade. I was called out [on] a long country journey and only got back at 10 o'clock that night…I fear that the European arm-chair anthropologists have little idea of the troubles we workers in the field have…If a prisoner dies and you want his skeleton, probably two or three regulations stand in the way, but the enthusiast does not worry about such regulations. I used to get the body sent up… then the remains would be buried in my garden, and in a few months the bones would be collected."

In his later works Broom divided the Khoe-San into three races: Bushmen, Hottentot and 'Korana'. In three papers (Broom, 1923; Broom 1929; Broom, 1941), Broom elaborated on a theory that the !Kora ('Koranna') represented an ancient 'physical type' that had hybridised with the San to form the Khoe. According to Morris (1986) Broom's comparative samples consisted of no more than two or three 'type specimens', each of which had been selected with care to illustrate the preconceived morphological pattern which he wished to describe. However, towards the end of his career, when he was asked about the !Kora, whose status as a distinctive taxon was questioned by many, he replied, "I invented the Korana" (Štrkalj, 2000:113).

Racial categorisation of skeletal material from this period must therefore be viewed with sceptism.

Dr F. Ludorf

Fortunately the surname 'Ludorf' is relatively uncommon in South Africa. Following extensive research through the National Automated Archival Information Retrieval System (NAAIRS) and later at the National Archives Repository in Pretoria, the family tree of the Ludorf line since their arrival in South Africa in 1842 was traced. Table 3.7 presents the Ludorf genealogy. Joseph David Martin Ludorf arrived by boat from Germany in 1842 to serve as a missionary. He worked primarily in printing stationed initially at a missionary in Beerseba, and later at Thaba Nchu (Historical Papers A926, William Cullen Library, Wits). His great grandson Frederik was born in 1903 and became a doctor of medicine (fig.3.19). Frederik committed suicide in Johannesburg in 1950. He left behind an ex-wife, widow and one daughter, none of whom could be traced. One of Frederik's brothers (Theophilus Franscois Herbert Ludorf) has daughters living in Johannesburg namely Norma Maxilian Ludorf and Wanda Antoinette Brown (neè Ludorf). They were traced through the Telkom directory and later met for informal discussion. Norma and Wanda in turn phoned their relatives in the country, however no information on the mummified remains were known to any family member. A suitcase of family memorabilia and documents similarly produced no new information. Interestingly though, another of Frederik's brothers (Joseph Francis Ludorf) worked as an attorney in the Pretoria region and several documents at the National Archives Repository in Pretoria record successful bids he made to prospect in the area of Cullinan west of Bronkhorstspruit (National Archive numbers: SAB MNW 469; SAB MNW 326; SAB MNW 837 and SAB

MNW 902). While interesting, the attempt to illicit more information on the circumstances surrounding TM PAL 92-136's provenance and circumstances through tracing the presenters' relatives was unfruitful.



Figure 3.19: Photograph of Dr Frederik Ludorf from Wanda Ludorf's 'family memorabilia' suitcase.

Table 3.7: Genealogy of the Ludorf family in South Africa

1. Joseph David Martin Ludorf (b. 1819 – Mannheim, Germany; d. 12 Jan 1872 – Lekatlong Missionstation)
   sp: Frederika Zahn (m. Oct 1853)
      2. Theophilus Frederick Ludorf (b. 1948 – Basutoland; d. 1897 – Kimberley)
         sp: Rebecca Adeline Short (b.1857; d. 1880)
            3. Theophilus Bourvalet Ludorf (b.1874; d.1954 – Brits)
               sp: Maria Jane Naude (b.1885; d. 1952)
                  4. Theophilus Francois Herbert Ludorf (b. 1908; d. 1972)
                     sp: Doris Eleanor Wood
                        5. Theophilus Norman Ludorf
                        5. Avril Delores Ludorf
                           sp: NN Hinks
                        5. Norma Maxilian Ludorf
                        5. Wanda Antoinette Ludorf (b. 1947)
                           sp: Brown
                  4. Norman Ludorf (d. 2004)
                  4. Raymond Ludorf
            3. Louisa Ludorf (b. Jan 1876; d. Jul 1964)
               sp: Sidney Dawson (b. 1876; d. 1961)
                  4. Dudley Dobson
                  4. Doris Joan Dobson
                     sp. NN Coetser
                  4. Sidney Thomas Dobson
            3. Joseph Francis Ludorf (b. 1877 – Potchefstroom; d. 1958 – Jhb)
               sp: Jacoba Aletta Botha (d. 1963 – Pta).
                  4. Joseph Francis Ludorf (b. 1913)
                     sp: Sarah Adriana van Hees
                  4. Maria Elizabeth Ludorf
                     sp: Trevor Clark
                  4. Frederick Ludorf (b. 1903; d. 1950 – Jhb committed suicide) ←
                     sp: Marjorie Clymer (divorced)
                        5. Adele Barbara Eilene Ludorf (b.1944)
                     sp: Hester Aletta Steyn (b.1923; m. 1949)
            3. George Hubert Ludorf (b. 1879; d. 1940)
               sp: Lettie Louisa Steyn (b.1889; d. 1969)
                  4. Layton Lionel Ludorf
         sp: Susanna Elizabeth Zietsman (b. 1850; d. 1930 – Pta)
            3. Bernard Ludorf (b. 1891; d. 1926 – Pta)
      2. Josephine Frederike Ludorf
         sp: George Siddle

Bronkhorstspruit

Bronkhorstspruit lies north north east of Pretoria (fig. 3.20). Informal discussion with police inspectors, the local magistrate and local residents did not illicit any knowledge of Frederik Ludorf or of the mummified remains. No caves are known in the area, however, several rock shelters with San rock art are known, particularly on the nature reserve Ezemvelo north east of the town (Ansie Steyn, *pers comm*.).

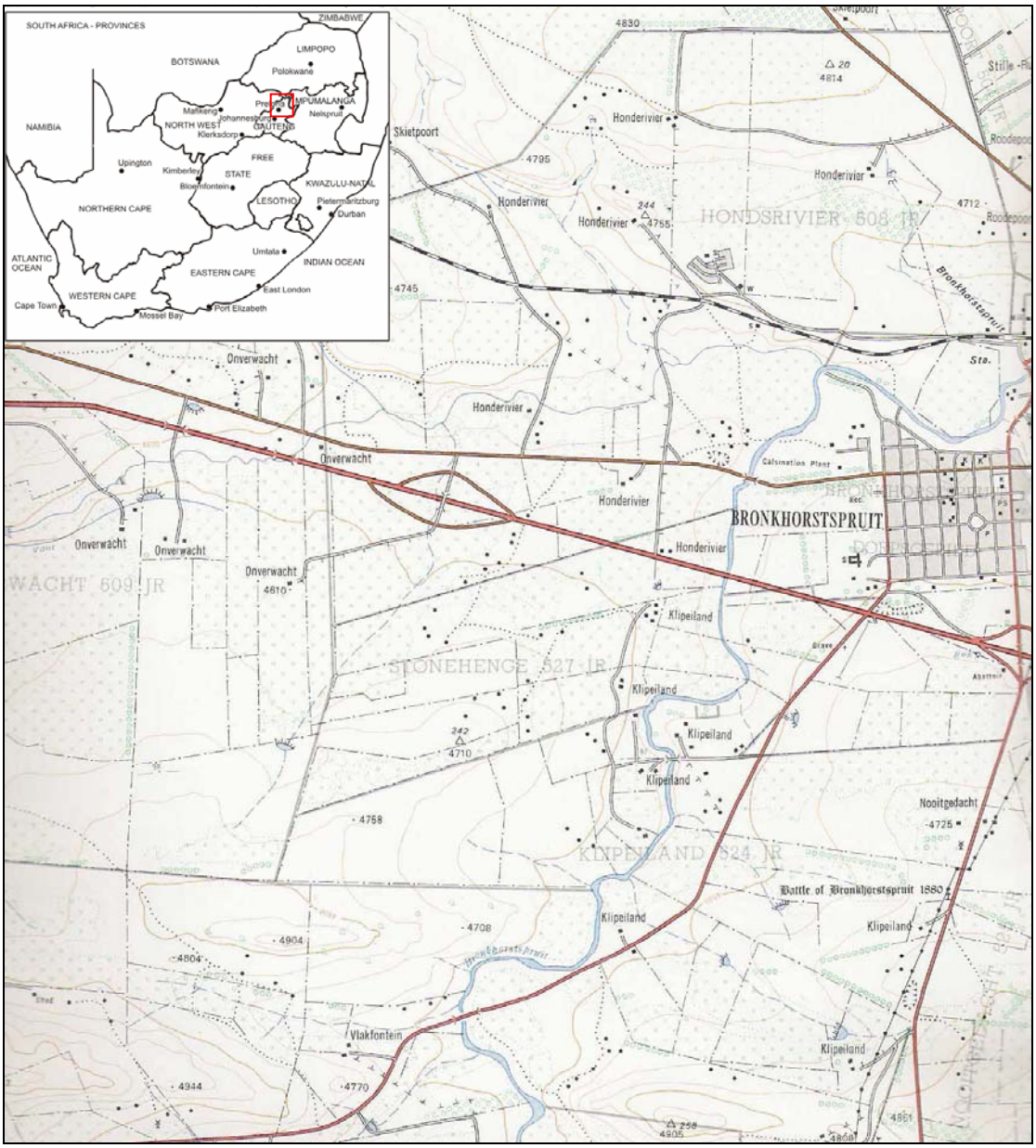


Figure 3.20: Area immediately west of Bronkhorstspruit (from 1971 topographic map 2528DC Bronkhorstspruit).

Chapter 4 - Discussion and Conclusions

Introduction

> "Bioarchaeologists focus their research on ancient human skeletal remains, not out of idle scientific curiosity, but instead because they believe that the information contained within the remains of our ancestors is of great value to modern people. Human skeletal remains are a unique source of information on the genetic and physiological responses our ancestors made to the challenges posed by natural and sociocultural environments. Consequently, they provide an extremely valuable adaptive perspective on the history of our species." (Walker, 2000: 13)

Human remains in museums have something to tell us about their own time and context. This relates not only to the lifestyle, health and behaviours of the individual, but also to the greater scientific practices in acquiring the specimen, treatment and study thereof. Much of what we know about our recent history in southern Africa is based on inferences derived through analysis of artefacts, documents, oral histories, rock art and other products of human cultural activity. It is well recognized that subjective aspects of attempting to interpret cultural artefacts from the perspective of our current milieu come into play: "Historical works often reveal more about the cultural values and political biases of the historian than they do about the reliability of the historical event being described" (Walker, 2000: 13).

The information about interactions with past environments encoded in human remains (because of its biological basis in the physiological processes of growth, development,

and acclimatization to environmental change) provides an extremely valuable comparative basis for evaluating interpretations of the past based on artefacts, documents, rock art and other culture-based sources. The methodological problems inherent in extracting data from skeletal remains differ from those which historians face when they attempt to interpret the historical significance of the cultural products with which they work. And therein lies the strength of multi-disciplinary research. As Walker (2000) points out, the only way we can reduce cultural biases inherent that distort our understanding of past events is through collecting a diversity of evidence from sources that are susceptible to different types of interpretive error, and through cognizance of what those biases may be. It is easier to rule out alternative interpretations of the past that are unlikely to reflect actual events when the diversity of information about the past increases. By using a series of data sources that, standing alone, would be open to many different interpretations, multiple strands of evidence or possibility provides constraints on, and sets guidelines for the other. In restoring context and identity to TM PAL 92-136, the following avenues have been explored: skeletal analyses, taphonomy, aDNA, entomology, floral analysis, geological analysis, cultural analysis, dating and ethnographic and historical analyses. Some of these avenues provide fairly unequivocal data (such as the dating) while others require further discussion and interpretation.

TM PAL 92-136 dates to *ca* ~AD 1162 (870 yrs BP ± 70) which is a time period from which not many other remains are known, particularly from the Highveld region of South Africa. Eight other entries of human remains from South Africa have been catalogued which date to within this time frame (table 4.1) (Morris, 1992a). Of these, the majority are from the Western Cape. The two closest to the area of provenance of

TM PAL 92-136 are the Koffiefontein and Munro burials from the western Free State. The Koffiefontein entry represents 57 human remains and were accessioned by Robert Broom. Again the remains are identified by Broom as 'Korana' or 'Bush'. Three of the burials were double burials (Morris, 1981). All of the burials were recognised by a surface cairn and the depths of the graves range from "about 2 ft 6 in to 3 ft 6 in, with two 'deep' graves being noted at 5 ft and 4 ft 6 in." (Humphreys, 1970: 111). For some of these burials, the skeletons were in a 'hunched' or 'crouched' position and associated grave goods include ostrich egg shell beads, grinding stones and cowrie shells (Humphreys, 1970). The Munro site yielded two burials. Both skeletons were found in the flexed position (Mason, 1969, 1986). No details of ethnic affinity of these remains is recorded. These contemporaneous finds from Koffiefontein and Munro are re-visited later in this chapter.

Table: 4.1. Holocene Skeletons from South Africa which fall within the same date range as TM PAL 92-136 (after Morris, 1992a)

Catalogue No.	Map Index	Precise Location	Absolute Date	Archaeological Association	Burial Style	Associated Grave Goods	Excavator (Donor)	Date of Discovery	Preservation	Publications
UCT 60	3317 BB	Saldanha Bay	950 ±50 yrs BP (Pta 2005)	Grave 2.5 feet deep in soft sand of hill	Sitting upright, covered by stones	none	J.D.T. van Zyl	ca 1929	Complete skeleton	Hausman, 1980; Sealy, 1989
SAM 6221	3318 AC	Ysterfontein	880 ±50 yrs BP (Pta 4356)	From building foundations on hill above Versveld St.	No data	Marine shells	Mr M. Wepener	-	Incomplete skeleton	Sealy, 1989; Sealy and v.d.Merwe, 1988
SAM 1863	3418 AB	Cape Point	800 ±50 yrs BP (Pta 4708)	No data	No data	No Data	M. Smith	-	Fragments mandible and skeletal remains	Sealy, 1989; Sealy and v.d.Merwe, 1988
SAM 1457	3422 AA	Klein Brak River, at back of jail	910 ±35 yrs BP (Pta 2149)	Midden burial	No data	No data	C.W. Black	-	Cranium and skeletal remains	-
UCT 428	3218 AD	Elands Bay. No 1, south side of Vlei mouth near causeway	940 ± 70 yrs BP (Gx-14815)	Found by road workers digging trench, 60 to 70 cm deep	No data	No data	R.Yates	1988	Partial skeleton	-
MMK 227	2924 BD	Weltevrede, Koffiefontein	890 ±50 yrs BP (Pta-2898)	No data	Oval grave with few stones, 0.75 m deep	Ostrich egg shell beads, copper ear-rings	W. Fowler	1939	Cranium, mandible and some post-cranials	Humphreys, 1970; Morris, 1981; 1984; 1992b
WA 23	2725 DA	Oppermansdrif, Munro Site, E. of Bloemhof on S. side Vaal	850 ±60 yrs BP (Pta 87)	Isolated grave, LSA living floor	Stone cairn, tightly flexed on L.	None	R.J. Mason	1968	Nearly complete burial	Mason, 1969, 1974, 1986
UFH 3	3226 DD	On Fort Hare University campus, Alice	880 ±50 yrs BP (Pta 3101)	Skeleton exposed during building operations	No data	No data	P. D. Banghart	1980	Incomplete skeleton	-

The osteological study has demonstrated that the remains are those of a female in her early to middle twenties.

Population affinity

As described in the literature review the racial categories created by the anthropological researchers in the late nineteenth and early twentieth centuries are arbitrary by definition and have been heavily influenced by the cultural preconceptions of the researchers (Littlefield, Lieberman and Reynolds 1982). The definition of races was largely determined by the aim of the classification and the convenience between race and ethnicity. Much of the early work at this time in physical anthropology assumed an exact fit between the two, with people of a given race having a specific and reified culture. It has now been shown repeatedly that race and culture are totally separate concepts and that they may vary independently (Tobias, 1972; Hall and Morris, 1983; Morris, 1992).

This redirection in physical anthropological thought has had a profound effect on the study of human ancestry. A prime interest in these studies remains the understanding of the origins of humanity and of particular human groups and therefore continuity or discontinuity of temporally consecutive archaeological samples is important, though the focus has moved away from the strict categorisation of people. While the racial categories produced by the typologists were assumed to have been stable units which could be traced back to a remote time when they were in their 'pure' homogeneous state, it is now recognised that we have no objective scientific evidence that 'pure' or genetically homogeneous races of humans exist anywhere today or that a 'pure' race has ever existed (Tobias, 1972). Whether categories based on present trait

distributions are valid when applied to earlier peoples is also questioned (Weiss and Maruyama, 1976). Variability has been accepted as a normal feature of human groups and groupings of people are transitory phenomena. In other words, human populations are dynamic rather than static entities (Morris, 1992). However, standard anthropometric techniques remain a useful tool when their limitations and possible biases are understood.

In order for the cranial measurements and indices to be of use, they obviously need to be compared to measurements of known population affinity specimens to find their placement. In this study, data from Morris (1992) were used for the Caucasoid, Negroid and Khoe-San data. It is important to evaluate where these data were obtained to judge the relevance of the data for comparative purposes. The skeletal remains of Caucasoid and South African Negro individuals used in Morris's study were drawn from the Raymond A. Dart collection of Human Skeletons in the Department of Anatomy at Wits. The identity of the Khoe-San remains, however, are problematic.

As Morris (1992) points out, problems remain in recognizing specifically San or Khoe skeletons. As discussed earlier, in the past, ethnic separation was based on typological assessment of morphology but the subjectivity in the definition of those types invalidated the results of those studies. Skeletons have been identified as Khoe or San if "known in life" individuals. That requires that either the individual personally identified as San or Khoe, or the donor of the skeleton testified that the remains were San or Khoe and knew the individual personally, or circumstantial evidence exists indicating that the individual could only be San or Khoi. Morris

(1992) used only "known in life" specimens bolstered by archaeological specimens where long-term contact with Iron-Age peoples has been ruled out.

The cranial indices and cranial measurements from TM PAL 92-136 are compared to those obtained from Caucasoid, South African Negro and Khoe-San groups in Morris's (1992b) study and presented in tables 4.2 and 4.3 respectively. The results of the single specimen of TM-PAL 92-136 do not fit neatly into any of the categories. To take the cranial indices as an example, the results for the cranial and zygomatico-frontal indices cluster with Morris's Khoe-San remains, while the cranial height, transverse and orbital indices are closest to Caucasoid. The vertical, foramen magnum and gnathic indices cluster with South African Negro and the upper facial and nasal indices fall between Caucasoid and Negroid. TM PAL 92-136 is prognathic, implying that morphologically she is not Khoe-San. Fig 4.1 presents these non-diagnostic results schematically. Microevolutionary changes in cranial dimensions (Henneberg and Steyn, 1993) of people living in subsaharan Africa make the results of craniometric analyses doubtful. Morphological changes took place in populations over the last few hundred years, and it seems best that craniometric analyses be confined to groups that were roughly coeval (Steyn, 1994). The Koffiefontein and Munro remains have not been studied in enough detail to allow such a comparison at this time.

Table 4.2: Comparison of cranial indices between Caucasoid, South African Negro, Khoe-San groups and TM PAL 92-136

Comparison of indices between population groups				
Index	*Caucasoid*	*South African Negro*	*Khoe-San*	***TM PAL 92-136***
Cranial	77.4	73.0	76.0	**75.3**
Cranial height	70.9	71.1	69.0	**72.5**
Vertical	92.0	97.6	90.8	**96.3**
Transverse	66.5	71.5	70.3	**68.7**

Frontoparietal				
Foramen Magnum	82.8	78.4	80.4	**78.3**
Gnathic Index	94.1	100.7	97.7	**103.4**
Zygomatico-Frontal	75.3	77.6	78.2	**78.0**
Upper Facial	56.2	53.9	48.9	**54.7**
Orbital	89.0	88.4	80.0	**89.5**
Nasal	47.3	57.6	60.2	**53.7**

Table 4.3: Cranial measurements of female Caucasoid, South African Negro and Khoe-San (after Morris, 1992) and TM PAL 92 136.

Cranial Measurements				
Measurement	*Cauca-soid*	*South African Negroid*	*Khoe-San*	***TM PAL 92-136***
Maximum cranial length	176,6	177,9	173,1	**178**
Maximum cranial breadth	138,3	129,7	131,3	**134**
Bizygomatic diameter	122,0	119,6	118,6	**118**
Basion-bregma height	127,0	126,4	119,4	**129**
Cranial base height	96,6	95,6	90,8	**89**
Basion-prosthion length	90,8	96,2	88,9	**92**
Minimum frontal breadth	91.9	92,7	92.3	**92**
Nasal height	48,9	46,6	42,4	**41**
Nasal breadth	23,0	26,8	25,4	**23**
Orbital breadth	38,8	37,6	38,7	**38**
Orbital height	34,4	33,2	30,9	**34**
Biorbital breadth	100,0	100,7	102,1	**101**
Interorbital breadth	20,2	21,8	22,2	**23**
Frontal chord	106,8	108,3	105,6	**108**
Parietal chord	110,7	109,0	104,3	**108**
Occipital chord	96,6	93,4	88,0	**96**
Foramen magnum length	36,4	36,7	36,2	**37**
Foramen magnum breadth	30,1	28,7	29,1	**29**
Mastoid length	28,4	25,4	22,7	**27**
Bigonial width	88,2	82,7	83,9	**85**
Minimum ramus breadth	29,0	32,2	32,6	**32**
Maximum ramus breadth	43,3	44,2	42,8	**44**
Maximum ramus height	50,1	43,9	40,9	**48**
Mandibular length	106,0	103,1	96,8	**99**
Mandibular angle	129,6	126,7	123,4	**123**

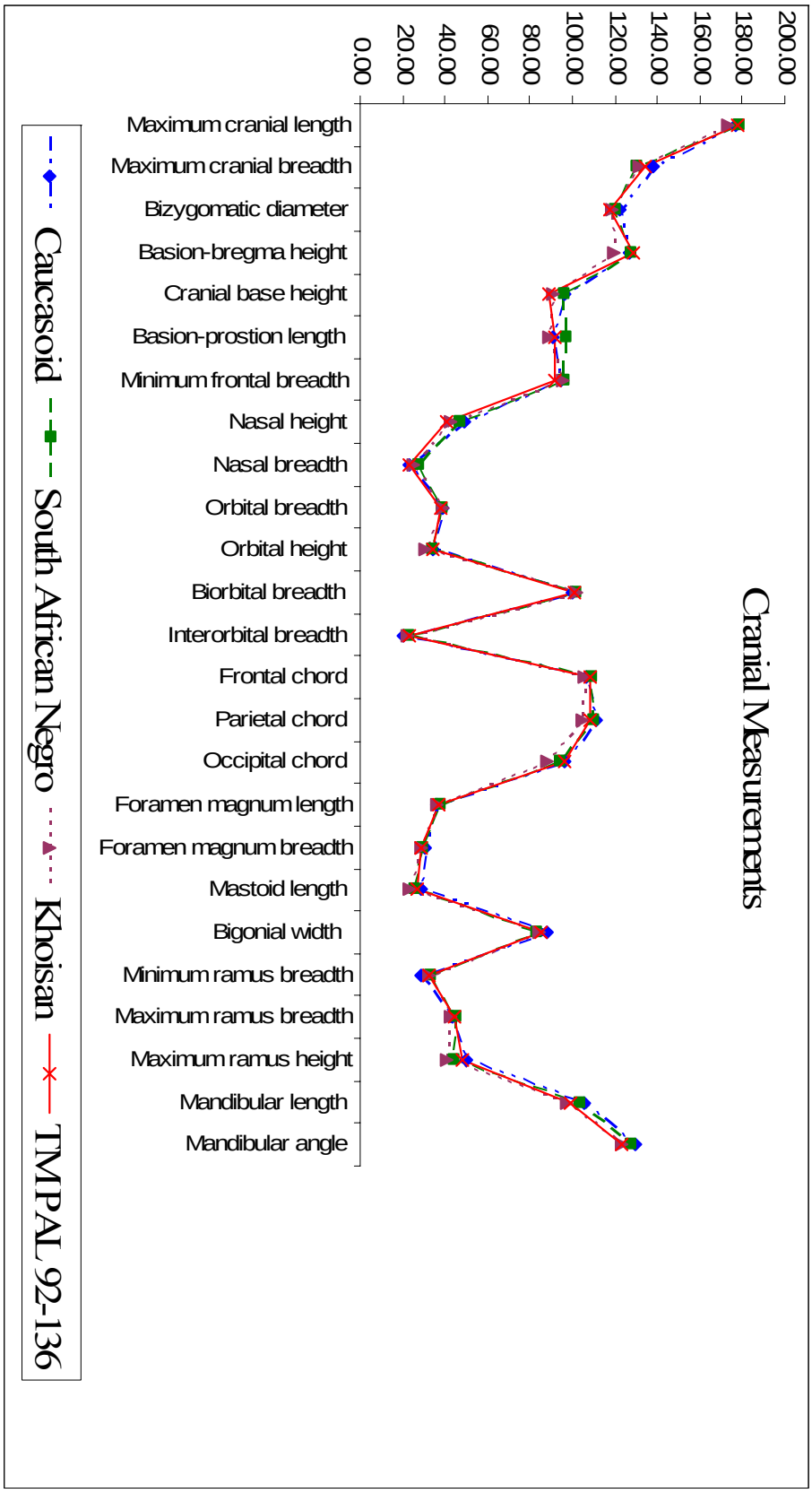


Figure 4.1: Schematic representation of cranial measurements of Caucasoid, South African Negro and Khoe-San groups and TM PAL 92-136

The results from the aDNA study, however, are more promising. DNA studies allow us to investigate patterns of change through time in a non-racial perspective (Howells, 1989; Lahr, 1996; Morris and Ribot, 2006). An almost complete HVS-1 sequence was obtained from the remains. The majority of the sequence is recorded in the results chapter. The sequence is motifs for haplogroup LOd representing the Khoe-San lineage. Both Khoe and San have L0d mtDNA lineages, and they are found in the different San and Khoe groups at different frequencies. Genetic data indicates two separate macro-groups that mixed, however this cannot be dated (Jenkins, 1982; Nurse, Weiner and Jenkins, 1985). The Khoe-San mtDNA pool includes primarily members of ancient haplogroups L1d and L1k, suggesting that extant groups represent a small and recent splinter from a widespread and ancient Khoe-San population (Salas, *et al*. 2002). Present-day Xhosa and Zulu may have ~25% and ~50% Khoe-San lineages respectively (also all L1d) (Soodyall, 1993). High levels of Negroid assimilation are evident in modern Khoe-San and *vice versa*. This level of assimilation is observed with the presence of Khoe-San click consonants in both languages. Present-day Khoe-San speakers themselves present high levels of assimilation of Bantu lineages ~23% in the Vasikela !Kung (Chen *et al*., 2000), ~24% in the Sekele !Kung (Soodyall, 1993) and 61% in the Khwe. Points of genetic divergence are said to be primarily the result of recent gene inflow from neighbouring Negro groups to the Khoe rather than from protected isolation and attendant drift (*ibid.,* 1985). Smith and Ouzman (2004: 515) argue for a separate San and Khoekhoen identity in the past as seen in separate rock art traditions: "[b]ecause southern Africans have been interacting for more than 2,000 years, the distinction between Khoekhoen and San is less apparent today than it was in the past." It is not possible to determine which group introduced the lineage in TM PAL 92-136 (Soodyall, *pers*

comm.). Broom identified TM PAL 92-136 as 'Koranna' on the museum accession register (fig 2.18). The !Ora are not a morphologically independent grouping though they may have self-identified as such. Rather the !Ora were a multi-ethnic grouping (Smith and Ouzman, 2004). To avoid confusion, TM PAL 92-136 is therefore defined by the generalized term Khoe-San and meaning a range of variation that includes both Khoe and San morphological limits.

Stature

No stature estimation formulae have been developed that are specifically appropriate for Khoesan people (Pfeiffer and Sealy, 2006). Table 4.4 shows estimated average female statures based on femoral lengths from studies on San by Dart (1937) and Holocene skeletons from the Cape (Pfeiffer and Sealy, 2006). Kouga? The Holocene skeletons from the Cape range are dated to between 560 – and 9750 BP. The stature of TM PAL 92-136 is 1.58m which is tall by comparison (although it does fit within the ranges of variation) and may indicate the individual's history of healthy nutrition in balance with the energy demands of activity within the context of the population genotype. It may be associated with the inclusion of agricultural products in the diet.

Table 4.4: Estimated average female statures based on femoral lengths of San and Holocene skeletons from the Cape and TM PAL 92-136

	N	**Mean (cm)**
San (Dart, 1937)	19	146.1
Holocene skeletons from the Cape (Pfeiffer and Sealy, 2006)	56	149.4
TM PAL 92-136	1	158.0

Provenance of TM-PAL 92-136

Entomology

Insects are confined regionally or temporally by certain biological limitations, principally their ability to survive inimical temperatures. The result of this is that some species range through certain areas only. Their presence on a body therefore provides a broad region whence the remains came. It may also indicate season of death. Breaks in the normal succession of arthropod colonizers or interrupted stages may suggest multiple movements of remains soon after death. It was hoped that the entomological remains on TM-PAL 92-136 would give some indication of area of provenance – or at least exclude some areas as possible areas of provenance. The species identified on the remains were *Dermestes*, subgenus *Dermestinus* and the genus *Attagenus*. The latter genus probably dates to the remains' time in the museum, and the former is ubiquitous in its geographical range. In conclusion therefore, the insect remains did not provide any additional information on the provenance of TM PAL 92-136.

Floral Artefacts

Three floral species were identified among the artefacts found with TM PAL 92-136. These are sorghum and the two grasses *Hyparrhenia hirta* and *Cenchrus ciliarus.* Combining the (modern) distribution ranges of the grasses and excluding areas which are not common to both, produces a fairly broad geographical area of potential provenance for the human remains (fig 4.2). Perhaps the strength of the map lies in the areas that are excluded. The sorghum could not be identified to species and hence a distribution map could not be produced.

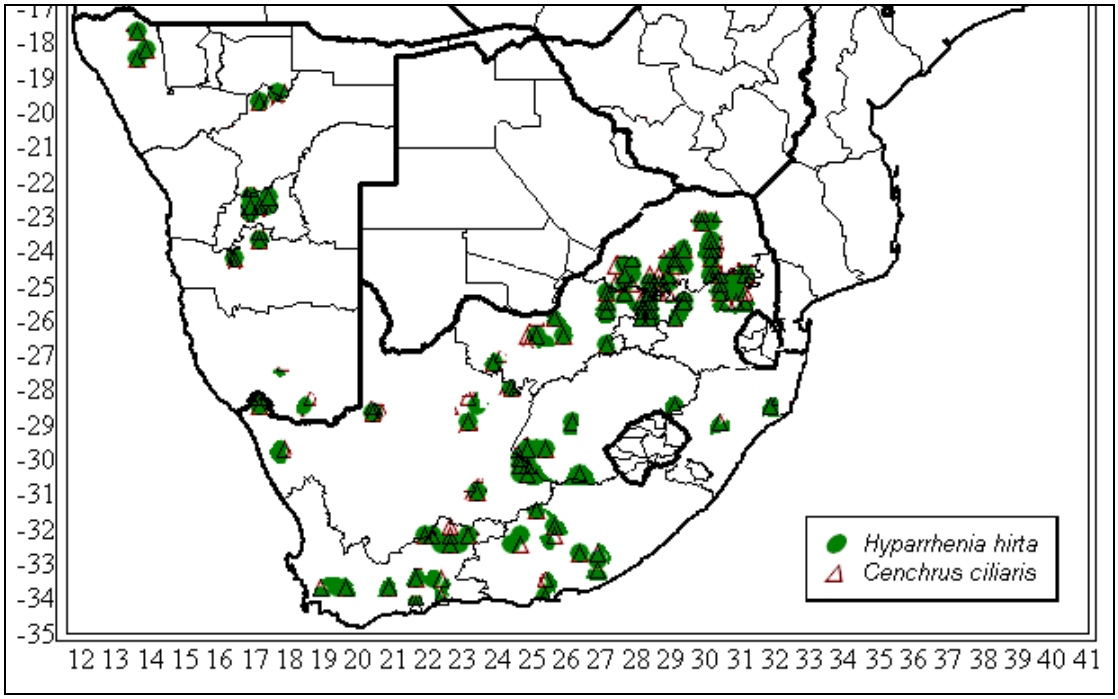


Figure 4.2: Areas in southern Africa where ranges of *Hyparrhenia hirta* and *Cenchrus ciliarus* overlap

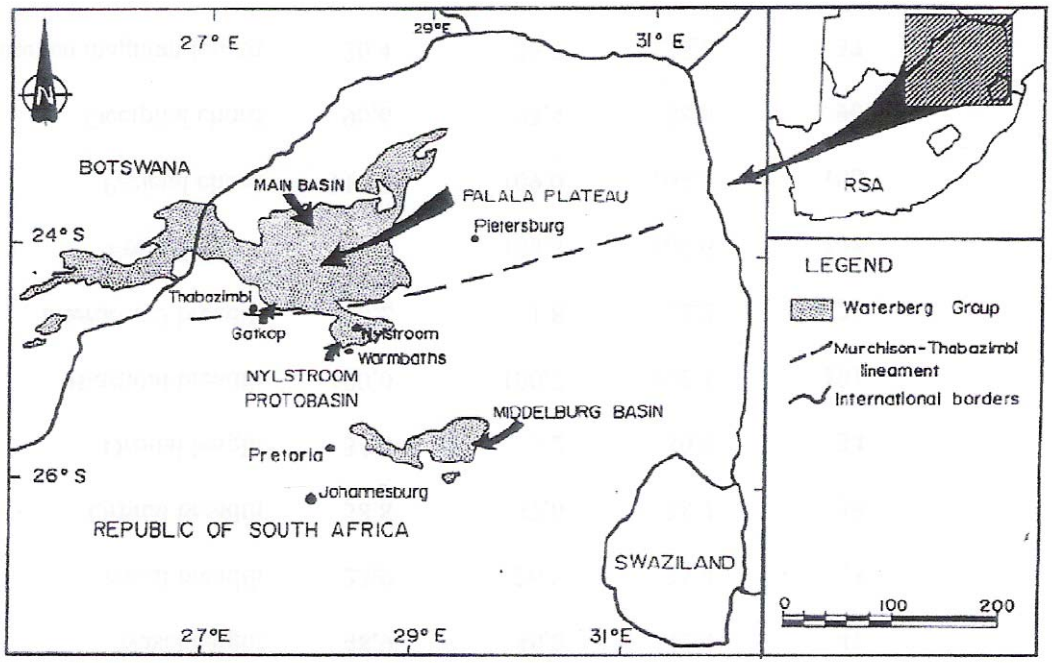


Figure 4.3: Outcrops of the Waterberg Group in southern Africa (after Callaghan and Brandl, 1991)

Geological Analysis

TM PAL 92-136/art10/stone is a highly weathered fine-grained sandstone most likely

from the Waterberg Group. Outcrops of the Waterberg Group are shown in figure 4.3.

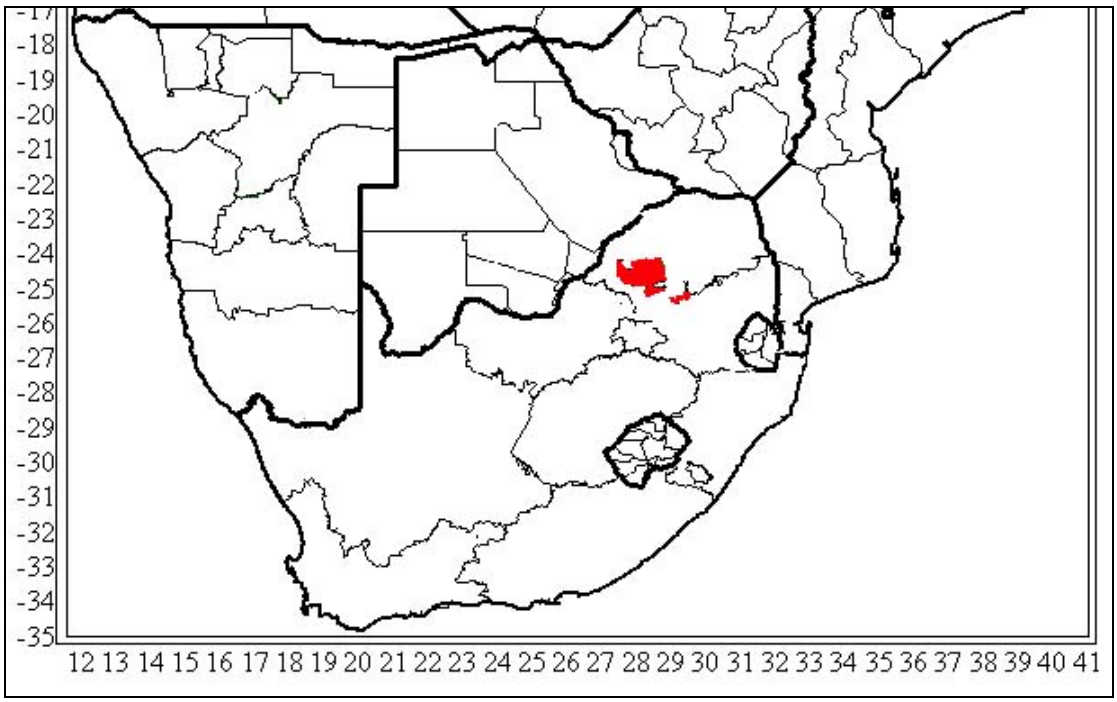


Figure 4.4: Areas in southern Africa where the Waterberg Group outcrops and *Hyparrhenia hirta* and *Cenchrus ciliarus* occur together (base map after PRECIS)

Figure 4.4 represents areas common to Waterberg outcrops, and *Hyparrhenia hirta* and *Cenchrus ciliarus* distribution. This limits the possible provenance area of the mummified remains to parts of Gauteng, Limpopo Province and eastern Mpumalanga. Provenance could not be pin-pointed more narrowly than this in this study. Strontium isotopes have been used by researchers to detect provenance as soil $^{87}Sr/^{86}Sr$ values vary with the geological age and rubidium content of the underlying rock from which soils are derived (Dasch, 1969). The technique was not applied in this study for two reasons. Firstly, cost limited the range of techniques available for use, and secondly, the technique requires that the remains be compared to an established 'library' of strontium isotopic levels known in the country. This has not been documented. The results presented in figure 4.4 do not disqualify what was recorded on the accession

register card that the remains "came from a cave west of Bronkhortspruit". Figure 4.5 illustrates outcrops of the Waterberg Formation that occur in the Bronkhorstspruit area (and overlap with the grass distribution described above). The Waterberg sediments in the Bronkhorstspruit area consist of conglomerate, grit, sandstone and quartzite with sub-ordinate shale. Colours vary from reddish-brown to purple while texture is medium- to coarse- grained. Sandstone, quartzitic sandstone, grit, conglomerate and shale predominates (Visser et al. 1961; SACS 1980). The distinct reddish colour is due to the iron oxides in the rock (Viljoen and Reimold, 1999). Cave sites are not known from the area, however rock shelters with pre-historic rock art are known (Ansie Steyn, *pers. comm*.).

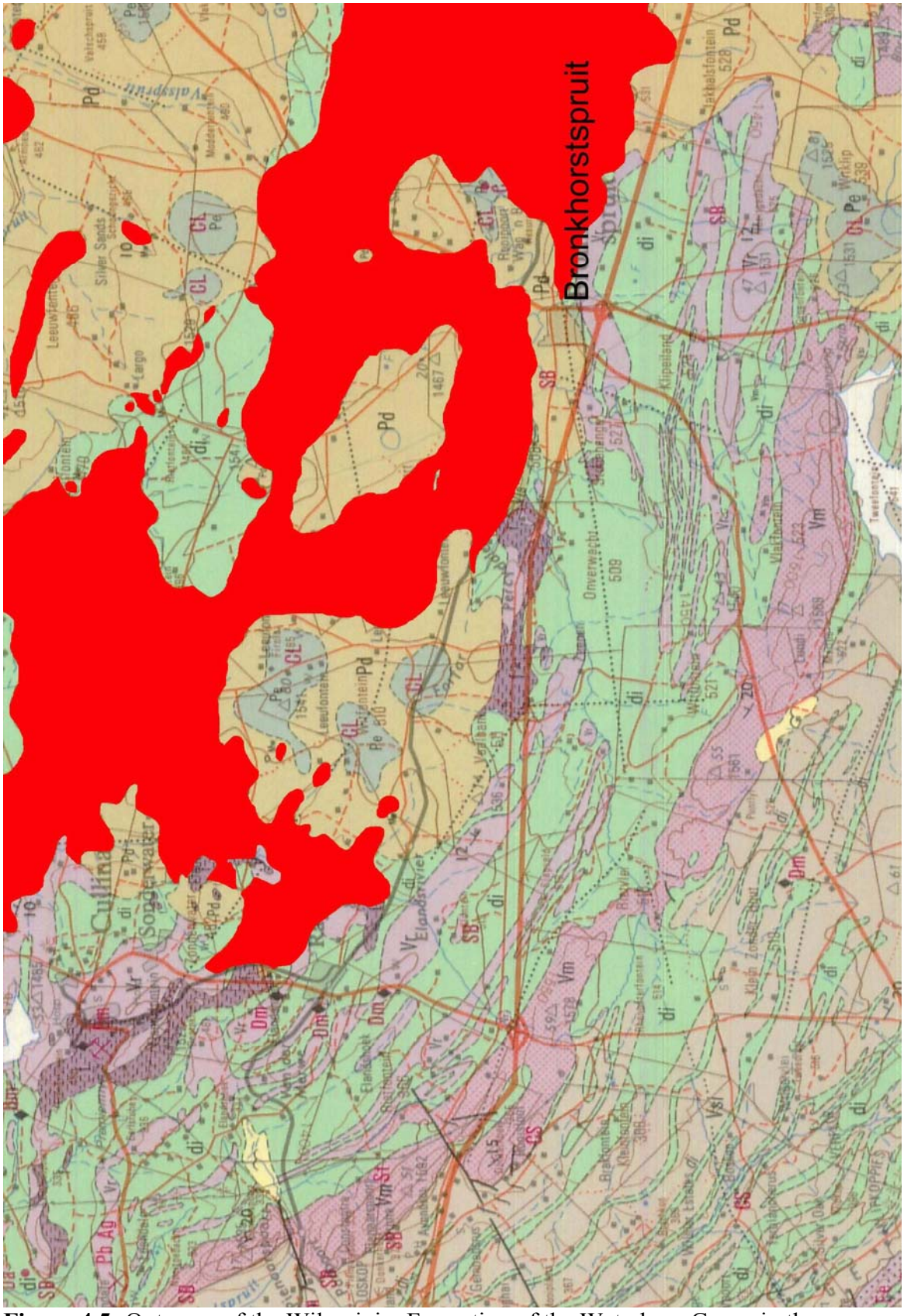


Figure 4.5: Outcrops of the Wilgerivier Formation of the Waterberg Group in the vicinity of Bronkhorstspruit (highlighted in red) (1:250 000 PRETORIA geological map).

Taphonomy

Since the accumulation of most bone assemblages is a dynamic process, often with complex taphonomic histories, there may occur differential modification, or taphonomic overprinting (Shipman, 1989). Several taphonomic signatures and surface modifications are evident on TM PAL 92-136. The most plausible explanation for the 'candle wax' residue on the cranium seems to be that it resulted when the remains were found – suggesting that the environment was dark – such as one would encounter in a cave or mineshaft. The breaking of the legs at the knees to fit the specimen into the museum display cabinet was clearly a recent taphonomic occurrence. No evidence suggests that the mummification of TM PAL 92-136 was not natural. It is hypothesised that the body was naturally mummified. Natural mummification requires specific conditions such as extreme cold (Ötzi Iceman) (Murphy Jr et al., 2003), acidic (oxygen-depleted) conditions (Tollund Man) (Thorvildsen, 1951), saltiness (David Livingston) (Ransford, 1978) or desiccating dryness (Tarim mummies) (Mallory and Mair, 2000). It is most probable that the remains came to be mummified in an environment of consistent dryness fairly shortly after death. The common element in naturally mummified remains from elsewhere in South Africa is that they were interred in a cave or rock shelter which is dry, relatively cool and protected from the elements [e.g. the Kouga remains (Steyn *et al*., 2007), Eland Cave remains (Sealy *et al*., 2000), Makapans Valley remains (Esterhuizen, 2006) Steenbokfontein remains (Jerardino *et al*., 2000) and Faroskop remains (Manhire, 1993)].

The distal right humerus and right calcaneus are disarticulated and partially cremated. Colours on the burnt bone are black, gray-blue, gray and white. Following Mayne

Correia (table 1.2) these represent the carbonization of bone burned in an oxygen-starved state, the result of the pyrolization of the organic components of the bone, and the final stage of calcinations where the china-like texture represents a complete loss of the organic portion and fusion of bone salts respectively. The surface colour and texture of burned bone can indicate the temperature to which the bone was heated as well as the duration of heating (Brain, 1981, 1993). Bone surface colour darkens to brown when burned at less that 400˚C. It then carbonises typically turning black (at around 400˚C – 500˚C) and becomes grey to grey-blue in colour at around 600˚C-900˚C. The bone develops a chalky consistency and white colour in the final stages (see Hansom and Cain, 2007). This implies that the burned extremities of TM PAL 92-136 burned in places to at least 600˚C. Stinson and Wright (1969) demonstrated that natural range fires tend to be less than 400˚C, although temperatures near 700˚C can be reached under optimal conditions. This implies that the burning could have resulted from a veld fire. The bones were exposed to the fire and not buried at the time of burning. This is known as sediments are good insulators, and the temperatures even 1 cm beneath the fire rarely reach 500˚C (Bellemo and Harris, 1990; Canti and Linford, 2000). The breakage pattern on the humerus is not fresh (spiralled) but stepped indicating that the breakage occurred some time after death. it is proposed that the body came to be buried either intentionally or accidentally and that the extremities were exposed on the surface, where they were later damaged through fire. Further evidence for the burial of the body comes from the colour of the remains.

TM-PAL 92-136 is coloured a reddish hue as described in chapter 3. The red colour may be as a result of the deliberate application of a red substance such as ochre to the

body. The smearing of bodies with ochre as part of the burial practice has been known for over 50 000 years (Walker, 2000). Two of the minerals identified from TM PAL 92-136/art10/stone are kaolinite (a clay) and geothyte (an iron oxide). When ground and mixed together, they produce a fine ochre (Dixon, *pers comm*.) Alternatively, the colour was absorbed from the surrounding sediment. When the remains were turned over (fig. 4.6) to extract a tooth for DNA extraction, it was noted that the red colour was not only on the dried and mummified skin, but also on the bone suggesting that the colour was absorbed from surrounding sediment and that the body had been buried for some length of time. In arid zones "almost anything buried in sand will dry out to a naturally mummified state." (Vreeland Jr, 1998: 183)

Further supporting evidence of burial is the absence of insect remains associated with the decomposition process. Once autolysis begins, and in the absence of trauma, colonization begins through the nine natural body orifices. Of these, first preferences are those on the face particularly the nose and mouth as the odours that emanate from these two sites attract carrion flies (Haskell et al., 1997). Haskell (et al., 1997) found that in many instances where the bodies were clothed, the eyes are used due to the high moisture presence and the protection afforded by the deepened eye corners and small spaces around and under the lids. Later, the hair and folds in clothing and the ground/body interface served as major sites of egg deposition once high numbers of flies find the remains. Where bodies were naked, the vaginal and anal openings attract a sizeable number of flies with moderate colonization with eggs and larvae.

TM PAL 92-136 is well preserved yet no fly pupae are present. The first to point this out was Mervyn Mansell (*pers comm*.) who mentioned that all other mummified

remains he'd investigated were covered in fly pupae. This suggests that there was a barrier of some sort to colonization. Mansell suggested that either the cave from which the remains came was incredibly deep, or that the remains had been buried shortly after death. In the case of bodies buried deeply in the ground, insects usually make little to no contribution of the body (Aufderheide, 2003). Indeed, Rodriguez and Bass (1985) found that bodies buried deeper than 0.3 meters had no insects on them after one year. A further suggestion to explain the absence of 'decomposition' insects came from Amanda Esterhuizen, (*pers comm*) who suggested that smoke deterred the insects.



Figure 4.6: Red colouring on underside of TM PAL 92-136

The most parsimonious explanation for the preceeding is that the individual died and was shallowly buried either intentionally or accidentally with outer extremities exposed. The body became naturally mummified and absorbed the reddish colour

from the surrounding sediment. The exposed extremities were burned in a natural fire. No carnivore markings were found on the bones and no pathological signatures were found to suggest the cause of death.

Lifestyle

As discussed in the Literature Review, carbon and nitrogen isotope data can provide clues to the diet of an individual. Identifying the annual rainfall and vegetation patterns of the area whence the remains originate aids in interpreting the isotope data (Lee-Thorp *et al.,* 1993).

It has been established thus far that the area of provenance for TM PAL 92-136 can be narrowed down to parts of Gauteng, Limpopo and Mpumalanga Provinces (fig. 4.4). Given that the southern African environment has remained broadly similar over the past 2000 years [there is no evidence for substantial climatic change (Deacon and Lancaster, 1988)], the environment of the area of provenance can be established. Following Lee-Thorp *et al*., (1993), the area is divided into two regions based on similar rainfall and vegetation patterns (after Rutherford and Westphal, 1986 and Acocks, 1975). Region 1 is the north-west of the provenance area and falls in the south-west of the Limpopo Province. The regional vegetation is broadly savannah woodland and the average rainfall varies between 400-600 and 600-800mm in the higher areas. In the moister areas, 'sourveld' grasses dominate which are not well suited to grazing. However, the area is suitable for agriculture (*Ibid*.). Region 2 covers the parts of the provenance area which fall in the Gauteng and western Mpumalanga provinces. Here, the grass is again predominately 'sourveld' while the

rainfall is higher at about 800mm per annum. The grasses in both regions are predominantly C_4 (Vogel *et al.,* 1978).

Lee-Thorp et al. (1993) investigated carbon and nitrogen isotopic values from human remains in four environmental regions in South Africa including the Region 1 and Region 2 outlined above. In addition, they sampled from the arid far northern Limpopo and Northern Cape provinces. They found that in the more arid environments, nitrogen isotope values are generally enriched.

The $^{12}C/^{13}C$ and $^{15}N/^{14}N$ values for TM PAL 92-136 are -8.2‰ and 9.4‰ respectively. These values fit within the range of variability of Lee-Thorp *et als'* (1993) samples from the same areas and display a relatively enriched $\delta^{13}C$ and depleted $\delta^{15}N$ over the other areas. This shows that the subsistence base for TM PAL 92-136 was primarily C_4.

On the basis of nitrogen and carbon isotopes alone, one cannot distinguish whether the individual was a pastoralist, hunter-gatherer, or practised a mixture of the two. TM PAL 92-136 ate mostly terrestrial foods and was a high-trophic level feeder. The presence of sorghum (TM PAL 92-136/art7/flora7) is interesting on two counts. Firstly it fits in well with the carbon isotope results as sorghum is a C_4 cereal. Secondly, it suggests contact with agriculturalist and perhaps semi-sedentism - as does the sesiu (TM PAL 92-136/art1/flora1 and TM PAL 92-136 art2/flora2).

The advent of farming in southern Africa is associated with the arrival of the first Bantu-speaking peoples. Following archaeological and linguistic evidence, the Bantu

diaspora is thought to have originated from the Cross River Valley area of western Central Africa (Huffman, 1982). From this region, the Bantu dispersal followed two main dispersal avenues because Bantu languages fall into two main sub-groups: west and east (the latter appearing to be of a more recent origin). The second group moved through the rainforest southwards. This was possibly facilitated by a more open period during the arid phase between 3 000 and 3 500 BP. The 'eastern stream' migrants are thought to appear in the archaeological record as the Early Iron Age Chifumbaze complex to the west of Lake Victoria *circa* 2 500 BP. Thereafter, a number of related archaeological complexes are thought to track the dispersals of various groups of slash-and-burn agriculturalists eastwards and southwards, finally reaching the southern savannah *circa* 1700 BP (Phillipson, 1993). At this point, Khoe-San hunters and herders were gradually assimilated or displaced. Khoe-San clicks are present in several Bantu languages (e.g. Huffman, 1982).

The Post-Wilton Stone Age of the interior of the country is related to recent San and is partly historic. The pattern of mid-Holocene settlement is restricted and the interior of South Africa appears to have been sparsely occupied (Wadley, 1989) as inferred from the low visibility of archaeological sites. Late Iron Age sites (between AD 1025 and AD 1300) are similarly scarce (Vogel and Fuls, 1999). Wadley (1989) found that at this time, Holocene hunter-gatherers in the (area formerly known as) Transvaal moved into some shelters that were far smaller than any previously occupied such as Fort Troje and Kinofendal Shelter. She suggests that perhaps bands were smaller than before because of environmental stress. Strain on local resources may have been exacerbated by the arrival of stock-owners as well as by environmental stress. The dominant episode in the global Holocene climate record is the cool, dry 500-year

manifestation of the 'Little Ice Age', from AD 1300 to about 1800, with the lowest temperatures at around AD 1700 (Preston-Whyte and Tyson, 1988). Stalagmite based high-resolution studies indicate that in the northeast of South Africa, the regional expression of the medieval warming and high variability was during the centuries from AD 900 to 1300 (Holmgren *et al.*, 1999) which is when TM PAL 92-136 lived and died.

Small bands have modest nutritional needs and can sometimes feed themselves in territories with a low biomass (Wadley, 1989). It is likely that agricultural practices were passed on or adopted through exchange, diffusion or acculturation. "Even the usually distinct material cultures of farmers and foragers blur during initial contact" (Smith and Ouzman, 2004:501). Social interactions, cultural exchange and the ----------dynamic nature of group identifications are a normal part of the human experience.

Conclusion

TM PAL 92.136 has elicited information on the ante-mortem, peri-mortem, post-mortem and post-discovery phases of her journey to the present. The remains represent an important period in South African pre-history as they date to a time of initial contact in the central interior between traditional hunter-gatherer societies and relatively recent agro-pastoralists in the area. TM PAL 92-136 was an adult female in her early to middle twenties who stood at 1.58 m when she died. Her genetic ancestry is Khoe-San, yet she lived at a time of contact between Iron Age pastoralists and traditional hunter-gatherers ~AD 1160. The presence of sorghum and the remains of a grain storage basket demonstrate contact between the two lifestyles. The extent to which she was immersed in either way of life cannot be gleaned from the data apart

from to say that she was most probably associated with a semi-sedentary agricultural lifestyle. The issue of her ethnic identity are therefore blurry and probably transcend any ideas of a strict hunter-gatherer or agro-pastoralist dichotomy.

In terms of the peri-mortem circumstances surrounding her death, there is little data to indicate the events at her death. No pathologies are evident on the body. Perhaps frailty or malnutrition made her susceptible to illness although the absence of perikymata suggests that she was exposed to little dietary stress during her life. Harris lines and parturition scarring were also absent. Whatever the cause of death no visible traces are found on the skeletal remains. The original position of the body before the lower limbs were intentionally broken at the museum could not be re-constructed. Contemporaneous burials have revealed skeletons in a flexed position with the burials often marked on the surface of the ground with a cairn. It is not known whether TM PAL 92-136 was intentionally and 'ceremonially' buried or came to be that way accidentally.

In any case, the body became covered in iron-oxide rich sediment from the Waterberg Group during the post-mortem phase of her journey resulting in natural mummification of the remains. Outer extremities became exposed some time later and were broken. The extremities are no longer mummified, have stepped fractures and were exposed to fire burning at up to 600˚C, possibly a veld fire which may burn at up to 700˚C under optimal conditions.

The post-discovery circumstances of TM PAL 92-136 tell us something about the approach to human remains and state of physical anthropology in the early 20th

century in this country. In the 1930's the remains were discovered, possibly by people carrying candles in a dark environment such as a cave or mineshaft, who spilled wax on the cranium. Dr Frederik Ludorf – a man in his thirties of German and missionary descent – donated the remains to the Transvaal Museum in Pretoria. Human skeletal remains were highly sought after at the time as specimens in the study physical anthropology and presumably for display. Museums at the time frequently used private donors and collectors as a primary source of skeletal remains. Interestingly, Morris (1987a) reports on a private collector H. Kling who was based at a mission Station in Namaqualand in the early 20th century. Morris (*ibid*: 159) notes that "Kling's perception of Khoesan ethnicities seems to have been based on a combination of folk taxonomy and late nineteenth century German ethnology." It is not far-fetched to expect that Ludorf held the same preconceptions. In any case, Robert Broom acquisitioned the remains to the Transvaal Museum applying a designation of 'Koranna' to them – despite later admitting that he'd 'made up' the classification. It says volumes of the attitude of physical anthropologists to human remains that in order to fit into the display cabinet, the remains were deliberately broken and folded over at the knees. More recently, and following public disapproval about the display of human remains, the remains are now stored in the based of the NCHM. 'Museum beetles' (Dermestidae sp.) have caused slight damage to the remains. The remains have been returned to the museum along with the results from this project.

Future research on the remains is suggested. Dating of the cultural remains found with the body in the museum cabinet to support or refute the hypothesis that they are contemporaneous would obviously be useful. Strontium isotope analyses would be

useful in provenance identification. Strontium on teeth enamel and bone could also elicit migration/movement patterns. Carbon and nitrogen isotopic analysis using laser ablation techniques on tooth enamel when sampling and on the diaphysis ad epiphyses of bone could show change in diet at different stages of life. aDNA analyses of possible pathogens may point more closely to a cause of death. A further useful exercise, using the methods employed in this project, would be the extraction of ancient DNA from many more skeletons during this period of contact in our history – giving clues to the timing, extent of and patterning of interactions between different groups together with the associated artefactual remains. A more sophisticated craniometric analysis would be useful, particularly if a similar approach was used with contemporaneous remains allowing comparison. Describing a morphological pattern for the individual to form a divergence or 'closest distance' from TM PAL 92-136 to mean population values would be useful particularly for additional data eliciting variation in reference groups in studies which rely entirely on this approach. This is because we know with certainty that the remains are of Khoe-San descent. The conclusive outcome of the DNA study in this project meant that further sophisticated craniometric analyses were unnecessary in this project. However, as suggested, future such analyses on the specimen could prove useful.

The remains have been discussed in terms which extend far beyond the field of osteology. Latent information resident in the remains have informed us about the life and post-mortem circumstances of the individual. Information has been drawn from ethnographic, historical and archaeological sources and taken together these data present a broad picture of the bio-cultural situation of the prehistoric remains. TM PAL 92-136 is a unique specimen particularly taking into account the date of AD

1162. Few Stone Age Post-Wilton and Early Iron Age sites are known on the landscape of the central interior at this time, and none present definite Khoe-San remains with (potentially) associated sorghum remains and grain storage artefacts suggesting an at least semi-sedentary way of life. The successful extraction and amplification of DNA from this time is the first in southern Africa and is a positive outcome for future research on ancient remains from the region. As Morris *et al* (2006) found with the Driekopseiland remains, there is some difficulty in deducing unambiguous morphological affinities for a single individual. The results reiterate that in terms of food-producing peoples "if the changes of the past decade and more in southern Africa's politics and archaeology teach one thing, it is that compartmentalized understandings of the region's past are deeply flawed, embedding and perpetuating rigid distinctions that did not, in fact, exist" (Mitchell and Whitelaw, 2005: 209).

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