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DIALOGUES WITH THE DEAD: AN OSTEOLOGICAL ANALYSIS OF THE PALAEODEMOGRAPHY AND LIFE HISTORY OF THE 18TH AND 19TH CENTURY NORTHERN FRONTIER IN SOUTH AFRICA

University of Cape Town

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Thesis submitted to the Faculty of Health Sciences, Department of Human Biology, University of Cape Town, in fulfilment of the requirements for the degree of Doctor of Philosophy.

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DECLARATION

I declare that this thesis is my own, unaided work. It is being submitted for the degree of Doctor of Philosophy in the University of Cape Town, Cape Town, South Africa. It has not been submitted before for any degree or examination in any other University.

Signed by candidate

15 day of February 2002

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DEDICATION

This thesis is dedicated to my parents, Walter and Charlotte Peckmann. You have always instilled in me to go after my dreams, to never give up no matter what obstacles may come along, and to pursue a career, not for money or fame, but for love of the subject. Thank you for all of your wisdom.

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ABSTRACT

Osteological, dental, and molecular analyses were conducted on remains from seven historical archaeological sites within South Africa. The emphasis was on the collection of lifestyle data for the purpose of adding to the unwritten history of indigenous South African peoples and to give voice to a once forgotten group of peoples.

The demographic distribution reveals three different community dynamics: the Griqua sample are a pastoralist group incorporating some agricultural activities, the Colesberg individuals are an indigenous group resembling a migrant workers population living on the margins of society, and the Wolmaransstad demographics are suggestive of a Zabantu labouring community.

All individuals are relatively healthy with low rates of dental disease and trauma and share similar growth patterns to living populations. However all of these individuals display high frequencies of porotic hyperostosis and cribra orbitalia, skeletal manifestations of iron deficiency anaemia. Many theories about the occurrence of anaemia are discussed and the hypothesis that, in these individuals, it is related to infection by the smallpox virus is investigated through the analysis of ancient DNA.

Poor preservation and curation methods can limit detailed data collection. However, more importantly, they also limit our knowledge about the lives of indigenous peoples whose history has consistently been ignored by the ruling class.

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CHAPTER 1

INTRODUCTION

1.1 WHAT IS THE PURPOSE OF THIS PROJECT?

This research project combines physical anthropology and history and strives to demonstrate how this knowledge is important to the living indigenous peoples. The central objectives are:

1. to attempt to identify lifestyle and disease patterning present within different communities through an examination of late 19th and early 20th century South African skeletal remains.
2. to combine the physical anthropological evidence with historical documentation (written and oral) to provide a *context* in which to view the data and provide answers to the question, 'what was life like for these people during this time?'
3. to make a contribution to the knowledge of South African history so that we may be able to understand the present in terms of the past.

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This project analyses the skeletal remains from seven historical sites, of the 19th and early 20th centuries, comprised of three distinct indigenous South African communities, Griqua, Khoe and Zabantu peoples. The historical documents, both written and oral, are incorporated with the skeletal and archaeological data in order to provide a more comprehensive picture of what life was like for these people living in the Northern Frontier of South Africa during the 19th and early 20th centuries.

The Griqua sites are represented by five different settlements: Campbell, Danielskuil, Philippolis, Bethulie and de Tuin in the Northern Cape and Free State provinces. All of these sites are dated to the 19th century although one of the individuals in the Danielskuil sample may be from the early 20th century. The Khoe individuals are from an historic cemetery located on the outskirts of Colesberg in the Northern Cape province; the cemetery is known through oral history as a 'Hottentot begrafplaas' or Hottentot graveyard from the 1866 smallpox epidemic (personal communication Professor M. De Jongh, 2001). The Wolmaransstad site, located in the North West province, probably represents a 20th century informal Zabantu community residing on a farm for the sole purpose of fulfilling local labour needs.

This project is important as it helps to build 'hidden histories' of common people. Poor and politically insignificant peoples often escape the witness of written documents however, archaeology and physical anthropology provide a possible window to see the life of these 'forgotten' individuals. The actual events are lost in time but the result of these events live on forever as they leave tell tale marks on the skeleton about what life was like for these people. This project is about empowerment through learning about past events and is of direct value to both science and the descendants of the indigenous communities.

This research examines excavated human skeletons as a tool to analyse the life history of the people of the northern frontier. Both the skeletal demographic profiles and the historical descriptions of each site are compared to gain a better understanding of population dynamics during this time period. The dentition is also examined. It provides physical evidence of dietary and non-dietary behaviours. The analysis of musculoskeletal stress markers create an understanding for the social organisation of work. The skeleton also provides the researcher with information about health and activity patterns present in these communities.

This project also links lifestyle data to the known history of the northern frontier. In South African history, the frontier was a place where people from various cultural backgrounds lived in order to escape the oppression of Colonial society. With so many different people living together and vying for the same land conflict was inevitable. Although these people were physically separated from the Colony their conflicts affected both the indigenous and Colonial societies.

Many of the remains examined for this project are housed in museums and anatomy departments throughout South Africa. However, whenever possible, communities were contacted and asked for permission to examine the skeletal remains of their ancestors.

1.2 UNDERSTANDING HISTORY

Fundamental to understanding the historical context is understanding the issues of frontier life and definitions of group identity (Table 1.01). Many words employed to describe indigenous South African peoples carry negative connotations as most are attached to biological differences that exist between individuals. The history of such words is examined in this project and alternative 'language' is proposed when referring to the many diverse cultures present in South Africa. This research examines

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Group Name	Ethnic Identification
Bastaards	European & Khoe
Basuto	Southern Sotho - Zabantu
Griqua	European, Khoe & Zabantu
Khoe	Khoe
Kololo	Sotho - Zabantu
!Kora	Khoe
Kwena	Tswana - Zabantu
Matabele	Ndebele - Zabantu
Nama	Khoe
Ndebele	Zabantu
Ndwandwe	Zabantu
Ngoni	Zabantu
Oorlams	Khoe
Rolong	Tswana - Zabantu
San	San
Shona	Zabantu
Tlhaping	Khoekhoen & Sotho-Tswana
Xhosa	Zabantu
Zabantu	Zabantu
Zulu	Zabantu

Table 1.01 : Table of ethnic identity terminology

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lifestyle data and therefore is not rooted in genetic differences or similarities that may exist between individuals but rather focuses on ethnic identification – the dynamics of cultural identity which are not necessarily tied to biological identity and have a strong influence on community relations.

Although this project looks back in time, the historical issues remain prominent in the minds of the descendent communities. This is particularly important because South Africa is beginning the process of returning cultural and physical remains to indigenous people in the hopes of 'mending wounds' from the past. Much of the skeletal material presently available in museums within the United States, Canada and Australia is awaiting reburial by indigenous communities. Some indigenous communities have allowed researchers an extended period of time to examine the remains and record the findings before final reburial must occur while others are insisting on immediate repatriation (Avery 2000; Truscott 2000). In South Africa the process of 'healing past wrongs' in relation to museum collections has only begun. However, museums throughout the country have acknowledged the importance of working with indigenous communities and returning ownership of these individuals back to their families (Legassick & Rassool 2000). Therefore it is critical that we fully understand the definitions of the historical contexts and how they relate to what we understand about ethnic identity today.

1.3 THE FRONTIER DEFINED

The concept of the 'frontier' was developed in 1893 by an American historian, Frederick Jackson Turner. Turner believed that the frontier had shaped American history as it was not only a place but a process where the "unsettled" became the "settled" by the physical movement of settlers onto the land; land with less than two Europeans per square mile was Turner's definition of 'unsettled' (Turner 1962:3). The frontier was a region of continuous transformation because it was a "meeting place between savagery and civilisation where some became more savage and others more civil" (Turner 1962:4). This view was embraced throughout the writings on South African history (MacCrone 1937; Walker 1930) as scholars only explained the frontier in so far as it affected the European society. An exception to this is Marais' 1939 book *The Cape Coloured People 1652-1937*. However, in 1969 Martin Legassick re-examined the concept of the frontier and its significance in South African history and stressed the idea of a 'frontier zone'; a place where there was no single authority but rather where 'mutual acculturation' occurred, which was temporary, unstable, fluid and dynamic. The frontier was a place where different cultures co-

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operated or conflicted with each other with repercussions for all the societies involved not just colonial society.

The people living in the frontier zone, frontiersmen and women, were therefore from various cultural backgrounds, which included stock farmers, licensed hunters, official explorers and fugitives, all escaping the Colony and its repressive ideologies. Fugitives were described as individuals trying to remove themselves from Verenigde Oost-Indische Compagnie (United Netherlands Chartered East India Company or VOC) laws, such as deserted sailors, absconding soldiers, convicts or runaway slaves. The frontiersmen were an integral part of the northern frontier as they became incorporated into many cultural and political groups (Legassick 1969; Penn 1995). In 1834, Dr. Andrew Smith explored the Cape interior to collect information on 'native tribes'. According to one of his informants the life style of the Bushmen changed when the Europeans and other 'tribes', by this he meant Khoekhoe herders, 'Black' agro-pastoralists and 'Bastaards', invaded the Bushmen territory (Smith *et al.* 2000:44).

This project will employ Legassick's (1969) concept of the frontier. This will provide a better understanding of the dynamics of the 19th and early 20th century northern frontier in relation to all peoples present, South Africans and Colonists; a broader more holistic approach to explaining past events and their effect on the lives of all of the people living in the surrounding areas.

1.4 Construction of Identity

The 'race paradigm', the concept of separating *Homo sapiens* into different groups (races) based on physical criteria, permeated all of the social literature of the 18th and 19th centuries and therefore influenced the emerging social configuration of the 20th century (Boonzaier 1988; Smith *et al.* 2000). This is particularly true of southern Africa because of its historical human diversity.

In The Oxford History of South Africa (1971:3), Monica Wilson and Leonard Thompson stress as their major theme the "interaction between peoples of diverse origins, languages, technologies and social systems, meeting on South African soil". This theme is embraced throughout the present research. Since this project is concerned with the reconstruction of lifestyles it will focus on the ethnicity of individuals and not biological race; ethnicity is the cultural identification of a group and is not determined by genetic origins. In southern Africa, biology does not necessarily dictate culture, language, or origin. For

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example, in different texts the term 'Bushmen' can refer to a group of languages, a way of life i.e. hunting and gathering, or physical appearance.

An International Symposium was held in June 1971 to discuss this topic. The proceedings were published by Jenkins and Tobias (1977). The delegates agreed that a separation of terms used by physical, social and cultural anthropologists was necessary. They suggested a system that separates biological entity, language and economy (way of life). For the 'Khoikhoi' this would be:

- Biological entity: Khoikhoi
- Language: Hottentot
- Economy: Herders or pastoralists

Many of the terms employed by the 1971 conference have since become inappropriate, e.g. for biological entity, 'Negro' or 'South African Negro' and are therefore not used in this project. However, following the 1971 convention this project does disconnect ethnicity, language and economy requiring separate precise terms e.g. Zabantu Sotho-speaking pastoralists. The construction of identity is concerned with discourse and language. The terminology provides information about the individual's origin, culture, language, and politics. The names used to describe the different groups of people studied for this research are justified in the following paragraphs.

There have been many debates over the origin of the words 'Hottentot' and 'Khoikhoi', none more interesting than that presented in the journal CABO between A.J. Böeseken and R.H. Elphick. The argument revolves around the question of whether historians are justified using terms like 'Hottentot' when giving accounts of people in the 17th and 18th centuries. Böeseken (1972) cites three historical reports between 1620 and 1623 which claim that the 'Hottentots' used this term to describe themselves. Böeseken (1972) asserts that the term 'Khoikhoi' was adopted by Europeans and not used by the people themselves. Since the Europeans used the term 'Hottentots', historians should do so as well.

However, Elphick (1974) disagrees with Böeseken's statements. He cites Van Riebeek's journal as the first recorded evidence for the word 'Khoi'. The word dates from January 9, 1653 when the 'Khoikhoi' interpreter Harry called 'the brown skinned pastoralists' 'Quena' and contrasted them to the 'San' peoples. Elphick (1974) also argues that the term 'Khoikhoi' was used as a generic name by the 'Hottentots' and it was first recorded as khoé-khoe by Le Vaillant in 1780.

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The variations for the word 'Khoikhoi' recorded above are probably related to the idea that pronunciation of a word is not universal since the 'mother tongue' of the researchers is not exactly the same. Even within the same language there is never complete uniformity about how a word is pronounced (Wilson 1998). Elphick (1974) also states that it was the Europeans, who were not fluent in the 'Khoikhoi' language, who developed the name 'Hottentot' in about 1650. Therefore the name 'Hottentot' became entrenched in the language of the Europeans and it appears in Western discourse because it is the Europeans who are doing the recording, not the indigenous peoples. Elphick (1974) also claims that in the 17th and 18th centuries the 'Khoikhoi' did have a generic name for themselves, which were the equivalents of the Namaqua words 'Khoikhoi' and 'Khoi'. He suggests the usage of these terms as opposed to 'Hottentot' which "for centuries has been a synonym for brutishness and savagery in many European languages" (Elphick 1974:7).

Böeseken's (1974) argument differs in suggesting that if the indigenous people did not condone the name, i.e. 'Hottentots', used by the Europeans then they would have told them the correct name. But it is likely that the 'Khoikhoi' did not realise that the Europeans were using the term 'Hottentot' as a derogatory term; the 'Khoikhoi' were not literate in European languages and therefore would not have read the many journals and reports sent back to Europe about themselves. Böeseken's (1972) claim, that since the Europeans used the term 'Hottentots' historians should do so as well, is inappropriate and culturally insensitive.

In Elphick's final rebuttal he asserts that the 'Khoikhoi', who were culturally united, had a generic name for themselves, a term that identified them as stock keepers and different from the 'San' and 'Black' African peoples in the surrounding areas. Elphick (1975) states that all 'Khoikhoi' languages that have been fully studied contain a generic name for themselves: 'Khoikhoi' or its equivalent. Elphick (1975) asserts that there is ample evidence (see Elphick 1974) to support a 17th, 18th and 19th century claim for the generic name 'Khoikhoi'. He also comments that although the early travellers were amateur linguists and prone to error in their transcription of the indigenous language, it is interesting to note that eight independent sources lend evidence to similar variants of the same word, 'Khoikhoi'. If so many diverse writings illustrate similar forms of the same word present in one language then it is hard to disbelieve that this word existed.

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This project will employ the term Khoekhoen as suggested by Boonzaier and co-workers (1996), the name that the herding people of the Cape use to describe themselves, rather than the term Khoikhoi or the derogatory designation of 'Hottentot'. Khoekhoen is the non-gender specific plural for 'people' and Khoekhoe or Khoe is the adjective. The translation means 'the real people' or 'men of men' and refers to 'we people with domestic animals' as opposed to the Bushmen who did not domesticate animals and collected their food off the land (Smith *et al.* 2000).

In the 1600's the Dutch used the name 'Bushman' or 'Bossiesman' as a negative word to refer to the 'low-status' indigenous, South African population who collected their food off the land, had no domestic animals, and often worked for the Khoekhoen (Smith *et al.* 2000). The 'Bushmen' were described as 'hunters and robbers' and viewed as separate and inferior to the Khoekhoe herders since ownership of goods was the defining characteristic, for the Europeans, between rich and poor (Smith *et al.* 2000). The idea that 'Bushmen' "...were savages of a very low type (Theal 1894:1-2)...retained a culture that existed in Europe 10 000 years ago (Kroeber 1923:501)...so weak in frame as to be incapable of toil...their weapon of offence was a feeble bow...to the eye of a European no people in any part of the world were more unattractive" (Theal 1894:1-2) permeated society well into the 20th century.

Although, in the past, the term 'Bushmen' has been employed as a negative term it is now accepted discourse. Today, while the hunters have no single name for themselves, they have come to prefer to be called Bushman by outsiders (Smith *et al.* 2000) and therefore this terminology is employed throughout this research project.

The term Khoesaan is a general term used both by linguists to describe the click languages of southern Africa and by physical anthropologists to distinguish the aboriginal population of southern Africa from the 'Black' indigenous communities. The term originated in Germany and was spelled 'Koïsan' but later anglicised to 'Khoisan' (Wilson 1998). The term, as it will be employed in this project, is also applied to those individuals of both Khoekhoen and Bushmen ancestry who, in the 1600's and 1700's, were driven off their land and forced to live together due to the expanding Dutch Colony (Smith *et al.* 2000).

The term 'Bantu' was first introduced in language studies in 1857 by Wilhelm Bleek, a German philologist. Bleek was a student of Romanticism, the concept that culture is the organic product of a people or nation, an idea most often contributed to the German poet Goethe and the philosopher Hegel (personal communication Professor P.A. Harries, 2001; Thornton 1988). The term comes from an actual noun in the 'Bantu' language family which means "people" (Poulos 1990:2). However, this term has throughout history also been used in contexts other than language, and in South Africa, it has without a doubt become stigmatised. This is obviously because of the derogatory connotations that are associated with this term in its wider usage.

The 'Bantu' population was seen to be a "transmission from Asia or Europe" and not from 'pure stock' as were the Europeans (Boonzaier 1988:60; Kroeber 1923:500). Theal described the 'Bantu race' as "another branch of the human family...proof of a mixed ancestry of very unequal capability is afforded by the fact that most of these people seem unable to rise to the European level of civilisation, though not a few individuals have shown themselves possessed of a mental power equal to that of white men" (Theal 1902:8; 1894:4-5). Theal also illustrated the cranial capacity of the 'Bantu' groups giving them the largest brain size of all indigenous South African populations, but still smaller than that of the European (Theal 1902). Once again there was a distinction created between the 'civilised' European and the 'uncivilised', 'primitive' indigenous community.

The word 'Bantu', originally a linguistic term, was changed into a socio-political term and eventually used to distinguish a 'racial' group. The Apartheid era (1948-1991) categorised people in a hierarchical system based on physical characteristics and enhanced the negative connotations associated with the term 'Bantu'. The White racist government used this term in reference to those who *they* classified as 'Black' and whom *they* considered to be inferior and the lowest ranking group (personal communication Professor P.A. Harries, 2001). Even more disturbing is the archaic definition of 'Bantu' in the 1998 Webster's Revised Unabridged Dictionary "A member of one of the great family of Negroid tribes..." (www.Dictionary.com).

The word 'Kaffir' has also been used as a derogatory reference towards the 'Black' indigenous peoples of southern Africa. Its first appearance in 1819 (Rees 1819:25) illustrates that it was originally used to describe anyone who was not Muslim: "Arabic. Applied by Arabs, as a term of reproach, to all those who do not profess the Mohametan religion; the Portuguese taking the name in a more general sense..." This statement suggests that the term has been in use since the late 15th century, when the Portuguese first landed at the Cape. The Portuguese were responsible for passing the term onto the Dutch and English (Encyclopedia Britannica 1898). The word was later transposed by the ruling class of the

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time, i.e. Europeans, to mean "one who does not recognise the blessings of God (Murray 1893:18); unbeliever (Penny Cyclopedia 1836:125; Worcester 1859:189); general name to all inhabitants of the coasts of Africa – Muslims and Blacks; liar; impiotus wretch" (Murray 1893:18). The term 'Kaffir' once again illustrates the objectification of indigenous peoples, by the Europeans, as they are classed as lesser, brutish and irrational beings. The Colonists (including the Missionaries) used the term 'Kaffir' to refer to the Xhosas with whom they came in contact (personal communication Professor S. Satyo, 2002). When other 'Black' indigenous African groups were encountered they were called by their own names, e.g. Sotho, Shangaan, etc to distinguish them from the 'Xhosa/Kaffir'; it was only much later that all 'Black' indigenous Africans were 'lumped' together and referred to as 'Kaffirs' (personal communication Professor S. Satyo, 2002).

'Bantu' is still frequently used in scientific literature throughout sub-Saharan Africa to denote both people and languages, but like the word 'Kaffir', its use in South Africa is considered to be derogatory. The scientific usage of 'Bantu' is not intended to be understood in any negative way, and there is still a need for a word to describe the broad grouping of Southern African 'Black' peoples. The ultimate root of the word 'Bantu' is 'ntu' (meaning people) which can be broadened to 'abantu' (meaning people of any description) or to 'Zabantu' (meaning languages of the people) (personal communication, Professor S. Satyo, 2002). Since the word Zabantu refers specifically to a 'family' of 'Black' indigenous African languages which exceed 400 in number (Poulos 1990), Zabantu would be an appropriate term for general use as it distinguishes on linguistic grounds between 'Black' South African peoples and the broader grouping of Khoesan individuals. It has the added advantage of avoiding the negativity seen in the South African use of the term 'Bantu'.

During the seventeenth century, sexual relations between Colonists and Khoekhoen women was common. The offspring of these unions would remain with the mothers and become members of the emerging 'Coloured' community (Nurse *et al.* 1985). In the eighteenth century the term Bastaards (also spelled 'Bastards' and 'Basters'), which means hybridity, was used to describe the children of Colonist and Khoekhoen parents.

During the late eighteenth century all people of mixed origins on the periphery of the Cape Colony were known, and described themselves, as Bastaards. This name was not acceptable to the British missionaries, who did not understand its true meaning, and in 1813 Rev. John Campbell persuaded the

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followers of Cornelis Kok I (son of Adam Kok I) to change their name. They seemed to be partial to their Khoekhoen origins, which had contributed most to their formation, and conferred on themselves a shortened version of the 'tribal' name Chariguriqua (≠Karixurikwa in Khoe) that became Griqua. Other Bastaard groups, who had no ancestral link to the Koks or the Chariguriqua tribe, also changed their name to Griqua (Campbell 1974; Nurse 1975). This is an interesting aspect of the Griqua history because since the beginning there seems to be some attraction about being or becoming Griqua.

However, the Chariguriqua are not the only Khoe group to have ancestral links to the Griqua. The Griqua of Campbell retain two vestiges of Khoe culture: a female *rite de passage* known as the !gabadas and an almost extinct language referred to as Xiri, or Griqua (Nurse *et al.* 1985; Traill 1978).

The present Griqua of Campbell regard themselves as the true representatives of the nation. In the early 1970's Nurse and Jenkins (1975) collected genetic data on the Griqua population at Campbell in the hopes that their genetic blue print may reveal a picture representative of the extinct Khoe of the Western Cape. The results of the sero-genetic studies demonstrated a large Khoesaan component but also much 'Negro' and some 'Caucasoid' influence. Despite the retention of a language and social customs distinct from other mixed populations, the Griqua have received an appreciable inflow of non-Khoesaan genes. Nurse and Jenkins (1975:78) concluded that "the Griqua of Campbell do not constitute a genetic entity at all separable from the rest of the Coloured population of the neighbourhood".

The diverse biological ancestry of the Griqua can be attributed to many factors. They are unusually receptive to new members. This is most likely linked to their historical roots; the Griqua nation began with Adam Kok I who provided a refuge for fugitives from the Dutch settlement at the Cape as well as protection for the declining Chariguriqua tribe. The Griqua are also a prime example of Legassick's frontier acculturation. They embrace the twin themes of colonial subjugation and acculturation that characterise the northern frontier. Subjugation and acculturation are not only achieved by missionary influence but through warfare and trade, activities in which the Griqua were heavily involved. The Griqua were one of the first groups to transmit the disturbing influences of the Colony to the Sotho-Tswana peoples (Legassick 1969; Penn 1995).

The Griqua also have a diminished social significance for biological parentage. This made it impossible to detect genetic family traits among those claiming to be 'original' Griqua (Nurse 1976).

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Therefore Nurse (1976) decided that an examination of surnames of the Griqua at Campbell might be more revealing of the origins of the Griqua peoples. When all individuals at Campbell are considered, the 'original' Griqua and those that have been assimilated, the estimated proportions of groups represented by the surnames are: "43% Khoesaan, 19% British, 17% other North Western European, 10% Slave Negro, 7% Sotho/Tswana, 2% other Negroid, 2% uncertain" (Nurse 1976:285). These figures accord well with the earlier genetic findings (Nurse & Jenkins 1975).

Some researchers believe that the name Griqua has a very broad ethnic definition because of the ease of acceptance of new members into the group. To be a Griqua a person simply has to be accepted by the Griqua community as one of themselves and the easiest way for this to happen is through membership in one of the Griqua churches; being Griqua is more a state of mind than a physical condition (Morris 1997; Nurse 1975; Nurse *et al.* 1985). However, Umino-Shiotsuki (1997) explores Griqua ethnicity by examining the significance of writing in the Griqua community. In Griqua society, there is great importance attached to writing texts about <u>their</u> history, both at the individual level and at the social level. Writing a historical text gives the Griqua author special status within the society. The author, who is usually involved with the Griqua National Congress (GNC) and the Griqua Church, is <u>selected</u> by the Chief and referred to as a 'leader' of the community. At the social level, writing a text is a performance. By writing this text it assures the Griqua community about <u>their</u> history but also creates legitimacy about the Griqua 'nation' for the 'outside' world; the text only becomes 'authentic' when it is recognised by the GNC and appears with the logo or letterhead of the organisation. This 'authenticity' is important for the Griqua peoples as it reinforces the legitimacy of the Griqua 'nation' and all of its traditions, i.e. the Chiefs, and the 'true' history of the Griqua people.

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The attraction for outsiders to become Griqua is two-fold. Firstly, the Griqua have provided a sense of history and tradition, which other people of mixed origins have utilised in an attempt to develop an identity for themselves (Ross 1976). Within the Griqua community there is a presence of a distinct 'coloured-people's' history but also a cultural connection to their Khoekhoen origins (Morris 1997). Secondly, by identifying oneself as Griqua, one can gain access to aboriginal roots and all the political benefits that may come along with such an identity.

The Bastaards are a group of people from mixed origins. All Griqua peoples are Bastaards, but do not refer to themselves as such, but not all Bastaard individuals are Griqua. The Griqua identify more with their indigenous roots and the Bastaards embrace their European ancestry. Membership into either group is through acceptance from the community. Whereas the Griqua are accepting of new members the Bastaards are reluctant to admit new members as they want to maintain the perceived balance of their genetic origins, Khoe and 'Caucasoid'.

The construction of identity is related to discourse and language as the terminology applied to any individual suggests information about the persons origin, culture, language, and politics. There are many words that were previously employed, mostly pertaining to the indigenous groups in Africa, that are now considered 'dirty' due to their negative historical connotations, e.g. 'Kaffir' or 'Hottentot'. Alternative, more appropriate terminology, is used when referring to African indigenous groups. This project utilises descriptive terminology that tries not to invoke negative images about the people and historical events it is describing.

Knowledge is empowerment and it can allow indigenous peoples to begin to learn about their past, a past which has been hidden from South African history books for so many years, understand 'where they came from', and hopefully begin to reconcile their feelings of a sense of self loss. It is my hope that in a small way this project will help to give voice to groups of individuals who have been neglected and forgotten and allow them to begin to rebuild their history and their sense of self worth.

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CHAPTER 2

HISTORY OF THE NORTHERN FRONTIER

The history of the northern frontier is very complex, involving many different cultural groups all vying for land in the same region (Figure 2.01). During the 18th and 19th centuries the northern frontier transformed from an independent indigenous 'open' frontier to a 'closed' colonial frontier. The transformation occurred because of the combination of freeburgher movement out of the Colony and the creation of 'new' groups of peoples, like the Oorlams, Bastaards, and Griqua. The major themes that emerge from the examination of historical records, exploitation, domination, and dependence, almost inevitably lead to conflict.

2.1 TRADE IN THE 17TH CENTURY

The Portuguese were the first confirmed historic circumnavigators of Africa. In 1488 Bartholomew Dias rounded the southern African coast and on his return erected a limestone cross at Cape Point and named the land he had discovered 'Cabo de Boa Esperanza' (Muller 1981). In 1652 the VOC, under the leadership of Jan van Riebeeck, claimed occupation of Table Bay which would last for over a century. In 1795 the British were concerned that the French, whose armies occupied the Netherlands, would rule the Cape Colony. On 11 June 1795 a British fleet, under the command of Admiral Keith Elphinstone and Major-General James Craig, sailed into False Bay and took control of the Cape. The British stayed until 1803, when the threat of French occupation ended, and then ceded the Colony to the new Dutch Batavian government choosing rather to keep the island of Ceylon. When Anglo-French hostilities resumed in 1806 the British attacked Cape Town and regained control, their occupation was only confirmed at the end of the Napoleonic Wars in 1814, until the declaration of the Union of South Africa in 1910 (Davenport 1991; Worden *et al.* 1998).

In the mid-seventeenth century, trade in cattle and goods to Cape Town occurred via VOC officials who directly purchased them from the Khoekhoen or their middlemen. This all changed in October 1657, when a new social category, the 'freeburghers', was created by the VOC. The freeburghers were VOC employees who had been released from their contracts and were granted freehold

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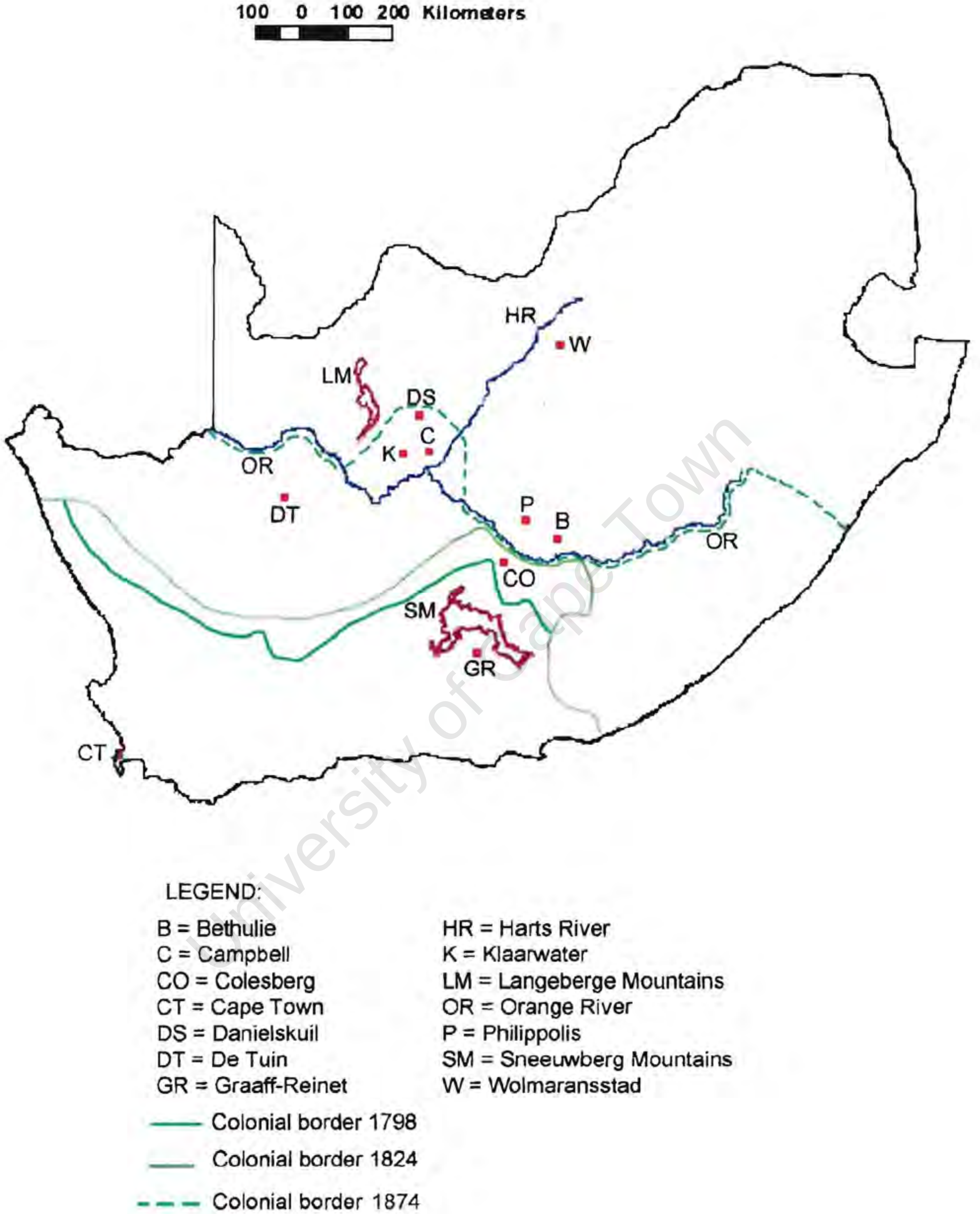

Figure 2.01 : Map of the Northern Frontier and location of historic sites

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lands so that they could become farmers, in turn providing the Company with grain and meat for its garrison and the ships. These burghers were kept under strict check. They were obliged to sell their produce to the Company at fixed prices, were restricted in their direct access to ships, forbidden to trade with the Khoekhoen, and were not even allowed to cross Company lands without permission. The freeburghers began to replace the previous middlemen, the Khoekhoen and Company officials, becoming the bearers of both trade and political authority (Legassick 1989; Worden *et al.* 1998).

The freeburghers were living in a " 'frontier zone', a fluid region of social transition, relatively autonomous from both colonial base and indigenous social systems, but dependent on both" (Legassick 1989:360). During the eighteenth century, the freeburghers began to move onto land outside of VOC control. The VOC could not assert uniform control over the area as the region was too vast and the distance from the colonial base too far. As a result, the VOC lost control of the land occupied by the freeburghers.

2.2 OPEN VERSUS CLOSED FRONTIER

The crucial features marking the open frontier were the abundance of land, near-subsistence farming, and the absence of regional markets. The closed frontier differed from the open frontier in three main ways. Firstly, there was a loss of liberty for individual groups to assert themselves and maintain their interests. The closing frontier was dependent on whether a group could establish its hegemony over others in its immediate vicinity or whether some external power was able to put an end to the relative anarchy of the open frontier (Giliomee 1989). Secondly, while the open frontier was sparsely populated, the closed frontier was characterised by pressures on the land caused by the arrival of several new groups of settlers (Giliomee 1989). Thirdly, the status of non-European labourers deteriorated, and many of them became fixed at the lowest stratum of society (Giliomee 1989).

The opening of the frontier began with the initial occupation of land in order to start near-subsistence farming in the most extensive way. It was also characterised by the incorporation of indigenous labourers, either through inducements or local controls (Giliomee 1981). Almost from the beginning of European settlement the Khoekhoen were dispossessed, yet the loss of land was not dramatic. In the Cape Peninsula and its vicinity the Europeans practised extensive agriculture and the pastoralist Khoekhoen could exist on good land between European farms. Gradually, however, the

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Khoekhoen were squeezed out, and by the end of the seventeenth century those who wished to obtain their independence had to retreat to the interior (Giliomee 1981).

In 1717, the government began to issue grazing licenses to stock farmers and lifted the ban on Europeans and other freemen bartering cattle with the Khoekhoen. For Europeans without any capital the open frontier offered the opportunity of becoming *bywoners*, tenant farmers who looked after their patrons' stock on a system of shares, which was often the first step toward an independent farming career (Giliomee 1981). In a country where land was abundant, European pastoral farmers could begin a life on the frontier with little capital, practising near-subsistence farming on the most extensive scale, and draw on the indigenous population for labour. A new class of colonists evolved called the *trekboers*, they practised an economy in which hunting was intimately tied to transhumant stock farming (Giliomee 1981).

The opening of new frontiers was propelled by a complex array of political, economic, and social factors. Politically, expansion offered a refuge from the controls of the government and the wealthy farmers in the Cape Peninsula and vicinity. Socially, for the Europeans, the open frontier was an escape from a loss of status; slaves now provided the manual and skilled labour in the western regions of the Colony. There was also an economic incentive. The *trekboer* who exploited the existing resources and abandoned them when they were exhausted could support himself with much less effort than the commercial farmer who stayed in one location and had to increase yields through manuring and weeding (Giliomee 1981).

New class relationships began to develop on the open frontier. Farmers had to find labour in a system which provided no market incentives or government labour compulsion. However, because of the lack of institutional controls, the farmers were able to exercise a great degree of local control over their workers (Giliomee 1981).

The *trekboers* required dependable labour and this could not always be accomplished through coercion. Hence, a patron-client relationship developed. In this system, a Khoekhoen client might seek out a frontiersman for protection against raiders. He would then enter a colonist's service while still retaining his own livestock, supplemented by payments for tending his master's cattle and accompanying him on Kommandos, a military form of the hunting and trading party, against the Xhosa and San. The Khoekhoen did not lose their independence in this new relationship as they maintained the bonds with

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their kinsmen, often settling on the same farm together. In the open frontier, disparate groups were often successful in preserving institutions that existed before contact (Giliomee 1981).

Ultimately though, it was the balance of power that determined whether the indigenous Africans could retain their independence or whether the colonists could impose forms of involuntary labour. Since the balance of power, which eventually resided in guns, most often rested in the hands of the colonists, the open frontier became an arena for local coercion and subordination of indigenous peoples. The *inboek* system (indentureship) evolved to fill the need for a more stable labour force. This system was analogous to slavery as the government legitimised the indenturing of legally free indigenous children and their families. The rational from the Europeans for binding indigenous people to service was justified in a cloak of frontier paternalism: their destitute condition warranted the 'care' and 'protection' of a master (Giliomee 1981).

As the coercive relations became unstable the Europeans approached the government for assistance in securing an indigenous labour force. However, the Colony was lax in their response, as they had no viable interest in the frontier zone since it was an area free from governmental control and regulations. Thus the frontiersmen had to rely upon themselves, and the creation of the Kommando system, for services and protection (Giliomee 1981).

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The characteristic feature of the closing frontier was the shift from abundant land and near-subsistence farming to a shortage of land leading to exploitation and the rise of commercial farming. Land in the open frontier had little monetary value but as the frontier began to close, and farms were surveyed and registered, the land gained value in money-terms. There was a transformation toward a money-based rather than cattle-based society that dramatically increased the difference between rich and poor with the indigenous populations struggling at the bottom (Giliomee 1981).

By the time of the Great Trek, 1834, the frontier economy was slowly progressing towards a transition from subsistence to commercial farming. Settlers began arriving at towns, such as Graaff-Reinet, to sell their marketable goods. They also began to barter their produce for manufactured goods. This was very important because it allowed them to discontinue the expense of purchasing items from Cape Town. For the Griquas, the boom meant an end to independent existence as they were edged out by immigrants to the area. For the Khoekhoen, the closing frontier brought about many challenges. Once Europeans instituted slave labour the Khoekhoen society grew poorer and eventually sank to a status not much higher than that of a slave; Khoekhoen were subjected to the same treatment as slaves but could not be sold and were bound to their masters via contracts. With the closing of the frontier, the deterioration of the non-European labouring class was linked to a decline in cultural structure that inhibited psychological support, and to the debilitating effects of alcoholism and disease (Giliomee 1981).

By the end of the 19th century gold mines and railways began offering wages four times higher than farm labour. Farmers had no option but to offer more acceptable conditions to Zabantu labourers. A new kind of farming developed, 'Kaffir farming', in which absentee landlords let their land to rent paying Zabantu peoples. Issues evolved as smaller European farmers resented the competition, which came from these newly created Zabantu farms (Giliomee 1981).

By the late 1800's the abundance of land and game that characterised the open frontier was no more. On the open frontier the Kommando system, which allowed the frontiersmen authority to resolve their own conflicts, bred regionalism and anarchy. On the closing frontier, this "government of men" was replaced by a "government of laws" executed by a modern bureaucracy and implemented by a police force (Giliomee 1981:114).

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2.3 The Influence of Kommandos and Firearms

The Kommando, a military-style organisation based on hunting, trading and raiding, began in the seventeenth century. During this time Khoekhoen resistance to Colonial land invasion was strong. Farmers complained about the vast amounts of stock theft and even reported that they "slept with their guns in their hands" because they were so afraid of attacks by the Khoekhoen (Newton-King 1986:107). The farmers complained that the VOC's protection was inadequate and obtained permission to form Kommandos, military levy's of volunteer free burghers supported by VOC soldiers (Legassick 1989). The Kommandos evolved in the eighteenth century first as a colonial settler phenomenon, but later as a broader social structure of many peoples on the open frontier. They embodied the characteristics of either a colonial military body or a political raiding group. For example during the 1840's the Griqua Kommandos were able to protect large numbers of followers including refugee Sotho-Tswana clans, yet they were not a military organ of the Colony they were effectively protecting.

The Kommandos' existence created a circle of violence in its attempt to acquire horses, guns and gunpowder. The ownership of guns meant the ability to keep livestock and attract followers and power.

Horses provided greater mobility and a wider range from which to acquire livestock (Lau 1983; Morris 1992b). What was intended as a military organisation to defeat the Khoesaan was adopted by indigenous peoples themselves to solve the problem of 'lawlessness' in the frontier zone.

The Kommando group, as an indigenous development, was comprised of a leading extended family with followers from many diverse groups: colonists, indigenous peoples, and those of mixed ancestry. Many of these followers had connections to the Colony and therefore access to guns, gunpowder and horses. The Kommando group had approximately 500-1000 members, which consisted of many smaller Kommandos units of only 10-15 men. Each Kommando group had a Kaptyn and a *raad* (council) which included 'family heads' from each of the smaller Kommando units. Although the Kaptyn had the right to select two lifelong assistants, the 'family heads' secured the right to refuse any new membership. Political authority was military-oriented and controlled by a small group of men (about 18-50) who organised the raids, seized most of the wealth, sent their wives and children to school and church, and displayed their superior status as "conspicuous consumption" (Lau 1983:31). The social organisation was strictly patriarchal. The constitution of the Kommando groups clearly stated that Kaptynship under no circumstances was to pass to a woman. Also, within the Kommandos, voting rights and other aspects of daily life were expressed in class relationships based on private ownership of means of production, i.e. guns and cattle; "there were different laws for kings, masters, fathers, and men" (Lau 1983:31). The Kommando was tied to both the indigenous and colonial systems but independent of each; its existence could only be realised with the constant supply of guns and gunpowder, which it obtained from the colonial base (Lau 1983; Morris 1992b).

Marriage within the Kommando groups was monogamous. This is highly significant as it reveals a shift from an indigenous kinship-based economy to a capitalistic society. The kinship-based society is highlighted by the quest for wives and female dependants as producers and mothers as the centrality of accumulation. The capitalistic society is emphasised with the procuring of cattle and hunting produce as an exchangeable commodity, for guns and horses, which entrenches the dominance of the Kommando within the Kommando groups (Lau 1983).

In 1715 the Strafkommando, the first garrison Kommando which did not have a complement of Company soldiers, was sent out to defend the colonial interior against attack from the Khoesaan. Unrest was precipitating throughout the interior. The Khoesaan peoples were resisting colonial intervention.

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The VOC had to rely upon the Kommando to defeat the Khoesaan, and in doing so had to supply them with guns and gunpowder forcing it to support an agency against which it was politically and economically opposed (Legassick 1989). With the absence of legal power and the strong presence of the Kommando, land that once belonged to a community of peoples was now being given over to private land holders, many of whom were not colonists. Occupation of land now meant individual ownership that also extended to their descendants. Subsistence depended on agricultural production, which was introduced along with land registration in order to guarantee ownership (Legassick 1989).

In the eighteenth century, there were two main northward expansions of the Kommandos through the northern frontier. The first movement occurred in the 1730's, along the plains near the west coast, over the Oliphants River, to Kamiesberg and Little Namaqualand, and into Namibia (Legassick 1989). Some of these individuals, however, turned east across the mountains south of Bushmanland. These first expansions were pioneered mainly by people who were not colonists (Marais 1939). In 1810, a second northward expansion of the northern frontier began in the east. Before this time, the area north of Graaff-Reinet and the Sneeuwberg was inhabited primarily by Bushman, but by 1810 became occupied by Kommandos. At the same time, the descendants of these Kommandos who moved east across the mountains began to move north, while the northward penetration along the west coast had turned eastwards along the valley of the Orange River. By 1820, the two streams of Kommandos, comprised of colonists, indigenous peoples and those of mixed ancestry, met in central Transorangia; "central Transorangia is the region north of the middle Orange River including Griqualand West and what was once called British Bechuanaland" (Legassick 1989:358).

As the Kommandos searched for new hunting and trading routes they came across Khoekhoen with whom they could trade arms and gunpowder, in exchange for serving as local guides. The Khoekhoen in this area had lost their cattle and land and would attach themselves to frontiersmen in the hopes of gaining cows, horses, or a gun (Legassick 1989). By the end of the eighteenth century, this group of Khoekhoen became known as 'Oorlams', "that is, Hottentots who come from the upper country [i.e. beyond the 'frontier'] and are born and bred with the farmers; most of whom understand and speak the low Dutch language" (Legassick 1989:369; Wannenburgh 1980). The Oorlams were also baptised, monogamous, wore European clothing, owned and invested property privately and not on a communal

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basis, and were skilled in all the 'frontier pursuits' (e.g. the use of guns, raiding and repairing ox wagons) (Lau 1983).

Frontiersmen were individuals from various backgrounds trying to escape the Colony and its repressive ideologies. The Kommando system was an integral part of frontier life as it provided people with the necessary authority to resolve their own conflicts in a 'lawless' society.

During the eighteenth century, the possession of arms and gunpowder was influential in determining the events of the northern frontier. The ownership of arms meant the ability to acquire and retain livestock, and hence followers, both of which were synonymous with the possession of power. A frontiersman could win the loyalty of an indigenous community because of the ease with which he could provide game. Even the Christianising work of the missionaries' was furthered through the physical superiority of owning a gun (Bradlow 1981). However, the trading of guns and gunpowder was a risky proposition. Frontiersmen retained the services of Kommando leaders, recruited from either deserters or from among the Oorlams, for the purpose of raiding neighbouring communities; by doing so, the frontiersmen acquired greater economic wealth and political authority (Legassick 1989). The cycle would continue. In turn, the indigenous communities raided upon became so depressed that they eventually joined the Kommando attacks on other communities in the hopes of eventually acquiring cattle, horses, and guns. It was one continuous, vicious cycle.

One such frontiersman was Petrus Pienaar, a well-respected owner of several farms in the northwest. While travelling through the middle Orange in the 1780's, he met Jan Bloem. Bloem was a German who had deserted a ship in Cape Town and within a year of arriving at the Cape, lived in four different parts of the Colony. He later married but, for reasons unknown, murdered his wife and fled to the Orange River. Pienaar allowed Bloem to stay on his farm, provided him with guns and gunpowder, and sold the cattle which Bloem was able to capture. Bloem secured a following of Khoekhoen and raided not only Khoekhoen communities but Sotho-Tswana as well. During the late eighteenth century, Bloem moved further into central Transorangia and Pienaar hired another Kommando leader, an Oorlam named Klaas Afrikaner. After refusing to be conscripted into the military service in Cape Town, he settled on Pienaar's farm. In the mid-1790's, Afrikaner began to accumulate a following of Khoesaan from the lower Orange River valley and Xhosa who were displaced from the eastern frontier to fight against the Colony. This group was joined by rebellious dependents and opposed by colonial

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Kommandos, including both colonists and leading Bastaard families. By the 1820's, Afrikaner and his followers moved into Namibia where they dominated the area through most of the nineteenth century (Legassick 1989).

2.4 THE BASTAARDS ROLE IN THE NORTHERN FRONTIER

At the same time, a new social category emerged, the 'Bastaards', who would also play a significant role in the northern frontier. The word 'bastaard' means a person born illegitimately. In the Cape Colony it also carried with it two other meanings: it signified children of mixed parents, Europeans and Khoekhoen or slave and Khoekhoen, but also, it denoted an economic category; Bastaards could become property owners under colonial law (Legassick 1989; Ross 1976; Wannenburgh 1980). They were able to acquire "less menial jobs such as transport riders, day labourers, small farmers, or craftspeople, because of their descent from higher status groups" (Legassick 1989:370; Ross 1976; Wannenburgh 1980). They were also "a superior and confidential type servant" who would oversee the farm during the owner's absence (Legassick 1989:370). When the owner died, the servant would assume his name, and retire on the goods and cattle left to him by the owner (Legassick 1989; Ross 1976).

The Bastaards sought to acquire other forms of colonial status. By practising Christianity they were held in high regard by the Colony, since church membership had a close correlation with citizenship (Legassick 1989; Ross 1976; Wannenburgh 1980). They even began "to consider themselves as superior to the rude Hottentots" (Lichtenstein 1930:244). Slaves, Khoekhoen, and Oorlams, who were not of part-European or mixed descent, would aspire to Bastaard status. Two of the most powerful and wealthy Bastaard families of the Orange River area had slave origins, the Kok and Berends families. Adam Kok the first was a manumitted slave who had secured a farm at Piketberg during the mid-eighteenth century. His son, Cornelius the first, later became an important figure in the northern frontier. The most notable members of the Berends family were the brothers, Klaas and Piet. It is not known for certain whether the Berends originated from slaves or 'mixed' Bastaards (Halford 1949; Legassick 1989; Ross 1976; Schoeman 1996).

The Koks were the most prominent family in Little Namaqualand during the 18th century (Figure 2.02). Adam Kok I was granted the farm, Stinkfontein, between 1751 and 1760 and received burgher rights at the same time. In this region, Adam I met a Khoekhoen woman, the daughter of the chief of the

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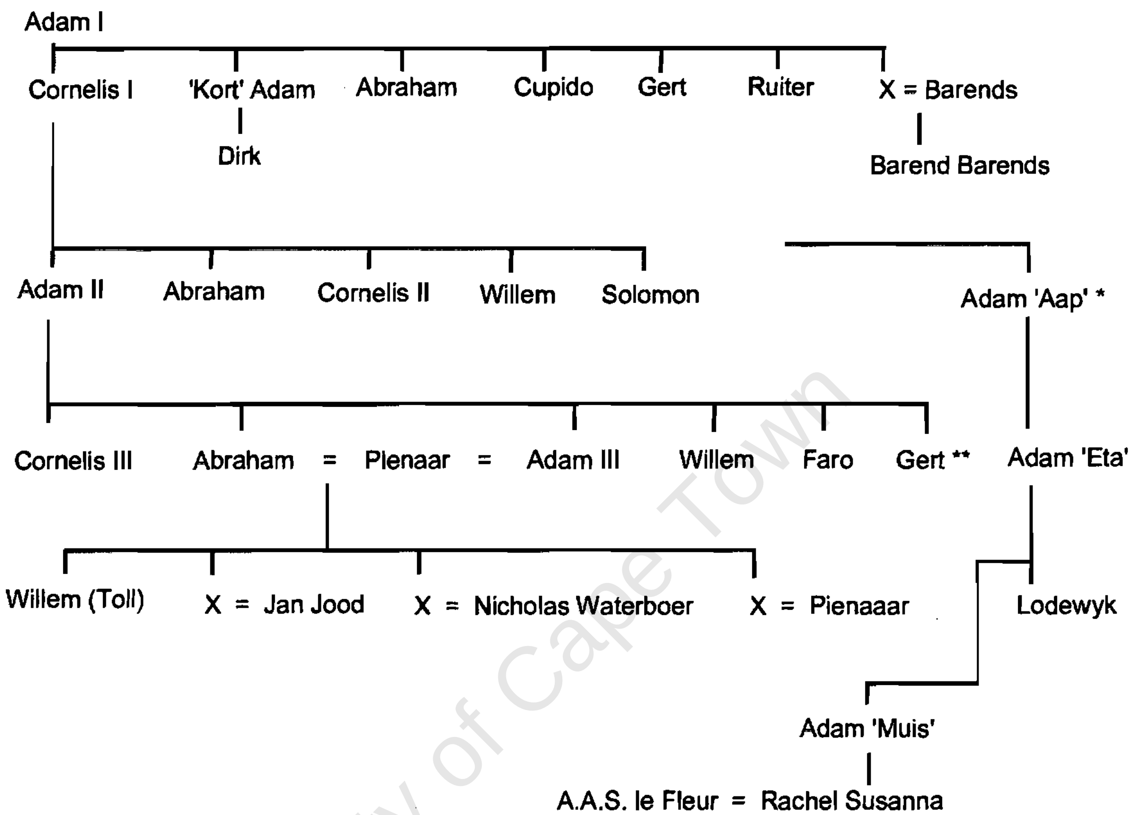

X = daughter, name unknown

* Adam 'Aap' was of this generation, but his father is unknown

** Gert was an illegitimate child

Figure 2.02 : Kok Family Tree (Developed from Ross 1976:139)

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Chariguriqua (≠Karixurikwa in Khoe) tribe, and married her. In 1795 Adam I died, but his son Cornelius I had already registered four other farms in his name. Historical records indicate Cornelius' considerable wealth and status. Cornelius Kok I was baptised sometime between 1795 and 1803 (Halford 1949; Legassick 1989; Ross 1976).

Throughout the eighteenth century, Bastaards and Khoekhoen had been active participants in officially authorised Kommandos. Although many colonists sent these dependents in their place, it was viewed as a problematic situation: "All the Hottentots and Bastaards fit for Kommandos...are going away to Namaqua country to evade serving on Kommandos...[they are] trafficking and bartering with the Namaquas" (Legassick 1989:374). For the Bastaards the situation worsened with the formation of the 'Corps Pandoeren' in Cape Town in 1781-82. The 'Corps Pandoeren' was an auxillary corps of Khoesaan and Bastaards formed by the VOC, which later became the Cape Regiment under the British. Now they not only had to perform military service away from the northern frontier, but they also had to enrol under the lower status of 'Hottentot'. It was the summons to the 'Corps Pandoeren' which in 1814 provoked a revolt among Bastaards and Oorlams on the middle Orange (Legassick 1989).

During the late eighteenth century, tightened regulations began to be imposed on the Bastaards. By the 1770's, legislation was initiated to force Bastaards to carry passes. In 1783, one colonist expressed concern about the idea that the Bastaards might develop "a leader of talent to unite the injured Hottentots, and perhaps the slaves, against the white inhabitants" (Bannister 1829:211). The Bastaards, who were once a step above the menial labouring class due to their European ancestry, were now "steadily assimilated [by the Colony]...into the category of a homogeneous 'Hottentot' ['Coloured'] labouring class" (Legassick 1989:374).

During the late eighteenth and early nineteenth centuries, the most important community on the northern frontier was the Tlhaping, a Zabantu tribe. Their origin is very complex embracing both Khoekhoen and Sotho-Tswana customs and beliefs (Jacobs 1999; Legassick 1989). In 1801, their population was approximately 16,000 extending from Langeberg in the west to the Harts River in the east (Legassick 1989). At the end of the eighteenth century the ivory trade emerged on the northern frontier, complimenting the cattle trading already in existence. In order to better 'facilitate' the movement of goods, both the Kok and Berends families established relationships with the Tlhaping. By selling ivory

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directly to Cape Town, instead of through farmers acting as agents, the Bastaards were able to secure stability in the northern frontier; by assisting the authorities, the Bastaards hoped to have their rights and privileges of access protected by the Colony (Legassick 1989; Ross 1976; Schoeman 1996).

Between 1800 and 1820 the Bastaards had secured trading relationships with the Tlhaping but were not able to penetrate beyond this territory. The Tlhaping were extremely proficient at defending their territory from the movements of colonist and Bastaard traders and hence, created a monopoly for themselves. The Tlhaping were also very fastidious about what they would accept in exchange for cattle and ivory; ivory was sold for sheep, tobacco, or marijuana, and cattle were sold for selected beads, raw iron, or cloth (Legassick 1989).

For the Bastaards, their continued success in trading with the Tlhaping depended on their ability to control the diffusion of arms. This became almost impossible as colonists, with guns and gunpowder to sell, began to register land closer and closer to the Orange River. A new threat to this trade relationship emerged as the !Kora began acquiring illegal arms from frontiersmen and Bastaards from the Eastern Cape. Khoe groups to the east of present day Upington were, in the 18th century, known as !Kora Penn 1995). From 1820, the illegal trade in arms extended into central and eastern Transorangia. With the firearms trade being controlled by a new group of people two new consequences emerged; it weaned followers away from the leading Bastaard families, and it placed firearms in the hands of the !Kora and Tlhaping communities in Transorangia, something Bastaard ivory traders had sought to prevent (Legassick 1989; Ross 1976).

In the nineteenth century, colonists, indigenous peoples and those of mixed ancestry, who formerly claimed land through the power of the Kommando, now had to receive colonial 'legitimisation' for these titles. Land titles were granted with colonial recognition of status and rights to territory. This was significant because even Khoekhoen could retain their land titles as long as they could illustrate their status under a chief and rights to the area. In some isolated areas of the northern frontier, Bastaards continued to hold on to land whether it was registered or unregistered (Legassick 1989; Ross 1976).

Between 1805 and 1814 the communities of the middle Orange River valley and central Transorangia were tormented by approximately 300-500 Xhosa-led raiders who obtained their supplies and firearms from frontier farmers. One of its original leaders was Danster, a Xhosa who, in the past, was a follower of Afrikaner. In 1814 he was acting as a guide to Coenraad de Buys, a former eastern frontier

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rebel, in Transorangia. Soon after, De Buys lead the most prominent raiding community in Transorangia, winning support from Xhosa and dissident Bastaards and Oorlams by supplying them with firearms. His last effort, to over throw the Kwena chiefdom, Motlala, failed and soon after he moved to the East Coast (Legassick 1989).

Both the Kommando and firearms that accompanied them had a destructive effect along the whole Orange River valley. Between 1750 and 1800, the expansion of the northern colonial frontier drastically reduced the availability of land for the Khoesaan. They were now being pushed into Sotho-Tswana territory, which intensified the conflict even more (Legassick 1989). The dispossessed saw few means of survival other than raiding cattle, and those who owned the cattle sought the means to defend them. The means for both groups were firearms and gunpowder, but to get these meant selling cattle, thereby continuing the cycle of robbing and raiding in the northern frontier. Firearms not only transformed social structures but also political structures as well. The Kommando organisations, which were created because of colonial expansion into the northern frontier, were parasitic. They were only able to exist through the raiding of other communities while exhausting vital resources along the way (Eriksen & Moorsom 1985:34)

In 1804 the leading Bastaard families, numbering about 400 to 500 individuals, established themselves near fountains around Klaarwater (later Griquatown) and planted a variety of crops. In 1805 they started building stone houses and taking possession of springs 50 miles south-west and north-east of Klaarwater (Halford 1949; Legassick 1989; Ross 1976). At the same time, the London Missionary Society (LMS) started to establish mission stations in the northern frontier. In 1801, the Berends family invited the LMS to move to the middle Orange; the first missionary in this area was William Anderson. The northern communities saw the missionaries as a way to reduce their dependence on service with colonial farmers; the overcrowded mission stations made it possible for some Khoesaan to be given land of their own to farm. With the presence of a mission station, these communities also gained rights from the Colony that they were never afforded before; colonial citizenship was almost certainly associated with being Christian (Legassick 1989; Wannenburgh 1980). Along with citizenship, they also wanted to remain autonomous and continue with their trading activities. In 1801, the Colony regarded the Bastaard community at Klaarwater as "autonomous and under the control of the Kok and Berends families, but favourably disposed towards the Colony", although the dominant figure of authority for the Bastaards was

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Cornelius Kok I (Legassick 1989:378; Ross 1976). In 1801, Klaarwater was outside of the Colony, and therefore outside of its control but for the colonial government, the purpose of the mission stations was to keep social order and preach European values.

Stricter laws were put into effect in 1805 by Governor Janssen. They stated that trading to frontier farmers or to Cape Town could only be done through the missionaries; he was trying to encourage them to become agriculturalists and pastoralists. In order to ensure these laws were obeyed, the authority of colonial influence was given to the missionaries. If they did not enforce the laws, sanctions would be imposed on them and the community. The missionaries were quick to make use of their new power. Those who did not follow suit were forced to leave the station and in doing so would lose their guns and access to the Colony. The missionaries' responsibility included the distribution of gunpowder, negotiation with neighbouring hostile groups, redistribution of land, and punishment for crimes (Legassick 1989).

The Bastaard communities along the Orange increased tremendously in size during the early nineteenth century. The Berends following that started at about 200 people expanded to over 2,000 individuals by 1813. With this population increase also emerged a gradation of wealth. Cornelius Kok I, in 1816, owned approximately 45,000 sheep while poorer Bastaards in his group only owned 2 or 3 cows. The Orange River valley was becoming more and more populated and the need to allocate water and grazing rights was on the increase. The Bastaards thought that some degree of political cohesion would give them coercive power over the Bushmen and !Kora whom they attempted to reduce to dependent status. Treatment towards the Bushmen and !Kora varied between the wealthy Bastaard families. Although the Koks were known for their benevolence, other Bastaard families often flogged and abused their helpers. Bushmen were preferred as servants/helpers as the !Kora dependents were considered to be lazy. Pastoralism was the main form of production until 1804 when crop cultivation, primarily maize and wheat with some vegetables, increased. As the fountains near Klaarwater dried up cultivation by irrigation began in the nearby areas of Campbell and Danielskuil (Legassick 1989; Marais 1939; Ross 1976).

Starting in 1805, persons considered to be the most respected among the Bastaards were appointed as magistrates (Kaptyns) to take care of the community. All members appointed to the magistrate were either family or close friends of the Kok or Berends clan. The institutions of the church

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continued with some Bastaards acting as preachers in other communities. This proved of great importance to the church in furthering the process of acculturation. The missionaries were also actively involved in the social nexus of the community as they married into many Bastaard families. In 1807, they also commenced baptism in Klaarwater. There now existed a dual authority, on the one side the church and on the other the Kaptyns, who often conflicted in their ideas about what was in the best interest of the Bastaard communities (Legassick 1989; Marais 1939; Ross 1976).

Church membership offered not only citizenship to the Colony, but also political status to less wealthy families. The new 'church party' formed a political grouping that exerted power and influence over the community. One of the first converts was Andries Waterboer, a Bushman, who was born in 1789 and had no European ancestors. He may have come to Klaarwater as a dependent of Adam Kok II (son of Cornelis Kok I) but this cannot be confirmed. Eventually many of the magistrates also became church members, enforcing the 'laws' set out by the missionaries (Legassick 1989; Ross 1976).

The creation of this new church group, with its growing influence of the magistrates, caused a diversion of power and influence away from the leading families and into the hands of the missionaries; this caused a counter reaction. Between 1807 and 1809 the original magistrates were dismissed and replaced by Adam Kok II and Berend Berends. In 1809, William Anderson asked the Colony to grant baptised members of the mission 'common privileges' with other colonial citizens, particularly free access to the Colony. The counter reaction from the leading families, pointed out that the missionary influence had actually tried to regulate the community's previously unrestricted access to the Colony rather than provide any benefits (Halford 1949; Legassick 1989; Ross 1976). The political structure of the mission station was again in disarray, with two groups struggling to gain absolute influence and power.

2.5 The Influence of the London Missionary Society

In 1813, John Campbell, a director of the London Missionary Society (LMS), travelled to the northern communities in order to create a political structure favourable to both the missionaries and the leading families. One of his first suggestions was that the Bastaards change their name to 'Griqua" and that Klaarwater be renamed Griquatown. Campbell found "on consulting among themselves they [the Bastaards] found a majority were descended from a person of the name of Griqua" (Campbell 1974:235)

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that is, from an ancestor of the Khoekhoen clan, the Chariguriqua. This name change is important because it illustrates a shift in discourse from colonial origins to indigenous ancestry. It also aimed to breakdown the distinction between those who saw themselves as 'swarthy Hollanders' and those who were Oorlams, !Kora or Bushmen, and thus to provide a means whereby indigenous Khoesaan could become integrated into the polity. By the early 1820's, the distinctions between the 'descendants of the Colony' and the 'indigenous peoples' were breaking down, with the name Griqua surviving into the late nineteenth and early twentieth centuries of a nostalgic remembrance of a better past (Halford 1949; Legassick 1989; Marais 1939; Ross 1976).

Campbell also drew up a constitution with Adam Kok II and Berend Berends to allow them to remain as chiefs or Kaptyns and to act on matters relating to public safety. The Chiefs would form a court of appeal jointly with the missionaries. Thus the status of the leading families was now protected under law. This was significant because in 1811 it was reported that their influence extended "very little beyond a voluntary submission on part of the people" (Legassick 1989:382).

Campbell also instituted a 'native agency' created from Khoekhoen converts turned evangelists. These new converts would work with the missionaries in distant areas of the frontier and create a following for the church. Although this agency may have tried to weaken traditional communities by converting them to Christianity, it also provided, for the Griqua, a geographical extension of political authority over new territory and peoples with their political alliances not necessarily lying with the LMS; the area extended from the lower Orange in the west to the Tlhaping in the north and across to the Harts-Vaal area in the east. Thus, sometime between 1814 and 1820, Berend Berends moved to Danielskuil and members of the Kok family moved to Campbell, because both towns had greater potential for crop cultivation than did Griquatown (Legassick 1989; Ross 1976).

In January 1814 the colonial government commanded William Anderson to provide twenty youths between the ages of seventeen and twenty from the Griquatown mission to the Cape Regiment (formerly the Corps Pandoeren). The colonial government wrote to Anderson stating that if his community wanted continued protection from the Colony they too would have to contribute to the general protection of all areas (Legassick 1989). Through this order, the government aimed to both tighten its authority and to obtain further labour resources for the Colony. This order was the first attempt by the Colony to 'close' the northern frontier zone, as it had just completed the same on the eastern frontier.

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This request precipitated a rebellion that dislocated all existing political stability fought for by the Griqua communities (Halford 1949; Legassick 1989; Ross 1976).

Anderson could not support the Colony's request, as protection accorded from them to date, had been far from satisfactory; he had to struggle to secure arms, gunpowder, and access to the Colony. For the Griqua, serving in the Colony's lower status, 'Hottentot' regime was not an option. This order denied the Griqua their autonomy guaranteed by the colonial recognition of the Kaptyns in 1809 and by Campbell's constitution in 1813. The Griqua agreed to serve the Colony in their 'native place' but they would not furnish recruits to protect areas outside their communities. The Colony responded by withdrawing their support from the Kaptyns and eliminating any further protection from attack (Legassick 1989; Ross 1976).

In 1815, a revolt split the polity of Griquatown as many of its members moved to Harts River, approximately 80km away, and called themselves the 'Hartenaars'. They reverted to the raiding and trading patterns that predominated in the northern frontier up to 1800. They made connections with the illegal trade in arms and gunpowder and began to raid surrounding Khoesaan communities of their cattle. Significantly, Coenraad de Buys, the former eastern frontier rebel who crossed the Orange in 1814, was among the Hartenaars. The revolt was against the Colony and its attempt to extend its authority, but the major focus was on the Kaptyns, who were sanctioned by the Colony, and not the magistrates who were chosen by the communities (Halford 1949; Legassick 1989; Marais 1939; Ross 1976).

The tensions in Griquatown rose. Anderson and the Kaptyns were being blamed for the demand of conscripts, the lack of guns and gunpowder and for the prohibition on legal entry to the Colony. At the Harts River, the rebels had abandoned religious worship with some even testifying their aversion to it. They had also abdicated from speaking Dutch and asking about each other's welfare, the latter being a reference to bourgeois politeness insisted upon by the missionaries. Trusting that many at the station would support their actions, they planned to attack Griquatown, seize their guns and gunpowder, and shoot Anderson and Kaptyn Kok (but not Berends). Hostility also extended to those who remained supporters of the church and its actions (Halford 1949; Legassick 1989; Marais 1939; Ross 1976).

In an attempt to stop the rebellion, Anderson tried to reach a compromise between the Griqua and the Colony, which failed. Anderson therefore approached the rebels, claiming that he would withdraw support from the Kaptyns and endorse the council of magistrates. The Hartenaars began to return to

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Griquatown, and by 1817 they had been pardoned and readmitted into the church. Both Berends and Kok were summoned several times before the newly appointed magistrates and reprimanded for their neglect of duty. Eventually, both leaders left Griquatown with their family and followers: Kok to Campbell and Berends to Danielskuil (Halford 1949; Legassick 1989; Ross 1976).

Although there were good harvests between 1817 and 1818 in Griquatown, gardens were destroyed, cattle were injured, and Anderson continued to receive threats to his life. Finally, in February 1820, the situation grew so volatile that he left Griquatown, abandoning all attempts to create an independent Griqua polity. On his departure, he began to realise that some of the measures enforced by the Colony were actually meant to defeat the Bastaards and not help them gain their independence (Halford 1949; Legassick 1989; Ross 1976).

In 1817, in an attempt to 'close' the northern frontier, the colonial government, refused to allow LMS missionaries to take up their positions at stations outside the Colony, recommended that the Griquatown mission become directly subject to colonial law, and ordered the closure of the Orange River out-stations. In June 1819, Governor Somerset argued that the Griquatown mission should be broken up and re-established either within the Colony or so close that it would be considered under colonial law (Halford 1949; Legassick 1989; Ross 1976).

In February 1820, Anderson endorsed Governor Somerset's suggestion. Acting Governor Donkin responded by ordering Andries Stockenstrom, landdrost (chief administrator and magistrate of a district) of Graaff-Reinet, to take Griquatown by surprise, seize the firearms and cattle, and return all the Griqua to the Colony. Stockenstrom, who had visited Griquatown in 1818 and had spoken to the Kaptyns, refused. He claimed an attack on Griquatown would push the Griqua further into the interior. He suggested that either the colonial border be extended to include Griquatown, or the Griqua be given recognition as an independent community. Stockenstrom viewed the Griqua as potential allies to the Colony; renewed stability in the area would help 'close' the northern frontier. This view of the Griqua began to affect northern frontier policy after 1820, although it did not come into full appreciation until the 1830's (Halford 1949; Legassick 1989; Ross 1976).

In summary, the influence of missionaries in the northern frontier created a paradigm shift where peoples of mixed ancestry began to identify with their indigenous, rather than their colonial, origins. Yet, some groups such as the Griqua embraced preaching the Bible as a method to build alliances with other

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communities, and hence gain access to their resources. The attack was halted and the 'Hartenaars' returned to Griquatown. The events leading up to the 1830's transformed the Khoekhoen from pastoralists, organised in kin-groups, into frontiersmen uniting under military-style leaders (Legassick 1989; Ross 1976).

2.6 ANDRIES WATERBOER AND HIS INFLUENCE ON GRIQUA HEGEMONY

On 20 December 1820, Berend Berends followed Adam Kok II in resigning his office at Griquatown. Andries Waterboer was elected Kaptyn in his place. The two leading Bastaard families were now replaced by an elected Kaptyn of Bushman ancestry, a reinforcement of the popular political views of the community at that time. But Andries Waterboer was no more successful at creating a united Griqua polity than his predecessors; the contradictory expectations placed upon him by government, missionaries and his community allowed for the continuation of the turbulent northern frontier (Halford 1949; Legassick 1989; Ross 1976).

In 1822, John Melvill was appointed by the colonial government as its agent to Griquatown. He was sent to help Waterboer persuade the Griqua to accept the laws set out by the Colony, which in turn would place all other communities that resided within the Griqua territory under colonial law. The Griqua were less than accommodating, as the colonial authorities did not offer any support in the form of guns or ammunition, and did not allow the Griqua Kaptyns, nor Waterboer, authority over colonial subjects in the area (Legassick 1989; Ross 1976). Another hindrance to Griqua hegemony was disunity of the leading Griqua families. Kok and Berends had moved to Campbell and Danielskuil respectively, and re-established their authority in these communities. The other Kaptyns were reluctant to accept any unification that gave Waterboer authority over them. Many attempts were made to restore Griqua political unity but all failed. The struggle for independent authority and power of individuals was much more important than ethnic or political unity (Legassick 1989; Ross 1976).

From 1817 to 1828, in the eastern part of southern Africa, a period of warfare between ethnic groups, known as the Mfecane, led to major changes in the ethnic makeup and political structure of southern Africa. The Mfecane (Zulu for 'crushing'; it is known as the *Dificane* in Sotho) was a period of warfare and forced migrations among the peoples of southern Africa, initiated by the aggressive Zulu military leader, Shaka. The Zulu grew by the addition of other groups, all of which were politically

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integrated and culturally assimilated. During these years his depredations evicted several peoples from their lands, creating large-scale migrations and ultimately resulting in the formation of several new African kingdoms (Figure 2.03). The Basotho nation was thus created by King Moshoeshoe, who gathered his refugee followers in a defensible area of present-day Lesotho. The Ndebele marched north under Mzilikazi eventually to carve out a kingdom on land previously occupied by the Shona in modern Zimbabwe. The Ngoni, led by Zwangendaba, also disrupted Shona territory on their trek into the region now known as Tanzania. Soshangane took his Ndwandwe followers into present-day Mozambique, where he founded the powerful Gaza Empire. The Kololo, a Sotho group, were led by Sebetwane into modern Zambia, where they settled after defeating the Lozi. In addition, the Boers began their Great Trek during the same time period. All of these groups clashed with one another at various times on their wanderings, setting off ripple effects in all directions (Dibinga 1994; Hamilton 1996).

In 1823, Griqualand felt the effects of the Mfecane when it was attacked by a group of displaced Sotho speakers who had been pushed out by other groups in their former community. The Mfecane conflict in Griqualand differed from that in the eastern part of the country because it was perceived merely as a disruptive force. Although the three leaders of Griqualand united in a Kommando together with the Khoekhoen to fight off the assault, this unity against external attack could not be sustained due to the ever-increasing internal turmoil. The 'Bergenaar' rebels, who were resistant to the authority of the 'Hartenaars' and Waterboer, were deserting Griquatown (Legassick 1989; Ross 1976). A once united Griqua polity was becoming increasingly disconnected, not only geographically, but also politically.

In 1825, the superintendent of the LMS missions, John Philip, attempted to restore harmony by gathering together Waterboer, Kok, and Berends for a meeting of general affairs. The outcome of the meeting angered the missionaries; Melvill resigned as government agent in part because his recommendation to incorporate Griquatown into the Colony was rejected. He and Waterboer were also outraged because Philip had been persuaded by Stockenstrom to give Kok and Berends equal authority and power with Waterboer. In January 1826, Adam Kok II had his authority renewed by the colonial government. Although Berend Berends' position was also endorsed, he never gained the same patronage with the Colony as Waterboer and Kok (Shaw 1976). Philip's agreement also granted Kok and Berends the LMS Philippolis station; they now had a base far enough away from Griquatown to ward off influence from Waterboer. However, Berends decided instead to settle in Boetsap, which had better land, new lines

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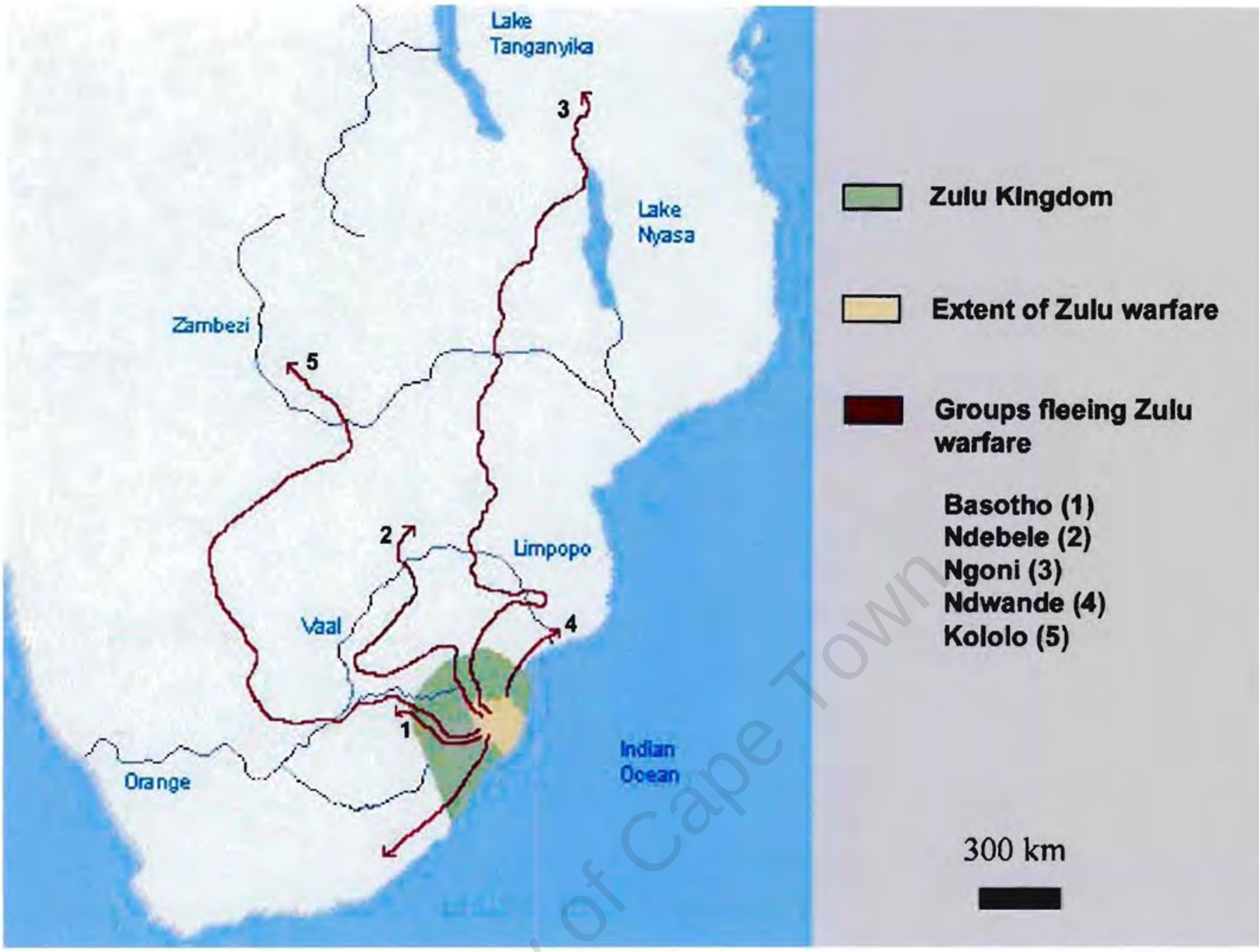

Figure 2.03 : Map of the Mfecane (Developed from Microsoft Encarta Encyclopedia 2000)

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of access to the Colony, and new communities from whom to recruit a following (Halford 1949; Legassick 1989; Ross 1976; Schoeman 1996).

In an effort to gain favour with the Colony and crush the Bergenaar rebellion, Waterboer tried to expose the tolerance being shown to the rebels from the 'old Kaptyns'. By capturing and executing six Bergenaar leaders, Waterboer provoked a revolt. The rebels besieged Griquatown, which only had 18 families remaining from 7 to 10 July 1827. Six people were killed, twelve houses burned, and 1200 cattle seized; the revolt only came to halt because both sides ran out of ammunition. For the following eight months fears loomed of the complete collapse of Griquatown. By 1828, the rebels could no longer sustain their revolt, as they were suffering from drought, disease, and being raided by neighbouring communities. Berends at Boetsap and Adam Kok II at Philippolis emerged as the central power for the Griqua (Halford 1949; Legassick 1989; Ross 1976; Schoeman 1996).

The Griqua Kommando emerged victorious over Mfecane bands at Old Dithakong in 1823 but by 1830 Transorangia faced a new threat from the Mfecane. Mzilikazi, the head of the powerful Ndebele, had established a military state in the central and in the southeastern Transorangia enveloping several Sotho-Tswana communities and threatening others. In 1831, Berend Berends, who had the most stable Griqua polity in the area, invited all to join a Kommando to fight against Mzilikazi. The Kommando seized large numbers of Matabele cattle but in the end was defeated by the superior forces of Mzilikazi (Legassick 1989; Ross 1976).

In 1833, John Philip reversed his recommendation of 1825, and now proposed that Waterboer should be head of the entire district and the Griqua Kaptyns subordinate to him. Philip envisaged a 'Christian Griqua Republic' with political rule that would enforce economic subjection; he wanted the Griqua to become agriculturalists and concede their old ways of hunting, trading, and raiding. The Griqua polity would be bound politically to the Colony through the missionaries and Kaptyns (Halford 1949; Legassick 1989; Ross 1976).

On December 11 1834, a treaty was signed between Waterboer and the Colony. Waterboer was in charge of protecting the colonial frontier, sending back fugitives, and warning of possible attacks. To the north, the limits of his territory were undefined. It soon became apparent that Waterboer could no more unite Griqua polity now than during the 1820's. All he could hope for was to prevent the Griqua from receiving colonial favours. Berend Berends began to distance himself from this situation and in

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1833-34 he and his followers moved to settlements along the Caledon valley (Legassick 1989; Ross 1976).

The Griqua community of Philippolis was filled with division, Bastaards wanting a settled existence and !Kora wanting to return to the old raiding way of life. The Bastaards hoped for support from the Colony but regarded the European settlers as rivals for the land, while the !Kora found the colonial laws restrictive but viewed the colonists as potential trading partners. By 1838, the widespread leasing of land by the Griqua to the European settlers began, despite the opposition from Adam Kok II and the Bastaard element; they were concerned that the settlers would not submit to Griqua authority or would undermine it by trading with the !Kora raiders (Legassick 1989; Ross 1976; Schoeman 1996).

In 1832, Waterboer and Philip tried to resolve the conflict at Philippolis by deposing Adam Kok II. They failed to do so because of opposition from Hendrick Hendricks, a man of impressive abilities who eventually became the dominant political leader in Philippolis. Hendricks learned to read and write at Griquatown, became a Bergenaar rebel, and then married Adam Kok's daughter. By 1834, Adam Kok II announced he would hand over his position to his second son, Adam III. Philip removed Waterboer's authority over the chiefs at Philippolis and even reconciled himself to the political role of Hendricks, who he had denounced in the past. Adam Kok II died before he could sign a declaration to pass on his office to Adam III. In January 1837, Abraham, the eldest son, took office instead of Adam III. He signed an agreement between himself and the Colony, as well with Waterboer, for "joint rule over the Griqua country, under two separate governments each governed by its own separate laws" (Legassick 1989:401).

By the end of 1837, Abraham was replaced by Adam Kok III, as he was more acceptable to Waterboer and his forces. In November 1838, a new treaty was signed between Waterboer and Adam Kok III, no longer enforcing separate governments but stating that "the chiefs and inhabitants of Griquatown and Philippolis will be considered as one people, and also stand in connection with each other, having one interest" (Legassick 1989:402). A treaty between Adam III and the Colony only came about in 1843 (Legassick 1989; Ross 1976).

This whole series of treaties reinforced Philip's conception of a 'Christian Griqua hegemony' over the people of Transorangia. Between 1838 and 1843, in conjunction with Adam III, Waterboer tried to assert this hegemony, but failed, primarily because of the resistance from the Sotho-Tswana.

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Nevertheless, Waterboer's actions were significant, as this was "the conclusion of a period in which the activities of brown frontiersmen dominated the history of the northern frontier" (Legassick 1989:402).

From 1834, Waterboer insisted the Sotho-Tswana were not suffering because of Griqua hegemony, but rather incorporating these new customs into their lives; a large number of Sotho-Tswana, particularly the Tlhaping, converted to Christianity. The conversions were the result of the resumption of a 'native agency' at the out stations. In 1835, Waterboer and his son-in-law Nikolaas, assembled the Tlharo chiefs together and insisted that their people become subjects of Waterboer because he reasoned that the territory was his by right of conquest; he was referring to the Kommando he had led against the Mfecane in 1823. If the Tlharo did not want to submit, he would deprive them of guns, ammunition, and visiting traders. The Tlharo responded by saying that they had their own chiefs, missionaries and access to guns and gunpowder. Waterboer threatened to remove their missionaries if the Tlharo did not comply with his demands. He stood by his convictions, even going as far as seizing wagons from those traders entering Tlharo territory (Legassick 1989; Ross 1976).

Missionaries sent to the Sotho-Tswana complained against Waterboer to Philip. Between 1838 and 1842, Waterboer pushed to assert Griqua political authority and all missionaries who complained about him were removed. By the early 1840's, Waterboer's Griqua were forced to renounce their pretensions of hegemony, less because of missionary resistance and more so because of the reassertion by the Sotho-Tswana of their independence. In 1838, Mzilikazi moved northwards and the Sotho-Tswana no longer needed the protection of the Griqua's guns and ammunition, so they began to leave Griquatown and Philippolis. In 1842, Waterboer signed a treaty with the Tlhaping ruler, Mahura, acknowledging northern limits on his rule (Legassick 1989; Ross 1976).

At Philippolis Adam Kok III was encountering a surge of colonist settlement taking place across the Orange. At first, this was not something to fear, as there was a relative peace that existed between Europeans and the Griqua. A treaty was signed in 1840 by both parties permitting the leasing of land to farmers north of a designated line. The Griqua promised to be of assistance to the farmers and approach them with any complaints and in return, the farmers acknowledged the government of Philippolis as proprietors of the land, but they would be permitted to retain colonial law for themselves (Legassick 1989; Ross 1976; Schoeman 1996). In 1843, 'hard line' Voortrekkers led by Jan Mocke threatened to assume government control over parts of Philippolis territory. The Griqua placed their faith in Britain

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and secured a treaty with the Colony in 1843. This was the beginning of conflict between Britain and the Voortrekkers, which would eventually lead to the proclamation of the Orange River Sovereignty by Britain in 1848. Soon afterwards followed the restoration of independence to the Orange Free State in 1854. By then, the Transorangia frontier zone was thoroughly closed. All of the Griqua territory in the northern Cape was annexed to the Cape Colony in 1871 (Legassick 1989; Ross 1976).

The impelling force for a closing frontier is marked by one group establishing its hegemony over others in its immediate vicinity or by some external power ending the relative anarchy of the open frontier (Giliomee 1989). The missionaries provided this impetus when they entered the northern frontier on a quest to 'civilise the savages'.

Basically this meant that indigenous peoples would have to discard all of their cultural, social and political beliefs and embrace Christianity, and hence embrace the Colony. By the early 19th century indigenous groups began to flock to the mission stations in search of a safe haven where they could gather in relative security. However, this was not the only reason for them to be drawn to the missionaries. The social fabric of entire societies had been torn apart, resulting in cultural and psychological trauma for individual members. This was fertile ground for Christianity as it promised a more stable order, socially, politically and economically. The converts believed that Christianity was the key to status enhancement within the Colony; once they were accepted as Christians by the Colony, the indigenous peoples thought the racial, social, economic and political discrimination against them would disappear. They were ultimately disappointed (Penn 1995).

2.7 Early Town Development Along the Frontier

In the northern frontier, the Griqua came to signify political, economic, and cultural power on the edge of the frontier and controlled events in the area from about 1800 to the 1840's. However, during the second half of the century increased European settlement and progressively more restrictive socio-economic conditions began to change the society and its characteristic features. The most important change was the development of small towns that became the focus of the rural farming population. It is the early cemeteries of these towns that provide the skeletal samples for this project. This research also investigates the population dynamics in different ethnicities within these sites. Since the first official

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census did not occur until 1865, population data are obtained from diaries and reports sent back to the Colony from Missionaries living in these areas or official travellers sent out by the Colony.

2.7.1 BASTAARD AND GRIQUA STATIONS

2.7.1.1 CAMPBELL

The town of Campbell was originally known as 'Knoffel Vallei'. It was first visited by Bastaard families around 1805 but no permanent site was established although an adequate water source was present. In November 1811, Burchell arrived at the springs, known to the Bastaards as 'Grootfontein', and found only Bushmen inhabiting the area. Burchell and his party, which included Adam Kok II who was then the Griqua chief at Klaarwater, recommended that Grootfontein become an outpost for the people of Klaarwater. John Campbell visited the area in July 1813 and discovered a small group of Dutch-speaking people living at the site and "cultivating the ground" (Morris 1992b:62). To commemorate the visit of John Campbell, the London Missionary Society (LMS) mission station changed its name to Campbell (Morris 1992a; Pettman 1985; Potgieter 1971).

After the Hartenaar rebellion in 1815 Adam Kok II left Klaarwater (Griquatown) and settled at Campbell. In June 1823, Thompson visited the station and commented that it contained "a few straggling reed huts, and three or four houses of little better construction, the latter are dwellings of the chiefs" (Morris 1992b:62). The same year, Adam II's brother, Cornelis Kok II was elected chief at Campbell and Adam II moved to Philippolis. Cornelis Kok II was not a popular leader, which led to both the population and political decline of the community (Morris 1992b).

Mr. Moffat, a missionary at Latakoo north-east of Campbell, reported in 1824 that there were Bushmen, Griqua, Bastaards and 'Bitchuana' peoples living together in the area. Slaves who arrived from the Colony were rejected by the Griquas and sent back. Some of the Bushmen worked for the Griqua, and were paid one or two cows as well as support for their family; women assisted in watching the fields and men were herdsmen. There was no slavery among the Griqua, however, Bushmen who worked for farmers were held in subjugation for fear of punishment. There were several hundred Bushmen living in the area but the Griqua population was more numerous as they could send out a

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Kommando from Griquatown of 300 men or more (Government Documents, Report No. 9, 20 April 1824).

The Griqua community was characterised by gardens with fences, cornfields and cattle kraals. The 'Bitchuana' people lived in large enclosed villages in the same area as the Griqua communities and subsisted on agriculture and raising sheep. The 'Bitchuana' women cultivated the land and built houses while men were responsible for tending to the flocks. They had a chief with many thousand subjects. All of the groups living in this area were friendly towards one another and bartered with each other (Government Documents, Report No. 9, 20 April 1824).

By 1835 there were still a large number of buildings at Campbell suggesting a community of substantial size, however many of the dwellings belonged to the mission station and were not residential homes. The population of Campbell increased in 1837 when Abraham Kok moved with many of his followers back to Campbell. When Adam II died in 1835 Abraham had become Kaptyn but was superseded by his younger brother Adam III and forced to leave Philippolis (Morris 1992b).

When Cornelis Kok died in 1858 the political authority for Campbell was transferred to Adam III at Philippolis. During 1862-3 Adam III began his trek across the Drakensberg Mountains to Griqualand East with many of the people from Campbell joining him leaving the town significantly depleted of population. All of the Griqua territory in the northern Cape was taken over by the Cape Colony in 1871. By 1880 the settlement could no longer sustain the few remaining Griqua inhabitants, as the Colony would only grant water rights at the village centre at Campbell for the benefit of European or Boer colonists, but not the Griqua peoples. Eventually, Campbell ceased to be a Griqua residence (Morris 1992).

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2.7.1.2 Danielskuil

The indigenous name for Danielskuil is *Tlhaka-la-tlou*. Folklore says that in the beginning of the eighteenth century the Tswana people killed an elephant in a spot full of reeds and thus named the area *Tlhaka-la-tlou*, reed of the elephant (Pettman 1985). At this time both the Tswana peoples and the Tlhaping peoples inhabited the area (Snyman 1988).

When the missionaries arrived in 1805, they stumbled upon a curious cavern, which reminded them of Daniel's Den (*kuil*, an enclosure). In the Bible (Daniel 6:16-23) Daniel was a slave to King Darius. Everyday Daniel would pray to God for wisdom. Eventually Daniel became King Darius' wisest and most trusted advisor, however, the other wise men were jealous of Daniel. They devised a plot to get rid of Daniel – they convinced the King that he should implement a new law whereby people would only be allowed to pray to the King or be thrown to the lions. Daniel refused to stop praying to God so he was thrown into the lions' den. The next morning the king looked into the lions' pit and was shocked to see that Daniel was unharmed. The king proclaimed that Daniel's prayer had saved him and that everyone must now pray to Daniel's God (de Angeli 1966). The pit at Danielskuil is a conical-shaped depression in the limestone that was created by the action of water; it has perpendicular sides and an arched roof and is entered by a hole on the top. According to oral history and missionary reports the pit was used by the Griqua as a prison; at 6 meters deep escape from it without assistance was not possible (Figure 2.04). The name Danielskuil was later applied to the village that arose nearby (Pettman 1985; Potgieter 1971; Snyman 1988).

The town of Danielskuil was originally established as a mission station in Griqualand West by the Berends Griquas sometime between 1813 and 1816. When John Campbell visited the mission station in 1813 he reported food shortages and malnutrition of the residents. By 1820 Berends had lessened his ties with the missionaries, whom he believed were promoting social inequality for traditional peoples, but did not completely reject them; Berends had created a prospering school with 10 pupils and a full-time Griqua teacher, Sina Bergover. In the same year Andries Waterboer, who was appointed by the government as Griqua Kaptyn, was ousted by Berends. In 1821, the Colony recognised Berends position as Kaptyn, which carried with it the responsibility to keep peace and security in the region (Snyman 1988).

Between 1820 and 1825 Danielskuil experienced a drought. The residents began raising cattle, however they eventually all died due to the geological composition of the area; Danielskuil is comprised of limestone formations that contain low phosphate levels. After 1825 Danielskuil became an agricultural outpost station (Snyman 1988).

By 1829 the Wesleyan missionaries resumed religious services at Danielskuil. Contention grew as to which religious group, the Wesleyan or LMS missionaries, would inhabit Danielskuil and in 1832

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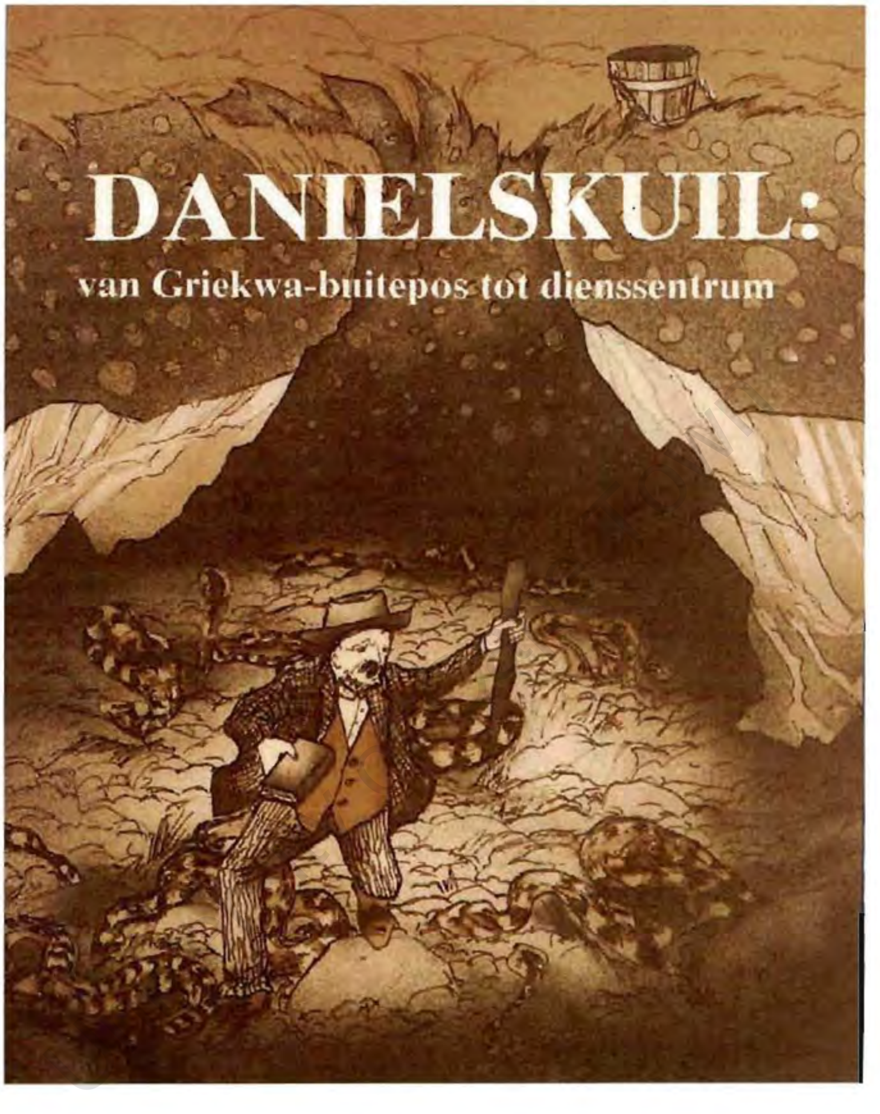

Figure 2.04 : Danielskuil – Historic dramatisation of Griqua pit into which prisoners, in this case Christians, would be thrown (Snyman 1988)

the Wesleyan missionaries left the station. By 1835, droughts, a locust plague and the drying up of fountains caused people to move to Danielskuil and the LMS mission station grew to over 100 residents. By 1838 a new school and church was built because of improved crops and sales. Businesses began to flourish, e.g. David Bergover rented his oxen to travellers in the region. From 1845 to 1850 the village of Danielskuil became an important Griqua outpost due to the abundance of crops which provided food and subsistence for more than 150 people (Snyman 1988).

Berends' death in 1839 left the Griqua community without a Kaptyn to negotiate with other indigenous groups for land usage. Conflicts occurred over land usage resulting in food shortages for everyone. By 1854 there were only 15 Griqua families living at Danielskuil (Snyman 1988).

During the 1860's and early 1870's circumstances caused the population of Danielskuil to rapidly decline. Between 1862 and 1863 droughts hit the area which caused many residents to leave. In the late 1860's Peter Wright, LMS missionary responsible for Danielskuil, and Sina Bergover, the teacher at Danielskuil both died. Two very important social structures had been obliterated, formal education and religious ceremonies, which resulted in Griqua peoples emigrating. In 1867 diamonds were discovered in the area and the region became of primary interest to the British government. In 1871 the area was annexed to the British government and disputes over land ownership between the government and the Griqua peoples arose. Eventually, the Griqua could not afford the court costs to fight for their land and the majority of the remaining Griqua residents left Danielskuil (Snyman 1988).

By 1870 the Tswana were the largest population group living in Danielskuil. As a result, in 1877 the land around Danielskuil was divided into regions: "163 000 hectares for 'Whites', 122 000 hectares to Griquas and 32 000 hectares for Zabantu peoples" (Snyman 1988:18). In 1880 Danielskuil was incorporated into the Cape Colony. A 'hut tax' was enforced which caused many Tswana to leave the region which allowed for an increase in European farmers to the area (Snyman 1988).

By the late1800's only a small number of rich (mostly 'Whites') had access to the land because in order to use the land one had to now buy it. Most of the residents were economically prevented from owning land and eventually became labourers (Snyman 1988).

Stock disease and drought forced many farmers out of the region in the late 1880's and by 1891 there were only 386 people living at Danielskuil: "30 'Whites' and 356 'location' people" (Snyman 1988:26). The concept of 'locations' (or reserves) was based on the premise that the 'natives' would

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remain 'peaceful' if they were allowed to retain their own land, or were rewarded alternative territory, in areas where they were too numerous and powerful to be expelled and their land appropriated. Once on 'locations' the 'natives' were more easily watched, controlled and taxed, and their legal exclusion from settling elsewhere made more land available for 'White' settlers (Shillington 1985).

By 1891 Danielskuil had characteristics of a town settlement; a post office had been established, as well as a police station and shops for buying goods. The farmers in the area also applied to the government for water ditches to increase the ease of farming and sowing. Eventually Danielskuil became a 'White' town; the town council established laws that allowed 'Whites' to control the indigenous population. Even the church cemetery grounds were divided as half of the land was used for 'White' burials and the other half for 'location' interments. In 1892 Danielskuil received town status from the Colonial government (Snyman 1988). Except for a few 'Coloured' residents, its days as a Griqua settlement were long past.

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2.7.1.3 Philippolis

The mission stations, which were founded among the Bushmen early in the 19th century at Tooverberg (Colesberg) and Hepzibah, on the southern bank of the Orange River, did not meet with much success. Consequently, a mission was founded in 1823 north of the Orange River with the aid of Dr. A. Faure, minister of Nederduitse Gereformeerde Kerk (NG Church; Dutch Reformed Church) of Graaff-Reinet and Andries Stockenstrom Jr. The site was named after Dr. John Philip, the superintendent of the society's missions in South Africa. Philippolis is the oldest town in the Free State (Figure 2.05) (Pettman 1985; Potgieter 1973).

In 1824 Dr. Faure instituted a school in Philippolis for the Griqua. The population also included !Kora and Tswana peoples (Schoeman 1996). Although the population of Philippolis was dispersed over a large area, The Cape of Good Hope Almanac and Annual Register for 1832 cites between 160 and 250 people frequenting Sunday worship and about 60-180 students attending school in Philippolis. In 1843 Philippolis had a clergyman, Rev. P. Wright and one 'Native' teacher for the school. In 1862 Philippolis became a separate parish of the NG Church and on April 18, 1863 Rev. Colin Fraser was called as its first minister. In 1866, JP Elstob was hired to teach for £90 per annum. At first he kept the school in a private

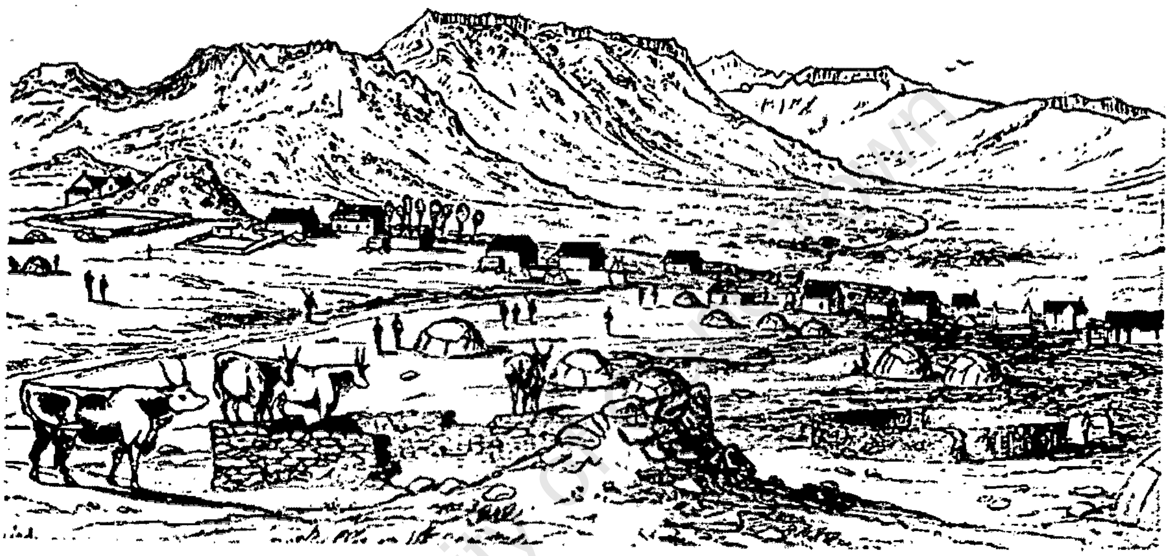

Figure 2.05 : Hand drawn portrait of historic Philippolis (Potgieter 1973:520)

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dwelling but in 1873 the first schoolhouse at Philippolis was built (Pettman 1985; Potgieter 1973; Van de Sandt 1843).

The raising of sheep for meat and wool was a very important industry in Philippolis. The wool was sold to the Colony and exported to Europe for great profit (Potgieter 1973).

After the second Anglo-Boer war, Emily Hobhouse founded a housecraft school for girls in Philippolis. The girls were taught English lace work, a craft that was practised in the vicinity for many years. Municipal status was achieved in 1862. Water for domestic use is obtained from boreholes and for irrigation from springs (Potgieter 1973).

2.7.1.4 Bethulie

The Bushman name for Bethulie is *T'kout'Koo*. The origin of the word probably comes from an African language for the Almighty, *u Tixo* (Pettman 1985). To the Basuto, the place is known as *Massimo*, meaning gardens (Pettman 1985). There are many boreholes that provide water for domestic use, and it is a fertile region for fruit and sheep.

In 1829, Mr. Clarke, of the LMS, established a school for Bushmen and tried in vain to Christianise them. In 1833, Rev. Jean Pellissier took over the small out station from the LMS on behalf of the Paris Evangelical mission station to work among the Tlhaping. He named the station Caledon, probably after the Caledon River. This created a problem since there was already a Caledon in the Cape Colony. Pellissier changed the name to Verhuellpolis in 1835, in honour of Admiral CH Verhuell, a Dutchman who became the first president of the Paris Mission. The directors preferred a Biblical name, and in the same year the name was changed again to Bethulia, after a city in the Apocrypha; Judith 4:6 & 7. The name means "Virgin of the Lord" or "Chosen by God" (Potgieter 1970:298).

In 1862 a congregation of the NG Church was established near the mission station Bethulie and application was made to the Volksraad to establish a town there. On 4 March 1863 the town was proclaimed under the name Heidelberg. Once again, since there were already towns of this name in both the Cape Colony and the Transvaal it led to much confusion, and in April 1872 the Volksraad decided to rename the town Bethulie (Potgieter 1970).

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The General Directory of the Cape Colony for 1870 cites Bethulie as having appraisers, a school, churches and a Volksraad. This suggests that the population was large enough to establish town-based infrastructures (Government Documents, General Directory of the Cape Colony 1870).

2.7.1.5 De Tuin

Hermanus van Wyk belonged to a leading family in the Bastaard community who established themselves at de Tuin, a fertile place where formerly someone had started a garden ('tuin') in the middle of the 19th century. Most of the community, who came to de Tuin from the Karee Mountains, were Bastaards, children of mixed parents, Europeans and Khoekhoen or slave and Khoekhoen,who traced their origins to some 30 Europeans who married 'Coloured' women in the Cape Colony during the 1820's. It became a refuge for those who were displaced by the advancing farmers (Von Rohden 1888; Wannenburgh 1980).

When the Rhenish Missionary Sterrenberg arrived at de Tuin he found many people living there: "Bushmen, Namas, Caffirs, Griqua, and Bastaards" (Von Rohden 1888:3). When he started to work here in 1863 there were only reed-huts and 'Matjes' huts, a frame covered in animal hide. He had to build a house for himself out of poles, reed, and bran. During the morning prayer, "150 people assembled under the thorn tree while 250 children attended school"; de Tuin received £30 per year from the Cape government to run the missionary school (Cape Archives, A.8-1866:10). The number of people living at de Tuin fluctuated, with about 50 to 70 families residing at the mission station at any given time. In 1864 more people began moving to de Tuin so the community built a stone church, school, and rectory to accommodate the burgeoning population. Many people from the surrounding areas came to de Tuin to be married (Cape Archives, A.8-1866; Von Rohden 1888).

Water was always scarce at de Tuin. There were no 'fountains' in the area. The people living at de Tuin would have had to dig 3.7 to 4.3 metres under the ground to access the water, which they would bail out in 'drans' made of wood. They were not able to irrigate the land but made gardens in good years when it rained. The riverbed that ran through the station only filled with water after rainstorms. After awhile, there were only a few water holes left which eventually dried up during the prolonged drought (Cape Archives, A.8-1866; Von Rohden 1888; Wannenburgh 1980).

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The community at de Tuin maintained themselves on "gardens, corn, goats, cows, and milk raised at Loeriesfontien, 290 kilometres away" (Cape Archives, A.8-1866:4). They also hunted, since there were many springbok in the area. Before settling at this site, the people lived in the vicinity and trekked about the land. There were more than 200 families living in this part of the country, 60 to 100 of them being Bushman, but only about 50 to 70 of them lived at de Tuin. Of the 200 families living in the area surrounding de Tuin, six were well-off Bastaard families who had as many as 1200 sheep and 60 head of cattle. This was not the norm as about half of the 200 families had no more than 200 sheep, and most of them had no more than 20 or 30 sheep (Cape Archives, A.8-1866)

The 'makke' (tame) Bushmen and the Bastaards lived together in peace; there were about 200 or 300 'wild' Bushmen living in the area that would come and steal from the surrounding communities. Since the Bushmen were very poor, the Bastaards would help by providing them with work; the rich Bastaards would not employ the poorer Bastaards to help on their farms because they would expect their own children to help out, as well, they could employ the Bushmen for a much cheaper wage (Cape Archives, A.8-1866).

Missionary Sterrenberg was transferred from de Tuin and Catechist Christian Schroder took over the mission for 15 months until 1866 when missionary Heidmann was put in charge. By the time Heidmann arrived at de Tuin, the mission station had been operating for four years. In 1866, the European *trekboers* who had followed the Bastaards into Bushmanland had begun to encroach on the grazing lands of de Tuin and harass the people who occupied the land. The Crown Pastures Licence of 1867, which stated a minimum charge of £3 per annum for the right to pasture stock on Crown lands, was an expense that most could not afford and caused outrage among the inhabitants of de Tuin. During this time, physical conflicts arose between the Bushmen and !Kora from beyond the Groote River, and the inhabitants of the mission stations in the area. The Bastaards of de Tuin were the first to lose their cattle, sheep, and goats. All attempts to pacify the chief of the !Kora were in vain. The Bastaards sent a deputation to Cape Town to ask that part of Bushmanland be reserved for them. Their request was refused in May 1868 and many of the families began to trek northward. De Tuin had to be completely abandoned in July 1868 (Cape Archives, A.8-1866; Strauss 1979; Von Rohden 1888; Wannenburgh 1980).

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After the departure of the main Bastaard group in 1868, small communities of Bastaards and !Kora continued to use the site for water and grazing. The development of the police post at nearby Kenhardt on 19 October 1868 (Potgieter 1970; Strauss 1979) helped to 'settle' the area and by the end of the second 'Koranna War' of 1879 the area was opened to European settlement (Strauss 1979). The first registered European farms at de Tuin were around 1900 and the remains of several early 20th century stock pens and house foundations indicate a fairly continuous use of the land by stock farmers. No record has been kept of 'Coloured' farm labourers living on the site, but oral history from labourers in the 1980's indicates that there has always been a labourer presence along with the European farm owner. The recent owner of the farm, Mnr. Du Plessis purchased the land in 1938 but has not had more than one or two labourer families living on the property since that time (personal communication Professor A.G. Morris, 2001).

2.7.2 Voortrekker and Settlement Towns

2.7.2.1 Colesberg

Colesberg was originally known as Tooverberg, (Mountain of the Wizard) as it was visible from a great distance, yet as the traveller moved closer, it mysteriously seemed to recede rather than get closer. In 1788 Governor Joachim Van Plettenberg erected a beacon, 32km from Colesberg on the present day farm of Quaggasfontein, to mark the northernmost point in the Cape Colony. In 1814 Erasmus Smith established a mission station for the Bushmen under the towering mountain known today as Coleskop. Ten years later Tooverberg became part of the Dutch Reformed Church district of Graaff-Reinet and Ds. Andrew Murray began to hold regular services in the veld under the mountain. A report to the Colonial government in 1825 states that there were approximately 100 Bushmen but only a few 'Hottentots' that lived in the area. In 1829 the Governor of the Cape, Sir Galbraith Lowry Cole, granted the Dutch Reformed Church 18, 138 Morgan to erect a church and the settlement that grew up around it was named Colesberg in his honour (Government Documents, Report No. 18, 1825; personal communication Belinda Gordon, 2001; Pettman 1985; Potgieter 1971).

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At first, the little town struggled to survive; hailstorms, drought, and locusts hampered the settlers and when the trekkers began to move through the area in 1838 many Colesberger's joined them. Those who stayed worked hard and soon there was a thriving community in the district. In 1840 Colesberg became a municipality, one of the earliest towns in the Cape to do so (personal communication Belinda Gordon, 2001; Pettman 1985). The population statistics published by the British Colonial Government in 1840, 1841 and 1843 reported that the population at Colesberg was almost entirely pastoral and growing sufficient corn for personal consumption. With the exception of the inhabitants of the village who were mostly shop keepers or artisans, the entire population was engaged in stock farming of sheep and cattle. There was also a scarcity of wood in the area so the people used sheep and cattle manure for fuel. Table 2.01 illustrates the number of people living at Colesberg from 1840 to 1843.

	1840	1841	1843
Whites - males	2 031	2 180	2 117
females	1 901	2 068	2 041
'Coloured' - males	1 645	1 854	1 589 †
females	1 578	1 791	1 548
Total	7 155	7 893	8 949 ?
Aliens & resident strangers*	1 228**	1 133	1 594 ‡
Population per square mile	3/5	2/3	~
Persons employed in agriculture	7 125	7 713	~
Persons employed in commerce	200	150	~
Manufacturers	30	30	~
Births	376	253	288
Marriages	118	100	100
Deaths	102	113	88

* Natives of countries beyond the boundary and serving with farmers
** other than the 15 Europeans, Natives of countries beyond the boundary and serving with farmers
† in 1843 the 'Coloured' population was cited as 'Hottentots and Bushmen'
? This total is incorrect even when the 'Aliens' group are included
‡ in 1843 the 'Aliens' are cited as "chiefly belonging to the [ethnic] group Mantates" (Van de Sandt 1843:449)

Table 2.01: Colesberg population statistics for 1840, 1841 and 1843 (Government Documents, Colony of Cape of Good Hope 1840 & 1841; Van de Sandt 1843).

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Interestingly, only the Whites and 'Coloureds' were considered as part of the total population and the 'aliens and resident strangers' were excluded. Also, the government in 1840 makes a point of excluding the 15 Europeans ('white' Europeans not counted in the 'white' category) from the category of 'aliens and resident strangers' and in 1843 changes the classification 'Coloured' to 'Hottentots' and Bushmen. After much research, the present author was not able to find any records relating to who these 15 Europeans may have been. It is possible that they were new immigrants who were neither British nor Dutch speaking and therefore discriminated against. The question still remains unanswered.

In 1854, Christ Church was built in Colesberg; it was designed by Sophy Gray, the wife of Bishop Gray, the first Anglican Bishop in the Cape. During the 1860's Colesberg prospered. Its first newspaper *The Colesberg Advertiser and Frontier Gazette* was published in 1860, and in 1861 the Colesberg Bank was established. This bank became one of the first branches of the Standard Bank of South Africa Ltd. in 1863. The NG Church was built in 1862 (personal communication Belinda Gordon, 2001).

The first official census in 1865 listed the number of people residing in Colesberg and the surrounding rural areas as: "White 7 684, 'Coloured' 9 425" (Government Documents, G.1-1866). The European population was almost twice as much as in 1843 and the 'Coloured' population had tripled. The majority of European men were involved in sheep and cattle farming or merchants in town, the European women were dressmakers or seamstresses. The majority of the 'Coloured' men were employed as agricultural labour and the 'Coloured' women as domestic servants (Government Documents, G.1-1866).

From 1843 to 1865 the number of manufacturers increased 7.5 times yet the number of people employed in agriculture declined by almost half. The most important agricultural product was wheat, then barley and rye, oats, maize, and finally peas and beans. Tobacco farming also became an important source of income. Sheep's wool was the most important stock product listed. This data suggests that the focus of employment was in the town and not in the rural areas. The town of Colesberg was becoming an important centre for commerce as people were buying material goods here to use in their daily lives (Government Documents, Colony of Cape of Good Hope 1840 & 1841; Government Documents, G.1-1866; Van de Sandt 1843).

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Smallpox raged in Colesberg in 1866 killing many people including a substantial number of 'Hottentots' (Gutsche 1968; personal communication Professor M. De Jongh, 2001; Slome 1929; South African Museum Catalogue). Local residents have always referred to the cemetery on the outskirts of town as the 'Hottentot begrafplaas' or Hottentot graveyard from the 1866 smallpox epidemic (personal communication Professor M. De Jongh).

The first diamond discovered in South Africa was found in Hopetown and was brought to Draper and Plewman's store in Colesberg where its authenticity was tested by scratching it on a windowpane. By 1870 rich deposits were discovered in Kimberley and the excitement brought many people through the Colesberg district. Although business increased, the population depleted as many of Colesberg's men left to try their luck and never returned (personal communication Belinda Gordon, 2001). The General Directory of the Cape Colony in 1870 reports the total population in the town of Colesberg as 1 395 residents. The economy thrived on the successful sheep farming and wool production but very little cultivation occurred in the area. Colesberg still suffered from a great scarcity of wood (Government Documents, General Directory of the Cape Colony 1870).

By 1875 the population of the rural and urban areas in Colesberg had again declined. The census data for Colesberg was as follows:

	Whites	Malay	Hottentot	Fingo*	Kaffir	Mixed & Other
<u>Town</u>						
Males	627	4	110	25	99	148
Females	685	4	147	24	71	208
<u>Rural</u>						
Males	2340	12	1140	152	1438	484
Females	2181	9	1028	79	1014	491

* "The Fingo form part of the Bantu family, but their peculiar relations with the Colony as involuntary immigrants within its boundaries and their intelligence and progress in civilisation lead to their being separately recorded" (Government Documents, G.42-1876).

Table 2.02: Colesberg population statistics for 1875 (Government Documents, G.42-1876).

It is evident, when comparing the 1875 and 1865 data that a decline of about 1/3 in both the European and the indigenous populations, town and rural combined, had occurred. However, the greatest population decline must have occurred in the rural communities since the town population in 1870 was 1 395 people and in 1875 only slightly decreased to 1 312 residents. In 1875, the 'White' population in the town of Colesberg outnumbered all other groups combined; there were six times more 'Whites' than 'Hottentots' or 'Kaffirs'. However, in the rural setting there were only twice as many 'Whites' as either 'Hottentots' or 'Kaffirs'. This data is not surprising since the 'Coloured' and Zabantu populations were employed as labourers and there would obviously be a greater demand for their services, i.e. more people would be needed, in the rural areas than in the towns. Sheep's wool was by far the most important economy in rural Colesberg along with cattle farming and angora goats. Records of pig and ostrich farming occurred for the first time in the 1875 census (Government Documents, G.42-1876).

The site for the Colesberg Bridge over the Orange River was first surveyed in 1873 by Mr. S. Stein and was eventually opened on July 10, 1880. By 1883 the railways reached the Colesberg junction. In 1882 a new Methodist church was built to house the growing congregation that first began in 1840. The first court house was erected in Colesberg in 1890 (personal communication Belinda Gordon, 2001; Pettman 1985).

During the 18th and 19th centuries Colesberg was also an important site for Nagmaal services. Nagmaal was a communion service held once every two months and would last for three days. It was a time when everyone from the surrounding communities would gather together to celebrate important events. It would start on Friday when Church Council meetings began and last until Sunday evening. On Saturday there was a preparation service where Christenings, weddings, and baptisms would take place. On Sunday was the actual communion followed by a thanks giving dinner that evening. Farming families in the Colesberg district had houses in town, which they kept especially for Nagmaal. People who did not have houses would arrive and stay in wagons. The fact that some farming families owned two homes, one rural and one town, suggests a certain degree of wealth in the area. (personal communication Belinda Gordon, 2001).

Colesberg also had a well-established Jewish community of which there still exists a cemetery on the outskirts of the town; a Synagogue was built in 1920 (personal communication Belinda Gordon, 2001).

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2.7.2.2 *Wolmaransstad*

After the discovery of diamonds in 1871, the main road from Kimberley to Johannesburg passed over the farms Rooderand and Vlakfontein on which Wolmaransstad was established. In 1876 the brothers W. and T.S. Leask opened a store there and a small community was formed. In 1884 the Volksraad approved of the establishment of a town and the first plots were surveyed in 1888. On 16 February 1891 the town was proclaimed and named after Jacobus M.A. Wolmarans, member of the Executive Council (Potgieter 1975).

In the early 1800's the Wesleyan Missionary Society set up mission stations along the Vaal River. Many of the inhabitants were Rolong peoples fleeing from attacks by Mzilikazi during the Mfecane (Lye & Murray 1980). In 1822, Thomas Hodgson (Wesleyan missionary) set up the mission station Matlwase just north of where Wolmaransstad now sits to preach Christianity to the local Tswana peoples, the Rolong. Hodgson's diary of 1825 describes the indigenous dwellings as "consisting of 2 houses, an outer and an inner one, to both of which is attached a small yard" (Mason 1986:914). According to Mason (1986) these houses are indeed related to Tswana-type structures. Hodson's diary also makes reference to him planting a garden at Matlwase, the multitude of "Caffre Corn" grown in the area and to the local Tswana people keeping livestock (Mason 1986:893-5). Also, Potgieter (1975) cites that in the late 1800's the main products of Wolmaransstad were maize, grain sorghum and peanuts. This information lends evidence for a pastoral way of life combined with some agricultural activities in this area.

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By the 1880's the Cape government, specifically the Native Affairs Department, proposed a hut tax and stock registration on all people living in 'locations'; areas that were designated by the government and occupied by indigenous African groups. This hut tax allowed the government closer controls over indigenous Africans as the financial implications and restraints of freedom of movement would provide, as the government suggested, "more inducements to work" (Shillington 1985:98). One of the main reasons for the implementation of the Native Locations Act of 1884 was to provide the Colonists with a source of cheap labour. However, the Act of 1884 was just present in theory, although it was sometimes 'enforced', and not formalised into law until after the Anglo-Boer War (1899-1902). By the early 1890's many of the 'location' residents had to earn cash to buy food and to do so the men had to leave their homes to search for employment on local farms, thus still being able to maintain contact with dependent families in the rural locations (Shillington 1985).

Up to the 1890's, many Zabantu people had been living on land and paying rent to absentee Colonist landowners. However, there was a fear among the farm owners that the Zabantu groups were gaining wealth and the Natives Land Act of 1913 came into effect. It stated that Zabantu people could only occupy tenancy on these farms as a condition of labour service (Phillips *et al.* 1996). In effect it allowed the land owners to profit from the cheap labour of indigenous communities. It is possible that the reason for so many males at the farm near Wolmaransstad is due to a Zabantu labouring community created by the Natives Land Act of 1913.

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CHAPTER 3

MATERIALS

This research project examines 227 human skeletons from seven different archaeological sites and three different ecological biomes in the Northern Cape Province, Free State, and North West province (Figure 3.01). All are historic samples housed in anatomy departments, the Florisbad Research Station (National Museum, Bloemfontein), or museums within South Africa. The prefix letters in each catalogue number refer to the institution in which the skeletons are housed and are the same as those used by Morris 1992a: A = Department of Anatomical Sciences, University of the Witwatersrand, NMB = National Museum, Bloemfontein (housed at Florisbad Research Station), SAM = South African Museum, Cape Town, UCT = University of Cape Town, Department of Human Biology, UOVS = University of the Free State, Department of Anatomy and Cell Morphology. The letters NMB are used to represent human skeletons, but the Florisbad Research Station uses this prefix to refer to its mammalian collection. The human skeletal collection is accessioned under the prefix P.

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3.1 EIGHTEENTH AND NINETEENTH CENTURY NORTHERN FRONTIER: CEMETERY SITES AND SKELETAL SAMPLES

The heart of the Colony was in the winter rainfall region of the western Cape and any movement out of the Colony needed to cross the Nama-Karoo biome which was comparatively poorly watered and supported only pastoralism and not crop agriculture. The populations selected for this project are either from the edge of the Nama-Karoo or are from just beyond the ecological edge of this biome. The fact that indigenous peoples are present, in any numbers, is a sign of the increased capability of livestock production in these regions. Philippolis, Bethulie, De Tuin, and Colesberg are all fully within the Nama-Karoo. Although the people of de Tuin were only 'passing through' the area, as they were moving north eventually settling in Namibia, the Bushmanland grasses provided reasonable grazing for the group while on their trek. The more eastern settlements were on the margins of the grasslands where there were more opportunities for trade and travel. Wolmaransstad reflects people living in the grassland biome, however

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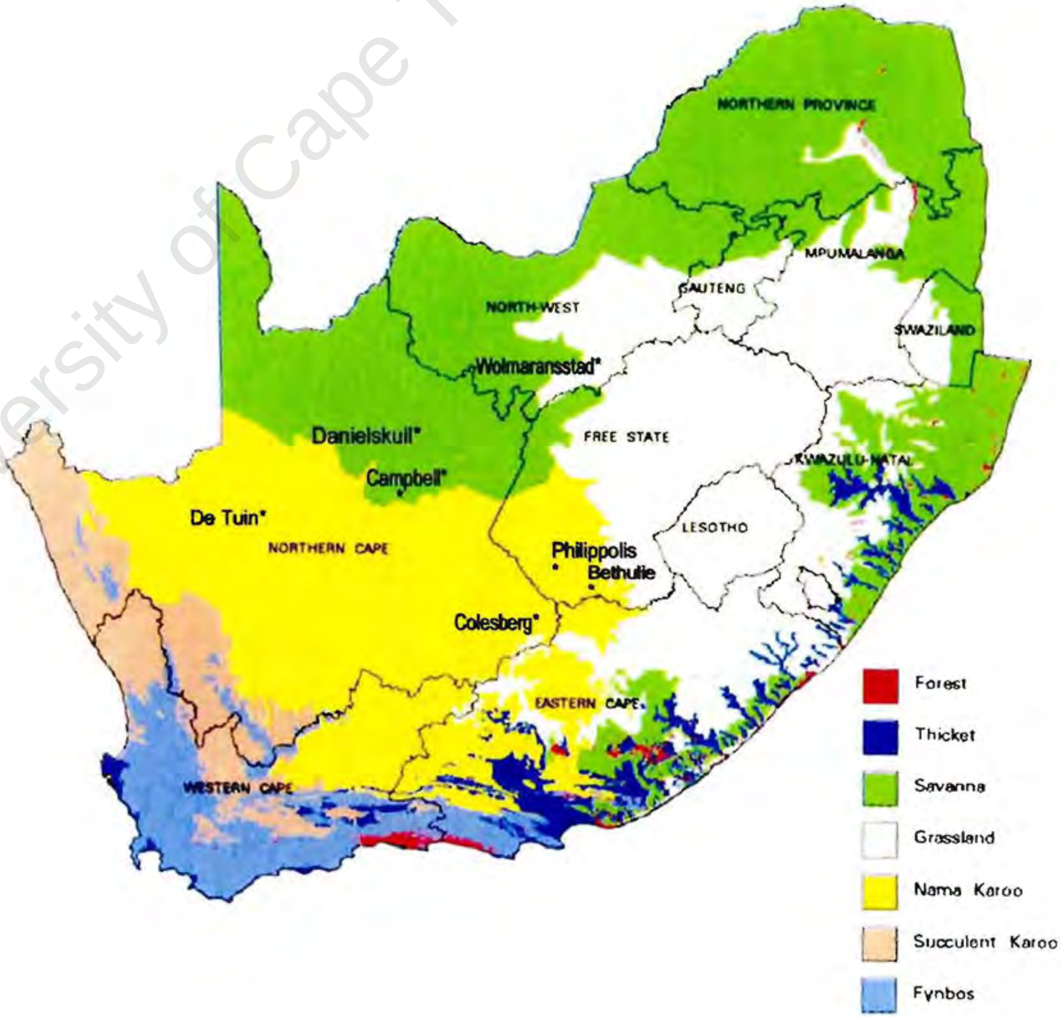

Figure 3.01 : Ecological biomes of South Africa, Lesotho and Swaziland with historic sites (Developed from Low and Rebelo 1996)

historically they were in the very last stages of the frontier development. The northern Griqua settlements were already in the Bushveld Savanna biome which is an exceptionally good pastoral environment; Campbell and Danielskuil are both located within the Savanna biome.

The Savanna biome, or Bushveld, is characterised by grassland with a widely spaced woody canopy. It extends from lower altitudes to higher rainfall areas in every province except the Western province and it almost completely encompasses the Northern province. The Savanna can be ecologically divided into two regions: arid and moist (below and above 625mm annual rainfall, respectively). The grasses in the arid Savanna are categorised as 'sweet' and have little competition from the 'sour' varieties. The northern and western Savanna have vast arid regions of 'sweetveld', which provide excellent pasture land and have a very high carrying capacity for grazing stock. The 'sourveld' is moister, providing less nutritional value in winter, and is therefore less ideal for livestock. When water is available, both areas are fertile for agricultural activities (Morris 1992a).

The Nama-Karoo, generally referred to as the Great Karoo, is characterised by dry shrubland with some grasses. The area within the western Bushmanland is grassier and offers reasonable grazing opportunities, which is excellent forage for sheep, although the Nama-Karoo generally does not have as high a carrying capacity for livestock as do the Grassland and Savanna regions. It is difficult to define biomes in the Nama-Karoo since the flora have broadened their range during the historic period and the area, represented in figure 3.01, may be larger than it was in prehistoric times (Morris 1992a)
The Grassland biome of South Africa is found in the eastern part of the high central plateau. The major plant species are grasses with trees or large shrubs in kloofs or other specialised areas. The Grassland biome includes the flat plains of the Highveld, mountainous areas of the Drakensberg, and the high sloping plateaux of the Eastern Cape and Kwazulu-Natal uplands. There are two types of vegetation found in this biome, 'sour' grasses and 'sweet' grasses. 'Sour' grasses are more common but they have lower palatability and nutritional value in winter as compared to the 'sweet' grasses. 'Sweet' grasses have less lignin, a higher nutritional value, and are more palatable to grazing stock but are more predominant in the arid regions (below 625mm per year rainfall). Since the grassland biome has a relatively high rainfall compared to other arid areas in South Africa 'sweet' grasses are not commonly found in this biome (Morris 1992a).

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3.1.1 Bastaard and Griqua Stations

3.1.1.1 Campbell

The Campbell graves, including that of Cornelius Kok I (A2270) who died in 1858, are associated with an historic Griqua cemetery from the early to middle nineteenth century (Morris 1992a, 1992b). The skeletons were all in the extended-on-back position and most of the individuals were placed in a niche at the side of the grave. Some individuals were also found in coffins. The graves were demarcated with headstones and footstones, flat slabs of rock embedded in the soil and placed in an upright position, and in some cases by low rounded stone cairns. They were orientated from east to west with the rows in a north-south direction (Morris 1992a, 1992b). Six of the stones at the Campbell burials were painted (Morris 1992b).

The average grave shaft was 1.2 metres but the base of the niche was much deeper at 1.5 metres. The Griqua style of burial is a combination of traditional and missionary influences; the well ordered cemetery containing headstones and footstones with extended-on-back burials represents the Christian style burial, while the niche graves characterise a traditional burial pattern (Morris 1992b).

Cultural materials include coffin wood and nails, buttons, a copper bracelet, piece of black cloth, pieces of leather, coir pillow (funeral furniture), large pieces of flat metal, and Middle Stone Age flakes associated with the grave fill (Appendix A). The flat metal pieces associated with individual A2263 could be the tin box, now disassembled, that is recorded by Morris (1992a).

The Campbell remains are housed at the University of the Witwatersrand in Johannesburg. The site is located in the Savanna biome of the Northern Cape province approximately four kilometres north-west of Campbell and west of the Papkuil road. The graveyard is not marked but is recognised, through oral history of the area, to be the resting-place of historic Griqua peoples. The skeletons were excavated between 1961 and 1971 by P.V. Tobias, G. Fock, B. Humphreys, H. Humphreys, and Anatomical Science students from the University of the Witwatersrand (Morris 1992b). The 'ownership' of the skeletons has been returned to the Griqua community and they are waiting repatriation, which is to occur in the near future (personal communication Dr. K. Kuykendall, 2000).

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There are 36 individuals represented in this sample. Individual A2270 was not located in the skeletal collection at the time of data collection and therefore not included in this project. An estimation of sex is only possible for 21 individuals due to the fragmentary nature and/or the young age of the skeletons; there are 14 infants, one juvenile, 10 adult males and 11 adult females present. Their age at death ranges from birth to 60+ years old. The majority of the skeletal remains are nearly complete and the preservation ranges from poor to excellent; the preservation of the cranial remains is generally excellent and the postcranial remains is very good.

3.1.1.2 Danielskuil

This site is a Griqua cemetery from the late 19th or early 20th century, and is associated with a Christian style burial, lying on their backs in coffins (Snyman 1988). Most traditional African burials are characterised by individuals buried in a flexed position (Morris 1992b). In 1976 maintenance workers discovered the human remains while digging a French drain close to the school hostel in Danielskuil. A French drain collects sub-surface water from poorly drained areas and carries it to a main drainage line, dry well, ravine, or the street (personal communication E. Englert and Professor B. McLeod, 2001) (Figures 3.02 to 3.03). The excavations took place in 1976 under supervision of (the late) Prof. Jan Toerien and in 1977 under supervision of (retired) Prof. De Villiers Lamprecht with help from students in the Department of Anatomy, University of the Free State (personal communication Dr. A. Gous, 2000; Peters 1986). The graves were all 1.8 metres apart and 1.8 metres deep. All of the skeletons were found in niche burials. Most of the graves had head and footstones, facing east and west, respectively. Remnants of coffin wood were found in many of the graves (Peters 1986; Peters & Gous 1987; Snyman 1988).

There were three gravesites excavated. Excavation one began in 1976. It was situated in the area of a new housing development. The ground was flat and full of stones and the skeletons were very weathered. Most of the graves had headstones on which the details were engraved in Dutch and English (Figure 3.04). Excavation two, which was also undertaken in 1976, was five kilometres outside of Danielskuil on the Kuruman-Swartput Road. The graves were also demarcated with large headstones and smaller footstones and layered with smaller stones at different levels (Figure 3.05). There were more than

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Figure 3.02 : School hostel in Danielskuil – Building on left (Photo by R. Rossouw, courtesy A. Gous)

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Figure 3.03 : Danielskuil – Building the french drain (Photo by R. Rossouw, courtesy A. Gous)

Figure 3.04 : Danielskuil – Headstone engraved in Dutch
Miss R Koopman
Born 11 28 1861
Died 29 No(?) 1911
Delivered into God's hands
(Photo by R. Rossouw, courtesy A. Gous)

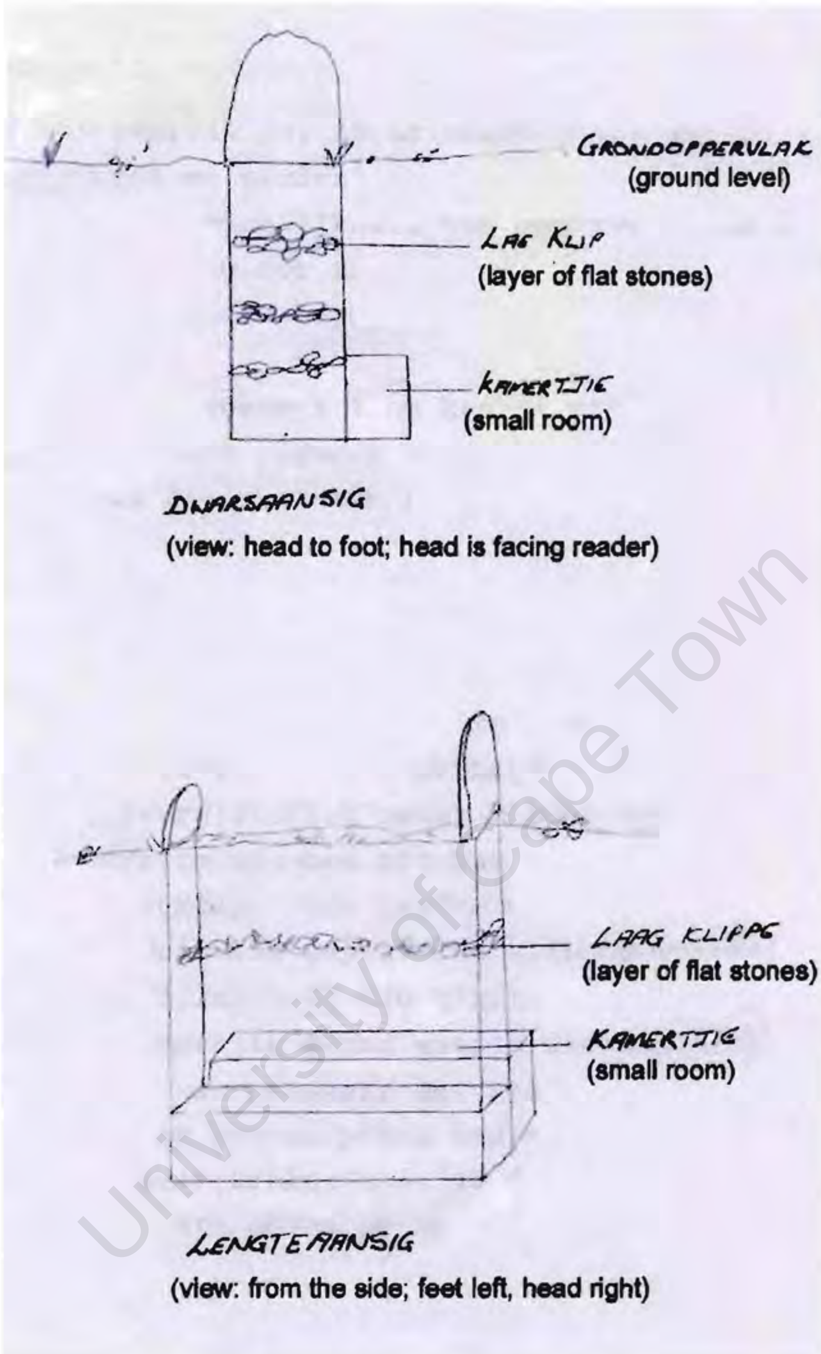

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Figure 3.05 : Danielskuil – Graves in excavation No. 2 (Modified from Peters 1986)

20 graves in this graveyard. The only artefacts found were a few glass beads and a brass bangle (personal communication Dr. R. Rossouw, 2001; Peters 1986; Peters & Gous 1987). According to Peters (1986) most of the skeletons from these graves were in good condition. There is a local story associated with the origins of the second graveyard that says a group of sheep sheerers, who died under abnormal circumstances, are buried at this site. Apparently, a farmer left a poisoned dead sheep for the jackals to eat, but some people ate it instead (Peters 1986).

The third excavation began in 1976 in the grounds of the school hostel in Danielskuil and has been associated with the descendants of Waterboer (Peters 1986; Snyman 1988). The first test pits were dug under the bluegum trees and yielded nothing. A later search was undertaken in 1977 in the same area but behind the boarding house. The first skeleton was found next to the boarding house drain. The skeletal remains were in very good condition. The niche graves were 2.0 metres apart and 1.8 metres deep with an east-west orientation of the head and feet respectively representing a combination of traditional (niche graves) and Christian style (head-foot orientation) burials (Peters 1986).

The only cultural material associated with the Danielskuil skeletal remains were two coffin nails, buttons, pieces of cloth, and fragments of ostrich egg shells. The coffin wood, glass beads, and brass bangle were all missing during the January 2000 data collection.

One male individual, Danielskuil/UOVS11b, displays signs of pipe-smoker's wear. The wear pattern present is more oval than round (Figure 3.06). The elliptical gap in the occlusal plane is similar to the cross-section of the ebonite mouthpiece, devised in England in 1878, and commonly attached to briar wood pipes after World War I (Figure 3.07) (Dunhill 1969; Morris 1988; www.encarta.msn.com). The briar, *Erica arborea*, is a low shrub that flourishes in France and other Mediterranean countries, therefore the pipe was not made in South Africa, and only the roots of the bush are employed for pipe making (Herment 1954:32). When referring to indigenous pipes in the Transkei and other areas copied in stone or wood, Shaw (1938:286) cites that "the mouthpiece is seldom copied, as the natives prefer a widely flanging end into which they insert a separable mouthpiece of a short length of reed, wood or bone". Clay pipe stems are round and other types of stems in European pipes would be rare before 1918. Indigenous pipe stems of reed, wood or bone would be unlikely to cause pipe-smoker's wear on the teeth. According to Morris (personal communication Professor A.G. Morris, 2001) the really habitual smoker tends to keep the pipe stem in the exact place so that the wear nearly matches the diameter of the pipe stem.

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Figure 3.06 : Wolmaransstad/NMB 1313a – Pipe smoker's wear on the mandibular and maxillary RC and RPM1; similar wear on Danielskuil/UOVS11b and Wolmaransstad/NMB18 (Photo by T. Peckmann)

Figure 3.07 : Ebonite mouthpiece on modern briar wood pipe – Notice elliptical shape of mouthpiece (Modified from www.eandrew.com/pagepipestraditional.html)

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All of this information is critical because it lends evidence for a 20th century date, after 1918, for at least one individual at Danielskuil. Since oral history cites the graves as being late 19th century and the one individual with pipe smoker's wear suggests an early 20th century date the Danielskuil burials must date between the late 19th and early 20th centuries.

The Danielskuil remains are housed at the Department of Anatomy and Cell Morphology, University of the Free State, Bloemfontein. This site is located in the Savanna biome of the Northern Cape province.

There are 42 individuals represented in this sample. Only 41 of the skeletons are useful for analyses; UOVS16 provides no information as it contains only an extremely fragmented skull of which the estimation of age or sex is not possible. An estimation of sex is only possible for 26 individuals due to the fragmentary nature and/or the young age of the skeletons; there are four infants, seven juveniles, 19 adult males, seven adult females, three unsexed adults, and one unsexed young adult present. Their age at death ranges from one year to 59+ years. Most of the skeletal remains are incomplete. The preservation of the skeletons ranges from poor to excellent; the preservation of the cranial remains is generally poor and the postcranial remains is very good.

3.1.1.3 Philippolis

There are no data to confirm an absolute date but the Philippolis remains are said to be from a "Griqua cemetery…on the edge of town" (Morris 1992a:80). However, one artefact suggests a late 19th century date. There is one unpublished expedition report, number 108 (25 September 1941), associated with this site written by the excavator, A.C. Hoffman in 1941.

The expedition report outlines the aim of the field trip: "to excavate Griqua graves" (Hoffman 1941). It also includes the approximate location of the two gravesites in relation to the town, dates on which they were excavated, approximate ages of the individuals exhumed, and condition of the skeletons. On September 15, 1941 A.C Hoffman and two Museum 'kaffirs' went by lorry to Philippolis. Their truck broke down and repairs took one day. On the 16th they arrived at the Philippolis magistrate and town clerk's office to obtain permission to excavate the graves. A few hours later they found a cemetery with 84 graves, which was located 150 paces out of town on the western side. They were small graves,

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probably of children. The first three he excavated were of babies. Four more graves were exhumed but the "skeletons were in poor [condition] and not suitable for mounting" (Hoffman 1941). On Wednesday 17 September they went to a hill approximately 500 paces south of the first site. There he found 12 graves that looked "relatively recent" (Hoffman 1941). All were excavated. Hoffman thought this second group of skeletons were in "the best" condition. On the 18th and 19th he went back to the original site of 84 graves and exhumed 14 more individuals. September 20th he closed all the graves and returned home (Hoffman 1941).

In the end 30 graves were excavated: 27 adults and 3 children. Twenty skulls were "fine" but the rest were "bad and broken" (Hoffman 1941). Only one or two of the skeletons were complete and "suitable for mounting" (Hoffman 1941). The bones of all the other individuals were in poor condition. Several stone tools were also discovered. Eight skeletons were found in coffins, two in "bags", two in "finer material", six in niche graves, and the rest were simply covered in soil (Hoffman 1941). The graves varied from 0.5 to 1.5 metres deep. Hoffman analysed the skulls and reported the following: "one skull was 'pure' European, but had strange eyes and a long, thin nose, the rest of the skulls showed that the Griquas were 'true' Bastaards" (Hoffman 1941). However, biological identity does not necessarily dictate ethnicity; the skeleton may have 'looked' European but this individual could have been of mixed descent, i.e. Griqua. There is a strong association between the historical information and niche burials at Philippolis and the lifestyle of the Griqua peoples.

The stone tools found in the 1941 excavation were not present during the January 2000 data collection. However, there was cultural material present that was not recorded in the 1941 excavation: buttons, 1 very unique piece of jewellery with a Star of David design, pocket knife, leather from a sole of a shoe, piece of leather and metal bracelet (Figures 3.08 & 3.09).

The cultural remains discovered with Philippolis/NMB1567a suggest a nineteenth century cemetery at Philippolis. Figure 3.09 illustrates a piece of jewellery with a very unique design, a raised Star of David with a 'flower' motif in the center of the star. The artefact was discovered along with other buttons however, since there was no button-back present it was difficult to assess its use; it was too large to be a cuff button and therefore was possibly a cloak button or a piece of jewellery. This artefact has been identified as made from black glass and probably Jewish in origin (Peacock 1986; personal communication Judy Stopke and Ronnie Wexler, 2001). During the 1800's Jews were involved in glass

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Figure 3.08 : Philippolis/NMB 1567a – Pocketknife (Photo by T. Peckmann)

Figure 3.09 : Philippolis/NMB 1567a – 'Star of David' jewellery (Photo by T. Peckmann)

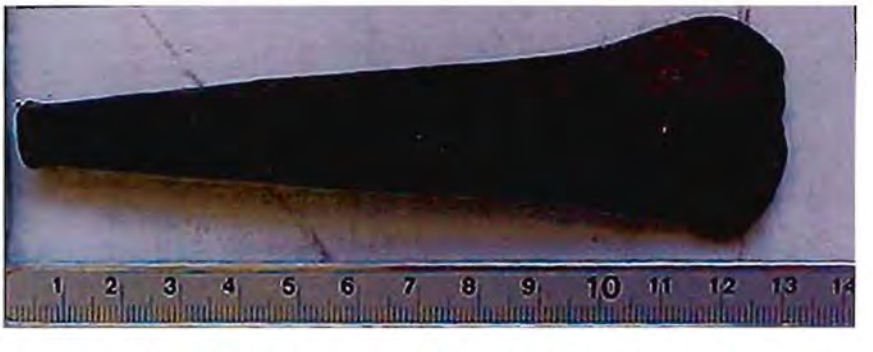

Figure 3.10 : Bethulie/NMB 1622a – Adze head used for farming (Photo by T. Peckmann)

works in what is today Czechoslovakia and Germany; the area of Bavaria is historically known for fine glass making. Many Jews designed Star of David motifs for buttons and jewellery and wore them to identify each other, for pride of identity (personal communication Judy Stopke, 2001). The use of black glass reached a peak following the death of Queen Victoria's husband, Alfred, in 1861 as she wore black for the rest of her days and the fashion world followed suit (personal communication Judy Stopke, 2001; www.encarta.msn.com). Also, the 'flower' motif, usually with eight points, in the center of the star represents the menorah. Even though the 'flower' illustrated in figure 3.09 seems to have only 6 points it may have had eight points at one time as it is slightly damaged.

Although they were few in numbers, Jews were present in widely scattered places throughout the Free State during the nineteenth century. The earliest Jewish families, the Baumanns, Leviseurs and Ehrlichs, arrived in South Africa, from Germany and Russia, during the 1830's. The first account of Jews at Philippolis was in the year 1876, "When, in 1876, the Port Elizabeth Hebrew Congregation made an appeal for funds for their synagogue, the Jews responded from such centres as Bloemfontein, Smithfield, Reddersburg, Bethulie, Winburg, Jacobsdal, Rouxville, Fauresmith, and Philippolis" (Pencharz & Sowden 1955:325). Whether individual Philippolis/NMB1567a is of Jewish descent can neither be determined nor is it of primary importance for this project. The significance of the Star of David jewellery is that it gives some clues as to the date of this site, possibly late 1800's, and its earliest occupants.

The Philippolis remains are housed at the Florisbad Research Station. The site is located in the Nama-Karoo biome of the Free State province.

There are 18 individuals represented in the Philippolis sample analysed for this research project, eight males, eight females, and two young adults too fragmentary to be accurately sexed. Hoffman (1941) excavated 30 skeletons but 12 skeletons could not be located in the museum collection. All individuals are adults and range from 17 to 50 years for age at death. The skeletal remains are mostly nearly complete. The preservation of the skeletons ranges from poor to excellent; the preservation of the majority of the cranial and postcranial remains is excellent.

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3.1.1.4 Bethulie

According to an elder in the town this was a cemetery for Griqua farm labourers (personal communication Dick Collett, 2000). The graves at Bethulie were discovered near a river above a homestead on a farm called Damfontein. They were excavated in 1963 by AC Hoffman and D. Esterhuyse. Some of the skeletons were interred in a Christian style burial lying on their backs in coffins, while others were found in niche graves which represent a tradition burial style (Morris 1992a).

The cultural materials include copper pins, buttons, and an adze head (a hoe used for farming) (Figure 3.10) (Appendix A). This list differs from that present in Morris (1992a), as all individuals in his study are recorded as having "associated grave goods: handles, copper pins, and shirt buttons" (Morris 1992a:85). Morris (1992a) obtained his data from the museum records and the discrepancy between the two projects could possibly be due to lost or misplaced artefacts throughout the years.

The Bethulie remains are housed at the Florisbad Research Station. This site is situated in the Nama-Karoo ecological biome of the Free State province.

There are 28 individuals represented in this sample. An estimation of sex is only possible for 11 individuals due to the fragmentary nature and/or the young age of the skeletons; there are 14 infants, three juveniles, six adult males and five adult females present. Their age at death ranges from foetus to 60+ years old. The majority of the skeletal remains are incomplete and the preservation ranges from poor to excellent; the postcranial remains are generally very good but the cranial remains are mostly poorly preserved.

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3.1.1.5 De Tuin

There were many different peoples present when the missionaries arrived and therefore it is possible that not all of the gravesites at de Tuin are associated with one occupation or group. There was a Rhenish mission station present at de Tuin from 1861-1868 and during the 20th century the farm has been a commercial stock venture employing a small labouring community. In 1979, Mr. H.A. du Plessis (late owner of the farm) contacted Prof. A.B. Smith of the Department of Archaeology, University of Cape Town, about a number of graves on his farm that he thought dated to the Mission Period. In 1982, Prof. A.G. Morris received a permit to excavate the graves (Morris 1982).

There were five field excavations between 1982 and 2000 by A.G. Morris, G. Louw, T. Peckmann, and third year Anatomical Science students. The de Tuin remains are housed at the Department of Human Biology at the University of Cape Town. This site is located in the Nama-Karoo biome of the Northern Cape province.

There are three burial sequences at de Tuin, with approximately 2 km between site 1 and site 3. The largest cemetery, gravesite 1, contained 33 graves and is located to the west of the river (Figure 3.11). These graves are not recent as they predate a grove of Acacia trees, which have grown in the midst of the cemetery. Many of the graves are badly disturbed by this growth and aardvark digging. The graves are selected for excavation where no sign of disturbance has occurred.

There were nine graves excavated at site 1: cairns 8, 9, 10, 11, 12, 13, 14, 19 and 25. The measurements of the graves are presented in table 3.01. All graves were marked by low cairns with head and footstones, facing east and west respectively (Figure 3.12). A north-south base line was placed west of the most outlying grave and ran the length of the cemetery. A grid of 1 metre squares was placed on top of the graves and the exact position of each skeleton was recorded in relation to the base line. The grids were in a north-south alignment. Each cairn was mapped on graph paper and the stones were removed leaving the grid intact. The graves were dug in 50 cm depth intervals and the grave fill from each depth interval was sifted separately. Once the skeleton was exposed, photographs were taken of the body position. After the skeletal remains and associated artefacts were removed the associated soil was sifted. All bones and cultural remains were placed into a labelled 'zip-lock bag' with the grave number. The individuals were all buried extended on their back with the head in the east and the feet facing west, which is suggestive of Christian influence, between 1.2 and 1.8 metres deep (Figure 3.13). The deepest grave shafts ended in the bedrock and therefore it is unlikely that anyone was buried deeper in the ground.

There were no human remains found in graves 9, 10, and 12. The reason for the missing remains is most likely a reflection of differential preservation since there was no evidence of aardvark or human disruption at these burials. There were two individuals found in grave 19; individual two contains only five phalanges from a new born which were found during the sifting of the soil around individual one.

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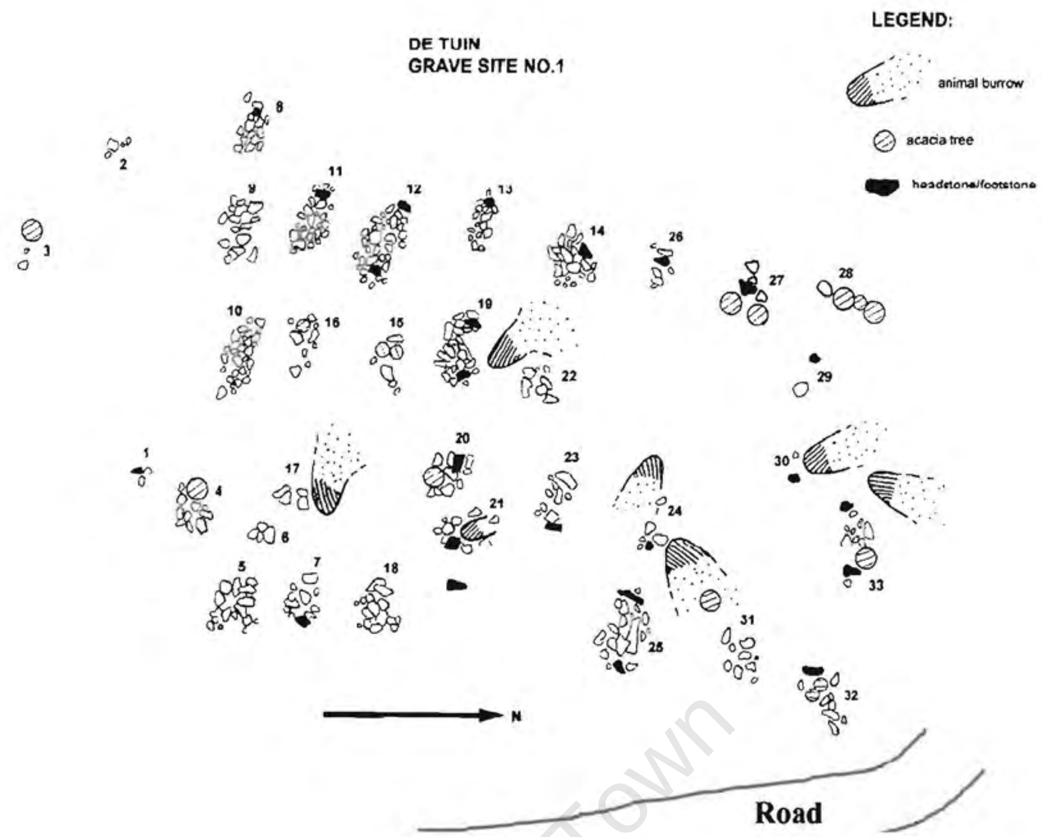

Figure 3.11 : De Tuin – Gravesite No. 1 (Map drawn by A.G. Morris from field observations by Morris, V. Phillips and T. Peckmann 1999)

Figure 3.12 : De Tuin – Arrows point to head and foot stones of grave No. 25 (Photo by T. Peckmann)

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Year	Gravesite	Grave No.	Accession No.	Length (m)	Width (m)	Depth (m)	Age of Individual
1982	1	8	UCT 335	1.80	N/A	1.50	5-6 yrs
1982	1	13	UCT 336	1.90	N/A	1.50	1.5-2 yrs
1994	3	4	UCT 469	N/A	N/A	0.11	2 mths
1995	3	1	UCT 467	2.60	0.90	0.95	4 yrs
1995	3	3	UCT 468	N/A	N/A	0.98	6-7 yrs
1995	3	7	UCT 470	1.50	0.45	0.70	Birth-2 wks
1995	3	18	UCT 471	1.75	0.50	0.70	5-6 yrs
1999	1	11	UCT 569	2.66	2.00	1.50	13-15 yrs
1999	1	19a	UCT 570a	2.66	2.00	1.45	< 1 yr
1999	1	19b	UCT 570b	2.66	2.00	1.44	4-5 yrs
1999	1	25	UCT 571	2.66	2.50	1.62	3-6 mths
2000	1	9	Empty	2.66	2.00	1.80	Empty
2000	1	10	Empty	2.66	2.00	1.80	Empty
2000	1	12	Empty	2.66	2.00	1.80	Empty
2000	1	14	UCT 579	2.66	2.00	1.50	3-4 yrs

Table 3.01 : Summary of individuals excavated at de Tuin

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Figure 3.13 : 'Christian-style' burial at de Tuin – Individual in supine position (Photo by E. Fuller 1982)

Although there is an aardvark hole between grave 19 and grave 22 it has not disturbed either grave (Figure 3.11). Since none of the graves surrounding cairn 19 were disturbed from aardvark activity the child skeleton found in cairn 19 was probably not from another grave. Since children's bones do not preserve as well as adult bones the best explanation is that two individuals were buried in this grave but the child's bones were too poorly preserved to be recorded.

Mr. du Plessis told Prof. Morris that burial eight had a wooden structure over it when he first arrived at de Tuin in 1938. According to the beliefs of the local 'Coloured' population, this was the grave of a young woman who was burned to death (Morris 1982). Since grave 8 is on the margins of site 1 it may be a late grave that is unrelated to the main grave sequence. The site 1 burial series contains the largest number of graves and is likely to be part of the most dense occupation of de Tuin, the Mission period (Morris 1982).

Gravesite 2 is a new cemetery from the 20th century. The cemetery contains 13 graves with two lines of cairns in a perfect east-west orientation. The preservation of the cairns is excellent whereas the cairns in sites 1 and 3 are significantly collapsed. This supports the idea of a 20th rather than 19th century cemetery.

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The third cemetery (gravesite 3) contains 18 graves of which only five were excavated: cairns 1, 3, 4, 7 and 18. This site is much older than gravesite 2 and is possibly contemporaneous in age with gravesite 1. It lies to the south of the historic Bastaard settlement site and modern farm buildings. The graves are ordered in rows but only some of the cairns, many are elaborate, have head or footstones associated with them (Figure 3.14). The individuals were all buried extended on their back, probably Christian influence, with the head in the east and feet in the west and found lying on top of a layer of hard bedrock. It was not possible to excavate any further because the soil was so hard (Morris 1994).

Coffin wood or nails were associated with five of the 11 burials: gravesite 1, cairns 8, 11, 14 and gravesite 3, cairns 1 and 18. Other cultural material included a small piece of white pottery, copper straight pins, screws, fragments of ostrich eggshells, and one bovid tooth. The presence of screws in cairn 8 suggests a date after 1870 for at least one individual. Screws were coming into general use in the mid-eighteenth century but it was not until a hundred years later, with the introduction of machinery for mass producing them, that they became cheap and plentiful (Waler, no date). The coffin wood was sent for analysis and confirmed to be of the species <u>Pinus</u>, pine wood (personal communication Dr. E. February,

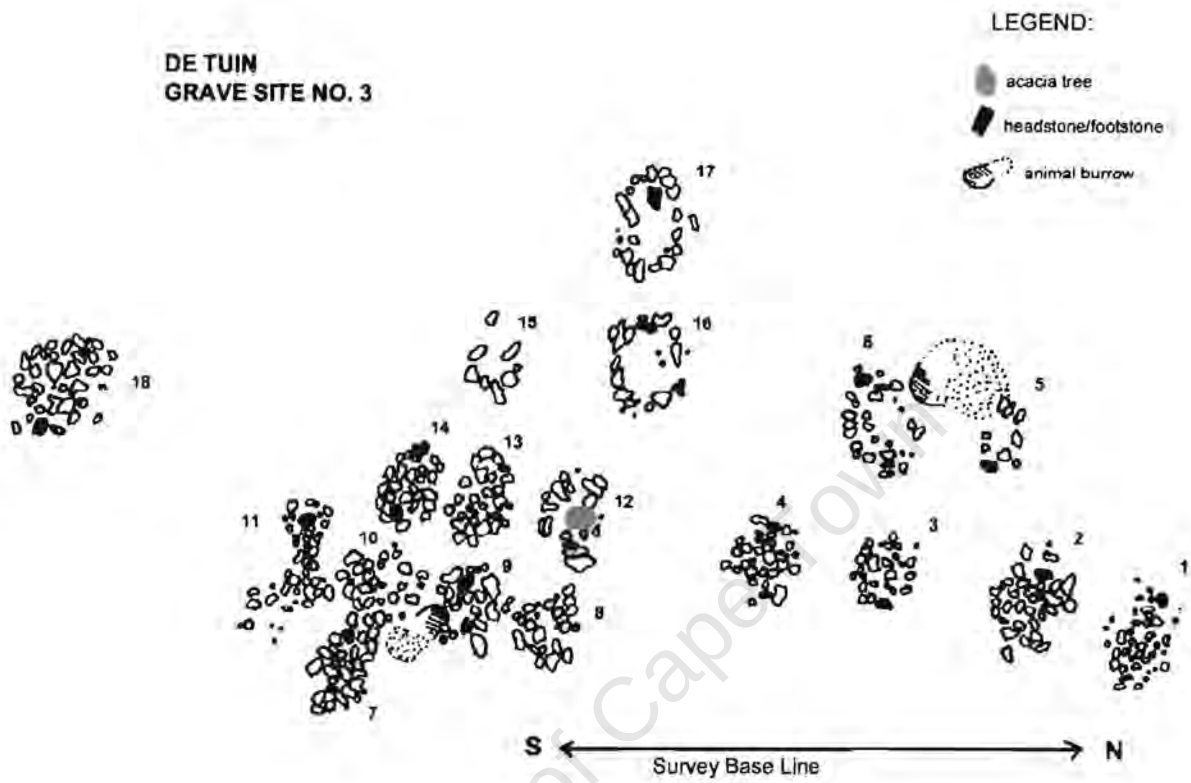

Figure 3.14 : De Tuin – Gravesite No. 3 (Drawn by A.G. Morris from fieldwork observations by Morris and G. Louw 1994 and 1995)

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Dept. of Botany, University of Cape Town to Professor A.G. Morris, 1996). Pine wood was not grown in the area but was planted around Cape Town. Through the 19th and early 20th centuries pine was the most common wood used commercially in South Africa. Fruit boxes were also made of pine wood at that time (February 1996). The lack of more prominent woods such as teak or oak suggests that the people either did not have access to, or could not afford it. February (1996) examined coffin wood from a cemetery near the town of Vredendal, South Africa. He concluded that the use of recycled wood, i.e. fruit boxes, and the absence of high status woods suggests the burials were from people who did not have access to wealth (February 1996). The lack of high status woods at de Tuin also lends evidence for a poorer community.

Gravesites 1 and 3 are probably associated with the mission period at de Tuin and the period afterward up to European settlement. The presence of coffin wood and nails and extended on back burials suggest Christian (missionary) influence in these cemeteries (Laidler 1929; Morris 1992b). February (1996) also notes that a shaft burial is associated with a Christian type grave. Research on historic South African cemeteries has reported the individuals lying supine in an east-west axis with the head in the west so they could sit up and face the sun on judgement day (Apollonio 1998; February 1996). However, all of the de Tuin skeletons lay in a west-east orientation with the head in the east and feet in the west. The reason for this is unknown. The use of pine wood for coffins suggests that the people either did not have access to, or could not afford, more expensive material.

There are 12 individuals represented in the de Tuin sample found in 11 graves from sites 1 and 2. Burial 19 at gravesite 1 contained two individuals. An estimation of sex is not possible for any of the skeletons due to their young age at death; all were under the age of 15 when they died. There are eight infants and four juveniles present. The majority of the skeletons are nearly complete. The preservation of the skeletons ranges from poor to very good; the preservation of the cranial remains is generally poor and the postcranial remains is very good.

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3.1.2 VOORTREKKER AND SETTLEMENT TOWNS

3.1.2.1 COLESBERG

The Colesberg skeletal remains are associated with an indigenous population who died during the smallpox epidemic of 1866 (personal communication Professor M. De Jongh, , 2001; Slome 1929; South African Museum Catalogue). Slome (1929:3) refers to these individuals as being "Cape Bush people" but De Jongh (2001) cites this as a 'Hottentot' cemetery. Historical references show that people with a hunter-gatherer lifestyle had long since disappeared from the area before 1866 (Morris 1984; personal communication Professor M. De Jongh, 2001). Local residents have always referred to the site as a 'Hottentot begrafplaas' or Hottentot graveyard (personal communication Professor M. De Jongh, 2001). The graves were situated just below a small range of hills, within about 90 metres (100 yards) of the present (c.1929) Colesberg wash-houses, which are approximately 2.5 km (1.5 miles) from the town (Slome 1929). According to Belinda Gordon (personal communication, 2000) the remains were found next to the present (c.2000) Caravan Park outside of Colesberg (Figure 3.15).

The skeletons were excavated by J. Drury in November 1926. Morris (1992a:82) does not provide any data on the burial style for these individuals, except SAM4500, which states "in grave". Yet, Slome (1929) provides a clear description of the Colesberg burials as told to him by the excavator, Drury. The graves were not placed in strait rows but arranged in irregular lines that extended for about 45.5 metres (50 yards). All of the graves had a pile of stones on top; large piles indicated adults, small piles indicated children. The graves ranged from 0.6-1.2 metres (2-4 feet) deep. Some of the interments had two skeletons in one grave but in two cases there was no trace of human bones in what was clearly marked as graves. All individuals were found buried in the extended position. Some of the graves were found associated with coffin wood and handles; Slome (1929) cites grave number 29 as having remnants of coffin wood and Morris (1992a) states burials SAM4496, SAM4504, and SAM4512 were all found in association with coffin handles. This would suggest a Christian style burial for these specific individuals.

Slome (1929) and Drennan (1929) measured various bones and examined the teeth from these skeletons and compared this data to other published measurements on 'typical' Europeans, Bushmen and 'Hottentots'. They concluded that this population was a combination of "pure Bushmen…mixed

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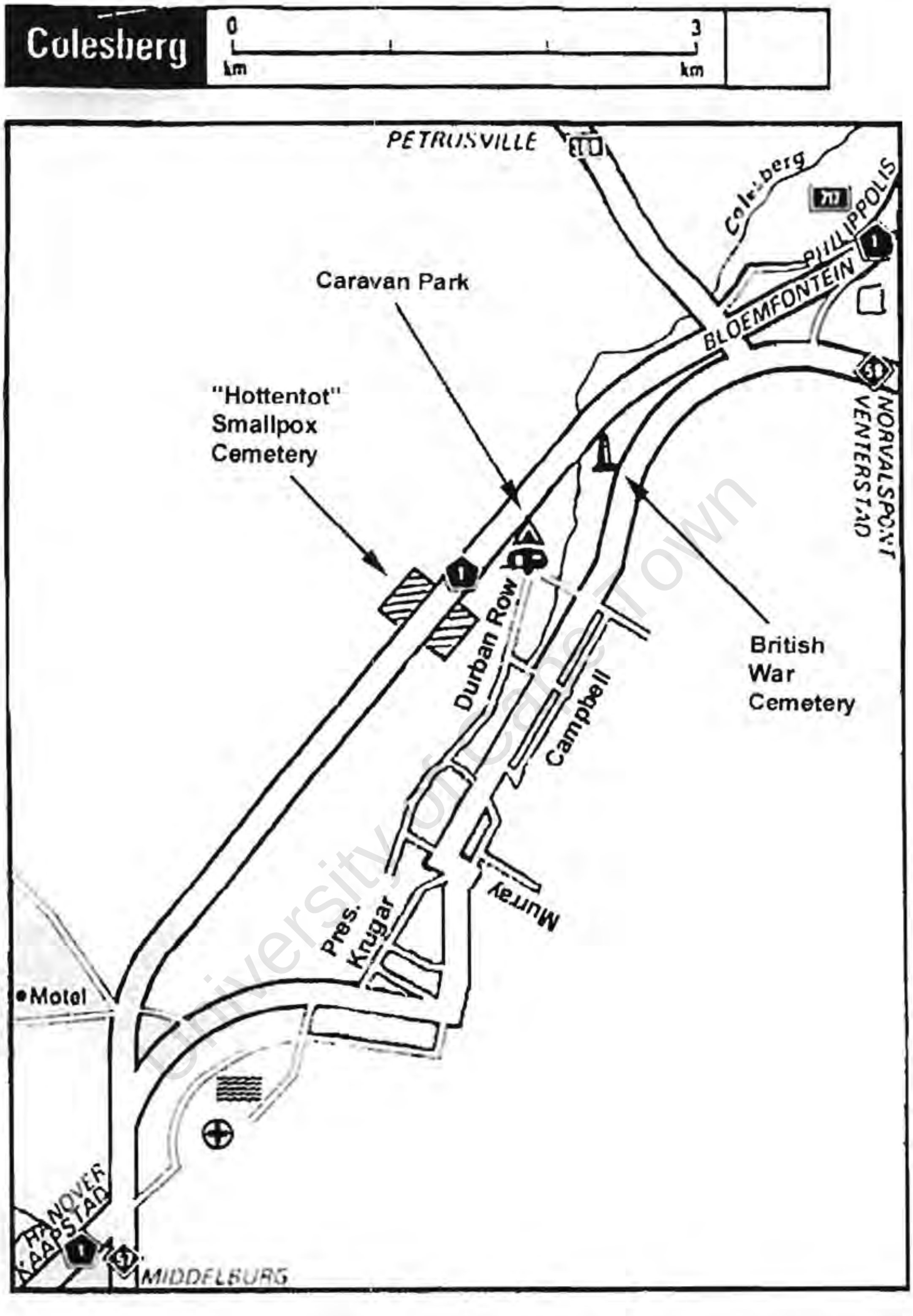

Figure 3.15 : Colesberg – Location of smallpox cemetery (Modified from De Jongh 2001)

types...Hottentot blood...and European blood" (Slome 1929:59). They determined the ethnicity of these individuals based on biological measurements. They did not present historical data about whom these people may have been. They present no discussion about who was living in Colesberg during this time and their professions. The methods employed by these two researchers assumed biology was the sole identifier of ethnicity, an approach now considered to be naïve and archaic.

There was an array of cultural material discovered with the skeletons. These included: iron bangles, glass beads, brass buckles, buttons, pins, traces of blankets (cloth), and leather belts. In one grave the excavator found an 1826 George IV shilling. The cultural material present during the June 1999 data collection included coffin handles, copper bracelets, a copper and leather buckle, copper finger rings, and preserved (desiccated) skin on a human hand (Figure 3.16).

The Colesberg remains are housed at the South African Museum in Cape Town. The site is located in the Nama-Karoo biome of the Northern Cape province.

There are 52 individuals present, one infant, five juveniles, 25 adult males and 21 adult females. An estimation of sex is not possible for 6 individuals due to the fragmentary nature and/or the young age of the skeletons. The age at death ranges from less than five to 50+ years. The majority of the skeletons are either nearly complete or incomplete. The preservation of the skeletons ranges from poor to excellent; the postcranial and cranial remains are mostly in very good condition.

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3.1.2.2 WOLMARANSSTAD

There are no burial styles or absolute dates for these individuals but they are identified as a "cemetery of local African farm workers" (Hoffman 1942). There is one unpublished expedition report, National Museum of Bloemfontein Report number 115 (15 April 1942) associated with these individuals. All of the skeletons were excavated by A.C. Hoffman in 1942.

The aim of the 1942 expedition to Wolmaransstad was "to excavate Bantu graves on the [Karreeboom] farm". The owner of the farm asked permission from the National Museum, Bloemfontein to excavate the graves so that he could work the soil. He received many complaints from Zabantu labourers in the area because they claimed that some of the graves belonged to their people. The farmer's son contacted the magistrate and was told not to remove the more recent graves. According to Hoffman

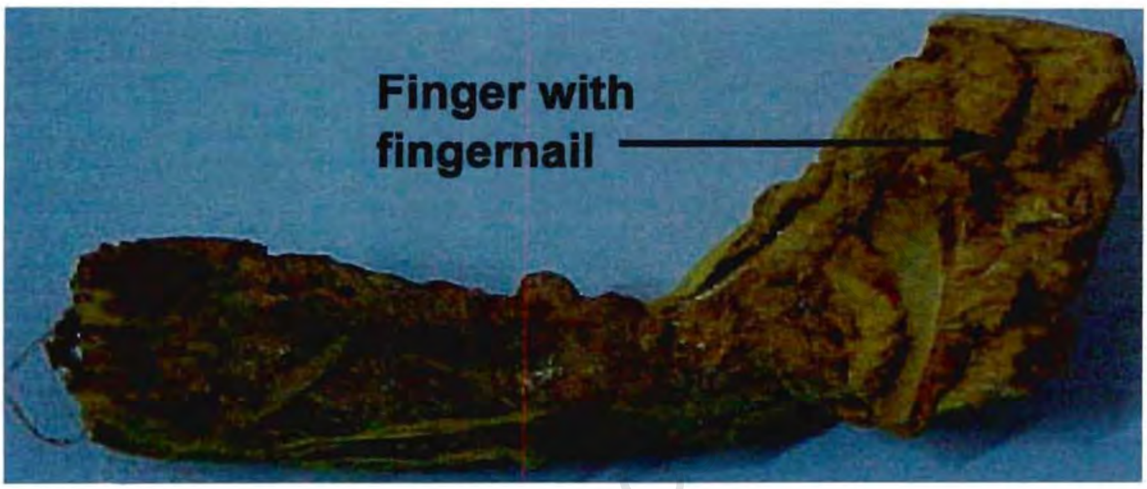

Figure 3.16 : Colesberg/SAM4329 – Desiccated skin on hand

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(1942) a large contingent of Zabantu labourers arrived on the farm to mark their ancestral burials, which would not be disturbed. There were 76 graves excavated, as Hoffman wanted a "good collection of Bantu skulls". Most of the skeletons were in very poor condition but there were 30+ skulls in which preservation was very good. By the end of the excursion approximately four complete skeletons, 26 incomplete skeletons, and more than 30 skulls were exhumed (Hoffman 1942).

The 76 graves that were eventually excavated were probably also of indigenous peoples. Before the arrival of the missionaries this area was inhabited by the Sotho-Tswana people who were pastoralists; they kept livestock and grew corn (Maggs 1976). It is very unlikely that Zabantu peoples and frontiersmen of other ethnicities, especially European missionaries who were there to 'civilise the savages', would be buried together. These graves were possibly so old that no living relative remembered them.

Thomas Hodgson and his companion, Samuel Broadbent (Wesleyan missionaries) built houses at Matlwase, just north of Wolmaransstad , in 1823. The remains of these structures were excavated by Mason and his crew in the late 1960's. The archaeological dating of these two dwellings, based on cultural material and radiocarbon dates, is consistent with the historical date of AD 1825; gunflint relates the site to a date prior to the mid 19th century when cartridge based guns were used in the South Africa interior (Mason 1986:869).

Two male individuals display pipe smoker's wear, Wolmaransstad/NMB18 and Wolmaransstad/NMB1313a (Figure 3.06). The wear pattern present is more oval than round. This lends evidence for the use of an ebonite mouthpiece commonly attached to briar wood pipes after World War I, August 1914 to November 1918 (Figure 3.07) (Dunhill 1969; Morris 1984; www.encarta.msn.com). Since briar shrubs only grow in France and other Mediterranean countries, the pipe is not originally from South Africa (Herment 1954). All of this information is critical because it lends evidence for a 20th century date, after 1918, for at least two individuals at Wolmaransstad. However the gravesite could be slightly older as some of the graves were excavated because no one could identify them as relatives. It is possible that the graves that were excavated at Wolmaransstad were from the early 20th century and the individuals buried in them had no living relatives in 1942.

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There is no cultural material associated with the Wolmaransstad skeletal remains, which are housed at the Florisbad Research Station. This site is located in the Grassland biome of the North West province.

There are 39 individuals, 23 crania and 39 with postcranial remains, represented in the sample used for this study: 30 males, six females, two unsexed sub-adults, and one infant. It is unknown why there are seven less skulls in the Wolmaransstad sample housed at the NMB (n = 23) than reportedly excavated from the farm at Karreeboom (n = 30). There are 39 individuals with postcranial remains from Wolmaransstad housed at the NMB but the 1942 report cites only 30 postcranial skeletal remains excavated (26 incomplete and 4 complete). The reason for this discrepancy is unknown. The estimated age at death ranges from less than five years to 55 years old. The majority of the remains are incomplete. The preservation of the skeletons ranges from poor to excellent; the preservation of the majority of the cranial and postcranial remains is excellent.

3.1.3 Summary

For purposes of analyses, five of the sites in this project, Bethulie, Campbell, Danielskuil, de Tuin and Philippolis, have been combined into one sample called 'Griqua sites', since there were too few individuals per site for accurate statistical analyses. More importantly, all of these five sites share a similar historic, cultural, and economic profile, as they are all associated with the Griqua and Bastaard communities of the 18th and 19th centuries. In the Griqua sites there are 135 individuals: 37 infants, 18 juveniles, 43 males, 31 females and six unsexed adults. The combination of these five sites is defined by cultural similarities and not related to biology.

The two Voortrekker sites, Colesberg and Wolmaransstad, have not been combined into one site as they represent two distinctly different cultural and economic groups, Khoe and Zabantu respectively. Their historical experiences are not shared. The 'Coloured' labourers in Colesberg lived on the edge of the town in family-based communities, i.e. men, women, and children all residing together in an area of proximity. Their income probably afforded them a few 'luxuries', e.g. white bread. However, this was quite different from the individuals residing at Wolmaransstad. The majority of the Zabantu labourers at Wolmaransstad were men living on the farm far away from their family units. The 'hut tax' of the early 1890's forced Zabantu residents to earn cash to buy food and to do so the men had to leave their homes to

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search for employment on local farms. Eventually the indigenous peoples were paying rent to absentee landowners. The Natives Land Act of 1913 stated that Zabantu people could only continue to occupy tenancy on these farms as a condition of labour service (Phillips *et al.* 1996). In effect it allowed the land owners to profit from the cheap labour of indigenous communities. The separation of the Colesberg and Wolmaransstad individuals into two separate sites is delineated by culture and not related to biology.

The ecosystems in which these communities reside are also a distinguishing feature for determining lifestyle patterning of these people. The Griqua sites are located within the Savanna and Nama-Karoo biomes: Campbell and Danielskuil are in the Savanna biome, Philippolis, Bethulie and De Tuin are in the Nama-Karoo biome. The two voortrekker sites, Colesberg and Wolmaransstad, are situated in the Nama-Karoo and Grassland biomes respectively.

The Bastaard and Griqua stations are all located within the Savanna and Nama-Karoo regions. Generally the Nama-Karoo is not an ideal environment for raising livestock other than sheep, e.g. Philippolis and Bethulie, however the Savanna biome, i.e. Campbell and Danielskuil, and the Western part of the Nama-Karoo, i.e. de Tuin, provide good grazing opportunities for larger stock. An analysis of the historical and ecological descriptions of these communities suggests that these people were pastoralists, growing gardens and hunting animals. This is a very different way of life compared to the Voortrekker communities of Colesberg and Wolmaransstad.

The Nama-Karoo biome is not an ideal place for farming, yet historical records indicate that some of the farming families outside of Colesberg owned houses in the town that were used during Nagmaal. Nagmaal was a very important celebration in the *trekboer* community. Every two months, for one weekend, family and friends would gather in Colesberg and celebrate weddings, Christenings and baptisms. For a farmer to own two separate dwellings, one of which was only used for 3 days every two months, his harvest must have been quite substantial. However, farmers were not the only people living around Colesberg. In 1814 a mission station was set up, in present day Colesberg, to Christianise the large population of Bushmen. By the 1830's the mission station grew into a town that acted as the business and social centre for the nearby rural communities.

Drury's (1926) description of the burials, two skeletons in one grave, placed in irregular lines, cairns on top of graves, extended on back position, coffin wood and nails, illustrates a combination of traditional and Christian belief systems. The location of the smallpox cemetery outside the town, rather

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than in a church cemetery within the town, possibly indicates less affluent, non-congregational individuals such as the 'Christianised' Bushmen. This information combined with the historical data suggests that the individuals found in these graves were probably pastoralists, 'poor' people, living on the margins of society.

The second Voortrekker town, Wolmaransstad, is located in the grassland biome in the southern Highveld region. This area is described as sparse grassveld with low nutritional content in winter. With rainfall around 500mm per annum and essentially sandy soils this must have been a marginal area for historic populations (Maggs 1976). Maggs (1976) also gives detailed historic information about the lifestyles of the traditional populations, Sotho-Tswana, living in this area. Men were associated with animals and livestock pens while women were responsible for cultivation, storing the harvest and preparing food. Their largest agricultural product was grain (Maggs 1976). By 1876 the town of Wolmaransstad was formed and agriculture was its main income. This area became known as the 'mealie basket' of the country (Maggs 1976). The historic and ecological information suggests that the people buried at this cemetery were Zabantu, from Sotho-Tswana communities, who were eventually colonised and reduced to farm labourers for the benefit of the Colonial farm owners.

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CHAPTER 4

METHODS

There are a number of techniques used to analyse the data collected for this research. No one methodology is solely relied upon and a wide range of techniques has been applied. The basis for ageing and sexing has been the Buikstra and Ubelaker 1994 text, but other reference guides have been used when greater depth of observation has been required. These are specifically referenced below. Whenever possible, both qualitative and quantitative approaches are combined in order to best assess population variability. The areas of investigation include:

- Preservation and condition of skeletal remains
- Estimation of sex
- Estimation of age at death
- Standardisation of measurements
- Radiography
- Estimation of muscularity
- Disease and disease processes observed in the human skeleton
- Detection of smallpox virus using PCR technique
- Statistical methods

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4.1 PRESERVATION AND CONDITION OF SKELETAL REMAINS

The preservation and condition, or completeness, of each skeleton examined for this study is recorded. The cranial and postcranial remains are recorded separately. When both left and right bones are present, measurements are recorded on the left side. The right bone is used only when the left bone is absent or not measurable (Buikstra & Ubelaker 1994). Measurements are not taken if the bones are fragmented or distorted. The preservation is recorded as follows:

- Excellent: minimal or no damage to skeleton, no reconstruction is required.
- Very good: slight damage to skeleton, and/or minimal reconstruction required.
- Good: moderate damage to skeleton, and/or moderate reconstruction is required.

- Poor: heavy fragmentation, many fragmented pieces that cannot be identified, reconstruction is not possible.

The condition of each skeleton is recorded as follows:

- Complete skeleton, 100% complete.
- Nearly complete skeleton, 50% to 99% complete.
- Incomplete skeleton, less than 50% complete.

Dental observations are also recorded. Each tooth of each individual is recorded based on the following categories:

- Absent
- Absent/bone absent (maxillary or mandibular bone absent)
- Absent/socket broken
- Absent/socket resorbed
- Present
- Present/bone absent
- Present/socket broken
- Present/erupting
- Present/root only
- Unerupted

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4.2 ESTIMATION OF SEX

The estimation of sex employs analyses of both the pelvis and crania. Since it is difficult to sex juvenile skeletons, these methods are only used on morphologically adult skeletons; skeletons where most of the epiphyses are united and long bone growth is complete, and landmarks for sexing the skeleton have developed (Buikstra & Ubelaker 1994; Ortner & Putschar 1985). Morphological adulthood is generally reached at about 18 years of age. The most accurate method for estimating the sex of an individual is by analysis of the pelvis. The most commonly used technique, the Phenice method, was published by T.W. Phenice (1969) and is still considered the "most accurate method yet known" (White 1991:323). Ubelaker (1978) claims it to have a 96% accuracy rate.

The Phenice method employs three readily observable characteristics of the pelvis; the ventral arc of the pubic symphysis, the sub-pubic concavity of the ventral pubic ramus, and the medial aspect of the ischio-pubic ramus. The advantage of this technique is that only a small portion of the pelvis need be present to determine the sex of the individual (Figure 4.01).

Ferembach *et al.* (1980) have shown that a sub-pubic angle of over 90 degrees indicates a female. Houghton (1974) demonstrates that the pre-auricular sulcus, recognised as a discrete trait, is more commonly found in females than males.

The greater sciatic notch also shows sexual dimorphism, tending to be broader in females (L-shaped) and narrower in males (J-shaped) (Buikstra & Ubelaker 1994; Milner 1992), however, it is not as reliable an indicator of sex as the sub-pubic region. The scoring system employed is based on the diagram presented in Buikstra & Ubelaker (1994) (Figure 4.02) where '1' is a typical female and '5' a typical male. To determine the sex of the skeletal remains, the straight anterior portion of the notch that terminates at the ischial spine is aligned with the right side of the diagram and the bone is moved until the closest match is achieved. Any exostoses that may be present near the preauricular sulcus and the inferior posterior iliac spine are ignored.

Although males tend to have larger, more robust skulls than females, individuals vary between and within different populations. Estimation of sex based solely on observed cranial dimorphism is not the most accurate method of identification but is sometimes the only method available. This project utilises a scoring system, for estimating sex based on cranial features, derived from Acsádi and Nemeskéri (1970) which emphasises five aspects of skull morphology: the nuchal crest, mastoid process, supra-orbital margin, supra-orbital ridge, and mental eminence (Figure 4.03). A typical female skull is represented by a score of '1' and a typical male skull by a score of '5'.

Loth and Henneberg (1996) assert that the presence or absence of flexure on the mandible is a highly reliable method for sex estimation in adult human skeletal remains. Although Loth and Henneberg (1996:483) state that no one morphologic trait should be relied upon as an accurate assessment of sex, they cite 94.2% overall accuracy rate even when applied to "fragmented mandibles from historic archaeological finds, rare fossil hominids, and modern forensic cases" (Loth and Henneberg 1996:483). However, many researchers question the reliability of this method (Donnelly *et al.* 1998; Haun 2000; Hill 2000). Haun (2000) tested this method on mandibles from the Tepe Hissar collection and reported a far

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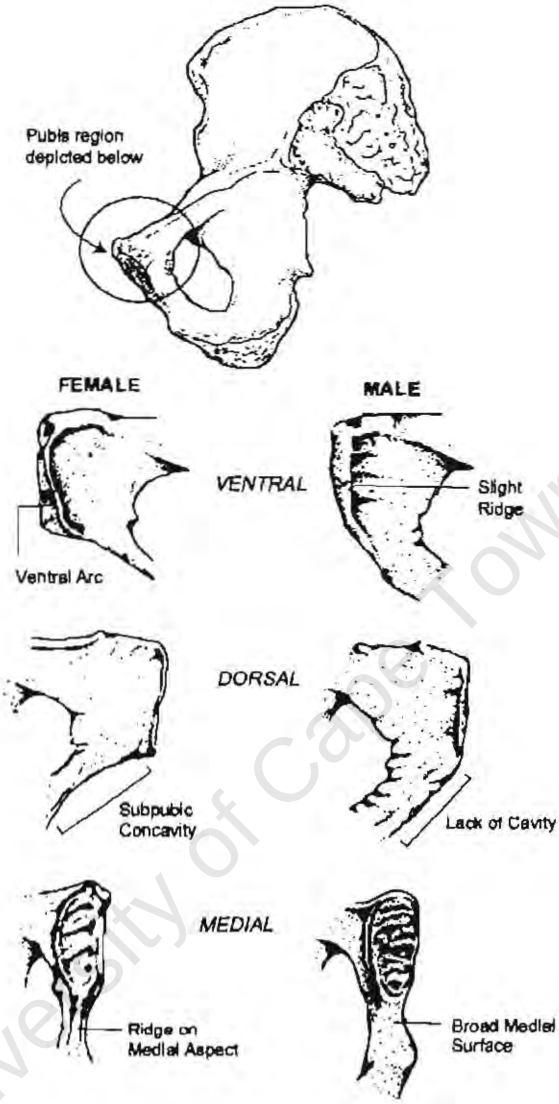

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Figure 4.01 : Estimation of sex from the pubic symphysis
(Buikstra and Ubelaker 1994:17)

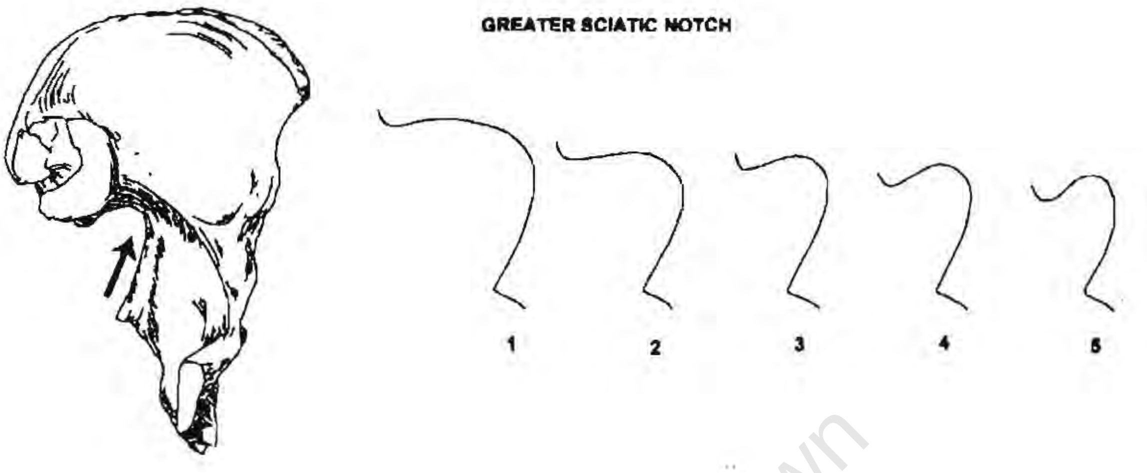

Figure 4.02 : Estimation of sex from the sciatic notch (Buikstra and Ubelaker 1994:18)

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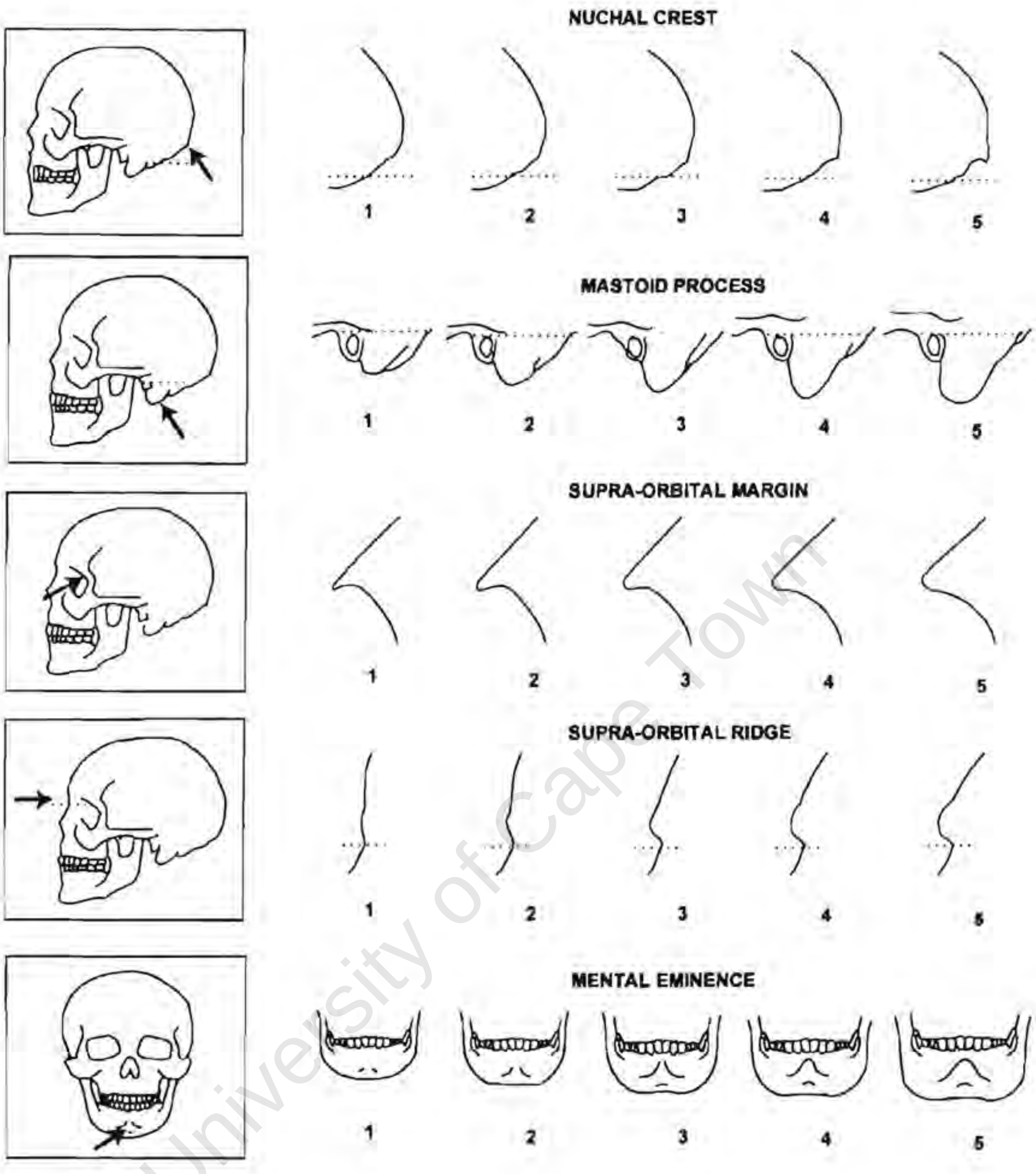

Figure 4.03 : Estimation of sex from the skull (Buikstra and Ubelaker 1994:20)

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lower accuracy rate (67.2%) than did Loth and Henneberg (1996). Hill (2000) employed mandibular flexure to test for sexual dimorphism in 158 individuals from the Hammn-Todd collection. She found an overall predictive accuracy of only 63-69%, well below that reported by Loth and Henneberg (1996). Donnelly *et al.* (1998) performed a blind test of mandibular ramus flexure and cited only 62.5% of the mandibles were correctly sexed. Donnelly *et al.* (1998:363) assert that the "association between ramus and flexure is weak, the predictive accuracy of Loth and Henneberg's (1996) method is better than chance for only one sex, males, and the method is based on a trait that cannot be reliably or consistently identified". Since the mandibular ramus flexure technique proves unreliable for sexing human skeletons, especially fragmented individuals, it will not be employed for this project.

The long bones can also be employed as indicators of sex in adult skeletons. Asala (2001) has illustrated a sex difference in the diameters of the femoral heads in South African Whites and 'Blacks'. Although he does comment on the usefulness of this methodology he also cautions that data from one biological grouping is not necessarily applicable to others. Since this thesis does not attempt to 'classify' individuals into biological groupings this methodology will only be relied upon when no other methods are available.

4.3 Estimation of Age at Death

Six methodologies are employed for the estimation of age at death.

- Dental calcification and eruption of permanent and deciduous dentition
- Diaphyseal and epiphyseal union of immature remains
- Age related changes in the pubic symphysis
- Age related changes in the auricular surface
- Age related changes in cranial sutures

One of the most accurate indicators of age at death, especially in sub adults and infants, is dental calcification and eruption. Ubelaker (1978) adapted and formalised earlier dental techniques for establishing the age at death in Native American populations of individuals between five months in utero to 35 years. His methodology includes patterning dental calcification, crown completion, tooth eruption, and root completion for both the deciduous and permanent teeth. Ubelaker's dental development

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standards for infants have a standard deviation of three months (Figure 4.04). However, Kotze *et al.* (1986) reported that the permanent teeth of Zabantu children erupt sooner than those of South African 'Coloureds', Europeans, and Indians. Since the identification of deciduous teeth is difficult this project utilises van Beek's (1983) illustrative guide to accurately record the deciduous dentition present.

Diaphyseal-epiphyseal union is useful for estimating the age at death for immature remains. Different bones unite at different ages during an individual's lifetime. Therefore, an estimation of age at death can be determined by analysing these unions. This technique is only useful until the age of approximately 32 years; this is approximately the age when the medial end of the clavicle fuses. After this time, epiphyseal union is complete and all bones have reached their maximum length (Figure 4.05) (Buikstra & Ubelaker 1994; Krogman & Iscan 1986; McKern & Stewart 1957; Redfield 1970; Suchey *et al.* 1984).

Osteological changes in the pubic symphyseal face present criteria for estimating age at death in adult remains. This technique was first developed by Todd in 1920. Many researchers have improved upon his methodology to include both males and females as well as (American) 'Blacks' and Whites (Brooks 1955; Brooks & Suchey 1990; Gilbert & McKern 1973; Katz & Suchey 1989; McKern & Stewart 1957). However, some cautionary notes regarding the estimation of age from the pubic symphysis must be cited. Sinha and Gupta (1995) employed Todd's (1927) method and observed significant differences in the mean age for phases II, III, VI-X for their sample of males from India. Hoppa (2000) utilised the Suchey-Brooks method on an historic skeletal sample of known ages. He found that the female skeletons in his sample showed statistically significant differences, when compared to the Suchey-Brooks casts, after about 30 years of age. Suchey and co-workers (1979) and Putschar (1976) also reported a greater variability in female pubic morphology and attributed it to reproductive changes in hormonal levels and the trauma associated with childbearing. Although there are problems associated with the estimation of age from the pubic symphysis it is still a viable method when used in combination with other aging techniques. Therefore, the Suchey-Brooks technique was employed for two reasons: it is the most reliable method to date (Brooks & Suchey 1990; Buikstra & Ubelaker 1994) and known-age casts were available for comparative purposes.

The auricular surface of the os coxae is also effective for estimating the age at death for adult skeletal remains. It is only reliable for individuals older than 19 years and younger than 60 years. This

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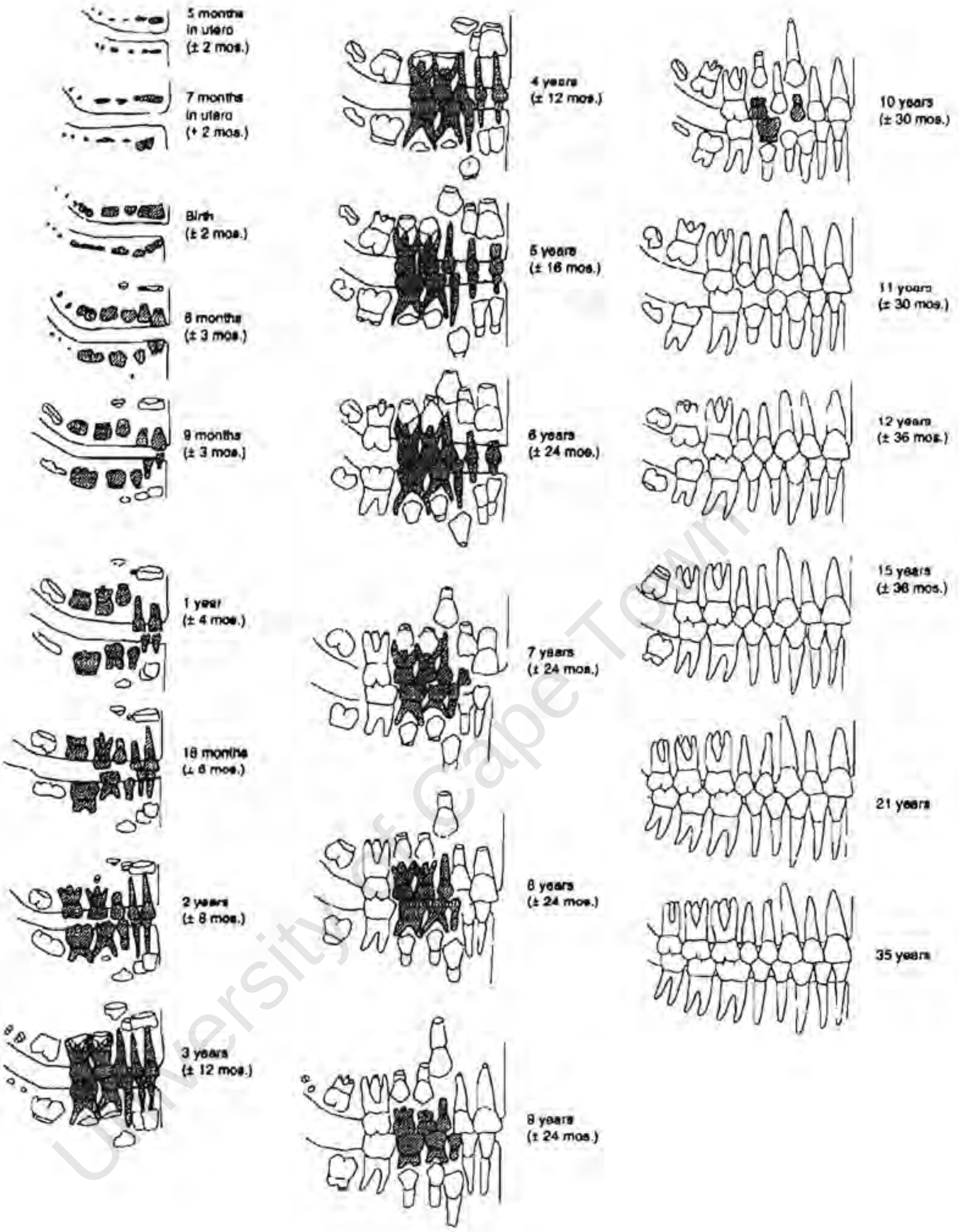

Figure 4.04 : Estimation of age – Tooth formation and eruption among Native Americans (Buikstra and Ubelaker 1994:51)

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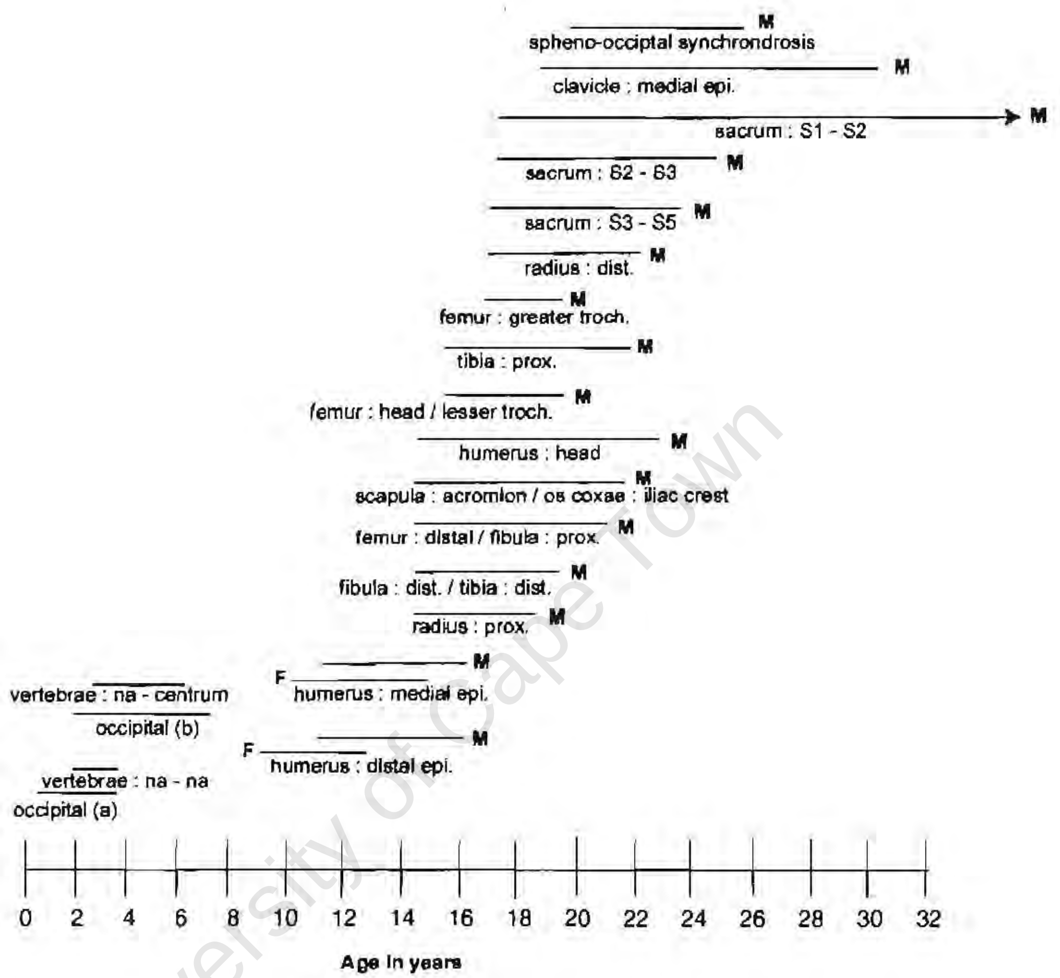

Figure 4.05 : Estimation of age from epiphyseal union; M – males, F – females (Buikstra and Ubelaker 1994:43)

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methodology is slightly more difficult to employ than the one used for the pubic symphysis, but since the auricular surface is more often preserved in archaeological contexts, it becomes quite useful to the researcher (Lovejoy *et al.* 1985; Meindl & Lovejoy 1989).

Cranial sutures generally fuse with advancing age, but this is extremely variable. Therefore, the value of this methodology is reduced (Masset 1989) and can only be valuable when used in conjunction with other techniques (Acsádi & Nemeskéri 1970; Meindl & Lovejoy 1985).

Iscan and Loth (Iscan & Loth 1986a, 1986b, 1986c; Loth & Iscan 1987, 1989) have developed a technique to estimate an individual's age at death from the sternal extremity of the fourth rib. Oettlé (1998) improved upon the technique by Iscan and Loth by developing standards for South African Zabantu populations. However, the rib method is difficult to use in archaeological contexts where fragmented or incomplete sets of ribs are common (Buikstra & Ubelaker 1994). Therefore this technique is not used in this project.

4.3.1 Age Categories

Age categories, as well as more defined ages, are determined for each individual. Age categories are utilised for comparative purposes because trends between groups of individuals, i.e. younger and older individuals, is important and not differences between specific ages. For comparative purposes this project utilises similar age categories as presented in Morris (1984): infant (birth to 5 years), juvenile (5.1 to 15 years), sub-adult (15.1 to 20 years), younger adult (20.1 to 40 years), older adult (40.1+ years). The reason for the adult age category beginning at 20.1 years is based on the average age of complete fusion for the long bones (Buikstra & Ubelaker 1994); once the long bones have completed epiphyseal fusion they no longer grow in length. Although the humerus, radius and tibia may continue to grow until approximately the age of 25, the additional length is very minimal; significant growth has stopped in most individuals by the age of 18 years (Ortner & Putschar 1985). By about the fourth decade of life the onset of normal degenerative processes begins and hence the separation at 40.1 years for older adults in this project (Aufderheide & Rodriguez-Martin 1998).

One additional age category is created for this project, namely mature individuals (MI). Mature individuals are osteologically adult but can not be aged precisely, e.g. 35+ years old, due to absent or damaged skeletal remains; these individuals can not be placed in either the younger adult or older adult

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age category. The MI category is only analysed when the adult categories of younger and older individuals are combined as a single adult cluster.

These age categories are based on the relationship between skeletal changes and chronological age. The skeletal changes include, epiphyseal union, fusion of primary ossification centers, dental formation and eruption, and morphological changes in bone with increasing age (e.g. pubic symphysis).

4.4 Standardisation of Measurements

Either the maximum (measured for adult individuals) or diaphyseal (measured for immature individuals) length of the four long bones most commonly reported by researchers is measured for this project: humerus, radius, femur, and tibia. Both the left and right bones are measured and recorded. All infant, juvenile and adult long bones are measured using an osteometric board as described in Buikstra and Ubelaker (1994). All bone measurements are recorded to the nearest millimetre. The child age categories are divided into intervals of five years in order to facilitate comparisons between and within sites. The bones were measured as follows:

1. Humerus
   - Diaphyseal length: maximum length of diaphysis.
   - Maximum length: direct distance from the most superior point on the head of the humerus to the most inferior point on the trochlea. Humerus shaft should be positioned parallel to the long axis of the osteometric board.
2. Radius
   - Diaphyseal length: maximum length of diaphysis.
   - Maximum length: distance from the most proximally positioned point on the head of the radius to the tip of the styloid process without regard for the long axis of the bone.
3. Femur
   - Diaphyseal length: maximum length of diaphysis.
   - Maximum length: distance from the most superior point on the head of the femur to the most inferior point on the distal condyles. Place the medial condyle against the vertical endboard while applying the moveable upright to the femoral head.

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4. Tibia

- Diaphyseal length: maximum length of diaphysis.
- Maximum length: distance from the superior articular surface of the lateral condyle to the tip of the medial malleolus. Place the tibia on the board, resting on its posterior surface with the longitudinal axis parallel to the instrument. Place the lip of the medial malleolus on the vertical endboard and press the moveable upright against the proximal articular surface of the lateral condyle.

4.5 Radiography

Radiographs were utilised to estimate the age of formation of Harris lines. Harris lines are radiopaque lines and bands of increased density that parallel the growing surfaces of round bones, tubular bones, and epiphyses (Harris 1933). These lines are often associated with episodes of disease in childhood and possibly adolescence (Acheson 1959; Clarke 1982; Schwager 1968). However, this explanation is limited as a new line may appear even though no disease has been reported in the previous six months. Also, the presence of Harris lines in an adult population does not conclusively point to a rugged childhood (Gray 1967). New lines on round bones and epiphyses have been shown in large numbers of therapeutic situations, e.g. following testosterone therapy, therapy for pituitary growth failure, and following realimentation of patients having protein calorie malnutrition (kwashiorkor) (Garn *et al.* 1968). Lines and bands have also been related to hypervitaminosis D, lead poisoning, and phosphorus poisoning (Garn *et al.* 1968). Harris lines are a sign of growth arrest but not related to any specific event.

Both the left and right tibiae of each individual, when available, were x-rayed. The tibia was utilised since it is the most commonly affected bone for Harris line formation (Aufderheide & Rodriguez-Martin 1998). The age of the individual at the time of Harris line formation was calculated using the Byers (1991) technique. Byers presents formulae for calculating the percent of mature bone length at time of radiopaque formation for the humerus, radius, femur and tibia. Only two values are needed to use these formulae, the total length from the proximal to the distal end of the bone, parallel to the long axis of the bone, and the distance from the transverse line to the closest end, parallel to the long axis (Byers 1991). The distance between the lines is measured utilising callipers and all measurements are recorded in millimetres. The answer, a percentage, corresponds to an age of line formation that is presented in

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tables in Byers (1991) article. According to Byers (1991:340), although these data are derived from modern populations they should be utilised with archaeological remains because "chronologies based on prehistoric populations would be incomplete due to deficiencies in sample sizes".

The individuals housed at the National Museum of Bloemfontein (Bethulie, Danielskuil, Philippolis, and Wolmaransstad) were radiographed at the Department of Radiology, University of the Free State. The x-ray unit employed was a Philips Optimus 80 (output 80 Kilovolts) with Agfa CP-G plus Orthocromatic double sided film. The skeletal material from de Tuin was radiographed at the Department of Radiology, University of Cape Town. The radiography equipment included a Gafmed Fast Screen and Medmark standard radiographic film. The Campbell skeletons were radiographed at the Animal Unit, University of the Witwatersrand Medical School, Johannesburg, using a Siemans Siregraph C radiograph machine and Konika AX film. The Colesberg skeletal remains were radiographed using the LODOX digital x-ray imaging machine at Groote Schuur Hospital, Cape Town.

The LODOX machine uses new technology that combines low dose radiation with computer generated x-rays. The LODOX programme enables the researcher to select the anatomical feature to be taken, e.g. long bones, or skull, etc, and the correct exposure value associated with a radiograph for that specific bone is already programmed into the machine. The radiograph is then stored on a digital database and viewed on a large monitor. One of the advantages of this machine is that the researcher can adjust the contrast of the x-ray so that minute details of the bone can be observed, e.g. Harris lines, and therefore only one radiograph has to be taken.

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4.6 Estimation of Muscularity

Robb (1994) developed written standards for coding muscle attachments on archaeological skeletons to infer activity patterns. He examined 56 adults from the Iron Age cemetery of Pontecagnano in Italy. Forty-two muscle attachment sites were recorded for the left and right side, each with six categories or grades from 0 to 5.

The present study utilises only ten sites of muscle attachment, eight from the humerus – subscapularis, supraspinatus/infraspinatus, pectoralis major, latissimus dorsi, anterior deltoid tuberosity, lateral deltoid tuberosity, common extensors, common flexors – and two from the tibia – patellar ligament and soleus. The reason for choosing these specific muscle sites is to compare the results from this research to those of Ledger (1997) who also concentrates only on the humerus and tibia for his project. Both the left and right sides are recorded but, as in Robb (1994), only the right side is utilised for analyses. Models for each category of entheseal development were selected from cadaver bones at the University of Cape Town osteology teaching collection. These illustrative standards (Figures 4.06 to 4.24) correspond to the written standards of Robb (1994). The present author compared the enthesis models to 50 cadaver skeletons housed in the Anatomy Department, University of Cape Town, in order to reduce intra-observer error.

Of the eight muscle attachment sites on the humerus, four were located on the head of the humerus, two on the shaft, and two on the distal end. The subscapularis enthesis is located on the lesser tuberosity of the humerus (Figures 4.06 & 4.07). The supraspinatus and infraspinatus entheses are found on the greater tuberosity of the humerus (Figures 4.08 & 4.09). The pectoralis major enthesis is located on the lateral lip of the bicipital groove and the latissimus dorsi enthesis on the floor of the bicipital groove (Figures 4.10 to 4.12). The deltoid tuberosity has two entheseal markings, one on the anterior edge and one on the lateral edge (Figures 4.13 to 4.16). The entheseal marking for the common extensors is located on the lateral epicondyle and the common flexors on the medial epicondyle (Figures 4.17 to 4.20). The two analysed muscle sites on the tibia are the patellar ligament insertion (quadriceps muscle) on the tibial tuberosity, and the soleus muscle insertion on the posterior shaft of the tibia (Figures 4.21 to 4.24). Theoretically, individuals who are continuously involved with lifting loads e.g. farm labourers would have more robust muscle markings than e.g. hunter-gatherers who, since they walk greater distances, would have more robust markings on their leg muscles (Churchill & Morris 1998).

A recent study (Sanders 2001) has shown that the detailed morphoscopic observations involved with Robb's scores should be combined with beam analyses in order to gain a better understanding of how bone remodelling occurs due to specific activities. Since beam analysis is beyond the scope of this project the entheses are analysed as a group of muscles and not as separate entities affecting the robusticity of either the arms or legs. The conclusions drawn from this methodology will therefore be of a more general nature and hopefully will reflect signs of overall lifestyle activity rather than precise occupations.

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Subscapularis Enthesis:

- Grade 1: No marking.
- Grade 2: Poorly defined facet lacking one of more margins; surface is smooth.
- Grade 3: Facet is defined clearly on all sides; surface is smooth.
- Grade 4: Facet is well defined on all sides, sometimes by slightly raised rim of courser-textured bone; surface is finely textured or rugose.
- Grade 5: Rim shows osteophytes, particularly on lateral margin; and/or surface shows destruction, particularly near medial margin, with extensive pitting.

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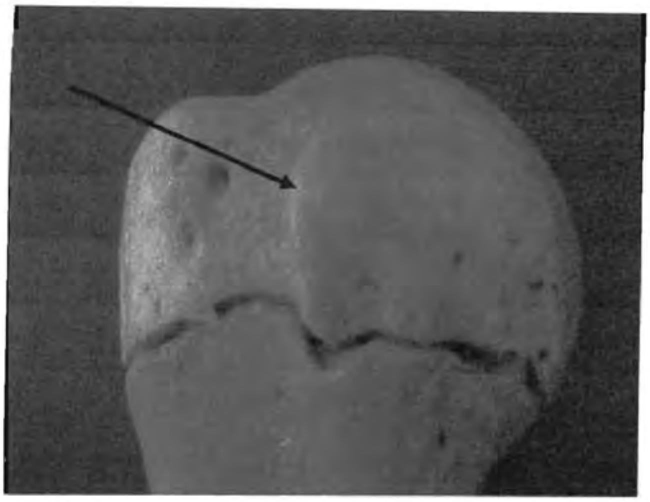
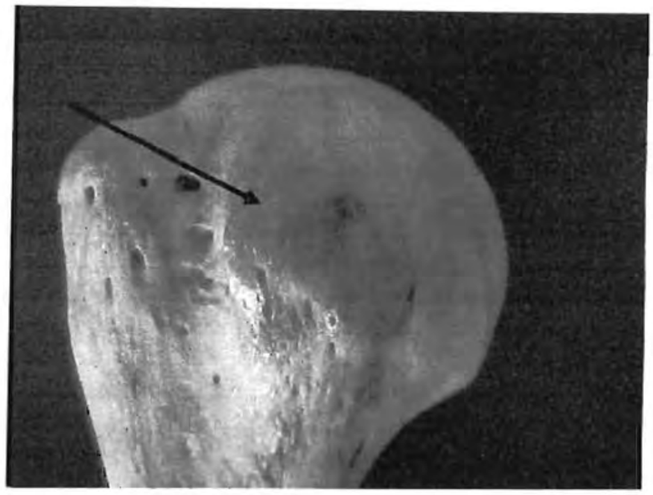
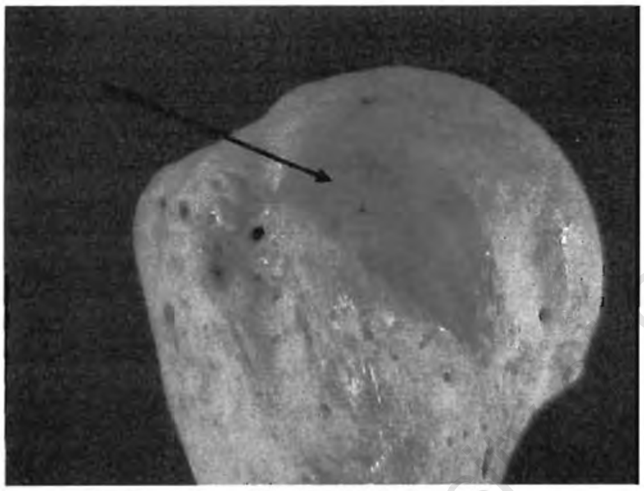
Figure 4.06: Robb's scores for the subscapularis enthesis (Robb 1994)



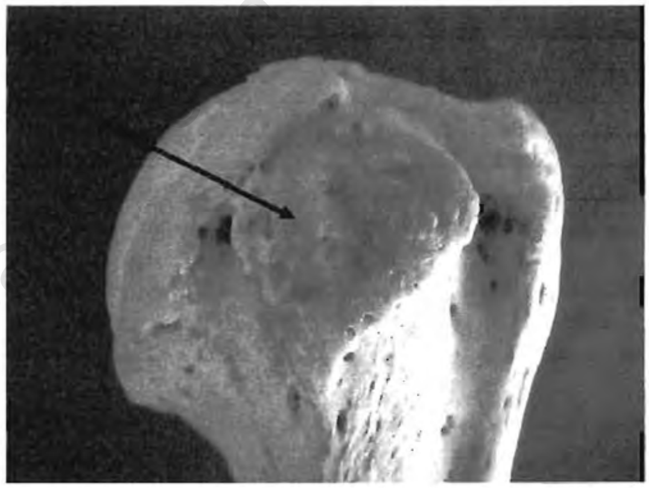
Grade 1



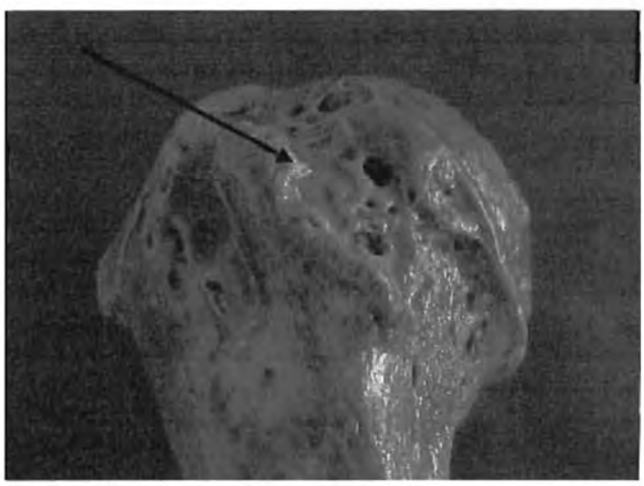
Grade 2



Grade 3



Grade 4



Grade 5

Figure 4.07 : Estimation of muscularity – **Subscapularis**

Supraspinatus/Infraspinatus Entheses:

- Grade 1: No marking.
- Grade 2: Poorly defined facet lacking one of more margins; surface is smooth. No clear boundary either of a muscle marking or a sharp line of relief, is visible between facets for supraspinatus and infraspinatus.
- Grade 3: Facet is defined clearly on all sides; surface is smooth.
- Grade 4: Facet is well defined on all sides, except the bottom, where the border with infraspinatus may again be indistinct; border may consist of a slightly raised rim of courser-textured bone. Surface is rougher, with a finely fibrous or rugose texture.
- Grade 5: Rim shows osteophytes, particularly on lateral margin; and/or surface shows destruction, particularly near medial margin, with extensive pitting.

Figure 4.08: Robb's scores for the supraspinatus/infraspinatus entheses (Robb 1994)

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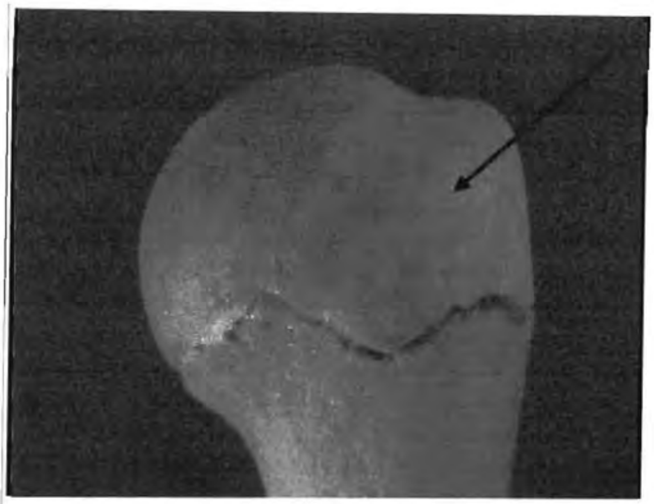
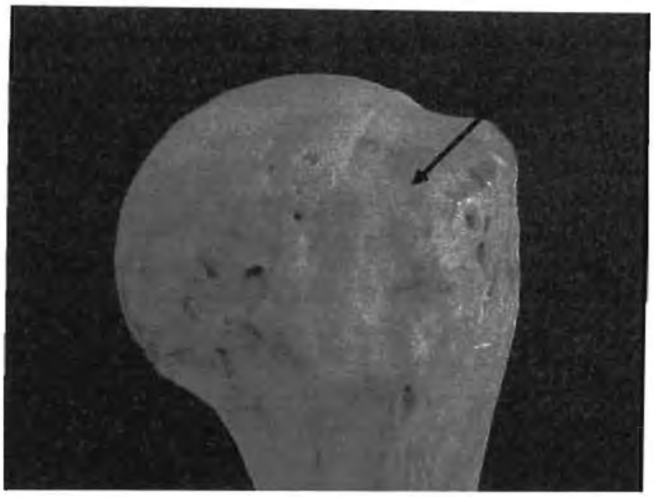
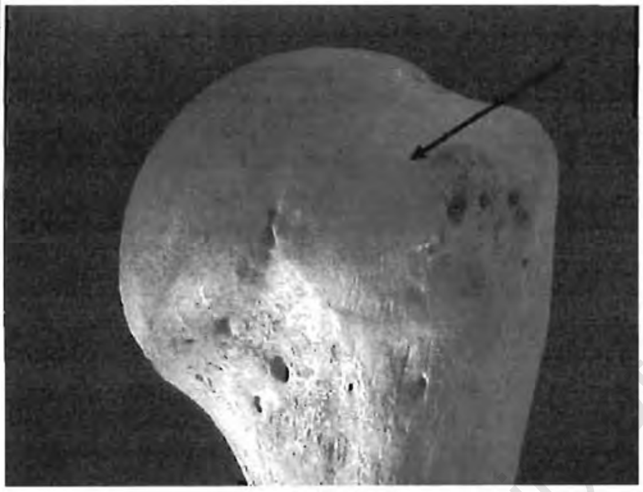


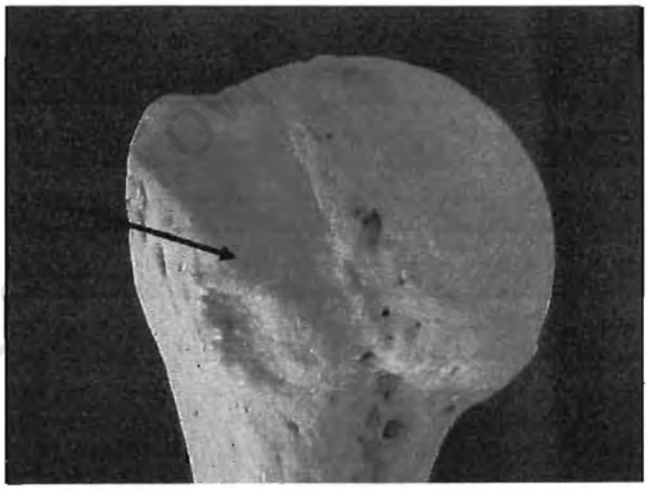
Grade 1



Grade 2



Grade 3



Grade 4

Grade 5

Figure 4.09 : Estimation of muscularity – **Supraspinatus/Infraspinatus**

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Pectoralis Major Enthesis:

- Grade 1: No surface marking visible.
- Grade 2: Small patch of finely rugose marking, which may be discontinuous or poorly defined.
- Grade 3: Well defined, moderately extensive patch, texture finely rugose to rugose.
- Grade 4: Extensive patch of rugosity creating a raised area, sometimes with pits; grain of markings appears fibrous.
- Grade 5: Osteophytes.

Figure 4.10: Robb's scores for the pectoralis major enthesis (Robb 1994)

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Latissimus Dorsi Enthesis:

- Grade 1: No marking.
- Grade 2: Traces or small patch of finely rugose texture, may be discontinuous.
- Grade 3: Well defined, moderately extensive patch, texture finely rugose to rugose.
- Grade 4: Extensive patch or strip of rugosity, with some raised areas and sometimes with pits; grain of markings may be fibrous.
- Grade 5: Osteophytes.

Figure 4.11: Robb's scores for the latissimus dorsi enthesis (Robb 1994)

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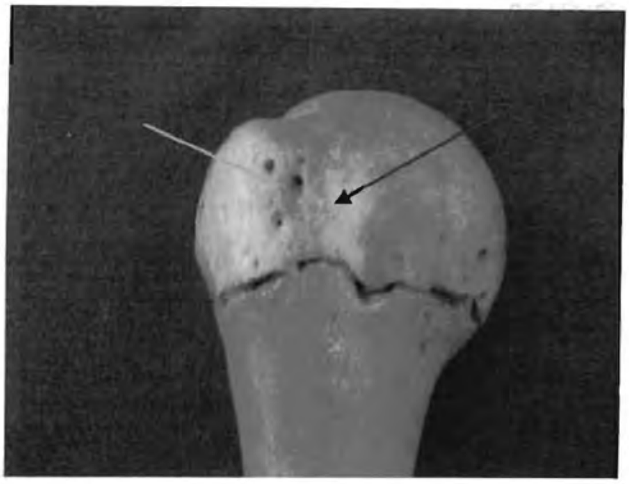
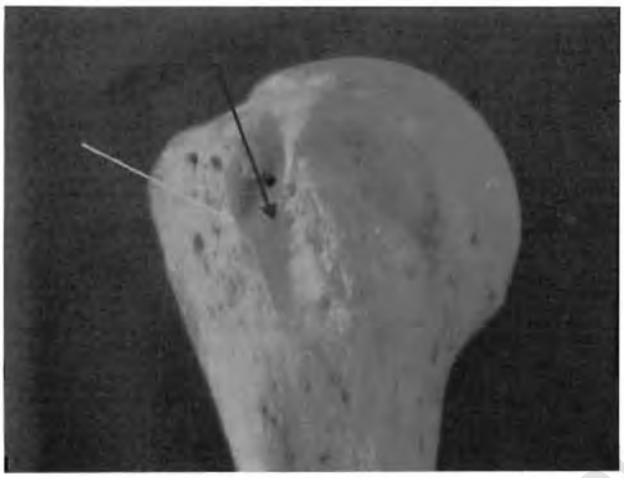
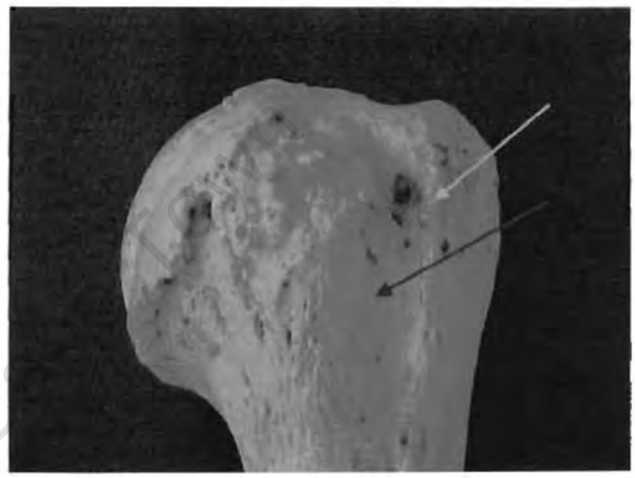


Grade 1

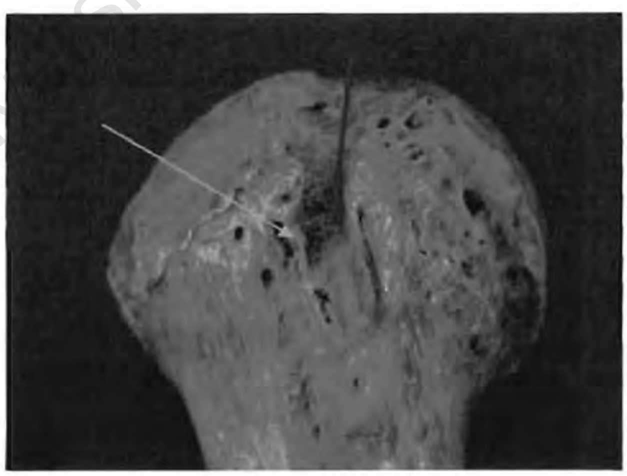
Grade 2



Grade 3



Grade 4



Grade 5

Pectoralis major →
Latissimus dorsi →

Figure 4.12 : Estimation of muscularity – **Pectoralis major and Latissimus dorsi**

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Deltoid Tuberosity (Anterior and Lateral) Entheses:

- Grade 1: No marking visible.
- Grade 2: Markings are faint and may be discontinuous; no raised spicules present.
- Grade 3: Markings define a well bounded strip with some raised spicules; they extend to meet pectoralis major (anterior ridge), or half way to lower margin of head (lateral ridge).
- Grade 4: Markings are both extensive and rugose, and include substantial raised areas.
- Grade 5: Osteophytes.

Figures 4.13 & 4.14 : Robb's scores for the deltoid tuberosity, anterior and lateral, entheses (Robb 1994)

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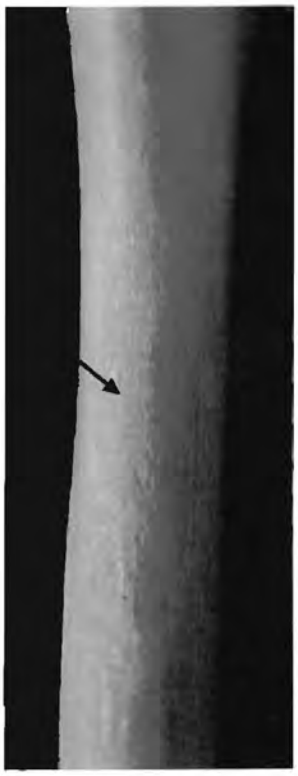
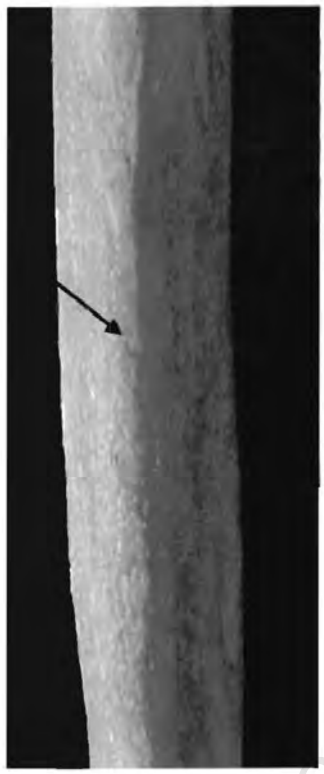
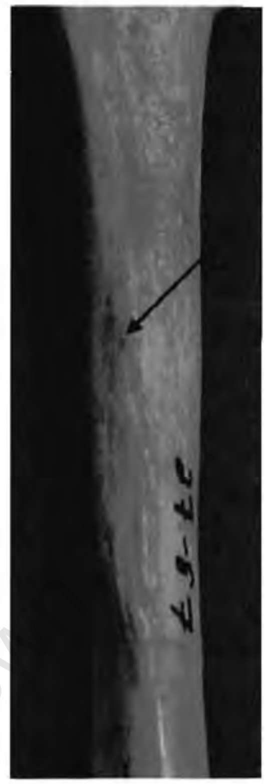


Grade 1



Grade 2



Grade 3

Grade 4

Grade 5

Figure 4.15 : Estimation of muscularity – **Deltoid tuberosity (anterior)**

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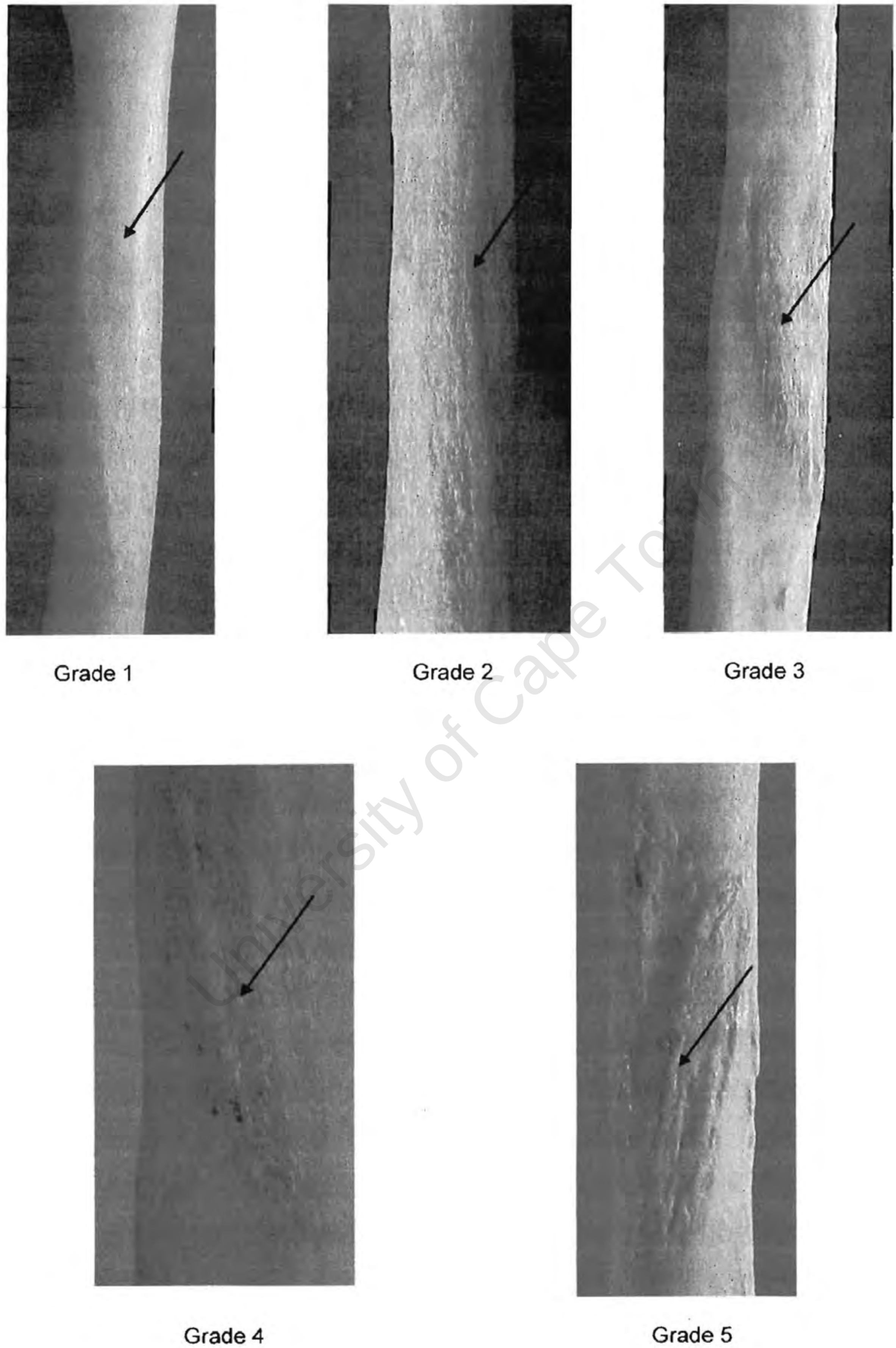

Figure 4.16 : Estimation of muscularity – **Deltoid tuberosity (lateral)**

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Common Extensors Enthesis:

- Grade 1: No trace of marking visible.
- Grade 2: Small facet; rim of facet is finely rugose and may be indistinct in places, and surface is smooth.
- Grade 3: Facet is larger and well bounded on all sides, rim may be slightly raised, and surface is smooth or finely rugose.
- Grade 4: Facet is large, covering much of the lateral epicondyle; surface is rugose or rugged, and border may be unclear due to rugosity or surface destruction; clear border with anconeus may be lacking.
- Grade 5: Osteophytes; an enthesopathy taking the form of a small protuberance below the edge of the lateral epicondyle may be present.

Figure 4.17: Robb's scores for the common extensor enthesis (Robb 1994)

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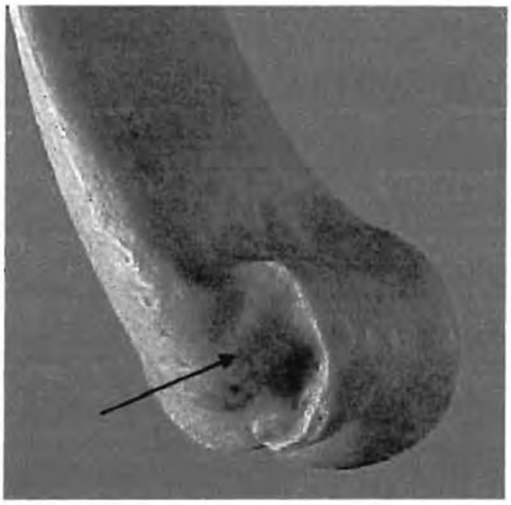
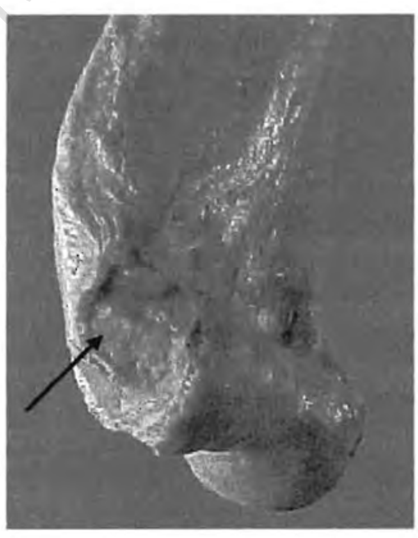


Grade 1

Grade 2

Grade 3

Grade 4



Grade 5

Figure 4.18 : Estimation of muscularity – **Common extensors**

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Common Flexors Enthesis:

- Grade 1: No trace of marking visible.
- Grade 2: Small facet is visible; rim of facet is finely rugose and may be indistinct in places, and surface of facet is smooth.
- Grade 3: Facet is larger and well bounded on all sides, rim may be slightly raised, and surface is smooth or finely rugose.
- Grade 4: Facet is large, covering much of the medial epicondyle; surface may be rugose or rugged, and border is unclear due to rugosity or surface destruction.
- Grade 5: Osteophytes; an enthesopathy taking the form of a small protuberance below the edge of the medial epicondyle may be present.

Figure 4.19: Robb's scores for the common flexor enthesis (Robb 1994)

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Grade 1

Grade 2

Grade 3

Grade 4

Grade 5

Figure 4.20 : Estimation of muscularity – **Common flexors**

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Patellar Ligament Enthesis:

- Grade 1: Tibia presents a straight shaft, with no tuberosity or only an incipient one; crest and superior border of smooth zone are not defined.
- Grade 2: Crest or superior border or both are defined, even if faintly, but region between crest and superior line consists entirely of smooth bone without ligament markings.
- Grade 3: All landmarks are clearly defined, and some ligament marking is visible above the crest, encroaching on the smooth zone; crest is well marked and shows fine vertical fibres or striations.
- Grade 4: Crest of tuberosity is raised in relief 1 mm or more, half or more of the smooth zone shows encroaching ligament markings, and crest may take an irregular or ragged outline, with upward bowing, or incipient fingers of bone.
- Grade 5: Osteophytes.

Figure 4.21: Robb's scores for the patellar ligament enthesis (Robb 1994)

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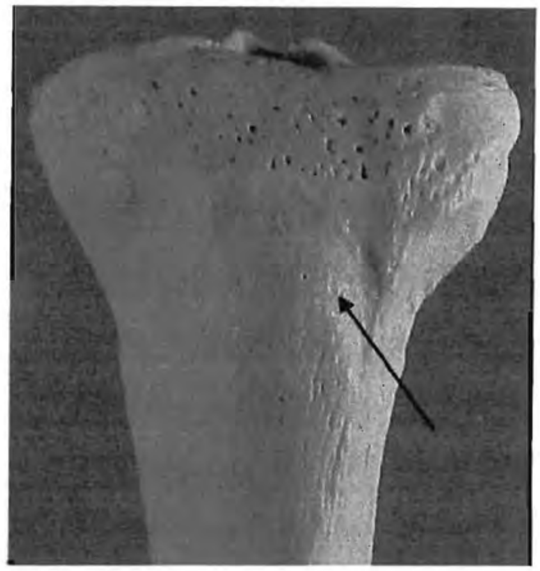
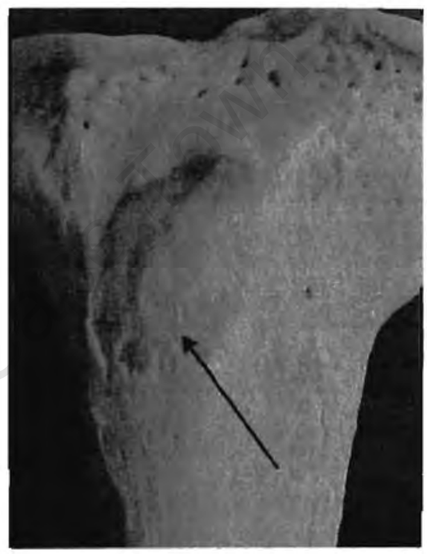
Grade 1



Grade 2

Grade 3



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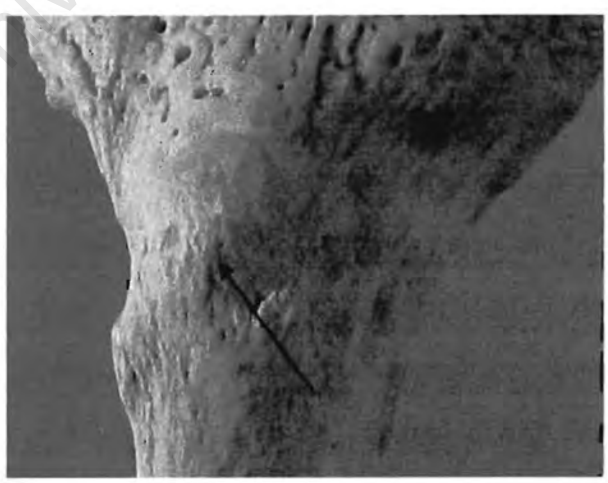

Grade 5

Figure 4.22 : Estimation of muscularity – **Patellar ligament**

Soleus Enthesis:

- Grade 1: No markings.
- Grade 2: Soleal line is faint and may be discontinuous.
- Grade 3: Markings define a continuous, easily visible line, which may contain infrequent raised spicules.
- Grade 4: half of length of line is raised, creating a crest.
- Grade 5: Osteophytes.

Figure 4.23: Robb's scores for the soleus enthesis (Robb 1994)

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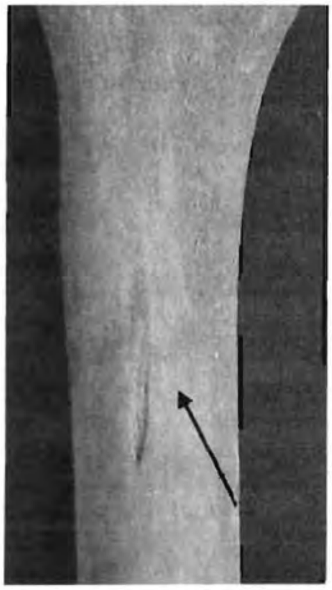

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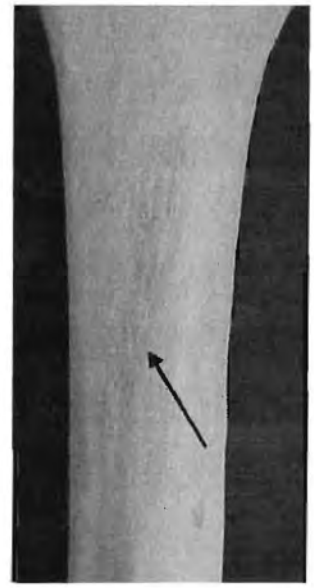

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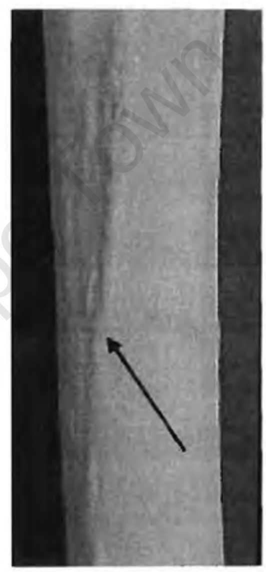

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Figure 4.24 : Estimation of muscularity – **Soleus**

4.7 DISEASE AND DISEASE PROCESSES OBSERVED IN THE HUMAN SKELETON

4.7.1 DENTITION

Teeth are important in archaeological studies since the dentition maintains its integrity in buried contexts where bones may not be well preserved. Studies of dentition also contribute to dietary reconstructions because patterns of dental wear and disease are influenced by the nutritional quality and physical characteristics of the food ingested. Unlike other calcified tissues, enamel does not remodel after it is formed therefore dental defects e.g. enamel hypoplasias are permanent records of childhood stress (Buikstra & Ubelaker 1994). Since human beings have two sets of teeth, deciduous and permanent, the type of tooth affected can add information about lifestyle differences at different times in the life cycle.

The number of individuals (n) is calculated based on the proportion of maxilla and mandible present; individuals represented by only one quarter of a maxilla or mandible are counted as one eighth of one individual (Figure 4.25). This method is a novel approach to calculating individuals based on partial dentition and it is indeed more accurate than past attempts. Recording one quarter of an individual may seem strange however, this data can be expanded up to represent an individual if other researchers want to use this information as a comparative sample.

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4.7.1.1 DENTAL ATTRITION

The occurrence and severity of maxillary and mandibular occlusal attrition in adult dentition is analysed. The wear of each tooth is scored from 0 to 4:

- 0 = unworn
- 1 = minimal
- 2 = slight
- 2+ = moderate
- 3 = heavy
- 4 = extreme

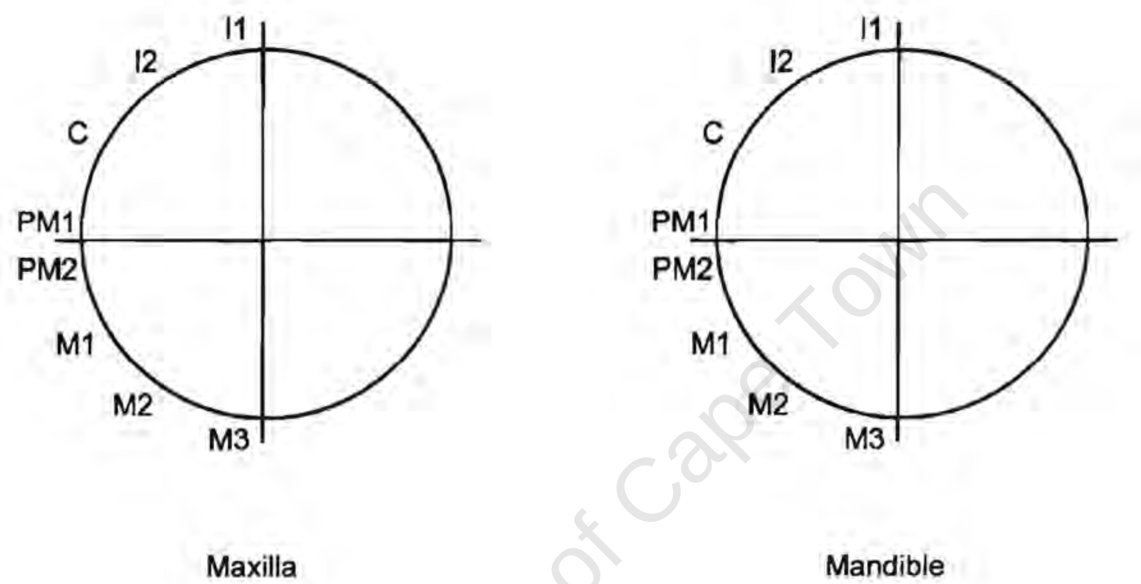

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Figure 4.25 : Number of individuals calculated based on proportion of maxilla and mandible present

Except for the 2+ category, these scores are adapted from and comparable to Morris (1984). The average rate of occlusal attrition per tooth, in each age category and sex is recorded. The 2+ category is scored as 2.5 when calculating attrition patterns. The anterior, posterior, and mean attrition scores are calculated. The anterior attrition score is the average rate of occlusion for the incisors and canines in each archaeological site, age category, and sex category. The posterior attrition score is the average rate of occlusion for the premolars and molars in each site, age category, and sex category. Finally, the mean attrition score is the average between the anterior and posterior attrition scores calculated for each site, age category and sex category.

Tooth wear analysis can also be used to assess lifestyle patterns (Table 4.01). The rate and patterns of dental wear are determined by tooth development sequences, tooth shape and size, internal crown structure, tooth angulation, non-dietary use, biomechanics of mastication, and diet (McKee & Molnar 1988). Since there are no standards for dental wear analyses in historic South African populations, this methodology was given less significance.

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4.7.1.2 Enamel Hypoplasias

Enamel hypoplasias are defined as circumferential lines, bands or pittings of decreased enamel thickness (Goodman *et al.* 1980, 1984a). Formation of enamel hypoplasias are viewed as an arrest of amelogenic growth during a period of stress, halting the completion of that particular increment (Aufderheide and Rodríguez-Martín 1998). Environmental factors which have been cited as etiological events resulting in these lines include: premature birth, dietary deficiencies of vitamins A, C, and D, newborn hypoxia, and malnutrition. However, prolonged malnutrition may not produce enamel hypoplasias as the lesions appear to be related to an acute, episodic event (Aufderheide and Rodríguez-Martín 1998).

When possible, teeth and enamel crowns have been thoroughly cleaned to remove calculus and foreign substances. Macroscopic observation of the dentition is conducted and, when present, hypoplasias are recorded (as absent or present) by tooth type.

Stages	Incisors and Canines	Premolars	Molars
0 unworn	No wear	No wear	No wear
1 minimal wear	Enamel only	Enamel only	Enamel only
2 slight wear	Dentine exposed as a thin line or in a mesio-distal ellipse	Cusps worn and one or two dentine patches are visible	All cusps have some exposure of dentine
2.5 moderate wear	Dentine patch is wide	Dentine exposures have coalesced	At least two dentine patches have coalesced but entire occlusal enamel is not yet removed
3 heavy wear	Large dentine exposure with only enamel rim remaining, surface may be flat, cupped, or rounded	Enamel rim with one large dentin exposure	One large dentin exposure with enamel rim, but crown wear may be enough to remove rim from one side
4 extreme wear	Tooth crown lost, pulp cavity exposed, and roots may be functioning in occlusal surface	Tooth crown lost, pulp cavity exposed, and roots may be functioning in occlusal surface	Tooth crown lost, pulp cavity exposed, and roots may be functioning in occlusal surface

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Table 4.01 : Numerical classification and description of tooth wear categories

(Developed from Morris 1984, Table 4.2)

4.7.1.3 Disease Processes in the Dentition

Both maxillary and mandibular teeth are examined and recorded for condition, wear, and caries. Caries rates, antemortem tooth loss, periodontitis and dental abscesses are all examined.

- Dental caries: decay of the teeth that appear as dark eroded regions on the enamel (Burns 1999:243).
- Antemortem tooth loss: when a tooth is lost antemortem the alveolar bone begins to resorb resulting in a decrease in the height of the maxilla and/or mandible (Burns 1999:242).
- Periodontitis: a chronic slowly progressive and destructive inflammatory process affecting the periodontium – the tissues that anchor, support, and protect a tooth in the oral cavity. There is also a progressive resorption of the gum line as a consequence of age that may not be related to periodontitis (Burns 1999:245).
- Abscess: a resorption of the maxillary or mandibular bone, characterised by damage to the corpus, signifying inflammation of the pulp chamber following excessive attrition or dental caries (Burns 1999:242).

Dental caries rates are frequently based on the 'observed caries rate', number of carious teeth divided by the total number of teeth observed. However, a proportion of the teeth lost antemortem will be lost due to severe carious decay, a factor not often considered by many investigators (Lukacs 1995). Moderate to high rates of tooth loss have significant implications for the accuracy and interpretation of dental pathologies, especially dental caries. According to Lukacs (1995) the problem with the observed caries rate lies in recording of the alveolar resorption rate. The alveoli of teeth lost immediately (days to a week) before death will not yield evidence of resorption or remodelling, and will be confused with cases of post-mortem tooth loss.

There is a significant distortion that moderate to high rates of antemortem tooth loss may have on dental caries rates. This problem becomes most apparent in groups where the loss of teeth before death is high, yet caries rates are based upon the few observable teeth remaining in the alveoli when the study is conducted. In some groups many of the teeth lost antemortem were probably missing due to severe carious decay. Therefore, caries rates based on observed numbers of teeth will be underestimated

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significantly. The problem lies in providing an accurate means of estimating what proportion of antemortem tooth loss (AMTL) in a skeletal sample is caries induced (Lukacs 1995).

Hardwick (1960) presented an early attempt to rectify the problem of AMTL rates biasing caries frequency in the dentition. Hardwick attempted to 'correct' caries rates by assuming that 25 percent of teeth extracted or lost through disease were missing due to caries when the proportion of carious teeth in a series was less than five percent. A sliding scale was developed so that when caries rates were between 5% and 20%, 33% of teeth lost antemortem were counted as carious. When the caries rate was above 20%, he assumed that half the teeth lost antemortem were carious. Brothwell (1963:208-213) objects to such correction factors on the basis that "...it seems very likely that the aetiological factors determining tooth loss have changed in importance through time and from area to area".

Kelley and colleagues advocate use of the Decayed and Missing Index (DMI), a modification of the clinical DMF index (decayed, missing, and filled), used primarily on living populations (Kelley *et al.* 1991). The DMI "...assumes that most antemortem tooth loss results from tooth decay. For many samples, this will be the case, but for peoples experiencing heavy attrition, severe periodontal disease, or tooth breakage with pulp exposure, tooth loss can also occur" (Kelley *et al.* 1991:203-213).

The caries correction factor proposed by Lukacs (1995) is of great value as it is neither fixed nor assumed, but derived from rates of dental disease specific to individual skeletal series. Because the observed proportion that caries and attrition contribute to pulp exposure are the basis for determining the correction factor, it will vary in a realistic manner through space and time, based on variations in ecology, diet, and food preparation methods.

The caries correction factor proposed by Lukacs (1995) is calculated by sequentially following these 4 steps:

1. Estimated number of teeth lost due to caries = [number of teeth lost antemortem] X [proportion of teeth with pulp exposure due to caries].
2. Total estimated number of teeth with caries = [estimated number of teeth lost due to caries] + [number of carious teeth observed].
3. Total number of original teeth = [number of teeth observed] + [number of teeth lost antemortem].

4. Corrected Caries Rate = [total estimated number of teeth with caries] + [total number of original teeth].

On the other hand, post mortem burial damage in relation to anterior and posterior teeth is not generally taken into consideration in dental anthropological studies; in post-mortem burial damage, the anterior teeth are more frequently lost than posterior teeth. Erdal and Duyar (1999) have proposed a new calibration procedure, called the proportional correction factor, which removes this disproportionality. The ratio of anterior tooth number to total tooth number for a quadrant of jaws is 3/8, therefore the caries rate of anterior teeth is corrected by multiplying by three-eighths. The ratio of posterior tooth number to total tooth number for a quadrant of jaws is 5/8, therefore the caries rate of posterior teeth is corrected by multiplying by five-eighths. The total caries rate would be the sum of the corrected anterior and posterior rates. The proportional correction factor is calculated as follows:

- Anterior teeth = Corrected Caries Rate (Lukacs 1995)% 3/8
- Posterior teeth = Corrected caries Rate (Lukacs 1995) % 5/8

Antemortem tooth loss and periodontitis are recorded for the adults, i.e. subadults, younger adults, older adults, with dentition in all sites. The incidence of dental abscesses is also recorded for each tooth and for location of the abscess.

4.7.2 Disease Processes seen in Osteology

Although not all diseases generate skeletal 'signatures', the study of abnormal bone formation provides important data about an individuals, and communities, health status (see for example, Buikstra & Ubelaker 1994). Some diseases affect all age groups e.g. cribra orbitalia while others are more commonly observed in older adults e.g. osteoarthritis. All preserved bones were examined for visual signs of abnormalities. Observations were recorded where bones were remodelled due to a disease process. Due to their interpretive usefulness for this project, the following aspects of palaeopathology were investigated: cribra orbitalia and porotic hyperostosis, arthritis, and trauma. Osteological signs of the presence of smallpox are of particular importance. Only about 20% of smallpox cases illustrate skeletal remodelling which occurs in the form of osteomyelitis variolosa. However, in 80% of individuals that do show remodelling, mainly children and adolescents, bilateral involvement of the elbows is cited followed

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by the wrists, hands, ankles and feet (Jackes 1983). Anomalies, features reflecting normal morphological variation without significant clinical influence, were not recorded for the purposes of this study.

4.7.2.1 Orbits and Skull Vault

Porotic hyperostosis (PH) is identified by a spongy, porous appearance on the cranial vault, primarily the frontal and parietal bones and less frequently the occipital bones, accompanied by diploic thickening and thinning of the outer table of bone. Cribra orbitalia (CO) is a similar lesion located on the orbital roof. Both PH and CO are related to iron deficiency anaemia. The pitting is probably related to pressure exerted on the tables of the skull by the expanding marrow (Ponec & Resnick 1984). The effect of pressure exerted depends on the shape of the bone.

> According to physical laws, the force exerted by a semiliquid substance (marrow) enclosed between two curved parallel bones (as in the calvarium) is directed perpendicular to the enveloping surface. Thus the outer table is subjected to a force that is diverging outward, resulting in radially oriented trabeculae, bone thinning, and perforation. The inner table, conversely, is subjected to a converging or compacting force, and is not thinned (Ponec & Resnick 1984:316).

Therefore, the bone thinning is not due to osteoclastic activity but rather to the pressure exerted by the above forces. Although there is little marrow activity in the orbits of the skull the thin bony cortex is easily perforated by marrow expansion (Ponec & Resnick 1984). Both PH and CO have similar aetiologies (Stuart-Macadam 1989).

The skeletal manifestations associated with porotic hyperostosis (PH) and cribra orbitalia (CO) have long been attributed to iron deficiency anaemia (Angel 1966, 1967, 1977, 1981; Cooley *et al.* 1927; Mensforth *et al. 1978*; Mittler & Van Gerven 1994; Ortner & Putschar 1985; Stuart-Macadam 1982, 1985, 1987a, 1987b, 1989, 1992). All individuals with skulls and/or orbits are assessed for the presence and severity of PH and CO. Both types of lesions are recorded schematically as occurring on either the skull (PH) or in the eye orbits (CO). The number of individuals in each category is calculated as:

- PH – number of individuals based on parietal and/or occipital and/or frontal bones present.
- CO – number of individuals based on orbits present; 2 orbits = 1 individual.

Although 90% of cribra orbitalia lesions are bilateral, 10% are unilateral (Aufderheide and Rodríguez-Martín 1998). Therefore it is more accurate to calculate the number of individuals exhibiting the lesion

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based on orbit pairs; to calculate two infected orbits as representing two people is more valid than assuming the two orbits belong to one individual.

The scoring system for the presence and severity of PH and CO is based on Stuart-Macadam (1985:392) and defined as follows:

1. Light: scattered fine foramina.
2. Medium: large and small isolated foramina that have linked to form a trabecular structure.
3. Severe: outgrowth in trabecular structure from the normal contour of the outer bone table.

In addition, the lesions are recorded for their status at time of death using the methodology established by Mensforth *et al.* (1978): Remodelled (healed at time of death) or Unremodelled (active at time of death) (Figures 4.26 & 4.27). Lesions that are active at time of death display very sharp, defined, edges regardless if the foramina are coalescing or not. This type of lesion looks as though someone took a sharp pin and made tiny (or not so tiny in the case of coalescing foramina) holes in a piece of clay. Lesions categorised as healed at time of death will display smoother edges around the porous holes, with many holes no longer appearing circular. It's as though the 'artist' made holes in the clay with a sharp, pointed instrument and then proceeded to gently smooth over the surface (personal communication Professor A. Grauer, 1999).

Although the primary consensus for the cause of PH and CO is iron deficiency anaemia, there are however two models to explain its occurrence: the dietary model and the parasite model. The dietary model suggests that PH and CO are linked to diets that are either low in iron or that contain substances that interfere with iron absorption, otherwise known as the 'maize-dependency' model (El-Najjar 1976; El-Najjar & Robertson 1976; El-Najjar *et al.* 1975, 1976, 1982; Henschen 1961; Lallo *et al.* 1977; Mensforth *et al.* 1978). Tannins (polyphenols) which are found in vegetables inhibit iron absorption. Cereal grains, especially maize, have a very low iron content and contain phytic acid which chelates any iron present rendering it unusable (Garn 1992). Adding to the problem is that many cereal grains, e.g. maize, rice, black beans, soybeans and wheat, lack the enzyme phytase which counteracts the phytic acid. Haeme iron (found in animal organs and skeletal muscle) has about 20 to 40% absorption rate while non-haeme iron (found in grains and vegetables) has approximately 5% absorption rate when consumed alone, i.e. without meat (Arthur & Isbister 1987; Dallman 1986; Holland & O'Brien 1997). Therefore this

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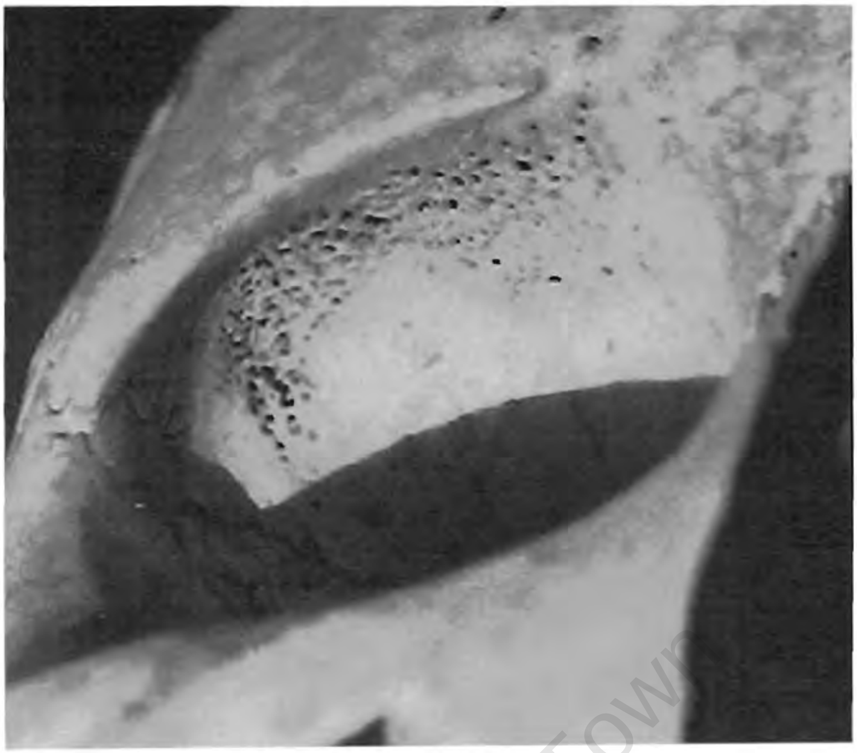

Figure 4.26 : Cribra Orbitalia – Remodelled, healed at time of death
(Picture from Fairgrieve and Molto 2000:323)

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Figure 4.27 : Cribra Orbitalia – Unremodelled, active at time of death
(Picture from Fairgrieve and Molto 2000:324)

model assumes that populations dependent on a vegetable staple will suffer higher rates of iron deficiency anaemia which will create a hyperblastic bone marrow response and create more PH and CO.

The parasite model suggests a link between iron deficient anaemia and biological fitness. Since many pathogens, e.g. bacteria and viruses, require iron to reproduce, the state of chronic hypoferremia would make it "difficult for pathogens to obtain the necessary iron for growth and development" (Stuart-Macadam 1992:44) and therefore this state would be beneficial for the host. This model views PH and CO as an attempt of an individual to adapt to its environment. Therefore PH and CO are seen as a sign of successful adaptation, i.e. the body's defence mechanism against disease. However, many researchers have argued that anaemia, no matter what the cause, is never beneficial or adaptive as it is a sign that something is seriously wrong (Cook 1990; Holland & O'Brien 1997; Scrimshaw 1990).

Anaemia, literally meaning no blood, is a condition characterised by a decrease in red blood cells and/or haemoglobin concentrations (Garn 1992). Anaemia is a *symptom* and not a disease and in clinical medicine it is a sign of an underlying disorder. Iron deficient anaemia is characterised by one or more of the following: low serum ferritin (iron storage protein) concentration, low transferrin (iron transport protein) saturation, or an elevation in the erythrocyte protoporphyrin level (Early & Wotecki 1993). Iron deficient anaemia is tested from blood samples as more than 65% of the body's iron is in haemoglobin. Deficiency is defined as a "haemoglobin concentration below the 95% reference range for age and sex" (Dallman 1986:17). The targeted daily intake for iron is 20 mg and once lower levels are reached iron deficient anaemia occurs (Garn 1992).

Populations with high rates of iron deficiency anaemia generally also have high rates of infectious disease (Arthur & Isbister 1987; Beisel 1979, 1982; Bhaskaram 1988; Dallman 1986, 1987; Sherman 1990). The exact mechanisms by which iron functions in immunity are unclear. However, during an infectious process the availability of iron for invading microorganisms is limited by two factors: firstly, the rapid sequestration of iron in tissue storage forms, and second, the presence of iron transport proteins i.e. unsaturated transferrin and lactoferrin (transferrin present in milk). These iron transport proteins have strong binding affinities for iron that allows them to withhold iron from invading microorganisms; bacteria and viruses require iron to reproduce. Lactoferrin is released by phagocytising white blood cells in areas of inflammation to help restrain bacterial/viral growth in the immediate area. However, in iron deficient patients lymphocyte numbers are reduced (Fletcher *et al.* 1975). There is also a redistribution of iron into cellular storage sites in the liver, spleen and marrow which has two effects: decreasing the availability of iron throughout body fluids and increasing the percentage of unsaturated transferrin circulating in the body. Moreover, iron excess can also increase an individuals risk of infection, as some bacteria are able to chelate iron in the environment to increase its availability for uptake by the bacteria (Beisel 1982).

The relationship between iron and other vitamins and minerals has also been observed. During an infection not only is there a redistribution of iron, but also zinc, into the liver which aids in the increase of unbound transferrin and serves to prevent the invading organism from obtaining the iron it requires to grow (Beisel 1979). Also, ascorbic acid facilitates the absorption of iron from the gastrointestinal tract and inadequate amounts of vitamin C alters iron metabolism; a deficiency in vitamin C can result in a decrease of folic acid and iron (Clark *et al.* 1992; Fairgrieve & Molto 2000). Magnesium deficiency is also associated with iron deficiency. On analysis of subadults from a Nubian cemetery (550-1450 AD) Sandford *et al.* (1983) found lower concentrations of magnesium in individuals affected with CO. Insufficient amounts of magnesium can produce clinical symptoms of haemolytic anaemia; after only a few days of chronic diarrhoea a child can become magnesium deficient (Sandford *et al.* 1983).

Iron deficiency is one of the most common disorders seen in clinical medicine (Wintrobe 1993). Iron requirements are relatively high for infants, children and pregnant women due to rapid growth and in all females of reproductive age due to menstrual blood loss. However, in relation to iron deficiency, humans appear to be maladapted. Other animals have approximately 10 times the iron loss present in humans (per kg) but iron absorption in humans is only one-fiftieth to one-hundredth of that in other mammals (Arthur & Isbister 1987). Therefore humans have a limited ability to compensate for excessive iron absorption and losses.

Porotic Hyperostosis (PH) and cribra orbitalia (CO) do not appear in the skeletal record of the Palaeolithic era and there are only a few cases in the Mesolithic era (Arthur & Isbister 1987; Meiklejohn *et al.* 1984). This condition appears more frequently in the archaeological records about 10 000 years ago with the adoption of agriculture and increasing sedentism; the inorganic iron in grains is poorly absorbed. However, there is a general decrease in the frequency of PH and CO towards the 20^{th} century and increase of the skeletal manifestation in populations closer to the equator and in lowland compared to highland environments (Arthur & Isbister 1987; Stuart-Macadam 1998).

Agricultural subsistence strategies produced a deterioration of hygienic conditions that accompanied population growth and an increase in sedentism, which created prime situations for pathogenic infestation. Also, Campbell, Danielskuil, De Tuin, and Wolmaransstad are all geographically located within the 'hookworm belt' (Holland & O'Brien 1997). A single hookworm can remove between 0.2 ml and 0.05 ml of blood per day which can lead to a negative iron balance when large numbers of worms are involved (Cook 1980). However, according to Prof. Christopher Appleton (personal communication, 2002), the concept of a 'hookworm belt' must be viewed with caution; it was a broad-based interpretation of experiments that examined the temperature tolerances of the free-living larvae. In South Africa, hookworms occur only on (or in) sandy soils such as those present along the East coast of Kwa-Zulu Natal to about 150 metres altitude and here their presence is more likely to be correlated with sugar cane and not maize (Appleton *et al.* 1999). Although the prevalence of hookworm in South Africa ranges from 100% to about 40% within individuals the intensities of infection (eggs/g faeces) are generally low by world standards (personal communication Professor Appleton, 2002). However, moderate levels of hookworm infection have been found in small sandy areas separated from the coastal plain by clay-dominated soils (Appleton *et al.* 1999). Areas in the Kalahari, including Bushmanland in Namibia, have reported an 80% hookworm prevalence in 'Bushmen' peoples living in the area (Evans *et al.* 1990).

Dunn (1972) has shown that ground housing as opposed to pile housing provides a greater chance of exposure to pathogens which in turn is related to high levels of iron deficiency anaemia.

Since increased iron deficiency is related to infectious disease and children are more susceptible to infection than other age groups, due to their low immunity, it would not seem unusual to have large percentages of PH and CO in the childhood years. Lovric (1970) found that 20% of children admitted to hospitals with infections had iron deficiency anaemia as compared to 3% iron deficiency anaemia in same aged children. Mackay (1928) reported an increase in gastrointestinal and respiratory infections in iron deficient infants. Iron deficiency can also be related to prolonged breast feeding or weaning onto an iron poor alternative (e.g. goat's milk or cereal gruel).

Foetal iron stores are sufficient for only four to six months after birth. Breast milk is iron poor declining from 0.5 mg/litre during the first month postpartum to 0.3 mg/litre by the fourth month (Holland & O'Brien 1997). If a child is breast fed for longer than four months or weaned onto an iron

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poor cereal gruel, i.e. maize, iron deficiency anaemia will develop. Goat's milk is also a poor alternative to human milk as it is lacking in folic acid, which in turn can lead to iron deficiency in infants and therefore the skeletal manifestations of PH and CO (Fairgrieve & Molto 2000). Lactoferrin, the iron-binding protein in human milk, accounts for 20% of human milk's total protein content, whereas bovine milk contains only one-tenth as much lactoferrin (Weinberg 1984). Lactoferrin makes iron unavailable to invading organisms and therefore human milk is a better defence mechanism than cow's milk. Among the Bahima in Uganda cow's milk is fed in large quantities to infants from the first few months of life. Chronic iron deficiency may also be related to the bovine milk diet (Jelliffe & Blackman 1962).

Iron requirements are high in reproductive women due to blood loss and pregnant females due to rapid growth. During pregnancy a woman's daily iron requirements increase by approximately 3.5 mg and if the diet is not supplemented with iron a negative balance occurs (Holland & O'Brien 1997). Multiple or frequent pregnancies compound the problem. Arthur and Isbister (1987:182) comment that even "if a female can achieve positive iron balance of 1 to 2 mg/day postpartum it will still take months or years to replenish stores." The National Academy of Sciences (1980) reports that the increased requirement for iron during pregnancy can not be met by the amount of iron contained in red meats and iron supplements are recommended. The high rates of PH and CO in adult males could be related to a multitude of factors: pathogens, infections, ground housing. However, Arthur and Isbister (1987) have noted that individuals with adequate iron stores would take two or three years to develop iron deficiency anaemia and therefore iron deficiency in adults [in their study] is almost never due to dietary deficiency. The problem with this statement is that their study focused on individuals in Sydney, Australia who maintained an "average Western diet" (Arthur & Isbister 1987:176). What about communities that are chronically iron deficient? What was the situation facing early agriculturalists?

Research suggests that CO, because it usually occurs more often than PH, is possibly the more sensitive marker for the underlying stimulant of iron deficiency (Aufderheide & Rodríguez-Martín 1998; Caffey 1937; Stuart-Macadam 1989, 1998). Therefore the intensity, i.e. light, medium or severe, of PH and CO and active versus healed lesions are important indicators when correlating anaemia with bioarchaeology. Skeletal remains displaying active lesions suggest that the 'disease' was still present when the individual died and light lesions suggest that the 'disease process' was in its initial stages when

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the person died (Grauer 1993). Healed lesions suggest that the body was in the process of recovering, or had recovered from, the condition (Grauer 1993).

Stuart-Macadam (1985) states that PH and CO present in adults is most probably representative of an anaemia acquired during early childhood. In this scenario, active lesions in adults would represent unhealed lesions existing from childhood therefore implying a population chronically iron deficient; the body is not 'fit' enough to repair the skeletal 'damage' of PH and CO. The problem arises when there is both active and healed lesions present in adult individuals. How can the population be chronically iron deficient and yet still show signs of healed PH and CO?

4.7.2.2 Vertebrae

Osteophytosis, the formation of leaves of bone at the margins of the intervertebral disk, and collapsed vertebral bodies are the most visible illustrations of disease in the spine. However, vertebral osteophytes may not necessarily indicate a disease process, i.e. arthritis, but may be a 'normal' condition associated with older age groups. Care was taken to differentiate postmortem damage from antemortem disease processes. Osteoarthritis is included in the arthritis category below.

4.7.2.3 Arthritis and Trauma

Degenerative joint disease (DJD) is the most common form of joint pathology and is usually detectable during the fourth decade of life (Aufderheide & Rodriguez-Martin 1998). Osteoarthritis is DJD that occurs in a synovial joint. The lack of standardisation for DJD limits comparison between authors (Ortner & Putschar 1985). The diagnostic criterion employed for this project includes the presence of one or more of the following: eburnation (smooth, shiny, polished surface produced by bone-to-bone contact in cartilage-free areas during joint movement), osteophytes (process of bone remodelling producing focal nodules of new bone formation at the bone margins), and alteration of joint surface contours (e.g. DJD of the hip may reveal a 'mushroom' type deformation of the femoral head) (Ortner & Putschar 1985).

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Traumatic lesions, e.g. a broken bone, when healed will show signs of a callus formation at the location where the bone broke and began to unite again. Signs of trauma were recognised by changes in bone contour associated with callus remnants or with osteomyelitis. Although the most common form of osteomyelitis is indirect contamination by bacteria in the blood stream, acute osteomyelitis resulting from direct contamination – traumatic injuries – is also often seen (Aufderheide and Rodríguez-Martín 1998).

4.8 Detection of Smallpox Virus Using PCR Technique

The polymerase chain reaction (PCR) technique is used in this project to investigate the presence of smallpox in the skeletal remains of 18th and 19th century South African populations. Survival from smallpox affords the individual natural immunity for the remainder of their life. The virus is undetectable in a smallpox survivor, as they now possess the antibodies for that disease. Therefore, positive identification of the viral DNA will only be present in individuals who died from the virus. The historical record combined with the presence of large numbers of individuals exhibiting porotic hyperostosis and cribra orbitalia are the main reasons for investigating the presence of smallpox in these communities; there is no link between smallpox and porotic hyperostosis or cribra orbitalia, however, there is a link between smallpox and iron deficiency anaemia. Since viruses lack the vital features for energy production, they are entirely dependent upon a living cell for reproduction. The host cell provides the necessary energy, raw material, and machinery for reproduction (Aufderheide & Rodriguez-Martin 1998); viruses require iron in order to survive.

However, before the PCR technique is utilised, DNA must be extracted from the bone. This project uses ribs for two reasons: 1) Due to the sensitive nature surrounding destructive analyses of human remains only small amounts of bone were authorised, and 2) The process also requires consistency of bone material, i.e. the same kind of bone from each individual. Despite many individuals being incomplete, ribs tended to be preserved. One rib was taken from each individual, regardless of age, within each site. The ribs were separated based on the archaeological site from which they were found, i.e. seven test samples to represent seven archaeological sites. Since DNA degenerates over time individual ribs probably did not contain adequate amounts of DNA for this procedure, therefore archaeological sites were tested for the presence of smallpox and not individuals. Since the majority of individuals were probably not immune to smallpox there is a high chance that if one individual was infected in a community many more were also infected.

The procedure for grinding the bone, decalcifying the ribs and extracting the DNA is described below. Two different methods were employed to extract the DNA from the bone. Some of the steps are modified from Kolman and Tuross (2000). All materials placed in the 50 ml tubes and the YM10 filters were centrifuged in a swinging bucket centrifuge. All of the molecular biology techniques are performed under the guidance of Professor Girish Kotwal, an expert of pox viruses, and Dr. Jane Yeats, a PCR specialist, from the Department of Virology, University of Cape Town.

1. Clean the ribs with ROH_2O (autoclaved water) and then let dry.
2. Weigh ribs and record total bone weight for each archaeological site.
3. Immerse ribs into liquid nitrogen for 20 to 30 seconds to freeze thoroughly and then grind to a fine powder (Lee *et al.* 1991).
4. Place 15 grams of ground bone into 50 ml centrifuge tube and add 20% bleach solution to 45 ml line (Kolman & Tuross 2000). Shake vigorously and leave for 2 minutes. Then centrifuge at 2 000 rpm for 5 minutes.
5. Remove liquid solution on top and discard but leave bone in tube.
6. Add ROH_2O to 45 ml line and centrifuge as in step 4. Remove liquid solution and discard. Steps 4 and 5 are necessary to remove any foreign DNA from the bone samples due to handling (Kolman & Tuross 2000).
7. Put bone in autoclaved dialysis tubing and let sit in 0.5 *M* EDTA, at 4°C, on a magnetic stirrer for 10 days. This will decalcify the bone (Kolman & Tuross 2000). The calcium will build up on the bottom of the beaker so the EDTA solution must be changed every few days.
8. Once decalcified, pipette out all of bone and liquid solution from dialysis tubing and put into 50 ml centrifuge tubes. Centrifuge at 2 500 rpm for 10 to15 minutes.

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Method 1:

1. Pipette out liquid only and put through a 0.22 micron filter. This will remove any dirt but still allow the DNA to pass through.

2. Remove 15 ml of solution and put into a YM10 filter. Centrifuge at 2 500 rpm until less than 1 ml of liquid remains.
3. Remove the liquid solution and place in 2 ml vial. Add to it a Lysis buffer (50 m *M* Tris-HCL, pH 8.0, 1 m *M* Na_2EDTA, 0.5% Tween-20 and proteinase K) to give a final concentration of 1000 µL (1 ml) (Meyer *et al.* 1998).
4. Add 1 ml of 25:24:1 Phenol:chloroform:isoamyl alcohol mixture to 2 ml vial with liquid bone solution (Meyer *et al.* 1998).
5. Centrifuge at 14 000 rpm for 5 minutes. The tube will have 3 separate layers; top is buffer and DNA, middle is protein, bottom is phenol:chloroform:isoamyl alcohol mixture.
6. Pipette off top layer and put into separate 2 ml vial. Label as 'original top layer'. Mark other 2 ml vial (from step 13) as 'original bottom layer'.
7. Add to 'original top layer' solution 500 µL phenol:chloroform:isoamyl alcohol mixture. The chloroform:isoamyl will extract and precipitate any protein that may have been left behind. Centrifuge at 14 000 rpm for 5 minutes.
8. Pipette off top layer and put into separate 2 ml vial. Mark as 'top layer 2'. Discard the bottom layer from this tube.
9. Add to 'original bottom layer' solution 500 µL ROH_2O. The ROH_2O will extract any DNA that may have been left behind. Centrifuge at 14 000 rpm for 5 minutes.
10. Pipette off top layer and put into separate 2 ml vial. Mark as 'bottom layer 2'. Discard the bottom layer from this tube.
11. Now all tubes contain only top layer (buffer and DNA).
12. To 2 ml vials with DNA, add double the amount of 100% ethanol than present in vials. The ethanol will recover the DNA. Put in freezer for 30 minutes.
13. Take out of freezer and thaw DNA. Centrifuge at 14 000 rpm for 10 minutes. The DNA should 'pellet', or sediment, at the bottom of the vial.
14. Store tubes with DNA and ethanol in freezer over night.
15. Thaw DNA and then centrifuge at 14 000 rpm for 2 minutes.
16. Pour out liquid but keep DNA 'pellet' in vial.
17. Add 1 ml of 70% ethanol solution to vial with pellet.

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18. Centrifuge at 14 000 rpm for 2 minutes. This will clean the DNA 'pellet'.

19. Pour out liquid but keep DNA 'pellet' in vial.

20. Open tubes and rest on an angle against a pipette to dry DNA 'pellet'.

21. Add 50 µL ROH_2O to DNA and store in fridge for later PCR testing.

22. Before the PCR test can be performed the DNA must be cleaned with a Qiagen DNA testing kit.

Method 2: NucliSens Lysis Buffer Nucleic Acid Release

1. Pipette out liquid only and save in a separate tube. In a 15 ml centrifuge tube tightly pack slightly less than 2 ml of the bone material.
2. Pour in 9ml of NucliSens Lysis buffer (5 mol/l guanidine thiocyanate, Triton X-100, Tris/HCL). Let sit in the fridge for 48 hours. This buffer will disintegrate all structures and particles in the cell but release the nucleic acids.
3. Centrifuge at 3 000 rpm for 10 minutes and remove liquid from the top layer and place in a separate 15 ml centrifuge tube.
4. Centrifuge at 1 000 rpm for 2 minutes to remove any liquid from the cap of the tube.
5. Add 50 µL of silica to 15 ml tube and repeatedly invert tube for 2 minutes so that the silica does not settle on the bottom.
6. Pour out all solution from 15 ml tubes into extractor vials. Place vials on machine and set for 11 ml blood run. After 40 minutes, if any DNA is present, it will settle in the collecting tube.

The PCR technique was devised by Kary Mullis in the mid-1980's. This technique has revolutionised molecular genetics as it enables the researcher to produce millions of copies of a *specified* DNA sequence, which become detectable on an agarose gel; one copy of the *specified* DNA is invisible on a gel. There are two very important features of the PCR technique. Firstly, the *Taq* polymerase (an enzyme) can be directed to synthesise a specific region of DNA. Secondly, PCR results in the amplification of the specified region (Watson *et al.* 1992).

The starting material is a double-stranded DNA molecule that contains the sequence to be amplified. It is not necessary to isolate the sequence to be amplified, as it is defined by the primers used in the reaction. The two oligonucleotide primers directing the starting and ending points for DNA

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synthesis, DNA polymerase (enzyme) and a mixture of all four deoxynucleotides (adenosine triphosphate, guanosine triphosphate, cytosine triphosphate, thymine triphosphate) are added to a tube containing the DNA. The reaction mixture is then heated to 94°C. This high temperature will completely separate the double stranded DNA molecules into single strands that become the templates for the primers and DNA polymerase. The temperature is then lowered in order to allow the oligonucleotide primers to anneal (bind) to the complementary sequences in the DNA molecules. This binding temperature is an important variable in determining the specificity of a PCR, therefore temperatures and times vary depending on the sequences to be amplified. The lowering of the temperature generates the primed templates for DNA polymerase. The next step is to raise the temperature to 72°C, the optimal temperature for the heat-stable *Taq* polymerase, for DNA synthesis to proceed. The temperature is raised once again to 94°C so that the short pieces of double-stranded DNA (the original strand and the newly synthesised complementary strand) separate. These single strands become templates for another round of DNA synthesis. The cycle of heating to separate strands, annealing of primers, and synthesis by DNA polymerase is repeated for 25 to 60 cycles depending on the specificity of the DNA (Figure 4.28) (Watson *et al.* 1992:80-2).

The exact cycling times and temperatures employed in this project are as follows:

- Cycle 1: 6 minutes 94°C.
- Cycle 2: 1 minute 94°C, 2 minutes 55°C, 10 minutes 72°C.
- Cycle 3: 1 minute 94°C, 2 minutes 55°C, 3 minutes 72°C (repeat 24 times for a total of 25 cycles).

The primers used in this project are:

- vaccinia virus
- CCR5Δ1, 5'-ACCAGATCTCAAAAAGAAGGTCT (738-760)
- CCR5Δ2, 5'-CATGATGGTGAAGATAAGCCTCACA (962-938)
- β-actin sense, 5'-TCACCAACTGGGACGACATG
- β-antisense, 5'-AGGCTGTGCTATCCCTGTAC
- β-actin probe, 5'-CAGCCATGTACGTTGCTATC

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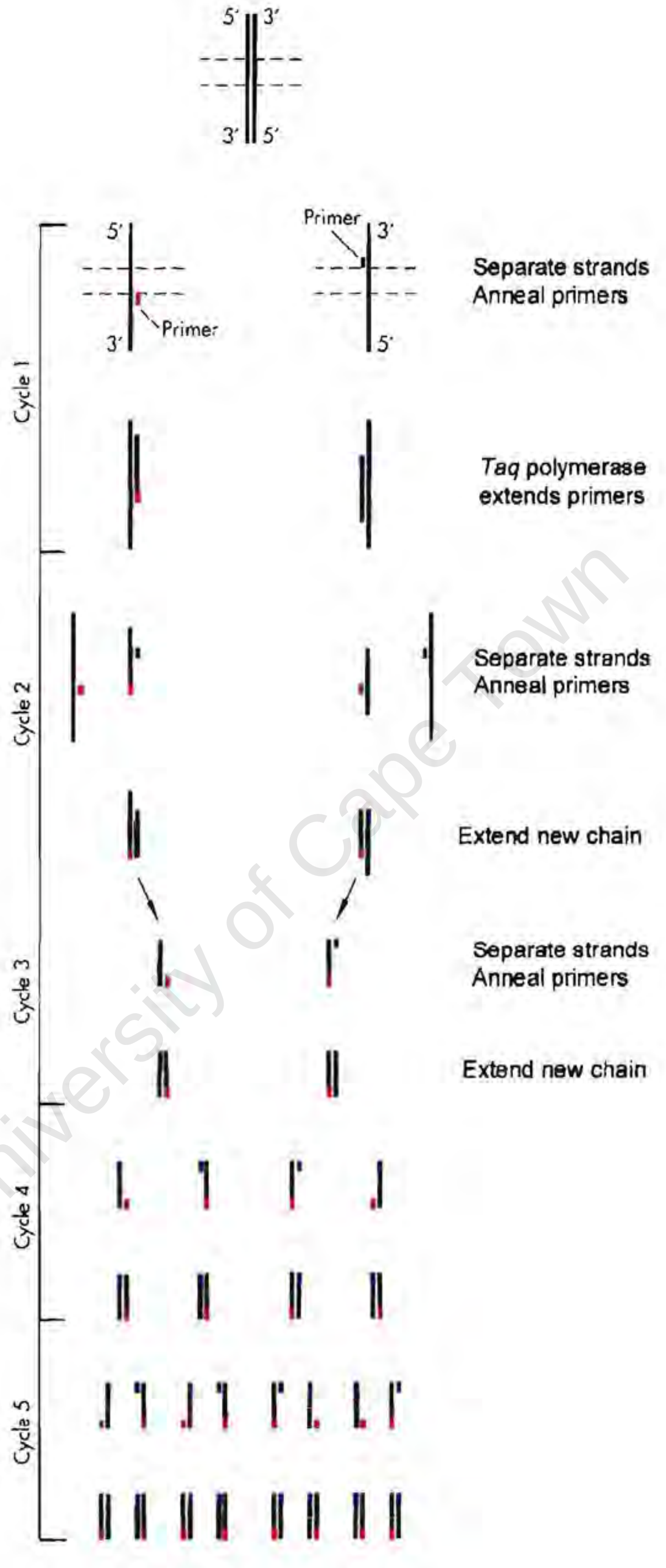

Figure 4.28 : Polymerase Chain Reaction (PCR)
(Watson, Gilman, Witkowski, Zoller 1992: 83)

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The vaccinia primers are used as they are genetically very similar to smallpox; it is the vaccine that is used to vaccinate people against smallpox (Aufderheide & Rodríguez-Martín 1998). Both the CCR5 and β-actin primer sets are for single copy genes in the human genome (personal communication Dr. J. Yeats, 2001). PCR for 'single genes' is used to demonstrate the presence of amplifiable human DNA (from any tissue) in a sample, i.e. DNA is present and no inhibitors (personal communication Dr. J. Yeats, 2001). There is no specific reason to target any particular gene; the CCR5 and β-actin primers just happened to be available in the laboratory at the time of testing (personal communication Dr. J. Yeats, 2001).

4.9 Statistical Methods

Both parametric and nonparametric statistical methods are employed. The Chi squared test, which is a measure of the level of agreement between a set of observed and expected values, is employed with qualitative data to test for significance of frequency of occurrence, or differences, between and within groups. Parametric tests are calculated on numerical data, means or variances, that follow a Normal distribution pattern characterised by a symmetric, bell-shaped curve. The most common parametric statistical test is the analysis of variance (ANOVA) which is used to test the hypothesis that the *means* from two or more samples are equal, i.e. drawn from populations within the same mean. When the test determines a difference between groups the Bonferroni, used for a small number of pairs of means, or the Tukey, used for a large number of pairs of means, post hoc pairwise comparison test is performed to determine which pairs differ. Nonparametric methods are utilised when the results are measured on an ordinal scale, i.e. data that uses a ranking system. These data do not follow a Normal distribution pattern and to attempt to calculate means and variances based on a ranking philosophy is completely incorrect. Two nonparametric methods utilised for ranking data are the Kruskal-Wallis statistical test, which is used to compare the medians of several independent samples and Mann-Whitney U statistical test, which is used to compare the medians of only two independent samples (Hassard 1991; SYSTAT 8.0). Testing is done using the statistical programme SYSTAT 8.0 (Wilkinson 2000). The results are presented as a probability value. If $p<0.05$ then the difference between means is significant and a significant difference exists between the samples. A low p-value indicates rejection of the null hypothesis of equivalency. The formulae employed for these tests are found in Hassard (1991) and listed below.

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- Chi squared test

$X^2 = \Sigma(\text{Observed} - \text{Expected})^2 / \text{Expected}$

- ANOVA

$F = S_1^2 / S_2^2$

Where S_1^2 is the larger variance.

When a difference occurs the Bonferroni or Tukey test is utilised.

- Kruskal-Wallis

$H = 12 / N(N+1) \times (S_1^2/n_1 + S_2^2/n_2 + S_k^2/n_k) - 3(N+1)$

Let n_i denote the number of individuals in group number i, N denote the total number of individuals, S_i denote the rank sum for group number i, and k denote the number of groups involved.

- Mann-Whitney U

The smaller of:

$T_a - n_a(n_a + 1) / 2$ or

$T_b - n_b(n_b + 1) / 2$

Where n_a is the number of results in group A, T_a is the rank sum for group A, n_b is the number of results in group B, T_b is the rank sum for group B.

In many instances the small sample sizes present in this project suggest a degree of caution when examining the data. When analysing the standard deviation (SD) often the number of individuals present is very small (n < 5) and/or unequal, therefore these SD values are not comparable between sites as the SD is calculated using, and therefore correlated with, sample size; it is not statistically viable to compare the SD across sites. Since it is not statistically viable to use *t*-tests when analysing a multi-group (more than two) experiment, the analysis of variance (ANOVA) test is employed for this project. Although it is

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statistically viable to use the ANOVA test the results (F-ratios) may not be meaningful, as the sample sizes are often uneven. All Chi squared values are significant at $p < 0.05$ level unless otherwise specified.

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CHAPTER 5

RESULTS : BIOARCHAEOLOGY OF THE NORTHERN FRONTIER

5.1 PRESERVATION AND CONDITION OF SKELETAL REMAINS

Tables 5.01 to 5.04 illustrate the postcranial and cranial preservation and condition of the skeletal remains in each site analysed for this project. The preservation of the Griqua remains is generally good. The individuals from Campbell and Philippolis are the best preserved and most complete. Bethulie is also relatively well preserved but has fewer complete individuals than the previous two sites. The skeletal remains from Danielskuil and de Tuin display the worst preservation and completeness of all the Griqua skeletons. The poor preservation and incompleteness of the Danielskuil remains is a result of improper curation. Even though the de Tuin sample resulted from a series of controlled excavations it is also composed entirely of juvenile skeletons which do not preserve as well as adults. The Colesberg site, which also arose from a series of controlled excavations, shows very good preservation and completeness of the skeletal samples, which is a result from proper curation by the SAM. Although the Wolmaransstad skeletons were excavated by an individual trained in zoology they exhibit excellent preservation, which is a result of proper curation by the NMB.

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5.2 DEMOGRAPHIC MODELS AND MORTALITY PROFILES

5.2.1 SEX AND AGE DISTRIBUTION

The distribution of males and females varies considerably between, and within, the Griqua, Colesberg, and Wolmaransstad samples (Tables 5.05 & 5.06). One individual, Campbell/A2835, illustrates a discrepancy between this project and Morris (1984) for the biological sex. The present author estimates the sex of Campbell/A2835 as female however Morris (1984) estimates the sex as male. The skeletal catalogue in the Department of Anatomy, University of the Witwatersrand cites the biological sex

Site	Excellent n	Very Good n	Good n	Poor n	Total n
Griqua	29	28	39	24	120
Campbell	13	11	6	6	36
Danielskuil	0	1	18	13	32
Philippolis	15	1	1	0	17
Bethulie	1	12	5	5	23
De Tuin	0	3	9	0	12
Colesberg	5	9	11	5	30
Wolmaransstad	31	3	0	1	35

Table 5.01 : Postcranial preservation of skeletal samples

Site	Excellent n	Very Good n	Good n	Poor n	Total n
Griqua	41	13	20	42	116
Campbell	22	4	4	4	34
Danielskuil	0	6	9	20	35
Philippolis	14	1	0	1	16
Bethulie	5	1	6	7	19
De Tuin	0	1	1	10	12
Colesberg	8	17	11	15	51
Wolmaransstad	18	1	3	1	23

Table 5.02 : Cranial preservation of skeletal samples

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Site	Complete n	Nearly Complete n	Incomplete n	Total n
Griqua	3	51	66	120
Campbell	2	30	4	36
Danielskuil	0	2	30	32
Philippolis	0	5	12	17
Bethulie	0	5	18	23
De Tuin	1	9	2	12
Colesberg	1	26	3	30
Wolmaransstad	0	2	33	35

Table 5.03 : Postcranial condition of skeletal samples

Site	Complete n	Nearly Complete n	Incomplete n	Total n
Griqua	36	41	39	116
Campbell	26	6	2	34
Danielskuil	2	12	21	35
Philippolis	3	13	0	16
Bethulie	5	7	7	19
De Tuin	0	3	9	12
Colesberg	23	28	0	51
Wolmaransstad	17	6	0	23

Table 5.04 : Cranial condition of skeletal samples

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as being 'indeterminate'. The skull is very male-like however the pelvis is female-like: there is a sub-pubic concavity and pre-auricular sulcus. Since the most accurate method for estimating the sex of an individual is by analysis of the pelvis, Campbell/A2835 is included as a female in this research.

Within the Wolmaransstad site there are five times as many males as females, the greatest within population disparity. When Wolmaransstad is compared to either the Colesberg or Griqua communities, it has nearly 3.5 times as many males as females. The Griqua and Colesberg populations share similar sex ratios within and between their communities; the male to female ratio in the Griqua sample (1.4:1) is slightly higher than the ratio present in the Colesberg sample (1.2:1). There is a small percentage of adult individuals (3.5%) for which the estimation of sex could not be determined. In the Griqua and Wolmaransstad populations there were six (4.4%) and two (5.13%) adult individuals, respectively, who could not be classified as either male or female. All adult remains in the Colesberg community could be categorised as either male or female.

The results of the Chi square test illustrate a significant difference in the composition of males and females between all of the groups ($p = 0.02$), between the Griqua and Wolmaransstad sites ($p = 0.03$), and between Colesberg and Wolmaransstad ($p = 0.01$). There is no significant difference in the composition of males and females between the Griqua and Colesberg sites ($p = 0.15$).

The ages between and within the samples also vary greatly (Table 5.05). The largest percentage of individuals in the Griqua sample are infants (29.6%) whereas in the Colesberg sample they are younger adults (67.3%) and in the Wolmaransstad sample they are older adults (35.9%). The child/adult ratio where child includes infants, juveniles and sub-adults and adult includes younger adults and older adults is a useful general guide to age differences in the samples (Tables 5.05 to 5.07). The Colesberg and Wolmaransstad populations contain mostly adult individuals, whereas the Griqua population has a large representation of children as well as adults. The largest percentage of individuals in the Griqua sample are children (44.4%). However, in the Colesberg sample (88.5%) and in the Wolmaransstad site (92.3%) the largest percentage of individuals are adults.

The Chi square test for significance shows a significant difference in the frequency of age categories when all sites are included ($p < 0.001$). There is also a significant difference ($p < 0.001$) when each site is tested against one another, i.e. Griqua and Colesberg, Griqua and Wolmaransstad, and Colesberg and Wolmaransstad. When the test is applied to the child/adult ratio, there is a significant

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			MALES				FEMALES					
Site	Infants	Juveniles	SA	YA	OA	MI	SA	YA	OA	MI	Unsexed	Total
Griqua	40	15	3	17	17	6	2	14	9	6	6	135
Bethulie	14	3	0	0	5	1	0	0	3	2	0	28
Campbell	14	1	0	5	5	0	1	6	4	0	0	36
Danielskuil	4	7	3	7	5	4	0	3	1	3	4	41
De Tuin	8	4	0	0	0	0	0	0	0	0	0	12
Philippolis	0	0	0	5	2	1	1	5	1	1	2	18
Colesberg	1	5	0	18	4	3	0	17	2	2	0	52
Wolmaransstad	1	0	1	3	14	12	1	2	0	3	2	39
TOTAL	42	20	4	38	35	21	3	33	11	11	8	226

Infants = Birth - 5 years
Juveniles = 5.1 - 15 years
SA = sub-adults; 15.1 - 20 years
YA = younger adults; 20.1 - 40 years
OA = older adults; 40.1+ years
MI = mature individuals, osteologically adult, can only estimate large age range
Unsexed Adult = Osteologically adult but unable to estimate sex

Table 5.05 : Sex and age distribution for the Griqua, Colesberg and Wolmaransstad sites

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Site Name	Male : Female Ratio
Griqua	1.4 : 1
Colesberg	1.2 : 1
Wolmaransstad	5.0 : 1

Table 5.06 : Male to female ratio for each site, only includes adults, MI's included.

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Site Name	*Child : Adult Ratio
Griqua	0.80 : 1
Colesberg	0.13 : 1
Wolmaransstad	0.14 : 1

*Child = includes infants, juveniles and sub-adults

Table 5.07 : Child to adult ratio for each site, MI's included.

difference between all sites ($p < 0.001$), and between Griqua and Colesberg ($p < 0.001$), and Griqua and Wolmaransstad ($p < 0.001$). There is no significant difference in the child/adult ratio between Colesberg and Wolmaransstad ($p = 0.85$).

5.2.2 MORTALITY PROFILES

Mortality curves illustrate only those individuals who died in a population. Skeletal samples are never fully representative of all the individuals who are at risk of disease or death at any given age, but only those who die at that age (Wood *et al.* 1992). However, they are still useful tools for answering the question, 'what was life like for these people at this time?'

Since mortality profiles are constructed based on the individual's age-at-death, the MI category is not included in the analysis. However, within all three samples there are older adult individuals who can not be accurately aged, e.g. 45+ years, but since the parameters for the OA category are 40.1+ years of age they are included within this age group. These individuals are included in the 40-45 years age range in figures 5.01 to 5.06. Weiss (1973) asserts that the general pattern of human sub-adult mortality in anthropological populations is one of very high infant mortality, which decreases between the ages of 1-5, and further declines until ages 10-15. According to David Bourne (personal communication, 2001), normal mortality profiles for historic populations have a large number of infants and juveniles dying, a lesser number of sub-adults, and an increase in deaths in the younger adult and older adult age categories. Only the Griqua sample represents what could be accepted as a normal mortality curve for historic populations (Figures 5.01 & 5.02); Griqua infants (n = 40), juveniles (n = 15), sub-adults (n = 5), younger adults (n = 31), older adults (n = 26). In the Griqua sites there are more younger adult males (n = 17) than females (n = 14) and two times as many older adult males (n =17) as older adult females (n = 9). There are eight OA males and five OA females that can not be aged specifically. The Griqua sites also contain two unsexed younger adults.

The Colesberg site does not represent a normal mortality curve for historic populations (Figures 5.03 & 5.04) as there are a very small number of infants (n = 1) and juveniles (n = 5) dying, no sub-adults, large numbers of younger adults (n = 35), and only six older adults. There are approximately equal numbers of males (n = 18) and females (n = 17) in the younger adult category and more older adult males (n = 4) than females (n = 2) dying at the Colesberg site. Four OA males and one OA female can

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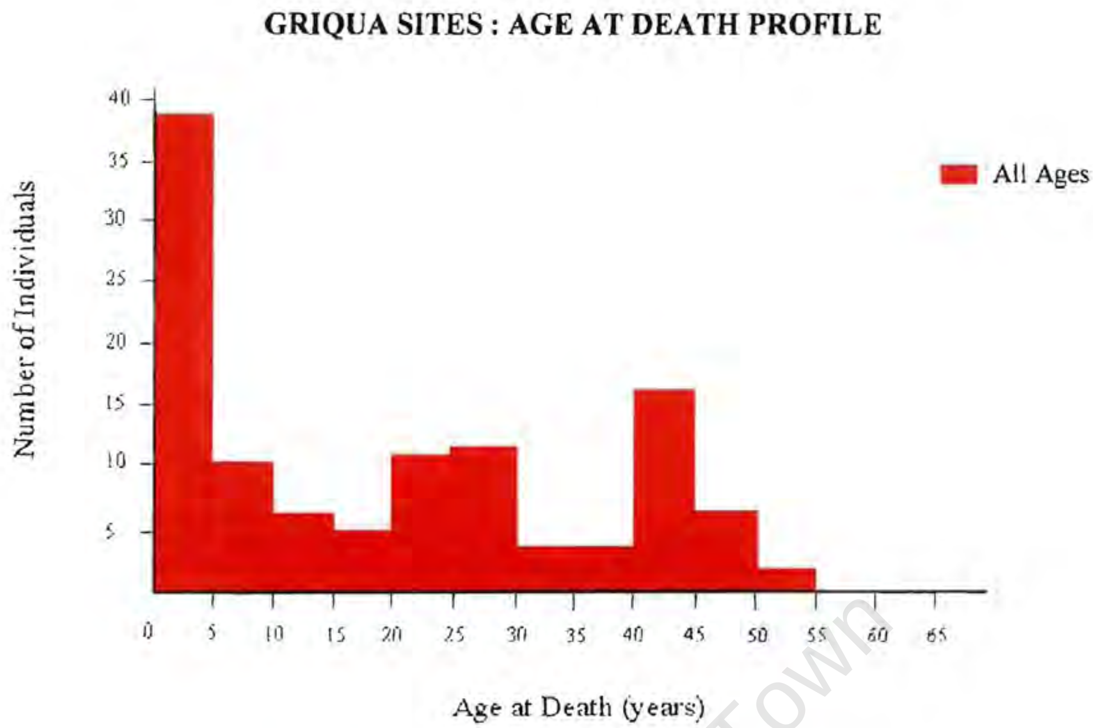

Figure 5.01 : Griqua sites age-at-death profile – all ages

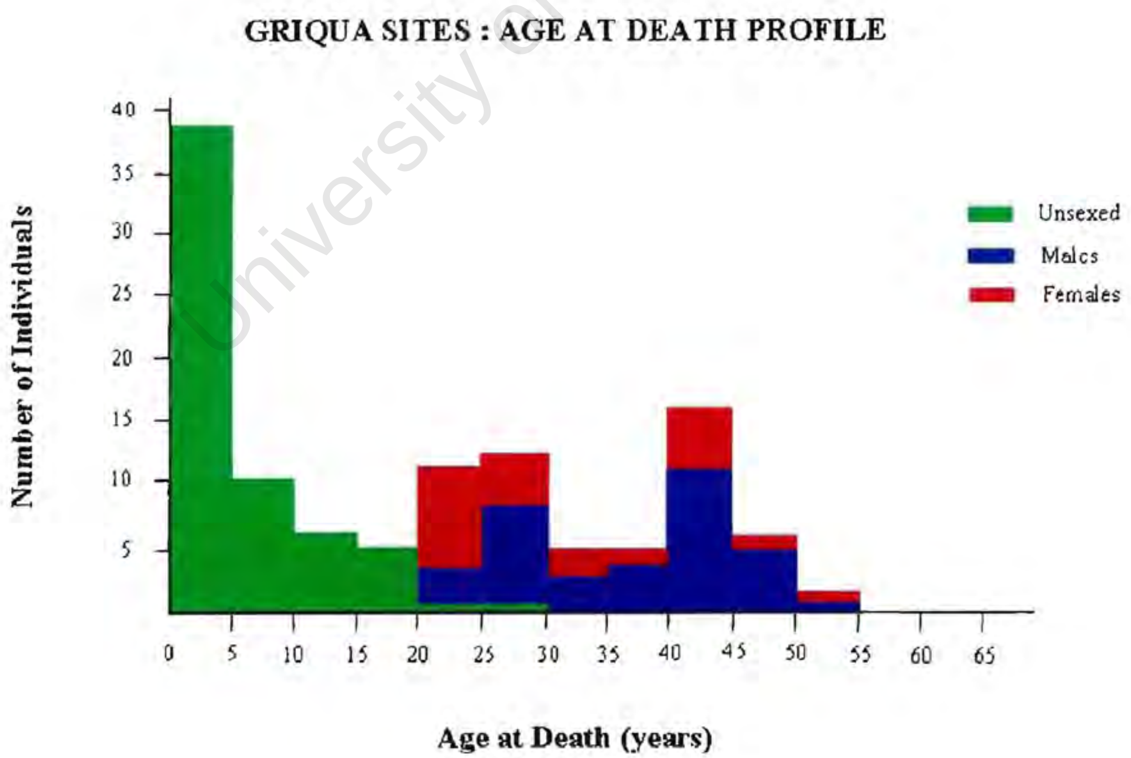

Figure 5.02 : Griqua sites age-at-death profile – males and females

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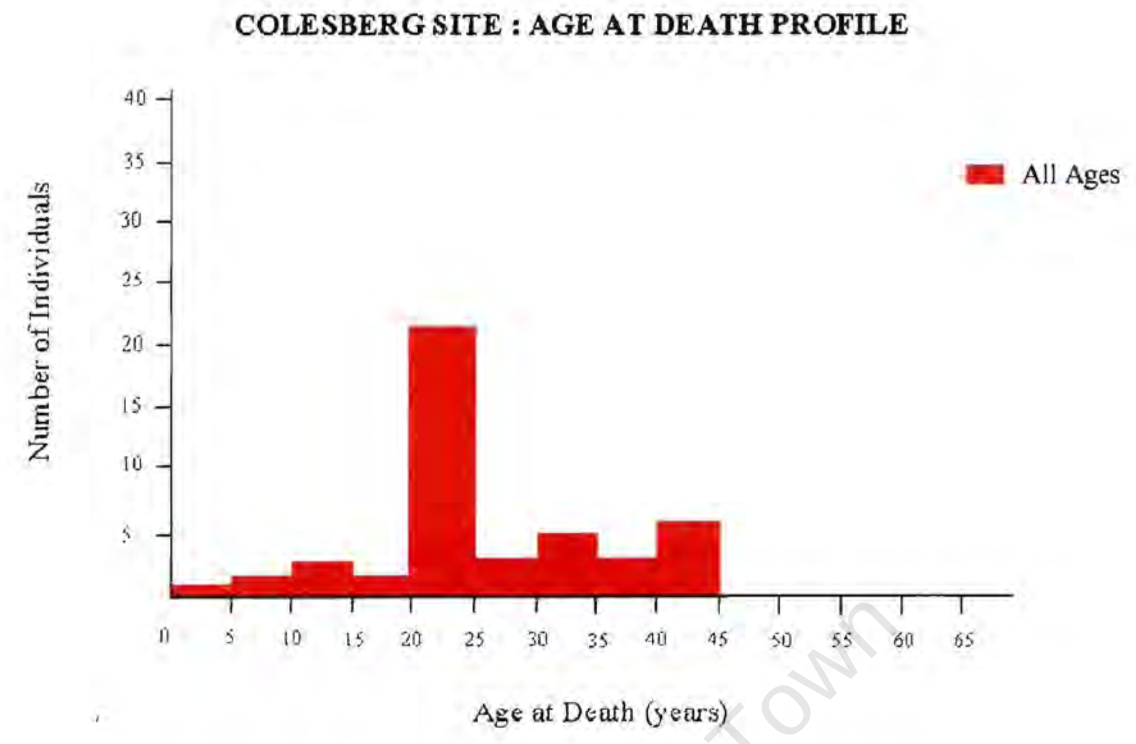

Figure 5.03 : Colesberg site age-at-death profile – all ages

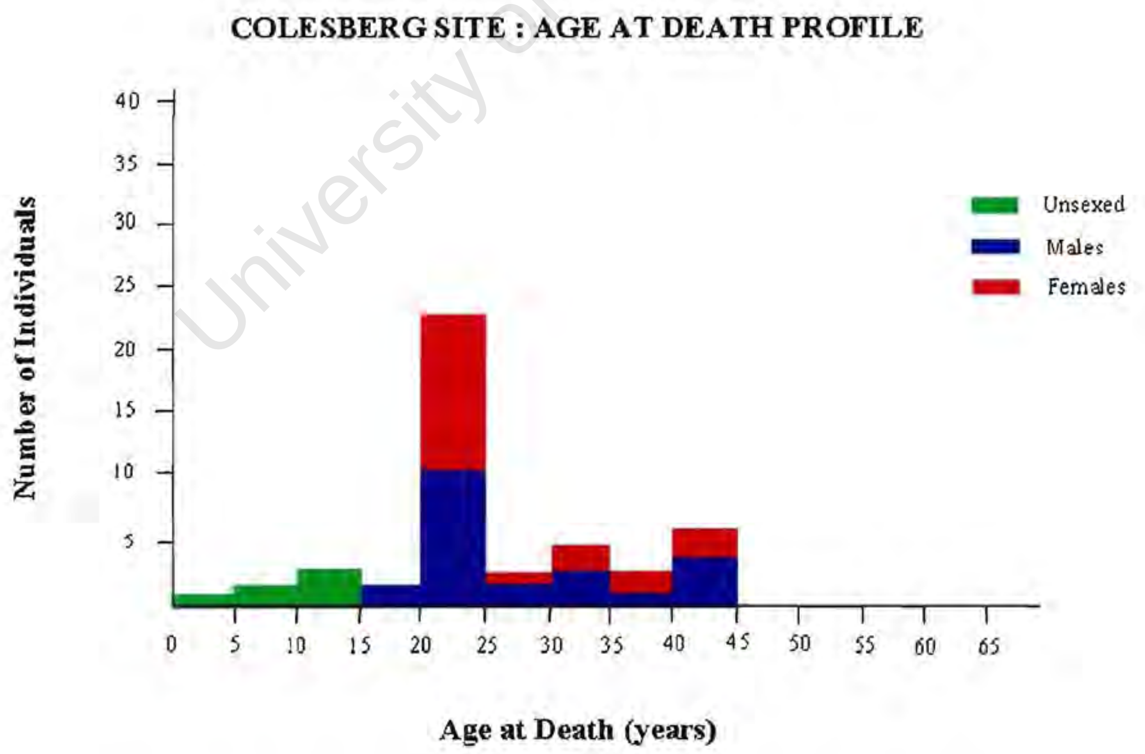

Figure 5.04 : Colesberg site age-at-death profile – males and females

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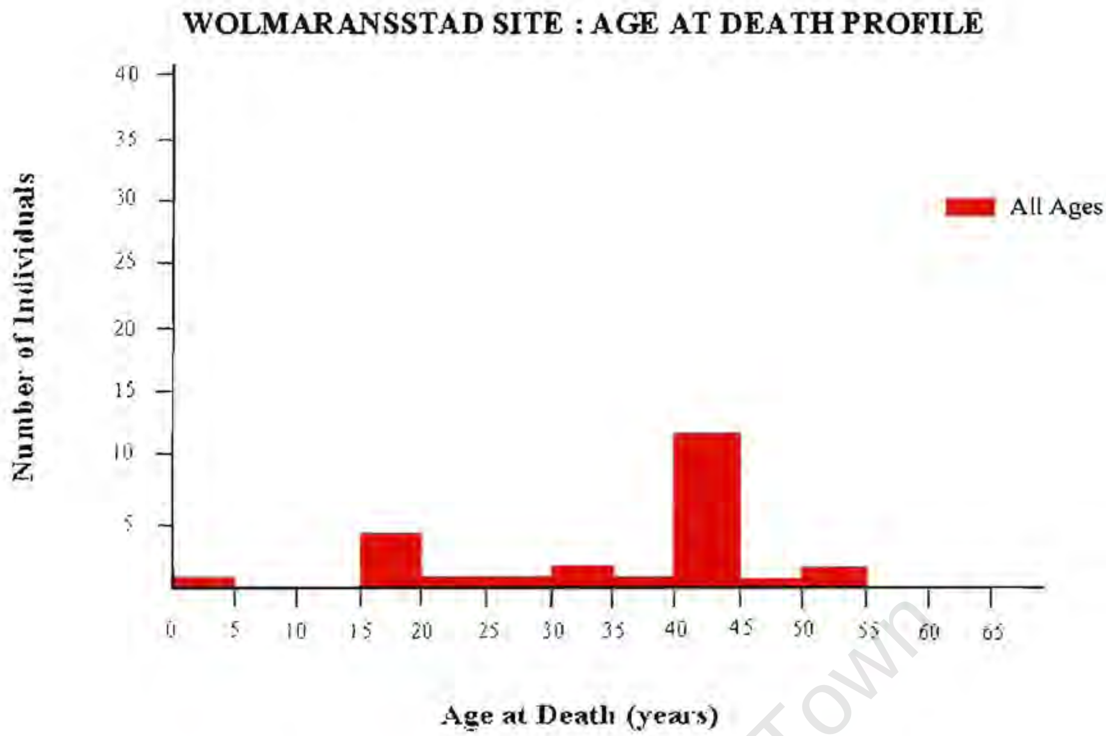

Figure 5.05 : Wolmaransstad site age-at-death profile – all ages

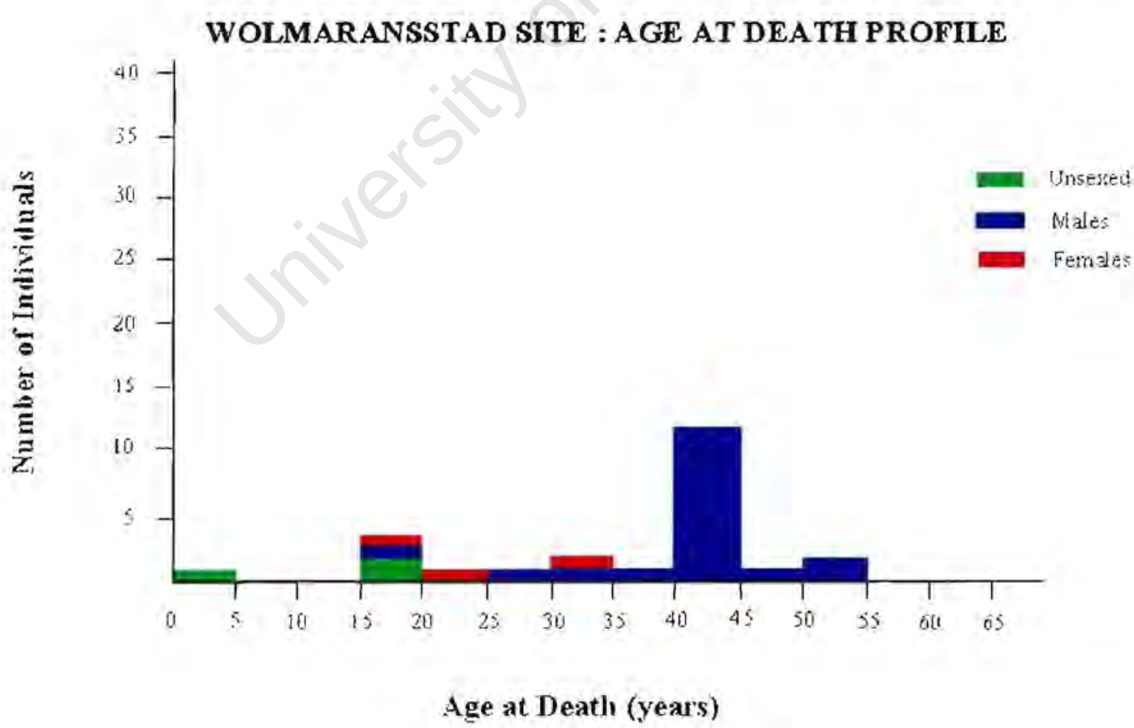

Figure 5.06 : Wolmaransstad site age-at-death profile – males and females

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not be aged specifically. The Wolmaransstad site also does not represent a normal mortality curve for historic populations (Figures 5.05 & 5.06). There is only one infant present, no juveniles, very few sub-adults (n = 2) and younger adults (n = 5), and the majority are older adults (n = 14). Two unsexed sub-adults are also present. There are five times as many males as females in this site. The sub-adult category has equal numbers of males and females, but the younger adult and older adult category contain more males than females. There are no older adult females present. There are nine OA males that can not be aged specifically.

5.3 Growth

5.3.1 Long Bone Length

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This project utilises the Lundy and Feldesman (1989) femur stature ratio of 3.745 to estimate stature. This ratio is employed as it is said to be gender and ethnic group neutral (Wilson & Lundy 1994). Other published stature formulae require the estimation of biological races (Genovés 1967; Lundy & Feldesman 1987; Steele 1970; Steele & McKern 1969; Trotter & Gleser 1951, 1952, 1958), which may be inappropriate for this geographical region. Accurate height reconstruction data are not available for all indigenous South African populations. Long bone lengths are therefore utilised as a general guide to stature, but not as an accurate assessment of living stature as in the forensic sense. Statures will be reconstructed and compared only from the femur and all other bones will only be used for direct comparison. Long bone measurements are employed in two contexts:

- Reflecting adult stature
- Reflecting growth in children

The younger adult, older adult and MI age categories are employed for the adult long bone lengths. Although the long bones continue to grow until approximately the age of 25, the additional length is very minimal; significant growth has stopped in most individuals by the age of 18 years (Ortner & Putschar 1985).

The ANOVA (Analysis of Variance) test is applied to the mean long bone lengths in all sites. The Bonferroni or Tukey multiple comparison test is used to determine <u>where</u> the significant difference occurs; the test adjusts the observed significance level to compensate for multiple comparisons (Hassard 1991).

The mean maximum adult femur length is compared between each site and stature estimation is presented (Table 5.08). In all groups males are taller than females but there is also a distinct stature difference between sites. The Wolmaransstad males (1723.8 mm) and females (1554.2 mm) are the tallest and the Colesberg males (1558.7 mm) and females (1471.8 mm) are the shortest. Within the femur, tibia, humerus and radius there is a significant difference in mean bone length when sites are compared (Figures 5.07, 5.09, 5.11, 5.13). In each long bone category there is also a significant difference in mean length within the males when the following sites are compared: Griqua and Wolmaransstad and Colesberg and Wolmaransstad. However the tibiae also display a significant difference in mean length between the Griqua and Colesberg sites (Figures 5.08, 5.10, 5.12, 5.14). There is no significant difference in female humeri lengths. The female long bones show a significant difference in mean length when the Griqua and Colesberg sites are compared. The radii also display a significant difference in mean length when the Colesberg and Wolmaransstad sites are compared (Figures 5.08, 5.10, 5.12, 5.14).

Long bone lengths can also illustrate degrees of differences between males and females. Hamilton (1982) proposes a formula for testing sexual dimorphism in human skeletal samples:

$$(\text{Male mean} - \text{Female mean}) \div \text{Female mean} \times 100$$

The formula assumes males are taller than females, which is generally the norm within most human populations (Hamilton 1982; Wolfe and Gray 1982). The answer expresses how much taller males are compared to females. Using the mean stature the Griqua show sexual dimorphism of 6%, Colesberg 5.9% and Wolmaransstad 10.9%. In the Griqua and Colesberg communities the males are about 6% taller than the females, whereas in the Wolmaransstad sample the males are almost 11% taller than the females. Stini (1975) comments that a decrease in sexual dimorphism is indicative of increased stress since growing males are more susceptible to stress than growing females. However, Larsen (1984) argues that an increase in sexual dimorphism is associated with an increase in stress – the increased physical work load placed on females decreases their growth. There are many variables that confound the analysis of

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	GRIQUA	COLESBERG	WOLMARANSSTAD	ANOVA p-values**
MALES				
FEMUR*	~	~	~	< 0.001
n	24	14	16	
mean (mm)	432.9	416.2	460.3	
SD	22.1	26	23.5	
Stature (mm)	1621.2	1558.7	1723.8	
TIBIA*	~	~	~	< 0.001
n	19	14	14	
mean (mm)	366.9	343.8	397.3	
SD	16	27.9	20.7	
HUMERUS*	~	~	~	< 0.001
n	19	11	10	
mean (mm)	300.8	287.3	319.9	
SD	12.9	14.8	18.9	
RADIUS*	~	~	~	< 0.001
n	17	10	13	
mean (mm)	234.4	225.3	253.1	
SD	13.5	19.7	16.8	
FEMALES				
FEMUR*	~	~	~	0.01
n	20	13	3	
mean (mm)	408.1	393.0	415.0	
SD	13.1	24.5	22.6	
Stature (mm)	1528.3	1471.8	1554.2	
TIBIA*	~	~	~	0.01
n	18	12	4	
mean (mm)	345.3	327.8	350.8	
SD	14.4	17.1	25.1	
HUMERUS*	~	~	~	0.05
n	18	10	3	
mean (mm)	280.8	266.5	282.7	
SD	12.4	17.8	18.9	
RADIUS*	~	~	~	0.01
n	15	9	3	
mean (mm)	219.5	201.4	230.7	
SD	14.1	16.4	8.1	

*Left bone measured or right when left is missing

** ANOVA comparison of all three samples combined; p < 0.05 is significant

Table 5.08 :Long bone lengths for individuals 20+ years

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	1	2	3
1	-		
2	0.008	-	
3	<0.001	<0.001	-

1 = COLESBERG
2 = GRIQUA
3 = WOLMARANSSTAD
P ≤ 0.05 is significant

Figure 5.07 : Bonferroni test of significance for mean femur length

MALES

FEMALES	1	2	3
1		0.15	<0.001
2	0.01		0.001
3	0.13	1.00	

1 = COLESBERG
2 = GRIQUA
3 = WOLMARANSSTAD
P ≤ 0.05 is significant

Figure 5.08 : Bonferroni test of significance for mean femur length- males & females

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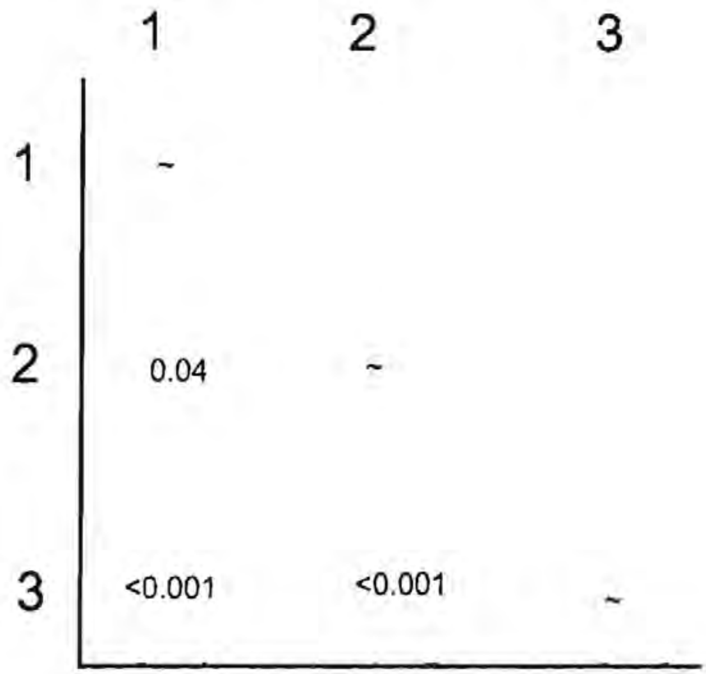
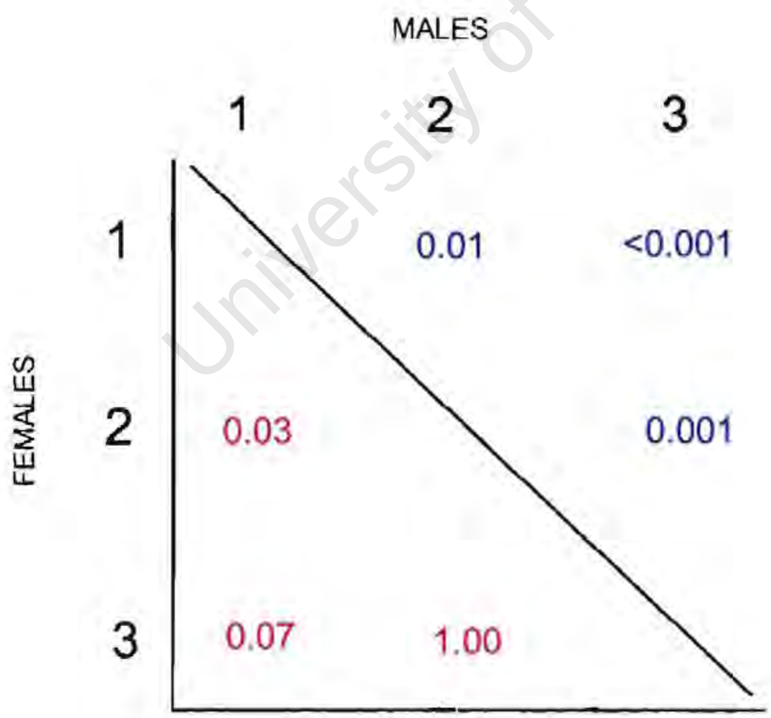


1 = COLESBERG
2 = GRIQUA
3 = WOLMARANSSTAD
P ≤ 0.05 is significant

Figure 5.09 : Bonferroni test of significance for mean tibia length



1 = COLESBERG
2 = GRIQUA
3 = WOLMARANSSTAD
P ≤ 0.05 is significant

Figure 5.10 : Bonferroni test of significance for mean tibia length- males & females

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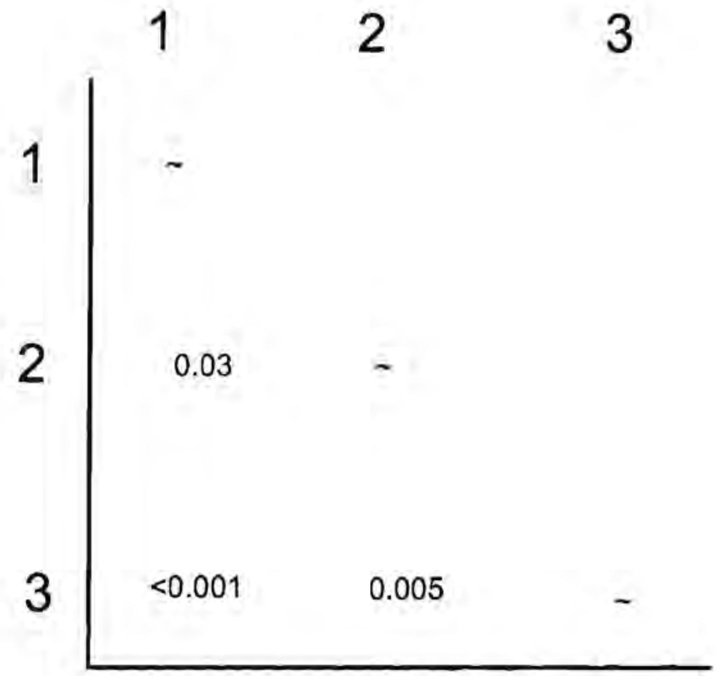
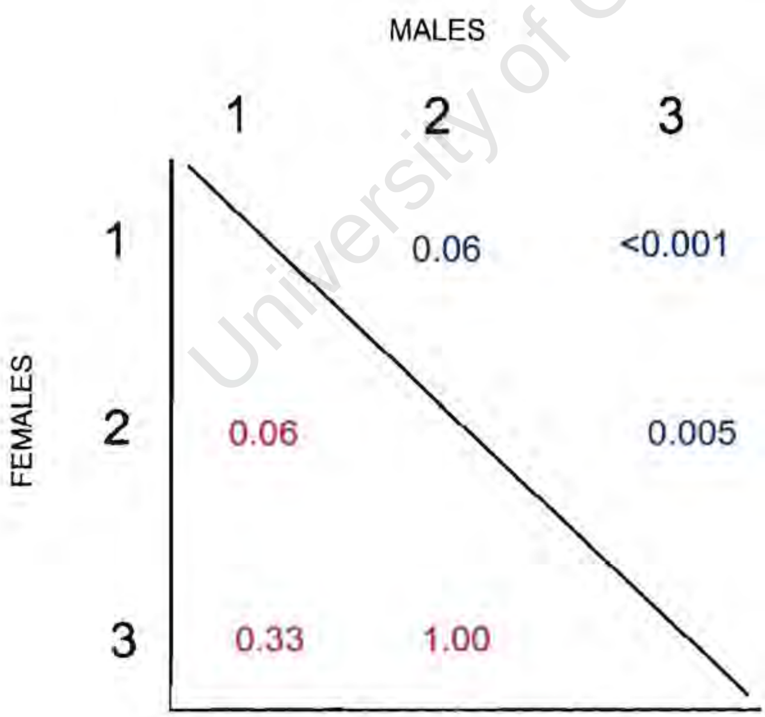


1 = COLESBERG
2 = GRIQUA
3 = WOLMARANSSTAD
P ≤ 0.05 is significant

Figure 5.11 : Bonferroni test of significance for mean humeri length



1 = COLESBERG
2 = GRIQUA
3 = WOLMARANSSTAD
P ≤ 0.05 is significant

Figure 5.12 : Bonferroni test of significance for mean humeri length- males & females

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	1	2	3
1	-		
2	0.03	-	
3	<0.001	<0.001	-

1 = COLESBERG
2 = GRIQUA
3 = WOLMARANSSTAD
$P \leq 0.05$ is significant

Figure 5.13 : Bonferroni test of significance for mean radius length

MALES (columns) / FEMALES (rows)

	1	2	3
1		0.53	<0.001
2	0.02		0.007
3	0.02	0.61	

1 = COLESBERG
2 = GRIQUA
3 = WOLMARANSSTAD
$P \leq 0.05$ is significant

Figure 5.14 : Bonferroni test of significance for mean radius length- males & females

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sexual dimorphism: genetic variation in the degree of sexual dimorphism in a given population, likelihood that males are protected from stress in many societies, the same traits which are employed to estimate sex are often used to access the degree of dimorphism, thus engendering circularity (Goodman *et al.* 1984b).

The diaphyseal femur lengths of each individual under the age of 20 years are illustrated in figure 5.15. Only the Griqua diaphyseal femur lengths are represented as the Colesberg and Wolmaransstad samples contain too few individuals below 20 years old. Since many of the individuals have age ranges rather than specific ages e.g. 6 to 9 months old, the mean age for each individual is recorded on figure 5.15. The growth curve illustrates a normal biological progression: as the individuals increase in age their femur length also increases. Although the distal end of the femur continues to grow until approximately 21 years of age the majority of growth has ceased in most individuals by about 18 years (Ortner & Putschar 1985). There is no adolescent growth spurt evident in the graph as there are too few individuals in the 10 to 14 age range. Since juveniles can not be sexed osteologically the sex ratio may be biased for these juveniles, i.e. there may not be a 1:1 sex ratio for males to females.

5.3.2 Harris Lines : Lines of Arrested Growth

The occurrence of Harris lines, transverse lines of radiodensity at the ends of long bones, are recorded and analysed in the tibia of the Griqua, Colesberg and Wolmaransstad samples (Table 5.09). They are of interest because they are related to periods of stress so great as to arrest long bone growth (Aufderheide & Rodríguez-Martín 1998; Garn *et al.* 1968). Steinbock (1976) cites two factors involved in the formation of these lines. Firstly is the arrest of bone growth due to nutritional deficiency or disease when the layer of cartilage cells below the growth plate is replaced by osteoblasts which form a thin layer of bone. Secondly, as the individual begins to recover from the stress incident this thin layer of bone thickens and forms a transverse radiopaque line visible on a radiograph. Therefore, it is not the cessation of growth that causes the Harris lines but rather the recovery from the stressful condition.

The Griqua population has a slightly higher percentage (10.4%) of individuals expressing Harris lines than either the Colesberg (5.8%) or Wolmaransstad (10.3%) sites. The Griqua sample also has a larger number of lines per person (2.4 lines/person) than either the Colesberg (2 lines/person) or Wolmaransstad (2 lines/person) sites. In the Griqua sites there are more females (n = 8) who express Harris lines than males (n = 6). Since there are no females with Harris lines in the Colesberg and

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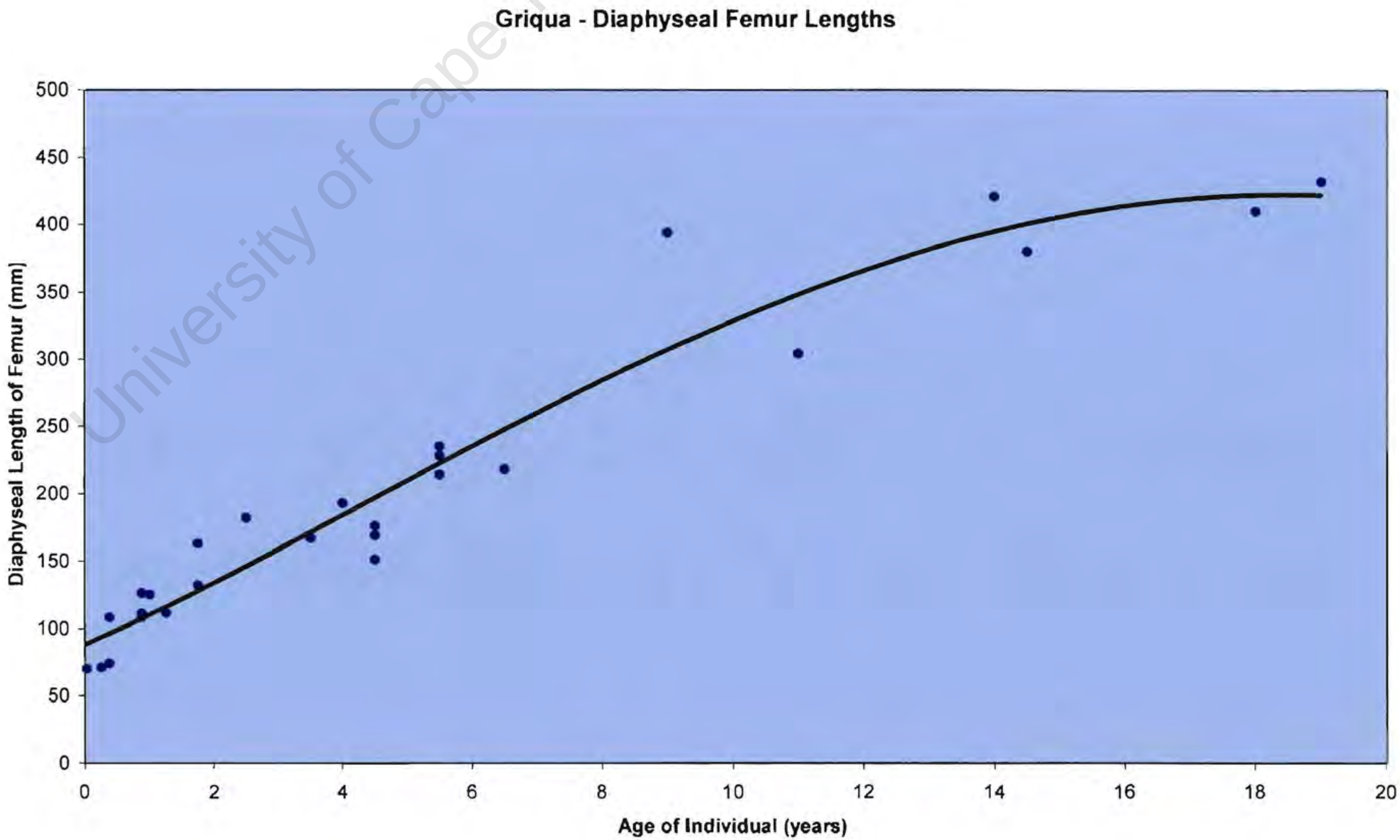

Figure 5.15 : Diaphyseal length of femurs in the Griqua population

Individual	Sex	Age-at-death (years)	Number of Lines	Age of line formation (years)
Griqua				
Campbell/A2264	female	30-40	1	1-2
Campbell/A2265	female	60+	4	1-2
				6-7
				8-9
				13-14
Campbell/A2269	female	45-50	3	1-2
				3-4
				12-13
Campbell/A2507	female	18-20	1	3-4
Campbell/A2826	male	40-50	2	6-7
				9-10
Campbell/A2832	female	20-25	1	6-7
Philippolis/NMB1570	male	35-40	2	11-12
				11-12
Philippolis/NMB1604	male	40-45	4	10-11
				11-12
				13-14
				14-15
Philippolis/NMB1606	male	25-30	6	10-11
				11-12
				13-14
				14-15
				15-16
				17-18
Philippolis/NMB1609	female	17-20	1	2-3
Philippolis/NMB1610	female	30+	4	10-11
				11-12
				12-13
				15-16
Philippolis/NMB1612	male	30+	1	3-4
Bethulie/NMB1617b	male	50	1	13-14
Bethulie/NMB1621	female	45-50	2	5-6
				8-9
Colesberg				
SAM4489	male	35	1	14-15
SAM4493	male	35+	4	11-12
				12-13
				13-14
				14-15
SAM4515	male	21-23	1	11-12
Wolmaransstad				
NMB23b	male	30+	3	< 1
				3-4
				4
NMB1185b	male	18-20	2	7-8
				11-12
NMB1345	male	25+	2	14-15
				17-18
NMB1346b	male	26+	1	17-18

Table 5.09 : Individuals exhibiting Harris Lines

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Wolmaransstad sites the frequency of Harris lines between the sexes can not be discussed; it is not statistically viable. The frequency of lines in the Griqua population peaks between one and four years and again between 10 and 14 years. The highest frequency of lines in the Colesberg sample is between 11 and 15 years. The Wolmaransstad sample contains too few individuals with Harris lines to comment on their frequency (Figure 5.16).

5.4 Musculoskeletal Stress Markers : Robb's Scores

Ten entheseal sites on the humeri and tibiae are analysed, using Robb's scores (Robb 1994), for their response to biomechanical stress. Sex and age categories are analysed separately to highlight differences that may occur between males and females and with increasing age (Tables 5.10 to 5.23). Since age is an important variable MI's are not included in this analysis. The Mann-Whitney U test, a nonparametric test that compares ranked data of two independent samples, and the Kruskal-Wallis test, a nonparametric test that compares ranked data of three or more samples, are employed to test for statistically significant differences in entheseal data. The sample size disparity in all age groups warrants a degree of caution when comparing data between sites. There are too few females present in the Wolmaransstad sample for analysis. The standard deviation cannot be compared between populations, as the sample sizes are unequal and too small. The upper limb and lower limb are analysed independently to determine if there is a difference in muscle grade expression between males and females between and within each site.

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Table 5.20 illustrates the entheseal scores when the upper limb muscles are analysed as one unit. Mean entheseal scores are calculated by pooling all scores – weighted averages are not calculated. In the Griqua sites the younger adult males have higher muscle grades than the younger adult females however, the older adult females have higher scores than the older adult males. The large standard deviation present in the Griqua YA females (SD = 0.73) is due to the wide range of scores: the entheses vary from grade 1 to grade 4. Statistical analyses are not computed on samples when $n < 5$ as these are not statistically viable.

Table 5.21 illustrates the entheseal scores when the lower limb muscles are analysed as one unit. Mean entheseal scores are calculated by pooling all scores – weighted averages are not calculated. In the Griqua sites the younger and older adult males have higher muscle grades than the younger and older

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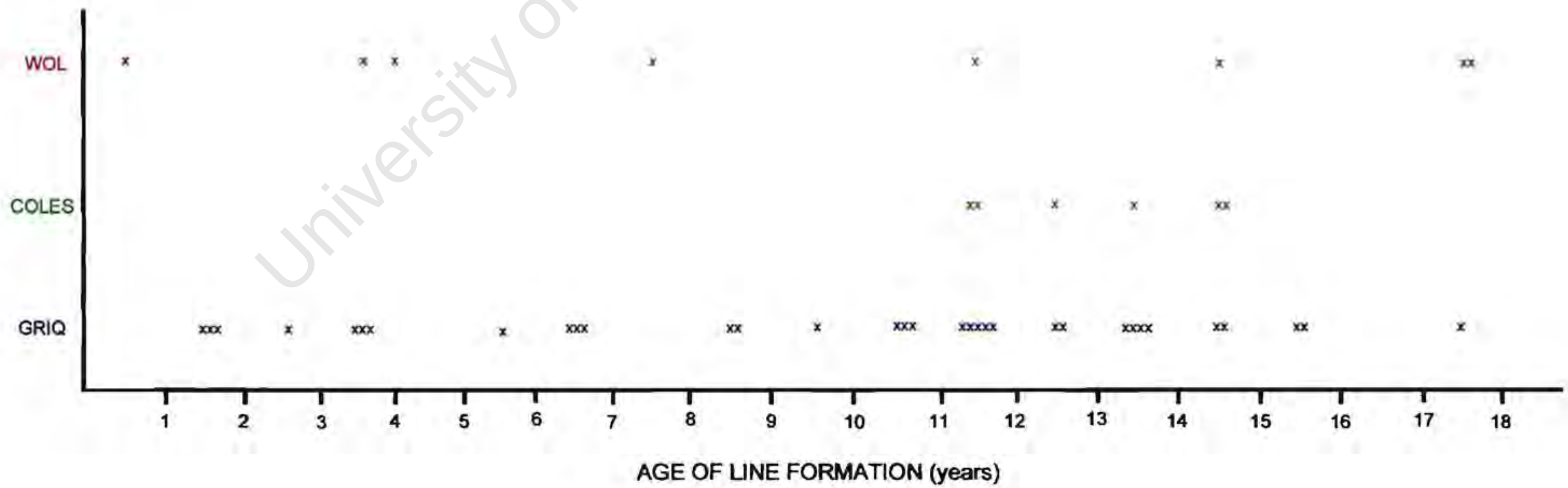

GRIQ = Griqua
COLES = Colesberg
WOL = Wolmaransstad

Figure 5.16 : Harris Lines – Age of formation in each site

	GRIQUA	COLESBERG	WOLMARANSSTAD
YA males			
n	7	2	1
Mean	2.83	2.50	4.00
SD	0.41	0.71	~
OA males			
n	8	1	2
Mean	3.25	2.00	4.50
SD	0.71	~	0.71
YA females			
n	9	5	0
Mean	3.00	3.40	~
SD	0.87	0.55	~
OA females			
n	7	0	0
Mean	3.86	~	~
SD	0.69	~	~

YA = younger adult
OA = older adult

Table 5.10 : Enthesis scores - Subscapularis

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	GRIQUA	COLESBERG	WOLMARANSSTAD
YA males			
n	5	2	0
Mean	3.00	2.00	~
SD	0.00	0.00	~
OA males			
n	6	0	1
Mean	3.00	~	4.00
SD	0.63	~	~
YA females			
n	8	4	0
Mean	2.63	2.75	~
SD	0.92	0.50	~
OA females			
n	7	0	0
Mean	3.71	~	~
SD	0.76	~	~

YA = younger adult
OA = older adult

Table 5.11 : Enthesis scores – Supraspinatus/Infraspinatus

	GRIQUA	COLESBERG	WOLMARANSSTAD
YA males			
n	5	2	1
Mean	3.00	2.00	4.00
SD	0.00	0.00	~
OA males			
n	7	0	1
Mean	3.00	~	4.00
SD	0.58	~	~
YA females			
n	9	5	0
Mean	3.00	3.00	~
SD	0.71	0.71	~
OA females			
n	7	0	0
Mean	3.86	~	~
SD	0.69	~	~

YA = younger adult
OA = older adult

Table 5.12 : Enthesis scores – Pectoralis major

	GRIQUA	COLESBERG	WOLMARANSSTAD
YA males			
n	8	6	1
Mean	2.88	2.17	4.00
SD	0.35	0.41	~
OA males			
n	9	1	2
Mean	2.89	3.00	4.00
SD	0.60	~	0.00
YA females			
n	9	6	0
Mean	2.89	2.67	~
SD	0.78	0.52	~
OA females			
n	7	1	0
Mean	3.71	2.00	~
SD	0.49	~	~

YA = younger adult
OA = older adult

Table 5.13 : Enthesis scores – Latissimus dorsi

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	GRIQUA	COLESBERG	WOLMARANSSTAD
YA males			
n	8	8	2
Mean	3.00	2.75	4.50
SD	0.76	0.46	0.71
OA males			
n	10	1	2
Mean	2.80	4.00	4.00
SD	0.63	~	0.00
YA females			
n	10	10	1
Mean	2.50	2.50	3.00
SD	0.53	0.71	0.00
OA females			
n	7	1	0
Mean	3.57	3.00	~
SD	0.53	~	~

YA = younger adult
OA = older adult

Table 5.14 : Enthesis scores – Deltoid tuberosity (anterior)

	GRIQUA	COLESBERG	WOLMARANSSTAD
YA males			
n	8	8	2
Mean	3.00	2.75	4.50
SD	0.76	0.46	0.71
OA males			
n	10	1	2
Mean	2.80	4.00	4.00
SD	0.63	~	0.00
YA females			
n	10	10	2
Mean	2.50	2.60	3.00
SD	0.53	0.70	0.00
OA females			
n	7	1	0
Mean	3.57	3.00	~
SD	0.53	~	~

YA = younger adult
OA = older adult

Table 5.15 : Enthesis scores – Deltoid tuberosity (lateral)

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	GRIQUA	COLESBERG	WOLMARANSSTAD
YA males			
n	5	1	1
Mean	3.40	4.00	4.00
SD	0.89	~	~
OA males			
n	9	0	2
Mean	2.89	~	4.50
SD	0.33	~	0.71
YA females			
n	6	1	0
Mean	3.17	3.00	~
SD	0.75	~	~
OA females			
n	6	0	0
Mean	3.67	~	~
SD	0.52	~	~

YA = younger adult
OA = older adult

Table 5.16 : Enthesis scores – Common extensors

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	GRIQUA	COLESBERG	WOLMARANSSTAD
YA males			
n	5	0	1
Mean	3.40	~	4.00
SD	0.89	~	~
OA males			
n	9	0	2
Mean	3.00	~	4.50
SD	0.50	~	0.71
YA females			
n	7	0	0
Mean	2.71	~	~
SD	0.76	~	~
OA females			
n	6	0	0
Mean	3.83	~	~
SD	0.75	~	~

YA = younger adult
OA = older adult

Table 5.17 : Enthesis scores – Common flexors

	GRIQUA	COLESBERG	WOLMARANSSTAD
YA males			
n	8	4	2
Mean	3.13	2.50	4.50
SD	1.13	0.58	0.71
OA males			
n	10	1	3
Mean	3.50	2.00	4.00
SD	0.71	~	0.00
YA females			
n	9	8	0
Mean	2.89	2.13	~
SD	0.78	0.35	~
OA females			
n	7	1	0
Mean	2.86	2.00	~
SD	0.90	~	~

YA = younger adult
OA = older adult

Table 5.18 : Enthesis scores – Patellar ligament

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	GRIQUA	COLESBERG	WOLMARANSSTAD
YA males			
n	8	11	2
Mean	3.50	3.27	4.50
SD	0.76	1.10	1.41
OA males			
n	10	1	4
Mean	3.40	3.00	4.50
SD	0.84	~	0.58
YA females			
n	10	11	2
Mean	2.70	2.73	3.00
SD	0.67	0.90	1.41
OA females			
n	7	1	0
Mean	3.00	4.00	~
SD	0.82	~	~

YA = younger adult
OA = older adult

Table 5.19 : Enthesis scores – Soleus

	GRIQUA	COLESBERG	WOLMARANSSTAD
YA males			
n	51	29	9
Mean	3.04	2.55	4.22
SD	0.60	0.57	0.44
OA males			
n	68	4	14
Mean	2.94	3.25	4.21
SD	0.57	0.96	0.43
YA females			
n	68	41	3
Mean	2.78	2.76	3.00
SD	0.73	0.66	0.00
OA females			
n	54	3	~
Mean	3.72	2.67	~
SD	0.60	0.58	~

YA = younger adult
OA = older adult

Table 5.20 : Enthesis scores – Upper limb entheses combined

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	GRIQUA	COLESBERG	WOLMARANSSTAD
YA males			
n	16	15	4
Mean	3.31	3.07	4.50
SD	0.95	1.03	0.58
OA males			
n	20	2	7
Mean	3.45	2.50	4.29
SD	0.76	0.71	0.49
YA females			
n	19	19	2
Mean	2.79	2.47	3.00
SD	0.71	0.77	1.41
OA females			
n	14	2	~
Mean	2.93	3.00	~
SD	0.83	1.41	~

YA = younger adult
OA = older adult

Table 5.21 : Enthesis scores – Lower limb entheses combined

	All Sites ^
Upper Limb	
YA males vs females	0.05 *
OA males vs females	<0.001 *
Lower Limb	
YA males vs females	0.02 *
OA males vs females	0.03 *

*** P ≤ 0.05 is significant**
YA = younger adult
OA = older adult
^ Males and females from all sites are combined

Table 5.22 : Entheses scores – P–values

	G-C	G-W	W-C
Upper Limb			
YA males vs males	<0.001 *	<0.001 *	<0.001 *
YA females vs females	0.69	~	~
OA males vs males	~	<0.001 *	~
OA females vs females	~	~	~
Lower Limb			
YA males vs males	0.41	~	~
YA females vs females	0.12	~	~
OA males vs males	~	0.01 *	~
OA females vs females	~	~	~

*** P ≤ 0.02 is significant**
YA = younger adult
OA = older adult
G = Griqua
C = Colesberg
W = Wolmaransstad

Table 5.23 : Entheses p–values – Males and females, YA and OA separated

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adult females. The large standard deviation present in the Griqua YA males and OA females and the Colesberg YA males is due to the wide range of scores: the entheses vary from grade 1 to grade 4.

The p-values for the upper limb muscles are illustrated in tables 5.22 and 5.23. The Kruskal-Wallis test shows a significant difference, within each age category, between sex and muscle grade when all three samples are combined (Table 5.22). The results show that age and sex are important factors when analysing entheseal attachments and therefore males and females, as well as, YA and OA are separated for further analyses. Since there is no post-hoc test for the Kruskal-Wallis analysis the Mann-Whitney U test is applied to pairs of sites to examine between site differences. However, a series of two-group Mann-Whitney U tests increases the risk of a type 1 error. To control for this error each Mann-Whitney U test must meet a stricter level of significance ($p \leq 0.02$).

When the upper limb entheses of younger adults are examined there is a significant difference in the entheseal scores of males between the Griqua and Colesberg ($p < 0.001$), Griqua and Wolmaransstad ($p < 0.001$) and Colesberg and Wolmaransstad ($p < 0.001$) sites. However, the younger adult females do not show a significant difference in their entheseal scores between any of the sites. When the upper limb entheses of older adult males are examined the Griqua and Wolmaransstad ($p < 0.001$) sites display a significant difference in entheseal scores. There are too few ($n < 5$) older adult females to allow for statistical analyses (Table 5.23).

The p-values for the lower limb are illustrated in tables 5.22 and 5.23. The Kruskal-Wallis test shows a significant difference, within each age category, between sex and muscle grade when all three samples are combined (Table 5.22). Once again, age and sex are important factors when analysing entheseal attachments and therefore males and females, as well as, YA and OA are separated in subsequent analyses.

When the lower limb entheses of younger adult males and females are analysed there is no significant difference in entheseal scores between any of the sites. The lower limb entheses of older adult males show a similar pattern to the upper limb entheses: the Griqua and Wolmaransstad ($p = 0.01$) sites exhibit a significant difference in entheseal scores. There are too few ($n < 5$) older adult females to allow for statistical analyses (Table 5.23).

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5.5 Pathological Conditions

5.5.1 Dental Pathologies

5.5.1.1 Dental Attrition : Dietary and Non-Dietary Wear of Teeth

The occurrence of occlusal attrition in the adult dentitions is examined in the Griqua, Colesberg and Wolmaransstad sites (Tables 5.24 to 5.27). Since age and sex are important variables the unsexed adults and MI's are not included in this analysis. Statistical analyses can not be performed on the sub-adult teeth, as there are too few individuals present for the tests to be viable therefore the results only express data from the younger and older adults. The number of individuals (n) is calculated based on the proportion of maxilla and mandible present. Individuals represented by only one quarter of a maxilla or mandible are counted as one eighth of one individual.

In all three age categories, each site displays a larger total anterior attrition score than total posterior attrition score, i.e. the anterior teeth show a greater degree of wear than the posterior teeth. The anterior and posterior occlusal wear increases in the Griqua, Colesberg and Wolmaransstad sites as the age of the individual increases. Overall, the Colesberg and Wolmaransstad males show a greater mean attrition score than the females, however, in the Griqua sample the females display a larger mean attrition score than the males. The Mann Whitney U test , employed when two groups are compared, or the Kruskal-Wallis test, employed when three or more groups are compared, is utilised to determine if significant differences in occlusal wear occur between individuals of the various sites.

In the younger adult population, the total mean attrition score is very similar between all of the sites. The Griqua individuals show a larger anterior attrition score and therefore a greater anterior wear, than either the Colesberg or Wolmaransstad individuals, but the posterior attrition scores are very similar for all of the sites. The Griqua females illustrate greater anterior and posterior occlusal wear than the Griqua males. In the Colesberg sample, the males and females have exactly the same anterior (2.8) and posterior (2.5) attrition scores. However, the Wolmaransstad males exhibit a larger anterior attrition score (3.2) than the females (2.9), but the females show a slightly greater posterior attrition score (2.5) than the

Sub-Adults (15.1 - 20 years) [Not included in the analysis]

	GRIQUA			COLESBERG			WOLMARANSSTAD		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
n*	1	2	3	0	0	0	0	1	1
I1	N/A	2.0	2.0	N/A	N/A	N/A	N/A	3.0	3.0
I2	3.0	2.3	2.7	N/A	N/A	N/A	N/A	3.0	3.0
C	2.0	2.0	2.0	N/A	N/A	N/A	N/A	3.0	3.0
PM1	1.8	2.0	1.9	N/A	N/A	N/A	N/A	2.5	2.5
PM2	2.0	2.0	2.0	N/A	N/A	N/A	N/A	2.0	2.0
M1	2.0	2.0	2.0	N/A	N/A	N/A	N/A	3.0	3.0
M2	2.0	2.0	2.0	N/A	N/A	N/A	N/A	2.4	2.4
M3	0.6	1.0	0.8	N/A	N/A	N/A	N/A	1.5	1.5
Anterior Attrition Score	2.5	2.1	2.2	N/A	N/A	N/A	N/A	3.0	3.0
Posterior Attrition Score	1.7	1.8	1.7	N/A	N/A	N/A	N/A	2.3	2.3
Mean Attrition Score	1.9	1.9	1.9	N/A	N/A	N/A	N/A	2.6	2.6

n* = Individuals represented by only one quarter of a maxilla or mandible are counted as one eighth of one individual
N/A = Tooth is absent or damaged therefore wear can not be determined

Table 5.24 : Average stage of occlusal attrition in sub-adult dentitions

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Younger Adults (20.1 - 40 years)

	GRIQUA			COLESBERG			WOLMARANSSTAD		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
n*	12.5	12	24.5	18	16.75	34.75	1	1	2
I1	2.8	3.3	3.1	2.9	2.8	2.9	3.0	3.0	3.0
I2	3.0	3.3	3.2	2.9	2.8	2.9	3.0	3.0	3.0
C	2.7	3.0	2.9	2.6	2.7	2.7	3.5	2.6	3.1
PM1	2.1	2.5	2.3	2.4	2.6	2.5	2.3	2.0	2.2
PM2	2.5	2.5	2.5	2.5	2.7	2.6	2.5	2.0	2.3
M1	3.2	3.2	3.2	3.1	2.8	3.0	3.0	2.3	2.7
M2	2.4	2.4	2.4	2.5	2.4	2.5	2.0	3.0	2.5
M3	2.0	1.8	1.9	1.9	1.8	1.9	2.0	3.0	2.5
Anterior Attrition Score	2.8	3.2	3.1	2.8	2.8	2.8	3.2	2.9	3.0
Posterior Attrition Score	2.4	2.5	2.5	2.5	2.5	2.5	2.4	2.5	2.4
Mean Attrition Score	2.6	2.8	2.7	2.6	2.6	2.6	2.7	2.6	2.7

n* = Individuals represented by only one quarter of a maxilla or mandible are counted as one eighth of one individual
N/A = Tooth is absent or damaged therefore wear can not be determined

Table 5.25 : Average stage of occlusal attrition in younger adult dentitions

University of Cape Town

Older Adults (40.1+ years)

	GRIQUA			COLESBERG			WOLMARANSSTAD		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
n*	13	6	19	3.75	2	5.75	10	0	10
I1	3.7	4.0	3.9	3.8	N/A	3.8	3.7	N/A	3.7
I2	3.6	4.0	3.8	3.8	3.0	3.4	3.5	N/A	3.5
C	3.0	3.5	3.3	3.6	3.0	3.3	3.3	N/A	3.3
PM1	2.6	3.3	3.0	3.4	2.6	3.0	2.8	N/A	2.8
PM2	2.9	3.5	3.2	3.5	2.8	3.2	2.6	N/A	2.6
M1	3.5	4.0	3.8	4.0	3.0	3.5	3.4	N/A	3.4
M2	2.7	3.5	3.1	3.3	2.0	2.7	3.2	N/A	3.2
M3	2.5	3.0	2.8	2.8	2.0	2.4	2.9	N/A	2.9
Anterior Attrition Score	3.4	3.8	3.7	3.7	3.0	3.5	3.5	N/A	3.5
Posterior Attrition Score	2.7	3.5	3.2	3.4	2.5	3.0	3.0	N/A	3.0
Mean Attrition Score	3.1	3.7	3.4	3.5	2.3	3.2	3.3	N/A	3.3

n* = Individuals represented by only one quarter of a maxilla or mandible are counted as one eighth of one individual
N/A = Tooth is absent or damaged therefore wear can not be determined

Table 5.26 : Average stage of occlusal attrition in older adult dentitions

University of Cape Town

	Griqua	Colesberg	Wolmaransstad
YA			
anterior vs. posterior wear	0.13	0.17	0.02 *
avg wear: males vs. females	0.43	0.92	0.87
OA			
anterior vs. posterior wear	0.07	0.10	0.10
avg wear: males vs. females	0.06	0.004 *	~

* $P \leq 0.05$ is significant

Table 5.27 : Dental attrition – Probability of age and/or sex affecting dental wear

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males (2.4). There is no significant difference in anterior versus posterior wear within the Griqua and Colesberg sites but there is a significant difference in wear within the Wolmaransstad site (Table 5.27). There is no significant difference between sex and the amount of occlusal wear within any of the sites.

The total mean attrition score is greater in the Griqua (3.4) older adult sample than in either the Colesberg (3.2) or Wolmaransstad (3.3) older adult individuals (Table 5.26). The Griqua individuals exhibit greater total anterior and posterior attrition than the other two samples. The Griqua females show greater anterior and posterior occlusal wear than the males. Yet, in the Colesberg sample the males exhibit more anterior and posterior wear than the females. There are no older adult females present in the Wolmaransstad site therefore comparison between sexes is not possible. There is no significant difference in anterior versus posterior wear within any of the samples. However, there is a significant difference in average wear between males and females but only within the Colesberg site ($p = 0.004$) (Table 5.27).

There are also examples of dental wear due to non-dietary action. Three individuals, all male, display signs of pipe-smoker's wear. The individuals are from two different communities, Griqua and Wolmaransstad, and are of varying age groups: UOVS11b is 50+ years old, NMB18 is 35+ years old, and NMB1313a is 50-55 years of age (Figure 5.17). There is no maxilla present for UOVS11b but the mandible clearly shows bilateral pipe-smoker's wear. The calculus build up above the occlusal lesion may be the result of nicotine deposits. This illustration clearly shows the discoloration of adjacent teeth, possibly from the use of tobacco.

Signs of cultural behaviour are also illustrated in the dentition of Danielskuil/UOVS12 (Figure 5.18). According to Prof. V. Phillips (personal communication, 2001) the odd wear displayed on the Maxillary I1 and I2 of this juvenile is not caused by normal chewing but is rather due to tool use. There is no mandible present. There are no signs of dentinogenesis imperfecta, imperfect bonding between the enamel and dentine, that would lead to the enamel chipping off all the teeth (personal communication Professor V. Phillips, 2001).

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Figure 5.17 : Wolmaransstad/NMB 1313a – pipe smoker's wear on the mandibular and maxillary RC and RPM1

Figure 5.18 : Danielskuil/UOVS 12 – abnormal wear due to tool use

5.5.1.2 Enamel Hypoplasias

Only two individuals, both in the Griqua population, display signs of linear enamel hypoplasias: Campbell/A2507 and Philippolis/NMB1609. Both individuals are female sub-adults and both display enamel hypoplasias on the mandibular and maxillary permanent first incisors. The hypoplasias occurred when the individuals were approximately five years old (Reid & Dean 2000). Due to the small sample size statistical analyses are not viable.

5.5.1.3 Caries Rates

Tables 5.28 to 5.39, figures 5.19 to 5.22 and Appendices B to E illustrate the rate of caries present in the Griqua, Colesberg, and Wolmaransstad populations. Only younger adult and older adult individuals are analysed. The MI age category is only included when age categories are combined. The number of individuals (n) is calculated based on the proportion of maxilla and mandible present; individuals represented by only one quarter of a maxilla or mandible are counted as one eighth of one individual. In the Griqua younger adult females nine extra teeth from individual Campbell/A2835 are included: one I1, three C, one PM1, one M1, three M2. These teeth were not present during the 2000 data collection of the present author but they were present in Morris' 1980 data sheets. Since this one individual alone contains 13 carious lesions, excluding the nine carious teeth would substantially alter the caries rates of this study sample and therefore the numbers were augmented from Morris' 1980 data.

In all of the communities the percentage of carious teeth compared to total teeth is below six percent; the Wolmaransstad population is the highest at 5.6%, the Colesberg population is at 3.8%, and the Griqua community is the lowest at 2.4% (Table 5.39). The average number of carious teeth per mouth is also very low. When all ages are examined the Wolmaransstad site contains the highest total average number of carious teeth per mouth (1.4), the Griqua population is second (0.6) and the Colesberg sample is the lowest (0.5) (Table 5.31, 5.34, 5.38). When all sites are compared and the sexes are combined there is a significant difference in the presence of caries between all sites ($p = 0.01$). To determine where the significant difference occurs, i.e. between which two sites, pairs of sites are compared and sexes combined. Only the Griqua and Wolmaransstad ($p = 0.002$) sites show a significant difference in the presence of caries; there is no significant difference in presence of caries between any other pairs of sites.

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YOUNGER ADULTS (20.1 - 40 YEARS)

n*	MALE 12.5		FEMALE 12		TOTAL 24.5	
	No.	%	No.	%	No.	%
No. of carious teeth	2	0.6	21	7.7	23	3.8
No. of individuals with caries	2	16.0	5	41.7	7	28.6
Avg. no. of carious teeth per mouth	0.2	~	1.8	~	0.9	~

OLDER ADULTS (40.1+ YEARS)

n*	MALE 13		FEMALE 6		TOTAL 19	
	No.	%	No.	%	No.	%
No. of carious teeth	4	2.8	0	0	4	2.2
No. of individuals with caries	4	30.8	0	0	4	21.2
Avg. no. of carious teeth per mouth	0.3	~	0	~	0.2	~

MATURE INDIVIDUALS (MI)

n*	MALE 5.625		FEMALE 2.375		TOTAL 8	
	No.	%	No.	%	No.	%
No. of carious teeth	3	3.5	2	3.6	5	3.5
No. of individuals with caries	1	17.8	1	42.1	5	62.5
Avg. no. of carious teeth per mouth	0.5	~	0.8	~	0.6	~

ALL AGES OF ADULTS (YA, OA, MI)

n*	MALE 31.125		FEMALE 20.375		TOTAL 51.5	
	No.	%	No.	%	No.	%
No. of carious teeth	9	1.3*	23	5.7	32	2.9
No. of individuals with caries	7	22.5*	8	39.3	15	29.1
Avg. no. of carious teeth per mouth	0.3*	~	1.1	~	0.6	~
Total no. of teeth	698	~	403	~	1101	~

0.3* = 9/31.125
1.3* = 9/698
22.5* = 7/31.125
YA = Younger Adults
OA = Older Adults
MI = Mature Individuals, osteologically adult, can only estimate large age range
n* = Individuals represented by only one quarter of a maxilla or mandible are counted as one eighth of one individual

Tables 5.28 - 5.31 : Griqua sites – Summary of caries rates

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YOUNGER ADULTS (20.1 - 40 YEARS)

n*	MALE 18		FEMALE 16.75		TOTAL 34.75	
	No.	%	No.	%	No.	%
No. of carious teeth	22	4.8	16	3.7	38	4.3
No. of individuals with caries	9	50.0	8	47.8	17	48.9
Avg. no. of carious teeth per mouth	1.2	~	1.0	~	1.1	~

OLDER ADULTS (40.1+ YEARS)

n*	MALE 3.75		FEMALE 2		TOTAL 5.75	
	No.	%	No.	%	No.	%
No. of carious teeth	3	3.8	0	0	3	2.9
No. of individuals with caries	3	80.0	0	0	3	52.2
Avg. no. of carious teeth per mouth	0.8	~	0	~	0.5	~

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ALL AGES OF ADULTS (YA, OA, MI) ^

n*	MALE 21.75		FEMALE 18.75		TOTAL 40.5	
	No.	%	No.	%	No.	%
No. of carious teeth	25	4.4*	16	3.2	41	3.8
No. of individuals with caries	12	55.2*	8	42.7	20	49.4
Avg. no. of carious teeth per mouth	1.1*	~	0.9	~	0.5	~
Total no. of teeth	574	~	493	~	1067	~

1.1* = 25/21.75
4.4* = 25/574
55.2* = 12/21.75
^ There are no caries in the MI's
YA = Younger Adults
OA = Older Adults
MI = Mature Individuals, osteologically adult, can only estimate large age range
n* = Individuals represented by only one quarter of a maxilla or mandible are counted as one eighth of one individual

Tables 5.32 - 5.34 : Colesberg site – Summary of caries rates

YOUNGER ADULTS (20.1 - 40 YEARS)

n*	MALE 1		FEMALE 1		TOTAL 2	
	No.	%	No.	%	No.	%
No. of carious teeth	1	3.1	1	5.0	2	3.8
No. of individuals with caries	1	100.0	1	100.0	2	100.0
Avg. no. of carious teeth per mouth	1.0	~	1.0	~	1.0	~

OLDER ADULTS (40.1+ YEARS)

n*	MALE 10		FEMALE 0		TOTAL 10	
	No.	%	No.	%	No.	%
No. of carious teeth	10	4.1	0	0	10	4.1
No. of individuals with caries	5	50.0	0	0	5	50.0
Avg. no. of carious teeth per mouth	1.0	~	0	~	1.0	~

MATURE INDIVIDUALS (MI)

n*	MALE 5		FEMALE 4		TOTAL 9	
	No.	%	No.	%	No.	%
No. of carious teeth	11	7.6	6	7.3	17	7.5
No. of individuals with caries	3	60.0	1	25.0	4	44.4
Avg. no. of carious teeth per mouth	2.2	~	1.5	~	1.9	~

ALL AGES OF ADULTS (YA, OA, MI)

n*	MALE 16		FEMALE 5		TOTAL 21	
	No.	%	No.	%	No.	%
No. of carious teeth	22	5.2*	7	6.9	29	5.5
No. of individuals with caries	9	56.3*	2	40.0	11	52.4
Avg. no. of carious teeth per mouth	1.4*	~	1.4	~	1.4	~
Total no. of teeth	420	~	102	~	522	~

1.4* = 22/16
5.2* = 22/420
56.3* = 9/16
YA = Younger Adults
OA = Older Adults
MI = Mature Individuals, osteologically adult, can only estimate large age range
n* = Individuals represented by only one quarter of a maxilla or mandible are counted as one eighth of one individual

Tables 5.35 -5.38 : Wolmaransstad site – Summary of caries rates

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	Uncorrected			Corrected	
	Number of caries	Number of observed teeth	Caries rate (%)	Caries correction factor (%) ^	Proportional correction (%) *
GRIQUA					
Anterior teeth	7	362	1.9	1.6	0.6
Posterior teeth	25	739	3.4	2.8	1.8
Total	32	1101	2.9	2.4	2.4
COLESBERG					
Anterior teeth	2	357	0.6	0.5	0.2
Posterior teeth	39	710	5.5	5.8	3.6
Total	41	1067	3.8	4.6	3.8
WOLMARANSSTAD					
Anterior teeth	0	187	0	0	0
Posterior teeth	29	335	8.7	9.0	5.6
Total	29	522	5.6	5.6	5.6

^ Lukacs 1995
* Erdal & Duyar 1999

Table 5.39 : Observed and corrected caries rates – Ages and sexes combined

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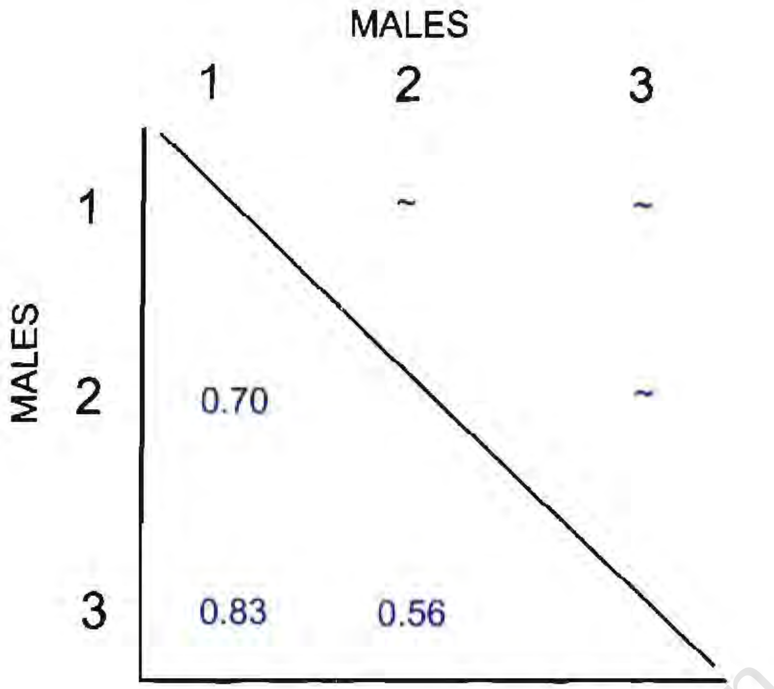
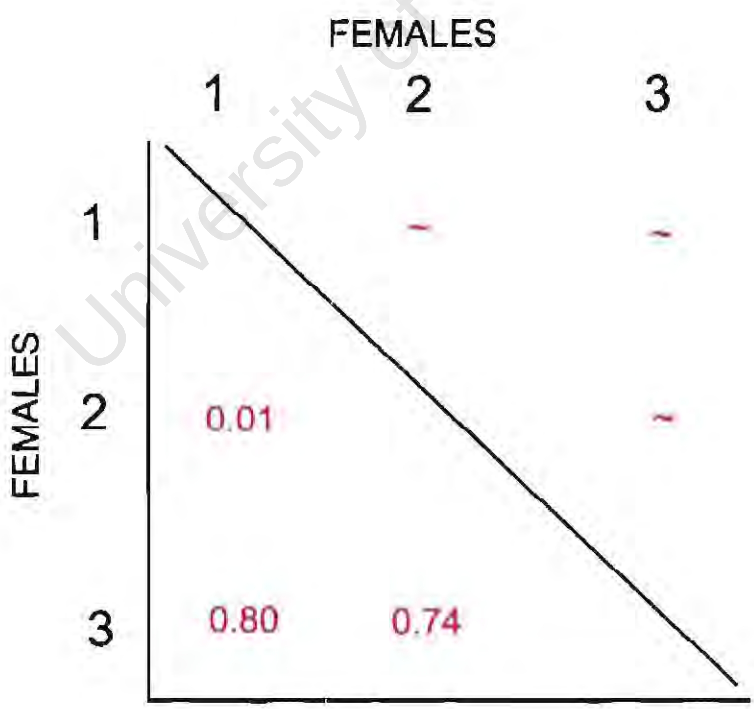


1 = Colesberg
2 = Griqua
3 = Wolmaransstad
$P \leq 0.05$ is significant

Figure 5.19 : Younger adult male caries – between site probability values



1 = Colesberg
2 = Griqua
3 = Wolmaransstad
$P \leq 0.05$ is significant

Figure 5.20 : Younger adult female caries – between site probability values

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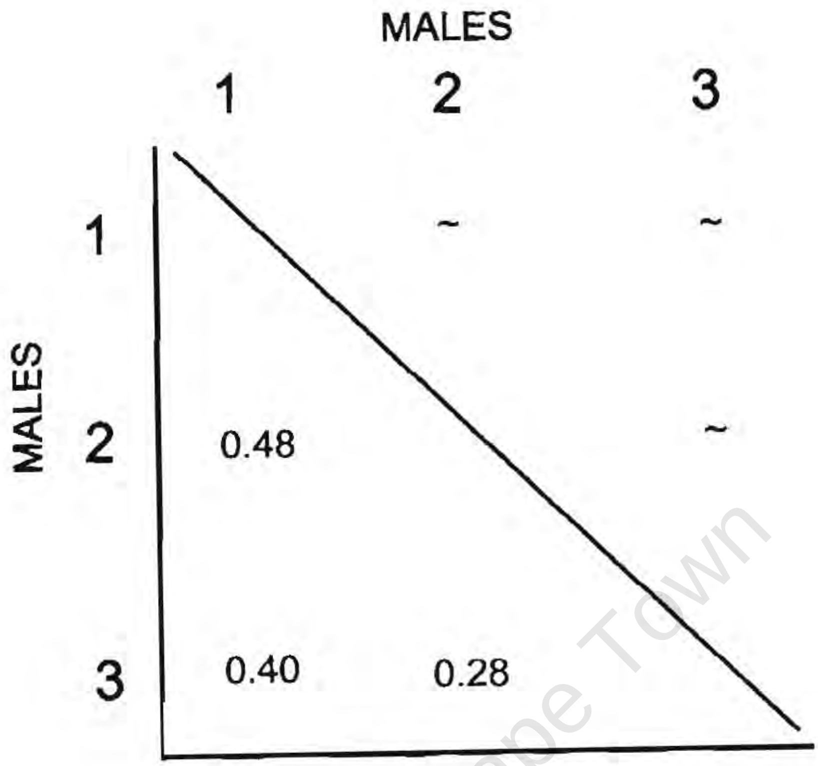

1 = Colesberg
2 = Griqua
3 = Wolmaransstad
P ≤ 0.05 is significant

Figure 5.21 : Older adult male caries – between site probability values

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MALES

MALES	1	2	3
1		~	~
2	0.66		~
3	0.75	0.56	

1 = Colesberg
2 = Griqua
3 = Wolmaransstad
$P \leq 0.05$ is significant

Figure 5.22 : Younger adult male caries – anterior vs. posterior

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FEMALES

FEMALES	1	2	3
1		~	~
2	0.01		~
3	<0.001	0.48	

1 = Colesberg
2 = Griqua
3 = Wolmaransstad
$P \leq 0.05$ is significant

Figure 5.23 : Younger adult female caries – anterior vs. posterior

The caries data become even more valuable when the ages are pooled. There are a larger percentage of females (39.3%) than males (22.5%) with caries in the Griqua population, but in the Colesberg community the percentage of individuals with caries is greater in males (55.2%) than females (42.7%) (Tables 5.31 & 5.34). In the Wolmaransstad population, the percentage of individuals with carious teeth is again greater in males (56.3%) than females (40%) (Table 5.38).

When age groups are analysed, the highest percentage of individuals with caries in the Griqua community is the younger adults (28.6%) and in the Colesberg (52.2%) community the older adults (Tables 5.28, 5.29, 5.32, 5.33). Within the Wolmaransstad community the younger adults also express the highest percentage of caries (100%), however, since the Wolmaransstad younger adults contain very few individuals the percentages probably reflect sampling error rather than significant difference (Table 5.35).

The Griqua younger adults have both the highest percentage of individuals with caries and contain the greatest percentage of carious teeth (3.8%) (Table 5.28). In the Colesberg (4.3%) community the younger adults reveal the greatest percentage of carious teeth but within the Wolmaransstad (4.1%) site the older adults have the largest percentage of carious teeth (Tables 5.32 to 5.35).

Each adult category is separated into males and females and analysed accordingly. In the Griqua population, the younger adult females show a higher percentage (41.7%) of individuals with caries as compared to the younger adult males (16%). The data illustrates the reverse situation in the Colesberg population where the younger adult males (50%) have a higher percentage of individuals with carious teeth than females (47.8%). The Wolmaransstad population has equivalent percentages of younger adult males and females (100%) with caries. However, the small number of individuals (n = 2) is not enough to use for statistical analysis.

The Griqua younger adult females (4.5%) display a greater percentage of carious teeth than the males (0.6%), whereas in the older adult category the males (2.8%) show a greater percentage of carious teeth (Tables 5.28 & 5.29). In the Colesberg community the younger (4.8%) and older (3.8%) adult males show a greater percentage of carious teeth than the females (Table 5.32). However, in the Wolmaransstad site the younger adult females (5%) display greater percentages of carious teeth than younger adult males (3.1%); there are no older adult females in the Wolmaransstad sample to compare to the caries found in the OA males (Tables 5.35 & 5.36). The Chi squared test is applied to all sites to test

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for a significant difference between age and sex categories and frequency of caries; YA and OA and males and females are separated for analyses. When $p < 0.05$ pairs of sites are tested to determine where the significant difference occurs. There is no significant difference in the frequency of caries in the younger adult males however, in the younger adult females the Griqua and Colesberg ($p = 0.01$) sites display a significant difference (Figures 5.19 & 5.20). The older adult males do not reveal a significant difference between age, sex and caries present. Since there are no older adult females in the Wolmaransstad sample and none with caries in the Colesberg site it is not statistically viable to test the OA female group (Figure 5.21).

Overall, when compared the total uncorrected caries rate (UCR), the caries correction (CC) factor (Lukacs 1995) and the proportional caries correction (PCC) factor (Erdal & Duyar 1999) do not yield significantly different data (Table 5.39). When anterior and posterior data are separated there are a few minor differences between the UCR and CC, but marked differences between the UCR and PCC. This is not surprising because the PCC demands an assumption about preservation of anterior versus posterior teeth. Therefore using PCC to clarify differences in anterior and posterior teeth is a circular argument and will always increase the difference because the researcher assumes a difference. Therefore, it is not viable to employ the PCC factor for anterior versus posterior teeth but the CC factor still can be utilised.

The frequency of anterior versus posterior caries is also investigated. The Chi squared test is applied to pairs of sites to test for a significant difference in frequency of caries between anterior and posterior dentition; YA and OA and males and females are separated for analyses (Figures 5.22 to 5.24). There is no significant difference in the frequency of anterior versus posterior caries in the younger adult males (Figure 5.22). However, in the younger adult females the Griqua and Colesberg ($p = 0.01$) sites and the Wolmaransstad and Colesberg ($p < 0.001$) sites reveal a significant difference in the frequency of anterior versus posterior caries (Figures 5.22 & 5.23). The only significant difference in the older adult male samples is between the Colesberg and Wolmaransstad ($p = 0.05$) sites; there are no OA females present in the Wolmaransstad site and no OA females with caries in the Colesberg site (Figure 5.24).

5.5.1.4 Antemortem Tooth Loss

The incidence of antemortem tooth loss is also analysed utilising the Griqua, Colesberg, and Wolmaransstad populations (Tables 5.40 to 5.51 & Appendices F to H). Only younger adult and older

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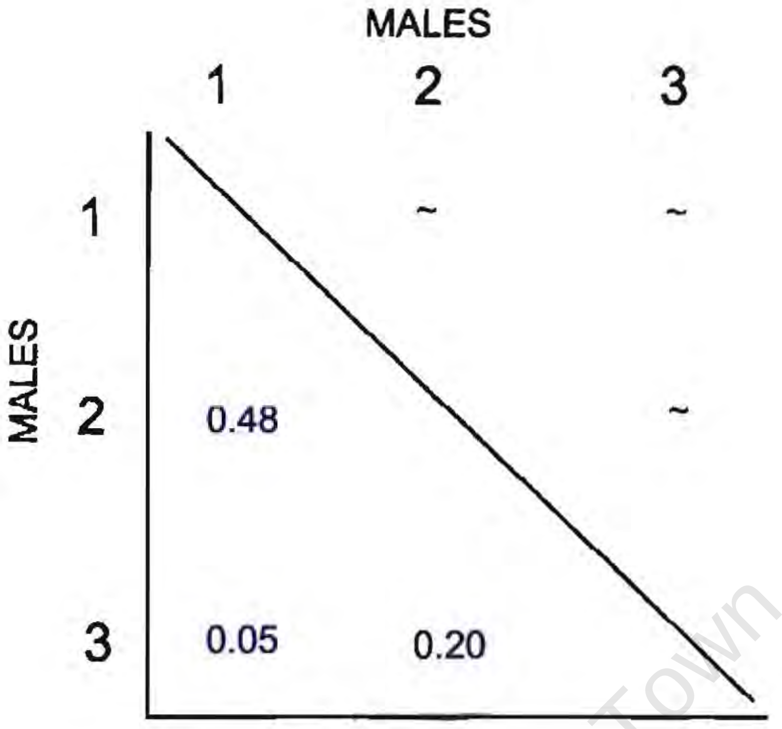

1 = Colesberg
2 = Griqua
3 = Wolmaransstad
P ≤ 0.05 is significant

Figure 5.24 : Older adult male caries – anterior vs. posterior

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YOUNGER ADULTS (20.1 - 40 YEARS)

n*	MALE 12.5		FEMALE 12		TOTAL 24.5	
	No.	%	No.	%	No.	%
No. of teeth lost ante-mortem	52	13.6	41	12.6	93	13.1
No. of individuals with ante-mortem tooth loss	8	64.0	6	50.0	14	57.1
Avg. no. of teeth lost ante-mortem per mouth	4.2	~	3.4	~	3.8	~

OLDER ADULTS (40.1+ YEARS)

n*	MALE 13		FEMALE 6		TOTAL 19	
	No.	%	No.	%	No.	%
No. of teeth lost ante-mortem	96	24.4	95	51.4	191	33.0
No. of individuals with ante-mortem tooth loss	9	69.2	6	100.0	15	78.9
Avg. no. of teeth lost ante-mortem per mouth	7.4	~	15.8	~	10.1	~

MATURE INDIVIDUALS (MI)

n*	MALE 5.625		FEMALE 2.375		TOTAL 8	
	No.	%	No.	%	No.	%
No. of teeth lost ante-mortem	23	20.2	23	25.8	46	22.7
No. of individuals with ante-mortem tooth loss	3	53.3	2	84.2	5	62.5
Avg. no. of teeth lost ante-mortem per mouth	4.1	~	9.7	~	5.8	~

ALL AGES (YA, OA, MI)

n*	MALE 31.125		FEMALE 20.375		TOTAL 51.5	
	No.	%	No.	%	No.	%
No. of teeth lost ante-mortem	171	19.2	159	26.5	330	22.1
No. of individuals with ante-mortem tooth loss	20	64.3	14	68.7	34	66.0
Avg. no. of teeth lost ante-mortem per mouth	5.5	~	7.8	~	6.4	~
Total no. of alveoli	890	~	600	~	1490	~

YA = Younger Adults
OA = Older Adults
MI = Mature Individuals, osteologically adult, can only estimate large age range
n* = Individuals represented by only one quarter of a maxilla or mandible are counted as one eighth of one individual

Tables 5.40 - 5.43 : Griqua sites – Summary of antemortem tooth loss

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YOUNGER ADULTS (20.1 - 40 YEARS)

n*	MALE 18		FEMALE 16.75		TOTAL 34.75	
	No.	%	No.	%	No.	%
No. of teeth lost ante-mortem	41	8.0	44	8.5	85	8.4
No. of individuals with ante-mortem tooth loss	7	38.9	9	53.7	16	46.0
Avg. no. of teeth lost ante-mortem per mouth	2.3	~	2.6	~	2.4	~

OLDER ADULTS (40.1+ YEARS)

n*	MALE 3.75		FEMALE 2		TOTAL 5.75	
	No.	%	No.	%	No.	%
No. of teeth lost ante-mortem	22	20.2	31	54.4	53	31.9
No. of individuals with ante-mortem tooth loss	3	80.0	2	100.0	5	87.0
Avg. no. of teeth lost ante-mortem per mouth	5.9	~	15.5	~	9.2	~

MATURE INDIVIDUALS (MI)

n*	MALE 3		FEMALE 2		TOTAL 5	
	No.	%	No.	%	No.	%
No. of teeth lost ante-mortem	50	58.8	13	22	63	43.8
No. of individuals with ante-mortem tooth loss	3	100.0	2	100.0	5	100.0
Avg. no. of teeth lost ante-mortem per mouth	16.7	~	6.5	~	12.6	~

ALL AGES (YA, OA, MI)

n*	MALE 24.75		FEMALE 20.75		TOTAL 45.5	
	No.	%	No.	%	No.	%
No. of teeth lost ante-mortem	113	16.0	88	14.1	201	15.1
No. of individuals with ante-mortem tooth loss	13	52.5	13	62.7	26	57.1
Avg. no. of teeth lost ante-mortem per mouth	4.6	~	4.2	~	4.4	~
Total no. of alveoli	705	~	624	~	1329	~

YA = Younger Adults
OA = Older Adults
MI = Mature Individuals, osteologically adult, can only estimate large age range
n* = Individuals represented by only one quarter of a maxilla or mandible are counted as one eighth of one individual

Tables 5.44 - 5.47 : Colesberg sites – Summary of antemortem tooth loss

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YOUNGER ADULTS (20.1 - 40 YEARS)

n*	MALE 1		FEMALE 1		TOTAL 2	
	No.	%	No.	%	No.	%
No. of teeth lost ante-mortem	0	0	8	25.8	8	12.7
No. of individuals with ante-mortem tooth loss	0	0	1	100.0	1	50.0
Avg. no. of teeth lost ante-mortem per mouth	0	~	8.0	~	4.0	~

OLDER ADULTS (40.1+ YEARS)

n*	MALE 4		FEMALE 0		TOTAL 4	
	No.	%	No.	%	No.	%
No. of teeth lost ante-mortem	6	4.7	0	0	6	4.7
No. of individuals with ante-mortem tooth loss	3	75.0	0	0	3	75.0
Avg. no. of teeth lost ante-mortem per mouth	1.5	~	0	~	1.5	~

MATURE INDIVIDUALS (MI)

n*	MALE 12		FEMALE 3		TOTAL 15	
	No.	%	No.	%	No.	%
No. of teeth lost ante-mortem	101	26.9	5	5.4	106	22.7
No. of individuals with ante-mortem tooth loss	11	91.7	1	33.3	12	80.0
Avg. no. of teeth lost ante-mortem per mouth	8.4	~	1.7	~	7.1	~

ALL AGES (YA, OA, MI)

n*	MALE 17		FEMALE 4		TOTAL 21	
	No.	%	No.	%	No.	%
No. of teeth lost ante-mortem	107	20.0	13	10.6	120	18.2
No. of individuals with ante-mortem tooth loss*	14	82.4	2	50.0	16	76.2
Avg. no. of teeth lost ante-mortem per mouth	6.3	~	3.3	~	5.7	~
Total no. of alveoli	535	~	123	~	658	~

YA = Younger Adults
OA = Older Adults
MI = Mature Individuals, osteologically adult, can only estimate large age range
n* = Individuals represented by only one quarter of a maxilla or mandible are counted as one eighth of one individual

Tables 5.48 - 5.51 : Wolmaransstad sites – Summary of antemortem tooth loss

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adult individuals are analysed. The MI age category is only included when age categories are combined. The number of individuals (n) is calculated based on the proportion of maxilla and mandible present; individuals represented by only one quarter of a maxilla or mandible are counted as one eighth of one individual. When sexes and age groups are combined the Wolmaransstad individuals have the highest percentage of individuals with antemortem tooth loss (76.2%), followed by the Griqua sites (66%) and then the Colesberg community (57.1%) (Tables 5.43, 5.47, 5.51). When males and females are analysed separately only the Wolmaransstad population has a higher percentage of males (82.4%) than females (50%) with antemortem tooth loss (Table 5.51). The Colesberg and Griqua communities contain a higher percentage of females than males with antemortem tooth loss. (Tables 5.43 & 5.47). When all sites are combined there is no significant difference for antemortem tooth loss ($p = 0.86$).

When the age categories are separated and analysed, the difference between the populations becomes even more obvious. In the younger adult category, the Griqua sample contains the highest percentage of individuals with antemortem tooth loss (57.1%), as compared to the Colesberg (46%) and Wolmaransstad (50%) samples. Within the Colesberg and Wolmaransstad sites, female younger adults have higher percentages of antemortem tooth loss as compared to males (Tables 5.44 & 5.48). In the Griqua sample younger adult males display a greater percentage of individuals with antemortem tooth loss than females (Table 5.40). In the older adult category the Colesberg (87%) community shows the greatest percentage of individuals with antemortem tooth loss, as compared to the Griqua (78.9%) and Wolmaransstad (75%) sites. The Chi squared test is employed to determine if a significant difference occurs between posterior and anterior antemortem tooth loss. There is no significant difference in the younger adult males, however in the younger adult females the Griqua and Colesberg ($p = 0.005$) sites show a significant difference in antemortem tooth loss between the posterior and anterior dentition; the Griqua sites show greater posterior AMTL whereas the Colesberg site shows greater anterior AMTL (Figures 5.25 & 5.26; Appendices B5 & B6). There are no YA females with AMTL in the Wolmaransstad sample. The older adult males do not display any significant difference in antemortem tooth loss between the posterior and anterior dentition; there are no OA females in the Wolmaransstad sample (Figure 5.27).

There is a link between antemortem tooth loss and dental caries, which must be considered when analysing the data. Within all three samples the younger adults have more caries than the older adults,

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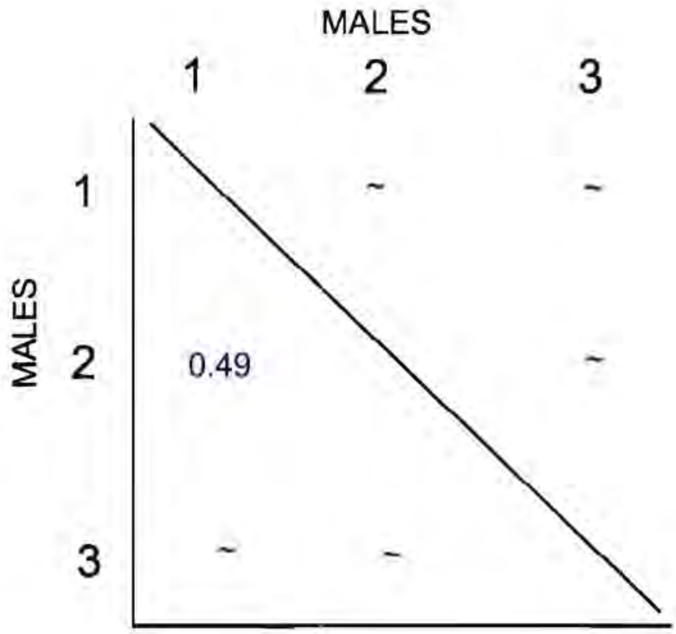
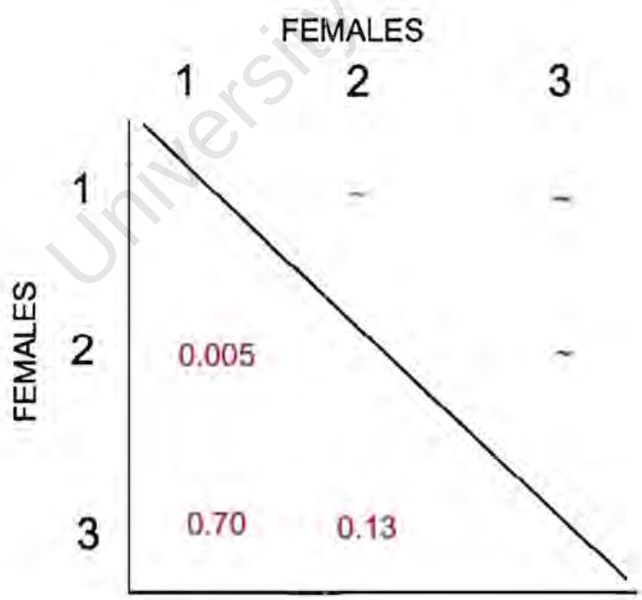


1 = Colesberg
2 = Griqua
3 = Wolmaransstad
P ≤ 0.05 is significant

Figure 5.25 : Younger adult males AMTL – anterior vs. posterior probability values



1 = Colesberg
2 = Griqua
3 = Wolmaransstad
P ≤ 0.05 is significant

Figure 5.26 : Younger adult females AMTL – anterior vs. posterior probability values

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MALES	1	2	3
1		-	-
2	0.47		-
3	0.54	0.89	

1 = Colesberg
2 = Griqua
3 = Wolmaransstad
P ≤ 0.05 is significant

Figure 5.27 : Older adult males AMTL – anterior vs. posterior probability values

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however, with the exception of Colesberg, the older adults have higher numbers of teeth lost antemortem than the younger adults; some of the teeth lost antemortem in the Colesberg MI age category may be OA individuals.

In the younger and older adult Griqua individuals the tooth most often affected with caries is the M3 (Appendix B1). Although the M3's show the highest frequency of caries in the Griqua older adults, the number of M3's affected is smaller than in the younger adults. This is most likely due to the M3's displaying the highest frequency of AMTL in the older adult Griqua sample (Appendix B5). The tooth with the highest rate of AMTL in the younger adult Griquas is the M3 but the number of teeth lost is far less in the younger adults than in the older adults. In the younger and older adult Colesberg individuals the tooth most often affected with caries is the M1, M2 and M3 (Appendix B2). Although the molars show the highest frequency of caries in the Griqua older adults, the number of molars affected is smaller than in the younger adults. Unlike the other two samples, the younger adults in Colesberg have higher rates of AMTL than the older adults; the younger adults have a total caries rate of 4.3% and an AMTL rate of 8.4%, however the older adults have a caries rate of 2.9% and an AMTL rate of 31.9% (Appendices B2 and B6). There is still far more AMTL occurring in the older adults than in the younger adults. In the younger and older adult Wolmaransstad individuals the tooth most often affected with caries is the M2 (Appendix B3). The teeth with the highest rate of AMTL in the younger and older adult Wolmaransstad samples are the I1, M1 and M3 but the number of teeth lost is far less in the younger adults than in the older adults (Appendix B7).

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5.5.1.5 Periodontitis

The occurrence of periodontitis in the Griqua, Colesberg, and Wolmaransstad individuals is also examined (Tables 5.52 to 5.54). Periodontitis is a chronic, slowly progressive and destructive inflammatory process affecting the periodontium. Only younger adult and older adult individuals are analysed. The MI age category is only included when age categories are combined. The number of individuals (n) is calculated based on the proportion of maxilla and mandible present; individuals represented by only one quarter of a maxilla or mandible are counted as one eighth of one individual.

The overall frequency of periodontitis in the Colesberg sample is extremely high (94.1%) compared to either the Griqua (64.1%) or Wolmaransstad (57.1%) samples (Table 5.54). In the Griqua,

SITE	MALES								
	Younger Adults			Older Adults			MI		
	n*	No.*	%	n*	No.*	%	n*	No.*	%
GRIQUA	12.5	11	88.0	13	4.5	34.6	5.625	4	71.1
COLESBERG	18	17	94.4	3.75	3	80.0	3	2	66.7
WOLMARANSSTAD	1	1	100.0	10	8	80.0	5	0	0

SITE	FEMALES								
	Younger Adults			Older Adults			MI		
	n*	No.*	%	n*	No.*	%	n*	No.*	%
GRIQUA	12	10	83.3	6	2	33.3	2.375	1.5	63.2
COLESBERG	16.75	15.75	94.0	2	2	100.0	2	2	100.0
WOLMARANSSTAD	1	1	100.0	0	0	0	4	2	50.0

SITE	MALES			FEMALES			TOTAL		
	n*	No.*	%	n*	No.*	%	n*	No.*	%
GRIQUA	31.125	19.5	62.7	20.375	13.5	66.3	51.5	33	64.1
COLESBERG	24.75	23	92.9	20.75	19.8	95.4	45.5	42.8	94.1
WOLMARANSSTAD	16	9	56.3	5	3	60.0	21	12	57.1

MI = Mature Individuals, osteologically adult, can only estimate large age range
n* = Individuals represented by only one quarter of a maxilla or mandible are counted as one eighth of one individual
No*. = Number of individuals with periodontitis

Tables 5.52-5.54 : Occurrence of periodontitis in the adult dentitions

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Colesberg and Wolmaransstad samples males and females express similar frequencies of the disease. However, in all sites the females show a greater percentage of periodontitis than males (Table 5.54).

Age categories are also analysed (Tables 5.52 & 5.53). In the younger adult males, the Colesberg (94.4%) and Wolmaransstad (100%) communities exhibit the highest frequency of periodontitis. Since there is only one individual in the Wolmaransstad sample no statistical analysis could be done. In the older adult males the Colesberg (80%) and Wolmaransstad (80%) sites express high rates of periodontitis compared to the Griqua (34.6%) sites. In the younger adult females the Wolmaransstad (100%) individuals exhibit the greatest percentage of periodontitis, as compared to the Griqua (83.3%) and Colesberg (94%) sites. Again, since there is only one individual in the Wolmaransstad sample no statistical analysis could be done. In the older adult female category the Colesberg (100%) site displays a very large percentage of individuals affected with periodontitis whereas the Griqua sites have a very low expression (33.3%); there are no older adult females present in the Wolmaransstad sample.

Overall, the Griqua sites tend to show more periodontitis in the younger age group whereas the Colesberg and Wolmaransstad sites show equally large percentages of individuals with periodontitis in both the younger and older age categories.

5.5.1.6 Dental Abscesses

The number of individuals affected with dental abscesses is very low in all of the communities studied (Tables 5.55 & 5.56). The Griqua population has the highest frequency (9.7%) of dental abscesses, the Colesberg population is second (6.6%) and the Wolmaransstad population is the lowest (4.8%). More males show signs of infection than do females in all of the populations. The age category with the greatest frequency of infection is not consistent between all populations. In the Griqua population the older adult males and the younger adult females show the greatest rates of infection, but in the Colesberg sample it is the younger adult males. Statistical analyses are not viable due to the small numbers of individuals affected with dental abscesses.

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SITE	SEX	AGE	DESCRIPTION OF ABSCESS
GRIQUA			
Bethulie/ NMB 1617a	M	50+ years	Maxilla LM3 distal surface
Campbell/ A 2261	M	45-50 years	Mandible RM2 buccal surface
Campbell/ A 2262	F	30-35 years	Mandible RM1 buccal surface
Danielskuil/ UOVS 23	M	35+	Mandible LM3 buccal surface
Philippolis/ NMB 1613	F	25-35 years	Mandible RP1 labial surface
COLESBERG			
Colesberg/ SAM 4512	M	30-35 years	Maxilla RM1, RM2 & RM3 buccal surface
Colesberg/ SAM 4514	M	26-30 years	Maxilla RP1 buccal surface
Colesberg/ SAM 4326	M	30+	Maxilla RM1 buccal surface
WOLMARANSSTAD			
Wolmaransstad/ NMB 21	M	26+ years	Mandible LM3 buccal surface

Table 5.55 : Individuals with dental abscesses

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	MALES			FEMALES			TOTAL
	YA	OA	MI	YA	OA	MI	
GRIQUA							
Total no. of individuals *	12.5	13	5.625	12	6	2.375	51.5
No. of individuals with an abscess *	0	2	1	2	0	0	5
%	0	15.4	17.8	16.7	0	0	9.7
COLESBERG							
Total no. of individuals *	18	3.75	3	16.75	2	2	45.5
No. of individuals with an abscess *	2	0	1	0	0	0	3
%	11.1	0	33.3	0	0	0	6.6
WOLMARANSSTAD							
Total no. of individuals *	1	10	5	1	0	4	21
No. of individuals with an abscess *	0	0	1	0	0	0	1
%	0	0	20.0	0	0	0	4.8

* = Individuals represented by only one quarter of a maxilla or mandible are counted as one eighth of one individual
YA = Younger Adults
OA = Older Adults
MI = Mature Individuals, osteologically adult, can only estimate large age range

Table 5.56 : Occurrence of dental abscesses

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5.5.2 SKELETAL PATHOLOGIES

5.5.2.1 SKULL AND ORBITS : POROTIC HYPEROSTOSIS AND CRIBRA ORBITALIA

Porotic hyperostosis (PH) is characterised by symmetrically distributed pitting of the compact bone of the skull and is usually associated with an increase in thickness of the adjacent diploic bone; the lesions are more commonly found on the frontal and parietal bones and less frequently on the occipital bone. Cribra orbitalia (CO) is a similar lesion located on the orbital roof.

Porotic hyperostosis and cribra orbitalia are analysed separately in this project. Although the aetiologies may be similar the exact nature of the relationship between lesions found on the orbits and the skull vault remains uncertain (Stuart-Macadam 1987b). In this project PH and CO occur in different frequencies, between males and females, and within the age categories of all the sites (Appendix I1, I2, J1, J2, Tables 5.57 to 5.76). The number of individuals is also calculated differently for each lesion type.

- PH – number of individuals based on vault bones present (parietal and/or occipital and/or frontal bones).
- CO – number of individuals based on orbits present; 2 orbits = 1 individual.

Since age and sex are important factors in the investigation of PH and CO the unsexed adults are excluded from the analysis. The MI age category is only included when age categories are ignored. When the frequencies of PH and CO are examined across age categories the Wolmaransstad sample will be included only in the younger adult and older adult analyses. There are no infants or juveniles and only a small number of sub-adults (n = 1) present in the Wolmaransstad site.

POROTIC HYPEROSTOSIS

This section presents data on the occurrence of PH. This includes data on PH when it coincides with CO. Since there are very few juveniles and no infants or sub-adults in the Colesberg sample these age groups are combined to make them statistically viable, into one category called 'children' when analysing the frequency of PH between age categories. The Wolmaransstad site is not included in the child versus adult comparison as it only contains one individual under 18 years old.

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	Total no. Individuals with Vaults	No. of Individuals with PH	%
Infants	18.5	4	21.6
Juveniles	7.5	5	66.7
SA Males	2	0	0
SA Females	2	2	100
YA Males	13	6	46.2
YA Females	13	9	69.2
OA Males	11	6	54.5
OA Females	7	3	42.9
MI Males	5	5	100
MI Females	5	2	40
Adult Males *	29	17	58.6
Adult Females *	25	14	56
TOTAL	84	42	50

SA = Sub-adults
YA = Younger adults
OA = Older adults
MI = Mature Individuals, osteologically adult, can only estimate large age range
Adults * = Includes YA, OA, MI
PH = Number of individuals based on presence of vault; parietal and/or occipital and/or frontal bones

Table 5.57 : Griqua sites – Occurrence of Porotic Hyperostosis

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	Total no. Individuals with Vaults ^	No. of Individuals with PH	%
Infants	0	0	0
Juveniles	4.5	1	22.2
SA Males	0	0	0
SA Females	0	0	0
YA Males	17.5	7	40
YA Females	17	9	52.9
OA Males	4	2	50
OA Females	2	1	50
MI Males	3	1	33.3
MI Females	2	1	50
Adult Males *	24.5	10	40.8
Adult Females *	21	11	52.4
TOTAL	50	22	44

^ = There are no sub-adults in the Colesberg sample; there are no infants with skulls in the Colesberg sample
SA = Sub-adults
YA = Younger adults
OA = Older adults
MI = Mature Individuals, osteologically adult, can only estimate large age range
Adults * = Includes YA, OA, MI
PH = Number of individuals based on presence of vault; parietal and/or occipital and/or frontal bones

Table 5.58 : Colesberg site – Occurrence of Porotic Hyperostosis

University of Cape Town

	Total no. Individuals with Vaults ^	No. of Individuals with PH	%
Infants	0	0	0
Juveniles	0	0	0
SA Males	0	0	0
SA Females	1	0	0
YA Males	1	0	0
YA Females	1	1	100
OA Males	9	6	66.7
OA Females	0	0	0
MI Males	7	4	57.1
MI Females	3	1	33.3
Adult Males *	17	10	58.8
Adult Females *	4	2	50
TOTAL	22	12	54.5

^ = There are no juveniles or OA females in the Wolmaransstad sample; there are no infants or SA males with skulls in the Wolmaransstad sample
SA = Sub-adults
YA = Younger adults
OA = Older adults
MI = Mature Individuals, osteologically adult, can only estimate large age range
Adults * = Includes YA, OA, MI
PH = Number of individuals based on presence of vault; parietal and/or occipital and/or frontal bones

Table 5.59 : Wolmaransstad site – Occurrence of Porotic Hyperostosis

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	G-C	G-W	C-W
Younger adults vs children*	0.76	~	~
Older adults vs children*	0.79	~	~

$P \leq 0.05$ is significant
G = Griqua
C = Colesberg
W = Wolmaransstad
*Children = infants, juveniles and sub-adults

Table 5.60 : Significance of the differences between frequencies of PH in various sites

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Site	Light No.	Medium No.	Severe No.	Total no. of Individuals Affected
Griqua				
Children *	10	0	1	11
Adult Males *	17	0	0	17
Adult Females *	13	1	0	14
TOTAL	40	1	1	42

Site	Light No.	Medium No.	Severe No.	Total no. of Individuals Affected
Colesberg ^				
Children *	0	1	0	1
Adult Males *	7	3	0	10
Adult Females *	8	3	0	11
TOTAL	15	7	0	22

Site	Light No.	Medium No.	Severe No.	Total no. of Individuals Affected
Wolmaransstad **				
Children *	0	0	0	0
Adult Males *	9	1	0	10
Adult Females *	2	0	0	2
TOTAL	11	1	0	12

^ = There are no sub-adults in the Colesberg sample; there are no infants with skulls in the Colesberg sample
** = There are no juveniles or OA females in the Wolmaransstad sample; there are no infants or SA males with skulls in the Wolmaransstad sample
Adults * = Includes YA, OA, MI
Children * = Includes infants, juveniles, sub-adults
PH = Number of individuals based on presence of vault; parietal and/or occipital and/or frontal bones

Tables 5.61 - 5.63 : Severity of Porotic Hyperostosis

University of Cape Town

Site	Active No.	Healed No.	Total no. of Individuals Affected
Griqua			
Children *	11	0	11
Adult Males *	17	0	17
Adult Females *	13	1	14
TOTAL	41	1	42

Site	Active No.	Healed No.	Total no. of Individuals Affected
Colesberg ^			
Children *	0	1	1
Adult Males *	6	4	10
Adult Females *	9	2	11
TOTAL	15	7	22

Site	Active No.	Healed No.	Total no. of Individuals Affected
Wolmaransstad **			
Children *	0	0	0
Adult Males *	10	0	10
Adult Females *	2	0	2
TOTAL	12	0	12

^ = There are no sub-adults in the Colesberg sample; there are no infants with skulls in the Colesberg sample
** = There are no juveniles or OA females in the Wolmaransstad sample; there are no infants or SA males with skulls in the Wolmaransstad sample
Adults * = Includes YA, OA, MI
Children * = Includes infants, juveniles, sub-adults
PH = Number of individuals based on presence of parietal and/or occipital and/or frontal bones

Tables 5.64 – 5.66 : Active versus healed Porotic Hyperostosis

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	Total no. Individuals with Orbits	No. of Individuals with CO	%
Infants	20	10	50
Juveniles	9.5	6.5	68.4
SA Males	2	0	0
SA Females	2	2	100
YA Males	13	4	30.8
YA Females	13	5	38.5
OA Males	11	3	27.3
OA Females	5.5	1	18.2
MI Males	5	3	60
MI Females	4.5	2	44.4
Adult Males *	29	10	34.5
Adult Females *	23	8	34.8
TOTAL	85.5	36.5	42.7

SA = Sub-adults
YA = Younger adults
OA = Older adults
MI = Mature Individuals, osteologically adult, can only estimate large age range
Adults * = Includes YA, OA, MI
CO = Number of individuals based on orbits; 2 orbits = 1 individual

Table 5.67 : Griqua sites – Occurrence of Cribra Orbitalia

University of Cape Town

	Total no. Individuals with Orbits	No. of Individuals with CO	%
Infants	0	0	0
Juveniles	5	1	20
SA Males	0	0	0
SA Females	0	0	0
YA Males	18	5	27.8
YA Females	17	7	41.2
OA Males	4	2	50
OA Females	3	1	33.3
MI Males	3	1	33.3
MI Females	2	1	50
Adult Males *	25	8	32
Adult Females *	22	9	40.9
TOTAL	52	18	34.6

^ = There are no sub-adults in the Colesberg sample; there are no infants with skulls in the Colesberg sample
SA = Sub-adults
YA = Younger adults
OA = Older adults
MI = Mature Individuals, osteologically adult, can only estimate large age range
Adults * = Includes YA, OA, MI
CO = Number of individuals based on orbits; 2 orbits = 1 individual

Table 5.68 : Colesberg site – Occurrence of Cribra Orbitalia

University of Cape Town

	Total no. Individuals with Orbits	No. of Individuals with CO	%
Infants	0	0	0
Juveniles	0	0	0
SA Males	0	0	0
SA Females	1	1	100
YA Males	1	0	0
YA Females	1	1	100
OA Males	9	5	55.6
OA Females	0	0	0
MI Males	7	3	42.9
MI Females	3	1	33.3
Adult Males *	17	8	47.1
Adult Females *	4	2	50
TOTAL	22	11	50

^ = There are no juveniles or OA females in the Wolmaransstad sample; there are no infants or SA males with skulls in the Wolmaransstad sample
SA = Sub-adults
YA = Younger adults
OA = Older adults
MI = Mature Individuals, osteologically adult, can only estimate large age range
Adults * = Includes YA, OA, MI
CO = Number of individuals based on orbits; 2 orbits = 1 individual

Table 5.69 : Wolmaransstad site – Occurrence of Cribra Orbitalia

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	G-C	G-W	C-W
Younger adults vs children*	0.16	~	~
Older adults vs children*	0.46	~	~

P≤0.05 is significant
G = Griqua
C = Colesberg
W = Wolmaransstad
*Children = infants, juveniles and sub-adults

Table 5.70 : Significance of the differences between frequencies of CO in various sites

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Site	Light No.	Medium No.	Severe No.	Total no. of Individuals Affected
Griqua				
Children *	11.5	5	2	18.5
Adult Males *	3	6	1	10
Adult Females *	4	4	0	8
TOTAL	18.5	15	3	36.5

Site	Light No.	Medium No.	Severe No.	Total no. of Individuals Affected
Colesberg ^				
Children *	0	1	0	1
Adult Males *	3	5	0	8
Adult Females *	7	2	0	9
TOTAL	10	8	0	18

Site	Light No.	Medium No.	Severe No.	Total no. of Individuals Affected
Wolmaransstad **				
Children *	0	0	1	1
Adult Males *	5	3	0	8
Adult Females *	1	1	0	2
TOTAL	6	4	1	11

^ = There are no sub-adults in the Colesberg sample; there are no infants with skulls in the Colesberg sample
** = There are no juveniles or OA females in the Wolmaransstad sample; there are no infants or SA males with skulls in the Wolmaransstad sample
Adults * = Includes YA, OA, MI
Children * = Includes infants, juveniles, sub-adults
CO = Number of individuals based on orbits; 2 orbits = 1 individual

Tables 5.71 - 5.73 : Severity of Cribra Orbitalia

University of Cape Town

Site	Active No.	Healed No.	Total no. of Individuals Affected
Griqua			
Children *	14.5	4	18.5
Adult Males *	9	1	10
Adult Females *	4	4	8
TOTAL	27.5	9	36.5

Site	Active No.	Healed No.	Total no. of Individuals Affected
Colesberg ^			
Children *	0	1	1
Adult Males *	4	4	8
Adult Females *	8	1	9
TOTAL	12	6	18

Site	Active No.	Healed No.	Total no. of Individuals Affected
Wolmaransstad **			
Children *	0	1	1
Adult Males *	6	2	8
Adult Females *	2	0	2
TOTAL	8	3	11

^ = There are no sub-adults in the Colesberg sample; there are no infants with skulls in the Colesberg sample
** = There are no juveniles or OA females in the Wolmaransstad sample; there are no infants or SA males with skulls in the Wolmaransstad sample
Adults * = Includes YA, OA, MI
Children * = Includes infants, juveniles, sub-adults
CO = Number of individuals based on orbits; 2 orbits = 1 individual

Tables 5.74 – 5.76 : Active versus healed Cribra Orbitalia

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The highest percentage of individuals expressing PH is found in the Wolmaransstad site (54.5%), then in the Griqua (50%) sites and lastly in the Colesberg (44%) site (Tables 5.57 to 5.59). In the Griqua and Colesberg samples females show a higher frequency of PH than males, whereas in the Wolmaransstad site males display higher frequencies of PH than females (Tables 5.57 to 5.59). When males and females are analysed separately and all sites are compared there is only a significant difference in the frequency of PH between males in the Griqua and Colesberg ($p < 0.001$) sites. There is no significant difference in the frequency of PH in females between any of the sites (Figures 5.28 & 5.29).

Generally, these lesions show greater severity and prevalence in juveniles and sub-adults (Mensforth *et al.* 1978; Stuart-Macadam 1982, 1987b). The Griqua (36.7%) sites show a larger percentage of children exhibiting PH than the Colesberg (22.2%) site (Tables 5.57 & 5.58). The Griqua (46.2%) sites also contain a greater percentage of younger adult males expressing PH than either the Colesberg (40%) or Wolmaransstad (0%) sites. However the Wolmaransstad site exhibits the greatest frequency of younger adult females (100%) with PH and older adult males (66.7%) with PH. Since there is only one YA female this data must be viewed with caution (Tables 5.57 to 5.59). The Colesberg (50%) site displays the greatest frequency of older adult females with PH. When younger and older adults are separated and the sites are compared there is no significant difference in the frequency of PH within males or females in any of the sites. Since the Wolmaransstad site only contains one YA male and female it is not included in the statistical analyses. The Colesberg OA males and females do not contain large enough numbers of individuals ($n < 5$) to be included in the statistical analyses (Figures 5.30 to 5.32). The frequency of PH between younger adults, older adults and children is also examined for the Griqua and Colesberg sites. There is no significant difference in the frequency of PH between younger adults and children ($p = 0.76$) and older adults and children ($p = 0.79$) (Table 5.60).

The scoring system for presence and severity of PH is based on the model devised by Stuart-Macadam (1982). The severity of lesions is recorded as, light, medium, or severe (Tables 5.61 to 5.63). These data are not viable for statistical analyses since the number of individuals expressing medium and severe PH is very small ($n < 5$). In all of the communities, light PH occurs more frequently than either medium or severe PH. In the Griqua and Wolmaransstad sites males express light PH more often than females, however in the Colesberg site females express light PH more often than males. The only individual who expresses severe PH is a child in the Griqua sample.

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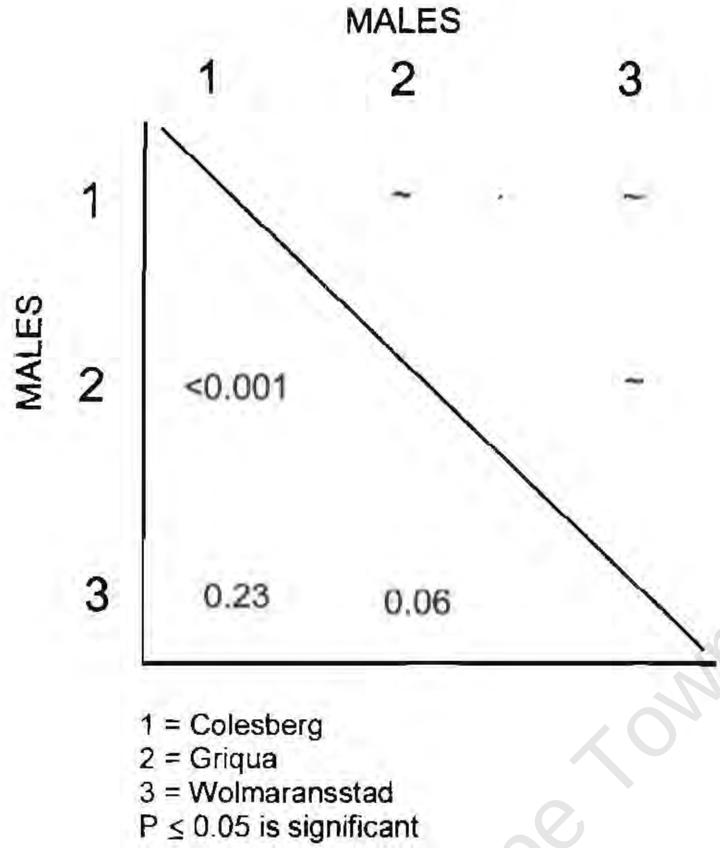

Figure 5.28 : Significance of the differences of PH in males – YA and OA combined

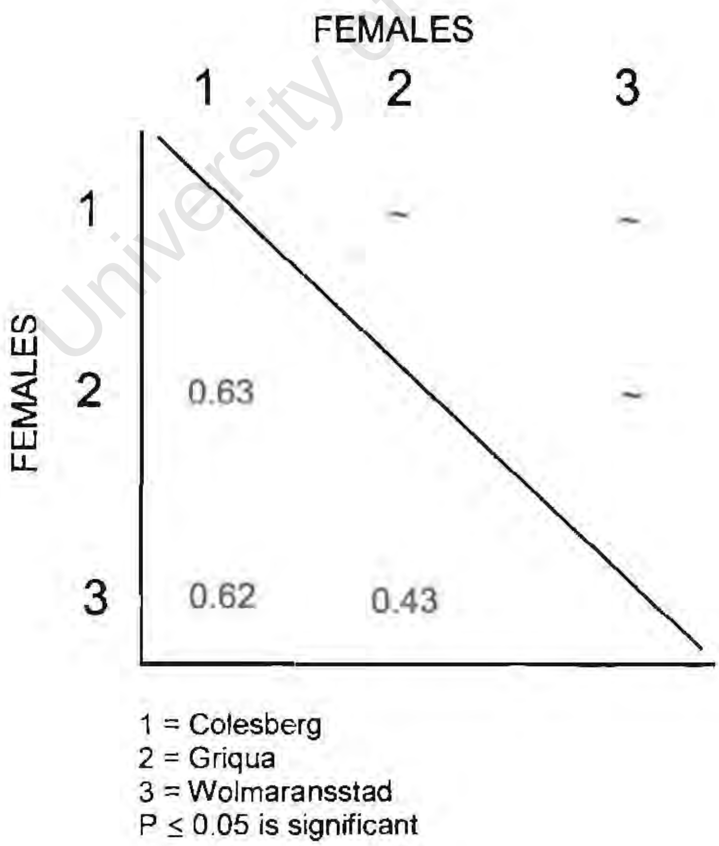

Figure 5.29 Significance of the differences of PH in females – YA and OA combined

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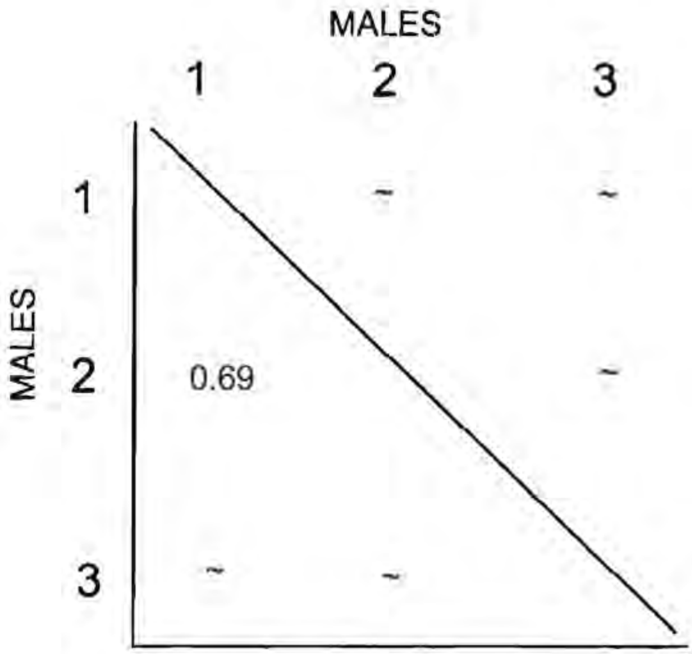
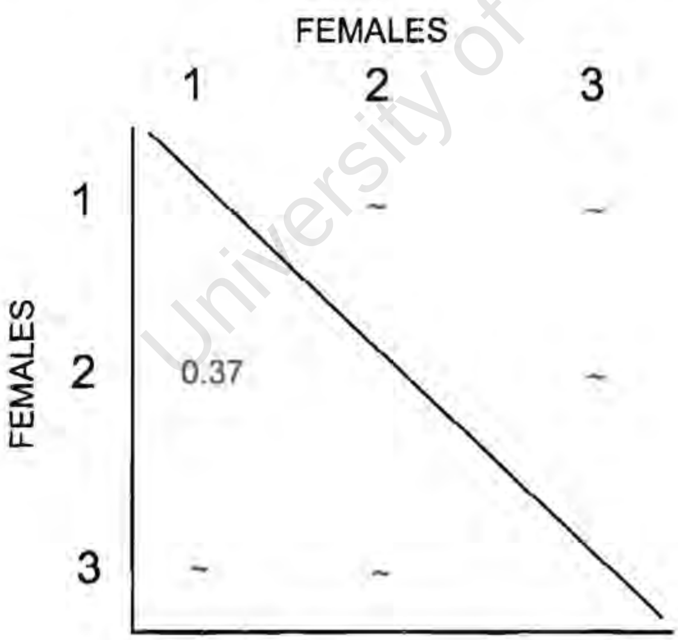


1 = Colesberg
2 = Griqua
3 = Wolmaransstad
P ≤ 0.05 is significant

Figure 5.30 : Significance of the differences of PH in younger adult males



1 = Colesberg
2 = Griqua
3 = Wolmaransstad
P ≤ 0.05 is significant

Figure 5.31 : Significance of the differences of PH in younger adult females

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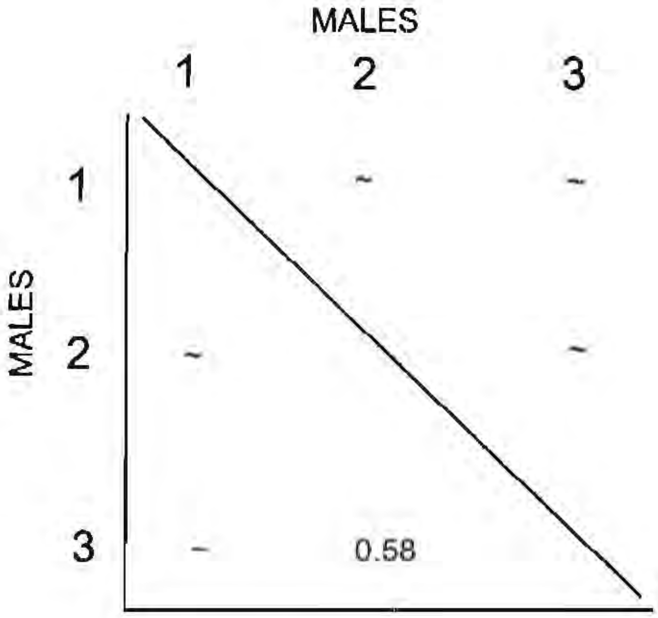

1 = Colesberg
2 = Griqua
3 = Wolmaransstad
P ≤ 0.05 is significant

Figure 5.32 : Significance of the differences of PH in older adult males

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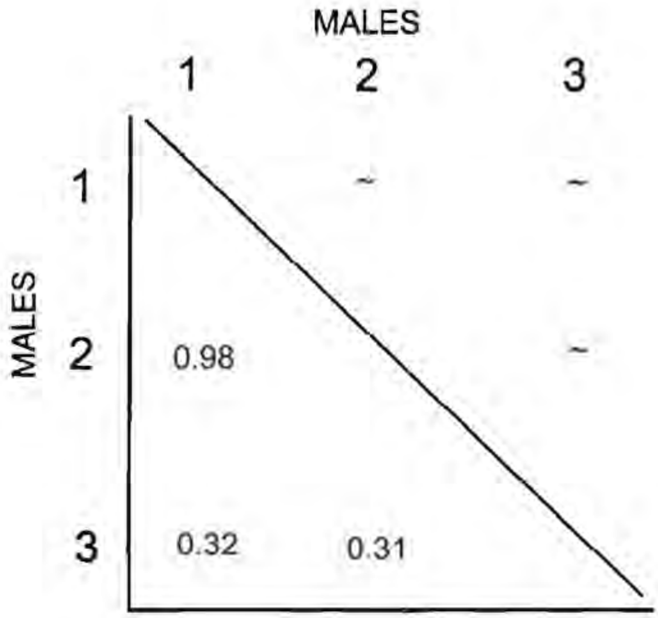
The lesions are also recorded for their status at time of death (i.e. remodelled, healed at time of death, and unremodelled, active at time of death) following Mensforth *et al.* (1978). Again, these data are not viable for statistical analyses since the number of individuals in each site expressing healed PH is very small ($n < 5$). Active PH is present more often than healed PH in all sites (Tables 5.64 to 5.66). In the Griqua and Wolmaransstad sites more males express active PH than females, however in the Colesberg sample females express active PH more often than males. Both males and females display a greater frequency of active PH than healed PH.

CRIBRA ORBITALIA

This section analyses data for the occurrence of CO which will include data when CO and PH occur in the same individual (Tables 5.67 to 5.76, Figures 5.33 to 5.37). In the Colesberg sample there are very few juveniles, no sub-adults present and no infants with skulls, therefore in order to allow for statistical analyses these age groups are combined into one category called 'children'. The Wolmaransstad site is not included in the child versus adult comparison as it only contains one individual under the age of 18 years.

The highest percentage of individuals expressing CO is found in the Wolmaransstad site (50%) followed by the Griqua (42.7%) sites and lastly the Colesberg (34.6%) site (Tables 5.67 to 5.69). In all of the sites females show a higher frequency of CO than males. When males and females are analysed separately, ages are combined, and all sites are compared there is no significant difference in the frequeney of CO within the males or females (Figures 5.33 & 5.34).

These lesions generally show greater severity and prevalence in juveniles and sub-adults (Mensforth *et al.* 1978; Stuart-Macadam 1982, 1987b). The Griqua (55.2%) sites show a larger percentage of children exhibiting CO than the Colesberg (20%) site (Tables 5.67 & 5.68). The Griqua (30.8%) sites also contain a greater percentage of younger adult males expressing CO than either the Colesberg (27.8%) or Wolmaransstad (0%) sites. Yet, the Wolmaransstad site exhibits the greatest frequency of younger adult females (100%) and older adult males (55.6%) with CO (Tables 5.67 to 5.69). However, since there is only one YA female this data must be viewed with caution. The Colesberg (33.3%) site displays the greatest frequency of older adult females with CO, there are no OA females in the Wolmaransstad sample. When younger and older adults are separated and the sites are compared



1 = Colesberg
2 = Griqua
3 = Wolmaransstad
P ≤ 0.05 is significant

Figure 5.33 : Significance of the differences of CO in males – YA and OA combined

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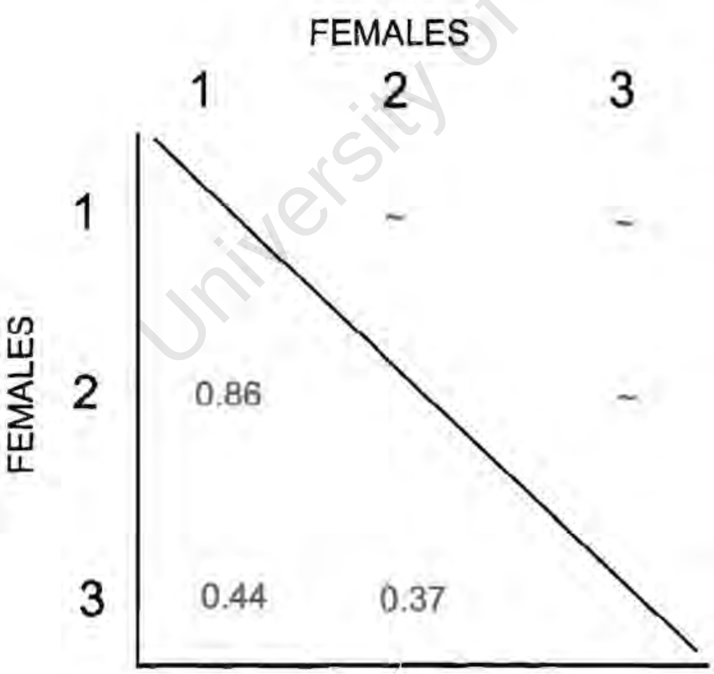
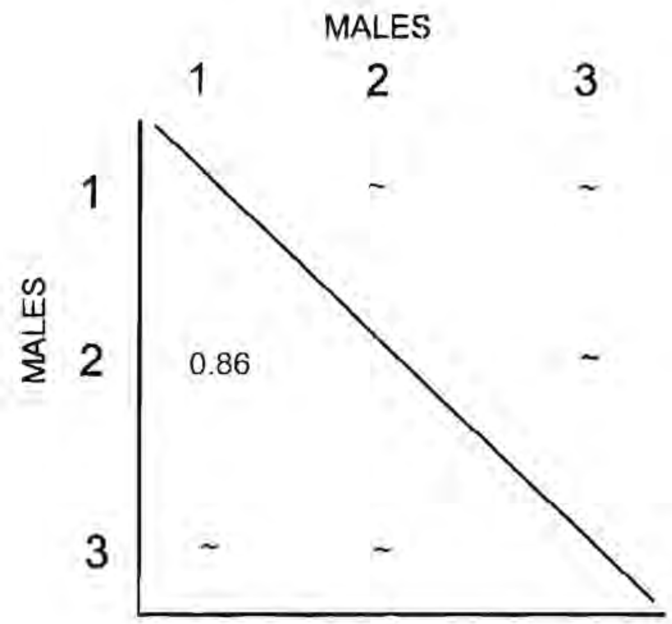


1 = Colesberg
2 = Griqua
3 = Wolmaransstad
P ≤ 0.05 is significant

Figure 5.34 : Significance of the differences of CO in females – YA and OA combined



1 = Colesberg
2 = Griqua
3 = Wolmaransstad
P ≤ 0.05 is significant

Figure 5.35 : Occurrence of CO in younger adult males – probability values

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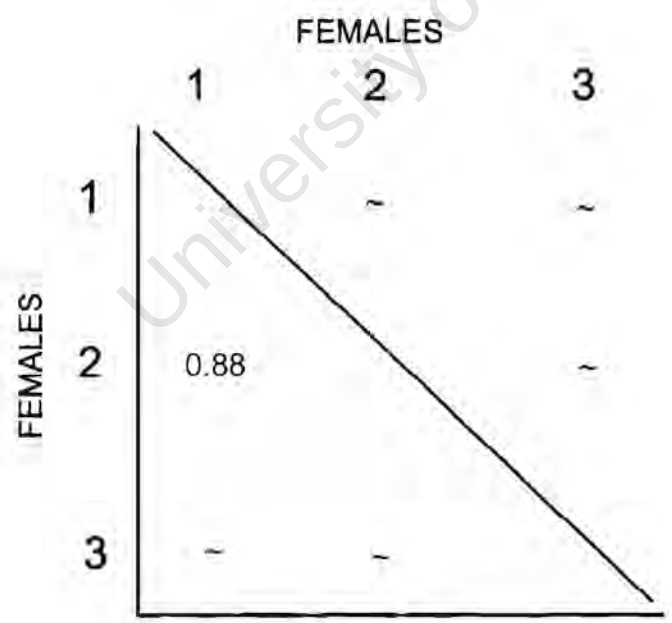
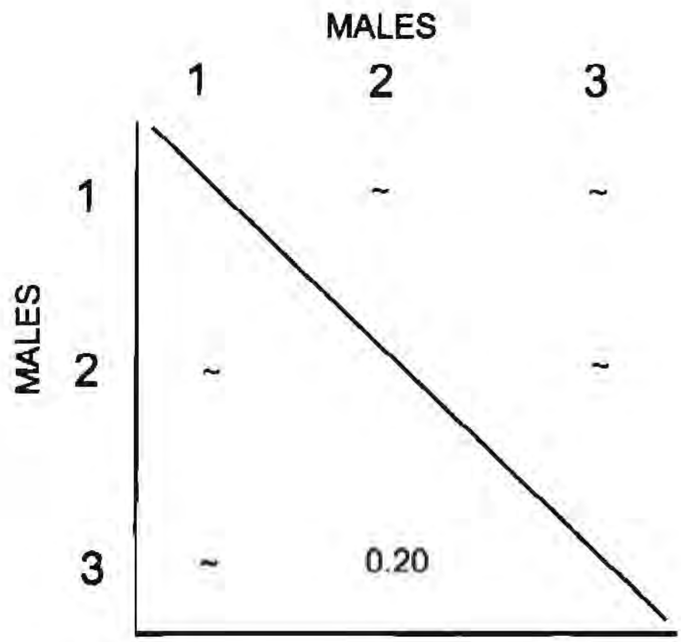


1 = Colesberg
2 = Griqua
3 = Wolmaransstad
P ≤ 0.05 is significant

Figure 5.36 : Occurrence of CO in younger adult females – probability values



1 = Colesberg
2 = Griqua
3 = Wolmaransstad
$P \leq 0.05$ is significant

Figure 5.37 : Occurrence of CO in older adult males – probability values

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there is no significant difference in the frequency of CO within the males or females in any of the sites. Since the Wolmaransstad site only contains one YA male and female it is not included in the statistical analyses. The Colesberg OA males and females do not contain large enough numbers of individuals ($n < 5$) to be included in the statistical analyses (Figures 5.35 to 5.37).

The frequency of CO between younger adults, older adults and children is investigated for the Griqua and Colesberg sites. There is no significant difference in the frequency of CO between younger adults and children ($p = 0.16$) and older adults and children ($p = 0.46$) (Table 5.70).

The scoring system for presence and severity of CO is also based on the model devised by Stuart-Macadam (1982). The severity of lesions is recorded as, light, medium, or severe (Tables 5.71 to 5.73). Once again, these data are not viable for statistical analyses as the number of individuals in each category is far too small. There are a few exceptions where the number of individuals in a sub-sample is greater than five, however these sub-samples are too few to make statistical analyses have any meaning. In all of the communities light CO occurs more frequently than either medium or severe CO. In the Wolmaransstad site males express light CO more often than females, however in the Griqua and Colesberg sites females express light CO more often than males. In all samples, males express medium CO more frequently than females. In the Griqua and Wolmaransstad sites children display severe CO more often than adults.

The lesions are also recorded for their status at time of death (i.e. remodelled, healed at time of death, and unremodelled, active at time of death) following Mensforth *et al.* (1978). Again, the number of individuals in each site expressing healed CO is very small. Active CO is present more often than healed CO in all sites (Tables 5.74 to 5.76). In the Griqua and Wolmaransstad sites more males express active CO than females, however in the Colesberg sample females express active CO more often than males. Generally, males and females display a greater frequency of active CO than healed CO.

Porotic hyperostosis occurs most frequently in juveniles and younger adult females in the Griqua population, younger adult females in the Colesberg site and older adult males in the Wolmaransstad sample. In the Griqua and Wolmaransstad sites, males express a higher percentage of PH than females, whereas in the Colesberg sample females express higher percentages. The only significant difference in the frequency of PH between any of the sites is when the Griqua and Colesberg males ($p < 0.001$) are compared and younger and older adults are combined. Light PH occurs more often than medium or

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severe, and active PH more often than healed. However, the Colesberg sample has a large percentage of healed PH (7/22 = 32%). Cribra orbitalia occurs most frequently in juveniles in the Griqua sample, younger adults in the Colesberg sample and older adults in the Wolmaransstad site. In all three samples females express a higher percentage of CO than males. There are no significant differences in the frequency of CO between any of the sites. As in the PH data, light CO occurs more often than medium or severe and active CO more often than healed. However there are more cases of medium and severe CO than present in the PH data; PH tends to be expressed less intensely than CO. The Colesberg sample again exhibits the largest percentage of healed CO (6/18 = 33.3%) as compared to either the Griqua or Wolmaransstad sites.

5.5.2.2 Arthritis

When arthritis, irrespective of cause, occurs in a synovial joint, it is termed osteoarthritis. Generalised osteoarthritis is more likely to be age-related, while osteoarthritis caused by disease is usually localised (Burns 1999). The MI age category is only included in analyses when the ages are combined. The small numbers (n < 5) of individuals affected with osteoarthritis in each category does not allow for statistical analyses (Tables 5.78 to 5.83). Tables 5.77 to 5.83 illustrate the total number of joints affected by osteoarthritis.

The Griqua and Colesberg younger and older adult females display a greater frequency of osteoarthritis than the males in the same age categories however, there is only one OA female in the Colesberg sample so this observation must be viewed with caution; there is no occurrence of osteoarthritis in the sub-adult age group in any of the sites (Table 5.77). Comparisons within the Wolmaransstad sample can not be illustrated since there are no females with arthritis and no OA females present. In the Griqua sample, younger adult females display arthritic changes almost two times more often than males in the same age group whereas in the Colesberg sample the younger adult males and females express similar frequencies of arthritis. In the Griqua site older adult females display osteoarthritis almost three times as often as males in the same age category, however in the Colesberg sample the younger adult females exhibit arthritic changes only two times as often as the older adult males.

In the Griqua males the synovial joint most often affected by osteoarthritis is the elbow, whereas in the Colesberg males it is the knee and in the Wolmaransstad males it is the tibia-calcaneal joint (Tables

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	Younger Adults (20.1 - 40 years)			Older Adults (40.1+ years)			Mature Individuals (osteologically adult, can only estimate large age range)		
	n*	No. of specimens with arthritis	%	n*	No. of specimens with arthritis	%	n*	No. of specimens with arthritis	%
<u>GRIQUA</u>									
male	68	2	2.9	84	5	6.0	16	2	12.5
female	95	5	5.3	58	10	17.2	1	0	0
TOTAL	163	7	4.3	142	15	10.6	17	2	11.8
<u>COLESBERG</u>									
male	124	3	2.4	14	1	7.1	21	0	0
female	116	3	2.6	14	2	14.3	1	0	0
TOTAL	240	6	2.5	28	3	10.7	22	0	0
<u>WOLMARANSSTAD</u>									
male	7	2	28.6	34	10	29.4	19	2	10.5
female	5	0	0	0	0	0	10	1	10.0
TOTAL	12	2	16.7	34	10	29.4	29	3	10.3

* = Total number of synovial joints

Tables 5.77 : Incidence of synovial joint arthritis in younger adults, older adults and mature individuals

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MALES			
Synovial joint	n*	No. of specimens with arthritis	%
Upper body			
temporo-mandibular	21	0	0
shoulder	11	0	0
elbow	16	3	18.8
radii-carpal	10	1	10.0
carpo-metacarpal	12	1	8.3
vertebrae	15	2	13.3
sacro- iliac ^	12	0	0
Lower body			
hip	19	0	0
knee	19	1	5.3
tarso-metatarsal	12	1	8.3
tibia-calcaneal	9	0	0
phalangeal*	13	0	0
TOTAL	169	9	5.3
Upper body	97	7	7.2
Lower body	59	2	3.4

n* = Total number of synovial joints (includes SA)
^ = Anterior sacro-iliac joint is synovial
* Can not determine if hand or foot phalange therefore not included in upper or lower body analysis

FEMALES			
Synovial joint	n*	No. of specimens with arthritis	%
Upper body			
temporo-mandibular	19	0	0
shoulder	11	0	0
elbow	13	3	23.1
radii-carpal	11	0	0
carpo-metacarpal	12	0	0
vertebrae	11	4	36.4
sacro- iliac ^	14	1	7.1
Lower body			
hip	19	2	10.5
knee	19	5	26.3
tarso-metatarsal	13	0	0
tibia-calcaneal	12	0	0
phalangeal*	11	0	0
TOTAL	165	15	9.1
Upper body	91	8	8.8
Lower body	63	7	11.1

n* = Total number of synovial joints (includes SA)
^ = Anterior sacro-iliac joint is synovial
* Can not determine if hand or foot phalange therefore not included in upper or lower body analysis

Tables 5.78 & 5.79 : Anatomical location of synovial joint arthritis in the Griqua sites

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MALES			
Synovial joint	n*	No. of specimens with arthritis	%
Upper body			
temporo-mandibular	22	0	0
shoulder	13	0	0
elbow	12	0	0
radii-carpal	12	0	0
carpo-metacarpal	11	0	0
vertebrae	14	1	7.1
sacro- iliac ^	13	0	0
Lower body			
hip	13	0	0
knee	14	2	14.3
tarso-metatarsal	11	0	0
tibia-calcaneal	14	0	0
phalangeal*	10	1	10.0
TOTAL	159	4	2.5
Upper body	97	1	1.0
Lower body	52	3	5.8

n* = Total number of synovial joints (includes SA)
^ = Anterior sacro-iliac joint is synovial
* Can not determine if hand or foot phalange therefore not included in upper or lower body analysis

FEMALES			
Synovial joint	n*	No. of specimens with arthritis	%
Upper body			
temporo-mandibular	17	0	0
shoulder	12	0	0
elbow	9	1	11.1
radii-carpal	9	0	0
carpo-metacarpal	8	0	0
vertebrae	9	2	22.2
sacro- iliac ^	11	0	0
Lower body			
hip	12	1	8.3
knee	12	1	8.3
tarso-metatarsal	11	0	0
tibia-calcaneal	12	0	0
phalangeal*	9	0	0
TOTAL	131	5	3.8
Upper body	75	3	4.0
Lower body	47	2	4.3

n* = Total number of synovial joints (includes SA)
^ = Anterior sacro-iliac joint is synovial
* Can not determine if hand or foot phalange therefore not included in upper or lower body analysis

Tables 5.80 & 5.81 : Anatomical location of synovial joint arthritis in the Colesberg sites

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MALES			
Synovial joint	n*	No. of specimens with arthritis	%
Upper body			
temporo-mandibular	13	0	0
shoulder	0	0	0
elbow	9	4	44.4
radii-carpal	3	2	66.7
carpo-metacarpal	3	0	0
vertebrae	4	0	0
sacro- iliac ^	6	0	0
Lower body			
hip	6	1	16.7
knee	12	4	33.3
tarso-metatarsal	3	0	0
tibia-calcaneal	2	2	100.0
phalangeal*	3	1	33.3
TOTAL	64	14	21.9
Upper body	38	6	15.8
Lower body	23	8	34.8

n* = Total number of synovial joints (includes SA)
^ = Anterior sacro-iliac joint is synovial
* Can not determine if hand or foot phalange therefore not included in upper or lower body analysis

FEMALES			
Synovial joint	n*	No. of specimens with arthritis	%
Upper body			
temporo-mandibular	4	0	0
shoulder	2	0	0
elbow	3	0	0
radii-carpal	0	0	0
carpo-metacarpal	0	0	0
vertebrae	1	0	0
sacro- iliac ^	1	0	0
Lower body			
hip	2	1	50.0
knee	3	0	0
tarso-metatarsal	0	0	0
tibia-calcaneal	0	0	0
phalangeal*	0	0	0
TOTAL	16	1	6.3
Upper body	11	0	0
Lower body	5	1	20.0

n* = Total number of synovial joints (includes SA)
^ = Anterior sacro-iliac joint is synovial
* Can not determine if hand or foot phalange therefore not included in upper or lower body analysis

Tables 5.82 & 5.83 : Anatomical location of synovial joint arthritis in the Wolmaransstad sites

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5.78, 5.80, 5.82). In the Griqua and Colesberg females the synovial joint most often affected by arthritic changes are the vertebrae, and in the Wolmaransstad females it is the hip (Tables 5.79, 5.81, 5.83).

In order to facilitate a better comparison, osteoarthritis is analysed as occurring in either the upper or lower body: above and below the sacro-iliac (SI) articulation (Tables 5.78 to 5.83). The SI joint is functionally part of the upper body as it is involved in transmitting weight from the vertebral column to the lower limbs (Williams *et al.* 1989) The Griqua males display more arthritic changes in the upper body whereas the females show more osteoarthritis in the lower body. However, in the Colesberg and Wolmaransstad samples both the males and females show more osteoarthritis in the lower body.

Osteophytosis, bone remodelling producing focal nodules of new bone formation at the bone margins, is a result of degeneration of the intervertebral disk. Irritation from bony contact at the vertebral margins stimulates the periosteum to form nodules of new bone or osteophytes. The involved locations are those most commonly flexed: C5-C6, T8-T9, L4-L5 (Aufderheide & Rodríguez-Martín 1998). The incidence of vertebral osteophytosis increases with advancing age (Tables 5.84 to 5.86, Figure 5.38). The number of specimens with osteophytes is calculated based on the total number of complete or nearly complete (15+ vertebrae) vertebral columns. The MI age category is only included when ages are combined. The small numbers ($n < 5$) of males in the Wolmaransstad site and older adult individuals in the Colesberg and Wolmaransstad sites are not viable for statistical analyses. Therefore, significance testing will only be employed when comparing males and females, combining all ages, and younger adults in the Griqua and Colesberg sites.

In the younger adult category, Griqua males and females express vertebral osteophytosis at the same rate (57.1%), but in the Colesberg sample it appears in males (27.3%) at a rate two times greater than females (12.5%) (Table 5.84). In the older adult category, Griqua females (75%) express the trait more often than males. The one older adult female in the Colesberg sample has vertebral osteophytosis whereas the male does not express the trait (Table 5.85). Overall, Griqua females (63.6%) exhibit vertebral osteophytosis slightly more often than males (60%), yet Colesberg males (35.7%) display a much higher frequency than females (22.2%) (Table 5.86 & Figure 5.38). In the Griqua and Colesberg sites the lumbar vertebrae are the most frequently affected with osteophytes whereas in the Wolmaransstad sample the entire vertebral column is equally affected. There is no significant difference

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	n*	No. of specimens with osteophytes	%
GRIQUA			
male	7	4	57.1
female	7	4	57.1
TOTAL	14	8	57.1
COLESBERG			
male	11	3	27.3
female	8	1	12.5
TOTAL	19	4	21.1
WOLMARANSSTAD			
male	0	0	0
female	0	0	0
TOTAL	0	0	0

n* = Total number of complete or nearly complete
(15+ vertebrae) vertebral columns

Table 5.84 : Incidence of vertebral osteophytes in younger adults

	n*	No. of specimens with osteophytes	%
GRIQUA			
male	7	4	57.1
female	4	3	75.0
TOTAL	11	7	63.6
COLESBERG			
male	1	0	0
female	1	1	100.0
TOTAL	2	1	50.0
WOLMARANSSTAD			
male	1	0	0
female	0	0	0
TOTAL	1	0	0

n* = Total number of complete or nearly complete
(15+ vertebrae) vertebral columns

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Table 5.85 : Incidence of vertebral osteophytes in older adults

	n*	No. of specimens with osteophytes	%
GRIQUA			
male	15	9	60
female	11	7	63.6
TOTAL	26	16	61.5
COLESBERG			
male	14	5	35.7
female	9	2	22.2
TOTAL	23	7	30.4

n* = Total number of complete or nearly complete
(15+ vertebrae) vertebral columns

Table 5.86 : Incidence of vertebral osteophytes in males and females

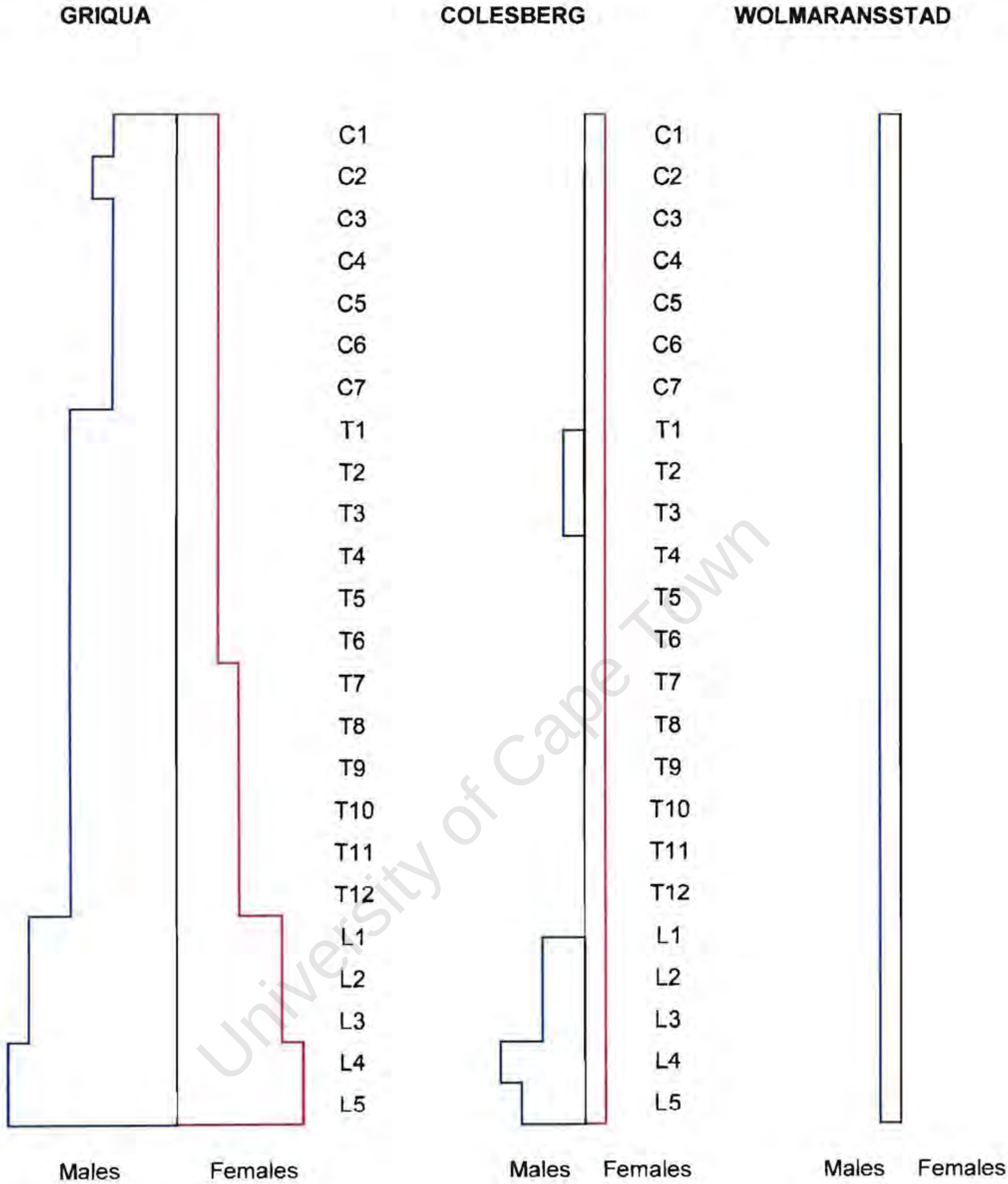

Figure 5.38 : Distribution of osteophytes in males and females

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between the occurrence of vertebral osteophytes and age or sex between the Griqua and Colesberg sites (Table 5.87).

The occurrence of collapsed vertebrae is also analysed (Table 5.88). There are too few individuals displaying collapsed vertebrae to warrant statistical analyses. The MI age category is only included in analyses when ages are combined. In the Griqua sites, the total frequency of collapsed vertebrae is high (7.7%) occurring within 9 individuals. The total frequency of collapsed vertebrae in males (7.7%) and females (7.6%) is very similar. There is only one collapsed vertebra (L5) in the Colesberg site occurring in only one individual, therefore the frequency is very small (2%). No individuals in the Wolmaransstad site exhibit collapsed vertebrae.

5.5.2.3 Trauma

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The occurrence of trauma in the Griqua, Colesberg, and Wolmaransstad populations is analysed (Table 5.89). Statistical analysis of this data is not possible, as the number of individuals exhibiting trauma is very small. The MI age category is only included when ages are combined.

Fractures are structural failures that result in the breaking of bone or cartilage (Buikstra & Ubelaker 1994). Skull fractures are caused by blows to the head from either a fall or a violent encounter (Figures 5.39 & 5.40). Overall, most of these lesions occur within the younger adult age category. In at least one of these individuals – not illustrated in the figures – remodelling of the bone is just beginning and therefore the lesions are probably perimortem, i.e. occurring around the time of death.

Within the Griqua population, more females than males (2:1) and more older adults than younger adults (3:0) display signs of trauma. Campbell/A2502, an older adult female, exhibits a healed break on the distal end of the left radius (Figure 5.41). A callus has formed where the bone was broken and the contour of the bone has also changed. There is a lateral bowing of the distal end of the radius. Healed wounds are illustrated on the left coronal suture of Danielskuil/UOVS13a and the left frontal bone of Philippolis/NMB1568 (Figures 5.39 & 5.40). In the Colesberg sample more females than males (3:2) and more younger adults than older adults (4:1) exhibit signs of trauma.

The right femur head of SAM4322 displays signs of a hip dislocation (Figure 5.42). The femoral head is flattened and oval-shaped and the femoral neck is short (Aufderheide & Rodríguez-Martín 1998).

	G-C	G-W	C-W
Males vs. Males	0.19	~	~
Females vs. Females	0.06	~	~
YA males vs. YA males	0.21	~	~
YA females vs. YA females	0.07	~	~

P≤0.05 is significant
G = Griqua
C = Colesberg
W = Wolmaransstad
YA = Younger adult

Table 5.87 : Significance of the differences of frequencies of vertebral osteophytes between sites

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	n*	No. of vertebrae	No. of individuals with collapsed vertebrae	No. of collapsed vertebrae	% of collapsed vertebrae	Location of collapsed vertebrae
<u>GRIQUA</u>						
male lumbar	13	65	4	5	7.7	L3 / L5 / L4 & L5 / L5
female lumbar	12	60	3	3	5.0	L3 / L5 / L5
female cervical	12	84	2	8	9.5	C3 - C6 / C3 - C6
Total	37	209	9	16	7.7	~
<u>COLESBERG</u>						
male lumbar	10	50	1	1	2.0	L5

n* = Total number of complete cervical, thoracic or lumbar sets

Table 5.88 : Incidence of collapsed vertebrae

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SITE	SEX	AGE	LOCATION OF TRAUMA
GRIQUA			
Campbell/ A 2502	F	54+ years	Left radius, distal end, healed break
Danielskuil/ UOVS 13a	F	45+ years	Left coronal suture, compression fracture
Philippolis/ NMB 1568	M	45-50 years	Left frontal bone, compression fracture
COLESBERG			
Colesberg/ SAM 4322	F	22-25 years	Right frontal bone, compression fracture
			Right femur head and acetabulum, dislocation
			Left 5th metacarpal and phalanx, osteomyelitis
Colesberg/ SAM 4330	F	24 years	Phalanx, osteomyelitis
Colesberg/ SAM 4496	M	40+ years	Nasal bone, healed break
Colesberg/ SAM 4505	F	35-40 years	Left parietal bone, compression fracture
Colesberg/ SAM 4507	M	22-25 years	Left parietal bone, compression fracture
WOLMARANSSTAD			
Wolmaransstad/ NMB 17	M	25-30 years	Right zygo-frontal suture, compression fracture
			Left orbital ridge, compression fracture
			Left coronal suture, compression fracture
Wolmaransstad/ NMB 19	F	17-19 years	Left frontal & parietal bones, compression fracture
Wolmaransstad/ NMB 21	M	26+ years	Left lambdoid suture, compression fracture
Wolmaransstad/ NMB 23a	M	50+ years	Left coronal suture, compression fracture
Wolmaransstad/ NMB 1313a	M	50-55 years	Nasal bone, healed break
Wolmaransstad/ NMB 1327a	M	40+ years	Left radius & ulna, distal end, break healed improperly
Wolmaransstad/ NMB 1328a	M	30+ years	Right radius, distal end, break healed improperly

Table 5.89 : Incidence of skeletal trauma

Figure 5.39 : Philippolis/NMB1568 – healed compression fracture

Figure 5.40 : Close up of Philippolis/NMB1568 – healed compression fracture

Figure 5.41 : Campbell/A2502 – Healed parry fracture of the distal radius

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Figure 5.42 : Colesberg/SAM4322 – Hip dislocation

Figure 5.43 : Colesberg/SAM4322 – Septic Arthritis

Figure 5.44 : Colesberg/SAM4322 – Septic Arthritis

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The acetabulum is not unusually shallow, as is most common in congenital malformations, and therefore the dislocation is probably a result of trauma (Buikstra & Ubelaker 1994).

Only the Colesberg site contains individuals, two younger adults, who exhibit skeletal manifestations of infections (Table 5.89). The Colesberg site shows one phalanx and one left fifth phalanx and metacarpal that possibly exhibit septic arthritis – an infection of the synovium and later all structures within a joint by a pathogenic infectious agent that can lead to joint destruction (Figures 5.43 & 5.44) (Aufderheide & Rodríguez-Martín 1998). Inside the joint, pus destroys the articular cartilage. Arthritic changes follow because joint cartilage does not regenerate. Direct infection of the joint through a penetrating wound in the skin is a possible diagnosis. The Wolmaransstad site contains more males than females (6:1) with traumatic injuries. Since the number of males, found at this site, is five times greater than the number of females it is not surprising that more males exhibit signs of trauma. The individuals in the Wolmaransstad site exhibit two severe fractures: NMB1327a displays an improperly healed break of the left distal radius and ulna and NMB1328a shows a break of the distal radius in which the anterior part of the radius is now positioned posteriorly (Figures 5.45 & 5.46).

Bowing of long bones is also analysed. The entire "anterior surface of the femur is smooth and gently convex" (Williams *et al.* 1989:435). Bowing refers to smooth, gradual curvature, beyond the normal range, as opposed to angulated changes that are commonly the result of healed fractures. Bowing can be caused from deficiency diseases such as rickets, scurvy, or anaemia (Hershkovitz *et al* 1997) or can be the result of normal genetic variation, i.e. African Americans have less bowed femora than other North American populations (Buikstra & Ubelaker 1994; Gill & Rhine 1990). Bowing occurs at a very low rate in all of the sites, but it appears more frequently in the Colesberg site, more often in the legs than the arms and at a greater frequency in males than females (Table 5.90).

5.5.3 Microscopic Pathologies: Analysis of Smallpox DNA

DNA extraction and PCR analysis are incredible technological advances that allow the researcher to gain insights into the reconstruction of population origins and evolution of infectious diseases. However, they are excruciatingly slow and meticulous research tools and do not fair well when analysing ancient DNA (aDNA) for two reasons: the inability to amplify a significant number of samples, as aDNA

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Figure 5.45 : Wolmaransstad/NMB1327a – Healed fractures of the left distal radius and ulna

Figure 5.46 : Wolmaransstad/NMB1328a – Healed Colles' fracture of the distal right radius (right); normal anatomical position (left).

SITE	SEX	AGE	LOCATION OF BOWING
GRIQUA			
Philippolis/ NMB 1604	M	40-45 years	Right humerus, distal end bowed
Philippolis/ NMB 1608	F	45+ years	Left femur bowed laterally
Philippolis/ NMB 1613	F	25-35 years	Right radius bowed laterally
Philippolis/ NMB 1701	M	25-35 years	Right humerus & radius bowed anteriorly
COLESBERG			
Colesberg/ SAM 4326	M	30+ years	Left & right femurs bowed laterally
Colesberg/ SAM 4490	M	35 years	Left & right femurs bowed laterally
Colesberg/ SAM 4493	M	35+ years	Left & right femurs bowed laterally
Colesberg/ SAM 4509	F	35-40 years	Left & right radii bowed laterally Left & right ulnae bowed medially
Colesberg/ SAM 4515	M	21-23 years	Left & right humeri bowed anteriorly Left & right tibiae bowed laterally
Colesberg/ SAM 4518	M	19-22 years	Right humerus bowed medially Left femur bowed laterally Left & right tibiae bowed laterally
WOLMARANSSTAD			
Wolmaransstad/ NMB 1221	M	40+ years	Right femur bowed anteriorly
Wolmaransstad/ NMB 1195	M	30+ years	Left tibia bowed laterally

Table 5.90 : Incidence of long bone bowing

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is very fragmented, and the contamination of samples with modern DNA (Kolman, *et al.* 1999; Kolman & Tuross 2000).

This project utilised aDNA technology to confirm the presence of smallpox in the communities studied which would also lend scientific evidence to the probably impetus for their death. Unfortunately, neither method 1 nor method 2 of the aDNA extraction proved to amplify on a PCR gel.

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CHAPTER 6

DISCUSSION :

PALAEODEMOGRAPHY AND LIFE HISTORY

Bioarchaeology utilises palaeodemography, growth, activity patterns, and paleopathology to reconstruct life histories and these are therefore the central issues examined in this discussion. Palaeodemography will only be discussed in terms of mortality curves as the population samples are not large enough to calculate life expectancy or other demographic features.

Only two sites, Campbell and Colesberg, have significant archaeological information published previous to this project. Philippolis and Wolmaransstad each have one unpublished Expedition Report dating from 1941 and 1942 respectively, and data on Danielskuil have only been published as an abstract in a scientific journal (Peters & Gous 1987). There is no previously published archaeological information on either Bethulie or de Tuin.

Comparative sites are employed to demonstrate similar patterns and possible explanations for the results. By using the contexts of samples from the literature, which have valid explanations for similar patterns, a more comprehensive understanding of the bioarchaeology of the Northern Frontier is revealed.

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6.1 PALAEODEMOGRAPHY

6.1.1 HOW HAS THE EXCAVATION AND SUBSEQUENT POST-EXCAVATION STORAGE AFFECTED THE SKELETAL SAMPLES?

Palaeodemography attempts to reconstruct a population's age (at death)-sex profile while also being an estimator of its diet and health status but only if the death assemblage reflects in some way the original population. The excavation methods as well as the degree of care employed during curation can bias the palaeodemographic analysis. Tables 5.01 to 5.04 illustrate the postcranial and cranial preservation and condition of the skeletal remains in each site analysed for this project. Overall, the preservation of the Griqua remains is generally good. However, the skeletal remains from two Griqua sites are in poor condition: Danielskuil, which is a direct result of poor excavation methods and improper curation, and de Tuin, which resulted from a series of controlled excavations but is composed entirely of juvenile skeletons which do not preserve as well as adults. However, the Colesberg site, which was also excavated using poor archaeological methods, shows very good preservation and completeness. The Wolmaransstad excavation also employed poor archaeological methods but the skeletal remains exhibit excellent preservation and generally very good completeness.

The Campbell and de Tuin excavations were supervised by anatomists with archaeological training, P.V. Tobias and A.G. Morris. Their present condition is a direct result of proper curation methods employed by both institutions. Proper curation involves the following: the skeletons are stored in wooden boxes large enough to accommodate all of the bones, the skulls are protected and stored in a separate box so as not to cause any post-mortem damage, each individual is assigned an accession number that corresponds to the burial in which it was found, and the skeletal material is kept on shelves in a locked room with only a few individuals having access. Although the juveniles at de Tuin are not well preserved they were properly stored so that further damaged did not result. Many of the de Tuin cairns had been disturbed by aardvarks or acacia trees but the excavators consciously avoided these graves on the assumption that the skeletons may have been damaged by animal activity or plant root acids. All skeletons excavated from the graves at Campbell and de Tuin were kept and were available for study.

The lack of adult representation at the de Tuin site is almost assuredly not due to sampling biases since acacia trees and aardvarks were unlikely to be specifically attracted to adult cairns. Sometimes smaller cairns were also disturbed by these agents. The predominance of children at the site must therefore reflect either differential mortality in the community or a conscious effort to bury children in one location. Since no ethnographic or historical information exists in South Africa to indicate child cemeteries, it must be assumed that the age frequency best reflects mortality.

The Danielskuil excavation was also supervised by two anatomists and completed with help from students in the Department of Anatomy at UOVS, but none of them had any formal archaeological training. Although formal training does not always guarantee good archaeology, in this case the lack of training has resulted in poor record keeping and especially poor post-excavation curation. Figures 6.01 and 6.02 illustrate the methods in which these human remains were stored: cardboard paper towel boxes

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Figure 6.01 : Curation of Danielskuil remains at UOVS, January 2000.

Figure 6.02 : Curation of Danielskuil remains at UOVS, January 2000 – Notice individuals 11, 26 and 27 are stored in the same box

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cut down to size with no lids. All osteological material was wrapped in paper towelling and marked in black ink on the outside with a number corresponding to the burial, i.e. number 1 represents individual 1 from grave 1. However, each box did not contain a separate individual rather, different bones from many different individuals were arbitrarily placed in each box, e.g. bones from individuals 11, 26 and 27 were in the same box. None of the artefacts described in Peters 1986 report of Danielskuil were present during the January 2000 data collection and therefore are presumed to have been lost. Peters (1986) also describes the skeletal remains as being in 'good' and 'very good' condition.

In February 1996, Dr. C.M. Engelbrecht, Director of the National Museum in Bloemfontein (NMB), replied to a letter from the Department of Anatomy and Cell Morphology at the University of the Free State (UOVS) to put the Danielskuil material on permanent loan at the NMB. In May 1996, the Head of the Department at UOVS, Prof. P.P.C. Nel, stated in a letter addressed to Dr. Engelbrecht that the collection was "incomplete due to losses over the years" (Figure 6.03). However, since there was insufficient field notes and documentation pertaining to the excavation of the Danielskuil remains the NMB would not approve the transfer of skeletal remains from UOVS (personal communication Dr. Z. Henderson, 2001). How then did the remains deteriorate from very good condition to poor, sometimes unrecognisable, condition? This is most definitely related to improper curation of the human remains from the Danielskuil site.

The South African Heritage Resources Agency (SAHRA), an agency of the government that over sees legal issues pertaining to archaeological artefacts and human remains, has published specific guidelines for archaeologists, palaeontologists and historians in museums and universities. This document cites that "proper arrangements should be made for the storage of [artefacts] with the approval of SAHRA" (SAHRA Draft P0, Section 3e, June 2001). The use of cardboard boxes with no lids is most definitely not considered, by SAHRA, as 'proper storage' for human remains. SAHRA also requires that "the [human] remains from each grave should be placed in individual caskets or other suitable containers, permanently marked for identification" (SAHRA Draft P0, Section 3f, June 2001). The Danielskuil skeletons were placed in boxes, combining bones from different individuals in each box, and wrapped in paper towel. In addition, all archaeological objects are property of the State, and SAHRA must "ensure that such objects are lodged with a museum or other public institution that has a collection policy acceptable to [SAHRA]" (National Heritage Resources Act No. 25, Section 35, 1999). The Department

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20 MEI 1996

DR. C. M. ENGELBRECHT
DIREKTEUR
NASIONALE MUSEUM
BLOEMFONTEIN

Beste Dr. Engelbrecht

BRUIKLEEN VAN SKELETMATERIAAL

Soos vroeër vanjaar met u ooreengekom dra ons graag die antropologiese menslike skeletmateriaal wat hierdie departement oor beskik. aan u organisasie oor op 'n bruikleen-basis. Ons sluit alle inligting waaroor ons beskik in by die weefsel. Ongelukkig het baie inligting deur die jare verlore gegaan en is die inligting nie meer volledig nie. Ons vertrou egter dat die inligting wat ons wel kan verskaf. vir u van nut kan wees.

Die uwe

PROF. P.P.C. NEL
HOOF: ANATOMIE EN SELMORFOLOGIE

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Figure 6.03 : Letter from Head of Anatomy and Cell Morphology, UOVS to C.M. Engelbrecht, Director of NMB authorising loan of Danielskuil skeletal remains

of Anatomy and Cell Biology at UOVS does not have a collection policy, for archaeological artefacts, accepted by SAHRA.

Philippolis, Bethulie and Wolmaransstad were excavated by A.C. Hoffman, a trained Zoologist, who was Assistant Director of the National Museum Bloemfontein (NMB) from 1934-1946 and Director from 1951-1969 (National Biography of South Africa, Vol. V). Once again, the incompleteness of the skeletal material excavated from Bethulie is probably due to Hoffman's poor archaeological methods. The excellent preservation found in the Philippolis and Wolmaransstad sites may not be representative of the sites as a whole since Hoffman only chose skeletons that were in "the best" condition (Hoffman 1941, 1942); he wanted a "good collection of Bantu skulls" (Hoffman 1942) and left behind skeletons that "were in poor [condition] and not suitable for mounting" (Hoffman 1941).

Some of the demographic biases present at Philippolis, Bethulie and Wolmaransstad may have been a direct result of Hoffman's poor archaeological methods. Hoffman's 1941 and 1942 reports state that he only wanted skeletons in "the best" condition and therefore it is possible that the lack of children represented at Philippolis and Wolmaransstad are a direct result of this objective. At the Philippolis site, Hoffman comments that the small graves of children were "not suitable for mounting" (Hoffman 1941), although he did remove three child skeletons but these could not be located during the data collection in 2000. However, Hoffman also excavated at Bethulie which has 17 children of a total of 28 individuals. This suggests that Hoffman <u>would</u> have retained children's skeletons if they were in good condition. Therefore, although Hoffman did not always keep child skeletons it does appear that he did accession child skeletons to the museum when the preservation was reasonable.

The Colesberg skeletons were excavated by James Drury, a taxidermist employed by the South African Museum in Cape Town with no formal training in archaeological methods. Drury was under pressure from L.A. Péringuey, the Director of the South African Museum, to make life-casts of 'Hottentots' and 'Bushmen' and wanted to ensure that all 'pure' types of these 'races' were represented in his collection of skeletons at the museum (Legassick & Rassool 2000; Morris 2000; Voget 1988). Drury did not make adequate field notes and it is often difficult to find any archaeological references in his data but there is no evidence that he selectively excavated skeletons. Drury wanted to 'dig up' the skeletons and was not concerned about the archaeological context in which they were found. The Colesberg skeletons range from poor to excellent preservation and most are nearly complete or incomplete. The

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well preserved and complete individuals in this sample are probably not due to Drury's excavation of the site but rather Colesberg's ecological location which is an ideal climate for skeletal preservation; the Nama-Karoo is characterised by dry, shrubland with some grasses.

Both the Danielskuil and Wolmaransstad sites have large percentages of mature individuals (MI's) 17.1% and 38.5% respectively (Table 5.05); MI's are individuals who are osteologically adult but whose age at death can only be estimated with large age ranges. The MI's can not be accurately aged due to the incompleteness of the skeletal material. Poor excavation methods probably contributed to the incompleteness of these individuals.

Palaeodemographic analyses may be biased due to improper archaeological excavation and/or curation methods. Although two of the Griqua sites display poor preservation, the majority of the skeletal remains exhibit good preservation; the poor condition of the Danielskuil remains is a direct result of inadequate excavation methods and improper curation, whereas the poor condition of the de Tuin skeletons is a result of their age-at-death. The overall completeness and good preservation found at the Colesberg site is not related to Drury's excavation methods, since he employed poor archaeological methods, but probably due to Colesberg's ecological location; Colesberg is located in the Nama-Karoo which is characterised by dry shrubland and grasses an ideal climate for skeletal preservation. Although there is a lack of children excavated from the Colesberg site which produces a slight age bias, it is probably related to something other than poor excavation methods. Wolmaransstad also exhibits excellent preservation and general completeness. Once again, there is a lack of children found at this site which is probably not due to excavational biases but more likely a result of population dynamics; Hoffman would retain children's skeletons if they were in good condition.

Since the Department of Anatomy and Cell Biology at UOVS did not adhere to the laws of conduct when storing the archaeological material from Danielskuil, important information about the past lives of Griqua peoples has been lost forever. Although other collections within South African museums have been badly curated, these institutions have at least attempted to keep the skeletal and cultural material in good condition. In addition, since no claim has been lodged for the return of these skeletons it is probable that the existence of these human remains is unknown to the Griqua peoples. SAHRA cites that "institutions have an ethical obligation to make communities aware of their holdings" (SAHRA and South African Museum, 18 May 2000). If something good can come from this project it would be the

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return of the Danielskuil Griqua skeletal remains to their rightful 'owners'. This would allow these individuals a proper burial and afford the much deserved dignity and respect that is owing to them.

6.1.2 How Does the Skeletal Demography Link with the Historical Descriptions of the Populations of the Northern Frontier?

Weiss (1973) asserts that the general pattern of human sub-adult mortality in anthropological populations is one of very high infant mortality, which decreases between the ages of 1-5, and further declines until ages 10-15. Only the Griqua sites represent a 'normal' mortality profile for historic populations; large numbers of infants and juveniles dying, lesser number of sub-adults and an increase in deaths among younger and older adults. There are more males (n=43) than females (n=31) dying at this site. The Colesberg and Wolmaransstad sites do not represent a 'normal' mortality profile for historic populations. In the Colesberg site the vast majority of individuals dying are in the younger adult age category (n=35). There are more males (n=25) than females (n=21) dying at Colesberg. In the Wolmaransstad sample there are very few children (n=1) and a large number of older adults (n=14) present with five times as many males (n=30) as females (n=6) dying (Figures 5.01 to 5.06, Tables 5.05 to 5.07). The sex discrepancy at the Wolmaransstad site is very unlikely to reflect excavation bias and is therefore suggestive of a different demographic dynamic from both the Griqua and Colesberg samples.

Although each Griqua site may have different demographic profiles, i.e. the ratio of children to adults, their similar histories and ethnic composition warrants them to be combined for comparative purposes. Yet, how can De Tuin, which only has children and Philippolis, which only has adults be combined into one sample? When Hoffman (1941) excavated at Philippolis he probably did not remove many badly preserved children's skeletons however, he probably also did not remove badly preserved adult skeletons. Also, Hoffman did retain child skeletons at Bethulie. This suggests that Hoffman was not biasing in favour of adult skeletons when he excavated other sites but rather keeping the ones, whether child or adult, in 'best condition'. There are only children excavated at de Tuin. Excavation and preservation bias is unlikely to account for this and therefore the age bias reflects the predominance of children at the site. These two sites can be 'lumped' together because of cultural continuity and by 'lumping' it will negate some of the 'biases', i.e. only children or adults present. De Tuin and Philippolis

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contain the smallest number of individuals, 12 and 18 respectively and are therefore open to statistical error in sampling if considered independently in the analysis. By not combining them the sample size disparity would suggest a degree of caution when performing data analyses. Therefore, all five Griqua sites will be combined for comparative purposes.

The death demographics in an archaeological site do not necessarily represent the greater population living at that time (Grauer and McNamara 1995; Roth 1992). Large numbers of infant and child skeletons may indicate a disease process affecting the weakest of society and may not reflect the actual percentages of living subadults in a population; there may have been very small numbers of children living in the community but the death sample would indicate the opposite. Therefore, the skeletal sample is not an accurate representation of all individuals who are at risk for disease at a particular age. Migration of healthy people into an area would not be accurately reflected in the skeletal sample as gravesite demographics represent the individuals who died not the survivors. Whereas historical records illustrate the experiences of the living population, skeletal remains echo the lifetime of nutritional and disease experiences of the deceased population.

The Griqua sites can be compared to the St. Thomas Cemetery located in Belleville, Ontario, Canada. St. Thomas' Anglican cemetery was used from 1821 until its closure in 1874. Belleville was originally a 19th century pioneer town, which grew rapidly during the 1840's and 1850's and became a centre for marketing farm and lumber products (Saunders *et al.* 1995). The object of comparing the Bellville site, which is fairly culturally uniform and urban, to the Griqua sites, which are ethnically mixed and marginalised, is not to match them. Rather, it is because the Bellville site is more urban and stable that it can be used as a reference group to help understand the Griqua sample. The key issue is that the Belleville site represents a 'complete' death sample in that all graves are removed and examined in the context of large numbers of individuals. The Belleville site is also directly comparable to the Griqua sites as they both are part of the 19th century 'frontier' movement. The age-at-death demographics of these two samples are similar with large percentages of infants and children dying (Table 6.01).

The reasons for so many children represented in the St. Thomas skeletal data are related to poor sanitation, nutrition and disease (Saunders *et al.* 1995), which may also explain the high child mortality in the Griqua sites. Diarrhoeal diseases were prevalent in infants in 19th century Belleville due to the tendency to dilute, already poor quality weaning foods e.g. gruels, with contaminated water (Saunders *et*

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	% of Total
<u>Belleville</u>	
Juveniles *	50.5
Adults	49.5
<u>Griqua</u>	
Juveniles *	40.7
Adults	59.3

Juveniles* = includes infants and juveniles

Table 6.01 : Demographics of the Belleville and Griqua cemeteries

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al. 1995). Also, Church records indicate that children were exposed to many contagious infections, e.g. cholera, smallpox, measles, meningitis, scarlet fever, typhoid fever and whooping cough. Although the Griqua sites were mostly pastoralists, agriculture was introduced by the missionaries in 1804 (Legassick 1989). Three of the five Griqua sites, Campbell, Danielskuil and de Tuin, were growing maize during the 19th century which is of poor nutritional value and may have also been used as a weaning food. In addition, smallpox swept through South Africa during the 18th and 19th centuries. In the early 1800's it was present in the Griqua region at Campbell and Philippolis and in the 1880's in Kimberley (Burrows 1958; Gilder 1984). Therefore it is probable that the children of the Griqua sites died of similar causes as the children present at St. Thomas' cemetery.

The Colesberg sample is composed of indigenous people who were living on the margins of society. With the exception of the inhabitants of the village, who were mostly shop keepers or artisans, the entire population of Colesberg was engaged in stock farming, mostly sheep and cattle, and horticulture, mainly wheat, barley, rye and oats. The majority of the 'Coloured' men were employed as agricultural labour and the 'Coloured' women as domestic servants (Government Documents, G.1-1866). The historical data as well as the death demographics suggests a possible explanatory model is a migratory workers population; large percentage of younger adult females (33%) and males (35%) dying.

The demographics of Colesberg are compared to migrant populations in Ecuador. Although the skeletal population is not a reflection of the living population the following discussion may shed some light on the reasons for such large percentages of younger adults present in the Colesberg cemetery. Migrants, both men and women, who move from the rural areas of Ecuador to the city of Guayaquil, tend to be highly selected: young and mostly single. About a third of the women have children with them, usually only one and a maximum of two. Both men and women are motivated by 'pull' factors: the perceived opportunities in the city for jobs and "a better way of life" (Scrimshaw 1975:312). In the classic pattern migrants usually move first to the city slums that are outside or very near the city boundaries and only later to the squatter settlements located within the city limits (Scrimshaw 1975).

This pattern is also present in the living Colesberg 'Coloured' community during the mid-19th century. From 1843 to 1865 the number of manufacturers increased 7.5 times and the number of people employed in the agricultural sector declined by almost half (Government Documents, Colony of Cape of Good Hope 1840 & 1841; Van de Sandt 1843; Government Documents, G.1-1866). This data suggests

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that the focus of employment moved from the rural areas to the town. The town of Colesberg was becoming an important centre for commerce as people were buying material goods here to use in their daily lives. Interestingly, the Proclamation of 1812 regulated the apprenticeship of 'Hottentot' children from the age of eight to eighteen years, who had been born during the service of their parents. Since the farmer helped to support the 'Hottentot' children for the first eight years of their life, he expected 10 additional years of free labour from them in return (Government Documents, Report No. 584 1830). This suggests that possibly there were more children living at Colesberg than this death sample illustrates.

The Wolmaransstad burials are cited from oral history as a cemetery of Zabantu labourers where men worked in the fields and women laboured in the domestic space (Hoffman 1942; Maggs 1976). Since many of the farm labourers interviewed during Hoffman's 1942 excavation remembered many of the people buried in this cemetery it is possible that the Wolmaransstad remains are 20th century. The Natives Land Act of 1913 lends evidence for this time period. It stated that Zabantu people could no longer rent farms from absentee land owners but could only occupy tenancy on these Colonial farms as a condition of labour service (Phillips *et al.* 1996). In effect it allowed the land owners to profit from the cheap labour of indigenous communities. Therefore the large percentage of males, small percentage of females and few children, present in the Wolmaransstad site is representative of an informal community based on local labour needs.

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6.2 What was Life Like for the People Living in the Northern Frontier?

6.2.1 Dental Attrition as a Sign of Economic Activity

Different economic modes and lifestyles are revealed through analyses of dental attrition. Occlusal wear patterns reflect different masticatory and dietary behaviours. Studies reveal that generally, foragers have more severe wear than agriculturalists, agriculturalists show higher angles of occlusal wear than hunter-gathers and wear is usually cupped in agricultural populations and flat in hunter-gather communities (Larsen 1997). However, this does not always hold true as the occlusal wear in the Griqua (present study), Colesberg and Wolmaransstad populations is all flat wear. The difference in wear patterns between hunter-gatherer populations and agriculturalists is related to the 'fibrous' foods eaten by foragers as compared to the individuals in an agriculturalist community (Larsen 1997).

Dental attrition rates are also employed to determine lifestyle patterning within and between communities. The occlusal dental wear is presented in tables 6.02 to 6.05. The Kruskal-Wallis statistical test, used when three or more samples are compared, is employed to determine if there is a significant difference in dental wear between populations. The occlusal dental wear for the Griqua (present study), Colesberg and Wolmaransstad samples is compared to the Riet River which is a hunter-gatherer economy that includes some pastoralist activities (Morris 1984, 1992b), Kakamas which is a skeletal sample probably associated with the Khoe group, Einiqua (Morris 1984, 1992b), the Griqua sites present in Morris (1984), and the agriculturalists from the K2 and Mapungubwe sites (Steyn 1994). The Morris (1984) Griqua sites include the Campbell sample employed in the present study and the Brink sample of six individuals housed at the South African Museum (see Morris 1992b for details on how Morris' Griqua sample was constructed). Since age and sex are important variables the unsexed adults and the MI's are not included in this discussion. The small numbers of individuals present in the sub-adult category prevents any legitimate conclusions and therefore this age category will be excluded from analyses.

Although the dental attrition methodology presented in table 4.01 is similar to Morris (1984) there is some variability which makes direct comparison difficult. Both the present study and Morris' (1984) methodology are based on a grading system from 0 to 4, with 0 representing no wear and 4 extreme wear. However, the present study includes an extra category, 2+, scored as 2.5, for moderate wear. Morris (1984) uses grade 2 to illustrate slight and moderate wear, however, since there are significant differences between these categories, the present author added another category, 2+, for moderate dental attrition. The addition of this extra category makes it difficult, even impossible, to directly compare the dental attrition <u>means</u> to previously recorded data as the means recorded in the present study are consistently higher than those illustrated in previous studies. Statistical analyses illustrate significant differences in dental attrition between all the sites compared, however if different methods are employed then significant differences will occur (Table 6.04). Therefore <u>patterns</u> of dental attrition are analysed and compared and not the specific mean numbers.

The Griqua (present study), Colesberg and Wolmaransstad, younger adult and older adult groups consistently display much higher total anterior, posterior and mean attrition scores than the same age

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Younger Adults (20.1-40 years)

	Male n*	Female n*	Anterior Attrition Score Male	Female	Total	Posterior Attrition Score Male	Female	Total	Mean Attrition Score Male	Female	Total
Griqua (present study)	12.5	12	2.8	3.2	3.1	2.4	2.5	2.5	2.6	2.8	2.7
Colesberg	18	16.75	2.8	2.8	2.8	2.5	2.5	2.5	2.6	2.6	2.6
Wolmaransstad	1	1	3.2	2.9	3.0	2.4	2.5	2.4	2.7	2.6	2.7
Riet River ^	17	15	2.3	2.5	2.4	2.1	2.1	2.1	2.2	2.2	2.2
Kakamas ^	15	16	2.0	2.0	2.0	1.7	1.6	1.6	1.8	1.7	1.8
Griqua (Morris) ^	9	3	2.0	1.8	2.0	1.5	1.2	1.4	1.7	1.4	1.6
Mapungubwe & K2**	6	4	2.0	2.0	2.0	1.9	1.8	1.7	2.0	2.0	2.0

Older Adults (40.1+ years)

	Male n*	Female n*	Anterior Attrition Score Male	Female	Total	Posterior Attrition Score Male	Female	Total	Mean Attrition Score Male	Female	Total
Griqua (present study)	13	6	3.4	3.8	3.7	2.7	3.5	3.2	3.1	3.7	3.4
Colesberg	3.75	2	3.7	3.0	3.5	3.4	2.5	3.0	3.5	2.3	3.2
Wolmaransstad	10	0	3.5	~	3.5	3.0	~	3.0	3.3	~	3.3
Riet River ^	6	7	2.7	3.0	2.9	2.5	2.4	2.5	2.6	2.7	2.6
Kakamas ^	4	5	2.4	3.0	2.7	2.5	2.7	2.6	2.4	2.8	2.6
Griqua (Morris) ^	5	6	2.9	2.2	2.5	2.4	2.0	2.2	2.6	2.1	2.3
Mapungubwe & K2**	2	1	~	2.1	2.0	2.2	2.0	2.0	~	2.0	2.0

n* number of individuals calculated differently in this study, Morris (1984) and Steyn (1994)
^ Data from Morris (1984)
** Data from Steyn (1994)

Tables 6.02 & 6.03 : Dental Attrition Rates – South African comparative samples

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	All Sites *
YA	
amount of occlusal wear	< 0.001
OA	
amount of occlusal wear	< 0.001

P ≤ 0.05 is significant

*All sites = Griqua (present study), Colesberg, Wolmaransstad, Riet River, Kakamas, Griqua (Morris), K2 and Mapungubwe sites

Table 6.04: Dental attrition p-values (sexes pooled) – All sites combined

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	Younger Adults	Older Adults
Griqua (present study)	124.0%	115.6%
Colesberg	112.0%	116.7%
Wolmaransstad	125.0%	116.7%
Riet River*	114.3%	116.0%
Kakamas*	125.0%	103.8%
Griqua (Morris)*	142.9%	113.6%
Mapungubwe and K2**	125.9%	~

* Data from Morris (1992b)
** Data from Steyn (1994)

Table 6.05 : Dental attrition ratios (sexes pooled) – Anterior versus posterior wear

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groups present in the Riet River, Kakamas and Griqua (Morris) sites (Tables 6.02 to 6.05). This is probably not due to differences in lifestyle but rather to difficulties associated with recording discrete traits in the human skeleton.

In the younger adult population the Griqua (present study) females display greater anterior wear than the males. However, in the Griqua (Morris) sites the males show more anterior wear than the females. In the Wolmaransstad sample the males exhibit greater anterior wear but the females show slightly more posterior wear. The Riet River females display more anterior wear but there is no sexual difference in the posterior wear. There is no sexual difference for either anterior or posterior dental wear in the Colesberg site. The Kakamas site exhibits no sexual differentiation in the anterior attrition however males show slightly greater posterior attrition.

In the older adult population, the males from Colesberg and Griqua (Morris) sites display greater anterior and posterior dental wear, whereas in the Griqua (present study) and the Kakamas sites the females show more anterior and posterior wear. The Riet River females exhibit greater anterior wear and the males greater posterior wear.

Table 6.05 illustrates the ratio of anterior wear to posterior wear for the Griqua (present study), Colesberg and Wolmaransstad sites when compared to data in Morris (1992b) and Steyn (1994). There are too few older adults (n = 3) in the Mapungubwe and K2 site for statistical analyses. The ratio for dental wear is calculated as follows:

Ratio of Anterior to Posterior wear = (Anterior Attrition Score ÷ Posterior Attrition Score) X 100

In all the groups, except Colesberg and Riet River, the ratio of anterior to posterior wear decreases with age until wear is almost equal (100%) on the front and back dentition in the older individuals. According to Steyn (1994) the decrease in anterior to posterior wear with increasing age may be related to the initial accelerated rates of anterior wear due to smaller tooth mass. When the anterior dentition are so intensely worn the teeth are no longer in proper occlusion and the posterior dentition may experience a 'catch-up' period, until both anterior and posterior attrition is almost equal in the older adults (Steyn 1994). In the Colesberg and Riet River samples there is a slight increase in anterior wear from the younger adults to the older adults age category.

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The mean attrition scores are analysed for overall patterns that exist between males and females of different populations (Tables 6.02 & 6.03). In the younger adult category, males and females show similar attrition patterns in all populations except the Griqua (Morris) sites where males show slightly greater dental wear than females. In the older adults, only the Riet River sample displays similar attrition scores between males and females; there are no older adults in the Mapungubwe site, no OA females in the Wolmaransstad dental sample and no mean score for the OA males in the K2 sample. In the Griqua (present study) and the Kakamas sites females exhibit greater dental wear than males. However, in the Colesberg and Griqua (Morris) samples males display much greater attrition scores than females.

Since, for this project, specific means are not comparable and only patterns of dental wear are analysed conclusions about specific economic modes can not be discussed. However, similar patterns of dental attrition between differing populations can also shed light on lifestyle patterning. In the younger adult sample all groups share similar patterns of mean dental attrition between males and females, except the Griqua (Morris) site. In the older adults, the Griqua (present study) females and the Kakamas females exhibit greater dental wear than the males. However, in the Colesberg and Griqua (Morris) samples males display much greater attrition scores than females. The difference in occlusal wear patterns between males and females in differing populations could be related to behavioural variability in tooth use between the sexes (Larsen 1997). These data suggest that similar dental behaviours exist between populations who display similar dental attrition patterning.

The dentition of Danielskuil/UOVS12, a juvenile of estimated age-at-death 11-13 years old, displays odd wear on the maxillary I1 and I2 (Figure 5.18). According to Prof. Vince Phillips (personal communication, 2001) the unusual wear found on the teeth of this juvenile is not due to normal chewing behaviour and it is not associated with pipe smoker's wear but rather to some sort of tool use, possibly rope tying or the tying and untying of leather thongs.

6.2.2 Dental Disease as a Sign of Economic Activity

Dental caries is not simply the lesions commonly seen in teeth but rather, it is a multibacterial, multifactorial chronic disease process affecting the hard tissues of the teeth (Aufderheide & Rodríguez-Martín 1998; Larsen 1997). Dental caries affects populations worldwide, both sexes, all ages and socio-economic strata. There is a discrepancy between this project and Morris (1984) for the biological sex of

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one younger adult individual, Campbell/A2835. The present author estimates the sex of Campbell/A2835 as female however Morris (1984) estimates the sex as male. Since this one individual contains 13 carious lesions, there is a substantial difference for the Campbell caries rates, in relation to sex differences but not overall percentages, between the Griqua (present study) and Griqua (Morris) data. Individual Campbell/A2270 was not analysed for this project but included in Morris' (1984) data. This individual is entirely edentulous and may have slightly altered the rates of antemortem tooth loss in the Griqua sample. Therefore in the opinion of this author, Morris'(1984) Griqua data overestimate the caries and AMTL rates.

The percent of carious teeth for each tooth type is illustrated in figures 6.04 and 6.05. In order to analyse caries rates accurately, antemortem tooth loss (AMTL) must also be included in the examination (Figures 6.06 & 6.07). The tooth with the highest frequency of caries in the younger adult Griqua (present study) males is the M1, however this is the only tooth type affected with carious lesions, and in the females it is the M2. The greatest frequency of dental caries in the younger adult Colesberg and Wolmaransstad males and females is exhibited in the M2 (Figure 6.04). Overall, the younger adult Griqua (present study), Colesberg and Wolmaransstad individuals display very low frequencies of carious teeth (Tables 5.28, 5.32, 5.35). However, these three groups show very high rates of AMTL in the younger adults (Tables 5.40, 5.44, 5.48). The low caries rates exhibited in the younger individuals is probably related to the high rates of AMTL mainly occurring in the posterior teeth. In the younger adult Griqua (present study) males and Wolmaransstad females only one tooth type is affected with caries. This is possibly due to the high rates of AMTL in the rest of the dental type for these two groups (Figures 6.04 & 6.06). In general younger adult males have higher rates of AMTL for the anterior teeth whereas the females have greater rates of AMTL for the posterior teeth (Figure 6.06).

In the older adults only the males in the Griqua (present study), Colesberg and Wolmaransstad sites show carious teeth and primarily the molars are affected (Figure 6.05). Once again this is probably related to the very high rates of AMTL, in the anterior and posterior dentition, for both male and female older adult individuals (Figure 6.07). Except for the Griqua (present study) females, the highest rates of AMTL in all groups are the molars. In the Griqua (present study) and Colesberg sites, the older adult males have lower frequencies of AMTL than the females; there are no older adult females in the Wolmaransstad sample.

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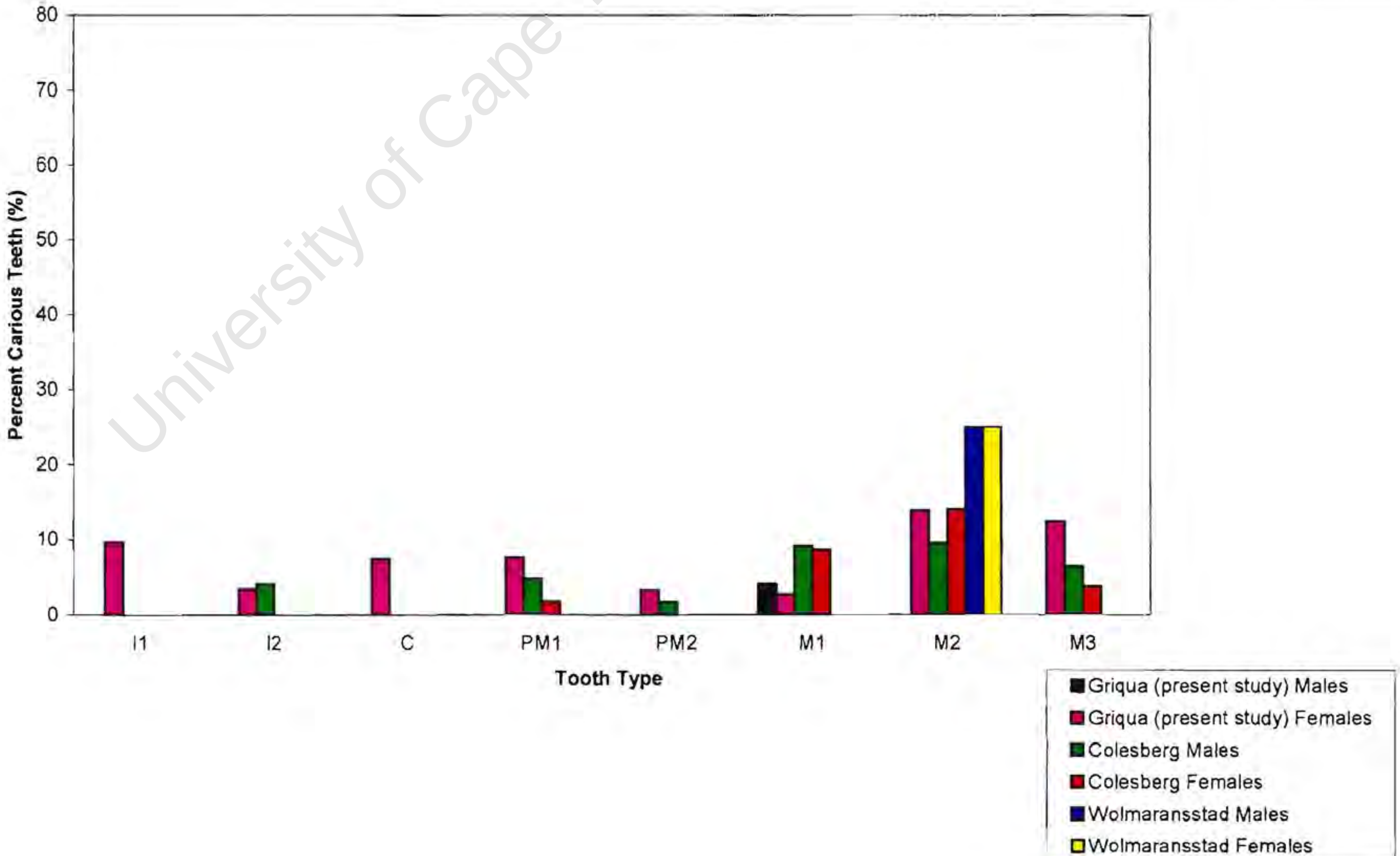

Figure 6.04 : Pattern of dental caries – Younger adults

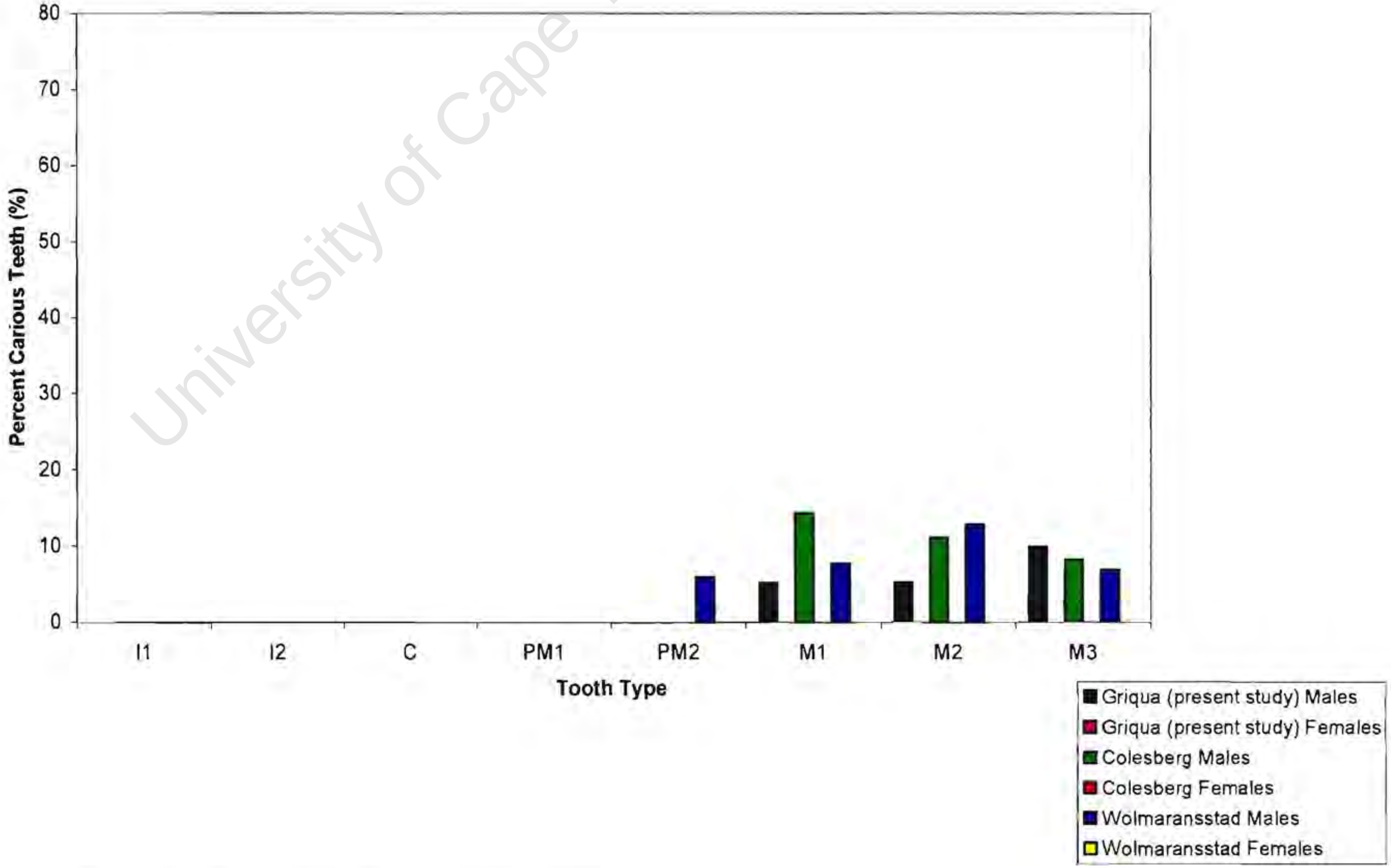

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Figure 6.05 : Pattern of dental caries – Older adults

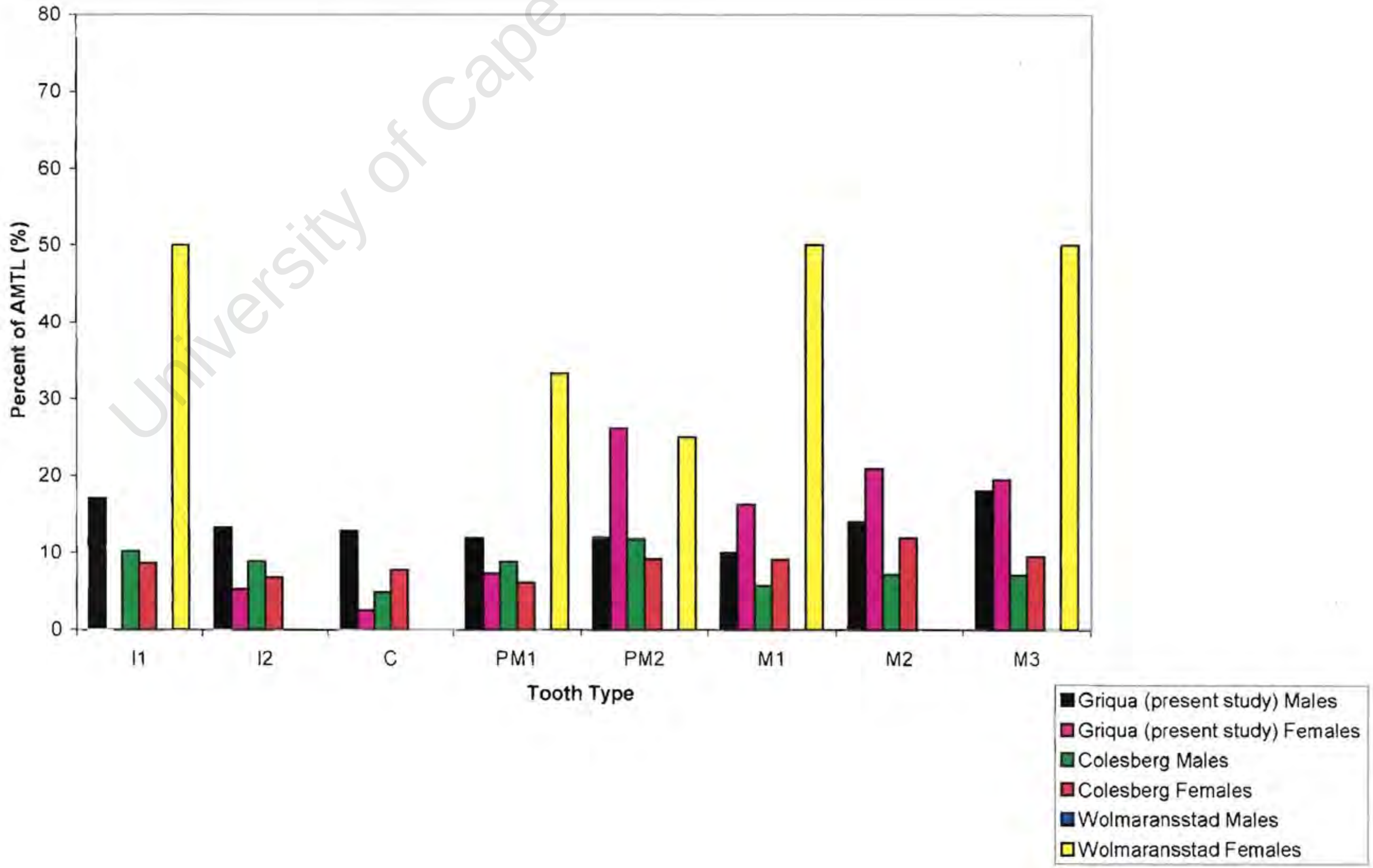

Figure 6.06 : Pattern of AMTL – Younger adults

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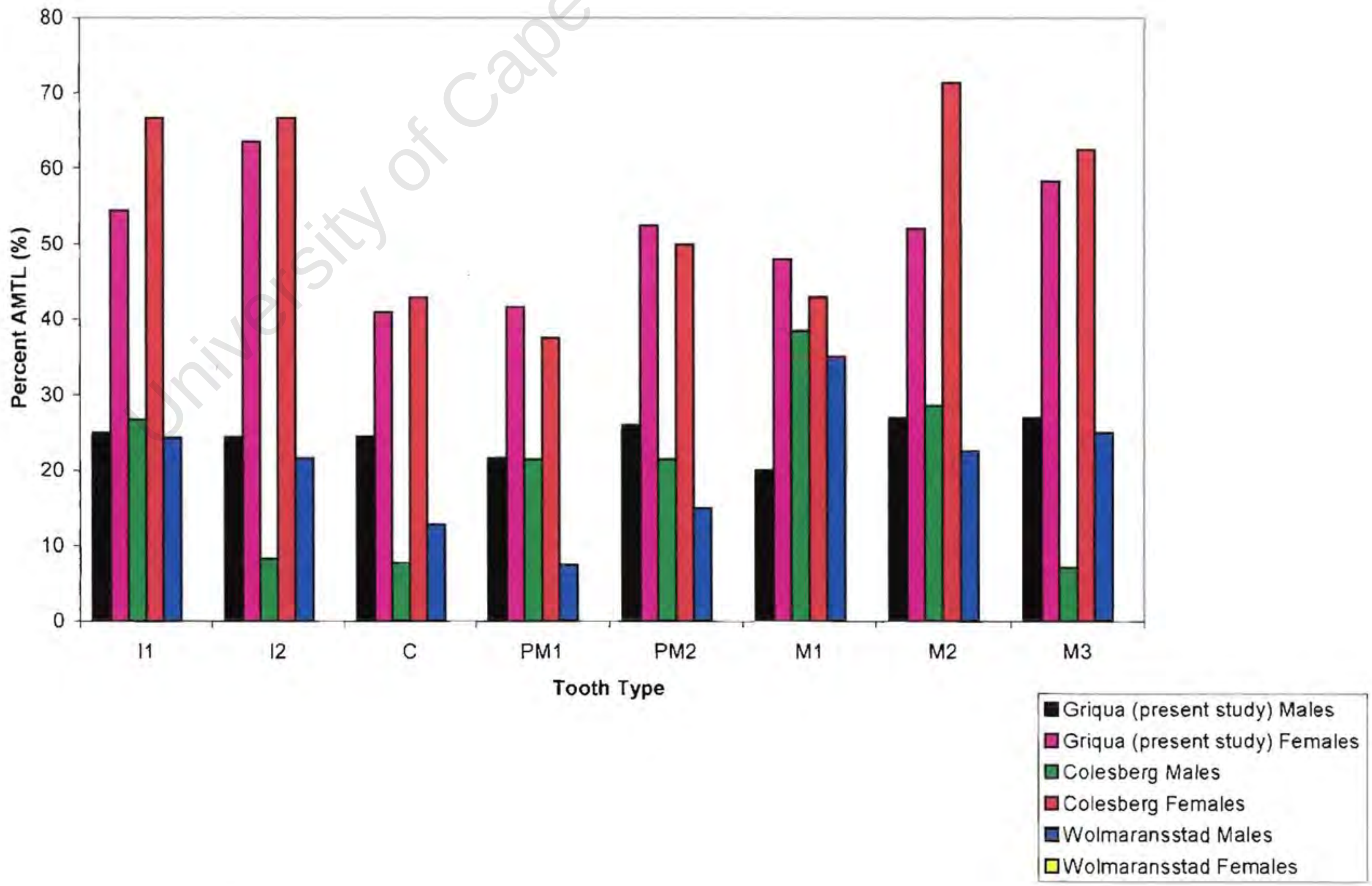

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Figure 6.07 : Pattern of AMTL – Older adults

The Griqua (present study), Colesberg and Wolmaransstad dental and AMTL data are compared to other archaeological populations (Figures 6.08 to 6.11). The K2 and Mapungubwe sites contain only dental caries data and no AMTL data. In the comparative samples the younger adults display high caries rates and very low rates for AMTL (Figures 6.08 & 6.09). This is in contrast to the data presented for the Griqua (present study), Colesberg and Wolmaransstad sites which show low caries frequencies and high rates of AMTL in the younger adults (Figures 6.04 & 6.06). Overall, the older adult comparative samples display a similar pattern to the Griqua (present study), Colesberg and Wolmaransstad individuals: low caries rates and high AMTL rates (Figures 6.09 & 6.11). Table 6.07 illustrates dental data from a wide variety of populations. The caries rates present in the Griqua (present study) sites is much lower than those exhibited by the Colesberg and Wolmaransstad individuals. This is most probably related to the kinds of food they ate and hence their lifestyle patterning.

The type of food consumed and the manner in which it is prepared strongly influences the caries rates in human populations. Historically, agricultural populations have more carious teeth than foraging communities since there is an increase in caries rates when carbohydrates are introduced into the diet (Mayhall 1970; Oranje *et al.* 1935-37; Powel 1985). Although the Griqua communities were mostly pastoralists, Legassick (1989) remarks that irrigation and agriculture were introduced by the missionaries in 1804. Ross (1976) comments that by the 1840's the Griqua diet was altered by the importation of refined foods, primarily tea, coffee and sugar. The Griqua (present study) individuals (2.9%) show higher rates of caries than the Kakamas individuals (1.3%), pastoralist Khoe, and the rural 'primitive Negro' sample (2.3%) (Table 6.06). However, these percentages are lower than the caries exhibited by the agricultural communities of Colesberg and Wolmaransstad.

The high caries rates (3.8%) exhibited in the Colesberg population is probably related to their proximity to town; the 'Hottentot begrafplaas' from 1866 was located only 2.5 km from the town of Colesberg and therefore the community linked to the burial ground would have had easy access to processed foods. Since, in 1866, the majority of 'Coloured' men were employed as agricultural labourers and the 'Coloured' women as domestic servants (Government Documents, G.1-1866) they would have been able to afford a few luxuries from the town store, e.g. sugar, white bread and milled mealie meal, which are highly cariogenic. From 1843-1865 the most important agricultural plant products in Colesberg were wheat, barley, rye, oats, maize, peas, beans and tobacco, and the most important animal

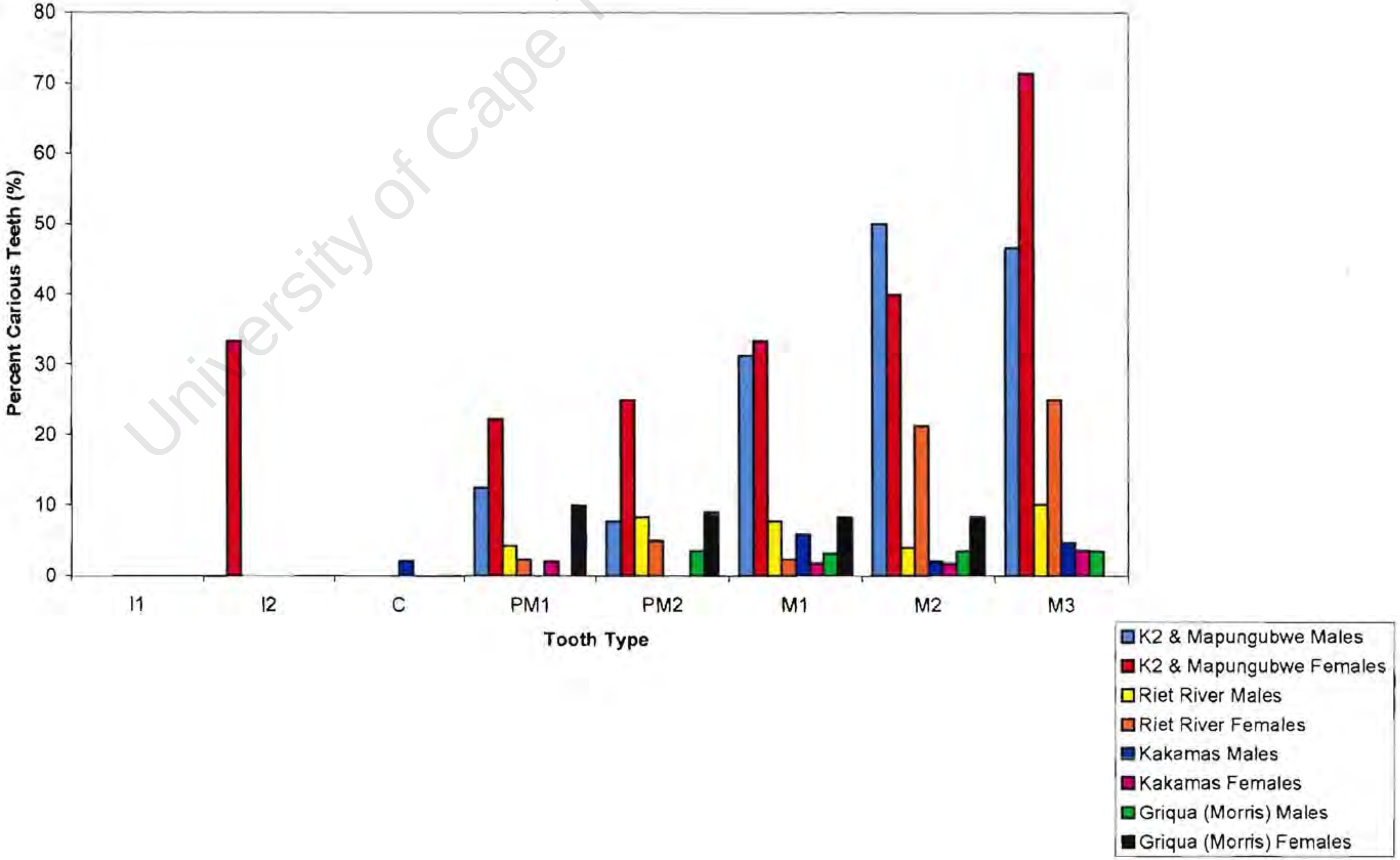

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Figure 6.08 : Pattern of dental caries – Younger adults

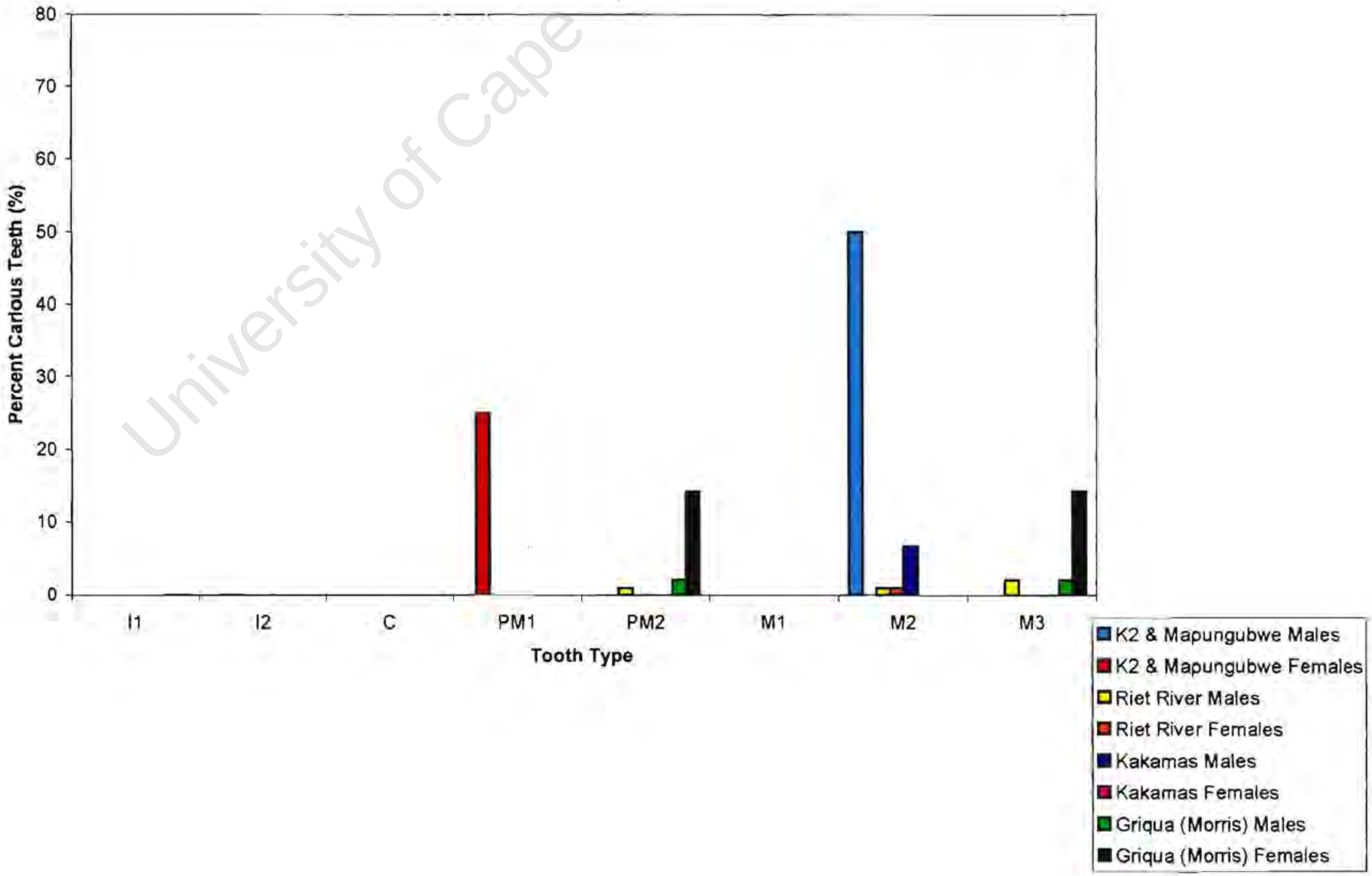

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Figure 6.09 : Pattern of dental caries – Older adults

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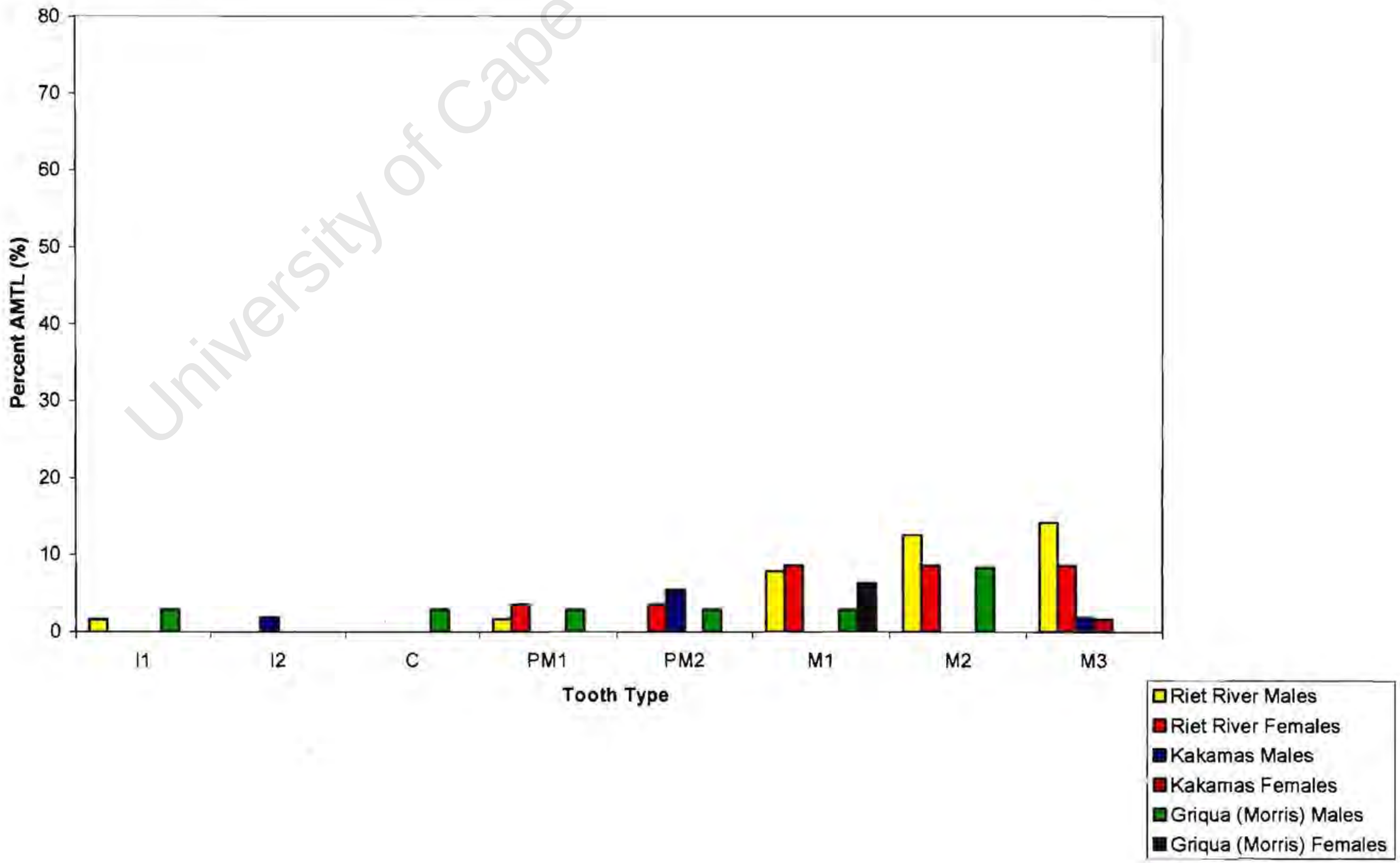

Figure 6.10 : Pattern of AMTL – Younger adults

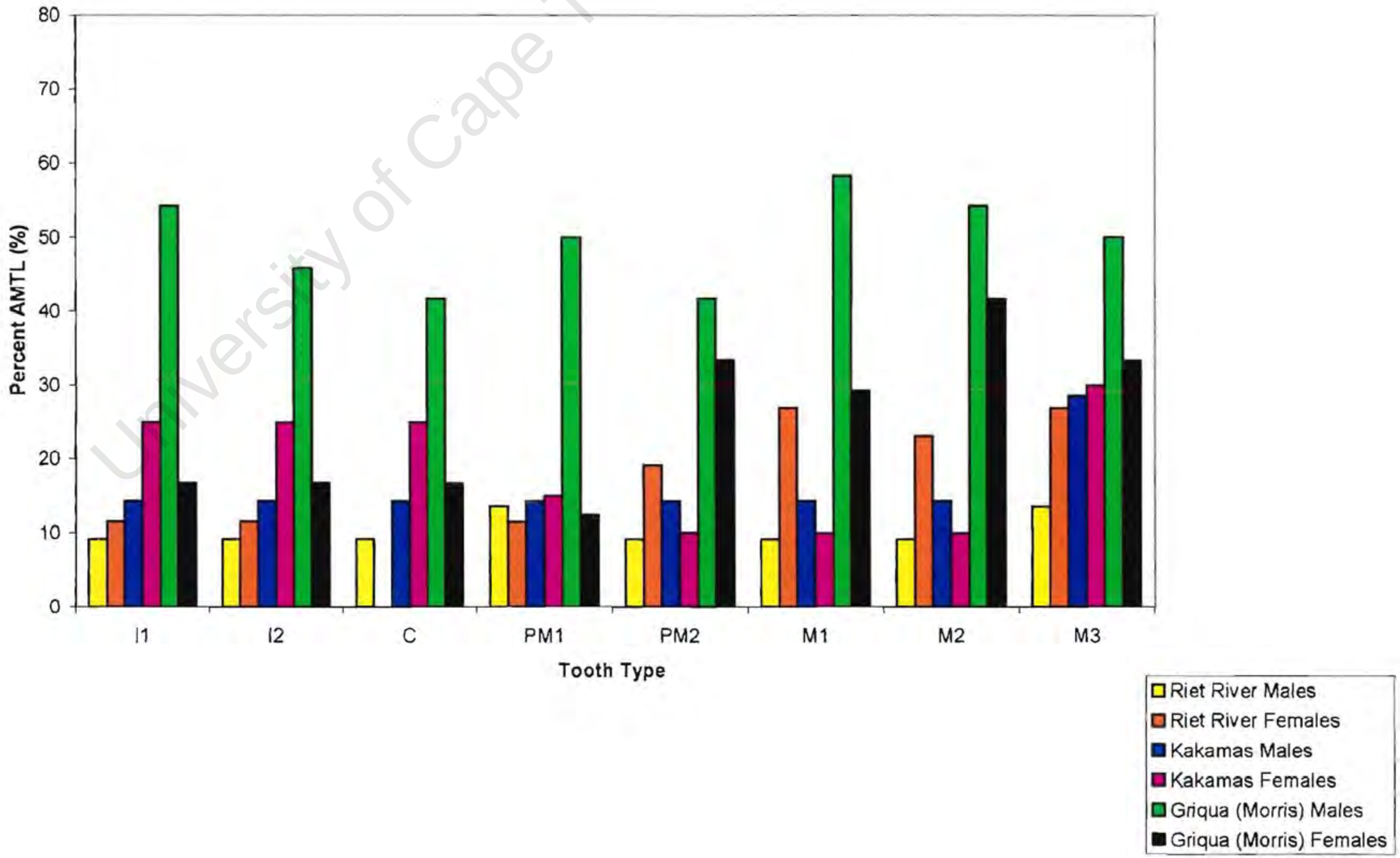

Figure 6.11 : Pattern of AMTL – Older adults

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	n*	% Indivs. with caries	Total No. of teeth	% Teeth carious	Avg. No. carious teeth per mouth	Source
Griqua	51.5	29.1	1101	2.9	0.6	This study
Colesberg	40.5	20.0	1067	3.8	0.5	"
Wolmaransstad	21	11.0	522	5.5	1.4	"
Riet River *	46.5	41.7	1061	4.3	1.0	Morris (1984)
Kakamas *	42.5	18.8	989	1.3	0.3	"
Griqua (Morris) *	26	42.3	575	5.2	1.2	"
K2 & Mapungubwe **	47	48.9	485	14.0	1.4	Steyn (1994)
Cobern Street (historic)	43.25	68.2	1019	12.9	3.1	Morris and Phillips (1997)
Rural Xhosa (living) **		36.0	~	~	~	Oranje *et al.* (1935/36)
Urban "Bantu" (living) **		68.0	~	~	~	"
Rural "Primitive Negro" (living) **	300	38.3	9226	2.3	0.7	Staz (1938)
"Urban Negro" (living) **	300	90.0	9178	14.3	4.4	"
S-W Cape coast **		~	948	2.6	~	Sealy *et al.* (1992)
Faraoskop **		~	138	8.7	~	"
Oakhurst **		~	192	17.7	~	"

n* = Number of individuals calculated differently in each study
* Data from Morris (1984)
** Data from Steyn (1994)

Table 6.06 : Dental caries comparisons of South African populations (Modified from Steyn 1994)

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product was sheep's wool (Government Documents, G.1-1866; Van de Sandt 1843). Maize in particular is highly cariogenic as it contains sucrose, a simple sugar, which is readily metabolised by oral bacteria (Larsen *et al.* 1991). This dependency on agricultural plants may also be a reason for high caries rates displayed in the Colesberg individuals.

In the 1880's the Cape government proposed a hut tax on all people living in 'locations'. The hut tax was instituted to provide a source of cheap labour to the Colonists. It drew the traditional people of the Wolmaransstad area, the Tlhaping, into a money-based economy and forced them to work for poor wages in order to pay their taxes (Shillington 1985). By the early 1890's many of the 'location' residents had to earn cash to buy food and to do so the men had to leave their homes to search for employment on local farms or in the mines, thus still being able to maintain contact with dependent families (Shillington 1985). The Natives Land Act of 1913 stated that Zabantu peoples were only allowed to occupy tenancy on farms as a condition of their labour service (Phillips *et al.* 1996). The labouring population at Wolmaransstad displays high caries rates (5.5%) which were probably a result of their agricultural lifestyle and diet. In the late 1800's the main products of Wolmaransstad were maize (highly cariogenic), grain sorghum and peanuts (Potgieter 1975).

The high caries rates found at the Colesberg and Wolmaransstad sites are not unusual as many researchers have reported high frequencies of caries during the 16th and 17th centuries due to an intensification of maize production and consumption (Figure 6.12) (Larsen *et al.* 1991; Milner 1984). Turner (1979) determined caries rates from a sample of populations drawn globally. He concluded that there is an increase in carious lesions from foraging to agricultural life ways: foraging 1.7%, mixed foraging/agriculture 4.4%, and agriculture 8.6% (Larsen 1997). Turner's (1979) cites a 2% non-agricultural threshold where most hunting and gathering populations fall below this figure. Figure 6.12 illustrates the dental caries prevalence between foraging and agricultural populations. The three forager groups (Archaic, Early Woodland and Middle Woodland) have less than 7% carious teeth while the three agriculturalist groups (Late Woodland, Mississippian, Contact) have rates of dental caries over 17% (Larsen 1997).

Some researchers have found a negative correlation between frequency of occlusal surface caries and degree of dental wear. Powell (1985) examined dental data from two populations, Fourche-Maline foragers and late prehistoric Caddoan farmers, in the American Southeast. She found that three times

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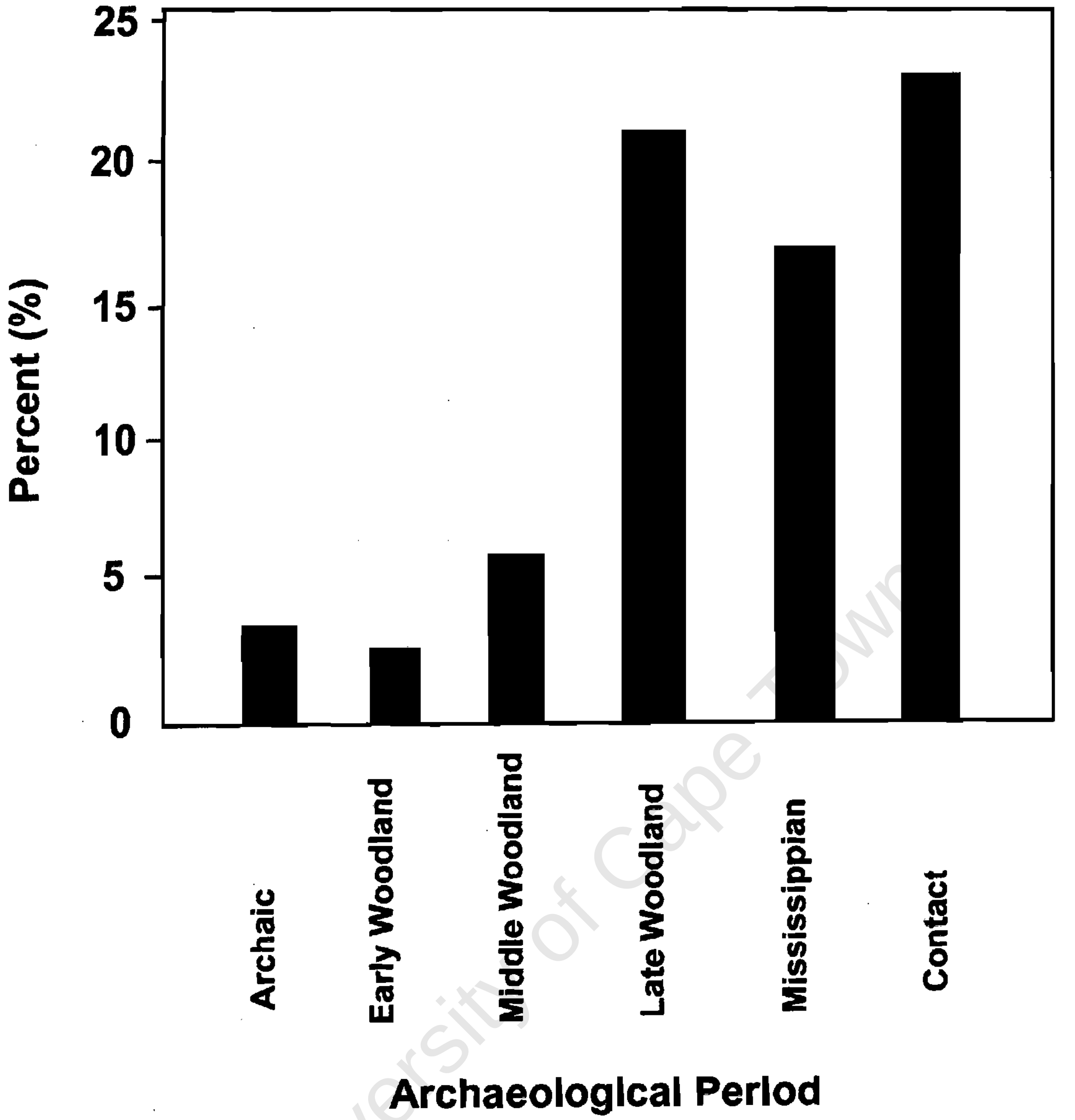

Forager = Archaic, Early Woodland, Middle Woodland
Agriculturalist = Late Woodland, Mississippian, Contact

Figure 6.12 : Caries rates between forager and agricultural populations (Based on data from Milner 1984 and Larsen *et al.* 1991; Modified from Larsen 1997:69)

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more farmers had carious teeth than individuals in the foraging population. Powell (1985) concluded that high caries rates is correlated with a reduction in occlusal wear. Reduction in attrition rates, especially in the premolars and molars, increases the rate of cariogenesis; bacterial colonies thrive in the multitude of grooves present in the cusps of posterior teeth (Corbett & Moore 1976; Maat & Van der Velde 1987; Powell 1985). Maat and Van der Velde (1987) also found a negative correlation between attrition rates and dental caries. They studied skeletons of sailors recovered from a seventeenth and eighteenth century Dutch whaling station in the Spitzberg Archipelago. The authors concluded that the increased dental wear appears to be associated with fewer caries; less dental grooves present for bacteria to survive. This pattern is found in the Wolmaransstad younger adult males and the Griqua (present study) older adult males where the least worn tooth displays the highest percentage of caries (Tables 5.25 & 5.26, Figures 6.10 & 6.11).

However, Meiklejohn and co-workers (1992) report a positive correlation between caries rates and dental attrition where the most heavily worn teeth are the most carious. Their study population is foragers from Cabeço da Arruda and Moita do Sebastião in Portugal and date to the Mesolithic. During this time period these individuals ate figs and carob; foods that are high in sugar content but also produce high rates of dental wear. Hartnady and Rose (1991) document excessive surface wear and high rates of caries in Archaic-period foragers from the lower Pecos region of southwestern Texas, U.S.A. The dental wear is extreme, resulting in pulp cavity exposure and tooth loss, and 14% of teeth exhibit carious lesions. Analysis of coprolites reveal highly abrasive materials being consumed such as phytoliths, seeds, small bones, and calcium-oxylate crystals from succulents and cacti. Historic accounts also detail ash used for baking of sotol cactus and dirt to 'sweeten' meals. Foods rich in carbohydrates, which caused cariogenesis, were also consumed e.g. succulent fibres, prickly pear fruits, pecans and mesquite. This positive relationship between caries and dental wear is displayed in the Wolmaransstad younger adult females and the Colesberg older adult males (Tables 5.25 & 5.26, Figures 6.04 & 6.05). There is no correlation between caries and tooth wear present in the Colesberg younger adults or the Wolmaransstad older adults.

The increase of carious teeth with the introduction of agriculture in archaeological samples mirrors observations of living populations with similar diets. Walker and Hewlett (1990) investigated caries rates in the Aka, who are central African pygmy foragers, and Zabantu farmers. The Aka display a

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total caries rate of 5.2% whereas the Zabantu group exhibit an overall caries rate of 8.1% (Walker and Hewlett 1990). The Aka obtain most of their food through hunting and collecting however, they do acquire some manioc through trade with the Zabantu peoples. These cultigens may account for higher caries rates than expected in a foraging group. Most of the food consumed by the Zabantu farmers is domesticated plants, including manioc, maize, rice, peanuts and plantains (Walker and Hewlett 1990). The difference in caries rates expressed between these two populations is a direct result of their differing lifestyles.

Only the Griqua (present study) populations show a greater prevalence for caries in women than men (Table 5.31). In both the Colesberg and Wolmaransstad communities men display higher rates of caries than women (Tables 5.34 & 5.38). This is possibly due to differential access to foods between men and women. Since there are very few women in the Wolmaransstad sample this is difficult to conclude. However, observations of living populations indicated differences in food consumption between males and females in forager groups but not in farming communities (Larsen 1997).

Since the Griqua communities were located so far away from Cape Town men would travel there to sell and buy items only once a year (personal communication Professor A.G. Morris, 2001). Historically, the traditional food eaten on long treks was 'biltong', dried meat. It is possible that the women, who stayed 'back home', were eating more plant products than the men and therefore had a higher prevalence of dental caries. There is a discrepancy between the Griqua (present study) data and the Griqua (Morris) data. Morris (1984) cites more caries in the Griqua men than women. One younger adult female, Campbell/A2835, is recorded as male in Morris' (1984) data and female in the present study; the accession catalogue at the University of the Witwatersrand records the sex as 'undetermined'. Since this one individual alone contains 13 carious lesions, its presence dramatically alters dental caries data based on gender. Also Morris' (1984) data only incorporates 41 individuals (35 individuals from the Campbell site and 15 from the Brink series) whereas the present study employs 135 individuals from five different sites (Campbell, Danielskuil, Philippolis, Bethulie, de Tuin). The present study contains more individuals and has a broader focus than previous research projects.

In the Colesberg community men show higher rates of caries than women. The 'Coloured' men were working as agricultural labour and the 'Coloured' women as domestic servants in town (Government Documents, G.1-1866). Although the women worked in the towns and had greater physical

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access to 'store-bought' goods, it is possible that the men earned more money than the women and therefore had greater monetary access to 'store-bought' goods, i.e. processed foods.

Men show a greater prevalence for caries than women in the Wolmaransstad population. This is probably a result of the small numbers of women present in the study and not an actual gender difference in caries rates; there are 17 men and four women analysed for dental data. Therefore conclusions about dental caries based on sex differences can not be presented for the Wolmaransstad population.

There has also been a long held notion that sex differences in eruption timing or pregnancy explains the greater prevalence of caries in females as compared to males. However, tooth eruption differences between men and women show either weak or no correlation with prevalence of dental caries (Larsen 1997). There is evidence for increased gingivitis in some pregnant women but no evidence exists for increased tooth loss or dental caries due to gingivitis or other factors relating to pregnancy (Larsen 1997; Larsen *et al.* 1991). Therefore dental caries differences between males and females is behavioural.

Periodontal disease, caries and AMTL is markedly increased in populations that have high consumption rates of plant carbohydrates and processed foods (Lukacs 1992; Owsley *et al.* 1987). Overall, the Wolmaransstad sample displays the highest rates of caries (5.5%) and AMTL (76.2%) while the Colesberg population exhibits the highest rate of periodontitis (94.1%) (Tables 5.38, 5.51, 5.54). Patterson (1984) found that in prehistoric Ontario, Canada caries rates increase by 2.5 times when changing from foraging to farming subsistence strategies (Larsen 1997). In the foraging communities tooth loss is most commonly due to pulp exposure, whereas in the farming groups tooth loss is due to periodontal disease and dental caries. European samples also show similar trends for dental diseases (Larsen 1997). In Britain, individuals from the 17th century exhibit higher rates of periodontitis than 6th century Anglo-Saxon groups. The greater frequency of periodontal disease in the later population is due to the consumption of softer foods and increased intake of sugars and refined carbohydrates (Lavelle & Moore 1969). The overall dental health of the individuals in the Griqua (present study) sites suggests a pastoralist community with some agricultural products being consumed, while the Colesberg and Wolmaransstad dentition resemble individuals from agricultural communities.

6.2.3 Musculoskeletal Stress Markers: Understanding the Social Organisation of Work

Musculoskeletal stress markers (MSM) or enthesopathies are muscle markings found on the surface of bone. Their degree of expression is related to the activity of the corresponding muscle groups but is influenced by a variety of factors: age, sex, individual robusticity, metabolism, nutrition, duration of activity, forces applied to the bone from the muscle, biomechanics of the joint and genetics (Churchill & Morris 1998; Ledger 1997; Robb 1994; Sanders 2001). Enthesopathies are analysed to aid in the determination of a community's patterns of activities, i.e. the social organisation of work, rather than attempting to define the specific activities that may have caused them. Although many of the sample sizes are not statistically viable (n < 5) the data are still employed for comparison to allow for a general socio-cultural pattern to emerge.

Age and sex are important factors when analysing MSM's (Tables 5.10 to 5.23). Both Robb (1994) and Sanders (2001) found statistically significant relationships between muscle score and age of the individual which coincides with the findings of the present study; muscle markings increased steadily through the adult lifespan. Yet, Ledger (1997) found no significant relationship between expression of entheses and age of the individual in the Cobern Street population. However, his study populations did not contain a wide range of ages as Cobern Street was mainly younger adults and the cadaver sample was largely older adults. Robb (1994) and Ledger (1997) demonstrate significant differences in the degree of MSM scores between males and females, which is also consistent with this project. Sanders (2001) only analysed males for her project.

Churchill and Morris (1998) used the diet breadth model to predict labour intensity among prehistoric Khoisan peoples, i.e. ecological differences between biomes may have an impact on labour costs. They suggest that "the lower limb may be primarily reflecting search costs (foraging mobility) and the upper limb may be primarily reflecting handling costs (capturing and processing items)" (Churchill & Morris 1998:406). The high leg entheseal scores in the Griqua males and high arms entheseal scores in the Griqua females suggest that the men were primarily involved in the 'search costs' while the women were participating in 'processing items' (Table 6.07). This is consistent with historical records that reveal the Griqua were growing gardens and hunting animals while some also kept livestock. The Griqua living

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	GRIQUA	COLESBERG	WOLMARANSSTAD
YA MALES	legs	legs	legs
YA FEMALES	similar	arms	same
OA MALES	legs	arms	legs
OA FEMALES	arms	legs	~

Table 6.07 : Limb with highest entheseal scores

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at Danielskuil and de Tuin planted gardens, raised cattle and goats, and also hunted (Cape Archives, A.8-1866; Snyman 1988). The community living at Philippolis raised sheep for meat while the wool was exported to Europe for enormous profit (Potgieter 1973).

The Colesberg sample contains mostly younger adult males and females. The Colesberg YA males show higher MSM scores in the legs and the YA females exhibit higher entheseal scores in the arms. These data are consistent with historical records for the Colesberg area. The first official census in 1865 reports 'Coloured' men working as agricultural labour and 'Coloured' women employed as domestic servants (Government Documents, G.1-1866). MSM scores in the older adults display the reverse situation. The OA males have higher MSM scores in the arms and the OA females have higher scores in the legs. The sample size disparity suggests a degree of caution since there are less than five individuals in each of the older adult male and female categories; the small sample size may not be representative of the older adults living at this site.

The Wolmaransstad YA and OA males display higher MSM scores in the legs whereas the YA females show the same scores in both the legs and arms; there are no OA females present. This entheseal pattern coincides with both Churchill and Morris' (1998) diet breadth model and Maggs (1976) historical details about the indigenous people of the area: men were associated with animals and livestock pens while women were responsible for cultivation, storing the harvest and preparing food.

Previous research (Hawkey 1998; Kelley & Angel 1987; Stirland 1998; Wilczak 1998) suggests that the degree of entheseal rugosity directly relates to the activity induced on the muscle insertion sites. However, Sanders (2001) has found that the biomechanics of the joint, the ability of the joint to impart forces, and bone remodelling, not just in the entheseal area but affecting the entire bone, due to the distribution of abnormal strains may be more important factors when analysing MSM's. Robb (1994) suggests that the higher grades with increasing age is related to the lifelong accumulation of microtrauma, but Sanders (2001) ascertains that it is the <u>repetitive</u> microtrauma over a <u>shorter</u> period of time that causes the musculoskeletal response. Finally, both Sanders (2001) and the present research have found Robb's non-metric methodology for entheseal scoring to be questionable due to high intra-observer error. This does not invalidate the present nor previous research but suggests a degree of caution when comparing between sample populations.

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6.2.4 Joint Disease, Trauma and Activity Patterns

Degenerative joint disease (DJD), or arthritis, is a noninflammatory chronic, progressive pathological condition characterised by the loss of joint cartilage and subsequent lesions resulting from direct interosseous contact with diarthrodial joints (Aufderheide & Rodriguez-Martin 1998). Osteoarthritis occurs in a synovial joint. Generalised osteoarthritis usually occurs in older individuals while osteoarthritis caused by disease is commonly localised and can be found in all age groups (Burns 1999).

The overall rates of occurrence for osteoarthritis in the Griqua (present study), Colesberg and Wolmaransstad populations are compared to southern African data presented in Morris (1984) with ages and sexes combined (Table 6.08).

Only the Griqua (present study) sites show similar rates of osteoarthritis as Morris' (1984) data. The Colesberg community displays arthritic changes well below that of the other samples and this could be related to the small number of older adults present in this sample. The people from Wolmaransstad exhibit much more osteoarthritis than the other samples which lends evidence for a community of labourers. According to Bridges (1992) agriculturalists tend to show a low prevalence of arthritis in the wrists and hands due to a decrease in mechanical loading for these joints. This trend is found in the Griqua (present study) and Colesberg communities, whereas the Wolmaransstad sample displays a high rate of wrist and elbow osteoarthritis, which also suggests a labouring community.

Worldwide data show that the highest prevalence of vertebral arthritis is in the lumbar spine followed by the cervical spine (Bridges 1992, 1994; Jurmain 1990; Merbs 1983). Overall, the Griqua (present study), Colesberg and Wolmaransstad samples do not show this trend. In general, males exhibit higher frequencies of osteoarthritis than females regardless of subsistence strategy (Larsen 1997). Only the Wolmaransstad sample expresses this trend and is probably due to the small numbers of females present at the site (n = 6) (Tables 5.05, 5.78 to 5.83). However, studies on European populations show a decline in osteoarthritis from foraging to farming communities. These researchers suggest that this is due to a decline in mechanical loading with the adoption of agriculture (Meiklejohn *et al.* 1984; Kennedy 1984). This trend is illustrated in the Griqua (present study) and Colesberg sites; overall there is less osteoarthritis present at Colesberg (Table 5.86). The economic mode for the Griqua (present study) individuals was pastoralism with some agricultural activities (Cape Archives, A.8-1866; Government

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Site	Total Overall Rates of Osteoarthritis (%)
Griqua (present study)	7.2
Colesberg	3.1
Wolmaransstad	18.8
Riet River *	7.0
Kakamas *	7.9
Griqua (Morris) *	9.4

* Data from Morris (1984)

Table 6.08 : Rates of Osteoarthritis – Ages and sexes combined

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Documents, Report No. 9, 20 April 1824; Potgieter 1973; Snyman 1988). However the 'Coloured' males living at the Colesberg site were employed as farm labourers (Government Documents, G.1-1866).

The rate of vertebral osteophytosis, bone remodelling producing focal nodules of new bone formation at the bone margins, increases with increasing age in the Griqua (present study) and Colesberg sites (Tables 5.84 to 5.86). When compared to Morris' (1984) data the younger adults in the Griqua (present study) sites display a greater percentage of osteophytes than either the Riet River (40%) or Kakamas (16.7%) sites but much less than the Griqua (Morris) (72.7%) sites. The Colesberg (21.1%) site approximates the rates found in the Kakamas (16.7%) site. The older adult Griqua (present study) (63.6%) and Colesberg (50%) individuals display osteophytes at a lesser rate than the older adults in the Riet River (75%) or Griqua (Morris) (92.3%) individuals; there are no older adults in the Kakamas sample. The lower rates of osteophytes exhibited in the Griqua (present study) and Colesberg older adults when compared to the Griqua (Morris) and Riet River sites is possibly related to the small sample sizes; all of the sites contain less than 15 individuals for analysis. The small sample sizes are probably the reason for the discrepancies in osteophytes displayed by these sites.

Figure 5.38 illustrates the distribution of vertebral osteophytes in the Griqua (present study), Colesberg and Wolmaransstad samples. According to Aufderheide and Rodríguez-Martín (1998) the involved locations for vertebral osteophytosis are those most commonly flexed: C5-C6, T8-T9, L4-L5. In the Griqua (present study) sites the three most commonly flexed areas are affected with osteophytes. Both males and females have the greatest rates of osteophytosis in the L4 and L5 vertebrae. Studies have shown that increased rates of arthritis in the pelvic and lumbar joints is associated with horseback riding (Angel *et al.* 1987; y'Edynak 1976a). The lumbar osteoarthritis may be related to horseback riding as horses were widely used by the historic Griqua peoples (Bradlow 1981; Legassick 1989; Ross 1976). In the Colesberg sample, males display vertebral osteophytes only in the thoracic and lumbar region, L4 showing the highest rate of osteophytosis, whereas females exhibit vertebral nodules in all three regions of the spine, however at very small rates. Only the males in the Wolmaransstad sample display osteophytes in the cervical, thoracic and lumbar regions and at a very low rate.

The bioarchaeological literature argues that there is a reduction in the prevalence of osteoarthritis from foraging to agricultural communities caused by a decline in mechanical loading with the adoption of agriculture (Larsen 1997). Overall, this trend holds true for the Colesberg females, when compared to the

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Griqua (present study) sites, but not for the Colesberg males or either gender in the Wolmaransstad site (Tables 5.78 to 5.83). However, Bridges (1992:79) cautions that "no single consistent response to the introduction or intensification of agriculture can be inferred".

The increase in arthritic changes for the Colesberg males is not surprising. Although the rural areas of Colesberg were agricultural based the 'Coloured' males living at the Colesberg site were employed as farm labourers (Government Documents, G.1-1866). Labourers are not employed to help only with the crops but their duties probably also included general maintenance of the farm, buildings and land. This type of labour is still present in rural South Africa today, for example in rural areas of the Northern Cape Province. The Colesberg males show higher rates of osteophytosis in the lower body than in the upper body. If the 'Coloured' men in the Colesberg area were employed as shepherds to watch over the valuable sheep stock, then it they were probably walking great distances each day and therefore would show more 'wear and tear' on their lower limbs. This is a similar trend to seventeenth century Spanish Florida where Native populations were viewed as an inexpensive labour source; they were forced to make long distance trips to other provinces to deliver goods. Indian labours were employed for cargo bearing, agricultural production, construction projects and wood cutting (Larsen 1997). The Colesberg women show similar rates of osteophytosis in their upper and lower limbs. However, overall there is a decrease in osteoarthritis in the Colesberg females compared to the Griqua (present study) women. This is probably related to their differing work loads. The 'Coloured' women in the Colesberg area were employed as domestic labour (Government Documents, G.1-1866) whereas the Griqua (present study) women were involved with 'processing' the animals hunted and the crops grown (Cape Archives, A.8-1866; Snyman 1988).

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There is a large increase in upper and lower body arthritis in the Wolmaransstad males as compared to the Griqua (present study) males. By the early twentieth century Zabantu peoples could only occupy tenancy on farms as a condition of labour service (Phillips *et al.* 1996). Once again, their duties probably also included general maintenance of the farm, buildings and land. Therefore, these individuals were not participating in a single, agricultural-based, economy but were also performing general labouring activities as well. Since there are too few females in the Wolmaransstad sample, activity patterns based on gender can not be determined.

The incidence of collapsed vertebrae is also analysed. Only the Griqua (present study) and the Colesberg site display collapsed vertebrae. Generally, within these two sites the majority of collapsed vertebrae occur in the lumbar region; the Griqua (present study) display a much greater occurrence of vertebral collapses than the Colesberg population (Table 5.88). This could be related to the presence of osteoporosis, which is linked to factors such as age (usually occurring in individuals over 40 years), genetics (associated with osteoporosis in younger adults) and lifestyle (personal communication Professor G. Louw, 2001). Collapses of the cervical vertebrae are related to adult and postmenopausal bone loss (osteoporosis) as well as carrying heavy loads on the neck over many years (Allison 1984; Larsen 1997; Lovell 1994). Owsley and his co-workers (1991) examined the skeletal remains of Euro-American soldiers from the War of 1812. They conclude that compressed vertebrae, in this sample, are the result of excessive mechanical loading of the back; lifting heavy military hardware, carrying heavy packs for long distances, the construction of fortifications and participation in rigorous activity regimes. Owsley and his co-worker's (1991) data may help shed some light on possible activities related to the development of collapsed vertebrae in the Griqua (present study) and Colesberg populations. However, the higher rates present in the Griqua (present study) community as compared to the Colesberg site is possibly related to age distribution; there is a greater number of older adults, who are more prone to osteoporosis and hence collapsed vertebrae, present in the Griqua (present study) sample than in the Colesberg sample (Table 5.05).

The investigation of skeletal injuries is useful for assessing human behaviour relating to accidents and violence within earlier societies. Whether the individual affected actually died from the injuries is difficult, almost impossible, to determine. However, the amount of traumatic injuries exhibited within a community provides a glimpse into the cultural and social behaviour present at that time.

The Wolmaransstad community displays 17.9% occurrence of skeletal trauma whereas the Colesberg site shows 9.6% occurrence and the Griqua (present study) sites 2.2% occurrence (Table 5.89). The location of the injury on the skeleton provides information about the type of activity that was responsible for the injury. Three individuals display healed fractures of the distal radius and/or ulna: Campbell/A2502, Wolmaransstad/NMB1327a and Wolmaransstad/NMB1328a (Figures 5.41, 5.45 & 5.46). The radius of the Campbell individual reveals a Parry fracture, which involves the middle or distal end of the ulna and/or radius, but NMB/1327a and NMB/1328a exhibit Colles fractures, which involve

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approximately the distal 2 cm of only the radius; Colles fractures may also involve the ulnar styloid process (Hahn 2000). These two types of fractures are caused by different injuries. Parry fractures are very common in many populations and usually result from an individual's attempt to ward off a blow directed at their head or upper body (Larsen 1997). Colles' fractures occur when an individual attempts to break a fall by thrusting their arms forward (Larsen 1997). A strong force pushing the hand into the forearm, e.g. a sudden force pushing the hand backwards, can also cause a Colles fracture (Hahn 2000). Although the radius of NMB/1327a exhibits a Colles fracture the ulna displays a distal diaphyseal fracture, Parry fracture, located more proximal than the Colles fracture and therefore it is difficult to interpret the exact activity that caused the distal arm fractures of Wolmaransstad NMB/1327a. It is most likely that both the radius and ulna injuries of NMB/1327a occurred during the same encounter.

In all three sites, there is a high percentage of cranial injuries (Table 5.89). Cranial trauma found on the frontal bone or on the face indicates that the attacker and victim were facing one another when the injury occurred (Larsen 1997; Webb 1995). Webb's (1995) research on Australian prehistoric populations has shown that trauma to the left anterior side of the skull and left parietal attests to a right-handed attacker. A more irregular pattern of skull injuries or a high frequency of trauma on the right side or posterior cranium indicates that the injuries were endured while the victim was fleeing the attacker or possibly while lying prone (Larsen 1997); there are only two individuals who exhibit right side injuries to the skull while the majority show left side injuries. There are two male individuals, Wolmaransstad/NMB1313a and Colesberg/SAM4496, who display healed nasal bones that could also have been caused by a face-to-face attack. Overall, more men (n = 7) than women (n = 4) demonstrate skull fractures suggesting the aggression is directed towards the men; males are more often involved with warfare activities (Larsen 1997). If the forearm is employed to protect the head from an attack then the occurrence of forearm diaphyseal fractures and cranial injuries should coincide (Larsen 1997). Within the Griqua (present study), Colesberg and Wolmaransstad communities there are no cranial fractures for any of the individuals who display fractures of the forearms (Table 5.89). These injuries could have been caused by accidental situations, e.g. tripping and falling or falling off a horse, however when historical circumstances are considered it seems more likely that these injuries are conflict related. During the 18^{th} and 19^{th} centuries the northern frontier transformed from an independent indigenous 'open' frontier to a 'closed' colonial frontier. The transformation occurred because of the combination of freeburgher

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movement out of the Colony and the creation of 'new' groups of peoples, like the Oorlams, Bastaards, and Griqua. The major themes that emerge from the examination of historical records, exploitation, domination, and dependence, almost inevitably lead to conflict.

In the Colesberg site there is one individual who exhibits a hip dislocation due to trauma and two individuals who display osteomyelitis, possibly due to an open fracture, of two phalanges and the left fifth metacarpal. There were no other fractures identified in this study.

Overall the Griqua (present study) osteological data illustrate a pastoralist community incorporating some agricultural activities. Agriculturalists tend to show more arthritic development in the lower body than upper body. However, when compared to foraging communities, they exhibit a decline in osteoarthritis – probably related to a decline in mechanical loading with the adoption of agriculture. Interestingly, the lumbar osteoarthritis may be associated with horseback riding as horses were widely used by the historic Griqua peoples. The Griqua (present study) males display high MSM's in the lower body whereas females show high MSM's in the upper body. This is consistent with the historical data that cites males involved with hunting animals and females involved with 'processing' the animals and the crops. The high rates of cranial injuries and the one Parry fracture attest to the conflict present in the 19th century northern frontier.

The Colesberg osteological data represent a community of male agriculturalists and female domestic servants. The Colesberg males display high MSM scores in the lower body whereas the females show high MSM's in the upper body. A low prevalence of arthritis in the hands and wrists of both the males and females is consistent with the historical record; males were employed as agricultural labour and females as domestic servants. The healed nasal bones, dislocated hip and high rates of cranial injuries reveal the enormous amount of conflict that was present in the 18th and 19th century northern frontier.

The Wolmaransstad sample reveals a community of farm labourers. The males show high MSM scores in the upper body and the females in the lower body. There are high rates of elbow and wrist osteoarthritis which is consistent with a labouring population. When compared to the Griqua (present study) sample, both the upper and lower body show a large increase in osteoarthritis – the Wolmaransstad peoples were not just working in the fields but also performing general labouring duties. The Colles' fracture, healed nasal bones and high rates of cranial injuries all attest to an historical time when conflict was inevitable.

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6.3 HOW HEALTHY WERE THESE PEOPLE?

6.3.1 REFLECTIONS OF CHILDHOOD GROWTH

Growth is a general term used for the progressive incremental changes in size and morphology that occur throughout the developmental stages of an individual's lifetime (Scheuer & Black 2000). Although growth is positively correlated with age the relationship is not simple. It consists of two factors, an increase in size and an increase in maturity, which are linked but may not advance in synchrony (Scheuer & Black 2000). Therefore different individuals may reach biological ages at different chronological ages.

Growth varies within and between different tissues and organs in the body in all individuals. However, growth also varies between the sexes, between individuals in the same population and between different populations. These differences are due to both genetic and environmental factors i.e. the 'nature versus nurture' debate. Since it is impossible to study the effects of a single factor on their own, and since the effects may vary between individuals depending on their stage of development, causes responsible for differential growth across populations are difficult to assess. However, growth is inevitably the marker by which 'societies' measure development and maturity (Scheuer & Black 2000). Growth is analysed in this project to assess the health status of differing groups of people. The growth rate, and therefore the eventual adult stature, is recognised as a highly sensitive indicator of health and well-being within a community (Scheuer & Black 2000).

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6.3.1.1 GROWTH CURVES AND ADULT STATURE

This study compares differential biological growth patterns occurring between different historic populations: 'K2' an Iron Age site in South Africa (Steyn 1994), 'Libben' a Late Woodland site (800-1100 AD) in the USA (Lovejoy *et al.* 1990), an Inuit and Aleut site from pre-nineteenth century Canada on Kodiak Island (y'Edynak 1976b), 'Indian Knoll' an Eastern Archaic site (5000 years BP) in the USA (Sundick 1978), and 'Altenerding' a Medieval site (sixth to seventh century AD) in Germany (Sundick

1978). Only one population, the Griqua (present study), contains an adequate number of juveniles for assessing and comparing childhood growth patterns to other historic populations.

The diaphyseal femur lengths of two South African sites are compared, the Griqua and the K2 sites (Figure 6.13). These two sites are compared because both are rural indigenous populations. Since there are too few individuals present, in both sites, between the ages of eight and fourteen adolescent growth spurts can not be analysed. Although the Griqua infants have slightly shorter femurs, and therefore shorter statures, than the K2 infants and the Griqua juveniles have longer femurs, and therefore taller statures, than those present in the K2 site, the growth curves illustrate similar patterns of diaphyseal growth in both populations.

The diaphyseal femur lengths of the Griqua sites are compared to other historic populations (Figure 6.14). In general, the Griqua diaphyseal femur lengths are longer than those of the other comparative populations. However, the Griqua sites tend to approximate the growth pattern and direction present in the K2 and Libben populations.

Allometric growth, proportional growth of one body part against another, of the diaphyseal femur and diaphyseal humerus is plotted against one another, irrespective of age, and compared for the Griqua and K2 sites (Figure 6.15). This method of analysis reduces the errors present with biological ageing, since age is ignored, and therefore differential growth of bones may be indicators of environmental influences (Steyn & Henneberg 1996). Figure 6.15 illustrates similar growth patterns for both the Griqua and K2 children, although the number of individuals present in K2 is small. Allometric growth in the Griqua sample is also compared with two other sites: Indian Knoll and Altenerding (Figure 6.15). Figure 6.15 illustrates that all populations tend to display similar direction and pattern for growth. The correlation coefficient, which is an index ranging from 0 to 1 of the tendency of two continuous measurements to vary together, for these sites is calculated; the closer the r-value is to 1 the greater the correlation (Hassard 1991). The r-value for these sites (Griqua and K2) is very high, $r = 0.996$, indicating a very close relationship for growth patterning between all of the sites. Sciulli (1994) suggests that in communities with poor living conditions lower limbs should be shorter relative to upper limbs. The allometric comparisons present in figure 6.15 do not reflect this pattern. Therefore, if long bone length reflects the living conditions of a group the Griqua individuals must have been as well nourished, or better, than individuals in the comparative populations.

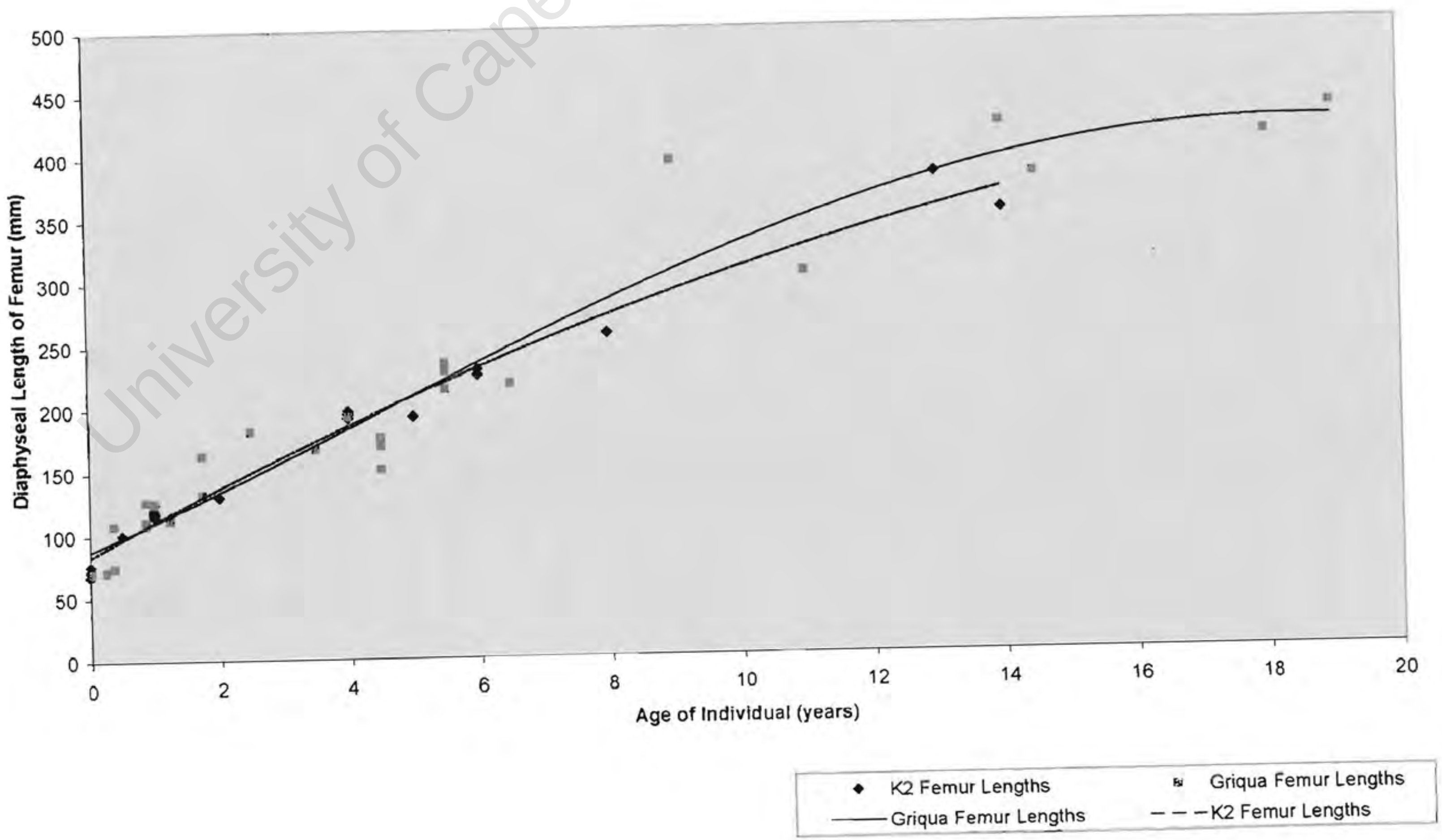

Figure 6.13 : Diaphyseal femur lengths

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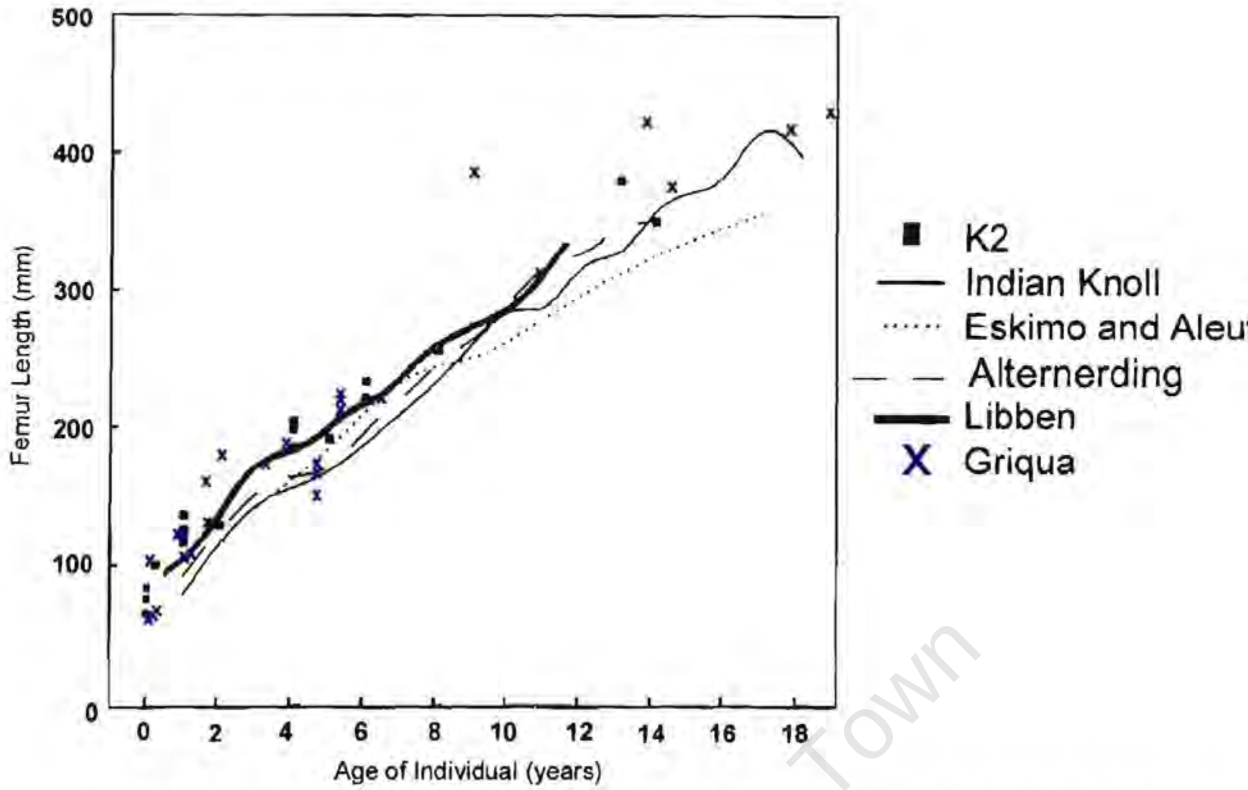

Figure 6.14: Diaphyseal growth of the femur (Modified from Steyn and Henneberg 1996)

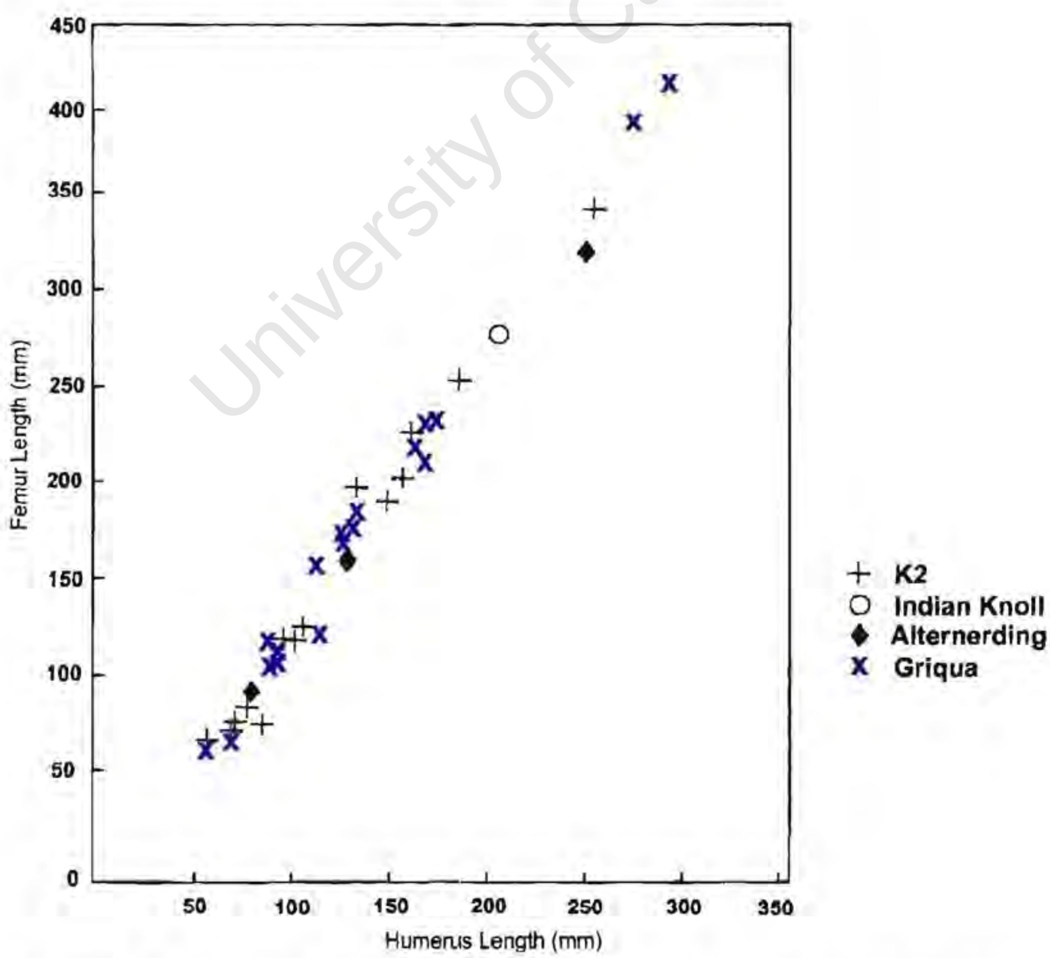

Figure 6.15: Allometric growth – Femur vs. Humerus (Modified from Steyn and Henneberg 1996)

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The growth curves for the Griqua and K2 children are also compared with living South African Cape 'Coloured' rural children (Steyn & Henneberg 1996) (Figure 6.16). The growth of the diaphyseal femurs from the Griqua and K2 sites are compared to upper leg (symphysion-tibiale) growth, which takes into account differences due to soft tissues and epiphyses, for the Cape 'Coloured' children (Steyn & Henneberg 1996). These data can not provide comparative information on diaphyseal femur lengths, however, they can illustrate similarities or differences in growth patterns between archaeological and modern populations. Figure 6.16 reveals that in both the Griqua and K2 juveniles the pattern of growth – direction and mode of growth – are similar to the living Cape 'Coloured' children. The absolute values are not being compared but rather the pattern of growth.

Although adult stature is influenced by genetics, poor nutrition also plays a vital role. There is a strong relationship between growth suppression in childhood and shorter terminal height in adults. Studies have compared undernourished Thai children and American children (Larsen 1997). Although the Thai children have a longer growth period, approximately one year, the consequences of reduced growth over their lifetimes was shortened terminal height (Larsen 1997). Adult stature is analysed in this study, as it is a reflection of the growth processes and therefore the living conditions intrinsic to a population.

Adult stature for the Griqua (present study), Colesberg and Wolmaransstad populations is calculated using the Lundy and Feldesman (1989) femur stature ratio of 3.745 since this value is said to be gender and ethnic group neutral (Wilson & Lundy 1994). The mean stature estimates for the Griqua (present study), Colesberg and Wolmaransstad groups are compared to other data for mean statures of southern African populations (Table 6.09).

The mean stature estimate for the Griqua (present study) males is 1621.2 mm (n = 24) (Tables 5.08 & 6.09). These individuals fall within the 'medium stature (1600-1700 mm)' category in Tobias' (1972) male Zabantu data. However, they also approximate the male mean stature estimates of the 'Nama Hottentots' who range from 1618.9 mm to 1633.1 mm (mean stature 1626 ±7.1 mm) (Tobias 1972). The Griqua (present study) female stature estimates of 1528.3 mm (n = 20) fall within the l?Auni-≠Khomani Bushmen stature data collected by Dart (1937) and also within the San and 'Negro' stature data recorded by Wilson and Lundy (1994) (Tables 5.08 & 6.09). These population groupings are not unexpected when analysing the Griqua (present study) stature estimates since the Griqua peoples are of

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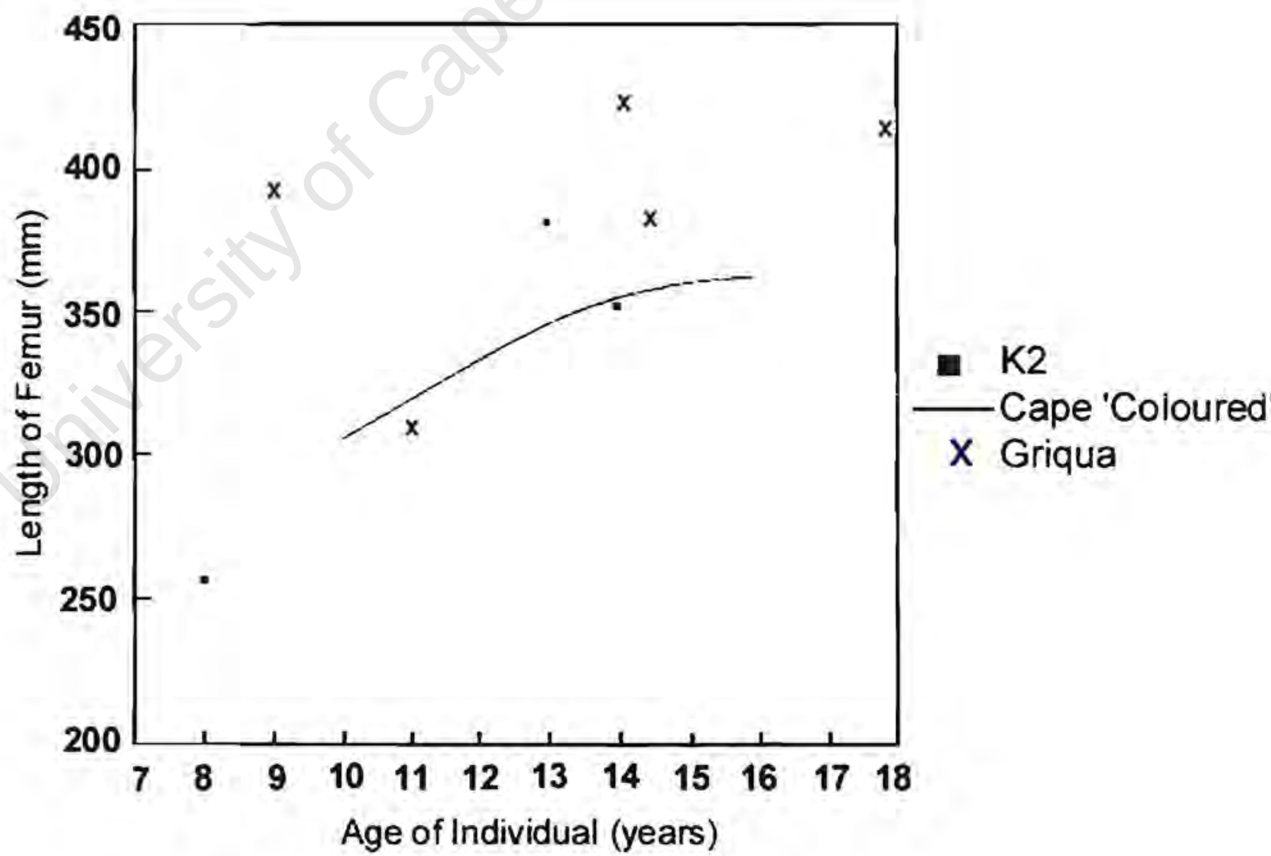

Figure 6.16 : Growth patterning compared (modified from Steyn & Henneberg 1996)

Population Group	Stature Range (mm)	Reference
Males		
I?Auni–≠Khomani Bushmen	1441.0 – 1648.0	Dart (1937)
San	1441.0 – 1648.0	Wilson & Lundy (1994)
'Negro'	1494.0 – 1765.0	"
Magon & Motokwe Bushmen	1465.0 – 1482.0	Tobias (1962)
Nama 'Hottentots'	1618.9 – 1633.1	Tobias (1972)
Southern African Negro (short)	1500.0 – 1600.0	"
Southern African Negro (medium)	1600.0 – 1700.0	"
Southern African Negro (tall)	1700.0 – 1800.0	"
Females		
I?Auni–≠Khomani Bushmen	1356.0 – 1594.0	Dart (1937)
San	1356.0 – 1594.0	Wilson & Lundy (1994)
'Negro'	1413.0 – 1669.0	"
Magon & Motokwe Bushmen	1573.5 – 1585.9	Tobias (1962)

Table 6.09 : Comparative stature data

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'mixed' biological origins (Nurse & Jenkins 1975). The Colesberg male mean stature estimate is 1558.7 mm (n = 14) (Tables 5.08 & 6.09). It falls within the short stature category (1500 mm to 1600mm) of Tobias' (1972) male Zabantu groups but also falls within the stature estimate range for male l?Auni-≠Khomani 'Bushmen' as collected by Dart (1937). The Colesberg male stature data also approximates the San stature data recorded by Wilson and Lundy (1994). The females at the Colesberg site display a mean stature estimate of 1471.8 mm (n = 13) (Tables 5.08 & 6.09). This figure falls within the stature category for female l?Auni-≠Khomani 'Bushmen' as collected by Dart (1937) as well as the San female data collected by Wilson and Lundy (1994). The stature estimates of the Colesberg females can also be included in the Wilson and Lundy's (1994) female 'Negro' category but only at the lower end of the range. The Colesberg skeletal sample is cited in history as a 'Coloured' population which includes 'Bushmen' and 'Hottentot' individuals (Slome 1929; South African Museum Catalogue). Therefore, it is not surprising that the stature estimates from the Colesberg community fall within recorded estimates for 'Bushmen' peoples. The Wolmaransstad male mean stature estimate of 1723.8 mm (n = 16) falls within Tobias' (1972) Zabantu 'tall stature category' (1700 mm to 1800 mm) (Tables 5.08 & 6.09). These data are closest to the male mean stature estimates for the Wilson and Lundy (1994) 'Negro' population. The Wolmaransstad female stature estimate of 1554.2 mm (n = 3) approximates the female 'Negro' mean stature estimates as recorded by Wilson and Lundy (1994) but also the Zulu (Durban) data cited by Tobias (1972) (Tables 5.08 & 6.09). However, since there are only three female femurs analysed this data must be viewed with caution. The male mean stature estimate lends evidence for a Zabantu population at the Wolmaransstad site.

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6.3.1.2 Growth Disruptions : Harris Lines and Enamel Hypoplasias

Harris lines are examined to demonstrate episodic stress within populations. There are a variety of conditions associated with growth arrest lines, the majority being either physically or emotionally related. However, since their aetiology is unknown it is not possible to predict the cause of the line nor the duration of the condition (Aufderheide & Rodríguez-Martín 1998; Garn *et al.* 1968; Jones & Dean 1959; Platt & Stewart 1962).

In the Griqua population, the Harris lines cluster in the one to four year age range and then again at 10 to 14 years whereas in the Colesberg sample there is only one cluster at 11 to 15 years (Figure 5.16, Table 5.09). During the first five years of life infants are very susceptible to disease and hardships, e.g. measles, starvation, vitamin deficiencies and emotional stresses associated with weaning, and therefore the formation of Harris lines in this age range is probably related to one or more of these conditions (Clarke 1982; Dettwyler 1987, 1988; Katzenberg *et al.* 1996; Stuart-Macadam & Dettwyler 1995). Although the adolescent period is generally associated with good health and low mortality, the high rate of growth arrest lines exhibited in the 10-14 year olds could be related to the adolescent growth spurt as the "frequency of line formation correlates positively with the periods of greatest rate of growth in childhood...the lines tend to cluster into a postnatal interval and again shortly before growth ceases in the mid teens" (Aufderheide & Rodríguez-Martín 1998:423).

Adults do not demonstrate Harris lines as often as children. With the loss of bone mineral and the effects of bone remodelling beginning at about age 20, only about one-fourth of lines present in sub-adults persist into adulthood (Steinbock 1976). The line that remained for the longest period of time is present in the Griqua individual Campbell/A2265, a 60+ year old female with a line that was formed between the age of one and two years.

The mean number of growth arrest lines, calculated by dividing the total number of lines by the total number of individuals (all ages are included), is calculated for the Griqua, Colesberg and Wolmaransstad samples and compared to other populations (Table 5.09). The Griqua sample contains 2.4 lines per individual while the Colesberg and Wolmaransstad samples each contain 2 lines per individual. Although Goodman *et al.* (1984b) and Aufderheide and Rodríguez-Martín (1998) have reservations about comparing Harris lines between populations, as interobserver variations are substantial and listed variables have not been standardised, the Griqua, Colesberg and Wolmaransstad samples tend to show low incidences of growth arrest lines when compared with other populations: Oakhurst 3.0 (Patrick 1989), Indian Knoll 11.3 (Johnston 1962), Fort Ancient at Hardin Village 4.1 (Cassidy 1984).

Only two individuals, Campbell/A2507 and Philippolis/NMB1609, show signs of enamel hypoplasias with both lines occurring around five years old. Due to the age of formation the lines could possibly be due to stresses suffered from weaning (Clarke 1982; Dettwyler 1987, 1988; Katzenberg *et al.* 1996; Moggi-Cecchi *et al.* 1994; Stuart-Macadam & Dettwyler 1995). These two individuals also exhibit

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Harris lines. However, correlation of Harris lines with enamel hypoplasias is poor as it may reflect differences in sensitivity, specificity or both (Aufderheide & Rodríguez-Martín 1998; Buikstra & Cook 1980; Wells 1967).

Interestingly, Harris lines and enamel hypoplasias reflect both the episode of stress and the individuals who *survived* the event. It has been suggested that the low incidence of hypoplasias among hunter-gatherer populations is because they often failed to *survive* stressful situations that would otherwise produce lesions (Cohen & Armelagos 1984). However, hypoplasias are reported to occur commonly in wild animals – including other primates (White 1978), Australopithecines (White 1978), and modern Australian Aborigines (Smith *et al.* 1984). Therefore, the relative scarcity of published data for Harris lines and enamel hypoplasias among hunter-gatherer populations suggests a lack of stress episodes. This, in turn, supports the argument that farming communities experienced stress episodes as often, or more often, than hunter-gatherer populations (Cohen & Armelagos 1984).

The growth curves for the Griqua (present study) population are compared to other historic sites: 'K2' (Steyn 1994), 'Libben' (Lovejoy *et al.* 1990), 'Kodiak Island' (y'Edynak 1976b), 'Indian Knoll' and 'Altenerding' (Sundick 1978). The Griqua (present study) and K2 individuals are compared to a living population of Cape 'Coloured' children. All populations display similar <u>direction</u> and <u>mode</u> of growth. These data suggest that the Griqua (present study), Colesberg and Wolmaransstad individuals must have been as well, or better, nourished than the comparative populations.

Interestingly, child mortalities and the Harris lines' data fall within the same age peaks (Tables 5.05 & 5.16). Since Harris lines are only present on the <u>survivors</u> of the stressful episodes, the similar peaks of Harris line formation and child mortalities are possibly an echo of a <u>single</u> hardship – the Harris line data are not a complete representation of all health events of the past.

6.3.1.3 LONG BONE BOWING

Bowing of long bones is caused from poorly mineralised bone that yields to the body's weight. Bowing has been reported in cases of metabolic disorders e.g. rickets and Paget's disease (Aufderheide & Rodríguez-Martín 1998). Hershkovitz and co-workers (1997) have also reported bowing of the tibiae and

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femora in a child with sickle-cell anaemia. The relationship of iron deficiency anaemia and long bone bowing could possibly be the reason for the numerous cases of bowing present in this study (Table 5.90).

The incidence of long bone bowing is compared to individuals who also exhibit skeletal manifestations of anaemia, i.e. porotic hyperostosis and/or cribra orbitalia (PH and/or CO). In table 5.90 three of the four (75%) Griqua (present study) individuals who exhibit bowing, NMB1608, NMB1613, NMB1701, also display signs of PH and/or CO. In the Colesberg sample 66.7% (4/6) of the individuals who exhibit bowing, SAM4493, SAM4509, SAM4515, SAM4518, display signs of PH and/or CO. There are only two individuals in the Wolmaransstad sample who display long bone bowing therefore comparisons are not statistically significant. Since large percentages of individuals in the Griqua (present study) and Colesberg samples display both PH and/or CO and long bone bowing it is possible these two pathologies are linked to iron deficiency anaemia. Individuals who express Harris lines are also compared to those who display long bone bowing. However, only two individuals who exhibit Harris lines, Colesberg/SAM4493 and Colesberg/SAM4515, also show signs of long bone bowing. Therefore no conclusions comparing growth arrest lines and long bone bowing can be inferred from these data.

6.3.2 Reflections of Illness as Population Stress

6.3.2.1 Porotic Hyperostosis and Cribra Orbitalia as Indicators of Stress: Single Cause or Multiple Correlations?

The high percentages of PH and CO exhibited in the Griqua (present study), Colesberg and Wolmaransstad populations are probably related to iron deficiency anaemia, however the reasons for this disorder may be multifactoral (Tables 5.57 to 5.59, 5.67 to 5.69). The high rates of PH and CO, in adults and children, could be linked to their agricultural economies since the inorganic iron in grains is poorly absorbed; the Griqua (present study), Colesberg and Wolmaransstad communities were all involved in growing maize. Maize was historically grown at Campbell (Government Documents, Report No. 9, 20 April 1824) and de Tuin (Cape Archives, A.8-1866). From 1843-1865 one of the most important

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products in Colesberg was maize (Government Documents, Colony of Cape of Good Hope 1840 & 1841; Government Documents G.1-1866; Van de Sandt 1843). Iron deficiency in children is associated with poor maternal diets (Dallman *et al.* 1980; Grauer 1993). However, there could also be other factors involved.

Agricultural subsistence strategies produced a deterioration of hygienic conditions that accompanied population growth and an increase in sedentism, which created prime situations for pathogenic infestation. PH and CO have been cited as having relatively high frequencies in lowland and coastal areas and relatively low frequencies in highland areas (Stuart-Macadam 1992; El-Najjar 1976). Moreover, Campbell (Government Documents, Report No. 9, 20 April 1824), Danielskuil (Snyman 1988), de Tuin (Cape Archives, A.8-186) and Wolmaransstad (Mason 1986), which historically all grew maize, are also geographically located within the 'hookworm belt' (Holland & O'Brien 1997). A single hookworm can remove between 0.2 ml and 0.05 ml of blood per day which can lead to a negative iron balance when large numbers of worms are involved (Cook 1980). There are no published data for rates of hookworm infestation in the areas of Campbell, Danielskuil, de Tuin and Wolmaransstad (personal communication Professor Appleton, 2002) however, unrecorded data do not validate an exclusion of the possibility.

Dunn (1972) has shown that ground housing as opposed to pile housing provides a greater chance of exposure to pathogens which in turn is related to high levels of iron deficiency anaemia. Many of the indigenous people at the Griqua (present study), Colesberg and Wolmaransstad sites may have been living in traditional housing which is built on the ground's surface; figure 2.5 shows indigenous people at Philippolis living in ground housing and Mason (1986) cites traditional Tswana housing at Matlwase north of Wolmaransstad.

The Griqua (present study) population shows a high frequency of PH and CO in juveniles (Tables 5.57 & 5.67). There are too few juveniles (n = 1) in the Colesberg sample and none in the Wolmaransstad sample for discussion. This high frequency of PH and CO in juveniles is consistent with the results of other researchers (Arthur & Isbister 1987; Sherman 1990; Stuart-Macadam 1982, 1985, 1989). Since increased iron deficiency is related to infectious disease and children are more susceptible to infection than other age groups, due to their low immunity, it would not seem unusual to have large percentages of PH and CO in the childhood years. Since the community at de Tuin raised goats and cows

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it is possible that either a prolonged breast feeding or weaning onto goat or cow's milk or a combination were responsible for the PH and CO lesions in the juvenile individuals.

Adult females and males also display high rates of PH and CO in the Griqua (present study), Colesberg and Wolmaransstad sites (Tables 5.57 & 5.67). The high frequencies in females could be related to either the general biology of reproductive women or numerous pregnancies.

The intensity, i.e. light, medium or severe, of PH and CO and active versus healed lesions are important indicators when correlating anaemia with bioarchaeology. In the Griqua (present study), Colesberg and Wolmaransstad sites light PH and CO occurs more often than medium or severe (Tables 5.61 to 5.63 & 5.71 to 5.73). In all three samples active lesions occur more frequently than healed lesions (Tables 5.64 to 5.66 & 5.74 to 5.76). Skeletal remains displaying active lesions suggest that the 'disease' was still present when the individual died and light lesions suggest that the 'disease process' was in its initial stages when the person died (Grauer 1993). Therefore it is possible that whatever contributed to the iron deficiency anaemia in these populations had only just begun to 'invade' the individuals of Griqua (present study), Colesberg and Wolmaransstad at their time of death.

On the other hand, healed lesions suggest that the body was in the process of recovering, or had recovered from, the condition (Grauer 1993). Healed PH lesions are absent from the Wolmaransstad sample and only occur once in the Griqua (present study) sites. However, in the Colesberg sample 32% (7/22) of the individuals display healed PH lesions. The CO data illustrates a different pattern. There are a greater percentage of active than healed CO lesions in the Griqua (present study), Colesberg and Wolmaransstad sites however healed CO occurs at a much greater frequency than healed PH. If CO is the more sensitive marker for the underlying stimulant of iron deficiency then the high rates of active CO suggest that the 'stressor' was present just before the individual died. However, the greater percentages of healed CO as compared to healed PH may suggest that some of the individuals were beginning to rally from the 'stressor' just before their time of death. The healed PH and CO lesions could be representative of a previous childhood 'incident' while the active PH and CO lesions may illustrate a 'disease process' at the time of death.

Many researchers have correlated age with active and healed lesions. Only the Griqua (present study) sample will be employed for this discussion as there are too few children displaying PH or CO at either the Colesberg or Wolmaransstad sites (Tables 5.64 & 5.74). Generally children show greater

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frequencies of active PH and CO than adults (Fairgrieve & Molto 2000; Mittler & Van Gerven 1994; Šlaus 2000). This trend is not revealed in the Griqua (present study) data. The PH data shows children – includes infants, juveniles and sub-adults – (100%) and adult males (100%) displaying equal rates of active lesions. The CO data illustrates adult males (90%) expressing higher frequencies of active lesions than children (78.4%). The small sample sizes may not accurately reflect the trends for active PH and CO in this population.

The rates of CO in the Griqua (present study), Colesberg and Wolmaransstad sites are compared to other published data from Morris (1984), Patrick (1989) and Steyn (1994). The data employed for comparison are for individuals suffering from only CO (Table 6.10). The large difference in the occurrence of CO when comparing the Griqua (present study) and the Griqua (Morris) study is probably due to sample size error in the smaller Morris sample.

The individuals from the comparative data have different subsistence economies that may help to explain the frequencies of CO present in the population.

- Griqua (present study) and Griqua (Morris) – pastoralists also growing agricultural products
- Colesberg – males are agricultural labour, women are domestic servants in the town
- Wolmaransstad – males are agricultural labour
- Riet River – hunter-gatherers
- Kakamas – pastoralists
- Oakhurst – hunter-gatherers dependent on marine foods
- K2 – agriculturalists

The Riet River burials extend from Jacobsdal in the west to about 5 kilometres east of Koffiefontein. The majority of the skeletons are recorded as being interred in the flexed position which indicates a traditional style burial pattern. Grave goods are very common with ostrich egg shell beads being the most frequent object. These individuals are associated with a hunter-gatherer economy with elements of pastoralism. Radiocarbon dating, trade beads and historical reports suggest a date for the burials between the 11th and early 19th centuries – all but one of the dates being within the 16th to early 19th centuries (Morris 1992b).

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	Younger than 2 years	2 - 13 Years	13 - 20 Years	Older than 20 Years	Total
Griqua (2001)					
n	15	12	5	53.5	85.5
No. of indiv's with CO	6	10.5	2	18	36.5
%	40.0	87.5	40.0	33.6	42.7
Colesberg					
n	0	4	1	47	52
No. of indiv's with CO	0	1	0	17	18
%	0	25.0	0	36.2	34.6
Wolmaransstad					
n	0	0	1	21	22
No. of indiv's with CO	0	0	1	10	11
%	0	0	100.0	47.6	50.0
Griqua (Morris) ^					
n	10	2	3	25	40
No. of indiv's with CO	3	1	0	0	4
%	30.0	50.0	0	0	10.0
Riet River ^					
n	2	17	8	47	74
No. of indiv's with CO	0	4	1	2	7
%	0	23.5	12.5	4.3	9.5
Kakamas ^					
n	1	7	4	41	53
No. of indiv's with CO	0	2	0	0	2
%	0	28.6	0	0	3.8
Oakhurst ^^					
n	7 *	1 **	1 ***	10	19
No. of indiv's with CO	7	1	1	3	12
%	100.0	100.0	100.0	30.0	63.2
K2 ^^^					
n	11	16	4	6	37
No. of indiv's with CO	3	8	1	2	14
%	27.3	50.0	25.0	33.3	37.8

Number of individuals affected and total number of individuals added incorrectly in the study by Patrick (1989); these numbers are the correct calculations

^ Data from Morris (1984)

^^ Data from Patrick (1989)

^^^ Data from Steyn (1994)

* = All individuals under 3 years

** = 3-15 years

*** = 15-20 years

Table 6.10 : Occurrence of CO in comparative populations

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The Kakamas burials are located on the banks of the lower Orange River from Augrabies Falls to Upington. All of the graves are marked by cairns. Although the position of the individual skeletons is not specifically detailed, there is mention of flexed burials. Grave goods are not common. The Kakamas graves are associated with the early historic Khoe pastoralist group known as the Einiqua. Radiocarbon dating and historical evidence suggest a middle to late 18^{th} century date (Morris 1992b).

The Oakhurst cave near George produced many human skeletal remains. The graves are characterised by a flexed burial pattern, ostrich egg shell beads and the presence of red ochre. These individuals are associated with South African indigenous pastoralists. Radiocarbon dates indicate a date ranging from two thousand to nine thousand years ago, with a majority of the dates in the range of four to six thousand years before present (Morris 1992b).

The K2 skeletons date between 100 and 1300 AD and represent the remains of people from a complex agricultural state. The economy was based on both cattle and agricultural crops, but trade was a significant factor (Meyer 1998).

Excluding Colesberg and Wolmaransstad, since very few children are present, all of the sites show higher frequencies of CO in children than adults, which is in accordance to research from other parts of the world (El-Najjar *et al.* 1976; Fairgrieve & Molto 2000; Lallo *et al.* 1977; Stuart-Macadam 1985). Generally, individuals in the 2-13 year age range show higher rates of CO than other age categories. The reason for these high rates could be due to weaning practices, but, as described above, many other factors may also be involved.

The higher incidence of CO in agricultural communities as compared to hunter-gatherers is also illustrated in the comparative groups. Although, the high rates of CO present in the Oakhurst sample do not comply with this trend. However, since the Oakhurst population was dependent on marine foods the high frequency of CO is probably due to water contamination or exposure to fish-borne parasites or a combination of both (Patrick 1989; Pietrusewsky *et al.* 1997; Walker 1986). High nutrient losses due to diarrhoea, i.e. infection, may be a more important factor in determining the aetiology of CO than a low intake of essential nutrients.

The appearance of porotic hyperostosis and cribra orbitalia in a population signifies the occurrence of iron deficiency anaemia. The Griqua (present study), Colesberg and Wolmaransstad sites all show high rates of PH and CO which is consistent with agricultural communities. However, the

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aetiology of this anaemia is probably multifactoral. Iron deficiency anaemia occurred very infrequently before agricultural based societies approximately 10 000 years ago. In agricultural communities iron poor cereal grains are the primary foods ingested; the Griqua (present study), Colesberg and Wolmaransstad communities were all involved with growing maize, which has a low iron content and the phytic acid chelates any iron that may be present. Agricultural subsistence strategies also create sedentism, which is associated with high-density populations and poor hygiene. Increased rates of infection, due to bacteria or viruses, are also correlated with high rates of iron deficiency anaemia. Campbell, Danielskuil, de Tuin and Wolmaransstad are geographically located within the 'hookworm belt' which would support the parasitic model of acquired iron deficiency. Houses built on the ground as opposed to piles also provide increased risk to pathogens and therefore iron deficiency anaemia; the indigenous houses built at Philippolis and near Wolmaransstad were traditional houses built on the ground. Children fed cow or goats milk have higher rates of iron deficiency anaemia since both are iron poor alternatives to human milk. However, prolonged breast feeding can also lead to high frequencies of iron deficiency anaemia as after the fourth month postpartum human milk becomes low in iron. The community at de Tuin raised cattle and goats and the ingestion of milk from these animals, or prolonged breastfeeding, may be linked to the high rates of juvenile PH and CO present. Due to biological needs, infants, adult females in their reproductive years and pregnant women require more iron which could be tied to the high rates of PH and CO found in the Griqua (present study), Colesberg and Wolmaransstad females. The high frequency of light and active PH and CO exhibited in the Griqua (present study), Colesberg and Wolmaransstad populations suggest that the 'process' was in its initial stages and still present in the individual when they died. All of these factors must be taken into account when constructing correlations between iron deficiency anaemia and PH and CO. Bioarchaeological research must be careful not to view human physiology as if it were "no more complex than house plumbing" (Goodman 1994:171).

6.3.3 Is there Evidence of Epidemics?

The smallpox virus, which robs iron from its host for reproduction and therefore could be correlated with iron deficiency anaemia, raged throughout South Africa in waves every 20 or 30 years during the 18th and 19th centuries. There are records of smallpox epidemics in 1713, 1735, 1755, 1767,

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1831, 1859, 1882, 1883, 1884, 1893, 1896 (Burrows 1958; Gear 1986; Gilder 1984; Kretznar 1972; Potgieter 1972; Slotow 1983; Smith 1989). There are also reports of it occurring in the Griqua regions of Campbell and Kimberley, areas in the Free State, and in Cape Town and Johannesburg (Burrows 1958; Gear 1986; Gilder 1984; Kretznar 1972; Potgieter 1972; Slotow 1983; Smith 1989). Only humans can contract the virus and there are no carriers, i.e. all infected persons show visible symptoms (Aufderheide & Rodríguez-Martín 1998). The smallpox (variola) virus has an 80 to 90% fatality rate among non-immune indigenous populations (Aufderheide & Rodríguez-Martín 1998; Young 1998). All ages are susceptible. However, in densely populated areas, where smallpox is endemic, infection during childhood is unavoidable. "Trial by smallpox was a prerequisite for adulthood for all but a small minority" (Crosby 1993:1008). Smallpox can only survive and reproduce in densely populated areas and therefore sedentary communities, such as those present in agricultural and pastoral based societies, are more susceptible to transmission of the disease.

Smallpox may remodel bone in the form of osteomyelitis variolosa and arthritis (Aufderheide & Rodríguez-Martín 1998; Jackes 1983; Ortner & Putschar 1985). The lesion is characterised by the disruption of the area around the metaphysis which may lead to detachment or destruction of the epiphysis resulting in the reduction or cessation of longitudinal bone growth (Jackes 1983). Osteomyelitis variolosa may occur in children but skeletal involvement of smallpox is only seen in adults when it represents recovery from a childhood illness; very few recorded cases of osteomyelitis variolosa are known for individuals over 15 years of age (Aufderheide & Rodríguez-Martín 1998; Jackes 1983). Osteomyelitis resulting from smallpox prefers the elbows. In the skeletal biology literature up to 80% of the suspected smallpox cases show bilateral infection of the three bones that comprise the elbow joint however, only 20% of the cases in the radiological literature display specific bone changes (Aufderheide & Rodríguez-Martín 1998; Bell *et al.* 1992; Jackes 1983:75). In severe cases pathological fractures can occur (Aufderheide & Rodríguez-Martín 1998). If the individual survives the virus, the bony changes associated with smallpox tend to disappear after several months to one year although growth retardation remains and degenerative joint disease usually develops (Aufderheide & Rodríguez-Martín 1998). Since smallpox only remodels bone in very few individuals and solely in children (Aufderheide & Rodríguez-Martín 1998; Jackes 1983) the only method for unconditionally determining the presence of the smallpox virus in a skeletal population is by performing DNA and PCR analyses.

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During the 18th and 19th centuries the smallpox virus was responsible for the deaths of many people and for the breakdown of indigenous communities. Mass illness, as caused by smallpox, impaired crop attention causing famine, was responsible for loss of specialists in the community, and due to their sedentary lifestyle individuals could not flee the area, hence community breakdown was more disastrous because of the communities' degree of interdependence on one another (Aufderheide & Rodríguez-Martín 1998).

Smith (1989:25) cites three major smallpox epidemics in South Africa during the 18th century, 1713, 1735, 1767, that "so decimated the Khoikhoi that the very names of some hordes were forgotten". When adults and children start dying it affects the whole social structure of indigenous society. For example, since the Khoikhoi society is hierarchical in nature if, historically, a lineage leader and his sons were to die the entire power base of this society would effectively be weakened and damaged, making this community more susceptible to invasion and control by outside forces, i.e. the Dutch (Smith 1989).

In 1831 smallpox broke out in the Griqua region at Campbell and Philippolis and Drs. Atherstone, district surgeon in Grahamstown, and Perry undertook "vaccination expeditions" to these communities (Burrows 1958; Slotow 1983:44). When they arrived at Campbell they vaccinated 100 individuals for smallpox (but without success) all of whom died later of the disease (Slotow 1983); 100 deaths in a small community like Campbell would have caused a serious breakdown of social structures. However, at Philippolis the vaccination was successful and this new vaccine was sent to Campbell (Slotow 1983).

In 1884 smallpox reached the Griqua community at Danielskuil. Many of the residents died and those who survived left Danielskuil to work in the diamond fields (Snyman 1988).

During the early 1880's smallpox reached the mining district of Kimberley. The virus was first 'misdiagnosed' as chickenpox and bullous pemphigus, which are blister diseases, by three of the six medical officers appointed by the magistrate (Gear 1986; Slotow 1983). Three of these doctors did not regard the disease as smallpox for financial and political reasons; a diagnosis of smallpox would have resulted in the quarantine of all the Zabantu workers and the loss of millions of rands for the various mining companies (Slotow 1983). One of the doctors, Dr. J.W. Matthews, diagnosed the disease as "Kaffir pox", an aggravated form of chickenpox believed to attack only the Zabantu peoples; he also called it "Wacht een Beitje" translated as 'Wait one bit' as it delayed the workers as they tried to work

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(Slotow 1983:46). Dr. Wolff, house surgeon to Kimberley hospital and backed by the mining fraternity, stated emphatically that the epidemic was not smallpox and put three individuals suffering from 'smallpox' in the ordinary hospital. Dr Wolff was tried and fined £10 for his actions (Gilder 1984). Finally, a doctor was sent from Cape Town, probably Sir Edwin Sinclair Stevenson, who correctly diagnosed the disease as smallpox (Slotow 1983). This year long disagreement between doctors led to the 'smallpox war' of 1882 and 1883. By the time it was resolved 2 300 cases had occurred with about 700 deaths (Gear 1986; Kretznar 1972).

Smallpox hit the area of Colesberg in1866 killing many people including a substantial number of 'Hottentots' (Gutsche 1968; personal communication Professor M. De Jongh, 2001; Slome 1929; South African Museum Catalogue). Local residents have always referred to the cemetery on the outskirts of town as the 'Hottentot begrafplaas' or Hottentot graveyard (personal communication Professor M. De Jongh).

The analysis of ancient DNA (aDNA) is an important new methodology for the construction of human origins and evolution. In this research aDNA technology was employed to test for the presence of the smallpox virus in historic South African populations. Unfortunately, due to problems associated with aDNA, neither methodology employed allowed for the virus to be amplified on a PCR gel.

There are many problems plaguing researchers who use aDNA technology (Kolman & Tuross 2000; Kumar *et al.* 2000; personal communication Dr. J. Yeats, 2001):

- Contamination of specimens with modern human DNA from people who have handled them
- Laboratory procedures involved in processing the specimens
- Modern DNA tested in laboratories may also contaminate aDNA samples
- DNA becomes degraded over time and therefore only a small minority of ancient specimens contain sufficient amounts of DNA for analysis
- Amplification of DNA on a gel requires a lot of DNA present. If the DNA is so degraded even the PCR will not produce sufficient DNA for amplification to occur

In this project there was one additional problem in that the area chosen for amplification was possibly too long since aDNA is very degraded. The primer length chosen was 20-30 base pairs but a shorter amplified area may be a possible solution for future research.

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The demographic profiles of the Griqua (present study), Colesberg and Wolmaransstad sites reveal a possible epidemic in the communities. In the Griqua (present study) there are large numbers of infants and juveniles dying, lesser number of sub-adults and an increase in deaths among younger and older adults. There are more males than females dying at the Griqua (present study) sites. In the Colesberg site the majority of individuals dying are younger adults; there are slightly more males than females dying. In the Wolmaransstad site there are a large percentage of older adult men dying.

Although all of the individuals in this study are dead, their skeletal data reveal a relatively healthy population. An epidemic is an outside influence that does not reflect on the general health of any given population. A population with 30% mortality from smallpox can hardly be referred to as 'healthy' however, it is only in reference to the time of the epidemic, not the period before or after. The paradox is that these individuals 'died healthy' (Wood *et al.* 1992). The high rates of porotic hyperostosis (PH) and cribra orbitalia (CO), both skeletal manifestations of anaemia suggest an epidemic such as smallpox. The rates of caries, dental abscesses, arthritis and trauma do not suggest a severely unhealthy population. The overall (uncorrected) caries rates for the populations are as follows: Griqua (present study) 2.9%, Colesberg 3.8%, Wolmaransstad 5.6% (Table 5.39). The dental abscess rates are also low: Griqua (present study) 9.7%, Colesberg 6.6%, Wolmaransstad 4.8% (Table 5.56). The overall rates of arthritis for the Griqua (present study) (7.2%), Colesberg (3.1%) and the Wolmaransstad (18.8%) samples are also minimal. The incidence of skeletal trauma, Griqua (present study) (2.2%), Colesberg (9.6%) and Wolmaransstad (17.9%) suggest relatively healthy populations. However, the high rates of porotic hyperostosis (Griqua [present study] 50%, Colesberg 44%, Wolmaransstad 54.5%) and cribra orbitalia (Griqua [present study] 42.7%, Colesberg 34.6%, Wolmaransstad 50%) imply a population under stress.

The primary cause for PH and CO is iron deficiency anaemia (Stuart-Macadam 1989). Although the bony changes associated with PH and CO could be related to maize consumption in all of the samples, the question still remains, why were these people dying? Since people do not normally die from anaemia (personal communication Jill Finlayson, 2001) and the smallpox virus raged throughout South Africa during the 18^{th} and 19^{th} centuries it is more likely that the high rates of PH and CO are possibly related to smallpox epidemics and not dietary causes.

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CHAPTER 7

CONCLUSION

The 18th and 19th century northern frontier, a place of 'mutual acculturation' was occupied by a variety of cultures and ethnicities, many of whom were indigenous to Africa while others came from Europe to this land of opportunity to settle and start a new life. What occurred was the emergence of new communities, such as the Griqua and Oorlams, with a way of life distinct from others around them. However, contact between people of differing backgrounds was often dynamic and violent as indigenous peoples fought to keep the slowly disappearing vestiges of their ancestry and livelihood, namely land. With the influx of Europeans also came a new way of life for the indigenous African peoples. They were now being 'conquered' and dominated and used as a cheap source of labour to improve the lives of the wealthier settlers. The data gathered in this project allow for a better understanding about the palaeodemography and life histories of the people living in the 18th and 19th century Northern Frontier.

The Griqua sites (Campbell, Danielskuil, Philippolis, Bethulie, de Tuin) contain 135 individuals ranging from infants to old adults. Although the Griqua sites were mostly pastoralists, agriculture was introduced by the missionaries in 1804. Refined foods such as sugar, tea and coffee were introduced into the Griqua diet by the 1840's. This in turn was responsible for the increased caries rates found at this site as compared to other South African indigenous groups. However, these percentages are lower than those found in the agricultural communities at Colesberg and Wolmaransstad. The musculoskeletal muscle markers (MSM's) also help shed light on the lifestyle of the Griqua peoples during the 19th century. The high leg entheses scores in the males and high arm entheses scores in the females illustrate a community where men were involved in 'search costs' and women with 'processing items'. This is consistent with historical documents that cite the Griqua as growing gardens, hunting animals and keeping livestock. The high rate of osteoarthritis in the Griqua community, as compared to the Colesberg and Wolmaransstad samples, also suggests a more traditional economic-based community since osteoarthritis tends to decrease with the adoption of agriculture. The overall low frequencies of trauma and growth arrest lines present in the Griqua community suggest a relatively healthy population. Since the growth patterns of the Griqua sub-adults approximates that of other healthy archaeological and living populations, it is valid to

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conclude that the Griqua individuals must have been as well or better nourished than the comparative populations. However, the high rates of porotic hyperostosis and cribra orbitalia (skeletal manifestations of iron deficiency anaemia) may suggest an epidemic, such as smallpox, within the community as viruses require iron in order to survive.

The sample at Colesberg comprised 52 individuals, the majority of whom were young adults. The individuals analysed in this project were probably an indigenous Khoe community who lived on the outskirts of town but provided the rural and urban population with a cheap source of labour. The economy of Colesberg during the 1800's was based on horticulture, sheep and cattle farming. The high caries rates in these individuals suggest a population dependent on agricultural plants such as maize or with access to processed foods. This would only be possible if they were participating in a money-based economy. The MSM's also lend evidence for a labouring population with men employed as agricultural labour and women as domestic servants; the males display higher MSM's in the legs and females in the arms. The lower incidence of osteoarthritis in the Colesberg population, as compared to the Griqua sites, also lends evidence for an agricultural community as there is a decline in mechanical loading with the adoption of agriculture. The higher rates of osteophytosis in the lower body of the Colesberg males, as compared to the Griqua males, is possibly related to activities such as being a shepherd as this would require walking great distances all day to tend to the flock; sheep farming was of primary importance during the 1860's and 1870's in Colesberg. The low frequencies of trauma and growth arrest lines suggest a relatively healthy population. However, the high rates of porotic hyperostosis and cribra orbitalia may suggest an epidemic, such as smallpox, within the community since historical documentation lends evidence for smallpox raging throughout South Africa during this time.

The population living near Wolmaransstad was possibly a 20th century informal Zabantu community whose existence was dependent on local labour needs. During the 1880's the Cape government proposed a hut tax on people living in 'locations'. In effect, this forced the traditional African communities to become part of a money-based society and work for poor wages; men would leave their homes to search for work in a nearby community. The high ratio of men to women, 5:1, present at this site is very representative of this situation. The Natives Land Act of 1913 stated that Zabantu peoples were only allowed to live on farms as a condition of their labour service. The high caries rates present in this site, as compared to either the Griqua or Colesberg sites, lend evidence for a

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population with an agricultural lifestyle and diet; the main products of 20th century Wolmaransstad were maize which is highly cariogenic. The higher MSM's in the legs of the Wolmaransstad men, compared to women, combined with historical data for the area also provides evidence for an agricultural labouring population; men were associated with animals and livestock and women were responsible for cultivation, storing the harvest and preparing food. The men at this site also display higher rates of upper and lower body arthritis as compared to the Griqua population. This is probably related to their duties as farm labourers, e.g. maintaining the crop, land and farm buildings. The low rates of trauma and growth arrest lines indicate a relatively healthy population. However, the high rates of porotic hyperostosis and cribra orbitalia may suggest an epidemic, such as smallpox, within the community since historical documentation lends evidence for smallpox in epidemic proportions throughout South Africa in the 18th, 19th and 20th centuries.

Smallpox was a significant shaper of life histories for South African indigenous peoples during the 18th and 19th centuries. It was responsible for the demise of entire social structures and even entire communities of peoples. Through the analysis of aDNA this project attempted to construct palaeodemographic death data about the effects of smallpox on South African indigenous peoples. Although the methodologies attempted were not successful, the demographic data and historical context indicate that this line of research should continue and may prove to be extremely valuable in future research.

I truly believe that the only way the study of physical anthropology will continue is through bridging the gap of discourse between the scientists and the indigenous communities, i.e. each side must learn from the other, and by compromising on acceptable forms of future research. This may frighten and even enrage some scientists, however, in my personal experience, both in Canada and South Africa, most indigenous communities are just as interested in gaining knowledge about their history as the physical anthropologists. The frontier movement brought an influx of non-traditional values and ideas which threatened the traditional ways of indigenous peoples. This transformation has created a present generation of people who feel a loss of cultural awareness and hence a loss of self. The overall significance of this project lies in the understanding of health and disease in the 18th and 19th century of South Africa. It will also add to the unwritten history of indigenous peoples, and a history of South Africa, which allows for a new connection to be created between indigenous peoples and the scientific

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community. This research tries to mend the 'wrongs of the past' by giving back a forgotten past to the indigenous communities which in turn will allow for them to rebuild their lives and create for themselves a new sense of dignity and self worth.

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APPENDIX A1
Griqua Sites

Site/Catalogue Number	Sex	Age Category	Cultural Materials
Bethulie/NMB1617a	m	older adult	3 white buttons, symmetrical, possibly plastic
Bethulie/NMB1617b	m	older adult	
Bethulie/NMB1618a	m	MI	
Bethulie/NMB1618b	f	older adult	
Bethulie/NMB1619a	f	MI	
Bethulie/NMB1619b	m	older adult	
Bethulie/NMB1620a	f	older adult	
Bethulie/NMB1620b	m	older adult	
Bethulie/NMB1621a	m	older adult	
Bethulie/NMB1621b	f	older adult	
Bethulie/NMB1622a	f	MI	adze head - hoe used in farming
Bethulie/NMB1622b		infant	
Bethulie/NMB1622c		juvenile	
Bethulie/NMB1624		infant	
Bethulie/NMB1625		infant	hair on skull is black, curly, wirey
Bethulie/NMB1627		infant	
Bethulie/NMB1628		infant	3 small copper pins
Bethulie/NMB1629a		infant	
Bethulie/NMB1629b		infant	
Bethulie/NMB1629c		infant	
Bethulie/NMB1629d		infant	
Bethulie/NMB1629e		infant	
Bethulie/NMB1629f		juvenile	
Bethulie/NMB1629g		infant	
Bethulie/NMB1630		juvenile	
Bethulie/NMB1631		infant	
Bethulie/NMB1632		infant	
Bethulie/NMB1634		infant	
Campbell/A2261	m	older adult	3 pieces of leather, 1 copper bracelet, 1 coir head pillow-funeral furniture
Campbell/A2262	f	younger adult	piece of black cloth, 10 coffin nails, 1 piece of coffin wood
Campbell/A2263	m	younger adult	coffin wood, large flat pieces of metal
Campbell/A2264	f	younger adult	

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Site/Catalogue Number	Sex	Age Category	Cultural Materials
Campbell/A2265	f	older adult	
Campbell/A2266		infant	50+ coffin nails
Campbell/A2267		infant	
Campbell/A2268	f	older adult	2 white buttons possibly mother of pearl and handmade, not perfect holes
Campbell/A2269	f	older adult	
Campbell/A2271	m	older adult	
Campbell/A2272	m	older adult	
Campbell/A2273a		infant	
Campbell/A2273b		infant	
Campbell/A2273c		infant	
Campbell/A2502	f	older adult	
Campbell/A2503	f	younger adult	
Campbell/A2504	m	younger adult	
Campbell/A2505		infant	
Campbell/A2506		infant	
Campbell/A2507	f	sub-adult	
Campbell/A2508	m	younger adult	
Campbell/A2522		infant	coffin wood, 2 coffin nails
Campbell/A2824		infant	
Campbell/A2825		infant	1 white button possibly mother of pearl
Campbell/A2826	m	older adult	1 coffin nail, 4 buttons
Campbell/A2827		juvenile	
Campbell/A2828		infant	2 buttons possibly mother of pearl, coffin wood, 1 coffin nail
Campbell/A2829	m	younger adult	
Campbell/A2830	m	older adult	
Campbell/A2831	m	younger adult	
Campbell/A2832	f	younger adult	
Campbell/A2833	f	younger adult	
Campbell/A2834		infant	
Campbell/A2835	f	younger adult	
Campbell/A2836		infant	2 coffin nails, 2 black stones-middle stone age flakes associated with grave fill
Campbell/A2837		infant	
Danielskuil/UOVS01	m	younger adult	
Danielskuil/UOVS02	f	younger adult	2 copper buttons
Danielskuil/UOVS03		juvenile	
Danielskuil/UOVS04	m	sub-adult	

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Site/Catalogue Number	Sex	Age Category	Cultural Materials
Danielskuil/UOVS06	f	younger adult	
Danielskuil/UOVS07	m	younger adult	
Danielskuil/UOVS08		MI	
Danielskuil/UOVS09		younger adult	
Danielskuil/UOVS10	m	MI	1 coffin nail, pieces of cloth
Danielskuil/UOVS11a		juvenile	
Danielskuil/UOVS11b	m	older adult	
Danielskuil/UOVS12		juvenile	
Danielskuil/UOVS13a	f	older adult	
Danielskuil/UOVS13b		juvenile	
Danielskuil/UOVS13c	m	MI	
Danielskuil/UOVS14	m	younger adult	
Danielskuil/UOVS15	m	younger adult	
Danielskuil/UOVS16		unknown	
Danielskuil/UOVS17	m	younger adult	
Danielskuil/UOVS18	f	MI	
Danielskuil/UOVS19	m	sub-adult	
Danielskuil/UOVS20	m	older adult	
Danielskuil/UOVS21	m	older adult	
Danielskuil/UOVS22	m	older adult	
Danielskuil/UOVS23	m	MI	ostrich egg shell fragments
Danielskuil/UOVS24	f	younger adult	
Danielskuil/UOVS25a		infant	
Danielskuil/UOVS25b		juvenile	
Danielskuil/UOVS25c		infant	
Danielskuil/UOVS25d	m	older adult	
Danielskuil/UOVS25e		juvenile	
Danielskuil/UOVS25f		infant	
Danielskuil/UOVS25g		MI	
Danielskuil/UOVS26a	m	sub-adult	
Danielskuil/UOVS26b		infant	
Danielskuil/UOVS27		MI	1 coffin nail
Danielskuil/UOVS28	m	younger adult	
Danielskuil/UOVS29a	m	younger adult	
Danielskuil/UOVS29b		juvenile	
Danielskuil/UOVS30	f	MI	
Danielskuil/UOVS31a	f	MI	
Danielskuil/UOVS31b	m	MI	
De Tuin/UCT335		juvenile	1 small piece of white pottery (1cm x 1cm), 2 coffin nails, coffin wood

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Site/Catalogue Number	Sex	Age Category	Cultural Materials
De Tuin/UCT336		infant	
De Tuin/UCT467		infant	7 complete coffin nails, 15 fragments of coffin nails, 2 copper straight pins
De Tuin/UCT468		juvenile	
De Tuin/UCT469		infant	
De Tuin/UCT470		infant	
De Tuin/UCT471		juvenile	coffin wood and nails, 4 straight pins
De Tuin/UCT569		juvenile	3 buttons, coffin wood and nails, 25+ ostrich egg shell fragments
De Tuin/UCT570a		infant	
De Tuin/UCT570b		infant	3 fragments of copper pins, 1 bovid tooth
De Tuin/UCT571		infant	
De Tuin/UCT579		infant	8 coffin nails
Philippolis/NMB1567a	f	younger adult	10 buttons, jewellery with 'Jewish' symbol, pocket knife, shoe sole leather, second piece of leather
Philippolis/NMB1567b		younger adult	
Philippolis/NMB1568	m	older adult	
Philippolis/NMB1569		MI	metal bracelet
Philippolis/NMB1570	m	younger adult	
Philippolis/NMB1604	m	older adult	
Philippolis/NMB1605	m	younger adult	
Philippolis/NMB1606a	m	younger adult	
Philippolis/NMB1606b	m	younger adult	
Philippolis/NMB1608	f	older adult	
Philippolis/NMB1609	f	sub-adult	
Philippolis/NMB1610	f	MI	
Philippolis/NMB1611	f	younger adult	
Philippolis/NMB1612	m	MI	
Philippolis/NMB1613	f	younger adult	
Philippolis/NMB1701	m	younger adult	
Philippolis/NMB1702	f	younger adult	
Philippolis/NMB1703	f	younger adult	

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APPENDIX A2
COLESBERG SITE

Site/Catalogue Number	Sex	Age Category	Cultural Materials & Preserved Items
Colesberg/SAM4316		juvenile	
Colesberg/SAM4317	f	younger adult	
Colesberg/SAM4318		juvenile	
Colesberg/SAM4319	f	younger adult	
Colesberg/SAM4320	m	younger adult	
Colesberg/SAM4321		juvenile	
Colesberg/SAM4322	f	younger adult	
Colesberg/SAM4323	f	MI	
Colesberg/SAM4324	m	younger adult	
Colesberg/SAM4325	f	younger adult	
Colesberg/SAM4326	m	MI	
Colesberg/SAM4327	m	younger adult	
Colesberg/SAM4328	m	younger adult	
Colesberg/SAM4329	m	younger adult	preserved skin on hand
Colesberg/SAM4330	f	younger adult	
Colesberg/SAM4331	m	younger adult	
Colesberg/SAM4488	m	younger adult	
Colesberg/SAM4489	m	younger adult	
Colesberg/SAM4490	m	younger adult	
Colesberg/SAM4491	f	younger adult	
Colesberg/SAM4492	m	MI	
Colesberg/SAM4493	m	MI	
Colesberg/SAM4494		juvenile	
Colesberg/SAM4495a	m	younger adult	
Colesberg/SAM4495b		infant	
Colesberg/SAM4496	m	older adult	3 coffin handles
Colesberg/SAM4497	m	older adult	
Colesberg/SAM4499	f	younger adult	
Colesberg/SAM4500	f	younger adult	
Colesberg/SAM4502	m	older adult	
Colesberg/SAM4503	m	younger adult	
Colesberg/SAM4504	m	younger adult	copper bracelet, hair
Colesberg/SAM4505	f	younger adult	
Colesberg/SAM4506		juvenile	
Colesberg/SAM4507	m	younger adult	copper bracelet
Colesberg/SAM4508	f	older adult	
Colesberg/SAM4509	f	younger adult	
Colesberg/SAM4510	f	older adult	
Colesberg/SAM4511	f	younger adult	
Colesberg/SAM4512	m	younger adult	copper and leather buckle, coffin handle

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Site/Catalogue Number	Sex	Age Category	Cultural Materials
Colesberg/SAM4513	m	older adult	
Colesberg/SAM4514	m	younger adult	
Colesberg/SAM4515	m	younger adult	
Colesberg/SAM4516	f	younger adult	
Colesberg/SAM4517	f	younger adult	
Colesberg/SAM4518	m	younger adult	2 copper finger rings
Colesberg/SAM4519	f	MI	1 shell
Colesberg/SAM4520	f	younger adult	
Colesberg/SAM4521	f	younger adult	
Colesberg/SAM4522	f	younger adult	
Colesberg/SAM4523	m	younger adult	
Colesberg/SAM4525	f	younger adult	

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APPENDIX A3
WOLMARANSSTAD SITE

Site/Catalogue Number	Sex	Age Category	Cultural Materials
Wolmaransstad/NMB016	f	MI	
Wolmaransstad/NMB017	m	younger adult	
Wolmaransstad/NMB018	m	MI	
Wolmaransstad/NMB019	f	sub-adult	
Wolmaransstad/NMB021	m	MI	
Wolmaransstad/NMB022	f	MI	
Wolmaransstad/NMB023a	m	older adult	
Wolmaransstad/NMB023b	m	MI	
Wolmaransstad/NMB024a		infant	
Wolmaransstad/NMB024b		sub-adult	
Wolmaransstad/NMB024c		sub-adult	
Wolmaransstad/NMB1185a	f	MI	
Wolmaransstad/NMB1185b	m	sub-adult	
Wolmaransstad/NMB1186a	m	older adult	
Wolmaransstad/NMB1186b	m	MI	
Wolmaransstad/NMB1193	m	older adult	
Wolmaransstad/NMB1194a	m	older adult	
Wolmaransstad/NMB1194b	m	MI	
Wolmaransstad/NMB1195	m	MI	
Wolmaransstad/NMB1220	m	MI	
Wolmaransstad/NMB1221	m	older adult	
Wolmaransstad/NMB1228a	m	MI	
Wolmaransstad/NMB1228b	m	younger adult	
Wolmaransstad/NMB1229a	m	older adult	
Wolmaransstad/NMB1229b	m	MI	
Wolmaransstad/NMB1313a	m	older adult	
Wolmaransstad/NMB1313b	m	older adult	
Wolmaransstad/NMB1313c	m	older adult	
Wolmaransstad/NMB1314	f	younger adult	
Wolmaransstad/NMB1326	f	younger adult	
Wolmaransstad/NMB1327a	m	older adult	
Wolmaransstad/NMB1327b	m	older adult	
Wolmaransstad/NMB1328a	m	MI	
Wolmaransstad/NMB1328b	m	older adult	
Wolmaransstad/NMB1331a	m	older adult	
Wolmaransstad/NMB1331b	m	younger adult	

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Site/Catalogue Number	Sex	Age Category	Cultural Materials
Wolmaransstad/NMB1345	m	MI	
Wolmaransstad/NMB1346a	m	older adult	
Wolmaransstad/NMB1346b	m	MI	

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APPENDIX B1

Griqua (present study) sites – Caries rates

	Younger Adults (20.1 - 40 years)								
	Male			Female			Total		
n*	12.5			12			24.5		
Tooth No.	No.	#	%	No.	#	%	No.	#	%
I1	0	32	0	2	30	6.7	2	62	3.2
I2	0	35	0	1	29	3.4	1	64	1.6
C	0	38	0	0	37	0	0	75	0
PM1	0	41	0	2	38	5.3	2	79	2.5
PM2	0	45	0	1	30	3.3	1	75	1.3
M1	2	50	4.0	0	36	0	2	86	2.3
M2	0	48	0	2	33	6.1	2	81	2.5
M3	0	45	0	4	32	12.5	4	77	5.2
TOTAL	2	334	0.6	12	265	4.5	14	599	2.3

	Older Adults (40.1+ years)								
	Male			Female			Total		
n*	13			6			19		
Tooth No.	No.	#	%	No.	#	%	No.	#	%
I1	0	29	0	0	6	0	0	35	0
I2	0	33	0	0	4	0	0	37	0
C	0	35	0	0	10	0	0	45	0
PM1	0	36	0	0	11	0	0	47	0
PM2	0	35	0	0	8	0	0	43	0
M1	1	39	5.3	0	12	0	1	51	4.3
M2	1	36	5.3	0	12	0	1	48	4.3
M3	2	36	10.0	0	10	0	2	46	8.3
TOTAL	4	279	2.8	0	73	0	4	352	2.2

	Mature Individuals (MI)								
	Male			Female			Total		
n*	5.625			2.375			8		
Tooth No.	No.	#	%	No.	#	%	No.	#	%
I1	0	9	0	0	1	0	0	10	0
I2	0	11	0	0	3	0	0	14	0
C	0	9	0	0	7	0	0	16	0
PM1	2	12	16.7	0	8	0	2	20	10
PM2	0	12	0	1	9	11.1	1	21	4.8
M1	1	12	8.3	0	11	0	1	23	4.3
M2	0	12	0	0	8	0	0	20	0
M3	0	8	0	1	9	11.1	1	17	5.9
TOTAL	3	85	3.5	2	56	3.6	5	141	3.5

n* = Individuals represented by only one quarter of a maxilla or mandible are counted as one eighth of one individual
# = Total number present for each tooth place, for each gender
MI = Mature Individuals, osteologically adult, can only estimate large age range

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APPENDIX B2

Colesberg site – Caries rates

	Younger Adults (20.1 - 40 years)								
	Male			Female			Total		
n*	18			16.75			34.75		
Tooth No.	No.	#	%	No.	#	%	No.	#	%
I1	0	38	0	0	49	0	0	87	0
I2	2	49	4.1	0	49	0	2	98	0
C	0	57	0	0	54	0	0	111	0
PM1	3	62	4.8	1	57	1.8	4	119	3.4
PM2	1	60	1.7	0	56	0	1	116	0
M1	6	66	9.1	5	58	8.6	11	124	8.9
M2	6	63	9.5	8	57	14.0	14	120	11.7
M3	4	62	6.5	2	52	3.8	6	114	5.2
TOTAL	22	457	4.8	16	432	3.7	38	889	4.3

	Older Adults (40.1+ years)								
	Male			Female			Total		
n*	3.75			2			5.75		
Tooth No.	No.	#	%	No.	#	%	No.	#	%
I1	0	9	0	0	0	0	0	9	0
I2	0	9	0	0	2	0	0	11	0
C	0	12	0	0	4	0	0	16	0
PM1	0	11	0	0	5	0	0	16	0
PM2	0	11	0	0	4	0	0	15	0
M1	1	7	14.3	0	4	0	1	11	9.1
M2	1	9	11.1	0	2	0	1	11	9.1
M3	1	12	8.3	0	3	0	1	15	6.7
TOTAL	3	80	3.8	0	24	0	3	104	2.9

	Mature Individuals (MI)								
	Male			Female			Total		
n*	3			2			5		
Tooth No.	No.	#	%	No.	#	%	No.	#	%
I1	0	2	0	0	2	0	0	4	0
I2	0	5	0	0	4	0	0	9	0
C	0	5	0	0	7	0	0	12	0
PM1	0	6	0	0	5	0	0	11	0
PM2	0	5	0	0	4	0	0	9	0
M1	0	4	0	0	4	0	0	8	0
M2	0	6	0	0	8	0	0	14	0
M3	0	4	0	0	3	0	0	7	0
TOTAL	0	37	0	0	37	0	0	74	0

n* = Individuals represented by only one quarter of a maxilla or mandible are counted as one eighth of one individual
\# = Total number present for each tooth place, for each gender
MI = Mature Individuals, osteologically adult, can only estimate large age range

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APPENDIX B3

Wolmaransstad site – Caries rates

	Younger Adults (20.1 - 40 years)								
	Male			Female			Total		
n*	1			1			2		
Tooth No.	No.	#	%	No.	#	%	No.	#	%
I1	0	4	0	0	2	0	0	6	0
I2	0	4	0	0	3	0	0	7	0
C	0	4	0	0	4	0	0	8	0
PM1	0	4	0	0	2	0	0	6	0
PM2	0	4	0	0	2	0	0	6	0
M1	0	4	0	0	2	0	0	6	0
M2	1	4	25.0	1	4	25.0	2	8	25.0
M3	0	4	0	0	1	0	0	5	0
TOTAL	1	32	3.1	1	20	5.0	2	52	3.8

	Older Adults (40.1+ years)								
	Male			Female			Total		
n*	10			0			10		
Tooth No.	No.	#	%	No.	#	%	No.	#	%
I1	0	27	0	0	0	0	0	27	0
I2	0	26	0	0	0	0	0	26	0
C	0	33	0	0	0	0	0	33	0
PM1	0	37	0	0	0	0	0	37	0
PM2	2	34	5.9	0	0	0	2	34	5.9
M1	2	26	7.7	0	0	0	2	26	7.7
M2	4	31	12.9	0	0	0	4	31	12.9
M3	2	29	6.9	0	0	0	2	29	6.9
TOTAL	10	243	4.1	0	0	0	10	243	4.1

	Mature Individuals (MI)								
	Male			Female			Total		
n*	5			4			9		
Tooth No.	No.	#	%	No.	#	%	No.	#	%
I1	0	17	0	0	9	0	0	26	0
I2	0	14	0	0	10	0	0	24	0
C	0	19	0	0	11	0	0	30	0
PM1	0	20	0	0	10	0	0	30	0
PM2	0	20	0	0	11	0	0	31	0
M1	4	18	22.2	1	12	8.3	5	30	16.7
M2	4	20	20.0	3	10	30.0	7	30	23.3
M3	3	17	17.6	2	9	22.2	5	26	19.2
TOTAL	11	145	7.6	6	82	7.3	17	227	7.5

n* = Individuals represented by only one quarter of a maxilla or mandible are counted as one eighth of one individual

= Total number present for each tooth place, for each gender

MI = Mature Individuals, osteologically adult, can only estimate large age range

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APPENDIX B4

Caries Correction Tables – Lukacs (1995)

GRIQUA (present study)	GRIQUA (present study)
ANTERIOR	POSTERIOR
Estimated no. of teeth lost due to caries	Estimated no. of teeth lost due to caries
102 x [1 / 234] = 0.44	228 x [4 / 398] = 2.29
Total estimated no. of teeth with caries	Total estimated no. of teeth with caries
0.44 + 7 = 7.44	2.29 + 25 = 27.29
Total no. of original teeth	Total no. of original teeth
362 + 102 = 464	739 + 228 = 967
Corrected Caries Rate	Corrected Caries Rate
7.44 / 464 = 1.60 %	27.29 / 967 = 2.82 %

COLESBERG	COLESBERG
ANTERIOR	POSTERIOR
Estimated no. of teeth lost due to caries	Estimated no. of teeth lost due to caries
63 x [0 / 251] = 0	138 x [24 / 344] = 9.63
Total estimated no. of teeth with caries	Total estimated no. of teeth with caries
0 + 2 = 0	9.63 + 39 = 48.63
Total no. of original teeth	Total no. of original teeth
357 + 63 = 420	710 + 138 = 848
Corrected Caries Rate	Corrected Caries Rate
2 / 420 = 0.48 %	48.63 / 848 = 5.73 %

WOLMARANSSTAD	WOLMARANSSTAD
ANTERIOR	POSTERIOR
Estimated no. of teeth lost due to caries	Estimated no. of teeth lost due to caries
42 x [0 / 180] = 0	78 x [20 / 191] = 8.17
Total estimated no. of teeth with caries	Total estimated no. of teeth with caries
0 + 0 = 0	8.17 + 29 = 37.17
Total no. of original teeth	Total no. of original teeth
187 + 42 = 229	335 + 78 = 413
Corrected Caries Rate	Corrected Caries Rate
0 / 229 = 0 %	37.17 / 413 = 9.0 %

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APPENDIX B5

Griqua (present study) sites – Antemortem tooth loss rates

	Younger Adults (20.1 - 40 years)								
	Male			Female			Total		
n*	12.5			12			24.5		
Tooth No.	No.	#	%	No.	#	%	No.	#	%
I1	7	41	17.1	0	38	0	7	79	8.9
I2	6	45	13.3	2	38	5.3	8	83	9.6
C	6	47	12.8	1	40	2.5	7	87	8.0
PM1	6	50	12.0	3	41	7.3	9	91	9.9
PM2	6	50	12.0	11	42	26.2	17	92	18.5
M1	5	50	10.0	7	43	16.3	12	93	12.9
M2	7	50	14.0	9	43	20.9	16	93	17.2
M3	9	50	18.0	8	41	19.5	17	91	18.7
TOTAL	52	383	13.6	41	326	12.6	93	709	13.1

	Older Adults (40.1+ years)								
	Male			Female			Total		
n*	13			6			19		
Tooth No.	No.	#	%	No.	#	%	No.	#	%
I1	11	44	25.0	12	22	54.5	23	66	34.8
I2	11	45	24.4	14	22	63.6	25	67	37.3
C	12	49	24.5	9	22	40.9	21	71	29.6
PM1	11	51	21.6	10	24	41.7	21	75	28.0
PM2	13	50	26.0	11	21	52.4	24	71	33.8
M1	10	50	20.0	12	25	48.0	22	75	29.3
M2	14	52	26.9	13	25	52.0	27	77	35.1
M3	14	52	26.9	14	24	58.3	28	76	36.8
TOTAL	96	393	24.4	95	185	51.4	191	578	33.0

	Mature Individuals (MI)								
	Male			Female			Total		
n*	5.625			2.375			8		
Tooth No.	No.	#	%	No.	#	%	No.	#	%
I1	0	12	0	4	8	50.0	4	20	20.0
I2	0	12	0	4	9	44.4	4	21	19.0
C	2	12	16.7	1	10	10.0	3	22	13.6
PM1	4	14	28.6	1	11	9.1	5	25	20.0
PM2	4	16	25.0	2	12	16.7	6	28	21.4
M1	2	17	11.8	2	13	15.4	4	30	13.3
M2	5	17	29.4	5	13	38.5	10	30	33.3
M3	6	14	42.9	4	13	30.8	10	27	37.0
TOTAL	23	114	20.2	23	89	25.8	46	203	22.7

n* = Individuals represented by only one quarter of a maxilla or mandible are counted as one eighth of one individual

No. = Number of alveoli resorbed

= Total number alveoli present

MI = Mature Individuals, osteologically adult, can only estimate large age range

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APPENDIX B6

Colesberg site – Antemortem tooth loss rates

	Younger Adults (20.1 - 40 years)								
	Male			Female			Total		
n*	18			16.75			34.75		
Tooth No.	No.	#	%	No.	#	%	No.	#	%
I1	5	49	10.2	5	58	8.6	10	107	9.3
I2	5	56	8.9	4	59	6.8	9	115	7.8
C	3	61	4.9	5	64	7.8	8	125	6.4
PM1	6	68	8.8	4	66	6.1	10	134	7.5
PM2	8	68	11.8	6	65	9.2	14	133	10.5
M1	4	70	5.7	6	66	9.1	10	136	7.4
M2	5	69	7.2	8	67	11.9	13	134	9.7
M3	5	70	7.1	6	63	9.5	11	133	8.3
TOTAL	41	511	8.0	44	508	8.7	85	1017	8.4

	Older Adults (40.1+ years)								
	Male			Female			Total		
n*	3.75			2			5.75		
Tooth No.	No.	#	%	No.	#	%	No.	#	%
I1	4	15	26.7	4	6	66.7	8	21	38.1
I2	1	12	8.3	4	6	66.7	5	18	27.8
C	1	13	7.7	3	7	42.9	4	20	20.0
PM1	3	14	21.4	3	8	37.5	6	22	27.3
PM2	3	14	21.4	4	8	50.0	7	22	31.8
M1	5	13	38.5	3	7	42.9	8	20	40.0
M2	4	14	28.6	5	7	71.4	9	21	42.9
M3	1	14	7.1	5	8	62.5	6	22	27.3
TOTAL	22	109	20.2	31	57	54.4	53	166	31.9

	Mature Individuals (MI)								
	Male			Female			Total		
n*	3			2			5		
Tooth No.	No.	#	%	No.	#	%	No.	#	%
I1	7	9	77.8	1	6	16.7	8	15	53.3
I2	6	10	60.0	0	8	0	6	18	33.3
C	5	10	50.0	0	8	0	5	18	27.8
PM1	5	10	50.0	2	7	28.6	7	17	41.2
PM2	6	11	54.5	2	8	25.0	8	19	42.1
M1	8	12	66.7	2	8	25.0	10	20	50.0
M2	6	11	54.5	2	7	28.6	8	18	44.4
M3	7	12	58.3	4	7	57.1	11	19	57.9
TOTAL	50	85	58.8	13	59	22.0	63	144	43.8

n* = Individuals represented by only one quarter of a maxilla or mandible are counted as one eighth of one individual

No. = Number of alveoli resorbed

= Total number alveoli present

MI = Mature Individuals, osteologically adult, can only estimate large age range

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APPENDIX B7

Wolmaransstad sites – Antemortem tooth loss rates

	Younger Adults (20.1 - 40 years)								
	Male			Female			Total		
n*	1			1			2		
Tooth No.	No.	#	%	No.	#	%	No.	#	%
I1	0	4	0	2	4	50.0	2	8	25.0
I2	0	4	0	0	4	0	0	8	0
C	0	4	0	0	4	0	0	8	0
PM1	0	4	0	1	3	33.3	1	7	14.3
PM2	0	4	0	1	4	25.0	1	8	12.5
M1	0	4	0	2	4	50.0	2	8	25.0
M2	0	4	0	0	4	0	0	8	0
M3	0	4	0	2	4	50.0	2	8	25.0
TOTAL	0	32	0	8	31	25.8	8	63	12.7

	Older Adults (40.1+ years)								
	Male			Female			Total		
n*	10			0			10		
Tooth No.	No.	#	%	No.	#	%	No.	#	%
I1	9	37	24.3	0	0	0	9	37	24.3
I2	8	37	21.6	0	0	0	8	37	21.6
C	5	39	12.8	0	0	0	5	39	12.8
PM1	3	40	7.5	0	0	0	3	40	7.5
PM2	6	40	15	0	0	0	6	40	15
M1	14	40	35	0	0	0	14	40	35
M2	9	40	22.5	0	0	0	9	40	22.5
M3	10	40	25.0	0	0	0	10	40	25.0
TOTAL	64	313	20.4	0	0	0	64	313	20.4

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	Mature Individuals (MI)								
	Male			Female			Total		
n*	5			4			9		
Tooth No.	No.	#	%	No.	#	%	No.	#	%
I1	6	23	26.1	0	10	0	6	33	18.2
I2	8	23	34.8	0	11	0	8	34	23.5
C	4	23	17.4	0	11	0	4	34	11.8
PM1	4	24	16.7	1	12	8.3	5	36	13.9
PM2	4	24	16.7	1	12	8.3	5	36	13.9
M1	6	24	25	1	12	8.3	7	36	19.4
M2	4	24	16.7	1	12	8.3	5	36	13.9
M3	7	24	29.2	1	11	9.1	8	35	22.9
TOTAL	43	189	22.8	5	91	5.5	48	280	17.1

n* = Individuals represented by only one quarter of a maxilla or mandible are counted as one eighth of one individual
No. = Number of alveoli resorbed
# = Total number alveoli present
MI = Mature Individuals, osteologically adult, can only estimate large age range

APPENDIX C1

Individuals with CO

Individual	Age	Sex	Severity	Active/Healed
Griqua (present study)				
Bethulie/NMB 1618a	MI	M	L	A
Bethulie/NMB 1621a	OA	M	M	A
Bethulie/NMB 1622a	MI	F	L	A
Bethulie/NMB 1624	INF		L	A
Bethulie/NMB 1627	INF		M	H
Bethulie/NMB 1628	INF		M	H
Bethulie/NMB 1629a	INF		L	A
Bethulie/NMB 1634	INF		L	A
Bethulie/NMB 1630	JUV		L	A
Campbell/A 2262	YA	F	L	A
Campbell/A 2267	INF		L	A
Campbell/A 2507	SA	F	M	A
Campbell/A 2825	INF		M	A
Campbell/A 2827	JUV		L	A
Campbell/A 2829	YA	M	M	A
Campbell/A 2833	YA	F	M	H
Danielskuil/UOVS 1	YA	M	M	A
Danielskuil/UOVS 2	YA	F	L	A
Danielskuil/UOVS 6	MI	F	L	A
Danielskuil/UOVS 7	MI	M	L	A
Danielskuil/UOVS 12	JUV		L	A
Danielskuil/UOVS 13a	OA	F	M	H
Danielskuil/UOVS 22	OA	M	S	H
Danielskuil/UOVS 25b	JUV		S	H
Danielskuil/UOVS 25c	INF		M	A
Danielskuil/UOVS 26b	INF		S	H
De Tuin/UCT 335	JUV		L	A
De Tuin/UCT 467	INF		L	A
De Tuin/UCT 468	JUV		L	A
De Tuin/ UCT 471	JUV		L	A
Philippolis/NMB 1567a	YA	F	M	H
Philippolis/NMB 1568	OA	M	L	A
Philippolis/NMB 1605	YA	M	M	A
Philippolis/NMB 1609	SA	F	L	A
Philippolis/NMB 1611	YA	F	M	H
Philippolis/NMB 1612	MI	M	M	A
Philippolis/NMB 1701	YA	M	M	A

INF = Infant
JUV = Juvenile
SA = Sub-Adults
YA = Younger Adults
OA = Older Adults
MI = Mature Individuals, osteologically adult, can only estimate large age range
Sex: M = Male, F = Female
Severity: L = Light, M = Medium, S = Severe
Active/Healed: A = Active, H = Healed

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APPENDIX C1 (CON'T)

Individuals with CO (Continued)

Individual	Age	Sex	Severity	Active/Healed
Colesberg				
SAM 4506	JUV		M	H
SAM 4512	YA	M	L	A
SAM 4515	YA	M	L	A
SAM 4320	YA	M	M	A
SAM 4324	YA	M	M	H
SAM 4503	YA	M	M	H
SAM 4499	YA	F	M	H
SAM 4516	YA	F	L	A
SAM 4517	YA	F	L	A
SAM 4520	YA	F	L	A
SAM 4522	YA	F	L	A
SAM 4317	YA	F	L	A
SAM 4322	YA	F	L	A
SAM 4496	OA	M	M	H
SAM 4513	OA	M	L	A
SAM 4510	OA	F	M	A
SAM 4492	MI	M	M	H
SAM 4519	MI	F	L	A
Wolmaransstad				
NMB 19	SA	F	S	H
NMB 1326	YA	F	M	A
NMB 1193	OA	M	L	A
NMB 1194a	OA	M	M	H
NMB 1327a	OA	M	L	A
NMB 1331a	OA	M	L	A
NMB 1346a	OA	M	M	A
NMB 1195	MI	M	M	H
NMB 1328a	MI	M	L	A
NMB 21	MI	M	L	A
NMB 1185a	MI	F	L	A

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Severity: L = Light, M = Medium, S = Severe
Active/Healed: A = Active, H = Healed

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APPENDIX C2

Individuals with PH

Individual	Age	Sex	Severity	Active/Healed
Griqua (present study)				
Bethulie/NMB 1617a	OA	M	L	A
Bethulie/NMB 1618a	MI	M	L	A
Bethulie/NMB 1619a	YA	F	M	H
Bethulie/NMB 1621a	OA	M	L	A
Bethulie/NMB 1622a	MI	F	L	A
Bethulie/NMB 1624	INF		L	A
Bethulie/NMB 1625	INF		L	A
Bethulie/NMB 1627	INF		M	H
Bethulie/NMB 1630	JUV		L	A
Campbell/A 2262	YA	F	L	A
Campbell/A 2263	YA	M	L	A
Campbell/A 2265	OA	F	L	A
Campbell/A 2502	OA	F	L	A
Campbell/A 2507	SA	F	L	A
Campbell/A 2508	YA	M	L	A
Campbell/A 2830	OA	M	L	A
Campbell/A 2831	YA	M	L	A
Campbell/A 2832	YA	F	L	A
Danielskuil/UOVS 2	YA	F	L	A
Danielskuil/UOVS 7	MI	M	L	A
Danielskuil/UOVS 12	JUV		L	A
Danielskuil/UOVS 15	YA	M	L	A
Danielskuil/UOVS 20	MI	M	L	A
Danielskuil/UOVS 21	OA	M	L	A
Danielskuil/UOVS 22	OA	M	L	A
Danielskuil/UOVS 23	MI	M	L	A
Danielskuil/UOVS 25c	INF		L	A
De Tuin/UCT 335	JUV		L	A
De Tuin/UCT 468	JUV		S	A
De Tuin/ UCT 471	JUV		L	A
Philippolis/NMB 1567a	YA	F	L	A
Philippolis/NMB 1568	OA	M	L	A
Philippolis/NMB 1605	YA	M	L	A
Philippolis/NMB 1608	OA	F	L	A
Philippolis/NMB 1609	SA	F	L	A
Philippolis/NMB 1610	MI	F	L	A
Philippolis/NMB 1611	YA	F	L	A
Philippolis/NMB 1612	MI	M	L	A
Philippolis/NMB 1613	YA	F	L	A
Philippolis/NMB 1701	YA	M	L	A
Philippolis/NMB 1702	YA	F	L	A
Philippolis/NMB 1703	YA	F	L	A

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Severity: L = Light, M = Medium, S = Severe
Active/Healed: A = Active, H = Healed

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APPENDIX C2 (CON'T)

Individuals with PH (Continued)

Individual	Age	Sex	Severity	Active/Healed
Colesberg				
SAM 4494	JUV		M	H
SAM 4512	YA	M	L	A
SAM 4515	YA	M	L	A
SAM 4331	YA	M	L	A
SAM 4495a	YA	M	L	H
SAM 4504	YA	M	L	A
SAM 4507	YA	M	L	A
SAM 4518	YA	M	L	A
SAM 4499	YA	F	M	H
SAM 4516	YA	F	L	A
SAM 4517	YA	F	M	A
SAM 4520	YA	F	L	A
SAM 4522	YA	F	L	A
SAM 4500	YA	F	M	H
SAM 4505	YA	F	L	A
SAM 4509	YA	F	L	A
SAM 4521	YA	F	L	A
SAM 4497	OA	M	M	H
SAM 4502	OA	M	M	H
SAM 4508	OA	F	L	A
SAM 4493	MI	M	M	H
SAM 4519	MI	F	L	A
Wolmaransstad				
NMB 1326	YA	F	L	A
NMB 1193	OA	M	L	A
NMB 1194a	OA	M	L	A
NMB 1327a	OA	M	M	A
NMB 1331a	OA	M	L	A
NMB 1346a	OA	M	L	A
NMB 1186a	OA	M	L	A
NMB 1195	MI	M	L	A
NMB 1328	MI	M	L	A
NMB 21	MI	M	L	A
NMB 1221	MI	M	L	A
NMB 22	MI	F	L	A

INF = Infant
JUV = Juvenile
SA = Sub-Adults
YA = Younger Adults
OA = Older Adults
MI = Mature Individuals, osteologically adult, can only estimate large age range
Sex: M = Male, F = Female
Severity: L = Light, M = Medium, S = Severe
Active/Healed: A = Active, H = Healed

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