

Application

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Application Reference	AOP13122159234
Applicant Name	Prof JOHN Parkington
Applicant ID/Passport Number	4411205119105
Applicant Email Address	john.parkington@uct.ac.za
Applicant Race	White
Applicant Gender	Male
Applicant Date of Birth	20 November 1944
Applicant Citizenship	United Kingdom
Applicant Organisation	University of Cape Town
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Application

Disability

Project Information

Applicant's Institution	University of Cape Town
Short Title of Project	Faraoskop: a unique opportunity in palaeodemography
Is this project multi-disciplinary?	Yes
Project Abstract	Faraoskop is a small rock shelter in the vicinity of Graafwater in the northwestern (Greater) Cederberg. Preliminary excavations there have revealed thirteen human burials with almost identical 14C ages, between 2000 and 2150 years ago, and extremely similar 13C isotope values, suggesting a common diet. More may remain in the undisturbed deposits at the site. It reflects a unique opportunity to investigate the circumstances of burial of a small, almost certainly related community of hunters and gatherers, quite possibly a single event. The time is also significant in falling precisely at the dated appearance of pastoralism in the Cape. In this transdisciplinary initiative we develop the rare (in South Africa) skills of palaeogenetics, geological micro-stratigraphy and proton magnetometry and link these to more conventional archaeological and isotopic studies. This is a rare field and laboratory opportunity to understand the circumstances of a multiple burial and its historic context.
Project Start Year	2014
Project End Year	2015
Budget Start Year	2014
Budget End Year	2015
Required Funding Period	2
Budget End Year	2015
Has this project previously been funded by the NRF?	No
Please indicate the programme	Not Applicable

Details of Research

Details of Research : Problem Identification

<p>South Africa has a considerable competitive advantage in understanding the palaeogenomics of San people, a community whose history is closely bound up with the appearance of our species, Homo sapiens. Whilst palaeogenomics laboratories are relatively common in the developed world, we here need to foster the appropriate skills by focusing on field opportunities at hand. Faraoskop is a small rock shelter that quite fortuitously has thrown up an almost unique circumstance that can become the platform for the development of significant new skills and training. Palaeogenetic, isotopic and stratigraphic skills are central to the work. This proposal identifies the opportunities and proposes a project to engage in research and training along several parallel, linked disciplinary lines.</p> <p>Faraoskop is a small rock shelter on the end of a rocky sandstone ridge some 5km north of the small town of Graafwater in the Western Cape. Quite hidden in the rocks and hardly visible from below the ridge, the shelter nevertheless offers a good view across the sandy coastal plains to the shoreline, 30km to the west. In the late 1980s the landowner illegally removed deposits from the shelter that included some remarkably well preserved artefacts of reed, bone and leather, as well as the remains of seven human burials. When we heard of these finds we visited the owner, retrieved the artefacts and skeletal remains and visited the site to check the condition of any remaining intact deposit. It was clear that he had substantially pitted about half of the surface area, but that there seemed to be more than a metre of sediments preserved in the front parts of the site.</p> <p>Our excavations a year and two years later, undertaken by Antony Manhire and Royden Yates, were designed to understand better the contexts of the removed burials and to assess the potential for further, more systematic excavation. After cleaning out the disturbed upper levels around the back wall, we were able to remove carefully a further 5 intact, but slightly impacted burials from a very small portion of the rear of the shelter, and to describe a stratigraphy that extended more than a metre into clearly Pleistocene levels with good bone preservation and substantial stone tool assemblages.</p> <p>Conventional radiocarbon dating of six of the skeletal remains from both landowner and archaeological excavations produced a set of uncalibrated ages between 2000 and 2150 years with standard deviations of about 50 years. The radiocarbon dates for organic material from the sediments, mostly charcoal, showed an episodic utilization of the cave with occupation in the last 1000 years, between 2000 and 2600 years, around 4500 years and intermittently between 10000 and 16000 years ago. Most other Western Cape sites also show such episodicity of occupation and some along the nearby Verloren Vlei show occupation at almost precisely the same times as Faraoskop. Careful accessioning of the human remains revealed that there may have been twelve or thirteen distinct individuals in total, not all of them represented by complete skeletal elements. Adult males and females, one juvenile and two young children were identified and aged by conventional bio-anthropological techniques (Alder 1988). Stable carbon isotope analyses of eight of the individuals generated values that cover a relatively narrow range between -16.5 and -18.5 per mil, illustrating a fairly similar diet with very little sea food (Sealy et al 1992).</p> <p>A site report has been published (Manhire 1993) with a brief description of stratigraphy, stone tool assemblages and raw material usage, organic artefacts, faunal and plant food remains. Since then the remarkable phenomenon of so many associated human burials so narrowly restricted in time at a single site has been mentioned but never significantly interrogated. We plan to do this in the project outlined below.</p> <p>Research issues are: how far back can we hope to extract analysable human DNA from buried skeletal remains? What light can such remains throw on the evolutionary history of San people? How can we combine archaeological, isotopic, bio-anthropological and genetic approaches to gain more information about San history? To what extent do these particular burials relate to the intrusion of pastoralists into the Cape?</p>
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Details of Research : Rationale and Motivation

<p>Southern Africa currently enjoys a prominent place in the investigation of modern human origins, with most of the key sites, significant human fossils and suggestive behavioural innovations located here. The ancient haplotype lineages exhibited by recent San people from the area link more recent, Later Stone Age, skeletons to this issue and give their study an international significance. Our human skeletal record from Southern Africa is fairly substantial but largely restricted to accidentally discovered, isolated individuals of limited context from the last 5000 years or so. Archaeologically excavated individuals, especially those from the Pleistocene, are rarer but very important because they are associated with artefactual and foodwaste assemblages. Recent improvements in the recovery of DNA from increasingly older remains foregrounds the palaeogenetic analyses of southern African hominin material, such as the unique set of remains from Faraoskop.</p>

However, whilst ancient DNA has been successfully recovered from 30-40 000 year old individuals in the cold northern hemisphere, it remains to be determined what age DNA can be recovered from bones buried in the soil in warmer temperate regions that are unfavourable for DNA preservation (Krause et al, 2010b, Lalueza-Fox C. and Gilbert MT. 2011).

The major challenges of recovering ancient DNA include that DNA is degraded to sizes less than 200bp over time and is chemically modified (Greene et al 2010). This makes amplification of specific mitochondrial and nuclear genes by PCR difficult (Krause et al 2010a). However, this problem has been circumvented with the advent of next generation sequencing technology and development of associated computational techniques, which has opened the door for direct sequencing of ancient DNA, and the subsequent assembly of these DNA fragments into draft mitochondrial and nuclear genomes. A further challenge in the analysis of ancient genomes, is that the small amount of surviving ancient DNA can be diluted with large amounts of endogenous DNA from microbial organisms that colonized the specimens after death, as well as contaminating modern DNA that comes in contact with specimens after their excavation. Contaminating microbial DNA is a particular problem for bone samples that are excavated from warmer regions (Fu et al. 2013). The recent development of DNA enrichment techniques, in which immobilized, specific, single-stranded mitochondrial and nuclear chromosome DNA fragments are used to capture ancient DNA specifically from a complex mixture of irrelevant DNA circumvents these problems (Maricic et al 2010). This technique has recently been successfully used to isolate and sequence the complete mitochondrial genome, and the entire non repetitive portion of chromosome 21 from a 40 000 year old human excavated from a cave in China outside the permafrost region, despite the fact that large amounts of contaminating microbial DNA were present in the sample (Fu et al 2013).

A major initiative to radiocarbon date the isolated skeletons, driven largely by Judy Sealy from the UCT Archaeology Department, has made many of them much more useful to researchers and has led to many advances in our understanding of ancient diet and behavior. Most of these studies have been stable isotope studies of teeth and bones combined with detailed morphological descriptions of the physical remains. This project describes a multifaceted approach, focused on a likely near-contemporary set of related individuals.

Faraoskop (Manhire 1993), the subject of this application, has the unique potential to expand these results by allowing the study of a set of at least 13 individuals excavated from a single site and associated with a very tight set of radiocarbon dates. These individuals may well be close relatives and their burial(s) may reflect a single event. One precedent for our study is a recent very high profile analysis of 12 Neandertal skeletons over 50 000 years old, found in a limestone cave system at El Sidron in northern Spain (Lalueza-Fox et al 2011). Results from these analyses have allowed scientists to propose quite surprisingly detailed, albeit currently debated, aspects of genetic diversity and ancient kinship on the basis of sequence information from ancient mitochondrial DNA (mtDNA) recovered from teeth, mandibles and femurs of individuals at this site. We are convinced that we can duplicate and extend these analyses here in South Africa and lay a platform for future work by developing scarce skills.

We propose a multifaceted analysis of the skeletal remains and their context by combining palaeogenetic, isotopic and micro-morphological studies, alongside a thorough re-investigation and re-analysis of the site of Faraoskop and its role as context for the burials. It is also worth noting that the suggested date for the burials, about 2050 years ago, is precisely that of the age of the earliest appearance of pastoralism in the Cape Fynbos region. It is clear that we have the potential to understand the historical and social context of these interments whilst at the same time developing our human resource and technical capacity to understand the evolution of San people.

Our multi-disciplinary team includes John Parkington and Antony Manhire as archaeologists, Judy Sealy and Nonhlanhla Dlamini as isotope researchers, Raj Ramesar, Nicola Illing and Tasneem Salie as geneticists, and Alan Morris and Nonhlanhla Dlamini (again) as biological anthropologists, all from the University of Cape Town. Their specific roles and involvements are described later. In addition we are joined by Claude Leon post-doc Paul Cavalier, a geophysicist, who will conduct a proton magnetometry study of the remaining Faraoskop deposits and Chris Miller from Tuebingen, a geo-archaeologist, who will supervise the micro-morphological analysis of the Faraoskop sedimentary record. Tasneem Salie will spend time at the laboratory of Professor Johannes Krause in Tuebingen, a co-author on several papers on the analysis of the Neandertal (Greene et al 2010, Krause et al 2010a) and Denisovian (Krause et al 2010b, Reich et al, 2010) nuclear and mitochondrial genomes. A new set of ams radiocarbon dates on both skeletons and sediments will be obtained from the Oxford laboratory and a complete re-analysis of all excavated stone tool assemblages and faunal remains from Faraoskop will be undertaken.

Details of Research : Research Aims

We are planning a biographic and demographic study of the Faraoskop skeletal collection. In this we treat the individuals as people rather than specimens and we ask questions about their relationships and the circumstances of their death. Our aims are to undertake the integrated and interconnected analyses of the morphology, genetics and isotopic composition of all Faraoskop individuals and to contextualize these with a detailed restudy of the stratigraphic and historical framework of the site. We are confident that the immediate research result will be interesting and the longer term payoff in terms of the development of new research tools even more so. Obviously, our aims revolve around the potential that this archaeological circumstance offers us a highly resolved critical moment in southern African prehistory. At one end of the spectrum of results, it may be possible to posit and understand events at a very precise, and historically significant moment in time. Even if this almost absolute contemporaneity is not forthcoming, the fact that so many skeletons were buried here within a few decades and no others in the millennia that preceded and followed this period, is highly significant and suggestive. Several investigatory directions need to be followed.

Obviously a major key to the nature of the events recorded in the site and the skeletal interments is the most precise dating of sediments and human remains. From the earlier excavation and report, we have 7 conventional radiocarbon dates on stratigraphic horizons and a further 6 on individual human remains. Our objective is to use ams radiocarbon dating to add precision to this chronology, although we do realize absolute contemporaneity is not strictly possible even from such an approach. The existing radiocarbon dates on human remains overlap one another at one standard deviation and the mean age estimate is almost exactly that derived from one of the stratigraphic units adjacent to the burial pits. Smaller ams-derived standard deviations, allied to a Bayesian approach and contextualized in a denser set of stratigraphic readings, and a reanalysis of the nature of the burial pits, may allow us to be firmer on whether the interments were singular or multiple events.

The genetic and morphological analyses will be designed to extract the most plausible evidence for phylogenetic (and indeed familial) relationships between individuals. Previous analyses, whilst recognizing the potential for establishing a communal burial of consanguineal or affinal relatives, were not designed to demonstrate this. Ours will be. Should such a situation be a reasonable possibility, the isotopic evidence for dietary variability, as well as the number and demographic profile of the burials become useful indications of past social and organisational circumstances. Perhaps the most critical observations from the bio-anthropological analyses, will then be any evidence of peri-mortem injuries, their nature, extent and severity. If our integrated analyses lead in the direction of a simultaneous interment of related individuals, disease and inter-group conflict need investigation. The median date, corresponding apparently with the appearance of pastoralism if not pastoralists, in the local social landscape will encourage us to compare these individuals with others buried before, simultaneously with, and after them in nearby locations. Current genomic technologies will allow the phylogenetic relationships between individuals, and their lineages relative to current African populations. We are sure this will re-ignite and re-energise issues of the impact of pastoralism and the distinctiveness, or otherwise, of extant San and Khoi populations.

All of these perspectives inform our aims with regard to the better, more detailed understanding of the stratigraphy and its relationship to the burial events. We do not propose at this stage to re-excavate the site, although the possible discovery of more pits and likely interments in the undisturbed part of the site may eventually encourage this. What we do aim to do is to open up the re-filled excavated section and to take a column sample of the sediments for microscopic analysis and to retrieve bone and tooth specimens freshly from the deposit. These microscopic techniques, collectively known as micro-morphology, were not ubiquitous at the time of the original excavation, but are standard practice now. We will follow the methods used, in fact by our current collaborator, at Diepkloof (Miller et al 2013), Sibudu and Pinnacle Point in the understanding of early modern human shelter use. It may be no coincidence that one substantial ash deposit at Faraoskop, too extensive to be simply a hearth, has a radiocarbon date exactly contemporary with those from the human skeletons. Described by the original excavators simply as an ash body, this deposit may microscopically hold clues to the nature of the burning, the materials burnt and the relationship to the pits containing the human remains. Further dates will focus on this time period.

We are well aware that the speculation of a very brief, integrative event is only one of several potential outcomes of our investigations. Nevertheless, having honed our skills across a range of sub-disciplines, we are confident that we will have prepared ourselves to tackle many other issues in Later and Middle Stone Age archaeology in southern Africa. At present, for example, we do not know how far back in time, under the general conditions of Cape rock shelters, useful genetic material can be retrieved. Our study, then, is a proof of concept initiative to discover this. Contemporary with human skeletal remains are many faunal remains of teeth and bones that

can be assessed for their palaeogenetic potential. Some palaeo-zoological issues may become amenable to these techniques. There is, in addition, an interesting set of contemporary human burials scattered across the Fynbos landscape, a group of individuals who almost certainly knew one another, many of whom were related to one another. We will, in due course, extend our palaeogenetic studies to include these people. In this way we can develop a biological layer to sit alongside the dietary reconstructions and isotopic conclusions about population movements and settlement systems.

Details of Research : Workplan: Research Activities

We understand that no destructive analysis is allowed without the appropriate permitting, and no intrusive analyses of human remains without this and, perhaps more importantly, ethical clearance. We are already seeking these permissions and clearances. In the meantime, however, we can begin to re-examine the excavated materials and start the non-intrusive examination and description of the remains currently curated in the UCT Health Sciences Faculty. There is, likewise, no reason not to begin immediately to sample and assess fragments of animal teeth and long bones from the various excavated levels at Faraoskop to try to predict the survival of intact mitochondrial or other DNA from the contemporary human remains. As soon as possible we will schedule the proton magnetometry survey of the site and use this field trip as an opportunity to familiarize the multi-disciplinary team to the site and its landscape context. As funds and permissions allow, we will embark on the isotopic and genetic sampling.

When schedules permit, we will revisit Faraoskop and open up the site to enable us to excavate animal bones of different ages for ancient DNA analysis, and to retrieve a column sample for micro-morphological analysis and, at that time remove small charcoal samples for further radiocarbon dating. During the second year of this project, we will organize at least one workshop in which collaborators will share results, debate interpretations and decide on such further analyses, dating or sampling that is needed. We will collectively present the results at the meetings of the constituent professional bodies, publish jointly in the highest level of journal attainable and put together a scientifically sound but publically accessible version of our findings.

A tentative workplan, with time lines, responsibilities, student involvements and uses of equipment and infrastructure, is detailed below.

January 2014: under the supervision of Parkington and Manhire, the collections from Faraoskop will be relocated to the UCT Archaeology laboratory, resorted and re-examined. Honours graduates will work on these materials and animal teeth and bones from each stratigraphic layer will be selected for DNA analyses. These specimens will be transferred to Professor Nicci Illing's laboratory in Molecular and Cell Biology (MCB) for assessment. Freshly excavated animal bones and teeth will later be added for examination and assessment.

At the same time, under Morris' supervision, he and Nonhlanhla Dlamini will begin to re-describe the skeletal remains from Faraoskop. Because some of the interments were recovered unprofessionally by the landowner, careful attention will be paid to the assembling of bones from individual burials, the re-assignment of sex and age to each individual and the cataloging of all morphological details related to diet, lifestyle and circumstances of death. Effectively we will be writing the biographies of past San people.

At the same time, under the supervision of Professor Judy Sealy, she and Nonhlanhla Dlamini will begin the sampling of human skeletal tissues for carbon, nitrogen, oxygen and strontium analyses in the laboratories of the Archaeology and Geology Departments at UCT. The procedures for sample extraction and preparation are standard in these established labs and will be carefully supervised. The emphasis will be on the multiple sampling of individuals, with the hope of reconstructing life history through individual trajectories of readings.

To analyze d13C and d15N in the protein component (collagen) of bone and dentin, collagen will be extracted using standard procedures employed for many years in the Stable Light Isotope Laboratory in the Department of Archaeology at the University of Cape Town. Small chunks (with diameters of a few millimetres) of dentin or bone will be surface-cleaned with fine sandpaper, decalcified in ca. 2% hydrochloric acid, rinsed in distilled water, then treated overnight with 0.1 M sodium hydroxide to remove humic acids. If rootlets are present, they will be removed from the wet collagen by hand, using fine tweezers. The collagen samples will be soaked in distilled water until all traces of acid and alkali have been removed, then freeze-dried. The dry collagen will be weighed and the % yield (% of the starting weight of whole bone or dentin) calculated.

Approximately 0.6 mg of dry collagen will be weighed into a tin cup that is tightly folded to exclude air. Each sample will be analysed in duplicate. The tin capsules will be loaded into an automated elemental analyser and combusted at 1020°C. The resultant gases are introduced into a Thermo-Finnigan Delta Plus XP or a Delta V Plus mass spectrometer via a continuous flow (ConFlo) inlet, using helium as the carrier gas. Standard deviations of repeated measurements of a homogeneous laboratory standard (Merck gelatine, n = 12) are typically less than 0.2‰ for both d13C and d15N. Results are reported relative to international standards Vienna PDB and AIR.

The d13C in the carbonate component of tooth enamel will be prepared and analysed as follows: For each tooth, a diamond-tipped drill will be used to burr a line on either the buccal or lingual surface, extending from the occlusal surface to the cementum-enamel junction, in order to sample tooth enamel formed over the duration of development of the crown. This inflicts only minimal damage on the tooth (see figure). About 10 mg of the resultant enamel powder will be collected and transferred to a microcentrifuge tube for pre-treatment according to the protocol used by Lee-Thorp et al. (1997), with slight modifications, as specified below. The powder will be reacted with 1.75% sodium hypochlorite for 15 min to remove organics, then rinsed three times with distilled water. It will then be treated with 0.1 M acetic acid for 15 min to remove any diagenetic carbonates that may be present, then again rinsed three times with distilled water and freeze-dried. The pre-treated powders will be analysed on a Thermo-Finnigan Delta Plus XP stable isotope ratio mass spectrometer coupled to a Finnigan Gas Bench II. Carbon dioxide is produced by reaction with 100% phosphoric acid at 72°C, then swept in a stream of helium through hygroscopic Nafion™ tubing to remove water, then through a glass capillary gas chromatograph, a second water trap, and finally into the mass spectrometer. The standard deviation of repeated measurements of homogeneous material (NBS 18, n = 12) is typically lower than 0.2‰ for d13C, and frequently lower than 0.1‰. Results are reported relative to the international standard Vienna PDB.

87Sr/86Sr in tooth enamel will be measured on a small sample of powdered enamel collected as described above for d13C analysis. 87Sr/86Sr in tooth enamel will be measured on a Nu Instruments NuPlasma HR (multi-collector inductively coupled plasma - mass spectrometer) in the Department of Geological Sciences at UCT. If isolated (loose) teeth are available, a single tooth can be placed in the sample chamber, where a small amount of tooth enamel is removed using a laser and fed directly into the instrument. If isolated teeth are not available, a small sample of powdered enamel will be collected as described above. This will be digested in concentrated nitric acid at 140°C, then taken up in dilute acid and passed through an ion exchange column in order to separate out the strontium. The strontium isotope ratios will be measured on the ICP-MS using NIST SRM987 as a reference standard.

March to May 2014: Professor Johannes Krause head of the Human Genetics laboratory at Tuebingen University will visit UCT as a Visiting Scholar to advise Prof Illing, Professor Ramesar and Ms Tasneem Salie, a PhD candidate supervised by Professors Ramesar, Morris and Parkington, on the techniques and methods of sample treatment of both animal and human bones excavated from this site. Ms Salie will spend 4-6 months in Prof Krause's laboratory during May-October 2014, extracting ancient DNA from the Faraoskop human bones, on a scholarship arranged through the International Office at the University of Cape Town.

May 2014: at this time we plan to arrange a group visit to the site of Faraoskop. This will allow all team members to familiarize themselves with the landscape context of the site and the circumstances within the shelter. On this trip we will conduct a detailed survey of the depositional surface of the shelter to gain an impression of the existence of further pits and likely burials. Dr Paul Cavalier, who is a visiting Claude Leon post-doctoral Fellow in the Department of Archaeology at UCT and Mr Jaco Boshoff from the Iziko Museums of Cape Town, will supervise this survey.

July 2014: we plan to revisit Faraoskop at this time in the company of Professor Chris Miller from the Department of Palaeo-Archaeology at Tuebingen University. Before this, we will locate a senior post-graduate student from the Department of Environmental Science and Geography at UCT to undertake supervised study of the micromorphology of the sedimentary column, and an Honours student from the Department of Molecular and Cell Biology for the determining the age at which ancient DNA can be recovered from animal bones excavated from the site. Antony Manhire will re-expose the sections from his 1980s excavations and assist Miller to make a column sample for preparation and study. Miller, Parkington and Manhire will re-describe the section and resample charcoal for 14C ams dating in Oxford.

July 2014 to April 2015: we anticipate that all parallel analyses will proceed through these months. Because most activities will be housed by UCT departments in local laboratories, there will be many opportunities to organise both informal and formal meetings to share results. Parkington, as Principal Investigator, will co-ordinate such

gatherings, inviting others to review and comment on our results and interpretations where necessary.

May 2015: we will organise a Workshop for all participating scientists at the Travellers Rest guest cottages in the Agter Pakhuis area of the Cederberg. NRF and UCT funding will be used or sought to facilitate the participation of our international colleagues.

July 2015: there are a number of sites in the western Cape that have produced skeletal remains, all of them curated in UCT or at Iziko Museums of Cape Town, that are contemporary with the Faraoskop individuals. Dependant on the implications from the results from Faraoskop, we propose to re-examine this material and visit the field locations from which they come.

July to December 2015: this will be a period of writing and conference presentations. Joint publications and individual or joint presentations at the annual meetings of local and international professional scholars is envisaged.

Details of Research : Workplan: Research Approaches/Methods/Techniques

Archaeology: Parkington and Manhire will resort and re-catalog the excavated collections from Faraoskop using standard methods also used for many other Holocene and Pleistocene assemblages. With the stone tools, the objective will be to identify changes in assemblage composition, to document changes in raw material sourcing and to link stone tool making with manufacturing debris among organic remains. Dr Marina Igreja Araujo, a visiting Marie Curie post-doctoral Fellow at UCT, will help analyse edge damage and use wear features as well as signs of mastics on tools, especially adzes. On the opening of the previous excavated sections, Parkington, Manhire and Miller will redraw, redescribe and resample all available newly cleaned sections.

Stratigraphy: micro-morphological study includes the careful sampling and consolidation of one or more column samples reflecting the stratigraphic deposition at the site. Thin sections are then prepared and examined microscopically for very small inclusions and the dip and strike of micro-stratigraphic horizons and objects (Miller et al 2013). Crucial observations can be made from these features that help interpret the nature of superimposed layers and their taphonomic history, a history that, we hope, will throw light on the short-lived burial phase of site use.

Proton magnetometry: previous excavations struggled with a portion of the site very badly disturbed by the landowner's illegal investigations. It remains crucial that we try to understand whether interments were made singly, sequentially or communally. A highly resolved, gridded survey of the remaining deposits may indicate the nature of any remaining pits and their relative chronology, though this is not guaranteed. We will take a proton magnetometer to the site and, under the supervision of Dr Paul Cavalier, a visiting Claude Leon post-doctoral Fellow, grid and survey the surface of the site seeking to understand sub-surface structure.

Radiocarbon dating: by using extensive pre-cleaning measures, the Oxford Radiocarbon Dating Laboratory will offer us the maximum resolution of the ages of the samples we will submit. We anticipate focusing on the micro-stratigraphic horizons that provide the depositional envelope for the burials. Bayesian analysis of the resulting ages may allow us to make an estimate of the 'precise' time of the interments, though there remain several possibilities for this event or events.

Stable isotope analysis: the Stable Light Isotope Laboratory of the Archaeology Department and the ICP mass spectrometer in the Geology Department will prepare and measure the isotope values for the elements carbon, nitrogen, oxygen and strontium. The strategy, in the case of most of these elements, will be to measure several samples per individual skeleton in an attempt to measure a sequence of moments in the life histories of individuals by targeting life history-linked tissues. Although previous experience cautions us to have limited expectations for these measurements, we anticipate that the real value will derive from the integration of the results with those of the genetic, bio-anthropological and chronological patterns.

Bio-archaeology: again, although preliminary analyses were carried out as an Honours project (Alder 1988), renewed analyses will focus on systematic re-assembling of individuals, confirmation of sex and age, and an intense study of lifestyle clues, especially any peri-mortem injuries. At this point, we appear to have a predominance of adults, but potential relations between adults and between adults and children remain untested.

Genetics: the international reputation of the collaborating Tuebingen laboratory team, as reflected in the reading of Neandertal and Denisovan mitochondrial and nuclear genomes, underpins the strategy for examining mtDNA of the Faraoskop sample. The intention is to use the collaboration with Professor Krause and the experiences we will gain from the Faraoskop remains to lay a platform for the development of a UCT palaeogenetics facility. This is not, however, the intention within this application and will be the subject of further applications, depending on results achieved.

There will be two aspects to the paleogenetics pillar in this proposal. Professor Ramesar and Ms Salie will directly recover and analyze ancient DNA from human teeth and long bones in Professor Krause's laboratory at Tuebingen (Germany) and in the Health Sciences facility at UCT. The Ramesar laboratory has just been granted funds from the NRF to acquire a Next Generation Sequencer. The comparison of DNA sequences from these preserved remains, with that of current, extant populations, will be important towards understanding genomic variation in response to environment and other pressures. It will also reveal details of inter-individual relationships. Beginning even before this, Professor Illing and an MCB Honours student will isolate ancient mitochondrial DNA from animal bones of different ages, excavated from the Faraoskop site to calibrate the age at which ancient DNA can be successfully recovered in the warmer South African environment. A strategy of DNA enrichment using a custom-designed all mammalian mtDNA array designed by Dr Matthias Meyer (Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany) will be followed to capture ancient mitochondrial DNA from these bone and tooth samples, followed by library construction, next generation sequencing, and mitochondrial genome assembly and analysis. This work will be done at the University of Cape Town as a first step in setting up ancient DNA capability and establishing the feasibility of doing this work locally, in addition to answering an important question on the age of ancient DNA recovery in the South African context.

Trans-disciplinary studies and data storage: This application is the beginning of a longer term initiative to develop a palaeogenetics laboratory at the University of Cape Town and to integrate the results from several disciplines into a Biographic and Demographic evolutionary history of San and Khoi people. With its long history of studies in Rock Art, Holocene and Pleistocene human prehistory, its housing of the ethno-historic Bleek and Lloyd Archive and a record of late pre-colonial and early colonial San history, UCT is a natural choice to house an extended San archive of this kind. In addition, all sequence data generated in this project will be made publically available via submission to the National Centre for Biotechnology Information (NCBI) in the USA.

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Krause J, Fu Q, Good JM, Viola B, Shunkov MV, Derevianko AP, Pääbo S. 2010b. The complete mitochondrial DNA genome of an unknown hominin from southern Siberia. Nature. 464(7290):894-7. doi: 10.1038/nature08976. Epub 2010 Mar 24. PMID: 20336068 [PubMed - indexed for MEDLINE]

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Maricic T, Whitten M, Pääbo S. 2010 Multiplexed DNA sequence capture of mitochondrial genomes using PCR products. *PLoS One*. 2010 Nov 16;5(11):e14004. doi: 10.1371/journal.pone.0014004.

Miller, C., P. Goldberg and F. Berna 2013 Geo-archaeological investigations at Diepkloof Rock Shelter, Western Cape, South Africa. *Journal of Archaeological Science* 40 (9): 3432-3452.

Reich D, Green RE, Kircher M, Krause J, Patterson N, Durand EY, Viola B, Briggs AW, Stenzel U, Johnson PL, Maricic T, Good JM, Marques-Bonet T, Alkan C, Fu Q, Mallick S, Li H, Meyer M, Eichler EE, Stoneking M, Richards M, Talamo S, Shunkov MV, Derevianko AP, Hublin JJ, Kelso J, Slatkin M, Pääbo S. 2010 Genetic history of an archaic hominin group from Denisova Cave in Siberia. *Nature* Dec 23;468(7327):1053-60. doi: 10.1038/nature09710.

Sealy, J. C., Patrick, M. K., Morris, A. G., & Alder, D. 1992. Diet and dental caries among later Stone Age Inhabitants of the Cape Province, South Africa. *American Journal of Physical Anthropology* 88: 123-134.

Details of Research : Potential Impact on HR Development

Archaeology, including geo-archaeology and coastal archaeology, is well established in, albeit few, South African academic institutions, as is the analysis of stable carbon, nitrogen and oxygen isotope ratios for the purpose of reconstructing ancient diets and environments. There is also a rapidly strengthening tradition of the genetic analyses of modern human populations, especially descendant San and Khoi, to aid in reconstructing human evolutionary history. There are, however, no palaeogenetic laboratories in South Africa capable of recovering detailed records of genetic materials surviving in fossil hominins. Obviously, because of contamination and recovery hurdles, such laboratories are expensive to build. This has meant that preliminary attempts have been based in overseas laboratories, with authorship by and large dominated by international colleagues. In parallel to this, the study of the archaeological evidence for the behavioural record of early Homo sapiens, a record that is abundant in South African sites, has been carried out by a research community dominated by international colleagues attracted to the sites from Europe, North America and Australia (where such opportunities do not exist). South African-based scholars have played an important but perhaps not proportionally significant role.

It is in this context that we propose to use the multi-disciplinary analysis of the unique Faraoskop shelter to develop and extend local expertise in research areas that are under-represented in our institutions. This includes attracting young postgraduates, assigning them to senior international as well as local scholars and improving our capacity to maintain a tradition of research appropriate to an African Origins Platform. At least five postgraduate learning, mentorship and training opportunities are offered here.

Ms Nonhlanhla Dlamini, a graduate of the Archaeology Department at UCT is currently finishing her PhD under the supervision of Professor Alan Morris of the Department of Human Biology at UCT. She will, thereafter, take up a postdoctoral Fellowship with Professor Judy Sealy in Archaeology, as a part of which she will participate in both the bio-anthropological and the isotopic studies of the Faraoskop human remains.

Ms Tasneem Salie, a graduate of Human Biology in the Health Sciences Faculty at UCT, is currently registered for a PhD under the joint supervision of Professors Ramesar, Morris and Parkington and will undertake the genetic analyses of Faraoskop human remains at UCT under the guidance of Professor Ramesar and at Tuebingen under the guidance of Professor Johannes Krause.

An as yet unselected graduate in the Engeo Department at UCT will undertake the micro-morphological study of a column sample from Faraoskop under the supervision of Professor Chris Miller at Tuebingen and Professor John Parkington at UCT.

Dr Paul Cavalier, a Claude Leon postdoctoral Fellow in the Archaeology Department at UCT will head the ground penetration survey of the remaining Faraoskop deposits.

The 2014 UCT Archaeology Honours class will study the Faraoskop faunal remains as a class project during the course of their Honours core learning module. One candidate will be recruited for a masters degree from 2015.

A UCT Molecular and Cell Biology Honours student will be recruited to recover ancient DNA from animal bones as her/his dedicated research project (June-October 2014). If successful, the student will be encouraged to stay on for a Masters in 2015.

Details of Research : Potential Impact on Redress and Equity

Our multi-disciplinary team includes a number of women and people who would previously not have been described as white.

Details of Research : Collaboration

This initiative is driven from the University of Cape Town through members of the Science Faculty (Parkington, Sealy, Illing) and Health Science Faculty (Ramesar and Morris). It includes archaeologists, human anatomists, microbiologists and geneticists. All of these participating scholars know one another well and have previously collaborated but not as a complete team. The proposed research takes advantage of new advances in our fields that encourages wider collaboration. Faraoskop provides an irresistible opportunity. The University of Tuebingen is a major, critical even, collaborating institution with the research and supervisory roles of Professors Krause and Miller in palaeogenomics and micro-morphology essential, as the skills they bring are precisely ones we envisage developing at UCT. Fortunately the Archaeology Department of Archaeology at UCT is currently already hosting two prestigious post-doctoral Fellows (Drs Igreja Araujo and Cavalier from Portugal and France respectively) who bring scarce but relevant skills in artefact analysis and proton-magnetometry surveying. We regard these partnerships as a major enrichment of the project and an unusual opportunity to develop among our postgraduate body some extremely valuable skills and technical experience.

Details of Research : Potential Outcomes and Outputs (dissemination strategy and impact in society)

There is a growing literature on the genetics of living San and Khoi descendants based on the research of a small number of active and internationally known South African scientists (Soodyall, Ramesar and others). Similar exposure on the relevance of this to broader studies of human evolution has been achieved by these same scientists as well as other international scholars attracted by the implications of results from southern African societies for the specific issue of the origins of our species. There is, however, very little research so far directly on fossil and sub-fossil skeletal material from archaeological contexts, although a few samples have been taken and are just reaching publication stage. The attempts to carry out genomic analyses of South African stone age human skeletal remains has been largely driven by very recent advances in capacity to obtain well preserved DNA from ancient bones and teeth. International laboratories lead this movement and South African institutions are keen to play a more prominent role. Partly by collaborating with the leading institutions with experience of ancient DNA extraction, partly by taking advantage of highly developed local skills, but primarily by approaching the issue of local human evolution through an explicitly trans-disciplinary research framework, we are confident of widespread exposure and acclaim. The Faraoskop opportunity is rare even by global standards and we are sure it will pay extremely well in terms of research results and high impact journal publications.

This research is not directed at the developments of products in a literal sense. However, there is a very real and tangible product in the form of knowledge of human evolutionary history, local as well as global, that is invaluable to South African society, particularly but not exclusively to San and Khoi descendant communities. South African society is almost fixated on versions of its recent and sub-recent past. Issues of school curricular content, personal and group identities as well as the

vulnerability of surviving heritage all hinge on the retrieval and dissemination of accurate but accessible versions of our common past. Archaeology, particularly when allied with other disciplines that bear on the past, can offer these versions. The study of the Faraoskop remains that we propose will not do this on its own, but the research direction opened up can provide an invaluable social product that can, and undoubtedly will, be used to promote a number of educational and social issues.

Faraoskop is in the Cederberg Municipality of the Western Cape Province. Based in nearby Clanwilliam, the Clanwilliam Living Landscape Project has already established a set of relationships with local communities and school authorities that will enable our results to be rapidly and effectively disseminated. CLLP is based in an old school, purchased some years ago by UCT, that has facilities and display capacities to show the scientific findings we anticipate in a way that communities can understand and comment on. We believe that research is not finished if it has found its way into school curricula and intend to spend substantial effort in the translation of research findings into popular texts.

Of course, we also anticipate more conventional publications in high impact journals. Our collaborators as well as ourselves have achieved publication in the very best journals (Nature, Science, PNAS, Journal of Human Evolution, Journal of Archaeological Science) and we have little doubt that our results will also find space here. Locally the South African Archaeological Bulletin is a logical and widely read format. Moreover, all of the UCT participants have long histories of public lecturing and popular dissemination of their work. We anticipate that this will continue, especially as we are very sure our results will be of as much public as scientific value.

Details of Research : Progress to Date: Summary

The site of Faraoskop was partly excavated in the late 1980s and the excavated materials are housed at UCT in the Archaeology and Human Biology Departments. The research we propose on these remains is new and hasn't yet begun, but all UCT participants have NRF track records that speak to high levels of research competence. The Principle Investigator (Parkington) has a B1 rating

Details of Research : Progress to Date: Research Outputs

The applicant, Emeritus Professor John Parkington, has a long record of survey, site recording, excavation and analysis of pre-colonial stone age sites in the Western Cape. This has resulted in more than 100 published papers in a range of local and international journals. He is B1 rated by the NRF, has a google scholar H Index of 35, with over 3200 citations. His web of Science H rating is 17. Faraoskop is one of over 6000 sites on a data base that he has, with substantial help from colleagues and students, assembled for research, community engagement and heritage conservation purposes. His collaborators in this application (Ramesar, Illing, Morris, Sealy) are all senior researchers well known internationally and highly rated locally, generally B rated by the NRF.

Emeritus Professor John Parkington, Archaeology, UCT
NRF rating B1

Geoff Bailey and John Parkington (eds) 2009 The Archaeology of Prehistoric Coastlines. Paperback Edition. Cambridge. CUP. ISBN 978-0-521-10841-6

JE Parkington, J-Ph Rigaud, C Poggenpoel, G Porraz and P-J Texier 2013 Introduction to the Project and Excavation of Diepkloof Rock Shelter (Western Cape, South Africa): a view on the Middle Stone Age. Journal of Archaeological Science 40: 3369-3375.

John Parkington 2010 Coastal diet, encephalisation and innovative behaviours in the late Middle Stone Age of Southern Africa. In S. C. Cunnane and K.M. Stewart (eds) Human Brain Evolution: the Influence of Freshwater and Marine Food Resources. Pp 189-202. New York. John Wiley and Sons, Inc. ISBN 978-0-470-45268-4

Professor Raj Ramesar, Director of the MRC Human Genetics Research Unit at the University of Cape Town.

PhD in the area of bacterial 'genetic engineering' (1984-1988), trained in the laboratories of two of the premier NRF A-rated scientists, Professors David Woods and Doug Rawlings at UCT, and immediately moved to the area of Human Genetics at UCT's Faculty of Health Sciences in 1989, worked extensively in human molecular genetics, with the emergent technologies from the human genome project. Professor Ramesar has more than 150 original research publications pertinent to characterising human genetic variants, mostly relating this to disease in African populations. More recently, it has become necessary to look more expansively at whole human genomic variants in terms of understanding global genomic variation, when looking at complex diseases. These population data is important for establishing phylogenetic lineages between populations, and individuals, and also for investigating environmental selective pressures on the genomes of individuals/populations being studied.

Chimusa ER, Meintjes M, Tchang MS, Mulder NJ, Seioche C, Soodyall H, and Ramesar R. (2014) Genome-wide Haplotype and Signature of Selection in Indigenous Southern African Populations. PLoS Genetics (Accepted for publication) Jan 2014

Chimusa ER, Daya M, Möller M, Ramesar R, Henn BM, van Helden PD, Mulder NJ, Hoal EG. Determining ancestry proportions in complex admixture scenarios in South Africa using a novel proxy ancestry selection method. PLoS One. 2013 Sep 16;8(9):e73971. doi: 10.1371/journal.pone.0073971. PubMed PMID: 24066090; PubMed Central PMCID: PMC3774743.

Patrinos GP, Al Aama J, Al Aqeel A, Al-Mulla F, Borg J, Devereux A, Felice AE, Macrae F, Marafie MJ, Petersen MB, Qi M, Ramesar RS, Zlotogora J, Cotton RG. Recommendations for genetic variation data capture in developing countries to ensure a comprehensive worldwide data collection. Hum Mutat. 2011 Jan;32(1):2-9. doi: 10.1002/humu.21397. PubMed PMID: 21089065; PubMed Central PMCID: PMC3058135.

Hardy BJ, Séguin B, Ramesar R, Singer PA, Daar AS. South Africa: from species cradle to genomic applications. Nat Rev Genet. 2008 Oct;9 Suppl 1:S19-23. doi: 10.1038/nrg2441. Erratum in: Nat Rev Genet. 2009 Jan;10(1):68. PubMed PMID:

Professor Nicci Illing, Molecular and Cell Biology, UCT.

NRF Rating: B3
Research Interests

My primary research interest is to use the tools of modern genetics to unravel the answers to interesting evolutionary biology questions, using examples from the rich biological landscape of southern Africa. Genetic analysis of organisms that are currently alive, can be used to delve into the past, for example, understanding how flight evolved in bats 50 million years ago. Similarly, we are using next generation sequencing technology to understand how desiccation tolerance evolved in flowering plants. The development of new methods to extract small amounts of ancient DNA means that we can now turn to the archaeological biological record, and start to answer important questions about human society and biodiversity thousands of years ago.

Web of Science
Total citations 1694
H-index 25
I10-index 36

Schlebusch S, Illing N. 2012. Next Generation Shotgun Sequencing and the challenges of de Novo Genome Assembly SA J Science. 108: 8 pages <http://dx.doi.org/10.4102/sajs.v108i11/12.1256>

Ravasi DF, O'Riain MJ, Davids F, Illing N (2012) Phylogenetic Evidence That Two Distinct Trichuris Genotypes Infect both Humans and Non-Human Primates. PLoS ONE 7(8): e44187. doi:10.1371/journal.pone.0044187

Hockman D, Cretekos CJ, Mason MK, Behringer RR, Jacobs DS, Illing N. (2008) A second wave of Sonic hedgehog expression during the development of the bat limb. Proc Natl Acad Sci. 105,16982-7.

Professor Judith Sealy, Archaeology, UCT

NRF B1 rated, holder of SARChI chair in Stable Isotopes in Archaeology and Palaeoenvironmental Studies, have held a series of NRF grants over past 25 years.

Sealy, J. 2010. Isotopic evidence for the antiquity of cattle-based pastoralism in southernmost Africa. Journal of African Archaeology 8(1): 65-81.

Sealy, J. 2006. Diet, mobility and settlement pattern among Holocene hunter-gatherers in southernmost Africa. Current Anthropology 47:569-595.

Sealy, J., Pfeiffer, S., Yates, R., Willmore, K., Manhire, A., Maggs, T. & Lanham, J. 2000. Hunter-gatherer child burials from the Pakhuis Mountains, Western Cape: growth, diet and burial practices in the Late Holocene. South African Archaeological Bulletin 55:32-43.

Details of Research : Progress to Date: Students

The project has yet to begin. Ms Salie and (soon to graduate) Ms Dlamini will be significant partners in the research. Other graduate students in Archaeology, MCB and Environmental Studies will be recruited.

Details of Research : Public Engagement and Awareness Plan

The South African public has a great though patchily expressed interest in the significance of our region and existing communities for the story of human evolution. For the earlier stages in the history of our lineage this is manifest in the popularity and public awareness of the Cradle of Humankind. For later stages, including the emergence of our species, evidence from the Fynbos Biome is more critical and more accessible to Cape-based scientists. The project proposed here initiates a trans-disciplinary (meaning an issue that crosscuts the boundaries of disciplines and requires the collaborative engagement of specialists from several fields) programme that will eventually reveal the behavioural and biological history of southern Africa's First People. Given that descendants of these San aboriginal South Africans are very much represented in, particularly rural, communities of the Cape, we anticipate an ongoing interaction between ourselves and such groups. The existing Clanwilliam Living Landscape Project (www.cllp.uct.ac.za) has pioneered this interaction, though many others exist. We will follow a strategy of publication and dissemination that approaches both the scientific as well as the wider community. The CLLP has facilities for exhibitions in the UCT-supported facility in Clanwilliam and has established links through Cape Nature, the Department of Economic Development and Tourism and various District and Local Municipalities with many other schools, libraries and organisations across the Province. We will work hard to distil the essence of our work and its relevance to matters of individual and group identity, heritage significance and conservation and the potential rewards of archer-tourism.

Ethical Clearance

Does this project require ethical clearance?	Yes
Has ethical clearance been obtained	No
Additional Comments on Ethical Clearance	Ethical clearance to undertake genetic analyses from excavated remains has been applied for from the University of Cape Town.

Attachments

Description	Tuebingen genetics procedures
Document Type	Other
File Name	Meyer_CSHProtocols10.pdf

Participating Members

Title	Prof
Surname	Ramesar
Initials	R
First Name	Raj
Gender	Male
Citizenship	
Race	Indian
Department	Department of Human genetics
Faculty	Health Sciences
Organisation	University of Cape Town
Email Address	raj.ramesar@uct.ac.za
Role	Co-investigator
Description of Role in Project	A major component of the research and training will revolve around detailed genetic analysis of human remains by Ramesar and a co-supervised PhD student Ms Tasneem Salie. Professor Ramesar will oversee this.
Field of Specialisation	Human genetics
Type of Collaboration	New
Co-investigator response: Are you a co-investigator on the above project	N/A

Title	Prof
Surname	Morris

Initials	AG
First Name	Alan
Gender	Male
Citizenship	
Race	White
Department	Human Biology
Faculty	Health Sciences
Organisation	University of Cape Town (Department of Human Biology)
Email Address	alan.morris@uct.ac.za
Role	Co-investigator
Description of Role in Project	A key element in this project is the bio-anthropological analysis of the human remains from Faraoskop Rock Shelter. Professor Morris and Nonhlanhla Dlamini, currently his PhD student, will undertake this.
Field of Specialisation	Human anatomy
Type of Collaboration	Continuation
Co-investigator response: Are you a co-investigator on the above project	Yes

Title	Prof
Surname	Illing
Initials	N
First Name	Nicola
Gender	Female
Citizenship	
Race	White
Department	Microbiology and Biochemistry
Faculty	Science
Organisation	University of Cape Town
Email Address	nicola.illing@uct.ac.za
Role	Co-investigator
Description of Role in Project	Professor Illing will lead the interpretation of the supposed genetic links between individual buried individuals.
Field of Specialisation	Comparative genetics
Type of Collaboration	New
Co-investigator response: Are you a co-investigator on the above project	Yes

Title	Prof
Surname	Sealy
Initials	JC
First Name	Judith
Gender	Female
Citizenship	
Race	White
Department	Archaeology
Faculty	Science
Organisation	University of Cape Town
Email Address	judith.sealy@uct.ac.za
Role	Co-investigator
Description of Role in Project	The intention is to do multiple stable carbon isotope readings from all buried individuals so as to investigate life histories and their interconnections. Dr Sealy along with her post-doctoral student Dr Nonhlanhla Dlamini will implement these analyses.
Field of Specialisation	Archaeological techniques
Type of Collaboration	Continuation
Co-investigator response: Are you a co-investigator on the above project	N/A

Possible Reviewers

Reviewer	Dr RG Richard Klein
Email Address	rklein@stanford.edu
Institution	Stanford University
Specialisation	Not Applicable
Indicate your association, if any, with the reviewer	long term colleague
Indicate your reason for nominating this reviewer	Chosen for his encyclopaedic knowledge of human evolution in Africa
Priority	1

Reviewer	Dr P Peter Mitchell
Email Address	peter.mitchell@st-hughs.ox.ac.uk
Institution	University of Oxford
Specialisation	Not Applicable
Indicate your association, if any, with the reviewer	long term colleague

Indicate your reason for nominating this reviewer	Chosen for his understanding of current work in the stone age of southern Africa
Priority	2

Reviewer	Dr R Robert Foley
Email Address	raf10@cam.ac.uk
Institution	University of Cambridge
Specialisation	Not Applicable
Indicate your association, if any, with the reviewer	long term colleague
Indicate your reason for nominating this reviewer	Chosen because currently working in East Africa on similar evolutionary issues
Priority	3

Reviewer	Dr M Marta Lahr
Email Address	mbml1@cam.ac.uk
Institution	University of Cambridge
Specialisation	Not Applicable
Indicate your association, if any, with the reviewer	long term colleague
Indicate your reason for nominating this reviewer	Chosen for her deep understanding of the genetics of human evolution especially in Africa
Priority	4

Reviewer	Prof L Lynette Wadley
Email Address	lyn.wadley@wits.ac.za
Institution	University of the Witwatersrand
Specialisation	Archaeology - Middle Stone age, Cognitive archaeology, Experimental archaeology
Indicate your association, if any, with the reviewer	colleague in South African Stone Age studies
Indicate your reason for nominating this reviewer	Chosen because of her understanding of recent human evolution in South Africa
Priority	5

Excluded Reviewers

Financials: Operating Costs

Financial Category	2014	2015
Research Materials and Supplies		
Item: Excavation consumables	R 5000	R 2000
Motivation: During the re-excavation and re-filling of the site, a supply of bio-degradable bags, stationary and photographic consumables will be needed. Major excavation equipment is available from UCT.		
Item: Library Construction costs, DNA extraction and sequencing	R 58970	R 0
Motivation: Sequencing costs: "90 USD per GB of data...we are targeting mitochondrial DNA for this analysis, so won't need to sequence at great depth to get good coverage" (Illing). (8 needed, R7770) DNA extraction (R10000) custom designed all mammalian mtDNA array (R20000) Library Construction Library construction costs: \$250 per library (8 needed, cost R16200) special lobind plastiware (R5000) These costs are for the testing of animal bones and teeth to assess how far back usable DNA survives in circumstances like Faraoskop.		
Sabbatical Leave		
Research and Technical Assistance		
Item: Field trips	R 39900	R 15900
Motivation: The intention is to make two field trips to the site in 2014 and one in 2015. The first field trip will involve all local participants and Professor Krause. The intention is to inform the team about the site, its form and context. The second, involving Professor Miller, will uncover and sample the cave sediments. The groups will stay in nearby Clanwilliam at the UCT field station. Costings are for accommodation (R330 pp per day), meals (R250 pp per day) and vehicles (2 @ 700km round trip, R3.50 per km).		
Item: ams radiocarbon dating	R 50000	R 25000
Motivation: The high precision ams radiocarbon dates we are seeking from the Oxford Radiocarbon Dating Laboratory are needed to allow Bayesian seriation of ages in the pursuit of resolution of burial events. 10 dates are projected for 2014 @ R5000 per date, and 5 further dates for 2015.		
Item: Laboratory assistance	R 10000	R 10000
Motivation: Although most sorting, descriptive analysis and classification will be done by the collaborators and graduate students, some basic laboratory assistance from non-academic but experienced laboratory assistants will be sought. Costs are anticipated at R100 per hour for 100 hours each year of the project.		
Local Conference		
Item: Participants Field Workshop	R 0	R 65000
Motivation: Our intention is to arrange a field workshop in Clanwilliam for all local and international collaborators in April 2015. We will use other sources of funding for international colleagues. This amount is based on similar workshops we have held in 2013 for other projects and includes transport, accommodation and meals for a group of 20 participants at the Travellers Rest facility in the Agter Pakhuis.		
International Conference		
Local Study Visit/Training Visit		
International Study Visit/Training Visit		
Item: Ms Salie training visit to Tuebingen	R 11000	R 0
Motivation: Contribution to airfare and visa costs to cover part not paid by IAPO at UCT		
Research Equipment		
Total:	R 174870	R 117900

Financials: Other Sources

Source	2014	2015
n/a	R 0	R 0
Total:	R 0	R 0

Financials: Student Support

Financial Student Support	2014	2015
Honours (Full-time)	R 25000	R 25000
Masters (Full-time)	R 40000	R 80000
Doctoral (Full-time)	R 65000	R 65000
Postdoctoral (early career researchers)	R 0	R 225000
Total:	R 130000	R 395000

Details of Research : Co-investigator Outputs (if applicable)

<p>Sealy Sealy, J. 2010. Isotopic evidence for the antiquity of cattle-based pastoralism in southernmost Africa. <i>Journal of African Archaeology</i> 8(1): 65-81.</p> <p>Sealy, J. 2006. Diet, mobility and settlement pattern among Holocene hunter-gatherers in southernmost Africa. <i>Current Anthropology</i> 47:569-595.</p> <p>Sealy, J., Pfeiffer, S., Yates, R., Willmore, K., Manhire, A., Maggs, T. & Lanham, J. 2000. Hunter-gatherer child burials from the Pakhuis Mountains, Western Cape: growth, diet and burial practices in the Late Holocene. <i>South African Archaeological Bulletin</i> 55:32-43.</p> <p>Illing Schlebusch S, Illing N. 2012. Next Generation Shotgun Sequencing and the challenges of de Novo Genome Assembly SA J Science. 108: 8 pages http://dx.doi.org/10.4102/sajs.v108i11/12.1256</p> <p>Ravasi DF, O'Riain MJ, Davids F, Illing N (2012) Phylogenetic Evidence That Two Distinct <i>Trichuris</i> Genotypes Infect both Humans and Non-Human Primates. <i>PLoS ONE</i> 7(8): e44187. doi:10.1371/journal.pone.0044187</p> <p>Hockman D, Cretokos CJ, Mason MK, Behringer RR, Jacobs DS, Illing N. (2008) A second wave of Sonic hedgehog expression during the development of the bat limb. <i>Proc Natl Acad Sci.</i> 105,16982-7.</p> <p>Ramesar Chimusa ER, Daya M, Möller M, Ramesar R, Henn BM, van Helden PD, Mulder NJ, Hoal EG. Determining ancestry proportions in complex admixture scenarios in South Africa using a novel proxy ancestry selection method. <i>PLoS One.</i> 2013 Sep 16;8(9):e73971. doi: 10.1371/journal.pone.0073971. PubMed PMID: 24066090; PubMed Central PMCID: PMC3774743.</p> <p>Patrinos GP, Al Aama J, Al Aqeel A, Al-Mulla F, Borg J, Devereux A, Felice AE, Macrae F, Marafie MJ, Petersen MB, Qi M, Ramesar RS, Zlotogora J, Cotton RG. Recommendations for genetic variation data capture in developing countries to ensure a comprehensive worldwide data collection. <i>Hum Mutat.</i> 2011 Jan;32(1):2-9. doi: 10.1002/humu.21397. PubMed PMID: 21089065; PubMed Central PMCID: PMC3058135.</p> <p>Hardy BJ, Séguin B, Ramesar R, Singer PA, Daar AS. South Africa: from species cradle to genomic applications. <i>Nat Rev Genet.</i> 2008 Oct;9 Suppl 1:S19-23. doi: 10.1038/nrg2441. Erratum in: <i>Nat Rev Genet.</i> 2009 Jan;10(1):68. PubMed PMID:</p> <p>Morris</p>

Registration Details

Title	Prof
Surname	Parkington
Initials	JE
First Name	JOHN
Maiden Name/Previous Surname	
Citizenship	United Kingdom
ID Type	SA ID Number
ID/Passport/Unique Number	4411205119105
Race	White
Gender	Male
Date of Birth	20 November 1944
Primary Email Address	john.parkington@uct.ac.za
Alternate Email Address	
Mobile Number	0798724807
Please tick for sms notifications	No
Are you a full-time student?	No
Current Organisation	University of Cape Town

Contact Details

Organisation where based	University of Cape Town
Is this the organisation which funds your salary?	Yes
Primary Organisation which Funds your Salary	University of Cape Town
Department/School/Institute	Archaeology
Faculty	Science
Work Postal Address (excluding department)	University of Cape Town Private Bag Rondebosch
City/Town	Cape Town
Code	7701
Primary Telephone Number	021 6504662
Fax Number	021 6502352
Mobile Number	0798724807
Primary Email Address	john.parkington@uct.ac.za
Alternate Email Address	
Web Address	
Country	South Africa
Province/State	Western Cape
Country	South Africa

Qualifications

Level	Doctoral
Name of Degree/Diploma (e.g. BSc)	PhD
Field of Study	Archaeology
Institution	University of Cambridge
Full-time	No
Distinction	N/A
Date of First Registration	January 1974
Completed	Yes
Highest Completed Qualification	Yes
Date Obtained	September 1977
Status	Not Applicable
Reason	Not Applicable
Anticipated Date of Completion	Not Applicable

Level	Undergraduate degree (three year)
Name of Degree/Diploma (e.g. BSc)	BA honours
Field of Study	Archaeology
Institution	University of Cambridge
Full-time	Yes
Distinction	No
Date of First Registration	January 1963
Completed	Yes
Highest Completed Qualification	No
Date Obtained	July 1966

Status	Not Applicable
Reason	Not Applicable
Anticipated Date of Completion	Not Applicable

Career Profile

Position	Emeritus Professor
Organisation	University of Cape Town
Sector	Higher Education Sector
Type	Permanent
Full-time	Yes
Appointed From	January 2010
Current	Yes
Appointed To	N/A

Position	Senior Scholar
Organisation	University of Cape Town
Sector	Higher Education Sector
Type	Contract
Full-time	Yes
Appointed From	January 2012
Current	Yes
Appointed To	N/A

Position	Professor of Archaeology
Organisation	University of Cape Town
Sector	Higher Education Sector
Type	Permanent
Full-time	Yes
Appointed From	July 1986
Current	No
Appointed To	December 2009

Position	Visiting Professor
Organisation	University of California, Berkeley
Sector	Higher Education Sector
Type	Temporary
Full-time	No
Appointed From	January 1995
Current	No
Appointed To	May 1995

Position	Visiting Professor
Organisation	Rutgers University
Sector	Higher Education Sector
Type	Temporary
Full-time	Yes
Appointed From	July 1988
Current	No
Appointed To	November 1988

Position	Associate Professor
Organisation	University of Cape Town
Sector	Higher Education Sector
Type	Permanent
Full-time	Yes
Appointed From	January 1978
Current	No
Appointed To	June 1985

Position	Visiting Professor
Organisation	University of California, Berkeley
Sector	Higher Education Sector
Type	Temporary
Full-time	Yes
Appointed From	January 1985
Current	No

Position	Visiting Professor
Organisation	University of California, Berkeley
Sector	Higher Education Sector
Type	Temporary
Full-time	Yes
Appointed From	September 1983
Current	No
Appointed To	May 1984

Research Expertise

Scientific Domain	Natural Sciences
Primary Research Field	Earth and marine sciences
Secondary Research Field	Archaeology
Fields of Specialisation	Rock art
	Coastal archaeology
	Fossil record of human evolution

Student Supervision Record

Title	Ms
Surname	Hallinan
Initials	E
Race	White
Gender	Female
Citizenship	United Kingdom
ID/Passport/Unique Number	
Institution	University of Cape Town
Level	Masters
Name of Degree/Diploma (e.g. BSc)	MPhil
Full-time	Yes
Year of First Registration	2010
Completed	Yes
Year in which Degree was Awarded	2013
Year Supervised From	2010
Year Supervised To	2013
Supervisor	Yes
Co-supervisor	No

Title	Ms
Surname	Viljoen
Initials	Y
Race	White
Gender	Female
Citizenship	South Africa
ID/Passport/Unique Number	
Institution	University of Cape Town
Level	Masters
Name of Degree/Diploma (e.g. BSc)	MPhil
Full-time	Yes
Year of First Registration	2009
Completed	Yes
Year in which Degree was Awarded	2012
Year Supervised From	2009
Year Supervised To	2012
Supervisor	No
Co-supervisor	Yes

Title	Mr
Surname	Wiltshire
Initials	N
Race	White
Gender	Male
Citizenship	South Africa
ID/Passport/Unique Number	
Institution	University of Cape Town
Level	Masters
Name of Degree/Diploma (e.g. BSc)	MSc

Full-time	Yes
Year of First Registration	2008
Completed	Yes
Year in which Degree was Awarded	2011
Year Supervised From	2008
Year Supervised To	2011
Supervisor	Yes
Co-supervisor	No

Title	Mr
Surname	Archer
Initials	W
Race	White
Gender	Male
Citizenship	South Africa
ID/Passport/Unique Number	
Institution	University of Cape Town
Level	Masters
Name of Degree/Diploma (e.g. BSc)	MSc
Full-time	Yes
Year of First Registration	2009
Completed	Yes
Year in which Degree was Awarded	2010
Year Supervised From	2009
Year Supervised To	2010
Supervisor	No
Co-supervisor	Yes

Title	Mr
Surname	Manthi
Initials	FK
Race	Black
Gender	Male
Citizenship	Kenya
ID/Passport/Unique Number	
Institution	University of Cape Town
Level	Doctoral
Name of Degree/Diploma (e.g. BSc)	PhD
Full-time	No
Year of First Registration	2003
Completed	Yes
Year in which Degree was Awarded	2006
Year Supervised From	2003
Year Supervised To	2006
Supervisor	No
Co-supervisor	Yes

Title	Mr
Surname	Hahndiek
Initials	C
Race	White
Gender	Male
Citizenship	South Africa
ID/Passport/Unique Number	
Institution	University of Cape Town
Level	Masters
Name of Degree/Diploma (e.g. BSc)	MPhil
Full-time	Yes
Year of First Registration	2009
Completed	No
Year in which Degree was Awarded	
Year Supervised From	2009
Year Supervised To	2013
Supervisor	Yes
Co-supervisor	No

Title	Ms
Surname	Kyriacou
Initials	K
Race	White
Gender	Female

Citizenship	South Africa
ID/Passport/Unique Number	
Institution	University of Cape Town
Level	Doctoral
Name of Degree/Diploma (e.g. BSc)	PhD
Full-time	Yes
Year of First Registration	2009
Completed	No
Year in which Degree was Awarded	
Year Supervised From	2009
Year Supervised To	2013
Supervisor	Yes
Co-supervisor	No

Title	Mr
Surname	Mguni
Initials	S
Race	Black
Gender	Male
Citizenship	South Africa (Permanent Resident)
ID/Passport/Unique Number	
Institution	University of Cape Town
Level	Doctoral
Name of Degree/Diploma (e.g. BSc)	PhD
Full-time	Yes
Year of First Registration	2006
Completed	No
Year in which Degree was Awarded	
Year Supervised From	2006
Year Supervised To	2013
Supervisor	Yes
Co-supervisor	No

Title	Ms
Surname	Salie
Initials	T
Race	Indian
Gender	Male
Citizenship	South Africa (Permanent Resident)
ID/Passport/Unique Number	3456789
Institution	University of Cape Town
Level	Doctoral
Name of Degree/Diploma (e.g. BSc)	PhD
Full-time	Yes
Year of First Registration	2012
Completed	No
Year in which Degree was Awarded	
Year Supervised From	2012
Year Supervised To	2014
Supervisor	No
Co-supervisor	Yes

Personal Profile

Committees: Member of Advisory Board 1997-2012 Trust for African Rock Art
Member UCT Iziko Advisory Board 2001-2010
Committees: Member 1995-2001 International Advisory Committee on Chauvet Cave
Proposal Reviewer. approximately 15 Leakey Foundation grant proposal reviews each year.
Proposal reviewer. approximately 10 NSF grant applications each year.
CSD Top Researcher Award 1994
Fellow UCT
Fellow Royal Society of South Africa

My archaeological interests span field research, laboratory analyses and include an involvement with method and theory. I have focused on hunter gatherer history in the Cape. I am eclectic in the sense that I work with rock paintings, shell middens, stone artifacts and faunal remains. I have a deep interest in what the archaeological record records, how it is constructed and what we can try to make it reveal about the past. I show here that all of these interests interconnect and in fact rely on one another to supply insights into past behaviours. For much of my career I have concentrated on the last 10000 years but recently I have become heavily involved in excavations and analyses of materials as much as 100000 years old. Throughout I have tried to integrate the results of different kinds of analyses, use different sets of ecological, ethnographic, isotopic and material frameworks and write readable, hopefully interesting, versions of long term history.

My work is well known internationally and I have a wide range of international connections, developed during several years of visiting professorships in the US, lecturing and seminar-giving in the US, Africa and Europe, visits to many of the most significant European and African palaeolithic sites and flourishing collaborations with a wide range of European, African and US colleagues. This has led to invitations from time to time to serve on editorial boards (Antiquity, African Archaeological Review), on PhD examination panels (Berkeley, Rutgers, Oxford, Monash, Canberra, Sydney, Michigan), on other Boards (Trust for African Rock Art, International Scientific Committee for Chauvet cave), as reviewers of grant applications (Swan Fund, Leakey Foundation, NSF, Wenner-Gren) and to give invited addresses at many Universities.

I am a Fellow of UCT, a Fellow of the Royal Society of South Africa, a recipient of the (former) CSD Top Researcher Award, a co-recipient of the UCT Book Prize, one of UCT's Distinguished Teachers and have been Professor of Archaeology at UCT since 1986. I am currently Emeritus Professor and Senior Scholar in Archaeology and was Acting Pro Vice-Chancellor of the African Climate and Development Initiative at UCT in 2011. I know, from many invitations to talk at Universities all over the world, that my publications are widely respected and quoted, with the themes of my research (in seasonality, the spatial analysis of domestic organisation, understanding rock art, assessing the impact of people on pre-colonial shellfish, diet and human evolution) being widely admired.

Since 1995 I have directed the Clanwilliam Living Landscape Project through my membership of the Krakadouw Trust. This is a successful educational and training initiative using the results of 45 years of research to create jobs in the community of the greater Cederberg region. The CLLP has undertaken a range of schools projects funded by the Lottery Board, the Department of Environmental Affairs, CATHSSETA and the National Heritage Council, collaborating with many other institutions both locally and internationally.

Absence from Research

Reason	n/a
Date From	January 2014
Date To	January 2014

Books

ISSN/ISBN Number	978 0 620 55666 8
Title of book	Cederberg Rock Paintings
All Authors in Order Appearing on Output	Parkington, John
Status	Published/produced
Year	2013
Editor	n/a
Publisher	Krakadouw Trust
Total Pages in Book	128
Own Contribution	Author
Web Address	

ISSN/ISBN Number	978-1-77007-815-4
Title of book	San Rock Engravings
All Authors in Order Appearing on Output	John Parkington
Status	Published/produced
Year	2010
Editor	n/a
Publisher	Struik
Total Pages in Book	128
Own Contribution	Author of text
Web Address	

ISSN/ISBN Number	978-0-521-10841-6
Title of book	The Archaeology of Prehistoric Coastlines
All Authors in Order Appearing on Output	John Parkington
Status	Published/produced
Year	2009
Editor	Bailey and Parkington
Publisher	Cambridge University Press
Total Pages in Book	295
Own Contribution	Co-editor and chapter co-author
Web Address	

ISSN/ISBN Number	979-0-620-40649-9
Title of book	Karoo Rock Engravings
All Authors in Order Appearing on Output	David Morris, Neil Rusch
Status	Published/produced
Year	2008
Editor	n/a
Publisher	Krakadouw Trust
Total Pages in Book	127

Own Contribution	Main author
Web Address	

Chapters in Books

ISSN/ISBN Number	978-1-84217-454-8
Title of book	Casting the Net Wide
Title of chapter	The Tortoise and the Ostrich Egg: projecting the home base hypothesis into the 21st century.
All Authors in Order Appearing on Output	Parkington, J and Fisher J W Jnr
Status	Published/produced
Year	2011
Own Contribution	Co author and originator of paper
Web Address	
Editor	Jeanne Sept and David Pilbeam
Publisher	Oxbow Books
Start Page of Chapter	191
End Page of Chapter	192

ISSN/ISBN Number	978-0-470-45268-4
Title of book	Human Brain Evolution: the influence of Freshwater and Marine Food Resources.
Title of chapter	Coastal Diet, encephalisation and innovative behaviours in the late Middle Stone Age of Southern Africa.
All Authors in Order Appearing on Output	n/a
Status	Published/produced
Year	2010
Own Contribution	author
Web Address	
Editor	SC Cunnane and KM Stewart
Publisher	John Wiley and Sons
Start Page of Chapter	189
End Page of Chapter	202

ISSN/ISBN Number	978-0-521-51794-2
Title of book	Cambridge History of South Africa: Volume 1.
Title of chapter	The appearance of food production in southern Africa 1000 to 2000 years ago.
All Authors in Order Appearing on Output	Hall, S
Status	Published/produced
Year	2010
Own Contribution	Senior author
Web Address	
Editor	C Hamilton, BK Mbenga and R Ross
Publisher	Cambridge University Press
Start Page of Chapter	63
End Page of Chapter	111

Articles in Refereed/Peer-reviewed Journals

ISSN/ISBN Number	
Article Number	
Title of Article	Coastal Adaptations and the Middle Stone Age lithic assemblages from Hoedjiespunt 1 in the Western Cape, South Africa
Title of Journal	Journal of Human Evolution
Volume	64
All Authors in Order Appearing on Output	Manuel Will, John Parkington, Andrew Kandel and Nicholas Conard
Status	Published/produced
Year	2013
Web Address	
Own Contribution	Co-excavator and co-author
Page From	518
Page To	537

ISSN/ISBN Number	
Article Number	
Title of Article	Limpet gathering strategies in the Later Stone Age along the Cape West Coast, South Africa.
Title of Journal	Journal of Island and Coastal Archaeology
Volume	8:1
All Authors in Order Appearing on Output	Parkington, J, Fisher, J. W and Kyriacou, K
Status	Published/produced
Year	2013

Web Address	
Own Contribution	Senior Author
Page From	91
Page To	107

ISSN/ISBN Number	
Article Number	
Title of Article	OSL and TL dating of the Middle Stone Age sequence at Diepkloof Rock Shelter (South Africa): a clarification.
Title of Journal	Journal of Archaeological Science
Volume	40
All Authors in Order Appearing on Output	Tribolo, C., Mercier, N., Douville, E., Joron, J-L., Reyss, J-L., Rufer, D., Cantin, N., Lefrais, Y., Miller, C.E., Porraz, G., Parkington, J., Rigaud, J-P. and Texier, P-J.
Status	Published/produced
Year	2013
Web Address	
Own Contribution	co-author
Page From	3401
Page To	3411

ISSN/ISBN Number	
Article Number	
Title of Article	The context, form and significance of the MSA engraved ostrich eggshell collection from Diepkloof Rock Shelter, Western Cape, South Africa.
Title of Journal	Journal of Archaeological Science
Volume	40
All Authors in Order Appearing on Output	Texier, P-J., Porraz, G., Parkington, J., Rigaud, J-P., Poggenpoel, C. and Tribolo, C.
Status	Published/produced
Year	2013
Web Address	
Own Contribution	co-author
Page From	3412
Page To	3431

ISSN/ISBN Number	
Article Number	
Title of Article	The MSA sequence of Diepkloof and the history of southern African Late Pleistocene populations.
Title of Journal	Journal of Archaeological Science
Volume	40
All Authors in Order Appearing on Output	Porraz, G., Parkington, J., Rigaud, J-P., Miller, C.E., Poggenpoel, C., Tribolo, C., Archer, W., Cartwright, C.R., Charrie-Duhaut, A., Dayet, L., Igreja, M., Schmidt, P., Verna, C. and Texier, P-J.
Status	Published/produced
Year	2013
Web Address	
Own Contribution	co-author
Page From	3542
Page To	3552

ISSN/ISBN Number	
Article Number	
Title of Article	Introduction to the project and excavation at Diepkloof Rock Shelter (Western Cape, South Africa): a view on the Middle Stone Age.
Title of Journal	Journal of Archaeological Science
Volume	40
All Authors in Order Appearing on Output	Parkington, J.E., Rigaud, J-P., Poggenpoel, C., Porraz, G. and Texier, P-J.
Status	Published/produced
Year	2013
Web Address	
Own Contribution	Senior author
Page From	3369
Page To	3375

ISSN/ISBN Number	
Article Number	
Title of Article	The Middle Stone Age human remains from Diepkloof Rock Shelter (Western Cape, South Africa).
Title of Journal	Journal of Archaeological Science
Volume	40
All Authors in Order Appearing on Output	Verna, C., Texier, P-J., Rigaud, J-P., Poggenpoel, C. and Parkington, J.
Status	Published/produced
Year	2013
Web Address	

Own Contribution	co-author
Page From	3532
Page To	3541

ISSN/ISBN Number	
Article Number	
Title of Article	Rounded but not reworked? Spatial patterning in the stone tool assemblage from Dunefield Midden.
Title of Journal	South African Archaeological Bulletin
Volume	68
All Authors in Order Appearing on Output	John Parkington
Status	Published/produced
Year	2013
Web Address	
Own Contribution	Single author
Page From	211
Page To	216

ISSN/ISBN Number	
Article Number	
Title of Article	Mussels and Mongongo Nuts: logistical visits to the Cape west coast, South Africa
Title of Journal	Journal of Archaeological Science
Volume	39
All Authors in Order Appearing on Output	n/a
Status	Published/produced
Year	2012
Web Address	
Own Contribution	sole author
Page From	1521
Page To	1530

ISSN/ISBN Number	
Article Number	
Title of Article	A Howiesons Poort tradition of engraving ostrich eggshell containers dated to 60 000 years ago at Diepkloof Rock Shelter, South Africa
Title of Journal	Proceedings of the National Academy of Sciences
Volume	107
All Authors in Order Appearing on Output	Porraz, G, Parkington, J, Rigaud, J-P, Poggenpoel, C, Miller, C, Tribolo, C, Cartwright, C, Coudenneau, A, Klein, R, Steele, T, Verna, C
Status	Published/produced
Year	2010
Web Address	
Own Contribution	co-author
Page From	6180
Page To	6185

ISSN/ISBN Number	
Article Number	
Title of Article	Rethinking Shellfish Measurements
Title of Journal	South African Archaeological Bulletin
Volume	64
All Authors in Order Appearing on Output	n/a
Status	Published/produced
Year	2009
Web Address	
Own Contribution	sole author
Page From	195
Page To	196

ISSN/ISBN Number	
Article Number	
Title of Article	Ambiguite dans la representation des animaux et des hommes dans les peintures rupestres du Cap, Afrique du Sud
Title of Journal	L'Anthropologie
Volume	113 (5)
All Authors in Order Appearing on Output	n/a
Status	Published/produced
Year	2009
Web Address	
Own Contribution	sole author
Page From	839
Page To	847

ISSN/ISBN Number	
Article Number	
Title of Article	"The fires are constant, the Shelters are whims": a feature map of Later Stone Age campsites at the Dunefield Midden site, Western Cape Province, South Africa.
Title of Journal	South African Archaeological Bulletin
Volume	64
All Authors in Order Appearing on Output	Fisher, JW Jnr, Tonner, T
Status	Published/produced
Year	2009
Web Address	
Own Contribution	Senior author
Page From	104
Page To	121

Refereed/Peer-reviewed Conference Outputs

Patents

Articles in Non-refereed/Non-peer Reviewed Journals