TITLE

A Critical Evaluation of Representations of Hominin Evolution in the Museums of the Cradle of Humankind World Heritage Site, South Africa.

by

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Declaration

I hereby declare that this report has not been submitted, either in the same or different form, to this or any other university for any degree

Signature:

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Abstract

This study will attempt to examine the exhibits in the museums in the Cradle of Humankind World Heritage Site in South Africa with a view to understanding whether they complement the National Curriculum Statement currently being implemented by the National Department of Education, with specific emphasis on the evolution section of the curriculum for Grade 12 Life Sciences. Human evolution exhibits have also historically been associated with racial and gender stereotypes which can influence the way human evolution is understood by the broader public and by museum visitors like teachers and learners. This will also be discussed in the evaluation of the content of the museums in the Cradle of Humankind World Heritage Site as these limitations continue to influence the way human evolution is understood by the broader public and by museum visitors like teachers and learners.

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List of Acronyms and Abbreviations

ANC	African National Congress
COHWHS	Cradle of Humankind World Heritage Site
CNE	Christian National Education
CO	Critical Outcomes
DNA	Deoxyribonucleic Acid
DO	Developmental Outcomes
DOE	Department of Education
DWEA	Department of Water and Environmental Affairs
FET	Further Education and Training
GDE	Gauteng Department of Education
GPG	Gauteng Provincial Government
ICC	Interpretation Centre Complex (Maropeng)
ID	Intelligent Design
LED	Local Economic Development
MA	Management Authority
MAL	Maropeng a' Afrika Leisure (Pty) Ltd
MEC	Member of the Executive Committee
MtDNA	Mitochondrial Deoxyribonucleic Acid
mya	Million Years Ago
NAPTOSA	National Professional Teachers' Organisation of South Africa
NCS	National Curriculum Statement
OBE	Outcomes-Based Education
PPP	Public Private Partnership
UNESCO	United Nations Educational, Scientific and Cultural Organisation

> The recent record reinforces the lesson of the years since 1858: that Darwin's account of evolution remains intact. Hereditable variation and natural selection are indeed the agents that shaped the present richness of life on Earth. The new genetics does not challenge Darwinism but, on the contrary, is the means by which the details of the course of evolution will be unravelled from the sketchy fossil record and the growing accumulation of data about the genetic constitution of animals and plants (Maddox, 1998: 22).

PART 1: INTRODUCTION

1.1 Aim

The aim of this report is to assess the educational content of the exhibitions at Maropeng and Sterkfontein in the Cradle of Humankind World Heritage Site (COH WHS) in South Africa in order to establish whether they meet the criteria set out in the National Curriculum Statement (NCS) and more specifically the outcomes of the evolution section of the Grade 12 Life Sciences curriculum. This will be done to ascertain whether the displays provide learning opportunities, are suited to the implementation of the curriculum, and if they provide an educational resource for teacher and learner alike. In addition to this, an assessment will be undertaken to determine whether the exhibits, in relation to the aims and spirit of the NCS, reinforce or revert to older ways of thinking about what scientific knowledge is and what it means to teach science.

Furthermore, an attempt will be made to examine whether the exhibits address and confront stereotypes associated with human evolution, particularly racial and gender stereotypes, and whether the exhibits clarify some common misconceptions about the way human evolution is perceived and understood by the broader public.

1.2. The Context: Cradle of Humankind World Heritage Site

The COHWHS, situated in the north-western quadrant of the Gauteng Province in South Africa, was listed as a World Heritage Site by the United Nations Educational, Scientific and Cultural Organisation (UNESCO) in 1999. This area together with the serially listed sites of Makapans Valley in Limpopo Province and the Taung site in North West Province (both listed in 2005) form the UNESCO enlisted Fossil Hominid Sites of Sterkfontein, Swartkrans, Kromdraai and Environs. (see Fig. 5, p. 37). These

are sites of outstanding universal value because of the wealth of significant hominin fossils that have been unearthed in the area, and in particular, the fossils of human ancestors or relatives such as the *Australopithecus africanus* and *Homo ergaster*. The most famous of these finds are the Taung Child skull, Mrs Ples, and Little Foot, which is currently being excavated by Professor Ron Clarke of the University of the Witwatersrand (COHWHS Strategic Plan, 2009-2012).

The COHWHS site is managed on behalf of the Minister of Environmental Affairs of South Africa by the COHWHS Management Authority (MA) reporting to the MEC for Economic Development in Gauteng. The MA undertook a comprehensive master planning process in 2000 and this has been implemented over the last 10 years for the site as a whole. The primary aim of the MA is to protect and preserve the site, promote further scientific research, encourage community participation and stimulate tourism development that will benefit local communities and ultimately contribute to Local Economic Development (LED). A large amount of this work has entailed investment in strategic economic infrastructure projects which included the building of a visitor interpretation centre at Maropeng which was opened to the public in December 2005 by then President Thabo Mbeki.

Called 'Maropeng' which means 'returning to the place from where we come' in Setswana, this architecturally unique centre allows everyone to embark on a journey of discovery that begins with the birth of our planet through the history of humankind and into the future. The Tumulus Building at Maropeng (see Fig. 2, p.4) boasts 2100m^2 of orientation and exhibition space, an underground lake and boat ride that transports the visitor back in time to when Earth was first formed, as well as an original fossil display area where fossils are rotated regularly. Maropeng also offers education and conferencing facilities and a hotel and restaurant (www.cradleofhumankind.co.za; www.maropeng.co.za). The layout and analysis of the museum will be discussed in Part 3 of this report.

The world famous Sterkfontein Caves (see Fig.1, p. 7) continue to be the site of the longest palaeoanthropological excavation in the world and has yielded a wealth of ancient hominin fossils. It also boasts a human evolution exhibition. (COHWHS Master Plan, 2001: 6). It is the exhibitions at the Maropeng Interpretation Center

Complex (ICC) and the exhibits at the Sterkfontein Exhibition Centre which will be evaluated in this report. Facilities at the Sterkfontein site were upgraded and opened to the public in September 2005.

The museums at Sterkfontein and Maropeng are touted as museums with cutting-edge educational exhibits on evolution and human evolution. Evolution covers the broader issue of the evolution of life from more than 3 billion years ago whereas the human evolution story can be told from roughly seven million years ago, widely believed to be the approximate period for a split between the apes and hominins. An assessment will also be made of whether the hominin exhibitions are sensitive to gender and racial stereotypes often associated with human evolution exhibits in natural history museums. The intention here is not so much an attempt at ascertaining how far the exhibitions succeed in breaking down prejudice and stereotypical concepts, but rather whether or not the exhibits address or confront racial and gender stereotypes.

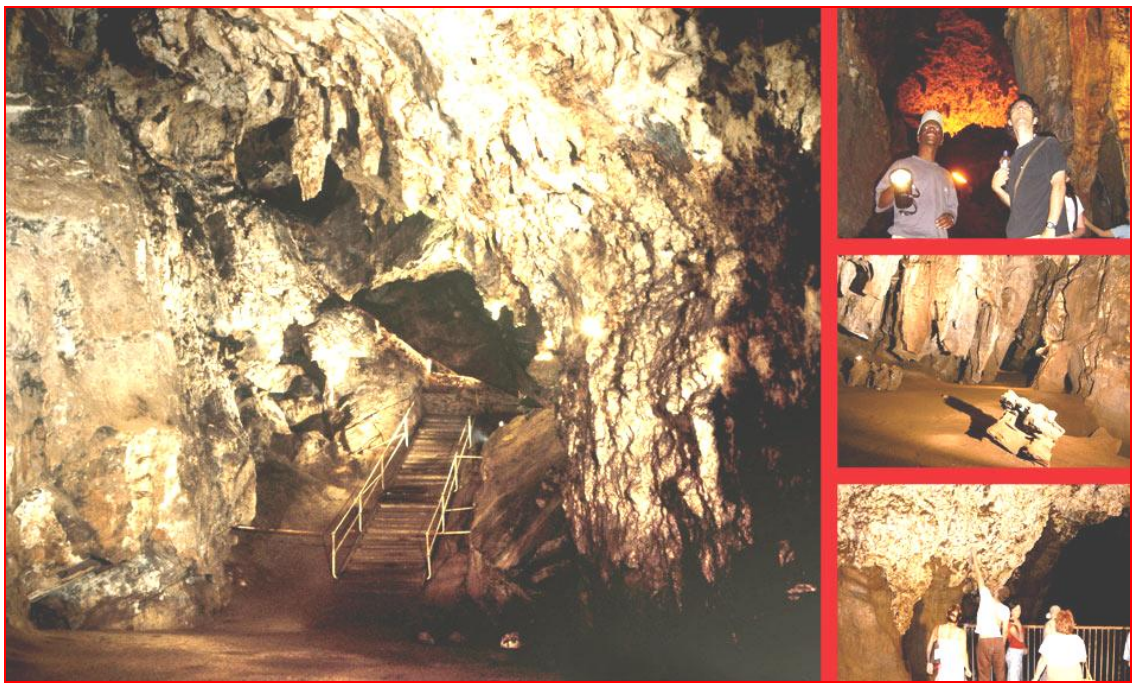

Figure 1: Sterkfontein Caves in the Cradle of Humankind World Heritage Site, South Africa
Photo: Courtesy of the Cradle of Humankind World Heritage Site Management Authority

Figure 2: The Tumulus Building at the Maropeng Interpretation Center Complex, the official visitor centre in the Cradle of Humankind World Heritage Site

The assessment of the exhibitions in the COHWHS will be done within the context of the hugely significant role that South Africa has played in the field of palaeoanthropology at a global level, both in the past and currently, and in particular the significant fossil discoveries that continue to be unearthed in the COHWHS. South Africa's high profile in world palaeoanthropology carries a responsibility to ensure that good scientific education and further research opportunities exist and are encouraged. It needs to meet its obligation to UNESCO by managing the COHWHS in a responsible manner.

1.3 Structure of the Research Report

Part One of the report deals with the aim and objectives and contextualizes the project for the reader. It also presents a discussion about what the NCS is as well as its objectives and knowledge outcomes. There is a brief discussion of the history of science and education in South Africa with an emphasis on the teaching of evolution in schools in both the apartheid and post-apartheid democratic South Africa. Thereafter there is a discussion on museums and how human evolution exhibits have played out over the years, with a particular emphasis on racial and gender stereotypes

associated with human evolution exhibits and perceived misconceptions about human evolution.

Part Two covers all the illustrations and visuals pertaining to the study and are mainly photographs of the exhibitions at Sterkfontein and Maropeng.

Part Three contains an analysis of the exhibitions in the COHWHS, explaining the method of analysis that was employed, and outlining the key criteria that were used to evaluate the exhibitions and recommendations. The final part deals with overall conclusions and recommendations.

2. The New National Curriculum Statement (NCS)

In 1995 the South African Government began the process of developing a new curriculum for the school system. There were two imperatives for this. First, in order to meet the demands of the 21st Century, learners needed to be exposed to different and higher level skills and knowledge than had been provided by the existing South African curricula. Secondly, by 1995, the curricula for schools required revision to reflect new values and principles especially those enshrined in the Constitution of South Africa (South Africa, Department of Education, 2008: 2).

The curriculum was revised in three main stages after 1994: the first stage involved the purging of the Christian National Education (CNE) curriculum of its racist and sexist elements. The second involved the implementation of outcomes-based education through the introduction of a new curriculum, Curriculum 2005. During the third stage, Curriculum 2005 was reviewed and revised in accordance with recommendations made by a Ministerial Review Committee appointed in 2000 (Chisholm 2003: 1; South Africa, Department of Education 2008: 2). The National Curriculum Statement (NCS) emerged from the latter process of revision.

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The NCS is based upon the values of the Constitution of the Republic of South Africa and therefore is meant to lay the foundation for the achievement of the goals of the Constitution by introducing in a simple document the key principles and values that underpin it, all of which are based upon the principles of social transformation.

The NCS was implemented for the first time in 2008 by the South African Government through the National Department of Education (NDE). It adopts a constructivist and creative approach to education and marks a shift away from learning by transmission of knowledge, to learners actively constructing knowledge through individual or social activity. In other words, it adopts an activity-based approach to education and learning. Learners are meant to learn through experimentation, and are encouraged to make their own discoveries, inferences, and conclusions. It offers an incremental learning experience whereby students learn new information by building upon knowledge that they already possess. Outcomes-based education (OBE) importantly emphasizes that all learners can be successful if allowed to develop at their own pace.

In South Africa this outcomes-based approach to learning marked a movement away from a very conservative education system that served to indoctrinate and discriminate. OBE and the NCS provided a broad framework for the development of an open, non-prescriptive system that is reliant on teachers creating their own learning programmes and learning support material (Chisholm, 2003: 3).

This learner-centred approach has impacted on other centres of learning. Museums worldwide have undergone similar transitions. There has been a shift from object and explanation to interactive exhibitions which help the learner to construct meaning cumulatively, for example. Old-style [western] museums have been criticized for fixing gender and racial stereotypes and reinforcing the negative image of 'native' societies thereby alienating many people from their past. There are also inherent gender and racial stereotypes associated with many of these exhibitions (see for example Scott, 2007). Some museums have reinvented themselves and, by drawing on sophisticated technology, have become invaluable resources for teachers and learners alike. This shift will be addressed in greater detail in Part 3 of this report.

2.1 Background to Science and Education in South Africa

- **Darwinism and Evolution**

The significant fossil discoveries that have been unearthed in the COHWHS, in other parts of Africa and in the rest of the world, have all contributed significantly to the understandings of human origins. The boundaries of science in the COHWHS are

regularly being expanded through new fossil discoveries, and through entirely new domains of science previously unimagined, such as DNA studies and new dating technologies (Bonner, 2007: 1).

As a result of continuing excavations in the COHWHS, Professor Lee Berger from the University of the Witwatersrand (Wits) will during 2010 announce a new find in the COHWHS which is likely to make a significant contribution to our further understanding of our early ancestors and their relatives. In fact, major advances in modern day genetic studies and various other scientific disciplines are yielding significant new insights into the evolution of our species and our planet in general. There is general consensus today that anatomically modern humans (*Homo sapiens*) evolved in Africa in the last 200 000 years and then spread out into the rest of the world. Modern science is continuously accumulating evidence and creating a remarkably coherent picture of the way our planet has evolved over the last few billion years, including humanity's recent place and evolution in the larger scheme of things (Bonner, 2007).

It was the significant and scientifically ground breaking fossil hominid discoveries in South Africa (the Taung Child and Mrs Ples) in the first half of the twentieth century that put South Africa firmly on the palaeoanthropological world map. Their existence challenged the popularly held view by American and European scientists that the evolution of our species and origins could be traced back to the Asian continent. This unfolded an entirely new picture in the palaeo-anthropological world and postulated Africa as the origin of our species. In all of this, Smuts, as the leading South African politician of the time and prime minister between 1919-1924 and again during 1939-1948, helped to put South Africa on the scientific world map. 'Smuts was especially adept in placing South African scientific achievements in a broader perspective and harnessing them to the purposes of statecraft' (Dubow, 2007: 21).

Bonner expands on this underlying logic:

> The higher stages of evolution were accomplished by those other enterprising hominins who migrated out of Africa into Europe and Asia, and whose subsequent achievements and advancement on the African continent were then credited to a flow of reverse migrations from the north as, for example, Smuts believed was the case with regard to the early civilization of Mapungubwe, in the northern region of South Africa. The technological

> revolution associated with stone tools was still believed to have occurred outside of South Africa and then to have been imported back into the region (Bonner, 2007: 5-6).

The misconception that sophisticated technologies evolved in Europe and elsewhere and were then imported back into Africa has been refuted and disproved. Soodyall, for example, has shown how studies of mitochondrial DNA (mtDNA) of 500 individuals have supported earlier research by Cann (1987) that modern humans can trace their mtDNAs to an African origin, and more specifically, to a common ancestor who lived in Africa approximately 200 000 years ago. This Out of Africa theory which is supported by most evolutionary geneticists and palaeoanthropologists, claims that there was only one region (Africa) where there was a complete evolutionary sequence from earlier human ancestors. The multiregional theory on the other hand says that modern humans have evolved from their *Homo erectus* ancestors in various regions of the world and the reason why humans have remained one species is because of the gene flow between ancient and modern humans. The Out of Africa theory is supported by evidence of mtDNA distribution from populations in different parts of the world, with the common ‘trunk‘ of the mtDNA tree having its roots in Africa (Soodyall, 2007: 86).

Dubow (2007) points out that scientific and other forms of knowledge in South Africa have always been bound up in views of national identity and belonging. It is important that some of these sorts of historical experiences are reflected in the exhibitions in the COHWHS in order to contextualise evolution for both the South African and international museum visitor. They should also reflect the way the teaching of evolution in schools has unfolded historically. This will be expanded on in greater detail in Part 3.

Significant recent discoveries in the Western Cape in South Africa have yielded evidence of early expression of modern human behaviour at least as long ago as 77 000 years, long before it appears in other parts of the world. At Blombos cave, for example, modern humans were already making shell beads by this time, thereby implying symbolic thought with this type of behaviour (Henshilwood, 2009: 32).

- **Education: The Apartheid Years**

The emergence of apartheid policy, imposed upon the rest of the South African population by Malan's Purified National Party in 1948, had a significant impact on the way evolution and Darwinism were perceived. The strongly Calvinist government excluded it from the school curriculum. It paved the way for the entrenchment of ideology of Christian National Education (CNE) to dominate the school system in South Africa in the decades to come. In many ways it further ignored the significant discoveries that had been made up until the end of the Second World War in South African palaeoanthropology, and also further retarded the teaching of evolutionary thought in schools.

> Accompanying apartheid was the implementation of the policy of Christian National Education, which denied evolution, reasserted special creation, affirmed Afrikaners to be God's chosen race in South Africa, and infantilized African society and culture. Important African achievements of the past were neither imagined nor sought (Bonner, 2007: 7).

It was Afrikaner nationalism, the Afrikaner churches and Afrikaner universities that sought to entrench CNE and deny any validity of Darwinism and the theory of evolution despite the significant discoveries and strides that had been achieved in documenting evolutionary development in South Africa (Bonner, 2007: 7).

The policy, therefore, was one of entrenching the dominance and superiority of the white population over the rest of the South African population and to Christianise the black and coloured populations so that they could occupy an inferior place in South African society. Nowhere in the school curriculum was the notion of evolution or Darwinism mentioned or promoted as this was seen as heathen and anti-biblical (Esterhuysen, 2000: 160).

Sadly, this situation still exists to a certain degree today, although major strides in introducing the teaching of evolution in schools have been achieved in post-1994 South Africa with the implementation of Curriculum 2005. Despite the phenomenal fossil discoveries of the 1920s-1940s in the form of Mrs Ples and others, CNE discounted any validity in Darwinism and despised it as being against the teachings of Christ. The majority of the available literature in schools and references to the subject of evolution seemed either to be entirely denialist or sketchy.

Darwinian evolution forms the basis of our current biological knowledge and is therefore indispensable in the school environment. It also assists the learner to make broader conclusions about biology and evolution by providing some intellectual structure and order. If evolutionary thought is excluded from the school curriculum, it can deprive learners of this basic biological framework, and affect undergraduates grasp of biology (Lever, 2002: 39-41).

In examining the issue of the teaching of evolution in schools, Grievers (2002) is of the view that it is not *whether* but rather *what* aspects of evolution should be taught in schools. The Australian Academy of Science has published a biology textbook called *The Web of Life* and yet, in Grievers opinion, this is considered unpractical, unrealistic and arrogant in South Africa (Grievers, 2002: 50). It is these sorts of exclusions in the past that the new NCS sought to address.

- **Education: post - 1994**

When the ANC government came to power in 1994, it stressed the need for the 'reconstruction' of school curricula (Esterhuysen and Smith, 1998: 135). There was clearly a recognition by the new government of the stereotypes and dogma entrenched in the school curriculum by the apartheid state and its predecessors in excluding any form of teaching of Darwinism and evolutionary thought.

In 1998, Esterhuysen and Smith were requested by the then Deputy Director of Curriculum Development in the Gauteng Department of Education (GDE) to explore the teaching of hominin evolution in the classroom. They were required to ascertain how teachers felt about teaching this sensitive topic and to assess whether learners from the younger grades could assimilate the content. This research was carried out both in the classrooms at advantaged and disadvantaged schools as well as on site at Sterkfontein Caves. The lectures provided an outline of the present evidence for and understanding of human evolution, as well as an understanding of the geology of the caves and the process of fossilisation. The available literature and support material was scant at the time. 'Issues relating to change through time, the dynamics of evolution, the fossils, different types of evidence and interpretation: indeed everything

that makes the subject comprehensible, interesting and exciting is ignored' (Esterhuysen and Smith, 1998: 135).

It was not surprising, given the apartheid history of the country and palaeoanthropology, that this research showed that very little had been done in schools to promote evolutionary thought and Darwinism. The researchers found that the support material for teachers wanting to teach evolution was wholly inadequate. The years of CNE, entrenched by the apartheid government, had deliberately neglected and consciously avoided any form of teaching of evolution in schools.

> It would seem then that the most fervent resistance to evolution may have had very little to do with whether a god created the earth or not and more to do with resisting new knowledge and ideas that were rapidly eroding the racial hierarchies that became the accepted norm in South Africa (Esterhuysen and Smith, 1998: 6).

Thus, the problem with introducing human evolution in the South African classroom after 1994 was that it was not only part of a bigger debate about science and faith, but it also brought to the fore fundamentals about identity politics and the perceptions and entrenched stereotypes about black and white. Coupled with this are the gender stereotypes and androcentric messages that they often convey such as the white and hairless male being the more advanced hominin compared to the ape-like and black depictions of early *Homo* as well as the benign and subservient manner in which females are portrayed in reconstructions of the past.

> In image after image, the males hunt, make tools, protect their dependents, practice incipient rituals and solve evolutionary problems. Their gender-specific role is written in their upright physical form, marked out for straightforward and determined action. They are masters of their environment. Meanwhile the females crouch low, nursing children, skinning animals and tending fires — bystanders to male activities (Wiber, 1998: 2).

According to Wiber these gender biases underpin all the literature (Wiber, 1998: 2). It is these entrenched biases that museums dealing with human evolution need to untangle and present in new ways.

Esterhuysen and Smith have pointed out that an important aspect of introducing human evolution in the classroom is the need to deal proactively with these deeply entrenched racial and gender perspectives and stereotypes that have been embedded in the psyche of South Africa's broader population (Esterhuysen & Smith, 1998: 137). In

other words, there is a need to address entrenched stereotypes both within and outside of the classroom.

In her 2002 paper, Chisholm looked at the evolution and education debate in the context of the Africa Human Genome Initiative and the establishment of its South African branch. She identified some of the main questions as follows: first, how do you design a curriculum in light of the constantly developing knowledge that is so much a feature of contemporary life while taking into account different styles of learning and grossly unequal resources and schooling in South Africa? Secondly, how does the NCS deal with evolution, and thirdly, how did the public respond and what does this tell us about South Africa, the NCS, and the education challenges that South Africans face. She goes on to explain that it is important for teachers and materials developers to design a curriculum in a way that takes into account new scientific developments and advancements, and it is equally important to preset the information in a way that challenges and interests the learner (Chisholm, 2002: 52).

According to Chisholm, the curriculum needs to be designed in a way so that it can incorporate new knowledge as it emerges and to address the skills ability of teachers to be able to do that through outcomes-based education approaches which basically embodies flexibility in its approach. The revised NCS does provide space for teachers, teacher educators and materials to teach evolution through learning programmes, and to relate what they are teaching to current events, the interests of learners and evolving knowledge. Another challenge as identified by Chisholm (2002) was whether some teachers and others in provinces outside of Gauteng found that the introduction of human evolutionary teachings in schools was acceptable or not. Evolution was still seen as a controversial subject and some Christian groups opposed not only the concept of evolution but also did not want to expose their children to 'pagan' faiths and cultural practices' (*ibid.*). Invariably, teachers will shape the perceptions of learners.

The year 2008 saw the introduction and incorporation of the teaching of evolution into the Grade 12 Life Sciences Curriculum. It is important that all teachers are made aware of the topic of evolution being taught in the Grade 12 Life Sciences as it is of relevance to all, not only those who teach it. Other teachers need to be made aware of

such issues despite them having objections to teaching evolution. They will need advice about how to handle such situations (NAPTOSA, 2008: 28). This poses a particular challenge for teachers in seeking help to source resources. Many teachers do not have access to good resources, particularly those in the poorer, marginalised and rural schools in South Africa. The state, in implementing the teaching of evolution in schools, needs to support teachers by providing the necessary mentorship and resources required such as access to computers and the internet.

According to the National Professional Teachers' Organisation of South Africa (NAPTOSA), the debate between science and faith is at the root of the controversy surrounding the introduction of evolutionary thought and teaching in schools.

> Those that adopt the *science over faith* viewpoint maintain that evolution is based on scientific research and that therefore evolution is right and faith is wrong if it does not accept that view. Some (like Richard Dawkins) go even further to say that a belief in evolution therefore demands a commitment to atheism. Those of the *faith over science* persuasion reject evolution on the grounds that it contradicts the viewpoint of sacred texts that (a) there was an external, divine, force (usually called 'God') behind creation and (b) that human beings – in particular, Adam and Eve – arrived as fully-fledged creatures, and that all other forms of life were the result of separate acts of creation (Venter, 2008: 28-29).

In many instances, in order to support their own religious beliefs, teachers turn to a middle ground, by espousing Intelligent Design (ID) which claims that God is behind evolution and is the driving force for all existence on the planet.

There are also a number of additional terms and understandings of the science versus faith debate such as Intelligent Design (ID) as indicated above, Scientific Creationism and Theistic Evolution. The controversy of the faith and evolution debate and the introduction of it in schools still persists.

So what exactly should teachers teach when it comes to evolutionary thought? This question has been dealt with in some parts of the world like in the USA and Australia and the following conclusions were reached:

1. Replace evolution with creationism (this has met with strongly negative reactions from scientists);

2. Teach creationism along with evolution (this was thrown out of the courts in 1987 on the grounds that teaching creationism in public schools implies an endorsement of a religious view and therefore violates the US Constitution's prohibition on government establishment of religion);
3. Teach ID (first with God, later without mentioning him) instead of or alongside evolution (this has also foundered, although some states are allowing the two to be taught, with various compromises - e.g. Florida, where they teach that it is merely a 'theory' and students are called upon to debate the two) (Venter, 2008: 29).

In South Africa teachers have their own difficulties. It is clear that teachers in South Africa are faced with a challenge in a society that is multi-religious, multi-cultural and multi-ethnic as well as being the country with the greatest divide between rich and poor in the world and a highly racialised past. In addition to this, teachers come to the classroom with already preconceived views about evolution and are expected to implement the teaching of evolution by following the curriculum, even though it may clash with their own world view.

NAPTOSA has recognized two different contexts for teachers when adopting strategies and approaches for teaching evolution and these may in turn require different decisions. These are:

- *Teacher as believer*: teach evolution as academic content while not endorsing it personally OR follow the Theistic Evolution approach, where you indicate that you can reconcile evolution with your beliefs;
- *Teacher as non-believer***:** teach evolution (which you endorse), but be sensitive to those learners who have religious queries. Get them to accept that they have to learn the theory as content but do not have to endorse it. They are free to practice their religion in terms of the Constitution and to be free from religious prejudice OR expose them to Theistic Evolution as an option (Venter, 2008: 32).

The role of the museum in the context of teaching evolution therefore becomes important as the teacher can take a back seat and allow learners to experience and

learn about evolution in a manner that does not challenge, compromise or confuse teacher belief systems. In this way, the museum can also be complementary to the constructivist approach to teaching as espoused by outcomes-based education and the NCS where learners are able to construct their own meanings from interaction with the exhibits (See Fig.14, p. 39). The following quotation sums this up succinctly:

> Persons are complicated and learners are persons! However, by taking seriously the spiritual, social and other dimensions of learners and by using illustrations, analogies and simulations that work with and around these and by appropriately relating science and religion, learners can be more readily helped to be open to the merits of the theory of evolution (Anderson, 2008: 40).

- **The National Curriculum Statement: Knowledge Outcomes**

The NCS is a means whereby education in South Africa can and should ultimately align with the values and objectives of the Constitution and provides a basis for curriculum transformation and development in South Africa. The Constitution states that 'everyone has the right…to further education which the state, through reasonable measures, must make progressively available and accessible'. The National Curriculum Statement for Grades 10 - 12 lays a foundation for the achievement of these goals by stipulating outcomes and standards, and by spelling out the key principles and values that underpin the curriculum (South Africa, Department of Education, 2005: 2).

The National Curriculum Statement is underpinned by the following principles:

- Social transformation
- Outcomes-based education
- High knowledge and high skills
- Integration and applied competence
- Progression
- Articulation and portability
- Human rights
- Inclusivity
- Environmental and social justice
- Valuing indigenous knowledge systems
- Credibility, quality and efficiency

The following competences are addressed in the Life Sciences Curriculum:

- Scientific enquiry and problem solving skills
- Construction and application of Life Sciences knowledge
- Understanding of the interrelationship of Life Sciences, technology, the environment and society; and of different related attitudes and values.

In an outcomes-based curriculum a subject is broadly defined by learning outcomes and not only by body of content, and in the South African context, the learning outcomes should lead to the achievement of critical and developmental outcomes. Learning outcomes are defined in broad terms and there is flexibility in allowing for the inclusion of local sources. A learning outcome is a statement of an intended result of learning and teaching and describes knowledge, skills and values that learners should acquire by the end of the Further Education and Training (FET) band. The critical and developmental outcomes in turn inform the learning outcomes that are set for each subject in the NCS and therefore inform the learning, teaching and assessment process in Life Sciences. The learning, critical and developmental outcomes as outlined in the NCS are as follows (South Africa, Department of Education, 2005: 10):

LEARNING OUTCOMES	**CRITICAL OUTCOMES**	**DEVELOPMENTAL OUTCOMES**
LO1: Scientific inquiry and problem solving skills	**CO 1:** Solve problems, decision-making and thinking **CO 4**: Collect, analyse, organise and critically evaluate information **CO5**: Communicate effectively using visual, language, symbolic and other modes	**DO**: Reflect and explore a variety of learning strategies
LO2: Construction and application of Life Sciences knowledge	**CO6:** Use science and technology effectively and responsibly towards environment and people **CO3:** Organise and manage themselves and their activities responsibly and effectively **CO7:** Demonstrate understanding	**DO2:** Particpate as responsible citizens in the life of local, national and global communities **DO4:** Explore education and career opportunities

	of the world as a set of related systems by recognizing that problem solving contexts do not exist in isolation	
LO3: Life Sciences, technology, environment and society	**CO2:** Work with other as members of a team, group, organisation and community **CO6:** Use science and technology effectively and responsibly towards environment and people	**DO2:** Particpate as responsible citizens in the life of local, national and global communities **DO3**: Be culturally sensitive across a range of social contexts **DO5:** Develop entrepreneurial opportunities

It is within this context of the NCS that the exhibits at Maropeng and Sterkfontein museums will be evaluated.

- **Grade 10 and Fossil Studies**

It is important to reflect here on the new Grade 10 syllabus as the section on fossil studies has been moved to this grade from the Life Sciences Grade 12 curriculum and has been implemented in this grade from January 2009. Since the study of fossils is critical to an understanding of hominin evolution, the Grade 10 Life Sciences curriculum has been evaluated as it appears under the section on the 'History of Life on Earth' in the curriculum (refer to Annexure 1, p. 80) where the learning outcomes are listed in the left-hand column, while the right-hand column contains an evaluation of each outcome with respect to the exhibitions at Maropeng and Sterkfontein).

- **The Concept of Evolution: Grade 12 Life Sciences Curriculum**

As indicated, both the theory of evolution and human evolution are covered in the Life Sciences Curriculum for Grade 12 under the strand of Diversity, Change and Continuity. In Annexure 2 (refer to p. 85) the learning outcomes and applying Life Sciences in society are listed in the left-hand column, while the right-hand column

contains an evaluation of each outcome with respect to the exhibitions at Maropeng and Sterkfontein.

Figure.3: The fossil of Little Foot in the Silberberg Grotto at Sterkfontein Caves still under excavation by Professor Ron Clarke in 2009

- **Conclusion**

In evaluating the way in which human evolution has been presented in the museums in the COHWHS and whether this acts as a useful resource for teachers and learners, it is important to keep the following in mind:

- This study highlights the educational content of the exhibitions, assessing this against the NCS and its knowledge outcomes
- The historical context of palaeoanthropology and current global and national politics provide a context for the teaching of evolution in South African schools
- Specific changes came into effect in the way evolution was to be taught in schools after the successful establishment of a democratic state in South Africa in 1994

- The phenomenal advances in a number of sciences such as genetics feed into palaeoanthropology and their enormous contribution these make to an advancement of an understanding of our idea of human evolution
- There persistence of common and entrenched misconceptions about human evolution and about race and gender
- Museum exhibits on human evolution have long embodied such misconceptions and stereotypes
- Teachers need help in accessing good resources to assist them to teach evolution in ways that will not compromise their own religious belief systems
- To support their own religious beliefs, some teachers often turn to a middle ground approach when teaching evolution such as the concept of Intelligent Design (ID) which postulates that evolution is an act of God

Figure 4: A learner meticulously taking notes at the Sterkfontein exhibition

3. Museums - Evolution and Public Perceptions

- **Introduction**

Natural history museums and those museums exhibiting the evolution of humans play an important role in educating children and adults about evolution.

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A number of studies have been carried out on evolution, public perceptions and museums, and research is being conducted on museum visitors in order to ascertain how they think about evolution and what can be done to improve visitor understanding through improved exhibits (Spiegel *et al.*, 2006: 69). These studies have found that public perceptions about evolution can be influenced by a variety of factors such as education and media influence, for example.

Evolution is also often not addressed in institutions that consider nature or biodiversity as their primary mission. These include zoos, aquaria and botanical gardens. This hiatus remains a challenge and is surprising since such institutions often use animals to highlight the underlying similarities between humans and other species based on genetics. In order to get children to understand and accept evolution as part of the natural world and as a description of the changes over time in the natural world, there is a need to understand how to incorporate these new findings in displays on human evolution in museums (Weiss, 2006: 3).

Evans has found that children have some prevalent cognitive biases about the biological world which can affect the way they interpret evolution. They understood that species are stable and unchanging which is clearly in contrast with an evolutionary perspective. They also believe that animal behaviour is goal directed and intentional. If these perceptions are not corrected and explained they often persist into adulthood. It was also found that children are exposed earlier on to concepts such as metamorphosis, adaptive variation, fossilation and the like, are the ones most likely to accept major evolutionary changes (Evans, 2006: 11).

If evolutionary teaching is to be understood in its proper context, it is clear that learners should be exposed to these critical building blocks of evolutionary science from as early an age as is possible in the school environment.

Spiegel *et al.* have argued that while museum visitors in the United States show an interest in learning about evolution and in most instances are less likely to reject evolutionary thought than the general public, most of these visitors tend to have a very limited understanding of evolutionary concepts. This is not surprising given the previous point about children not being exposed to key critical concepts that help in an understanding of evolution. Spiegel and her co-researchers claim that a new conceptual framework based on developmental research, has indicated that museum visitors reason about evolution differently depending on the type of organism they are considering. This study has shown that museum visitors apply evolutionary principles to some species-change scenarios, but not to others. These and other studies can lead to a greater understanding of how museum visitors reason about evolution and how museums may use this in improving the effectiveness in their exhibits (Spiegel *et al.*, 2006: 69). In South Africa evolution was not taught under apartheid so the views of most South African adults would not be influenced by what was learnt in school.

Ongoing research about museum visitors and their complex ways of interacting with content in museums can shed more light on how museum visitors interpret and internalize human evolution exhibits. This will, in turn, address how the public understand evolution and also gives insight into museum visitor misconceptions and the way museum visitors distinguish between the evolution of humans and the evolution of the rest of the animal kingdom. Similarly, research on visitor reasoning can and should inform the design of exhibits on human evolution (Spiegel *et al.* 2006: 72-73).

It is important that museums confront concerns about science and religion openly, explaining that while evolution cannot fully explain *why* humans exist on Earth, it certainly does address the causes and mechanisms that explain 'how we got where we are' – in other words, the processes of evolution (Evans, 2006: 13).

- **Museums, Politics and Media**

It is evident that people interpret museum exhibitions through their prior experiences and through various influences such as culture, learned beliefs, values and skills

(Scott, 2007: 3). In evaluating the hominin representations in the museums in the COHWHS, it is important to bear in mind that the museum visitor already comes with culturally as well as politically pre-conceived ideas about evolution and hominin evolution. The image of the caveman with club and the progression from ancient African bestial ancestry to a more progressive, developed and advanced modern European culture is entrenched in the psyche of the majority of museum visitors and ordinary people the world over (see Fig. 6, p. 35). Inherent in this outlook are serious racial undertones that accompany this, whereby white in most instances represents technological advancement whereas black represents backwardness. This will be discussed in greater detail in Part 3 of this report as it is an important element of the way hominin representations in museums are presented and interpreted.

We live in a modern world where communication about evolution is not restricted to books and films such as *Planet of the Apes* (a hit science fiction film of the 1970s and remade in 2001 that depicted a planet where talking apes rule over humans). There is an overload of information via the internet and television channels such as Discovery and National Geographic. This in turn has been shaped by their cultural and historical traits and experiences, their preconceived and learnt biases, religious upbringing and dtraditional Victorian anthropological linear progression perceptions about the evolution of our species.

According to Scott, the museum, is 'less about inspiring wonder than about providing validation' (Scott, 2007: 42). Hominin representations in museums must not only educate but must unpack in a critical way the science of palaeoanthropology. It should reflect the inherent difficulties and challenges faced by the scant record of the human evolutionary tree through the fossils unearthed to date. It should also break down preconceived learned, historical and cultural influences on the way evolution is presented to the museum visitor.

It is clear that powerful influences in modern-day popular culture play a significant role in shaping people's perspectives about human evolution. This is not always a good thing. For example, the popular animated series, *The Flintstones,* shows cavemen alongside extinct creatures like dinosaurs. Such examples of popular culture have left a legacy of misunderstandings of evolution.

Scott makes an important observation about globalisation and the way evolution is understood in general and which is particularly pertinent to this study because of the sterotypes and misconceptions that shroud the theory of evolution and continue to do so in modern times:

> …when we consider the ways evolutionary images circulate or are entrenched, we must consider the effect of globalisation on the mass media images museums visitors bring with them to the museum. As part of a 'global village', museum visitors are impacted by certain images circulating cross-culturally and cross-nationally. Thus, in addition to the many individual and community lenses shaping visitors' experiences, there is also the global lens derived from the images audiences receive in an increasingly globalised world. There is, then, a paradox of information existing everywhere in context and information existing nowhere at all in content (Scott, 2007: 47-48).

This is another challenge that presents itself to museums which attempt to interpret and explain human evolution.

Modern-day museums exhibiting the human evolution story should take into account influences on the museum visitor and attempt to break down the generalisations, stereotypes and misconceptions that that have been created about human evolution during the last century-and-a half. The explanation of the scale of time for example, is crucial to this. A clear understanding or conceptualisation of the difference between 5000, 5 million or 50 million years before the present era is fundamental to any understanding of evolutionary science. This has to be approached in an innovative, enlightening and entertaining manner in order to begin to break down misunderstanding or a lack of understanding of the time-scale of human evolution and distant time. Exhibitions should try to show that ancient human ancestors only started to evolve about 60 million years *after* the last dinosaurs walked the earth and that ancient humans did not share the planet with the dinosaurs but came about after the demise of the dinosaurs through evolution and natural selection over tens of millions of years.

- **The Human Evolution Logo: Marching Forward or Going Backwards?**

  > The single most powerful and persuasive image of human evolution is the linear march of progress, forward-facing men marching single-file toward the future with a progressive gain in stature, brain size, tool refinement, and striding posture, and progressive decrease in hair and skin colour (Scott, 2007: 49).

At the turn of the twentieth century evolutionary theory came to be portrayed as a linear progression from apes to man, from a distant and dark Africa to a modern and enlightened Europe. These notions became reinforced in popular culture and museums. Southern African Bushmen were regarded as the missing link between apes and humans and were regarded as proof of African evolutionary history. Such misconceptions were represented widely in museums throughout the world (Scott, 2007: 55).

Sadly, these imprints are still very much in existence today.

The fact that we shared a distant common ancestor with the modern ape species does not mean that we evolved in a linear fashion or that we evolved from apes as we know them today. There is general consensus in the scientific world that our split occurred some seven million years before the present. And yet the image of the forward-marching hominin as in the official logo of the COHWHS (see Fig. 16, p. 40) creates an impression of a simple progression from bestial and ape-like being to one of modern human being. This shaping and limitation has transcended geographical, racial and generational boundaries and is widespread throughout the world, including in South Africa.

The people in southern Africa who were subjected to public scrutiny and humiliating practices of anthropometry were the Khoisan and in fact all people of colour. The reason for this is that the Khoisan were considered as being at the very lowest rung of the evolutionary ladder - the closest to nature and the highest form of ape, thereby representing civilized man's prehistory. They were fast disappearing and therefore became the focus of intensive research (Coombes, 2004: 210-215). Scientific racism was prevalent during this time and knowledge about genetics and the way it would shape evolutionary understandings in the future was not available at that time.

Stephen J. Gould argued cogently that visual imagery is central to our lives and explained how 'underlying personal and social biases become exposed in the pictures that we use' (Gould, 1995: 41). In other words, according to Gould, the image that we see (for example the linear march of hominins as in the COHWHS logo) 'reflects our social preferences and psychological hopes, rather than palaeontological data or Darwinian theory' (Gould, 1995: 42).

Gould is making an important point here which has an impact on this study because of the biases associated with human evolution.

Gould noted that the most serious misunderstanding was that evolution equates the concept with a notion of progress which is neither supported by the fossil record nor by evolutionary theory. We should bear in mind that Darwin's concept of natural selection only produced adaption to changing local environments and did not postulate a global scheme of progress. Furthermore, Darwin himself was taking a position that was uncommon in nineteenth-century biology by not positioning evolutionary change as inherently progressive but by claiming that in reality lineages alive today owe their existence to luck and good fortune (Gould, 1995: 44-67).

Gould puts it aptly:

> … the false equation of evolution with progress records a socio-cultural bias, not a biological conclusion, and one hardly needs great insight to locate the primary source of this bias in our human desire to view ourselves as the apex of life's history, ruling the earth by right and biological necessity. This fundamental misconception of evolution is strongly abetted by one of the most pervasive of all canonical icons for any scientific concept - the march or ladder of evolutionary progress. But the caricature works because it epitomizes, by simplication and exaggeration to be sure, the essence of what many people understand by evolution: in a word, progress (Gould, 1995: 44).

These canonical icons have 'continued to constrain our thinking, for pictures are such powerful guides to our theorising' (Gould, 1995: 66).

Sadly it has been shown that these sorts of scientific misrepresentations are extremely difficult to supplement once they have become entrenched and, even when new

scientific evidence is found, these old images still remain. (Scott, 2007; Gould, 1995; Wiber, 1997).

- **Race and Evolution in Museums**

> ‘ Why do you care so much where we come from? We come from America.’
> A ten-year black child in one of Scott’s research studies
> (Scott, 2007: 125).

The racial atrocities suffered by indigenous people are well documented throughout the world, ranging from the humiliating experiments carried out on the Khoisan in Southern Africa to the inhumane and cruel acts against Australian Aboriginal people. Nineteenth century ethnographic museums have been complicit in justifying many of these acts using the guise of ‘research’ by acquiring, for, example, life-casts, anthropometric photographs, human remains, and the results of measurements that were produced to conserve the features of non-European ‘races’, which the collectors conceived of as ‘dying out’. (Hoffman, 2009: 4).

> “ By the turn of the twentieth century there was widespread belief in the European scientific community in the direct correlation between physical type and evolutionary status (and consequently intellectual, cultural and social status), and physical anthropology became a dominating intellectual force in South Africa, particularly in relation to the development of the country’s prehistory. It was also the time when ‘racial segregation started to be discussed at a political level’ (Coombes, 2004: 215).

The discovery in 1924 of the significant find of the Taung Child skull did not do much to retard growing Afrikaner Nationalism that would, in later years, intensify segregationist policies that would eventually lead to the institutionalisation of apartheid.

Many respondents in Scott’s study and extensive qualitative research assume a unique connection between black peoples of today and [evolutionary] distant African ancestors and she refers to how ‘museum visitors typically pointed to modern black people as living emblems of our deep evolutionary history, a lazy extrapolation common to nineteenth-century social evolutionism’ (Scott, 2007: 79).

Scott has also pointed out how racial misconceptions are not unique to Euroamericans, and that they are ingrained in popular culture, formal systems of education, and museum institutions. She quotes a black Jamaican visitor to the Natural History Museum in London who wrote that he believed in African ape-men as ancestors 'because we as Africans possess hair texture unique to animals (of far different quality)". Such self-referential responses reveal just how much folk explanations of race and racial characteristics can distort the way people of colour come to see themselves' (Scott, 2007: 80).

So the notion of racial limitations and racial inaccuracies associated with hominin evolution exhibits cuts across the racial divide primarily because the Out of Africa II theory (one that is supported by genetic research and postulates that all of modern humankind can trace a common ancestry to Africa about 200 000 years ago) is not properly understood. The multi-regionalist perspective (a view that various hominins evolved separately and in different parts of the world at different times) is still widely accepted because it offers separate evolutionary moments that are not necessarily related to Africa and does not point to Africa as being the common place of origin for all of modern humanity. The superficial racial differences among modern humans - for example, Japanese eyes, African hair or European skin tone - seem to be the consequence of the evolution of humans in different areas at the same time. However, some see racial differences as fundamental and biological. They use this to create a hierarchy of racial groups, with a range of primitive to advanced. It is important that human evolution exhibits challenge these concepts of racial stereotypes.

Scott's surveys focussed on how people view Africa as the 'Cradle of Mankind' with the vast majority of respondents acknowledging the biological link to Africa but seeing western civilization as essentially more advanced with one visitor explaining that 'mankind has developed outside of Africa to a greater degree'. This epitomises the cultural biases and progress-driven logic associated with evolution tto which Gould refers. The vision of Africa as a troubled continent can therefore influence perceptions, as well as inspire resentment, of Africa's role in prehistory (Scott, 2007: 83).

This multiregionalist perspective could be a result of museums not updating scientific content in line with scientific findings as they happen. The findings in genetics that support the Out of Africa II theory have unfolded primarily in the last few decades and museums need to update their exhibits with this information. Interpretations of human evolution tend to get entrenched and can prove difficult to undo.

There is also the notion that people recognise racial differences as fundamental, and the satisfaction that people derive from such racial dissimilarities (Scott, 2007: 83). This is a reflection of anti-African sentiment and Eurocentrism.

It is precisely these kinds of ingrained and entrenched perceptions that modern-day museums need to untangle about race. These include the concepts of race, about our origins as a species and indeed the Out of Africa II theory. In so doing, museums can begin to dispel the myth of racial differences being fundamental and explain cultural differences with a view to positioning our species as one, with significant cultural differences that have taken root only in the recent past. Art for example, even its most elementary and rudimentary form, existed in sub-Saharan Africa at least as far back as 80 000-100 000 years. This is confirmed by the Blombos Cave and other findings in southern Africa. Indeed, Scott has summed it up nicely by saying: 'Ultimately, abstract Africans and bodily Africans (those confronting visitors in exhibition models, reconstruction images, photographs and real life) are seen differently - the former theoretical brethren, the latter a threatening burden' (Scott, 2007: 90).

It is clear that significant strides have been made in twentieth century evolutionary science, genetics and related disciplines. These, together with the significant hominin fossil evidence found mainly in East and Southern Africa have begun to

> dismantle Victorian notions of human biology culture. Most significantly, throughout the twentieth century, scholars and scientists worked to discredit older theories of race and environmental determinism; as a result, they revealed the concept of race to be biologically insignificant, a social rather than biological construct (Scott, 2007: 90).

In her research at the museums in Kenya, Scott has shown how the achievements of black paleoanthropologists have received less recognition and have been overshadowed by their white counterparts like the Leakeys. Similarly, in other

museums in the world and in South Africa, not enough recognition has been afforded people of colour who have made contributions in palaeoanthropology and other fields. These contributions, whether they be scientific and substantial or less significant and peripheral, are often overshadowed by white and prominent personalities. This issue of race is discussed in greater detail in the analysis section of this report in relation to the exhibits in the COHWHS, arguing for a greater emphasis to be placed on contributions from others as well as from women in science. In this way, museums exhibiting human evolution will, at the same time, begin to break down misconceptions and stereotypes.

- **New Images, Old Perceptions**

But why have museums been so slack in being able to initiate a fresh approach to the way hominin evolution is depicted in museums in order to address and change perceptions and preconceptions about evolution? Perhaps one reason for this is the entrenched biases for locating a European origin for modern humans. Museums have lagged behind by not incorporating into their exhibits the genetic and fossil evidence for modern humans originating in Africa, particularly evidence of sophisticated black modern humans in sub-Saharan Africa some 100 000 years ago being the evolutionary ancestors of all humans today (Scott, 2007: 94).

These and other factors remain a challenge for the museums in the COHWHS when presenting exhibits and explanations of human evolution.

South Africa has the opportunity of reframing the way hominin exhibitions are represented by using a shared common ancestry as postulated in the Out of Africa II theory, taking into account historical, political, religious and cultural baggage that have dogged human evolution exhibits throughout the world. South Africa could come up with uniquely South African and African ways of presenting human evolution in museums. This complexity of politics is all too pervasive in human evolution exhibitions which often depicts certain cultures, albeit unintentionally, as evolutionary privileged and advanced.

Both the racial and spatial implications of human evolution come out strongly in the linearity model, which is also discussed in greater detail in the analysis section in Part 3 of this report.

It therefore does present unique opportunities and challenges for the museums in the COHWHS to be able to look at hominin evolution from a uniquely South African and African perspective, and to forge new ways of constructing this knowledge and presenting it in a refreshingly new and pioneering way. For example, the reverence that is afforded the icon of South Africa and indeed the world, Nelson Mandela, can, for example, be likened to the phenomenal survival skills of our early ancestors, from the early *Australopithecines* to the later *Homo* species leading to our very own *Homo sapiens sapiens*. In other words, a parallel can be drawn between the hardships faced by our ancient ancestors in ancient environments and their ability to overcome these against the hardships and sacrifices that Mandela and his peers had to endure in the fight against apartheid. If we can revere someone who was incarcerated for 27 years only to emerge as a global iconic symbol and leader who led his country to freedom, then surely a similar sort of reverence is deserved by our earliest ancestors who would have had to overcome a plethora of circumstances and hardships to triumph and survive in often hostile environments with competition from similar and other species. They would also have had to face factors such as climatic changes and the tenacity to adapt to that, and numerous other survival challenges such as disease and competition from rival hominin and animal species.

Another important aspect that should be taken into account by museums is the assumptions that are made by them about who their visitors are likely to be and how they will interpret their displays. Some responses to questions by black museum visitors challenge many of the key assumptions made by natural history museums and their visitors (Scott, 2007: 113). In the South African context reference must be made to how the apartheid state, and even the pre-1948 segregationist state, managed to downplay the significant strides made by the discoveries of the Taung Child and Mrs Ples in the last century.

It is also important that museums take into account socio-economic, cultural, political and other institutional factors when explaining human evolution – factors which could

negatively impact and influence museum-going by black visitors and which could exacerbate a situation of a lack of a museum-visiting culture among many black people. Museums are sometimes viewed as white institutions by black communities and can be seen as inherently racist. The hominin linearity model as well as the multi-regionalist perspective must be contextualised since the way black museum visitors respond to narratives and exhibits of human evolution should not be taken for granted and are neither simplistic and certainly not predictable. 'Museums must do more to recognize black people in particular as not simply passive origins icons but as important participants in the creation of origins ideologies' (Scott, 2007: 128).

There is a need for new and innovative ways of portraying human evolution exhibits, not simply as linear and goal-oriented, with more potent and realistic modern day-approaches to the displays that will capture the imagination of both young and old. In this way, it will assist in a move away from viewing museums as a white invention and a view of evolution from a white perspective, to one that gives meaning to all visitors. In so doing, it could then command the respect that human evolution and its remarkable story deserves from both black and white museum visitor alike. It is the "colour-coded yardstick of evolutionary progress" that needs to be broken down in museums - the notion of progress from a black, dark and African prehistory to an advanced and white modern civilization so often depicted in popular culture and entrenched in the public mind (Scott, 2007: 148).

What more can museums depicting human evolution and its complexities do to make the subject more meaningful, understandable and educational for the museum-going public? It is important that museums understand their visitors, their specific cultural and historical backgrounds and the way the general public understand and interpret the human evolution story.

Museums should also work towards demystifying the science and the way it is perceived in popular media. While it is important to give museum visitors information about their evolutionary past in the spirit of outcomes based education within the parameters of a democratic Constitution, it is far more important to give people the tools to think critically about evolution. Scott (2007: 149) suggests the following ways to achieve this:

- Taking visitors behind the scenes and giving them insight into how reconstructions and dioramas are actually produced
- Evolutionary brain-storming where visitors are encouraged to create their own scenarios and to imagine the future of evolution
- By presenting the *processes* of evolution and not just the *products* of it

The extent to which this has been achieved in the museums in the COHWHS will be elaborated on in Part 3.

There is a need for modern-day museums that deal with human evolution exhibits to explain in simple and greater detail the biological and cultural aspects of modern humanity thereby encouraging and educating people on the course of evolutionary history. In addition to this it is important to include new visual images associating dark skin with modern human behaviour, thereby representing humans and their diversity at the so-called end of the evolutionary story. In so doing, it will encourage museum visitors to reconstruct and picture the modern human evolution story in a different light – one that deviates from the old and often dogmatic understanding of human evolution – to one that incorporates explanations of Africa's role in this story as is evident from the Out of Africa II theory. This will stimulate the writing of a new story of modern human evolution and encourage different thinking around this.

These are the sorts of changes we need to start seeing in natural history museums that exhibit human evolution. So instead of learners, for example, pointing to the dark skin or 'funny look' of hominin displays, the exhibits should create a reverence and admiration for early beings. This can only be achieved through an explanation of human evolutionary history which takes into account the stereotypes and misconceptions that have been associated with human evolution exhibits in the past, some of which are very much alive today and to turn these around in a manner that will engage the younger generations. A proper explanation of the Out of Africa II explanation needs to contextualise the South African situation, to show that culture did not evolve in Europe but had existed a long time previously in Africa, and that this was the beginning of human culture.

In the case of South Africa, this presents both a challenge and an opportunity to be able to present human evolution exhibits in a new way. The question is whether the museums in the COHWHS are confronting these issues. This will be discussed in the analysis part of this report.

- **Summary**

In analysing the museums in the COHWHS, cognisance will be taken of the fact that certain public perceptions exist in the way human evolution is perceived; that politics, history, the media and socio-economic factors, amongst others, influence the way human evolution is perceived by the broader public; and that there are inherent historical racial and gender stereotypes associated with human evolution exhibits. These contributing factors will be taken into account when analysing the museums in the COHWHS. The following elements will also be analysed in the context of the NCS and its knowledge outcomes. These criteria were identified as some the crucial elements of the exhibition and agreed to by my supervisor, Dr Amanda Esterhuysen.

Table 1: Key issues identified in the evaluation of the exhibits in the Cradle of Humankind World Heritage Site in relation to the National Curriculum Statement

Understanding the processes of evolution
The geological timescale
Mass extinctions
The Human Genome Project
The Out of Africa theories
Stereotypes (both gender and racial) associated with human evolution exhibits
Misunderstandings associated with human evolution
The role of South Africa and Africa in world palaeoanthropology
The stereotyping of Africa as backward and primitive
Explaining that Africa gave rise to humanity

PART 2: ILLUSTRATIONS

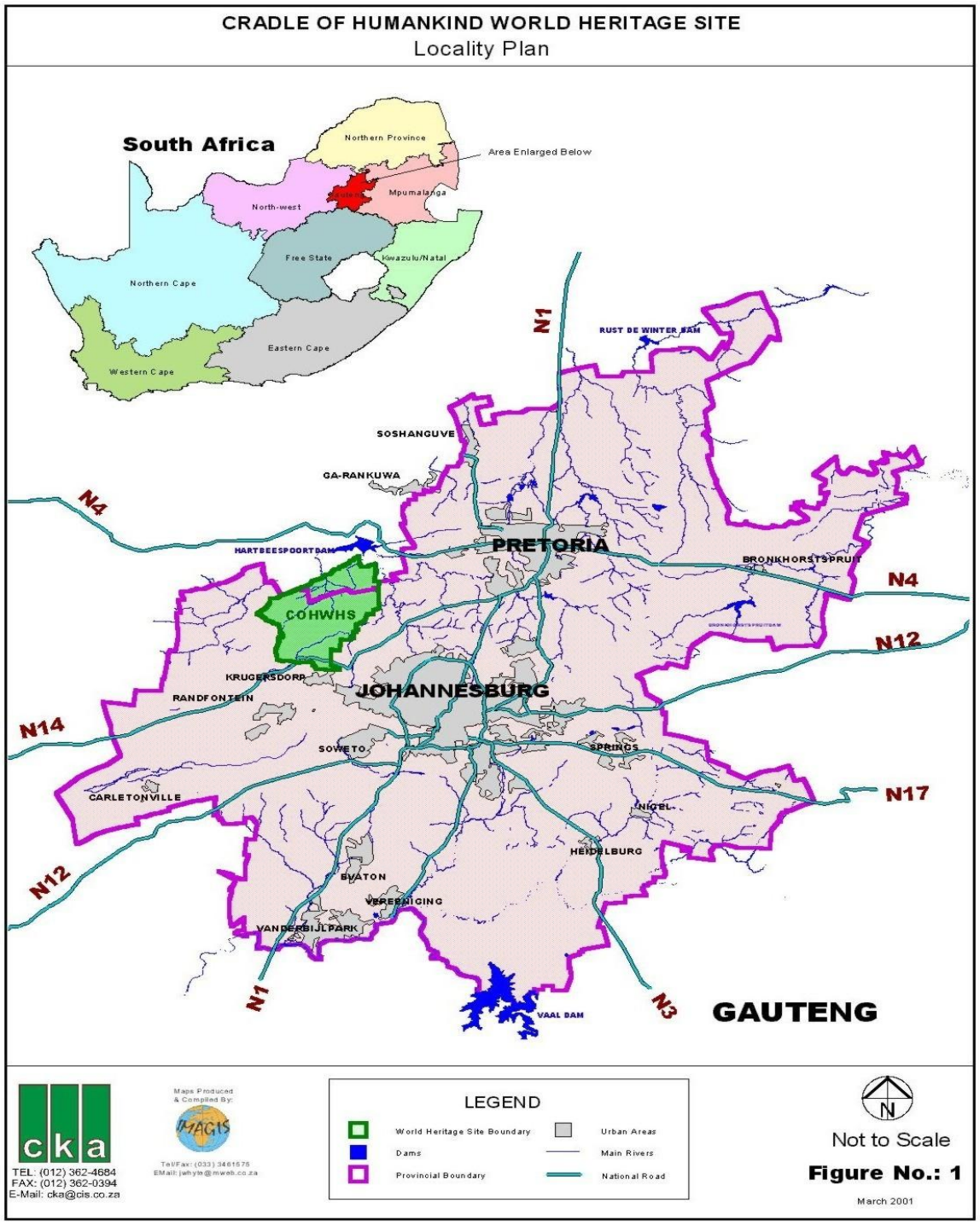

Figure 5: Location of the Cradle of Humankind World Heritage Site, South Africa

Graphic courtesy Cradle of Humankind World Heritage Site Management Authority

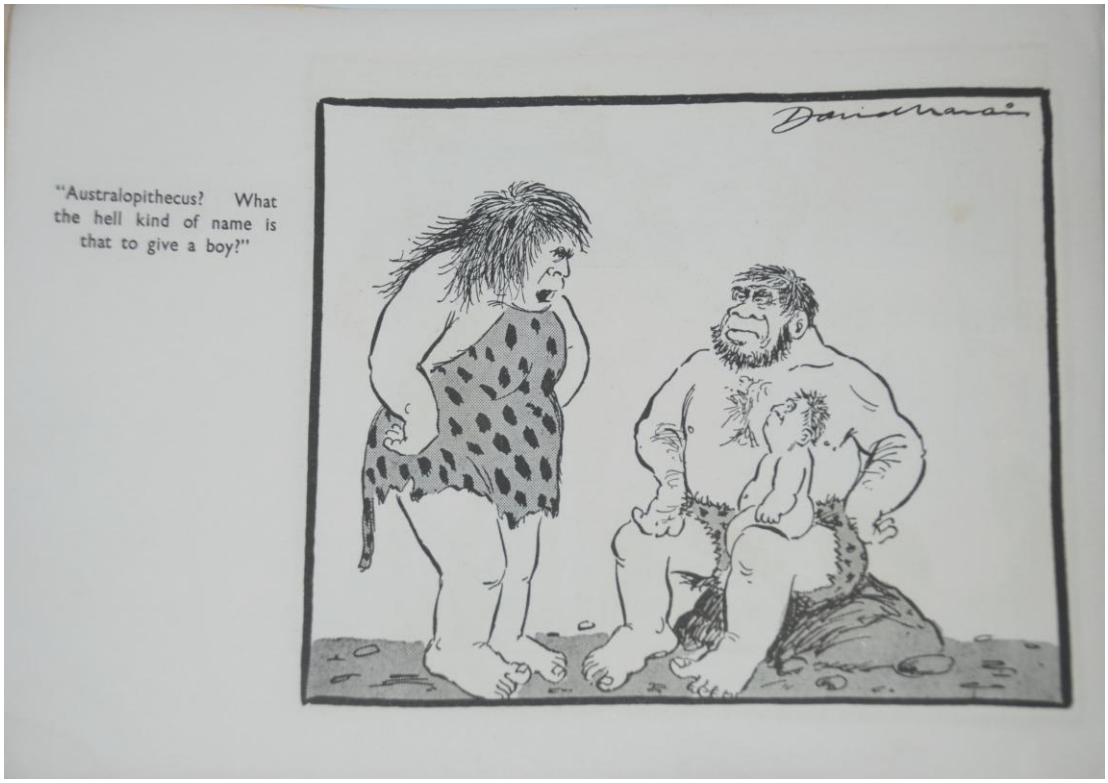

Figure 6: Cartoon by David Marais, 1962. I Got a Licence: A New Collection of Cartoons

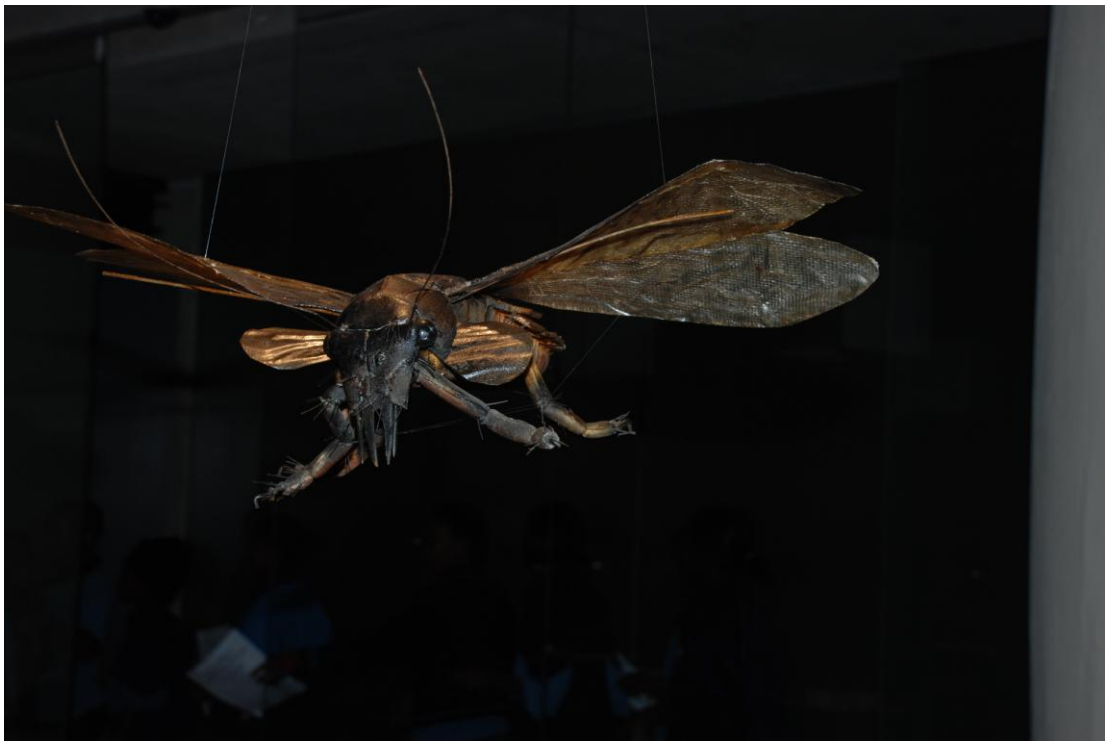

Figure 7: Re-creation of an ancient extinct insect species, Maropeng

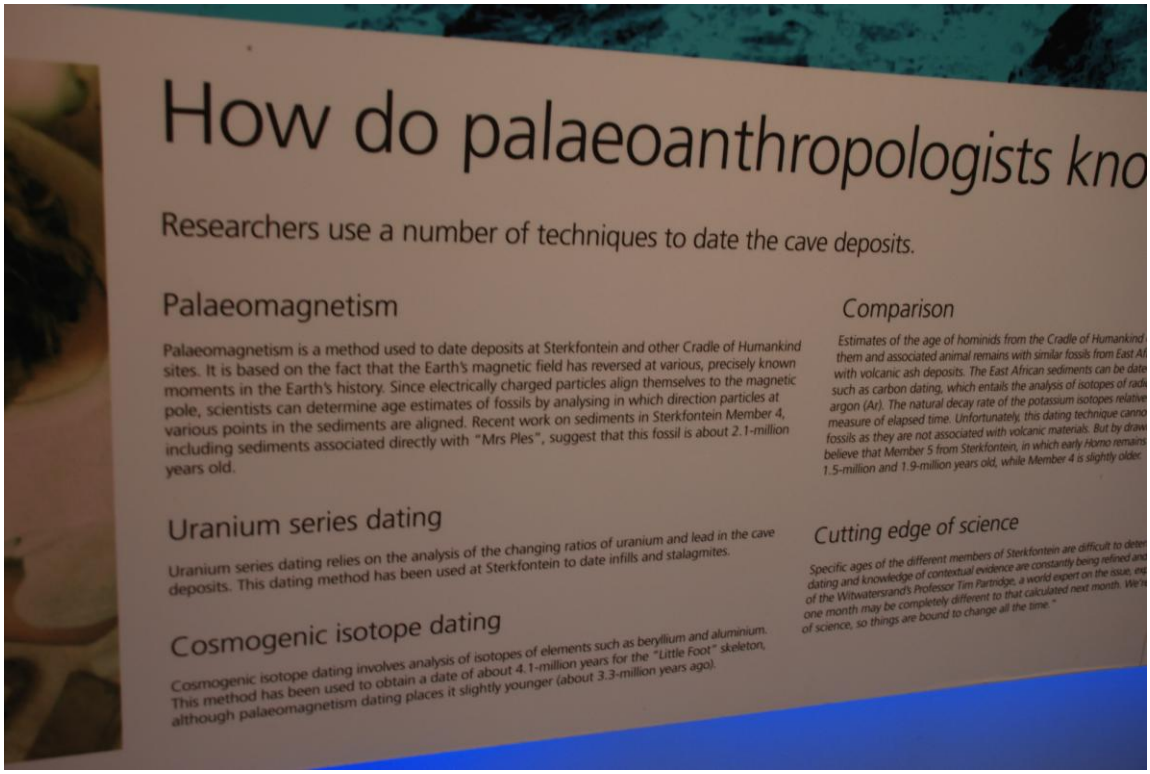

Figure 8 : An explanation of fossil dating techniques at Sterkfontein

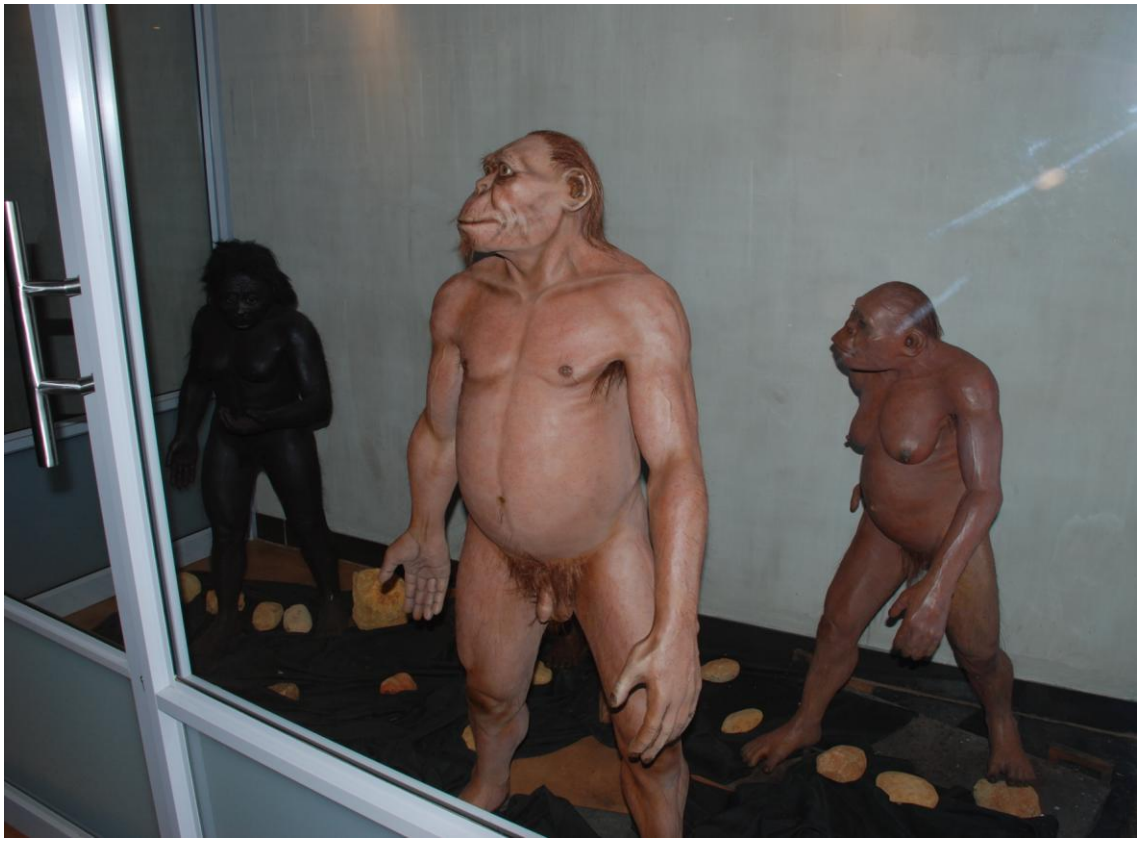

Figure. 9: Models of hominins at the entrance at Maropeng

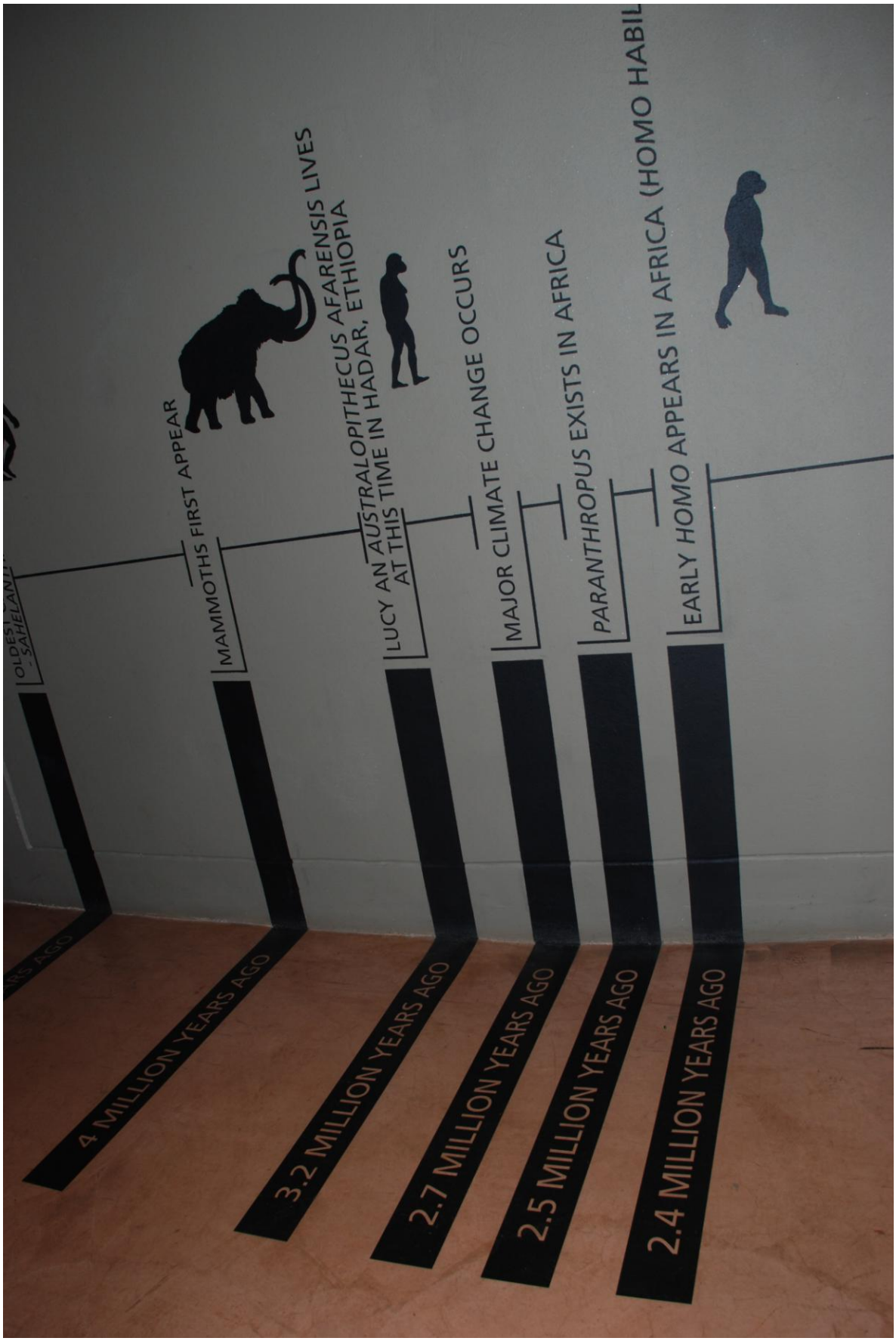

Figure 10: Timeline explanation on the ramp to the boat ride experience at Maropeng

Figure 11: An explanation of the Out of Africa II theory for the populating of the Earth by humans, Maropeng

Figure 12: Reference at Maropeng to all modern humans being genetically very closely related

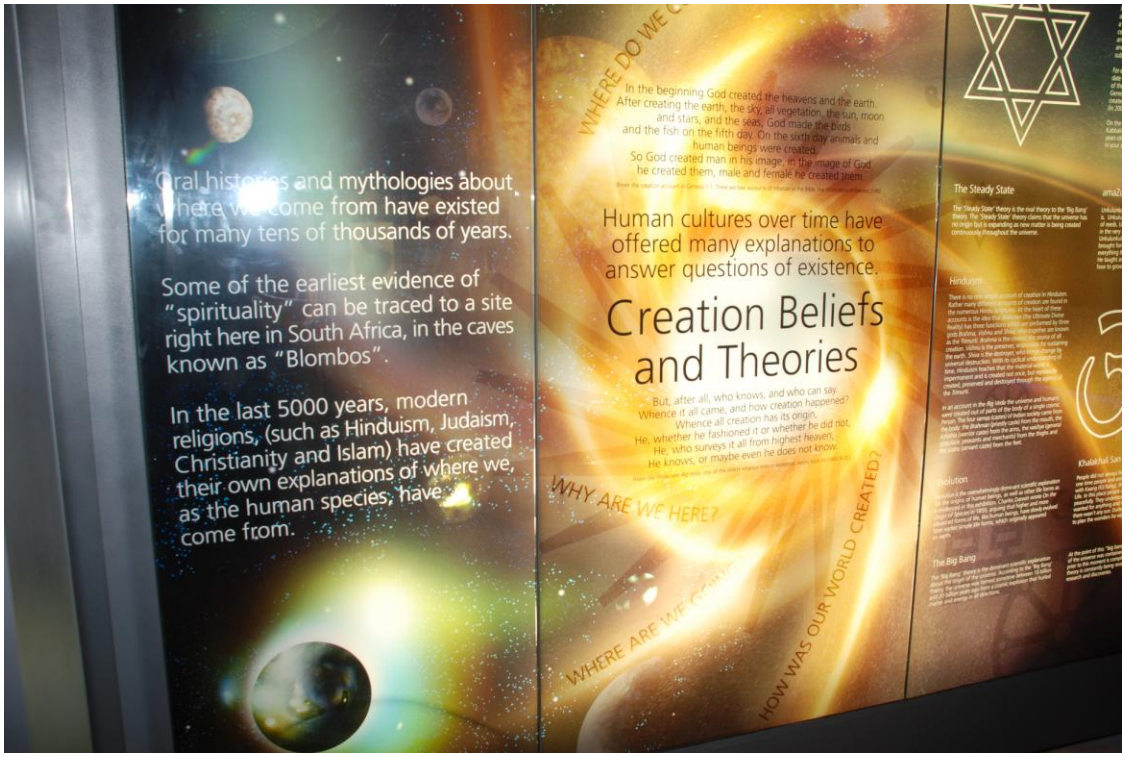

Figure 13: The Religion Wall at Sterkfontein

Figure 14: Learners interacting with the displays in the main exhibition area at Maropeng

Figure. 15: Early life forms in the exhibition at Sterkfontein

Figure 16: The official Cradle of Humankind World Heritage Site logo

Courtesy of the Cradle of Humankind World Heritage Site Management Authority

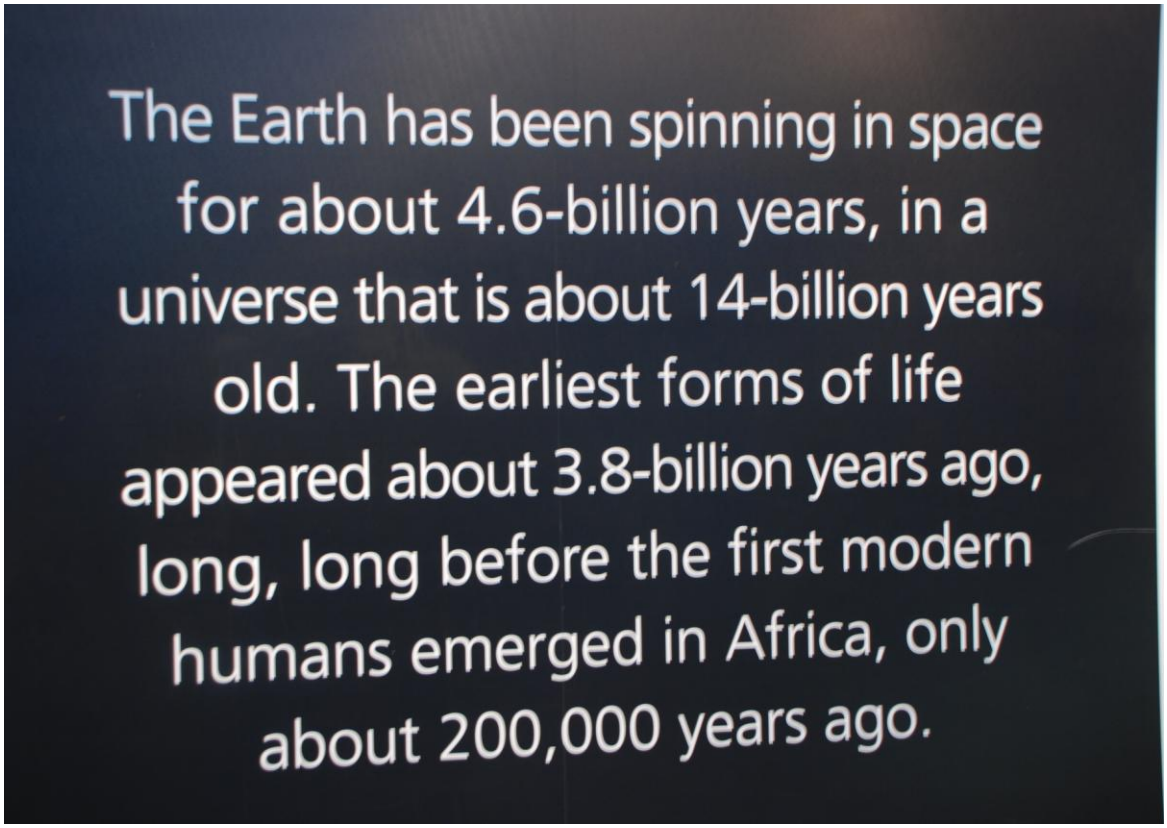

Figure 17: A textual representation of the geological timescale in the exhibit at Sterkfontein

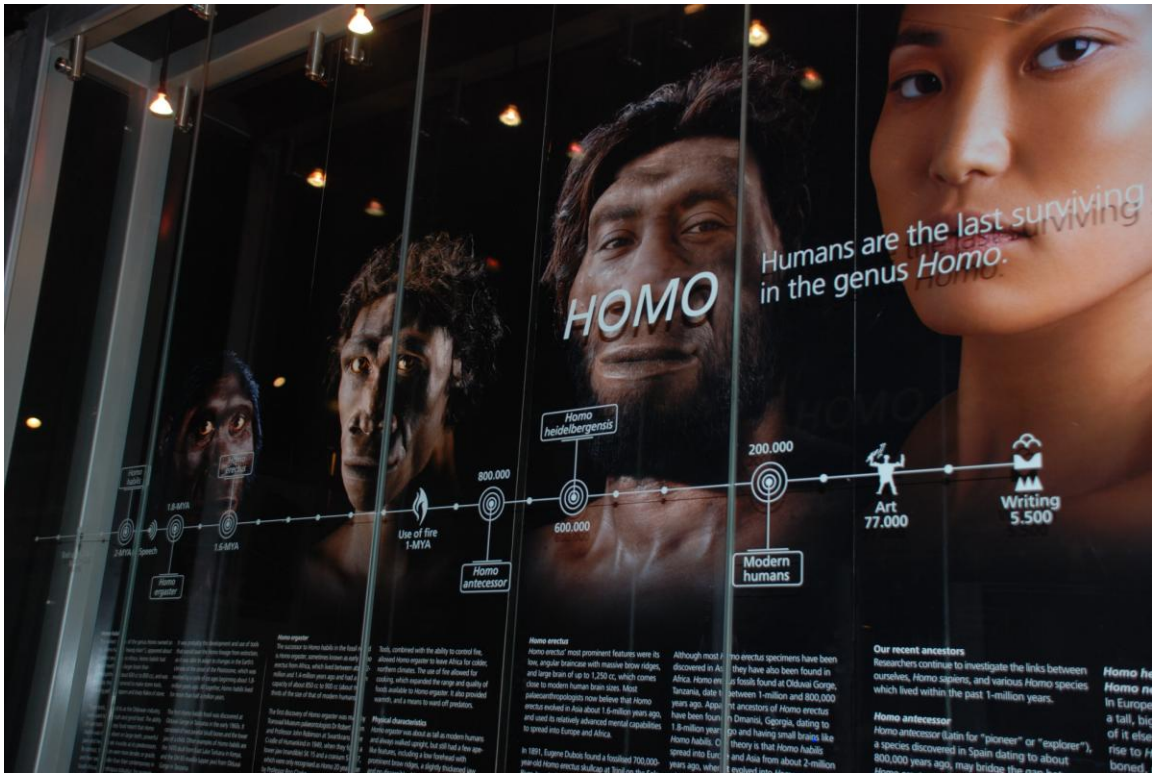

Figure 18: Depiction of the timeline in the hominin display at Sterkfontein

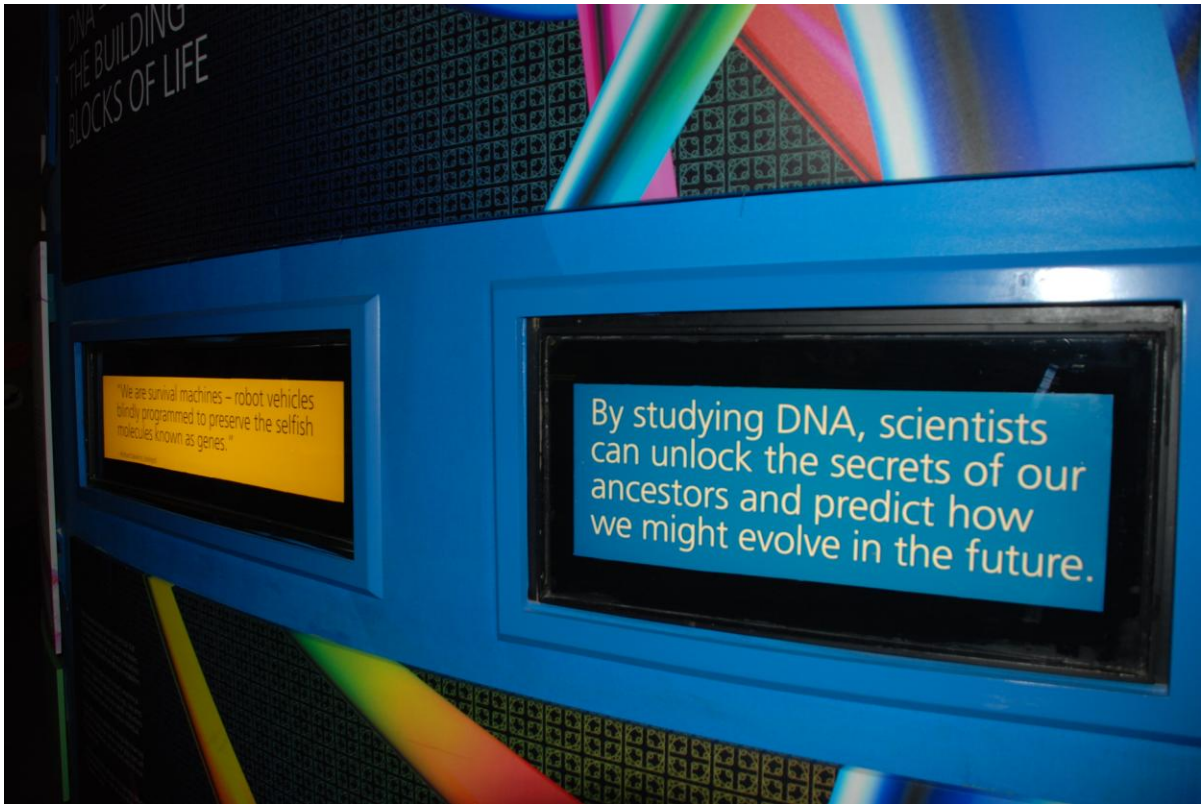

Figure 19: The DNA wall in the main exhibition area at Maropeng

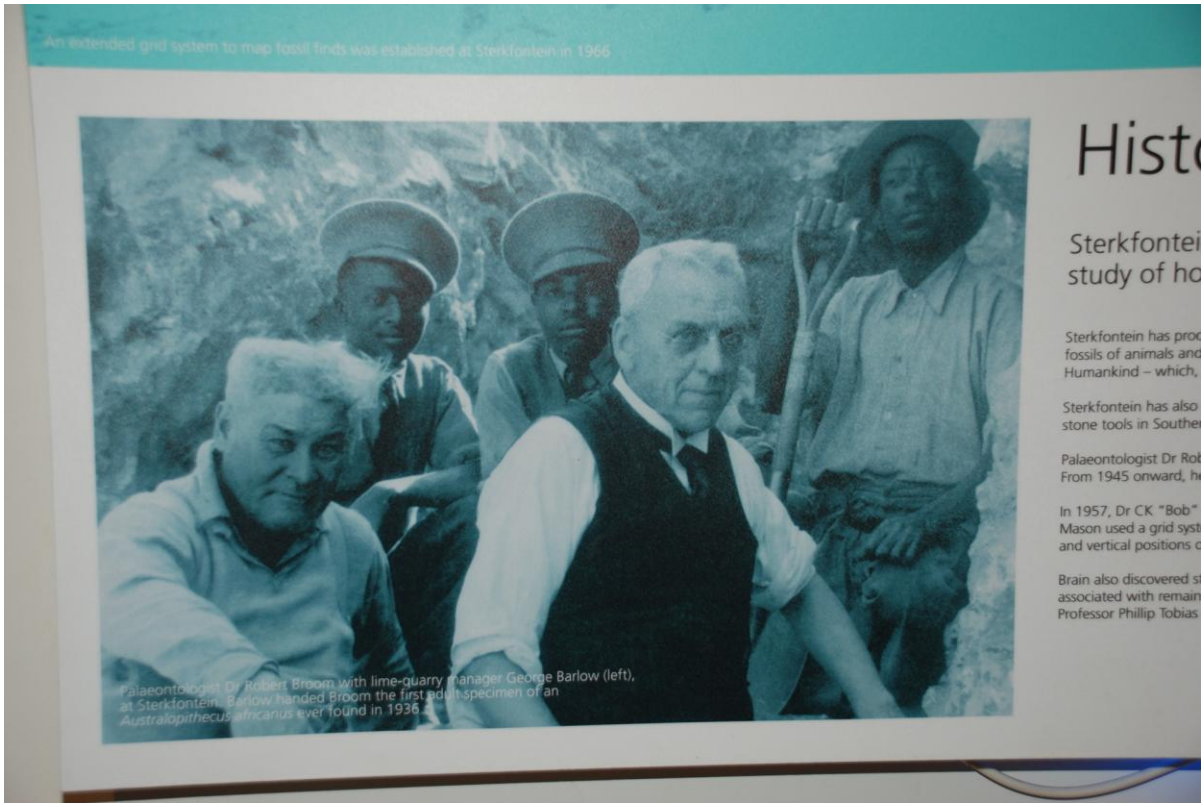

Figure 20: The depiction of a white scientist, mine manager and black mineworkers in the exhibition at Sterkfontein

Figure 21: The Stone Tool display at Sterkfontein is text-heavy and difficult to read because of inappropriate lighting and positioning

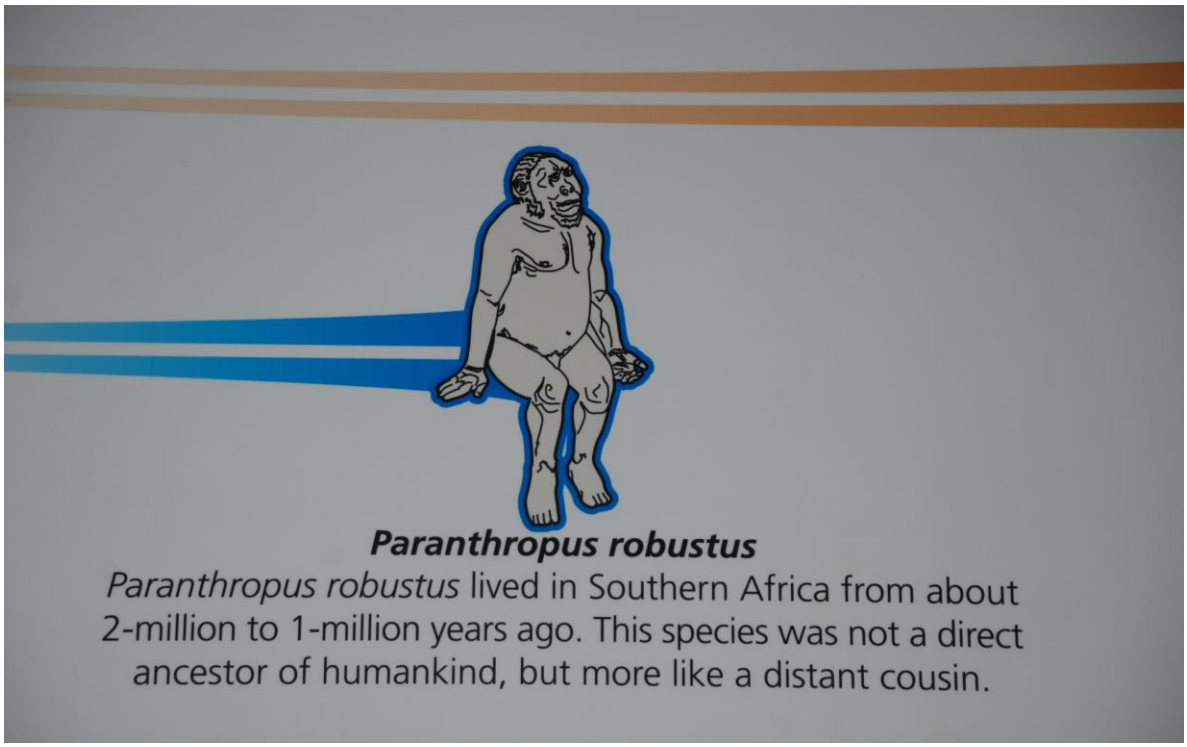

Figure 22: An exhibit in the Meet the Family display at Maropeng, distinguishing other hominins from those of the ancestors of humans

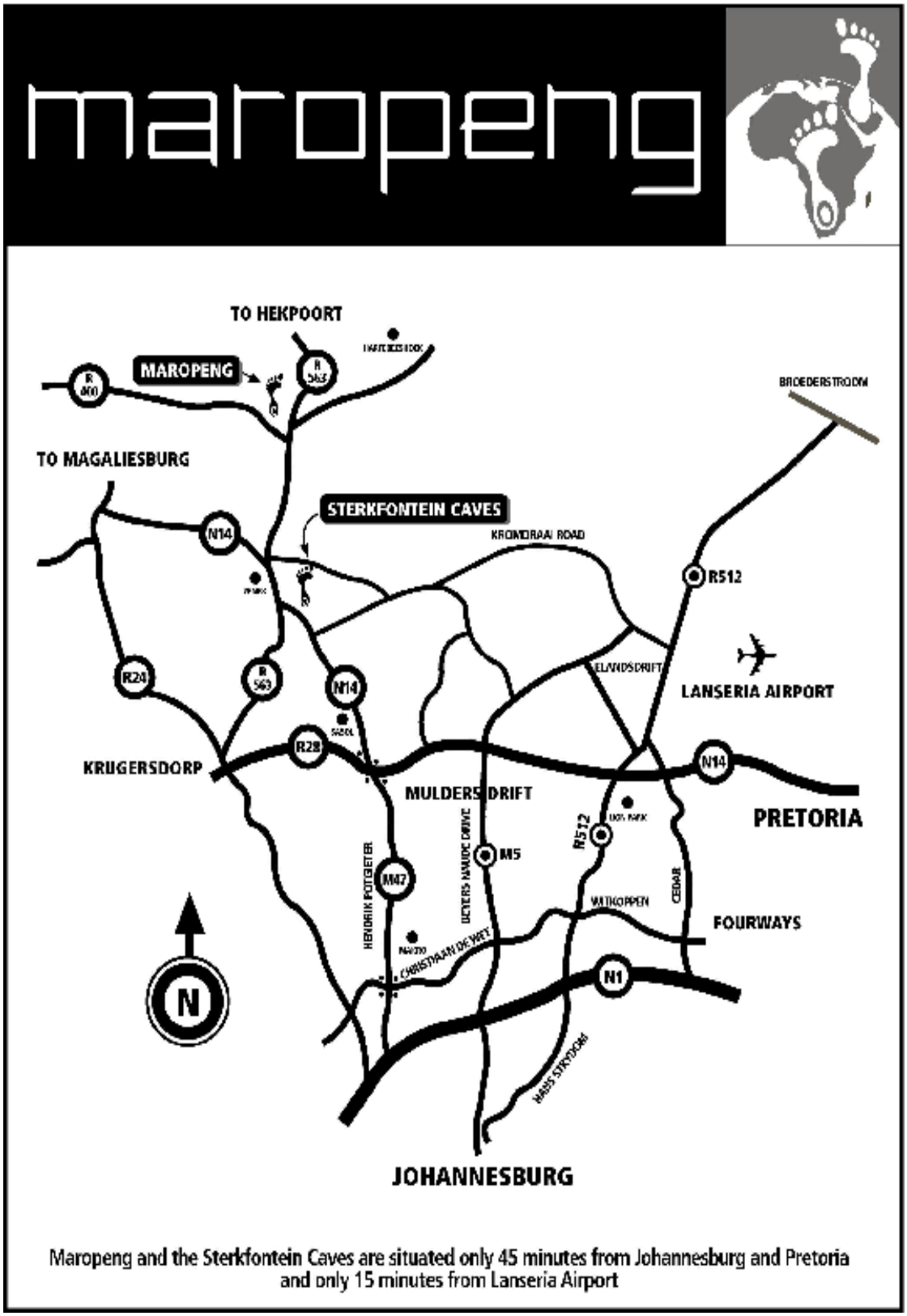

Figure 23: Location of Sterkfontein and Maropeng in relation to Johannesburg and Tshwane (Pretoria) Courtesy of Maropeng a' Afrika Leisure (Pty) Ltd

PART 3: ANALYSIS OF THE MUSEUMS IN THE CRADLE OF HUMANKIND WORLD HERITAGE SITE: STERKFONTEIN AND MAROPENG

- **Introduction**

Given its unique racialised historical experience as a nation, South Africa is uniquely poised to be able to address human evolution explanations in new ways. This can be achieved within the context of the significant role that the country has played and continues to play in world palaeoanthropology. The COHWHS, with its wealth of fossils (both discovered and yet to be discovered), can lead the way in presenting human evolution in new ways that challenge existing orthodox approaches, many of which continue to perpetuate stereotypes and misconceptions often associated with human evolution exhibits. This has been highlighted by research undertaken by Scott and others in the first part of the report.

Instead of presenting only the scientific explanations of hominin evolution, the exhibitions in the COHWHS should also contextualise for the visitor the social, cultural and political aspects which have shaped South African history. This can attempt to break down entrenched stereotypes and misconceptions long associated with earlier human evolution exhibits. This is necessary in order to start to reverse the trend of how human evolution has been understood and interpreted in the past.

The linear march towards progress that is so dominant in the psyche of the general public is one example of this and will be discussed in more detail later on in this section.

The findings of new and ongoing research into how museum visitors interpret human evolution exhibits (as indicated earlier on page 20) should be instrumental in informing exhibits on human evolution.

- **Method of Analysis**

In evaluating the exhibits in the COHWHS and in analysing whether they meet the criteria as set out in the NCS, whether they act as a resource for teacher and learner

and whether stereotypes and misconceptions are confronted, the following process was followed:

A list of key criteria to be evaluated was identified taking into account research that had been carried out previously on human evolution exhibits, and in particular, the study by Scott (2007). The NCS was also examined, particularly the section of the curriculum that looks at fossil studies which form part of the Grade 10 Life Sciences curriculum as well as the more substantial section on evolution as outlined in the Grade 12 Life Sciences syllabus. The key issues were identified in Table 1 on page 33.

With these criteria in mind, I walked through both museums in the COHWHS, starting with the exhibition at Sterkfontein, examining and studying each section of the exhibits as a unit, including the different zones at the Maropeng exhibition. In order to substantiate any discussion, evaluation or criticism of the museums, I undertook to photograph as much of the exhibits as possible in order to assist with this process. Some of the photographs were presented in Part 2 of this report.

The exhibitions were also analysed bearing in mind the outcomes-based approach of the NCS and the new constructivist approach to teaching and learning, as well as the broader objectives of the South African Constitution. I questioned whether the exhibitions met the cririea as set out in the NCS, whether the interactive aspects of the exhibits support of the constructivist approach to learning and whether the exhibits challenge stereotypes associated with human evolution exhibits.

The exhibitions were also analysed from my perspective as a South African of Asian descent. It is neither an analysis from a purely scientific perspective, nor is it an evaluation from an educationist, but is rather reflective of the view of an ordinary South African citizen who has a keen interest in palaeoanthropology and the evolution of humans, and how evolutionary thought is being taught in schools in South Africa, particularly within the context of the NCS.

The establishment and opening to the public of the museums at Sterkfontein and Maropeng in the COHWHS offered an opportunity to provide supportive and good

scientific information that is missing in school textbooks. It also created an opportunity to present the relevant sciences in new and exciting ways, thereby offering an opportunity to address the stereotypes and misconceptions so often associated with human evolution exhibits.

The analysis will also attempt to unpack whether the museums in the COHWHS provide an adequate resource for learners and teachers with regard to the Life Sciences Grade 12 curriculum and whether the exhibits complement the knowledge outcomes of the NCS.

- **Sterkfontein**

Sterkfontein Caves is a well-established scientific site and popular tourist attraction in South Africa and is situated within the COHWHS (refer to Fig. 24, p. 48). The site has been attracting large numbers of visitors since its refurbishment and re-opening to the public in September 2005. It boasts a new hominin evolution exhibition centre situated adjacent to the longest single palaeoanthropological dig in the world. It has yielded some of the most significant hominin fossils ever found to date, such as Mrs Ples and Little Foot, as well as a host of other important hominin fossils and other extinct faunal species. Guided cave tours and the hominin evolution exhibit at Sterkfontein are the main drawcards for tourists to the site. People visit Sterkfontein Caves to engage with the internationally significant landscape and fossil collection, experience the caves and fossils and the information that is specific to the site and to se first hand archaeologists and scientists at work in the fossil preparatory laboratory. Also significant for the visitor is experiencing a sense of this site as being where distant relatives of humankind once walked the earth and in so doing, realizing the authenticity of the site (Cradle of Humankind World Heritage Site, 2004: 5).

The site is owned by the University of the Witwatersrand (Wits) and is managed, together with the Maropeng Interpretation Centre Complex (ICC) on behalf of Wits and the Gauteng Provincial Government (GPG), by Maropeng a'Afrika Leisure (Pty) Ltd. This is done as a tourism Public Private Partnership (PPP). In addition to the hugely popular cave tour, the site also boasts the official hominin exhibition centre in the COHWHS, as well as a restaurant and conference facilities. Both Sterkfontein and

Maropeng are the official visitor centres in the COHWHS. The almost complete skeleton of the more than 3 million year old hominin fossil, Little Foot, still lies buried in the Silberberg Grotto in the Sterkfontein Caves and an audio-visual display of the actual excavation and narrative by Professor Ron Clarke can be viewed by visitors at both Sterkfontein and Maropeng.

Fig 24: An aerial view of the Sterkfontein Caves site with the exhibition centre, restaurant and conference facility in the foreground and the actual caves in the top right corner
Photo courtesy of the Cradle of Humankind World Heritage Site Management Authority

- **Maropeng**

The Maropeng Interpretation Centre Complex (Fig. 25) was opened to the public by the then President Thabo Mbeki in December 2005. It is situated on 100 hectares of land on the outskirts of the core area and UNESCO-declared site on land that was donated to the GPG by Standard Bank of South Africa. The site, like Sterkfontein, is managed on behalf of GPG and WITS by the private partner in the PPP agreement, Maropeng a' Afrika Leisure (Pty) Ltd.

Fig 25: The entrance to the Tumulus Building at Maropeng, Cradle of Humankind World Heritage Site
Photo courtesy of the courtesy the Cradle of Humankind World Heritage Site Management Authority

Fig. 26: The Tumulus Building at Maropeng represents an ancient burial mound upon entering and a modern architectural spectacle upon exiting (photo courtesy of the COHWHS MA)
Photo courtesy of the Cradle of Humankind World Heritage Site Management Authority

Maropeng is the orientation showcase and gateway for the whole of the COHWHS and is the anchor and pivot of the whole project. The visitor experience is meant to be adventurous and inspirational, thematic and theatrical as well as wide ranging and more generalist to accommodate a wider audience. It also acts as a filter to Sterkfontein Caves and other cave sites to protect them from overexploitation from visitation (COHWHS, 2004: 5).

Maropeng is meant to draw visitors to the exhibition centre and to the broader COHWHS tourism catchment area, and for them to be inspired through a sense of discovery and exploration of the past and the future. This enables visitors to reflect on as well as experience adventure and history by engaging in hands-on scientific analysis and displays (COHWHS, 2004: 5).

Maropeng also contains a hotel, learners' accommodation, events amphitheatre, conference centre and restaurant. The building is an iconic architectural design of world class significance that represents an ancient burial mound. The building boasts a ramp descent that leads to an underground boat ride experience that transports the visitor back in time to when Earth formed some 4.6 billion years ago. The visitor then proceeds through a 'vortex' experience which is meant to give one a sense of time and space. Next, the visitor enters the main exhibition area (refer to Figs. 26-28, pp. 49-50). Future plans for Maropeng and the COHWHS include a network of hiking trails that aim to criss-cross the site and a range of other visitor attractions and infrastructure developments.

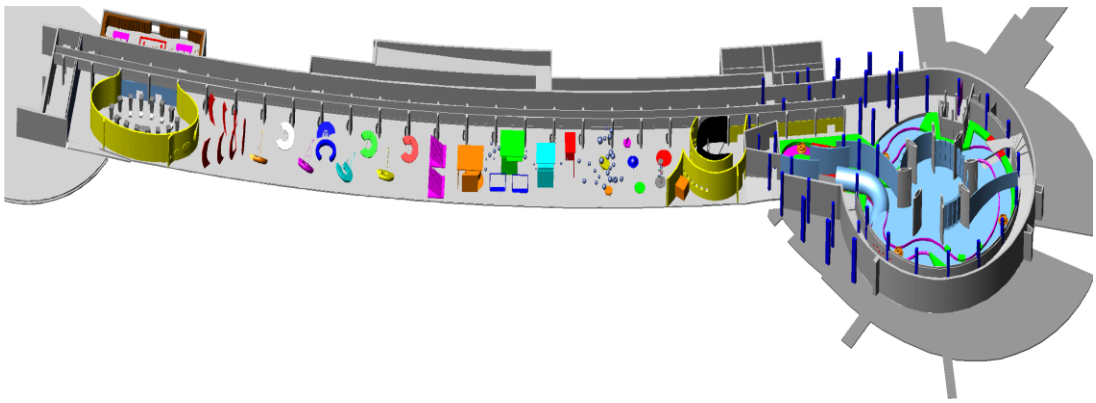

Fig. 27: Graphic showing the boat ride experience (right) leading into the main exhibition area (left) at Maropeng (Graphic courtesy of Maropeng a' Afrika Leisure (Pty) Ltd)

1. Understanding the Processes of Evolution

- **Introduction**

The history of the way the story of human evolution has unfolded must be adequately addressed in the museums for the visitor to be able to contextualise the story of the evolution of the planet and its species. The entire spectrum of this history must be presented, from the time of Darwin to modern-day interpretations of human evolution.

It is important that the story of evolution is presented in a logical and easy-to-understand way for learners, teachers and the ordinary museum visitor. The storyline should be clear and understandable and must follow a logical sequence - a sequence that explains the basic building blocks of life and how the very first organisms evolved from simple single-celled organisms to the highly sophisticated and variety of life forms in existence today, and how this has occurred over hundreds of millions of years. As Lever has indicated (refer to Part 1, page 10), evolution is key to understanding the basic building blocks of life and is the basis of our current biological knowledge (Lever, 2002: 39-41).

It is equally important to remember that visitors come to museums with preconceived ideas about evolution and that they come from a variety of cultural and religious backgrounds. Museums should also take into account that while museum visitors may be open to and accepting of the story of evolution, many do not have a thorough background and understanding of the concept.

The way the geological timescale is presented must assist the visitor in contextualizing, for example, that dinosaurs did not coexist with humans and that humans evolved tens of millions of years after the last dinosaurs had died out at the end of the Cretaceous some 60 million years ago (mya). The geological timescale issue, which will be discussed in greater detail further on in this analysis is crucial in any understanding of human evolution as it helps to place the history of our species in context, along with other aspects of evolution of our planet. It is when the geological timescale is understood that an appreciation of the processes of evolution can be

understood. These are some of the key issues that should be addressed in presenting an understanding of the processes of evolution.

- **Analysis of the processes of evolution at the Sterkfontein museum**

In my analysis of the exhibition at Sterkfontein, I have found that the storyline is fluent and does help place the processes of evolution in context for the visitor. For example, there are some excellent exhibits of what the fauna and flora would have looked like in prehistoric times (refer to Fig. 15, p. 40).

In some instances, the displays are text-heavy and not clearly legible. They are also not child-friendly as some of the text and explanations are positioned higher than what the average child can see. It is also questionable whether the learner or visitor can comprehend what is trying to be explained (refer Fig. 21, p. 43).

Nevertheless, the storyline at Sterkfontein follows a logical sequence from the early evolution of life on the planet to the Later Stone Age and the emergence of modern humans.

- **Recommendation**

The Religion Wall in the exhibit at Sterkfontein (refer Fig. 13, p. 39) can support the Grade 12 Life Sciences curriculum and the section on Alternative Theories (refer to Annexure 2, p. 85). There is, however, no distinction made between beliefs and theories and they are both presented as one and the same thing. This can be confusing and divisive and can actually obscure the difference between faith and science. It is recommended that this part of the exhibition should either be removed altogether or clear explanations should be given for the two schools of thought.

It is debatable whether religion should be presented in a museum exhibiting evolution and the evolution of the humans as it does not really help the learner or visitor understand the processes of evolution. On the contrary, it can lead to more confusion rather than clarity. There is no clear distinction between a scientific theory and faith-based beliefs.

It is also recommended that, in the refurbishment of the exhibition at Sterkfontein, the amount of text is reduced and more visuals added, that the text be changed from white lettering to a more visually appealing colour that is easier to read, and that the displays are adjusted in such a way that they accommodate the fact that children are not able to view and read some of the text.

It is also recommended that the Religion Wall is redesigned and presented in ways that do not create confusion between what a belief is and what a theory is, or alternatively be removed altogether to avoid confusing the museum visitor and learner.

There is also reference to Piltdown Man in the exhibition at Sterkfontein but there is no explanation of how this is regarded as one of the greatest hoaxes in evolutionary science because of the British race to find a missing link to match the discoveries being made by the Germans and French at the time. There should be more of an explanation about this. This exhibit can actually complicate or undermine the story of evolution for the visitor and is proof of people falsifying evidence for evolution which could be counter productive when selling the evolution story as an explanation for life on earth.

There is also no explanation of what a hominin actually is. There are also references to close relatives of humans (like bonobos) but not always supporting visuals of these.

- **Analysis of the processes of evolution at the Maropeng museum**

The first impression the visitor has when entering the site at Maropeng is the Tumulus Building which is meant to portray an ancient burial mound (refer to Figs. 25 and 26, p. 49; also Fig. 2, p. 4). Burial mounds are a phenomenon more readily associated with European and not African prehistory, but it can be argued, in my opinion, that the European *Homo sapiens sapiens* who buried their dead and made use of burial mounds were after all the descendents of humans who had walked out of the African continent to populate other areas of the world as posited in the Out of Africa II theory. Burial mounds are therefore still representative of our ancestors. There is, however, nowhere in the exhibition at Maropeng an explanation of the rationale for the

architectural design of the building and an explanation of what or where burial mounds originated.

Similarly, there is no explanation given of the hominins that are displayed at the entrance at Maropeng, who they are, what they represent and at what stage of our evolutionary history they existed (refer to Fig. 9, p. 36). This can lead to visitors failing to identify them as our direct ancient ancestors.

As one enters the Tumulus Building, one then proceeds down a ramp that leads to the underground boat ride experience. There are clear explanations of the geological timeline (refer to Fig. 10, p. 37) on the walls of the ramp descent, together with the boat ride experience. This is meant to portray to the visitor the journey back in time.

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The geological history of the earth is well-explained at Maropeng, particularly when one exits the boat ride and views the globe display which clearly explains the changes that have occurred over hundreds of millions of years with regard to plate tectonics and continental drift and which helped shape the way the planet looks today.

There is no explanation of early forms of life like there is at Sterkfontein and no explanation of how all living things are connected through the process of evolution. In other words the storyline and flow at Maropeng is far less fluent than it is at Sterkfontein, particularly as visitors enter the main exhibition area which immediately talks about Darwinism and DNA studies without proper explanations of the processes of evolution (refer to Fig. 19, p. 42). There are inadequate explanations of the connectivity between all living things, and how all living things can be traced to a common ancestry.

The main exhibition area at Maropeng is done in a somewhat haphazard manner and in a way that does not build on the storyline in a logical and sequenced way. As the visitor completes the boat ride and enters the main exhibition area, there is no structured approach to viewing the exhibition. For example, there are no footprints indicated where the visitor should begin viewing the exhibition and where it ends. The visitor is largely left to his or her own devices. This may present difficulties to

learners and visitors alike when piecing together the complex processes of evolution and in trying to understand human evolution.

The original fossil display area at the end of the exhibition hall acts as a useful resource for fossil studies. These original fossils are rotated on a regular basis.

- **Recommendation**

It is recommended that there should be an exhibit at the entrance at Maropeng explaining the significance of the Tumulus Building as well as the *Australopithecines* displayed at the entrance. The explanation should place these hominins in context on the human evolution tree. Alternatively, the models of the hominins should be displayed later on in the main exhibition area once the visitor has had some understanding of the processes of evolution as well as an idea of where the *Australopithecines* fit into the human evolution tree.

In the refurbishment of the exhibition at Maropeng, attention needs to be paid to the processes of evolution and a logical and understandable storyline needs to be developed and implemented, one that explains the building blocks of life and the role of evolution in this process.

2. The Geological Timescale

- **Introduction**

One of the greatest challenges facing museologists and educators is how best to represent the scale of time in the museum in a way that is easily understandable to the layperson. This has been highlighted as a challenge for museums (refer to page 23 in Part 1). Generally people can conceptualise time in days, weeks, months, years, hundreds of years or even thousands of years. But when it comes to imagining what the earth and life forms would have looked like tens of thousands of years ago, hundreds of thousands of years ago or even hundreds of millions of years ago, this is very difficult to conceptualise.

As Scott puts it, which is also picked up by Esterhuysen and Smith (1998), a misunderstanding of the scale of evolutionary history is the biggest problem to plague the public's knowledge of human evolution and its racial and cultural implications (Scott, 2007, 43).

Key milestones in geological and evolutionary history of the planet such as the mass extinctions must take into account and explain that hominin evolution is very recent in the bigger story of the evolving planet, beginning roughly around six or seven million years ago when there was a split in the lineage between the great apes and hominins. It should also show in an unambiguous manner that our own species, *Homo sapiens sapiens*, has evolved only in the last 200 000 years or so. It is only in the last 100 000 – 200 000 years that our own species emerged as the species that would conquer all the survival odds and emerge as the one surviving hominin species to triumph over all other related species of hominin, including the Neanderthals. This can be addressed in the museum exhibits through an explanation of the Out of Africa II theory as opposed to the mult-regional perspective, showing that the growing consensus today in the scientific world is that we have all evolved from a single ancestor that can be traced back to Africa as indicated in Part 1 (p. 8) in research conducted by Soodyall for example.

- **Analysis of the Sterkfontein presentation of the geological timescale**

There are references to certain time periods in the exhibition at Sterkfontein, such as the Miocene period and a brief explanation of this epoch. There is also a representation of the geological time-scale in the visual depicting hominins that existed and evolved throughout the ages (refer to Fig. 18, p. 41).

Human evolution in both museums, however, is almost always presented in a linear manner. There are references at both Maropeng and Sterkfontein to the complex human evolutionary tree but there is no supporting explanation of the inaccuracy associated with depicting human evolution in a linear fashion and how this has dominated the way human evolution has been and continues to be presented in popular media and understood by the broader public, leading to misconceptions about

the complexities surrounding human evolution. This has been discussed in Part One (refer to page 28) and the importance of the work of Gould and others on this issue.

While there is some reference to various geological epochs, albeit in the form of text, there is very little reference to the issue of space in the exhibits at Sterkfontein. In other words, very little is done to explain graphically, for example, where Olduvai Gorge in Tanzania is (or even its significance) or Hadar in Ethopia (as described in the exhibits), which leaves the visitor with the impression that all the most significant finds in palaeoanthropology have occurred in Sterkfontein and in South Africa. There is not enough reference made to the remarkable finds that have been unearthed in East Africa for example as well as the ongoing excavations there and elsewhere on the African continent and other parts of the world.

- **Recommendation**

Because of the text-heaviness in some parts of the exhibits, the displays at Sterkfontein, while often making reference to various geological epochs in the history of the planet, should represent the timescle in diagrammatic form. This will help the visitor conceptualise the vast amount of time that transpired between the formation of the earth 4,6 billion years ago to the evolution of our own species which is a very recent phenomenon in the history of life on earth. There should be visuals to accompany the text using events such as the extinction of the dinosaurs that places the issue of the geological timescale in context for the museum visitor (refer to Fig. 17, p. 41).

It is also recommended that a greater emphasis is placed on both time and space in the exhibits in the COHWHS thereby creating a platform for learners and museum visitors to be able to better conceptualise and contextualise the issue of time, making an understanding of evolutionary science a little easier to grasp.

- **Analysis of the Maropeng presentation of the geological timescale**

The experience at Maropeng goes a little further when trying to capture the issue of geological time in the exhibits, but the issue of space is not represented. The hugely popular boat ride in the experience at the Maropeng Interpretation Centre is meant to

take the visitor on a journey back through time using the elements of water, air, earth and fire. The visitor descends the ramp to the boat ride and there is an explanation of geological time on the wall of the ramp (refer to Fig. 10, p. 37). This is a well conceptualized and easily understandable representation of the geological timescale.

What is not covered in the timeline on the ramp descent, and which is crucial in understanding human evolution, is reference to a common ancestry between the great apes and hominins and the split that occurred between the ancestors of the great apes and hominins around 6-7 mya. There is also no reference to the evolution of mammals in the period 30-50 mya — both of these being crucial periods in the evolution of mammals and hominins.

There is also no reference in the ramp descent to the extinction of the dinosaurs in the fifth mass extinction that occurred around 65 mya. This is important as people generally relate to dinosaurs because of the influence of popular media and placing this event in context within the geological timescale will assist the museum visitor to contextualise the issue of time in relation to the evolution of humans.

While the boat ride is an exhilarating and fun-filled experience, particularly for the younger visitor, the concept of time and its meaning and the opportunity that this experience presents is lost to a certain extent as there is no narrative explaining the different epochs in the history of the earth, from being a fireball of gases some 4 billion years ago to the blue planet that we know today. This could easily lead to misunderstandings of time which has implications for the understanding of how hominin evolution has unfolded in the last seven or eight million years.

In other words, many visitors may find it difficult to conceptualise the difference between 4 billion years ago and (say) three million years ago when our ancient ancestors would have shared the planet *together* with a variety of other hominin and faunal species, those discovered and possibly others that have not yet been discovered. This conceptualization of the time-scale is crucial in any understanding of palaeoanthropology, palaeoantology, archaeology and any of their related disciplines.

The clock in the main exhibition area at Maropeng attempts to explain the timescale in an understandable way with the appearance of humankind appearing on the scene at the very last minute on the clock, showing humans as a very recent phenomenon in the history of the planet. While the dial does attempt to address the concept of time, there is no concise explanation of the complexity or diversity of evolution in this particular exhibit.

Similarly, while the telephone interactive exhibit explains the extinction of woolly mammoths and dodos in a stimulating way, the learner and museum visitor cannot easily conceptualise that the dodo died out a few hundred years ago whereas *Paranthropus robustus*, for example, walked the earth a few million years ago, or that there were woolly mammoths in existence ten thousand years ago.

As with the displays at Sterkfontein, while there is some reference in both museums to the issue of time, the issue of space is not contextualised for the visitor at Maropeng. The maps in the Out of Africa theory exhibit encapsulates the migration of the human species throughout the world, but there needs to be further explanations of other significant finds in Africa depicting why Africa is referred to as the birthplace of humankind.

- **Recommendation**

It is recommended that the timescale as represented on the ramp to the boat ride is updated to include descriptions of all the previous mass extinctions in Earth's history as reflected in the geological and fossil record of the planet, and not only the fifth mass extinction.

It is also recommended that prominence be afforded the crucial period between 30-50 million years ago when early mammals started to flourish, as well as the inclusion of hominin evolution and the split in the lineage from the ancestors of modern day ape species widely regarded as being in the period approximately 7 mya. Reference must be made to the shared common ancestor of modern apes and modern humans which will go a long way in dealing with the misconception that *homo sapiens* have *evolved* from apes as opposed to us having *shared* a common ancestor.

What is also recommended is an audio narrative for the boat ride that will explain the timeline and the geological history of the earth in relation to the boat ride experience. This could be done with a set of headphones that the visitor could wear on the boat ride that would explain geological epochs, or an audio-visual explanation of the boat ride could be added to the exhibition.

While the telephone exhibits are somewhat useful as an interactive display, it could muddle the issue of time for the learner. It does deal with the issue of recent extinctions in the history of the planet such as those of woolly mammoths and dodos.

At the same time the exhibition should also address the issue of space as indicated above in the Sterkfontein analysis and recommendation.

3. Mass Extinctions

- **Introduction**

Mass extinctions are key events in the history of our planet and need to be adequately presented in any depiction of the evolution of our planet or the evolution of humans.

- **Analysis of mass extinctions in the Sterkfontein museum**

The storyline in the exhibition at Sterkfontein does not make mention of the mass extinctions that have taken place in the history of the earth in any of the displays.

- **Recommendation**

It is recommended that this omission in the exhibition at Sterkfontein is addressed in any refurbishment of the exhibition. This topic also forms part of the Grade 12 Life Sciences curriculum on evolution and is an important aspect in understanding the process of evolution and the evolutionary history of the planet. It is important because it talks directly to the issue of the scale and enormity of geological time. It will also directly address misconceptions such as dinosaurs co-existing with humans.

- **Analysis of mass extinctions in the Maropeng museum**

The timeline on the ramp descent to the boat ride at Maropeng makes mention of the fifth mass extinction, but there is no reference to the fact that this led to the extinction of the dinosaurs 65 mya.

There is also no reference to the other mass extinctions that have occurred throughout the history of the planet.

The Sustainabilty Wall in the main exhibition area at Maropeng explains that the onset of the sixth mass extinction is currently being experienced largely due to humankind's indiscriminate use and exploitation of the world's resources and destruction of species and habitats. While this is a useful exhibit, it could muddle the issue of mass extinctions for the learner as there is no explanation given of all the other mass extinctions in the history of the planet.

- **Recommendation**

The refurbishment of the exhibition at Maropeng needs to make reference to all the mass extinctions that have taken place in the history of the planet as well as include in the ramp descent timeline the fact that the dinosaurs died out 65 million years ago as a result of a catastrophic collision with the earth by a meteor as has already been mentioned in the geological timeline explanation.

The split that occured between humans and apes, widely regarded as having occurred approximately 7 mya should also be included on the ramp descent exhibit of the geological timescale.

A brief explanation as to how scientists come to conclusions about mass extinctions and the evidence for this is also missing and necessary in the exhibits.

4. The Human Genome Project

- **Introduction**

Advances made in the field of genetics support an explanation of modern human origins being traced back to Africa. This is a crucial part of the human evolution story, (refer to pp 6-8). Explanations of DNA, mtDNA, as well as the Out of Africa II theory are key pieces of information in the human evolution story and are an indispensable tool for teachers and learners.

- **Analysis of the Human Genome Project at the Sterkfontein museum**

There is very little mention of the Human Genome project in the exhibition at Sterkfontein. This is an oversight in the light of the importance that genetics plays in the story of the evolution of modern humans.

- **Recommendation**

The refurbishment of the exhibition at Sterkfontein should address the issue of the Human Genome Project and the importance and contribution that genetics has made to the further understanding of the origins of modern humans. It is also essential in understanding evolutionary science and will complement the Grade 12 Life Sciences curriculum and the section on genetics. This will enhance the usefulness of the exhibition as a resource for teachers and learners alike.

- **Analysis of the Human Genome Project at the Maropeng museum**

The DNA wall at Maropeng (refer to Fig. 19, p. 42) is out of place in the exhibition and its positioning is inappropriate with regard to the flow of the storyline. There are no explanations of what mitochondrial DNA and the Y-chromosome are, neither is there any mention that all living things are connected by a common ancestry. In other words, there is no clear storyline as the visitor descends from the boat ride experience into the main exhibition area.

The museum provides no logical route for the visitor to follow in the main exhibition area that pieces together in a clear manner the story of evolution, how humans have

evolved, and the role that genetics has played in our understanding of the origin of modern humans. There is a lot of sound content everywhere but a clear lack of coherency and storyline flow.

- **Recommendation**

There needs to be a proper sequencing of the storyline in the exhibition at Maropeng including an explanation of how all things are connected through the evolutionary process and the contribution made by genetics in this understanding.

The refurbishment of the exhibition needs to take into account the importance and positioning of the Human Genome Project in the exhibition at Maropeng, which as indicated above, constitutes an important part of the Grade 12 Life Sciences curriculum. This is explained to some extent in the Out of Africa exhibit, but there is no coherence and logical sequence linking the Out of Africa II theory with DNA studies and the science of genetics as well as the important discoveries made with regard to mitochondrial DNA.

5. The Out of Africa Theories

- **Introduction**

The key issues pertaining to the Out of Africa theories are the understanding that there were two main migrations by hominins out of Africa: the first occurred when very early hominins migrated out of Africa hundreds of thousands of years ago to populate the other continents and the second was the more recent migration of our direct ancestors during the last 200 000 years. The alternative to the Out of Africa II theory is the multiregional theory which argues that hominins and modern humans evolved independently in different parts of the world and at different times in history. In other words, the multiregional perspective does not recognize a common African origin of modern humans in the last 200 000 years.

The Out of Africa II theory is a crucial part of the evolutionary story and is the chapter that deals with modern human evolution. It is key to breaking down stereotypes such as those associated with race and together with the supporting

findings in genetics research, is key to breaking down racial stereotypes. It convinces the museum visitor to recognize and appreciate that modern humas have a common ancestry.

- **Analysis of the Out of Africa theories at the Sterkfontein museum**

The Out of Africa theories (I &II) are mentioned in the exhibition at Sterkfontein, although not in as much detail as in the exhibition at Maropeng.

- **Recommendation**

Any refurbishing of the exhibition at Sterkfontein should expand on the importance of the Out of Africa theories and the science of genetics and its importance and relevance in any explanation of human evolution.

- **Analysis the Out of Africa theories at the Maropeng museum**

The Maropeng exhibit has a greater explanation of the Out of Africa theories and depicts clearly how these theories fit into the human evolution story (refer to Fig.11, p. 38).

- **Recommendation**

That any refurbishment of the exhibition should attempt to make the storyline more coherent, thereby placing the Out of Africa theories in their proper context in the storyline and showing the importance of the Human Genome Project and mtnDNA when trying to understand human evolution.

6. Racial and Gender Stereotypes

- **Introduction**

Human evolution exhibits can offer an opportunity to deal with the entrenched racial and gender stereotypes that have been all too pervasive in human evolution exhibits since the time of Darwin and which continue to be entrenched in one way or another in popular media and culture. This has a particular significance for South Africa given our racialised past and the challenges posed by this in the present time. Do the exhibitions at Sterkfontein and Maropeng address these issues? My analysis of the

exhibits in the COHWHS have revealed that they do not address these stereotypes and misconceptions in any substantive manner.

- **Analysis**

In the exhibitions at Sterkfontein and Maropeng prominence is given to white male scientists such as Raymond Dart, Robert Broom and Charles Darwin, amongst others. This is both important and necessary given that these are important historical figures who have made enormous contributions to unravelling and explaining the human evolution story to the world. While it is a fact that the science of palaeoanthropology has been dominated by white scientists, the opportunity does exist to explain that there are a number of black scientists and ordinary black people who have also made a contribution in world palaeoanthropology, and who continue to do so throughout Africa and elsewhere in the world.

This one-sided approach to the exhibits can entrench the view that palaeoanthropology is a white science and a white construct to the museum visitor and to black people in particular. The young learner should be able to look at the science of palaeoanthropology as a career opportunity and the museum must be able to instill a sense of awe for the sciences.

There is some mention in the exhibitions at Sterkfontein and Maropeng paying tribute to the men who, for instance, assisted Professor Ron Clarke in the discovery of the enormously important hominin fossil Little Foot. Children, both black and white, visiting the exhibitions must be exposed to these sorts of exhibits that recognise black researchers and assistants and there must be a move away from the depiction of hominin evolution from a so-called white Eurocentric perspective.

There is also no acknowledgement in the exhibits at both museums and neither is mention made in the exhibits in general of prominent South African women who have made enormous contributions in the fields of palaeanthropology, archaeology, genetics and related fields such as Dr Kathy Kuman, Dr Himla Soodyall and Dr Amanda Esterhuysen, to name a few. Profiling women in science can help change the notion that these fields of study are the sole preserve of male scientists.

There is a picture at Sterkfontein profiling a white female archaeology student. A picture of a black female student could have been used to address the racial issue and gender imbalances that exist in the museums. This could assist in encouraging young people to think about taking up careers in these fields, making palaeoanthropology and its associated disciplines more accessible to the black community at large while at the same time addressing the obvious gender disparities apparent in the displays in the museums.

Prominence is also afforded geologists who are male and white with black mine workers often being depicted in the background thereby relegating black mine workers and their contributions as being less relevant or important. More information could be presented in a concise manner about the actual mineworkers and their role in mining and excavations, where they would have lived, the type of lives they would have led and the hardships that they would have had to endure. Apart from making interesting stories, they would also tell the true story of South Africa's history while at the same time addressing fundamental issues about race that existed in the past and present in South Africa which could help to situate the human evolution story for ordinary people (refer to Fig. 20, p. 42). In this way, the exhibits would be complementary to one of the objectives of the NCS which is to use local content in teaching and learning.

- **Recommendation**

Is profiling black scientists and black people or trying to find a way of addressing gender imbalances in the exhibits sufficient in addressing entrenched notions of racial and gender misconceptions? Probably not, but at least it will act as a start in trying to reverse stereotypes and imbalances inside and outside of the museum.

Another important omission in the exhibitions and one which needs addressing in any refurbishment of the exhibitions at both Sterkfontein and Maropeng is the lack of explanations about superficial racial differences such as hair texture or skin tone caused primarily by environmental factors and geographic isolation, rather than by biological differences. The difference, for example, between the way the hominins

look compared to the modern Asian woman in the display at Sterkfontein (refer to Fig. 18, p. 41) is not explained and does not address some of the racial sterotypes associated with human evolution understandings and human evolution exhibits that this report has sought to highlight.

7. Misunderstandings Associated with Human Evolution

- **Introduction**

The official logo of the COHWHS (refer to Fig. 16, p. 40) uses the linear progression model of forward-facing men marching single file towards an advanced and modern future. This representation of human evolution is simplistic and inaccurate as it does not portay the complexities and different branches of hominin evolution and further entrenches the stereotypes associated with human evolution. This has been discussed at some length in the first part of this report with reference to scientists like Stephen J. Gould and others. These sorts of images continue to reinforce the limitations of understanding of hominin evolution which shapes the way visitors look at human evolution. This image, widely familiar to many people and which has its roots in Victorian culture and thinking, does very little to break down stereotypes and misconceptions. There are also gender stereotypes associated with the logo as the figures are depicted as forward facing men marching towards an advanced future.

- **Analysis of racial and gender stereotypes**

There needs to be a new approach in breaking down this linear perspective of human evolution which also has racial connotations. The logo is often interpreted and comes across as a prehistoric and bestial African hominin versus the more modern and advanced western European man or woman as described earlier.

There are no explanations in either of the museums of the role that environmental factors would have played in shaping the way we look today and the reason for our diversity as a species.

In the case of the COHWHS logo a change was made to attach breasts to the more advanced hominin in the logo in an attempt to address the maleness of the evolution

of humans and by changing the colour of the hominins to green which is more representative of neutrality than either black or white. The breasts on the advanced hominin are not easily identified and while the intention of this would have been an attempt at presenting the linearity model of the evolution of humans in a more acceptable way, and one that would address the gender imbalance, the logo still entrenches the notion that humans have evolved in a linear fashion and not in the complex manner as portrayed in the human evolutionary tree with its myriad of branches and incomplete picture as reflected by the fossil record.

- **Recommendation**

How do we begin to reverse this entrenched notion and its associated inherent misunderstanding of our evolutionary history? How do we begin to change the way evolution is viewed?

As a result of the continued circulation of outdated and biased cultural media, a significant number of visitors still perceive the African continent as fixed in remote and prehistory, falsely picturing aboriginal Africans as evolutionary intermediaries, and mistakenly believing that the emergence out of Africa signifies the emergence of true humanity. Despite new scientific findings, people often rely upon an old story to make meanings of human origins by believing that humanity progressed out of African evolutionary prehistory and into an advanced European evolutionary finishing school (Scott, 2007: 148). It is this perception that the logo mistakenly continues to convey.

Perhaps it is time to change this logo in a way that will have a greater impact on turning this perception around by using means that seek to avoid the use of stereotypes. One way of doing this, for example, would be to include a hominin tree of evolution alongside the linear model that will explain for the museum visitor the complex tree of human evolution. Another suggestion would be to depict the march of evolution with various different lineages that eventually lead to modern humans, like a river and its tributaries. In the digital and advanced technological age that we live in, innovative ways could be explored of presenting this image of human evolution using

modern design technology. The new ways of presenting the human evolution story could help erode the entrenched misconceptions.

Another possible way of addressing some of these misconceptions could be by explaining and elaborating how the painters of the remarkable Lascaux images in Southern France are in all likelihood the direct descendents of the southern African *Homo sapiens* who were already experimenting with art as far back as 70 000 or 80 000 years ago.

Another approach could be by explaining that Australian aboriginal people had taken from Africa with them to their continent the skills that had already been passed down from generation to generation long before crossing the divide about 40 000 years ago and populating a continent that was devoid of primates as reflected in that continent's fossil record. Australian Aboriginal people would thus have taken with them artistic as well as survival skills when they migrated to the new continent of Australia about 40 000 years ago, evolutionary survival skills that would have been passed down from generation to generation a long time ago, beginning in Africa. This could show the link between ancient and modern humans which will in some way address some of the misconceptions as noted above.

The museums could portray ancient hominins as being inventive and creative and not bestial and backward, thereby dispelling the notion that advanced modern humans are a phenomenon associated with Europe and the Western world and giving recognition and respect to indigenous people the world over.

A question often asked is if we have progressed so phenomenally as a species why have the great apes and the rest of the primate world 'lagged behind' in this regard. This brings us back to Gould's explanation about equating evolution and progress, which is such a pervasive concept in everyday understanding of evolution. Evolution is not progress; it just happens. The answer lies in how we define progress. If going to the moon is defined as progress compared to using a stick to take out termites from a nest, then indeed we have progressed!

When you emerge from the museums in the COHWHS, have they helped to debunk the stereotypes and misconceptions associated with human evolution exhibits?

From my analysis of the exhibitions for this research report, to a large extent I believe they do not. There are certain exhibits that help to clarify some of the issues with regard to the distinction between the great apes and hominin evolution such as in the Meet the Family display at Maropeng (refer to Fig. 22, p. 43) and the Out of Africa theory explanations.

The exhibits in the museums in the COHWHS do not effectively help to break down the misunderstandings, misconceptions and stereotypes associated with human evolution such as the linear progression model, and the racial and gender stereotypes.

There is a need for new ways of addressing these concerns and skewed perceptions about evolution, about progress, and about the evolution of humans in particular.

8. The Role of South Africa in World Palaeoanthropology

- **Introduction**

The museums in the COHWHS should portray and display specific references to the African and Southern African experience, and must include both ancient and modern history within the broader context of palaeoanthropology in the world and the specific sub-Saharan experience and findings. There is a gap in the museums not profiling new evidence for an African Eve from which all of modern humankind can trace their ancestry. No doubt natural history museums and those depicting the human evolution story have lagged behind and have not updated perspectives on human evolution, particularly the story that is slowly emerging about the evolution of modern humans in the last 200 000 years.

To a large extent this is encapsulated in the displays at the museums in the COHWHS but as mentioned earlier, there needs to be more information and recognition given to the contributions made by the whole of Africa and the world to palaeoanthropology. This can be done in a way that complements new findings in sub-Saharan Africa.

- **Analysis of the role of South Africa in World Palaeoanthropology**

Explanations need to be placed in their historical context in a way that is easily understandable to the layperson by incorporating aspects of the particular local experience of that specific country in a way that is educational, understandable and enlightening.

In the case of South Africa, our racialised past can be used in an advantageous way in presenting the issue of race and by turning around the misperceptions associated with race. To a certain extent, this is done in the museums in the COHWHS. This support material will also help the teacher and learner achieve some of the critical outcomes of the NCS that are in line with the Constitution of South Africa.

- **Recommendation**

The wealth of ancient human fossil evidence found in South Africa, whether it is the Taung Child or the increasing evidence emerging of modern human existence (within the last 100 000 years) in the Western Cape excavations such as Blombos Cave and Pinnacle Point, needs to be explained in the exhibitions in order to contextualize the old with the new (in terms of our evolutionary past). These need to be displayed alongside the many important African discoveries made elsewhere on the continent, thereby positioning Africa as the true cradle of humanity.

The compilation of teaching material on evolution and the way hominin evolution is represented in museums should come up with new and innovative methods of addressing the misconceptions that exist with regard to the evolution of humans. South Africa has contributed significantly to the body of scientific knowledge about the evolution of our species and there must be a fluent picture that emerges from the exhibits in the COHWHS which ties all of these stories together into a coherent whole. A picture needs to be painted of how ancient hominins evolved into more modern species through a well thought through storyline that incorporates important aspects of the relevant sciences and their contributions to the understanding of human evolution. This will go a long way in dealing with the notion that sophisticated modern humans originated outside of the African continent, and more specifically in modern-day Europe. It will counter this by showing that sophisticated modern humans

had already existed in Africa and then migrated outward and populated other parts of the world. It will also be important to incorporate explanations of how modern genetics is starting to reveal that racial differences among all people in the world are negligible and that all modern humans can trace their ancestry back to the same source, thereby explaining that racial differences are purely cosmetic and superficial. There is some mention of this in the exhibits in the COHWHS.

South Africans also have the opportunity of being able to use the museums in the COHWHS to break down the stigmas associated with museums and black visitors. Rather than making visitors feel alienated when they visit the museums in the COHWHS, visitors should be able to embrace the exhibits as a South African and African heritage and to be proud of an ancestry that can be traced back millions of years and one which is uniquely African. This proudly African heritage is well-reflected in the exhibits to a certain extent but more needs to be done to educate and explain the story of human evolution to the public in a uniquely South African and African way.

Despite there being a certain degree of understanding and acceptance among local South Africans of the importance of the COHWHS and its rich hominin fossil finds there is still a considerable amount of rejection of the notion that we have evolved from apes and of the theory of evolution. The increased visitation to the museums in the COHWHS by schools since the official opening of the museums in 2005 is encouraging as this has afforded learners and teachers an opportunity of dealing with the subject first-hand.

At an Education and Heritage Symposium held at Gallagher Estate in Midrand, Gauteng on 20 March 2009, Professor Mathole Motshekga, who is the ANC's Chief Whip, referred to the COHWHS as 'the Cradle of Baboons'. This view is both a combination of what is reflected or not reflected in the popular media and the historic lack of teaching of evolution in schools under apartheid. It is these sorts of misperceptions and articulation of human evolution by prominent individuals that further sets back the way the human evolution story is understood. South Africa has an important role to play in world palaeoanthropology, and the museums in the

COHWHS and other museums that profile human evolution are amongst the vehicles to do this.

- **Grade 10 and Fossil Studies: Summary and Conclusions**

There are ample opportunities in the museums for learners to gain first-hand knowledge of what fossils are, how they are formed and their importance. The exhibitions at Sterkfontein adequately address the learning outcomes of the Grade 10 syllabus on fossils. This is less true in the casse of the museum at Maropeng, which should incorporate some of the explanations of fossils from Sterkfontein when refurbishing the exhibition.

What is lacking and which could be included in refreshing both exhibitions are more interactive displays where learners could make their own fossil casts, dig for fossils or undertake to date fossils using different methods. In this way they could own the evolution process and be given an opportunity to imagine the 'future' of evolution and the place of humans in that picture. This approach would also complement the constructivist element of the curriculum and would add value to the developmental and critical outcomes of the NCS. The explanations and exhibits on fossils at Sterkfontein are an indispensable tool for the learner and teacher alike.

The fossil displays and detailed explanations at Sterkfontein afford the learner a means of reinforcing what is taught in the syllabus. Future refreshments of the fossil explanations merely need to update the displays where necessary and include more interactive displays in support of the NCS and OBE.

- **Grade 12 and Evolution Studies: Summary and Conclusions**

The exhibitions at both Sterkfontein and Maropeng address the issue of evolution and the evolution of the human species in an educational and sometimes interactive and entertaining manner. What is lacking in both displays is a greater explanation of modern human evolution, from about 200 000 years ago to the present. This needs to tie in with advances made in the field of genetics and other disciplines, and the link with sub-Saharan Africa in illustrating the importance of South Africa and Africa in the human evolution story.

While in a broader sense the exhibits do cover the outcomes according to the NCS, no attempt is made to confront the stereotypes, particularly the racial and gender stereotypes generally associated with human evolution exhibits throughout the world. Neither museums deal with misconceptions such as the linear model of human evolution.

The refurbishments of the exhibitions at both museums needs to make the museums and their content accessible to a wider audience, and should also make a contribution towards addressing the broader issues around race and gender, issues that are very important for building racial reconciliation in the democratic South African context.

While learning opportunities at both museums meet the criteria as set out in the NCS and the Life Sciences curriculum in particular, more needs to be done to break away from the way the human evolution story has been presented in the past. The scientific aspect of evolution is substantially covered at both museums but the wider social, economic and political implications are not captured in the exhibits and therefore fail, in a broad sense, to break down old stereotypes and misconceptions.

The exhibits act as an important resource for teacher and learner alike with regard to the curriculum and any refreshment of the exhibition needs to support what is in the teaching material by including aspects from the curriculum in the display at the museums. For example, the unique find of the coelacanth off South Africa's coast in the first half of the twentieth century needs to be properly placed in context in the wider fossil studies display in the museums and an explanation given of why the coelacanth is regarded as a living fossil, as well as its importance as a discovery.

CONCLUSION

This research report set out to ascertain primarily whether the educational content of the museums in the COHWHS provide learning opportunities for teachers and learners, whether they act as useful resources and whether they reflect the aims and spirit of the NCS. In doing so, it also sought to identify whether the museums entrench stereotypes and misconceptions associated with human evolution exhibits and whether they reinforce older ways of thinking about science and human evolution.

My research has led to the conclusion that the museums in the COHWHS are an indispensable and necessary resource for learners and teachers and are of immense significance for all of Africa and the world. Much of what has been done with the exhibits in these museums is commendable but there are areas that need attention as this report has tried to highlight.

It is clear that visitors, both young and old, bring with them to the museum a set of cultural and historical insights and expectations. Far from lessening the significance of the natural history museum and representations of hominin evolution therein, it places a greater responsibility and challenge upon these museums to present human evolution in new, exciting and challenging ways that incorporate the best manifestations of past exhibits and combine these with new ways of presenting human evolution that are informative, educational and pertinent. It is important, therefore, that the exhibits constantly challenge the outdated ways of presenting human evolution while at the same time look at ways of dealing with any stereotypes and correcting misconceptions traditionally associated with such exhibits.

South Africa has the ability to take a leading role in turning around the way hominin evolution is represented in museums given our unique history and the significant position we play in world palaeoanthropology, supported by the remarkable finds of both ancient and modern humans in the fossil record. Some suggestions for doing this are:

- The exhibits need to show that 100 000 years ago in sub–Saharan Africa there already existed modern humans who were probably practicing a variety of rituals, experimenting with abstract thought and art and who were living in coastal areas which provided a rich and abundant food source in some cases. In other words, the roots of symbolic thought could very well have had their origins in Africa and in southern Africa;

- The fossil preparatory laboratory at Sterkfontein is meant to allow the visiting public a chance to see at first hand how scientists work with fossils. Other important areas for improvement could be a cast-making facility for visitors to experience how specialists use original fossils to construct casts, or actual mock excavations by learners in reconstructed digs by creating a space for the activity of fossil-hunting. Some interactive displays have been attempted in the main exhibition at Maropeng (refer to Fig. 14, p. 39). There need to be more of these hands-on experiences. .

- Another aspect lacking in the hominin exhibits in the COHWHS museums are reconstructions of past environments and the creatures that would have occupied the earth at different phases in the evolution of our species. This would involve the presentation of dioramas that explain the important role that climate (for example) has played during different epochs in the history of the planet and in the evolution of our species and ancestors. What should be attempted is a reconstruction of past epochs in the history of human evolution that could captivate the minds of young and old through the use of modern technology.

- Another suggestion for the exhibits are explanations (textual and visual) of evidence for early human sophisticated behaviour in Southern Africa between 70 000 - 100 000 years ago. The Blombos Cave findings and other discoveries show that modern humans were relatively sophisticated a long time ago.

In South Africa, the museums in the COHWHS need to take into account the following in the representation of hominin evolution in their exhibits:

- The NCS and its learning and critical outcomes. It is important in rebuilding a nation with a racialised past that the younger generations are exposed to their rich natural and cultural heritage in new and refreshing ways with which they can identify;
- Cultural, religious, political, racial and class differences in South Africa and how these would influence and/or impact on the museum visitor. This must include both historical and modern day explanations of our history as a species and as a nation within the broader African context and how it all fits in with our palaeoanthropological history;
- Using the unique South African experience to construct an explanation of our human evolution story taking into account and explaining the enormous contribution local scientists have made to the understanding of the way our species has evolved. This would go far in correcting misconceptions about linear progress of human evolution;
- Innovative ways of encouraging more local people to visit the museums that will take into account influential factors such as socio-economic considerations and accessibility to the COHWHS, especially for poor people;
- There is a fair amount of displays of ancient human ancestors found in South Africa, but there is a need to expand the exhibition to include exhibits on more modern human ancestors (200 000 years ago to the present day);
- In depicting human evolution, museums need to reflect on past atrocities and inaccuracies if they want to present an updated and modern way of looking at human evolution. Exhibitions should embody new scientific findings about our evolutionary history and particularly our evolutionary history in the last 200 000 years. They should expose the atrocities against people like the San who were studied in the past as pure racial types, thereby showing the short-sightedness of looking at aboriginal people like the San as different to modern humans ;
- In the case of the museums in the COHWHS, factors that would contribute to the non-museum-going culture would certainly include issues of cost. A day out to the COHWHS for an ordinary lower-income household would need to take into account travel, food and museum-entry fees, which could place this beyond the ordinary working class family's budget. The museums in the

COHWHS need to find ways of addressing these issues in order to encourage greater attendance and participation, taking into account the diversity of the South African population. This can be done in a number of ways such as lowering the fee structures and price of food at the destinations, arranging cheaper and safer public transport to and from the museums and arranging events such as music festivals that could attract people to Maropeng which in turn could encourage visitation to the museums.

- The notion of a backward and primitive Africa is, fortunately, not forthcoming in the exhibitions in the COHWHS. On the contrary, the widely accepted notion in the scientific community of humankind having originated in Africa (whether this is in Southern or East Africa is immaterial in my opinion) is presented in a proudly African way in the museums.
- Finally, human evolution exhibitions must find a way of representing not only the 'they' in origins exhibitions (the 'ape-men' or the 'cave men') but the 'we' as well (the representatives of modern humankind). While the museums in the COHWHS do not entrench the notion of a bestial and backward Africa they are still presenting the human evolution story in ways that are Victorian in nature by not addressing the racial and gender connotations attached to exhibits of this nature, and by not telling the African and Southern African story in innovative enough ways that will meet the specific needs of the local population.

It is imperative when introducing and teaching evolution in schools in South Africa that the issues of race, gender and identity are adequately addressed, particularly in order to challenge inherent stereotypes perpetuated by evolutionary interpretations of the past. South African education is very deliberately addressed to upholding the values of the Constitution which includes equality. These stereotypes need to be addressed and reflected in the exhibitions which play a huge role in perceptions of our evolution as a species. Many of these prejudices and stereotypes are alive and well today and need to be debated rigorously at classroom level.

The need for the teaching of evolution at school level alongside all other disciplines remains the responsibility of each and every educator, parent and government.

Denying the young mind full exposure to surely one of the most profound explanations of life and the origins of humans is a great injustice, and future generations may not be able to fully comprehend why this was so.

> " I am ahead… I am advanced…I am the first mammal to wear pants…I am at peace…I can kill cause in god I trust….It's evolution baby….(Pearl Jam, 1998, Do the Evolution from the album *Yield).*.

ANNEXURE 1

An evaluation of fossils as it appears in the curriculum (Life Sciences Grade 10) against the exhibitions in the Cradle of Humankind World Heritage Site

Curriculum/Learning Outcomes	Evaluation against Exhibits/Comment
Fossil Studies: Suggested Sequence Introduction: • Define biological evolution as the changes that living things have undergone over long periods	Adequately covered in the exhibition at Sterkfontein, from earliest forms of life to the present day diversity of species on the planet. A thorough explanation of fossils is lacking in the museum at Maropeng. There are sporadic references in the displays and plaques, both within and outside the museum
• State that life-forms have gradually become more similar to present life-forms, but even in the last million years, significant changes have occurred in species occurring in Africa (such as humans)	Sufficiently covered in the exhibition at Sterkfontein with the learner being able to draw logical conclusions between ancient and present day life forms. The changes occurring in Africa in the last million years related to hominin evolution is covered sufficiently at Sterkfontein as well as at Maropeng. There are explanations and displays at both museums related to the Out of Africa I and II theories, although there are greater explanations of this at Maropeng
Explain why fossils are regarded as evidence of changes in living things over millions of years	This is addressed sufficiently in the exhibitions at both museums but there is more detail at Sterkfontein
State that there are different types of fossils (e.g., mineralized fossils, cast fossils, compression fossils, amber/resin fossils, trace fossils such as footprints, micro fossils such as plankton)	There is reference to different types of fossils as well as dating techniques in the exhibition at Sterkfontein which allows the learner to make inferences about the importance of fossil dating techniques (refer Fig. 9, p. 39). There is mention in the exhibition at Maropeng of trace fossils such as the Laetoli footprints, an important palaeoanthropological discovery in Africa.

Describe the formation of mineralized fossils	Addressed at Sterkfontein but not at Maropeng
Examine fossils at a museum or fossil site or look at photos of fossils	Learning opportunities regarding fossils exist at both Sterkfontein and Maropeng. The original fossil display at Maropeng contributes substantially to this learning outcome (refer to Fig. 8, p. 39) and the explanations and visuals at Sterkfontein are more than sufficient to meet the learning outcomes as per the syllabus
List the uses of fossils in what the fossil record tells us about:	
• The age of the Earth	Covered in greater detail at Sterkfontein than at Maropeng
• When life forms first developed	Covered extensively at Sterkfontein and moderately at Maropeng
• The complexity of life forms today compared to those that existed in the past	Covered in both museums but in greater detail in the exhibition at Sterkfontein
• The appearance of today's life forms compared to those that existed in the past	Addressed at both museums
Fossil Dating	
State what is meant by fossil dating	Detailed explanations of fossils and how they are formed are addressed in the exhibition at Sterkfontein with less focus on this at Maropeng
Explain the following methods of fossil dating: • relative dating • radiometric dating	Adequate reference to this appears at the museum at Sterkfontein .
Describe how scientists use the results from fossil dating to make inferences (deductive reasoning)	Covered extensively in the exhibition at Sterkfontein but not at Maropeng.
Missing link between dinosaurs and birds	
State that scientists regard Archaeopteryx as the missing link between dinosaurs and birds	Not addressed in the exhibitions at either museum. An important aspect in the evolution of species on earth that should be addressed in the exhibitions

List general features of dinosaurs and birds	Not addressed in either of the exhibitions
Explain why scientists regard Archaeopteryx as the missing link	Not addressed in either of the exhibitions
Life's History	
Explain what is meant by the geological time-scale	Addressed in both museums but more needs to be done in explaining in greater detail an understanding of the geological time-scale and its importance in an understanding of evolution. The ramp to the boat ride at Maropeng covers the timeline in some detail (refer Fig. 11, p. 41)
Describe the geological time scale in terms of: • The need for the geological time-scale • The structure of the geological time-scale • The three eras: Paleozoic, Mesozoic and Coenozoic • Each era divided into periods • Major events (extinctions/appearances of life forms) in each era of the geological time scale	 Not addressed in either of the exhibitions Not addressed in either of the exhibitions Not covered in great detail at either museum Covered to a degree at Sterkfontein but not extensively There is greater emphasis in both exhibitions on the fifth mass extinction which led to the demise of the dinosaurs, as well as mention of what scientists are calling the sixth mass extinction brought about by humankind. There are no detailed references to the other mass extinctions that have occurred throughout the history of the Earth
Interpret different diagrammatic representations of life's history	There are adequate learning opportunities at both museums for this learning area
Describe the influence of each of the following on the history of life on earth: • Geological events (e.g., movement of continents) • Climatic factors (e.g., increase in oxygen levels, ice ages)	This is covered substantially in both museums
Discuss the Cambrian explosion in terms of the origin of early forms of animal groups	Detailed explanations are given at Sterkfontein with less reference to this at Maropeng

Mass Extinctions	
State that there were five mass extinctions	Not covered in either exhibits
State possible reasons that have been provided for the following two mass extinctions: • Cretaceous extinction (250m years ago)-led to extinction of about 90% of all life on earth • Permian extinction (65 mya)-resulted in the extinction of many species including the dinosaurs	Not covered Mentioned at both Sterkfontein and Maropeng
Select one hypothesis proposed (e.g. meteorite impact theory and volcanic eruptions in India theory) for Permian extinction and describe evidence scientists have gathered in support of this hypothesis	Reference is made of this at both museums
Explain why the current rate of extinction is referred to as the sixth mass extinction	Covered in the exhibition at Maropeng in the Sustainability Wall
Debate the impact of human population on biodiversity and the natural environment	Covered extensively in the Sustainability Wall at Maropeng
Key events in life's history in Southern Africa	
Describe evidence for the following key events and identify the locations of each event on a Southern African map: • Origins of the earliest forms of life (fossilized bacteria from the Barberton district, Mpumalanga) • Soft-bodied animals in Namibia • Early plants in the Grahamstown area • Forests of primitive plants such as glossopteris (near Mooi River and Estcourt) and which form most of the coal deposits in Southern Africa • The coelacanth as a 'living fossil', of the group that is ancestral to amphibians • Mammal-like reptiles in the Karoo • Dinosaurs (Drakensberg and Maluti mountains, Euskylosaurus from Lady	Not mentioned in either of the exhibitions Not mentioned in either of the exhibitions Not mentioned in either of the exhibitions Not mentioned in either of the exhibitions Not mentioned in either of the exhibitions Not mentioned in either of the exhibitions Not mentioned in either of the exhibitions

Grey in the Eastern Cape and cone-bearing plants) • First mammals (Eastern Cape & Lesotho)	Not mentioned in either of the exhibitions
With regard to the coelacanth: • Describe the role of South African scientists in the discovery of the first living coelacanth • Describe the appearance of the earliest amphibians and state how this links to the coelacanth	Not mentioned in either of the exhibitions Earliest amphibians are covered adequately in the exhibition at Sterkfontein but there is no link or explanation of this in relation to the coelacanth

ANNEXURE 2

An evaluation of evolution as it appears in the curriculum (Life Sciences Grade 12) against the exhibitions in the Cradle of Humankind World Heritage Site

Curriculum/Learning Outcomes	Evaluation against exhibits/comment
Origin of an idea about origins • The theory of evolution emerges from different lines of evidence e.g. fossil record (Grade 10), modification by descent, and the evidence from biogeography (Grade 11), genetics (Grade 12) as other forms of evidence	This learning outcome is mentioned in various forms at both exhibitions but what is lacking at Maropeng is a 'tying in' of all of this into a coherent whole as a comprehensible explanation of evolution on Earth, as well as the evolution of the human species
• Evolution as a scientific theory and not just a hypothesis. The difference between hypothesis and theory	The difference between hypothesis and theory is not expanded upon at either of the exhibitions, although there are detailed explanations of what evolution is
• The role of Erasmus, Lamarck, Darwin and Wallace in the development of the theory of evolution	There is sufficient reference of this at both museums
• Beginning of conflict between religion and science with respect to evolution	Not covered in either museum except for the 'Religion Wall' at Sterkfontein which addresses the 'Alternative Theories' section in the curriculum
Evolution by natural selection *Darwin's theory of evolution by natural selection:* • Life forms have evolved from previous life forms by natural selection (link to Genetics). Most species are unable to survive in a new environment, and become extinct, but a few species may successfully adapt to a new environment	Adequately covered in both museums although there is greater detail at Sterkfontein

• Natural selection only operates on variation in inherited characteristics (link with Genetics)	Discussed in the exhibitions at Maropeng and Sterkfontein but there needs to be greater attention paid to linking natural selection with genetics and an explanation of this
• Artificial selection mimics natural selection. Artificial selection as illustrated by at least one domesticated animal species and one crop species	Not covered in either exhibit
Formation of new species	
• Biological species concept: a group of organisms that can interbreed and produce viable offspring	Not covered in either exhibit
• Speciation as a mechanism for producing new species. Geographic speciation due to isolation. Select ONE example e.g. cichlid fishes in Lake Malawi, Galapagos finches, mammals on different land masses	This is covered at a basic level in the explanation of Darwin and the formation of his theory of evolution, but there is no specific part of the exhibitions that examine in detail Darwin's discoveries on his HMS Beagle voyage for example. Another good example would be how mammals and other species in Australia or Madagascar have evolved in a unique way due to their geogrphc isolation
• Mechanisms of reproductive isolation: - breeding at different times of the year - species-specific courtship behavior (animals) - adaptation to different pollinators (plants) - Infertile offspring (e.g., mules)	Not covered in either exhibit

Human evolution	
• Map out the sequence of human evolution from ape-like ancestor around 5 mya to modern Homo sapiens. Emphasise the fossils found in Africa, and the simultaneous existence of several species at various times in the past	This is covered sufficiently in both museums but with greater clarity and detail at Sterkfontein. More attention needs to be paid to explaining in greater detail the geological time scale, for example, the difference between 200 000 years ago, 2 million years ago, 20 million years 200 million years ago or 2 billion years ago, in order to place human evolution in perspective. The huge influence of climate on evolution needs to be explained in greater and simpler detail. What could perhaps be included in both museums are reconstructions of past environments and the influence of climate on these environments and their species in dioramas, for example, reconstructions of environments depicting dinosaurs that evolved in the colder polar climes of (say) the Jurassic period versus the environments in which other dinosaurs thrived compared to the hardships of what early hominin species would have had to face
• Evidence for common ancestors for living primates including humans	Adequate explanations in both museums
• Out of Africa hypothesis and evidence for African origins of all modern humans	There is sufficient explanation of the Out of Africa theory in both museums with greater detail and attention paid to this at Maropeng (refer Fig. 12). This includes both the Out of Africa I and the Out of Africa II theories
• All modern humans are genetically very closely related	This is not covered substantially in the displays at Sterkfontein but there are considerable exhibits about this in the exhibition at Maropeng (refer Fig. 13)
• African fossils have made a huge contribution to understanding human evolution e.g. Cradle of Humankind World Heritage Site, Great Rift Valley	South African fossil discoveries are given prominence in both museums but there are inadequate displays and explanations of similarly significant fossil finds from other parts of Africa

Evolution in present times	
• Examples that evolution is still occurring, e.g. the development of resistance to insecticides in insects; resistance to antibiotics in various bacteria	No reference to this learning area in either museum
• Use of DDT and consequent resistance to DDT in insects can be explained in terms of natural selection	Not covered in either exhibit
• Development of resistant strains of TB –MDR, and, more recently, XDR strains of tuberculosis-causing bacteria	Not covered in either exhibit
Alternative explanations	
• Investigate and discuss cultural and religious explanations for the origin and development of life on earth	This is covered adequately in the display of the 'Religion Wall' in the Sterkfontein exhibition. There is no reference to alternative theories and their explanations in the displays at Maropeng. There is no mention of the limits of science in explaining 'faith-based' matters (refer Fig. 14)
• Alternatives to Darwin's explanation: - people have different ways of understanding the history of life and the place of humans in life - science has limits: it can explain physical structures and events, but not spiritual or faith-based matters. Both are important to humans, but in different ways	This is covered adequately in the display of the 'Religion Wall' in the Sterkfontein exhibition. There is no reference to alternative theories and their explanations in the displays at Maropeng (see comments on this under the Analysis section of this report, pg 57).

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