

AFRICAN ORIGINS

A

STRATEGY

OF THE

DEPARTMENT OF SCIENCE AND TECHNOLOGY

for the

PALAEOSCIENCES



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AFRICAN ORIGINS: A RESEARCH STRATEGY FOR THE PALAEOSCIENCES

EXECUTIVE SUMMARY

South Africa's fossil and human genetic heritage is remarkable. No other country in the world can boast the oldest evidence of life on Earth extending back more than 3 billion years, the oldest multi-cellular animals, the most primitive land-living plants, the most distant ancestors of dinosaurs, the most complete record of the more than 80 million year ancestry of mammals, and, together with several other African countries, a most remarkable record of human origins and of human achievements through the last eight million years.

Given the uniqueness of this heritage resource, the *African Origins* programme is conceived as an integral part of the National Research and Development Strategy to provide an opportunity for South Africa to become leaders globally in the field through world-class scientific excellence in the study of the palaeoworld.

The vision of the *African Origins* programme is:

A South Africa and Africa united in promoting a new awareness of life in the past through the study of the continent's rich heritage in fossils, artefacts and human genetics for the intellectual enrichment and empowerment of all its peoples.

This vision will be accomplished by linking excellent science projects to human capital development through learnership and mentorship programmes, and takes the research output to the public in interesting and stimulating ways. A key element is that the heritage belongs to every South African, is a source of pride, and should be jealously protected and carefully conserved. Indeed, the fossil and artefact record is so widespread that there are few districts that are not richly endowed. By increasing local and international awareness of our remarkable treasures the programme aims to stimulate innovative palaeo- and archaeo-tourism, and to build a training programme in support of small business developments to bolster this industry.

The *African Origins* programme identifies the following research themes

- The origin, speciation and extinction of life
- Changes in biodiversity and ecosystem through time
- Age relationships and biostratigraphy
- The evolution of humankind
- Emergence of modern humans

The strategy furthermore recognizes the following:

- The need deliver cutting edge science in all these fields in order to become a global leader and thereby to do justice to our unique heritage. This will require the

development of specific skills where, in the past, South Africa and Africa has relied heavily on skills from abroad.

- Empowerment of the previously disadvantaged to become fully-fledged participants in all fields of palaeontological and archaeological endeavour as a critical success factor.
- South Africa's position and responsibilities regarding the palaeosciences within a broader African context, particularly in capacity building through collaboration and fostering a continental scientific identity.
- The statutory obligations regarding the preservation of our heritage and the need to liaise very closely with the appropriate authorities to ensure unencumbered access to sites for research, the proper management of fossiliferous heritage sites and the maintenance of high ethical standards when excavating sites for research purposes.
- All fossil collections are regarded as part of our national heritage. Their proper management and curation for research, education and outreach is paramount to the success of this strategy.
- The need for access to specialized research equipment will continuously be monitored within the context and provisions of the National Equipment Strategy.
- Science outreach and awareness activities will be closely aligned to the three strategic thrusts of the South African Agency for Science and Technology Advancement, i.e. science awareness platforms, science communication and science education, in order to ensure maximum impact.
- The potential of palaeotourism as a means to create sustainable small businesses, create jobs and in some instances, as e.g. the Cradle of Humankind, income for investment in research.

The strategy identifies the need to establish an Advisory Board that can assist the DST in the further development of policies and strategies regarding *African Origins* and to monitor progress on a regular basis. Funding for implementation of the strategy has a two pronged approach, i.e.

- Provision for longer term support to build and sustain the core competencies in the palaeosciences, commensurate with the uniqueness of our heritage. Calls for proposals of this type will either be of an open nature or be solicited for very specific activities of national interest, but in all instances subject to stringent peer review.
- Provision for very specific short-term, ad hoc research projects, bursary grants for students, and outreach activities.

Both will be handled on behalf of the Department of Science and Technology by an appropriate funding agency. The agency will be tasked to continue government's commitment to a close working relationship with industry through PAST in order to retain industry's interest and support of the palaeosciences.

The sustainability of the *African Origins* programme is rooted in developing links throughout Africa and internationally, as well as with business. The objective is to create growth in

palaeoworld science that is not solely dependent on the ongoing investment made by the Department of Science and Technology. Instead the *African Origins* programme will explore sustainability by way of a connectivity plan that will create synergies across all facets of the strategy and thereby identify opportunities and leverage resources that would otherwise not have materialised.

1. INTRODUCTION

Within a new, democratic South Africa, the special contribution of studies that concentrate on the rich and ancient heritage of the country is increasingly being recognized. This is reflected among others in the National Research and Development Strategy (DST, 2002) in which palaeontology¹ is recognized as one of the few areas of science where South Africa has a competitive advantage and where South African scientists need to be enabled to excel internationally. Studies of Southern Africa's rich fossil and cultural record were undertaken independently of the state as support for these were largely marginalized by the apartheid-era government because it pursued an ideology based on a history that only began with the arrival of Europeans and discouraged the teaching of evolutionary theory. Research in this field has profound relevance to all people, and is central to the recent emphasis on Heritage Development by the South African Government. This is exemplified by the National Heritage Resources Act (Act No. 25 of 1999) according to which access and control over our heritage resources have been tightened considerably. Already symbols from this distant past adorn South Africa's national coat-of-arms and the country's national merit awards.

Few things related to science capture the imagination of people more than the allure of worlds gone by. This includes the origins of life, the worlds of dinosaurs, mass extinctions, meteorite impacts, as well as the evolution of humans and their technological and artistic achievements. Understanding the evolution of life is central to the way we view ourselves and the way we view others around us. It is therefore of the utmost importance to develop and communicate the study of life's evolution.

South Africa's fossil and archaeological heritage is truly remarkable to the extent that it is not possible to write a text on the evolution of life on Earth without extensively referring to it. Because of the unique antiquity of its rock record, South Africa is the only country in the world that can boast all of the following:

- the oldest evidence of life on Earth,
- the oldest multi-cellular animals,
- the most primitive land-living plants,
- the most distant ancestors of dinosaurs,
- the most complete record of the more than 80 million year ancestry of mammals,
- a remarkable record of the origins of humans and their earliest technological achievements over the last four million years.

¹ Within this strategy document the term "Palaeontology" includes "Palaeoanthropology" unless stated otherwise.

The rich fossil bearing rocks of the Karoo Sequence, which cover two thirds of the surface area of this country, tell a unique, uninterrupted story over more than 100 million years of the ancestry of plants, tortoises, dinosaurs and the distant origins of mammals and ultimately of humans. No other country has such a complete, largely uninterrupted terrestrial rock record covering the Carboniferous, Permian, Triassic and Jurassic periods documenting a climatic shift from glacial polar conditions to subtropical desert. This is also the period when the ancestral reptilian lineage diversified into tortoises, lizards, crocodiles, dinosaurs, birds and mammals. With the exception of birds all the lineages are represented in the rocks of the Karoo, and many of them actually began their radiation into the areas adjacent to the South African portion of the ancient supercontinent of Gondwana. Because of this unique heritage captured in the rocks of the Karoo Sequence within South Africa, this sequence is considered the international stratotype of Permian-Jurassic continental deposits. The same succession of rocks is known to extend all the way into Namibia, Angola and Tanzania, but very little is known about them and their potential for hosting significant fossil resources.

Increasingly scientists are trying to understand the cause and effect of extinction events and the subsequent recovery of biodiversity. Studies on the Karoo Sequence hold the clues to understanding both the end-Jurassic and end-Permian extinctions. The latter is often termed the “Mother of all Extinctions” as 95% of species on earth disappeared, and nobody yet knows why! In the current biodiversity crisis posed by the so-called ‘Sixth Extinction’, and in probing ideas for sustainable development, scientists are increasingly looking at past phylogenetic biodiversity trends to predict the future. The Karoo Sequence of South Africa and equivalent rock sequences to the north may hold many of these answers.

The origin of humans in Africa is undisputed and fossils of early hominins have been discovered in several African countries. Research on hominin origins in South Africa has a rich tradition and is recognized as one of the most visible and acclaimed fields of science unique to the sub-continent. The South African fossil record of hominin evolution is arguably one of the most complete and spans more than four million years. In particular, cave sites in South Africa hold behavioural and morphological evidence of early human species and a rich archaeological record including some of the oldest stone tools and the earliest evidence of the controlled use of fire.

South Africa also has one of the world’s oldest and most extensive rock art traditions. Some 15,000 documented sites testify to the richness of this heritage (compare this to the some 300 decorated Upper Palaeolithic caves in Europe). It is not only the antiquity of the art and large number of sites that make South African rock art so important, but the fact that it is amongst the best-understood of all rock art traditions world-wide. Researchers from all over the world seek to emulate the South African success story by adopting the methods of analysis developed by South African researchers. Rock art researchers working in the United States, Canada, Mexico, France, Spain, United Kingdom, Sweden, Norway, Poland, North Africa, East Africa and Australia regularly refer to South African rock art studies for guidance. In contrast to most other disciplines that have to import their theory and method from other parts of the world, in rock art studies South Africa is a strong exporter.

Interest in our common humanity will ensure that this initiative always remains a topic of local, national and international relevance to academics, researchers, students and the public generally.

The *African Origins* programme has the potential to bring unparalleled opportunities for international collaboration, new teaching and training programmes, and poverty relief through tourism. Because South Africa has an obvious geographical advantage in palaeontological, palaeoanthropological and archaeological research, this country should emerge as a globally leading centre of research excellence in these fields of study.

2. PALAEOONTOLOGICAL AND ARACHAEOLOGICAL ENDEAVOUR IN SOUTH AFRICA

a. Research

Palaeontological and archaeological research is currently undertaken at the Council for Geoscience and several museums and universities in South Africa (Table 1). These centres have, to varying degrees, scientists and technicians on their staff who are employed in palaeontological and archaeological research. Additionally, all of these institutions hold palaeontological collections of one form or another. Only the universities engage in postgraduate teaching.

Table 1. South African Institutions where palaeontological research is undertaken

	Scientists Tenured	Techn. Tenured	Scientists Grant Funded	Techn Grant Funded	Total
<i>Museums</i>					
Iziko Museums of Cape Town	7	14	2	5	28
Albany Museum	1	1	1		3
National Museum, Bloemfontein	3	12			15
Northern Flagship Institution	2	1	1		4
<i>Universities</i>					
University of Cape Town	4	2			6
University of Witwatersrand	8	9	5	20	42
University of Stellenbosch	1				1
University of Free State	1	1			2
<i>Council</i>					
Council for Geosciences, Pretoria	1	2.5			3.5

Scope and quality of research:

Little research has been undertaken in the recent past on evidence of the earliest forms of life, i.e. that in rocks of the Barberton Mountain Land. The little that has been done was with collaborators abroad and although published internationally in journals with very high impact factors, remains speculative and leaves a lot of scope for further cutting edge investigations. Some more attention by scientists, mainly from the United States and Germany, but to a limited extent also from South Africa, has in recent years focused on

some of the oldest multi-cellular organisms known to occur in the late Precambrian Otavi and Nama Groups in Namibia.

The rocks of the Cape Supergroup host a large variety of invertebrates, fish, and plant taxa comprising the famous Malvinokaffric fauna of Gondwana. Currently little research is being undertaken by South African scientists on this important aspect of the South African fossil record, and it is largely left to scientists from abroad to exploit this gap.

Most palaeontological research undertaken by South African institutions is on the fossils from the Karoo and from the Plio-Pleistocene hominid-bearing deposits as these are the only fields for which there are tenured palaeontological positions at universities and museums. Despite the fact that there are relatively few palaeontologists employed in this country, productivity of these researchers is regarded as good (see DST document “State of Palaeontology research in South Africa 2004”) and their papers are published in good quality internationally accredited journals.

In the past, research on the fossils of the Karoo has largely been the description of new taxa, revision of past taxonomic assessments, and the acquisition of newly discovered specimens into museum collections. Since about 1990, research in this field has become more multidisciplinary, and while still undertaking the essential basic tasks of taxonomy and morphological description, this work is now being contextualized by incorporation of fields such as morphometrics, taphonomy, biodiversity and biogeographic studies, computer based phylogenetic analysis, GIS, palaeomagnetism, plate tectonics, isotopic dating and fingerprinting for environmental change, sedimentology and basin analysis. This, coupled with the largely uninterrupted record of Permian-Jurassic terrestrial deposition within South Africa, has led to great advancement of the field in South Africa, so much so that the multidisciplinary research of South African Karoo palaeontologists is internationally acclaimed for its innovative approach.

By contrast there has been a perception that South Africa is producing proportionately large numbers of scientific publications in palaeoanthropology that are predominantly site announcements and lack rigorous interpretation. More prestigious publications with proper analysis and interpretations are often multi-authored, frequently with expertise from abroad. Pioneering work in isotope studies and taphonomy in this field date back to the 1980's and the scientists involved have largely retired. Although isotope work of quality is continuing at the University of Cape Town and at the Quaternary dating laboratory at the CSIR, methodological and technical advancements have meant that South African chronologists have been left behind because of the lack of investment in new equipment. Consequently, much of the dating work, specifically on samples from the Cradle of Humankind has been done abroad in recent years.

Population genetics research has been carried out in the Department of Human Genetics, School of Pathology, at the University of Witwatersrand for some decades. With the advent of molecular genetics technology highly acclaimed publications from this department on genetic variation of sub-Saharan populations helped confirm the “out of

Africa” theory of human origins and the populating of the old World by modern humans as recently as 100 000 years.

It is within this last 100 000 years of human evolution where South African scientists have and continue to make groundbreaking contributions in the study of early human behaviour and cultures. These are based on the unique archaeological heritage contained first and foremost in the seemingly continuous record of rock art over the past 27 000 years, but also the geometric motifs uncovered recently at Blombos and dated 77 000 years before the present. There are many other sites with deposits that have the potential of revealing discoveries of similar or even greater importance, and again, because of lack of local capacity, these are valued destination of scientists from abroad.

Critical mass of world class researchers:

The small number of world class specialists in the field of palaeontology and archaeology in South Africa is a combination of historical, economic and social factors. Several have left the country for political or career reasons, others have retired and many of the posts so vacated have not been filled because of financial constraints in the institutions concerned. Many scientists active in the field at present are involved in exploration and fossil recovery, but to derive full benefit from the collections, researchers with complementary skills are required as alluded to above.

b. Collections

In terms of the National Heritage Resources Act (Act No. 25 of 1999), all fossils excavated post 1999 are the property of the state and may not be removed from their place of origin without a permit from the South African Heritage Resources Agency (SAHRA) or from provincial heritage resources authorities where such exist. SAHRA in turn is responsible for ensuring that the fossils removed in terms of its permits are placed in museums or universities that have acceptable formal collecting policies and the facilities to look after them for future generations. Every permit therefore includes a clause that specifies the institution that has agreed to house the collection. The Act does not dictate policy to the curating institutions. Such policies are the prerogative and responsibility of the individual institutions. Institutions that house significant palaeontological collections are listed in Table 2.

Table 2. South African Research Institutions housing fossil research collections:

<i>Institution</i>	<i>Size of collections</i>	<i>Cape Sgroup</i>	<i>Karoo Sequence</i>	<i>Paleo-botany</i>	<i>Tertiary</i>	<i>Quaternary</i>	<i>Palaeo-anthrop.</i>	<i>Archaeology</i>
Universities:								
Cape Town	small							
Stellenbosch	small							
Witwatersrand	major		x	x		x	x	x
Museums								
Albany	notable		x	x				
East London	small							
Iziko	major	x	x		x	x	x	

National Bloemfontein	notable		x			x		
Northern Flagship	major						x	
McGregor	small							
Science Council								
Council for Geoscience	notable	x	x	x				

Size of collections: major: >50 000 specimens; notable: 5000 – 50 000 specimens; small: <5000 specimens

X: refers to significant holding of specimens in the category

Considerable problems have been experienced in the past regarding access to the collections. This has been exacerbated by the fact that pre 2000, prevailing legislation did not stipulate ownership of collected fossiliferous material, even though permits were required to remove such material from the site of origin. Ownership of certain collections is presently still under dispute.

There is furthermore no nationally accepted agreement regarding access by scholars to fossils after excavation and study by the permit holder, and as a result some of the collected material remains inaccessible for research for undue length of time. This can be to the detriment of national interest as the permit holder can hold advancement of science to ransom by refusing to release the material after a reasonable timeframe.

The lack of qualified support staff, in particular collection managers and preparators to curate our fossil collections as an important component of our national heritage is an area of great concern. Skilful, responsible preparation is the most time-consuming aspect of palaeontological research and such support is a *sine qua non* at any institution undertaking research on fossils. In addition, poor storage facilities, and lack of adequately trained collections managers is a cause for concern at some institutions and place the integrity of collections at serious risk.

c. Collaboration with scientists in Africa

Very little capacity exists in Africa regarding palaeontology and archaeology, and research on sites in the rest of Africa is conducted primarily by scientists from outside Africa. Furthermore few if any facilities for training in the palaeosciences exist outside South Africa. Some collaboration has taken place in the past between scientists from South Africa and countries such as Namibia, Kenya, Zimbabwe, Niger, Zambia, Tanzania and Malawi, but is to some extent hampered by the limited number of suitably qualified people and lack of infrastructure in several of these and most of the other African countries.

d. Significance of the Cradle of Humankind (CoH)

The importance of our fossil heritage is recognized world wide by inclusion of the Sterkfontein area as the ‘Cradle of Humankind’ on the world Heritage List in 1999. The significance of this site is described in the nomination for World Heritage Status as follows:

The Sterkfontein Valley landscape comprises a number of fossil-bearing cave deposits which are considered to be of outstanding universal value, because they encapsulate a superbly preserved record of the fauna, including an invaluable record of the stages in the emergence and evolution of humanity, over the past 3.5 million years. This makes it without doubt, one of the world's most important sites for human evolutionary studies and research.

As envisaged at the time, the fossiliferous sites of Makapansgat and Taung were added to the Cradle of Humankind World Heritage Site in 2005.

The acceptance of a World Heritage Site brings with it very specific obligations which, in the case of South Africa, have become statutory by virtue of the World Heritage Convention Act (Act No. 49 of 1999). This Act provides for the enforcement and implementation of the World Heritage Convention in South Africa and allows amongst others for the establishment of authorities to safeguard the integrity of World Heritage Sites and for integrated management plans and other controls. The Minister of Environmental Affairs and Tourism is responsible for implementing the Act, but must consult with the Minister of Arts and Culture and with interested parties, e.g. SAHRA when establishing an Authority to manage a site. In the case of the Cradle of Humankind, the Gauteng Department of Agriculture, Conservation, and Environment is the duly appointed management authority. Through the Blue IQ initiative of the Gauteng Government, the CoH is being developed by way of a public-private partnership into a major tourist attraction with numerous opportunities for employment and science awareness activities.

How the extensions of the CoH in the Northern Cape and Makapansgat in Limpopo will be managed in conjunction with the Gauteng sites has yet to be resolved.

e. The Statutory Environment

The National Heritage Resources Act became operational on 1 April 2000 and governs, amongst others, the fossil occurrences within South Africa. The stipulations contained in this Act impact significantly on the collection and storage of fossiliferous material for research, viz.:

- In terms of Section 35(2) of the Act all archaeological objects and paleontological material are the property of the State. The South African Heritage Resources Agency (SAHRA), established in terms of Section 11, or the provincial heritage resources authorities, established in terms of Section 23 on behalf of the State, must at their discretion “ensure that such objects are lodged within a museum or other public institution that has a collection policy acceptable to the heritage resources authority and may in doing so establish such terms and conditions as it sees fit for the conservation of such objects.”

- In terms of Section 35(4), no person may, without a permit issued by the responsible heritage resources authority, destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site. The Act does make provision though (Section 48 (3)) for a heritage resources agency to grant exemptions from the requirements to obtain a permit. A heritage resources agency may, with the issue of a permit, prescribe the standards and conditions for the excavation of archaeological and palaeontological objects and material; and also demand a financial deposit to be lodged and held in trust for the duration of the permit.
- SAHRA must, in consultation with the Minister and the MEC of every province, establish a system of grading of places and objects which form part of the national heritage (Section 7). The Act makes provision of three grades of heritage, viz.:
 - Grade I: Heritage resources with qualities so exceptional that they are of special national significance.
 - Grade II: Heritage resources which, although forming part of the national estate, can be considered to have special qualities which make them significant within the context of a province or region, and
 - Grade III: Other heritage resources worthy of conservation

SAHRA is specifically tasked with the identification and management of Grade I heritage resources (Section 8 (2)).

- In accordance with Section 25(2)(1) of the Act, SAHRA, by way of a recent notice in the Government Gazette, gave notice that fees will be payable for permit applications as from 1 February 2006. This notice stipulates that permits for archaeological or palaeontological research and conservation, irrespective of whether this relates to Grade I, Grade II or Grade III categories, is R100 per permit.

Except for the CoH, all palaeontological and archaeological heritage has to date been treated as being of the Grade II status. Although this may be appropriate for archaeological research, which is very site specific and hence normally requires dealings with one heritage resources agency, this is not the case for palaeontological research. Palaeontology deals with research on fossil-bearing rock strata of specific ages and which in the case of South Africa extend over provincial and in some cases also across national boundaries into neighbouring states. The implication of this is that for meaningful palaeontological research to be conducted, the researchers would in most cases have to apply to several provincial heritage resources agencies for permits to conduct their research within the country. Apart from the cost aspect of having to apply for of multiple permits, this introduces a considerable administrative burden on the researcher to remain compliant with the differing stipulations of the permits issued from the different agencies.

f. Funding

Prior to 1994 funding for research in palaeontology at universities and museums was primarily provided by the state through the then Foundation for Research Development, although the University of the Witwatersrand made some substantial contributions from own funds in support of palaeoanthropology and the Bernard Price Institute of Palaeontology. Available funding however did not keep pace with the rising cost to sustain the research, so that several research posts and posts for support staff were cut, mostly at museums. Palaeoanthropology was also hard hit particularly because of expenses related to excavations, so much so that industry stepped in and created the Palaeo-Anthropology Scientific Trust (PAST) in 1994. This trust receives donations from industry and distributes these funds to applicants for research and thereby created an environment for research in palaeoanthropology to continue at a respectable level in South Africa. Funding for excavations remains sub-critical however.

On the basis of the National Research and Development Strategy which identified palaeontology as an area where South Africa has, by virtue of its significant fossil heritage, a distinct competitive advantage, the Department of Science and Technology has been setting funds aside since 2002 specifically in support of research in these disciplines. Funding is made available through the National Research Foundation to PAST for disbursement on a competitive basis to researchers in these fields.

3. VISION AND MISSION OF THE AFRICAN ORIGINS PROGRAMME

3.1. Vision

A South Africa and Africa united in promoting a new awareness of life in the past through the study of the Continent's rich heritage in fossils, artefacts and human genetics for the intellectual enrichment and empowerment of its peoples.

3.2. Mission

The *African Origins* programme draws on South Africa's and Africa's unique palaeontological, archaeological and genetic heritage to develop and encourage a nation and continent wide spirit of pride and custodianship. This will be accomplished through:

quality multidisciplinary research that achieves international acclaim, demonstrates research leadership, and encourages mentorship and research capacity development.

training programmes that focus on equity and redress, promote economic empowerment, local job creation and the maximisation of human capital.

educational initiatives in schools that incorporate curriculum revision, the provision of school texts and other educational materials and visits to palaeontological and archaeological sites.

public participation and awareness programmes that address issues of social identity, empowerment and intellectual property by means of effective displays, workshops and accessible media initiatives.

partnerships with researchers throughout Africa enabled by bilateral agreements, political facilitation, and the sharing of expertise and equipment.

partnerships between government, private sector and academic institutions within a framework of sustainable development that links the *African Origins* programme to the Environmental Impact Assessment methodology, a learnership and apprenticeship scheme, and a viable permitting and accreditation system.

4. THE STRATEGIC ELEMENTS

4.1 RESEARCH

The unique antiquity of the South Africa rock record lends itself to a large number of cutting edge interdisciplinary research programmes, which, when viewed from an African context become even more significant. The implication of this is not merely to understand the evolution of life on earth, but the evolution of the earth as such and hence also present day natural processes that impact on the well-being of humanity. This necessitates an Earth System Science approach whereby every facet of research must be motivated as, and ultimately contributing to deriving a better understanding of the earth as a system. The importance of this is that well conceptualized research in the palaeosciences can become, in many respects, either a portal to or influence the direction of research on other scientific fields

The *African Origins* programme will support research under the following themes:

Origin, Speciation and Extinction of Life:

A rigorous taxonomic framework is the foundation for any palaeontological research and understanding of speciation. Ongoing research in this field is essential to fully understand the significance and importance of Africa's fossil record and apply this information in more integrative research. It is thus important to keep this field vibrant. Computer based phylogenetic analysis is an important component which needs to be addressed as well as looking at taxonomic changes linked to global natural changes, both gradual and calamitous.

Ecosystem and Biodiversity Changes through Time:

Biodiversity and ecosystems, which are constantly changing, are unique at any particular point in geological time. With the current threat of the so-called "6th Extinction", driven by global warming and other human activities, it is important to understand what factors drive changes in biodiversity. This theme will include studies on past climates and environments and their affect on biota over the extensive time periods which are covered by the African rock record and how different life forms adapted to environmental changes.

Age Relations and Biostratigraphy:

Age determination is an essential component of palaeontological research and underpins the succession of the palaeontological and archaeological record. It is the basis for assessing biodiversity and biomass at any point in geological time and for correlating rock strata of similar ages. A rigorous biostratigraphic framework is essential for global correlation of biota to understand migratory patterns of animals and plants in the past, for palaeocontinental reconstruction, and for the correlation of rock strata for academic and commercial (mining and mineral as well as oil exploration) purposes

The Evolution of Humankind:

The origin of humans in Africa is undisputed, based on this continent's rich record of history, from the earliest manifestations of the hominin line to the emergence of modern humans. This theme will involve anatomical studies on fossils as well as faunal studies as related to hominin co-habitation and will include those studies in the earth and life sciences that will enhance understanding of the factors which have driven human evolution.

Emergence of modern Humans:

Africa, with its rich diversity of living peoples from different cultures, is a laboratory for the study of human origins and diversity. Research under this theme will study living human populations as the key to unravelling their past history and will rely on disciplines such as genetic reconstruction, indigenous knowledge systems and other studies relating to human origins.

4.2 CAPACITY BUILDING

Skills requirements for Africa to be a global leader

The palaeoworld is a multifaceted subject which incorporates a number of related earth and life-science disciplines. The topics to be explored have a multidisciplinary focus and include taxonomic, anatomical, taphonomic, and stratigraphic studies, isotope analysis for the purpose of dating, diet and palaeoenvironmental reconstruction and basin analysis studies. In addition advanced skills in data management and manipulation as well as image analysis are becoming of increasing importance. The approach in this strategy is from an earth system perspective and hence the need for research leaders with the capacity to translate the research outcomes into the wider earth system science context.

Because of the multi-disciplinary nature of palaeo-research and the lack of certain mission-critical skills in South Africa, collaboration both nationally and internationally has been extensive, among others to access the best analytical facilities. However, in order to become leading in the field and to be recognized as such South Africa and Africa need to rely much less on foreign key skills and build own capacity in this regard. This will require the creation of a limited number of carefully selected specialist posts and the filling of these either with acknowledged specialists in the field or with candidates of potential that can grow into acknowledged specialists. The creation of such posts will need to be linked to well conceived, long term research projects that will constitute part of the *African Origins* Programme.

It is recognized that any research endeavour aimed at global leadership needs to be underpinned by the appropriate support systems and infrastructure. The strategy regarding infrastructure is discussed below. Other necessary support in the palaeosciences should include the availability of appropriately skilled technical support staff for optimal productivity in palaeontological research and production of educational exhibits. The specialist skills revolve around

- the extraction of fossils from the rock, both on site and in the laboratory, which involves a variety of technologies depending on the nature and state of preservation of the fossils,
- the extraction of material for isotope analysis,
- sample preparation for image analysis,
- curation and conservation of the collections,
- casting of fossils for research and display purposes
- special design and communication skills in the preparation of exhibits to attract the attention of different targeted audiences,

All of these require various degrees of technical training, some of which will need sojourns abroad to acquire the appropriate skills.

It is acknowledged that there is a serious shortage of technical skills in these fields at present and that this will need to be addressed in any strategy that aims to place the palaeosciences of South Africa and Africa at the forefront of science globally.

Equity, redress and empowerment

The palaeosciences in South Africa have for many years been the exclusive domain of white scientists, mostly male. It is very encouraging though that females, and in particular black females, have made significant scientific breakthroughs in recent years, and are now recognized as acknowledged world leaders in their respective fields. The palaeosciences are fortunate to have these as key role models, which will no doubt add greatly to an acceleration of equity and redress initiatives within these disciplines.

As indicated above, for South Africa to be world leading in the African based paleosciences, a critical mass of top researchers and support staff is required. The *African Origins* Programme aims to create the required critical mass, but will link this to concrete strategies within any funding proposal to address the demographic and gender profile not only within the disciplines but ultimately also the leadership positions within them. It is envisaged that this will be accomplished through apprenticeship and mentorship programmes that will constitute an integral part of the research activities. Young black and women researchers will therefore be provided with opportunities to participate in high level research and to demonstrate their capabilities.

It is recognized that research activities will need to be expanded with some tenured employment opportunities to do justice to our huge fossil heritage and in order to effectively cover the spectrum of research disciplines within the palaeosciences. Even though the number of tenured academic/research positions within these disciplines will remain limited, the study of palaeosciences within the context of a vibrant *African Origins* Programme, will in itself create a

cohort of postgraduates as critical thinkers with skills in a variety of fields, such as image analysis, X-ray tomography, isotope geochemistry, manipulation of large datasets that will find applications in many vocations; sedimentology, basin analysis and micro-palaeontology for the oil industry; environmental impact assessment; etc. Graduate or honours students in the field will in the foreseeable future also find employment as accredited tourist guides within the Cradle of Humankind and its extensions as well as other sites of interest.

Training destination for African students and African capacity

Formal training in the fields of palaeontology and archaeology are limited to very few institutions on the African continent, with programmes at the Universities of the Witwatersrand and Cape Town the best known, mainly by virtue of the possibility of training up to PhD level within different palaeoscience disciplines at these institutions. In order to build the desired human capacity in fossil-rich countries within the rest of Africa, particularly Kenya, Ethiopia, Tanzania, Zimbabwe and Namibia, South Africa should establish close linkages/partnerships with universities in these countries, so that vibrant training programmes, both at undergraduate and at postgraduate level can ultimately be established there. The South African institutions can play a key facilitatory role in this regard, initially by providing training for students from these countries and later by cooperating closely with scientists from them. The ultimate aim should be for African scientists to dominate research on their own heritage in a way where the collective capacity can advance the palaeosciences at the forefront of the disciplines much more vigorously than individual country efforts separately.

The unique fossil heritage of Africa and the undisputed origins of humans on this continent make Africa a unique laboratory for research in palaeontology and palaeoanthropology. This needs to be recognized in the science agenda for Africa, particularly also as research on the early hominids and their environments will provide important information on palaeoclimates and nature induced climate change patterns in recent geological times. In order to afford palaeosciences the status on the African science agenda it deserves, will require them to become an integral part of the science and technology action plan of NEPAD.

Capacity building in Higher Education institutions

Important for the success of the *African Origins* Programme is to attract the required number of students to the disciplines and also to create a better understanding of the importance of the palaeosciences within the broader context of understanding earth systems processes. Institutional capacity must aim at ensuring that the palaeosciences feature prominently in the syllabi of relevant undergraduate and/or honours courses in all higher education institutions, particularly the earth and life sciences. This is to be achieved in two ways, first by providing staff within some of these institutions with the required skills and ideally also to become involved in research in the field, and secondly, by way of experts at the institutions with established programmes in these disciplines sharing their knowledge through targeted courses at other institutions.

Integral to the projects funded through the *African Origins* Programme will therefore be initiatives involving assistance to staff of some of the higher education institutions in acquiring the desired skills and for established researchers in their field to share their knowledge as guest lecturers in others.

4.3 INFRASTRUCTURE

Fossil sites and site management

More than $\frac{3}{4}$ of the surface area of southern Africa is covered by fossil-bearing sedimentary rocks, and because of good road infrastructure access to sites is relatively easy. Most of these sites are spread over large tracts of ground and systematic fossil exploration and exploitation by scientists with appropriate permits does not require close management. Of concern though is that because of the widespread nature of these fossiliferous rocks there is virtually no way unauthorized removal or even destruction of fossils by unqualified persons can be prevented.

Palaeoanthropological and archaeological sites on the other hand tend to be localized, and many sites have been given the status of National Heritage Site. Their exploration for research requires proper management plans the design and implementation of which are comprehensive processes. These could involve among others:

- Negotiation and agreement of land owners to access the site
- Environmental impact assessment and heritage survey
- Construction of access roads
- Logistical on-site support to researchers with permits to excavate the site
- Monitoring and evaluation to ensure that internationally best practice is continuously applied to the excavations
- Management of visitors and educational tours
- Rehabilitation of a site after excavations

The strategy must therefore make provision for researchers to be provided with the wherewithal for the efficient and effective exploration and exploitation of sites of this nature and that the sites are protected from unauthorized entry.

Current Heritage legislation requires permits for palaeontological and archaeological exploration to be handled by the respective Provincial Heritage Resources Agencies (PHRAs). While this may be appropriate for palaeoanthropological and archaeological sites which are localized in nature, it is stifling to palaeontological research where rock formations cross provincial boundaries and where researchers are required to apply and report back to a number of separate PHRAs each with its own individual provisions and criteria.

This strategy aims to encourage and enhance the research endeavour in the paleaeosciences and wherever possible to overcome through consultation with appropriate authorities situations where statutory requirements place undue restrictions or unnecessary administrative burdens on the advancement of science.

Collections and their curation

Our palaeontological and archaeological heritage is the property of the state, as defined by the ‘national estate’ in the National Heritage Resources Act. The exploitation of this heritage for research has been subjected to statutory requirements both pre and post 1 April 2000, when the National Heritage Resources Act came into operation. Ownership before 2000 vested in the institution to which the researcher was affiliated, on condition that the collected material was properly curated, whilst post 2000 ownership of the material vests in the state, with the researcher’s home institution fulfilling the role of custodian on behalf of the state. Over the years, the amount of excavated material that accumulated has reached significant proportions, which in the case of palaeoanthropology is in no small measure due to the hunt for hominid remains and the concomitant uncovering of vast quantities of little researched non-hominid fossils. Proper storage of this material, its preparation for research and its curation has as a result become a serious burden on the institutions involved with research, both universities and museums alike, so much so that the integrity of these collections is at risk if not appropriately supported.

This strategy recognizes that these collections, and the material to be added in years to come, collectively constitute an important national asset and that their proper conservation and curation is critical to the success of the *African Origins* initiative of the National R&D Strategy. They constitute an asset of significance similar to the national fish collection of SAIAB, the National Herbarium, BioBank SA, the borehole repository of the Council for Geosciences and similar collections that receive state support. Hence the conservation and curation of these collections for research constitutes part of this strategy.

The collections are presently housed in a variety of institutions with varying curation capacity. For these collections to become a true national asset, the following needs to be pursued:

- Rationalizing the multitude of collections to create a limited number of key repositories with the appropriate infrastructure and support staff to ensure proper curation and accessibility for research and science outreach activities. Such an approach will create economies of scale within the context of limited resources.
- Digitization of the collections and the creation of a national databank of palaeontological material for education and research.
- A commitment by owners of pre-2000 fossil collections to make available these collections for research and educational exhibits in the national interest.
- An agreement with SAHRA and the provincial heritage resources agencies which will limit the conservation of excavated fossiliferous material to those repositories recognized and supported by the DST as housing the “national” collections.
- The development of a collections policy based on internationally benchmarked standards for conservation and curation of these “national” collections.
- Negotiating a binding agreement which will limit the period of time during which permit holders enjoy exclusive access to newly excavated material before it becomes available for more general access.

The repositories recognized to house the “national” collections need to be equipped with appropriate laboratory facilities and trained staff to extract fossils from the rock in accordance with the latest technologies. Such facilities will have to be available to researchers both from the institution that hosts such a repository and researchers who do not have such facilities at their own institutions.

Part of the strategy to rationalize the collections to a limited number of recognized “national” collections which are appropriately curated with trained curators and scientific staff, is to maintain proper control, to facilitate the exchange of material nationally and internationally for comparative studies, and to properly contextualize South African research findings. This will also require digitised databases that include digital photographic images. The databases should be linked to GIS (Global Information System) containing detailed references to localities, both regarding cave deposits and regionally distributed collection sites. One of these national collections should be identified as a central reference facility to house and manage all digital data generated for archiving, future reference and research purposes and must be supplied with the necessary support staff.

Characterisation

All palaeontological research makes use of specialized analytical facilities including; dating, isotope and imaging facilities which need to be established and maintained. Some of this equipment is readily available in South Africa, whereas some is outdated, so that researchers have to rely heavily on facilities abroad. Equipment in these categories and the accompanying technical support staff, as well as ready access to state-of-the-art dating facilities is essential if South African is to become globally leading in the palaeosciences.

Imaging

State-of-the-art non destructive imaging techniques for high resolution 3D visualisation and tomography of key fossil material by nuclear and X-ray scanning techniques are becoming increasingly more important in palaeontological and palaeoanthropological research. Such techniques have been used to a limited extent by South African researchers in the past, amongst others by using some of the facilities and skills available at NECSA. Given that NECSA has a range of nuclear and X-ray based analytical and materials characterisation techniques and supporting expertise on offer and is in a process of developing capacity in some complementary techniques, it is proposed that a National Radiography/Tomography Facility be established here. To become fully operational such a national facility would require investment in gamma-, neutron- and X-ray radiation equipment to complement existing facilities for X-ray and neutron diffraction and radiation analysis.

Important to note though is that the facilities referred to above can only scan samples with a maximum size of 20 x 20 cm. CT (Computerised Tomography) Scanning equipment that can handle larger samples, e.g. skulls of hominids and other fossils is considerably more expensive. Because of similar techniques involved, such a scanner is best also placed together with the other radiography and tomography facilities at NECSA.

High resolution 3D visualisation and tomography facilities should initially be available routinely for research purposes, and subsequently for routine documentation of individual fossils in collections. Fossil material would initially have to be transported safely and securely to the facility for characterisation. The acquisition of mobile CT scanning facilities that can handle samples larger than 20 cm x 20 cm will need to be investigated as possible future extensions of the capabilities of the national facility.

Dating

This country's capacity to do high quality dating of fossiliferous deposits of Pleistocene/Holocene age has deteriorated over the past decade and requires urgent attention. Fortunately much of the basic infrastructure to resurrect this capability exists, but it will require some investment in infrastructure and high level skills to do justice to the palaeontological heritage of the country. The following will be required:

Accelerator Mass Spectrometry (AMS)

AMS has developed into a major analytical tool amongst others also for C¹⁴ dating over the past two decades. The importance of the technique lies in its sensitivity (which is as much as a million times better than conventional mass spectrometry), the small sample size (up to 1 000 times smaller than that required for other decay counting techniques), and high throughput. A facility of this nature requires a tandem nuclear accelerator, which is available in iThemba LABS (Gauteng), the former Schonland Research Centre. The establishment of an AMS facility at iThemba LABS (Gauteng) is planned as part of its recapitalisation programme, which should include the establishment of specialised sample preparation laboratories at the facility.

Complicated facilities of this nature generally do not supply a routine service. Their operation requires highly specialized scientific skills on which the quality of the data depends. Such skills are not readily available in South Africa and hence an issue that requires serious consideration by management of iThemba LABS in order to operate the AMS as a national facility.

It needs to be noted that AMS techniques have apart from palaeontology, application in a large variety of disciplines, such as environmental sciences, climatology and Global Climate Change, palaeoclimatology, oceanography, hydrology, archaeology and several others.

CSIR (ex QUADRU) Facilities

The C¹⁴ detector facility to do conventional C¹⁴ dating, situated in a shielded bunker several tens of metres underground, is among the best in the world. Although the CSIR does continue to support C¹⁴ dating on a cost recovery basis as a service to the broader science community, it no longer considers chronology as one of its core functions.

Given that the expense involved in C¹⁴ dating with AMS is 2 – 3 higher than for conventional C¹⁴ dating, and the anticipated demand for AMS in a variety of disciplines, the C¹⁴ dating facility at the CSIR should be retained.

The Luminescence equipment at the CSIR is a top of the range research facility that requires a highly skilled and dedicated person to operate, i.e. somebody who is passionate about the subject as a research area. It is not operational at present because of the recent resignation of the responsible research scientist. The facility does not lend itself as a routine dating service, and will require a dedicated research scientist to become operational again.

Both these facilities can not operate optimally within the CSIR under its present funding models and they can not be subsidised from its parliamentary grant as the CSIR does not consider chronology to be a core function. What is required is national facility type support to create a research environment for the facilities by funding the salaries of a core of research scientists, technical support staff and the running expenses to operate and maintain these facilities.

The age-gap 250 000 to 2.5 million years

This age gap is of critical importance to palaeoanthropology and covers the range intermediate of that which can readily be covered by C¹⁴ and Luminescence techniques (<250 000 years) on the one hand, and Thermal Ionisation Mass Spectroscopy (TIMS) (>2.5 million years) of which there only seems to be one operational facility at UCT on the other hand. It is anticipated though that the new ICPMS facility being installed at UCT should be able to readily cover all dating requirements >2.5 million years.

Various other dating techniques have been used in the past to cover the critical age-gap with varying degrees of success, such as Electron Spin Resonance (ESR) and uranium series disequilibrium studies. It would seem though that for absolute dating of fossils in this critical gap AMS seems the best option, but often in conjunction with other techniques. A R&D programme designed to identify the most appropriate dating technologies to cover this gap should be considered once the AMS facility is operational.

In the light of the above, it is recommended that a “northern” national dating facility be established that focuses on ages <2.5 million years. This northern facility should incorporate the AMS dating capacity to be established at iThemba LABS (Gauteng) and the facilities of the former QUADRU at the CSIR. In order to ensure a critical mass of specialist scientific and technical staff to operate these facilities it is proposed that these resort under the management responsibility of iThemba LABS, an existing National Facility under the NRF. Details of the most appropriate management model particularly as far as the ownership of and access to equipment at the CSIR are concerned will need to be negotiated between iThemba LABS and the CSIR.

Ages >2,5 million years

For the dating of fossils in rocks older than 2.5 million years a “southern” national dating facility at the University of Cape Town is proposed and to primarily utilise the multi-

collector ICPMS equipment presently being installed with the aid of an Innovation Fund grant for this purpose.

Stable isotopes and palaeoclimatology

State-of-the-art light isotope gas source mass spectrometers for O, N and H stable isotope analysis exist at UCT and at the CSIR, whereas the facility at iThemba LABS (Gauteng) is somewhat older. The mass spectrometers at UCT are coupled to silicate extraction lines and are run as effective national facilities with users from across the continent. Such facilities have a variety of applications particularly in the environmental sciences to study the effects of climate change and pollution, but also find their application in research to reconstruct late Pleistocene/Holocene climates of southern Africa. This is of importance to understand how climate has changed in different parts of the country in the recent past, so that a better understanding can be developed of the environment within which hominid evolved in the region.

In view of the fact that the AMS facility, once completed, will also be able to do high precision analyses for light stable isotopes, and even expand the capabilities to include some elements of higher atomic number, no additional infrastructure seems to be required at this stage in this area.

4.4 SCIENCE OUTREACH

Public interest and fascination in the palaeoworld is immense and a topic that has been used most successfully in several blockbuster science-fiction films (*Jurassic Park*) and science documentaries (*Walking with Dinosaurs*, *Walking with Beasts*, various National Geographic and Discovery Channel documentaries). We in South Africa have not really managed to capitalize on this inherent interest of the public in worlds gone by and it is a key objective of this strategy to achieve this and to generate a greater interest among the youth in the study of science, particularly among those from previously disadvantaged communities.

The science outreach strategy will be closely aligned to the strategic thrusts of the South African Agency for Science and Technology Advancement (SASTA) in order to achieve maximum impact. The *African Origins* Programme in general and the palaeosciences in particular can make significant contributions to science outreach within the context of SASTA's three strategic outreach thrusts.

SET Awareness Platform

The South African SET awareness platform with the highest profile is undoubtedly the Maropeng visitor's centre, presently under construction on the edge of the CoH, and a satellite visitor centre at Sterkfontein. It is anticipated that 450 000 people will visit the Maropeng visitor's centre and sites within the CoH annually. Although the focus within this centre will be the evolution of humankind, the proximity of major palaeontological and archaeological collections within museums in close proximity such as the Origins Centre at the University of

the Witwatersrand and the Northern Flagship Institution can constitute part of this platform, together with the various excavation sites within the CoH.

Similar platforms, albeit somewhat reduced in scale, need to be developed at Taung in Northwest Province and Makapans Valley near Mokopane in Limpopo, the Langebaanweg exposures in the Western Cape and a number of potential sites in the central Karoo, as e.g. at Nieu Bethesda and the Karoo National Park. Makapans Valley is situated very close to the first discovery site of gold in South Africa on the farm Eersteling, a Breeding Centre of the National Zoological Gardens and the platinum mines northwest of the town. This area therefore lends itself perfectly for development into a SET awareness platform to serve the towns of Mokopane and Polokwane and adjacent areas, with the science center at the University of Limpopo as an ideal partner in such an initiative.

Science communication

With growing interest and excitement developed around the discoveries of fossils and artefacts and the scientific process of unraveling their meaning, it is envisaged that the *African Origins* Programme will grow and diversify a constituency that takes ownership of the science. Growing public participation in the Programme will be essential in developing a sense of custodianship and pride that will result in the protection and conservation of these valuable heritage sites. A unique opportunity rests in the widespread occurrence of fossils and artifacts, so that no South African needs to be excluded from experiencing the captivating evidence of our heritage first hand.

To achieve this, the *African Origins* Programme will need to have a coordinated information dissemination arrangement through the various media (electronic, newspapers, scientific literature, popular scientific publications, television and radio). Each project supported through the *African Origins* Programme must emphasise those outputs that will excite and interest the public, preferably linked to stimulating and appropriate displays. Such an approach will reflect a transformation of the role and process of heritage science in South Africa, but will require cultivation to the extent that *African Origins* branding can ultimately be used as an advertising device that will elicit support from business and industry for the Programme. Successful branding will also have other outcomes such as ready sponsorship of television documentaries.

A most effective way of bringing the message to the people is by interactive performances, such as PAST's "Walking Tall", which has been performed with great success to numerous audiences in a variety of settings. Other initiatives will focus on regular interactions with policy makers such as the relevant portfolio committees of parliament, ministers and deputy ministers, as well as senior officials of national and provincial authorities.

Science education

The *African Origins* Programme will emphasise public awareness and outreach initiatives associated with the research projects. In addition to the traditional academic outputs, there will be structures and requirements that will facilitate the dissemination of information to all levels of society. A primary mechanism will entail engagement with schools in order to excite teachers

and learners in both science and the wealth of South Africa's heritage. This will involve practical site visits as well as school visits by the scientists. Linked to this will be a teacher education programme and feedback mechanisms that allow material to be included in the teaching curriculum. The latter will include texts that can readily be assimilated into school educational material and other teaching aids such as fossil casts. Palaeontology has recently been included in the high school syllabus and it is thus essential that educational material be developed and made accessible to learners and teachers.

4.5 PALAEO TOURISM

Palaeontology and archaeology have tremendous potential for the development of tourism as there is much interest in our pre-history amongst the public. Palaeotourism activities are currently underway at the West Coast Fossil Park at Langebaanweg and at an unparalleled pace at the Cradle of Humankind site with the recent completion of multi-million Rand visitors' centres at Maropeng and at Sterkfontein. The development of this site is through a Public Private Partnership, initiated by the Blue IQ initiative of the Gauteng Provincial Government and promises to become a most popular tourist destination. The success of this venture will in many ways provide a blueprint for similar tourist destinations at other sites, such as Makapans Valley, Langebaanweg, Nieu Bethesda and others, particularly if these can be linked to other places of interest in the immediate vicinity. The initiative taken by the Gauteng government in developing a tourism industry around our palaeontological and archaeological heritage has from the beginning been conceptualized to create self sustaining businesses and job opportunities and is a sterling example where science makes a direct contribution to economic activity.

Although tourism is not the responsibility of the DST, it does have a responsibility to see to it that the outcome of research in the palaeosciences is translated wherever possible into tourism related activities. The *African Origins* strategy recognizes the importance of initiatives of this nature and the significant potential of developing our unique palaeontological and archaeological heritage into a tourism industry of note. Some efforts of this strategy will therefore be directed to the DEAT and to provincial authorities to drive and facilitate tourism developments on sites under their jurisdiction, as well as to organizations such as SATOUR for the promotion of palaeotourism packages for the international market. Such an approach will not only serve to create businesses and much needed jobs, but also create an awareness of the uniqueness of our heritage and the need of its preservation for research and hence a better understanding of our origins.

It is recognized that not all fossil sites of potential interest to the public may lend themselves to the establishment of businesses. Many such sites may however be identified and opened to the public with the appointment of a local inhabitant as custodian, tasked with keeping such sites neat and protected from vandalism against a nominal entrance fee. Inclusion of such sites and their significance in any palaeotourism documentation would be imperative for the success of such a venture. All palaeotourism activities would need to be in line with the Palaeotourism Protocol which has been produced and ratified by the Palaeontological Society of Southern Africa.

5. IMPLEMENTATION STRATEGY

Governance

The implementation of the palaeosciences thrust of the National R&D strategy will be by way of the *African Origins* Programme, guided at a strategic level by an Advisory Board. This board, appointed by the Department of Science and Technology, will advise the DST on policies and strategies in the broad sphere of the palaeosciences and related endeavors. Such an advisory board will be constituted from senior researchers from the higher education and museum sectors, senior officials from various institutions, including SAHRA, the DEAT, PAST, the implementation agency, provincial authorities where appropriate, and be chaired by the DST.

The DST should furthermore appoint an appropriate agency to disburse funds for research, curation of collections and outreach activities on its behalf. The agency will disburse funds on a competitive basis, either by way of open call for proposals or, where appropriate, solicit proposals for specific activities deemed to be of national importance by the Advisory Board and the DST. The agency will be tasked to manage the funds entrusted to it by the DST in accordance with the regulations of the PFMA. Business plans, including the prioritization of equipment needs, and Annual Reports would be submitted by the agency to the DST through the Advisory Board. The Agency would furthermore also be responsible for developing appropriate performance indicators, ensuring that targets set for the *African Origins* Programme are being met, and also conducting regular external reviews of the Programme at five yearly intervals with more specific reviews of subsections of the Programme at appropriate interim intervals.

Call for proposals

Calls for proposals will take on two forms, viz.:

- open calls funded on a competitive basis involving rigorous peer review and panel selection, and
- soliciting proposals for the implementation of very specific activities decided on by the DST on recommendation of the Advisory Board. Submission received under such a call would also be submitted to peer review.

Funding criteria for open calls would be finalized by the agency in conjunction with the DST, but would include excellence in research, equity and redress, networking to enhance capacity building and science outreach. Funding would in general be for multi-year projects and the agency would be required to monitor progress of individually funded projects on a regular basis to ensure that milestones were being met and that funds were being spent in accordance with the approved project plans. In order to achieve this, performance indicators would be identified and participants in the programme would be required to report progress annually against such indicators.

Regular Reviews

Regular independent review (five yearly) of the Programme will be conducted by a panel of internationally acclaimed experts in order to ascertain whether the Programme is achieving its goals in:

- Quality research of international impact
- Curating the collections to the highest international standards
- Equity and redress
- Science awareness and outreach
- Building capacity locally and in Africa through collaboration in research and training in research

Regular interim review will also be called for to assess the outcome of sub-programmes and projects on completion of their respective funding cycles. Such reviews will feed into the five yearly independent reviews of the entire Programme.

Funding considerations

The implementation of this strategy will of necessity require the investment of new moneys in the palaeosciences. As the success of the strategy will depend largely on the building of capacity to reach a stage where South Africa achieves the desired global leadership, it is envisaged that funding requirements will gradually increase over a number of years and then stabilize.

Apart from the existing funding provided by DST for the palaeosciences through NRF to PAST, the immediate priority will be to ensure that the existing infrastructure for research, in particular the integrity of the collections, is safeguarded as a national asset. This will include support for the preparation of fossils and the creation of digital databases of this national heritage. Additional resources will be made available on a competitive basis for a limited number of cutting edge comparatively “big science”, longer term research proposals with an emphasis on the renewal of approaches to the paleosciences as envisaged in this strategy in capacity building with focus on equity and redress, and on outreach activities. Cross-institutional collaboration, both locally and beyond our borders for the purpose of capacity building will be integral to the approach.

Successful research proposals within the *African Origins* Programme will be considered for funding of periods of up to ten years, including approved posts. The longer-term sustained funding of such posts will need to become integrated into the funding strategy of the institution concerned.

The *African Origins* strategy acknowledges the valuable financial contribution by industry, primarily through PAST, and the DST is committed to a close working relationship with industry to retain their interest and support for the palaeosciences. It is envisaged that the present arrangements with PAST will continue, with PAST being the primary vehicle for funding very specific shorter term research projects, bursary grants in

the hand of the students and outreach activities. These will be complementary and additional to the longer term activities envisaged above which are aimed more at longer term sustainability of a limited number of core activities.

The upgrading and acquisition of the required equipment will be done wherever appropriate within the context of and in adherence to the principles of the National Key Research and Technology Infrastructure Strategy. Mechanisms will be created within the context of the *African Origins* Programme to prioritise equipment needs. The DST will, wherever feasible, partner with the NRF, the implementing agency of the National Key Research and Technology Infrastructure Strategy, in the acquisition and placement of the research equipment requirements of the *African Origins* Programme.

The funding of research from income generated through the tourism activities linked to the Cradle of Humankind is a principle accepted by the Gauteng government and has e.g. been factored into the contract between the Gauteng government and The University of the Witwatersrand for access to the sites at Sterkfontein and vicinity. It is too early to assess the level of income that can possibly be generated from such a source, but it may well be that certain research activities will be funded on a sustainable basis in years to come from such a source.

Connectivity Plan

For South Africa and to some extent Africa, to benefit optimally from its rich palaeontological and archaeological heritage requires more than the separate elements of this strategy. It requires a plan that fully integrates the disparate elements into a comprehensive strategy that needs to be driven and coordinated centrally, that sees the bigger picture, recognizes opportunities to leverage resources, business opportunities and job creation, exploits latest scientific discoveries, etc., etc. The CoH World Heritage site has adopted an approach of this nature with great success. It goes far beyond that which one can expect from the scientist on the one hand and what one can expect from the entrepreneur businessman on the other hand. It requires a “Proudly South African” image that will only be realized by tightly connecting all facets into a synergistic whole. In this way opportunities will arise to grow the programme in sustainable ways that make it less dependant on state funding but simultaneously justifying the vision of government to invest in our palaeontological and archaeological heritage.

A further dimension of connectivity would be to investigate the use and application of research methodologies and technologies which are traditionally the domain of other disciplines to the palaeosciences and vice versa.

Connectivity in itself is a major challenge and will require a separate in depth study as part of this strategy.

6. CONCLUSIONS

Collectively, the various elements of the *African Origins* strategy are designed to transform the constituent disciplines and activities into a vibrant programme that enables on the one hand excellence and global leadership in research and on the other hand the integration of the science with society through capacity building, education, economic empowerment and public awareness. The outputs of the research will achieve a much needed escalation of traditional academic objectives such as high impact scientific publications, international exposure through conferences and workshops as well as postgraduate training. Outputs of broader societal impact will focus specifically on schools and education, curriculum revision and the provision of teaching aids, as well as measures linked to public outreach programmes, and the media. In this way the ownership of our heritage shifts to a broader constituency that recognises its importance and significance through public participation.

An underlying premise of the *African Origins* programme is that our heritage has value beyond the academic and educational interest. This is recognised in the framework for sustainable development approved at the World Summit on Sustainable Development, and is a guiding influence on the way in which business and industry will operate into the future. By linking with industry, and partnering with government, the programme will lead to job creation both in the scientific environment, and throughout the country by realising the potential of responsible palaeotourism.

The palaeontological and archaeological heritage of South Africa can be used in nation building only when it is taken to the people and becomes a source of pride. The integration and dissemination of palaeoworld science to a broad South African constituency will result in a transformation of the way that the science is done, and who does it. It optimises the investment and ensures coordination between practitioners within and between different disciplines and with society. In the words of President Thabo Mbeki it is this heritage that “unites us in a common humanity”.

GvG/BR
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