



2019 Progress Report Summary

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1 Executive Summary

It has demonstrated that the geographic advantage offered by the extensive palaeoscience record of South Africa provides the DSI-NRF Centre of Excellence in Palaeoscience with opportunities for world-class research. It is not possible to write a comprehensive document on the development of life without referring extensively to the South African fossil and archaeological record.

Our Centre has an extensive network of collaborators who significantly enhance the quality and scope of research projects, the Centre undertakes and provides a superior training experience to students. The Centre adopts a multi- and interdisciplinary approach to interpreting the unique and time expansive South African Fossil Heritage. Use of South Africa's large fossil and archaeological collections is enhanced through the development of a shared digital database of CoE-Palaeo partner institutions, which enables long-lasting network/collaboration. Curatorial efficiency has been increased by the development of a Pan-African curatorial network. We commit to expanding our collaborative horizons to include researchers in education facilities: Southern African Association of Science and Technology Centre's (SAASTEC), South African Museums Association (SAMA), South African Agency for Science and Technology Advancement (SAASTA) and South African Heritage Resource Agency (SAHRA).

The Centre undertakes a diverse range of research projects including the origin of life and multicellularity, invertebrate palaeobiology, palynology, and palaeobotany of various ages, taxonomy and palaeobiogeography of fishes, amphibians, parareptiles, therapsids and dinosaurs, origins of mammals and hominins. Additional projects include hominin morphology and behaviour, the earliest tools of hominins, the emergence of behavioural complexity, faunal analysis, and taphonomy. Additionally, palaeontology is applied in groundbreaking broader multidisciplinary studies to understand climate and biodiversity change, stratigraphy and basin development studies. The CoE-Palaeo is proud of the productivity and quality of our members reflected in a large number of researchers who have National Research Foundation (NRF) ratings.

Knowledge brokerage and service rendering are an essential aspect of the Centre output. Almost all researchers and students participate in science communication or public awareness as this is a requirement of all our members. The Centre supports the salary of a Palaeoscience Outreach Education Officer, who in turn raises additional funding to employ an assistant and to run outreach activities, with the result that the Centre is very active in public engagements. Social media is a robust platform for science communication. The Centre hires, on a contractual basis, a Science Communication Officer who has experience in the field of palaeosciences.

Apart from supervising more than 46 MSc and PhD students and hosting 14 postdoctoral fellows, members of the CoE-Palaeo also teach in undergraduate and honours programmes in the archaeology, geosciences, and biological science curricula of Rhodes University, University of Cape Town, and the University of the Witwatersrand.

In collaboration with partners and the NRF African Origins Platform, National Science Collections Facility, the CoE-Palaeo assists in the maintenance and expansion of important palaeontological and archaeological museum collections and world-class palaeoscience research facilities. It is essential to keep updating these to ensure that the CoE-Palaeo Partner Institutions continue to be at the cuttingedge in the use and application of state of the art technology for palaeoscience research.

The Centre recognises the uniqueness and importance of the southern African fossil heritage and its significance to South Africa and the rest of the world. To maintain and enhance the momentum

which has been built up by the actions of the Centre to fulfil this mandate, we are strategising for the successful movement of the CoE in Palaeoscience to a National Institute for Palaeosciences at the end of the next five-year cycle in 2022. The Centre and its partners are working towards a strategy for developing a National Institute that further promotes South African Palaeosciences to maintaining the highest international ranking.

In summary, the South African fossil and archaeological record is of great international importance and plays a pivotal role in the palaeoscience output of South Africa, and indeed in Africa, in a wide variety of spheres facilitating research; expansion and custodianship of SA fossil collections; palaeoscience training at various levels (tourism guides, technicians, schools, undergraduate students, postgraduate students, postdoctoral fellows, emerging researchers); science communication and developing sites for palaeotourism. By international standards, it is a leading Centre for research and training in the palaeosciences, including international collaboration with some of the world's leading palaeoscientists, and has world-class research facilities which are utilised by palaeoscientists and students from many continents.

It is self-evident that the far-sighted vision of the DSI and NRF to establish a Centre of Excellence in Palaeosciences has paid off in many different spheres. It has dramatically enhanced the palaeoscience research output of South Africa, resulting in numerous local and international research collaborations. It has significantly increased the cohort of MSc and PhD graduations and is addressing the skills shortage of South Africa. The extensive Science Engagement Programme of the CoE-Palaeo has led to much greater science awareness by the public and resulted in more young people considering science as a profession. Now that the foundation is firm, future phases of the CoE in Palaeosciences will achieve even greater success.

2 Research Highlights

- 1. NRF Ratings
- NRF A1 rating given to Professor Lyn Wadley (Evolutionary Studies Institute, Wits) and elected a Fellow of the British Academy. <u>https://www.wits.ac.za/news/latest-news/general-news/2019/2019-07/prof-lynn-wadley-elected-as-fellow-of-the-british-academy-.html</u>
- NRF Y ratings were given to Dr Paloma de la Pena (Evolutionary Studies Institute, Wits), Dr Jennifer Fitchett (School of Geography, Archaeology and Environmental Studies, Wits), Dr Julien Benoit (Evolutionary Studies Institute, Wits)
- 2. Professor Lee Berger rated among the top 1% of all citations by the web of science.
- 3. Media releases:
- Beaudet A, Stratford D, Clarke R : Little Foot's inner ear sheds light on her movement and behaviour for the University of the Witwatersrand (<u>https://www.wits.ac.za/news/latest-news/research-news/2019/2019-01/little-foots-inner-ear-sheds-light-on-her-movement-and-behaviour.html</u>)
- Barrett PM, Chapelle KEJ, Staunton CK, Botha J, Choiniere JN. 2019. Postcranial osteology of the neotype specimen of *Massospondylus carinatus* Owen, 1854 (Dinosauria: Sauropodomorpha) from the upper Elliot Formation of South Africa. *Palaeontologia Africana* 53: 114-178.

- Chapelle KEJ, Barrett PM, Botha J, Choiniere JN. 2019. *Ngwevu intloko*: a new early sauropodomorph dinosaur from the Lower Jurassic Elliot Formation of South Africa and comments on cranial ontogeny in *Massospondylus carinatus*. *PeerJ*. DOI:10.7717/peerj.7240.
- Benoit J, Manger P. How did elephants evolve such a large brain? Climate change is part of the answer.<u>https://www.wits.ac.za/news/latest-news/opinion/2019/2019-07/how-did-elephants-evolve-such-a-large-brain-climate-change-is-part-of-the-answer.html</u>
- Valenciano, A: Chinese Media surrounding the release of "First Record of *Hoplictis* (Carnivora, Mustelidae) in East Asia from the Miocene of the Ulungur River Area, Xinjiang, Northwest China", published by us in Acta Geologica sinica English-Edition, March 2019: <u>http://www.uux.cn</u>
- Rubidge B. Govender R, Romano M. 2019 Tapinocaninus returns home.
- Wadley L, Backwell L, d'Errico F, Sievers C. Jan 6, 2020. Cooked Starchy rhizomes in Africa 170 Thousand years ago. Science. 367; 87–91.

2.2 Other Highlights

- 1. Translating palaeoscience into Zulu
 - Ososayensi bathole isilwane sasemandulo esandisa umlando wohlu lwezilwane by Sibusiso Biyela for SciBraai
 - Umlando Wamalahle: Amahlathi Asemandulo Aqhuba Isizwe written by Rose Prevec translated by ScienceLink for CoE Palaeo social media platforms
- 2. Student Awards
 - Five students from the Evolutionary Studies Institute participated in the Science Slam at the University of the Witwatersrand. David Groenewald (Doctoral student) won second place.
 - Silindo Masvuo received third place in the University of the Witwatersrand held FameLab
- 3. Accelerator Programme

The Palaeosciences Accelerator Programme, run by Professor Jonah Choiniere, is aimed at increasing the participation of previously disadvantaged student groups in the palaeosciences. In summary, the main objectives of the program are to:

- Identify high-performing undergraduate students from previously disadvantaged groups at the second-year level;
- Enrol those students in a supplementary academic program for 3 hours per week for 14 weeks, where they learn transferrable skills such as GIS data collection and analysis, palaeosciences legislation, three-dimensional data collection and analysis (e.g., CT-scanning), and palaeontological fieldwork methods;
- Give those students time to collect and analyze data as part of a larger palaeontological study which will lead to publication in peer-reviewed journals, and provide these students with assistance in finding financing for their postgraduate studies
- 4. Palaeoscience National Institute Workshop took place in July to discuss what happens to palaeoscience after the Centre of Excellence, how to move palaeosciences research forward, and how to make it sustainable for the future of SA palaeosciences.

3 Strategic Context for South African Palaeosciences

The National Research and Development Strategy (NRDS) has identified some knowledge fields in which South Africa should aim at achieving international research excellence because of our geographical position and natural or cultural heritage. The Palaeosciences (collectively including Palaeontology, Palaeo-anthropology, Palaeobotany, Middle Stone Age Archaeology and related disciplines) are areas in which South Africa has a geographical advantage, owing to the quantity and diversity of finds within our national borders.

The DST South African Strategy for the Palaeosciences document addresses five goals which recognise the need for a holistic approach to the development of palaeosciences:

- 1. Transform the minds of South Africans to instil a sense of pride and provide the intellectual content to their African heritage
- 2. Support the country's universities to produce a critical mass of palaeoscience researchers with a range of research, technical, curatorial, public engagement and managerial skills
- 3. Enhance the capacity of museums to curate, conduct and support research in palaeosciences
- 4. Ensure that South Africa's palaeoscience heritage is well managed and used for the benefit of current and future generations
- 5. Make South Africa the destination of choice for palaeo-tourism

The establishment of a DST-NRF funded Centre of Excellence in Palaeosciences has been by far the most productive and effective way to realise the long-term goals of the Palaeosciences Strategy (developed by the DSI).

4 Organizational Culture

The distinctive character of the Centre includes its value system of visibly committed academics and students, and a socially engaged and independent-minded Centre. To effectively manage and govern, we follow the guidance embedded in the *Handbook to assist with the Operation of a DSI-NRF Centre of Excellence* (2015), the *Framework for the Establishment of DST-NRF Centres of Excellence* (version 3.0, 2015).

The DSI-NRF Centre of Excellence in Palaeosciences, through its grants and programmes, seeks to increase the diversity of the universities and museum faculties by increasing their gender, racial, and ethnic diversity, to maximize the educational benefits of diversity. Also essential is to increase the number of researchers who can and will use diversity as a resource for enriching the education and the research environment of all students, postdoctoral fellows, emerging researchers, technical staff, and collaborators and are willing to share their research to a wider community that will help build an informed society.

5 CoE-Palaeo Partners

Partners that form our network

- 1. The University of the Witwatersrand, Johannesburg
 - a. Evolutionary Studies Institute
 - b. Geography, Archaeology, and Environmental Studies
 - c. School of Geosciences
 - d. School of Animal, Plant, and Environmental Sciences

- e. School of Anatomical Sciences
- f. Origins Centre
- 2. University of Cape Town
 - a. Dept of Geological Sciences
 - b. Dept of Biological Sciences
 - c. Dept of Archaeological Sciences
- 3. Rhodes University
- 4. Iziko Museums of South Africa, Cape Town
- 5. Ditsong National Museum of Natural History, Pretoria
- 6. National Museum, Bloemfontein
- 7. Albany Museum, Makhanda
- 8. Centre of Excellence in Modern Human Behaviour (SapiensCE), University of Bergen, Norway
- 9. Millennium Trust
- 10. Palaeontological Scientific Trust
- 11. Maropeng
- 12. Cradle of Humankind Management Authority
- 13. DSI-NRF Centre of Excellence for Integrated Mineral and Energy Resources Analysis (CIMERA)

Potential Partners

Collaborative Agreement under the advisement of institution management with:

- 1. University of Johannesburg
- 2. Sol Plaatje University

Engaging with:

- 1. Nelson Mandela University
- 2. Maropeng
- 3. University of the Western Cape
- 4. University of the Free State
- 5. University of Pretoria
- 6. Council of Geosciences

6 Aims & Objectives

South Africa's unique combination of a rich palaeontological and archaeological heritage, together with research excellence and experience in the field, positions this country to take on the lead in international research in Palaeosciences. The enabling research environment created by the CoE-Palaeo builds on opportunities provided by the temporally diverse southern African record and will develop new research linkages and collaborations enabling us to attain far higher levels of research accomplishment. Excellent internationally competitive research is the cornerstone of the Centre activities and is nurtured as this determines the nature of future international research collaboration and expansion.

The diverse projects undertaken by the CoE-Palaeo include research involving the earliest tools of hominins, the emergence of behavioural complexity and material culture, faunal analysis, bone taphonomy, taxonomy and palaeobiogeography of therapsids and dinosaurs. Palaeobotanical work includes the description of fossil pollen of varying ages, Palaeozoic and Mesozoic woods, and palaeobotany of fossil hominin sites in East Africa. The above are traditional areas of South African palaeoscience research strength, but to broaden its scope, the Centre has also funded additional areas in which South Africa has potential important fossil resources, e.g. Late-Precambrian origins of metazoan life, Ordovician-Carboniferous invertebrate and fish diversification. Palaeontology is also used in broader multidisciplinary studies to understand climate and biodiversity change, stratigraphy and basin development studies.

The research programme comprises five themes, which address research questions relating to the South African palaeosciences heritage record at different intervals of the stratigraphic succession:

- 1. *Evolutionary Processes:* This theme includes increasing knowledge of southern African palaeobiodiversity; study the timing of evolutionary events in major clades and significant climatic events; characterise the global geographic distribution of fossil taxa; investigate the nature of functional morphology and critical innovations in morphological evolution.
- 2. *Cultural and Behavioural Evolution: Material Culture and Behaviour:* This theme aims to explain key long-term transitions in hominid behaviour and how they led to modern human behaviour.
- 3. *Palaeo-environments and Palaeoclimates:* Earth systems change dynamically, and when stretched beyond certain thresholds lead to changes (and potentially collapses) in ecosystems and biodiversity. This theme will uncover variability in the resilience of past ecosystems to fluxes through space and time.
- 4. Applications and Innovations: This theme focuses on applying technologies to maximise the use of heritage objects through expanded efforts to discover, conserve, augment, and study them. Of vital importance is pursuing new, innovative means of information extraction and analysis.
- 5. *Palaeosciences and its Publics:* To redefine the ways in which we communicate the palaeosciences and re-associate the palaeosciences with a sense of value and prestige in the minds of South African public, there is a need to acknowledge, understand and be attentive to the different sectors of society and their attitudes towards and understanding of the deep past. South Africa's unique combination of a rich palaeontological, palaeoanthropological, and archaeological heritage, together with research excellence and experience in the field, positions this country to take the lead in international research in palaeosciences. The enabling research environment created by the CoE-Palaeo builds on opportunities provided by the temporally diverse southern African record and will develop new research linkages and collaborations enabling us to attain far higher levels of research accomplishment.

The above themes pertain to areas where the palaeoscience record of South Africa gives us a geographic advantage, particularly the Cape and Karoo Supergroups, the Tertiary and Quaternary fossil record including the cultural and behavioural evolution of *Australopithecus* and *Homo* and the development of Oldowan, Acheulean, and Middle Stone Age industries. Also of significance is research into establishing effective mechanisms of knowledge brokerage and information dissemination about the palaeosciences, particularly in a South African context. In addition to these "traditional" areas of research of the South African palaeo record, the Centre has encouraged exploration into the origins of life and multicellularity (including investigation of the Precambrian Nama and Vanrynsdorp Groups) and has inspired a strong focus on the Devonian biodiversity of the Cape Supergroup.

The CoE-Palaeo is committed to the development and strengthening of Palaeoscience in South Africa meeting the objectives outlined by the Department of Science and Technology, National Research Foundation and its Programmes (Centres of Excellence, the South African Strategy for the Palaeosciences, African Origins Platform) and the Science and Technology White Paper.

The National Research and Development Strategy (NRDS) has identified a number of knowledge fields in which South Africa should aim at achieving international research excellence because of our geographical position and natural or cultural heritage. The Palaeosciences are areas in which South Africa has a competitive and geographical advantage, owing to the quantity and diversity of finds within our national borders. The palaeosciences strategy addresses **five goals** that recognise the need for a holistic approach to the development of palaeosciences. This Progress Report highlights these objectives.

- To transform the minds of South Africans so as to instill a sense of pride and provide the intellectual content to their African heritage so as to make them informed and responsible citizens, and to engage all sectors of society in palaeoscience matters, through information on discoveries that will allow them to appreciate the special place of South Africa in the story of life and humanity on Earth.
- Support the country's universities to produce a critical mass of palaeoscience researchers with a range of research, technical, curatorial, public engagement and managerial skills and drive knowledge production and exploitation to make South Africa a world centre of scientific excellence in the palaeosciences.
- Enhance the capacity of museums to curate, conduct and support research in palaeosciences in ways that inform South Africans and the world.
- Ensure that South Africa's palaeoscience heritage is well managed to attain international standards of heritage management and ensure that the country's palaeoscience heritage is well managed and used for the benefit of current and future generations.
- Make South Africa the destination of choice for palaeo-tourism by building a network of site displays and interpretative centres that are managed in a socially responsible and sustainable manner.

The DST-NRF funded Centre of Excellence in Palaeosciences is one of the ways to realise the goals of this strategy.

The enduring commitment of the Centre to intellectual excellence and public engagement is embraced through the following values: independent enquiry and trust, intellectual excellence and integrity, debate and critical engagement, and academic freedom. The success of all phases of the development of the CoE-Palaeo depends on relationships between the partner institutions, collaborating with individuals and institutions in South Africa and internationally. The goals outlined above are the driving aims and objectives of the CoE-Palaeo.

The structure of the Centre is intended to accomplish the following:

- Establish a single organisational identity with latitude for independent, focused research, curation and outreach projects.
- Provide flexibility to allow growth and shifts in disciplinary emphasis.
- Retain the strengths, structures and reputations of the existing projects.
- Provide rigorous financial controls and governance.
- Offer the framework for multi-disciplinary and interdisciplinary interaction.
- Minimise bureaucracy while maintaining clear lines of responsibility and accountability.

6.1 Vision

The DST-NRF supported the Centre of Excellence in Palaeosciences to develop a unique Centre to promote and undertake the comprehensive study of the evolution of life on Earth. The CoE-Palaeo built on the foundation of research in the palaeosciences by the partner institutions on the exceptional palaeontological and archaeological resources available in South Africa. From this base, it will expand to embrace all forms of academic endeavour for the advancement and dissemination of knowledge of the development of life over time.

6.2 Mission

The CoE-Palaeo, in collaboration with its partner institutions, will provide the infrastructure, and resources in which excellence in the palaeosciences is stimulated and flourish. The mission and vision are achieved in five stages of development, each focusing on deliverables appropriate for that stage of development: Forming, Storming, Norming, Performing and Exiting. Deliverables are defined in the Service Level Agreement and entail activities in five key performance areas: research, education and training, information brokerage, networking, and service rendering.

Postgraduates Students/Postdoctoral Fellows	2019 Acheivements			
Honours Students	9			
Masters Students	19			
Doctoral Students	18			
Total Postgraduate Students Supported (Honours, Masters & Doctoral)	46			
Female Postgraduate Students (Honours, Masters & Doctoral)	27 (59%)			
Black Postgraduate Students (Masters & Doctoral)	29 (63%)			
Total RSA Postgraduate Students (Masters & Doctoral)	38 (82%)			
Total Other Foreign Postgraduate Students (Masters & Doctoral)	8 (17%)			
Honours Graduation	9			
Masters Graduations	11			
Doctoral Graduations Graduations	6			
Average Masters Duration (post Honours) (year/months)	2 years/ 18 months			
Average PhD Duration (year/months)	3 years / 27months			
Average Duration of submitted PhD degrees (upgraded from Masters) (year/months)	3 years / 27 months			
Postdoctoral Fellows	14			
Female Postdoctoral Fellows	10 (71%)			
Black Postdoctoral Fellows	2 (14%)			
Core Team				
Core team members received operational support	49			
Core team members	52			
Core team members with NRF Rating	28			
Total Collaborators (local and International)	761			
Core team members undertaking at least on scientific review per annum	100%			
Publications				
Number of peer-reviewed publications 196				
Total peer-review published articles/books with postgraduate students	40			

6.3 Service Level Agreement Stage 4 Key Performance Area Targets and Achievements

Total peer-review articles with female students	21
Total peer-review articles with black students	25
Books	0
Chapters in books	15
Peer-review published abstract	0
Keynote talks	5
Conference abstracts (not DE submissiable)	152
Journals (not DE)	0
Books (not DE)	0
Book chapters (not DE)	0
Editorialships	>50
Social Responsibility	
Number of joint venture postgraduate student training initiatives	1
Number of local conference/workshop/symposia/lectures organised	1
Number of international conference/workshop organised	0
Number of educational outreach events through outreach officer	>17
Number of outreach initiatives by members	>66
Number of attendants	>890K
Number of social media posts	>4469
Total reach from social media posts	>50000

Special Output Targets in the Current Stage				
Fine-tuned strategy to increase research and other output from the key	Yes			
performance areas	163			
At least one activity to encourage team spirit	Yes			
The CoE shall demonstrate a sound working relationship between the CoE host	Ves			
institution and the satellite institutions	103			
Develop at least two PhD academics from designated (formerly disadvantaged)	Ves			
groups	105			
A comprehensive strategy to increase research output	Yes			
Roadmap for career development implemented	Yes			
Number of prestigious international partnerships established or developed	Yes			
Number of emerging researchers given specific support	Yes			
Short courses	Yes			
Form Partnerships with Historically Black Universities in SA	Collaborations are			
	underway			
Development and implementation of Publication Mentorship Programme to	Ves			
assist Doctoral, Postdoctoral Fellows and Emerging Researchers to publish	103			
Introduce Palaeosciences to students from previously disadvantaged	Ves			
backgrounds				
	 Postdoctoral Fellowship 			
	given for Science			
	Communication and			
Provide new Master's Bursaries for Science Communication, Heritage	Education			
Management or Education (Palaeosciences in the classroom)	 Awaiting Higher 			
	Education to approve			
	Sol Plaajte Heritage			
	Management Course			
Maintain a strong Public Engagement and Science Communication profile	Yes			

Long-term Output Targets in the Current Stage	
Increase Human Research Capacity at Natural History Museums	 Next Generation Emerging Research Grant was developed Postdoctoral Fellowships are offered to target museums
Develop and implement a strategic plan for increasing our funding base	 Hired a consultant to develop a donation plan Programmes underway to provide tours and courses to bring income to the Centre
Develop a strategy to move towards a National Institution	 Successful workshop with 20 members of the palaeocommunity Substantial draft of Strategic Plan Document

7 Challenges

7.1 Natural History Museums as Partners

The DST South African Strategy for the Palaeosciences recognises the scarcity of well-trained human capacity as the most severe threat facing the discipline of palaeosciences. To address this issue, the Centre has funded and trained palaeoscience expertise at various levels, including school learners, technicians, collections curators, palaeo-tourism guides as well as undergraduate students, postgraduate students, and postdoctoral fellows.

The future of research at South African Natural History Museums is an important issue, which needs to urgently be addressed by the government for the future wellbeing of the Centre of Excellence in Palaeosciences and indeed for maintaining the internationally leading profile of South Africa in research relating to the discipline. The Natural History Museums curate the excavated South African palaeoscience record (fossils and artefacts) and were set up to undertake this critical function. In the past, they employed the largest number of palaeoscientists in the country. As a result, the Natural History Museums, which curate palaeoscience collections, were specifically chosen as partners under the CoE-Palaeo. However, the past five years have witnessed a dramatic decline in palaeoscience research undertaken by the museums, which would have been even more devastating had the CoE-Palaeo not intervened. Despite this intervention, the administrators of our partner Museums do not seem to have an understanding of the requirements to nurture natural history research in a museum environment.

Research traditionally is undertaken by natural science museums, by utilising and building up their biological reference collections through multidisciplinary research programmes. The collections offer answers to the impact of climate change in any specific country. Apart from research, these collections also play a vital role in education. For the public, seeing real objects at proximity has an incredibly powerful effect on people. The power of this authenticity is emphasised in an increasingly virtual world. Up to date, high impact museum exhibits are the products of research undertaken by scientists using the scientific collections curated in the museum. Increasingly around the world

museums are requiring collections curators to have a PhD degree and to conduct research in addition to curation.

A worrying trend in South Africa has been the steady decline in palaeoscience research productivity of all the museums, over the past 15 years – ever since the establishment of the Flagship museums. This decline in research productivity is linked to the decrease in the number of palaeontologists employed particularly at Iziko and Ditsong Museums. This trend is not only reflected in the palaeontology departments of these museums but all the other natural science departments as well, where there are less senior scientists employed to curate the collections, and this task is being left to the technical staff that lack the necessary qualifications and experience. Sadly, the number of palaeontological technical staff employed and paid by these museums has also declined, and the position for palaeosciences would be dire if the NRF had not established the African Origins Programme, which has made it possible for museums to employ technical staff.

The research productivity of the Centre is dependent on the accessibility of the palaeontological and archaeological collections of these museums, and also the resident and relevant scientific expertise linked to each of these collections. It is essential that museums employ scientists who are internationally competitive to maintain and expand these collections by actively researching the palaeoscience record of the country.

A decade ago, the NRF launched an audit into the state of Natural Science Museum Collections in the country. To rectify the poor state of many of the collections the NRF provided funding for the curation of museum collections over three years, and the Natural Science Collections Facility (NSCF) launched as part of the Department of Science & Technology's South African Research Infrastructure Roadmap (SARIR). The NSCF will support securing collections by improving storage, digitisation of collections and communication and outreach, and provide some opportunities for enhancing research. The NSCF cannot, however, appoint or employ permanent scientists at these institutions, and the research capacity at museums remains a risk to initiatives like the NSCF and the Centres of Excellence.

A major problem of museums in recent years is the non-competitive salaries paid to highly qualified museum scientists. As a result, highly productive scientists are not being attracted to apply for positions at museums. The lack of competitive salaries has a downward spiral effect with active research staff leaving museums and not being replaced by the best possible people. Another problem is the increasingly bloated administrative capacity of museums, especially the flagship museums, with less funding available for the natural science departments. In many cases, DAC Central administration, inappropriate Councillors and Directors of Natural Science Museums of South Africa have no experience in understanding natural science research. Thus, they do not understand the opportunities and challenges relating to natural science research and are not in a position to develop research projects, identify possible research collaborations, and so miss out on the opportunity to raise additional research funding through local and international research collaborations. The management and encouragement of Natural History Research require constant nurturing and reassurance by Council and Directorate. Currently, natural science museum researchers are spending too much time complying with bureaucratic legislation and policies with the result that very little research is conducted. A recent advert for a Director (CEO) for one of the sizeable natural science museums of the country does not list research as a priority, and the skills and knowledge required for the position do not include research experience or even exposure.

The fact that the major natural history museums of the country do not prioritise research as a critical function creates a significant problem for the CoE-Palaeo which is dependent on research productivity for its survival. Currently, the Centre expects each of its member scientists to produce

about five research publications per year. All museum staff produce much less than those researchers in an academic institution. The lack of research priority is the direct result of fewer scientists employed by the museums. In addition, low salaries fail to attract highly productive scientists. Furthermore, there are no incentives to produce publications in high ranking international journals, and little or no support from management to create an environment that is conducive to research.

The greatest crisis facing Earth is the biodiversity crisis, as Earth experiences global warming, climatic change and a massive decline in biodiversity, the so-called sixth extinction. The future of humanity on earth is dependent on the preservation of biodiversity. The biodiversity of South Africa, Africa, and indeed all countries, is curated by natural history museums where all the type and reference specimens are curated. Accordingly, these collections are essential to undertake audits of biodiversity and global climate change. Moreover, research productivity coming from these museums is essential to understanding the complexities of biodiversity, and how changes in biodiversity can affect our modern world.

Now is the time that the precious collections of the natural history museums reflecting the past and current biodiversity of our country, which have been built up over many decades and even centuries, need to be nurtured and researched, yet it appears that research is no longer a priority. This appalling state requires urgent rectification. Possibly a way to begin is to re-assess the appropriateness of the Department of Arts and Culture (DAC) as a governance structure for institutions responsible for scientific research. Additionally, there needs to be engagement with museums to find a way of addressing declining capacity and creating a strong research culture.

7.2 Transformation

Our Centre is proud of its achievements in attracting ever-increasing numbers of black female postgraduate students to the palaeosciences. Our Centre has established several initiatives to address this imbalance. These include but are not limited to:

- 1. Develop an Emerging Researcher Grant to black female researchers
- 2. Developed a special postgraduate bursary with funding support in collaboration with Palaeontological Scientific Trust to support an excellent black student in combination with excellent supervision
- 3. Increasing public awareness especially at all levels of education
- 4. Encourage academics who teach undergraduate courses, to be on the lookout for potential students from historically disadvantaged backgrounds
- 5. Developing a programme that brings students into the field or is involved with an ongoing research project

The biggest challenge facing South African palaeontology is the lack of finance to employ young palaeontologists at museums and academic institutions. Good students are trained, but there are limited positions available in South Africa. When there are positions, the salaries are on the same scale as a secretary. Offering a low salary to highly skilled individuals is an insult. Many good African researchers leave the field to pursue other fields that have higher earning power. Also, the downgrading of the research function at South African museums in recent years has dramatically affected the discipline of palaeontology and led to the attrition of palaeontological positions and expertise at museums. As discussed many times in Steering Committee meetings, there is a lack of research capacity at our museum partners. The MoA between Department of Science of

Technology and the Department of Arts and Culture for the support of Natural History Museums requires urgent follow-up.

Other factors that hinder improved inclusiveness within the field of palaeosciences:

- Few students see palaeosciences as a viable career path that earns a competitive salary, where other sciences with a BSc degree would earn competitive industry salaries
- Reduced funding availability from Government
- The downturn of the economic climate locally and globally. The climate for palaeo careers at academic institutions are constrained by the economic downturn. This, in turn, reduces the number of academic positions locally and globally
- Increase stress of working at academic institutions

Where there is a wall, break it down or go around it! The Centre makes every effort to resolving these surmountable issues by:

- In the short-term attract more promising young scholars from historically disadvantaged groups into the palaeosciences and to provide them with necessary postgraduate training to become proficient independent researchers. This will require the Centre to offer competitive bursary opportunities to postgraduates.
- Medium-term to encourage the NRF and other bodies to make postdoctoral fellowships available to promising young PhD candidates to continue working in South Africa or, if necessary, to pursue postdoctoral research overseas to gain more experience
- The long-term to create more jobs for PhD-level palaeoscientists in South Africa; this will be achieved by establishing a National Institute for Palaeosciences. The Universities of Johannesburg, Sol Plaatjie, and Nelson Mandela Metropolitan (Universities which have not previously undertaken palaeoscience research) have recently employed palaeoscientists. Museums need to step-up their game and employ the necessary scientists to curate and conduct research on the large collections curated at these institutions. This will require a change of thinking in the way national history museums are run by DAC and the current short-sighted approach in not supporting natural history research. Also, positions to undertake Palaeontological Impact Assessments need to be exploited by PhD graduates, and opportunities can also be made available to young scientists through palaeo-tourism ventures.

1.3 Establishment of a National Institute for Palaeosciences

Successive Ministers of Science and Technology, realising the global importance and significance of the South African palaeoscience record and the considerable interest in it manifested by the participation of scientific collaborators from every continent of the world (even Antarctica), suggested that a "Smithsonian type institute" be established for the palaeosciences. The DSI, in turn, has recommended that National Institutes be established to ensure the longevity of productivity for successful centres of excellence. The CoE for Palaeosciences has demonstrated the national and international interest in southern African palaeosciences, its great scientific productivity, and the ability of the discipline of palaeosciences to capture the imagination of the public and to engage young people in considering science as a career.

Although the Director and staff of the CoE-Palaeo have been able to raise additional funding for the Centre, this is not an easy task for a discipline such as palaeosciences, which will always be dependent on some level of state funding as has been recognised internationally. In its short, existence the CoE-Palaeo has demonstrated the capacity of the discipline to catapult South Africa as

an important and major player in the forefront of the international scientific arena, and thus the establishment of a multidisciplinary National Institute for the palaeosciences is a logical follow-on to enhance the high level of productivity achieved so far.

The question is to decide whether to establish a single building to house the national institute or to run the institute as a virtual centre, with a hub, much like the current CoE-Palaeo model. This issue will require the input of the South African palaeoscience community together with the DSI and NRF.

The final configuration will depend on the future management of natural history museums, the curation of their precious and internationally famous palaeoscience collections, and their capacity to participate as full partners in the productivity of the National Institute.

7.4 Current Funding Climate

- Our practice is to ensure that, for the funding received; we try to make the most impact in the fields of research, training of students, curation of collections and public outreach. As the CoE would like to make bursaries available to a greater number of students, we need to find ways to increase the number of bursaries by supplementing bursaries made available via other NRF programmes.
- 2. The NRF African Origins Platform has in the past supported most of South Africa's flagship palaeoscience projects, and this support, together with funding from the CoE resulted in the surge in the international significance of South African palaeoscience discoveries and research output. Internationally it has been shown that it is difficult to secure large funding for the palaeosciences from the private sector. The CoE has been able to secure substantial support from the Millennium Trust to support research on the Devonian of South Africa, and additional funding has been raised from the Norwegian government for the South African based Middle Stone Age SapiensCE project run by Professor Chris Henshilwood.

DESCRIPTION	Jan 19	Feb 19	Mar 19	Apr 19	May 19	Jun 19	Jul 19
Balance brought forward	1 512 722.84	- 675 815.86	-1 407 877.17	3 284 120.00	2 489 222.92	915 892.09	466 875.59
NRF			6 700 478.00				
Interest							
Other							
TOTAL INCOME	1 512 722.84	- 675 815.86	5 292 600.83	3 284 120.00	2 489 222.92	915 892.09	466 875.59
Salaries - S	1 017 784.43	344 609.26	323 235.54	323 235.54	537 732.62	244 399.31	1 036 558.07
Student costs - C	546 589.00	79 268.00	1 142 601.33	340 825.94	831 768.00	339.00	887 029.00
Conferences and related travel - D	5 478.60	20 000.00	16 189.00	43 177.86	92 601.15	20 977.73	51 990.15
Equipment - E		-	-	-			
Running - R	618 686.67	288 184.05	526 454.96	87 657.74	111 229.06	183 300.46	277 636.04
TOTAL EXPENSES	2 188 538.70	732 061.31	2 008 480.83	794 897.08	1 573 330.83	449 016.50	2 253 213.26
				604 100.00	371 114.33		
NET SURPLUS / DEFICIT FUNDS	- 675 815.86	-1 407 877.17	3 284 120.00	2 489 222.92	915 892.09	466 875.59	-1 786 337.67

8 Cashflow

Total Income and Expenditure						
Committed from 2013 to Funds Date	TOTAL for 2019	Dec 19	Nov 19	Oct 19	Sep 19	Aug 19
1 512 722.84	1 512 722.84	1 754 437.92	2 287 295.80	3 006 758.29	4 512 376.94	-1 786 337.67
81 420 086.00	13 400 957.00					6 700 479.00
842 539.11	-					
518 343.24	16 158.99			16 158.99		
82 780 968.35	14 929 838.83	1 754 437.92	2 287 295.80	3 022 917.28	4 512 376.94	4 914 141.33
12 768 849.05	6 478 366.82	992 122.20	252 442.23	252 442.23	906 014.32	247 791.07
67 858 432.24	4 817 615.27	470 339.00	678.00	287 839.00	230 000.00	339.00
- 840 317.25	419 948.90	- 6 336.40	12 672.80	81 480.68	29 980.00	51 737.33
21 073 117.00	-					
23 979.56 24 660 946.99	3 235 153.26	319 558.54	267 064.85	113 859.57	339 624.33	101 896.99
23 979.56 82 802 213.80	14 951 084.25	1 775 683.34	532 857.88	735 621.48	1 505 618.65	401 764.39
23 979.56 - 21 245.45	- 21 245.42	- 21 245.42	1 754 437.92	2 287 295.80	3 006 758.29	4 512 376.94