

## **Sterkfontein Description and Motivation**

### **Sterkfontein History and Significance**

Sterkfontein was first recognised in 1936 as an important heritage site with Robert Broom's discovery of the first adult fossil of *Australopithecus africanus*. Dating from ca 3 Myr to 100,000 yrs, Sterkfontein is the richest site of palaeontological deposits in South Africa because it preserves the largest number and longest sequence of fossil fauna, hominids, and early cultural remains.

In 1998, the most complete ape-man skeleton yet discovered in Africa was announced and, even though still under preparation, 'Little Foot' has been published in a series of preliminary papers by Director of research, Prof. R.J. Clarke. Today, Clarke has finally lifted this 3 Myr old skeleton from an underground cavern and is in the process of final cleaning, 3D scanning, and reconstruction for comprehensive publishing. This work will undoubtedly further highlight and profile the importance of this historically rich heritage site.

In addition to these two remarkable finds, Sterkfontein contains palaeontological and archaeological deposits which span several critical periods in human evolution. Deposits in the Jacovec Cavern appear to be of similar age to Little Foot and include nine hominid fossils (some of which may be a different species to the skeleton) and two rich faunal assemblages. Younger breccias in Member 4, ca 2.6-2.1 Myr, contain over 600 specimens of other ape-man fossils, including the two species of *Australopithecus* (*A. africanus* and *A. prometheus*).

In deposits ca 2 Myr, Sterkfontein has yielded a small number of *Paranthropus robustus* fossils, a sister hominid species which became extinct ca 1 Myr, plus a large number of Oldowan stone tools. These tools are the oldest cultural remains yet discovered in southern Africa. In another infill ca 1.7/1.6 Myr, the site has preserved the next phase of cultural development in the form of early Acheulean artefacts, which include handaxes and cleavers. These tools are associated with some fossils of *Homo ergaster*, our most direct human ancestor, which appeared ca 1.7 Myr. Thus far, Sterkfontein has provided the most direct association in Africa between *H. ergaster* fossils and this important industry, which led to the successful and widespread Acheulean technological development across the African continent.

Additional research highlights at Sterkfontein over the decades include the only demonstrated fossil wood of Pliocene age in South Africa, excavated from the Member 4 *Australopithecus* deposits. Study of the wood by Dr M. Bamford has shown that remnants of tropical/sub-tropical forest survived in the Sterkfontein river valley in the time of *Australopithecus*. Most numerous of all have been studies of the many thousands of faunal remains by environmental specialists, who have used this data to reconstruct the environments and landscapes in which the early hominids lived for the last three million years. Faunal studies are today highly advanced and also include isotopic work to reconstruct diet. Sterkfontein has been a key site in many of these interpretations and debates.

### **Research Proposal**

Since the early 1990s, Professor Ron Clarke has held the permit for excavations of Sterkfontein and Professor Kuman has been the senior archaeologist for the site. Both have supervised a number of field and laboratory-based theses on Sterkfontein. This year Prof Clarke turns 68 and he wishes to assist a new generation of palaeoanthropologists to take increasing responsibility for the direction of research. He will remain involved with Stratford as a collaborator and mentor but from 2013 will devote most of his time to completing the

cleaning and publishing of the StW 573 skeleton known as Little Foot. Prof Kuman continues to be employed by the university until the end of 2013, and she wishes to continue her involvement with the archaeology and site formation issues at Sterkfontein that she has developed over the years. Stratford has completed two theses on Sterkfontein research. Both have involved his own excavations of underground deposits in several locations (in the Milner Hall and the Name Chamber). This has been specialised work which has not received adequate attention in the past. He has advanced training in microstratigraphy and chemical analysis of the breccias and is working on a clearer, more detailed picture of the inter-relationship of the various cave infills<sup>1</sup>.

The research projects outlined below are part of the ongoing palaeoanthropological research programme which has been conducted for over 70 years at Sterkfontein. The projects fit within Sterkfontein's primary palaeoanthropological research questions. These include: qualifying and quantifying the different morphologies of the multiple hominid species found at Sterkfontein; clarifying the functional and cognitive capabilities of the hominids through the analysis of hominid anatomy and stone tool assemblages; understanding the role and place of the hominids in their original environmental context through the study of associated faunal, archaeological material and stratigraphy. Concurrently to the projects described below, long-term processing of the lime-mining dumps is carried out to supplement our hominid and faunal assemblages. This has been ongoing since the start of work at Sterkfontein and still produces important specimens (e.g. a molar and premolar originally belonging to the important TM1511 specimen found by Broom in 1936). The main areas of focus for the next three years are: the detailed analysis of the morphology and context of the StW 573 'Little Foot' skeleton of *Australopithecus*; detailed stratigraphic analysis of the underground cave system; further research into Member 4; and excavations in the Member 5 artefact-bearing deposits.

## STW 573

Prof R.J. Clarke (Director of Excavations and Research) will carry on with the lengthy process of cleaning and describing the complete skeleton known as Little Foot, which he has published in a preliminary paper as a second species of *Australopithecus* (*A. prometheus*). The entire fossil has now been removed from its underground cavern and is systematically being developed from the breccia by Clarke and two skilled technicians, Abel Molepolle and Stephen Motsumi. Concurrently, parts of the skeleton still encased in hard breccia will be scanned with the newly acquired micro-CT scanner at the university. This scanning will produce a virtual 3D reconstruction of the skeleton, and it will also create the first resin casts of the individual elements. Dr Kris Carlson (IHE) will work with Dr D. Stratford to produce the scans. Stratford will be in charge of the lengthy process of assembling the component scans, using special software applications which accurately join the individual images. For detailed study of the anatomy and for research exchanges between specialists, each bone must

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<sup>1</sup> Stratford, D.J. 2008. A Study of Newly Discovered Lithics from Earlier Stone Age deposits at Sterkfontein, Gauteng Province, South Africa. Msc. Thesis. University of the Witwatersrand, Johannesburg. Avery, M., Stratford, D.J., & Senegas, F. 2010. Micromammals from the Name Chamber at Sterkfontein, South Africa; a contribution to site correlations and palaeoenvironments. *Geobios* 43(4): 379-387. Stratford, D.J. 2011a. The underground central deposits of Sterkfontein, South Africa. PhD. Thesis. University of Witwatersrand, Johannesburg. Stratford, D.J. 2011b. Cave excavation: Some methodological and interpretive considerations. *Journal of Cave and Karst Science* 38 (3): 112-116.

also be cast individually in the traditional method, which preserves the most precise detail. Two of the permanent technicians at Sterkfontein (A.Molepolle and S.Motsumi) are experts in moulding and casting and will be working with Professor Clarke to produce these.

Clarke and Stratford will carry out further excavation in the grotto in 2013-2014, which has three main objectives:

- 1) to extract fossils of animals associated with the skeleton;
- 2) to further elucidate the stratigraphic history and clarify dating of the deposit, which has been controversial; and
- 3) to explore deposits beneath the *Australopithecus* skeleton, with the hope of obtaining further fossil remains, and perhaps even more hominid fossils.

In addition, computer scientists from France collaborating with our karst stratigrapher, Dr Laurent Buxelles (INRAP, CNRS), have completed 3D scanning of the skeleton within the cave before it was removed, and they return in 2012 to scan the chamber itself and work towards producing a virtual 3D projection of the chamber to aid our understanding of the formation history of the Silberberg Grotto.

### **Stratigraphic research**

In addition to his work on the skeleton, Stratford is working on deciphering the complex stratigraphic relationships between several of the underground deposits, including the one which contains the skeleton (M2). Stratford uses a comprehensive multidisciplinary approach to stratigraphy that combines the traditional faunal analyses of taphonomy and taxonomy, and integrates these data with chemical and physical sedimentological analyses and biofabric analyses. By analysing the position, condition and associations of every component of the deposit (sediments, fossils and artefacts), Stratford is able to clarify how the deposits have formed and identify the source of the sediments. This is particularly important as the deeper, lesser known deposits are explored. Stratford's methods also allow the identification of damage and modification to the assemblages at different stages of the deposit formation, thereby providing a formation sequence and a perspective on the original depositional conditions. Ongoing multidisciplinary research of this kind will enable a greater level of contextual control at Sterkfontein and will enable a better understanding the original associations between the hominids and other fauna. Stratford recently received training in soil micromorphology at the University of Central London, Department of Archaeology. His specialist training will allow this powerful microstratigraphic technique to be applied to the Sterkfontein deposits, pioneering the technique within the Cradle of Humankind sites. The combination of these complementary techniques enables the complex site formation processes found in caves to be clarified. This is of the utmost importance for providing a clear context for the hominid fossils and providing the support needed for the environmental and behavioural reconstructions for the hominids at Sterkfontein.

#### **Member 4**

Over the next two years, excavations within the breccias exposed at the surface will also continue. Member 4 has yielded the bulk of the *Australopithecus* fossils, and we will uncover more hominids in order to improve our understanding of the anatomy and variability of *Australopithecus*. Concurrently to the Little Foot investigations, Stratford will be applying the same stratigraphic methods to Member 4 and subsequently the other, younger, Sterkfontein deposits to clarify the formation history and contexts of the many cave infills and associated faunal and archaeological assemblages.

#### **Member 5**

The oldest stone tools in southern Africa were obtained in the early 1990s from the Member 5 breccias. The older of the assemblages contains a large number of Oldowan artefacts, dated by the cosmogenic nuclide burial technique to *ca* 2 million years. We are working on applying the same technique to dating of the early Acheulean assemblage in an adjacent infill. The faunal age suggests it is about 1.6 Myr old, but further excavations are required to provide cobbles deep enough for dating with the cosmogenic burial method to confirm and refine this age. Another benefit of continued excavations in the archaeological breccias is that we may recover more early *Homo* remains. In contrast with the ape-men, such fossils are always very rare finds. Both *H. habilis* and *H. ergaster* were highly intelligent species that coped well with the challenges posed by predators on the African landscape. Early *Homo* fossils across Africa are limited and are the subject of much debate over their species identification. Sterkfontein can contribute significantly to this debate.