

# First ever Discovery of a well-preserved Skull and Associated Skeleton of *Australopithecus*

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Although 74 years have elapsed since the discovery at Taung of the *Australopithecus fossil*, and despite intensive fieldwork in East Africa and 32 years of non-stop excavation at Sterkfontein, there has not been a discovery to date of a reasonably intact skull and associated skeleton of an ape-man. This is an account of the extraordinary series of events that led to just such a discovery and a preliminary assessment of the significance of the fossil, which is still largely embedded in the Member 2 breccia of the Sterkfontein Caves near Krugersdorp, South Africa (Fig. 1, 2).

Between 1936 and 1947, Robert BROOM, later assisted by John ROBINSON, recovered numerous fossil remains of *Australopithecus* and other fauna from the ancient infilling of the Sterkfontein Caves. A subsequent programme of excavation, initiated in 1966 by Phillip V. TOBIAS under the field direction of Alun HUGHES, greatly enlarged the sample of *Australopithecus* fossils from these deposits, which are estimated to be older than 2.6 Myr (CLARKE & TOBIAS 1995) and which PARTRIDGE (1978) defined as Member 4 of the Sterkfontein Formation (Fig. 3).

In 1978 TOBIAS decided that it was time to investigate the lower and older Members 2 and 3 of the Sterkfontein Formation, which were exposed in the Silberberg Grotto named after Dr. H. K. SILBERBERG, who, around 1942, had collected from there part of the fossilised upper and lower jaw of the *Chasmoporthetes*, the Pliocene hunting hyaena (TOBIAS 1979; TOBIAS in press).

This fossil was found in a block of breccia among piles of other fossil-bearing breccia blocks left on the floor of the cavern by lime workers, who, in the 1920s or early 1930s, had blasted away a huge stalagmite boss. The removal of the boss left Member 3 forming the upper north wall of the cavern, the dolomite cave wall forming the south wall, and Member 2 forming a steep talus slope dipping to the west, with a densely fossiliferous layer to the east.

Access to the floor of the cavern from the surface excavation site was provided in 1978 by Randfontein Estates Gold Mine, who installed wooden steps and a winch platform. HUGHES then organised the removal to the surface of the lime workers' dump of breccia blocks and rubble from the cave floor. The bones were subsequently cleaned out of the breccia by technicians at Sterkfontein and labelled with various dates between 1978 and 1980 and »D20« for »Dump 20« sorted and stored. The bulk of the collection, consisting of cercopithecoid fossils, was stored in the Department of Anatomy, University of Witwatersrand (Wits), while two boxes of sundry fossil fragments were stored in the workshop at Sterkfontein.



Fig. 1: StW 573, postcranial skeleton.

## The first hominid from Member 2

By 1992, TOBIAS was anxious to see more fossils extracted from the oldest deposits and, accordingly, we selected an appropriate place for excavation at the fossil-rich eastern end of the Silberberg Grotto. Because of the solid nature of the deposit and the fact that we had to excavate into a vertical wall, we enlisted the help of John CRUISE and Dusty van ROOYEN, who, on 26 October 1992, blasted out a large sample of breccia that proved to be rich in carnivore and cercopithecoid fossils. I was puzzled by the paucity of bovid fossils and went to check, on 6 September 1994, for bovids in the two boxes stored in the Sterkfontein shed. To my astonishment, I identified among the miscellaneous foot bones of bovids, carnivores and primates, first a talus, then the navicular, medial cuneiform and proximal half of the first metatarsal of one hominid left foot. I also found what looked like a badly damaged hominid lateral cuneiform that was morpho-



Fig. 2: StW 573, cranium.

logically incompatible with the left foot and a fragment of what I thought was possibly hominid calcaneum but could not be certain. The four other foot bones were a revelation in that they represented not only the oldest hominid from Sterkfontein but also revealed ape-like as well as human characteristics and, in particular included a first metatarsal that had a somewhat mobile joint with the medial cuneiform, indicating the probability that this particular ape-man (catalogued as StW 573) spent at least some time in the trees, as well as on the ground.

### The vital clue

On 15 May 1997, I chanced to open a cupboard in our hominid strong room at Wits Medical School to extract some fragments of the hominid StW 53 that I knew to be there, when I noticed a box labelled »D18 Cercopithecoids«. I found that it also contained »D20 Cercopithecoids« and, as I was interested in these monkeys from the Silberberg Grotto, I removed the box to study the contents. The following Monday, 19 May, I had time to study the fossils, and, to my delight, when I extracted the first polythene bag, I spotted through the plastic a tell-tale white bone that was clearly a hominid intermediate cuneiform that fitted with the medial cuneiform of StW 573. Next, in the same box, I found the left lateral cuneiform, the proximal end of the left second metatarsal and the left distal fibula. On 21 May, in another bag, I found what proved to be a vital clue in the chain of events, the disto-medial portion of a hominid tibia. It did not fit perfectly with the StW 573 talus, but I assumed that this was only the medial portion and was slightly damaged. Since the oblique break across the shaft looked as if it

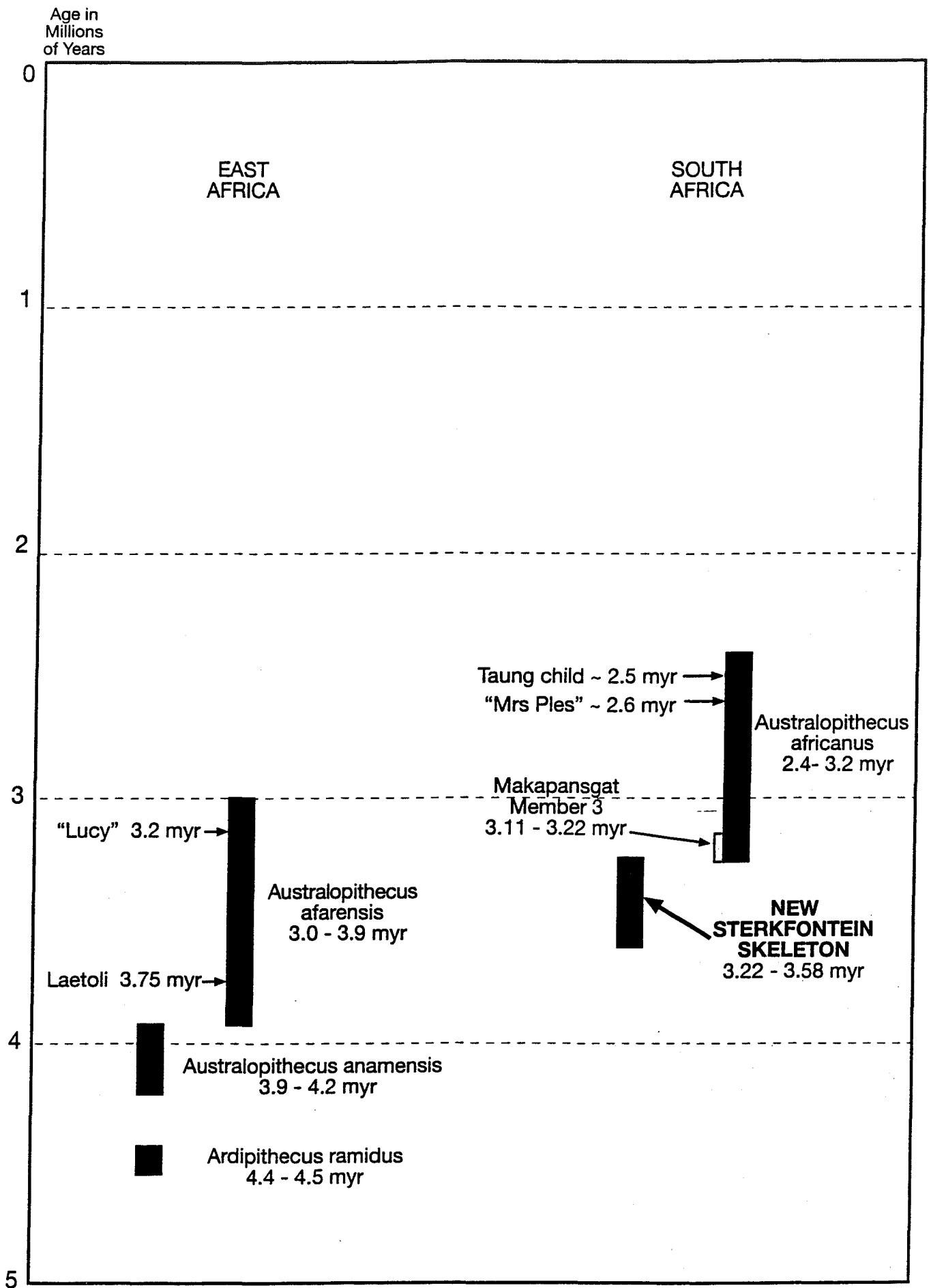
could have happened during the miners' blasting, I decided to look for a tibia shaft among the two boxes of miscellaneous Dump 20 fragments at Sterkfontein. On 27 May, in a bag labelled as bovid tibiae, I found a shaft, with the distal end intact, of what was clearly a hominid tibia, and it fitted perfectly with the left talus of StW 573. Then I realised that the other distal tibia fragment was from the right leg of the same individual. In this light, I checked again the damaged, supposed cuneiform that I had noted earlier and found that it was indeed a mirror image of the left lateral cuneiform that I had just found. I now had part of the right foot of the same individual. I also found in a bag labelled »Dump 20, Bovid Humeri« at Sterkfontein a heavily damaged chunk of bone that I identified as part of a hominid calcaneum. When I checked it against the previous fragment that I had thought was calcaneum, they fitted together. The smaller fragment formed part of the articular surface for the cuboid and, significantly it was bowl-shaped, like that of a chimpanzee, indicating mobility, whereas that of a human has a notch that receives a keel on the the articular surface of the cuboid in order to provide greater stability. Here was yet another indication of the ape-like morphology of the StW 573 foot, complemented by the three cuneiforms that were also more ape-like than human.

I now had a total of 12 foot and lower leg bones of one ape-man individual – the left tibia and fibula, which joined to an articulated set of eight foot and ankle bones, and the distal fragment of a right tibia and right lateral cuneiform. On 11 June 1997, I announced this new discovery (CLARKE 1997; FRIEND 1997; HIGHFIELD 1997) – the implication was stunning: I stated my conviction that the rest of the skeleton was still encased in the cave breccia of the Silberberg Grotto.

### Prophecy fulfilled

At the end of June 1997, I gave a cast of the distal fragment of the right tibia to two of the Sterkfontein fossil preparators, Nkwane MOLEFE and Stephen MOTSUMI, and asked them to search the exposed breccia surfaces in the entire Silberberg Grotto (except for the area we had recently blasted) to find a matching cross section of bone for which this would provide an exact fit. The task I had set them was like looking for a needle in a haystack as the grotto is an enormous, deep, dark cavern with breccia exposed on the walls, floor and ceiling. After two days of searching with the aid of hand-held lamps, they found it on 3 July 1997 near the bottom of the Member 2 talus slope at the western end of the grotto. This was at the opposite end to where we had previously excavated. The fit was

Fig. 3: The world's earliest Hominid specimens. Hitherto, the oldest skeleton yet found was »Lucy«, from Afar in Ethiopia, with an age of 3,2 million years. Older specimens recovered from East Africa are, without exception, fragmentary. The new find at Sterkfontein is, therefore, the oldest hominid skeleton yet discovered anywhere in the world. ▶



perfect, despite the bone having been blasted apart by lime workers 65 or more years previously. To the left of the exposed end of the right tibia could be seen the section of the broken-off shaft of the left tibia, to which the lower end of the left tibia with foot bones could be joined. To the left of that could be seen the broken-off shaft of the left fibula. From their positions with the lower limbs in correct anatomical relationship, it seemed that the whole skeleton had to be there, lying face downwards.

MOLEFE, MOTSUMI and I soon began to excavate, using hammers and chisels for the bulk of the breccia, the travertine and dolomite blocks, while I used a small hammer and chisels for the breccia close to the fossils. As I proceeded to excavate upslope, I uncovered the left tibia shaft and the distal ends with lower shafts of the left and right femurs, which were slightly displaced and in reversed positions relative to the tibiae. Next to a large dolomite block I uncovered, between 1 and 5 May 1998, a complete left radius on the right side of the skeleton, and to the right of the right tibia was the distal end of the right fibula.

To our consternation, upslope of shafts of the femurs, we found nothing more, despite removing, slowly and carefully, a large volume of breccia and big blocks of dolomite that had to be broken with chisels into smaller pieces. Because of the natural relationship of the two lower legs and the completeness of the delicate radius, logic demanded that the rest of the skeleton and skull should be there. By early September 1998, after we had carefully exposed more of the strata, I realised what had happened: there had been an ancient collapse of the part of the breccia immediately upslope of the broken femur shafts and that this collapsed portion had been subsequently covered by thick travertine. I asked MOTSUMI to chisel away the very hard, thick travertine down to the breccia and then I selected a small area and asked him to remove the breccia carefully, and telephone me if he found bone. This he did the very next day, 11 September. It turned out that his chisel had made a direct hit on the distal end of a hominid humerus that was positioned almost vertically right next to another bone. By 17 September, when I had cleaned enough of that bone, it proved to be an ape-man mandible that was attached to its cranium. These were situated about 62 cm upslope and to the left of the distal end of the right femur. Further cleaning has revealed a so far intact left side of an ape-man skull with upper and lower dentition in occlusion. This discovery indicates that the pelvis, vertebrae and other limb bones are probably still within the breccia at a lower level between the skull and the lower parts of the femurs.

### Significance of the discovery

The skull remains embedded in very hard breccia containing numerous dolomite and chert stones that are in many cases right against the bone; the face is in close proximity to a large dolomite block. Until the skull is more fully exposed, it is not possible to say anything about its

exact taxonomic status or whether it is male or female. We can, however, state that it is a mature adult with a massive zygomatic arch (unlike known crania of *Australopithecus africanus*) and a temporal line that encroaches far sagittally onto to the low frontal squamae. It does not fall obviously into the morphology of known Member 4 hominids. Although the skull and radius seem to have unusual characteristics, I prefer to reserve judgement on the fossil's exact taxonomic affinities, although it does appear to be a form of *Australopithecus*. It is worth recording, even at such a preliminary stage, that it is not only the most complete *Australopithecus* skull ever discovered, but it is associated with the most complete ape-man foot and the most complete tibia, radius and humerus.

### The taphonomic situation and chronological age

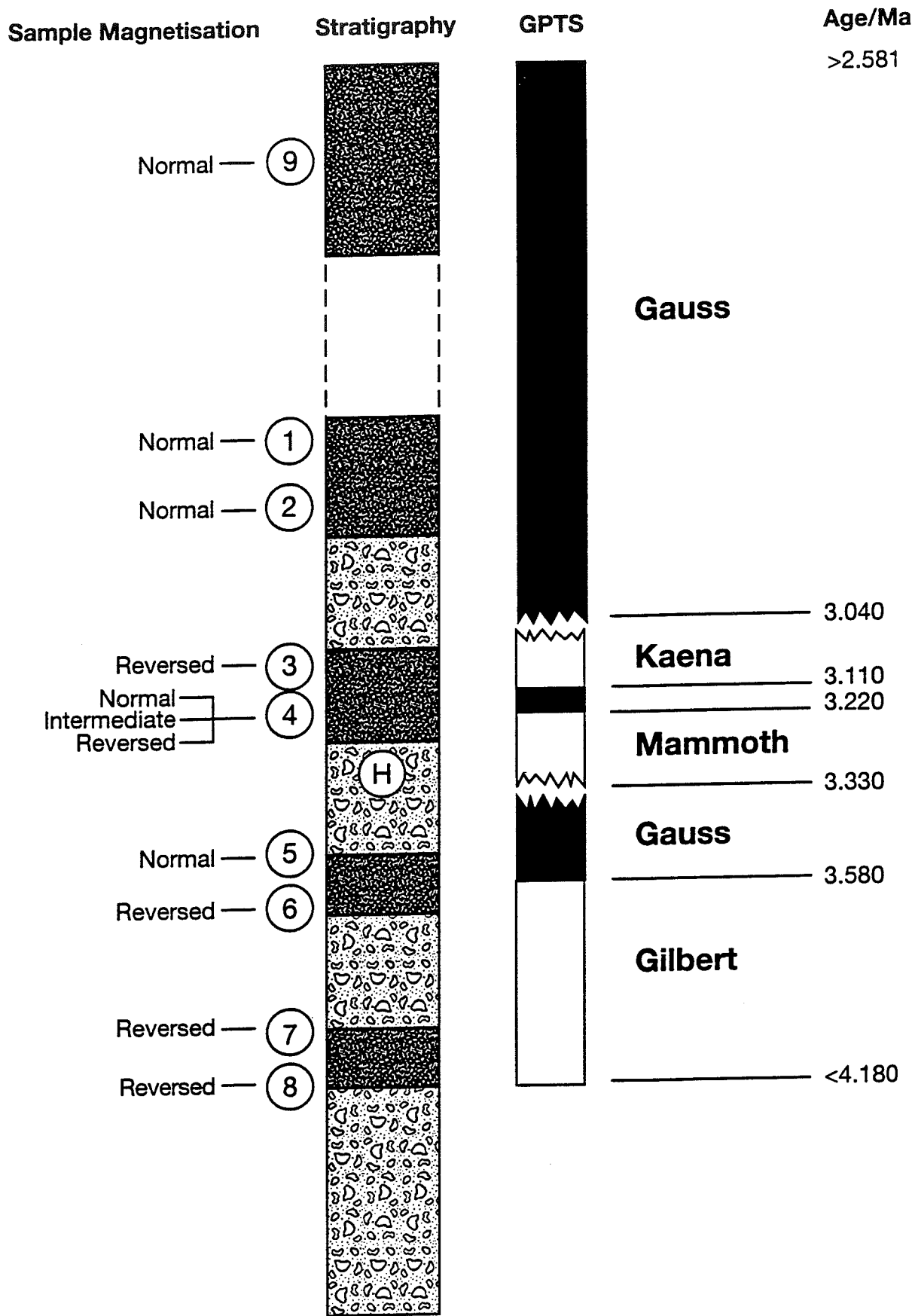
The skull and postcranial elements recovered so far indicate that the whole skeleton lay on the talus slope, which, in addition to breccia containing large and small dolomite and chert blocks, has layers of reddish sediment, dark brown mud flows and travertine flows. Other fossils are virtually absent in the vicinity of the skeleton, with the exception of an occasional small fragment of bone of other fauna. This contrasts with the Member 2 deposit at the eastern end of the cavern, which has a dense concentration of bones and skulls, including partial skeletons of monkeys and carnivores (CLARKE 1994). This raises the question of how such an intact hominid skeleton came to be in that isolated spot within the cavern.

The situation of the skull sealed beneath the thick travertine that separates Members 2 and 3, and the 6,5 m depth of Member 3, indicate that a great span of time elapsed between the deposition of Members 2 and 4, and that Member 2 is thus probably older than 3 Myr, perhaps as old as 3,5 Myr (CLARKE & TOBIAS 1995; Fig. 4).

The new and complete skeleton has the same age as the foot bones announced by CLARKE and TOBIAS (1995). T. C. PARTRIDGE commented on the possible age in a footnote to their paper in 1995. The material dated was similar to layer in the chamber designated by Partridge as Member 2., a part of the underground chamber known as the Silberberg Grotto. Member 2 in the Silberberg Grotto is about 10 metres below (and therefore older than) the deposits from which such famous specimens as Mrs. Ples, *Plesianthropus transvaalensis*, (BROOM 1936) were excavated.

Since Member 4, above Member 2, contains antelope remains which existed in East Africa between about 2,5 and

*Fig. 4: Geomagnetic time scale in South-Africa. Ages are based on Geomagnetic Polarity Timescale (GPTS) of Cande and Kent (1995). Because the top of Sample 9 and the base of Sample 8 are not positioned on reversal boundaries it is only possible to give minimum and maximum ages for the top and bottom of the section respectively.*



(8) Sample Number      (H) Hominid Remains

Sampled Flowstone Layer      Cemented Cave Fill

2,7 million years ago, Member 2 must be older. PARTRIDGE estimated that thus the vertical separation of about 10 metres between the two layers could represent a lapse of time of several hundreds of thousands of years. At that time he concluded that the foot bones were probably in excess of 3 million years old. The author demonstrated that the foot bones belong to the astonishingly complete hominid skeleton now exposed *in situ* in the Silberberg Grotto and eliminates the possibility that the original specimens may not have come from Member 2 and it also places the new remains very accurately within the documented sequence of deposits contained within this part of Sterkfontein Cave. Careful scrutinizing revealed that the skeleton is sandwiched between two of five flowstone (or stalagmite) layers within the Silberberg Grotto. These were carefully sampled and analysed in the Geomagnetism Laboratory at the University of Liverpool, England, by J. SHAW and D. HESLOP. Their dating indicated that no fewer than five changes in magnetic polarity occurred during the time represented by the deposition of these flowstones. Thus, the position of the earth's magnetic pole changed from the »normal« to the »reversed« position, or vice versa, of five separate occasions. Timing and duration of these changes in the earth's magnetic field in the past 118 million years are precisely known and documented. However, to place changes of local sequences, as for example in the Silberberg Grotto, within a complete record requires that broad upper and lower age limits be set from other evidence. The antelope remains Member 4 of 2,7 million years provide thus an upper limit and a lower limit of 4,0 million years may be assumed with great certainty from the oldest and rather fragmentary hominid remains yet found in East Africa. Given these constraints, the correlation of the evidence from the flowstone layers above and below the skeleton to the global palaeomagnetic timescale appears to be quite clear: the hominid remains are positioned between the Gauss-Gilbert reversal boundary and the termination of the Mammoth event.

On this basis the specimen can be assigned a palaeomagnetic age between 3220 and 3580 million years.

Furthermore, it is noteworthy that Turner's analysis of a *Chasmoporthetes* partial skull from the Member 2 east deposit did not identify it as a *Chasmoporthetes silberbergi*, previously recorded from there, but indicated a possible link with the much earlier lower Pliocene *Chasmoporthetes australis* from Langebaanweg (TURNER 1997).

## Conclusion

No matter what kind of ape-man StW 573 turns out to be, the discovery of this skull with its skeleton provides us with a wealth of potential information on the anatomy, locomotor behaviour and evolution of an early hominid. It offers a fascinating taphonomic puzzle coupled with insights into stratigraphic problems in dolomite caves. It demonstrates the important role that Sterkfontein and

South Africa have to play in the understanding of human ancestry (Fig. 3).

Alun HUGHES used to tell me of a recurrent dream that he had of his breaking into a cavern and finding a complete skeleton of an *Australopithecus* lying there. I am pleased that, through strange circumstances, it has been my good fortune to realise Alun's dream and to bring to fruition the expectations of Phillip TOBIAS, that an archaic form of *Australopithecus* would be recovered from the lowest levels of Sterkfontein.

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