Bones of Contention: Shifting Paradigms in Human Evolution with the Skeletons of *Australopithecus sediba*

Inaugural lecture of Prof. Lee R. Berger

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Opening Slide

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Palaeoanthropology is not generally known for its well preserved record.

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With the entirety of the fossil hominin record from Africa numbering in just the few thousand, and with the vast majority of these remains comprising just isolated teeth and small fragments of bone, often from poor context, reconstructing an accurate picture of human evolution over the last several million years has proven difficult, often resulting in fierce debate over what amount to differences in what are quite literally scraps of fossilized bone.

Slide – new finds

But recent discoveries are dramatically improving the hominin fossil record and allowing us greater insight into the mode and tempo of human evolution. With the discovery of these more complete remains, including partial skeletons, and our ability to more accurately date these same remains, the potential for a clearer understanding of the evolution of the homininae has never been greater. But increasingly, these better preserved, better contextualized remains are not, in their morphology nor in their timing, synching with the story of human evolution as derived from the more fragmentary record we had recovered over the past more than eight decades. In fact, some fossils differ so dramatically from our pre-conceived image of how human evolution occurred, that they appear to tell another story entirely, different from that based upon the previous record.

Slide – complex phylogeny

Could there be, as some commentators suggest, a vast complexity in human evolution, with many species existing at one time, and multiple examples of homoplasy occurring over and over, where similar looking features evolve at different time for similar purposes in the hominin lineage? Or must we ask, were the hypotheses derived from that fragmentary, poorly contextualized record simply wrong, and that the story derived from this more complete, better contextualized record that is now emerging should simply replace the hypotheses generated over the last several decades of research? For scientists outside of palaeoanthropology the answer might seem simple – the better record should, until proven otherwise, replace the more fragmentary one.

But the study of human origins is after all, conducted by humans, and sacred cows – even in science, are often hard to slaughter. In order to highlight the difficulties we face in the study of human origins, in comparing this “new” record with the “old” one,

Slide - sediba

I am going to briefly examine here the case for the fossils from the site of Malapa, representing the species *Austrlopitheces sediba* as a potential candidate ancestor for the genus *Homo*, contrast this against the existing record, and attempt to explore where this species might fit in the story of human evolution. At the same time I will elaborate upon arguments for, and against it being the best candidate for the ancestry of our genus and attempt to explain why these fossils are so important to human evolutionary studies at this moment in time.

Slide - Malapa

The site of Malapa represents an unusually rich early hominin locality in Africa and may represent one of the single richest assemblages of pre-Holocene hominins yet discovered. Dating to just under 2 million years in age, it contains a number of associated skeletal remains of several individuals. These remains are found alongside an abundant, well preserved fauna and flora that is probably unmatched in its quality among known South African cave sites. The hominin skeletons of Malapa additionally preserve critical areas of anatomy that have, in many cases, not been seen in such completeness, or lacking distortion, in the entirety of the early hominin fossil record.

I first discovered the site of Malapa on August 1, 2008, during the course of a geospatial survey for new fossil-bearing cave deposits in the dolomitic region of the Cradle of Humankind World Heritage Site, Northwest of Johannesburg. I recognized Malapa as a de-roofed cave of at least 25 x 20 meters, in an area where limited lime mining had taken place, probably during the late 19th or early 20th century, almost certainly before Robert Broom began exploring the area in the mid-1930's.

Slide - Matthew

On the 15th of August, 2008, on the first trip back to the site to investigate its fossil-bearing potential, the first hominin specimens were discovered by my then 9 year old son Matthew – this specimen would become known by its accession number of MH-1 or Malapa Hominin 1. In the following weeks and months we quickly recognized that the site had significant potential, as additional hominin fossils were encountered,

Slide – MH-2 Discovery

including my discovery on September 4, 2008, of a second, well-preserved adult partial skeleton. This skeleton was importantly found *in situ*, thus giving us the precise location of the hominin remains and leading to the discovery of the *in-situ* location of MH1 just a few centimeters above her.

Slide – skeletons

Over the course of the last five years, my team and I have conducted a number of analyses of this material and in 2009 and early 2010 came to the conclusion that the fossil hominin remains from Malapa represented a new species of early hominin, previously unrecognized in the fossil record. It was clear that the species possessed a number of both primitive and derived characters that were unexpected given the fossil hominin record that had been recovered to date.

Slide – Science Cover April 2010

This led us in 2010 to describe a new species of early hominin – *Australopithecus sediba*. We would eventually put a very precise date of 1.977 to 1.98 million years ago on the deposit using uranium-lead dating, a method of dating in part pioneered here at Wits.

Slide – Article Covers

We have clearly demonstrated in more than thirty academic publications over the past three and a half years that *Australopithecus sediba* is an unexpected addition to the early hominin record. With its small but in some ways derived brain, reduced dental size and incipient nose among other characters, the cranial morphology of this species appears to share features with both more primitive australopiths and later *Homo.*

Slide – Mosaic traits

Post-cranially, we have equally found *Australopithecus sediba* to show an unexpected mosaicism in its anatomy including longer, more ape-like arms, hands that exhibit an elongated thumb and shortening of the fingers, a more derived pelvic structure and aspects of the foot and ankle that are both surprisingly primitive, as well as surprisingly derived. With the significant amount of research published about *Australopithecus sediba* and the site of

Malapa, the species and site, even in this short period of time, is perhaps now as well known as any other early hominin species.

Slide – Standing sediba

Though some colleagues were critical of the novel species designation, as is to be expected, the veracity of our assignment of these remains to a new species now has practically universal acceptance. What does not have universal acceptance is one part of our hypotheses put forward that suggests that *Australopithecus sediba*, while different than other hominins found, may be the best candidate direct ancestor of the genus *Homo*.

Slide - Cladogram

In the first publications of this material my colleagues and I suggested that *Australopithecus sediba* was most probably derived from *Australopithecus africanus* via a cladogenetic event, or that it might represent some form of anagenetic lineage from a species not dissimilar to *africanus,* although one probably less megadent.

In our analysis *Australopithecus sediba* forms a stem group of *Homo* based upon craniodental characters. As we have discussed, anatomical support for a cladogenetic interpretation comes from the constellation of *Homo*-like characters in *sediba,* that appear directly alongside its *Australopith*-like traits.

Slide – Sediba between afarensis and Turkana boy

This mosaicism places *sediba* outside the range of variability seen in the whole of the *Australopithecus africanus* samples, even though the *africanus* samples derive from the four different sites of Taung, Sterkfontein, Gladysvale and Makapansgat. Even though *Australopithecus sediba* is morphologically closest to *africanus*, the derived appearance of aspects of the cranium and postcranium prevent inclusion within the *africanus* hypodigm.

Slide –Sediba and africanus

At least one commentator has, however, suggested that *Australopithecus sediba* is simply a chronospecies of *africanus*. This however, seems unlikely, given both the extremely short time period between the last known occurrence of *africanus* at around 2.1 million years, and the date of Malapa at just under 2 million years, and the many apparent retained primitive characters of the younger *Australopithecus sediba*.

Another valid point raised by commentators is that given the many characters that *sediba* shares with early *Homo* across its body, and the many variances in morphology between *sediba* and other australopiths, why do we not simply place it in the genus *Homo*?

Slide – Lucy, Sediba and Turkana boy

My colleagues and I have, however, have argued that despite the numerous differences between *sediba* and *Australopithecus africanus*, and indeed between *sediba* and all other australopiths, we have maintained the opinion that *Australopithecus sediba* is better placed with the genus *Australopithecus*, rather than in the genus *Hom*o for the simple reason that if the definition of a genus is accepted as being a Grade level one, *sediba* is certainly adaptively closer to the australopithes than it is to definitive members of the genus *Homo*. *Australopithecus sediba* differs from *H. erectus* in a significant number of postcranial characters, many of which are in critical functional areas of anatomy that almost certainly indicate fundamental differences in the adaptive niche of *sediba* compared to that of *Homo erectus*. We therefore have concluded that the conservative approach is to maintain *sediba* within the genus *Australopithecus* until such time as a definition of the genus *Homo* would be shown to encompass such rather critical adaptive differences.

Slide – Sediba skull

Of course we have also considered the possibility that given all of these differences between both australopiths and early *Homo,* that *sediba* should be placed within in its own genus, and my colleagues and I have corresponded numerous times over such matters with as yet no conclusion to the debate, though I have gone so far as to suggest, only half-jokingly, that if it were found that our arguments justified naming a separate genus, we should use a generic name such as *Humanapithecus* loosely translating to "human ape", or some similar name that both recognize the close affiliation with both the genus *Australopithecus* and the genus *Homo*, but also pays tribute to the mosaic nature of sediba's anatomy.

Slide - Phylogeny

So where does *sediba* fit within the family tree of hominins? Despite the shortcomings of the fossil record around 2 million years, something I will address in more detail in a moment, there are enough fossil hominin remains from East- and southern Africa, so that if we take that record at face value, we can hypothesize as to the phylogenetic position of *sediba*. As mentioned previously, based on presently available evidence, *sediba* appears derived from *Australopithecus africanus*, or something closely resembling at least the more gracile specimens attributed to this species. In turn, *Australopithecus sediba* appears to share more derived characters with specimens assigned to specific fossils presently associated with early *Homo*, but more particularly with early *Homo erectus* more so than any other candidate ancestor, including *Australopithecus afarensis*, *Australopithecus garhi*, or *Australopithecus africanus*. In the initial announcement of *sediba*, my colleagues and I proposed four possible hypotheses regarding the phylogenetic position of *sediba*: 1) *sediba* is ancestral to *Homo habilis*; 2) *sediba* is ancestral to *Homo rudolfensis*; 3) *sediba* is ancestral to *Homo erectus*; or 4) *sediba* is a sister group to the ancestor of the genus *Homo*.

Slide - Phylogeny

In an accompanying cladistic analysis in that paper, and several that have followed the most parsimonious cladograms always places *sediba*, perhaps not surprisingly, as a stem or sister taxon for the *Homo* clade comprised of *H*omo *habilis*, *Homo rudolfensis* and *Homo erectus*.

But is *sediba* at 2 million years in age simply too young to have given rise to the genus *Homo*?

Slide – Phylogeny with early Homo – old dates

While we have continued our analysis of the phylogenetic status of *sediba* along numerous avenues of research that are focusing particularly on the comparative anatomy of this species, there has been some discussion generated over the approximate two million year old age of *sediba* as seeming to exclude it, through chronological arguments alone, from being considered a potential ancestor of the earliest members of the genus *Homo*. It has been argued, time and again, that *sediba* is simply too young at two million years in age, and this is based on the widespread perception that there are substantially earlier, better candidate fossils that actually represent the earliest members of the genus *Homo*. If this were so, then at least from a relatively simplistic view of anagenetic evolution, the *sediba* fossils from Malapa could not of course, give rise to the genus *Homo*.

Slide - sediba

So let us examine the question of whether *sediba* is simply too late in time to be considered a candidate ancestor of the genus *Homo*? Before addressing this question in detail, it has to be said that such a view of the potential phylogenetic position of *Australopithecus sediba,* somewhat disingenuously ignores the possibility that the Malapa fossils represent a late surviving population of the species that gave rise to these other forms.

In addition, given the extraordinary importance that these supposedly early candidate fossils purportedly representing members of the genus *Homo* now have in laying claim to the earliest origins of the genus, their morphology and context deserve critical scrutiny if they are going to weigh themselves against the new, well-preserved, well-provenienced evidence from Malapa. Hypothesizing that any given species gave rise to our genus is an extraordinary claim, and extraordinary claims require extraordinary evidence. So let us, for a moment examine the evidence that is put forward for fossils that are better candidates for the ancestry of the genus *Homo* than *Australopithecus sediba*.

Slide – early Homo fossils

Three main candidate fossils are typically put forward as exceeding the Malapa assemblage substantially in age and therefore being contenders for the first members of the genus *Homo*. These are the Stw 53 skull from Sterkfontein, the A.L. 666 maxilla from Ethiopia, and the U.R. 501 mandible from Malawi.

Slide dates

Each of these fossils have, at one time or another, been said to exceed 2.1 million years in age, with the latter two specimens purported to be between 2.3 and 2.4 million years in age.

Slide - 1470

More recently, re-dating of the Koobi-For a sequence in Kenya has suggested an age for the 1470 cranium within error of the age of the sediba fossils, placing it as a contemporary of *Australopithecus sediba*, and thus this specimen becomes critical to the discussion as well.

So let us briefly examine each of these important specimens.

Slide – Stw 53

Let us first look close to home at Stw 53 from Sterkfontein. This fragmentary skull has been referred to early *Homo* ever since its discovery in the 1970's. Derived from the "Stw 53 Infill" or Member 5 at Sterkfontein, it has traditionally been thought to be over 2 Ma,

Slide - Age

but more recent work in fact suggests an age as young as 1.78-1.43 million years ago, making it actually two hundred to nearly six hundred thousand years younger in time than *sediba*.

Slide – Alan and Philip

Alun Hughes and Philip Tobias initially described Stw-53 as most probably belonging to a species of early *Homo* closely related to *Homo habilis,* a hypothesis that soon came to be widely accepted due to the small face and its dentition as well as interpretations of the shape of its cranium among other traits.

Slide – Stw 53 and sediba

But given finds over subsequent years, Stw 53 now looks less *Homo*-like and more like a late australopith. In fact *sediba* itself shows that in these features Stw 53 is in fact more *africanus*-like in those features than *sediba* is. The derived craniodental morphology of *Australopithecus sediba* alone, therefore raises further doubt regarding the attribution of Stw 53 to early *Homo*, as Stw 53 quite simply overall looks more *africanus*-like relative to MH1, while MH1 looks more *Homo*-like relative to Stw 53. Thus, to summarize, there is little evidence at present as to why Stw 53 should be considered at all as a candidate for the first evidence of the genus *Homo,* as it neither appears to exceed *Australopithecus sediba* in chronological age, nor is it morphologically compatible with such a hypothesis.

Slide A.L. 666

If there is a "sacred cow" of early Homo older than two million years then it would be the A.L. 666 palate from Ethiopia dated to 2.3 million years. Most scientists and even most commentators view this fossil as the best single candidate for the earliest occurrence of the genus in Africa. The specimen in question is a single, fragmentary maxilla.

Slide – AL 666 side view

As I mentioned earlier the claim to the first definitive fossil evidence of the genus *Homo* is an extraordinary one and of great importance. And to be rather blunt, in my own opinion, the A.L. 666 maxilla quite simply does not meet the criteria of extraordinary evidence for a number of reasons.

Slide – Discovery site

Firstly, it is an isolated surface find. Like many of the fossils from the lacustrian environments of East Africa, the fossil was found fragmented across the surface of a slope. The maxilla was then reconstructed from these fragments, a task that in and of itself leaves aspects of its reconstructed morphology open to interpretation. When excavations were conducted, no further evidence of this specimen was found *in-situ* leaving its provenience also in question. Thus, although it has been placed within the context of the horizon it lay *on*, there is no absolute certainty that it is from this 2.3 million year old horizon. The very fragmentary nature of A.L. 666 clearly indicates that it underwent some taphonomic and erosional process that displaced it from its original situation. Given the importance of its bearing on the question at hand, it is not an understatement to say that A.L. 666's exact stratigraphic position is of some considerable importance - and it is definitely in question.

Secondly, the completeness of the *Australopithecus sediba* material illustrates to us some very important lessons about what questions we may address using isolated, and often fragmented areas of anatomy in fossils, and those which we should not.

Slide – Diversity of sediba

To illustrate this important point, if, in almost any area of anatomy, my colleagues and I had tried to use an individual element or complex to determine the genus of *sediba*, we might very well have come up with very different conclusions than we did. This is true of even the maxillary-dental complex. As I mentioned earlier, many colleagues have put forward differing interpretations to those of our original studies, with a significant number of scientists arguing that *sediba* should in fact rather be placed within the genus *Homo*. Without belaboring the details of these arguments, the fact now stands that the Malapa hominins demonstrate that ***we cannot use at least some isolated areas of anatomy – such as the maxilla – in isolation, specifically to answer questions about the generic association of a particular specimen***. Put simply, if the generic position of *sediba* is in question based upon a myriad of anatomical areas that are well preserved, how can we begin to ask such a complex question of a fragment like A.L. 666?

Slide – Sediba comparison

It is now clear to me, that we as a field must now turn to a more holistic anatomical approach to answer such questions, in conjunction with contextual approaches that clearly acknowledge both the strength and weaknesses of the geological context of any given specimen. *Sediba* has clearly demonstrated to us that dentitions, other parts of the structures associated with mastication and many areas of the postcrania are quite simply not suitable for asking questions of this nature, no matter how many shared derived features they contain. It is thus in my opinion not unreasonable to apply such a conservative approach as my colleagues and I have to any early hominin species until fossils of a certain completeness prove otherwise. This does not in any way mean that there are not meaningful questions to be answered by these isolated and often fragmentary finds, it is simply that we now recognize certain questions that cannot be answered by these finds outside of extraordinary context.

Slide - AL 666

Additionally, I would like to make the point that the simple fact that a fossil – such as AL 666 - has been accepted as being assigned to a certain taxa for many years, does **not mean that new evidence should not be taken into account regarding existing interpretations. To repeat my earlier comments, extraordinary claims require extraordinary evidence and even more to this point - nostalgia is not evidence**. A.L. 666 at the time of its discovery was extraordinary. In the light of a myriad of new, more complete, better provenienced finds – such as those of *Australopithecus sediba* from Malapa - it is no longer so extraordinary in its completeness nor context and thus is insufficient in and of itself to be used with reference to the question of the origins of the genus *Homo*.

Slide – UR 501

The isolated mandible UR 501 from Malawi has also been put forward as a good candidate ancestor for the genus *Homo*. Found on the surface next to Lake Malawi and dated using fauna also found on the surface in nearby deposits, it too suffers many of the same problems as presented by A.L. 666 when applied to the question of the origins of the genus *Homo*. In fact, its context and anatomy might be considered more in question. It is after all a surface find, from a lacustrian deposit, and it is dated **only by faunal comparisons** to a purported 2.4 million years ago. The use of an isolated mandible to assign generic association has been clearly drawn into question by the constellation of morphologies found in *sediba*, and the derived nature of *sediba's* mandibular and dental morphology. Thus the U.R. 501 mandible also, therefore quite simply does not meet the criteria of extraordinary evidence with reference to the question of whether it represents the earliest member of the genus *Homo*. Finally there are the series of fossils presently lumped into the taxon *Homo rudolfensis*.

Slide– 1470 and others

Chief among these is the fragmentary skull KNMER 1470. This specimen has been taxonomically controversial since its discovery. It may be hard to imagine, but the KNM-ER 1470 skull has varyingly been assigned to *Homo* species indeterminate, the genus *Paranthropus*, the species *Australopithecus africanus*, *Homo habilis* and finally *Homo rudolfensis* which its presently most popular taxonomic affiliation. It should be clear from this list, that the fragmentary nature of the fossil itself and the resultant varying reconstructions of its actual form, are in part responsible for such a diversity of opinions on its taxonomy. Additionally, as Bernard Wood has noted, the presence and degree of sexual dimorphism in early *Homo* can and will greatly influence with what taxon KNM-ER 1470 is associated with. That is, we don't know whether early *Homo* is highly sexually dimorphic or not, and thus we don't know whether 1470 is a big female or small male of whatever taxon it actually belongs to. Unfortunately, KNM-ER 1470 also lacks dentition, preserving only the roots, thus we get no real glimpse of even this critical area of anatomy.

Slide – Nature cover

More recently some colleagues have attempted to associate other specimens found in both Kenya, and in Tanzania with 1470 to make arguments about the variability in *Homo rudolfensis*. While I acknowledge it is tempting to impose the morphology of such similar sized specimens found around similar temporal periods to the same morphology as 1470, and thus the same taxon, I would caution that such an exercise could result in false associations, and such an exercise is thus simply not worth the risk.

Slide 1470 and Sediba

Given the proposed temporal overlap of *sediba* and KNMER-1470, it is fascinating to note the many differences in the crania of *Australopithecus sediba* and the 1470 cranium, even given their great disparity in preservation. Such areas of anatomy such as endocranial volume, facial shape and dental root form and size, as well as simply overall size, show these two species to be very different from each other. That both hominin species - whatever species 1470 represents - exhibit a number of derived traits of the genus *Homo*, yet barely share any of the ***same*** derived traits is in my opinion remarkable. Whether these intriguing differences are demonstrating the reality of homoplasy in hominins in this critical time period, or they are in fact questioning the temporal context proposed for 1470 and the other surface finds associated with this genus, will only be answered by better preserved finds found *in-situ* and preferably in association with partial skeletons.

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In summary, at first glance *Australopithecus sediba* appears to add despairing complexity to our present understanding of the emergence of early *Homo* by adding yet another species, this time with an unexpected mosaic of primitive and derived characters, to what we thought we knew of the experiments occurring between the last australopiths and the first definitive members of the genus *Homo* somewhere around 2 million years ago. *Homo habilis* and *Homo rudolfensis* both appear to show a trend in encephalization without the frontal complexity seen in *Australopithecus sediba*, as well as a retention of the general megadentia seen in many late australopiths, as well as, at least in the case of *Homo habilis*, retention of more primitive australopith aspects in its post-cranial anatomy, surprisingly **more** primitive in some areas than that observed in *sediba*.

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If however, we have been mislead in the past five decades since the description of *Homo habilis* by a fragmentary and poorly contextualized fossil record into developing a hypothesized evolutionary scenario that was simply incorrect, then the picture may not be as complex as it first seems. If *Australopithecus sediba*, or a species very much like it, arose out of an *Australopithecus africanus*-like species, or even if *sediba* stems from an even earlier branching from an at present unrecognized australopithecine and gives rise directly to early *Homo*, then *Australopithecus sediba* is not morphologically far from a plausible candidate ancestor of the genus *Homo*, having already acquired a great many of the most complex functional areas and adaptations usually considered critical to our genus.

Furthermore, if one removes from this debate fossils representing isolated areas of anatomy that are now shown to be of low taxonomic value, as well as removing from the debate fossils from poorly contextualized situations – such as surface finds - there is very little left but the fossils from Malapa to consider prior to 1.9 million years ago.

Slide

It would be in this situation that *sediba* might be seen as simply an ancestor of the later encephalized forms presently attributed to two separate but poorly known species within the genus *Homo – Homo habilis* and *Homo rudolfensis*. Alternatively, it may be that we have simply mixed both australopiths and early *Homo* specimens - due to their fragmentary nature - together into *Homo habilis* and/or *Homo rudolfensis,* and some, or all of the fossils presently assigned to these species might be better placed within the genus *Australopithecus.* This seemingly surprising idea has in fact been suggested or endorsed by a wide range of colleagues over many years.

Slide - Phylogeny

It may also be that *Australopithecus sediba* is simply the direct ancestor of *Homo erectus*, bypassing the need for including these other forms in the phylogeny leading to the origins of the genus *Homo*. In this latter case, invoking the near unsolvable argument that all shared-derived characters we see in these near contemporaneous forms of early hominin are simply homoplasy is unnecessary. Regardless of its actual phylogenetic position, it is probable that certain species once considered as potential candidate ancestors of the genus *Homo* are simply too derived in their morphology to be now considered ancestral to our lineage.

Slide

Given what I have presented this evening, I hope you have understood why my colleagues and I suggest that at the very least, *Australopithecus sediba,* **should be considered as likely a candidate ancestor for the earliest members of the genus *Homo* as any other presently available fossil species, or individual fossil specimen - and perhaps the best candidate**.

Slide

This is regardless of whether *Australopithecus sediba* fits our pre-conceived ideas of what that ancestor should look like, these pre-conceptions largely being based upon what I hope you now see is an extremely fragmentary fossil record as well as a large number of fossils from poor geological and chronological context.

Slide – Sediba skeleton

Despite the now recognized limitations that *Australopithecus sediba* places upon the use of certain fragmentary areas of the anatomy of fossil hominins when dealing with questions of generic and possibly specific associations, we face, in my opinion, an exciting period in palaeoanthropology. Practically never before have we seen more associated remains being discovered, in good context, so rapidly from across the continent. Improved absolute dating methods and excavation techniques are allowing us to now contextualize these finds, particularly in the South African context, in a way not possible even just a few years ago.

Slide – Vitruvian sediba

With the largesse of these recent, more complete finds however, must come the recognition that we now understand the greater complexity in the anatomy of early hominins and that we must be cautious in what questions we ask of certain aspects of the often fragmentary hominin fossil record. The remarkable skeletons of *Australopithecus sediba* from Malapa clearly demonstrate that we may still find surprising and often unpredicted mosaicism in early hominin anatomy, and this should breed caution and conservatism in our interpretations and analyses, particularly when it comes to the interpretation of more fragmentary remains. This situation will of course improve as more, and more complete fossils are discovered for each species of early hominin, in different temporal ranges, and in varying geographical areas of the World. I hope that you realize that the situation we find ourselves in at present in palaeoanthropology is not one of despair in the face of an unsortable mess of fossil fragments, but one with an expanding record of better and better preserved specimens. I believe these most recent discoveries, of which Malapa is just a single example, should be viewed as a clarion call for more exploration and more excavations, and the discovery of more and better fossils in good context.

Thank you