Remains of a new species of early human discovered in South African cave

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Newly announced findings of hominin fossils from a South African cave promise to provide new insights into human evolution. The remains are from a previously unknown species of early humans, *Homo naledi*. The research was reported in two companion articles published in the open-source journal *eLIFE*.

The original discovery was made accidentally by a pair of cave explorers who spotted bones lying on the floor of a deep, underground chamber of Rising Star Cave, located near Johannesburg. The find was reported to Lee Berger, an American paleoanthropologist who is a professor at the University of the Witwatersrand. He and a group of 60 international collaborators have conducted a systematic, two-year study of the remains.

So far, over 1,550 fossilized bone fragments have been recovered, representing a minimum of 15 individuals, and more are likely present. This already constitutes the largest collection of human fossils from a single site in Africa, and one of the largest in the world. Another such large accumulation is from Sima de los Huesos ("Pit of the Bones") in the Sierra de Atapuerca in Spain, dated to 350,000 years ago, where 6,500 fossil human bone fragments associated with *Homo heidelbergensis* have been recovered.

The large number of remains is a boon for researchers studying this period. Usually, the remains of early humans are found in small numbers at any given location, representing one or at most just a few individuals. This greatly limits researchers' ability to examine the range of variation that existed in a population at any one time and place, posing the danger of drawing highly skewed conclusions from a small and possibly unrepresentative sample. It's as if a handful of individuals were assumed to provide an accurate picture of the world's entire current human population. Such a statistically unrepresentative sample would present the danger of over- or underemphasizing the significance of characteristics present in the fortuitously selected individuals.

One of the more remarkable examples of this problem was manifested in one of the first discoveries of Neanderthal fossils. The remains painted a picture of a physical form very different from modern humans. When more specimens were unearthed, however, researchers realized that the previously found fossils were deformed as a result of arthritis and that Neanderthals in fact have a form and stature very similar to modern humans, though generally more robust.

By contrast, the Rising Star Cave group appears to represent a substantial sample of a more or less contemporaneous population, including individuals of different ages and sexes, as well as differing personal histories which would be reflected in their bones (e.g., the effects of accidents and diseases, variations in nutrition, etc.). This allows for a more complete understanding of the humans of that period, whose date is still uncertain.

Another intriguing aspect of the find arises from the setting in which the *Homo naledi* remains were found. The fossils were located 80 meters deep in a cave, making access both difficult and dangerous. Moreover, the specific chamber in which the bones were found is only accessible by a passage which at times is only about 20 centimeters (7.5 inches) wide. To that end, a specially selected team of six excavators, all women slender enough to fit through the gap, were engaged to conduct the two field seasons of investigation. The difficulty in reaching the chamber is illustrated in a NOVA/National Geographic video.

Based on the studies conducted to date, the Rising Star Cave group is already the most well documented early human population anywhere in the world. Their physical characteristics encompass a range of primitive and derived (advanced) traits. Their wrists, hands, legs, and feet appear more modern than those of the early hominin genus *Australopithecus*. By contrast, small brain size, curved fingers, and form of the shoulder, trunk, and hip joints are similar to those of the earlier genus. Their jaws and teeth have an intermediate appearance.

The researchers have concluded that this previously unknown combination of characteristics warrants

classification as a new species, an early member of the genus *Homo*, which they have named *Homo naledi*, "naledi" being the word for star in the local Sesotho language.

The age of the Rising Star Cave population has not yet been securely established. Fossil hominins are usually recovered buried in rock or sediment layers, the ages of which can be determined by a variety of methods, including radiometric dating and associated plant and animal fossils whose ages have previously been established. So far, there has not been the recovery of enough secondary material to use these methods reliably.

The small size of the *H. naledi* brain, between 465 and 560 cubic centimeters, roughly a third of that of modern humans, and other "primitive" characteristics are taken to indicate that these are very early members of the genus *Homo*. By comparison to other hominins, the researchers estimate that the age of this population dates back at least between 2.5 million and 2.8 million years. Geologists put the age of the cave at no more than 3 million years, thus placing the human remains within a span of about half a million years.

One criticism that has been raised of the research so far is that further efforts should have been made to determine the age of the fossils. Basing the age estimate on anatomy alone is questionable, given, for example, the small brain size and stature of the much more recent *Homo floresiensis*, the so-called hobbit from Indonesia, dated to as little as 12,000 years ago.

Despite their small brains, some characteristics of their hands and wrists suggest that, like other early members of *Homo*, they may have been toolmakers, though no tools have been reported from the cave. However, the curved fingers suggest that this population was not far removed from a tree-climbing existence.

The mosaic of anatomical characteristics exhibited by *Homo naledi* presents the opportunity to reassess the evolutionary status of many other, less well represented early hominin fossils. Potentially, specimens that possess traits which were previously thought sufficiently distinct to constitute separate species could now be seen as representing aspects of a single, evolving species with a wide range of variation. Chris Stringer, a researcher in human evolution at the Natural History Museum in London, states that he sees similarities to the early *Homo erectus* population of Dmanisi in the Republic of Georgia, dating to about 1.8 million years ago. Such a reassessment would bear on a fundamental question in human evolution.

In general, as species of plants and animals spread out over larger territories, they tend to evolve to adapt to local environments. Over time, this divergence often leads to the development of new, separate species. Uniquely, humans have increasingly used cultural (technology, etc.) rather than physical adaptation to cope with new environments, thus dampening the tendency to split into distinct species. The key question then is posed—how early did the use of cultural means of adaptation become a significant influence on the biological evolution of humans and what was the relative balance between the two at various times and places? The remains from Rising Star Cave may shed light on this question.

Another question arises—how did the *Homo naledi* individuals end up in this location? The chamber of the cave in which they were found is not only remote and difficult to reach, but has no natural light. The near-total absence of any fossils of other species is puzzling, tending to reduce the probability that natural processes were responsible for creating the accumulation of bones.

The researchers report that they entertained a range of possible scenarios regarding how this death assemblage was created. The one they ultimately propose is that the corpses, apparently complete at the time of deposition, were intentionally placed in this remote location by surviving members of the group. Such behavior suggests some sort of ritual meaning to this action, which would imply a level of abstract thought not previously associated with such early humans. It also implies the use of fire for light.

Modern humans during the Upper Paleolithic period in Europe intentionally penetrated deep into caves to create magnificent works of art. The placement of the art in such remote and relatively inaccessible settings must have had particular significance, reflecting a complex view of the world. The possibility that, more than 2 million years earlier, much earlier, less evolved humans were engaged in at least a rudimentary form of such behavior requires critical examination.

One alternate explanation is that there was once a much less difficult access route to the cave, which has subsequently been sealed. If so, disposal of the dead may have been a much simpler, "hygienic" measure. However, the researchers state that, after an extensive physical search and geological analysis, no evidence of any former entrances has been found.

Notwithstanding the issue of how the assemblage of bones was created, the Rising Star Cave discovery represents a major contribution to the study of human evolution, and demonstrates the importance of continued scientific research in this field.