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NUMBER 2

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BREATHING LIFE INTO FOSSILS:

Taphonomic Studies in Honor of C.K. (Bob) Brain

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Stone Age Institute Press · www.stoneageinstitute.org
1392 W. Dittemore Road · Gosport, IN 47433

COVER CAPTIONS AND CREDITS.

Front cover, clockwise from top left.

Top left:
Artist's reconstruction of the depositional context of Swartkrans Cave, South Africa, with a leopard consuming a hominid carcass in a tree outside the cave: bones would subsequently wash into the cave and be incorporated in the breccia deposits. © 1985 Jay H. Matternes.

Top right: The Swartkrans cave deposits in South Africa, where excavations have yielded many hominids and other animal fossils. ©1985 David L. Brill.

Bottom right: Reconstruction of a hominid being carried by a leopard. © 1985 Jay H. Matternes.

Bottom left: Photograph of a leopard mandible and the skull cap of a hominid from Swartkrans, with the leopard's canines juxtaposed with puncture marks likely produced by a leopard carrying its hominid prey. © 1985 David L. Brill.

Center: Photo of Bob Brain holding a cast of a spotted hyena skull signed by all of the taphonomy conference participants. © 2004 Kathy Schick, Stone Age Institute.

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Published by the Stone Age Institute.
ISBN-10: 0-9792-2761-5
ISBN-13: 978-0-9792-2761-5

CHAPTER 11

TAPHONOMY OF STERKFONTEIN *AUSTRALOPITHECUS* SKELETONS

RON J. CLARKE

ABSTRACT

The rarity of complete or partial skeletons of Plio-Pleistocene hominids in open-air sites is due to the scattering and breakage of bones by carnivores and scavengers. In caves, it is also due to those factors, plus the scattering and breakage caused by falling rocks and movement in a talus slope. At the Sterkfontein Cave site, however, there are two partial skeletons (Sts14 and StW431), consisting of torsos that appear to have resulted from feeding by a particular predator or scavenger. There is also a virtually complete skeleton that resulted from an individual falling into a shaft, being apparently mummified, and then sealed in by flowstone before the bones could be crushed and scattered by rock movement on the steep talus slope. This paper discusses the factors involved in the preservation and distribution of hominid skeletal remains at Sterkfontein, including those hominid remains less complete than these three skeletons.

INTRODUCTION

Under the right conditions it is possible for complete animal skeletons and even soft tissues and stomach contents to be preserved as fossils for millions of years as they were in the 50 million year old Eocene oil shale deposits of Messel, near Frankfurt, Germany (Schaal and Ziegler, 1992). Thus, theoretically, there is no reason why, with correct conditions for preservation, complete skeletons and soft tissues of early hominids should not somewhere have been preserved. However, except in the case of deliberate burials by Neanderthals and Cro-Magnons of relatively recent times, complete or partially complete skeletons of early hominids are very rare. Natural preservation of soft tissues has only occurred in very recent mummified bodies such as those from the Bronze Age in the Alps and the Incas in the Andes that were preserved by freezing or from the Iron Age of Denmark and England preserved in peat bogs (Bahn, 1996).

In the case of the Plio-Pleistocene sites that have yielded fossil remains of early hominids it is rare to find complete or partial skeletons. Although in East Africa the sedimentary conditions for preservation are good (volcanic deposits in ancient lake beds), most hominid skeletons were damaged and disturbed either before burial by predators and scavengers and/or after burial by water disturbance, erosion, weathering and animal trampling. Classic examples of such post-burial disturbance are the skeletons of "Lucy" and Olduvai Hominid 62.

The preservation conditions in the dolomite caves of South Africa, while very different to those of the East African lake beds, were affected by their own set of modifying factors. The degree of completeness of a fossil specimen at Sterkfontein Caves, be it cranial or post-cranial bone or whole or partial skeleton, is dependent upon the following factors:

1. Mode of introduction to the cave, for example, by big cat, hyena, porcupine, bird of prey, death trap or slope wash.
2. Position within the cave, such as under protective roof overhang, beneath open shaft, on talus slope which is subject to rock fall and displacement, in water, beneath stalactites, or on floors which might be subject to collapse into lower chambers.
3. Decalcification of cracked and crushed specimens that had been held together by the natural consolidant calcium carbonate.

4. Mode of recovery of fossils can also damage or separate parts of what was a more complete specimen. These recovery methods are dynamite blasting by the lime miners and palaeontologists, drilling and breaking of fossil-bearing rock, pick-axe and shovel in decalcified cave infill, chiselling away of breccia encasing fossil bones and acetic acid cleaning of cracked and crushed specimens.

As with much of the other fauna from the Sterkfontein caves, the *Australopithecus* specimens usually consist of either partial or almost complete cranial material or fragments of cranial and post-cranial material. There are only two partial skeletons, Sts 14 and StW 431 from member 4 (dating to between 2 and 3 million years ago) and one virtually complete skeleton, StW 573 from member 2 dated to at least 3.3 million years ago. It is of interest to examine these skeletons in order to determine whether there are any clues as to how the individuals came to be in the cave and why it is that all other hominid specimens are so fragmentary.

Australopithecus partial skeleton Sts 14

This individual is represented by nine thoracic vertebrae with some rib fragments, six lumbar vertebrae, a sacrum and both os coxae forming a virtually complete pelvis, superior shaft and neck of left femur, and a tibia fragment (Oakley et al., 1977). These elements, with the exception of the tibia and ribs are described by Robinson (1972) and the partial skeleton is illustrated in Howell (1965) and Reader (1981).

These bones were present in a relatively small block of breccia that according to Broom et al. (1950) "was blasted out on 1st August 1947." As it was Broom and Robinson who were blasting there at that time we can assume that they would have recovered any associated blocks from the blast. Unless other parts of the skeleton had been in adjacent breccia blasted out prior to 1939 by the lime miners we might also assume that the specimen Broom and Robinson recovered represented all that had been preserved of the individual in the cave. Broom et al. (1950) described only the right side of the pelvis (ilium, ischium and pubis) illustrating it from both lateral and medial sides. They also described and illustrated the left femur. Robinson (1972) referred to the right "innominate" having been separated from the block and that a "natural cast of the lateral face of the right innominate was intact in the block". He clearly meant the medial face of the innominate because one published photograph (Findlay, 1972) shows Broom holding the block with the lateral face of the right ilium exposed on the surface and the medial face still buried in the block. Two other photographs (Place, 1957) show the same view of the block in close-up and also John Robinson cleaning the ilium out of the block with the aid of hand-held tools. Robinson (1972) explained that because of the natural cast of the right "innominate" and "the fragmentary, damaged, and delicate appearance of the remaining pieces in the block," Broom decreed that no preparation was to be done on the block. Only after Broom's death did Robinson use acetic acid to extract the remaining parts of the pelvis, the vertebrae and ribs from the block.

Broom et al. (1950) mentioned part of a badly crushed skull being associated with the skeleton. This specimen must have been Sts 13 recovered on 29th July 1947 (i.e., two days before the pelvis) and consisting of an elderly adult partial face with most of right dentition and part of left dentition. Unfortunately the specimen was never described and is listed as missing by Oakley et al. (1977). It would anyway have been impossible to demonstrate that such a crushed partial maxilla belonged with the Sts 14 partial skeleton even had it been found in the same block. Firstly, there are many other adult *Australopithecus* cranial fossils in the surrounding member 4 breccia and any of them could potentially have come from the same individual as Sts 14. Secondly, as so much of the Sts 14 individual is missing (cervical vertebrae, shoulder girdle, arms, hands, feet and both legs apart from the proximal femur fragment and tibia fragment) there is no reason to suppose that the torso had an associated skull when it reached its final resting place in the cave.

The big question concerns what happened to those missing parts and how is it that just the central part of the body is intact? Theoretically the lime-mining of the 1930s could have removed those missing portions but, if so, then at least some parts should have been found during our processing of the lime miners breccia dumps. Many hominid fragments have been discovered during that processing and I found that some of them fitted with specimens recovered by Broom (Clarke, 1990). One of the most important of such associations occurred on 29th of August 2002 when I identified a hominid tooth just cleaned out of breccia from the miners dump (D18) as being the missing left upper third molar from Broom's 17 August 1936 discovery of the first *Australopithecus* adult cranium TM1511. It then occurred to me that if there was one tooth from the dump, perhaps there had been others and so on 2nd September I checked our collection of fossil hominids from D18 and identified the missing right upper third premolar that had been recovered on 24 March 1981 and catalogued as StW 91 (Figure 1). Although we have a large amount of the dump still to process it seems most probable that, had there been any other parts of skeleton belonging to Sts 14 we should by now have found at least one bone and we have not. Thus I am drawn to the conclusion that possibly the fact that mainly the spinal column, pelvis, and an attached partial limb-bone are preserved in Sts 14 suggests the action of a particular predator or scavenger. Support for such a conclusion comes from another partial skeleton of *Australopithecus*, StW 431 which will now be discussed.

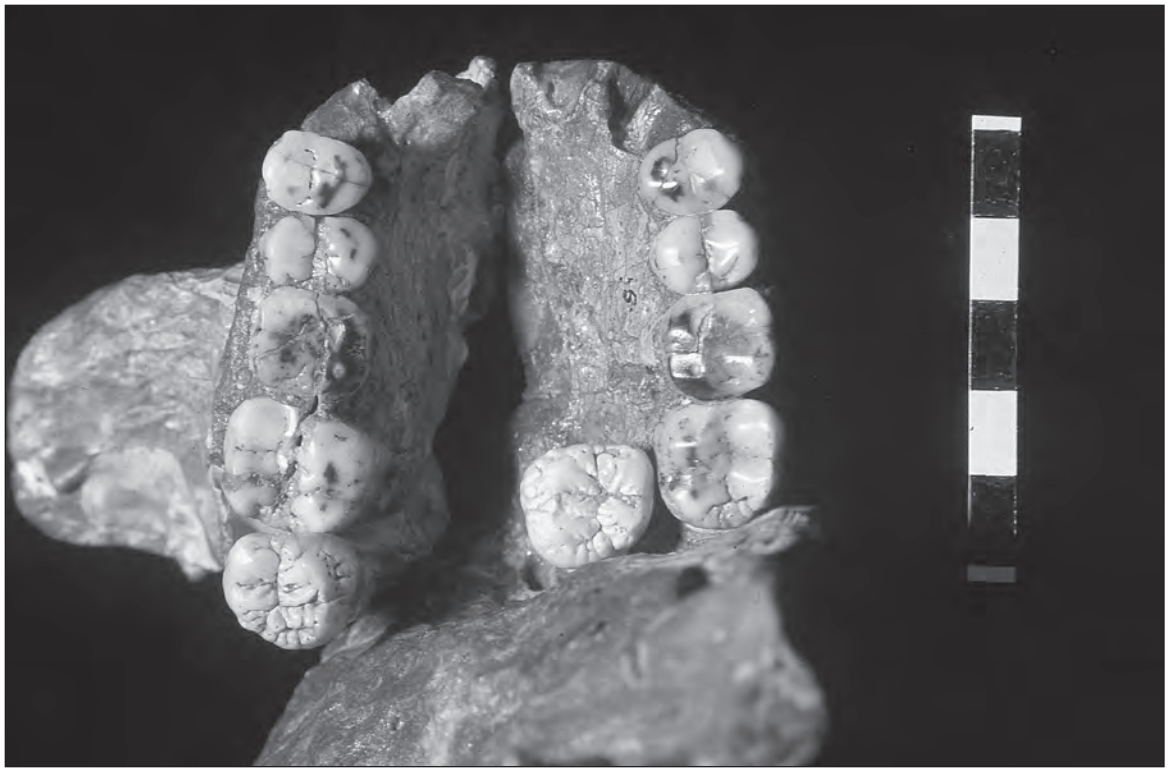

Figure 1. A left upper third molar set on the lingual side of the maxillary toothrow of TM1511 is clearly the antimere of TM1511's right upper third molar, as discovered and identified by the author in breccia from a lime miners dump. He also identified the right upper third premolar from that dump.

Australopithecus Partial Skeleton StW 431

This individual is represented by nine consecutive thoracic and lumbar vertebrae, sacrum that joins to left and right incomplete os coxae, one right rib fragment, partial right scapula, partial right clavicle, distal half of right humerus and the articulating proximal halves of right radius and ulna (Toussaint et al., 2003, Kibii and Clarke, 2003) (Figure 2). These fossils were recovered close together during excavation of an area of decalcified Member 4 breccia by A. R. Hughes in February and March 1987.

As with Sts 14, the specimen consists largely of the pelvis and spinal column (minus the cervical vertebrae) and parts of one limb. Again the question arises as to what happened to the skull and other missing parts of the skeleton. In this case all the surrounding areas of decalcified breccia were excavated and sieved by Hughes and his excavation team. Thus, if there had been other parts they should have been recovered. Job Kibii analysed all of the faunal remains from the excavated decalcified Member 4 area and did recover a crucial fragment of the ilium that provided a link with the sacrum. This piece had previously been misidentified as bovid. A subsequent thorough search by Kibii and Clarke of all the bags of bone fragments from that area resulted in the recovery of four more small but important fragments of the pelvis (Kibii and Clarke, 2003). If there had been other

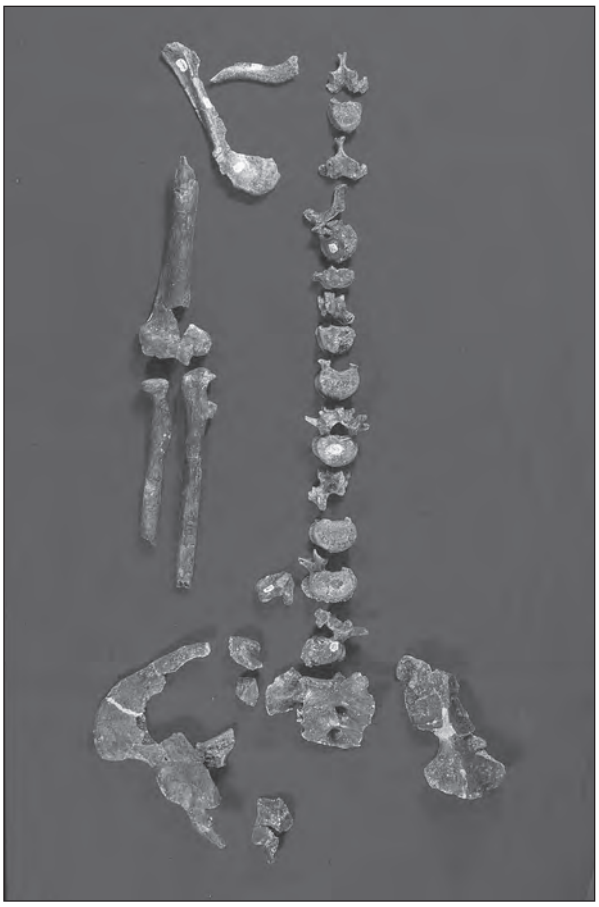

Figure 2. StW431, a partial Australopithecus *skeleton from Sterkfontein Member 4.*

substantial elements of the same skeleton present they would have been identified by Kibii during his detailed analysis. He did indeed identify eleven other hominid post-cranial fossils of different individuals from various parts of the Hughes excavation (Tobias et al., 2003).

Thus the fact that the preserved skeletal portion of the StW 431 individual follows a similar pattern to that of the Sts 14 individual suggests that both could have been subjected to the same kind of predation or scavenging that left only the thoraco-lumbar vertebrae and pelvis with remnants of ribs and of one limb.

Other Sterkfontein *Australopithecus* pelvic and vertebral fossils

It is of interest to note that from 68 years of fossil recovery and excavation of the Sterkfontein member 4 breccia and out of a substantial collection of hominid post-cranial fossils, only two other catalogued pelvic fossils and three catalogued vertebral fossils have been recovered. These are Sts 65 right ilium associated with a vertebral fragment (Robinson, 1972), StW 611 left ischium found by Job Kibii (Tobias et al., 2003), Sts 73 thoracic vertebra (Robinson, 1972) and StW 8 four lumbar vertebrae conjoined with StW 41 two thoracic vertebrae (Tobias, 1973) (Figure 3). These conjoining vertebrae are of significance because they suggest that they could have been part of a torso similar to that of Sts 14 and StW 431. The four lumbar vertebrae (StW8) were identified by P.V. Tobias in November 1969 in a display cabinet in the Sterkfontein tea room, and the two thoracic vertebrae (StW 41) were cleaned out of breccia from the limeminers' Dump 18 on 10th of January, 1975. Thus there is a strong possibility that other parts of the same skeleton were blasted out by the lime miners and taken or sold as souvenirs. Although the ilium of Sts 65 could potentially have belonged with these vertebrae there is a size difference suggesting that they are probably from two different individuals. The StW 8 lumbar vertebrae are considerably larger than those of Sts 14 whereas the Sts 65 ilium is of similar size to Sts 14. The Sts 73 thoracic vertebra is however of similar size to the StW 41 thoracic vertebrae and therefore could possibly have come from the same individual.

Figure 3. The conjoining hominid thoracic (StW 41) and lumbar (StW 8) vertebral series from Sterkfontein Member 4.

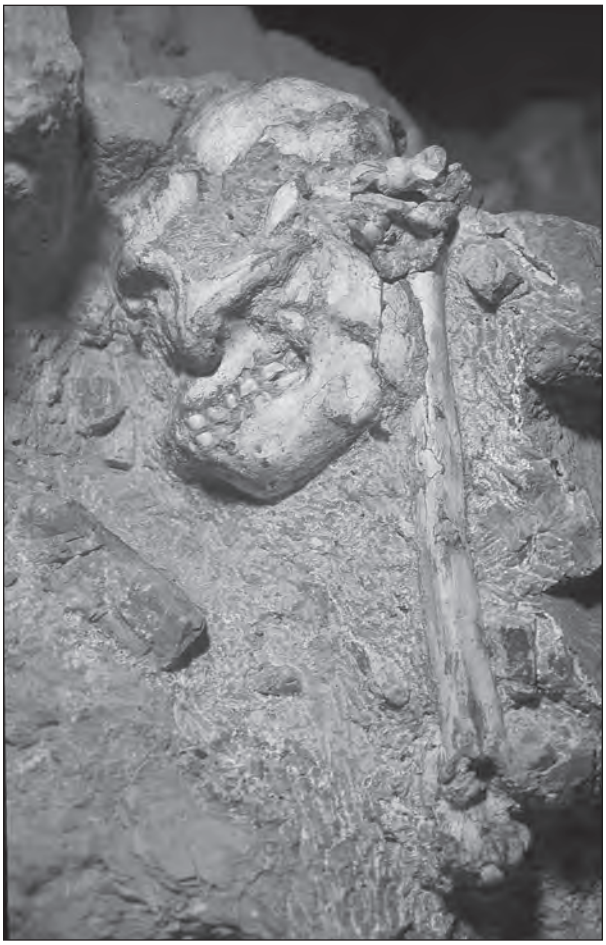

Figure 4. The skull and left humerus of StW 573, a complete Australopithecus *skeleton from Sterkfontein Member 2.*

Australopithecus complete skeleton StW 573

This individual is represented by virtually a whole skeleton including the skull, currently being excavated

from the Member 2 breccia within the Silberberg grotto (Clarke, 1998, 1999, 2002) (Figure 4). Its significance lies in the following factors: 1) it is complete apart from most of the foot bones that were blasted away by lime miners and were never recovered. No other such complete skeleton of *Australopithecus* has ever been found. 2) it has an age of at least 3.3 million years old. (Partridge et al., 1999) and has also been dated by another method to *c*. 4 million years old (Partridge et a., 2003). It is thus the oldest *Australopithecus* in South Africa. 3) its total anatomy is revealing information for the first time about a complete *Australopithecus* individual including stature, limb ratios and clues to its mode of locomotion. 4) it provides for the first time an opportunity to analyse the taphonomic history of a complete *Australopithecus* skeleton.

The fact that the skeleton is complete and does not show any signs of carnivore damage rules out carnivore as the agent of accumulation. The location of the skeleton near the base of a steep talus cone suggests that it was probably an individual that either fell into a shaft by accident or climbed in but was unable to climb out. The pose of the skeleton with left leg crossed over right and one arm stretched above its head is suggestive of a body that rolled down the talus slope. The skull is intact with the mandible still in its closed position and the other skeletal elements are generally in correct anatomical relationship to each other. The left hand is particularly informative as it is not only complete but is clenched with the thumb across the palm (Figure 5). This indicates that the body possibly mummified in dry conditions in the cave and that the mummified skin and tendons held the bones in their correct anatomical relationships. It seems that the corpse was not accessed by dermestid beetles because, had they cleaned the flesh from the bones, then many of the skeletal parts, especially the hand bones, would have been disarticulated and scattered on the stony talus slope.

Following the mummification during a dry phase there was a change in climate to wet conditions. This resulted in water removing sediment beneath part of the surface of the talus slope and forming a cavity into which the infill supporting the mid-section of the skeleton collapsed. This collapse had the effect of wrenching the left humerus away from the forearm at the elbow joint and breaking the femurs in mid-shaft. The disturbance caused to the central part of the skeleton by this collapse in the rock-filled matrix also resulted in breaking and scattering of ribs and of the right forearm, wrist and hand as well as crushing and partial disintegration of the pelvis. Some of this disruption could also have been exacerbated by the water still partially flowing through that collapsed area. Following this there was the build-up of a massive stalagmite within the cavern and part of it consisted of a thick flowstone that covered the Member 2 talus slope and sealed in the upper part of the skeleton down to the broken ends of the upper femur shafts. At this point the flowstone filled the cavity beneath the

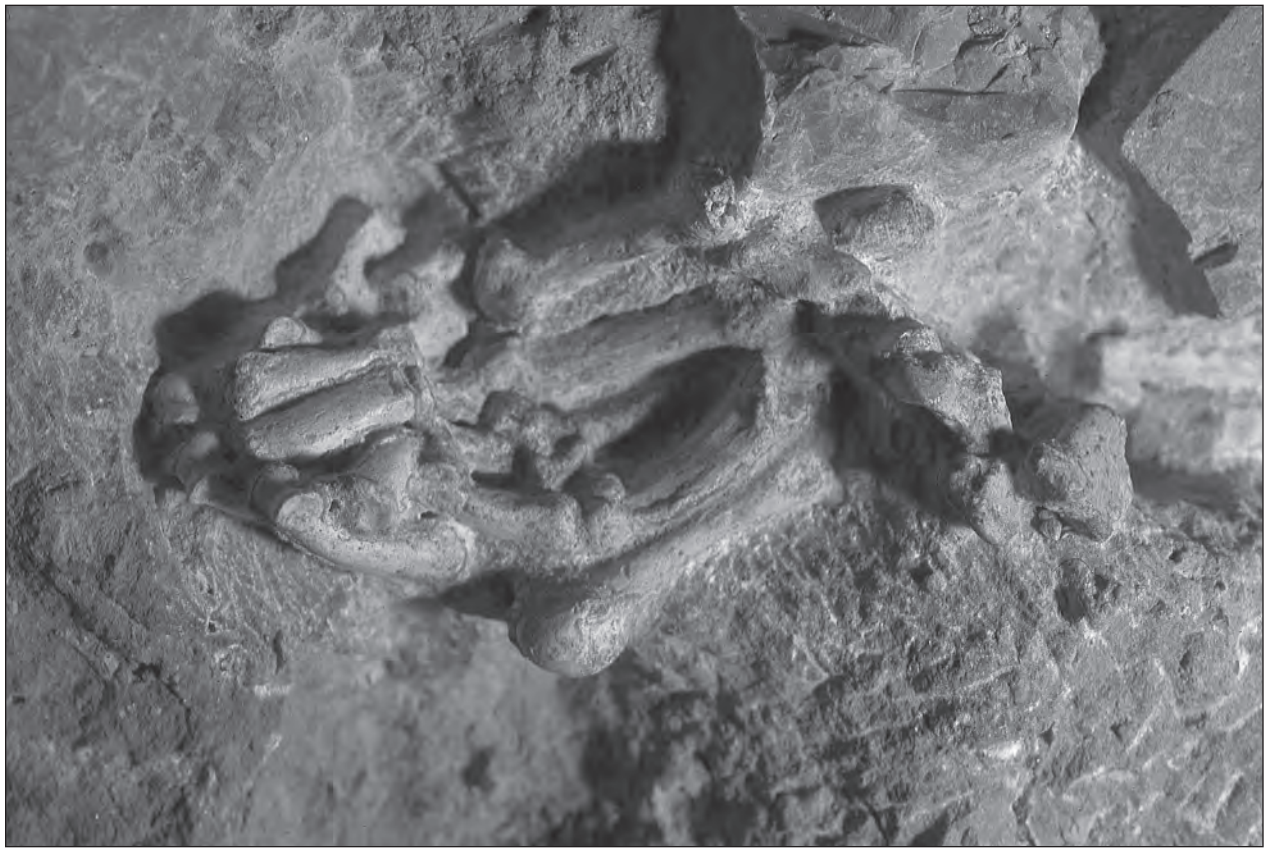

Figure 5. View of the left hand bones of StW 573.

lower femurs, tibiae, fibulae and feet.

Thus one can see in this one individual skeleton three different conditions of preservation resulting from different post-depositional influences. Firstly, there is the intact preservation of the left hand skeleton as a consequence of apparent mummification followed by burial with no disturbance. Secondly, there is the broken up nature and fragmentation of the central part of the skeleton and right arm due to collapse into a cavity. Thirdly, there is the crushing and disintegration of parts of the pelvis due to rock fall and pressure and possibly to the water action from the flow beneath the talus surface.

One can thus see that in a talus deposit within dolomite caves a complete skeleton could be broken, fragmented and scattered by rock-fall, collapse, water-flow and filtering of small elements through holes in the talus slope. However, if the skeleton of StW 573, was to be subjected to decalcification there would still remain some substantial identifiable post-cranial and cranial portions and the end result would be very different to that of the decalcified StW 431 or the breccia-encased Sts 14. Those two cases do appear to have resulted from predation or scavenging in which the skull, cervical vertebrae, most of the limb bones, hands and feet were separated from the torso before it reached its final resting place in the talus slope. There are no signs of carnivore gnawing on any of the elements of these torsos but there are definite carnivore gnaw marks on several of the isolated limb bones from other parts of the member 4 talus deposit. One very good example is that of the heavily gnawed distal right humerus StW 339 which was recovered from an adjacent square, just above the right radius shaft StW 348 and right ulna shaft StW 349. These two bones both display apparent carnivore tooth crushing on their proximal and distal ends and I consider them to belong to the same individual as StW 339 humerus. As a unit this mid portion of arm contrasts markedly with the StW 431 mid portion of right arm which displays no carnivore marks (Figure 6).

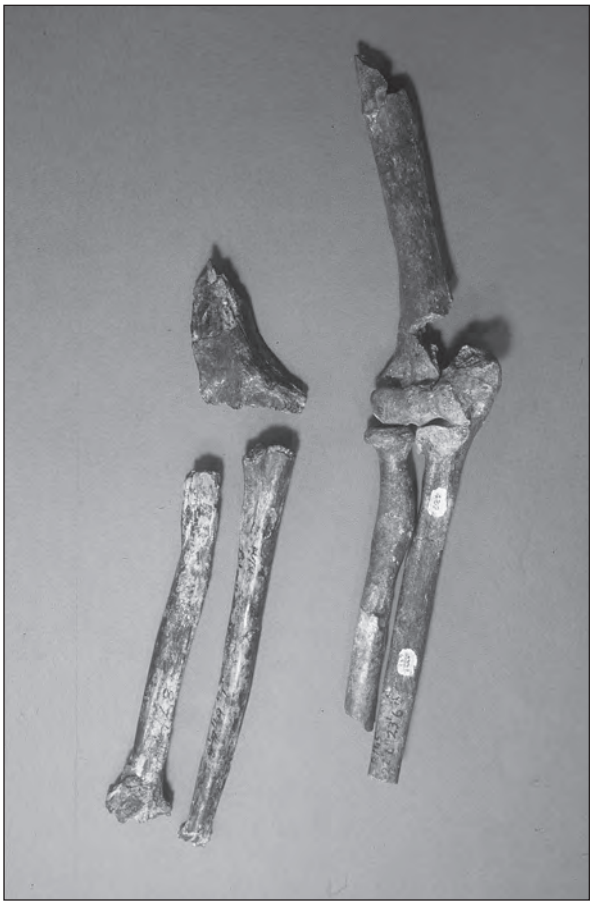

Figure 6. Comparison of a hominid forelimb set heavily gnawed by carnivores at the elbow joint (note the missing distal end of humerus StW 339 and damage to proximal ends of radius StW 348 and ulna StW 349; left side of photograph) and an undamaged forelimb from the partial Australopithecus *skeleton StW 431 (right).*

Summary

From the complete articulated skeleton and skull of StW 573 it is apparent that it was an individual that fell into the cave, was not attacked by carnivores or fed upon by scavengers, was apparently mummified and buried before the bones could be scattered. The cranial fossils from a large number of *Australopithecus* individuals in the Member 4 breccia suggest that there should also have been, in the vicinity, an equally large number of *Australopithecus* skeletons. Yet only two partial skeletons have been recovered and they have no associated cranial fossils. These two torsos seem to be what was left after the individuals had been fed upon by a particular type of carnivore or scavenger that had removed the skull, cervical vertebrae and most of the limbs.

The postcranial bones from the other *Australopithecus* individuals represented by skulls could have been broken up and scattered by predators, scavengers, rock-fall and filtering of the fragments through the talus cone. Indications of all these taphonomic agents are shown by the condition of the bones and the widespread distribution of elements assigned to single individuals within the Member 4 talus.

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