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New Neanderthal remains associated with the ‘Flower Burial’ at Shanidar Cave, Iraqi Kurdistan

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Shanidar Cave in Iraqi Kurdistan became an iconic Palaeolithic site after Ralph Solecki’s discoveries in 1951-1960 of 10 Neanderthals, some of whom he argued had died in rockfalls and others—controversially—buried with formal burial rites, including one with flowers. New excavations began in 2015. In 2018 the team discovered the articulated upper body of an adult Neanderthal near to the ‘Flower Burial’ location, dating to 70–60 thousand years ago. Stratigraphic evidence suggests that it was a deliberate burial. The new find is the first articulated Neanderthal discovered for some 35 years, so of considerable potential importance for Neanderthal studies.

[Map provided by *Antiquity*]

Introduction

Shanidar Cave (Figure 1a) is a large south-facing karstic cave in the foothills of the Baradost Mountains, at c.750 metres above sea level. In four campaigns between 1951 and 1960 Ralph Solecki dug a c.20 m long × 6 m wide trench orientated approximately north/south in the centre of the cave floor. At its deepest the trench reached 14 m below the ground surface (Figure 1b). Below Epipalaeolithic and Upper Palaeolithic ('Baradostian') occupation levels, he discovered at 4-7 m depth the skeletal remains of 10 Neanderthal men, women and children (Trinkaus 1983; Cowgill *et al.* 2007), a unique assemblage that has given the site iconic status in Neanderthal archaeology (Solecki 1955, 1960, 1961, 1963, 1971). Solecki argued that some of the Neanderthals had been killed by rocks falling from the cave roof but that others had been buried with formal burial rites, including Shanidar 4, the famous 'Flower Burial', so-called because clumps of pollen grains from adjacent sediments were interpreted as evidence for flowers being placed intentionally with the corpse (Leroi-Gourhan 1975; Solecki 1975).

[Figure 1 about here]

Though doubt was later cast on the 'Flower Burial' hypothesis (Gargett 1999; Sommer 1999), the Shanidar Neanderthals have played a central role in shaping our understanding of Neanderthal biology and behaviour. The injured and disabled Shanidar 1 suggests care for group members (Stewart 1977; Trinkaus 1983; Trinkaus & Villotte 2017), while the puncture wound to Shanidar 3's ribs suggests interpersonal violence (Stewart 1969; Trinkaus 1983; Churchill *et al.* 2009). The assemblage continues to feature strongly in debates over Neanderthal mortuary activity and the evolutionary origins of intentional burial (e.g., Gargett 1989, 1999; Smirnov 1989; Riel-Salvatore & Clark 2001; Pettitt 2002, 2011; Vandermeersch *et al.* 2008), as well as Pleistocene hominin behaviour, diet and morphology (Henry *et al.* 2011; Saers *et al.* 2017; García-Martínez *et al.* 2018; Power *et al.* 2018). Recent evidence for interbreeding between Neanderthals and modern humans (Green *et al.* 2010; Prüfer *et al.* 2017; Fu *et al.* 2015), and the likelihood that this occurred in southwest Asia (Kuhlwilm *et al.* 2016), bring new relevance to the archaeology of Shanidar Cave.

When the Shanidar 4 remains were discovered in 1960, the decision was taken to remove them in a sediment block measuring c. 1 m² and 50 cm deep encased in wood and

plaster, which was transported to the Baghdad Museum for excavation (Solecki 1971; Stewart 1977). On excavation in 1962, it became evident that at least three adults were represented in the block (Shanidar 4, 6 and 8), as well as the vertebrae of an infant, Shanidar 9 (Stewart 1977; Trinkaus 1983). Because of disturbance during the block's transport from Shanidar to Baghdad (on a taxi roof! [Stewart 1977: 155]), the precise stratigraphic relationships between the individuals are unknown. However, it is clear that Shanidar 4 was the uppermost in a cluster that suggests either that multiple individuals died and/or were buried in the same place, or that Neanderthals returned to almost exactly the same spot to deposit multiple individuals (Solecki 1971, 1972; Stewart 1977). Either scenario would offer important, indeed unique, evidence for the complexity of Neanderthal mortuary activity, but the detailed relationships between the individuals, and evidence for whether or not they were intentionally buried, have been lacking.

The new excavations

In 2014, at the invitation of the Kurdish Regional Government in Iraq, GB, COH, and TR established a project to conduct the first excavations at Shanidar Cave since 1960. The 2014 fieldwork was curtailed by the ISIS threat to Kurdistan and excavations began in 2015, opening up the eastern side of the Solecki trench where he had found most of the Neanderthals (Figures 1b and 2). The objective was to conduct detailed work at the trench margins in order to place Solecki's findings in a robust chronological, palaeoclimatic, palaeoecological and cultural framework using the full range of archaeological science techniques not available to him. Though we did not expect to find further remains of the Solecki Neanderthals, we needed to establish their likely locations in order to date the sediments in which they were found, because their age could not be established by him beyond a *terminus ante quem* ¹⁴C date for the upper remains (Shanidar 1, 3 and 5) of around 50,000–45,000 years ago, the then maximum age range of the ¹⁴C method. Surprisingly, in 2015 and 2016 we found several Neanderthal bones including part of an articulated leg at c.5 m depth that from archive photographs and morphological comparisons can be ascribed to Shanidar 5, a male estimated to be 40–50 years old (Reynolds *et al.* 2015; Pomeroy *et al.* 2017). Initial ¹⁴C and OSL dates from the University of Oxford indicate that this and the other upper Neanderthal remains (Shanidar 1 and 3) date to c.55,000–45,000 years ago.

[Figure 2 about here]

The new Neanderthal skeletal remains

In 2017 we exposed and cleaned the upper part of the eastern face of Solecki's Deep Sounding and at a depth of c. 7 m observed two sets of truncated ribs separated by a thin layer of sediment, the neural arch of a lumbar vertebra, and the distal ends of metacarpals associated with several intermediate and distal phalanges belonging to a single clenched right hand. These remains appeared to represent two separate individuals, all within a stratigraphically-distinct curved-base scoop or depression and overlain by two large rocks (Figure 3 and 4a-b). Except for the lumbar vertebra, the skeletal remains showed anatomical congruence indicating *in situ* articulated hominin remains. They lay at an almost identical level to, and just to the east of, the Shanidar 4 remains (Figure 4c), and small pockets of white powdery deposit in the adjacent backfill are likely to be remains of the plaster used to encase the Shanidar 4 sediment block (e.g., Constable 1973). In cutting around the block, T. Dale Stewart, the palaeoanthropologist on Solecki's project, recalled that additional hominin remains were dislodged that clearly did not belong to Shanidar 4 (Stewart 1977) and Solecki (1971: 243-4) recalled that some bones were visible in the east section after the removal of the block, although he expressed doubt as to whether they were hominin and if so, part of the Shanidar 4, 6, 8 and 9 group. The new *in situ* remains are presumably part of the same individual(s), given their proximity to and truncation by the removal of the Shanidar 4 block. Compact unexcavated sediments c.25 cm below the new hominin remains that extend westwards from the section would be consistent with the bottom of the ledge left by the removal of the Shanidar 4 block in 1960 (see Figure 4). The newly exposed bones were protected with sandbags at the end of the 2017 season but given signs of disturbance to the section above them the following year, the decision was taken to cut the section back and excavate them in plan.

[Figures 3 and 4 about here]

Removal of the overlying sediment first exposed a compacted dark brown layer containing charcoal, occasional lithics, and splintered animal bone, presumably an occupation horizon (Figures 4a and 4b). It dipped steeply to the south, and was overlaid by a shattered

slab of rock. The rock and the presumed occupation deposits below it were deformed by the impact of large rocks falling from the cave roof, resulting in some of the animal bone splinters lying vertically alongside and among the rock fall. Above this rock fall was a partly breccia-filled void (Figure 4) created between a large vertical slab of roof collapse that was *in situ* before the deposition of the hominin remains (which abut this slab) and subsequent substantial roof collapse. The skeletal remains on the northern side of the depression were capped by two stones, one on top of the other (Figure 4a and b). These stones are anomalous within the extent of the excavated area at this level, which otherwise is composed only of sand-sized or smaller sediments, laid down by low-energy wash-processes or by anthropogenically-mediated processes in occupation floors. The upper stone overlying the remains can be identified as the same distinctively-shaped triangular stone visible in a 1960 photograph behind T. Dale Stewart's hand to the east of the *in situ* Shanidar 4 remains (Figure 4c), confirming the adjacency of the new remains to Shanidar 4. The hominin remains lay within the same sedimentary unit as the triangular stone, which was horizontally oriented. This contrasts with the vertically-oriented rocks higher in the stratigraphy that appear to have resulted from cave roof collapse (Figure 3 and 4a-b). The unit containing the hominin remains was paler than that above it, and also contains animal bone, lithics and charcoal.

The uppermost remains consisted of a relatively complete but extremely fragmented skull, squashed almost completely flat (Figure 5). The triangular stone lay to the north of the skull and did not overlap any cranial bones by more than a few millimetres, although it did lie above some of the ribs, suggesting that it was originally located behind the skull. The skull lay on its left side, facing to the south with its mouth open. The thickness of the orbital margin and receding chin are consistent with its identification as a Neanderthal. The relatively worn tooth crowns suggest a middle- to older aged adult (more detailed analyses are underway). The left hand was directly below the skull: the wrist was tightly flexed and the forearm lay horizontally in an east-west orientation (Figure 6). The left fingers were flexed, but less tightly than the right, with the metacarpo-phalangeal joints extended. The right shoulder (acromion process of the scapula and shadow of a very poorly preserved proximal humerus) was almost adjacent to the triangular stone, while the left shoulder was at the same level as the right, lying to the east and slightly to the south. The right humerus was truncated by Solecki's excavation, preserving only the proximal quarter to third of the bone, but the position and orientation of the right humerus and relative position of the right hand are consistent with a

horizontal orientation of the right arm, which must have been tightly flexed at the elbow. The right hand was visible in the section to the south west of the skull, and excavation in plan confirmed that the fingers were tightly flexed. The left first and second ribs and left clavicle were identified between the shoulders and close to the left metacarpals. A single lithic artefact was located within the curvature of the first left rib, near to the rib neck but not in contact with the rib surface (Figure 7). This piece is a distal chert blade-flake fragment that had been transversely snapped and displays some evidence of edge damage/use. Even within the overlying occupational layer, lithics of this size are very infrequent finds, and within the deposits containing the hominin bones, this is one of only two substantial lithics to date. Its rarity may support an interpretation of this lithic as having a greater significance other than being a chance inclusion in the surrounding sediments, although clearly additional evidence would be needed to make any firm inferences.

[Figures 5, 6 and 7 about here]

All bones were in anatomical position, with only slight displacement of some bones, for example at the carpo-metacarpal joints of the left wrist. The bone itself was poorly mineralised, highly fragile and often friable. Multiple (3-4) coats of a ~20% solution of Paraloid B72 in acetone were applied to consolidate the bone, which was then lifted in small blocks (typically 50-100 mm diameter, 10-20 mm thickness) with the surrounding sediment. Because of time constraints, the first and second left ribs and all remains below that level, including the possible second individual observed in section in 2016 and 2017 (Figure 4), had to be left *in situ* for future excavation.

Although the skeleton is only partially excavated, we can offer some initial interpretations of body position. It was probably placed on its back with the shoulders and head raised, and the head resting on its left side on top of the left hand (Figure 8). The triangular stone would have been behind the head and right shoulder. The shoulders lay approximately level with one another and both arms were flexed at the elbow, with the left arm crossing the body and the right projecting laterally. The left wrist was tightly flexed while the right was probably not, given the position of the right proximal humerus. We do not know the position of the lower limbs, but they were probably flexed given the proximity of the vertical slab to the south. The right elbow and potentially other parts extended underneath,

or extremely close to, the body of Shanidar 4. The position of the body contrasts with that of Shanidar 4, which was in a foetal position on its left side.

[Figure 8 about here]

The limited extent of the excavation and tight space within which the excavation had to take place did not allow us to delimit in plan the sides or base of the depression or scoop in which the remains (and the possible lower individual) are located. Nor could we gain a view of the depression or scoop in section from another angle, which might have helped clarify the natural or anthropogenic origin of the feature containing the bones. However, its anthropogenic agency is strongly suggested both by the stratigraphic observations in 2016/2017 (Figure 4) and the micromorphology of a sediment block cut across the 'scoop' boundary (Figure 9). This shows two hominin rib fragments, in cross section, lying on a very abrupt truncation contact marked by an irregular planar void between two main sediment types. According to the macro-stratigraphy, these sediments relate to the geomorphological cave deposits underlying the cut feature and the deposits in-filling the cut feature. The fill deposits likely relate to the same event as the body placement, and there is no evidence for the accumulation of fluvial or colluvial material that may be expected in a natural channel. The deposits underlying the cut feature are predominately well-sorted silts and clays which appear to be compacted just below the base of the cut (again consistent with an anthropogenic cut rather than a natural channel), and exhibit discontinuous fine bedding suggestive of localised, low energy erosive inputs. The sediment overlying the rib fragments is a homogenous dark brown silt containing amorphous sesquioxide-replaced plant tissue fragments and phosphatic (red-brown) material infilling the pore spaces. The plant tissue fragments are clearly of great interest given previous discussions of plant matter associated with Shanidar 4 (Solecki, 1971, 1975; Leroi-Gourhan, 1975), so in-depth analyses to identify the plant material, including any pollen that may be present, are underway. The cementing phosphatic material may relate in part to *in situ* diagenesis of human bone and soft tissue, though some is probably derived from sources such as guano and animal bone, both of which seem to be significant components of this part of the cave fill. Bedforms and structures characteristic of mass flow, aeolian and fluvial sedimentary processes (e.g. grain size sorting,

fabric and bedding structures) are absent, which could imply a singular rapid-deposition event difficult to ascribe to natural processes.

[Figure 9 about here]

This evidence, in conjunction with the macroscopic stratigraphic observations, the articulated nature of the remains, and the presence of multiple individuals within a small horizontally and vertically confined space, combine in our view to make a strong case for deliberate burial in a cut feature. In addition, the sedimentary association of the triangular rock with the bones and the rock's morphological and locational distinctiveness compared with other rocks resulting from rock fall in adjacent parts of the stratigraphy could suggest that deliberate placement at the time of the burial is a distinct possibility. It is unlikely that the cluster represents a group of individuals who died from exposure, or from rock fall from the fault in the cave roof above. Solecki (1971, 1972) argued that several Shanidar Neanderthals were killed by rock fall (although notably not the Shanidar 4/6/8/9 group, which he considered burials). However, the 4/6/8/9 cluster and newly-discovered remains were deposited in a climatically warm period, based on the palynological and sedimentological evidence, making deaths from exposure unlikely. Rockfall events are associated with colder periods, and are absent in these layers. Finally, the completeness and articulated nature of the remains would argue against natural deaths that left the bodies exposed (and susceptible to scavengers) for any period of time.

The age of samples taken for OSL dating from immediately below the depression and from stratigraphically equivalent layers 1.5 m to the north is still being assessed in the light of extensive background radiation measurements taken in 2018, but the preliminary indications are that the new skeletal remains—and probably the burial stack with which they are associated—date to between 70,000 and 60,000 years ago.

The relationship between the new remains and the known Shanidar Neanderthals

After they were excavated in the Baghdad Museum in 1962, Shanidar 4 was assessed as a male and the two smaller adult individuals were designated as females (Stewart 1977; Trinkaus 1983). Bones that could not belong to Shanidar 4, because they duplicated existing

elements or were incompatible in size, were attributed to Shanidar 6, and any further duplicated adult skeletal elements were assigned to Shanidar 8 (Figure 10). Clearly the new remains cannot belong to Shanidar 9 based on age at death. It is likely that they belong to one of the other two adults found with Shanidar 4, given the close proximity between the new and old remains, and the fact that the new individual must have been truncated in the removal of the sediment block. Although the new finds duplicate some of the Shanidar 6 elements, Shanidar 6 and 8 are essentially collections of additional adult skeletal elements that could not have belonged to Shanidar 4 (Trinkaus 1983) rather than representing discrete, coherent individuals. These finds clearly need to be re-assessed alongside the new remains to try to distinguish correctly the two (or potentially more) individuals they collectively represent. The only parts of Shanidar 6 observed *in situ* by T. Dale Stewart on excavation in 1962 were the right 4th and 5th metatarsals, which were near the centre of the sediment block (as viewed in plan), the distal part of the left fibula, and part of the right fibula, which lay to the south (Stewart 1977). It is therefore plausible that the lower legs and feet, as well as other elements, currently attributed to Shanidar 6, actually belong to the new individual.

Conclusion

The discovery of new articulated Neanderthal remains directly adjacent to the Shanidar 4 'Flower Burial' offers a rare opportunity to investigate Neanderthal mortuary activity with the full range of modern archaeological techniques. Debates continue around whether Neanderthals intentionally buried their dead and, if they did, how their mortuary activity varied spatially and geographically. These ongoing debates necessarily rely heavily on re-evaluating older excavations conducted at a time when standards of excavation, sedimentary analysis and documentation differed from those today. The new *in situ* articulated Neanderthal remains from Shanidar Cave reported here, in combination with their stratigraphic contexts, provide strong evidence for the deliberate burial of this individual. They also offer an unparalleled opportunity to reassess the relationships between the individuals represented by the Shanidar 4, 6, 8 and 9 remains, and to consider whether this unique assemblage represents evidence of contemporary burial activity or of Neanderthals returning to the same place over time to deposit their dead. An array of analyses of the new Neanderthal remains and of the sediments in which they are located is underway or planned

to investigate the morphology, diet, health and genetic relationships of this unique collection of Neanderthal remains.

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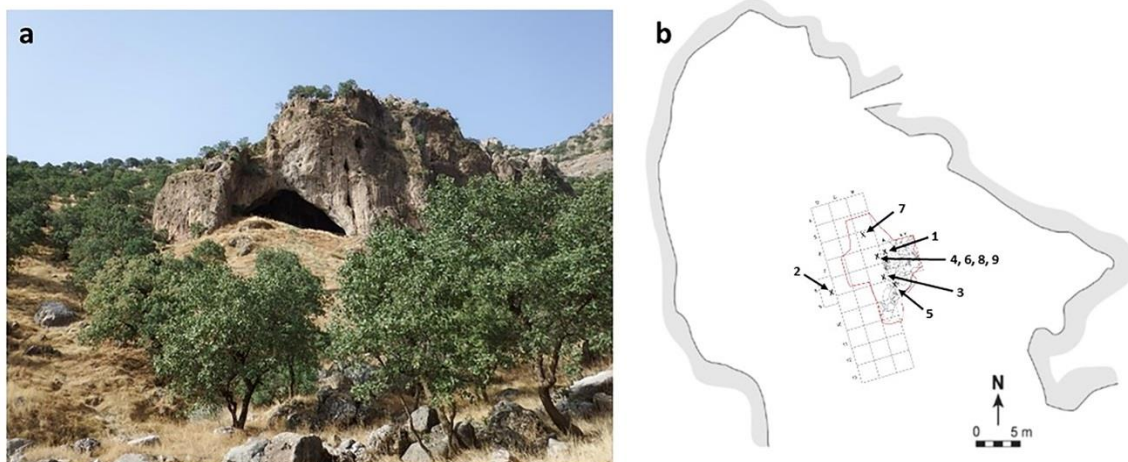
Figure captions

Figure 1. Shanidar Cave as viewed from the south (a), and plan of Ralph Solecki's excavations at Shanidar Cave (b), showing Ralph Solecki's trench (black grid), the locations of the Neanderthal skeletons he discovered (numbered), and the area of the new excavations undertaken since 2015 (red outline) (photograph by Graeme Barker, illustration by Ralph Solecki and Ross Lane).

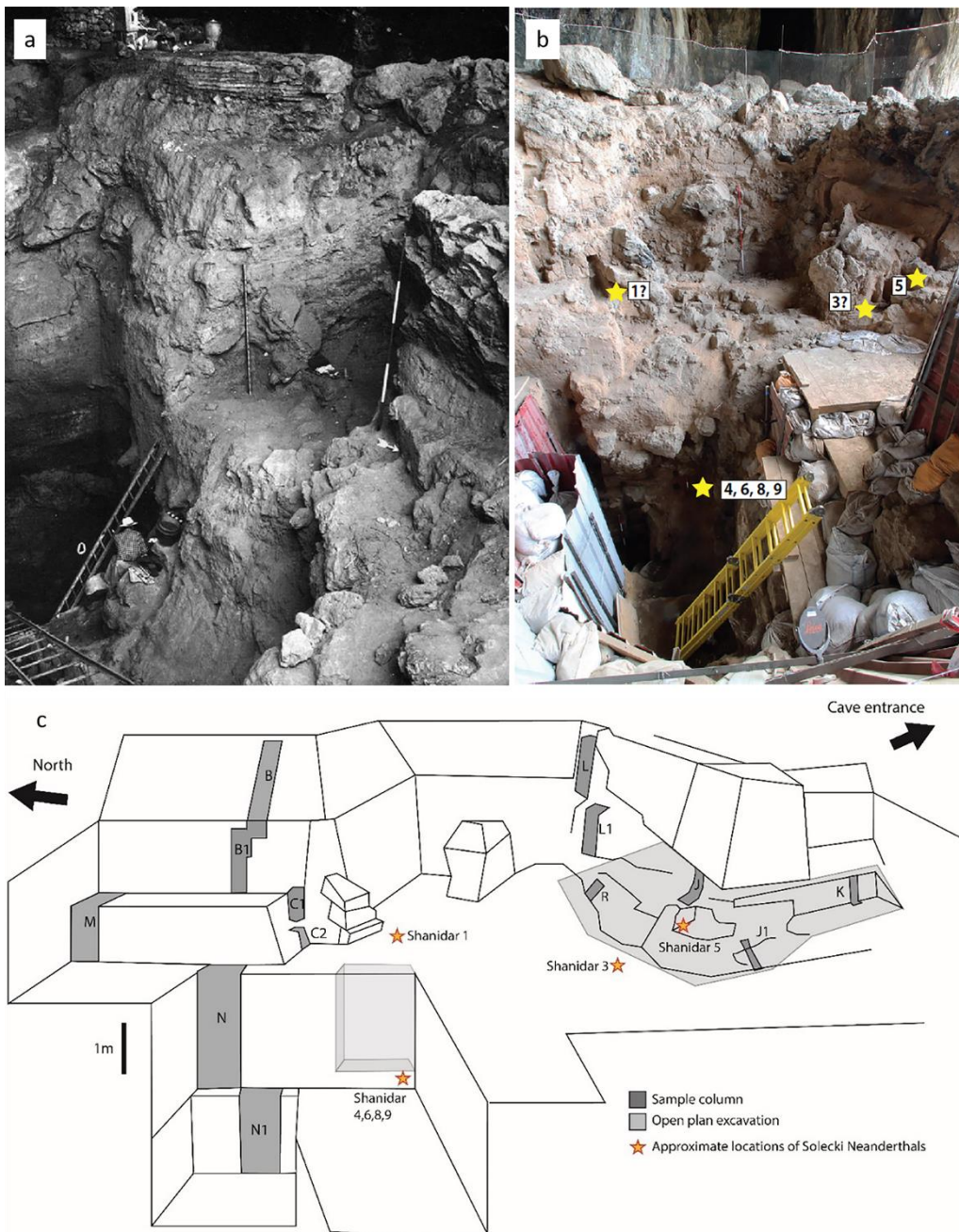


Figure 2. (a) The Shanidar Cave excavations in 1960, looking north west. T. Dale Stewart sits excavating Shanidar 4, the central scale marks the location of Shanidar 1, and small white arrow indicates Shanidar 5 location (photograph by Ralph Solecki) (b) Photograph of the new excavations showing the location of Solecki's Neanderthal finds (photograph by Graeme Barker). (c) Schematic diagram of the new excavations viewed from the west, showing: the estimated locations of the Neanderthal skeletal remains discovered by Solecki; the locations of the sample columns excavated in the new work; and the locations of the two main areas of open plan excavation (illustration by Evan Hill).

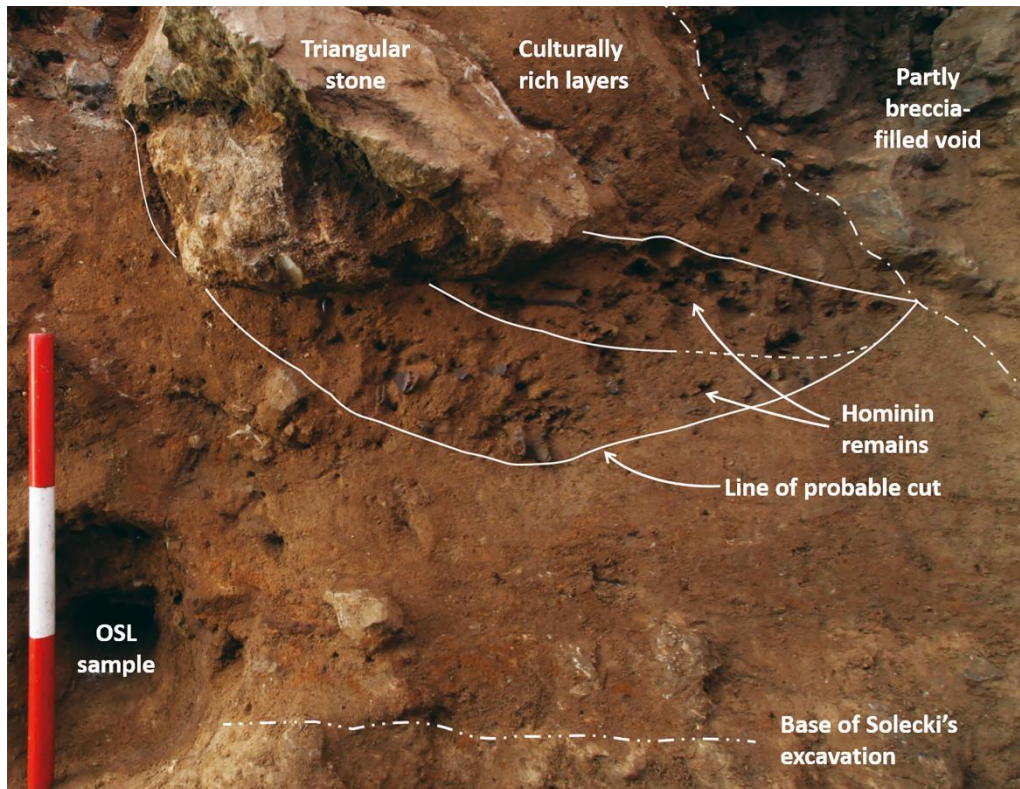


Figure 3. Detail of the new hominin remains in section, looking east; scale 30 cm (photograph by Graeme Barker).

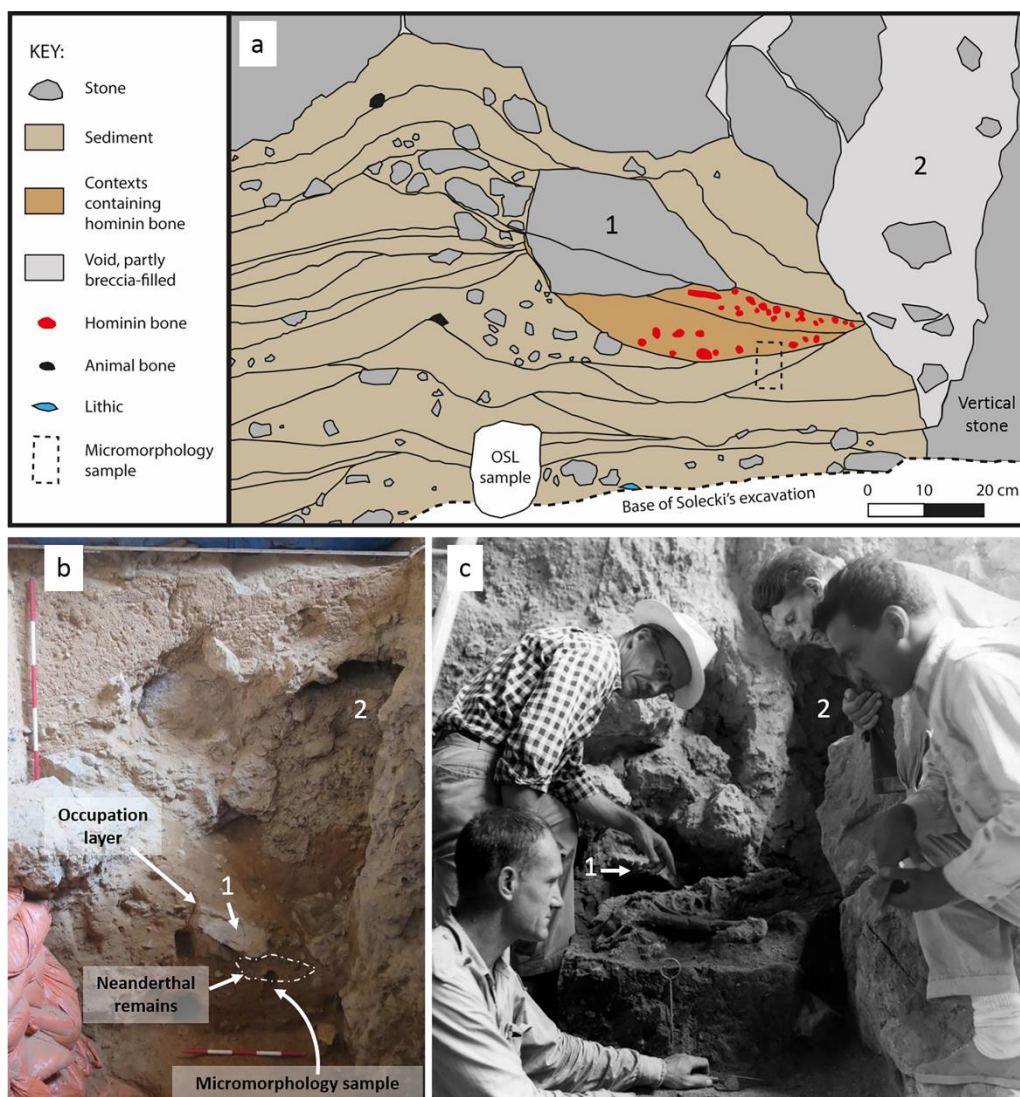


Figure 4. Drawing (a) and photograph (b) of Section 70.1 showing the main features discussed in the text, viewed from the west. ‘M’ refers to the micromorphology sample location (Illustration: Paul Bennett and Emma Pomeroy; photograph: Graeme Barker) (c) Photograph of Shanidar 4 in situ in 1960, with Ralph Solecki on the left in the foreground and T. Dale Stewart behind him, and Jacques Bordaz at the back on the right. (Photograph: Series 1.7 Photographs and Slides 1950-2017, Box 59, Folder “Shanidar 4 Flower Burial”, Ralph S. and Rose L. Solecki papers, National Anthropological Archives, Smithsonian Institution). Note the triangular stone (1) and partly breccia-filled void (2) in all three images.

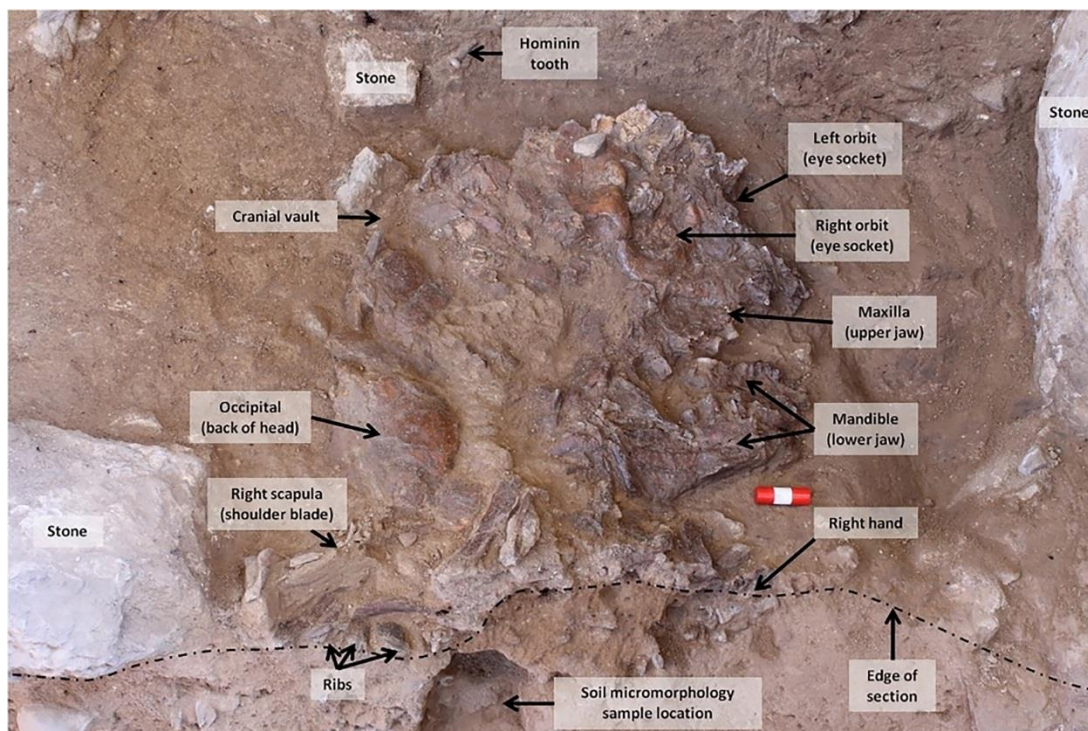


Figure 5. Excavated skull in situ; north is to the left of the image and the scale is 3 cm (photograph by Graeme Barker).

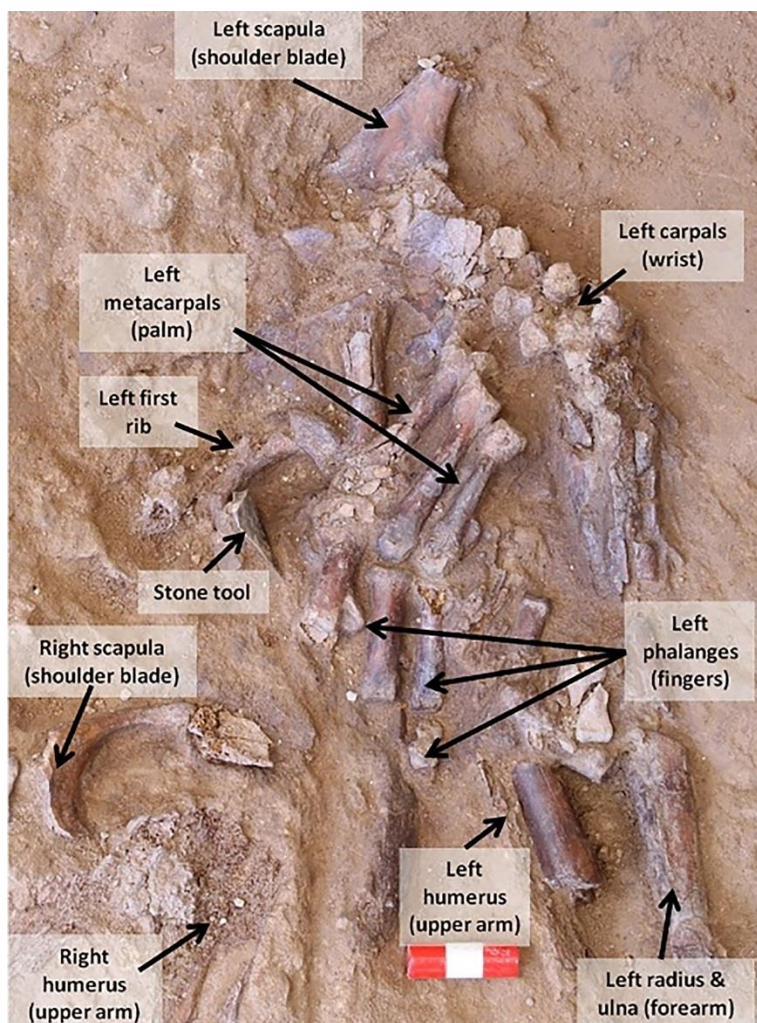


Figure 6. The upper body and left arm remains that lay beneath the skull; north is to the left of the image and the scale is 3 cm (photograph by Graeme Barker).



Figure 7. (a) The lithic (indicated by white arrow) sitting inside the curvature of the first left rib and near to the left hand of the new Neanderthal remains; looking northeast; scale = 10cm (photograph by Ross Lane, from photogrammetry model of the excavations). (b) Detail of the lithic, scale = 10 mm (photograph by Tim Reynolds).



Figure 8. Reconstruction of the possible burial position of the new Neanderthal remains from Shanidar Cave. The stone behind the head is shown in grey (illustration by Emma Pomeroy).

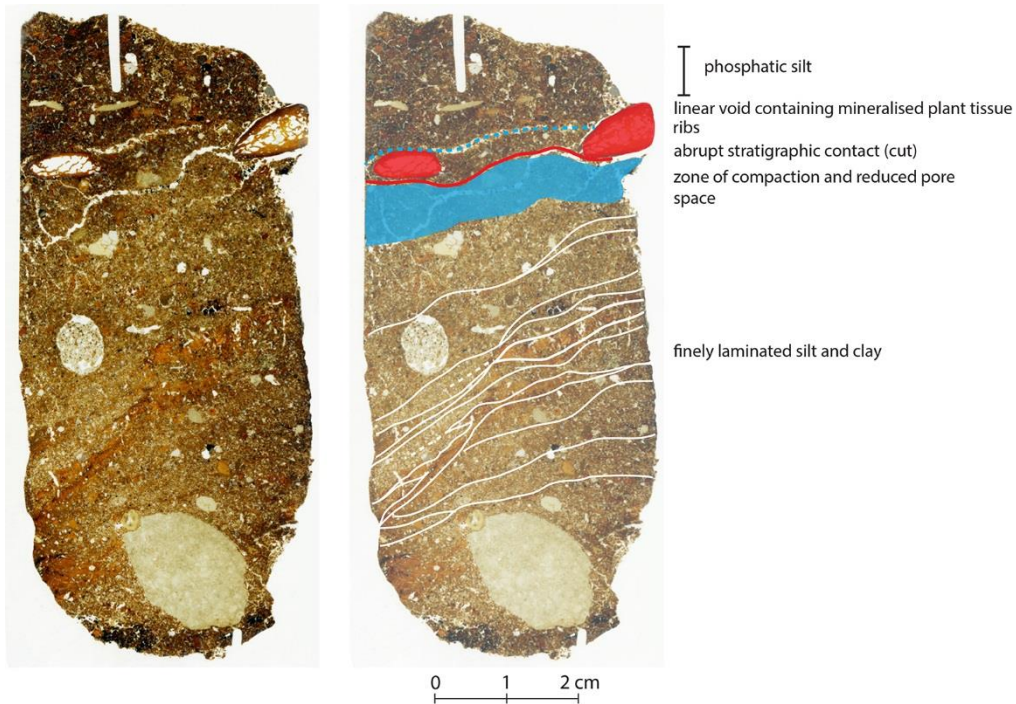


Figure 9. Micromorphology thin section through the cut feature containing the new hominin remains (image by Lucy Farr).

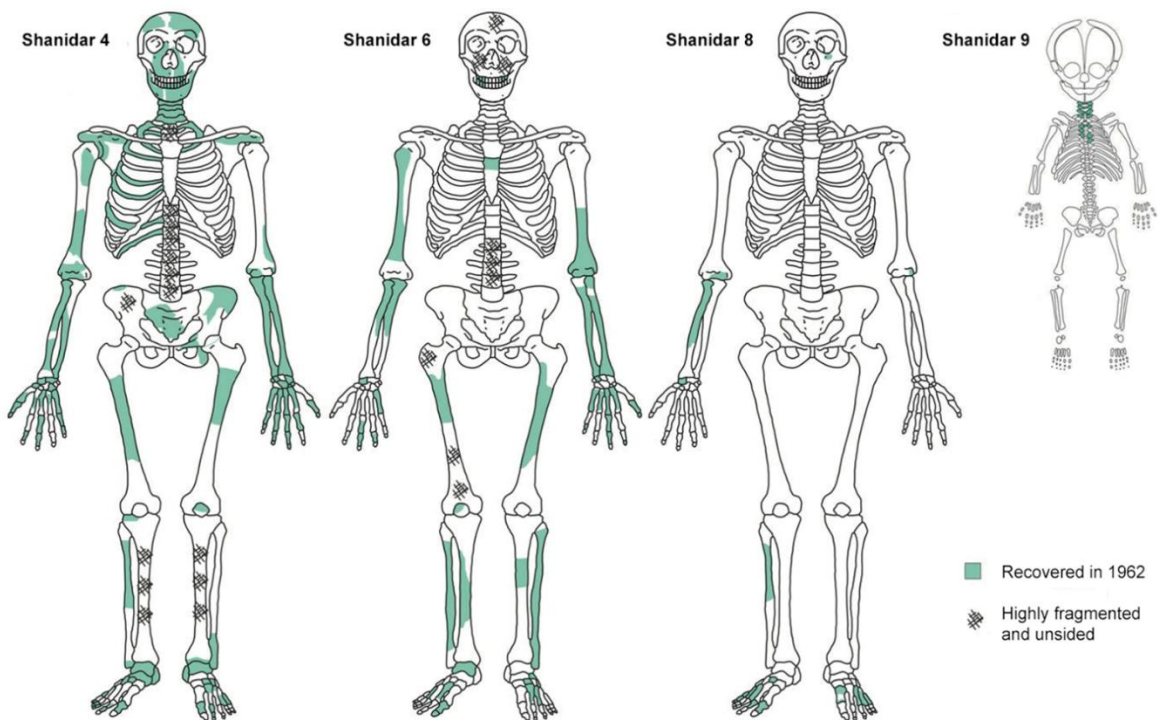


Figure 10. Preserved skeletal elements of Shanidar 4, 6, 8 and 9, compiled based on Trinkaus (1983). Note that skeleton outlines are not scaled relative to one another (illustration by Emma Pomeroy).