SKELETON CAVE, LEIGH WOODS, BRISTOL

by

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ABSTRACT

An account is given of the discovery and excavation of this small cave in the 1960s. It is recorded that archaeological finds were made, but of these, only a single human mandible can now be traced. Radiocarbon dating shows the specimen to be early Neolithic in age; a metrical analysis was less conclusive.

INTRODUCTION

Skeleton Cave is a small shelter found on the south side of the Avon Gorge, just below the western side of Stokeleigh Camp and 3 m north of a footpath known as Lucy's Path (Figure 1). It is very hard to locate as it is quite small and is heavily obscured by vegetation. The NGR is ST 56125 73237 and it is at an altitude 92 m AOD. The entrance is approximately 1 m wide and 1 m high and immediately opens into a small chamber, 3 m wide, 2 m deep and 1.1 m high. The floor slopes down into the chamber and is superficially the same deposit as that blocking the entrance. It was dug, briefly, in 1965. This paper describes what is now known of that excavation and of the finds made.

THE 1965 EXCAVATION

In 1965, Geoff Workman, a caver from Yorkshire spent a short time in Bristol, in connection with his work. On a day off, he was studying the limestone outcrops on the west side of the Avon Gorge when he "discovered the hidden entrance to a cave in a somewhat dense part of the woods." Mr Workman felt that the site was interesting enough to be worth excavating, in search of new cave passage, and contacted a local caving friend, Tony Oldham, for advice. Oldham was keen to assist, but argued that formal permission should not be sought "... in case it was refused!" Workman was not wholly happy with that, but, being a stranger to the area, accepted Oldham's view of local circumstances.

The dig was not an archaeological excavation, and several digging sessions took place, between July and November 1965. In Oldham's log, the site is referred to as the *Grotte de Artisan* as a pun on Workman's name. It seems that the name *Skeleton Cave* was first used in print in *The Caves of the Avon Gorge Part 1* produced by the Rodway School Speleological Group (1973). This group was mentored by Oldham and led by Mrs Anne Oldham. Oldham described, but did not name, the cave in an article in his privately published news-sheet *The Mendip Caver* later copied verbatim in *The British Caver* (Oldham, 1966a and b). They ceased work in November 1965 after the discovery of some specimens of human bone. The last digging trip recorded in Oldham's personal log was on 20th November 1965. Shortly after, Workman returned to Yorkshire. He took with him some of the finds and the remainder were entrusted to Oldham.
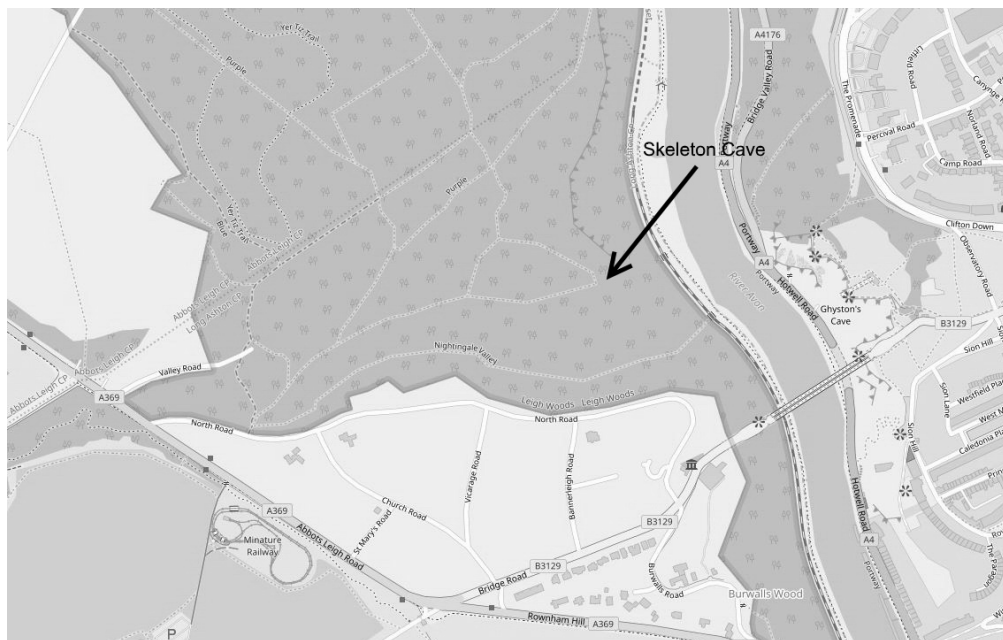
Figure 1. *Location map, showing the position of the cave in Leigh Woods,*
above the River Avon.
From openstreetmap.org

The work came to light when it was described in a brief illustrated report in the Bristol Evening Post, for Wednesday 15th December (Dafter, 1965). This publicity resulted in a flurry of correspondence between E.K. Tratman, the then President of the UBSS, J.G.S. Young, the Clerk to the National Trust's Leigh Woods Committee of Management, and others.

Once the site had been brought to the attention of the National Trust, Oldham and Workman agreed that no further digging should be done. After some initial procrastination, Oldham handed over the part of the finds that he had to Mr Young in June 1966. Mr Workman agreed to also hand over the remainder of the material when he was next due to be in Bristol, in September of the same year. It cannot now be ascertained whether he did so, though the fact that the human mandible was in his possession and was certainly returned to Bristol at some point implies that he did.

No more documentary evidence can be found of the whereabouts of any of the finds until 1970, when Tratman passed the mandible to Bristol City Museum. The Museum's accession register refers to a "Human Jawbone from cave near Stokeleigh Camp, Leigh Woods, nr. Bristol" and has the accession number 205/1970. The Museum has no record of having received any of the other material.

MR. WORKMAN'S REPORT

The most detailed account of the work carried out and the finds made is contained in a letter from Geoff Workman to Mr Young dated 29th June 1966. Mr Young subsequently passed this letter to Tratman. The original is preserved in the Society's Library (Workman, 1966).

The report describes the background to the excavation and notes that work ceased after the human bones were found. It states that the finds included four worked pieces of flint, two human ulnae, one human mandible and a number of animal bones. The flints and the animal remains were not described in any detail. Oldham's two articles (1966a and b) and the Evening Post article (Dafter, 1965) all mention red deer, but no other species are noted. He did, however give some detail of the human finds and also included a sketch section through the dig (Figure 2). He described the deposit as having four layers, as follows:

Layer	Description	Thickness
A	Loose stones, leaves, rubbish etc.	3" approx
B	Earth with some stones and many roots	1' approx
C	Stones with some earth and some roots	3' 6" approx
D	Large stones, wedged and lightly cemented; few roots	Base not found

Table 1. Stratigraphy of Skeleton Cave according to Workman, 1966.

The human bones are recorded as being from layer "D" and the flints were above them in layer "C".

Workman states that according to tables given by Trotter and Gleser (1952, 1958) the ulna suggests that the individual concerned would have been almost 6' (1.83 m) tall. This would have been from the specimen in his possession; nothing is said about the one retained by Oldham. He is rather more forthcoming about the mandible stating:

> *Mandible well preserved. Abscesses beneath both first molars. 1st rt. incisor, 2nd left incisor, 1st rt & [?] left molar missing. 1st left incisor loose. Slight calculus formation & some alveolar resorption present. Dental attrition considerable; probable age at death 40+. Found beneath rock appox 9" diam with some stalagmitic cementation (rather soft).*

Dimension of Mandible

Bigonial Breadth	94 mm
Intercondylar Width	125 mm
Foramen Mentalia Breadth	50 mm
Symphysial Height	35 mm
Projective Mandibular Length	105 mm
Ramen breadth	39 mm
Coronoid Height	73 mm
Angle at Gonial	104° Right side ; 102° left side

The only other contemporaneous information are notes in Tony Oldham's personal log book, entries for Wednesday 10th November 1965 (A.D. Oldham, *pers. comm.*):

Noticed two distinct layers of earth (black Humus?) with many bones, mainly sheep and rabbit. Looks promising through the boulders.

And for Saturday 20th November 1965:

GW dug on the previous Wednesday and found a human jaw bone. Today's dig produced more human remains.
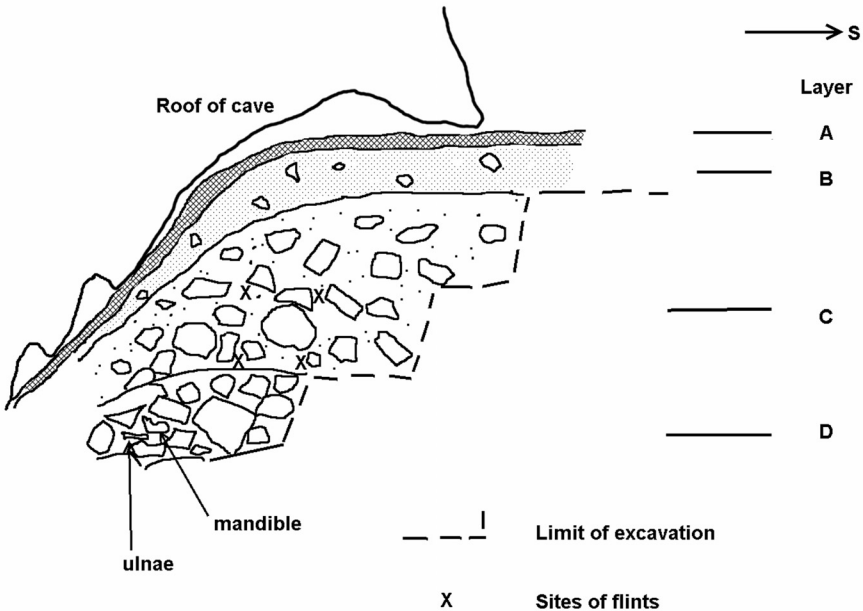

Figure 2. *Sketch section through the deposits.*
Redrawn from Workman, 1966.

LATER HISTORY OF THE SITE

In accordance with the instructions from the National Trust, no further work was carried out at the cave. It seems then to have fallen into obscurity. It is mentioned in a local cave guide, *Caves of the Bristol Region* by Mockford and Male (1974), in a bat survey carried out for the Avon Wildlife Trust (Quinn, 1999) and in an archaeological survey carried out for the National Trust (McDonnell, 2001). The latter states "Further research needs to be under-taken into the name of this cave." The sketch plan and section in Figure 3 are reproduced from this report.

The site first came to our attention in early 2016, when a Mendip Cave Registry and Archive registrar, Robin Taviner, was researching a number of sites in and around the Avon Gorge. The little information then available seemed to indicate archaeological potential and so needed following up. Thanks to work by Tony Boycott in the Society's Library, information came to light which allowed us to trace the mandible to Bristol City Museum, where it could be

viewed, thanks to the good offices of curator Gail Boyle. One curious thing discovered at this point is that a sample of bone appears to have been taken from the specimen. The Museum has no record of when this might have happened or who may have carried it out.
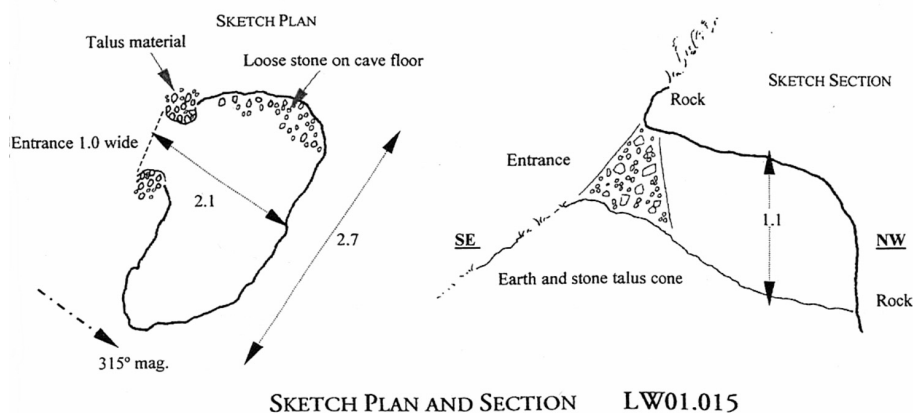
Figure 3. *Plan and section of the cave.*
After McDonnell, 2001.

Further research, which took place in the archives of the National Trust, at Tisbury and at Tyntsfield revealed the report by Richard McDonnell, but no more information on the fate of the various finds could be found. Enquires have also been made of their collections at Lacock and Stourhead, without success. It does now seem that these are completely lost.

DATING AND ANALYSIS

As the mandible is the only find from the excavation that could now be traced, it was the one specimen that could be used in any way to enquire into the possible archaeological significance of the site. It was therefore submitted to metric analysis and for sampling for 14C dating.

The specimen was submitted to the Bristol Radiocarbon Accelerator Mass Spectrometer (BRAMS) unit at the University of Bristol. The resultant date is shown in the calibration plot (Figure 4) as being mid 4th Millennium BC and thus within the earlier British Neolithic.

METRIC ANALYSIS
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The Problem and our approach

Initially, we were asked whether the measurements from the Avon Gorge mandible allow us to say anything further about the specimen, at the time of unknown age. The problem was analogous to our analysis of the Aveline's Hole cranium (AH9) in this journal (Meiklejohn *et al.* 2012). The question is whether metric data can be used to assess affinity of an unknown
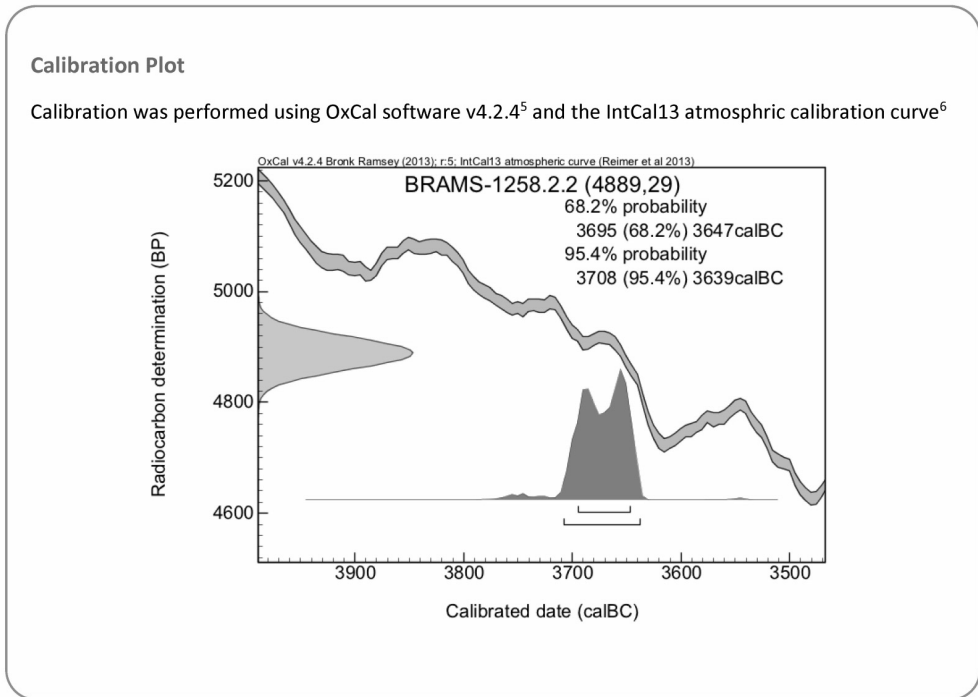
Figure 4. *Calibration plot of the 14C determination of the Skeleton Cave mandible.*

specimen; a problem that can arise in both archaeological context and forensic situations (Meiklejohn *et al*. 1999). For the Avon Gorge mandible, we have eight standardized measurements; the question is whether comparison with European specimens of known age could yield a meaningful conclusion. At the beginning of our analysis, when we did not have the direct 14C date, we felt that the specimen might lie at the earlier end of the chronological spectrum. In the aftermath of direct dating we know that this conclusion is incorrect. What can we say further?

In comparison of specimens and populations in a data matrix the problem concerns the location of a given individual in a multi-dimensional cloud of points, each point representing a specimen. Theoretically, the number of axes equals the number of variables. If populations being compared differ metrically, involving issues of size and shape, they will occupy different portions of the multi-dimensional cloud. Separation will depend on the degree to which populations differ in size and shape. In this case, we have three chronologically-separated populations and asking where the Avon Gorge individual might fit, assuming that the populations are in fact metrically separate (in practice, total separation of populations is rare to non-existent). Answering this may depend on where the unknown specimen fits in the cloud. If near the centre of the cloud, affinity of the specimen may not be predictable, since it will fall within the range of more than one of the populations under consideration. However, if peripheral, it is likely to sit outside the range of some of the populations, in which case affiliation within a further population may be discernible. In the AH9 case, raised above, we asked whether the specimen fell within the range of the Western European Mesolithic. Since AH9 lay outside the range of known

Mesolithic individuals, we concluded that we should have been able to predict that AH9 was unlikely to be Mesolithic in age. Direct dating showed it to be medieval or later.

Before proceeding to the Avon Gorge mandible some comment is needed on the database we are using, which overlaps that of the AH9 paper but with different variables and a larger chronological span. The data have been collected by one of us (CM) on European cranial material of Upper Palaeolithic, Mesolithic and post-Mesolithic age, to which data from colleagues and the literature have been added. It was created at the request of Ron Pinhasi, University College Dublin, and assisted by Winfried Henke, University of Mainz, beginning in 2007. Parts were used in two papers dealing with continuity in

Figure 5. *The mandible from Skeleton Cave.*
Photo © G. Mullan.

European Upper Palaeolithic populations (Brewster *et al*. 2014a, 2014b). The current full database includes data from 1233 individuals; 157 Upper Palaeolithic, 419 Mesolithic and 657 Neolithic or younger.

This case involves eight mandibular measurements from the Avon Gorge mandible, variables from the Martin/Saller system (M*) (see Martin and Saller 1957), labeled below for simplicity as X1 through X8.

     X1 = M65 = Bi-coronoid breadth
     X2 = M66 = Bigonial breadth
     X3 = M67 = Mandibular length (to gonial angle)
     X4 = M68(1) = Maximum mandibular length
     X5 = M69 = Symphysis height
     X6 = M70 = Ramal height (non-perpendicular)
     X7 = M71a = Ramal breadth
     X8 = M79 = Gonial angle

Our initial sample was of all specimens from all periods with values for all eight measurements. At this stage, we decided to exclude variable X8 (gonial angle), because it was an angle rather than a linear measurement. Though statistical methods are available for such values they are not directly comparable to those for linear values.

Our initial database with all eight measurements contained 51 individuals. For each of the seven variables remaining after the removal of X8, we:

- Examined side-by-side boxplots depicting minimum, first quartile, median, third quartile and maximum values for each of the three archaeological periods.
- Conducted a one-factor analysis of variance to test for a difference in population mean values for the three periods.

Variable X7 (ramal breadth) showed considerable potential, with X4 (maximum mandibular length) and X5 (symphysis height) showing some, though less potential, in separating mandibles from the three periods. The other four variables showed no significant difference
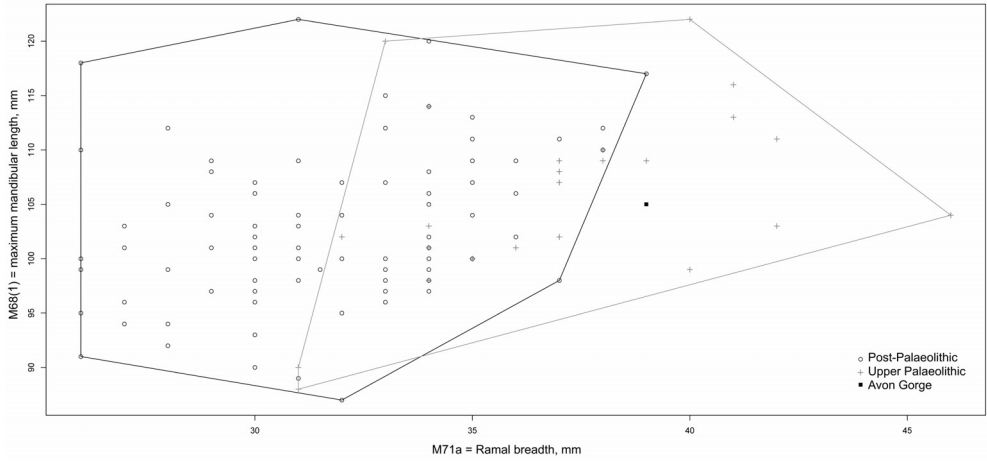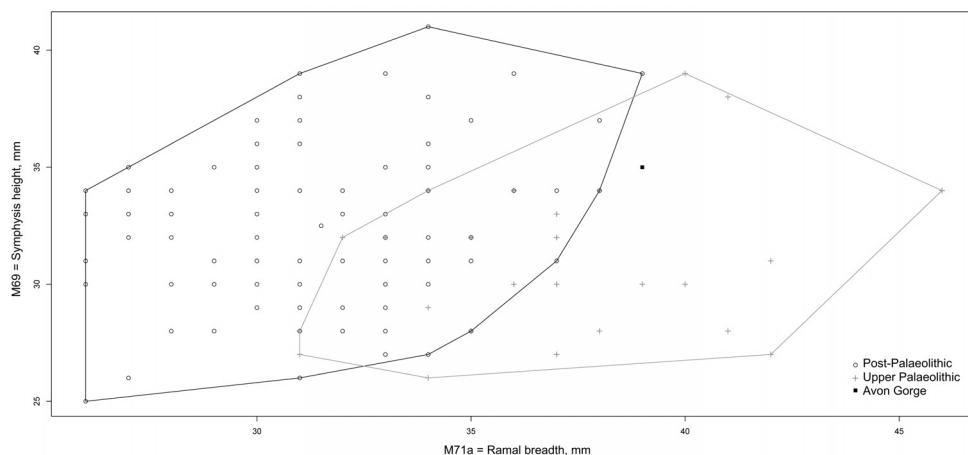

Figure 6. *M68(1) vs M71a with Convex Hull for Each Group.*
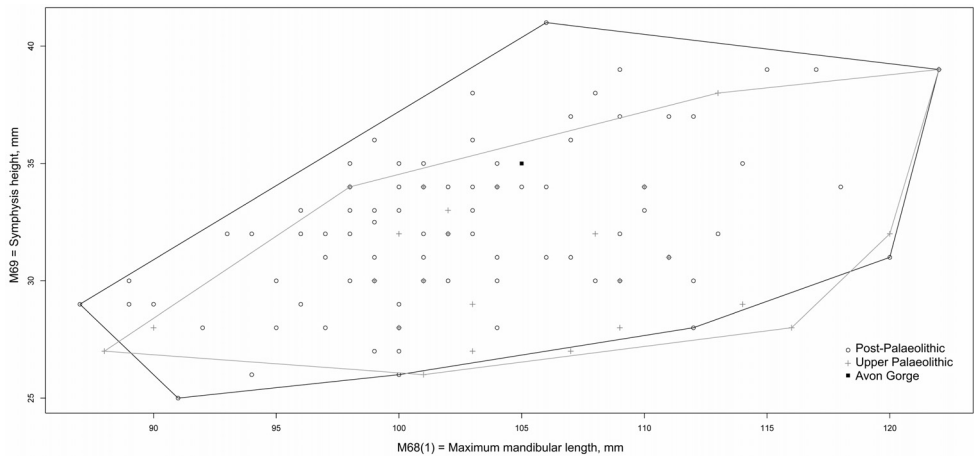
Figure 7. *M69 vs M68(1) with Convex Hull for each Group.*

Figure. 8. *M69 vs M71a with Convex Hull for each Group.*

between the time periods and we decided to remove them from further consideration as they provided no useful information in terms of solving our core problem, the separation of specimens into one of the three time periods.

At this point we reduced the database to three variables, and in so doing increased our overall sample to 141 individuals, almost three times as large. Further statistical and graphical investigations with the expanded sample showed that it was extremely difficult to statistically separate the Neolithic/Bronze Age and Mesolithic samples. Consequently, we decided to combine these two periods into one group that we have labeled post-Palaeolithic for comparison to the Upper Palaeolithic group. Our new sample contained 46 Upper Palaeolithic and 95 post-Palaeolithic individuals.

For each of the three variables, X7, X4 and X5, we:
- Examined side-by-side boxplots depicting the minimum, first quartile, median, third quartile and maximum values for both archaeological periods.
- Conducted a one-factor analysis of variance to test for a difference in population mean values for the two archaeological periods.

For the each of three pairings of variables X7 and X5, X7 and X4, and X5 and X4, we:
- Prepared scatterplots with convex hulls superimposed about the mandibles from both groups. We then superimposed a point corresponding to the Avon Gorge mandible (figures 1-3).
- Applied Hotelling's T^2 procedure to test for a difference in group means.
- Conducted a linear discriminant analysis to construct classification functions for separating the two groups and then used the classification functions to classify the Avon Gorge mandible.

For the triplet of variables X7, X4 and X5, we
- Applied Hotelling's T^2 procedure to test for a difference in group means.

- Conducted a linear discriminant analysis to construct classification functions for separating the two groups and then used the classification functions to classify the Avon Gorge mandible.

Conclusion

As the analyses turned out, based on the various scatterplots and linear discriminant analyses, there are two ways to look at these data. When X7 was compared to either X4 or X5 it was clear that the Avon Gorge specimen fell at the upper end of the range for X7 (ramal breadth), with only one post-Palaeolithic specimen showing a similar value, Teviec 11 (E1), a male individual. The seven Upper Palaeolithic specimens with similar or higher measurements were predominantly male and were specimens of known robustness, including two from Dolni Vestonice, one from Sunghir and one from Pestera cu Oase. All post-Mesolithic specimens were smaller. Our initial conclusion, before we knew the ^{14}C date, was that the most likely placement was that the specimen was Upper Palaeolithic, though a diagnosis of male was also highly probable. However, that diagnosis should be tempered by the fact that our Neolithic and younger sample is the most limited of the three datasets in comparison to the potential data available in the literature. Put differently, we are reasonably confident that *all* Upper Palaeolithic and Mesolithic mandibles for which data have either been examined by one of us (CM) or published in the literature are present in the full database. This is patently not true for the Neolithic and younger dataset.

It is therefore appropriate to look at whether further information is available from either variable X4 or X5, or their comparison. In this case, any conclusions are far less obvious. For X4 (maximum mandibular length) the Avon Gorge mandible is slightly shorter than the full sample mid-point (105 vs 107 mm), while for X5 (symphysis height) it is slightly higher (35 vs 33 mm), and the individual is clearly within the range of both comparative samples (Upper Palaeolithic and post-Palaeolithic). From the perspective of chronological placement neither variable is useful. In terms of size, and by extension robusticity, the specimen is not large. Therefore, from these variables, no comment can be made on sex identification. In the light of the direct 14C measurement the only meaningful comment is that the value for X7 suggests that the individual is robust and therefore likely male, as is visible in the photographs of the specimen. To make further comment requires comparison to a larger Neolithic sample than available here, something beyond the mandate of this paper.

Statistical Note

Please note, as discussed in Johnson and Wichern (2007), that in linear discriminant analysis, the apparent error rate (APER) tends to underestimate the actual error rate (AER). This tendency towards underestimation of AER, is because APER evaluates the classification function using the exact same data set from which the classification function was developed. Discriminant analyses were conducted using the linDA function available in the R software package DiscriMiner. Hotelling's two sample T^2-tests were conducted using the HotellingsT2Test function available in the R software package DescTools.

Of the four linear discriminant analyses conducted, that based on X5 and X7 yielded the lowest APER value and is therefore summarized below.

Linear discriminant analysis based on X5 and X7
Classification functions
Post-Palaeolithic: -74.10 + 2.16 X5 + 2.47 X7

Upper Palaeolithic: $-86.65 + 1.86 X5 + 3.09 X7$
Confusion matrix:

Actual	Predicted		
	Post-Palaeolithic	Upper Palaeolithic	Total
Post-Palaeolithic	88	7	95
Upper Palaeolithic	14	32	46
Total	102	39	141

APER = Apparent error rate: $21/141 \cong 0.149$
The apparent error rate should be compared to the error rate which would be obtained by simply classifying all of the specimens as Post-Palaeolithic = $46/141 \cong 0.326$.
Avon Gorge specimen: (X5 = 35, X7 = 39)
- Score on first classification function: 97.83
- Score on second classification function: 98.96
- Predicted classification: Upper Palaeolithic

Hotelling's two sample T^2-test on X5 and X7

   Hypotheses: H_0: $[\mu 5A, \mu 7A]' = [\mu 5B, \mu 7B]'$
   versus H_1: $[\mu 5A, \mu 7A]' \neq [\mu 5B, \mu 7B]'$
   $T.2 = 58.554$, df1 = 2, df2 = 138, p-value < 2.2e-16

DISCUSSION

   It is unfortunate that the original dig was carried out in such a haphazard fashion and equally unfortunate that, apart from this one mandible, all the finds have subsequently been lost. However, the studies that have been conducted on this specimen have demonstrated the potential of the site such that there may be benefit in carrying out a further, controlled, excavation in the future. The failure of the statistical analysis to correctly predict the population from which this individual came is, more than anything, a comment on the paucity of the data set outside the Palaeolithic and Mesolithic periods where, hitherto, this technique has been largely applied.

ACKNOWLEDGMENTS

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