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A REPORT ON THE EXCAVATIONS AT RHINOCEROS HOLE, WOOKEY

by

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ABSTRACT

Rhinoceros Hole lies in the side of the Wookey Hole ravine, Mendip. It was first excavated by H. E. Balch in the early 20th century, and a major excavation was carried out by the UBSS from 1970 to 1976, removing most of the deposits. The sediments comprised a wedge shaped sequence of subaerial cave earths filling an alcove in the ravine side, underlain by water laid silts and sands. An abundant fauna with dominant spotted hyaena and woolly rhinoceros and Middle and Early Upper Palaeolithic artefacts, suggest a middle Devensian age. Early reports of interglacial faunal elements have been shown to be erroneous. Uranium series dating of detrital speleothem blocks suggests an age of less than around 50 ka for the deposits and the fauna and industries are tentatively concluded to date from between about 50 and 25 ka.

INTRODUCTION

Rhinoceros Hole (NGR ST 5323 4793) is one of a small group of Pleistocene cave sites (with the Hyaena Den and Badger Hole) in the Wookey Hole ravine on the south flank of the Mendip Hills (Figure 1). The ravine has been formed where the River Axe emerges from Wookey Hole, the lower end of a cave system draining a large part of the Mendip Plateau. Most of this system is in Carboniferous Limestone, but the outer part of Wookey Hole, the ravine and the ravine caves are formed in Triassic Dolomitic Conglomerate draped over the limestone on the south flank of the hills.

The short passage segments comprising Rhinoceros Hole, the Hyaena Den and Badger Hole form a tight group on the east side of the ravine about 100 m downstream from the Wookey Hole resurgence (Figure 1), and probably represent fragments of a downstream continuation of the latter cave. Rhinoceros Hole itself comprises an alcove, probably the product of cavern collapse, in the steep hillside, with two short passages, one above the other, leading off from it (Figure 2). The lower passage is very close to the Hyaena Den and it is almost certain that a choked connection exists between the two caves.

The Hyaena Den and Badger Hole were extensively excavated in the 19th and early 20th century by Boyd Dawkins and Balch (Boyd Dawkins, 1874, Balch, 1947). They removed artefacts of Middle and Early Upper Palaeolithic industries associated with abundant Devensian faunal material. Excavations in Rhinoceros Hole began somewhat later, when Balch carried out a small excavation in the cave in the early years of the 20th century. No material from this excavation survives but Balch (1914) records that the site yielded remains of rhinoceros, horse and hyaena. The main bulk of the Rhinoceros Hole sediments were excavated by Professor E.K.Tratman, who turned his attention to the cave in 1970 after working in the Hyaena Den. He found a thick sequence of Devensian sediments with associated fauna and artefacts. He

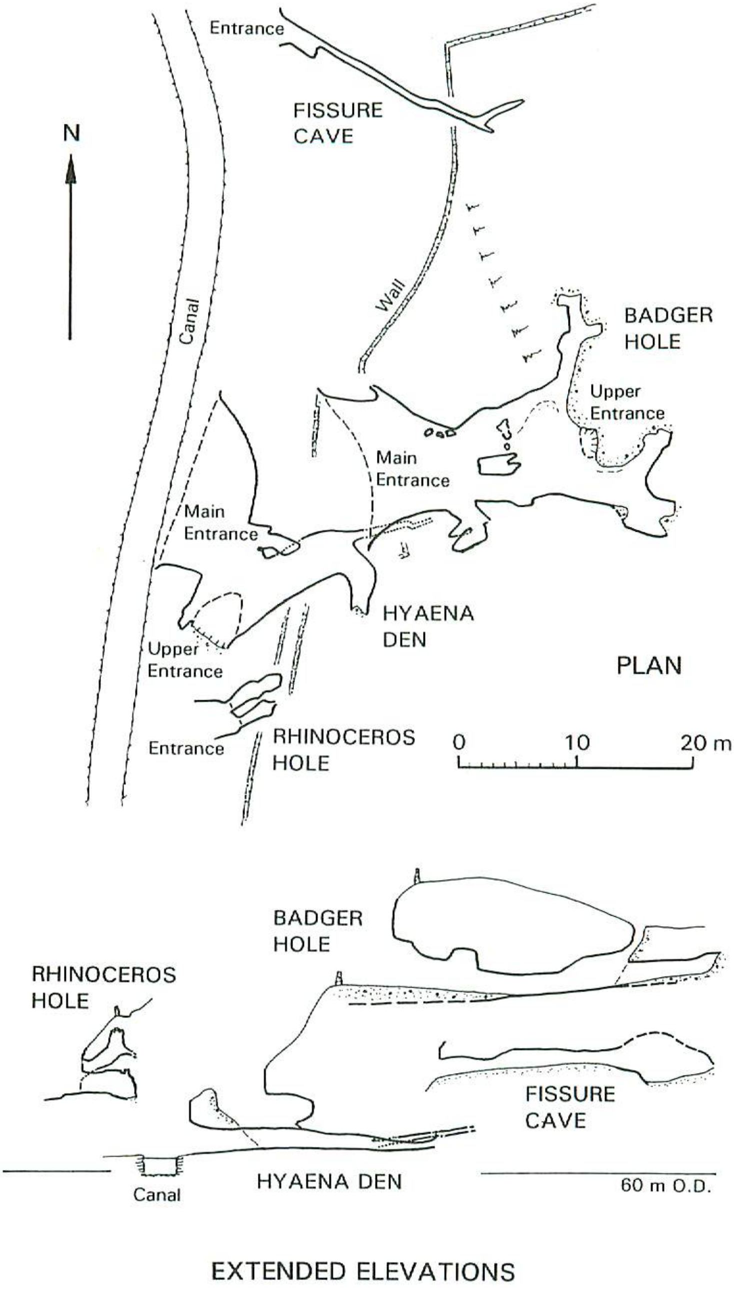


Figure 1. *Map of the Wookey Hole ravine caves, redrawn from Stanton (1973).*

continued working until 1976, removing the sediments to the rock floor over most of the site. The report of this excavation was delayed indefinitely following Tratman's death in 1977. Brief preliminary accounts were published (Tratman *et al.* 1971, Tratman, 1975, Hawkins and Tratman, 1977) but it has since become clear that there are major problems with some of the published interpretations. This account presents a new synthesis incorporating results obtained since Tratman's death.

THE SEDIMENTS

The sediments formed a wedge-shaped deposit completely filling the alcove and parts of the upper and lower tunnels. When first examined by Balch (1914) only a minute arch, the top of the Upper Tunnel, was visible over the top of the deposits. He dug a pit into them but fortunately did not excavate extensively so that the UBSS (under Tratman) in the 1970 excavation were able to examine a complete sequence. A complex series of layers was revealed by the excavation. Tratman subdivided these layers on the basis of gross morphological and palaeontological characters: the resulting stratigraphic scheme is idiosyncratic but is retained here for convenience. Sedimentary analysis was only carried out some years after the excavation ended (Collcutt, 1985): a detailed description of the sediments is given in appendix 1. The following sequence is recognised, described from base to top (summarised from appendix 1 and Tratman's unpublished manuscript and sections), (Figures 2 and 3).

(a) LAYER 6 (sands): quite clean fine to medium sand with clay balls, resting on the rock floor. Well compacted with clear and undisturbed horizontal bedding.

(b) LAYER 7 (removed by excavation, hence not sampled by Collcutt, 1985): A lens of reddened cave earth with abundant bone, locally developed interstratified with the basal part of the layer 6 silts. Elsewhere this horizon is marked by a reddened layer at the base of the layer 6 silts.

(c) LAYER 6 (silts): compact clayey silts with fine sand in places. Much contorted but with fine laminations sometimes preserved.

(d) LAYER 5: very stony sediment with matrix sandier towards the top and clayier towards the base. Clasts include Dolomitic Conglomerate, some calcite and common bone, and show no preferred orientation.

(e) LAYER 3aE: very stony silty clay with calcite and Dolomitic Conglomerate clasts: bone common. This unit is quite compact and may show a preferred subhorizontal clast orientation.

(f) LAYER 3a: clayey silt with abundant calcite and Dolomitic Conglomerate clasts, randomly or slope oriented. Fragments of a massive speleothem floor were found in this unit.

(g) LAYER 2al: silty clay with calcite sand and some larger calcite clasts, loose to compacted.

(h) LAYER 2ar: clayey silt with very common calcite grit and sand: this unit is interbedded with Layer 2al.

(i) LAYER 2a: loose to compact clayey silt with sand, and small calcite and Dolomitic Conglomerate clasts.

(j) LAYER 3: silty to gritty clay with small mostly Dolomitic Conglomerate clasts: quite loose.

(k) LAYER 2: extremely loose clayey silts with altered calcite and a few Dolomitic Conglomerate clasts, and patches of vein calcite sand.

(l) LAYER 1a: dark silt, clay and calcite sand and grit, with calcite and Dolomitic Conglomerate clasts; very loose with burrows and roots, some stone lines.

(m) LAYER 1: sediment similar to Layer 1a but a distinct depositional event.

Parts of the deposits were disturbed by large recent animal burrows which penetrated to the base of the sequence, and had caused some mixing of fauna and artefacts.

The morphology of Layers 1-5, comprising a series of sediment lenses and wedges, thickest under the uphill wall of the alcove, suggests that they have accumulated by trapping of sediment moving downslope from the hillside above. The often loose nature of the deposits, their poor sorting with a mixture of fine silts and clays and large conglomerate and calcite clasts, and the presence of a series of bedded layers, suggests that they are subaerial cave earths deposited by a combination of soil creep, wash and wall/roof breakdown (Laville, 1976, Collcutt *et al.* 1981, Collcutt, 1986). These separable layers are distinguished on the basis of variations in the relative proportions of their coarser fractions or on colour changes, and they are not in fact markedly differentiated in sediment type. This is consistent with the process of accumulation by a mixture of soil creep, wash and breakdown processes proposed above, since variations in the relative importance of these processes (with the occurrence of localised breakdown) would result in the accumulation of just such a sequence. All the material in the sediments could reasonably have been derived from the cave walls and roof, or the valley side above Rhinoceros Hole, which comprises a steep earth slope over bed-rock of Dolomitic Conglomerate with calcite veins.

The alcove must clearly have been unroofed (much as it is today) before the deposition of layers 1 to 5: indeed the absence of extensive collapse debris below layer 5 suggests that unroofing of the alcove must predate the entire sediment sequence. The broken speleothem fragments in Layer 3a comprise fragments of a massive crystalline flowstone floor, characteristic of those formed in a deep cave environment, which cannot have been formed *in situ* in Layer 3a in the alcove. Thus the speleothem is probably derived from somewhere above: its origin is further discussed below.

The silts and sands of Layer 6 are distinguished from the overlying sediments by their much better sorting, the horizontal bedded morphology of the sediment bodies and the preservation of laminated structure. These features point to these sediments being water lain (Reineck and Singh, 1980, Collcutt, 1985). The silts of layer 6 are the distorted remains of

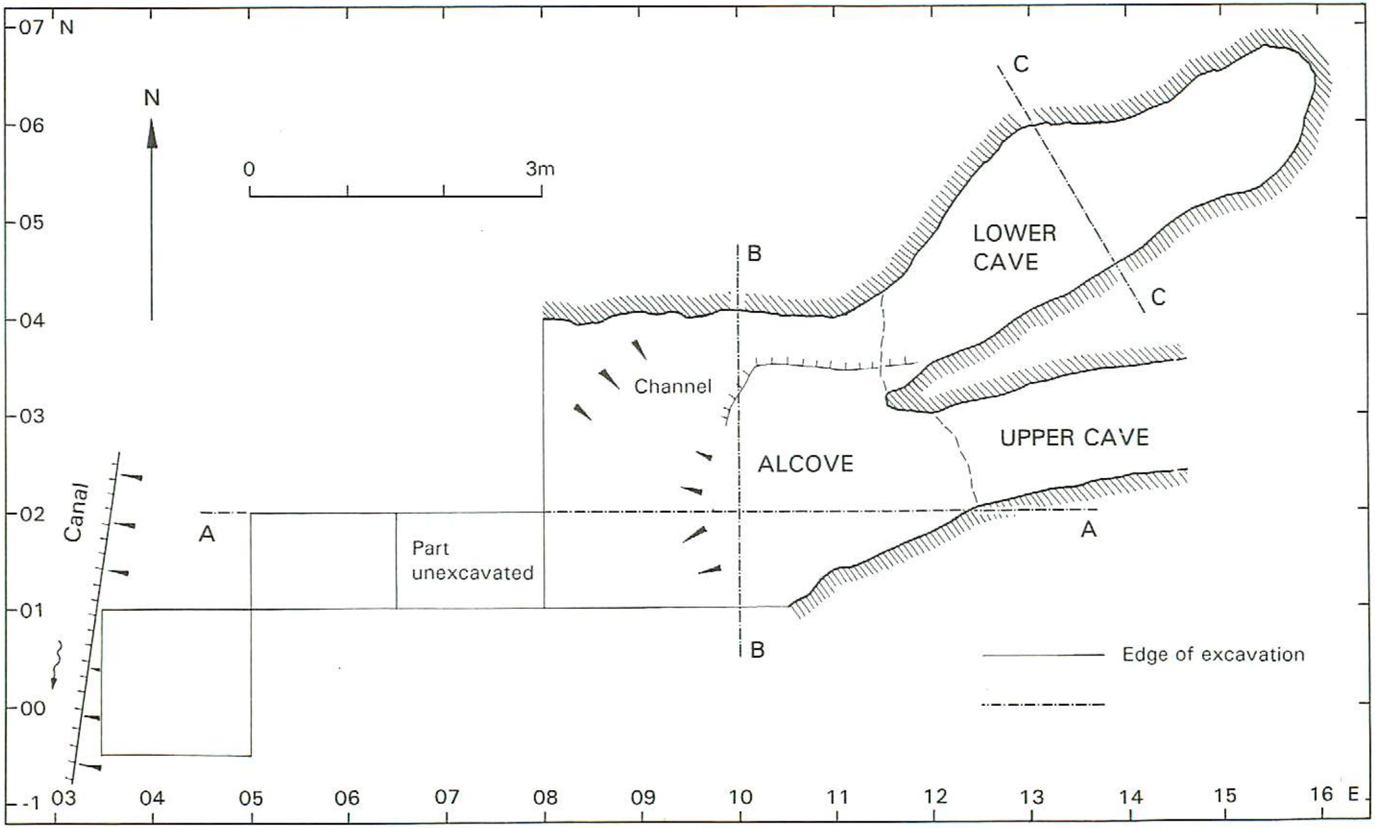


Figure 2. *Plan of the UBSS excavations in Rhinoceros Hole*

deposits laid down in a pool, or pools, representing stagnant or very weak flow conditions. The sands represent a higher energy environment and a more active stream.

The provenance of the layer 6 sediments was investigated using semi-quantitative microscopic examination of material between 0.125 and 4.0 mm from various sources in the Wookey area (table 1). It is difficult to compare the Rhinoceros Hole resurgence silts and clays with the other samples, since their fine particle size precludes the presence of larger organised and/or fragile units such as crinoids or shale. However a clear trend can be seen in the samples from the main Wookey Hole drainage system. Source sediments (two influent caves and an Old Red Sandstone outcrop) are quite varied and they still contain significant quantities of fragile rocks; rounding of particles is not marked. The resurgence, and the main source of the River Axe, at Wookey Hole has sediments containing fewer particles of fragile rock and well silicified crinoids and other hard rocks have been highly rounded and polished. Clay balls and calcite fragments have been added within the cave system. The abundance of sharp calcite mudstone fragments in this sediment is surprising; it may be due to recent tunnelling activities in the show cave. Even ignoring possible recent disturbance of Wookey Hole, the similarities between this sediment and that of the Rhinoceros Hole layer 6 sands (RH 6(5)) are striking; even the particle size distributions are close, although RH 6(5) is a little coarser. RH 6(5) would therefore appear to represent sediments of the River Axe itself, deposited perhaps in back channels, just downstream of the main resurgence. Tratman originally envisaged the sands as being due to a resurgence, but in area A (appendix 1) the sands have some microstructural features (e.g. lens elongation) that suggest, though not unequivocally, that flow was more nearly N-S than E-W. This would be more consistent with emplacement by a stream flowing past the entrance.

When due allowance has been made for the particle size difference, the sand fraction of the layer 6 silts of Rhinoceros hole is still very unlike those of the main Wookey Hole resurgence and of RH 6(5). The silts appear to have been deposited by a stream with a much more local sediment catchment (cf. the nearby soil sample from north of Hole Ground field: table 1), suggesting that they may have been deposited by a minor stream resurging from the cave. This is borne out by the plug of layer 6 silts which still blocks the end of the lower tunnel, suggesting that this passage acted as the feeder. The presence of layer 7 near the base of the layer 6 silts indicates that at least two separate flooding events occurred, since layer 7 is a poorly sorted cave earth with fauna, of subaerial type, suggesting that the cave dried out during its deposition.

Part of the lower tunnel was found to be free of sediments, and in this void there is a remnant of flowstone floor close to the roof level. This fragment is significant since its base was some distance above the surface of the sediments below, and it cannot have grown on them. It must therefore have grown on a deposit which was washed out before the deposition of Layer 6, the inference being that the lower tunnel was dry before the sands of Layer 6 were deposited. Thus there is evidence in Rhinoceros Hole of a complex sequence of events with at least two episodes of flooding which reactivated a previously dry cave, followed by accumulation of a sequence of subaerial cave earths. The significance of this is further discussed below.

	Angular quartz	Spherical grains	Clay balls	FeMnAl nodules	Altered crinoids	Polished crinoids	Dark minerals	Chert	Shale	Red sandstone	Limestone clasts	Vein calcite
NORTH HILL (ST 544 510) Soil sample, Old Red Sandstone	4	0	0	2	1	0	2	0	1	4	0	0
NORTH OF HOLE GROUND FIELD (ST 535 482) Soil sample, Dolomitic conglomerate	3	0	0	0	1	0	0	1	0	0	4 (c)	4
SWILDON'S HOLE (ST 531 513) Influent stream deposit	3	2	0	0	0	2	3	2	2	3	1 (a)	0
EASTWATER CAVERN (ST 539 506) Influent stream deposit	4	1	0	2	2	2	3	2	2	4	2 (a)	0
WOOKEY HOLE (ST 532 480) Resurgence stream deposit	3	3	2	2	0	3	3	2	1	2	4 (b)	2
RHINOCEROS HOLE (ST 532 479) Layer 6 (sands) – RH 6(5)	3	4	2	2	0	3	3	2	0	2	0	2
RHINOCEROS HOLE LOWER TUNNEL Layer 6 (silts)	4	0	0	0	-	-	1	0	-	-	-	3

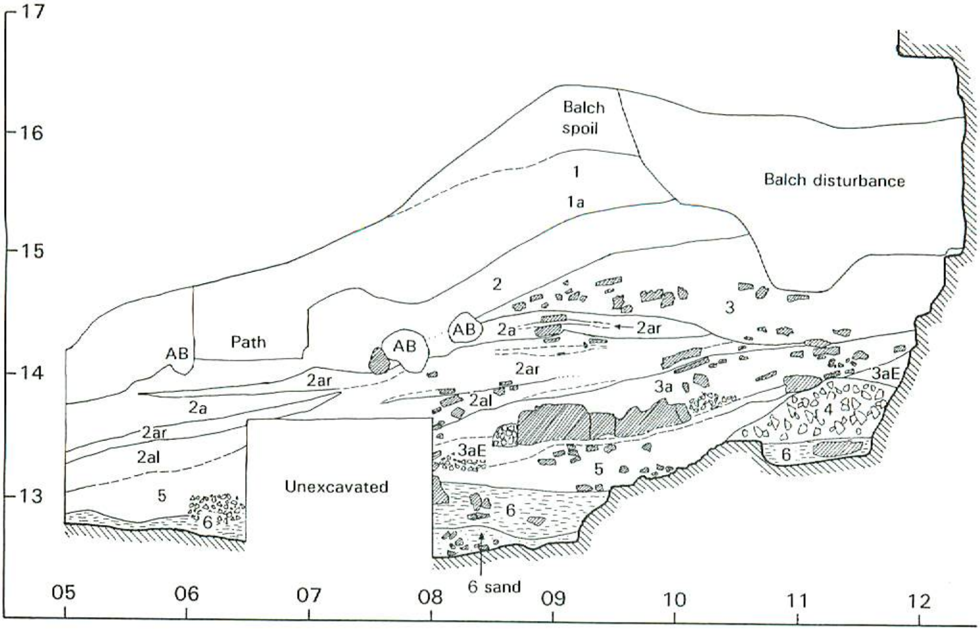
Table 1. *Clast lithology of the 0.125 mm to 4 mm size fraction of sediments in Rhinoceros Hole and the Wookey Hole catchment*
(0 : absent; 1 : trace; 2 : present; 3 : common; 4 : abundant; - : not applicable
a : massive limestone; b : calcite mudstone; c : dolomitic conglomerate)

THE FAUNA

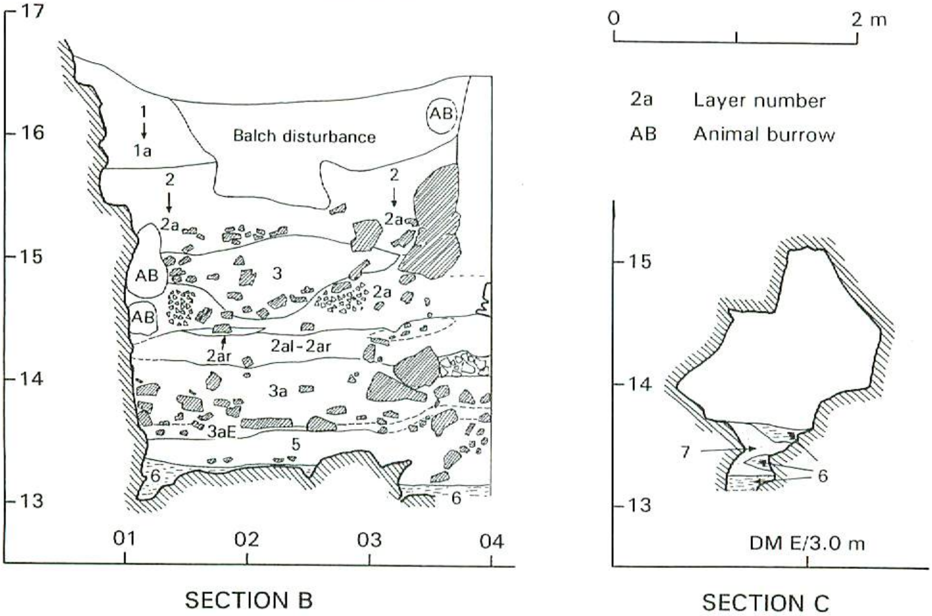
Faunal remains were found throughout the full thickness of sediments. Bone was generally distributed through Layers 1-5, though commoner in Layers 3aE and 5. Layer 7 was likewise rich in bone. The silt and sands of Layer 6 were almost devoid of bone. Most of the fauna recorded from Layer 6 came from the reddened layer at the base of the layer 6 silts (Tratman unpub. ms.). This layer occupies the same stratigraphic position as Layer 7: thus it is probable that it is contemporaneous with the latter unit.

The fauna was originally identified by S. Savage (unpub. list) upon whose records the brief published accounts (Tratman *et al.* 1971, Tratman, 1975, Hawkins and Tratman, 1977) are based. More recent work has shown some of Savage's records to be erroneous, most notably the warm stage species *Hippopotamus amphibius* (hippo), *Palaeoloxodon antiquus* (straight tusked elephant) and *Dicerorhinus hemitoechus* (narrow nosed rhino). The demise of this supposed interglacial fauna necessitates a radical shift in the interpretation of the site.

A revised species list is shown in table 2. The fauna forms a coherent assemblage through the whole sequence, with no evidence of any major change in the species present over



SECTION A
LINE N/02



SECTION B
LINE E/10

SECTION C
at DM E/3.0 m

Figure 3. *Sections of the deposits in Rhinoceros Hole. Locations of the sections are shown in figure 2.*

the period of deposition, or of any obviously derived elements. It comprises a classic Middle Devensian assemblage, dominated by *Ursus arctos* (brown bear), *Crocuta crocuta* (spotted hyaena), and *Coelodonta antiquitatis* (woolly rhinoceros). The presence of Coelodonta suggests the cave was in use as an hyaena den since this species was a preferred prey item of the latter animal.

	Rhinoceros Hole Layer												Hyaena Den	Badger Hole
	1	1a	2	3	2a	2al	2ar	3a	3aE	5	7	6		
Canis lupus				X				X	X	X				X
Vulpes vulpes			X					X	X	X	X	X	X	
Vulpes/Alopex sp.														X
Ursus arctos				X		X	X		X	X	X	X	X	X
Crocuta crocuta				X		X	X	X	X	X	X	X	X	X
Felis sp.														X
Mustela sp.										?				
Lutra lutra														X
Meles meles									X	?				X
Mammuthus primegenius				X					X					
Coelodonta antiquitatis					X		X	X	X	X	X	X	X	X
Equus ferus					X	X		X	X	X		X	X	X
Rangifer tarandus								X	X			X	X	?
Megaloceros giganteus														X
Large cervid				X				X				X	X	
Bos/Bison sp.				X	X		X	X	X			X	X	X
Ovis/Capra sp.														X
Sus Scrofa													?	
Lepus timidus								X					X	
Citellus sp.										X		X		
Microtus gregalis											X			
Microtus sp.	X	X			X				X	X				X
Arvicola terrestris		X							X					
Lemmus lemmus											X			
Dicrostonyx torquatus										X	X			X
Inderterminate Rodent							X			X	X			
Sorex sp.									X					
Bat									X					
Bird										X				

Table 2: *Fauna of Rhinoceros Hole. Faunal lists for the Hyaena Den (Tratman et al. 1971) and Badger Hole (Campbell, 1977) are given for comparison*

A few species are unlikely components of a Middle Devensian mammal fauna, notably the bat and *Meles meles* (badger) which is almost certainly a Holocene intrusion. The recent animal burrows penetrating deeply into the deposit may be attributable to badgers, and would account for these anomalous elements.

During the original excavations the microfauna were not systematically collected. Most of the species recorded were recovered during sedimentary analyses after the excavation was completed. Thus the microfauna are under-represented: the apparently restricted distribution of some species (i.e. *Citellus* (ground squirrel)) is likely to be an artefact of the sampling scheme.

THE ARTEFACTS

Six unequivocal flint artefacts were found low in the Rhinoceros Hole sequence during the UBSS excavations, and are considered in detail here. Besides these, a further small fragment (M41.5/2) was found higher in the sequence in Layer 3a, and Tratman (unpub. diaries) also recorded a number of possible worked bones and limestone flakes. None of these show definite signs of utilisation and they do not merit further consideration.

The six definite artefacts (Figure 4) are described in detail in appendix 2. Four are referable on typological grounds to the Middle Palaeolithic; a *bout coupé* handaxe (M41.5/9) and three handaxe trimming flakes (M41.5/10, M41.5/14 and M41.5/16). Of the remaining two, one (M41.5/11) is an indeterminate waste flake. The other is an unusual invasively retouched blade, which has some similarities with Early Upper Palaeolithic leaf points, and is therefore attributed to the Early Upper Palaeolithic.

Most of the pieces came from Layer 6. M41.5/16 (one of the handaxe trimming flakes) was in an animal burrow in Layer 6, and was probably derived from that layer. M41.5/14 (another handaxe trimming flake) was at the junction between Layers 5 and 6. M41.5/15, the fine retouched blade, certainly occurred in Layer 7. The remainder, including the handaxe (M41.5/9) and a handaxe trimming flake (M41.5/10) came from the reddened layer within Layer 6. The available evidence suggests that the artefacts may all belong in this reddened layer at the base of the Layer 6 silts, or its lateral equivalent, the Layer 7 cave earth. Of the two which were not found in this position, one was certainly disturbed. The occurrence of the retouched blade at a similar stratigraphic level to the Middle Palaeolithic handaxe might be taken to imply that they might be coeval. However Layer 7 might represent a significant hiatus in the deposition of Layer 6 and there is no need to suppose that they are even broadly contemporaneous. In support of this, R. Jacobi (*pers. comm.*) has observed that all the implements have suffered significant mechanical damage suggesting that they may have been exposed for some time before burial.

The Rhinoceros Hole artefacts seem on typological and technological grounds to derive from two phases of Palaeolithic occupation, both of which are also represented at other Mendip sites and elsewhere in the South-west, most notably at Kent's Cavern: Mousterian and Early Upper Palaeolithic. Traces of Mousterian occupation, in the form of small-scale occupations of caves and a scatter of open site finds, are distributed widely over southern Britain. By comparison with the numerous and often prolific Continental occurrences, they suggest only rare visits to Britain by small groups of people (Roe, 1981). Such Mousterian visitors would

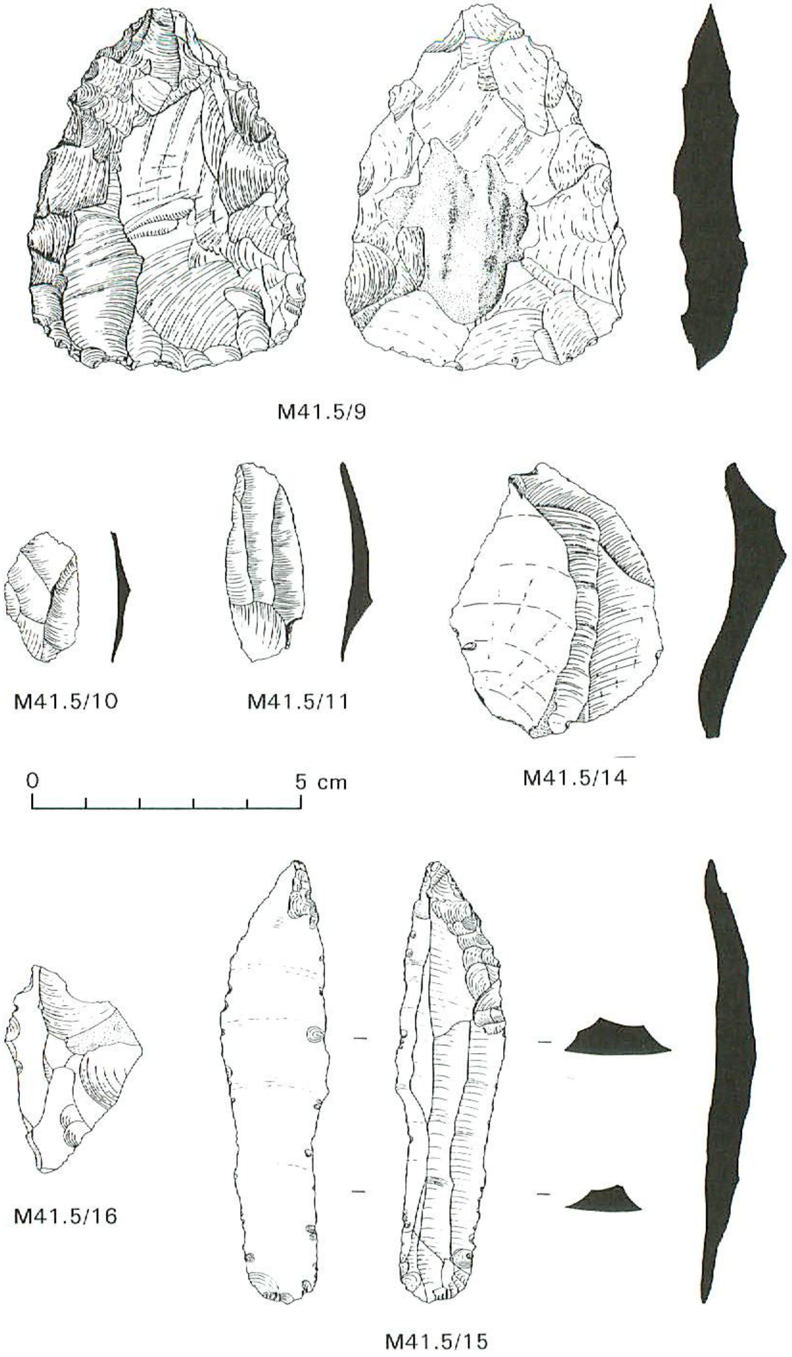


Figure 4. *Artefacts from Rhinoceros Hole. See text for description.*

have had to travel a long way before they came to habitable caves like those of the Mendips, and when they did reach the caves they would have found themselves leaving the areas of abundance of good quality flint. This may explain why none of the British caves has produced Middle Palaeolithic finds rich enough to suggest that it saw prolonged occupation as a base camp. The small quantities of artefacts which usually occur look more like evidence for brief stops made during occasional distant forays. In the particular case of the Wookey Hole caves, the evidence from the Hyaena Den as well as that from Rhinoceros Hole suggests that only a few implements were made by the Mousterian visitors, in a situation of scarce raw material where it was necessary to rework blunted handaxes rather than throw them away and make new ones. The small size of the artefacts could be interpreted in the same way. Such as they are, however, they are entirely typical of the Mousterian in Britain, which appears wholly to belong to the West European Mousterian of Acheulian tradition, and probably to the early version of it well seen in Northern France.

The Early Upper Palaeolithic of Britain is again a rather sparse phenomenon (Campbell, 1977) and may well also represent occasional brief visits to Britain, by small bands of hunters, probably during the summer months of periods of less extreme cold during the late Middle Devensian. There are no signs of really densely occupied sites, and the same factors concerning the distribution of the caves and of raw material would apply. Far fewer stray finds of Early Upper Palaeolithic material in open country are yet known, however, than is the case for the Mousterian. Radiocarbon dates (Allsworth-Jones, 1986, Gowlett *et al.* 1986a, 1986b, Hedges *et al.* 1989) suggest that the British Early Upper Palaeolithic comes fairly early in the general West European sequence. The leaf points are the most striking pieces, though somewhat rare in absolute quantities. Their presence in Britain in the approximate time range of 28 to 39 ka suggests the affinities of the British Early Upper Palaeolithic lie in Central and Eastern Europe, including Poland, rather than with the classic sequence of Southwest France (Allsworth-Jones, 1986). We should probably think accordingly of groups of people occasionally reaching as far as Britain in their movements westwards from those areas by way of the North European Plain and its continuation across what is now the Southern North sea. The fine blade from Rhinoceros Hole, and the Early Upper Palaeolithic artefacts from the Badger Hole and the Hyaena Den, are evidence for one such visit or more than one.

AGE OF THE DEPOSITS

Speleothems occur associated with the deposits in two situations. Detrital fragments occur buried within the sediments, and in the lower tunnel an *in situ* floor has been left suspended as a relict feature in the roof above the deposits. This hanging floor, and four fragments of detrital speleothem were sampled for uranium series analysis. Samples were dated using standard analytical and alpha counting methods modified from those of Gascoyne (1977). The results are shown in table 3.

All the samples had a very low uranium content (the highest measured was 0.045 μg/g) and produced low yields of both uranium and thorium, possibly due to organic contamination (revealed by frothing during sample dissolution). In addition most samples were significantly contaminated by detrital thorium with $^{230}Th/^{232}Th$ ratios as low as 1.59. The ages were

Sample No.	Name	Yield		U	$\frac{^{234}\mathrm{U}}{^{238}\mathrm{U}}$	$\frac{^{230}\mathrm{Th}}{^{234}\mathrm{U}}$	$\frac{^{230}\mathrm{Th}}{^{232}\mathrm{Th}}$	Age (ka)	
		U%	Th%	µg/g				Uncorrected	Corrected
6720	M41 . 9-59	57	1	0.121	1.411±0.016	0.627±0.062	1.59±0.22	101 (86–118)	51 (32–71)
6721	M41 . 9-8a-A	9	18	0.034	1.266±0.050	0.492±0.020	2.19±0.10	71 (67–76)	45 (41–50)
6722	M41 . 9-29D	29	7	0.036	1.163±0.030	0.633±0.032	3.67±0.38	105 (97–115)	86 (76–97)
6724	M41 . 9-26B	12	11	0.045	1.450±0.065	0.402±0.027	11.2±2.0	54 (50–59)	51 (45–56)
6725	M41 . 9-26C	36	5	0.025	1.230±0.041	0.631±0.056	38.2±32.2	104 (90–120)	–
6734	RH-90 -1D	–	–	–	–	–	–	–	–

Table 3. *Uranium series analyses from Rhinoceros Hole. Due to almost total thorium loss, no extended alpha spectrometry was carried out for RH-90-1D*

corrected for contamination using method 1 (equation 8) of Schwarcz (1980). This method is known to be unreliable when applied to grossly contaminated samples. Taking this into account, with the low uranium contents and low yields, the ages obtained must be treated with some caution. Due to the general unsuitability of the speleothem for dating, no attempts were made to analyse further samples.

The hanging speleothem in the lower tunnel (RH-90-1D) must predate the whole sequence, but no age was obtained due to almost total thorium loss. A broken stalactite from the top of Layer 6 (M41.9/59) yielded an age of 51 (32-71) ka: however with a thorium yield of only 1% this is perhaps best ignored. The remaining samples were obtained from Layer 3a. M41.9/29, a flowstone floor slab, yielded an age of 86 (76-97) ka. Another slab of the same floor (M41.9/26) yielded a basal age of 51 (45-56) ka and a middle age of 104 (90-120) ka. Finally a mammillated subaqueous speleothem (M41.9/8a) yielded an age of 45 (41-50) ka.

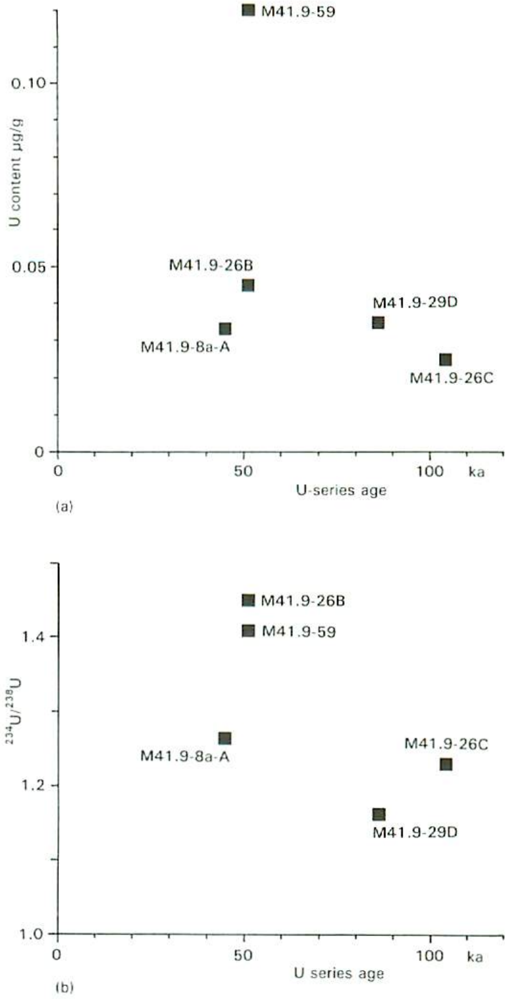


Figure 5. *Uranium series analyses from Rhinoceros Hole. (a) Graph of uranium content against uranium series age. (b) Graph of 234U/238U ratio against uranium series age.*

The morphology of the bases of the flowstone blocks (M41.9/26 and M41.9/29) suggests that they grew on top of subaqueous speleothem similar to, and presumably coeval with, M41.9/8a. The ages obtained are thus clearly stratigraphically inverted, confirming that there are major problems with at least some of the analyses. Detrital contamination cannot be the sole cause, since such contamination produces an overestimation of the sample's age, but the oldest age obtained was from the cleanest sample. The cause is probably leaching of the samples, which is likely to have been more severe in detrital blocks of limited size such as these.

A plot of uranium content against calculated age for the samples (Figure 5) shows that the samples (M41.9/29D and M41.9/26C) with 'old' ages of around 86 to 104 ka have low uranium contents. These same samples have the lowest $^{234}U/^{238}U$ ratios (Figure 5). This suggests that they have been leached, since leaching tends to result both in bulk uranium loss and preferential removal of ^{234}U. Support for this interpretation is provided by the fact that it is these samples which produced the oldest ages: uranium loss through leaching will result in an erroneously old age being obtained. By contrast the higher uranium contents and $^{234}U/^{238}U$ ratios of the remaining samples suggests they have not been leached and are more likely to produce reliable age estimates. As noted above, M41.9/59 suffered almost total thorium loss in analysis. M41.9/8a-A and M41.9/26B, from the broken flowstone floor in Layer 3a, produced uncorrected ages of around 71 and 54 ka, providing a maximum age for the floor. The good agreement between the corrected ages, at around 45 and 51 ka, suggests an age for the floor of around 45 to 50 ka. An age of around 50 ka is perhaps most likely: M41.9/26B, dated at around 51 ka, is much less detritally contaminated than M41.9/8a-A. Moreover, the N.W. Europe speleothem growth record shows widespread speleothem growth occurred before 49 ka, but little from 49 to 46 ka (Baker *et al.* 1993), supporting an age of around 50 ka for the floor.

M41.9/8a, M41.9/26 and M41.9/29 were all fragments of a broken speleothem floor represented by many blocks in Layer 3a. They clearly predate the enclosing sediments: however, the relationship between the dated speleothems and the underlying sediments is less clear. The speleothem is unlikely to have grown in the position it now occupies since its structure shows it grew in a deep cave, but the sediments show Rhinoceros Hole was already unroofed before the deposition of the present sediment sequence. Thus the floor must have collapsed down from above. It seems unlikely that it grew in a sealed cave on the steep slope above during the deposition of the lower part of the Rhinoceros Hole sequence. Rhinoceros Hole must have been open (probably much as it is today) before this sequence started to build up. It is difficult to imagine how another sealed cave could have existed upslope, and been subsequently destroyed without far more associated collapse than is evident at the site. Thus it is probable that the floor represents a relict feature left hanging high on the walls of the alcove or in the upper tunnel when an earlier fill was washed out. Subsequent collapse of this floor would have left the jumbled mass of fragments found in Layer 3a. This suggests that the speleothem predates the entire sediment sequence. The age inferred above for the floor, at around 50 ka, can thus be taken as an indication of the maximum age of the sediments.

DISCUSSION

The sedimentary sequence at Rhinoceros Hole shows considerable similarities with the other ravine caves, the Hyaena Den and Badger Hole. At the Hyaena Den, a fossiliferous cave earth with a rich *Crocuta* dominated fauna and Middle and Early Upper Palaeolithic industries overlay basal waterlaid sand and clay (Boyd Dawkins, 1874, Tratman *et al.* 1971). In Badger Hole an Early Upper Palaeolithic industry and associated fauna overlay waterlaid sands (Balch, 1947, Campbell, 1977). Thus all the caves preserve a basic sequence of basal water laid sediments overlain by deposits containing faunal remains (table 2) and artefacts of Middle to Early Upper Palaeolithic industries.

Collcutt (1985) noted that the similarities between the caves might suggest a similar coherent sequence in each cave, but that considerable difficulties were posed by the distribution of the caves, one above the other on the hillside. Thus any direct correlation of deposits between the caves would imply that streams were flowing at different levels at around the same time.

A possible explanation of these features is provided by valley aggradation. It has been inferred above that Rhinoceros Hole was dry before the deposition of the Layer 6 sands. The presence of a subaerial cave earth (Layer 7) interstratified with the waterlaid sediments of Layer 6 implies further fluctuations of water levels in the cave. Such periodic flooding suggests the valley floor may have become filled with sediment, which would have raised the water table and caused flooding. Further support for this hypothesis is provided by the composition of the Rhinoceros Hole Layer 6 sands, which suggests they were deposited by the Wookey Hole stream and that the valley floor lay at (or above) the level of the cave at that time. Such a process of valley aggradation well explains the occurrence of water laid deposits in caves at different altitudes since each could have been flooded within a short period as the valley floor became choked with sediment.

The probable cause for such valley floor sedimentation was the Ebbor Gorge and Rookham dry valley systems, which debouche into the Axe valley just downstream from the Wookey Hole ravine. These dry valleys are believed to have been active during cold stages of the Pleistocene, when permafrost and sediment choking of influent caves restored surface runoff from the Mendip plateau (Ford and Stanton, 1968). The arrival of large volumes of sediment in the Axe valley would have resulted in the deposition of an alluvial fan blocking the exit from the Wookey Hole ravine. Macklin and Hunt (1988) have mapped gravels of probable Devensian age in the valley about 1 km downstream from the Wookey Hole ravine. They suggest that these gravels represent the remains of an alluvial fan fed by the Ebbor Gorge and Rookham dry valley systems, strongly supporting the above hypothesis.

The presence of water laid sediments in Badger Hole implies that aggradation might have reached at least the level of this cave at 76 m O.D., which would have deeply buried both Rhinoceros Hole (at 67 m O.D.) and the Hyaena Den (at 62 m O.D.) (Stanton, 1973, figure 1). The latter two caves could have been cleared out by the stream as it cut back down through the aggradation deposits and exposed them. In both Rhinoceros Hole and the Hyaena Den, cave earths with similar rich *Crocuta* dominated faunas (table 2) occur overlying water laid sediments. It seems likely that these cave earths are contemporaneous. Such a correlation is supported by the presence in the Hyaena Den of a thin layer of waterlaid silty clay underlying the cave earth (C.J.Proctor, unpublished data). This might have been deposited by the same flooding event that left the Layer 6 silts in Rhinoceros Hole (any flooding event in Rhinoceros Hole can be expected also to have flooded the Hyaena Den, which lies at a lower level). If so, the thin Layer 7 cave earth in Rhinoceros Hole, which underlies the Layer 6 silts, may predate the Hyaena Den cave earth. This is of interest since Layer 7 yielded a blade referred to the Early Upper Palaeolithic, which would be expected to postdate the Middle Palaeolithic industry of the Hyaena Den. However Layer 7 in Rhinoceros Hole was overlaid only by a thin deposit of Layer 6 silts, with a void above: the possibility that the blade is a late intrusion cannot be discounted.

Collcutt (1985) suggested that the entire Rhinoceros Hole sequence above Layer 6 had been reworked. This was based upon the supposed presence of mixed warm and cold faunal elements, as well as on the loose, rather undifferentiated nature of the sediments. This interpretation is undoubtedly correct for the sediments themselves, in the sense that the accumulation of subaerial cave earths necessarily consists mostly of reworking of material from upslope by a combination of wash, soil creep and collapse. However, the fauna is now known to comprise a coherent Middle Devensian assemblage with no obviously derived elements and there is no reason to suppose it has been reworked. Furthermore, Rhinoceros Hole has much in common with a number of other British cave sites with Middle Palaeolithic industries, including (besides the Hyaena Den) Creswell (Jenkinson, 1984), Kent's Cavern (Campbell and Sampson, 1971) and Coygan Cave (Clegg, 1969, Aldhouse-Green *et al.* 1995). At all these other sites Middle Palaeolithic industries similar to that at Rhinoceros Hole have been found associated with Middle Devensian cold stage faunas. Thus Rhinoceros Hole fits into a known pattern of Middle Palaeolithic occupation, increasing confidence that the deposits are *in situ* and contain no radically older derived fauna or artefacts.

Such assemblages have been ^{14}C dated at Coygan Cave and Robin Hood's Cave, Creswell, yielding age estimates of around 38-40 ka (Allsworth-Jones, 1986, Aldhouse-Green *et al.* 1995). These really lie beyond the range of reliable ^{14}C dating, but provide a good minimum age for the Middle Palaeolithic. This is supported by the presence of such industries, with their associated faunas, below the Early Upper Palaeolithic (at Pin Hole, Creswell and Kent's Cavern: Jenkinson, 1984, Campbell and Sampson, 1971). The Early Upper Palaeolithic has been ^{14}C dated to between 26 and 38 ka (Allsworth-Jones, 1986, Burleigh, 1986, Gowlett *et al.* 1986a, 1986b, Hedges *et al.* 1989). The maximum age of the Devensian Middle Palaeolithic is less well known and the age of less than around 50 ka tentatively inferred for Rhinoceros Hole, despite its associated problems, represents a useful addition to a meagre data set. This age agrees well with the age of around 64 ka obtained for speleothem predating the Middle Palaeolithic at Coygan Cave (Aldhouse-Green *et al.* 1995), and the tentative attribution of the Kent's Cavern Middle Palaeolithic to less than 74 ka (Proctor, 1994).

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APPENDIX 1: the remaining sediments

The sediments of Rhinoceros Hole were examined and sampled by S.N. Collcutt in 1978 and 1979, after excavation had been completed. Two sections left by Tratman on the southern edge of the site were examined and are still extant, though now much overgrown. In addition to these sediment samples were collected by the excavators and are still available for future analysis.

Figure 6 is a semi-schematic section of the deposits examined. Sediment samples are numbered and referred to below as "RH". The original layer notation of the excavation has been retained, with numbered subdivisions in brackets where necessary. Sediment matrix colours are given in Munsell notation: the colours were recorded on site (damp, late autumn).

MAIN LOCUS (AREA C) N/01 SECTION.

(a) ROCK FLOOR: major vertical calcite vein in Triassic Dolomitic Conglomerate.

(b) LAYER 6(4): 3.75YR 3/4 (RH 1-3). Clayey silts; extremely compacted; some fine laminations but highly distorted; much decomposing calcite, otherwise no carbonates. (The unit sampled by this and the next three samples comprises the Layer 6 silts).

(c) LAYER 6(3): var. c.5YR 4/4 (RH 4,8). Mass of calcite clasts and grit decomposing in clayey matrix. Probably structural (vein) rather than depositional.

(d) LAYER 6(2): var. c6.25YR 4/5 (RH 5-7). Clayey fine sand and silt; extremely compacted; no apparent bedding; some decomposing calcite, otherwise no carbonates. No bone.

(e) LAYER 6(1): var. 7.5 to 5 YR 4/4 (RH 9-16). Clay and silt lenses; extremely compacted; signs of compression and plastic distortion in westerly direction; weak prismatic structure especially near base induced by loading; tongues of material from 6(4) and 6(3) injected into base; little sand, including FeMnAl nodule (concentric shells); rare calcite grit, otherwise no carbonates. No bone. Upper boundary moderately distinct but highly contorted and rising steeply to south.

(f) LAYER 5: 5YR 4/4 at top, darkening to 3/4 downwards (RH 17-20). Very stony, sandier near top, clayier towards base including distinct pockets and rafts under stones; well compacted; no preferential orientation of stones; common conglomerate clasts, moderately altered and differentially etched; some altered calcite; weak surface concretions; sands include calcite grit, FeMnAl aggregates and nodules, heavily altered crinoid ossicles, angular grey chert, irregular shiny quartz grains, carbonate concretions; matrix carbonates moderately rich near top, becoming rarer at depth. Common bone, including much sand sized debris. Upper boundary moderately abrupt, undulating.

(g) LAYER 3aE(2): 5YR 4/5 with "buff" speckles (RH 21). Very stony, silty clay; quite compact; stones mostly large calcite clasts, some conjoinable, with weak alteration and surface concretions; sand fraction includes rare, very altered crinoid ossicles, FeMnAl aggregates and nodules, rare carbonate concretions, irregular shiny quartz grains; common calcite grit in two quite distinct conditions – unaltered or almost totally decayed; small decayed stalagmite (?) fragments (speckles); carbonate rich. Common bone. Diffuse upper boundary.

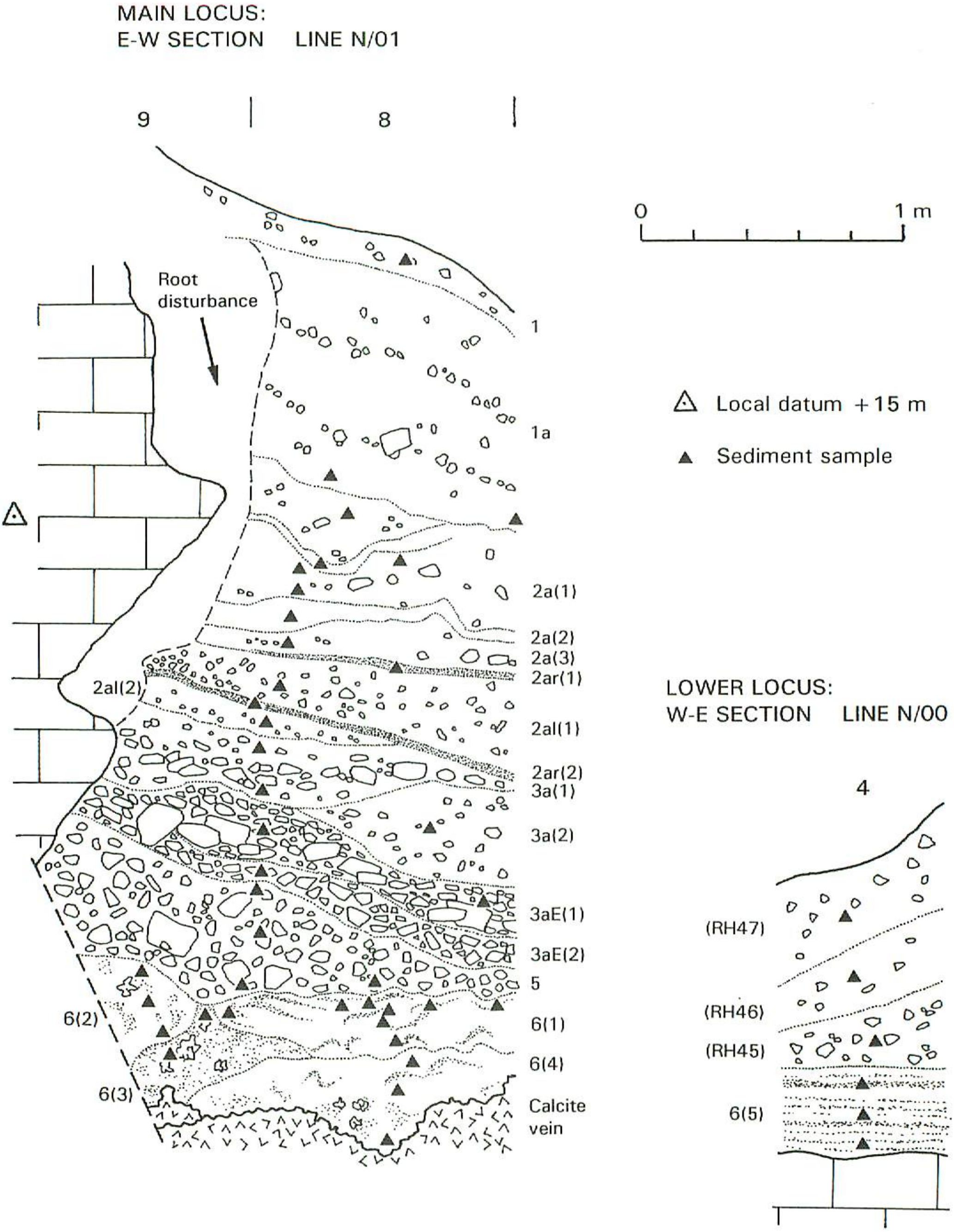

Figure 6. *The 1978-79 sampled sections showing sample sites.*

(h) LAYER 3aE(1): 5YR 4/4 (RH 22,23). Very stony, clayey; quite compact; sub-horizontal preferential orientation of stones; rounded conglomerate blocks, up to 25 cm; calcite clasts in two distinct conditions – unaltered and moderately altered with varied surface concretions; much calcite grit, again in two conditions; rare sand sized FeMnAl aggregates; very weak polyhedral structure in fines near top – stable surface?; carbonate rich. Very common bone, including sand sized debris. Sharp, undulating upper boundary.

(i) LAYER 3a(2): 6.25YR 4/4 (RH 24). Randomly oriented large stones in calcareous silt; quite compact; mostly calcite but some Dolomitic Conglomerate, with moderate surface concretions; calcite grit and carbonate concretions. Very rare bone. Rather diffuse upper boundary.

(j) LAYER 3a(1): 5YR 4/4 (RH 25,26). Clayey silt with large conglomerate clasts and increasing calcite with depth, all slope oriented, especially in the middle where the deposit is rather matrix-poor; rather loose; surface concretions and carbonates stronger towards base; slightly altered calcite grit. Rare bone. Distinct upper boundary.

(k) LAYER 2al(2): 6.25YR 4/4 (RH 27). Silty clay with small calcite clasts, slightly altered with weak surface concretions; rather loose; calcite grit and sand sized carbonate concretions; carbonate rich. Rare bone. Rather diffuse upper boundary.

(l) LAYER 2ar(2): 5YR 4/6 (RH 28). Silt with very common calcite grit and sand; rather loose; calcite slightly altered with weak surface concretions; very rich in carbonates. Rare bone. Rather diffuse upper boundary.

(m) LAYER 2al(1): 6.25YR 4/6 (RH 29). Clayey silt with calcite sand and some larger weathered calcite clasts; well compacted; surface concretions including a little organic matter; carbonate rich. Rare bone. Rather diffuse upper boundary.

(n) LAYER 2ar(1): 5YR 3/6 (RH 30). Clayey silt with very common calcite grit and sand; quite compact; varied but no extreme alteration. No bone. Upper boundary rather diffuse.

(o) LAYER 2a(3): 5YR 4/5 (RH 31). Clayey silt with calcite sand and a few large clasts; quite compact; varied alteration and surface concretions; common calcite grit; very rich in carbonates. Common bone, including much sand sized debris. Quite distinct upper boundary.

(p) LAYER 2a(2): 6.25YR 4/4 (RH 32). Clayey silt with only small calcite and conglomerate clasts, moderately altered with strong surface concretions; loose; rich in carbonates and sand sized carbonate concretions. Rare bone. Rather diffuse upper boundary.

(q) LAYER 2a(1): 5YR 4/5 (RH 33-35). Clayey silt and some calcite sand with large calcite and conglomerate clasts; moderate alteration and surface concretions; disturbed (burrows) and loose towards top but quite compact at base; carbonate rich throughout but particularly at base (sand sized concretions). Some bone near base only. Upper boundary quite distinct.

(r) LAYER 3: 5YR 4/4 (RH 36). Variable matrix of silty to gritty (calcite) clay, with some small mostly conglomerate clasts; moderate alteration and surface concretions; fine stone line at base; quite loose; some clay balls up to 4 mm; moderate carbonates. Bone and mollusca. Rather diffuse upper boundary.

(s) LAYER 2: 5YR 4/4 with light specks (RH 37). Clayey silt, altered calcite clasts with a little conglomerate, all with strong surface concretions; extremely loose, no apparent structure; patches of calcite sand with carbonate concretions. Mollusca, no bone. Quite distinct upper boundary.

(u) LAYER 1a: 2.5YR 3/2 (RH 38,39). Badly sorted matrix including silt, clay, and calcite sand and grit, with conglomerate and a few calcite clasts, all heavily altered; some stone lines; very loose especially at base (burrows, modern root layering) but slightly compacted upper surface; carbonate and humus rich; weak crumb structure. Recent and fossil bone, mollusca. Distinct upper boundary.

(v) LAYER 1: 5YR 3/2 (RH 40). Very similar to 1a but a distinct depositional event.

(w) MODERN SURFACE.

WESTERN LOCUS (AREA A) N/00 SECTION.

(a) ROCK FLOOR: Triassic Dolomitic Conglomerate.

(b) LAYER 6(5): 7.5YR 4/5 with dark flecks (RH 42-44). Quite clean fine to medium sand with a clay/silt component mainly in aggregates (clay balls); well compacted; horizontal bedding clear and generally undisturbed; sand contains well silicified, polished crinoid ossicles, varied dark minerals, spherical highly polished quartz grains, FeMnAl nodules; some heavily altered calcite grit and carbonate rootcasts near top, otherwise no carbonates. Rare bone only at top. Abrupt upper boundary. (This unit comprises the Layer 6 sands).

(c) Above 6(5) are three deposits (RH 45,46 and 47) that appear to represent material of units 5, 3 and 2 respectively. All these layers are finer (less stones and more clay) than any possibly corresponding deposit in the Main Locus.

APPENDIX 2: Description of the artefacts

The artefacts are now in the possession of Wookey Hole Caves Ltd. The writer (D.A. Roe) was able to see some of the originals, though not to make a proper examination, and this report was prepared in 1978 on the basis of a study of casts of excellent quality, supplied by Professor Tratman. A few references of later date have been added. The descriptive information given here should certainly be accurate as far as it goes, though anyone using it for really detailed specialist purposes will certainly wish to see the original objects. The measurements given here are taken from the casts and are maximum dimensions, measured parallel or at right angles to the long axis of each piece as appropriate.

(a) M41.5/9. Length 69.0 mm; breadth 51.8 mm; thickness 15.0 mm (Figure 4). Flint, now white patinated. This is a small bifacially worked handaxe, with a cutting edge extending right round its circumference. The section is somewhat plano-convex rather than evenly lenticular, but any notion that this might have arisen from the implement's being fashioned from a flake rather than a pebble is quickly dispelled by the presence of a large patch of cortex on the flatter face, covering indeed about a quarter of it. It was not feasible for this patch to have been removed by the maker, because it is uneven, with deep indentations, and there would have been hardly anything left of the piece of flint if it had been flaked away; he or she evidently got rid of a good deal of it, and to have achieved so flat a face and so thin a profile without sacrificing the overall regularity of the outline is no mean feat. The handaxe's shape is subtriangular, and it can be placed confidently in the general class to which the name *bout coupé* has been given (Roe, 1968, Mellars, 1974, Tyldesley, 1987). A distinctive feature of the *bout coupé* handaxes is the neat round angles of the meeting between the convex sides and the straight or slightly convex butt which is usually as finely worked as the sides themselves. British *bout coupé* handaxes range from cordiform and square-butted ovate to sub-triangular, and the standard of workmanship is invariably high. The present writer has discussed the British specimens in some detail and recorded over a hundred examples (Roe, 1981), offering the view that they fall outside the range of Acheulian handaxes and belong specifically to the Mousterian of Acheulian tradition.

This particular example is small, though others of a similar size are certainly known. It may in fact have been a little larger originally, since the tip appears to have been resharpened: there is a slight break in the outline, accompanied by a reduction in the size and change in the nature of the scars over the last inch of length up to the tip on the more domed face. There is a small swelling here which the maker was evidently at some pains to remove, though the attempt failed, leaving a collection of hinge and step fractures as evidence. The other major flake scars on this implement are flat and shallow, suggesting the use of a "soft" hammer, made of antler, bone or wood rather than stone. There are small handaxes generally similar to this one from the Hyaena Den (Tratman *et al.* 1971) and from Uphill Cave no 8 (Harrison, 1977).

(b) M41.5/16. Length 39.0 mm; breadth 23.5 mm; thickness 10.0 mm (Figure 4). Flint, very similar to the last in physical state. This is only a small waste flake, but the small platform and bulb, the curved profile and the disposition of the four main scars and the patch of cortex on the dorsal face announce it clearly as a handaxe trimming flake – a waste product of the manufacture of a bifacial implement such as that described above. The colouring and texture of the raw material, the nature of the cortex and the physical condition of the piece, all tempt one to suggest that it may well have been struck off in the making of M41.5/9, but this seems beyond actual proof. Though relatively thick at the point of maximum convexity, the flake appears to have been struck with a soft hammer.

(c) M41.5/10. Length 24.3 mm; breadth 14.2 mm; thickness 3.0 mm (Figure 4). Flint, whitish with very slight traces of ochreous staining. This is a very small and flat waste flake which, like M41.5/16, is a classic handaxe trimming flake removed at a late stage from a finely worked implement. It has lost a certain amount by crushing and snapping from each end, some perhaps at the time of striking and some probably after deposition. The lost areas include the actual point of impact and the tiny platform, but there can be no doubt that this is another soft hammer trimming flake and it probably came from an implement much like M41.5/9. The dorsal surface is wholly covered by portions of flat convergent scars left by the previous removal of other trimming flakes like this one whilst the implement underwent its final thinning and shaping. The profile again has the typical curve.

(d) M41.5/14. Length 50.6 mm; breadth 39.5 mm; thickness 11.5 mm (Figure 4). Flint, now with creamy-white patina and a thin wash of orange staining here and there, mostly near the edges. This is again a waste flake with all the classic features of a handaxe trimming flake detached at a late stage of manufacture with a soft hammer; curved profile, thin platform, diffuse bulb. It has four dorsal scars and terminates in a snap fracture: very probably the original flake broke into two at the moment of striking and somewhere there is, or was, a distal fragment that would conjoin with this rather than merely a step feature on the implement that was being flaked. This specimen could well belong with the other handaxe trimming flakes in this group of material.

(e) M41.5/11. Length 37.0 mm; breadth 14.8 mm; thickness 5.0 mm (Figure 4). Flint, greyish white patination slightly different from the creamy white of the other pieces. To the writer, this is the only piece of the six whose nature is not entirely clear. It is a rather small blade-like flake, with slight damage to the edges but no retouch. The platform is amongst the damaged areas, and must have been very thin while the bulb was clearly flat and diffuse. This is a waste piece, and could be either another handaxe trimming flake, of a somewhat atypical kind, or else a small blade struck off during the reduction of a blade core and not selected for use or retouch. The lengthwise trend of the scars on the dorsal surface make the latter more likely, the scars on a handaxe trimming flake normally being convergent. This piece would be perfectly at home amongst the debitage of a Mesolithic or perhaps an Upper Palaeolithic flaking site, but it is not really diagnostic of any particular period or industry and there is no point in trying to make it so.

(f) M41.5/15. Length 82.0 mm; breadth 20.4 mm; thickness 10.0 mm (Figure 4). Flint, patinated white with small areas of thin orange-brown staining near the edges, mainly on the dorsal face. This is a fine blade of medium size, invasively retouched to provide a fine, flat, pointed implement, probably some form of projectile point. The technology of the blank itself (which is certainly from a blade core and is not a flake whose shape is elongated by chance) and of the retouch (neat, shallow, regular, invasive scars) both separate this artefact from the first four described, though perhaps not from the fifth. The retouch is almost confined to the dorsal surface. On the bulbar surface there are four small shallow scars at the tip end and two at the extreme butt end which are all likely to be deliberate, though the edges of the piece have clearly also suffered some damage. The bulb and platform are not present, but the blade certainly appears to be punch-struck. The principal retouch on the dorsal side involves at least eleven invasive scars at the tip end, all from the right side as drawn. The tang-like appearance of the lower half of the blade is not however the product of retouch: the blade here is essentially as it left the core, with a slight fortuitous constriction.

There is nothing like this piece anywhere in the British Mousterian, and we must accordingly turn to the Upper Palaeolithic if we are seeking parallels with it. It would appear far more likely from its general shape and style of retouch to belong to the Earlier Upper Palaeolithic than to the Late Upper Palaeolithic (Campbell, 1977, Mellars, 1974) and the writer suggests that it lies towards the outer margin of the general class of leaf points which are important in the Earlier Upper Palaeolithic of Britain and certain parts of the continent. It is not notably leaf-like in its shape, but the classic foliate points do grade into invasively retouched pointed blades and the retouch is often unifacial or only partly bifacial. The European leaf points of this period have been extensively studied by Allsworth-Jones (1986). There is no space here to discuss the various British occurrences of leaf points (for which see Campbell, 1977) but some of the best examples come from Mendip caves (particularly Badger Hole and Soldiers Hole). Others come from Kent's Cavern (Torquay), Paviland Cave (Gower), Cae Gwyn (St Asaph) and Robin Hood's Cave (Creswell Crags, Derbyshire). While the present writer has not himself seen any piece precisely like this one, there are points of reasonably close resemblance in some of the artefacts from Badger Hole which lies only a very short distance from Rhinoceros Hole itself. Indeed since the diagnosis of the piece given here is necessarily a purely typological one, the existence of the Badger Hole material nearby is somewhat comforting. There is also some clearly Earlier Upper Palaeolithic material amongst the surviving or recorded artefacts from the Hyaena Den (Tratman *et al.* 1971), even closer at hand, including one broken leaf point, now in the Oxford University museum, and some good blade fragments (same collection and Wells Museum).

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