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The Hyaena Den (Wookey Hole), Mendip Hills, Somerset

ST532479 U.B.S.S. Cat. No. M35
Height 208 ft. O.D.

By

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ABSTRACT

The excavations at this Pleistocene site were undertaken to re-establish and amplify the stratification given by Boyd Dawkins It was found that the previous excavators had cleared out the deposits to rock floor over most of the cave so the main objective could not be directly achieved. The evidence is reviewed, particularly that for the stone implements. These fall into Late Middle Palæolithic (Mousterian) and Early Upper Palæolithic (proto-Solutrean) groups. There is no Creswellian. The fauna, pollen and soil analyses indicate a time span from the end of the Eemian inter-glacial through the Weichsel glaciation to post-glacial times.

SOURCES

The main sources of information about the site are the accounts by Boyd Dawkins (1862, 1863a, 1863b, 1906). These accounts are to some extent repetitive. The one in "Cave Hunting" (1874) contains information not included in the earlier papers. The J. Parker *m.s.* in the Geology Department of the University Museum, Oxford, include coloured plans and sections, which have obviously formed the basis for those published by Dawkins. They provide a little extra information. These accounts are

supplemented by Balch in his "Wookey Hole" (1914). He gives 1892 as the year in which the collapse of the roof of the cave took place at the back of the outer chamber. This produced the now (1970) large roof opening.

Garrod (1926) has written on the flint implements and there are discrepancies between her account and the original ones by Dawkins. But it is known that she was dependent, as a post-graduate student under Dawkins, to some extent on his personal recollections rather than on his original papers.

INTRODUCTION

The cave is formed in Dolomitic Conglomerate of Triassic age. It is in a ravine. This is closed at the north end by a cliff, within which lies the Great Cave of Wookey Hole. At the base of the cliff the river Axe rises. The Hyaena Den lies close to the left bank of the river about 50 metres downstream.

The cave was discovered accidentally in 1852 during the cutting of a mill leat. This date is supported by documents of the mill company concerned (W. S. Hodgkinson & Co.). Yet the first notice of the discovery is by Jones (1858), who, (p. 36), puts the year as 1857. No explanation for this discrepancy is offered. It is unimportant for this paper. Bones and teeth from the cave were presented by Dr. Boyd of Wells to the museum of the Somersetshire Archæological Society at Taunton.

About 12 ft. of the mouth of the cave and its contents were cut away and the material used to form an embankment for the west side of the leat or canal. The form of the original entrance is thus unknown. By analogy with the similar cave of Badger Hole nearby it can be assumed that the original entrance was wider and higher than the present one.

In 1970 the present entrance is low, 2·5m, and wide, 15m. This leads to other passages (*Fig.* 40). In 1852 the first part of the cutting for the mill leat was through solid rock and then the workmen unexpectedly encountered only earth and stones. The mass completely filled and concealed the cave mouth, the existence of which, according to the workmen, was not marked by any depression on the surface (Dawkins 1862, p. 116). In the superficial material several hundred Roman coins, mainly in silver, were found in a broken pot and were distributed amongst the men. They also found a bone bed about 1 ft. thick resting on the rock floor of the cave. The layer contained many teeth of woolly rhinoceros, hyaena and other animals. One workman is said to have sold 2 cwt. of upper molars of rhinoceros to a bone merchant in Wells (Dawkins 1863b, p. 200). Some

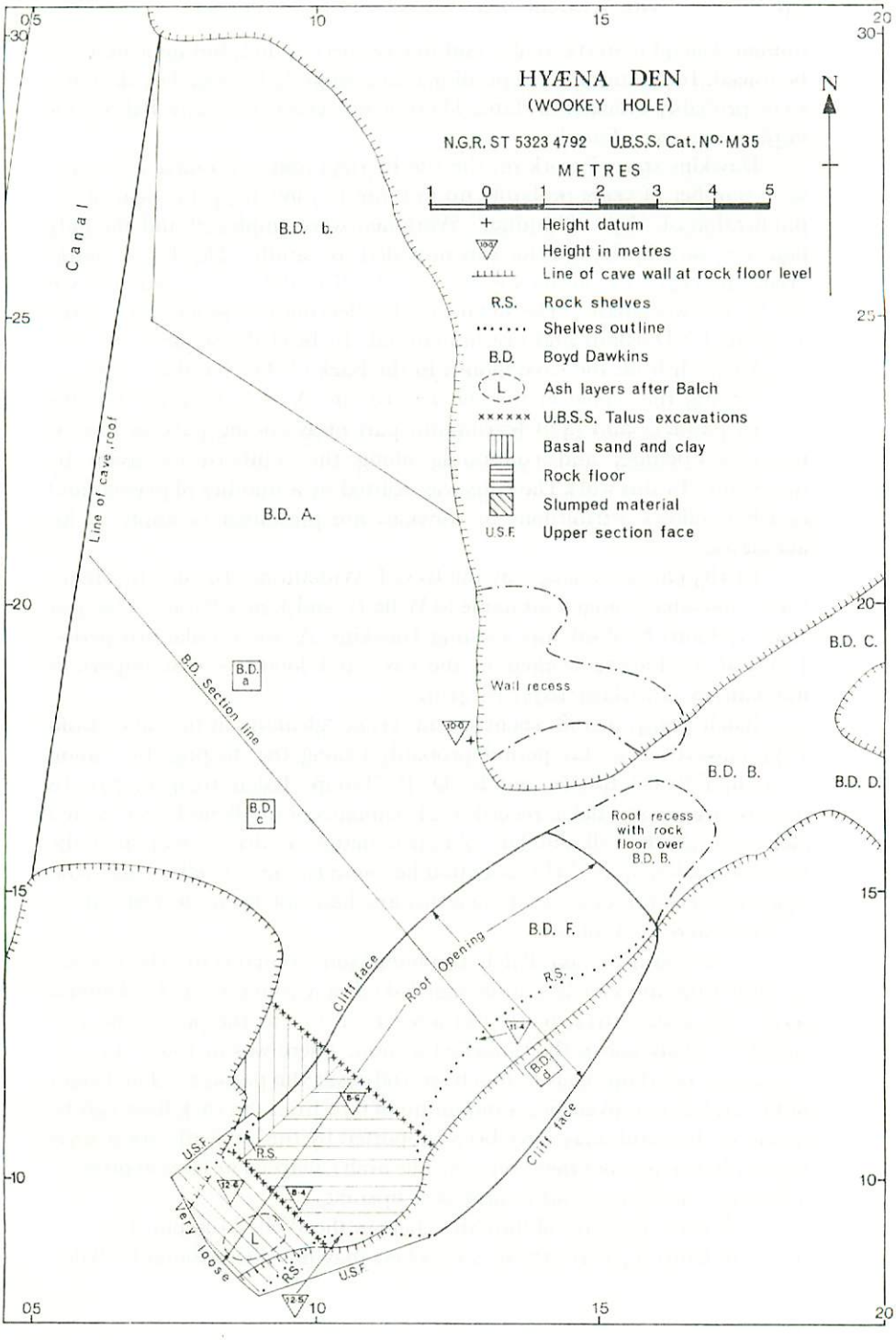

Fig. 40. Plan of cave.

human skeletal material is also said to have been found, but none of it can be traced. Its stratigraphical position is not properly known. The skeletons were probably Roman in date. There is no record that any Palæolithic implements were found.

Dawkins started work on the site in 1859 and continued seasonally for a number of years probably up to if not beyond 1874, the year of the publication of "Cave Hunting." Workmen were employed and the only light for work in the interior was provided by candles. Dawkins remarks (1862, p. 117) "I examined every shovel-full of debris as it was thrown out by the workman." The details of the clearing out process are in the accounts by Dawkins and are immaterial. In brief the sequence was:— (1) A trench from the cave mouth to the back of the chamber (*Antrum*), (2) clearing the whole of the *Antrum* (*fig.* 40, A), (3) Clearing out the eastern passages and (4) Clearing out part of ascending passage F, now the roof opening, and continuing along the southern extension by tunnelling. In this work Dawkins was assisted by a number of persons and in what follows attributions to Dawkins are presumed to apply to his associates.

In 1859 he was assisted by the Rev. J. Williamson. In 1861 by Henry Catt (who later changed his name to Willett), and James Parker. The next year Ayshford Sanford was assisting Dawkins. At some unknown period J. Wickham Flower worked in the cave and found several important implements (Dawkins 1874, p. 318).

Balch (1914, p. 168) spent several years "gleaning in the cave" from 1877 onwards. To this period probably belong the diggings by Canon Church, Edward Brooks and R. D. R. Troup (Balch 1929, p. 77). In the eastern passage Balch records that remnants of the Bone Layer existed along the north wall but he "obtained better results by searching the floor for small fissures." He states that he found two jaws of elk [*Megaloceros giganteus*]. He presumes that these fissures had not been cleared out by Dawkins and back-filled.

In the south passage Balch also found some remains in "the gravel" including the more or less undamaged skull of a young bear. He found a series of hearths (1914, p. 168) at a level "as low as the present floor of the Den". This was in the tunnelled section. There was in 1887 "an arch of gravel, very dangerous to touch (p. 168) over the passage". The height of the arch is not given but a minimum of 6 ft. from the rock floor can be deduced. The arch may have been supported by timber work (see *p.* 252) though Balch does not mention any. The arch collapsed in 1892 to produce a massive talus slope and a large roof opening.

There are six items of flint and chert in the Wells Museum. Four are shown in figure 44B (16, 17, 20, 21). These may have been found by Balch

or his friends. Two were almost certainly so, for their labels state "probably contemporary with charcoal," the charcoal being, presumably, the hearths mentioned in the preceding paragraph. The others have no accompanying information. Balch was friendly with Dawkins and it is not impossible that the others were lesser finds from the original dig, presented by Dawkins. They are exhibited separately in Balch's original arrangement of the material. There is also exhibited (desk case 16) a piece of worked reindeer antler presented by F. Brooks in 1895. The butt end is broken (*Pl.* 22C).

At some unknown date and over an unknown period the cave was developed as a show cave and was so used, according to Donovan, till about 1930. (See plates facing p.72 in Balch 1929). This was probably the time when the layer of ash and clinker found in the U.B.S.S. excavations was put down over a considerable area of the floor.

When Dawkins started work the cave was full to the roof. Rabbits and badgers had made but little inroads, so the deposits were essentially

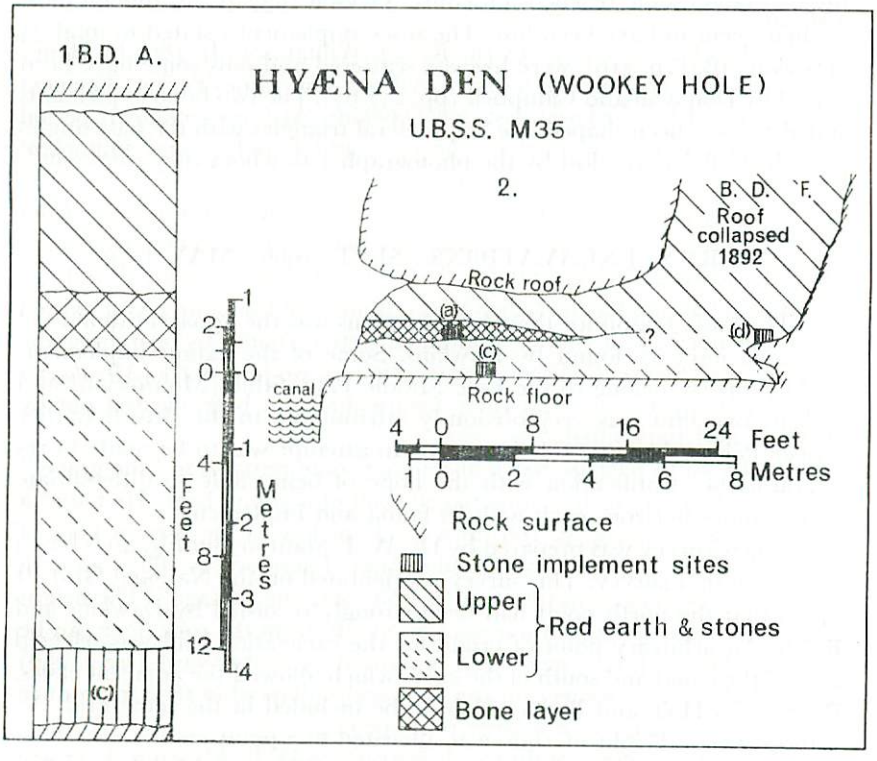

Fig. 41A. Sections after Boyd Dawkins (B.D.) A and F (1863, *figs.* 2 and 3).

undisturbed. He found three main areas where stone implements, not all of flint, lay (*fig.* 40 (*a*), (*b*), (*c*)) and a solitary implement at (*d*). The Bone Layer consisted of three black bands of manganese peroxide, which contained "many splinters of bones". Above each was a mass of bones and teeth. The layers first sloped down, inwards from the mouth, then rose fused and "became scarcely traceable". The Bone Layer was underlain by red earth and stones containing "few organic remains." In passages B, C and D, only partly shown in *fig.* 40, the Bone Layer was close to the roof with practically nothing above it. In these areas the Bone Layer was not continuous nor did it seem to be continuous with that in A. The sections in *fig.* 41A are based on those by Dawkins. The many pieces of calcite reported by Dawkins in the deposit can only have come from the several veins of the material in the rock. One major vein crosses area A. These veins would break down even more readily than the conglomerate under conditions of frost weathering.

The animal bones and teeth were distributed between Dawkins and his associates. Some reached museums (Jackson 1937, p. 20) though most of them seem to have been lost. The stone implements, stated to total 35 (Dawkins 1874, p. 310), were likewise scattered and only some have been traced by Donovan and Campbell (pp. 257-67). The two bone implements stated to have been shaped like "equilateral triangles with the base angles smoothed off" were "lost by the photographer to whom they were sent".

U.B.S.S. EXCAVATIONS. SEPT. 1966—MAY 1970

The basic reason for these investigations was the apparent duality of the stone industry found by Dawkins. Some of the extant implements could properly belong to the Late Middle Palæolithic [Mousterian] and at least one flint was very obviously attributable to the British Earlier Upper Palæolithic (proto-Solutrean). An attempt was to be made to re-establish the stratification with the hope of being able to differentiate two or more horizons each with its fauna and implements.

A new survey was prepared by Dr. W. I. Stanton and *Fig.* 40 is based on part of that survey. This survey is orientated on the National Grid. It shows that the north point had been wrongly recorded by Dawkins and Balch. An arbitrary point of origin for the excavation grid was selected west of the canal and south of the cave, which allowed the adjacent caves, Rhinoceros Hole and Badger Hole to be included in the same grid. An arbitrary base height of 10m. was allocated to a point on the rock floor of the outer chamber, the *Antrum* of Dawkins. The actual height is 208 ft. O.D.

The work was not continuous. Sondages were put down in the *Antrum*, immediately east of this and in passage B. The whole area was shown to have been dug to rock-bottom by Dawkins. Most of the area had been covered with a layer of ash and clinker.

The next step was to obtain a clean section of the deposits starting from the surface at the south end of the roof opening. The cutting was taken down to natural rock ledges, which sloped down to the cave and which were undercut. The actual gap between the ledges was less than one metre. (*Fig.* 41B). In the course of this work, in the central part of the face, evidence of a single collapse into the cave below was found, thus confirming Balch's account. There had been subsequent minor weathering.

The Upper Section (*Fig.* 41B) is largely self-explanatory. The deposits rest on rock save over the gap into the cave. The position of the soil sampling sites is shown. The southwestern part of the Upper Section was approximately along the strike. It showed only the features given in *Fig.* 41B. Layer (1) was humus and dark earth with stones and many tree roots. This changed quickly into (2a), which was a yellow, silty clay with

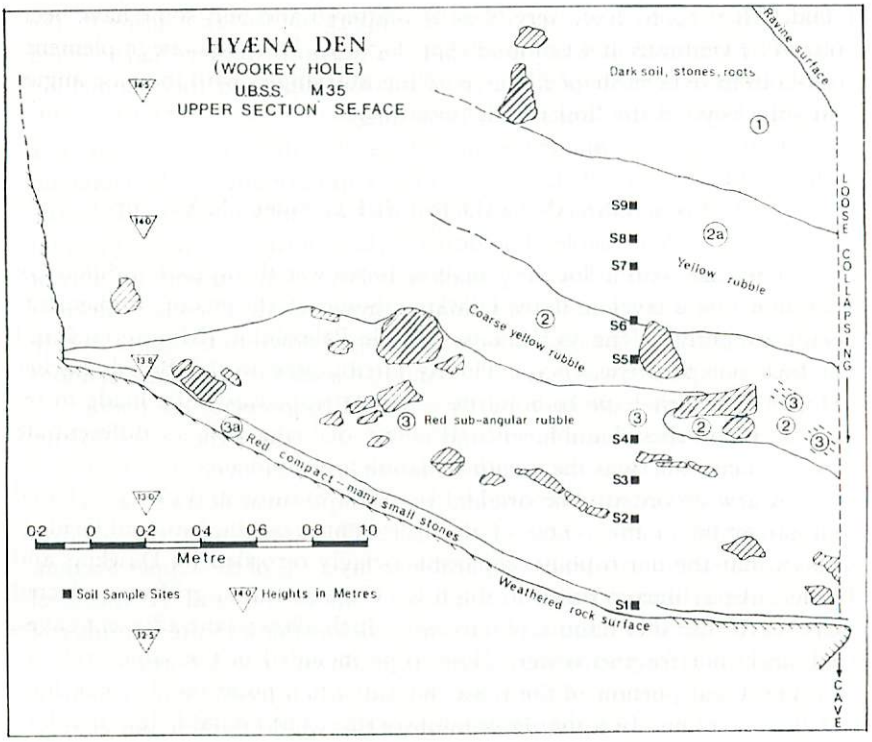

Fig. 41B. Upper Section. Southeast face.

large quantities of calcite derived from veins in the parent rock. In the upper part the crystals were small but they increased in size deeper in the layer (2) and became even more numerous so as to comprise about 30% of the mass.

Layer (2) rested, with an abrupt transition, on layer (3), which was composed of red earth and stones. Only close to the roof opening was there evidence of intermingling of layers (2) and (3). Layer (3) was a red rubble of small stones and finer material. It was, if allowance is made for the nature of the parent rock, essentially angular. Layer (3) passed without a break into a much more compact and brighter red layer (3a). This was thin and merged into the weathered rock surface. The upper layers were archæologically sterile. Only (3) and (3a) contained a few bones and teeth. The bones from (3a) included the two halves of the mandible of a bear. The fauna is shown in table 1. The nature of the deposit is described in Appendix 1.

Finally the sloping mass of talus produced by the collapse of 1892 was tackled. It involved moving many tons. There was ample evidence of a single main collapse. In the course of this work remains of timbers were found. They could have served as a support for the roof prior to the collapse. Eventually it was found that the previous workers had reached rock-bottom over most of the area of the sounding and their tunnelling had gone beyond the limits of the sounding.

On the west side and extending out east for about 1m. from the rock wall was a basal layer of clay, grey on first exposure but rapidly changing to a brown. It rested directly on the bed rock and pick marks made by the earlier diggers were visible. The upper surface of the clay was horizontal and nearly flat with a few very shallow hollows. On top with an abrupt transition was a layer of unconsolidated brown sand. The clay thickness varied according to the rock floor which sloped down to the south, where the thickest exposure was 0·4m. The sand had a uniform thickness of about 0·2 m. but it may have been partly removed by previous excavators.

On top of these basal layers and to the east, where they were absent, down to bed rock, was the collapse material. A face over 3 m. high was exposed and recorded. The original pre-collapse stratification was quite well preserved in the centre of the face. The upper part was a fairly uniform sub-angular rubble comparable to layer (3) of the Upper Section. It was entirely barren down to the first m. above the sand. At this level there was a thin silty band across the face. Below this a limited number of teeth and bone fragments were found right down to rock bottom.

The basal portion of the mass showed, when freshly cut, a lightish red/brown colour. In a matter of minutes this would darken and change to the uniform red/brown of layer (3) of the Upper Section.

The fauna represented in this fallen material is shown in table 1 (Talus Trench). The dominant animal was horse. Hyaena was relatively scarce though many of the bones and teeth had been gnawed. From a level just above the brown sand came a piece of animal rib (*Pl.* 22B). This had been sawn off the main piece by man and one end was slightly polished. Along one side were several incised lines.

It is emphasised that none of the talus material was strictly stratified. It was fallen material but the relative position of finds to each other more or less represents the relative position of the finds in their original relationships.

By this stage over 30 tons of material had been moved. There seemed but little chance of finding undisturbed material so the excavation was abandoned. The southern fissure had become narrower and could be seen to become narrower still beyond the face of the cutting. On the surface above the Upper Section no evidence for the continuation of the fissure for more than a few feet could be seen. The cut rockface southwards along the line of the canal from the cave mouth was solid so there could be no profitable length of cave unexplored in that direction.

The U.B.S.S. trench was lined with polythene sacks. Some of the shuttering used to support the north face was left in position. Later the area was partly back-filled with spoil from the excavation of Rhinoceros Hole. This spoil contains a quantity of lime and the bones of a modern cow that had been buried in the lime.

DISCUSSION ON THE EXCAVATIONS

The excavations described did not achieve their main objective. Dawkins had done more in the cave than had been realised. In the southern passage his account did not give any true idea of the extent of the clearing out that was done. Balch (1914, *pl.* 31) gave a broad hint as to the possible limits of the clearing.

At the south end of passage C Dawkins describes a barren grey clay, which, apparently, had come in through a roof opening. It rested on a barren layer of sand (1874, p. 307). He also mentions a barren grey clay in his ascending passage F, which is now the northern end of the roof opening. It is shown (1863, *fig.*3 d) as commencing—the digging was from below upwards—well above the cave floor. This grey clay was above the layers already described (p. 252). It is impossible to reconcile this clay with the basal clay *overlain* by sand in U.B.S.S. Talus Trench. One may speculate that Dawkins' clay was the finer portion of layer (2) of the Upper Section for, after all, Dawkins was working by candle light.

The basal silty-clay found by U.B.S.S. was non-plastic. Its position and nature mark it as a deposit laid down over a period from successive floodings of that part of the cave by more or less still water, which formed a pool here. The sand above could be the product of a single flood though the original thickness prior to Dawkins' work is unknown. Both deposits were laid down when the cave was used by the river running at a level at least 5 m. above its natural present level.

The workmen described the bone layer as being one foot thick and resting directly on the rock floor at the now-destroyed entrance. Dawkins started 12 feet in from this and found the Bone Layer was divided into three parts by layers of manganese peroxide, and overlying a Lower Red Earth and Stones. This contained "few organic remains" and went down to the bed rock. The manganese layers were full of bone splinters and each was overlaid by a mass of bone fragments and teeth. In the outer (west) part of the Antrum Dawkins' sections show the manganese subdivisions, especially the uppermost, sloping slightly down into the cave before beginning to rise, unite and disappear towards the back of the Antrum. He claims that the fused layers could be traced up and east on to the shelf on which implement (d) was found. This claim is contradicted by his *fig.* 88 (1874, p. 304) and also by the drawing numbered 3d in the Parker *m.s.* The upward slope to (d) is over an increasing thickness of the Lower Red Earth. Above this was an Upper Red Earth similar to the lower in every way. The passages B, C, D were largely filled by the Lower Red Earth and the Bone Layer, a single discontinuous deposit here, was close to the roof of the passages. In C, where the floor sloped up, it rested directly on the rock floor (1874, p. 306, *fig.* 90). The lack of continuity between the various portions of the Bone Layer could imply differences in the time of deposition. There is no means of deciding this point. On the whole contemporary formation seems the more likely interpretation.

The stratification implies that the main source of infilling of the cave was weathering products from the hillside and that these entered the cave through what was then, and again now is, an extensive roof opening. At the back of the *Antrum* (A) this material spread over the floor of the cave and was always deeper at the back. It spread into the side passages. In the outer parts of the *Antrum* the slope of the constituent parts of the Bone Layer implies a secondary route of infilling through the entrance with some acceleration of the rate of accumulation from the material brought in by hyaenas and man during the actual formation of the Bone Layer. A further entry route for in-filling material in the lateral passages B, C and D could have been down the vertical shaft, now choked, at the far end of Dawkins' passage D (1863, *figs.* 1 and 2).

The evidence of the use of the cave by man is referred by Dawkins

to four distinct areas (a–d) (*fig.* 40). The first area found was (a), (1862, p. 117). Here were found "one white flint spear-head of rude workmanship, one chert arrow-head . . . Two rudely fashioned bone arrow-heads . . .". All were found between dark bands of manganese and in "contact with some hyaena teeth". The spear-head is the implement usually figured in accounts of the cave (*e.g.* Dawkins, 1862, *figs.* 2–5 and here *fig.* 42(3)). There is no doubt of the association of man and the Bone Layer material though this does not imply that man and beasts, particularly the hyaena, were using the cave together, but presumably alternately over the period. The single implement (d) was found on a ledge in direct association with a tooth of hyaena and ashes (1874, p. 208). The Parker *m.s.* labelled 3d adds the information that the mass was partly cemented with stalagmite. The *m.s.* drawing also shows the Bone Layer ending well short of the shelf, and with no indication that the layer could be traced to rise on to the shelf. So (d) could well be later than the Bone Layer. Unfortunately there is no evidence to show whether this collection of ashes was a part of the layers of ash described by Balch (1914, p. 168). His account implies that the hearths were considerably lower than (d) and so earlier. Neither at (d) nor at Balch's hearths would it have been possible to have had fires unless there was a roof opening through which the smoke could escape.

Area (b), "where the roof and the floor of the cave gradually met together" (1874, p. 203) "furnished innumerable fragments of charcoal and many flint implements associated with the remains of horse, rhinoceros and hyaena." It is not expressly stated that these implements and hearths were directly associated with the Bone Layer. The area is close to, if not originally continuous with, the entrance area where the workmen declared that the Bone Layer rested directly on the bed rock. The bias of the evidence is towards grouping the material from (b) with (a) making both contemporary with the formation of the Bone Layer.

Implements belonging to group (c) are in quite a different category. They were found "*underlying* layers of peroxide of manganese and comminuted bone as in the case of those [group (a)] I described in my former paper" (1862, p. 262). But Dawkins contradicts himself here about group (a). See above. The position of group (c) on the rock floor well below the Bone Layer is also demonstrated in the Parker *m.s.* 3f.

Thus the implements of group (c) are stratigraphically earlier than any of the others as they rested on rock floor, which was here 3–4 ft. below the Bone Layer. No known individual implements can be allocated to this group. It is possible that the hearths recorded by Balch were contemporary with (c), for he described the hearths as being "at a level as low as the present floor of the den" and it is known from Dawkins and U.B.S.S.

excavations that the level of the floor was close to or at bed rock at the time of Balch's gleanings. As there were several layers of hearth material (1914, p. 168) they would indicate intermittent occupation. In this same area and at an undefined higher level Balch (p. 169) found an almost complete skull of a young bear. It was probably the only complete bone from the whole cave. The very fact that it was complete makes it highly probable that it post-dates the Bone Layer. It cannot ante-date that layer.

In *figure* 41A the position of implement (d) is taken from Dawkins (1874, *fig.* 83). Its position implies that the infilling of the cave had progressed so far that there was only a low creep under the rock arch to the cave mouth. So it is possible that by this time access was down the talus slope rather than through the mouth of the cave from the valley floor. On the stratigraphical evidence, such as it is, implement (d) is more recent than (a) and (b) and certainly more recent than (c). It is tempting to correlate (d) with the unifacial leaf point (*fig.* 44A (12)) and to put it as the latest in the sequence. Proof there is none.

The U.B.S.S. Talus Trench yielded scanty animal remains and one piece of animal rib that has been humanly worked (*Pl.* 22B). Its true stratigraphical position could not be determined. If allowance is made for the tunnelling and subsequent collapse this piece must have come down from a level well up in the deposits and thus stratigraphically considerably later than even implement (d).

In the Upper Section excavations the only layers to yield animal remains were the base of (3) and the bright red (3a), which gave most of the specimens and which rested on the rock ledges. Only a limited exposure was made. The animals represented are set out in table 1. The bear remains, which were from (3a), included the complete halves of the mandible of a young adult bear. The halves were disarticulated. The left side showed an old healed wound produced by a heavy blow from a blunt pointed object. It is considered that only man could have struck such a blow. The jaw was fractured, the bite of the teeth disarranged and several teeth were lost. One was eventually replaced by a bony outgrowth (*Pl.* 22A). The bear must have had a suppurating fracture for a considerable time.

The completeness of the bones argues for a pre- or post-Bone Layer date. The position of the jaw on the ledge suggested that it had slid down the slope and had come to rest on the edge of the drop into the cave. The jaw was in (3a), which the soil and pollen analyses (Appendix 1, p.270) show as probably belonging to the final stages of the Eemian or at the latest to the opening stage of the Weichsel glaciation. The layer is present on both sides of the roof opening on the shelves shown in figure 40. The most feasible explanation is that even by this time there

was sufficient in-filling of the cave to form a bridge across which (3a) could be laid down in this area from one side to the other.

The abrupt transition from (3) to (2) is puzzling. Its equivalent occurs at other sites so that it is a general and not a specific feature for the Hyaena Den. It is possibly the result of a fairly rapid change in climate commencing with a period of erosion. The coarseness of (2) could be due to rapid erosion under cold conditions. (See also Appendix 1).

At the present day it comes as a surprise to see how much of the floor of the main cave below the roof opening receives direct sunlight over so many hours daily. Under scrub vegetation, not woodland, the original entrance would have received quite a lot of sunshine in the afternoons though it is doubtful if the sunlight would have penetrated as far back, east, to the whole of area (b). The mouth area of the cave is nowadays dry and probably always was so. After frost cold air rolls down the side of the ravine through the roof opening into the cave and ice will form where there are drips from the roof. Even a single night of frost followed by thaw produces a steady fall of material from all round the roof opening. Under colder conditions with scrub vegetation cover the weathering rate would be substantially increased. The nature of the conglomerate assists rapid weathering so that thick deposits could form rapidly in this particular cave.

THE STONE ARTEFACTS

DESCRIPTION OF THE FINDS

The human artefacts were dispersed to many collections and not all can now be traced. Apparently excavators kept their own finds and on the joint excavations the finds were shared out. Boyd Dawkins' share is at the Manchester Museum, James Parker's at the Pitt-Rivers Museum, Oxford, and Wickham Flower's in the Geology collections of the University Museum, Oxford. Some of Henry Catt's collections went to Brighton Museum but no artefacts are now preserved there. Ayshford Sanford's bone collection is at Taunton, but again no artefacts are to be found there. There are plaster casts at Manchester and photographs at Oxford of artefacts which have not been traced. It is uncertain whether, but perhaps improbable that, these casts and photos represent all the missing artefacts.

No artefacts were found during the U.B.S.S. excavations. Many of the artefacts from the earlier digs have not been described or figured. The only evidence as to the number found is the figure of 35 implements in a

table published by Dawkins (1874, p. 310). The question is whether this figure refers to all pieces of flint and chert or to finished implements only. There is evidence for eleven implements and 26 flakes and cores from the early excavations, a total of 37. The writer believes that Dawkins' 35 refers to the total known to him, some found by other excavators not having been seen by him. The alternative, that 24 implements (i.e. bifaces, etc.) have been lost, seems improbable.

The artefacts described below are made of flint unless noted otherwise.

The drawings of the implements numbered 1, 2, 5, 6, 8 and 12 are by Mr. T. L. Gwatkin.

1. Pitt-Rivers collection, Oxford, *ex* J. Parker coll. (*fig.* 42(1)). Inscribed in faded brown ink 'WkH,' and more recently 'Wookey Hole/J. Parker/P. R. Coll.' Figured by Balch (1914, *fig.* 30b, p. 167).

One side (*fig.* 42(1a)) and a little of the other shows broad, flat flakes on the scars of which 'ripples' are seldom conspicuous. They meet at very obtuse ridges. The secondary flaking, well shown in *figure* 42 (1b), is of a different character: the flakes were much smaller, their scars bear prominent 'ripples,' and they more often than not terminate in abrupt steps. In one or two cases the scar of the bulb of percussion remains, in the others it has been removed by later flaking. There is minor flaking and 'bruising' all round the edge, and two zones of severe damage, attributed to use. Some of the secondary flaking may have been sharpening to provide a fresh cutting edge. The damaged condition of the edge shows that the implement was used for working a hard substance, presumably bone or wood.

2. Oxford University Museum, no. S287 (*fig.* 42 (2)). Inscribed 'Wookey Hole' in Sollas' hand. Figured by Garrod (1926, *fig.* 21, no. 2): a very poor drawing.

The primary flaking on both faces consists of broad, very shallow flake-scars. On one side (*fig.* 42 (2b)) near the upper end (as figured) this flaking continues over a narrow ridge bounded by hinge fractures. There is minor flaking along the edges on both sides, some of which may be due either to use or to resharpening. A small part of one end of the implement has been lost by a comparatively recent break, seen at the top of *figure* 42(2a).

3. Bristol City Museum, no. F540, *ex* Dawkins coll. (*fig.* 42 (3)). Presented to the Museum by Mr. A. C. Pass in 1923. Figured by Dawkins (1862, *figs.* 2–5; 1874, *figs.* 84–87), whose illustrations have been reproduced in a number of other works. Also figured by Garrod (1926, *fig.* 21, 3).

One face (*fig.* 42 (3a)) is almost flat, the other gently convex. The flat face shows large, shallow flake-scars, those from one side extending two-thirds of the way across. These flakes originated outside the present limits of the implement and were struck before it was trimmed to its final form. The convex face bears several large flake-scars and some smaller retouch. Both faces show small, irregular scars round the edges possibly resulting from use. The side views given by Dawkins show the implement too thin; the 'butt-end,' which is the thickest part, is 13mm. thick. This end is truncated by a flat surface, whose patination is the same as that of the rest of the tool.

The implement could have been made from a large flake. It is the most elegant of the surviving bifaces from the site.

4. Formerly in Bristol City Museum. Destroyed in air-raids in 1940. Never figured.

Known only from a passing mention by Garrod (1926, p. 100) as an 'ovoid,' presumably (from the context) a biface. It is possible that this was no. 7, formerly in the Dawkins collection (like no. 3), of which the present whereabouts is unknown.

5. Manchester Museum, no. 1723 (*fig.* 43 (5)). Figured by Dawkins (1906, *fig.* 4) (a photograph).

On one side (*fig.* 43 (5b)) part of a single, almost flat flake-scar extends nearly the whole length of the implement. It has been cut into both sides by smaller scars, some ending in 'steps' or hinge fractures. The other, more convex face is covered by small flaking. This face also bears small scars all round the edge, the result either of final trimming or of use.

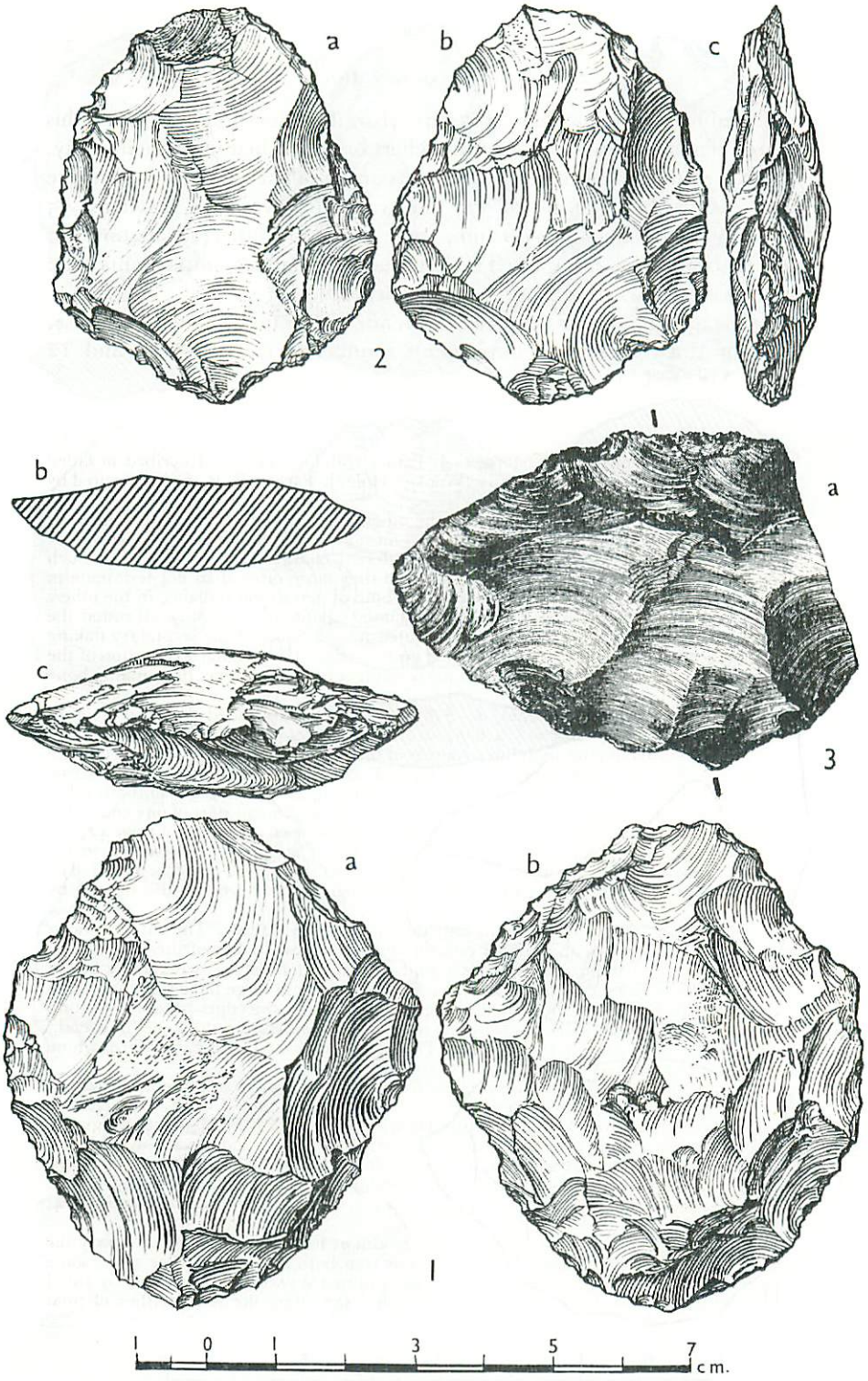

Fig. 42. Bifacial implements from the Hyaena Den. The numbers correspond with those in the text, where a full explanation will be found. No. 3 after Dawkins, 1862, *fig.* 3, with new cross-section added. All natural size.

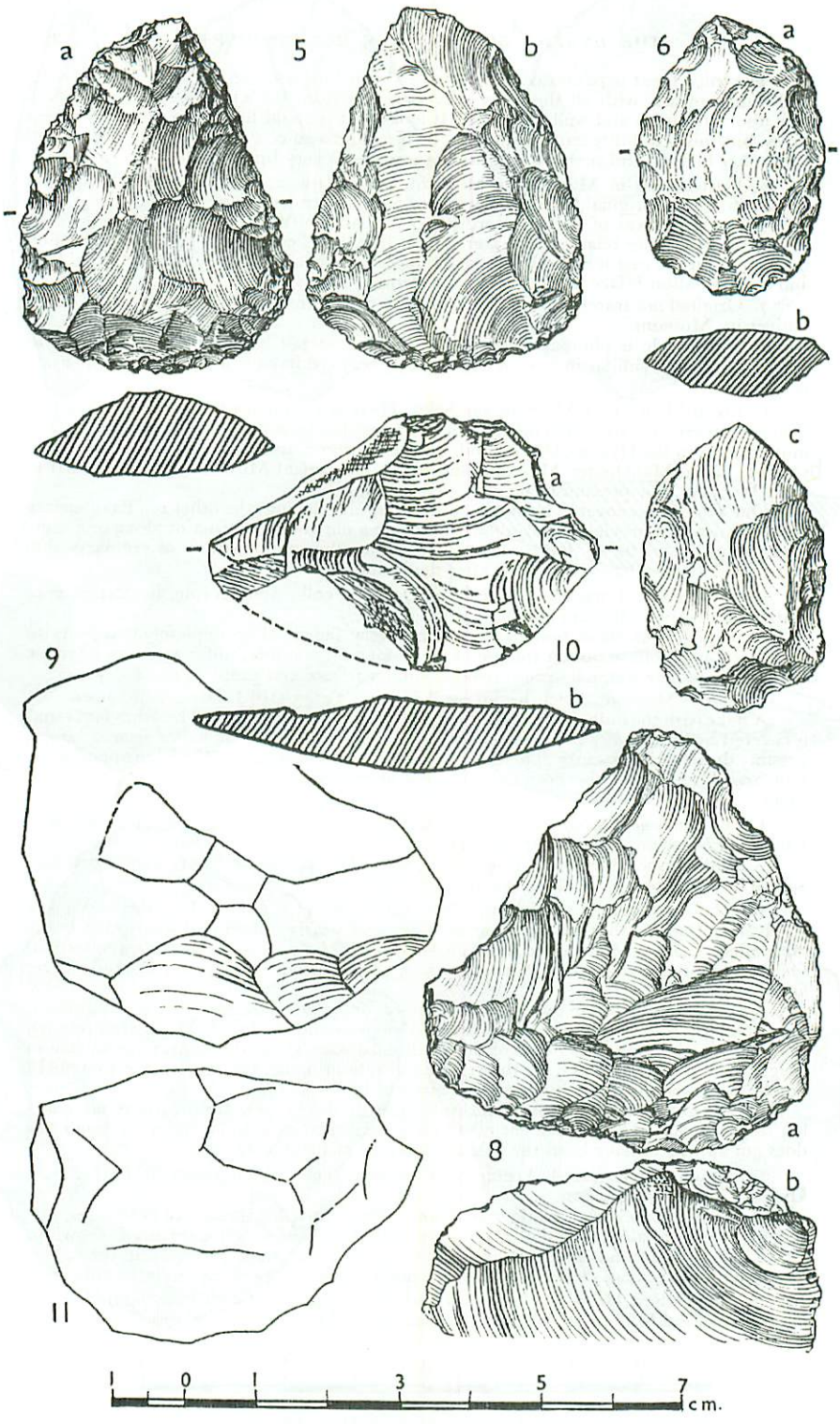

Fig. 43. Bifacial implements (5, 6) and related flints from the Hyaena Den. The numbers correspond with those in the text, where a full explanation will be found. Nos. 9, 11 are tracings from old photographs of lost implements. All natural size.

The implement is patinated grey, mottled with blue-grey on the more convex side, and thus contrasts with all the other surviving flint from the site which is dead white. It is also very sharp and well-preserved. It looks as if it could have been made in recent times, but this possibility can presumably be discounted since typologically it agrees well with other bifaces, and such an accurate forgery seems very improbable

6. Plaster casts in Manchester Museum, no. 1723:6, and the Geological Museum (*fig.* 43 (6)). The original has not been traced and has not been figured.

The original was of chert, according to the label of the Geological Museum cast. As with several other bifaces, there were larger flake-scars cut into by smaller ones round the edges, but the cast is not very sharp and little more can be said. It is only 40mm. long and is the smallest biface from the Hyaena Den.

7. Original not traced. Formerly in Dawkins coll., photograph in Parker *m.s.*, Oxford University Museum.

Only one side is photographed and hardly any detail is visible. The original was probably a biface, similar to 2, with trimming by resolved flaking. The greatest dimension is 59mm.

8. Oxford University Museum, no. S289. There is a comparatively recent inscription 'Kent's Cavern' on the implement, but this is evidently a mistake (? by Sollas). The implement is in the Hyaena Den exhibit, and old plaster casts in the Pitt-Rivers collection, Oxford, in the Manchester Museum, and in the Geological Museum are all labelled as from Wookey. Not previously figured. (*Fig.* 43 (8)).

One side (8a) is covered by small, rather irregular flaking: the other is a flake surface which truncates a previously flaked face, of which a narrow zone remains along one edge. This appears to be a large waste flake from the manufacture or resharpening of a biface. It may have been used after detachment.

9. Original not traced. Formerly in Dawkins coll., photographs in Parker *m.s.*, Oxford University Museum (*fig.* 43 (9)).

The photographs show both faces but are very faded. The implement appears to have been a flat biface, and a tracing of the flaking on one side, so far as it can be made out, is shown. The shape is semi-discoidal, similar in size and shape to no. 8.

10. Wells Museum, Balch Room, wall case 25 (*fig.* 43 (10)). History unknown.

A flake with the bulb, but none of the striking platform preserved. The other face (10a) is covered by broad, very flat flake-scars. It appears to be a flake detached from a biface, possibly during manufacture. There appears to be slight wear along the edge opposite the bulb and this edge has also been damaged by the removal of a crescentic piece in ancient times.

11. Original not traced. Formerly in Dawkins collection, photographs in Parker *m.s.*, University Museum, Oxford (*fig.* 43 (11)).

A small biface, maximum dimension 5·5cm. The photographs are very faded and appear to show broad, shallow flaking on both faces.

12. Oxford University Museum, No. S288 (*fig.* 44A (12)). Inscribed 'Wookey H/Hyaena Den' in Sollas' hand, over an older and nearly obliterated inscription to the same effect. Casts in Manchester Museum, Geological Museum, and Pitt-Rivers collection, Oxford. Figured by Dawkins (1906, *fig.* 5: 3 photographic views) and Garrod (1926, *fig.* 21, No. 1).

Both ends of the original flake have been lost or removed, but the breaks are ancient. What remains is part of a 'unifacial leaf point' or Jermanovice Point. The bulbar retouch is almost all from one side. Some of the small flake-scars along the edges must be due to usage, but the steep retouch on the right-hand side of figure 12a, giving rise to a slight notch, was intentional. Both edges show signs of use.

Both the ends were broken off and subsequently flaked, perhaps to trim rough edges left by the breaks. This implement could have been used as a end scraper although this does not appear to have been the primary purpose of these tools.

13. Original not traced. Formerly in Dawkins coll., photographs in Parker *m.s.*, Oxford University Museum.

A nearly parallel-sided blade 7·4cm. long. There are photographs of both sides; one shows elongated flake scars, the other is the bulbar face, of which a tracing is shown in figure 44A (13), and has shallow flaking all round one end, shown hatched in the figure. The original implement seems to have been a point like No. 12, perhaps similarly truncated.

14, 15. Oxford University Museum Nos. S440, S443. Not previously figured. Casts in the Geological Museum (both) and the Manchester Museum (No. 15) (*fig.* 44B (14, 15)).

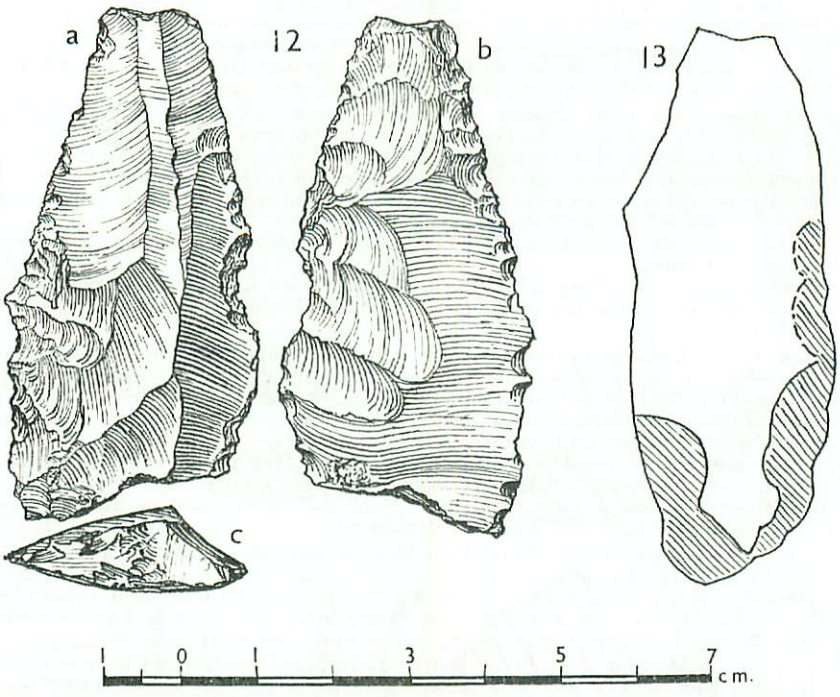

Fig. 44A Unifacial leaf points (12, 13), from the Hyaena Den. The numbers correspond with those in the text, where a full explanation will be found. No. 13 is a tracing from an old photograph of the bulbar face of a lost implement; cross-hatching indicates shallow flaking. Natural size.

Two thick flakes of Upper Greensand chert with triangular cross-sections. They show denticulate trimming and a crude resemblance to some of the denticulate tools of the French Mousterian. No. 14 shows some bulbar trimming.

16, 17. Wells Museum, Balch Room, wall case 25 (No. 16) and desk case 16 (No. 17). History unknown (*fig.* 44B (16, 17)).

Parts of paralled-sided blades. The edges show wear or retouch and No. 17 shows a little retouch on the bulbar face. The truncation of the ends is ancient and apparently intentional.

18, 19. Oxford University Museum Nos. S430, S431. Parts of flat, broad blades. No. 19 shows some retouch and probable signs of use.

20, 21. Wells Museum, Balch Room, wall case 25 (No. 20) and desk case 16 (No. 21). History unknown. (*Fig.* 44B).

Small irregular blades. The edges are not worn or retouched, but the bulbar ends show bruising.

22. Oxford University Museum No. S439.

A flat, broad blade of chert, like Nos. 16–19 which are flint. No retouch, edges probably utilised.

23 – 27. Oxford, Pitt-Rivers collection, Nos. vi. 24 [a–e] *ex* J. Parker coll. Some marked 'WkH' in ink (*fig.* 44B (23, 25).

Thin, flat flakes with irregular outlines. All or some of them may be trimmings from the manufacture of bifaces.

28 – 30. Oxford University Museum Nos. S428, S441, S442.

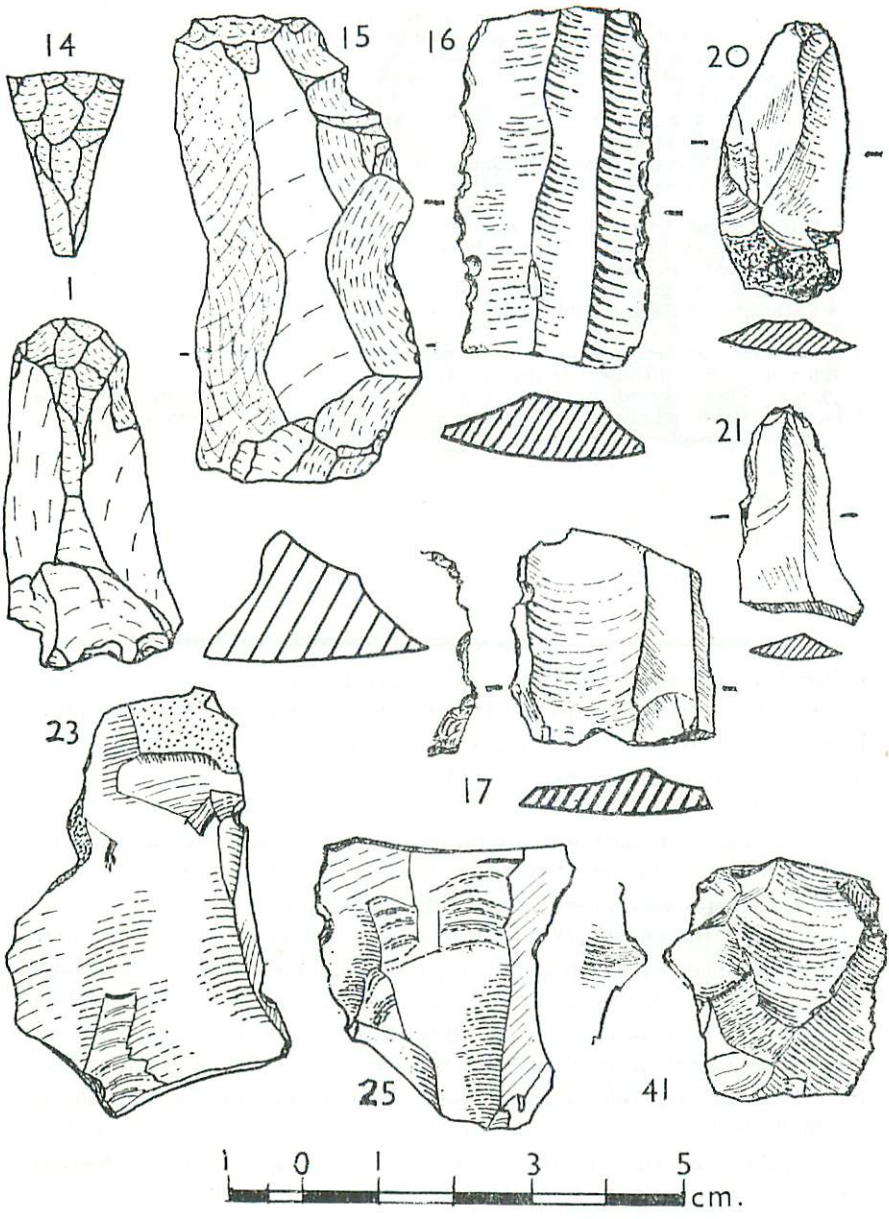

Fig. 44B. Flakes and blades from the Hyaena Den. The numbers correspond with those in the text, where a full explanation will be found. Natural size.

No. 28 (S428) is an unretouched flake off a flint nodule. The others are broad, flat flakes, terminating in hinge fractures which have been retouched. They are possibly biface trimmings which have subsequently been utilised.

31 – 35. Oxford University Museum, photographs with Parker *m.s.* of lost originals. These appear to have been unretouched waste flakes.

36, 37. Oxford University Museum Nos. S429, S432.

Flat flakes of chert. They show slight signs of retouch or utilisation.

38 – 40. Oxford University Museum Nos. S435, S436, S438.

Waste flakes of chert.

41. British Museum (Natural History), No. E20a. Labelled 'Pleistocene (Cavern), Wookey Hole, Somerset,' i.e. from the Hyaena Den. *Ex* Earl of Enniskillen collection. (*Fig.* 44B (41)).

Part of a blade which has been truncated at both ends, and a point formed on one of the side edges of the blade. Presumably used as a borer.

42. A blade core of flint.

43. Wells Museum, Balch Room, wall case 25. History unknown. A piece of pale grey Carboniferous chert, possibly a blade core.

The following specimens appear to be natural and not to show any signs of human workmanship: Oxford University Museum, Geology Department, Nos. S286, S433, S434, S437, S445. These are prismatic pieces of chert, perhaps thermally fractured. In the Wells Museum the left-hand of a row of five flints exhibited in the Balch Room, wall case 25, is a natural subangular pebble of pale brown flint, about 25mm. long.

CONCLUSIONS CONCERNING HUMAN CULTURES

On typological grounds the artefacts appear to fall into at least two cultural assemblages. The bifaces and associated forms, Nos. 1–11, (*figs.* 42, 43) form a consistent group. The rest seem to form one or more groups later than the bifaces, when viewed as a whole, although some individual flakes could not be excluded from the biface complex.

The bifaces are all small, and all those still extant show trimming by resolved flaking. Their outlines tend to be irregular, and lack the smooth outlines of good Lower Palæolithic hand axes. They correspond with bifaces of Mousterian type (Late Middle Palæolithic).

Similar, though larger and better-made, bifaces have been figured from Kent's Cavern, Torquay (Evans, 1897, *fig.* 387) and there is another, unfigured, in the British Museum (Natural History) (No. E85) which is very close to Hyaena Den No. 1. Rogers (1955, p. 10) recorded 8 'Mousterian Hand Axes' from Kent's Cavern; I do not know of any others that have been figured. According to Rogers, six of these bifaces came from the lower half of the Cave Earth, and 1 from the underlying breccia. The Cave Earth yielded a fauna (Ussher & Lloyd 1933, p. 130) which is closely similar to that of the Hyaena Den, except for the record of *Homotherium latidens* (*Machairodus latidens*) which must have been intrusive. Rogers (*op. cit.*) tried to reconstruct the stratigraphy of the Cave Earth from the surviving evidence, but concluded that this could not be done.

The Cave Earth also yielded unifacial points (see below) and abundant Upper Palæolithic artefacts.

There is in the British Museum (at Bloomsbury) an unfigured biface, 80 mm. in maximum length, which is very like Hyaena Den Nos. 1 and 2 in technique. It is from 'No. 6 Tunnel, Torbryan Caves,' and was briefly mentioned by Walker and Sutcliffe (1968, p. 91). The site is apparently the 'Unnamed cave behind the Old Grotto' of Walker and Sutcliffe (*op. cit.* p. 83). Widger (quoted by Walker and Sutcliffe) found there bones of hyaena, fox, reindeer, 'deer,' horse and ox in cave earth sealed by stalagmite.

Bifaces like those from the Hyaena Den were recovered by Benjamin Harrison from an open site at Oldbury, near Ightham, Kent. The site was re-excavated by Collins and Collins (1970) but there is no useful stratigraphy or associated fauna. The original finds are in the British Museum. They include about 20 bifaces (Smith 1926, pl. 5) of which some (e.g. *loc. cit.* Nos. 1, 3) are very like Hyaena Den tools (e.g. Nos. 3, 5). Other Oldbury bifaces are larger and better made. Oldbury was evidently a site at which flint was worked and the collection includes a large quantity of flakes and blades, many unretouched, as well as the bifaces. These include truncated blades (No. 93/3. 23/30) very like similar forms from the Hyaena Den (Nos. 16, 17).

Great Pan Farm pit, near Newport, Isle of Wight (Poole 1925) yielded a series of implements which are placed in the same subgroup as Oldbury by Roe (1969, p. 20).

Thus there is evidence for a late biface industry at several sites in southern England, and to judge from the Hyaena Den and from Kent's Cavern, it existed during the Last Glaciation. A number of similar bifaces from other localities can be found on looking through older works such as Evans (1897) and Smith (1926), but they are mostly surface finds whose ages and associations are unknown, so they do not add useful information, and no doubt some may be of earlier date. Nevertheless, the industry may be more widespread than has been recognised, on account of failure to differentiate it from the well-known and prolific Lower Palæolithic material. Roe (1969, pp. 18, 19) has distinguished this late industry as characterised by bifaces of '*bout coupé*' outline and has discussed their distribution in an unpublished thesis (Roe, 1967).

The majority of find-spots of such bifaces are open sites lying south-east of a line from Dorchester to Kings Lynn, but there are scattered sites north-west of this line and the Hyaena Den may now be added to these.

This bifacial industry appears to be a 'hand-axe Mousterian,' although at the Hyaena Den other tool types, commonly regarded as characteristic of Mousterian, are rare. Numbers 14 and 15 may be related to Mousterian

forms. Nevertheless the absence of Mousterian scrapers and points is surprising, especially as 18 of these are recorded from Kent's Cavern (Rogers *op. cit.* pp. 9, 10; *fig.* 3). Collins and Collins (1970) regard the Oldbury culture as Mousterian of Acheulian tradition.

It is possible that this late hand-axe industry may be represented at Pontnewydd Cave in North Wales where some rough hand-axes made of felstone were found (Hughes 1887, *pl.* 9). The associated (?) fauna included hyaena, bear, horse and *Dicerorhinus hemitoechus* (*op. cit.* p.107).

It appears from the number of biface trimming flakes (e.g. Nos. 8, ?9, 10, 11, 22–27, 29, 30, and possibly others) that bifaces were either manufactured or extensively resharpened on the site. The small size of the extant bifaces and their extensive resolved flaking also suggests much resharpening.

The unifacial leaf points probably do not belong to the Mousterian bifacial industry. This conclusion is supported by the distribution of this type: it is recorded chiefly from cave sites in south-west England, Gower, the Vale of Clwyd and Creswell Crags, although one example has been figured from Ipswich (Moir 1938). In contrast the Mousterian bifacial industries occur predominantly at open sites in the south-east, as already noticed above. The Ipswich site just mentioned has, in fact, yielded both types of implement, but as the finds were recovered by dredging from below water level their stratigraphical relationship is not known.

The associations of unifacial leaf points at cave sites are in most cases not clear because of inadequate stratigraphy. At Badger Hole, next to the Hyaena Den, however, they occur with an Early Upper Palæolithic assemblage which includes retouched blades and scrapers. At Kent's Cavern the stratigraphy has been reconstructed by one of us (J. B. Campbell) who finds that the unifacial points were associated with a bifacial point, a number of end scrapers, flakes, blades and a bone awl. These associations confirm an Upper Palæolithic, non-Mousterian age for the unifacial points.

The remaining finds comprise various flakes and blades. Some are unretouched or nondescript. More distinctive forms are the truncated blades (Nos. 16–19). The truncation is approximately at right angles to the blade edges and is thus different from that of the common Upper Palæolithic obliquely truncated blades. The retouch suggests that they may have been made as end scrapers, although edges were also utilised. As already noted, comparison with Oldbury suggests that these blades belong to the Mousterian phase.

Small blades such as Nos. 20, 21 cannot be distinguished from ones from local Creswellian or Late Upper Palæolithic sites (e.g. Gough's Cave, Cheddar; Davies 1929), but no characteristic forms of this well-

known industry are present at the Hyaena Den. It is concluded that the cave had been filled, to a point which rendered it uninhabitable, before people practising the Creswellian flint culture arrived in the area.

THE FAUNA

The descriptions by Dawkins of his excavations are imprecise. No distinction is made between the fauna of the Lower and Upper Red Earth and Stone Layers and that of the Bone Layer. All are lumped together in the faunal lists. The sole distinction is in the quantity of remains found. The Red Earth and Stones Layers had few remains. The Bone Layer was a complete mass of bones and teeth wherever it was found.

No part of the Bone Layer was found in U.B.S.S. excavations. There was a scanty fauna in the lower part of the fallen material which had formed the talus slope. This all belongs to a period well post-dating the Bone Layer. The faunal list is shorter than, but otherwise accords with, that of Dawkins. This is true also for the fauna from the Upper Section.

In the table of fauna the nomenclature used follows modern practice. This differs from the practice when Dawkins and Balch drew up their lists.

Dawkins published two lists of fauna in 1863 and 1874 respectively. The former listed bones as well as teeth and jaws. The latter only teeth and jaws. This may account for some of the discrepancies in the totals of the two lists. Balch's (1914) list is obviously largely taken from Dawkins' but he adds some fresh species. The source of these identifications, other than Balch himself, is unknown and there is no record of the levels and circumstances of the individual finds save for the two jaws of alleged elk.

The single bone of badger (*Meles meles*) from the *Antrum* is regarded as intrusive. This is also probably true for the bones of fox (*Vulpes vulpes*) found in the same area. Hyaena (*Crocuta crocuta*) is by far the dominant beast recorded. Woolly rhinoceros (*Coelodonta antiquitatis*) comes next in total in 1863, when 453 specimens were recorded. This becomes only 233 in 1874. This may be a simple typographical error. Horse (*Equus sp.*) comes next in number. These three animals dominate the faunal list.

The often-called Irish giant deer (*Megaloceros giganteus*) heads the list of deer. Reindeer (*Rangifer tarandus*) is recorded as 2 in 1863 and 30 in 1874. A major part of the discrepancy may be accounted for by re-identification of *Cervus sp.* (48 in 1863, nil in 1874) as reindeer in 1874. Red deer (*Cervus elaphus*) is known from two gnawed antlers only. Mammoth (*Mammuthus primigenius*) is included in the list. Bear and lion are poorly represented.

Essentially the fauna is that of a cold climate of the Weichsel (Würm) glaciation. There is only one discordant animal, namely *Dicerorhinus hemitoechus*, a form of rhinoceros which died out in Britain at the end of the Eemian (Riss-Würm) interglacial. One milk molar was listed in 1863 as being identified by Falconer. This becomes two in 1874. Dawkins claims that his discoveries prove that the two forms of rhinoceros were contemporary. The lack of stratigraphical data throws some doubt on this conclusion. Support for the presence of the animal has recently (Nov. 1970) come from the discovery of at least one tooth of *Dicerorhinus hemitoechus* in the deeper deposits in the small adjacent cave of Rhinoceros Hole (U.B.S.S. M41) now being excavated.

The presence of an inter-glacial animal is powerful support for the idea of at least two periods of use of the Hyaena Den by man.

CONCLUSIONS

1. After the river had abandoned the cave weathering products from the side of the ravine above the cave rolled down into it through a large roof opening at the back. A much more limited amount came in through the original cave mouth and perhaps some more through another roof opening.
2. This material was the Lower Red Earth and Stones. It spread out in a fan extending laterally into passages B, C and D, as well as forwards across the Antrum (A). Fairly early during this stage, man used the cave as his implements occurred low down in the deposit if not actually on the rock floor (Dawkins group (c)). This episode perhaps included the hearths described by Balch. The period presumably included the closing stages of the Eemian because of the presence of *Dicerorhinus hemitoechus*, though it cannot be specifically related to this basal deposit.
3. Subsequently more of the Lower Red Earth accumulated till there was use of the cave intermittently by hyaena as a den. This period was fairly short and its intermittent nature is illustrated by the subdivisions of the layer. The areas used by the hyaenas were the front of the cave and the side passages B, C and D, which by that time were nearly full to the roof. Man also used the cave during the period covered by the Bone Layer (Dawkins groups (a) and (b)). The distribution of these finds indicates that the access was from the floor of the valley and not down through the roof opening.
4. It is necessary to distinguish between the hyaena using the cave as a den, the Bone Layer, and the hyaena as one element in the fauna of the region. The Den episode was relatively short.

5. Sometime later, when the weathering products had accumulated to the level of the shelf at the back of the *Antrum* man again used the cave and left evidence of his occupation in the form of hearths and a single flint implement (Dawkins (d)). This occupation probably belongs to the basal part of the Upper Red Earth layer. Access then was probably down the talus slope and not through the cave mouth from the valley floor.
6. The cave continued to fill up with weathering products to the level of the rock shelves of the Upper Section. During this phase the fauna probably remained unchanged from that found at lower levels though presumably *Dicerorhinus hemitoechus* had long disappeared from the scene.
7. Subsequently the cave became completely filled and was buried by the uppermost of the weathering products. These deposits were archæologically sterile and carried the sequence up to the present.
8. The stone industries have been discussed (p.257-67). There are two main groupings of implements. Late Middle Palæolithic (Mousterian) with small bifaces and Early Upper Palæolithic with unifacial leaf points. There are no characteristic forms of the local Creswellian industry.
9. In the Upper Section the basal part of layer (3) marks the disappearance of the hyaena and other fauna. (3a) contained the majority of specimens. The material above covers the time span of Late Glacial to Holocene times. This conclusion is supported by the pollen and granulometry analyses.
10. The total age bracket extends from the last stage of the Eemian to modern times.

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DISPOSAL OF THE FINDS

All the material found in the U.B.S.S. excavations is in the Society's museum and catalogued under M35.

APPENDIX I

POLLEN AND DEPOSIT ANALYSES

J. B. Campbell

In May 1968 two sets of samples of the undisturbed deposits in the south-east face of the Upper Section were collected. The position of the nine samples dealt with in this report correspond with the column marked S1-S9 in figure 41B. (The other set of samples is held in Bristol). The nine samples were transported to the Deposit Treatment Laboratory at the Pitt Rivers Museum, Oxford, and there, in June 1968, they were dried at 80° to 90°C and stored. Initially in the case of sample 1 (S1), 50 gms. of sand, silt and clay were extracted for a preliminary pollen analysis. Some pollen and spores were found to have been preserved, and it was therefore decided to treat all the samples as soon as possible.

In November 1970, the samples were removed from storage and dry-sieved through a closed stack of graded sieves. This method of granulometry was chosen as the main components of the deposits appeared to have been mostly scree and sand, rather than silt and clay. Percentages were calculated for each sample on the basis of the total of the weights read for the amount of material caught in each sieve. Before weighing, all organic material (e.g., bones and roots) and possibly derived material (e.g., stalagmitic fragments) were removed. The deposit grades employed in this study were as follows: boulders > 100 mm. (not counted), coarse scree 100 to 15·4 mm., medium scree 15·4 to 3·1 mm., fine scree 3·1 to 1·73 mm., coarse sand 1·73 to 0·50 mm., medium sand 0·50 to 0·187 mm., fine sand 0·187 to 0·124 mm., silt 0·124 to 0·074 mm. and clay <0·074 mm. Screes were further sub-divided into thermoclastic (sharp freeze/thaw formed) scree and weathered (rounded, chemically eroded) scree, both of which were recognized macroscopically, although it should be stressed that due to the nature of the parent material (Dolomitic Conglomerate), these sub-divisions were not as clear as one would find them in limestone screes. The colour of these samples when wet and when dry was also recorded. After sieving 50 gms. of the finer components were removed from samples 2 to 9 for pollen extraction.

As had already been done with sample 1, each of the other samples was treated with various acids in order to isolate some of whatever pollen and spores might have been preserved. On average from about three to five slides were prepared for each sample to obtain total pollen and spore counts of at least above 50. A re-count was run on sample 1 because it had originally been examined before a reference collection of pollen and spore type slides had been obtained, the collection having been very kindly donated by Prof. G. W. Dimbleby in 1969. As the total count for each sample is relatively low in comparison with what one might expect from peat or organic mud, only a total pollen diagram has been prepared (*Fig.* 45). This diagram appears to indicate at least the general pattern of changes in the floral spectra of the Mendip region during the Last Glacial, and if the tentative zonation be correct, then it would seem that the deposition of faunal material at the Hyaena Den ceased before the Full Last Glacial, as indeed the archæological deposition presumably did. The association of *Crocuta* with sample 1 is inferred from the results of the 1966–70 excavations, and its association with sample 2 is more directly indicated by an incisor which was removed from the sample during sieving. The maximum scatter of bone fragments is according to those found in the deposit samples. It is tempting to suggest that the Later Middle Palæolithic-like tools (*figs.* 42, 43) and waste flakes found by Dawkins came from the lower portion of layer A2b, (layer 3) whilst the Earlier Upper Palæolithic-like tools (*fig* .44A) and waste found by him came from the upper portion of layer A2b, both assemblages thereby helping to account for the total scatter of bone fragments and falling into their more or less expected stratigraphic positions. Such a suggestion is of course almost entirely speculative.

Table 2 lists the individual pollen and spore counts and percentages. The occurrence of *Alnus* in sample 3 is probably due to derivation as the samples are from a sloping, partly soliflucted sequence. The possible presence of *Dryas* in samples 5 and 6 is extremely interesting as its pollen, which is difficult to identify, is apparently seldom encountered in British deposits, although macroscopic remains of *Dryas* have been recognized from various British Full and Late Last Glacial sites (Godwin, 1956). This possibility from the Hyaena Den has been checked against a reference slide which was prepared from a sample of *Dryas* pollen collected from the garden of Mr. D. F. W. Baden-Powell in Oxford on 1st June, 1970. At present *Dryas* is familiar in arctic and alpine regions (Polunin, 1959), and it occurs naturally in the Scottish Highlands and less frequently in the mountains of northern England, Wales and Ireland (Clapham, Tutin and Warburg, 1962). Considering the low values for trees and shrubs in samples 4 to 6 and the variety of herbs in those samples, conditions during deposition were probably quite open and fairly severe, except possibly in some of the sheltered ravines on the southern side of the Mendip Hills as at the Hyaena Den. The attribution of these samples to the Middle and Full Last Glacial (*Fig.* 45) in the absence of radiocarbon evidence is of course not beyond doubt. However, the higher frequencies of trees and shrubs in samples 1 to 3 and 7 to 9 certainly suggest an intervening rather cold phase. Further, the open heathland with some thermophilous trees and relatively abundant *Betula* indicated by sample 1 might well belong either to the very end of the Last Interglacial (compare West, 1968, *Fig.* 13.9)or to the beginning of the Early Last Glacial, perhaps before or just after the so-called "Chelford Interstadial" (Simpson and West, 1958) which does not appear, at least clearly, to be represented in this sequence. A Late Last Interglacial/Early Last Glacial age for the base of this sequence would certainly agree well with the presence of *Dicerorhinus hemitoechus* in the fauna found by Dawkins. Samples 7 to 9, on the other hand, seem to reflect the better known floral changes of the Late Last Glacial and Early Post Glacial, although only in a very general way (compare diagrams in Godwin, 1956 and West, 1968). The substantial rise in *Juniperus* in sample 3 to about 22% before the apparent Full Last Glacial might be indicative of some sort of interstadial, perhaps part of the so-called "Upton Warren Interstadial" (Coope, Shotton and Strachan, 1961) even though *Juniperus* is not listed for Upton Warren itself. Although pollen has been obtained from calcareous continental cave deposits for a quarter of a century (e.g., Welten, 1944; Schütrumpf, 1951; Campo and Leroi-Gourhan, 1956; Donner and Kurten, 1958; Amor and Florschutz, 1962), prior to this and related studies by the author it has not been extracted from British cave deposits. The method of pollen extraction employed is basically similar to that used on more polleniferous deposits, except that much larger deposit samples are prepared and an initial flotation process is added. The method and results obtained on various British cave entrance sequences will be published in much great detail in the near future.

Table 3 lists the individual weights and percentages of scree, sand, silt and clay in the Hyaena Den samples, as well as the colour and scree textures. Fig. 46 is a linear diagram of the differences in these percentages in the whole column. Samples 1 and 2 include some weathered scree and some apparently thermoclastic scree associated with mainly coarse and medium sand. Samples 3 and 4 give way to only what appears to be thermoclastic scree and are therefore probably indicative of colder conditions. Samples 5 and especially 6 show a rise in coarse, medium and fine sand and silt and clay associated with only thermoclastic scree and no coarse scree. It may be that a slightly loessic coversand element is the explanation of this rise in the finer components, as its increase and peak are associated with the highest herb frequencies on the pollen diagram (*fig.* 45). Also the interface of layers A2b (3) and A3 (2) has been subjected to intense solifluction and possibly cryoturbation (*fig.* 41B). Thus on the grounds of palynology, granulometry and field observations the erosion of the surface of layer A2b and the deposition of layer A3 would seem to date from a phase of very cold conditions, presumably the Full Last Glacial. Sample 7 shows a slight peak in coarse thermoclastic scree and a fall in sand, silt and clay, whilst sample 8 gives way to more medium thermoclastic scree. Presumably samples 7 and 8 are more or less Late Last Glacial as they are followed by a mixture of thermoclastic and weathered scree in sample 9, which is most likely indicative of the earlier part of the Post Glacial. Thus almost purely on granulometric evidence there seems to be a sequence of climatic change from mild to cold to maximum cold, and then a return through a brief cold or cool phase to mild conditions. Again the *Crocuta* teeth and associated faunas (and presumably artefacts) lie below the apparent maximum cold, or Full Last Glacial.

The suggestion that there may be a loessic coversand element in layer A3 is quite reasonable if that layer dates from the Full Last Glacial. In the Netherlands thick deposits of Last Glacial coversands have been radiocarbon dated to younger than about 26,000

years Before Present and older than about 13,000 years Before Present (Hammen, Maarleveld, Vogel and Zagwijn, 1967). They have been attributed to the maximum cold of the Last Glacial, and their distribution lies generally north of the loess-belt which runs across northern France, Belgium and Germany, as indeed would also be the case in England. The so-called "polar desert conditions" which may have prevailed in the Netherlands during the Full Last Glacial would not necessarily have been as severe in southern England, although they would certainly seem to have been in certain parts of the unglaciated areas of southwestern Wales (Watson, 1967) and on the unglaciated Peak District of England (Bryan, 1970).

The maximum ice advances of the British Last Glacial have now been generally radiocarbon dated to younger than 25,000 years Before Present, and in the case of the Dimlington Silts of eastern Yorkshire, specifically radiocarbon dated to younger than about 18,000 years Before Present (Penny, Coope and Catt, 1969). Briefly the radiocarbon and other dating evidence and the environmental evidence for the time span and changes within the British Last Glacial seem to indicate temperate to sub-arctic conditions during an Early Last Glacial of about 70,000 to 40,000 B.P., sub-arctic to arctic conditions during a Middle Last Glacial of about 40,000 to 20,000 B.P., arctic to high arctic conditions and maximum ice advances during a Full Last Glacial of about 20,000 to 15,000 B.P., and temperate to sub-arctic conditions associated with minor ice readvances in Scotland during a Late Last Glacial of about 15,000 to 10,200 B.P. (Campbell and Baden-Powell, 1971). The Earlier Upper Palæolithic leaf point industries appear to date from before the Full Last Glacial, and the Later Upper Palæolithic backed blade industries appear to date from after it, or more specifically from the Late Last Glacial and possibly the very earliest part of the Post Glacial (Campbell, 1970). Later Middle Palæolithic hand-axe industries, on the other hand, probably date from the Early Last Glacial and possibly the very earliest part of the Middle Last Glacial according to what evidence is thus far available in Britain and according to recent studies in France (Mellars, 1969). Again only Later Middle Palæolithic and Earlier Upper Palæolithic material appears to be represented in the collection obtained by Dawkins from the Hyaena Den; the site was quite likely sealed by scree during the Later Upper Palæolithic.

APPENDIX II

LIST OF MUSEUMS WITH ANIMAL REMAINS AND IMPLEMENTS FROM THE HYAENA DEN, WOOKEY HOLE

(After J. W. Jackson 1937)

1. Bath	Royal Literary and Scientific Institute. (This collection has passed into the keeping of the Bath Corporation).
2. Bristol	City Museum and Art Gallery. Practically the whole of the collection was destroyed in the war. The famous "spear-head" survived.
3. Bristol	Museum of the University of Bristol Spelæological Society. Material from excavations 1966–1970 only.
4. Glasgow	Hunterian Museum.
5. London	British Museum (Natural History).
6. London	Museum of the Royal College of Surgeons. (All material destroyed in war).
7. Manchester	City Museum. This museum holds several implements.
8. Oxford	University Museum, Department of Geology. Various stone implements and flakes.
9. Taunton	Somerset County Museum. Only animal bones and teeth.
10. Wells	The Wells Museum. Mainly animal remains found by Balch. Some implements and fragments (see pp. 262-4).
11. Welshpool	Powysland Museum. Animal remains only.
12. Wookey Hole	Wookey Hole Caves Museum. This has a few animal remains on exhibition.

Jackson in his paper uses the title of "Schedule of Cave Finds. Wookey Hole, Somerset." His list however refers to the Hyaena Den only and not to the present show cave. This held only remains of Iron Age–Romano British and later times. It had no Pleistocene material.

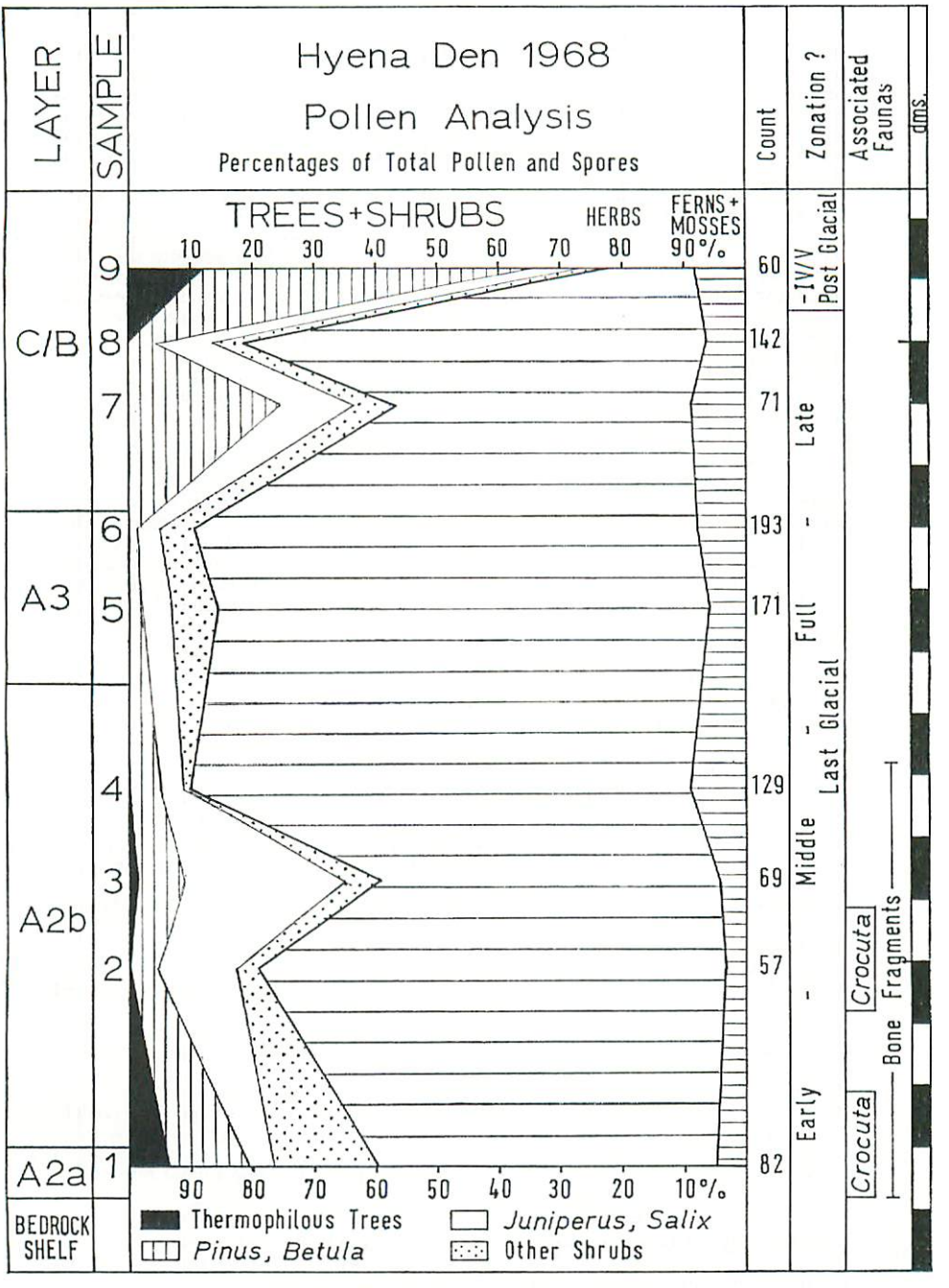

Fig. 45 Total Pollen and Spore Diagram.

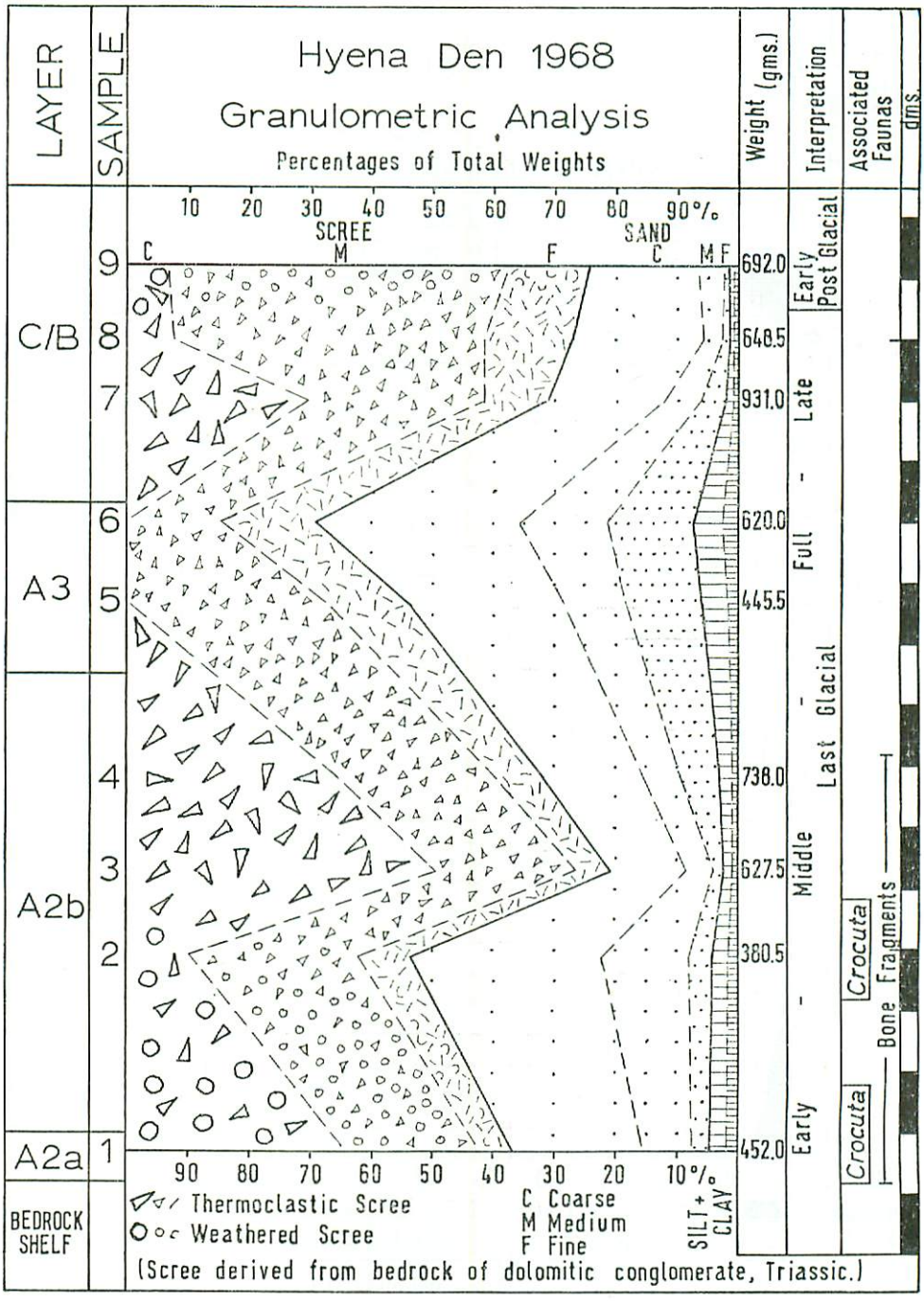

Fig. 46. Granulometry Diagram.

TABLE I
HYAENA DEN, WOOKEY HOLE. FAUNA

	Dawkins														Balch	Tratman 1970	
	Antrum A			Passage B			Passage C			Passage D			1863	1874			
	Bones	Jaws	Teeth	Bones	Jaws	Teeth	Bones	Jaws	Teeth	Bones	Jaws	Teeth	Totals	Totals	1914	Talus	Upper Sect.
Carnivora																	
Crocuta crocuta	4	26	229	4	46	67	1	8	7	5	41	30	477	467	×	×	×
Felis leo spelæa			5			2				3		2	9	15	×		
Felis sp.	1			2						3			6				
Ursus sp.		1	2	1									4		×	×	
,, *arctos*			1										1	49	×	×	×
,, *spelæus*		1	13						3			8	25		×		
Canis lupus	2	1	3	3						4			13	7	×		
Vulpes vulpes ..	3	3	2										8	8	×	×	
(*Meles meles*) ..	1												1	—	—		
Proboscidea																	
Mammuthus primigenius	4		13	2		4	1			3		13	40	30	×		
Perissodactyla																	
Coelodonta antiquitatis ..	32	3	88	144	4	63	22		10	38		29	433	233	×		×
Dicerorhinus hemitoechus			1										1	2	×		
Equus sp.	6		215	33	4	95	3		24	3		28	411	401	×	×	
Artiodactyla																	
Bos sp.	12	1		27			10			17			67	30	×	×	×
Bos primigenius			14			1			1				16	16	×		
Megaloceros giganteus ..		2	18		7	4				1		3	35	35	×		
Rangifer tarandus ..		2											2	30	×	×	
Cervus elaphus													2	2	×		
,, *sp.*	8		7	20			4			9			48	—	—		×
Capreolus capreolus ..													—	—	×		
Sus scrofa													—	—	×	× ?	
Rodentia																	
Lemmus lemmus ..													—	1	×		
Citellus citellus													—	—	×		
Lagomorpha																	
Lepus timidus													—	—	×	×	
Homo (from implements only)														35	×	×	

The nomenclature adopted for this table follows current practice. × = present.

TABLE 2

HYAENA DEN, WOOKEY HOLE POLLEN ANALYSIS: SOIL SAMPLES 1—9 FROM UPPER SECTION, S.E. FACE

Sample No.	1		2		3		4		5		6		7		8		9	
	N c.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Alnus	2	2·44	—	—	1	1·45	—	—	—	—	—	—	—	—	—	—	3	5·00
Corylus	1	1·22	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	6·67
Quercus	2	2·44	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Pinus	3	3·66	—	—	—	—	2	1·55	—	—	—	—	—	—	1	0·70	11	18·33
Betula	8	9·76	3	5·26	5	7·25	5	3·88	3	1·75	2	1·04	18	25·35	3	2·11	23	38·33
Juniperus	1	1·22	1	1·75	15	21·74	1	0·78	—	—	1	0·52	6	8·45	2	1·41	1	1·67
Salix	2	2·44	6	10·53	3	4·35	4	3·10	9	5·26	7	3·63	2	2·82	11	7·75	3	5·00
Helianthemum	—	—	—	—	—	—	—	—	3	1·75	1	0·52	—	—	3	2·11	—	—
Dryas?	—	—	—	—	—	—	—	—	8	4·68	5	2·59	—	—	—	—	—	—
Hippophæ	—	—	2	3·51	4	5·80	1	0·78	—	—	—	—	2	2·82	1	0·70	—	—
Hedera	3	3·66	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1·67
Calluna/Erica	9	10·98	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Empetrum	2	2·44	—	—	—	—	—	—	2	1·17	4	2·07	3	4·23	6	4·23	—	—
Ranunculus	—	—	—	—	2	2·90	1	0·78	—	—	2	1·04	—	—	4	2·82	—	—
Thalictrum	—	—	—	—	—	—	5	3·88	9	5·26	3	1·55	—	—	—	—	—	—
Chenopodiaceæ	2	2·44	—	—	—	—	8	6·20	6	3·51	2	1·04	—	—	—	—	—	—
Potentilla	1	1·22	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Polygonum	—	—	—	—	—	—	—	—	1	0·59	—	—	—	—	—	—	—	—
Rumex	—	—	1	1·75	—	—	1	0·78	11	6·43	6	3·11	—	—	8	5·63	—	—
Urtica	3	3·66	—	—	—	—	—	—	2	1·17	5	2·59	4	5·63	1	0·70	—	—
Armeria	—	—	—	—	—	—	6	4·65	5	2·92	—	—	—	—	3	2·11	—	—
Polemonium	—	—	—	—	—	—	—	—	4	2·34	—	—	—	—	—	—	—	—
Plantago	—	—	—	—	—	—	—	—	3	1·75	—	—	1	1·41	2	1·41	—	—
Campanula	—	—	—	—	—	—	—	—	4	2·34	3	1·55	—	—	2	1·41	—	—
Galium	—	—	1	1·75	6	8·70	15	11·63	2	1·17	1	0·52	2	2·82	6	4·23	—	—
Valeriana	—	—	—	—	—	—	—	—	2	1·17	—	—	—	—	—	—	—	—
Artemisia	—	—	7	12·28	12	17·39	8	6·20	13	7·60	9	4·66	5	7·04	17	11·97	—	—
Compositæ	7	8·54	4	7·02	2	2·90	12	9·30	3	1·75	12	6·22	3	4·23	6	4·23	5	8·33
Cyperaceæ	18	21·95	11	19·30	3	4·35	17	13·18	29	16·96	47	24·35	8	11·27	30	21·13	—	—
Gramineæ	14	17·07	19	33·33	13	18·84	31	24·03	42	24·56	68	35·23	11	15·49	27	19·01	4	6·67
Lycopodium	1	1·22	1	1·75	—	—	7	5·43	6	3·51	11	5·70	1	1·41	4	2·82	2	3·33
Selaginella	—	—	—	—	2	2·90	3	2·33	4	2·34	1	0·52	3	4·23	5	3·52	—	—
Dryopteris	—	—	—	—	1	1·45	—	—	—	—	—	—	2	2·82	—	—	1	1·67
Polypodium	3	3·66	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	3·33
Botrychium	—	—	1	1·75	—	—	2	1·55	—	—	3	1·55	—	—	—	—	—	—
Totals	82	100	57	100	69	100	129	100	171	100	193	100	71	100	142	100	60	100

TABLE 3

HYAENA DEN, WOOKEY HOLE, GRANULOMETRY ANALYSIS. SOIL SAMPLES 1—9 FROM UPPER SECTION S.E. FACE

Sample No.	1		2		3		4		5		6		7		8		9	
	Wt. gms.	%	Wt. gms.	%	Wt. gms.	%	Wt. gms.	%	Wt. gms.	%	Wt. gms.	%	Wt. gms.	%	Wt. gms.	%	Wt. gms.	%
SCREE																		
Coarse (100–15·4 mm.) ..	160·0	35·40	39·5	10·38	315·5	50·28	257·0	34·82	—	—	—	—	278·5	29·91	47·0	7·25	460·0	6·65
Medium (15·4–3·1 mm.) ..	100·5	22·24	106·5	27·99	145·5	23·67	187·0	25·34	146·0	32·77	95·5	15·40	263·0	28·25	327·0	50·42	386·0	55·78
Fine (3·1–1·73 mm.) ..	24·5	5·42	31·5	8·28	32·5	5·18	58·5	7·95	59·5	13·36	95·5	15·40	99·5	10·69	96·0	14·80	91·5	13·22
	285·0	63·06	177·5	46·65	496·5	79·13	502·5	68·09	205·5	46·13	191·0	30·80	641·0	68·85	470·0	72·47	523·5	75·65
SAND																		
Coarse (1·73–0·50 mm.) ..	96·5	21·35	119·5	31·41	76·5	12·19	121·0	16·40	114·5	25·70	210·0	33·87	177·0	19·01	137·0	21·13	120·5	17·41
Medium (0·50–0·187 mm.)	37·0	8·19	52·0	13·67	30·5	4·86	45·0	6·10	44·0	9·88	87·0	14·03	54·5	5·85	28·0	4·32	30·5	4·41
Fine (0·187–0·124 mm.)	13·5	2·99	15·0	3·94	10·5	1·67	48·5	6·57	55·5	12·46	86·0	13·87	39·0	4·19	5·0	0·77	6·0	0·87
	147·0	32·53	186·5	49·02	117·5	18·72	214·5	29·04	214·0	48·04	383·0	61·77	270·5	29·05	170·0	26·22	157·0	22·69
SILT AND CLAY																		
Silt (0·124–0·074 mm.) ..	11·5	2·54	11·0	2·89	7·5	1·20	16·0	2·17	19·0	4·27	30·5	4·92	15·0	1·61	5·0	0·77	5·5	0 80
Clay (<0·0074 mm.)	8·5	1·88	5·5	1·45	6·0	0·96	5·0	0·68	7·0	1·57	15·5	2·50	4·5	0·48	3·5	0·54	6·0	0·87
	20·0	4·42	16·5	4·34	13·5	2·16	21·0	2·85	26·0	5·84	46·0	7·42	19·5	2·09	8·5	1·31	11·5	1·67
TOTALS ..	452·0	100·01	380·5	100·01	627·5	100·01	738·0	100·01	445·5	100·01	620·0	99·99	931·0	99·99	648·5	100·00	692·0	100·01
COLOUR																		
Wet	Red		Red		Red		Red		Yellow		Yellow		Yellow		Yellow		Yellow	
Dry	Bright Red		Buff-Red		Buff-Red		Buff-Red		Light Buff-Red		Light Buff-Red		Buff		Buff		Buff	
SCREE																		
Thermoclastic (sharp) ..	+		+		+		+		+		+		+		+		+	
Weathered (rounded) ..	+		+		—		—		—		—		—		—		+	

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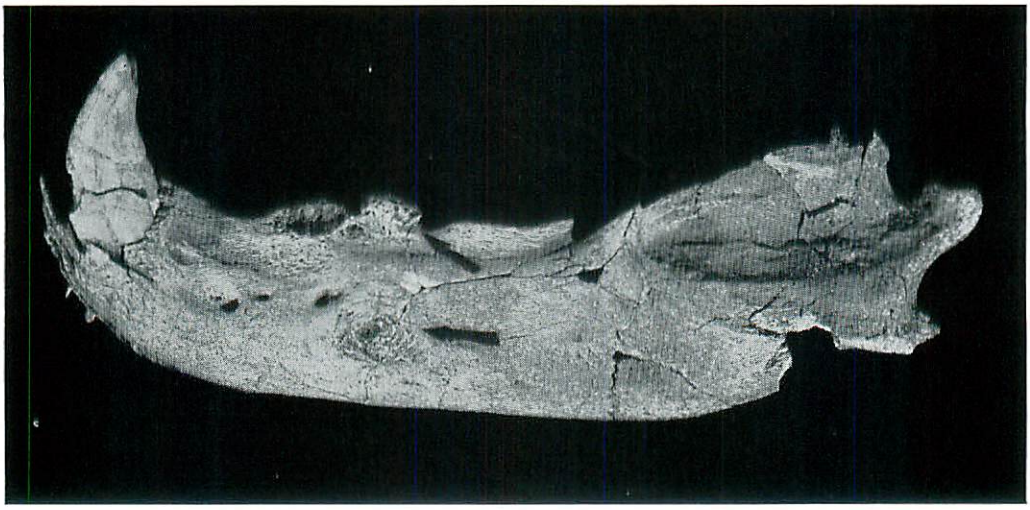

Plate 22A Bear jaw, *Ursus arctos* showing healed fracture.

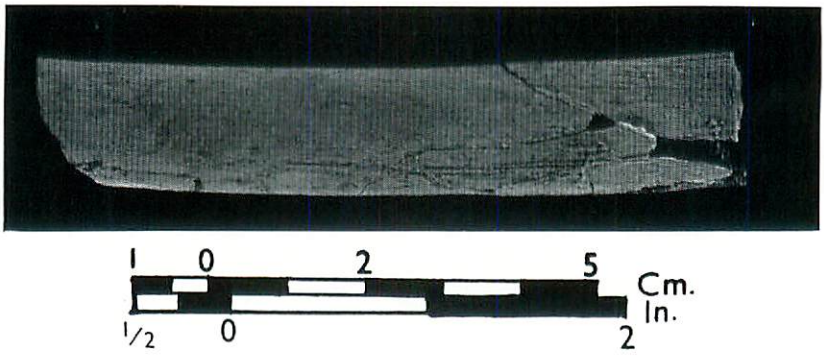

Plate 22B. Piece of worked animal rib.

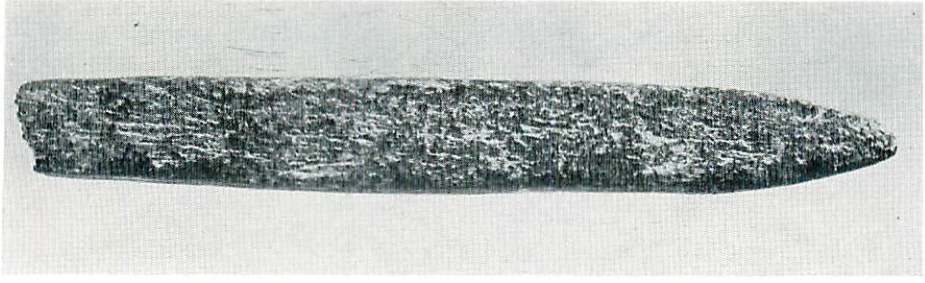

Plate 22C. Piece of worked reindeer antler. Broken at butt end.

Photographs by Robin Godwin.