Tornewton Cave

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Highlights

Tornewton Cave contains one of the most complete Upper Pleistocene sequences in Britain. Its deposits include the famous 'Glutton Stratum' and 'Hyaena Stratum', and recent studies confirm that the biostratigraphical succession spans at least two major interglacials — equivalent to Oxygen Isotope Stages 7 and 5. The cave provides the only record of the clawless otter in the British Pleistocene.

Introduction

The Torbryan Caves were discovered by James Lyon Widger (1823–1892) who referred to them asthe 'Alexandra Caves'. The first excavations in the group of cave passages now known as Tomewton Cave were undertaken by him around 1877. His only personal reference to the caves was published posthumously (Widger, 1892). Widger's large collection of Pleistocene vertebrate remains and human artefacts from the caves was sold to the London dealer F.H. Butler and subsequently dispersed. Some 600 specimens labelled merely 'Torbryan Caves', many of which may have come from Tornewton Cave, are now in the Natural History Museum, London. Other material, similarly labelled, is widely scattered in public and private collections.

Re-examination of Widger's description of the caves and of a longer manuscript version of the same account (Torquay Natural History Society archives) shows him to have been a perceptive and skilful interpreter of the complex history of events represented by the deposits and structures which he examined. Regrettably he was not successful in attracting the interest of the scientific establishment of his day and much valuable information was irretrievably lost on his death. Early accounts of Widger's life and work were given by Lee (1880) and Lowe (1918), and these have since been supplemented by Walker and Sutcliffe (1968): some of his finds were also figured by Reynolds (1902, 1906, 1909, 1922).

Although further excavations were undertaken in the cave by A.H. Ogilvie, the results were not published and the main account of the site remains that of Sutcliffe and Zeuner (1962). These workers tentatively ascribed the principal deposits at Tomewton, on the basis of their contained faunal remains, to the 'Penultimate Glaciation' (Saalian), 'Last Interglacial' (Eemian) and 'Last Glaciation' (Weichselian). However, distinctive species groupings within the Eemian (Ipswichian) mammal remains at Tornewton, and at other British sites, led Sutcliffe (1975, 1976) to the far-reaching conclusion that the Ipswichian Stage comprised two separate temperate phases. Rodent remains from the site were described by Kowalski (1967) and Sutcliffe and Kowalski (1976). The site is also widely referred to in accounts of both national and regional Pleistocene history (e.g. Sutcliffe, 1969, 1995; Macfadyen, 1970; Kidson, 1977; Cullingford, 1982; Lowe and Walker, 1984). The importance of the Torbryan Cave sequences has been confirmed by recent detailed reinvestigation (Willemsen, 1992; Proctor, 1994; Barton, 1996; Berridge, 1996; Cartwright, 1996; Caseldine and Hatton, 1996; Currant, 1996; Debenham, 1996; Gleed-Owen, 1996; Irving, 1996; Price, 1996; Proctor and Smart, 1996; Seddon, 1996; Stewart, 1996; Roberts *et al.,* in prep.).

Description

The Torbryan Caves (Figure 5.1) occur in an outcrop of Devonian limestone on the south-west side of the Torbryan Valley, near Ipplepen, Devon. Tornewton Cave [SX 8172 6737] is an ancient feature bearing no clear relationship to present topography. The cave comprises two sub-vertical phreatic rifts with associated horizontal passages. The larger rift is called the Main Chamber and now has three separate connections to the outside: the Upper, Middle and Lower entrances. The Upper Entrance is a rock arch and was Widger's original access to the cave. The Middle Entrance connects with the Main Chamber via a narrow passage called the Middle Tunnel. The Lower Entrance is partly artificial and has been enlarged to give access into the Lower Tunnel, a structural extension of the Main Chamber in its lower

part. The smaller rift is known as Vivian's Vault. It is a structural continuation of the Middle Tunnel, but the interconnecting passageway is narrow and totally blocked by stalagmite. A hole high in the wall towards the back of the Main Chamber now allows access to Vivian's Vault. Excavations outside the cave show that it once extended farther out into the Torbryan Valley.

An adaptation of Widger's description of the Tornewton Cave deposits (Widger, 1892; Widger, ms.) is repeated here because it provides the only firsthand account of several of the younger units and remains valuable for interpreting surviving deposits:

6. The 'Black Mould' — of unspecified thickness, containing flints, shells, pottery, pebbles, charcoal, a Roman coin and the remains of rodents. The pre-excavation floor of the cave was covered by slabs of angular stones.

5. 'Diluvium' (Widger believed in the Biblical deluge) — 5 feet (1.5 m) of an unspecified deposit containing a few worked flints, charcoal, and the remains of rodents and bats. This unit was capped by a white stalagmite floor about 1 foot (0.3 m) thick.

4. The 'Reindeer Stratum' — 6 feet (1.8 m) of red earth containing abundant reindeer antler, the ribs, vertebrae and limb bones of large animals and remains of a large species of bear. The Reindeer Stratum is covered by a stalagmite floor 'a few inches thick'.

3. The 'Dark Earth' — 2 feet (0.6 m) thick and emitting an unpleasant smell when first dug and containing jaws and teeth of different animals, mainly hyaena. The Dark Earth contained a scatter of well-rolled quartz pebbles on its upper surface.

2. The 'Great Bone Bed' — 3 feet (0.9 m) thick and containing 'most of the British cave fauna'.

1. The 'Bear Deposit' — originally 7 feet (2.1 m) thick but mostly washed out. The remains of the 'smaller species' of bear were found here.

Widger's excavations at Tornewton Cave appear to have been extensive but cannot be delimited with any certainty due to later digging, mainly by Ogilvie and others in the late 1930s. Although these later excavations are unpublished and undocumented, extensive collections from them are held by the Torquay Natural History Society. 5.

From 1944 until the early 1960s, the cave was excavated still further by A.J. Sutcliffe and colleagues. His findings elevated Tornewton Cave to international fame. He recovered a series of discrete mammal faunas in apparent stratigraphic superposition which were believed to span the period from the penultimate cold stage (in modern terms, Oxygen Isotope Stage 6), right through the last interglacial (Stage 5) and including much of the last cold stage (Stage 4 to Stage 2). The published stratigraphy and associated faunas (Sutcliffe and Zeuner, 1962) are summarized below with an updated taxonomy:

6. Hyaena Stratum — equated with Widger's 'Great Bone Bed'. Clearly the product of a prolonged phase of denning by the spotted hyaena *Crocuta crocuta* Erxleben. Much of this unit, which was also present throughout the Main Chamber and Lower Tunnel, consists of teeth, bones and bone debris, hyaena 3. coprolites and fragmented coprolitic material. As in the underlying Bear Stratum, rock clasts were few in number. Some 1300 isolated hyaena teeth were recovered representing a minimum of 76 adult and 41 juvenile animals. (Widger claims to have recovered around 20 000 teeth from the same deposit.) Hyaenas of all ages were represented. The body-part representation from this unit is highly biased in favour of teeth and foot bones, other skeletal elements being quite rare. It would appear that the hyaenas had consumed all but the least digestible parts, even of their own kind. Species other than hyaena were quite rare given the abundance of bone within this unit, and in all cases they were represented by either teeth, foot bones or very heavily gnawed limb bone fragments. The following animals are listed: spotted hyaena, wolf *Canis lupus*Linné, fox *Vulpes vulpes* (Linné), lion *Panthera leo* (Linné), bear *Ursus* sp., narrow-nosed rhinoceros *Stephanorhinus hemitoechus* (Falconer), hippopotamus *Hippopotamus amphibius* Linné fallow deer *Dama dama* (Linné), red deer *Cervus elaphus* Linné, a bovid (larger than that from the Glutton Stratum), hare *Lepus* sp., vole *Arvicola* sp., and undetermined species of bird. This fauna was taken to represent a considerable climatic amelioration and is assigned to the last interglacial (Stage 5/Ipswichian Stage).

5. Stalagmite Floor — forming a thin but fairly continuous sheet across the Main Chamber but represented by individual stalagmites in the Lower Tunnel.

4. Bear Stratum — described as immediately overlying the Glutton Stratum and extending the full length of the Main Chamber and Lower Tunnel. The authors maintain that there was no faunal distinction between the Bear Stratum and the underlying Glutton Stratum, but the nature of the deposit was apparently quite distinct. Although much of the remaining Bear Stratum was secondarily cemented, by infiltrating stalagmite, where it was not cemented the deposit was much less compacted than the Glutton Stratum and showed signs of faint internal stratification. There were occasional groups of related bones, and the very few contained rock clasts were of limestone rather than shattered stalagmite. No separate faunal list was given for this unit.

3. Glutton Stratum — a compacted, unstratified cave earth containing abundant teeth and bone fragments which represent a variety of vertebrate species, primarily bears. This deposit was believed to have accumulated by 'sludging' during periglacial conditions. The deposit was thickest (over 4.5 m) at the back of the cave, thinning out entirely at the mouth of the Lower Entrance. Other than abundant brown bear *Ursus arctos* Linné remains, those of wolf, fox and lion were recorded as common, while those of other species, such as glutton *Gulo gulo* (Linné), reindeer *Rangifer tarandus* Linné, a small bovid and hare *Lepus* sp. were said to be rare. Other animals, often represented by single specimens, included horse *Equus ferus* Boddaert, a rhinoceros, badger *Meles metes* (Linné) and clawless otter *Cyrnaonyx antiqua* Blainville. The remains of rodents, bats, shrews, birds and fish were listed without further identification.

2. Stalagmite Formation — although listed as a separate bed by Sutcliffe and Zeuner (1962), this material comprises a large quantity of broken stalagmite which is found in the overlying bed. No such material is found in the underlying Laminated Clay and evidently this speleothem once capped the clay as part of a substantial and probably continuous floor/wall dripstone layer. Its break-up and redistribution into the Glutton Stratum were attributed to periglacial processes.

1. Laminated Clay — unfossiliferous waterlain clays and silts, excavated down to the water-table. The upper part of this unit was much disturbed and deeply incised by the overlying deposit (in effect bed 3; see note in bed 2).

Sutcliffe and Zeuner also described higher units within the cave, but these descriptions are based on interpretations of Widger's report and so do not represent new data. They do, however, describe a series of deposits outside the cave which adds to its palaeontological interest. At the bottom of their excavations, heavily disturbed laminated clays similar to those found inside the cave could be traced beyond the present extent of the cave system, but no direct equivalents of the Glutton Stratum, Bear Stratum, Hyaena Stratum or Widger's 'Dark Earth' were present. A series of very poorly fossiliferous 'head' or talus deposits, apparently containing rare finds of reindeer, had accumulated against the limestone cliff outside the cave, up to the level of the Middle Entrance. It would appear that the Middle Entrance and the Middle Tunnel provided the main access route to the Main Chamber, at least until the end of the last interglacial, at which time the inner end of the Middle Tunnel appears to have become blocked by rocks (Widger's observation).

Immediately outside the Middle Entrance, on top of the poorly fossiliferous head deposits, was a unit which Sutcliffe and Zeuner (1962) named the 'Elk Stratum'. This material, which was of very limited extent, nonetheless produced quite a rich faunal assemblage, including spotted hyaena, woolly rhinoceros *Coelodonta antiquitatis* (Blumenbach), horse and reindeer. Overlying deposits, believed by the excavators to represent an external equivalent of Widger's 'Reindeer Stratum', contained less abundant remains of the same faunal assemblage, but with the interesting inclusion of a human lower incisor and several flint implements. This faunal grouping was attributed to an interstadial phase within the Devensian Stage. The 'Elk' from which this deposit took its name was later re-identified as a red deer (A. Lister, pers. comm.).

Subsequently, Sutcliffe extended his excavations into Vivian's Vault. Here, he removed a large quantity of spoil dumped by earlier excavators and discovered a previously unrecorded deposit containing abundant microvertebrate remains, including those of a white-toothed shrew *Crocidura* sp. (Rzebik, 1968), a large number of bird bones and the teeth and bones of the clawless otter *C. antiqua.* These discoveries are mentioned by Sutcliffe and Kowalski (1976) under the designation of finds from the Otter Stratum. The rodent remains from this deposit were listed by Sutcliffe and Kowalski (1976) as follows:

Cricetus cricetus Linné European hamster 2 specimens

Lagurus lagurus (Pallas) steppe lemming 1 specimen

Dicrostonyx torquatus (Pallas) collared lemming 12 specimens

Lemmus lemmus (Linné) Norway lemming 1 specimen

Microtus nivalis (Martins) snow vole 4 specimens

Microtus oeconomus (Pallas) northern vole 82 specimens

Apodemus sylvaticus (Linné) wood mouse 2 specimens

Clethrionomys glareolus (Schreber) bank vole 19 specimens

Microtus agrestis (Linné) short-tailed vole 5 specimens

Arvicola sp. water vole 8 specimens

The authors noted that this stratum contained a mixture of two possibly discrete faunal assemblages. Remains from a warm period predominated, and contained clasts of stalagmite yielded only temperate forms such as *M. agrestis, M. oeconomus, Arvicola* sp., *C. glareolus* and *A. sylvaticus.* This temperate fauna was attributed to the. last interglacial (Ipswichian Stage), while species such as *L. lagurus, C. cricetus* and *M. nivalis* were taken to indicate cold conditions during the penultimate cold stage (Oxygen Isotope Stage 6). The colder elements found in the deposits of the Otter Stratum were correlated with similar finds described from the Glutton Stratum in the same publication. Such an interpretation appeared to be secure, given the fact that the Glutton Stratum was stratified beneath the Hyaena Stratum and intervening Bear Stratum, and the Hyaena Stratum contained a large-mammal fauna characteristic of the Ipswichian.

Interpretation

Recent reappraisal of the Tornewton Cave collections now housed in the Natural History Museum, London, and selective excavation and sampling within the cave as part of the British Museum's Torbryan Caves Research Project, have together led to a partial reinterpretation of the Tornewton Cave sequence (Currant, 1996; Roberts *et al.,* in prep.).

Existing collections of material, recorded as having come from the Glutton Stratum, contain a much wider range of species than originally listed by Sutcliffe and Zeuner (1962). Newly identified species include: hedgehog *Erinaceus europaeus* Linné, marten *Martes* sp., narrow-nosed rhinoceros, hippopotamus, fallow deer, red deer, roe deer *Capreolus capreolus* (Linné) and wild boar *Sus scrofa* Linné. Together, these animals add a strongly 'temperate' component to what is supposed to be a cold, Oxygen Isotope Stage 6, assemblage. Samples taken from the Glutton Stratum during the British Museum excavations by Lorraine Higbee were examined for signs of internal stratification. She confirmed the complete admixture of temperate and boreal indicators noted above, and recovered the conjoining halves of a dentary of a glutton from two adjacent samples. This find was notable for its relative completeness and excellent state of preservation. Following a lead suggested by Widger's original description of the cave, in which he indicates the existence of some kind of partially blocked tunnel running down the back of the Main Chamber and through his 'Bear Deposit', this specimen yielded an Accelerator Mass Spectrometry (AMS) radiocarbon age estimate of 22 160 ± 460 BP (OxA–4587).

This dating has helped considerably in interpreting the controversial Glutton Stratum. The deposit would appear to have been emplaced, possibly under periglacial conditions, close to the Devensian stadial maximum (Oxygen Isotope Stage 2). It contains material from older units within the cave, including material which must have come from Widger's 'Reindeer Stratum' and from his 'Dark Earth', the Hyaena Stratum and the Bear Stratum. It may also include material from even older deposits which once adhered to the back wall of the cave. Sutcliffe and Zeuner (1962) described a 'cave within a cave' feature in the lower part of the Main Chamber, caused by the collapse of partly consolidated sediments which belonged to both the Bear Stratum and Hyaena Stratum. It seems likely that this collapse took place at the time of, or

shortly after, the emplacement of the Glutton Stratum beneath them.

This might explain the curious absence of Middle Devensian deposits inside the cave. It seems likely that most of the cave system was completely filled during the earlier part of the Devensian (Oxygen Isotope Stage 4) and remained so throughout the Middle Devensian (Stage 3). During this phase, the only access appears to have been to the Middle Tunnel, where the Elk Stratum and associated deposits contain the only characteristically Middle Devensian fauna. It seems likely that the Elk Stratum deposits are themselves part of a small debris flow issuing from the mouth of the Middle Tunnel. Only after material filling the upper part of the cave had become mobilized and flowed down the back of the Main Chamber, was the main cavern space partially reopened. It is possible that the dated glutton jaw belonged to an animal that was using the cave while the debris flow process was still active.

Excavations in the entrance to Vivian's Vault in 1991 and 1992 located a small remnant of *in situ* Hyaena Stratum overlying quite a large fragment of *in situ* Bear Stratum against the wall of the vault, confirming Widger's description of the sequence here. Immediately beneath the Bear Stratum, where the walls of the vault converge, a thin unit of barren clay overlies a partly broken stalagmite floor. This stalagmite contained pockets of sediment rich in *Crocidura* remains and had bones of clawless otter adhering to some of its broken surfaces. This stratigraphic relationship, between the Bear Stratum and the deposits of the Otter Stratum, would seem to confirm that the latter represents a pre-Stage 5 temperate phase. *Crocidura* has not been found in any Stage 5 contexts in Britain, but appears to be a characteristic element of what are believed to be Stage 7 faunas from other British sites such as Aveley and Orsett Road, Essex and Itteringham, Norfolk (Currant, 1989). Detailed examination of blocks of partly cemented sediment suggests a very complex history of deposition, but most of the deposits excavated in Vivian's Vault appear to represent material which originally accumulated under temperate conditions. At present there is no reason to suppose that the deposits belong to more than one temperate stage. The vault is less than 0.3 m wide in places, so digging conditions are extremely difficult, but it is believed that the exact area where Sutcliffe recovered the cold elements of his Otter Stratum rodent fauna has been located. Immediately beneath the entrance to Vivian's Vault from the Main Chamber there is a 'pipe' of sediment running down into the disturbed sediments of the Otter Stratum, apparently associated with the broken edge of the stalagmite floor mentioned above. A palate and dentary of a European hamster has been recovered from a sample of this deposit, which is tentatively interpreted as a smaller-scale debris flow, similar in character to the Glutton Stratum in the Main Chamber, though possibly much older. Sadly, the deposits immediately overlying this feature had already been excavated, so it was not possible to establish whether this feature was sealed by the Bear Stratum and Hyaena Stratum, or whether it cut through them.

An interesting microvertebrate assemblage has recently been recovered from a complex sequence of stalagmite deposits which block the passage between the inner end of the Middle Tunnel and Vivian's Vault beyond. Sandy partings in the stalagmite have yielded *Lemmus,* numerous teeth of *M. oeconomus* and as yet unidentified bird remains. This cold-stage assemblage superficially resembles some pre-Stage 5 faunas like that from Crayford, Kent, but its age remains uncertain.

In 1992 a large stalagmite mass blocking the back of the Main Chamber, just by the entrance to Vivian's Vault, was drilled through and access was gained to a small cavern space beyond. This has been named the Main Chamber Extension. The extension contained an undisturbed sequence equivalent to at least the upper part of the Bear Stratum, the Hyaena Stratum and Widger's 'Dark Earth'. These deposits were sampled for micro-vertebrate fossils and surprisingly the Hyaena Stratum yielded quite profuse remains of northern vole. This species, which is usually found in wet grasslands, tends to be absent from deposits representing the warmest part of the Ipswichian Stage (Stage 5e), yet there is good reason to suppose that this is the only period in which the hippopotamus was present in Britain during the later part of the Pleistocene. Stalagmite containing hippopotamus remains from Victoria Cave in North Yorkshire has been dated to around 125 000 BP (Gascoyne *et al.,* 1981). At Bacon Hole, West Glamorgan, a series of mammal faunas recovered from Stage 5 sediments shows that *M. oeconomus* is not present in local faunas during the earlier part of the stage, but is quite common during subsequent sub-stages of the interglacial (Currant *in* Sutcliffe *et al.,* 1987).

These findings have major repercussions for reevaluating the Tornewton Bear Stratum. Sutcliffe and Kowalski (1976) described a small assemblage of rodent remains found close to the entrance to the Lower Tunnel which they interpreted as being contemporary with the Bear Stratum. The assemblage includes *D. torquatus, L. lemmus, C. glareolus, Arvicola*

sp., *M. agrestis, M. nivalis, M. oeconomus* and *L. lagurus,* and was originally correlated with the Glutton Stratum as the equivalent of a Stage 6 assemblage. However, this collection of material appears to be far more closely connected with deposits immediately outside the originally narrow Lower Tunnel Entrance than it does with anything inside, and examination of Sutcliffe and Zeuner's own section through the cave deposits (Sutcliffe and Zeuner, 1962; plate 28) shows this to be the case.

It should be noted that the snow vole *M. nivalis* is not now believed to have been present in Britain during the Quaternary, and that material ascribed to this species actually represents a minor dental variant of *M. oeconomus* (A J. Stuart, pers. comm.). Moreover, the biostratigraphic significance that has previously been attached to the occurrence of this form (Sutcliffe and Kowalski, 1976) is equally unfounded, similar morphologies having been found in faunas of widely different age. It is possible that the records of such species as *L. lagurus* at Tornewton Cave represent new elements of a poorly known Early Devensian (Oxygen Isotope Stage 4) fauna rather than being part of an even more poorly known Stage 6 fauna. Even such well-known temperate species as *M. agrestis* and *C. glareolus* may be making spurious appearances in faunal lists, particularly when unequivocally associated with more boreal species. The teeth of the narrow-skulled vole, a boreal species, often closely resemble those of *M. agrestis,* and the more boreal species of *Clethrionomys,* such as *C. rutilus* and *C. rufocanus,* may well have gone unnoticed: the identity of all of this material has to be re-checked.

Returning to the Bear Stratum, examination of the collections from Sutcliffe's excavations arouses the 'suspicion that it was not always certain which deposit was being excavated. The only species which appears to have been common in the Bear Stratum was brown bear. In fact, there is nothing else in the collection which is definitely said to have come from the Bear Stratum, which is particularly odd given the observation that, on faunal grounds, the Bear Stratum could not be differentiated from the Glutton Stratum (Sutcliffe and Zeuner 1962; p. 131). There is a varied group of material marked up as 'H.S./B.S. undifferentiated' (including at least one specimen of *Hippopotamus*)and an even larger group marked up as 'B.S./S.B. undifferentiated' (S.B. = sub-Bear, the original name for the Glutton Stratum). The only firm information available on the fauna from the Bear Stratum comes from a series of samples collected inside the entrance to Vivian's Vault in 1991 by Cornish who was able to demonstrate that the contained microvertebrate fauna was consistently interglacial in character.

The Bear Stratum, therefore, accumulated under warm temperate conditions, most likely the early part of the last interglacial (Stage 5e). This fits in well with the abundance of *M. oeconomus* in the overlying Hyaena Stratum which can probably be placed in Stage 5c, and with the survival of interglacial fauna into the overlying 'Dark Earth' which probably represents Stage 5a, but does not square particularly well with the reported occurrence of *Hippopotamus* in the Hyaena Stratum, especially as the two deposits are separated by a minor phase of stalagmite formation, suggesting the passage of a significant period of time between their deposition.

Hippopotamus fossils are not common at Tornewton Cave, and nearly all of the individual specimens present in the collections at the NHM have something odd about them. Several are from poorly stratified contexts, one in the Glutton Stratum has been derived, and most of the remainder have clear signs that their original field data have been erased or altered. The largest piece, a fragment of canine tooth with a dark, heavy staining quite unlike all other Hyaena Stratum specimens, was found on a spoil heap (A.J. Sutcliffe, pers. comm.) even though it is marked '(H.S.)'. Sadly, it would appear that little faith can be placed on the provenance of a number of biostratigraphically significant specimens which have been attributed to the Hyaena Stratum. One should not be too critical of such discoveries. Interpretation of cave deposits is often difficult, particularly when dealing with huge amounts of compacted spoil from earlier excavations and isolated blocks of in *situ* sediments, themselves partly disturbed by collapse. Given the then-prevailing belief that the Bear Stratum represented a non-temperate environment, one can understand the collector's doubts about the provenance of earlier finds which originally may have been attributed to this unit but which were themselves temperate indicators.

Fortunately the new finds from the Main Chamber Extension are from unambiguous contexts. It is unlikely that some of the rarer species will be represented in the samples taken from the 1992 excavations, but there should be enough environmental data to resolve the exact placement of the various Stage 5 deposits. Particular hope is pinned on obtaining Uranium-series dates from a clean, crystalline stalagmite boss which was found growing on the Bear Stratum and sticking up through the Hyaena Stratum and the overlying 'Dark Earth', with 'skirts' marking the tops of each of these

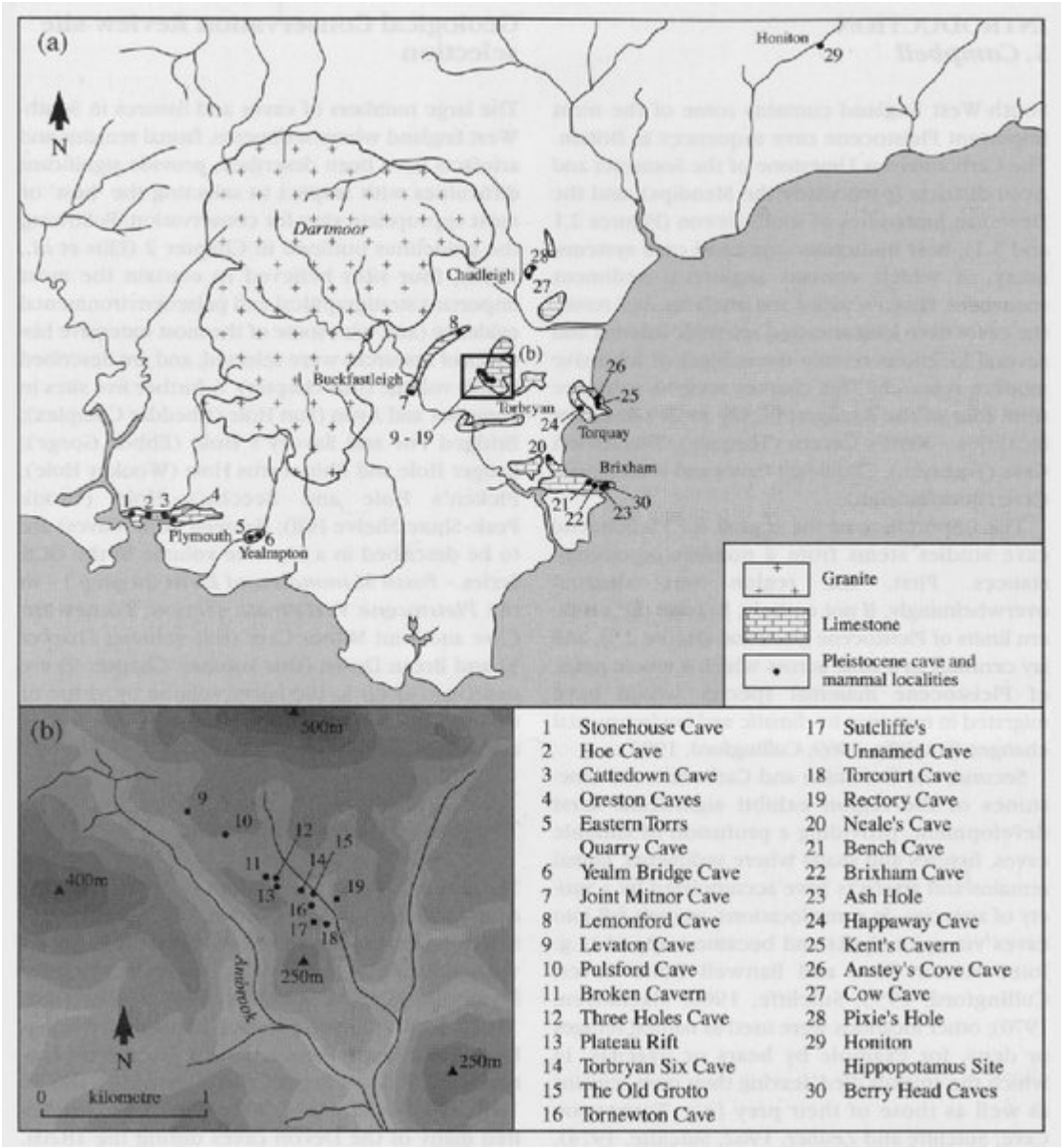
units.

The lateral equivalent of Widger's 'Reindeer Stratum' has been found in a previously unexplored horizontal 'tube' (Price's Passage) leading outwards from the Main Chamber just below the Upper Entrance. It may have had an entrance just above the Middle Entrance in what is now a mass of shattered rock and tree roots, but it would be unsafe to explore this further from the outside. Price's Passage is partly choked with soft, dark red loam which contains angular limestone fragments and a fauna with reindeer, bison and wolf. It appears to have been a wolf den for a significant time during the earlier part of the Devensian (Stage 4).

Conclusion

An interglacial vertebrate fauna with *C. antiqua* and abundant *Crocidura* has been recovered from the Otter Stratum of Vivian's Vault and is correlated with Oxygen Isotope Stage 7. A minor debris flow penetrating the Otter Stratum deposits contains a cold fauna with *Lagurus* and *Cricetus.* Its age is uncertain, but it could belong to Stage 6. The Bear Stratum, representing a major phase of denning by the brown bear, the Hyaena Stratum, representing a major phase of occupation by the spotted hyaena, and the 'Dark Earth', representing a less intense phase of hyaena usage, each contains interglacial faunas which appear to represent the warmer episodes of Stage 5. Overlying deposits, now found only as isolated remnants, contain what appears to be a Stage 4 fauna dominated by *Rangifer* and *Bison.* A coherent Stage 3 assemblage, with *Coelodonta, Equus* and *Crocuta,* is represented outside the cave by material at the mouth of the Middle Tunnel. At some time during Stage 2, a huge mass of cave deposit formed a debris flow which moved down the back of the cave and beneath the remaining stratified sequence. This constitutes the deposit known as the Glutton Stratum. It has been seen to fill deep, steep-sided cavities in the underlying waterlain sediments and contains a highly mixed and derived fauna. Later deposits have been entirely removed by previous excavators.

References



(Figure 5.1) (a) The principal localities where remains of Pleistocene mammals have been found in Devon, after Sutcliffe (1969). (b) Excavated caves in the Torbryan Valley, after Roberts (1996). The location of Berry Head 'sea caves' (Proctor, 1994, 1996) is also shown.