

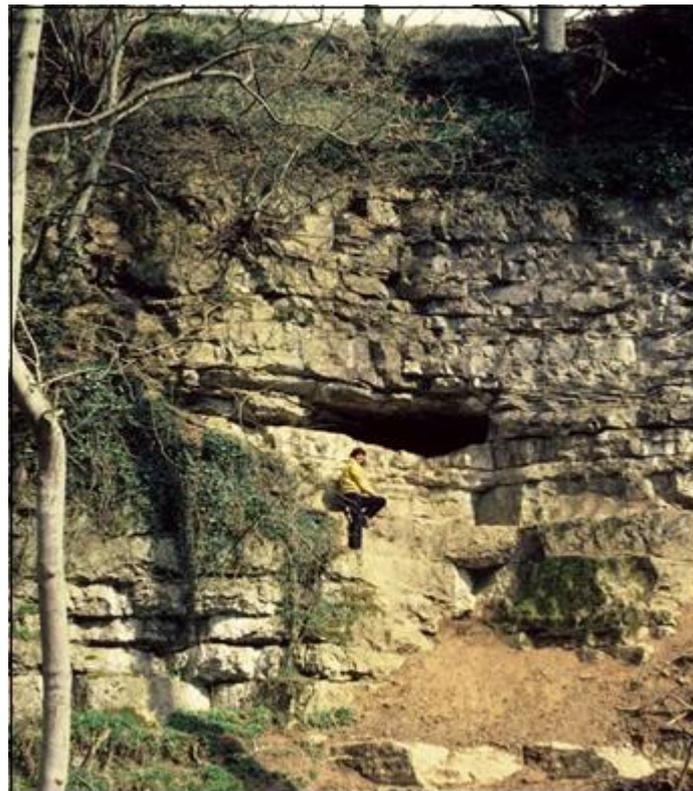


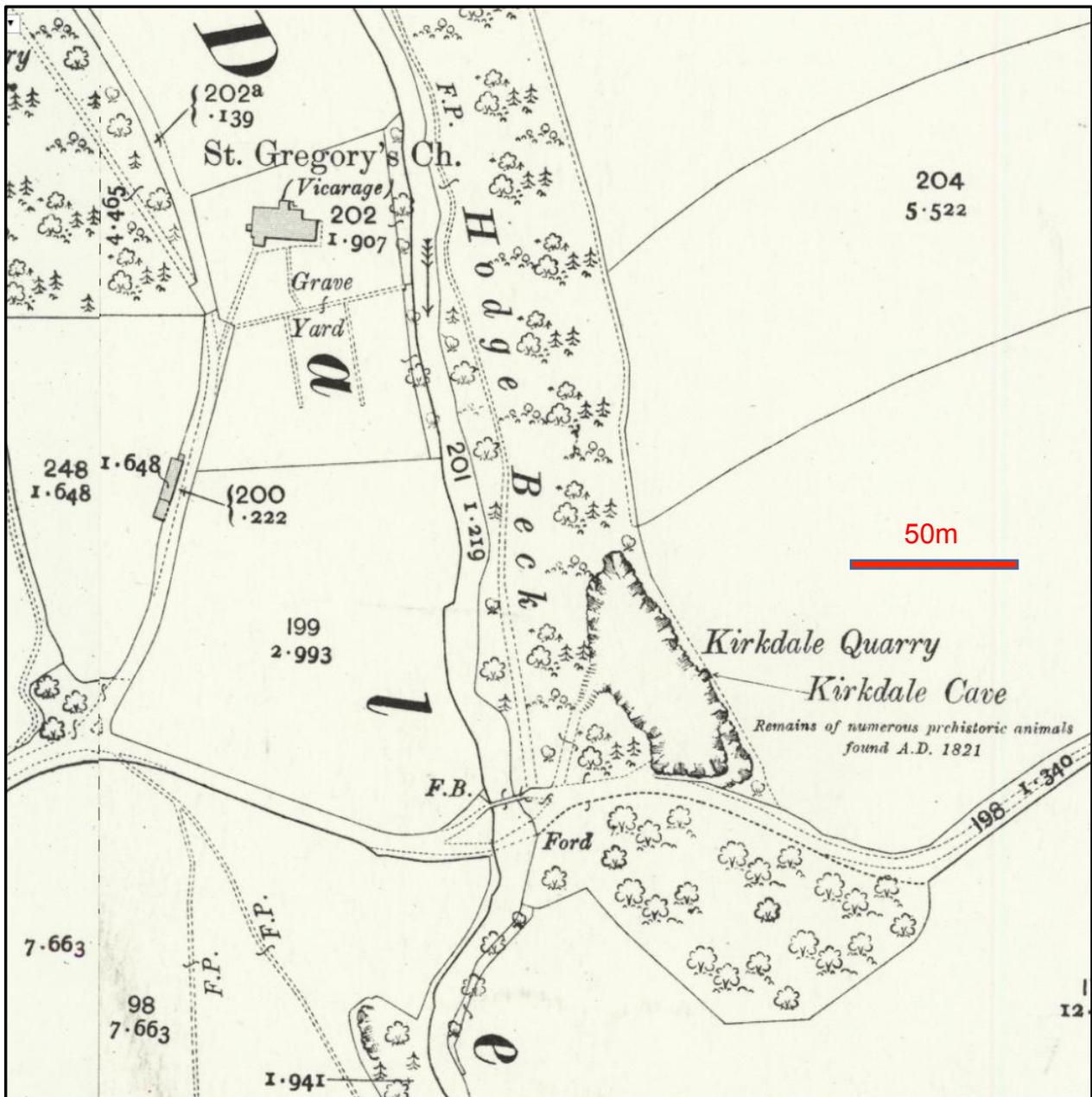
**The genesis of geology in York and beyond**  
**HOGG 25<sup>th</sup> Anniversary Meeting**  
Thursday 24<sup>th</sup> October  
**Field Excursion Notes**



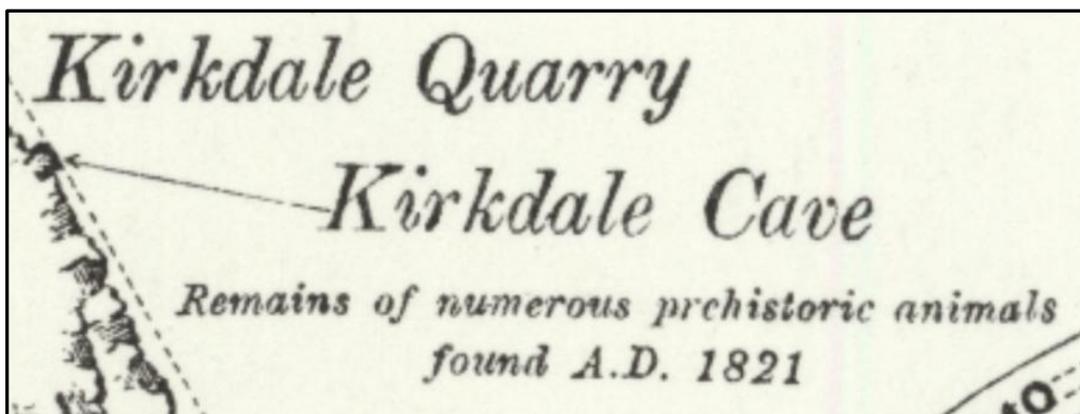
Thursday 24<sup>th</sup> October  
Field Excursion Notes

# KIRKDALE CAVE, nr. Kirkbymoorside





<https://maps.nls.uk/geo/explore/#zoom=18&lat=54.2622&lon=-0.9599&layers=168&b=1>  
 O.S. Yorkshire 1:2500 – XC.1 and XC.2 – revised 1910, published 1912.



**Extract from: “Records of warfare...embalmed in the everlasting hills”: a History of Early Coprolite Research**

MERCIAN GEOLOGIST 2009 17 (2), 101-111

*Christopher J. Duffin*

**Abstract:** Although ‘coprolite’ was introduced as a term for fossil faeces by William Buckland in 1829, specimens had been described and figured in earlier literature. John Woodward described specimens from the Chalk as fossil larch cones a century before Buckland’s work, an identity later confirmed by James Parkinson in 1804. Gideon Mantell described more Chalk specimens in 1822, whilst François- Xavier de Burtin described further spiral forms from the Brussels area as fossil nuts. Buckland first identified fossil hyaena faeces from the Ipswichian cave deposits of Kirkdale in Yorkshire, and then applied his experience to specimens from the Jurassic of Lyme Regis and the Rhaetic Bone Bed of the Severn estuary area. He developed a nomenclature for the specimens that he described, the first such attempt in ichnology. A rich network of domestic and foreign colleagues and correspondents either supplied him with information and further specimens, or applied his conclusions to their own material. Buckland’s coprolite research engendered good-natured ribaldry from his colleagues.

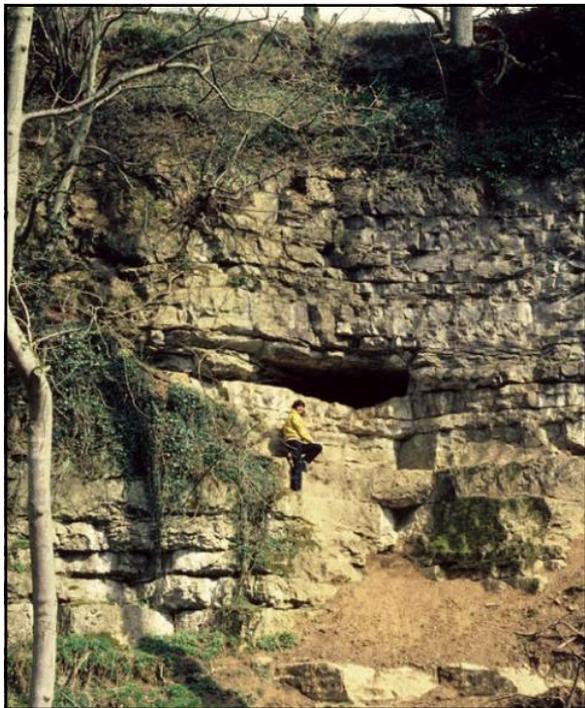
The first half of the nineteenth century was a time of radical change in thinking amongst the natural sciences in general, and in geology in particular. A cutting edge contributor to this rapid pace of conceptual change was William Buckland who worked tirelessly as a politician for science, gave many a helping hand to up and coming colleagues, developed a rich network of contacts and friends, and acted as a popular figurehead for geology. Among the many innovations for which he was at least partly responsible was the growing appreciation that the fossil record sampled a diversity of once living communities, rather than being the chaotic record of a universal deluge. It was Buckland who first recognized that in the same rocks that sported the panoply of body fossil such as shells, teeth and bones, there were also traces of the daily activities of once living organisms – footprints and faeces (Duffin, 2006). Coprolites were first identified by William Buckland, who also gave us the name, effectively making him a founder of palaeoichnology. Kirkdale Cave

William Buckland was born the eldest son of the Rev. Charles Buckland on 12th March 1784 at Axminster in Devon (Rupke, 1983; Duffin, 2006). In 1813, Buckland was appointed Reader in Mineralogy and then Reader in Geology in 1818. Quickly establishing himself as a popular lecturer, he illustrated his talks with the liberal use of specimens, maps and sections, holding the audience not only with the innovative approach and scientific content of his lectures, but also his rather theatrical style and sense of humour. Completing something of a ‘Grand Tour’ of European geology in the company of W.D. Conybeare and G.B. Greenough, he spent some time with August Goldfuss who was engaged with the careful excavation of the bone-bearing sediments in the cave floor at Gailenreuth near Muggendorf in German Franconia

*“Little did the boy think, who stepped amongst the bushes, with which the mouth of the Cave was overgrown; or the woodman, when felling the oak; that he was walking on a spot, which in some future time, would interest the literary world, and draw many from the smoke of populous and polished cities and towns, and from the retired cloisters of colleges, to explore a Cavern, then unknown, and to visit a situation, which before had been comparatively unobserved! But unexpected circumstances every day unfold some mysteries, and give fresh stimulus to the energies of the human mind.”* (Eastmead, 1824 p4).

His experience in Germany was to hold Buckland in good stead when he later examined

cave deposits at first hand in Yorkshire – deposits that would, indeed, “give fresh stimulus to the energies” of his mind! Quarrying of oolitic limestone was taking place near the small village of Kirkdale, a few miles away from Kirby Moorside in Yorkshire. During the summer of 1821, John Gibson (George, 1998), a manufacturing chemist, was visiting friends in the area. He noticed large blocks of limestone being used to repair the roads; scattered between them were various pieces of bone and tusk. Gibson traced the origin of the material to the small quarry by the side of Hodge Beck (SE678856), adjacent to Kirkdale Church. Believing the remains to have come from modern cattle which had either succumbed to the disease ‘murrain’ (probably Rinderpest), a highly infectious viral cattle plague, or had fallen into an open chasm, the quarrymen had scattered them as aggregate on the local roads. The land owners (the Welburn Estate and a local solicitor) generously gave permission for the cave contents to be fully excavated, hoping that the bones and teeth would, “fall into the hands of such persons, who would deposit them in public institutions or otherwise take care of them, to preserve the interesting memorials of this wonderful cavern” (Eastmead, 1824 p7). Keen amateur geologists, collectors and enthusiasts were happy to oblige and gathered up some of the material; local surgeon, coroner and apothecary, Thomas Harrison also discovered the cave in the autumn of 1821 (*Gentleman’s Magazine*, February 1822), while George Young and his co-worker John Bird, and Rev. William Eastmead an independent minister in the village, all collected from the site. Retired colonel William Salmond reputedly funded and superintended the excavation, and executed the plan drawing of the cavern used in subsequent publications. On December 7th 1822 Salmond met with his colleagues Anthony Thorpe and James Atkinson, a retired surgeon, in an attempt to bring their various collections of Kirkdale fossils together in a suitable repository; hence the Yorkshire Philosophical Society was born. Gibson was credited with completing the bulk of the excavation and accumulating a huge collection which was shown, among others, to James Parkinson. Other material found its way into a wide range of personal collections and public institutions.



*Entrance to Kirkdale Cave today.*

It was Edward Legge, Bishop of Oxford, who eventually informed Buckland about the discoveries at Kirkdale. Joseph Pentland was told of the finds. The Irishman was working in the laboratory of Georges Cuvier, Parisian father of comparative anatomy who, at that time, was engaged in writing the second edition of his *Recherches sur les ossements fossiles*. William Clift, curator of the John Hunter Collection at the Royal College of Surgeons, had also written to Cuvier, sending him some drawings of the better material from Kirkdale. Pentland wrote to Buckland on 26 November 1821, urging him to procure some specimens from Kirkdale for the French Professor. Buckland accordingly visited the cave in December 1821, and joined the team. At around 75m long, 4m high and up to 2m wide (Fig. 5), this cave was smaller and

contained thinner deposits than those he had seen during his visit to Germany. Buckland’s excited descriptions of the cave to his correspondents refer to a profusion of the comminuted, trampled bones and teeth of hyaenas, mixed together with a host of other species, including “Elephant, Rhinoceros, Hippopotamus, Horse, Ox, Deer, Fox and Water Rat”, forming a sort of pavement over the cave floor. A full faunal list is given

by Boylan (1981). Buckland went on to conclude that the assemblage represented a hyaena den, analysing breakage patterns of the bones to prove that they were from carcasses dragged into the cave and broken by feeding action. In doing so, he was the first person to conduct anything like a rigorous study of biostratigraphy.

Buckland was impressed by the fact that bone debris was strewn all over the cave floor, including the deepest recesses of the cavern, and that the walls and bone fragments had been polished by the passage of the predators through the cave. His ecological explanation of the fauna as a hyaena den was not universally accepted; there was some tension between Buckland and George Young, for example. Young preferred the notion that the accumulation of bones was part of a diluvial (flood) deposit and left the excavations as a result of the difference of views.

Many did embrace Buckland's view, however, and relished the idea of antediluvian hyaenas roaming the Yorkshire countryside in search of prey. Similar hyaena dens have been described much more recently from the volcanic plateau of Al-Shaam Harrat in Jordan (Kempe et al., 2006). The Dabié Cave (Fig. 6), with its almost unbroken covering of bone scatter, gives an impression of the sight, albeit partially obscured by marly sediment and stalagmite, that must have met Buckland's eyes as he entered and excavated Kirkdale cavern (Fig. 8).

Nestling between the bones and teeth, much as on the floor of Al-Fahda Cave (also in Jordan, Fig. 9), Buckland noticed some small balls of a white material. Intrigued as to their nature and origin, he wondered if they might be fossilised faeces deposited by the hyaena (Fig. 10). He referred to them both in his letters and in print as *Album Graecum*, an old apothecarial term pertaining to dog faeces which demonstrate the property of turning white on exposure to air. Rather frighteningly, *Album Graecum* (also known as *Stercus Canis Officinale*) was used as an ingredient, particularly in the 16th and 17th centuries, in the treatment of colic, dysentery, scrofula, ulcers (Wootton, 1910) and especially quinsy (a peritonsillar abscess that can form as a complication of acute tonsillitis), both as a component of a poultice or plaster and (possibly worse!) a gargle. The 'drug' was obtained by feeding otherwise half starved dogs with bone fragments; the protein inside was digested and absorbed from the bone, leaving an easily blanched phosphate-rich faecal pellet which was collected with some eagerness (Burnett, 1833). The parallel drawn by Buckland between *Album Graecum* and hyaena coprolites thus becomes both appropriate and striking.



Buckland described the Kirkdale material (Buckland, 1824 p20) as having an external form that *"is that of a sphere, irregularly compressed, as in the faeces of sheep, and varying from half an inch to an inch and a half in diameter; its colour is yellowish white, its fracture is usually earthy and compact, resembling steatite, and sometimes granular; when compact, it is interspersed with small cellular cavities, and in some of the balls there are undigested minute fragments of the enamel of teeth."* Anxious to confirm his suggested interpretation, he sent some of the material to William Hyde Wollaston, the chemist, physicist and mineralogist. Wollaston showed the specimens to the Menagerie Keeper at the Exeter Exchange, who immediately noted their similarity to the droppings produced by the Spotted Hyaena (*Crocuta crocuta*).

Painting by R. Ansdell R.A., from about 1843, of William Buckland.



Caricature by W.D. Conybeare, of Buckland entering the Kirkdale hyaena den, only to find it occupied.

The analysis conducted by Wollaston “finds it [the hyaena coprolite] to be composed of the ingredients that might be expected in faecal matter derived from bones” (Buckland, 1824 p22). In his reply to Buckland, Wollaston (24 June 1822; Buckland Papers, Royal Society) wrote that “though such matters may be instructive and therefore to a certain degree interesting, it may as well for you and me not to have the reputation of too frequently and too minutely examining faecal products.”

Buckland’s study of Kirkdale and its fauna was initially published in the *Philosophical Transactions of the Royal Society* in 1822, and then issued as the *Reliquiae Diluvianae*, published by John Murray in 1823. The importance of the work was recognised by the Royal Society, who awarded Buckland the prestigious Copley Medal for 1822, an honour reserved for “outstanding achievements in research in any branch of science”. Buckland’s was the 62nd in a long sequence whose pedigree included men such as Benjamin Franklin, William Herschel, Joseph Priestley, James Cook and William Wollaston himself, and was the first such award for geology. The then President of the Society, Humphrey Davey, commented, “I do not recollect a paper read at the Royal Society which has created so much interest as yours” (letter dated 18 March 1822; Buckland Papers, Royal Society).

Shortly afterwards (1827) Buckland published a note in the *Proceedings of the Geological Society of London* of his lecture of November 17 1826 entitled “*Observations on the bones of hyaenas and other animals on the cavern of Lunel near Montpellier, and in the adjacent strata of marine formation*”. Rather larger than Kirkdale, this cave contained a similar fauna to that of Yorkshire, but Buckland was astounded by the high incidence of hyaena faeces – “an extraordinary abundance of the balls of *album*

*graecum* in the highest state of preservation". He concluded that, at Kirkdale, "a large proportion of the faecal balls of the hyaenas appear to have been trod upon and crushed at the bottom of a wet and narrow cave, whilst at Lunel they have been preserved in consequence of the greater size and dryness of the chamber in which they were deposited."

Buckland was renowned for his rather earthy sense of humour. Indeed, Charles Darwin wrote of him in his *Autobiography*, "though very good-humoured and good-natured, [Buckland] seemed to me a vulgar and almost coarse man. He was incited more by a craving for notoriety, which sometimes made him act like a buffoon, than by a love of science". He was certainly not averse to a joke at his own expense and reveled in the cartoons and doggerel which flowed from the fertile minds and pens of some of his friends. Coprolites were, of course, grist to the mill for this type of ribaldry.

Philip Bury Duncan, a stalwart of the Bath Royal Literary and Scientific Institution (Chairman 1834- 1859), for example, wrote to Buckland with some oft-quoted verses :

*Approach, approach ingenuous Youth And learn this fundamental truth*

*The noble science of Geology*

*Is bottomed firmly on Coprology For ever be Hyaena's blest*

*Who left us the convincing test I claim a rich Coronam Auri For these  
Thesauri of the Sauri*

The couplet at the end links the golden crown with the 'treasures' (thesauri) of the extinct saurians, these treasures being their faeces. Duncan also delivers some lines of Latin :

*Avia Pieridum peragro loca nullius ante Trita solo, coecas iuvat explorare  
ferarum Speluncas, iuvat et merdas exquirere priscas Saurorum duro et vestigia  
quaerere saxo*

These lines are modeled on Lucretius' *De Rerum Natura* 1, lines 925-927. An English translation of the classical original reads as follows :

*I wander through the pathless places of the Muses, Previously trodden by the foot of  
none.*

*I am glad to approach the virgin springs, And drink; glad, too, to pluck new  
flowers*

Duncan's modified version can be translated as :

*I wander through the pathless places of the Muses, Previously trodden by the foot of  
none.*

*I am glad to explore the hidden caves of wild beasts, glad, too, to search out ancient  
turds of lizards, And to look for traces in the hard rock.*

On a fold of the envelope he wrote : "*Tear off the other side for Mrs B for she must know nothing of the Bona Dea Coprologia - Cloacina Ocaeaningae*". Even here, he is playing a coprolitic theme. The Good Goddess Coprologia is linked with the Cloacina Oceaningae or oceanic sewer, in the oblique reference to Rome's sewage system, the Cloaca Maxima, which ran into the River Tiber and thence to the sea. In a parallel with the Roman sewage system,

Mundane they might be, and a source of humour and fascination they certainly are, but who would have thought that in the excited conclusion to a careful piece of analysis by William Buckland they could also take on an air of romanticism: "*In all these various formations our Coprolites form records of warfare, waged by successive generations of*

*inhabitants of our planet on one another: the imperishable phosphate of lime, derived from their digested skeletons, has become embalmed in the substance and foundations of the everlasting hills; and the general law of Nature which bids all to eat and be eaten in their turn, is shown to have been co-extensive with animal existence upon our globe; the Carnivora in each period of the world's history fulfilling their destined office,—to check excess in the progress of life, and maintain the balance of creation.”* (Buckland, 1835 p235).

## References

- Boylan, P. 1981. A new revision of the Pleistocene mammalian fauna of Kirkdale Cave, Yorkshire. *Proceedings of the Yorkshire Geological Society*, **43** (3), 253-280.
- Buckland, W. 1822. Account of an assemblage of fossil teeth and bones of elephant, rhinoceros, hippopotamus, bear, tiger and hyaena, and sixteen other animals; discovered in a cave at Kirkdale, Yorkshire, in the year 1821; with a comparative view of five similar caverns in various parts of England, and others on the continent. *Philosophical Transactions of the Royal Society of London*, 112, 171-236, pls. XV-XXVI.
- Buckland, W. 1824. *Reliquiae diluvianae; or, observations on the organic remains contained in caves, fissures, and diluvial gravel, and on other geological phenomena, attesting the action of an universal deluge*. 2<sup>nd</sup> edition. London: J. Murray, 303 pp.
- Buckland, W. 1827. Observations on the bones of hyaenas and other animals on the cavern of Lunel near Montpellier, and in the adjacent strata of marine formation. *Proceedings of the Geological Society of London*, 1, 3-6.
- Buckland, W. 1835. On the Discovery of Coprolites, or Fossil Faeces, in the Lias at Lyme Regis, and in other Formations.
- Burnett, G.T. 1833. Inaugural Address. *The London Medical and Physical Journal*, 69, February 1833, 89-100.
- Duffin, C.J. 2006. William Buckland (1784-1856). *Geology Today*, 22 (3), 105-109.
- Eastmead, W. 1824. *Historia Rievallensis: Containing the History of Kirkby Moorside, and an Account of the Most Important Places in its Vicinity; Together with Brief Notices of the More Remote or Less Important Ones. To which is prefixed a dissertation on the Animal Remains*. London: Baldwin Chadock and Joy, 486 pp.
- Kempe, S., Al-Malabeh, A., Döppes, D., Frehat, M., Hensch, H.-V. & Rosend, W. 2006. Hyena Caves in Jordan. *Scientific Annals*,
- Wootton, A.C. 1910. *Chronicles of Pharmacy*. London: Macmillan, 2 volumes.

Plate 2

a slight sketch of the

Plate 2. Fig 2



Draft figure of Kirkdale cave intended for William Buckland's 'Account of the assemblage of fossil teeth and bones of elephant, rhinoceros, hippopotamus, bear, tiger, and hyaena, and sixteen other animals; discovered in a cave in Kirkdale, Yorkshire, in the year 1821: with a comparative view of five similar caverns in various parts of England, and others on the continent' in Philosophical Transaction, 1822. Courtesy of the Royal Society archive, PT/73/9/14.



Draft coloured geological map intended for William Buckland's 'Account of the assemblage of fossil teeth and bones of elephant, rhinoceros, hippopotamus, bear, tiger, and hyaena, and sixteen other animals; discovered in a cave in Kirkdale, Yorkshire, in the year 1821: with a comparative view of five similar caverns in various parts of England, and others on the continent' in *Philosophical Transactions*, 1822. Published uncoloured. Courtesy of the Royal Society archive, PT/73/9/13.



## Manor Vale, Kirby Moorside

### Duncan Hawley

NGR: SE 694868 - in the cliff face on east side of valley.

Cave length: 30m.

Buckland first reported this cave in his paper "*Account of an assemblage of Fossil Teeth and Bones of Elephant, Rhinoceros, Hippopotamus, Bear, Tiger and Hyaena and sixteen other animals; discovered a cave at Yorkshire, in the year 1821: with a comparative view of five similar caverns in various parts of England, and others on the Continent.*" read to the Royal Society on 1 February 1822. It is an addendum at the end of the paper that appears as the print version, published in 1822, writing as follows:

P.S. As this paper was going to the press, I have been gratified to hear that my conjecture, as to the abundance of such caverns as that at Kirkdale, has been verified by the discovery of another cave (containing chambers lined with stalactite, and having on its bottom mud, and bones imbedded in the mud), in a quarry close to the town of Kirby Moorside, on the property of C. DUNCOMBE, Esq., who has judiciously taken every precaution to secure it from injury, till some qualified person shall be present to observe, and record the undisturbed appearance presented by its interior. Should it be in my power, as I hope it may, to assist at its farther opening, I shall communicate the result to the Royal Society.

It is recollected also, that about 20 years ago, another cavity, containing bones, was discovered on the north of Kirby Moorside, but none of them have been preserved.

Buckland returned to Kirkdale Cave in June 1822 accompanied by Humphrey Davey and Henry Warburton. Accordingly the party of three visited Manor Vale on the outskirts of Kirby Moorside, where another cave had been reported.

Buckland did not find any further bones – and it is probably for this reason that this location has been generally overlooked. However Buckland did use the evidence (or absence of it) at Manor Vale to support his argument for Kirkdale cave having been a Hyena's den. Historically it is interesting to consider whether this is a case of the first use of negative evidence to support and argue a case using inference, and in this context, the Manor Vale site is important.

What follows is Buckland's description of Manor Vale taken from *Reliquiae Diluvianae*:

## CAVES AT KIRBY MOORSIDE.

I mentioned in my former paper, that a second cave had been discovered in the vicinity of Kirkdale, which was reported also to contain bones, and that it had been closed by Mr. Duncombe till I should come down to examine it, which I did in July last, accompanied by Sir H. Davy and Mr. Warburton. Our labour was lost as far as related to the discovery of more bones, or a second den of hyænas; but it was repaid by the confirmation which this cave afforded in all its other circumstances of my speculations on that at Kirkdale, and by the discovery of another cavity in Duncombe park containing animal remains, which throw much light on the mode in which the caves and fissures that were not inhabited as dens became filled with bones. I had also the satisfaction of demonstrating on the spot to Sir H. Davy and Mr. Warburton the actual state of many of the phenomena described in my account of Kirkdale. The cave at Kirby Moorside was intersected in working the face of a quarry of the same limestone as that at Kirkdale, at the north end of the town, and on the right side of a narrow gorge or valley called the Manor Vale, which descends from the north towards the Vale of Pickering, nearly parallel to the valley of Kirkdale, being about sixty feet broad, and bounded by slopes forty feet high, and forming one of the many smaller vallies of denudation excavated on this limestone by the diluvial waters as they subsided from the moorlands to the Vale of Pickering. A considerable portion of the right bank of this valley has been laid bare by the workings of the quarry, and on the

## CAVES AND FISSURES AT KIRBY MOORSIDE.

face of it there are traces of a fissure connected with several small cavernous holes. The aperture discovered last spring is in the centre of this quarry, and near its floor; on removing the wall with which Mr. Duncombe had caused it to be closed, it was found to pass obliquely into the body of the hill, and to be intersected at a few feet from its entrance by a large fissure; this point of intersection forms, as at Kirkdale, the widest and most lofty part of the cavern, within which it diminishes into smaller vaults, which soon become impassable: the outer part of the cave when first opened was about four feet high and six broad, and its entire floor covered with an uniform mass of loamy clay, precisely similar to that on the floor of the den at Kirkdale. On digging into this loam it was found to be six feet deep for a considerable distance inwards, and to contain no bones. At its bottom there was no stalagmitic undercrust dividing it from the limestone floor, nor any repetition or alternation of a second or third bed of stalagmite in any part of its substance; its surface alone was in many parts glazed over with an extensive sheet of it oozing outwards from the side walls, and sometimes entirely crossing and forming a bridge over the loam. Above this crust some parts of the roof and sides were loaded with stalactite in its usual fantastic forms; but there were no bones of modern animals, nor traces of loam, or even of dust, upon the surface of the superficial crust of stalagmite. In all its circumstances, as far as they went, it agreed with and confirmed the history and chronology I have given of the cave at Kirkdale, excepting the two accidents of its not having been inhabited as a den, or received any stalagmite on its floor, before the introduction of the diluvial loam. The absence of bones in this cave (the mud being present) adds to the probability that it was by the instrumen-

tality of the hyaenas, and not of the diluvial waters, that the animal remains were collected in such quantities in the adjacent den at Kirkdale.

At about a mile east of Kirby Moorside, at a spot called the Back of the Parks, there are other quarries on both sides of a comb that descends rapidly into the valley of the Dove, in the face of which there occur several small caverns and vertical fissures: these fissures vary from one to six feet in breadth, and rise from the bottom of the quarry to the surface of the land, and are entirely filled with diluvial loam, of the same kind as that in the caves both here and at Kirkdale, and the Manor Vale. It was in the upper part of one of the fissures that several human skeletons were found and taken out in the year 1786, but the spot on which they occurred has been destroyed in continuing the workings of the quarry: they were probably bodies that had been interred here after a battle.

#### OPEN FISSURE IN DUNCOMBE PARK.

The newly discovered fissure in Duncombe Park differs from those we have been last describing in the circumstance of its being of post-diluvian origin; it contains no diluvial sediment and no pebbles, and has within it the remains of animals of existing species only, and these in a much more recent and more perfect state of preservation than the bones at Kirkdale. It is a great irregular crack or chasm, in the solid limestone rock, which forms a steep and lofty cliff on the right side of the valley of the Rye, being in that most beautiful valley of denudation which descends from Rivaulx Abbey through Duncombe