

Anniversaries

Buckland Kirkdale Cave 200 years ago



WILLIAM BUCKLAND'S BONE CAVE (1822): TIME-TRAVEL INTO EARTH'S DEEP HISTORY

Martin J.S. Rudwick (U.K.)

Exactly two centuries ago, in February 1822, at three successive meetings of the Royal Society in London, a large audience of its Fellows and their guests listened to a major paper by William Buckland (1784-1856), describing how he had interpreted a small cave in rural Yorkshire, in the north of England, as the former den of a large extinct species of hyaena, with fossil bones that were the remains of equally exotic animals such as elephants, rhinoceros and hippopotamus. Larger and more spectacular caves with abundant fossil bones had long been known in continental Europe, but Buckland's analysis of the little cave at Kirkdale set an outstanding precedent. He used it to reconstruct not just a lot of extinct species but a whole ecosystem that belonged to a vanished 'former world'. His 'hyaena story', as he called it, gave geologists a newly effective model for thinking about the pre-human past; in effect, he constructed a conceptual time-machine that gave vivid and reliable access to the deep history of the Earth.



Fig. 1. The entrance to Kirkdale cave, as first exposed in 1821 by quarrying for building stone. Although lengthy, the cave was clearly much too narrow for mammoths and other large mammals to have been swept into it during the putative Deluge. Buckland argued that it had been a den of hyaenas, which had scavenged larger animals and dragged their dismembered carcasses into the cave, where their fossil bones were now found. (Author's collection)

Buckland's lengthy paper was published later in 1822 in the Royal Society's *Philosophical Transactions*, the world's oldest scientific periodical and, at this period, one of its most prestigious; and Buckland was the first geologist to receive the Copley Medal, the Royal Society's highest award, for the research on which it was based. Yet in modern times its author has often been dismissed as, at best, an intellectual lightweight and a buffoon, and, at worst, as a benighted forerunner of modern fundamentalists. Buckland was neither, and deserves better.

Buckland was the first 'reader' in (and self-styled professor of) geology at Oxford, where his lively lectures quickly became famous for bringing this relatively new science to the attention of some of England's cultural elites. The core of his teaching was what William Smith (1769-1839) had recently defined as 'stratigraphical': literally, the plain description of the pile of rock formations or 'strata', each with its 'characteristic' fossils. However, distinct from even the uppermost of these 'regular' formations were irregular 'superficial' deposits such as boulder clay (till) and river gravels; and river valleys themselves often seemed to be unrelated to the solid rocks through which they had somehow been eroded. Buckland adopted what at the time was a widely held causal explanation of these features, namely that they were due to an exceptional aqueous 'Deluge' in the relatively recent past. One possibility, suggested earlier by James Hutton's friend James Hall (1761-1832) among others, was, in modern terms, some kind of mega-tsunami: a hugely scaled-up version of the tsunami that had destroyed Lisbon in the wake of its disastrous earthquake in 1755. This was an essentially historical interpretation of distinctive features of the natural world, so it is not surprising that a link was sought with records of some such aqueous catastrophe in the distant past of human history. Of these the most familiar and accessible was the account of a worldwide Flood recorded in Genesis, the opening text of the Bible.

Buckland had argued eloquently for this correlation between geological Deluge and biblical Flood, in his inaugural lecture in 1819, published as *Vindiciae Geologicae* (1820). This received plenty of attention for its claim that the historical reliability of the biblical text was now decisively confirmed by scientific evidence. This went down well in Oxford, and it supported Buckland's plan to make the teaching of geology acceptable in the intellectual centre of the established Anglican church. But it was not in fact an essential component of his interpretation of Kirkdale cave, and Buckland tacitly conceded this by giving it no explicit role in the paper he read in the secular (but not anti-religious) environment of the Royal Society. What did matter to his argument was the fact that the deposit with fossil bones on the floor of the cave was overlain, and sealed in, by a layer of stalagmite: its modest thickness served as a 'natural chronometer' – as the Genevan naturalist Jean-André Deluc (1727-1817) had termed it – to prove that no geologically significant span of time had elapsed since the bones had accumulated in the cave: it was compatible with dating the putative 'Deluge' to no more than a few millennia in the past. This in turn made it more or less compatible with the timing of the biblical Flood, as computed on textual grounds by generations of scholarly 'chronologists' (long before, James Ussher's 2347 BC, for example, had been just one among many such proposed dates). But as Buckland was well aware, the leading French naturalist Georges Cuvier (1769-1832), to whom he deferred on almost any scientific matter, had set all such dates in a multicultural context characteristic of the late Enlightenment: in the *Discours préliminaire* to his great monograph on fossil bones (*Ossemens Fossiles*, 1812), he had mentioned the Genesis account very briefly among lots of other records in all the relevant ancient texts, ranging as far afield as China. That a possibly worldwide Deluge really had happened in early human history – and in the geologically recent past – was widely accepted by geologists. Whether it could properly be recruited to support the historicity of the biblical texts was a separate issue, and one that Buckland's Kirkdale paper deftly sidelined. (His later volume on *Reliquiae Diluvianae*, 1823, reprinting

his Kirkdale work and adding new material, gave him space to re-state his claim for their correlation, which continued to be controversial.)



Fig. 2. A lithograph depicting an imagined scene – in the contemporary style of a political caricature – showing Buckland himself crawling into Kirkdale cave, disturbing the resident hyaenas to their evident surprise, as they gnaw the bones they have brought into the cave. With the metaphorical light of science in hand, Buckland has travelled in time and become in effect an eye-witness of a scene from the deep past, making it reliably knowable in the present: in Cuvier's celebrated phrase, he had 'burst the limits of time'. (Author's collection)

The fossil bones found in caves scattered across continental Europe had been collected and studied by many naturalists in the preceding decades, and identified – most authoritatively by Cuvier – as belonging to a wide variety of mammals, most of them of apparently extinct species. How they had got there was debatable, but they were commonly assumed to have been swept into the caves, perhaps from far away in the tropics, during the enigmatic Deluge event. When Napoleon's final defeat in 1815 had made Continental travel feasible again for British geologists, Buckland had visited some of the best localities, in Bavaria, and therefore had first-hand knowledge of their problems. What he found striking about the cave at Kirkdale, in contrast, was that it was much too small for the carcasses of mammoths and other megafauna to have been swept into it. Buckland's sensational alternative explanation was that it had been a den of hyaenas before the Deluge event; they had scavenged much larger animals outside, and then dragged parts of their carcasses into the cave to consume at leisure. This inference was supported by Buckland's close study of the bones, which bore tooth marks that exactly matched those on bones chewed by living hyaenas; this was confirmed by an equally close match in the form and composition of their dung, past and present.

For these comparisons Buckland relied on his own observation of living hyaenas in a travelling show that was passing through Oxford, and on what he was told by those in charge

of hyaenas in menageries in London and Paris. He was using the ‘actualistic’ method of reasoning that took the present as obviously the best key to the past, a method that was already well established as normative for the essentially historical science of geology; but he was applying it to reconstruct a specific scene from deep time in unprecedented detail. In modern terms, he portrayed an entire ecosystem, with the scavenging hyaenas complemented by a varied fauna of herbivores and carnivores, ranging in size from mammoths down to water-rats; they had all flourished around the shores of a lake of which the surviving relic was the nearby alluvial Vale of Pickering.

The wider significance of Buckland’s work was recognised at once, not only by the great chemist Humphry Davy (1778-1829), who as president of the Royal Society chaired the meetings at which Buckland’s paper was read, but also by the leading English geologist William Conybeare (1787-1857), the principal author of what became the standard summary of British stratigraphy (also published in 1822). Conybeare composed a poem to celebrate his Oxford friend’s scientific achievement. He had this printed as a broadsheet, accompanied by a pictorial representation that was jocular in style but scientifically of outstanding significance. It suggested how geologists could now aspire to travel in time, at least in principle and in imagination, back into the furthest reaches of the Earth’s deep history; ‘scenes from deep time’ could be based reliably on the detailed forensic analysis of evidence that survived in the present.

Further Reading

This brief essay is based on the analysis of Buckland’s research in its international context, in Rudwick, *Bursting the Limits of Time* (2005), esp. pp. 600-638, and its sequel *Worlds before Adam* (2008), esp. pp. 73-87. This in turn is based in part on the valuable account of Buckland’s life and work in Boylan, *William Buckland* (1984) and subsequent articles. Buckland’s reconstruction of Kirkdale is set in its pictorial context, and Conybeare’s poem about it is printed in full, in Rudwick, *Scenes from Deep Time* (1992), esp. 27-58.

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Author: Prof. Martin J.S. Rudwick,
Honorary Senior Member of INHIGEO (U.K.):
IUGS International Commission on the
History of Geological Sciences (INHIGEO)

2 Welsh Street
Bishop's Castle,
Shropshire SY9 5BT
UK
Email: mjsr100uk@gmail.com

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