

THE EARLIEST PUBLISHED RECORDS OF COPROLITES

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Abstract—The earliest published records of coprolites appear to date from the late 17th and early 18th centuries. Edward Lhwyd, who succeeded Robert Plot as Keeper of the Ashmolean Museum in Oxford, figured and cited what appears to be a spiral coprolite, probably from the Jurassic Corallian Group (Oxfordian) of Garford near Abingdon in his *Lithophylacii Britannici Ichnographia* (1699). Gottlieb Friedrich Mylius figured a specimen from the Permian Kupferschiefer of Eisleben in Saxony in his *Memorabilium Saxonice Subterraeæ* (1709). Brief biographical details are given for these two authors. William Buckland seems to have been unaware of these reports as he included no mention of them in his various papers on coprolites in the 1820's and 1830's.

EDWARD LHWYD

The period prior to the identification of coprolites as fossil feces by William Buckland in 1829, although not entirely fallow, contained patchy records of these structures at best (Duffin, 2009). The first written report, accompanied by a figure, of a vertebrate coprolite appears to be that given by Edward Lhwyd (1660-1709).

Born near Oswestry in the Welsh Borders, Lhwyd was schooled locally before going up to Oxford (Jesus College) aged 22. The intellectual and scholarly environment of Oxford encouraged Lhwyd to flourish. An early interest in botany saw him leading field parties to Snowdonia and he quickly came to the attention of John Ray (1627-1705), in whose opinion Lhwyd was “no mean herbalist but a man of good skill in plants” (Roberts, 1984, p. 43). Indeed, the Snowdon Lily (*Lloydia serotina*) was named after him. Just before his matriculation 5 years later, Lhwyd became an assistant at the Ashmolean Museum under the tutelage of Dr. Robert Plot (1640-1696), the First Keeper of the Museum and Professor of Chemistry at the University, whose study of *The Natural History of Oxfordshire* is a well known classic of early geological literature (Plot, 1677, 1705). Here, Lhwyd excelled in chemistry, botany, geology, anatomy, philology and archaeology, succeeding Plot as Keeper in 1691 (Roberts, 1975, 1989; Emery, 1971). In the latter discipline, he was acclaimed to be the “best antiquary of his age” (Bodleian Library, ms J4 1-6, folio 76).

By the time of his accession to the keepership, Lhwyd had made an extensive collection of local fossils, as had Plot before him, by personal visits to local quarries, by rewarding quarrymen for any finds which they made for him, and by exchanging specimens with his growing number of correspondents. John Ray discouraged Lhwyd from publishing a descriptive catalogue of the specimens until he had a more extensive, fully representative sample from the whole of England. His new appointment gave Lhwyd greater freedom for travel, and he responded positively to Ray's advice, collecting information about archaeological sites, plants and much more besides a set of geological specimens. By 1695, John Woodward (1665-1728), Professor of Physic at Cambridge, was actively suggesting that Lhwyd's failure to publish was due to incompetence. This stimulated Ray and Tancred Robinson (1658-1748), a Yorkshire physician and naturalist who went on to attend George I, to urge Lhwyd to print his Catalogue. February 1698 found Lhwyd petitioning the University Press to publish his manuscript, claiming, not unreasonably, that it “contains the Grounds of a new Science in Natural History” (Gunther, 1945, p.22). Unmoved, the University refused, as did a number of London publishers. Lacking the finances to publish at his own expense, it was the famous diarist, Samuel Pepys (1633-1703), and the indefatigable Sir Hans Sloane (1660-1753), whose collections later became the nucleus of the British Museum, who came to the rescue. They coerced another eight supporters (including Martin Lister [1639-1712] and Isaac Newton [1642-1727]) to support the project by sub-

scribing to 10 copies each. The total print run of 120 copies meant that the author received 20 books himself. As a consequence, Lhwyd's *Lithophylacii Britannici Ichnographia* (“British Figured Stones;” Fig. 1) was eventually published in February 1699, and the subscribers ensured that the volume was distributed extensively both at home and on the continent (and even, by the end of the following century, to the USA; Davidson, 2010). Obviously seen as having some potential as a money-spinner, a pirated edition with poor quality plates was produced later that same year in Leipzig (Lhwyd, 1699b; Jahn, 1972). An approved second edition was published in 1760, long after Lhwyd's death from a combination of pleurisy and asthma, apparently originating from a “chill” caught whilst sleeping in the damp quarters of the Old Ashmolean Museum.

Lhwyd's aim was to build the Ashmolean Collection into as representative a sample of British fossils as was possible. Study of the material which he amassed naturally got him embroiled in the hot topic of debate in the 1660's – whether “formed stones” were petrified plants and animals, or “sports of nature” (*lusus naturae* or *lapides sui generis*), in which spontaneously formed mineral growths mimicked organic forms purely by chance. The former idea was the more progressive and championed by the likes of Ray, who wrote that “Nature (which indeed is nothing else but the ordinary power of God) [is] not so wanton and toyish as to form such elegant figures without further end or design than her own pastime and diversion” (Raven, 1950, p.422). Lhwyd's mentor, Robert Plot, and a close colleague, Martin Lister, fell into the second camp. Lhwyd initially found himself agreeing with Plot and Lister, but declaring it “an extraordinary delightful subject and worthy the inquiry of the most judicious philosophers,” he wavered somewhat in his opinion (Hellyer, 1996, p.45). He suggested that “ye plain Natural History” would furnish the evidence to resolve the problem, and set about establishing a fully representative collection of geological specimens for the museum.

The *Lithophylacii* was the first illustrated catalogue of a public collection of fossils to be published in England. The study of stones, wrote Lhwyd in the Preface, was “in no way less pleasant than the other Histories of multi-faceted Nature” but, being in rather a neglected state offered “the broadest scope for enlarging the Sciences.” This proselytising aim was furthered by illustrating representative specimens from the collections with carefully executed etchings, and indicating the localities from which they were collected. Produced as a small, octavo, pocket-sized volume, it was effectively the first field guide to fossils. “Even beginners” could identify the specimens which they collected by using the guide. Having piqued the interest of the budding natural scientist, Lhwyd wrote that *Experientia*, “the mistress of the Sciences, to be preferred to any other teachers whatsoever,” would complete their education (Hellyer, 1996, p.49).

Amongst the 1766 mineral and fossil specimens described and

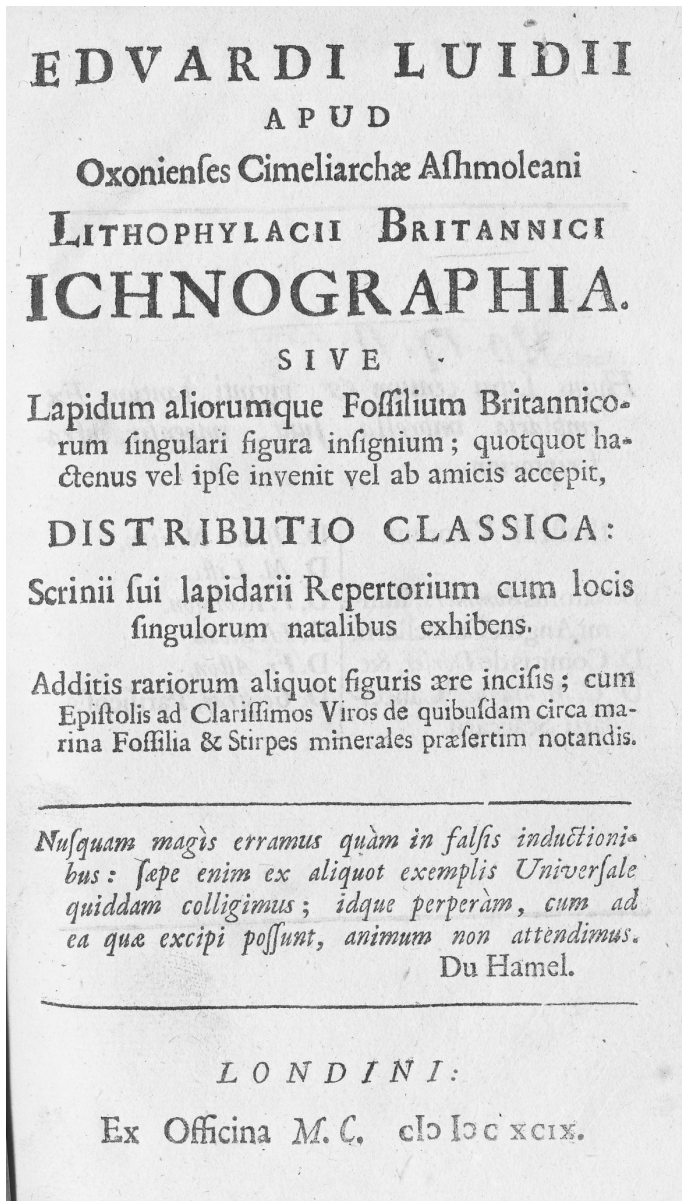


FIGURE 1. Title page of Lhwyd (1699a): *Lithophylacii Britannici Ichthyographia*.

figured by Lhwyd, one (specimen 1570) can be identified as a spiral coprolite (Lhwyd, 1699a, plate 17; Fig. 2). He placed it into his 11th Class of fossils – “Xylostea,” to include fossil bones and wood. A number of Lhwyd’s original specimens survive in the Oxford collections (at Oriel College), but unfortunately, 1570 is not numbered amongst them. Lhwyd’s entry for the specimen reads “FARIO vulgaris (sive Xylosteon versicolor striatum) Garvordiensium.” This might be translated as :

Common trout (?) (whether wood or bone streaked with various colours) from Garford.

“Fario” is an awkward term, but seems to consistently refer elsewhere to a freshwater fish, particularly the trout or fully grown salmon (see, for example, *Mosella*, a work by the Latin poet and rhetorician from Bordeaux, Decimus Magnus Ausonius [circa 310–395]; Adams, 1834, p. 119). Much later, the name was used as the diminutive for *Salmo fario* Linnaeus 1758, the River Trout.

The provenance of the specimen, Garford, is a small village, now in Oxfordshire but formerly part of Berkshire, around 6 km west of Abingdon and 14 km southwest of Oxford itself. Garford sits on a low



FIGURE 2. Possible microspiral heteropolar coprolite from the Corallian Group of Garford, Oxfordshire. Copper etching from Lhwyd (1699a, pl. 17).

ridge of Corallian Group sandstones and limestones (Oxfordian) which overly the Oxford Clay (Callovian) and are succeeded by the Kimmeridge Clay forming the floor of the Vale of the White Horse. A number of small, now largely overgrown quarries are known in the area. The Corallian Ridge was worked extensively for sands and local building stone from as early as the 12th century; the Coral Rag and the Wheatley Limestone from the upper part of the sequence supplied materials for many of the ancient buildings in the city of Oxford, as well as Windsor Castle.

The putative coprolite figured by Lhwyd is spiral in form and conforms to the heteropolar morphotype. The anterior end is marked by two (?) spirals which are concentrated in the top 30% of the specimen, making it micropolar (Hunt et al., 2007). The posterior end is strongly spindle-shaped with the long lip of the final coil clearly visible. The morphology of the specimen suggests that it belongs to the ichnogenus *Sauropros* Hunt et al., 2007, which is known from Late Triassic to Early Cretaceous rocks of Europe and North America.

The etchings which illustrate Lhwyd’s *Lithophylacii* seem to have been executed at or close to natural size. Assuming that to be true for specimen 1570, the total length of the coprolite would have been around 28 mm – considerably smaller than the majority of *Sauropros bucklandi* Hunt et al. (2007) from the Early Jurassic of Lyme Regis (Duffin, 2010, pl. 78 fig. 4).

Lhwyd (1760, p.80) goes on to list a further three specimens, none of which are figured, which he believes to be similar to 1570: *Fario scutellatus* from Garford (1571), another specimen from Stonesfield (1572), and *Fario carinatus*, also from Stonesfield (1573). The village of Stonesfield is located around 8 km north of Witney in Oxfordshire. Small quarries, mines and pits are dotted around the area, working the Middle Jurassic Stonesfield Slate (Taynton Limestone Formation, mid-Bathonian) for building stones, particularly roofing tiles, from at least the 16th century until the closure of the last mine in 1911. The quarries and pits have yielded a significant vertebrate fauna, and have been postulated as the best Middle Jurassic reptile site in the world (Benton & Spencer, 1995, p.139). Indeed, Lhwyd also gave the earliest brief description of a reptile tooth from Stonesfield (a megalosaur), illustrating the specimen with a copper etching (Lhwyd, 1699a, pl. 16, opposite p. 63).

G. F. MYLIUS

The next record and figure of a vertebrate coprolite appears to be that given by Gottlieb Friedrich Mylius (1675-1726). Secretary to the Elector of Saxony, Mylius was born in Halle and probably died in Leipzig where, toward the end of his life, he served as Chief Jurist (Gümbel, 1886). No pictorial portrait of Mylius seems to have been produced. His *Memorabilium Saxoniae Subterraneae* was first published as two volumes (1709-1718, but dated 1709; Fig. 3), whilst a second edition in 1720 brought both parts together into a single volume. Mylius amassed a large collection of minerals, rocks and curiosities of natural history – well over 5000 specimens in all – which was sold by auction in 1716, once his great descriptive work had been completed (Mylius, 1716). The collection included a large number of fossils from the Permian Copper Slates (Kupferschiefer) of Eisleben, hometown of Martin Luther and capital city of the Mansfelder-Land, an administrative district (“Kreis”) in Saxony. Mylius’s guide to subterranean Saxony was well illustrated with a number of plates depicting a range of minerals, rocks and landscapes. The lowermost unit of the Zechstein Group of the Central European Basin, the Kupferschiefer Formation is around 1 m thick and consists of anoxic, laminated black marls, mudstones and carbonates enriched with a range of heavy and precious metals, particularly copper, zinc, lead and silver, originating from epigenetic solutions ascending from Rotliegend sediments and volcanics (Josef, 2006). The formation is a famous Lagerstätte of nektonic fossils, particularly fish (Haubold and Schaumberg, 1985; Brandt, 1997).

Coprolites are well known from the formation, but have not yet been subject to any detailed study. Mylius figured one specimen from his collection, in which he was convinced he could see an image of Caesar (Fig. 4). The coprolite itself is quite small; assuming reproduction at natural size it would have measured around 27 mm long. Roughly cylindrical in shape, it terminates in a point anteriorly (?), and appears to have broken at the posterior end. The figure of the specimen given by Mylius suggests it has been the subject of considerable diagenetic alteration, and it does not appear to have spiral structure. The producer of the coprolite is most likely to be one of the actinopterygian fishes of the Kupferschiefer fauna, such as *Acentrophorus*, *Acrolepis*, *Boreolepis*, *Dorypterus*, *Platysomus*, *Palaeoniscium* or *Pygopterus* (Haubold and Schaumberg, 1985; Brandt, 1997).

CONCLUSIONS

The pre-Bucklandian era of coprolite research contains scattered citations, descriptions and figures of specimens whose real nature is only now being appreciated. Whilst Buckland himself was aware of some late eighteenth century works referring to coprolites, mostly as fossilised larch cones (Duffin, 2009), this paper shows that coprolites were figured in the even earlier (late seventeenth and early eighteenth century) works of Edward Lhwyd and Gottlieb Mylius. The specimens in question, now lost, come from the Late Jurassic (Oxfordian) Corallian Group of Oxfordshire, and the Permian Kupferschiefer of Eisleben in Germany. Neither coprolite fauna has received any significant subsequent attention in the literature.

ACKNOWLEDGMENTS

It is a pleasure to be able to thank Dr. Silvio Brandt (Halle, Germany), Prof. Jane Davidson (Reno, USA) and Dr. Arthur MacGregor (Oxford, UK) for their correspondence, and Renzo Console for his generous help with the interpretation of some Latin texts. Jane Davidson kindly provided the image of the title page of Lhwyd (1699). The manuscript was critically appraised by Drs. Paul Taylor and Zerina Johanson (NHM, London) and Professor R.T.J. Moody (Kingston), to whom my grateful thanks are extended.



FIGURE 3. Title page of Mylius (1709): *Memorabilium Saxoniae Subterraneae*.

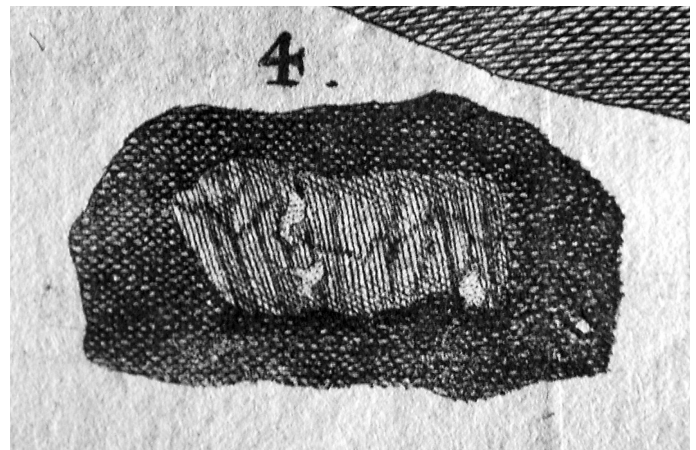


FIGURE 4. Vertebrate coprolite from the Permian Kupferschiefer Formation of Eisleben, Saxony, Germany. Copper etching from Mylius (1709, pl. 47).

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