

## COPROLITES AND CHARACTERS IN VICTORIAN BRITAIN

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**Abstract**—Mary Anning may have stimulated William Buckland’s thoughts about coprolites as early as 1824. The Lower Jurassic succession of the Dorset Coast proved to be something of a focus for collecting coprolites. Mary Anning and the Philpot sisters of Lyme Regis collected there, as did William Buckland, who also purchased specimens from local and metropolitan dealers. Following Buckland’s description of coprolites in 1829 and 1835, a number of colleagues repeated his experiments on filling the intestines of modern sharks with Roman cement in order to produce spiral coprolite analogues. Buckland’s students, Sir Philip de Malpas Grey Egerton and Lord Enniskillen, collected from the Lyme Regis coast, as did Buckland’s Oxford colleague, Charles Daubeny. Daubeny also saved some of Buckland’s original material for Oxford at the sale of his collection in 1857. The largest collection of Lyme Regis coprolites was made by Thomas Hawkins. Later Victorian coprolite collectors included Toulmin Smith and Samuel Beckles.

### INTRODUCTION

The study of coprolites, or fossil feces, was put on a scientific footing by William Buckland (1784-1856), the Oxford Don famed at the time for his engaging personality and lecture style, enormous enthusiasm, and innovative turn of mind (Rupke, 1983; Boylan, 1984; Duffin, 2006, 2009a, b). Whilst there were a few scattered citations, descriptions and figures of coprolites in late 17th century and 18th century literature (Duffin, 2009b, this volume), the identification of the true nature of these fossils in the 1820’s and 1830’s stimulated a surge of interest in the collection of fossil feces through the remainder of the 19th century, as reflected in a variety of private, provincial and national museum collections. Using two historical collections as a focus, many specimens from which remain undescribed, this paper will examine some of the leading characters and personalities, mostly from Victorian Britain, who contributed to what might be termed ‘copromania’, albeit in typically understated English fashion.

**Institutional abbreviations:** NHMUK, Department of Palaeontology, Natural History Museum, Cromwell Road, London SW7 5BD, U.K.; OUM, Oxford University Museum, Parks Road, Oxford, OX1 3PW.

### MARY ANNING

Mary Anning (1799-1847) was the most prominent member of a whole family of collectors who either made or supplemented their living from the discovery, excavation, preparation and sale of fossils from the exposures along the coastline of Lyme Regis on the Dorset Coast in southern England. Mary’s father, Richard (circa 1766-1810), a cabinet maker originally from Devon, seemingly fell victim to the trade, dying from a combination of ‘consumption’ (tuberculosis) and the effects of a fall from the cliffs. Mary’s mother, also called Mary (often referred to as ‘Molly’; circa 1764-1842), continued to run the family fossil business after Richard’s death. The family was left in debt to the sum of £120, and barren periods in their collecting history, combined with very slow payments from some customers, exacerbated their economic situation. The sale for £23 of an ichthyosaur collected by a very young Mary Anning helped to keep the family from penury at a time when they were suffering financially and on parish relief. Mary’s brother Joseph (1796-1849) also assisted with the family business, eventually going on to become an upholsterer in 1825. At various times in the family history, the Annings received financial assistance. Lieutenant-Colonel Birch (1768-1829), a retired Life-Guards Officer, sold his fossil collection in 1820 to provide for them at a time when they were in the process of selling their furniture. Henry de la Beche (1796-1855) gave the proceeds of his famous recon-

struction of life in the Jurassic (*Duria Antiquior*) to the family in 1830. Furthermore, Mary was granted a special annuity of £25 per annum from 1838; this was provided from £200 raised by private subscription at the 1835 meeting in Dublin of the British Association for the Advancement of Science.

Mary supplied numerous institutions with fossils (e.g., Price, 1986; Chapman and Milner, 2010), and her success as a collector brought a string of scientists and potential clients to the town, including the likes of William Buckland, Thomas Hawkins, Richard Owen, Henry Thomas de la Beche, William Daniel Conybeare (1787-1857), Sir Philip de Malpas Grey Egerton and Lord Enniskillen. Owen (1870, p.80) acknowledged Mary’s “singular tact of discernment of the feeblest evidence of a fossil in that dark matrix.”

Despite a presumably limited formal education, Mary obviously took care to make herself knowledgeable so far as her fossil finds were concerned. Lady Harriet Silvester (1753-1843) visited Mary at Lyme on 17th September 1824 and recorded in her diary:

“the extraordinary thing in this young woman is that she has made herself so thoroughly acquainted with the science that the moment she finds any bones she knows to what tribe they belong. She fixes the bones on a frame with cement and then makes drawing and has them engraved ... It is certainly a wonderful instance of divine favour – that this poor, ignorant girl should be so blessed, for by reading and application she has arrived to that degree of knowledge as to be in the habit of writing and talking with professors and other clever men on the subject, and they all acknowledge that she understands more of the science than anyone else in this kingdom” (Torrens, 1995, p.265).

Indeed, the Edinburgh mineralogist, Thomas Allen (1777-1833) recorded in his diary (25th June 1824) that “Mary Anning’s knowledge of the subject is quite surprising – she is perfectly acquainted with the anatomy of her subjects, and her account of her disputes with Buckland, whose anatomical science she holds in great contempt, was quite amusing.” Bearing this observation in mind, Sir Roderick Impey Murchison’s suggestion to the American geologist, George William Featherstonhaugh (1780-1866) that Mary had first identified certain fossils from Lyme as fossilised crocodile feces around 1824, and had therefore sowed the intellectual seed of such a concept in Buckland’s mind, is not impossible (Murchison to Featherstonhaugh in litt. 13th May and 20th June, 1829; Berkeley and Berkeley, 1988, p. 82-83). Certainly, Mary Anning was great friends with the Murchisons, particularly Charlotte (1792-1871), Sir Roderick’s wife, and stayed with them on probably her only visit to London (7th to 12th July 1829)(Torrens 1995, p. 267).

Whilst 19th century donors to national collections are usually acknowledged in publications, inventories and catalogues, the original collectors are generally not identified (Torrens, 1995). However, three coprolites known to have been collected by Mary Anning can be identified. NHMUK 2066\* and NHMUK 2066\*a (Fig. 1A-B) were collected by Mary Anning in 1832, and made their way into the London collections via the purchase of Thomas Hawkins' collection of Jurassic reptiles in 1834 (see below) (Lydekker, 1889, p. 115; Chapman and Milner, 2010, p. 405). Both specimens were figured by Hawkins (1840, pl. 29). The third specimen is OUM J2378. Torrens (1995, p.280) states that this is the only specimen known to have been donated by her to a major museum. The Oxford University Museum was constructed over the period 1855-1860, however, with the intention of bringing all aspects of science teaching in the university, then scattered around different colleges, together around a central display area. It is therefore much more likely that the specimen made its way into the OUM via the Buckland collection.

### THE PHILPOT SISTERS

Around 1805, John Philpot the elder (dates unknown), a London solicitor, took Morley Cottage (1 Silver Street, Lyme Regis) for his four sisters (Edmonds, 1978). Three of them, Mary (1777-1838), Margaret (died 1845) and Elizabeth (1780-1857) settled there and were actively collecting fossils from the Lyme Regis coastal exposures when Mary Anning was still only a young girl. Elizabeth, the youngest of the sisters, appears to have been the most directly concerned with matters to do with their collection, but all three enjoyed a close, affectionate relationship with Mary Anning, and were often cited in her letters (Edmonds, 1978, p. 43). Rather than collecting fossils for sale, the Philpot sisters accumulated specimens for their own personal "museum." Scientific visitors to the town obviously took a keen interest in their collection; as early as 1818, James Sowerby (1757-1822) borrowed what was to become the type specimen of *Ammonites obtusus* and figured it in his "Mineral Conchology." It was William Buckland, a regular visitor to the sisters, who acted as the intermediary between the Philpots and Sowerby on this occasion. Others, including Sir Richard Owen, Henry de la Beche, Louis Agassiz and Thomas Wright also visited the collection.

The collection eventually passed to John Philpot junior (dates unknown) whose wife, Elizabeth Mary Philpot (dates unknown) donated the collection to the Oxford University Museum in August 1880 in honour of her husband. At least six specimens of Early Jurassic coprolites, all from the "Lias of Lyme Regis," can be allocated to the Philpot collection with confidence (e.g., Fig. 2G). Several of these are of special interest because of the identity of their inclusions. OUM J23873 is a fairly large (70 mm x 35 mm) ovoid coprolitic mass with no clear spiral

structure (Fig. 2A). A number of small, disarticulated but closely associated chimaeriform notochordal sheath or sensory canal calcifications are located along one side of the specimen (Fig. 2B). Some of the calcifications are embedded in the coprolitic matrix, whilst about half of them are slightly detached from the coprolite margin. The calcifications probably travelled down the gut in a single unit and were held in place by a mucus sheath until early stage decomposition of the coprolite allowed some to become slightly detached from the specimen. The original handwritten label identifies them as belonging to "*Spinacorhinus polyspondyla*." This is a squalorajoid chimaeriform holocephalan with a complex nomenclatural history (Duffin, 1983, p. 27), but now generally allocated to *Squaloraja polyspondyla* (Agassiz, 1836). The type specimen was purchased from Mary Anning and then donated to the Museum of the Bristol Institution (now Bristol City Museum), but was subsequently lost. "A portion of the tail, subsequently found" made its way to the Oxford University Museum as part of the Philpot Collection (Edmonds, 1978, p. 46; OUM J3097). *Squaloraja* is known by only a small number of specimens from the Sinemurian of Lyme Regis, Osteno in Lombardy and the Hettangian of Belgium (Patterson, 1965; Duffin, 1983, 1998, 2010a; Duffin and Patterson, 1993; Delsate et al., 2002). Further sensory canal structures are visible on OUM J 23871 (Fig. 2E-F). OUM J23870 (old OUM number MM 826) in the Buckland collection also preserves evidence of holocephalan prey with the presence of a myriacanthid tooth plate preserved in occlusal view on the coprolite surface (Fig. 2C-D).

### WILLIAM BUCKLAND COLLECTION AT THE OUM

The history of the discovery, elucidation, identification and publication of coprolites by William Buckland (1784-1856) has been examined in some detail elsewhere (Duffin, 2009b). In brief, his examination of small whitish balls of phosphate-rich material from Pleistocene cave deposits at Kirkdale in Yorkshire led him to the conclusion that they were the fossilised feces of the Hyaenas who used the cave as a den (Buckland, 1822, 1824). This conclusion was reinforced by observations of similar material from a cavern at Lunel, near Montpellier in France (Buckland, 1827). In 1829, he extended these conclusions to structures found firstly in the black shales and limestones of the Lower Lias (Lower Jurassic) succession of Lyme Regis on the Dorset coast (Buckland, 1829a) and then to small brown and black structures in the chaotic jumble of the Rhaetic Bone Bed (Late Triassic) from the banks of the Severn Estuary, coining the word "Coprolite" for them (Buckland, 1829b). Further collecting and contributions from a wide range of colleagues and correspondents led to his seminal paper "On the Discovery of Coprolites, or Fossil Faeces, in the Lias at Lyme Regis, and in other Formations" (Buckland, 1835), published in the Transactions of the relatively re-

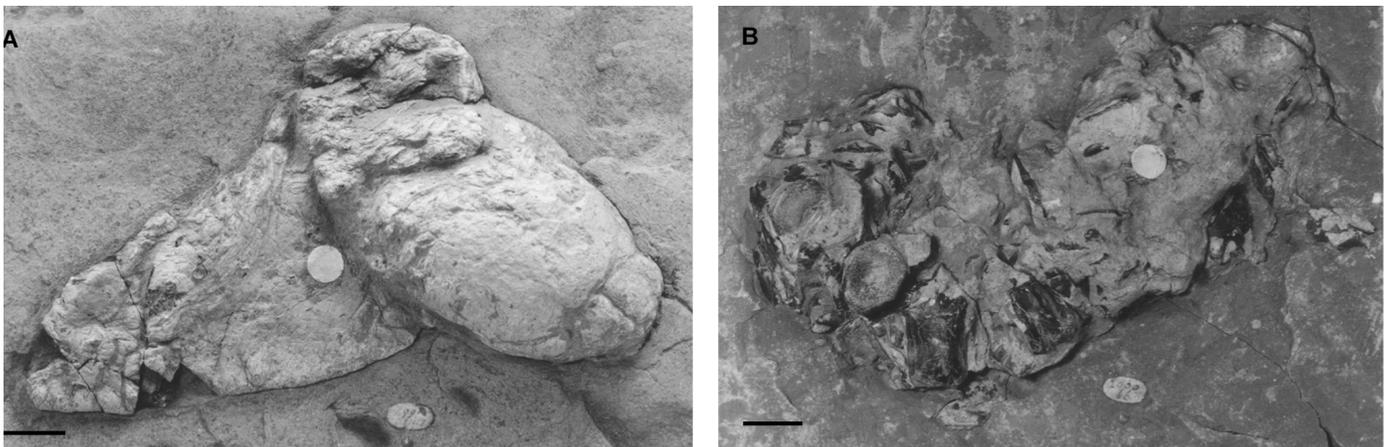


FIGURE 1. Coprolites collected by Mary Anning from the "Lower Lias" of Lyme Regis, Dorset. **A**, NHMUK 2066\*. **B**, NHMUK 2066\*a. Scale bar = 10 mm.

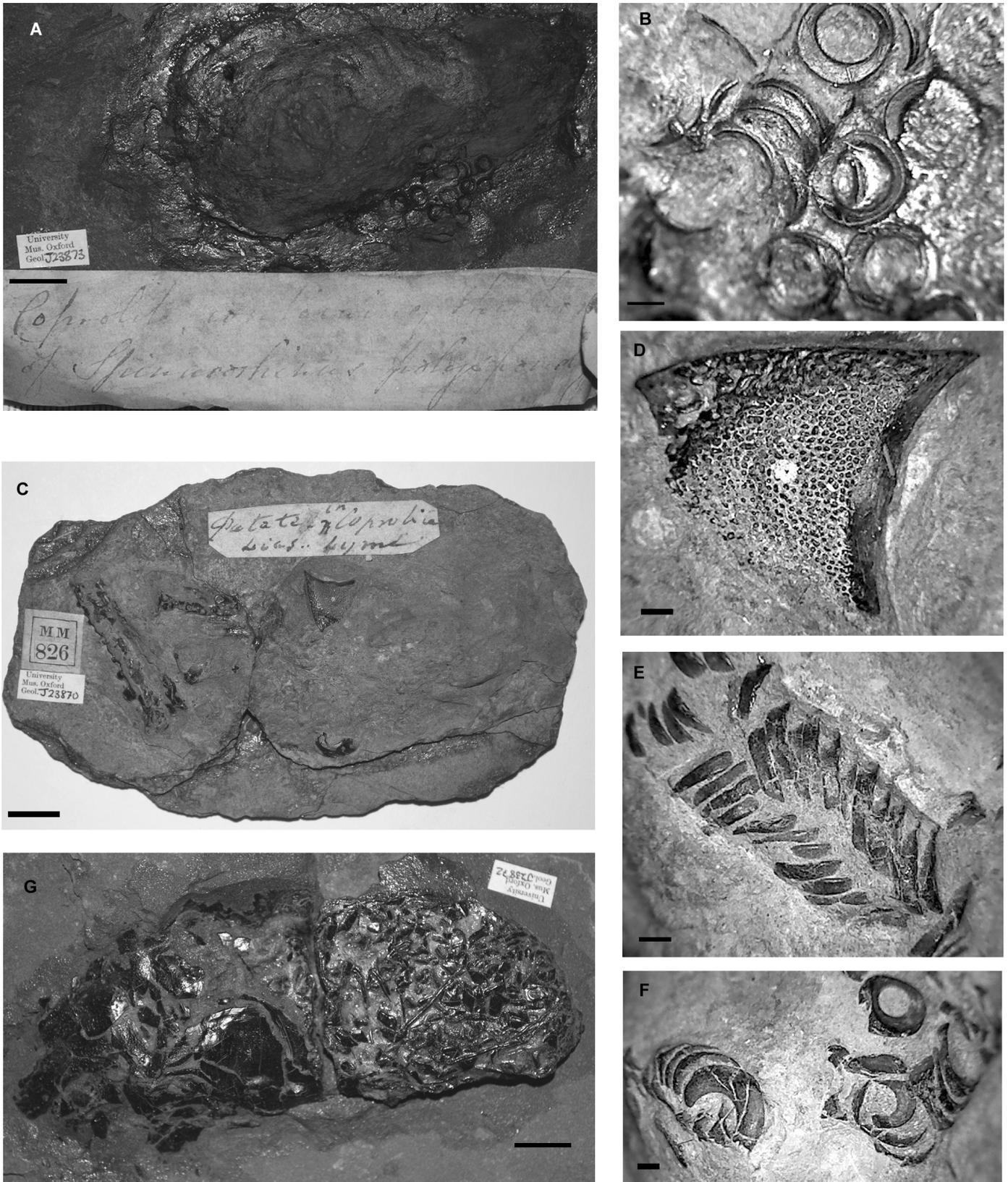


FIGURE 2. Coprolites from the Philpot and Buckland Collections, collected from the “Lower Lias” of Lyme Regis, Dorset. **A**, OUM J23873. **B**, Detail of chimaeroid notochordal sheath or sensory canal calcifications from OUM J23873 (Philpot Collection). **C**, OUM J23870 (Buckland Collection). **D**, Detail of myriacanthid tooth plate in occlusal view, OUM J23870. **E**, OUM 23871 (Philpot Collection), detail of undetermined chimaeriform sensory canal rings. **F**, OUM 23871, detail of undetermined chimaeriform sensory canal rings; **G**, OUM J23872 (Philpot Collection). Scale bars: **A**, **C**, **G** = 10 mm; **B**, **D**, **E**, **F** = 1 mm.

cently formed Geological Society of London, and a new summary in his volume prepared for the series of Bridgewater Treatises (Buckland, 1836).

Whilst numerous acquaintances and colleagues sent Buckland specimens of coprolites following the publication of his seminal work, Buckland himself was obviously not above purchasing specimens that took his fancy. One cut and polished spiral coprolite from the Lower Lias of Lyme Regis, still embedded in matrix (OUM J23748), has the sale label still adhering to the back of the specimen (Fig. 3A-B). The item was purchased from Sarah Mawe (1767-1846), trading from her shop at 149 The Strand in Central London. Sarah was the daughter of Richard Brown II (1736-1816), a Derbyshire sculptor, marble-worker and mineralogist, second in a three-generation eponymous dynasty of craftsmen, and referred to by Erasmus Darwin as the “fossil-philosopher of Derby” (Torrrens, 1990, 2004a). The Brown family firm had shops in Derby and Castleton, a “favoured resort of Mr Mawe” (Adam, 1851, p. 355). The Mr. Mawe in question was John Mawe (1766-1829). Up to 1793, Mawe had been a commander in the Merchant Navy, but the news from France was depressing – the revolutionary government had guillotined Louis XVI following a show trial, succeeded a few months later by the execution of his wife, Marie Antoinette, and a declaration of war against Great Britain and the Netherlands. With the imminent prospect of war, John Mawe joined Richard Brown’s lapidary staff. By 1794, Mawe was Manager of a shop in Covent Garden, and full partner in Brown, Sons and Mawe, a position he consolidated by marrying Sarah in the same year. Appointed mineralogist to the King of Portugal, Mawe spent six years in South America, publishing a travelogue on his return (one of the volumes taken by Charles Darwin on his Beagle voyage). While he was away, Sarah managed the shop. As the reputation of the business and its proprietors increased, a chain of shops and museums was established, and new premises were sought in The Strand, a few doors down from Somerset House, the home of the Geological Society of London from 1828 to 1860. This fortuitous proximity must have been mutually beneficial to Society Fellows and the business. A global system of contacts, diversification into shells (a new Victorian collecting craze), a strong reputation as a mineralogist and a highly successful and popular publishing career saw Mawe’s business flourish. John Mawe died in the same year (1829) that Buckland published his initial note on coprolites, and Sarah continued to manage and cultivate the business. Her success and reputation was evident by her appointment as mineralogist to Queen Victoria, shortly after her succession to the throne in 1837. Buckland’s specimen must have been obtained from Sarah Mawe at some time in the period between 1837 and 1840, as her name appears on the sale label, together with notice of her Royal Appointment, and the shop was sold to her manager and fellow mineral dealer, James Tennant (1808-1881) in

February 1840 (Cooper, 2006).

Many of the coprolites described and figured by Buckland in his various papers are still available in the OUM collections, but numerous specimens are unaccounted for, presumably having been returned to their original owners or, if retained by Buckland, disposed of during the sale of parts of his collection. Specimens from two of Buckland’s correspondents remain in the Oxford collections, however.

Biographical details for Rev. Benjamin Richardson (?1759-1832) are a little thin. He is believed to have studied at Oxford until around 1778 before taking Holy Orders. This led to a series of curacies before his appointment to the rectory of Farleigh Hungerford, near Bath in 1796, a post which he held until his death. He cultivated broad scientific interests, but “his favourite pursuit however was the study of Geology, and for the advancement of this important science he spared neither personal exertion nor pecuniary assistance to the utmost extent of his means” (Henry Jelly in Mitchell, 1872, p.325). Richardson was one of two clergymen who encouraged the endeavours of William Smith (1769-1839), the canal engineer and pioneer of geological mapping who was later to become known as the “Father of English Geology.” It was Richardson who wrote out the “Table of Strata of the Bath District” at Smith’s dictation. According to Sir Roderick Murchison, Richardson “collected only that he might give away; and regardless of all personal fame, he never failed, when a discovery was made, to call around him those who could profit by it” (Murchison in Mitchell, 1872, p. 329). That sentiment is certainly echoed in his donation of coprolites (OUM K1272) from the Rhaetic Bone Bed of Aust Cliff to Buckland for inclusion in his studies.

Coprolites provided by European correspondents are represented in the Buckland collection by two specimens (OUM GZ.104, GZ.105; Fig. 4B) from the Alaunschiefer (Lettenkeuper, Ladinian, Middle Triassic) of Gaildorf in Baden Württemberg, Germany (probably the famous Alum mine). These were sent by Georg Friedrich Jaeger (1785-1867; Fig. 4A), Professor of Natural History and Chemistry at the Eberhard-Ludwigs-Gymnasium in Stuttgart. Trained as a medical doctor at Tübingen University, Jaeger travelled through Germany, France and Switzerland following the completion of his inaugural dissertation. Whilst studying in Paris he met Baron Georges Cuvier (1769-1832), a former colleague of his father’s, and was consequently enthused to study fossils in addition to his medical and teaching duties (Gümbel, 1881, p. 648). He published extensively on a variety of fossil groups, especially from the Württemberg Triassic and Jurassic, and is probably most famous for his work on the Toarcian ichthyosaurs of Holzmaden. He received many honours during his lifetime, both for his medical and his geological contributions (Gümbel, 1881; Warth, 1992).

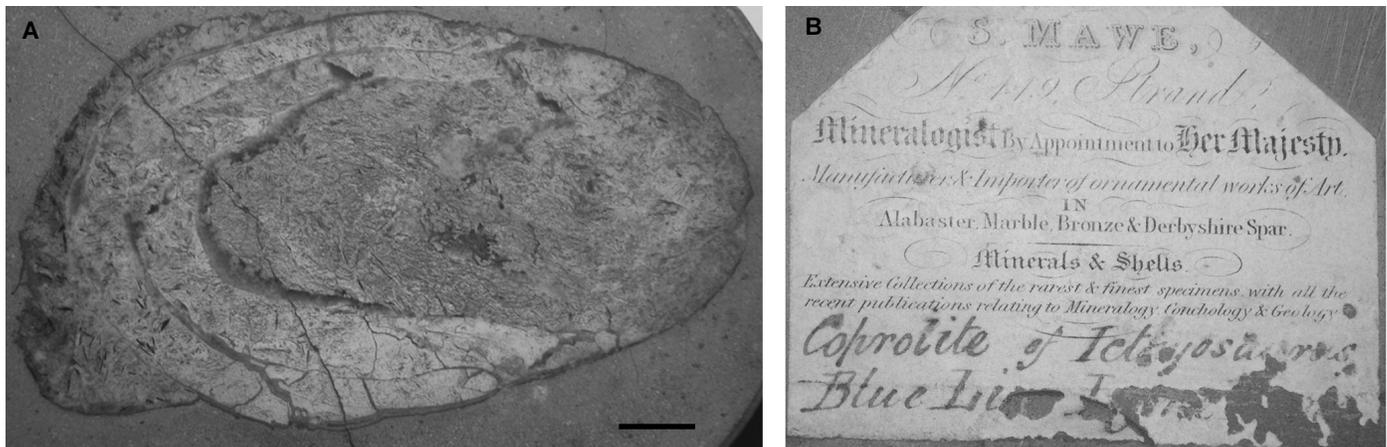


FIGURE 3. OUM J 23748, Buckland Collection. **A**, Polished section of spiral coprolite (scale bar = 10 mm). **B**, Sale label of Sarah Mawe on reverse of specimen.

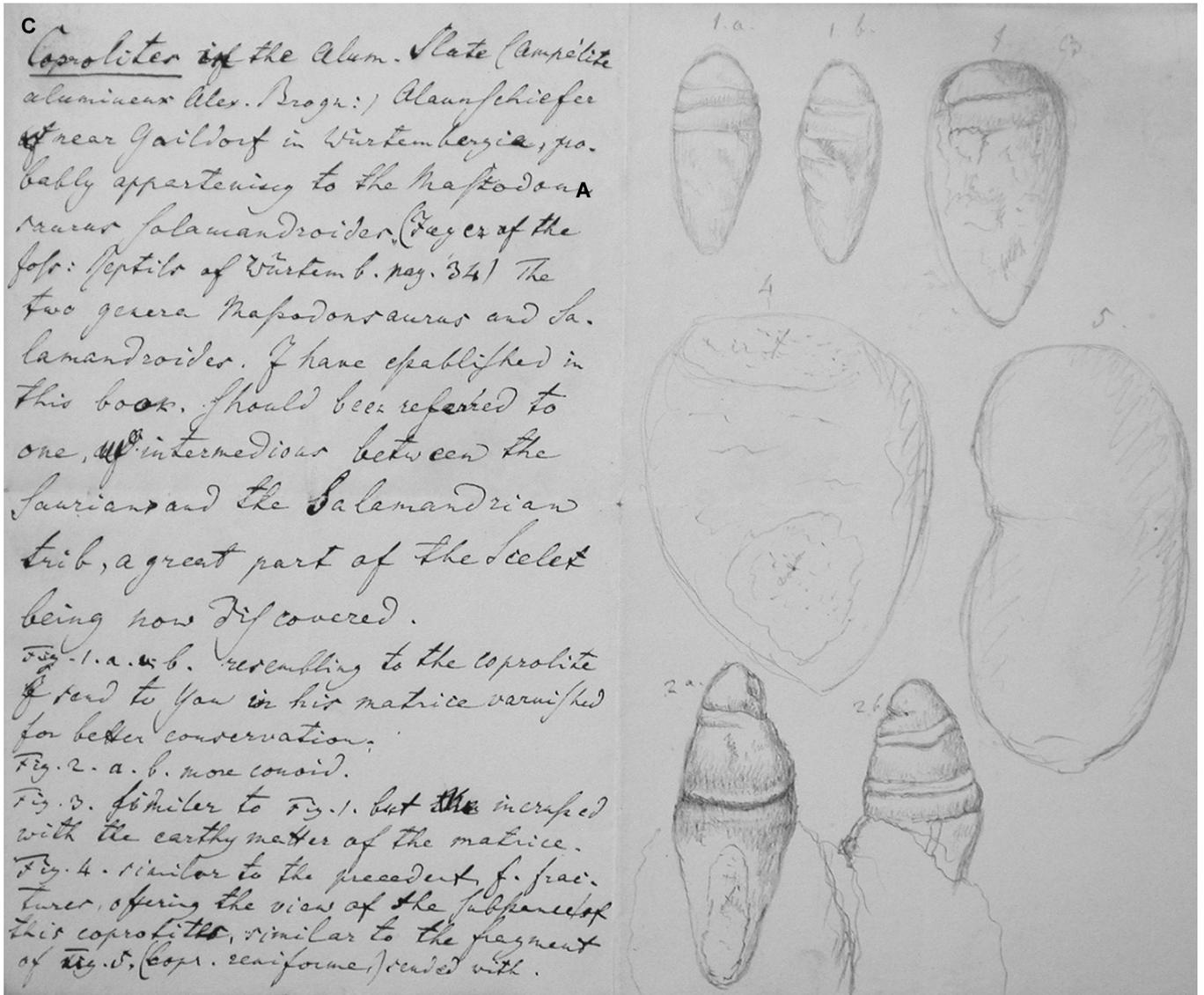
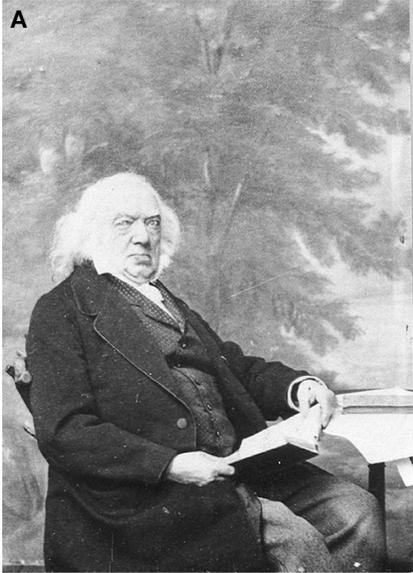


FIGURE 4. A, Portrait of Georg Friedrich Jaeger circa 1860. B, OUM GZ.105 from the Alaunschiefer of Gaildorf, Baden-Württemberg, Germany (scale bar = 10 mm). C, Part of a letter and sketch from Jaeger to Buckland (2nd April 1833; OUM Buckland Archive, Coprolite file).

In a letter from Stuttgart and dated 2nd April 1833, Jaeger wrote (in French) that he presumed Buckland would have received “the so-called coprolites of the Lias Beds that the Count of Mandelslohe got to you through Mr Sowerby” (Buckland Archive, OUM, Box 1/J). This is a rather intriguing statement as I can find no further evidence of this gift in the Buckland collections and archive. Friedrich von Mandelslohe (1795-1870) collected extensively in the Württemberg area and contributed to the understanding of its Jurassic stratigraphy (Fraas 1871; Zittel, 1901, p. 501). The member of the complex Sowerby dynasty who acted as a go-between for the specimen was probably George Brettingham Sowerby I (1788-1854), who set himself up as a dealer in shells and minerals in Regent Street, Central London, acting as Mary Anning’s London agent and helping produce the later parts of his father’s Mineral Conchology.

In the same letter, Jaeger wrote :

“At last I have found the opportunity to send you a doubtful coprolite, which appears to me, to be of *Mastodonsaurus salamandroides* of the aluminous shales of Gaildorf, which are the lowest beds of the Keuper. One was obliged to varnish the stone, because the sulphide of iron which is within the mass of the stone decomposes very easily.”

He sent some pencil drawings to accompany the specimens, apologising for their poor quality “but I was obliged to make them in haste”. The specimen and the drawings both reside in the OUM collections (Fig. 4C). The letter is interesting, not only because of the subject matter, but because very little of Jaeger’s correspondence survives, most having been destroyed during the bombing of Stuttgart in 1944. A few additional letters are present in the Owen correspondence in the NHM.

One of Buckland’s novel approaches to the study of coprolites anticipated the much later *Aktuopaläontologie* of the German School by modelling palaeontological situations by experiment (Duffin, 2009a). In an effort to prove that spiral coprolites could be produced by fecal material passing through a gut with a spiral valve, he filled the intestines of various extant chondrichthyans with Roman cement. This was a quick setting hydraulic cement patented in 1796 by James Parker and prepared by calcining and pulverising clay-rich septarian nodules (Duffin, 2009b, p. 107). The fruits of Buckland’s labours, 19 specimens in all, are still present in the OUM collections (OUM R1-R4, R13-R15, R16-R21, R133-R135; Fig. 5A-H).

#### CHARLES DAUBENY

Charles Giles Bridle Daubeny (1795-1867; Fig. 6A) was a Gloucestershire man, born in Stratton, just outside Cirencester. He studied at Magdalen College, Oxford, and attended the geology lectures given by Buckland. After a period studying medicine at London and Edinburgh (1815-1818), he returned to Oxford to take his M.D. Whereas Buckland took over the geological teaching of Dr John Kidd (1775-1851) from 1813, Daubeny succeeded Kidd to the Chair of Chemistry in 1822, the same year as he was elected FRS. He retained his post as Chemistry Professor until 1855. In 1834, he was also appointed to the Chair of Botany, conducting numerous experiments in the Oxford Botanical Gardens. The geological work for which he received most acclaim was a study of the volcanoes of the Auvergne, begun during the French section of a Grand Tour in 1819, and his descriptions of North American geology from observations made during a visit in 1837. Daubeny had quite a close relationship with Buckland, being pressed into performing chemical analyses of coprolites (Buckland Correspondence, OUM, 1/D6; Buckland, 1835, p. 236), and later collating various memorial verses to him in a collection of poems (Daubeny, 1869).

Daubeny was obviously an active field collector, and the OUM collections contain at least 14 specimens donated by him. At least four of these (OUM J23903, J23904, J17836 and L77; Fig. 6B) are ex-Buckland specimens, having been purchased by Daubeny from the auction sale of Buckland’s collection. The sale was held on Monday 26th and Tuesday

27th January 1857, at Stevens’s Auction Rooms (“The Great Rooms”) at 38 King Street, Covent Garden. The Auction Rooms sprang from a successful book sales business established in the 1750’s (Cooper, 2006, p. 240). John Crace Stevens (1809-1859) entered the firm as a partner in 1831, and within 3 years the company became “J.C. Stevens.” Large numbers of prestigious natural history collections, including those of G. Sowerby (1788-1854), A.R. Wallace (1823-1913) and Henry W. Bates (1825-1892) were disposed of through the sale rooms (Chalmers-Hunt, 1976). Daubeny purchased specimens from the Lower Lias of Lyme Regis, at least one of which had been figured in Buckland’s (1836) volume of the *Bridgewater Treatise* (J17836; Buckland, 1836, pl. 15, fig. 12). I have been unsuccessful in my efforts to trace the original sale catalogue, but the disposal of coprolites in mid-nineteenth century sales of specimens is not unprecedented. For example, Dr. McHenry’s collection, auctioned on 1st June 1855, included coprolites from the Burdiehouse Limestone (Oil Shale Group, Dinantian, Carboniferous), the Early Cretaceous of Tilgate Forest (Mantell’s stomping ground) and a number of unspecified localities and horizons (Lots 175, 179, 192, 196, 209; Stevens, 1855, p. 7-8). Similarly, the famous collection of Chalk fossils (especially rich in echinoderms and fishes) made by Henry William Taylor of Brixton (died 1853) included three lots of coprolites (Lots 262, 287, 292; Stevens, 1854, p. 13-14), auctioned on 26th June 1854. None of these sale lots have so far been traced in national or provincial museums.

#### EGERTON AND ENNISKILLEN

Sir Philip de Malpas Grey Egerton (1806-1881; Fig. 7A) was, together with William Willoughby Cole (1807-1886; Fig. 7C), a student of Buckland’s at Oxford during the 1820’s. Immediately following their course, the two young aristocrats embarked on a geological Grand Tour of the continent in 1830. Originally collecting information on German cave deposits for Buckland, who had recently published his masterful analysis of Kirkdale, their chance meeting with the young Swiss palaeontologist, Louis Agassiz (1807-1873), at Munich took them in a new direction. Agassiz enthused over fossil fishes and persuaded the pair of Englishmen to focus on collecting them, almost to the exclusion of everything else. They came to amicable arrangements over the distribution of specimens by sharing part and counterpart. If only a single slab were found, they decided the matter of ownership with the toss of a coin.

On their return to Britain, both Egerton and Enniskillen entered politics. Egerton served as Member of Parliament for Chester (1830-1831), Cheshire South from 1835 to 1868, and then for Cheshire West from 1868 to 1881. Enniskillen, meanwhile, was MP for Fermanagh from 1832 until 1840, before moving into the House of Lords as 3rd Earl of Enniskillen and Baron Grinstead (1840-1886). Despite their heavy workloads, both involved themselves fully in the intellectual life of Victorian London, and in the Geological Society in particular. Egerton was the more scientifically active of the two, publishing around 58 papers, mostly on fossil fishes, in his own right. He corresponded with Mary Anning (letter in Owen Correspondence volume XI, NHMUK) and had friendly relations with the Philpot sisters, all of Lyme Regis.

The two aristocrats each accumulated large collections through both personal endeavour and purchase. Egerton made small donations to various museums throughout his life, but the bulk of his collection was purchased from his estate by the NHMUK in 1882 (Cleevely, 1983, p. 109). Coprolites in the Egerton collection are catalogued together under NHMUK R.280 (e.g., Fig. 7B) and are all from the Lower Lias of Lyme Regis. It seems that Egerton also replicated Buckland’s experiments with Roman cement, since there are a number of injected shark intestines in the collection (NHMUK uncatalogued; Fig. 5I-J).

Enniskillen’s huge collection was purchased by the NHMUK by means of a special grant in 1883, requiring the expenditure of the Geology Department there to be reduced by £500 per annum for four consecutive years! Enniskillen lived at Florence Court, County Fermanagh, Northern Ireland (now a National Trust property). The task of trans-

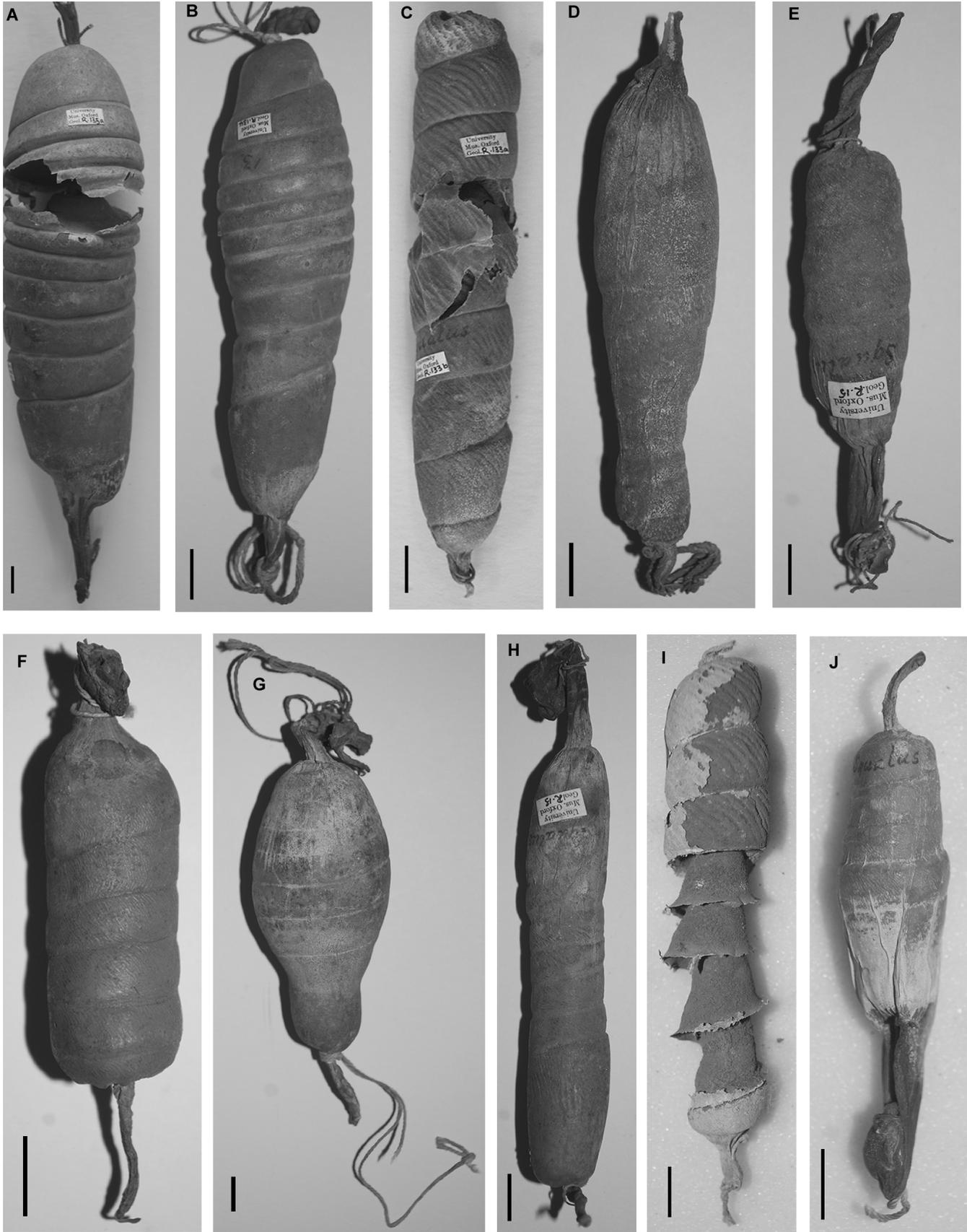


FIGURE 5. Intestines of extant chondrichthyans filled with Roman cement. **A-H**, Buckland Collection. **A**, OUM R.135a, *Raja* sp. **B**, OUM R.134, *Raja* sp. **C**, OUM R.133a, *Squalus* sp. **D**, OUM R.17, *Squalus* sp. **E**, OUM R.15, *Raja* sp. **F**, OUM R.14, *Raja* sp. **G**, OUM R.1, unidentified skate. **H**, OUM R.13, *Raja* sp. **I-J**, Egerton Collection. **I**, NHMUK uncat. R.13, unidentified but probably *Raja* sp. **J**, NHMUK uncat. R.13, *Raja* sp. Scale bars = 10 mm.

porting the collection to its new home in London was immense, and one crate of specimens was stolen en route. The thieves, disappointed at finding stones in place of the riches they expected in crates bearing the insignia of the Earl of Enniskillen, threw the specimens into the River Dee, a few hundred metres from the Chester and Holyhead railway bridge. A local naturalist retrieved some of the specimens, and others were recovered from the river bed the following spring, but the loss of a few specimens necessitated a reduction in price of the consignment to the tune of £25 (Gardiner and Mason, 1974, p. 35). Enniskillen certainly accompanied Egerton to Lyme Regis, making his own collection of specimens. He also purchased material from Mary Anning, the most noteworthy of which was a specimen of *Plesiosaurus macrocephalus*, subsequently described by Owen and reputedly obtained for the eye-watering sum of 200 guineas (James, 1986; Torrens, 1995). Enniskillen also donated specimens to various museums at different times in his collecting career. The single coprolite specimen (NHMUK R.396; Fig. 7D) attributed to him comes from the Lower Lias of Lyme Regis and is remarkable for the inclusion of a large (60 mm long) lower jaw of *Eugnathus* sp.

### GIDEON MANTELL

The story of Gideon Mantell (1790-1852; Fig. 7D) has been told many times over (e.g., Dean, 1999; Critchley, 2010). Born in Lewes, Sussex, Mantell trained as a medical doctor and soon had a thriving country practice. A passionate interest in geology and collecting, especially from the deposits of the Weald, led to the discovery of Cretaceous dinosaurs, particularly *Iguanodon*, and a rich output of publications. Relocating his medical practice to Brighton in 1833, Mantell found himself financially overstretched. The town council transformed his house into a museum, but that, too, eventually failed. In 1838, Mantell was forced to offer his huge collection for sale to the British Museum. He initially requested £5000 but eventually accepted a counter-offer of £4000. Relocating his practice once again, this time to Clapham Common, Mantell's fortunes continued to plummet; his wife left him, his son Walter emigrated to New Zealand, and his daughter died. Mantell eventually died from an overdose of opium, self-medicated for the crippling and painful condition associated with a traumatic carriage accident sustained in 1841.

Mantell was a great populariser of geology and enjoyed good relations with many early 19th century scientists, although Richard Owen was his nemesis. His early descriptions of Chalk coprolites as fossil larch cones (Mantell, 1822, 1833) was tempered by the comment that "they may hereafter prove to be the parts of fishes" (Mantell, 1822; Duffin, 2009b). Buckland had visited Mantell's collection in the early 1830's (Buckland, 1835, p. 232). Following Buckland's description and identification of coprolites from the Lyme Regis succession, Mantell made specimens from his collection, including those from Lyme Regis, available to the Oxford don for description, illustration and chemical analysis (Buckland, 1835, p. 234, pl. 28, figs. 1, 2, 4, 7, 9). The originals of the figured specimens are no longer present in the OUM or NHMUK collections, but both institutions possess various casts (OUM J23880/p1; NHMUK 9660, 9652, 9657 and 9664). The NHMUK casts, plus some further specimens collected from Lyme Regis (NHMUK 11427, 33284c) as well as some unattributed material (NHMUK 9645-9651, 9636-9638, 9640-9643 and 11256; Fig. 7F) form part of the 1838 purchase from Gideon Mantell.

### THOMAS HAWKINS

Thomas Hawkins (1810-1889) was a somewhat enigmatic character. The son of a Somerset farmer and cattle dealer, he entered St Guy's Hospital as a surgeon-pupil in 1831, although it is unclear as to whether or not he completed his studies. He took Sharpham Park near Glastonbury as his residence for the period of approximately 1832 to 1845. Here, he was well placed to monitor, visit and collect from a host of small pits in the Hettangian Pre-Planorbis Beds (lower part of the "Lower Lias") of the area around the village of Street in Somerset. His ability and persis-



FIGURE 6. A, Charles Bridle Daubeny (courtesy of the Geological Society of London). B, OUM J.23904, ex Buckland Collection, Lower Lias of Lyme Regis. Scale bar = 10 mm.

tence as a collector led to the formation of a large and important collection of marine reptiles, which he supplemented with numerous purchases from Mary Anning, local quarrymen and personal collecting from the cliffs and foreshore sections at Lyme Regis. He often supervised the extraction of specimens himself, and mechanically prepared his booty with considerable finesse. Adept at restoring lost elements of the skeleton with Plaster of Paris, he once fell foul of Charles Koenig, Keeper at the British Museum, for being over enthusiastic with his reconstruction of a piece offered for sale as complete. Hawkins illustrated his reptile collection in two huge folio volumes; *Memoirs on Ichthyosauri and Plesiosauri* (Hawkins, 1834), and *The Great Sea Dragons* (Hawkins, 1840). Here, anatomical description is bound up with rapturous, outlandishly lurid and grandiloquent hyper-Miltonian prose, presenting these



FIGURE 7. **A**, Sir Philip de Malpas Grey Egerton. **B**, NHMUK R.280 from the Lower Lias of Lyme Regis. **C**, William Willoughby Cole, Lord Enniskillen. **D**, NHMUK R. 396 from the Lower Lias of Lyme Regis. **E**, Gideon Mantell (from Woodward, 1910). **F**, NHMUK 9636-8, 9640-3 grouped together in the same tray, Lower Lias of Lyme Regis. Scale bars = 10 mm.

Jurassic reptiles in a great literary spectacle before the general public (O'Connor, 2003). The volumes were dismissed as scientifically negligible. One wonders how William Buckland, elsewhere in the text referred to as "Imperial Buckland" (Hawkins, 1840, p. 23) felt as the dedicatee :

"At twenty, it was my happy fortune to obtain the honourable sanction of your high name and approbation. In my twenty-third year, your alliance helped me to effect the first step towards the end of my ambition, and my early Saurian Remains were deposited in the British Museum. You have ever since given me a thousand flattering testimonies of Friendship, and tightened all the Chords of that Sentiment, by which man is bound to man."

Mantell supposedly referred to him as "Mad Hawkins". Purcell and Gould (1993, p. 95) characterised him as "eccentric and demented" and saw evidence in his writings of a progressive slide into insanity. Certainly, he was no stranger to bizarre behaviour. He laboured under the delusion, for example, that he was the "Rightful Earl of Kent." He inundated *The Times* newspaper and various dignitaries with crankish letters, published a stream of opinionated pamphlets, he was highly litigious (he once sued a transport company over a billing error of two pence) and even claimed to have saved former Prime Minister Robert Peel from assassination (Taylor, 1997, 2004, p. 938).

Hawkins' collection has a complex history of dispersal. He offered some specimens for sale to the Bristol Institution (now the Bristol City Museum and Art Gallery) in 1829, but the offer was refused because of lack of funds. Some specimens were sold privately (Charlesworth, 1840) and others donated to Cambridge University (1854) and Oxford University (1874). Several hundred specimens of vertebrates and invertebrates were auctioned in 118 lots by J.C. Stevens on 25th July 1844 (Stevens, 1844). Two large collections (including figured material) were sold to the British Museum (Natural History) in 1834 and 1840 for a total of £3110 and five shillings (Taylor, 1989, p. 113; Bulleid, 1943, p. 70). It would appear that Hawkins survived on the proceeds of these sales until his eventual death from intestinal blockage and haemorrhage on the Isle of Wight.

Hawkins' collection of coprolites from Lyme Regis consists of over 30 specimens in the NHMUK. Fourteen of these were figured in two plates of his *Memoirs on Ichthyosauri and Plesiosauri* (Hawkins, 1834, pls. 29-30), and repeated in his *Great Sea Dragons* (Hawkins, 1840, pls. 27-28; Figs. 8-9). Two of the specimens are ascribed to the collecting prowess of Mary Anning (NHMUK 2066, 2066a; Fig. 1A-B), whilst a third was designated the holotype of *Liassocopros hawkinsi* by Hunt et al. (2007, p. 90, 93, figs. 5D-E). A few coprolites have been freed from the enclosing matrix (e.g., NHMUK 2102, 2117, 2119, 2120), but most are preserved on small blocks of black calcareous shale, with clear evidence of fairly coarse mechanical preparation (e.g., NHMUK 2105, 2109-2116, 2120). Spiral coprolites are well represented in the collection (e.g., NHMUK 2102-3, 2107, 2117, 2119, R4857), but a significant number of usually smaller, non-spiral forms is also present. These have a variety of shapes, but include elongate, parallel-sided specimens lacking vertebrate inclusions and often tapered at one end (e.g., NHMUK 2110). One specimen has a single central twist (NHMUK 2116). The collection remains undescribed, as although Hawkins carefully figured them in his publications, he did not refer to them in the accompanying text, apart from the plate captions. The Early Jurassic coprolite faunas of Street and Lyme Regis are long overdue for descriptive review, a project which is currently in its early stages and will be published elsewhere.

### SAMUEL BECKLES

Samuel Husbands Beckles (1814-1890; Fig. 10A) spent his early life in Barbados where his family pedigree stretched back several generations to early colonial days. Following his father and grandfather into the legal profession, he was admitted to the Middle Temple in May 1835

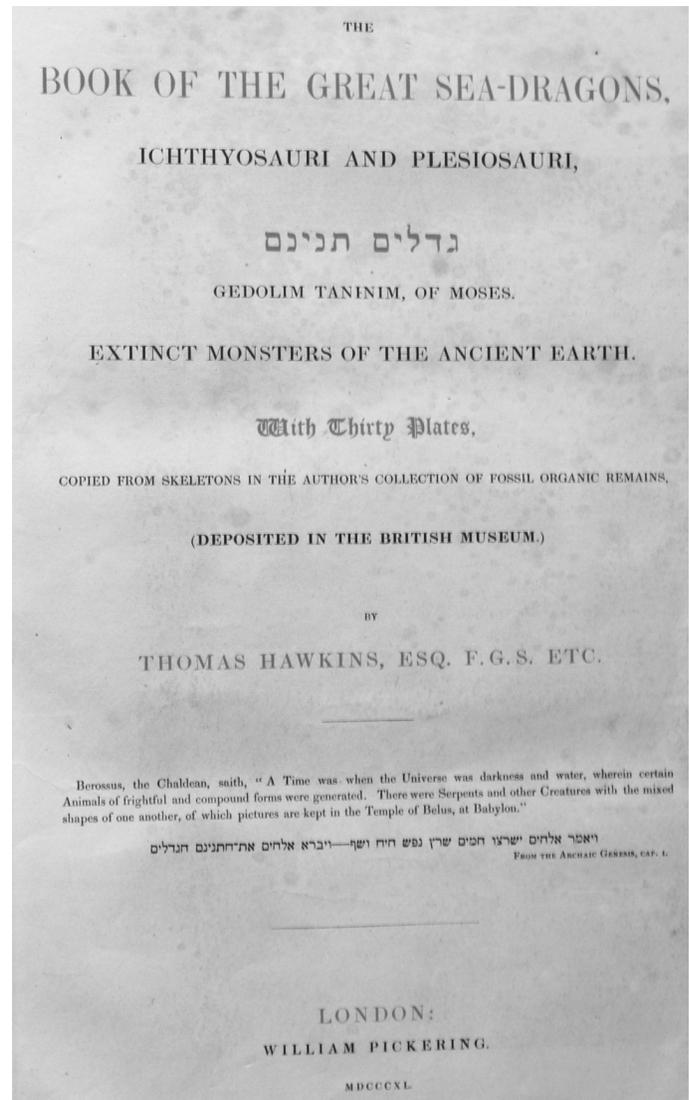


FIGURE 8. Title page of Hawkins (1840).

and called to the Bar in November 1838. He practiced as a barrister for a relatively short time, retiring through ill health to St Leonards-on-Sea, a suburb of Hastings on the East Sussex coast, around 1845. The nature of his illness was not so incapacitating as to curb his emerging enthusiasm for geology, however, which he pursued for another 45 years until his death. He published a small number of papers in the *Quarterly Journal of the Geological Society* between 1851 and 1862, becoming a Fellow of the Society in 1854 and a Fellow of the Royal Society in 1859. He also collected works of art and was a poet of some critical acclaim, publishing his collection under the title *Moments of Pleasure* in 1872. Indeed, his version of the *Charge of the Light Brigade* was described as being superior to the earlier (1854) but now infinitely more famous narrative poem by the then Poet Laureate, Alfred, Lord Tennyson.

Beckles' geological publications focused on dinosaur footprints from the Wealden of Hastings, Dorset and the Isle of Wight. He discovered the first virtually complete hind foot of *Iguanodon* (Woodhams, 1990), subsequently described by Sir Richard Owen. His geological field work also took him to Lyme Regis and Swanage on the Dorset coast, collecting coprolite specimens at both localities. Beckles spent a year in Swanage, renting a property there. Owen charged Beckles with excavating the Purbeck section following the discovery of a mammal jaw at Durlston by Swanage resident William R. Brodie (dates unknown). Over a nine month period, Beckles organised a large work force in the removal

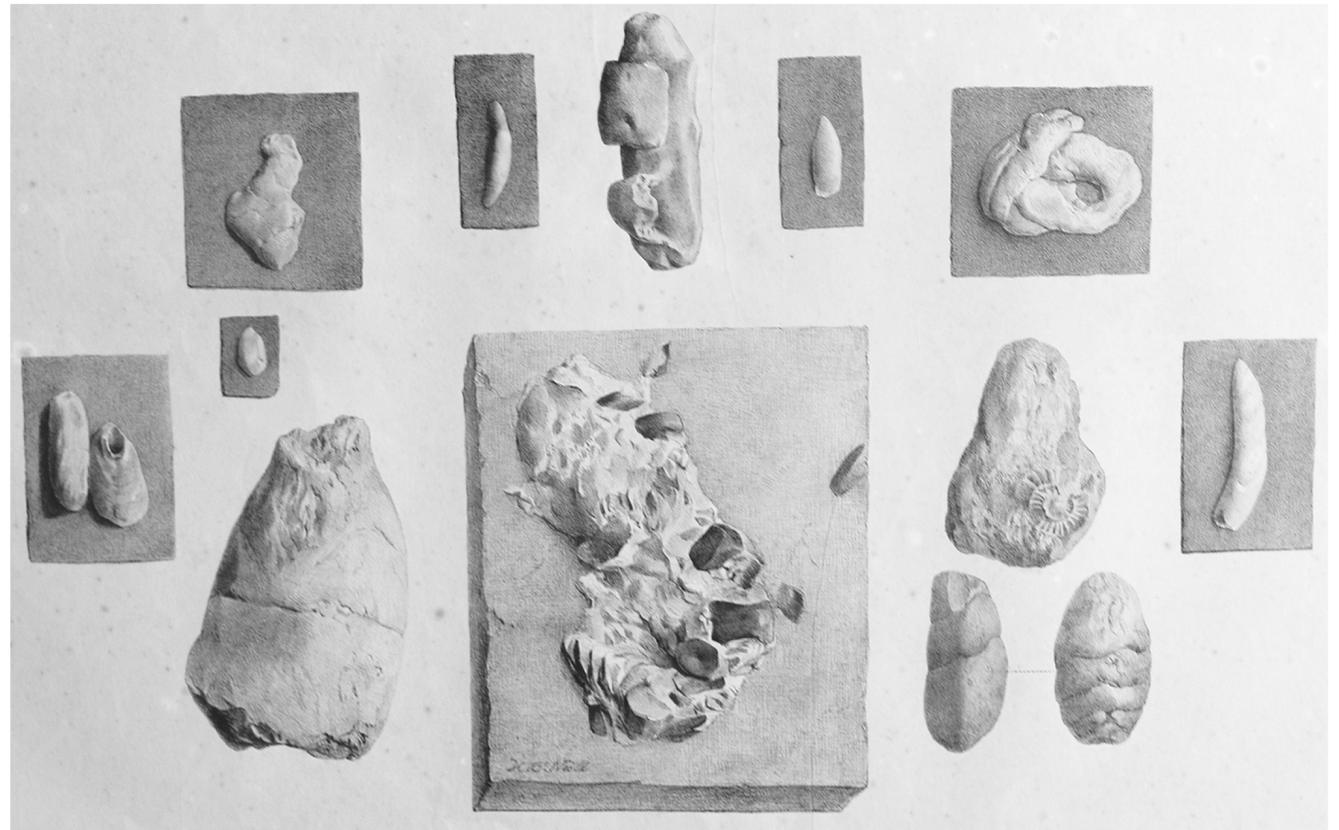


FIGURE 9. Plates 27 and 28 from Hawkins (1840).

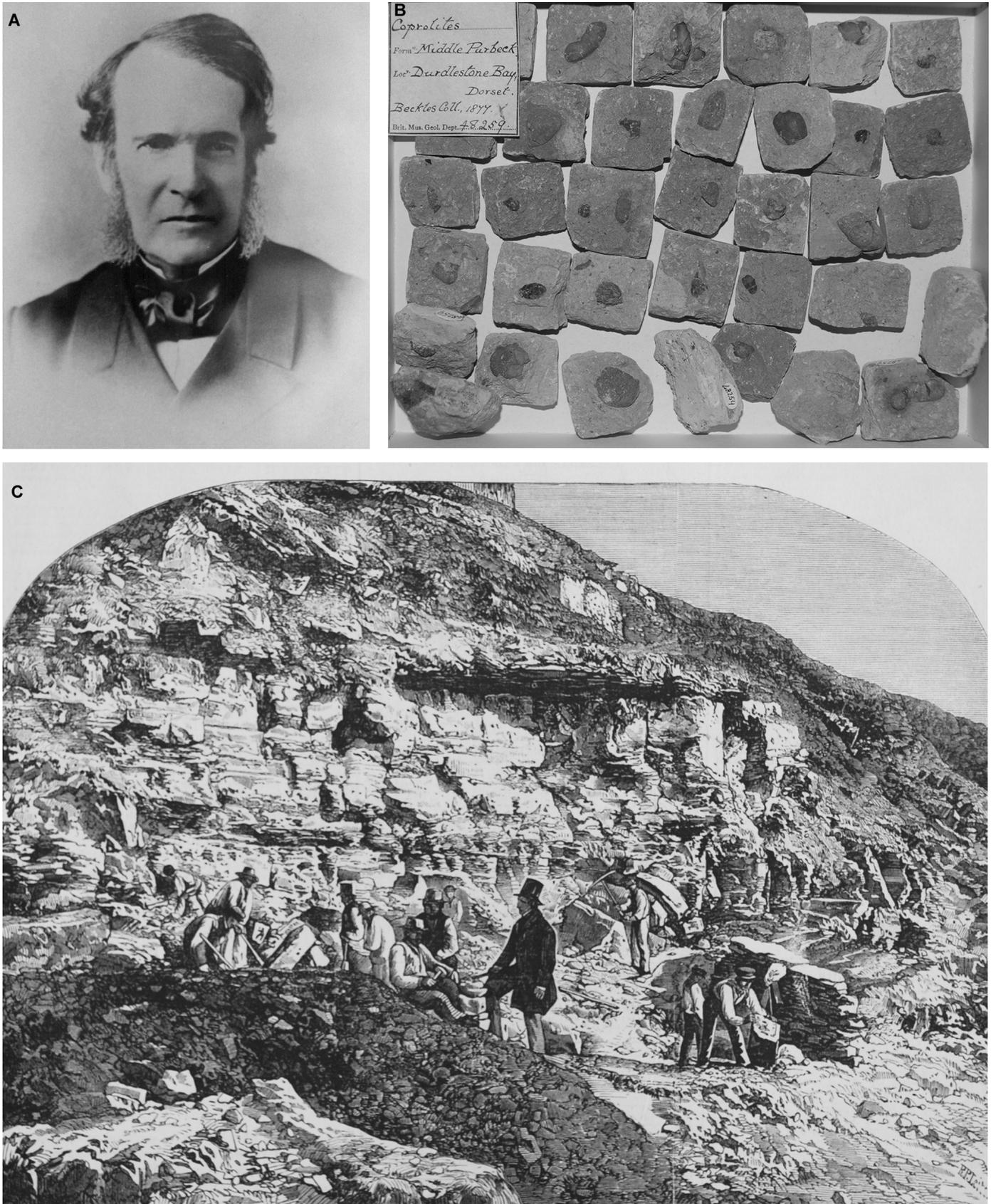


FIGURE 10. **A**, Samuel Husbands Beckles (1814-1890). Photograph courtesy of Ken Woodhams. **B**, NHMUK 48259, part of Beckles' coprolite collection from the Purbeck of Durlstone Bay, Swanage, Dorset. **C**, Excavation at Swanage from *Illustrated London News*, 26th December 1857.

of some 5m of overburden over an area of 600 square metres. The excavation was reported by *The Illustrated London News* with Beckles figured, complete with top hat, overseeing operations (Kingsley, 1857; Fig. 10C). Part of Beckles' collection passed to the Natural History Museum in London, and part was obtained by the Hastings Museum and Art Gallery in 1891, following his death. The coprolites collected by Beckles, including the coprolites from his excavations in the Purbeck (Fig. 10B), appear to be confined to the Natural History Museum collections; there are no coprolites in his collection at the Hastings Museum and Art Gallery (C. Walling, written communication).

### MINOR COLLECTORS

John Edward Lee (1808-1887) was a typical Victorian polymath, interested in a wide range of disciplines to which, despite his amateur status, he made significant contributions. Born at Kingston upon Hull, Lee was raised by two uncles on the early death of his father and worked in their shipping company (Anonymous, 1887, p. 526; McConnell, 2004, p. 86). Failing health stimulated a burst of foreign travel. His scientific interests were wide-ranging, commencing with entomology, but giving way to a more focused approach to geology and archaeology. Lee travelled with John Phillips (1800-1874), who succeeded Buckland as Professor of Geology at Oxford, to study the eruptive activity of Vesuvius in 1868. He recorded and illustrated many of the geological observations made in his travels at home and abroad in *The Note-Book of an Amateur Geologist*, published in 1881. Lee collected extensively (especially from the Devonian), exchanged fossils with others and cultivated a wide network of geological correspondents. His huge collection of over 21,000 specimens arranged in 31 cabinets was purchased by the British Museum (Natural History) in 1885. Four specimens of *Liassicopros hawkinsi*, some as waterworn pebbles from the Lower Lias of Lyme Regis, are registered under NHMUK R.662.

John Eddowes Bowman (1785-1841) was born at Nantwich in Cheshire, and joined, but vehemently disliked, his father's tobacconist business as a young man (Tayler, 1846). Early on in life he determined to pursue his intellectual interests and habitually rose at a time which would permit him a good two hours of reading and study before he began work at 6 am. He married his first cousin, a not unusual event for the times (so did Charles Darwin), and eventually entered banking, moving to Welshpool in North Wales. Bowman's interest in geology was stimulated by reading Georges Cuvier's *Theory of the Earth*, first published in 1813 and then in an English translation by Robert Jameson in 1817. He retired in 1830, and on his move to Manchester in 1837 became one of the founders of the Manchester Geological Society, contributing numerous papers on botany and geology to its publications. He responded positively to a request from Sir Roderick Impey Murchison to investigate the Silurian rocks of the Vale of Llangollen, North Wales, but also published on Carboniferous trees. Bowman obviously collected extensively, as his diary records that he was so impressed with Louis Agassiz (1807-1873), who visited him in North Wales, that he turned his entire collection of fossil fishes over to him for description in his *Recherches sur les Poissons Fossiles* (Agassiz, 1833-1843; Duffin, 2007). On his death, his collection seems to have been dispersed by Edward William Binney (1812-1881) of Manchester, with much of the material going to the Sedgwick Museum in Cambridge (Cleevely, 1983, p.63). Some obviously made it to Oxford, however, as three coprolites from the Late Triassic Rhaetic Bone Bed of Aust Cliff are present in the OUM collections (OUM H.36, H.37 and H.38).

Joshua Toulmin Smith (1816-1869, formerly Joshua Smith) hailed from Birmingham and gave up early aspirations to enter the Unitarian ministry in order to study law (Matthew, 2004, p. 237). A man of many parts, he published on Latin grammar, philosophy, history and politics, in which he was particularly active in the latter stages of his life. Following a five-year sojourn in the USA (lecturing on phrenology and philosophy in Boston) he returned to Highgate in London to resume his legal studies, eventually being called to the bar (1849). Toulmin Smith's geo-

logical activities were no more than recreational, but nevertheless lead to his appointment as the first President of the Geologists' Association (1858-1859). He became especially interested in the Ventrilitidae, Late Cretaceous poriferans from the Chalk, publishing his results in a series of papers in the *Annals and Magazine of Natural History*, gathered together and published as a monograph in 1848 (Long et al., 2003). Toulmin Smith's collecting was by no means restricted to the Chalk, however, as several large specimens of cut and polished spiral coprolites from Lyme Regis, donated to the NHMUK collections in 1869, indicate (NHMUK 41645; Lydekker, 1889, p. 117).

Charles Dawson (1864-1916) was a Hastings solicitor and enthusiastic amateur geological and archaeological collector. Once dubbed the "Wizard of Sussex" by a local newspaper on account of his spectacular discoveries, it was he who collected the infamous Piltdown Man specimens from a gravel pit in 1912. Dawson has always been a prime candidate for the Piltdown forger, especially in light of a large number of antiquarian fakes ascribed to him (Russell, 2003). A somewhat contorted, 120 mm-long coprolite with rough spiral structure (NHMUK R.1526) from the Wadhurst Clay (Wealden Group, Valanginian, Lower Cretaceous) of Hastings, however, seems to be authentic.

Sir Richard Owen (1804-1892), who famously coined the Dinosauria, was the driving force behind the establishment of the British Museum (Natural History) (now The Natural History Museum). The premier comparative anatomist of his day, Owen, arch-nemesis of Gideon Mantell, Charles Darwin and various others who strayed into the cross hairs of his intense intellectual and scientifically political sights, was not renowned for his fieldwork. There were occasions when he visited Mary Anning at Lyme Regis, however (Duffin, 2010a, p. 24), and seemingly accompanied her in the field. Two specimens in the NHMUK are recorded as having been donated by Owen in 1860. Both appear to be *Liassicopros hawkinsi* from the Lower Lias of Lyme Regis, and the date of their collection is unknown.

Bristolian Richard Bright (1789-1858) switched from philosophy, economics and mathematics to medicine during his student days at Edinburgh University. He later worked at Guy's Hospital in London where his eminence as a physician and medical researcher grew. Dubbed the "Father of Nephrology" he described the kidney disease that now bears his name. He took several travel breaks from his medical work, during which he indulged his interest in geology. A lifelong member of the Geological Society, he joined during the early days of its history (Kark and Moore, 1981). Bright's collection of Icelandic and Hungarian rock and mineral specimens were donated to the Geological Society in 1811 and 1816, while a collection of Mesozoic fossils, including a specimen purchased at the sale of James Parkinson's collection, was presented to the British Museum in 1873 (Cleevely, 1983, p. 66). Amongst this collection is a cut and polished coprolite from the Lower Lias of Lyme Regis (NHMUK 44813a).



FIGURE 11. NHMUK R.1526, a coprolite from the Wadhurst Clay (Wealden Group, Valanginian, Lower Cretaceous) of Hastings, East Sussex. Scale bar = 10 mm.

## CONCLUSIONS

The early decades of the nineteenth century in Britain represents a period of rapid change in geological thought. One of the main participants in this revolution was William Buckland, whose innovative approach to the interpretation of fossils as living components of past ecosystems was a significant departure from the rather staid safety of specimen description. The advances which he made depended upon a steady supply of specimens from a small band of collectors and mineral dealers, as well as loans and donations from colleagues and the fruits of his own efforts in the field. This was certainly true of his coprolite research, which spanned the latter part of the 1820's through to the mid-1830's. Once the true identity of coprolites as fossil feces was established beyond reasonable doubt, a new generation of collectors sprang up who added coprolites assiduously to their collections, some of which

were eventually sold by public auction, and others either presented or sold to institutional collections. The Oxford University Museum and Natural History Museum in London both contain historically significant collections of coprolites which together form the focus of this current study.

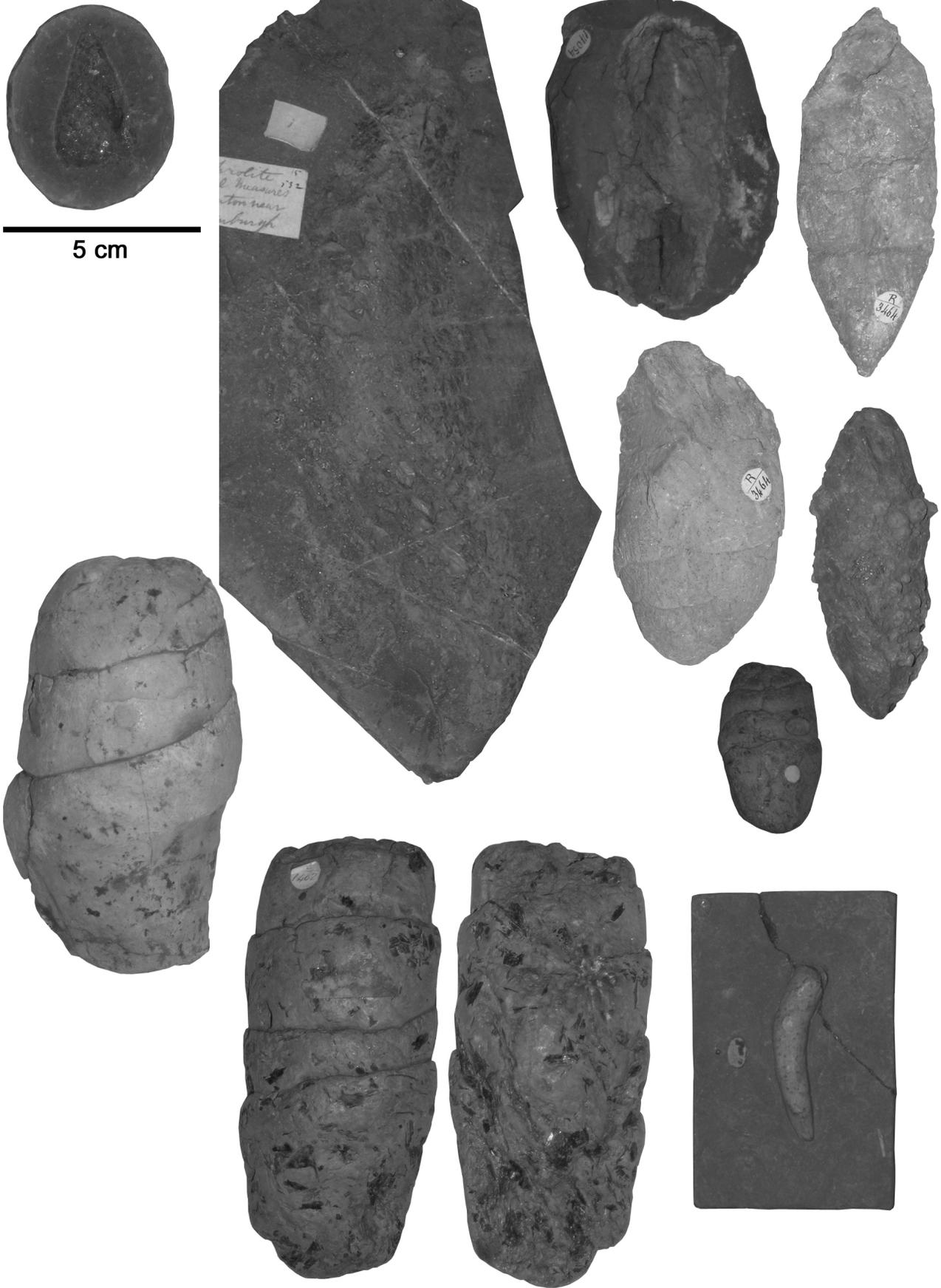
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Selected coprolites from the collection of the Natural History Museum, London.