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SOME EARLY COLLECTORS AND COLLECTIONS OF FOSSIL SPONGES REPRESENTED IN THE NATURAL HISTORY MUSEUM, LONDON

by Sarah L. Long, Paul D. Taylor, Steve Baker and John Cooper

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Fossil sponges have a long geological history dating to the late Precambrian, yet they are poorly understood both palaeobiologically and taxonomically. In part the latter is due to problems with preservation but further contributory factors are the number of key papers that date from the 19th Century, and the intrinsic problems in tracing, re-identifying and locating original data associated with the specimens used in these publications. The large collection of fossil sponges at The Natural History Museum, London (NHM) includes important material described by several 19th Century naturalists. Notable among these were J.S. Bowerbank, Gideon Mantell, J. Toulmin Smith, G.J. Hinde and H.A. Nicholson. Brief biographies of these naturalists are given, along with an introduction to their collections and additional paper archives held by the NHM.

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Introduction

Modern sponges are not as widely studied as many other invertebrate groups, despite the fact that they are becoming an important source of natural products as well as having a role in understanding the ecology of marine and non-marine environments, and in conservation management. Fossil sponges are even less well-understood than their Recent counterparts. Sponges have a long geological history. The earliest sponges date from the late Precambrian, where they provide us with the earliest evidence of filter feeding and are the first multicellular animals to evolve a method for silica biomineralization (Brasier *et al*. 1997). Phylogenetic relationships remain obscure at all taxonomic levels in fossil sponges. In part this is due to problems caused by deficiencies in preservation, such as the almost total lack of body fossils of the Lower Palaeozoic Hexactinellida (Krautter 2002) and the poor preservation potential of microscleres as in the fossil 'lithistids' (Pisera 2002). Taxonomic difficulties also result from the large number of key papers that date from the 19th Century and the associated problems involved in studying old collections in which type material may be hard to recognise and original data lacking. The Natural History Museum (NHM) contains an archive of both specimens and original documentation that forms a valuable, but under used, resource for fossil sponge specialists.

Since 1753, when the sale of Sir Hans Sloane's Collection to the nation resulted in the foundation of the British Museum (BM), many important specimens of fossil sponges and manuscripts pertaining to these specimens have been acquired through donation, purchase or bequest. This paper highlights some historically and taxonomically important fossil sponge collections obtained during the early years of the Museum's history, and focuses on the lives of the early naturalists who described these sponges.

Although some fossil sponges held at the NHM are from collections first made in the 18th Century, such as those of Thomas Pennant (1726-1798), a zoologist and antiquarian from Flintshire whose collection was donated in 1912, by which time the BM had become the British Museum (Natural History) (BMNH), many more are from collections that were either purchased or donated in the 19th Century. These include sponges of historical importance, such as those described and figured by William Smith (1769-1839) whose collections were purchased in 1816 and 1818. Smith's illustrations (Smith 1816-1819) include sponges figured by him as *Alcyonites*.

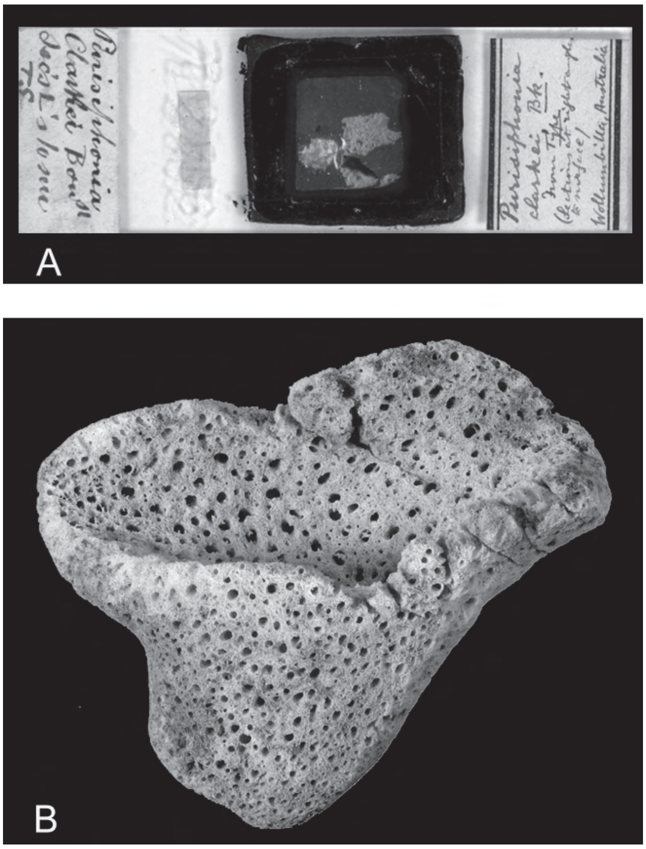

Figure 1. The sponge *Purisiphonia clarkei* Bowerbank from the Cretaceous, Albian, Wollumbilla Creek, N. Queensland, Australia. (A) Slide (NHM R.2592) prepared from the holotype by Bowerbank (the red label notes the preparation details "Taken from the white part pre=pared (*sic*) by acid" it is not clear if these notes were made by Bowerbank himself). (B) Fragment of holotype specimen (NHM S.5191a), X1. Bowerbank figured the type specimen in 1869 (pl. 25, figs 6, 7) and 1870 (pl. 17, fig 1). The type is now in two large fragments and a tube of small pieces.

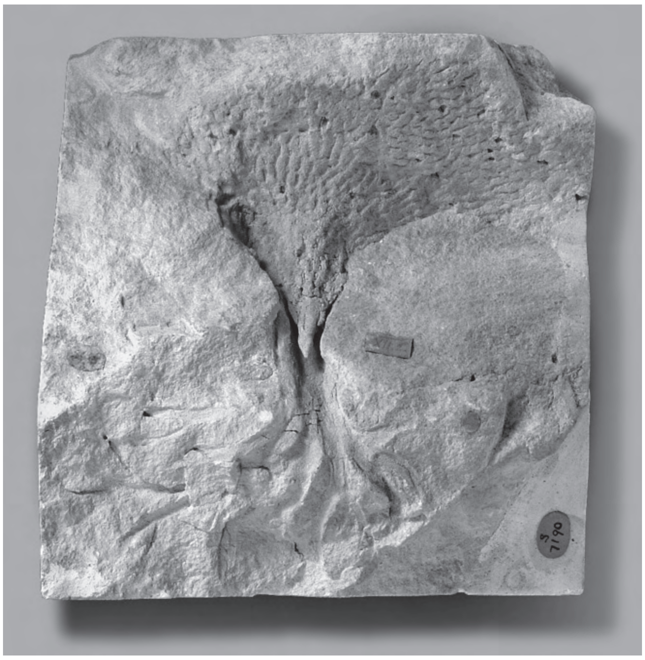

Figure 2. *Ventriculites chonoides* (Mantell) (NHM S.7190) from the Cretaceous Upper Chalk of southern England, X0.75. Thought to have come from Mantell's own collection, this hexactinellid was figured by him firstly in 1815 (pl. 28, fig. 1) as *Alcyonium*, an extant cnidarian and subsequently in 1822 (pl. 10, figs 4,6; pl. 12, figs. 1, 2) as *Ventriculites radiatus*.

The earliest taxonomically important specimens are those, described from the 1820s onwards, which represent the first attempts at understanding the British fossil sponge fauna, especially the rich assemblages from the Upper Cretaceous Chalk. Amongst those who contributed to the collection at this time were J.S. Bowerbank and G.A. Mantell.

James Scott Bowerbank

Born in Bishopsgate, London, the son of a wealthy merchant and distiller, James Scott Bowerbank (1797-1877) developed an interest in natural history at an early age. He particularly enjoyed collecting plants and reading books on botany (Stephen 1885-1900). Whilst working as an active partner in the family distillery (Bowerbank & C^{o}.) he spent his free time studying geology. He accumulated a large collection of British fossils which served as a basis for not only his own work, principally in the study of palaeobotany and sponges, but also the research of his contemporaries. Palaeontological soirées held at his home led to the formation of the London Clay Club. In 1847 after attending a lecture by Professor Prestwich at the Geological Society of London, he invited various leading scientists, including Henry De la Beche, to the Geological Society's tearoom. There he proposed the formation of a society whose aim would be to publish undescribed British fossils. This became the Palaeontographical Society (Anon. 1877). Palaeontologists were not the only scientists received into the museum Bowerbank created for his specimens - he welcomed all natural history students and gave his time and expertise willingly. An enthusiastic researcher into microscopy (he was a founder member of the Microscopical Society), Bowerbank spent considerable sums of money purchasing the newest and best equipment that he also placed at the disposal of his visitors.

In May 1864 Bowerbank retired to St Leonards-on-Sea and his extensive fossil collection was offered for sale to the British Museum (BM), but the offer was declined. However, the BM did purchase much of his collection during the course of five days in November 1865 when it was sold at auction by J. C. Stevens. A total of 1189 lots were sold, including not only Bowerbank's British fossils, but also skeletons

Figure 3. The holotype of *Verrucocoelia vectensis* Hinde (NHM P.1604) from the Upper Cretaceous (Cenomanian) of Ventnor, the Isle of Wight, X0.75. This specimen is from Mantell's collection and was figured by Hinde (1883, pl. 24, fig. 3, 3a-b).

and examples of Recent animals, mineralogical specimens, display cases and equipment for cutting and polishing rocks (Stevens 1865). Among the specimens purchased by the BM were many fossil sponges figured by Bowerbank, including type specimens of two species (Table 1), one of which is depicted herein (Figure 1). Several of Bowerbank's specimens were subsequently figured and redescribed by Hinde (1883) as new species and genera. Bowerbank also accumulated a large collection of Recent sponges from all over the world, now housed in the Department of Zoology at the NHM. His understanding of fossil sponges was undoubtedly enhanced by his knowledge and researches into Recent sponges, and his passion for microscopy. One of his conclusions from studying both fossil and Recent sponges was that the formation of flints in the Chalk was due to the silica in sponges (Bowerbank 1841). This was a controversial idea in the 1840s.

Bowerbank died on 8th March 1877. He published over fifty papers during his lifetime, not only on sponges, but also on entomology, palaeobotany, osteology, shell structure, fossil birds and sharks.

Gideon Algernon Mantell

Much has been written about the life of Gideon Mantell (1790-1852). Articled to a surgeon in Lewes as a young man, he was made a partner in the practice on the completion of his studies. He published on medical matters in the *Lancet* and had an interest in forensic science, proving how tests for the presence of arsenic employed in trials by the Crown in cases of poisoning were untrustworthy (Stephen 1885-1900). Mantell was inspired by James Parkinson, a pioneer of palaeontology in the British Isles and also a surgeon; Parkinson's disease was named after him following his 1817 *Essay on the shaking palsy* (Cleevely 1983). As his interest in geology developed Mantell devoted most of his free time to fossil collecting, sleeping only four hours a night and leading to the breakdown of his marriage even though his wife had been responsible for some of Mantell's major vertebrate finds (e.g., the dinosaur *Iguanodon* discovered at Cuckfield, Sussex in 1824). Mantell initially collected from the chalk pits of Sussex, later expanding his studies to include the whole of southeast England. Mantell regularly took opium to ease the pain he suffered from a spinal injury. Following a lecture at Clapham Athenaeum in November 1852 he took a dose of opium that proved fatal. The acquisition history of his collections by the BM is complex, with the purchase of one entire collection in 1838 and of selected items from a second collection after his death in 1853 (Cleevely and Chapman 1992).

Although best known for his research on fossil vertebrates, Mantell also worked on sponges. The NHM houses various sponges described by him between 1815 and 1854 (Mantell 1815, 1822, 1854), including types of at least seven of his species (Table 1; Figure 2), as well as specimens he collected that were subsequently illustrated by other scientists (e.g., Figure 3).

Joshua Toulmin Smith

Joshua Toulmin Smith (1816-1869) (Figure 4), known as Toulmin Smith after 1854, was born in Birmingham, the son of an economic and educational reformer. Articled at the age of sixteen to a solicitor, he later moved to Lincoln's Inn to complete his studies and become a barrister (Stephen 1885-1900). He cultivated interests in ancient history, law, public health and Latin, on all of which he published. Before he became qualified in law he moved to the United

Table 1. Species of fossil sponges described by Bowerbank and Mantell represented by type material in the NHM collections.

Species	Provenance	Material
Alcyonites parasiticum Bowerbank, 1849	no horizon or locality information	S.3758$1. Slide. Holotype
Purisiphonia clarkei Bowerbank, 1869	Lower Cretaceous. Wollumbilla Creek, near Roma, Waldegrave, N. Queensland, Australia.	S.5191a,b,c. Holotype. S.1673-5$3, slides made from the holotype
Homalodora ramosum Mantell, 1822	Cretaceous. Upper Chalk. South of England.	P.1258. Syntype
Choanites flexuosus Mantell, 1822	Cretaceous. Upper Chalk. Near Lewes, Sussex, England.	P.3195 (ex 5022). Holotype.
Choanites konigii Mantell, 1822	Cretaceous. Upper Chalk (flint). Near Lewes, Sussex, England.	P.1418. Syntype
Choanites subrotundus Mantell, 1822	Cretaceous. Upper Chalk. Near Lewes, Sussex, England.	P.3171. Holotype
Ventriculites benettiae Mantell, 1822	Cretaceous. Upper Chalk. Near Lewes, Sussex, England.	P.3130. Holotype
Alcyonium chonoides Mantell, 1815	Cretaceous. Upper Chalk. South of England [S.7190]. Chalk. *Sternotaxis* [*Holaster*] *planus* Zone. Bridgewick Quarry, Lewes, Sussex, England [S.7184]. Upper Chalk. South Downs, Sussex, England [S.3722].	S.7190 (ex P.1678), S.7184, S.3722 (ex P.1733). Syntypes
Spongia townsendi Mantell, 1822	Cretaceous. Upper Chalk. Near Lewes, Sussex, England.	P.1733. Syntype

Figure 4. A portrait of Joshua Toulmin Smith published in 1909 in the *Proceedings of the Geologists' Association*.

States where he lectured on phrenology and philosophy for a few years. While in the USA he also wrote books and articles on education and early history. In 1842 he returned to England, settling in Highgate, and continued his law studies until called to the Bar in 1849. It was on his return to England that Smith became interested in geology, publishing on sponges in a series of articles spanning two volumes of *The Annals and Magazine of Natural History* (Smith 1847, 1848). When the Geologists' Association was formed he was invited to become their first president, but other than his inaugural lecture given in January 1859, he appears to have played little part in the Association's proceedings. After 1847 he campaigned for better public health (Watts 1869), gradually becoming more and more involved in fighting for causes he believed strongly in and using his legal knowledge to work tirelessly for many social reforms. He drowned whilst bathing at Lancing on 12th April 1869.

Toulmin Smith's fossil and manuscript collection, including his scrapbook on ventriculitid sponges, was subsequently purchased by the BM. Although the genus *Ventriculites* was initially proposed by Mantell (1822), Toulmin Smith was the first to review thoroughly the descriptions of the species assigned to

Table 2. Species of fossil sponges described by Toulmin Smith represented by type material in the NHM collections. *It is unclear at present which of these two specimens is Toulmin Smith's type specimen figured Smith, J.T. 1848, pl. 15, figure 6.

Species	Provenance	Material
Brachiolites racemosum Smith, 1848	Cretaceous. Upper Chalk. Kent, England	P.1762(a) and P. 1762. Holotype?*
Ventriculites simplex Smith, 1848	Cretaceous. Upper Chalk. South of England.	S.8332 (ex P.3140). Syntype.
Brachiolites elegans Smith, 1848	Cretaceous. Upper Chalk. South of England.	S.8333-4. Syntypes.
Brachiolites foliacea Smith, 1848	Cretaceous. Upper Chalk. South of England.	S.3729-30. Syntypes.
Brachiolites labrosus Smith, 1848	Cretaceous. Upper Greensand. Near Folkestone, Kent, England.	P.3227. Syntype.
Brachiolites racemosus Smith, 1848	Cretaceous. Upper Chalk (flint). South of England.	P.1761. Syntype.
Brachiolites tuberosus Smith, 1848	Cretaceous. Upper Chalk. Kent, England.	P.1760. Syntype.
Brachiolites tubulata Smith, 1848	Cretaceous. Upper Chalk. South of England [P.1600]. ?Culver Cliff, near Brading, Isle of Wight, England [P.1586].	P.1600, P.1586. Syntypes
Cephalites alternans Smith, 1847	Cretaceous. Upper Chalk. South of England.	P.3165 (ex 46997). Holotype.
Cephalites bullatus Smith, 1847	Cretaceous. Upper Chalk. South of England.	S.3727 (ex P.3146). Two Syntypes
Cephalites campanulatus Smith, 1848	Cretaceous. Upper Chalk. South of England.	P.3176, P.3177 (ex 46997). Syntypes.
Cephalites capitata Smith, 1848	Cretaceous. Upper Chalk. South of England.	P.3174. Syntype.
Cephalites catenifer Smith, 1848	Cretaceous. Upper Chalk. South of England.	S.3726, P.3164, P.3164(b). Syntypes.
Cephalites compressus Smith, 1848	Cretaceous. Upper Chalk. South of England.	P.3164. Holotype.
Cephalites longitudinalis Smith, 1847	Cretaceous. Upper Chalk. South of England.	S.3728 (ex P.3161). Syntype.
Cephalites perforatus Smith, 1848	Cretaceous. Upper Chalk. South of England.	P.3150. Syntype.
Cephalites retrusus Smith, 1848	Cretaceous. Upper Chalk (flint). South of England.	S.3740. Wax impression figured by Smith, pl. 14, fig. 8
Ventriculites impressus Smith, 1847	Cretaceous. Upper Chalk. South of England.	P.1683. Syntypes.
Ventriculites striatus Smith, 1848	Creatceous. Upper Chalk. South Downs, England.	S.3731. Syntype
Ventriculites tessallatus Smith, 1848	Cretaceous. Upper Chalk. South of England.	P.1699. Holotype?

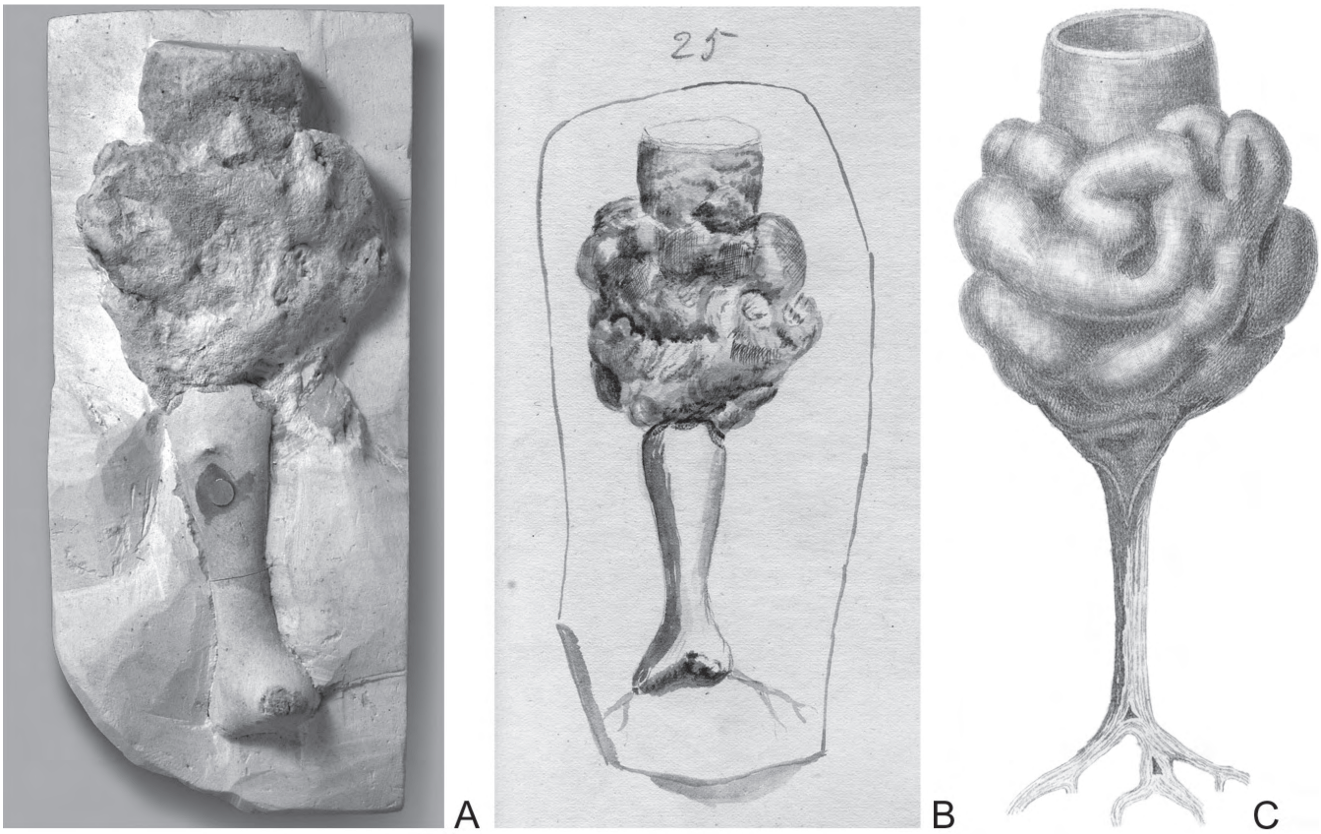

Figure 5. Specimen (A), watercolour (B) and published illustration (C) of a syntype of *Oncolpia elegans* (Smith), NHM S.8333, from the Cretaceous, Upper Chalk of southern England, X0.75. Smith figured this specimen in 1848 (pl. 15, fig. 4) as *Brachiolites*. Smith's final illustration appears to be a composite with the head of NHM S.8333 and stem of another specimen (NHM S. 8334).

this genus at both macroscopic and microscopic scales. As a result he developed the concept of the family Ventriculidae. His scrapbook contains corrected proofs of his papers on ventriculitids (Smith 1847, 1848), in which some 20 new species were named (Table 2), as well as watercolour sketches of his specimens (both published and unpublished) and pencil drawings of sponge microstructure (Figure 5). These items form part of an ongoing project to identify the specimens from Smith's collection that were published by him, which is not always straightforward as his final illustrations were sometimes composites of two or more specimens.

George Jennings Hinde

The taxonomic work of G.J. Hinde (1839-1918) was pivotal in bringing the British fossil sponge fauna to the attention of palaeontologists worldwide. In comparison with other northern European sponge faunas that had been extensively monographed by Goldfuss, Roemer, Geinitz and others, British sponges

Figure 6. *Chenendopora michelinii* Hinde (NHM P.1197) labelled as from the Cretaceous, Upper Greensand of Wiltshire, England, but considered more likely to be from France (Parkinson, 1808: p. xv, and Hinde 1883: p. 35), X0.6.

Figure 7. Pencil drawings of the microstructure of *Geodites wrightii* (Hinde) and *Bactronella parvula* Hinde from Hinde's manuscript drawings held at the NHM.

had been neglected prior to Hinde's work. In 1883 Hinde published *A Catalogue of the fossil sponges in the Geological Department of the British Museum (Natural History), with descriptions of new and little-known species*. This was the first attempt to monograph British fossil sponges and took into account the knowledge and ideas on taxonomy that had been developed and published in continental Europe by eminent palaeontologists such as K. A. von Zittel. Hinde revised all the material then stored in the BMNH. He figured and published descriptions of material previously described or donated by several important British (and Canadian) geologists and collectors, such as William Bean, Elkanah Billings, James Bowerbank, Edward Charlesworth, Gideon Mantell and Nathaniel Wetherell.

G.J. Hinde was born and brought up in Norwich. At the age of 16 he was sent to a farm in Suffolk to learn agriculture. When not working on the farm he taught himself Latin, French, algebra, physics and chemistry. A lecture by Hugh Miller sparked his passion in geology and, in 1862, he attended a series of lectures given by William Pengelly which furthered his interest. This led him to make the acquaintance of BM geologist Henry Woodward who went on to become the first Keeper of Geology following the opening of the BMNH in South Kensington in 1881. Woodward was a distant relative of Hinde by marriage and they developed a close friendship. Later that same year (1862) Hinde emigrated to Argentina where he took up sheep farming. He returned to England briefly before setting out for North America and Canada (*c*. 1867) where he studied geology for 7 years, becoming a student of H.A. Nicholson at Toronto University. He returned to the England in 1874 but continued to travel and publish his findings, visiting Sweden (including Gotland), Denmark, then travelling through Europe to Palestine. Between 1879 and 1880 he studied under Karl von Zittel in Munich where he was awarded a PhD. Following his marriage in 1881 he lived permanently in England. He worked extensively on the collections at the BMNH, writing a monograph of the fossil sponge collection (Figure 6), as well as collecting new material and preparing thin sections, a technique he undoubtedly learnt from Nicholson. An active member of the Geological Society of London, Hinde strongly advocated women being allowed to become fellows of the Society - a draft proposal written by Hinde for an enabling amendment to the rules is held in the archive at the NHM. Unfortunately, he was unsuccessful and at the time of his death women were still barred from fellowship of the Society. Hinde never lost interest in his studies and worked up until his death on 18th March 1918 (Woodward 1918).

Hinde was a constant collector who took great care to label the many hand specimens and slides in his collection. Many of the specimens from his personal collection that were figured throughout his career in numerous publications (listed in Woodward 1918) are held in the NHM collection (e.g., Figure 6), either donated at various times by Hinde himself or by his widow following his death in 1918. His archive also includes proofs, research notes with detailed pencil sketches (Figure 7) of hand specimens, spicules and slides used in his research, newspaper cuttings, and details of trips and visits. These are contained in fourteen volumes of manuscript notes, the majority of which were indexed and dated by Hinde himself. The dated volumes cover the periods 1875-1880 and 1886-1914. Hinde's collection, along with material purchased from A. Schrammen, are probably the two most important 20th Century acquisitions of fossil sponges.

Henry Alleyne Nicholson

Born in Penrith, Cumbria, H.A. Nicholson (1844-1899) was the son of a biblical scholar. He attended Appleby Grammar School, and in 1862 went to Edinburgh University to study Medicine and Surgery, graduating with a D.Sc. in 1867 and an M.D. in 1869. Following his first appointment to a lectureship in Natural History at Edinburgh, he moved on to occupy

Figure 8. The memorial tablet to H.A. Nicholson at the University in Aberdeen, reproduced from the *Geological Magazine* (Woodward 1903, plate 12).

Figure 9. A slide of *Actinostroma verrucosum* (Goldfuss) P.5537 from the Middle Devonian of Büchel, from the Nicholson collection, figured by him in 1889 (pl. 16, fig. 7). The slide shows Nicholson's typical labels, a red circle containing his specimen number and a white slide label giving the taxonomy, stratigraphy and locality.

the Chair of Natural History at Toronto, Canada, in 1871. It was in Toronto that Nicholson met G.J. Hinde, who became his student. Following his return to Britain, Nicholson took up a post in Newcastle (1874) prior to moving to St Andrews (1875) and Aberdeen (1882). Elected FRS in 1897, he remained at Aberdeen until his sudden death in 1899 (Hinde 1899). His friends and colleagues erected a memorial tablet at Aberdeen University (Figure 8), in the Arts and Crafts style typical of that period, depicting many of the fossil groups that Nicholson had worked on, including graptolites, brachiopods, trilobites and corals, as well as the hills of his hometown Penrith (Woodward 1903).

During his career Nicholson worked on a wide range of taxa, but is most well known for his research on bryozoans, corals and stromatoporoids. In all, Nicholson published some 167 papers and 12 textbooks, including manuals of palaeontology, zoology and geology, each of which were sufficiently popular to go through several print editions.

Nicholson pioneered the use of thin sections in identifying and interpreting the internal structure of fossil invertebrates. Nicholson also understood within-species variability and avoided excessive taxonomic splitting.

He is thought to have made over 4000 slides during the course of his work (Benton 1979). Many of the slides described in his *Monograph of the British Stromatoporoids* (1886-1892) and other publications (see Benton 1979) are housed at the NHM. The

Figure 10. The original specimen of *Labechia conferta* (Lonsdale) (NHM P.6317) from the Silurian, Much Wenlock Limestone Formation of Shropshire, X0.5. Figured by Nicholson (1886, pl. 3, fig. 7).

stromatoporoid monograph is still a standard reference work much used by specialists on this extinct group now considered to be sponges with calcareous basal skeletons despite the lack of preserved spicules. The slides in Nicholson's collection usually bear distinctive labels (Figure 9) and many of the hand specimens (Figure 10) are associated with original labels in Nicholson's characteristic handwriting. The collection was purchased in 1895 from the dealer F.H. Butler (Cleevely 1983). Accompanying the collection was a handwritten catalogue made by Nicholson that lists his specimen number, locality, age, type of section, source and where the slide has been figured.

Discussion

Although the work of Mantell is important both historically and scientifically, it is the other collectors outlined in this article and their collections that are of more particular interest. One of the most important aspects of the work of Bowerbank, Hinde, Nicholson and Toulmin Smith is their use of microscopy and sponge microstructure to elucidate species. All were pioneers in the fields of light microscopy and interpretation of thin sections. Their work contrasts with the taxonomy of sponges as practised by many of their contemporaries who concentrated on gross morphology. This has led to considerable taxonomic confusion surrounding descriptions of some genera and species, particularly in the case of those sponges described by Goldfuss and Quenstedt (Pisera, 1997). The scientific value of the NHM collection is enhanced by the presence of different kinds of data that can be combined to try to understand the concepts these authors had of their various species and higher taxa, including original manuscripts and labels written by Toulmin Smith, G.J. Hinde and H.A. Nicholson (Figure 11). It is hoped that further research into the NHM sponge collection will continue to pinpoint material belonging to and identified by 19th Century natural historians.

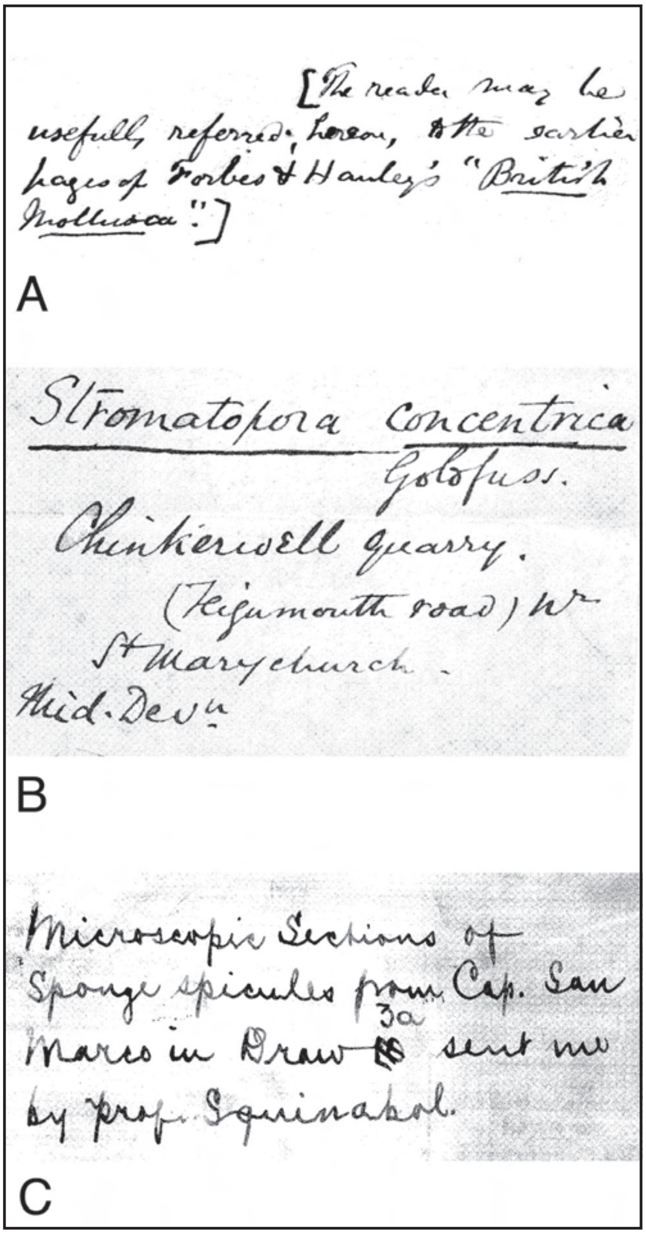

Figure 11. Examples of handwriting. (A) A note made by J.T. Smith in his scrapbook on the Ventriculitidae held in the special collections of the Earth Sciences Library, NHM. (B) An original label written by H.A. Nicholson. (C) An original label written by G.J. Hinde.

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COMMENT ON 'TYPE AND FIGURED SPECIMENS IN THE GEOLOGY MUSEUM, UNIVERSITY OF THE WEST INDIES, MONA CAMPUS, JAMAICA'

by Stephen K. Donovan

Donovan, S.K. 2003. Comment on 'Type and Figured specimens in the Geology Museum, University of the West Indies, Mona Campus, Jamaica'. *The Geological Curator* 7(10): 363-364.

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Brown and Langner's (2002) recent compilation of the specimens in the type and figured collection of the Geology Museum, University of the West Indies, Mona (UWIGM), is a welcome contribution. It alerts the geological community to some of the treasures in a museum that has failed to be noticed in some notable and widely referenced compilations of geological collections (Cleevely 1983, Webby 1989). However, in reading Brown and Langner's paper, it was obvious that records in their list of type and figured specimens were incomplete or incorrect. I am therefore writing to provide a brief supplement to an already valuable resource.

Lucas Barrett Collection

The list of specimens from the Lucas Barrett Collection figured by Wood (1997) is incomplete, only considering those in Figure 2a-e. The following bivalves, scleractinian coral and serpulid were figured in the same place. Locality data is derived from Wood (1997, table 1).

Inoceramus sp. cf. *I. balticus* (Böhm), UWIGM LB 7194; figured in Wood (1997, fig. 2f); from Plantain Garden River, parish of St. Thomas, eastern Jamaica (Upper Cretaceous).

Pinna sp., UWIGM LB 7265H (one of two specimens); figured in Wood (1997, fig. 2g); locality unknown (presumed Upper Cretaceous; Wood 1997, p. 11).

Cyclolites jamaicensis Wells, UWIGM LB 7265A (one of 31 specimen); figured in Wood (1997, fig. 2h); locality unknown; Campanian (Upper Cretaceous) (Wells 1934, Wood 1997, p. 11, fig. 3).

serpulid worm tube, UWIGM LB 7265T (one of 29 specimens); figured in Wood (1997, fig. 2i); locality unknown (presumed Upper Cretaceous; Wood 1997, p. 11).

Trace fossils

Entobia sp. cf. *E. laquea* Bromley & D'Alessandro; figured in Donovan and Blissett (1998, fig. 1); collected from the Eocene Chapelton Formation, Yellow Limestone Group, at Wait-a-Bit Cave, south of Green Town, parish of Trelawny, central Jamaica (NGR 951 769). (Although Brown and Langner (2002, p. 302) correctly mentioned the infested substrate, Donovan and Blissett (1998) was a discussion of the significance of these clionid sponge borings in a giant *Campanile* shell.)

Rocks

Not another specimen, but, rather, a tale of 'one that got away.' The list of septarian nodules is a sad reminder of what hasn't been deposited in the UWIGM. Wood and Donovan (1996) was a paper on good museum practice, which used a septarian nodule in the UWIGM, deposited with poor registration details, as the focus for the discussion. Unfortunately, the readers of *Journal of the Geological Society of Jamaica* were rather more interested in the question of provenance of septarian nodules in the Jamaican rock record (Porter 1997, Mitchell and Crowley 1999). Mitchell and Crowley's (1999) specimens were deposited in the UWIGM (Brown and Langner, 2002, p. 303). Unfortunately, despite a direct plea (Donovan and Wood 1997, p. 48) that the nodule figured by Porter (1997) be deposited in the UWIGM, it obviously has not been added to the collections. Sadly, this suggests that the central message of Wood and Donovan (1996) failed to be noticed even by some close readers of the article.

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CURATION OF PALYNOLOGICAL MATERIAL: A CASE STUDY ON THE BRITISH PETROLEUM MICROPALAEONTOLOGICAL COLLECTION

by Jayne Dunn

Dunn, J. 2003. 'Curation of palynological material: a case study on the British Petroleum micropalaeontological collection'. *The Geological Curator* 7(10): 365-372.

A curation and conservation survey of palynological material in the former British Petroleum Microfossil Collection is presented. The history of processing, slide preparation and storage of slides and residues in this 'industrial' collection is documented. The current conservation state of the collection suggests that good preparation techniques are critical to the long-term stability of palynology slide collections. The long term retention of duplicate residues is essential, providing a safeguard against damage or decay to original slides.

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Introduction and background to the collection

The British Petroleum Exploration Operating Company Ltd (BP) donated their micropalaeontological and palynological collections to the Natural History Museum in 1991, and provided a short-term grant to curate and maintain them. The collection is comprised of over 200,000 slides and residues and covers all the major microfossil groups from locations worldwide with extensive stratigraphical coverage. The collection was started in the late 1950s and continued to grow until the laboratory closed in July 1992.

The collection was received in a poor condition and with a minimum of documentation. It has subsequently been curated and catalogued and the major part of the collection is now available as a searchable database on the Natural History Museum web site at http://www.nhm.ac.uk/palaeontology/micro/collections/bp/bp.html. If you have any enquires concerning the collection please contact the e-mail address: BP-Collection@nhm.ac.uk

The database holds details of material from over 3,500 individual well-runs from over 120 countries world-wide. This represents the only hard catalogue of the collection due to vast size of the collection.

There are three main sections to the collection:

1. The Micropalaeontology Reference Collection of *c*. 60,000 named foraminifera and ostracod slides. This was the reference library of microfossils used by BP to aid identification of specimens by their research scientists. This part of the collection was actively used until the 1970s when it fell into disuse.

2. Micropalaeontology picked slide (foraminifera and ostracods) and residue collection from BP well runs and outcrops.

3. Palynological and Calcareous Nannofossil Strew Slide and Residue Collection comprising mainly BP well runs and outcrops.

The present study was undertaken on the Palynological Slide and Residue Collection, to determine its condition and to ascertain if improvements can be made to enhance the life of the slides and residues.

The Palynology Collection is unrivalled in size at the Natural History Museum, covering a history of 30 years of work produced by a single laboratory. Until recently, most major oil companies maintained a processing laboratory and staff trained in palynology. Sample processing was of a high standard due to the consistency of work produced by experienced technicians and the interaction with palynologists. As with BP, many such laboratories have since been shut down and work is now carried out by contractors. The collection therefore, represents an important part of the development and history of palynological processing at BP and in the UK, providing valuable material for studying the conservation of slides and residues.

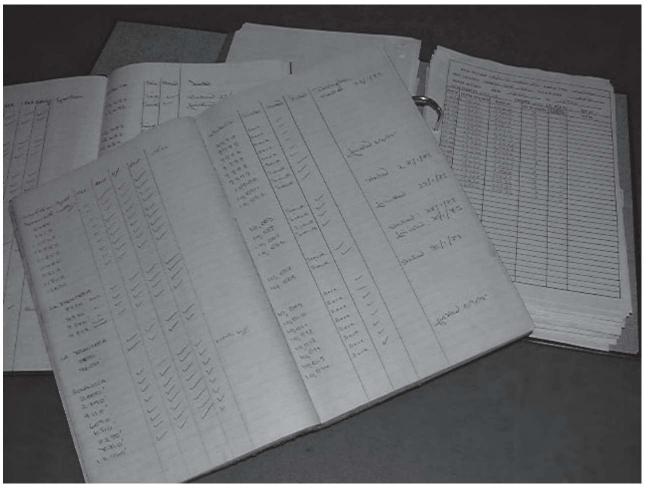

Figure 1. Laboratory books contain information about the processing dates of the samples, chemical treatments and if a residue was retained in storage.

The Palynology Collection consists of an estimated 20,000 slides and a large volume of corresponding residues, ranging from sample number 1 through to 49035. Documentation of the palynology material is limited to laboratory books and index catalogues, but these provide information about the processing techniques applied to each sample and the date when the work was completed (Figure 1). Unfortunately, the laboratory notebooks only record details from sample number 6000, but from here the accurate date of sample preparation is known. For this reason it is possible to undertake a survey of the condition of the collection and by looking at the preservation of the material through time, we can potentially recognise problems and causes, documenting them for future workers.

The purpose of this paper is fourfold: (a) to document the palynological processing and storage techniques used in an 'industrial' setting at British Petroleum; (b) present results from a condition survey of the BP palynological collection to establish if time, storage or preparation techniques are the critical factors in the long-term storage of palynological preparations; (c) study the recoverability of damaged slides and dehydrated residues, and (d) provide recommendations for future slide and residue storage.

Palynological processing techniques used by British Petroleum

Through the documentation of the processing methods used on the samples an understanding can be gained of the long term effects of chemicals used and how they may affect the future stability of the palynological material. The history of processing documented has been compiled by examining laboratory records and discussions with former BP laboratory personnel and palynologists, Jonah Chitolie, John Williams and Geoff Eaton (pers. comms).

There are many references to palynological processing techniques (e.g. Gray, 1965; Traverse, 1988) and every palynological laboratory has developed and adapted standard processing methods and practices depending on resources. The British Petroleum laboratory followed widely used techniques but did not apply a standard routine. Samples were treated according to the type of cuttings, the lithology of the samples and, to some extent, the results required, adapting techniques in response to each sample, i.e. a typical commercial approach. Commercial commitments required results quickly and cheaply and samples were processed in batches for rapid turn over. This did not compromise the quality of the work as samples would be treated individually and constantly monitored through each stage of processing to apply different methods as necessary.

When treatment was completed, the residue was concentrated by spinning in a centrifuge and pouring off top water and held in distilled water ready for slide preparation. In many cases the residue was divided into two and splits kept of the sample before and after oxidation, (a treatment with Potassium Chloride solution to remove excess 'background' organic matter, to clean the preparation before mounting on slides) for comparison and as a safeguard against accidents. Every processed sample was given an accession number, recorded in a laboratory catalogue and found on all corresponding slides and residues.

Slide preparation techniques used by BP

Both glycerine jelly and Elvacite have been used in the BP laboratory. Glycerine has an optimal refractive index to give good definition to the palynomorphs; it is water soluble, has good dispersing properties and is easy to use. Elvacite on the other hand is durable, permanent and the coverslip does not have to be sealed.

Glycerine jelly was originally used up until 1984 but the increase in the use of fluorescence microscopy for analysis at BP led to the use of Elvacite. Autofluorescence is a property of palynomorphs that becomes evident when specimens are excited by ultraviolet light. Elvacite as a medium does not fluoresce, therefore was more favourable to glycerine jelly that shows a small amount of autofluorescence that may cause interference. In 1986 Elvacite was abandoned after a number of problems became evident.

Figure 2. View of slide drawers that hold individual slides in position.

Elvacite cures from the edges towards the centre, taking considerable time to harden, sometimes up to two days, which is a major disadvantage in a busy laboratory. Problems also occurred with the development of dendritic-shaped air bubbles appearing on the slides after a short period of time in storage, a sign that may suggest drying out. Due to the problems with curing it was impossible to determine if it was set through to the centre of the slide. If moved to early, if still soft in the middle, movement caused by handling created air pockets under the coverslip. Additionally, when large grains are found in the preparation, lifting under the coverslip took place and again created air pockets that began to creep outwards along the slide. Furthermore, Elvacite is stored with xylene, used as a solvent to keep the product fluid. Xylene is a carcinogenic substance, which is hard to completely drive off and therefore posed a health risk during slide preparation.

Slides went back to being mounted in glycerine jelly once again and Elvacite was only used when florescence analysis was to be carried out. The glycerine was made up in-house following the recipe below.

1. Glycerol 70 ml
2. Gelatine 10 g
3. Phenol 0.2 g
4. Distilled water 60 ml

The mixture was warmed gently in a water bath until the ingredients were completely dissolved. Phenol was added to the jelly to prevent any fungal growth on the slides. This method was thought to reduce the water content and subsequently prolong the life of the slide. Water remaining in the mixture after the slide had been made is thought to evaporate and create problems with desiccation under the coverslip.

Due to restraints on cost and time, glycerine jelly slides produced in the BP laboratory were not sealed

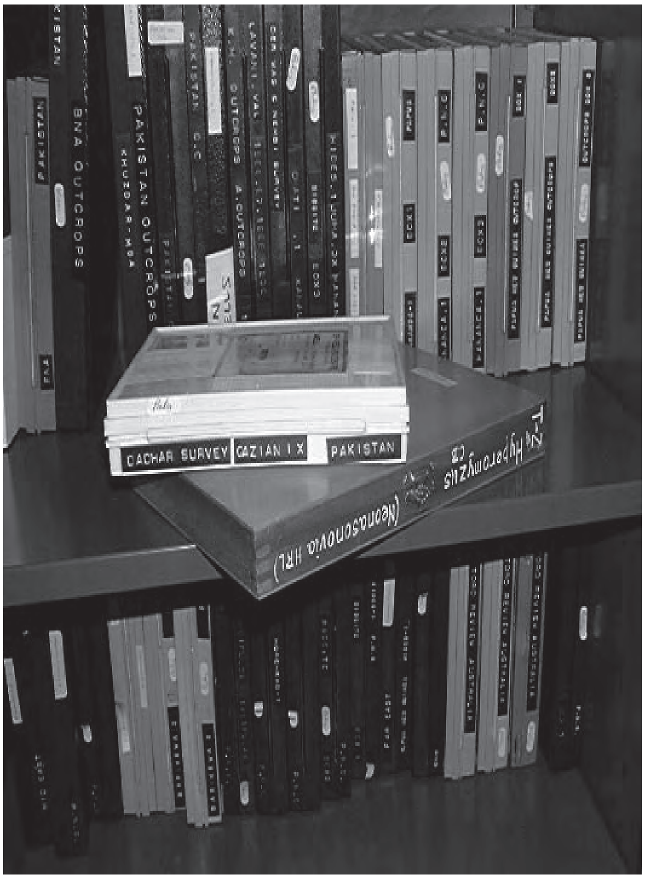

Figure 3. Slides are held in slide-boxes in a vertical position so that coverslips are horizontal and uppermost where possible. Two types of slide boxes have been used; A4 sized wooden boxes or smaller moulded plastic containers.

after preparation. The standard use of nail varnish or paraffin as a sealant would not have been feasible in a busy laboratory and was not a necessity for the purpose of these slides. Due to the commercial nature of the collection long term storage and preservation was not a requirement.

Storage of palynological material used by BP

Slides

The BP palynological slides are grouped into two sections. The earliest slides produced by BP are stored in narrow steel drawers that hold each individual slide in a vertical position. The earliest slides produced by BP are stored in narrow steel drawers that hold each individual slide in a vertical position (Figure 2). The slides are organised by sample number and are systematically ordered, from 1 to 4540. The remaining slides are stored separately, grouped by well name and stored as a 'well-run' regardless of sample number order. They form the bulk of the main slide collection, grouped geographically and stored in steel cabinets (Figure 3). Due to the vast size of the collection it is not

Figure 4. A view of the steel drawers with an average of 350 glass bottles in each drawer. The drawers are divided by a series of metal grids that hold the bottles in a vertical position preventing them from being crushed.

possible to store the slides on trays in purpose-built cabinets.

Residues

For every slide made the remaining residue was kept and stored for future reference. These are a vital addition to the slide collection. Occasionally, if the residue was very small a stored reserve was not possible; consequently there are a few gaps in the run of sample numbers. The residues are held in steel drawers (Figure 4). As with the use of mounting medium, BP also used a range of storage methods to retain the residues in the BP laboratory.

When the laboratory first began palynological work, the majority of samples processed were for research purposes. As the laboratory grew bigger and more commercial in output, a more efficient scheme was required as time became an important factor. Initially time was allocated for the curation of residues and therefore, samples were stored in glycerol. This involved a slow, time-consuming process, to minimise contamination, whereby water was drawn off the residue. Later, as less time was available to carefully store processed samples, residues were left in distilled water with a few drops of methanol added to prevent fungal growth. The growth and volume of work produced by the laboratory can be seen in the entries in the laboratory books. From 1970 to 1971, 740 samples were processed, from 1980 to 1981, 934 samples were processed and, by comparison, from 1991 to 1992, 1,661 samples were processed.

As well as varying the slide storage medium BP also experimented with different residue bottle and lid types (Figure 5). The earliest residues, from sample number 201 to 2280, are stored in glass vials with cork stops. These residue bottles are unlabelled with only a sample number written on top of the cork lid. From sample number 2281, BP moved to glass vials with plastic lids (pop-tops) although glycerol was still used. A sample number was written on the lid and a hand written label attached to the side with Sellotape, documenting details such as the well name, locality and depth of sample. From approximately sample number 6000 all the details on the processing

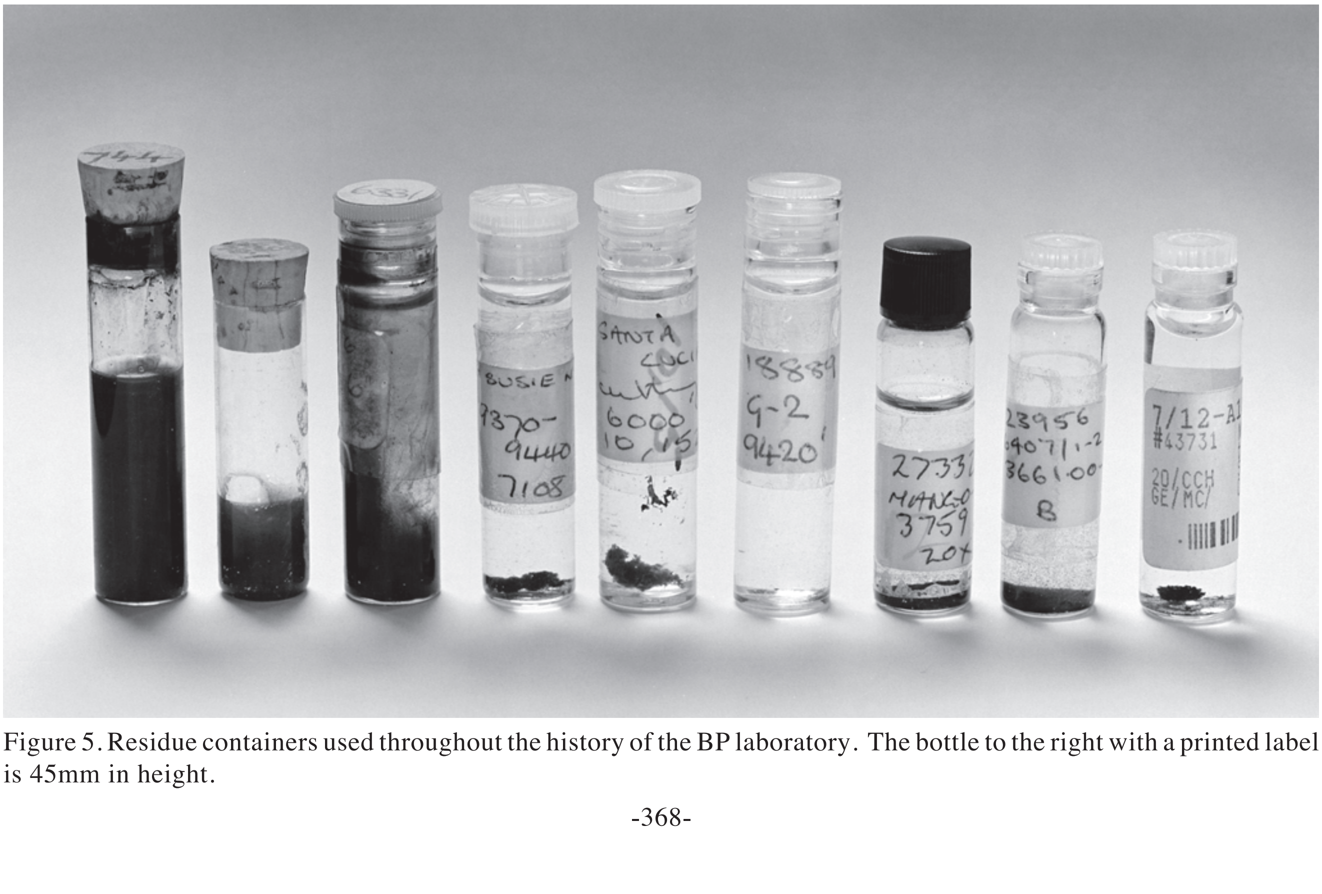

Figure 5. Residue containers used throughout the history of the BP laboratory. The bottle to the right with a printed label is 45mm in height.

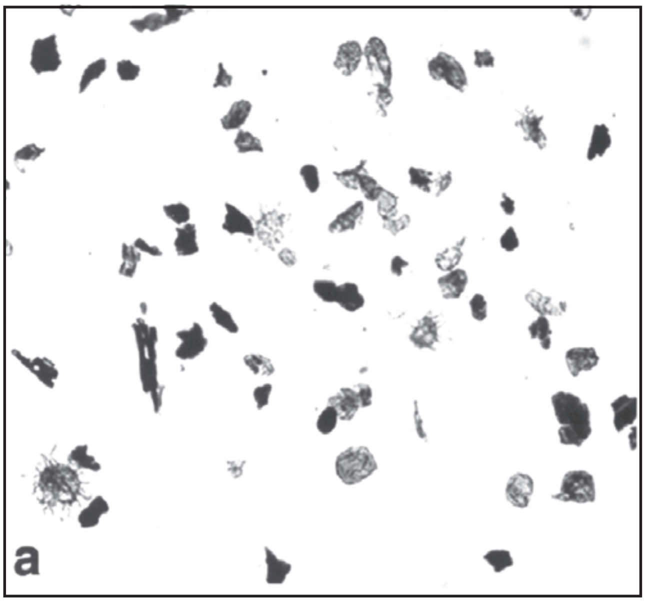

Figure 6a. Clean slide free of crystal growth and air bubbles (prepared in 1989).

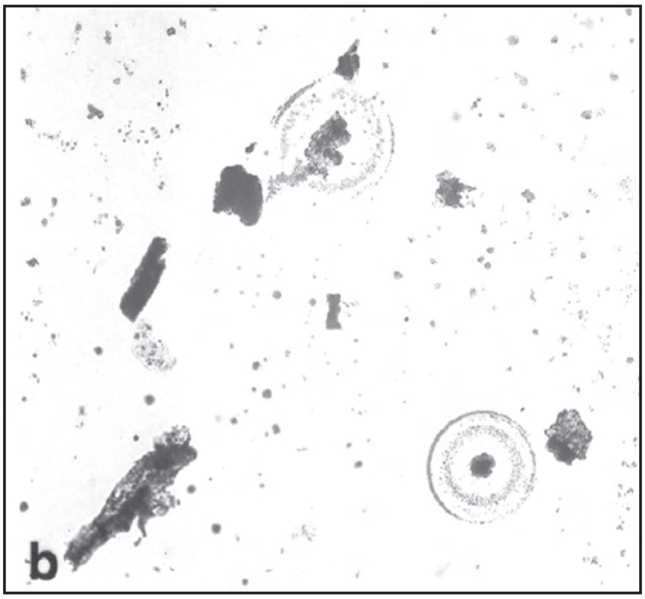

Figure 6b. Crystals have developed across the slide and around large grains (prepared in 1984).

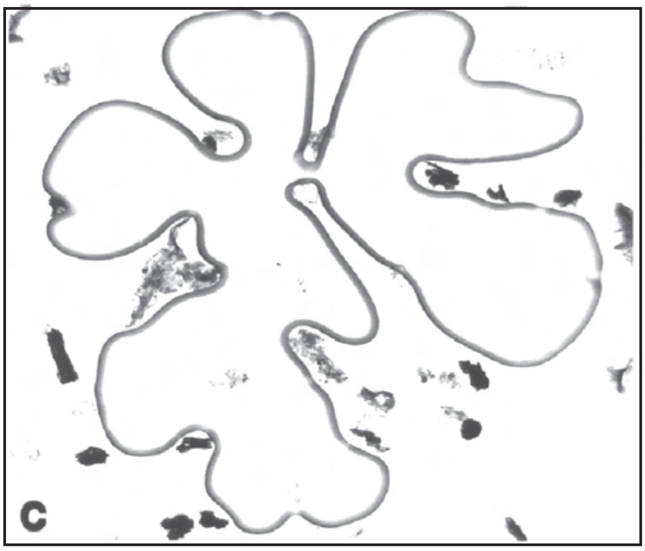

Figure 6c. Dendritic-shaped air bubbles in Elvacite (prepared in 1984).

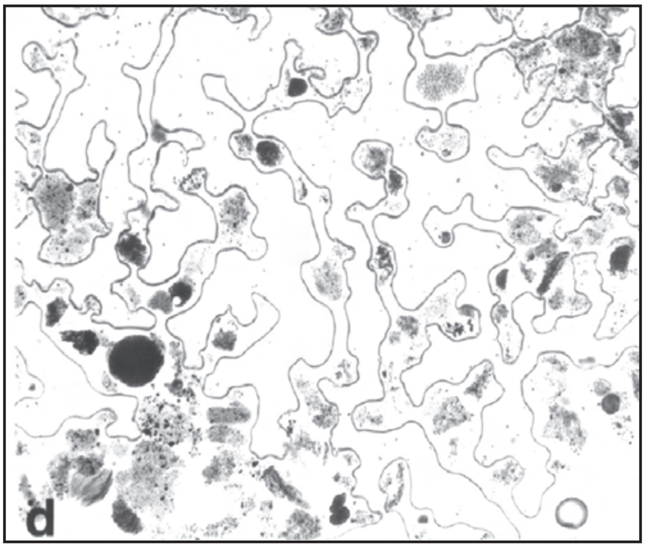

Figure 6d. Air bubbles in glycerine jelly (prepared in 1975).

history for each residue is known and bottles have a hand-written label, with basic information attached to the side with Sellotape. Later in the history of the palynology collection, residues were stored in bottles with various plastic lids (all pop-tops) and in distilled water with labels that continued to be wrapped around the side and attached with Sellotape.

Conditions survey of the collection

Slides

The earliest produced slides are stored individually in steel drawers. The drawers do not provide any protection and therefore the slides are very dusty and exposed to the atmosphere, humidity and temperature changes and damage from impaction. Each drawer holds around 140 slides and the condition varies between drawers. The first 2,000 slides have cover glasses sealed with nail varnish. Of the damaged slides, between 15 and 20% are suffering from deterioration resulting from pockets of air extending under the coverslip. Of these slides less than 10% of the total area of the slide is affected in this way. From sample number 2223 the slides are no longer sealed and a great range in their condition is seen. In one drawer only 36 out 140 where dehydrated, yet the poorest drawer had 93 of 140 slides damaged. Unsealed slides that were in a very poor condition have up to 90% of the slide area affected. Damaged slides occur in batches so it would appear that there was a problem with the method of preparation of that batch. Slides in good condition have a thin glycerine layer with any excess cleaned away and labelled clearly.

The slides stored in boxes again show major differences in condition. For example, a number of slides that are older are very discoloured and dusty. The slides are badly labelled and badly prepared with a thick layer of glycerine jelly covering the slide. Later slides on the other hand are clearly labelled and have been cleaned after slide preparation. This variation in condition is due to the preparation of the slides being at fault rather than the slide containers.

As the boxes were worked through, a number of problems seen throughout the palynology slide collection became apparent. Air pockets were seen in both Elvacite and glycerine jelly preparations. Dendritic air bubbles, which are common in Elvacite mounted slides, are often found in the centre of the coverslip suggesting problems with curing (Figure 6c). Air pockets in the glycerine jelly slides were not as common and arise from slow dehydration; they are present around the edges of the coverslip working inward (Figure 6d). Such problems were seen in the glycerine jelly slides produced from the 1960s through to the late 1980s.

On inspection of slides under the microscope secondary crystal growth is also evident. In slides produced in the early 1950s an even spread of small rounded crystals is seen and could be due to a number of factors. It is difficult to identify the cause but maybe due to residual chemicals or contamination. A different type of crystal growth, this time seen in slides throughout the entire collection, is again attributed to preparation procedures. The crystals develop around material on the slide, creating halos around larger grains (Figure 6b). This is due to a common problem of re-crystallisation of cellosize or polyvinyl alcohol solution (PVA). Both products were made in-house and added to residues before slide preparation to give good dispersion of the organic material across the coverslip.

Residues

The palynology collection of residues varies greatly in condition in accordance with the type of storage vial used. The earliest residues are stored in glycerol and, despite having only cork tops appear to be in good condition. In places, the cork tops appear to be soaked in glycerol causing some decay to the residue. Residues stored in glycerol with plastic lids are in very good condition with very few samples having suffered dehydration. Only when lids had not been correctly fitted and sealed were the levels of glycerol low. Problems with desiccation have also arisen from damage that has occurred to some of the bottles. A large number of the drawers are designed in such a way that bottle tops can get caught and become loose during routine opening and closing.

The main problem encountered with the glycerol-filled bottles is not with dehydration. Some bottles have been overfilled with glycerol so that liquid has leaked or overflowed causing disintegration of the paper labels and tape. In some cases, the sample number had been written in permanent ink around the bottle as a safeguard, but this is not the case on all samples. In many cases all documentation has been lost due to leakage and disintegration of the paper and Sellotape on the bottles.

From 1970 all documentation with the residues was written on a paper label and attached by Sellotape. The tape has caused the paper to discolour and due to decay of the adhesive, labels are often detached from the glass and are only held in position by the metal framework in which they stand. Residues produced in 1992 also have decaying Sellotape and in some cases the computer-printed labels are beginning to fade.

Residues stored in distilled water are in varying condition. A survey of four drawers was carried out on residues that were prepared over a period of a year, and also when residues changed from being stored in glycerol to water. In two of the drawers, residues have been stored in glycerol and in the other two drawers, residues were stored in water. Residues held in glycerol were in good condition with no signs of dehydration, whereas the bottles filled with water suffered greatly with 2% completely dried out and a further 25% suffering reduced water levels.

The greatest deterioration was seen in bottles with screw-top lids, with residues held in distilled water. In the 11 drawers that contain such bottles, over 40% of residues were dried out and a further 30% had low water levels.

A small percentage of bottles were affected by fungal and mineral growth. The mineral growth was limited to a few sporadic cases but fungal growth was seen throughout the drawers. Fungus is only present in water-based residues and not glycerol and its sporadic nature suggests that the preparator occasionally forgot to add a drop of methanol before storage.

Recovery of slides

On occasions when limited residue was available or slides became damaged, a number of authors have attempted to remount prepared slides. Wilson (1971) used a simple method of placing cleaned slides vertically into a beaker of distilled water, enough to cover the level of the coverslip. The beaker is then placed on a hotplate and heated. Eventually the jelly melts, the coverslip is removed and the liquid can be sieved and the residue used for remounting. An alternative method is to submerge slides individually into petri dishes of 5% HCL, leaving them for up to 48 hours, resulting in hydrolysis of the jelly (Hill, 1983).

Remounts of slides can only be undertaken with non-permanent mounting media such as glycerine jelly. Slides with elvacite therefore cannot be re-mounted. A test was undertaken to determine whether re-mounting of the palynomorph slides in the BP Collection was possible. This might save damaged or desiccated mounts where no residue is available. A number of slides where tried, covering the history of slide preparation. Wilson's (1971) method was followed, with the slides firstly cleaned and any detail on the labels recorded. The experiment highlighted numerous problems and the remounting of dehydrated slides proved to be very disappointing. All the slides tested were very dehydrated and unfortunately, proved to be beyond rescue.

Recovery of residues

Given that some of the slides are damaged due to dehydration and cannot be reclaimed, it is clear that the residues represent an important part of the collection. A number of residue samples were selected for experimentation, one from every year of processing, to observe how the slides and residues had responded to storage. These residues were used to make new slides for comparison with the originals, noting any changes that may have taken place. Residue samples were randomly selected from the collection so they varied in the quality of palynomorph assemblage; in some cases slides contained only unidentifiable organic matter.

Residues were washed through a 15mm sieve and rinsed thoroughly with distilled water. Part of the residue was then concentrated and a few drops of cellosize added to help disperse palynomorphs evenly. Both slide and coverslip were wiped with velin tissue to rid them of any dust particles and the residue dried onto the coverslip before being mounted onto a slide with glycerine jelly.

The results were positive and only minor changes were seen in the new slides made from residues. The palynomorphs appeared to be unaffected, although no quantitative analysis was undertaken to establish if smaller palynomorphs had been lost. In many cases the organic material clumped together, but this was easily avoided by adding a small amount of cellosize or PVA to the residue when making the strew slide. If clumping still occurred a very short treatment in an ultrasonic bath was used to disperse the particles. This method should be used with caution as it has potentially destructive consequences. Soaking the residue in HCl can also prevent clumping. Slow drying of the strew slide on a low heat or alternatively, left covered overnight, also helped eradicate this problem.

Experimental reclamation of residues that exhibited total dehydration were also undertaken. A few drops of 10% HCl were added and left overnight then flooded with water. This resulted in the residue being re-hydrated and it was possible to make a new slide. In places the residue remained stuck to the base of the bottle and was only displaced by a short ultrasonic bath. Although disaggregation was successful the organic material was prone to clumping.

The experiment was not quantitative but the results seen were good. No counts or identification of the palynomorphs were carried out, therefore it is impossible to determine if specimens have been lost. Small palynomorphs and fine morphological details may have been lost over time or degraded. Total dehydration of residues can clearly be resolved but further detailed studies need to be carried out on the specimens.

Conclusions and recommendations

The BP Collection was a working/commercial collection between 1950 and 1992 and not used primarily for academic research. Since it fell into disuse its importance and value have now changed and for this reason the study was undertaken.

This collection allows an ideal opportunity for a curation and conservation study on the palynological material resulting in the following recommendations:

Palynologists should be aware of the shortfalls of the materials they use to process and prepare slides and store residues.

- No mounting or storage medium has long-term stability.
- Some methods and materials consistently have better results than others.
- Good preparation of samples and slides is the key to future stability. It is important to always use distilled water and rinse residues thoroughly after every stage of processing to remove any residual chemicals. All water should be reduced before making slides and all mounting media (including products used to aid dispersion such as cellosize and PVA) should be kept to a minimum.

• Always keep a record of all laboratory preparations undertaken so that any resulting problems can be identified later and any possible causes eliminated in the future.

• Carefully label all slides and residues with permanent ink as an addition or instead of a paper label. This is a safeguard, if the paper labels decay, to avoid problems with future curation.

• Consider all the mounting media available and select according to your needs.

• Prepared slides need to be stored in closed boxes with coverslips horizontal and uppermost. All slides and containers need to be clearly labelled and well documented.

• Always retain residues of oxidised and unoxidised preparations and think about how they are stored. Residue bottles need to be airtight to prevent evaporation and should be plastic where possible to avoid problems with breakages.

• A fungal inhibitor such as methanol or HCl should be added to the residue.

• Monitor residue collections periodically and top up liquid levels as necessary. If residues are stored in water then this should be undertaken on a regular basis.

Acknowledgements

I would like to thank Jonah Chitolie and John Williams for background information on the processing history of the palynology collection and helpful advice on laboratory techniques. I would also like to thank Susanne Feist-Burkhardt and Peter Stafford for discussions on conservation of palynological material. Thanks also to Giles Miller for his help and encouragement during work on this project.

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UPPER CARBONIFEROUS CRINOIDS: AN EXTRAORDINARY COLLECTION BY LATE 19TH CENTURY AMATEUR PALAEONTOLOGISTS, KANSAS CITY, MISSOURI, U.S.A.

by Richard J. Gentile

Gentile, R.J. 2003. 'Upper Carboniferous crinoids: an extraordinary collection by late 19th Century amateur palaeontologists, Kansas City, Missouri, U.S.A.'. *The Geological Curator* 7(10): 373-380.

Amateur palaeontologists Edward Butts, a civil engineer, and Sidney J. Hare, a landscape architect are responsible for bringing to the attention of professional palaeontologists the discovery in 1889 of a bed of exceptionally well-preserved Upper Carboniferous crinoids in the excavation for the basement of a large building in downtown Kansas City. Over 450 crinoid specimens, many of them embedded in slabs of shale were prepared by Butts, Hare and, assisted by several additional amateur fossil enthusiasts. The specimens they collected and prepared are housed in museum, departmental and private collections throughout the United States and Europe. The discovery led to 8 new species of crinoids. Three of these were named in honour of Butts and Hare and include the inadunate dicyclic crinoids *Aesiocrinus harii* Miller and Gurley, *Ethelocrinus harii* (Miller) and *Ulocrinus buttsi* Miller and Gurley. Ed Butts and Sid Hare emphasize the important contributions that amateur fossil enthusiasts can make to the advancement of palaeontology.

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Introduction

In the late 19th century numerous construction projects were in progress in the Central Business District of Kansas City, Missouri, U.S.A. Typically, the excavations for large projects extended into a bed of bluish-gray shale about 6 m (20 feet) thick that underlies the city and its environs.

A major construction project in 1889 was the excavation for the basement of the Emery, Bird and Thayer (EBT) Building, a large dry goods store at 11th and Grand Avenue. (Figure 1). The original name of the building was the Bullene, Moores and Emery Building but it was renamed shortly after it opened for business in 1890. Excavating a basement that covered 80% of a city block, an area of 3,500 m^2 (38,000 square feet was a slow process in the latter part of the 19th century. Horse drawn scrapers and men wielding picks and shovels broke the shale into large slabs that were loaded onto drays pulled by teams of horses. At a depth of a few metres the men reported finding weird-looking fossilized creatures in the shale. The news quickly reached Edward Butts (Figure 2) and Sidney J. Hare (Figure 3). Both of these early Kansas Citians were familiar with the construction projects in the rapidly developing central business district. Butts was employed as a civil engineer with the Metropolitan Railway Company and Hare, a landscape architect and city planner had the responsibility of supervising for the city the construction of the EBT Building. Fortunately, Butts and Hare were knowledgeable and scientifically-minded amateur palaeontologists. They recognized the significance of the find. Butts, Hare and several additional amateur fossil enthusiasts collected over 450 specimens. Most of the crinoid specimens recovered from the excavation were partially embedded in slabs of bluish-gray shale. The matrix around the specimen was carefully removed with a sharp instrument such as a needle and the fragments of shale brushed aside exposing the specimen in relief. Butts and Hare had extensive fossil collections and were experts at the tedious task of extracting good specimens from layers of shale. This was a time-consuming but rewarding task and one way early Kansas Citians spent the long winter nights before the advent of radio, television and other modern day forms of entertainment. No other discovery in palaeontology could be more intriguing than an almost complete crinoid.

The excavated specimens are notable particularly for the preservation of detail but there are several other species of invertebrate fossils in particular mollusc. Less common are brachiopods, cnidaria and

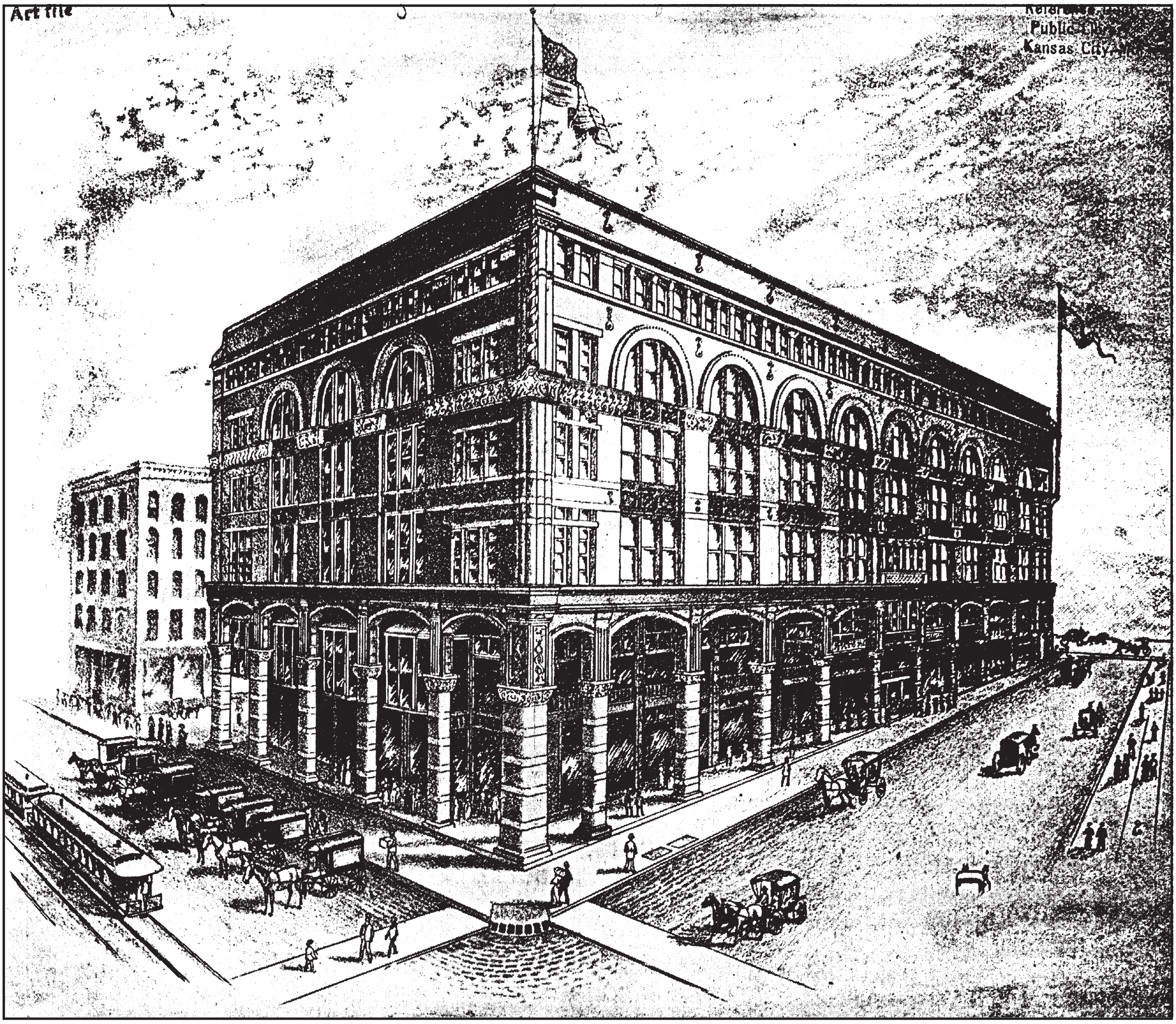

Figure 1. The Bullene, Moores and Emery wholesale Building, *c.* 1890. The Kansas City Crinoids were collected from the excavation for this building in 1889 (sketch by the Kansas City View Company).

bryozoans. Also present are a few fragments of terrestrial plants.

The collection soon became known as “The Famous Kansas City Crinoids” and the news of the discovery spread quickly among palaeontologists throughout the United States and Europe.

Biographical sketch of Edward Butts (1853–1940)

Ed Butts was born in Rensselaer, New York and came to Kansas City as a young man (Anon. 1940). He was a civil engineer for the Kansas City Belt Railway Company from 1883 until 1890. He then went to work for the City of Kansas City, a position he held until 1893. Butts was a civil engineer for the Metropolitan Railway Company from 1894–1918, and for part of the time he held a dual appointment as

Figure 2. Edward Butts (1853–1940) from *The Kansas City Journal,* 23rd June 1912.

a civil service examiner, Kansas City area, 1912–1918. He spent the latter years of his life as Curator of the Daniel B. Dyer Fossil Collection at the Kansas City Library Museum. He donated his collection of over 200 specimens to the Museum in 1920, included were several crinoid specimens from the excavation for the EBT Building (Anon. 1920). He retired as curator of the museum on 8th July 1938 and died on 20th December 1940.

Edward Butts described in scientific journals new species of crinoids from the Upper Coal Measures at Kansas City (Butts 1890, 1898) and fossil tracks that he interpreted to have been made by amphibians (1891*a*, *b*). He was president of the Kansas City Academy of Science in 1891. In addition to publishing articles on palaeontology and holding office in professional societies, he wrote on a variety of subjects. He authored *The civil engineer's field-book* (Butts 1886); *The Triskelion* in which he gave a comprehensive explanation of an ancient calendar system(Butts 1925); and *Polaris*: *Poems and Stories*, a volume on translations from French and German philosophical jingles, lyrics and religious poems that included *The Salem Witches* a narrative poem where he discussed the peculiar madness that blackened early American colonial history (Butts 1930).

Biographical Sketch of Sidney J. Hare (1860–1938)

Sid Hare was born in Louisville, Kentucky on 26th January 1860 and moved to Kansas City in 1868. (Anon. 1938) He was a widely known landscape architect, civil engineer and city planner. Hare was employed in various capacities of landscape surveying and city planning from 1881-1909. In 1889 he had the responsibility for the city of supervising the excavation for the basement of the EBT Building. Hare was secretary of the Kansas City Academy of Science in 1891. He opened an office in the Gumbel Building in downtown Kansas City in 1909 and headed a successful landscape architectural company with his son, S. Herbert Hare until he retired in 1924 to a 21 acre farm where he devoted his time to the preservation of wild flowers and experimentation with rock garden plants (Anon. 1926). He published on trilobites (Hare 1891), on echinoderms (Rowley and Hare 1891*a*, *b*), and lectured about his favourite topic, the Kansas City crinoids (Anon. 1924). He was an avid fossil collector and amassed a large collection that eventually was donated in 1939 to the Kansas City Museum of History and Science at 3218 Gladstone Boulevard (Anon. 1963).

Figure 3. Sidney J. Hare (1860–1938) from *The Kansas City Star*, 27th August 1911.

Sid Hare was noted for his diverse and unorthodox interests outside of his professional occupation. He became interested in the Great Pyramid of Egypt and spent 25 years of his leisure time studying the structure (Anon. 1911). He believed that he had discovered the entrance to the secret chamber of the Great Pyramid. There is no evidence that he ever fulfilled his wish to visit Egypt.

Crinoid morphology and palaeoecology

The species of crinoids from the basement excavation for the EBT Building belong to the Subclass Inadunata, Class Crinoidea, Phylum Echinodermata (Figure 4). The inadunates are the largest and the most successful of the Palaeozoic Crinoidea. They are characterized

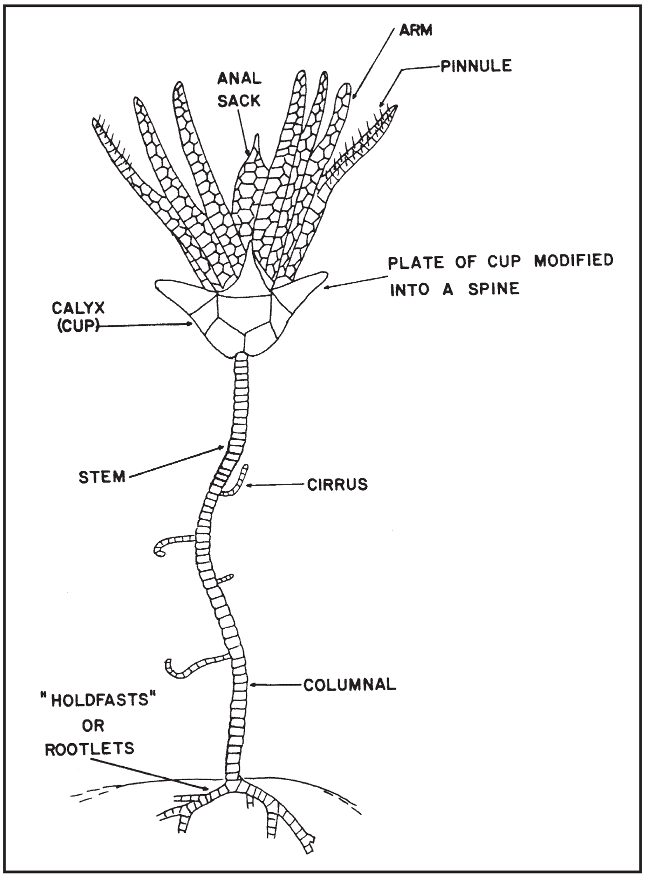

Figure 4. Morphology of *Delocrinus missouriensis*, a typical inadunate dicyclic crinoid (Sketch by R.J. Gentile).

by a cylindrical or bowl-shaped calyx (cup) (Figures 5-9). The calyxes in most species consist of three rows of plates. A type of structure that is described as dicyclic. Hence the name inadunate dicyclic crinoids. The plates are sutured together tightly. The arms generally are not incorporated in the cup. The inadunata have been called "free-armed crinoids" by some workers. Most species of crinoids recovered from the excavation have an anal sac, an odd-looking structure that resembles a miniature fossilized "ear of corn." A skin-like tissue hold together the plates and is devoured by predators or it decays upon death of an animal. Consequently, the skeleton falls apart and for that reason complete crinoids are rarely found as fossils. An exception is the excellently preserved specimens of almost the complete skeleton recovered from the excavation for the EBT Building in 1889. The specimens from the excavation were preserved under a unique set of favourable conditions that prevailed on a shallow sea floor during the Late Carboniferous (Pennsylvanian) about 300 million years ago. The palaeoenvironment of sediment deposition in which the suite of crinoids were preserved is interpreted to have been a quiet lagoon or bay situated at the distal end of an advancing deltaic lobe (Wanless and Wright 1978). The environment was favourable and the crinoids grew in great profusion, probably resembling an "undersea garden." Soft sediments accumulated at the bottom of the bay where the effects of current and wave action and the foraging activity of predators was at a minimum. Upon death the crinoids lay on the bottom and were rapidly covered by a preserving layer of mud. Vegetation that floated into the bay included fragments of the genus *Calamites*, a relative of present-day horse tail, rushes belonging to the order Equisetales (Figure 8). *Calamites* lived on a nearby swampy deltaic plain.

Palaeontology

The shale bed in the excavation for the basement of the EBT Building in 1889 contained one of the finest collections of crinoids in the world. It yielded eight new species.

Aesiocrinus harii Miller and Gurley
Aesiocrinus lykinsi Butts
Aesiocrinus magnificus Miller and Gurley (Figures 6 and 7)
Delocrinus missouriensis Miller and Gurley (Figures 5 and 8)
Ethelocrinus harii (Miller)
Ethelocrinus magister Kirk (Miller and Gurley) (Figure 9)
Ethelocrinus sphaeralis (Miller and Gurley)
Ulocrinus buttsi Miller and Gurley

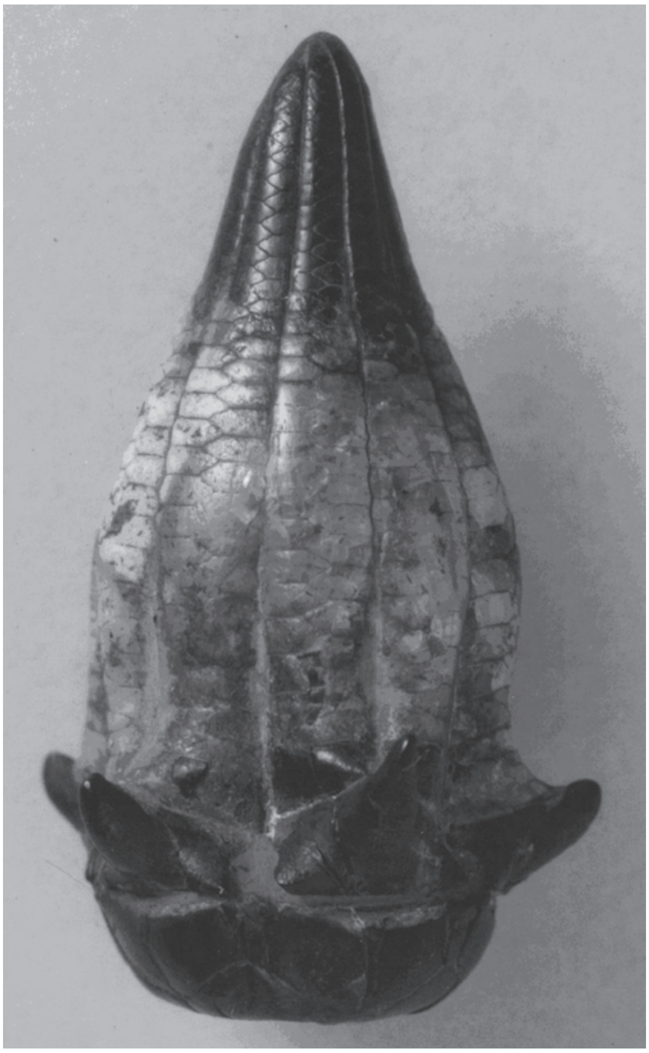

Figure 5. *Delocrinus missouriensis*, the specimen that is the name-bearer of the official fossil for the State of Missouri, USA (Photograph by R.J. Gentile).

S.A. Miller and Wm. F.E. Gurley described six of the new species (Miller and Gurley 1890). One new species was named by S.A. Miller (1891) and the species *Aesiocrinus lykinsi* was named by Butts (1890) to honour William H.R. Lykins, whom Butts described as "one of our most enthusiastic collectors." The genus *Ethelocrinus* was erected by Kirk (1937) by segregating it from the genus *Eupachycrinus* that included several diverse crinoid types. Three of the new species were named in honour of Butts and Hare by the grateful palaeontologists Miller and Gurley.

A calyx of an exquisitely preserved specimen of *Delocrinus missouriensis* (Figure 5) was designated the official state fossil of Missouri by presiding Governor John Ashcroft upon signing House Bill 515 on 15th June 1989. The specimen of *D. missouriensis* designated as the state fossil was collected from the Lane Shale in the Greater Kansas City area in the 1970s. It is not part of the collection from the excavation for the EBT Building. The specimen is in the collection of Richard J. Gentile in the University of Missouri-Kansas City.

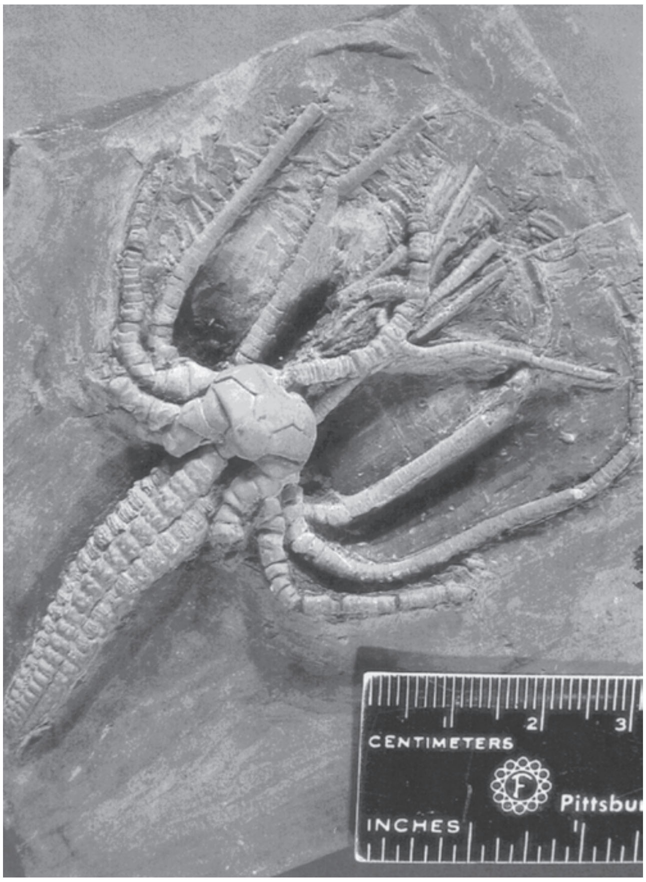

Figure 6. *Aesiocrinus magnificus*, Lane Shale, Upper Carboniferous, Kansas City, Missouri, U.S.A. Posterior view of specimen collected in 1889 from the excavation for the basement of the Emery, Bird and Thayer Building. Courtesy of the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

A specimen of *A. magnificus* (Figure 6) from the excavation for the EBT Building is in the collection of the National Museum of Natural History, Smithsonian Institution. It has been reproduced in leading palaeontology publications among them the textbook *Fossil Invertebrates* by Boardman, Cheetham and Rowell (1987, p. 579, figure 18.33D) and *The Fossil Book* by Rich *et al*. (1996, p. 310).

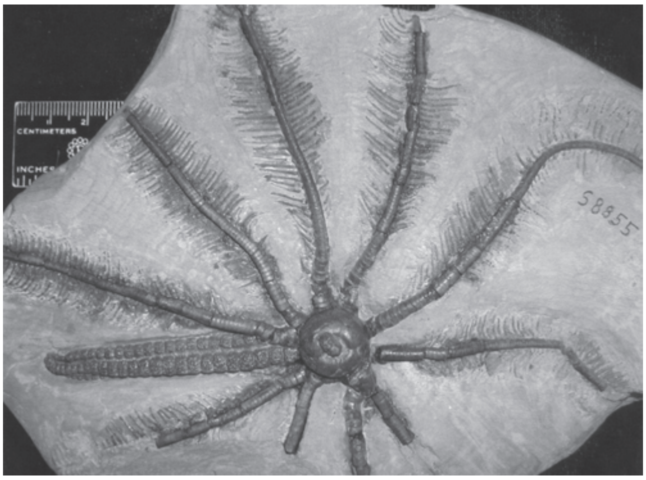

Figure 7. *Aesiocrinus magnificus*, Lane Shale, Upper Carboniferous, Kansas City, Missouri, U.S.A. Dorsal view of specimen collected in 1889 from the excavation for the basement of the Emery, Bird, and Thayer Building. Courtesy of the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Stratigraphy

The 6 m (20 feet) thick bluish-gray shale bed in the excavation for the EBT Building in 1889 was once known as the Upper Chanute Shale (Broadhead 1872). The name was changed several years later to the Lane Shale. The entire thickness of the Lane Shale was removed to the top of a thick limestone bed, the Raytown Limestone Member of the Iola Formation, in order to place the building on a stable foundation. The thin crinoid-bearing facies occurs about 2.4 m (8 feet) from the bottom of the Lane Shale (McCourt, Albertson and Bennett 1917). It has been traced continuously along the northeast-southwest trending outcrop belt for a distance of about 25 km (16 miles) to the northeast of the city and about 20 km (12 miles) to the southwest of the city. Skeletal remains of crinoids are a common occurrence on weathered

Figure 8. *Delocrinus missouriensis*, three specimens on a slab of Lane Shale, Upper Carboniferous, Kansas City, Missouri, U.S.A. A fragment of the limb of the scouring rush *Calamites* is in the upper right corner. Specimen collected in 1889 from the excavation for the basement of the Emery, Bird, and Thayer Building. Courtesy of the Geosciences Museum, University of Missouri, Kansas City, Missouri.

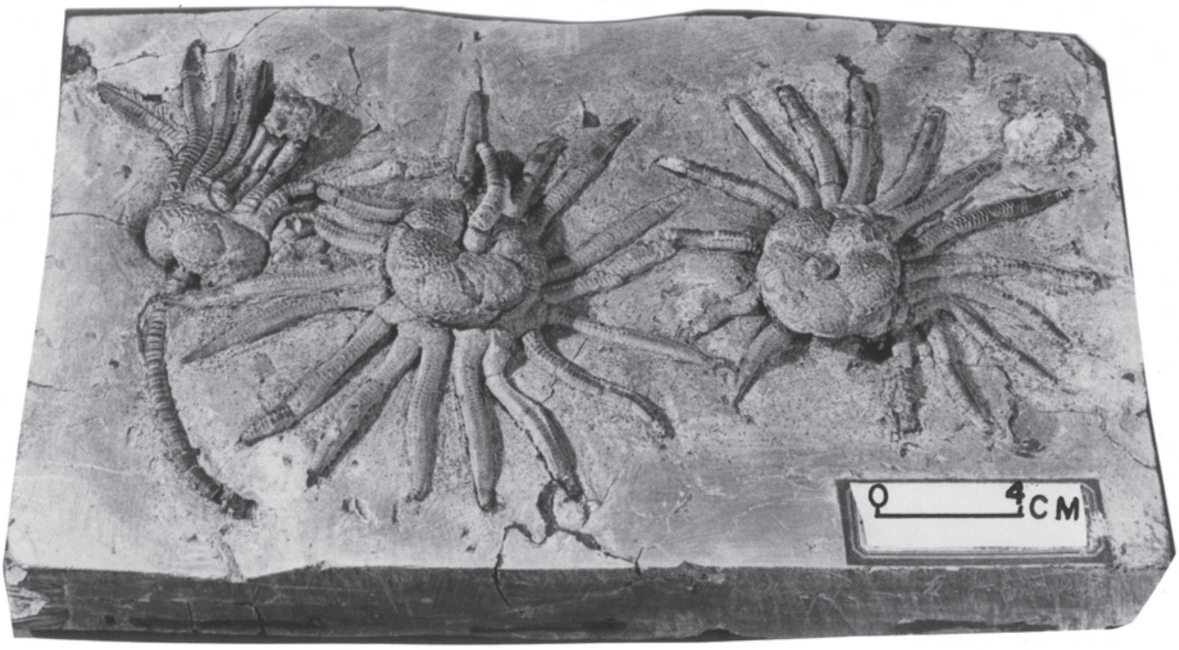

Figure 9. *Ethelocrinus magister*, three specimens on a slab of Lane Shale, Upper Carboniferous, Kansas City, Missouri, U.S.A. Specimen collected in 1889 from the excavation for the basement of the Emery, Bird and Thayer Building. Courtesy Geosciences Museum, University of Missouri, Kansas City, Missouri.

exposures. Typically, the collector finds loose plates, in particular fragments of the stem. Occasionally a calyx is reported. But to collect an almost complete crinoid specimen comparable to the specimens recovered in the excavation for the EBT Building would require stripping off the overlying soil and shale to expose the crinoid-bearing facies. An operation that would require patience and a good bit of luck. It would not be practical to use heavy machinery to expose a large area along the outcrop belt the size of the basement of the EBT Building.

Epilogue

Large buildings are being constructed periodically in downtown Kansas City and the Lane Shale is exposed in many of the excavations. The EBT Building was demolished in the early 1970s and The United Missouri Bank Building occupies the site at 11th and Grand Avenue in downtown Kansas City. A few fractured crinoid specimens were recovered with pieces of shale that were removed from the excavation as the Lane Shale became exposed. Unfortunately, present-day contractors use heavy machinery and the work proceeds rapidly and on a strict schedule. There is no time to stop the operation to collect fossils and their liability insurance does not cover fossil collectors. In 1889 work proceeded at a more leisurely pace. Ed Butts and Sid Hare were kept informed of the construction projects underway in the city; moreover, they had access to the excavations. I doubt if a collection of the size and quality as the one exposed during the excavation for the EBT Building in 1889 will ever be made again. It is a relic of a bygone age. The percentage of the 450 specimens collected from the excavation for the EBT Building that were donated to museums in comparison to the number sold is not available. Hare reported that high prices were paid by scientists for prize crinoid specimens (Hare, n.d.). Letters dated 25th November and 28th December 1898 from R. Kreite, a dealer in naturalist supplies with a shop at 406 E. 12th Street, Kansas City, Missouri, to Professor Charles E. Beecher, Professor of Paleontology at Yale University included the prices of crinoid specimens that Kreite was offering for sale from the excavation from the basement for the EBT Building. Kreite wrote that he purchased the specimens from a civil engineer who collected them (Peabody Museum, Yale University, New Haven, Connecticut, account no. 2440 Invertebrate Paleontology). Regardless of the method or the motive for the dispersal of the specimens, Ed Butts and Sid Hare were knowledgeable amateur palaeontologists who were experts at the time consuming and tedious tasks of extracting good specimens from slabs of shale. They need to be given recognition for the discovery, preparation and for informing professional palaeontologists of an outstanding suite of fossil crinoids. Ed Butts and Sid Hare exemplify the important contributions that amateur collectors make to the advancement of palaeontology.

Acknowledgements

The assistance and information provided by the following individuals and organizations are gratefully acknowledged.

Copeland MacClintock, Peabody Museum of Natural History, Yale University, New Haven, Connecticut provided copies of correspondence between Yale University Professor Charles E. Beecher and a fossil dealer in Kansas City, and graciously offered to photograph 11 specimens in the Museum Collection. Among them are specimens of *Aesiocrinus magnificus* and *Delocrinus hemispaericus* that were procured for the museum by O.C. Marsh, famous for his dinosaur discoveries in the American West and J.D. Dana, one of the foremost American geologists of the 19th century who coined the term 'geosyncline'. No other tectonic hypothesis had as much sway until the advent of plate tectonics.

Daniel Levin and Jonathan Wingerath, National Museum of Natural History, Smithsonian Institution, Washington, D.C. provided photographs of an exceptional specimen of *Aesiocrinus magnificus* in the Frank Springer Room. Also, in the non-type collection at the National Museum are specimens of *Aesiocrinus magnificus*, *A. harii*, *Ethelocrinus magister* and *Delocrinus missouriensis* from the basement excavation for the Emery, Bird and Thayer Building.

Scott Lidgard, Field Museum of Natural History, Chicago, Illinois reported that the Wm. F.E. Gurley Collection of 6 type specimens described in an 1890 publication by S.A. Miller and Wm. F.E. Gurley were in the museum collection.

James T. Sprinkle, University of Texas, Austin assisted in locating depositories with Kansas City crinoids in their collection.

Dave Lewis, Natural History Museum, London, England supplied the names of depositories in the United Kingdom.

Lyall Anderson, National Museum of Scotland, Edinburgh located a specimen of *Ethelocrinus magister* from Kansas City in their museum collection but the cited locality where the specimen was reported to have been collected does not correspond to the geology, consequently, the site location and the stratigraphic interval at Kansas City where the specimen was collected is unknown.

Patrick N. Wyse Jackson, Trinity College, Dublin, Ireland made a special effort to locate depositories of Kansas City crinoids.

Gay Clemenson, collections manager, Kansas City Museum, Kansas City, Missouri allowed the author access to the museum collection to study 2 slabs of shale. The first with a specimen of *Aesiocrinus magnificus* and productid brachiopods, and a second slab with a specimen of *Ethelocrinus* sp. with long cirri on a slender stem.

David Boutros and Nancy B. Piepenbring, Western Historical Manuscript Collection, Necombe Hall, University of Missouri-Kansas City supplied copies of historical data useful to conducting research on the project.

The services rendered by Nancy Beverage and Sherrie Smith reference librarians at the Missouri Valley Room, Kansas City, Missouri Public Library were of vital importance to the completion of this paper.

The late Charles Baker, fossil enthusiast *extraordinaire* called to the author's attention the important contribution to palaeontology made by Ed Butts and Sid Hare, and made available a set of informative notes.

The Geology Museum, University of Missouri-Kansas City has on display three slabs of shale with almost complete specimens: (a) an 18 x 30 cm slab with 3 specimens of *Ethelocrinus magister*, (b) a 15 x 25 cm slab with 3 specimens of *Delocrinus missouriensis* and the fragment of the stem of *Calamites*, and (c) one specimen of *Aesiocrinus magnificus* on a 18 x 18 cm slab. The specimens were purchased from Charles Baker for $500.00, a very modest sum for a collection of prized fossils.

The following individuals are acknowledged for searching their collections for Kansas City crinoid specimens.

Richard Leary, Curator of Geology Emeritus, Illinois State Museum, Springfield; Roger L. Kaesler, Professor Geology, University of Kansas, Lawrence; Howard Feldman, American Museum of Natural History, New York, NY; Markus Bertling, Geologisch-Palaeonotologisches Institut und Museum, Muenster, Germany.

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JOHN NORTON 1924–2002: AN APPRECIATION

John Norton (1989)
Photograph courtesy Daniel Lockett.

John Norton (1924-2002) who died on 17th June 2002 was a great naturalist and curator interested in everything within the natural world. John was a member of the GCG since 1975, and was elected one of its earliest Honorary Members in recognition of his many years of exceptional curatorial work at Ludlow. In 1983 he was awarded the MBE for 'services to museums'. He will be remembered as a true gentleman and a fine curator. He was an honorary, and founder member of The Shropshire Geological Society. I first met John in the early 1950s when my mother used to take me on fossil hunting outings to Shropshire. When I came to Shropshire to live in 1971 John was already established as the highly respected curator of Ludlow Museum. Although John was charged with looking after everything in the museum, which he did with great efficiency, geology was his real love. When he took over the museum in 1959 the collections had been decimated following closure of the museum in the late 1940s. John set about retrieving many of the lost specimens and building up a huge collection of local material which would become a classic reference collection for the type area of the Ludlow Series. Geologists came from all over Britain and the world to study this type material. John was a great ambassador for Shropshire geology, and, although changes in the late 1970s by Shropshire County Council meant that he could not spend as much time as he wanted on his beloved fossils, he still tirelessly worked and campaigned for better geological displays and storage for the reference collection. Many of us know the story that John had the best collection of shirt boxes in Britain in which were stored, perfectly safely and beautifully labelled in his own handwriting, all the museum's fossils. Since John's retirement in 1989 the collections have been housed in better containers and thanks to local pressure the new geology gallery below the Assembly Rooms was named the John Norton Geology Gallery when it opened in 1995. I know that John dearly wanted to live to see the Library and Resource Centre open in Ludlow where all his beloved collections would at last be properly housed. He asked his doctor to make sure he lived until that day but it was not to be. Nevertheless, John Norton will be remembered as one of the great curators of geology, who set the highest standards, and who did so much for Shropshire geology. A local man, much loved by his community as testified by a packed Bromfield church at his funeral, he will be sorely missed, but Shropshire and the geological community at large are better for his life.

Peter Toghill

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John Norton (*c*. 1989) at the Ludlow Bone Bed. Photograph by P.G. Bartlett (courtesy C.H. Holland).

John Norton (1979) showing children some geological exhibits in the Ludlow Museum. Photograph courtesy Daniel Lockett.

LOST & FOUND

Enquiries and information, please to Patrick Wyse Jackson (Department of Geology, Trinity College, Dublin 2, Ireland; e-mail: wysjcknp@tcd.ie). Include full personal and institutional names and addresses, full biographical details of publications mentioned, and credits for any illustrations submitted.

The index to 'Lost and Found' Volumes 1-4 was published in *The Geological Curator* 5(2), 79-85. The index for Volume 5 was published in *The Geological Curator* 6(4), 175-177.

Abbreviations:

CLEEVELY - Cleevely, R.J. 1983. *World palaeontological collections*. British Museum (Natural History) and Mansell Publishing Company, London.

GCG - *Newsletter of the Geological Curators' Group*, continued as *The Geological Curator*.

LF - 'Lost and Found' reference number in GCG.

258. Catherine Raisin collection.

Cynthia Burek, Department of Biology, Chester College of Higher Education, Parkgate Road, Chester CH1 4BJ, UK (e-mail: c.burek@chester.ac.uk) writes:

Catherine Alice Raisin (1855-1945) was head of Geology Department at Bedford College from 1890 until 1919 and during that time or shortly after she presented a picture of herself to the Department. With the closure of that Department and the move to Royal Holloway College, this portrait has been lost or at least nobody seems able to find it. There is only one photograph of this geological pioneering lady; a group photograph taken sometime between 1898 and 1906 (Figure 1). Also lost or mislaid are her extensive collection of over 270 hand specimens, and the related thin sections, of serpentines from Anglesey, the Vosges and the Brenner area, all of which she collected herself. Raisin wrote over 24 scientific papers and many of these refer to these samples and slides (Burek, 2003).

Figure 1. The only known photograph of Catherine Raisin.

I would really like to know what has happened to Raisin's collections. I have already contacted the curator at Royal Holloway and a previous Head of Department, now retired, to see if they could help track down this material, but without success.

Any information on the whereabouts of this collection, photographs, or further details on Raisin would be most welcome.

Reference

BUREK C. 2003. Time to take responsibility for collections. *Earth Heritage* **20**, 22-3.

259. A collection of fossils including many from the Silurian of Dudley, West Midlands.

Dr Michael Le Bas, Rockleigh, 9 Park Lands, Bryanston Street, Blandford Forum, Dorset DT11 7BA, UK (e-mail: mjlb@soc.soton.ac.uk) is hoping that someone will recognise this recently discovered fossil collection.

This fascinating collection was given some months ago to Mike at the museum in Blandford Forum, Dorset, a private museum run by the Blandford Forum Museum Trust. It includes many fine examples of fossils particularly some from the Dudley area,

Figure 2. Fossils now at Blandford Forum Museum Trust: Box 2 (left) and Box 11 (right).

beautifully mounted on pink cotton wool in little round boxes some with glass tops (Figure 2). It was found in the attic of a house, probably in Blandford, by a Mr Goodbody (now believed to have left) and arrived via the solicitor's secretary whom Mike knows through the museum. No further information could be obtained. All the labelling is in the same hand in black ink and looks to be Victorian or Edwardian. Nothing is printed and it seems to be a private collection arising from various travels. Any information that might help identify the origin of the collection, ascertain its value and find its owner would be most welcome?

List of specimens

Most of the fossils 2-22 are complete, clean, and both valves usually present where appropriate, and with little or no matrix, i.e. 'perfect' specimens. The numbers 1-42 are given by MJLB.

1. Cardboard box 10x7x3 cm covered and lined with red and gold starry paper and with photo in hinged lid of Vesuvius in eruption. Inscription reads "Vesuve Ploie de cendre des jours 22-23-24-25-26 Mars 1944" Box contains ten small pieces of supposed volcanic tuffs. 3 or 4 appear to be genuine, others are mica/quartz rocks. Sealed glass tube with 5 different coloured ash/sands.
2. Dernal tubercles x3 each 1-2 cm across of Ray. Red Crag, Suffolk. In 55 mm diam, 14 mm deep, round, glass-topped, cardboard pill box. With label "Dernal tubercles Ray Red Crag Suffolk"
3. Crinoid test 3 cm diam with calcite plates. In 50mm diam, 35mm deep, round, thin ply wood pill box. Labelled "Actinocrinus triacontadactylus Carb. Limestone, Lancashire"
4. *Pecten* shell 45 mm across, labelled "Pectenopercularis Coralline Crag Nr Woodbridge" . In 50 mm diam, 35mm deep, round, thin ply wood pill box.
5. Brachiopod with sulcus and strong ribbing, x3, each 15-20 mm across, two complete with both valves and hooked umbo. Labelled "Pentamerus galeatus. Silurian, Dudley district" In 50mm diam, 30mm deep, round, thin ply wood pill box
6. Cockle shell 3 cm diam labelled "Cardita Miocene Cannes". In 55 mm diam, 14 mm deep, round, glass-topped, cardboard pill box.
7. Whelk 25 mm long. Labelled "Eburna Miocene Cannes" In 55mm diam, 19 mm deep, round, glass-topped, cardboard pill box.
8. Two 'tubes' each 17 mm long, 4-5 mm diam Labelled "Dentalium Miocene Cannes" In 55 mm diam, 15mm deep, round, glass-topped, cardboard pill box.
9. Four small 5 mm diam winkles labelled "Ringicula Miocine Cannes". In 55 mm diam, 15mm deep, round, glass-topped, cardboard pill box.
10. Vertebra 17mm long and 5-10 mm across Labelled "Vertebra (Fish) Mammaliferous Crag Suffolk" In 55mm diam, 19mm deep, round, glass-topped, cardboard pill box.
11. Two *Turritella*-like winkles 17mm long and 1-3mm across Labelled "Terebra Miocene Cannes" In 55mm diam, 15mm deep, round, glass-topped, cardboard pill box.
12. Two flat discoid colonial corals each 3cm diam and 5mm thick and comprising 30-40 individuals. ?Favosites. ?from Dudley No label In 50mm diam, 38mm deep, round, thin ply wood pill box
13. Two brachiopods, one with bryozoa and crinoid ossicle. Labelled "Rhynchonella deflexa". Silurian, Dudley district. In 38mm diam, 26mm deep, round, red cardboard pill box.
14. Large 33-35 mm diam crinoid stem Labelled "Portion of gigantic Enc(?r)I(?)rital Stem Carb Limes Lancashire" In 50mm diam, 32mm deep, round, thin ply wood pill box
15. Two brachiopods 3-3.5 cm wide Labelled "Strophomena depressa" Silurian Dudley district. In 52mm diam, 37mm deep, round, thin ply wood pill box
16. One ribbed cockle with shell partly disintegrating. Labelled (external) "Tellina oblique Red Crag Nr Woodbridge" Inside is pencilled "Sudbourne" In 42mm diam, 30mm deep, round, thin ply wood pill box
17. Two welks 28x15 mm Labelled "Pupura tetragona var. alveolata Red Crag Walton Naze" In 42mm diam, 29mm deep, round, thin ply wood pill box
18. Single valve of bivalve 3 cm across similar to Trough Shell. No label. Looks to be from Red Crag." In 34mm diam, 20mm deep, round, thin ply wood pill box
19. Three small bivalves 4-6 mm across mounted on card. No label. Look to be from Red Crag." In 34mm diam, 20mm deep, round, thin ply wood pill box
20. Two brachiopods 20-22mm across Labelled "Atrypa reticularis. Silurian, Dudley district." In 48mm diam, 37mm deep, round, thin ply wood pill box
21. Five small bivalves each 7-9 mm across. Labelled "Orthic hybrida. Silurian, Dudley district." In 31mm diam, 20mm deep, round, red cardboard pill box.
22. Broken thick brachiopod 25x20 mm. Labelled "Productus costatus Carb Limest. Lancashire" In 40mm diam, 20mm deep, round, red cardboard pill box.
23. Fossil fish on mudstone. 12cm long 4cm high badly worn, most fish scales gone but impressions fairly complete. Labels completely worn out. Mudstone slab 13mm thick and 13x7 cm. Not boxed
24. Trilobite headshield on grey limestone matrix with rhynchonellids and 1-2mm diam crinoid ossicles. No label. Similar to *Calymene* but with two large round eyes. Head shield 45x25mm.
25. Pink striped paper bag with assortment of 20-30 modern shells, rocks. No label
26. Brown paper bag with assortment of modern shells and small pebbles. No label
27. Brown paper bag with assorted minerals, mostly fluorite, 1-2cm across. No label
28. Collection of 9 brachiopods (rhynchonelids, spirifers) and a solitary coral. No label. ?Silurian
29. Collection of 4 corals, 5 brachiopods, 1 crinoid +bryozoan, and ?echinoid. No label. ?Silurian
30. Three pieces of black glassy obsidian, 1-3 cm across. No label
31. Eight pieces of fluorite, some colourless with purple rims, each *c*. 2 cm across. No label
32. Collection of 15-20 pieces of fluorite mostly 1-2 cm across. No label
33. Two pectens 4.5 and 2.5 cm across. Labelled "Aldborough". Matrix looks Red Crag. And bryozoan globose colony 5 cm across, ?*Theonoa*
34. ?*Spirifer striatus* (nice complete specimen) 5 cm across. No label.
35. ?Head of crinoid, replaced by flint, pear-shaped, rimmed by annular cell structure with punctate texture down the walls. Label worn out.
36. Single coral 4 cm diameter. Strong growth lines, 7cm long. ?*Siphonophyllia gigantea*. No label
37. ?part of large coral 8 cm across in white limestone. ?Carboniferous. No label
38. ?part of large coral in pink/white limestone 4x6x7 cm. ?Carboniferous. No label
39. ?bryozoan nodule 4 cm across. in white limestone. ?Carboniferous. No label
40. Smooth black pebble 35x23x5 mm. No label
41. Two brown curved irregularly shaped cherty objects each about 3 cm long and 1.5 cm across. Both are highly polished and one has a one cm prominent knob in the middle, labelled "Earbones porpoise Red Crag". In 60 mm diam, 20 mm deep, round, glass-topped, black cardboard pill box.

BOOK REVIEWS

Stone, Richard. 2001. *Mammoth, the resurrection of an ice age giant*. Perseus Publishing, Cambridge, Massachusetts. 242 pp. Paperback. ISBN 0-7382-0775-6. Price: $15.00 (UK edition published in 2003 by Fourth Estate, ISBN 1-8411-5518-7. Price: £7.99).

The last sentence says it all 'Whether it is five years, five decades or five centuries from now, woolly mammoths will once again walk the earth.' So closes a journalist's account of the potential for a Pleistocene Park, the dream of ecologist Sergei Zimov. He is one of a number of characters to populate this popular account of the attempt to clone a mammoth from frozen remains buried in the Siberian permafrost. A readable introduction to the history of mammoth discoveries is followed by scene setting for the science that follows. Central to the book is a detailed account of the Jarkov specimen named after the family that found the specimen in 1998 and removed the tusks for their ivory. This is the mammoth excavated in a block of ice, which was seen on televisions in 146 countries in 2000 as it was hoisted aloft by a helicopter for a very hairy flight to the nearest town. The exercise was filmed by the Discovery Channel who had the tusks re-attached for the flight to dramatic effect, unfortunately the journey was the hairiest feature of this excavation. Despite early promise it was eventually revealed that there was much less intact frozen mammoth in the ice than had been hoped. The hopes were not only high for the Discovery Channel but also for the Japanese team searching for frozen mammoth sperm ready to clone a successor. The author recounts the tale second hand through the people involved in the Jarkov mammoth and various workers active in mammoth research. As a journalist he was unable to see the airlift or gain full access to the excavation, which was managed by the Discovery Channel, after all they were paying some of the bills in a very costly exercise. In all the book provides a very engaging introduction to the science in what the Guardian newspaper described as 'A nicely judged mix of adventure, history and scientific instruction.' What is more questionable is not the author's presentation of cloning but the almost blind zeal of the researchers planning to bring the mammoth back to life. There is considerable discussion of the ethical issues in attempting to recreate an animal whose habitat is lost and less cynicism of the actual possibility of producing the DNA to make the ethical issues worth worrying about. Read this and stock it in your museum shop although it would benefit from some decent illustrations (the US edition is even worse than the UK version in this respect). For the curator's bookshelf, you would be more sensible to invest in the beautifully produced book by Adrian Lister and Peter Bahn in 1994 – *Mammoths*, published by Macmillan, unfortunately out of print but widely available second hand.

Mr Nigel T. Monaghan, National Museum of Ireland, Merrion Street, Dublin 2, Ireland. 31st July 2003

McGowan, Christopher, 2001. *The Dragon Seekers, How an Extraordinary Circle of Fossilists Discovered the Dinosaurs and Paved the Way for Darwin*. Perseus Publishing, Cambridge, Massachusetts. 254 pp. Paperback. ISBN 0-7382-0673-3. Price: $17.00 US; $25.95 Can. (UK edition published in 2002 by Little, Brown, London, ISBN 0-316-8573-1. Hardback. Price: £18.99).

Christopher McGowan is Professor of Zoology at the University of Toronto and Curator of Paleobiology at the Royal Ontario Museum. With this academic background you would expect a precise and interesting account of the development of early fossil discoveries in their historical context. An informed account is exactly what you get with this book. The text is written for an American audience and developed for a reader who has a limited knowledge of the subject. The coverage is detailed and accurate, interspaced with suitable copies of early lithographic illustrations, the sources of which are well credited in the appendix. It has a good set of chapter notes including source references and a reasonable index.

The subject is well researched, starting in 1676 with the discovery of Robert Plot's "giant human" and emphasizing the great European ideas of people like Lemarck, Cuvier, Buckland and Lyell, progressing to Darwin's *Origin of Species* in 1861. There are good accounts of the collecting of Mary Anning as well as the works of William Buckland, William Conybeare, the Mantell's and Georges Cuvier. Also, less well credited and important researchers like Henry de la Beche and Charles König have significant coverage. Richard Owen also plays a significant and interesting part in the account. I am intrigued as to the choice of cover illustration, showing Richard Owen, head truncated, and a crocodile fossil poised as if about to bite a critical part of his anatomy. It seems to me that the author has a very good grasp of the competitive nature of some of the key "fossilists" of the time.

This book gives an account of the early fossil discoveries in chronological context, linking their finds to the ideas expressed at the time. Most of the text is dedicated to this end. It is an interesting complement to the earlier text, *The Dinosaur Hunters* by Deborah Cadbury, which has emphasis on the relationships between the characters involved. The interesting overview of *The Dragon Seekers* is how the science of vertebrate palaeontology developed from a very limited number of species and finds. In context, it shows how the scientific mind can quickly develop a reliable framework for classification and identification from fragmentary remains that can be used effectively for future generations. Whilst the ideas of these early pioneers have been refined and developed, the basis for modern fossil classification was set in a relatively short space of time. This development took place at a time of significant social and industrial change and its contributors were people from a wide social, educational and economic background. It must have been an exciting time in science, when ideas were shifting from a Christian religious framework to one of evolutionary change.

This book is well suited to both a general readership and academic reference. It is a suitable reference to the historical background of fossil hunting and will complement both library and museum reference collections.

Paul Pursglove, The Pterosaur Database, 67 Soames Crescent, Fenton, Stoke-on-Trent ST3 5UE, UK. 7th August 2003.

Aitkenhead, N. & Dennis, A. 1999. *Holiday Geology Map: Peak District*. British Geological Survey, Keyworth, 6pp. Pocket guide. ISBN 0-85272-340-7. Price: £1.95.

This represents one of the growing library of pocket guides to the varied facets of geology that are being published by the British Geological Survey, amongst others. It is attractively produced in full colour as a double-sided, folding guide printed on stiff, laminated card. It measures 140 x 297 mm, a convenient size for either jacket pocket or small backpack.

One side of three pages is a satellite image of the Peak District at a scale of 1:170,000, on which the solid geology within the National Park boundary has been superimposed. This produces some peculiar gaps in information; for example, the geology northeast and southwest of Chapel-en-le-Frith is included, but not the geology of the area in between. The image and map are attractive, permitting easy differentiation of features such as the White and Dark Peaks. Seven lithologies, units and geological features are differentiated: limestones; shales and sandstones; sandstones and gritstones; shales, sandstones and coals; lavas and dolerites; mineral veins; and faults.

The reverse of the map is the front cover and two pages of explanatory text, including a cross section. With a smaller illustration on the cover or at least one with a lot less sky, more explanation could have been crammed in, although what is presented will be adequate to introduce the broad geological features of the region. However, the lack of a structured discussion of lithostratigraphic succession, however brief, must be considered an unfortunate omission. Although terms such as Carboniferous Limestone, Millstone Grit and Coal Measures are mentioned, a simple stratigraphic log would have helped emphasise their relationships, although this can be more or less determined from the text and cross section. The oblique cross section might have been better reproduced larger, perhaps at the bottom of the map. It is reasonably easy to determine the line of section even though it is not marked on the map. Unfortunately, the brown colour that represents sandstones and gritstones on the map has become transformed to yellow on the section, that is, the same colour as the faults.

This map is aimed at anyone with at least a basic geological knowledge, who know what is meant by terms like 'Carboniferous', 'cross bedding' and 'gangue minerals,' who understand a geological map and can relate it to a cross section. It is attractively produced, easy to carry, durable and a welcome addition to my field equipment for rambles in the Peak District. Used as an adjunct to one of the latest volumes on the geology of the Peaks, such as Broadhurst (2001) or Ford (2002), or just on its own, this promises to be a favourite for many years to come.

References

BROADHURST, F.M. 2001. *Rocky Rambles in the Peak District: Geology beneath your Feet*! Sigma Leisure, Wilmslow, Cheshire, 157 pp.

FORD, T.D. 2002. *Rocks & Scenery of the Peak District*. Landmark Publishing, Ashbourne, Derbyshire, 96 pp.

Stephen K. Donovan, Department of Palaeontology, Nationaal Natuurhistorisch Museum, Postbus 9517, 2300 RA Leiden, The Netherlands. 12th August 2003.

Lord, Barry and Dexter Lord, Gail. 1997. *The manual of museum management*. The Stationery Office, London. 261pp. Paperback. ISBN 0-11-2905-18-8. Price: £25.00. (Published in the US by AltaMira, also available in Spanish, see www.lord.ca for details)

Many years ago, the year after I graduated, I spotted an excellent textbook on structural geology in the staff room of my old geology department. It covered everything in our final year course and was well written and effectively illustrated. I pointed this out to the lecturer who taught the course only to be told that he had put it on our reading list at the time! If only I had read it before the exams, rather than discovering it afterwards.

The same sense of déjà vu accompanied my reading of *The manual of museum management*, having come to the text only after I had already experienced much of it first hand. Museum management is a particular skill, or set of skills and having such a well crafted introduction in the form of this book could save a great deal of pain for new generations of museum staff. Many people find themselves sliding imperceptibly from working in museums at entry level into positions that are involved in management, even if they do not change title or salary in the process. Others come directly into museums as managers and need to learn the peculiarities of these strange organisations. Both groups would benefit greatly from reading this book.

The husband and wife team behind this valuable text are well known museum consultants, bringing long careers of experience to a worldwide audience from their base in Toronto. The book has its origins in a course on Museum Organisation and Management run for the Ontario Museum Association. Publication by The Stationery Office (the privatised wing of HMSO established in 1996) signals the target audience for this book, bringing international standards in museum management to a UK readership through an official state publisher. This is the third such venture involving Lord Cultural Resources, following *The cost of collecting* (HMSO 1989) and *The manual of museum planning* (HMSO 1991). Their latest publication is *The manual of museum exhibitions* (AltaMira 2002).

The style of the book strongly echoes its origins as a training course. It is clear and concise, with sufficient concrete examples of museum practice to mark the relevance of the main points. It is however almost completely devoid of references to any other publications, apart from those by the authors. With a growing literature in this field it is a shame not to include at least some level of bibliography, particularly as some topics could be explored in greater depth. That aside, it is self-contained as a primer in museum management and is comprehensive in scope.

Chapters follow a progression of the Why? Who? And How? of the management of museums. Why? covers the objectives, detailed under purpose, Statements of Purpose and the role of management in museums. This short section has a number of diagrams, which the reader can sense popping up on the screen of the original classroom in Ontario linking inspiration, mission, goals and communication with the manager. If only more managers read this they might learn answers to the fundamental question at the beginning of the book – what is the purpose of management in museums? To facilitate decisions is the answer. Now you know.

The second section of the book deals with the individuals and groups involved in the running of a museum, be they trustees, staff or volunteers. It is an excellent section that should be read by every member of a board or state body involved in the running of a museum. Any lack of clarity in roles and responsibilities has the potential for frictions in the management of a museum. If the rather peculiar and complex world of museums is not appreciated by a well meaning manager or trustee, whatever skills they may bring to the organisation may be useless if they ignore the warnings provided here.

Chapter three takes up three quarters of the volume, leading on from the firm grounding in museum basics of the earlier sections. The coverage is sufficient for the general reader as Corporate Plans, Performance Indicators, Strategic Plans and Master Plans are outlined. While many details are typical only of the larger museums, many smaller organisations following best practice would benefit from a clear understanding of these key tools. This is a general feature of this section of the book, little is irrelevant to any museum, it is just a matter of scale. Written policies and procedures are explained as the core tools which keep any museum focus on its mission.

Collections management explains the role of curator, conservator and preparator. As with other sections, this is at a level designed to educate managers and any reader looking at the museum as a whole. It is an effective distillation of ideas seen in a number of books on curation, seen with a detached clarity necessary for good management. Too many books in this field are written by passionate museum experts who run the risk of speaking to the converted, rather than converting those who need to be educated about the running of museums.

Sections on exhibition processes and education are punctuated with case studies supplied by staff of a number of museums. A total of eleven contributors help to ground the manual in the day to day realities of museums. There is a particularly useful introduction to planning of buildings, something that a number of applicants for Heritage Lottery Funding may wish they had read a few years ago. Financial management also gets good coverage, something which many museum staff may never see discussed openly. A number of appendixes cover job descriptions for various museum posts and a useful glossary.

In all it is a well written and clear text which would form a sound basis for an introduction to museums for managers or as an introduction to management for existing museum staff. If you don't read it, please read something similar – if you can find it. The issues dealt with need to be understood by all museum staff and perhaps we would all work in more balanced organisations if that happened. When you have read it, try getting your Director or Trustees to tackle it – it should give them food for thought.

Mr Nigel T. Monaghan, National Museum of Ireland, Merrion Street, Dublin 2, Ireland. 1st September 2003.

Ensom, Paul. 1998. *Discover Dorset Geology*. The Dovecote Press. 89pp. Paperback. ISBN 1-874336-52 0. Price: £4-95.

This title is one of a number in a handy format series of paperbacks providing informative illustrated introductions to Dorset's history, culture and way of life.

Consisting of 19 chapters, a five-page glossary, and a note about further reading it provides a very readable introduction to 200 million years of geological history in a part of Britain known all over the world for the quality and variety of its rocks, fossils and landscape.

There are excellent black and white illustrations on most pages and a county outline map (showing where the rocks may be found) at the start of the chapters to ensure that the reader is not overpowered with text – there is a lot to fit in but the easy, informative style left this reader wanting to discover more.

I have three minor 'gripes' – a diagram showing processes and environments which produce different rocks seems rather constricted by the page size; some of the photographs would have benefited from a scale and I feel a map showing places mentioned in the text might have been useful. We often tend to assume that everyone must know the locations we are writing about.

However, don't let this put anyone off, Paul has contributed much to Dorset geology and this title will ensure a wider audience have an intelligible, interesting and up to date introduction to the subject.

Tony Cross, Curator, The Curtis Museum, Alton, Hampshire, UK. 29th October 2003.

Lockley, M. 2000. *The Eternal Trail- a Tracker Looks at Evolution*. Perseus Books Reading, Massachusetts. ISBN 0-7382-0165-0. Price: £17.95.

Martin Lockley is a world-renowned expert on tracks and trails of vertebrates of various types. The style of the book varies from the chatty and anecdotal to dense and turgid. It ranges in scope from Cambrian worms through dinosaurs to Yetis and extraterrestrial tracking. Lockley calls upon his vast knowledge of vertebrate ichnology to support the major themes within this book to varying degrees of efficacy. These themes are based around the work of the biophysicist Mae-Wan Ho, the biologist Wolfgang Schad and a variety of spiritualistic works.

There are a number of astute observations of the ichnological record that support the hypotheses of Mae-Wan Ho and Schad and build on the observations of the best of recent trackers the "Bushmen" of South Africa. The links between hoof shape and horn patterns made by Lockley is convincing, as is the relationship between fleshiness of the foot and track width as a correlative to mode of life of the track maker. Of particular interest is the observation that, throughout the vertebrate track record, trace makers within a lineage trend from primitive narrow-gauge odd-toed ancestral forms to wide-gauge even-toed forms in repetitive "morphogenetic pathways" e.g. Stegosaurs to Ankylosaurs in the Thyreophora.

Lockley attempts to convince the reader that it is part of our remit as scientists to open philosophical open dialogue with creationists and to find God in the patterns and design we see in the fossil record. While I accept Lockleys' statement that we will not be able to refute the existence of God I for one do not see any benefit in invoking God's powers in the patterns seen in the rock record.

On the whole, the book is well written and produced with few errors in the text. The diagrams are a combination of new diagrams and some recycled from the (many) Lockley publications and are generally of good quality, though could be improved by more thoughtful figure captions. There are no photographic plates in the book. It does not really suffer as a result, but I for one was dying to see some of the fantastic trackways that Lockley and his team have excavated.

In summary, despite the religious theme running through the book, I enjoyed the book and have greatly benefited from the numerous snippets of information and ichnological insights that Lockley introduces throughout this book. The book is successful in achieving its aims of marrying new biophysical, biomechanical and biological information with track data from throughout the stratigraphic record. He is even relatively convincing in his review of the enigmatic neoichnological evidence for the Yeti. The book is reasonably priced and a mine of insightful information. If you are more receptive to the religious theme it could be the best £17.95 you have spent in a long while.

Duncan McIlroy, Sedimentology & Internet Solutions Ltd., 29 Proctor Road, Hoylake, Wirral CH47 4BB, UK [www.duncanmcilroy.com]. 4th November 2003.

Wills, C. & Bada, J. 2000. *The Spark of Life: Darwin and the Primeval Soup*. Perseus Publishing, Cambridge, Massachusetts, xx+291 pp. Paperback. ISBN 0-7382-0493-5. Price: US$17.00.

The origin of life is a suitable subject for study by biochemists, not geologists and palaeontologists. Your reviewer anticipated that *The Spark of Life* (*SoL*) discussed Darwin's ideas on the origin of life, whereas it is more accurately concerned with Darwinian natural selection in a pre-biotic environment. So, here is a review of the wrong book in the wrong journal by the wrong reviewer. Now you're warned, please read on.

Despite the above qualifications, I congratulate the author's of *SoL* on doing such a good job of making the biochemistry of life so comprehensible and, indeed, entertaining. This book is aimed at the scientifically literate reader, and explains many difficult concepts clearly without hiding from the complexities and difficulties involved. Whenever I became confused, the glossary, short albeit comprehensive, was welcome support for this biochemically challenged reader. To my eye, the only place the authors consistently stumble, perhaps not unexpectedly, is wherever they need to provide detailed explanations of geological phenomena. Otherwise, *SoL* is well written, well produced, informative, readable and affordable.

Wills and Bada also provide an optimistic, but balanced, appraisal of the problems facing astrobiologists as they look for evidence of pre-life or life on other planets and moons. Even with specimens with which to work (something noticeably lacking in astrobiology so far), their identification promises to be almost impossible and certainly the subject of more informed speculation than hard science. Indeed, studies of the fossil record of this planet are sufficient to illustrate that there are many potential problems. The search for the fossil record of early life (>3.5 billion years old) has shown that microbial blobs and squiggles in rocks look remarkably like many inorganic artefacts (Buick 2001, Simpson 2003). Unless an incontrovertible related geobiochemical signature supports an astrobiological identification, such structures will not receive general acceptance as artefacts of life.

I can't resist appending the following quotation from Conan Doyle (1912); "On the origin of life he was discretely vague. That the germs of it could hardly have survived the original roasting was, he declared, fairly certain. Therefore it had come later. Had it built itself out of the cooling, inorganic elements of the globe? Very likely. Had the germs of it arrived from outside upon a meteor? It was hardly conceivable. On the whole, the wisest man was the least dogmatic upon the point. We could not – or at least we had not succeeded up to date in making organic life in our laboratories out of inorganic materials. The gulf between the dead and the living was something which our chemistry could not yet bridge." Over 90 years later, this could almost be a summary of Wills and Bada's book. Our understanding of the biochemical mechanisms involved has increased enormously, but the underlying pattern remains the same.

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