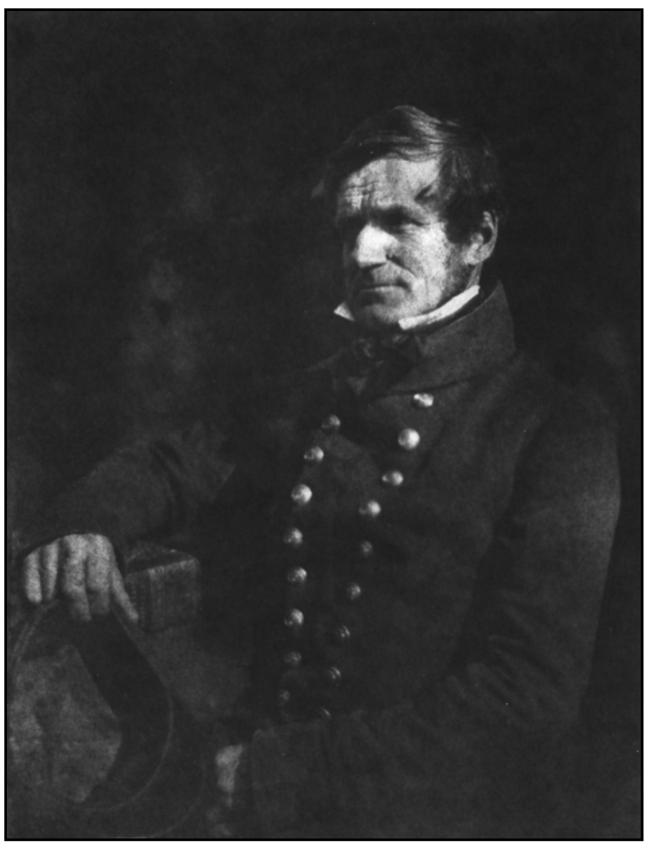
GEOLOGICAL CURATOR

Volume 8 Number 9



GEOLOGICAL CURATORS' GROUP

Registered Charity No. 296050

The Group is affiliated to the Geological Society of London. It was founded in 1974 to improve the status of geology in museums and similar institutions, and to improve the standard of geological curation in general by:

- holding meetings to promote the exchange of information
- providing information and advice on all matters relating to geology in museums
- the surveillance of collections of geological specimens and information with a view to ensuring their well being
- the maintenance of a code of practice for the curation and deployment of collections
- the advancement of the documentation and conservation of geological sites
- initiating and conducting surveys relating to the aims of the Group.

2008 COMMITTEE

Chairman	Helen Fothergill, Plymouth City Museum and Art Gallery: Drake Circus, Plymouth, PL4 8AJ, U.K. (tel: 01752 304774; fax: 01752 304775; e-mail: helen.fothergill@plymouth.gov.uk)
Secretary	Matthew Parkes, Natural History Division, National Museum of Ireland, Merrion Street, Dublin 2, Ireland (tel: 353-(0)87-1221967; e-mail: mparkes@museum.ie)
Treasurer	John Nudds, School of Earth, Atmospheric and Environmental Sciences, University of Manchester, Oxford Road, Manchester M13 9PL, U.K. (tel: +44 161 275 7861; e-mail: john.nudds@manchester.ac.uk)
Programme Secretary	Steve McLean, The Hancock Museum, The University, Newcastle-upon-Tyne NE2 4PT, U.K. (tel: 0191 2226765; fax: 0191 2226753; e-mail: s.g.mclean@ncl.ac.uk)
Editor of *The Geological Curator*	Matthew Parkes, Natural History Division, National Museum of Ireland, Merrion Street, Dublin 2, Ireland (tel: 353 (0)87 1221967; e-mail: mparkes@museum.ie)
Editor of *Coprolite*	Tom Sharpe, Department of Geology, National Museums and Galleries of Wales, Cathays Park, Cardiff CF10 3NP, Wales, U.K. (tel: 029 20 573265; fax: 029 20 667332; e-mail: Tom.Sharpe@museumwales.ac.uk)
Recorder	Michael Howe, British Geological Survey, Kingsley Dunham Centre, Keyworth, Nottingham NG12 5GG, U.K. (tel:0115 936 3105; fax: 0115 936 3200; e-mail: mhowe@bgs.ac.uk)
Minutes Secretary	Tony Morgan, Clore Natural History Centre, World Museum Liverpool, William Brown Street, Liverpool L3 8EN, U.K. (tel: 0151 478 4286; fax: 0151 478 4390; e-mail: tony.morgan@liverpoolmuseums.co.uk)
Committee	Michael Howe, British Geological Survey, Kingsley Dunham Centre, Keyworth, Nottingham NG12 5GG, U.K. (tel:0115 936 3105; fax: 0115 936 3200; e-mail: mhowe@bgs.ac.uk)
	Will Watts, Scarborough Museums & Gallery, Town Hall, St Nicholas Street, Scarborough YO11 2HG, U.K. (tel: 01723 232572; fax: 01723 376941; e-mail: Will.watts@scarborough.gov.uk)
	Hannah Chalk, School of Earth, Atmospheric and Environmental Sciences, University of Manchester, Oxford Road, Manchester M13 9PL, U.K. (tel: 0795 6208704; e-mail: Hannah-lee.Chalk@manchester.ac.uk)
	Cindy Howells, Department of Geology, National Museums and Galleries of Wales, Cathays Park, Cardiff CF10 3NP, Wales, U.K. (tel: 029 20 573554; fax: 029 20 667332; e-mail: cindy.howells@museumwales.ac.uk)
Co-opted members:	Steve Thompson, (NatSCA), Museum of North Lincolnshire, Oswald Road, Scunthorpe, South Humberside DN15 7BD, U.K. (tel: 01724 843533; fax: 01724 270474; e-mail: Steve.Thompson@northlincs.gov.uk)
	David Gelsthorpe, Manchester Museum, Oxford Road, Manchester M13 9PL, U.K. (tel: 0161 2752660; fax: 0161 2752676; e-mail: David.gelsthorpe@manchester.ac.uk)
	David Craven, Bolton Museums, Art Gallery and Aquarium, Le Mans Crescent, Bolton, Greater Manchester BL1 1SE, U.K. (tel: 01204 338764/557661; fax: 01204 332241; e-mail: david.craven@bolton.gov.uk)

 ISSN 0144 - 5294

Cover: A reproduction of the calotype of Charles Peach in his Coastguard uniform taken by the photographic pioneers Hill and Adamson (SNPG PGP HA 1761) in 1844. Image provided courtesy of the Scottish National Portrait Gallery, Edinburgh.

THE GEOLOGICAL CURATOR

VOLUME 8, NO. 9

CONTENTS

GEOLOGICAL CURATORS' GROUP - October 2008

CHARLES. W. PEACH, PALAEOBOTANY AND SCOTLAND

by Lyall I. Anderson and Michael A. Taylor

Anderson, L. I. and Taylor, M. A. 2008. Charles W. Peach, palaeobotany and Scotland. *The Geological Curator* 8 (9): 393 - 425.

The move south from Wick to the city of Edinburgh in 1865, some four years after retirement from the Customs service, provided Charles W. Peach with new opportunities for fossil-collecting and scientific networking. Here he renewed and maintained his interest in natural history and made significant palaeobotanical collections from the Carboniferous of the Midland Valley of Scotland. These are distinguished by some interesting characteristics of their documentation which the following generations of fossil collectors and researchers would have done well to emulate. Many of his fossil plant specimens have not only the locality detail, but also the date, month and year of collection neatly handwritten on attached paper labels; as a result, we can follow Peach's collecting activities over a period of some 18 years or so. Comments and even illustrative sketches on the labels of some fossils give us first-hand insight into Peach's observations. Study of these collections now held in National Museums Scotland reveals a pattern of collecting heavily biased towards those localities readily accessible from the newly expanding railways which provided a relatively inexpensive and convenient means of exploring the geology of the neighbourhood of Edinburgh.

Charles W. Peach had a very 'hands-on' practical approach to scientific investigation which led him to construct novel glass plates with mounted *Sphenopteris* cuticle, removed intact from Lower Carboniferous shales and limestones originating in West Lothian. These resemble the herbarium sheets with which he was familiar from his parallel and highly significant work on extant flora including nearshore marine algae. He also prepared hand-ground glass microscope slides, particularly of permineralised plant material from Pettycur in Fife, using whatever materials he had to hand at the time. Peach's collection raises questions about the evolution of accepted standards of documentation in private collections, in parallel with the evolution of collecting practices by the new professionals such as the workers of the Geological Survey. Its relatively rapid deposition in museums, compared to many private collections, may also have contributed to its apparently high rate of usage by contemporary workers.

Lyall I. Anderson, The Sedgwick Museum of Earth Sciences, Dept. of Earth Sciences, University of Cambridge, Cambridge CB2 3EQ, UK; e-mail land07@esc.cam.ac.uk
Michael A. Taylor, Department of Natural Sciences, National Museums Scotland, Chambers Street, Edinburgh EH1 1JF, UK, also Department of Museum Studies, University of Leicester; e-mail m.taylor@nms.ac.uk. *Received 12th January 2008.*

Introduction and key sources

Amongst the local heroes of Scottish geology one must always count those collectors who broke through the limitations of their social status through self-improvement and assiduous study and research to become widely known in their fields (if all too often still subordinate to the metropolitan grandees). Some of those lads o' pairts became especially 'weel kent' in their day thanks to the activities of journalists: for instance, take the three great heroes of the Old Red Sandstone north of the Great Glen. One might think that Hugh Miller (1802-1856) hardly needed other journalists to expound his own life story, being himself a newspaper editor (and eventually owner). But in actual fact he became known to many through the activities of Samuel Smiles (1812-1904), that exponent of self-help. Miller's fossil collection survives, mostly in National Museums Scotland (NMS). Another of Smiles' martyrs was Robert Dick, the poor baker of Thurso. But a third Smilesian geological hero is often overlooked

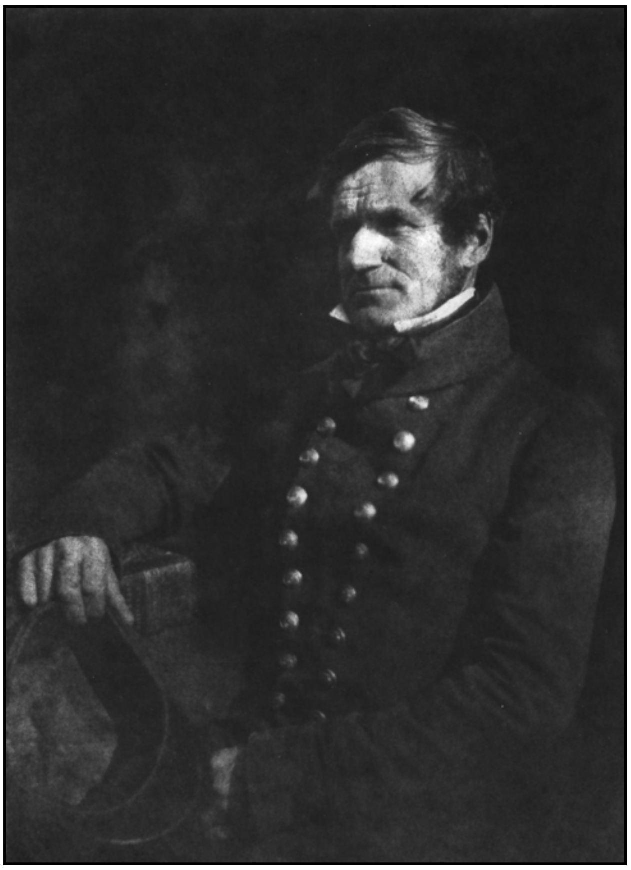


Figure 1. A reproduction of the calotype of Charles Peach in his Coastguard uniform taken by the photographic pioneers Hill and Adamson (SNPG PGP HA 1761) in 1844. Image provided courtesy of the Scottish National Portrait Gallery, Edinburgh.

because Smiles lumped him into the biography of Dick, presumably to fill it out, without mentioning him in the title. The subject of our paper is this third and last hero: Charles William Peach (born 30 September 1800 - died 28 February 1886) (Figure 1).

Charles Peach's collection was never lost, but some of it has only recently been recognised again within NMS. This arose during 2007 when the bulk of the Palaeobotany collections of NMS was audited and the data uploaded to the internal collections management database ADLiB. This work was undertaken by Dr Sarah E. Stewart, Dr Yves Candela, and the present authors, and has now generated a searchable summary database of NMS holdings within this subset of the collections. During this audit, which was in preparation for a move of the Palaeobotany collections to new storage, we had the good fortune to bring to light some historical treasures relating to Charles Peach. Some of those finds were well known to curators, but others had been overlooked, and certainly many had departed from institutional memory with the turnover of staff in recent years.

The Peach collection of fossil plants at NMS is distinctive above all for the attention paid to detail during the labelling of each find. In most cases, as well as the locality information, Peach indicated the date of collection. Those data allow us today to track his fieldwork day by day, and enable us to perceive why he was so highly rated by his contemporaries as a field collector. Furthermore, with some of the fossils, he provided small but accurate annotated sketches illustrating points of interest. These interpretive drawings talk down the years to us and give an insight into his meticulous observation and his obvious wonder at the beauty of the natural world.

As well as hand specimens of fossil plants, moreover, there is a significant collection of thin-section material mounted on glass. Much of this thin-section material appears to have been prepared by Charles Peach himself, judging from the handwritten annotated labels and variety of paper coverings. The technology of creating thin sections of fossils or minerals was long established in Edinburgh by the time Peach came to reside there. Morrison-Low (1992) detailed the life of William Nicol, a pioneer in this particular field of science, in which fossil plants such as the 1830 Craigleith tree played a major role. Oldroyd (1999) cited petrological thin sections as important sources of non-written evidence in studying the history of geology. From examining Peach's sections, we derive a sense of his commonsense attitude to getting science done by manufacturing his own thin sections from non-standard materials for microscopic examination (see Peach's handwritten notes in Figure 6).

We do not attempt general assessments of Smiles' (1878) broad-brush picture of Peach's life and work, or the later biography by Davey (1911, reprinted from a 1910 publication), badly needed as they are, as beyond the scope of our paper, which is in any case focussed on the NMS collections and their implications. But, in the absence (as far as we know) of any such recent attempt, caution is necessary in taking at face value the picture painted by Smiles (as with any other journalist or historian). Quite apart from the accuracy of his sources (which, in this instance, plainly included Peach himself: e.g. Smiles 1878, p. 393), Smiles had his own axes to grind, and his work is not always reliable (Jarvis 1997; for the views of another subject, Thomas Edwards, on Smiles' portrayal of him, see Secord 2003). One of us has long felt that Smiles' book on Dick is a blatant hagiography of a secular martyr of self-improvement, right down to going out collecting all night on a single oatcake and in wet socks, and it is a relief to find Jarvis arguing that in fact hagiographies were indeed the model for much of Smiles' writing, to the extent that Smiles did not always allow the facts to get in the way of a suitably improving moral tale - while Jarvis (1997, p. 22) commented that Smiles 'never hesitated to allow his feelings to govern what he wrote'. That is not to say that Smiles is necessarily wrong on Peach - to whom, in any case, Smiles allocated the role of foil to Dick, looker-on and mourner, rather than Second Martyr (though Archibald Geikie, in a *Nature* review of the book, felt that Smiles had unfairly downgraded Peach's work on the Old Red Sandstone compared to that of Dick himself, and was apparently happy to see that view reiterated in the official petition for a further pension for Peach: Anon. [1882]). We suspect Smiles included Peach's happier fate to relieve the gloom induced in the reader by Dick's sad story, which in itself does little to encourage the reader in the path of self-help. But Jarvis added that one does need to know, if possible, 'what lay behind [Smiles' work], especially if we are using it as factual evidence'. And that, as already noted, is beyond the scope of this paper, except in one or two areas where the issue is directly relevant, as shall be seen below.

Our paper also draws upon a newly available MS account of Peach's life and work (Anon. [1882], NLS MS Ac 10073/6) held by the National Library of Scotland which acquired it in 1990 from the Royal Society of Edinburgh (Ms Sheila Mackenzie, NLS, pers. comm. 2007). This appears to contain information which may not be available elsewhere, and our publication is apparently the first actually to draw upon it. It was neither available nor used when writing Oldroyd (2004b; Prof. D. Oldroyd, pers. comm. 2007; it is listed in the apparatus later editorially added to that account, which is how we learnt of it). We therefore outline its nature, provenance and dating briefly here. It is an undated MS comprising a short biography of Peach; details of his coastguard and customs service with notable events and formal commendations; a list of standard works in the natural sciences which drew upon his work; honours from scientific societies, etc.; and details of his personal finances in the past and at the time of writing. It was obviously intended as supporting evidence for an application for financial assistance, and was plainly written with a detailed knowledge of Peach's circumstances and doubtless in close liaison with him (though it is not in his own distinctive handwriting of which we possess numerous examples from 1845 onwards).

We date the RSE document to 1882, and more specifically mid-February onwards to 28 December, by an internal reference to its being written in the same, presumably calendar, year as the death of Peach's wife. His first and only known wife was Jemima *née* Mabson who died on 13 February 1882 (death certificate; death notice, *Scotsman*, 14 February 1882). A reference to Peach's daughter Jemima Mary Peach being aged 47 confirms this dating, as she was born on 28 December 1834. She was the 'eldest and only surviving daughter' (death notice, *Scotsman*, 2 September 1899), ruling out the possibility that she replaced an older sister who had carried the parental name of Jemima but died in infancy, as often happened in those days, as indeed it did with her two successive brothers Benjamin Neeve. This dating, and the RSE provenance, suggest strongly that the document was intended to support the application for funds recorded in the Minutes of Council for 1877-1884 of the Royal Society of Edinburgh (NLS Acc.10000, no.22). On 7 April 1882 "An application was submitted, requesting the Council to back up a Memorial for a Government pension to Mr Peach, senior. The Council resolved to take in the matter whatever action might be recommended by Professor Geikie"; and on 5 May 1882, there was "[r]ead Letter from Professors Geikie and Ramsay as to the Memorial in favour of Mr Peach. Professor Geikie's suggestion to request the Duke of Argyll to present the Memorial was approved of." (Ms Sheila Mackenzie, NLS, pers. comm. 2007).

Finally, it is often mentioned that Peach had nine children of whom seven survived to maturity, although usually only the famous Ben Peach receives any attention. We have attempted to trace all nine with some success, in the interests of verification, and as some siblings appear in our story, and our results are appended at the end of this paper (Appendix 1).

Archival sources. Repository and society abbreviations: BAAS, British Association for the Advancement of Science; BSE, Botanical Society of Edinburgh; CUL, Cambridge University Library; EGS, Edinburgh Geological Society; EMSA, Edinburgh Museum of Science and Art (renamed RSM in 1904); ENFC, Edinburgh Naturalists' Field Club; NAHSTE, Navigational Aids for the History of Science,Technology & the Environment project database, http://www.nahste.ac.uk/; NLS, National Library of Scotland; NMS, National Museums Scotland (formerly National Museums of Scotland, incorporating RSM); RBGE, Royal Botanic Garden Edinburgh; RPSE, Royal Physical Society of Edinburgh; RSM, Royal Scottish Museum (formerly EMSA and incorporated into NMS in 1985).

Statutory records of births, marriages, deaths, wills and executors' inventories, and census data in Scotland used were downloaded from www.scotlandspeople.gov.uk, the official Scottish Government web portal for statutory records such as those of the General Register Office for Scotland and the National Archives of Scotland. It should be borne in mind that under Scots law, wills often did not deal with 'heritable' property, i.e. real estate, which automatically went to the eldest son, and the resulting inventories commonly dealt only with 'moveable' property, i.e. money, furnishings, personal effects, etc. The data for the 1841 census were downloaded from http://freepages.genealogy.rootsweb.com/~kayhin/ukocp.html. All downloads from websites other than www.scotlandspeople.gov.uk were printed and filed (in NMS Palaeontology Sections/Persons files) on 11-14 December 2007 except where stated.

Charles Peach's life and work: an outline of some significant elements

Charles W. Peach earned his living from 1824 to 1845 as a coastguard in the customs service, patrolling a stretch of coast against smugglers, and from 1845 as a Customs officer, doing work such as reporting shipwrecks and claiming Crown rights in them. This wide-ranging duty gave him a scope for collecting which was geographically much broader than comparable collectors of similar social status, such as Hugh Miller of Cromarty, who was tied to his bank job from 1836 to 1840, and Robert Dick of Thurso, who was thirled to his baker's oven (Knell and Taylor 2006; Smiles 1878, especially p. 257). Originally from Wansford, Northamptonshire, Peach served in several parts of England (Norfolk, Dorset and Devon) before settling for a while in Cornwall. He was then moved to Peterhead in Aberdeenshire in 1849 (Figure 2). The 1851 Census records the household (Charles, his wife, the six children Charles, William, Jemima, Elizabeth, Joseph and Benjamin, and one servant) residing at 8 Maiden Street, close by the busy harbour of Peterhead where Peach was principally employed. Upon promotion in 1853 he moved to the port of Wick in Caithness (Figure 2). The 1861 Census records Charles and Jemima with only two of their offspring, Jemima and Joseph, remaining at home, and one domestic servant, living in Argyle Square, the main central square of Pulteneytown, the Wick fishertown laid out by Thomas Telford.

By this time Charles had an established reputation as a naturalist and marine biologist, although, sadly contrary to legend, he was not the custodian of 'Granny' the septuagenarian sea anemone, nor is she in the NMS collections (Swinney 2007). Quite separately, Peach developed as a geologist (Oldroyd 2004b), and he continued to engage in this interest while at Wick. For instance, his discovery of fossils in the Durness Limestone (Murchison 1867) was crucial in the early stages of what has been called the Highland Controversy over the dating and structure of the rocks of the North-west Highlands of Scotland (Oldroyd 1990).

Peach, on the face of matters, fell into Torrens's (2006) category of 'outsider': someone who derived his living from outwith the field of geology but who provided significant contributions to the science in terms of material data, published papers and interconnection with the leading figures of the day. For instance, in a major review of the geology of northern Scotland, Roderick Murchison (1859) repeatedly

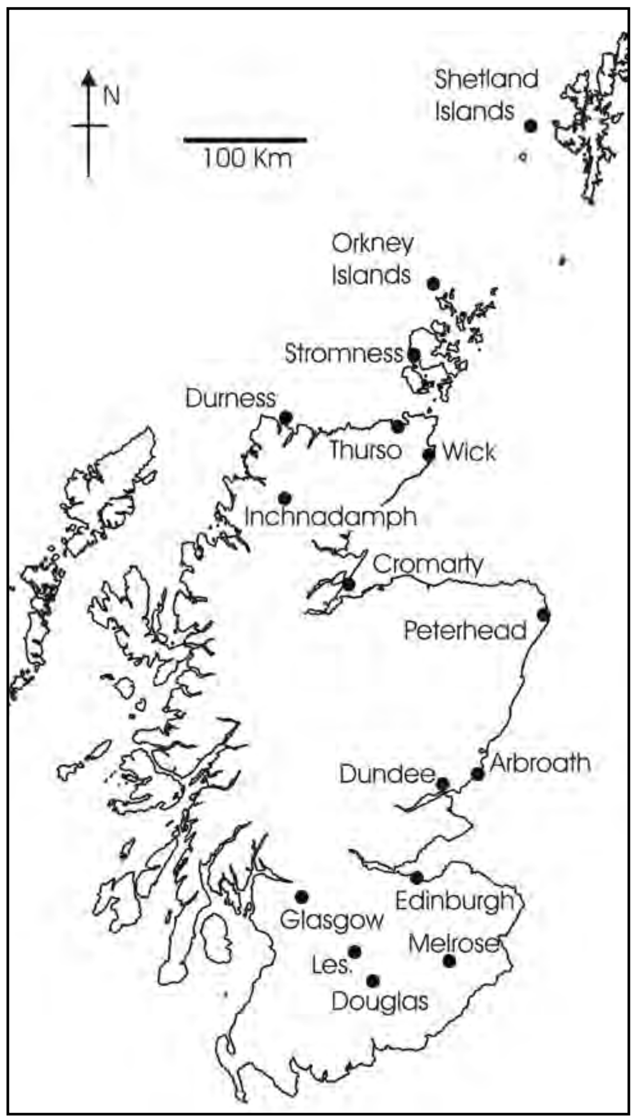


Figure 2. Map of Scotland displaying the place names referred to in the text excluding specific fossil localities as detailed in Figure 3. The village of Lesmahagow is indicated by the abbreviation 'Les.'.

cited the 'keen-eyed' (p. 367) Peach's collecting activities and field observations, which had provided Murchison with many critical data for his own theoretical synthesis (all too often the role of the provincial collector!). Murchison regretted that duty had allowed Peach to accompany Murchison for only part of his field trip, but noted that the fossil plant *Caulopteris peachii* Salter was named after Peach at Murchison's request by Salter in Murchison (1859). Dawson (1871) incorrectly attributed Salter's description of this species to a paper published in volume 14 of the *Quarterly Journal of the Geological Society of London* in 1858 (Salter 1858). He did however mention that he had seen the original specimen in London shown to him by Mr Etheridge. This specimen, BGS GSM 31663, matches Salter's figure and therefore appears to be the holotype (Dr Mike Howe, pers. comm. December 2007). Peach must have retained the counterpart which ended up in the NMS and was eventually registered as NMS.G.1964.13. Oddly enough, however, as Peach himself noted (1880, p. 151), "This very fine form was first found by Mr J. Budge of Thurso, in the Weydale Quarry near that place, and sent by him to the Museum of Science and Art in Edinburgh. Mine were placed in the Jermyn Street Museum, London, and at once described by Mr Salter, and figured to illustrate a paper by Sir Roderick Murchison … thus named after me". More generally, Peach's important contribution to Devonian palaeobotany was the recognition that plants previously considered to be aquatic, as for example by the Rev. John Fleming and Hugh Miller, were actually land-living forms (Jack and Etheridge 1877).

Another indication of Peach's status is evidenced by Peach's selection, by the early photographers David Octavius Hill and Robert Adamson, to sit for one of a set of calotypes of notable attendees apparently taken at the meeting of the British Association for the Advancement of Science at York in 1844 (Figure 1). Robert Chambers (1844, p. 323), the editor and publisher, and like Smiles an exponent of education and self-help, wrote:

> "But who is that little intelligent-looking man in a faded naval uniform, who is so invariably seen in a particular central seat in this section [The Zoological Section of the BAAS]? That, gentle reader, is perhaps one of the most interesting men who attend the association. He is only a private in the mounted guard (preventative service), at an obscure part of the Cornwall coast, with four shillings a-day, and a wife and nine children, most of whose education he has himself to conduct."

Chambers's description shows that Hill and Adamson plainly did not dress Peach up in his coastguard uniform specially for the sitting, especially as it was more usual then than now for members of the Services to wear their uniform on public occasions. But it is worth remembering that Hill and Adamson would often dress up their subjects to convey what they saw as a deeper truth, however technically inaccurate the costume was for that place and time. For instance, their famous images of Hugh Miller (1802-1856) posed him as a shirt-sleeved stonemason working on a tombstone in the Calton cemetery, Edinburgh, although Miller had long given up such manual labour (except on his fossils!) for the life of an accountant and then a newspaper editor (Stevenson 2002, Taylor 2007). Miller's example suggests conversely that Hill and Adamson's portrayal of Peach as a coastguard was not intended negatively. Hill and Adamson were surely portraying Peach as a significant man of science worthy of such a record, but also as someone whose place in society was different from the élite gentlemen running the Association - but who was, presumably, due all the more credit for the scientific work he did manage to do.

Charles Peach: the Edinburgh years

Developing a timeline of Charles Peach's life allowed us to fit various disparate pieces of information into a synthesis of his fossil-collecting activities in Cornwall, northern Scotland and latterly around the city of Edinburgh. For the purposes of this paper, a key event came on 15 August 1861, when a Treasury Warrant basically did away with Peach's grade within the Customs service, and forced him into retirement, which he resented. Oldroyd (2004b) recorded that on his retirement, Charles Peach's geological work was primarily on palaeobotany and glacial geology, both based on his Caithness work, as evidenced by his published work at this time (Peach 1858a; 1859; 1860a; 1863). This was natural, for to begin with, Charles Peach remained in Wick after his retirement, and it was only in May 1865 that he moved south with his household to Edinburgh (Figure 2). Smiles (1878) recorded that being made redundant from his job had a depressing effect on Peach, who was also prone to colds and bronchitis, and who now suffered an extended period of illness. We do not know for sure what exactly ailed Peach, and for how long. The labelled and dated fossil plants in NMS which we have so far examined do show very little fossil-collecting during the period 1861 - 1865, but this may simply reflect the fact that most of his pre-1870 collection was sold, and also that during this period Peach was not living on the

Carboniferous strata whence the fossils described in this paper were drawn. We have not yet been able to explore fully those NMS collections, such as fishes, which do contain material from this period of his collecting and from the kind of strata (such as the Old Red Sandstone) on which he was living (for instance, at least one fish, NMS.G.1875.29.78, was labelled as having been collected from South Head, Wick, on 6 April 1863; see also the Old Red Sandstone plants enumerated below). It is already plain that it would be an exaggeration to suggest that Peach ceased his scientific work completely. He continued to send papers in biology (e.g. Peach 1860b) and geology (some read *in absentia*) to the Royal Physical Society of Edinburgh almost every year up to the late 1860s and beyond, as judged by the actual dates of the meetings in the Society's *Proceedings* (vols. 2 and 3). Moreover, in 1864 Peach took part in John Gwyn Jeffreys' dredging trip to the Shetlands, which had primarily biological aims and which Peach also took as an opportunity to investigate the local Quaternary drift fossils (Peach 1863a,1863b). Inquisitive collectors often collect outwith their main fields of interest when opportunity presents itself and in Anderson (1865) we find evidence of Charles Peach doing just that. Referring to the archaeological excavation of a 'kist', i.e. burial cist, in a mound at Keiss, near Wick, the author noted:

> "These hammers or pestles, of oblong shore pebbles, are found in the shell-heaps or connected with the dwellings, as well as in the kists; and the one sent by Mr. Peach from the "Pict's House" at Old Stirkoke, must have been intended for a child's hand." (Anderson 1865, p. 161)

Later in the same article Peach's contribution to excavations alongside the author is referred to in relation to finding human remains amongst the ashes, bones of animals and shells of a 'midden heap'. Although in both cases it is a "Mr Peach" who is referred to, we are reasonably certain this is Charles rather than any of the rest of his family, especially as the name Peach is very unusual in the area as the 1861 census shows. By 1862, Benjamin Peach was actively engaged in Survey work on the coalfields of Fife. The only other possibility is that Charles Peach's son Joseph could be the mentioned Mr Peach, but he would have been only about 24 in 1864 and we have no indication whether he was an active collector in his father's footsteps.

Peach was in any case in full action soon after the move to Edinburgh. The Edinburgh years constituted a fruitful period of field collecting and scientific investigation which lasted well into his eightieth year in 1880. In 1866 Peach was recruited by the Edinburgh Museum of Science and Art (a precursor of NMS) to curate and display the Hugh Miller fossil collection, which it had acquired while still called the Natural History Museum in 1859 (Allman [1867]). Peach had paid tribute in one of his papers to Miller as "my late and valued friend … one whom I have long loved" (Peach 1858b, p. 431), and his MS. catalogue of the Miller Collection still survives, while he would use Miller specimens in his own research (e.g. Peach 1873c). The connection between the Miller and Peach families was sufficiently strong for Charles Peach to be listed as one of the eight chief mourners at the funeral of Lydia Miller, Hugh Miller's widow, in 1876 (*Scotsman*, 21 March 1876). Peach was evidently paid (Anon. [1882]) for his cataloguing of the Miller collection, as well as for curatorial work at the Watt Institute, Dundee in 1873 (B. N. Peach 1883) (which may be when he noticed a particularly interesting lepidodendroid in that collection: Peach 1876a). And in September 1867 he attended the British Association meeting in Dundee. By now, Peach had plainly regained his fire and zeal for scientific investigation (if indeed he had ever lost them for long). In 1868, he was elected as an Associate of the Linnean Society of London primarily on the basis of his zoological observations on marine life around the British coastline (Davey 1911).

Peach did not confine his interests to the Edinburgh area. He published on fossil fishes from the northern Old Red Sandstone (Peach 1868) and would collect fish from the ORS near Melrose in Roxburghshire (Peach 1874b). He also returned to the theme of Cornish fossils in 1868 (Peach 1869; also pseudofossils, Peach 1870b). In May 1869, he spent two weeks at the Royal Institution of Cornwall in Penzance, in order to sort out, and provide identifications for, a collection of fossils held there since its purchase from him in 1849 (when he and his household moved to Peterhead: Crowther 2003, Peach 1870a, 1878b). In 1870 the British Museum bought a quantity of Peach's collection of Scottish fossils up until that time: but, as we shall see, not all of his Scottish material was sold to London. He kept back in reserve some material which presumably either duplicated that already being sold, or was of interest to him from a research or personal point of view. At least some of those latter pre-1870 fossils would eventually be sold to the Edinburgh Museum of Science and Art. But, in any case, the 1865 move and the 1870 sale did not see the end of his fossil-collecting activities. For Peach embarked on a new phase of work on the Carboniferous plants of the Midland Valley of

Scotland, which had started by August 1868 and continued after 1880.

It would not be surprising if the 1849 sale had to do with the move to Wick - partly to save on shipping costs and housing needs, and also to raise money to defray the expenses of the move. The NLS document ((NLS MS Ac 10073/6) p. 14) states the financial position he was in at the time quite clearly:

> "While in the Coast Guard, his highest salary was £75 a year with £30 for the keep of a horse. If his horse died or became unserviceable it had to be replaced at his own expense. When changing stations a small allowance was made to himself only: nothing whatever was allowed for travelling expenses of his wife and family, or for the removal of his household goods."

There is no such clear link for an 1856 sale to the Jermyn Street Museum of the Geological Survey (Cleevely 1983), some years after the move to Wick, or for the 1870 sale, which took place after 1866, but it would be unsurprising if space at home were a factor. The British Census records everyone at a particular place on a particular night. On both 2 April 1871 and 3 April 1881, the census enumerators found Charles Peach and his wife Jemima at home at 30 Haddington Place, just off the thoroughfare of Leith Walk which connects the city centre of Edinburgh with the port of Leith on the Firth of Forth. They had been living here for most, perhaps all, of their stay in Edinburgh since the move of 1865 and would remain there until their deaths (death certificates; members' listing in the *Annual Report of the British Association for the Advancement of Science* for the 1866 meeting). The 1871 census caught daughter Jemima in the household of her sister at Arbroath; perhaps she was simply visiting - census data did not record who was normally resident, but simply who was present on the given night. She may well have been normally resident with her parents, for in 1881 she was with her parents, and a general servant, Mary Jane Johnston, on census night. This Haddington Place 'house' - to adopt Scots parlance - seems to have been one of at least 6 tenement flats in the block, in the usual Scottish urban manner often used to house the lower middle classes as well as the working classes. The 1881 census records some of his neighbours as including a teacher and a 'writer' or lawyer. The Peaches' youngest son, Benjamin, was at Douglas in Lanarkshire at the 1871 census, possibly on Geological Survey fieldwork, but the 1881 Census caught him living with his wife, four children, young brother-in-law, and a servant at 8 Annandale Street, just around the corner from his parents. This was no doubt for mutual support of the aged parents and of a young mother whose husband was often away on fieldwork.

Ben Peach and his household were still in Annandale Street at his father's death (death certificate) but thereafter, possibly as a result of his remarriage, to Margaret Macewen, in 1887, they moved to rather more upmarket districts in south Edinburgh. The *Post Office Edinburgh and Leith Directory* for 1887 - 88 recorded Ben at 13 Dalrymple Crescent, Edinburgh. He was still there in the 1891 - 92 edition, but in the 1892 - 93 edition he was at 86 Findhorn Place, until the 1900 - 01 edition when he was now at 30 Mayfield Road, close by what was to become the site of the King's Buildings of Edinburgh University. Christine Thompson (pers. comm. 2007) informs us that when Ben Peach and John Horne led a field trip to their classic stamping ground of Assynt for the 1912 BAAS meeting in Dundee, and Ben Peach signed the Inchnadamph Hotel's visitor book, he gave his home address as 72 Grange Loan. Rather alarmingly the directories record Charles Peach as resident in Haddington Place up to the 1891-92 edition, but this is probably simply because Jemima remained there, as shown by the 1891 census, and the record of her 1887 sale to the Museum of a collection of Charles Peach's fossils, as will be seen below. She may well have moved to 86 Findhorn Place when her brother moved in around 1892, and was certainly resident there at her death in 1899 (death certificate; death notice, *Scotsman*, 2 September 1899).

The RSE document (Anon. [1882]) greatly amplifies our knowledge of Charles Peach's finances. In particular, his annual income, depending on the time, was between one and about two hundred pounds including allowances and minor income such as payment for being sub-consul at Wick for Norway and Sweden; his highest Customs salary was £150; he retired on a basic pension of £130; and although he owned his Edinburgh house it was still mortgaged for more than half its value. Even allowing for the fact that money had something like a hundred times its modern value, and that we don't know if he inherited anything from his parents, this was not a lot on which to bring up seven children out of nine to adulthood. This financial pressure did not abate when the children reached adulthood: clearly Peach was seriously worried about what would happen to his unmarried daughter Jemima who still lived with her parents when almost 50 and was financially dependent on them (possibly disabled by illness: the RSE document refers to her as 'in delicate health' and her death certificate records her cause of death as 'Chronic Bright's disease [and] chronic diabetes'). In the will he made on 27 February 1882 he left his entire estate (in the legal sense) to her so long as she remained single; if she married (with the implication that her husband would support her), Ben Peach was to sell the estate and divide the proceedings between the siblings William, Ben, Elizabeth and Jemima (SC70/4/218 Edinburgh Sheriff Court Wills). Peach's estate was, in the end, valued at inventory at £571 16s 10d including payouts on life policies and £172 19s 6d for household contents and personal effects, including his 'Library & Collection of Minerals' (SC70/1/249 Edinburgh Sheriff Court Inventories). The 'minerals' we take to be lawyer-speak for fossils - minerals in legal parlance being anything that can be dug up for profit (Taylor and Harte 1988). It is pleasant to think that the £45 (see below) paid to her by the museum for what must have been those very fossils contributed to this aim, and in fact her finances remained sufficient for her to leave an estate valued at some £440 in 1899 (other than landed property, if any: SC70/1/383 Edinburgh Sheriff Court Inventories).

Peach's personal finance must always have affected his fossil-collecting, and like his periodic removals, pushed him towards selling his specimens. He was said, at least in later life, to have paid for the costs of his natural scientific interests solely from earnings from his geological work - collections sales, curatorial work, small grants from scientific bodies, and the like - without dipping into the household budget (Anon. [1882]). And it is very likely that sometimes he had to use money from the sale of fossils for family expenses, such as the removal from Cornwall to the far north, which was largely at his own expense (Smiles 1878, p. 251). However, as far as is known, he did not sell to private collectors, though the possibility remains that he kept quiet about any such sales. Finding a good home for his fossils in public collections, seeing them studied and published, helping his colleagues, and making a good name for himself must also have weighed with Peach alongside the simple cash price.

Peach's career also reminds us that selling one's fossils can have more indirect - but equally valuable - benefits than cash from outright sale (and further complicating the concept of 'amateur'!). One of Gideon Mantell's (1790 - 1852) motivations - or at least justifications - for his interest in palaeontology was to gain social status to boost his medical career (Dean 2004). He failed, as is well known. But one need only look at Charles Peach for a successful exponent of the art of patronage, at least at a rather lower income level. His son Joseph followed his father into Customs work, and was recorded as a Clerk first at Wick in the 1851 census and then subsequently at Leith in the 1861 census, where he was serving when he died on 28 February 1868 of 'phthisis pulmonalis' (i.e. pulmonary tuberculosis) at the early age of 27, still resident at 30 Haddington Place at least in the last few weeks of his life (death certificate; will made on 17 February 1868, SC70/4/116 Edinburgh Sheriff Court Wills). Peach's own transfer to a better position within the Customs in 1845 was said to have taken place after William Buckland and the Council of the British Association requested the intervention of the Prime Minister, Robert Peel, while William Buckland obtained an annuity of £15 for Mrs Peach from a fund controlled by Mrs Peel; moreover, Peach himself wrote to Henry De la Beche, then Director of the Geological Survey, in 1840, 1845 and 1846 seeking just such influence (Anon. [1882]; Sharpe and McCartney 1998, pp. 26-27, 85; Oldroyd 2004b). In 1850, also, Charles Peach attempted to secure De la Beche's and also Andrew Ramsay's influence in getting another of his sons, William, a position as a fossil collector in the Geological Survey (letter to De la Beche, 23 September 1850: Sharpe and McCartney 1998, p. 85). However, William eventually ended up as a Customs Clerk, no doubt with his father’s help (Appendix 1), while a later Director, Roderick Murchison, arranged for Ben to attend the Royal School of Mines and, in 1862, to take up a position with the Geological Survey. This was initially in London but soon Ben Peach was moved to Scotland, tasked with examining the coalfields of Fife and Clackmannanshire (Oldroyd 2004a). And in 1867, Sir Archibald Geikie, the Director of the Scottish branch of the Geological Survey, appointed Ben Peach as the Northern Area Geologist. Were it not for Charles Peach's association with Murchison in the North-west Highlands, and his good work in adding to the fossil riches of our museums, his son Ben Peach might neither have entered the Survey nor made his great researches with John Horne.

Plainly Charles Peach could not easily accumulate a large collection, given his household situation. And whatever pangs - if any - he might have had at seeing his finds go to museums, he did at least have other satisfactions and rewards. It is instructive to compare Peach, not just with Mantell, but also with Hugh Miller. In complete contrast to Mantell, Miller was almost obsessive in his independence from the great of this world, insisting on making his own way in life (apart from - and probably because of - one or two abortive early attempts: Taylor 2007). It would not be surprising if Miller was just the same in geology. It seems no coincidence that Miller kept most of his collection for his all too short life, apart from a few specimens going to museums in London, Newcastle, Paisley and Inverness (Cleevely 1983). And as for poor Robert Dick, he was too embroiled in his declining bakery, and perhaps by then also too socially alienated, even to escape. To stave off bankruptcy, Dick had to sell his collection to the lawyer and geologist John Miller (d. 1878), into whose collection (also in NMS today) it was unrecognisably incorporated, except for some specimens which Dick gave to Hugh Miller and which can be identified from the latter's books. Thus Dick's bankruptcy lost him not only his fossil collection but also his very name on the specimens he found. By contrast, Peach was a civil servant dependent on the favour of the great and the good, and their patronage was a fact in Peach's life. At least he realistically turned it to some use.

Materials examined

As far as fossil collections are concerned, this study is based wholly upon those held by National Museums Scotland (Edinburgh). Fossil specimens cited are indicated by the standard MDA prefix 'NMS', and sub-prefix G, originally for Geology, within the fully modernised NMS documentation system. Unfortunately it is sometimes also necessary to use the Z for Zoology prefix because of a problem in converting the number to the standardised modern format. During the first half of the twentieth century, the RSM effectively operated separate departments of Natural History and of Geology, each running its own register numbering system, but both collecting fossils. This led to considerable potential duplication of acquisition numbers once the palaeontological collections of Natural History were transferred into Geology in the mid-20th century, and a headache for the modern curator trying to fit them into a single consecutive machine retrievable numeric system. To avoid this, therefore, Charles Peach's collection is variously attributed an additional G. (Geology) or Z. (Zoology) letter after the NMS prefix, depending in part on the department in which it was originally registered. Material within the care of the Science and Technological History Department is prefixed 'NMS.T.' The source of our study material therefore consists largely of the following accessions:

o NMS.G.1875.29 is a collection of 230 "British Fossils" purchased from Mr. C. W. Peach, Edinburgh for the sum of £50, "embracing a large number of specimens of great rarity and importance" as the Annual Report had it (Traquair and Archer [1876]). The first 22 specimens are all fossil plants collected from West Lothian. The main body of the collection consists of fossil invertebrates from the Cambrian of Durness, Sutherland, Devonian fish from Caithness and the Midland Valley of Scotland, Carboniferous fish from localities around Edinburgh, and some Jurassic fossil invertebrates from Collyweston, Northamptonshire.

o NMS.G.1877.22 is a collection of 14 fossil fishes presented by Charles W. Peach.

o NMS.G.1887.35 comprises "a collection of fossils from the old red sandstone and carboniferous rocks of Scotland" (Traquair [1888]) sold by Miss J. M. Peach of 30 Haddington Place - i.e. Charles Peach's daughter, and no doubt as part of the clearout after his death. This collection was not properly registered at the time or since, and it is likely that at least some of the mass of originally unregistered Peach Collection fossils held in NMS originates from this acquisition.

o NMS.Z.1951.4 is a gastropod of the species *Platyschisma simulans* from the Silurian of Lesmahagow.

o NMS.Z.1951.5 is a specimen of the trilobite *Dalmanella budleighensis* from near Gorran Haven, Cornwall - presumably a specimen which he had retained or collected subsequent to the sale of his other Cornish fossils to the Royal Geological Society of Cornwall museum in Penzance.

o NMS.G.1958.8 is a specimen of the Carboniferous bivalve *Aviculopecten ellipticus* from Lesmahagow, Lanarkshire.

o NMS.G.1959.15 represents a reassignment of certain Palaeobotany collections previously numbered in a separate palaeobotanical register; some of this is Peach material.

o NMS.G.1962.10 consists of material that was found unregistered in the general palaeobotany collection but which Dr Charles D. Waterston (then, in 1962, Keeper of Geology) recognised as being from C. W. Peach's collection from its distinctive labelling style.

o NMS.G.1964.13 is the counterpart of the holotype of the Old Red Sandstone plant *Caulopteris peachii* Salter in Murchison (1859).

o NMS.G.1967.31.6, 7, 9, 11, 13-16 are specimens of the eurypterid *Erettopterus bilobus* from the Silurian of Lesmahagow.

o NMS.G.1973.57.1-47 is a collection of shells from the boulder clay of Caithness, found unregistered in the collections.

o NMS.G.1981.3 comprises a collection of Lower Carboniferous plants from the Midland Valley of

Scotland, found unregistered in the collections but almost all from Charles Peach's collection.

o NMS.T.1999.44 comprises Charles Peach's recently acquired microscope and associated items including a hand-illustrated notebook and glass microscope slides (many of which pertain to marine biology rather than geology).

o NMS.G.2007.28 (ex collection of C. W. Peach) is a newly accessioned lot which encompasses all the microscope slides found previously unregistered in the NMS palaeobotany thin section cabinet.

Of course, the later, retrospective, accessions doubtless include material which 'should' come under the original acquisitions, especially the 1887 one, but cannot now be positively linked to them.

Stace *et al*. (1987) listed the following entries for collections relating to Charles Peach held within the then Royal Scottish Museum Geology collections (now NMS):

o Carboniferous fossil (1) from Lanarkshire (this is the *Aviculopecten* listed above).

o Approx. 500 Devonian and Carboniferous fish from Scotland and England.

o 3 Ordovician fossils from Cornwall.

o 47 fossil shells from the Boulder Clay of Caithness.

The recognition of this sizeable palaeobotanical collection held at this institution adds an important record to this list, both in terms of subject matter and sheer quantity. Further odd candidate specimens continue to turn up and to need assessment, but we believe that we have located the bulk of this plant material, in the form of some 300-odd macrofossil specimens (mostly Carboniferous with a few Devonian and Jurassic plants) and a number of mounted thin sections constructed by Peach himself.

Peach's Collecting Localities

Peach's palaeobotanical collection held at NMS predominantly consists of Carboniferous fossils, reflecting his proximity to nearby localities and therefore collecting opportunities during the period 1865 - 1886. However, a small proportion of Devonian and Jurassic fossils augment this main body of the collection. Lower Devonian fossil plants are represented by a suite of 10 specimens from Turin Hill, near Forfar, collected on the "10th of October 1871" [Tuesday]. These may indicate a link to local fossil collectors in that area whom Peach may have met at the 1867 BAAS meeting in Dundee - the Turin Hill locality was the collecting patch of the local landowner, Mr James Powrie (1815-1895) of Reswallie (Davidson and Newman 2003), who was also Vice-President of the EGS at the time Peach was an Associate. The Middle Devonian plants originate from a variety of localities in Caithness and Orkney but do not always have associated find date information: Castlehill, Thurso (NMS.G.1959.15.53 - 4 November 1861), East Mey, Thurso (22 May 1857), John o' Groats, Thurso, Island of Stroma (24 June 1859 - NMS.G.1959.15.71; 19 June 1863), Ackergill Castle, Wick (NMS.G.1959.15.60 - 18 September 1858), Harland Wick (NMS.G.1959.15.50, NMS.G.1959.15.61), Thurso, Canis Bay (NMS.G.1959.15.77; 23 July 1862) and Dale Quarry, Stromness, Orkney (NMS.G.1959.15.75, NMS.G.1959.15.78). Some of those dateline points indicate that Peach visited and collected from some Middle Devonian sites in Caithness and Orkney after his retirement but prior to his move to Edinburgh in 1865.

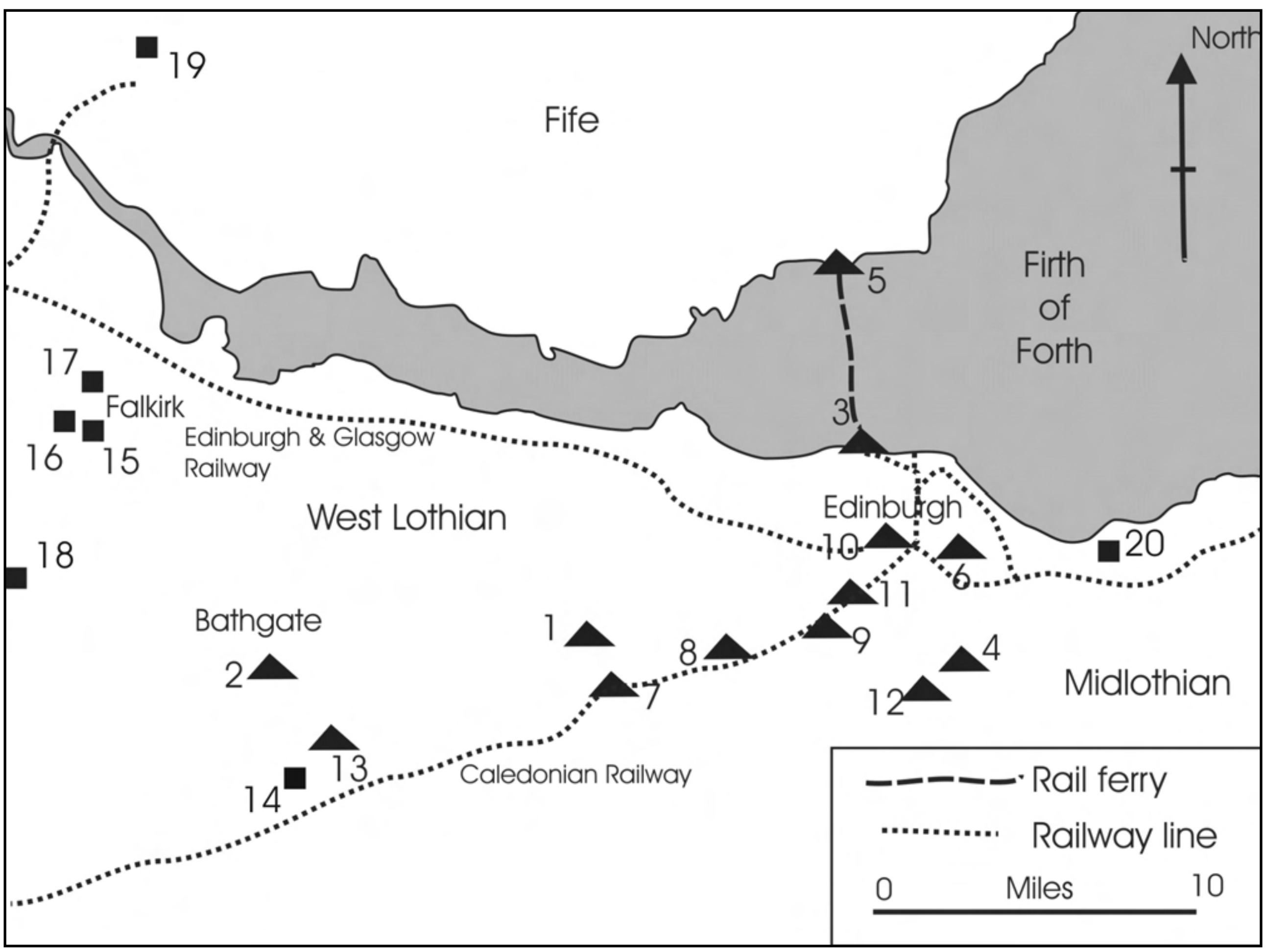
Two important questions are when Peach first started his system of annotation, and when he started using it systematically (if this was later). The earliest fossil plant displaying this form of labelling was collected on 22 May 1857, but it was only after Peach ventured amongst the Carboniferous fossils in the neighbourhood of Edinburgh that the usage becomes regular, at least as far as the plants are concerned. Possibly this reflects the sheer volume of material he was now collecting. However, another interpretation is that he had been advised, perhaps by a fellow palaeontologist or a previous purchaser, as to good practice in labelling which could increase the scientific and monetary value of his finds. One such occasion relating to improved labelling and documentation could well be the purchase of some of his collection by the Geological Survey in 1856. But it is possible to point also to his more general association with Survey workers - not least his own son Ben who would have been heavily indoctrinated with Survey practice at the School of Mines, which Ben attended in 1860-61, even before starting at the Survey. The Survey had found during the 1840s that they could better do the job of collecting by ensuring that appropriate information (for their purposes) was gathered with the fossil at the same time (Knell 2000). One interesting point, however, is that Peach never seems to have adopted a continuous numbering system for his own collection. Was this because he was accustomed to seeing chunks of it move on to other homes? It cannot be out of ignorance as he was, during his Edinburgh years, carrying out just such a numbering scheme on the collection of Hugh Miller. Indeed, this curatorial work may well have acted to reinforce the link with Survey practice given that the Survey in Scotland was, right from the start, associated with the Museum, with its offices just round the corner on George IV Bridge, and its collections housed and largely displayed in the Museum until 1950 (though legally and, to begin with, practically and physically separate from the Museum's own collections: Flett 1937, Allan [1951], Waterston 1997). This was doubtless partly for administrative convenience - both were initially part of the Department of Science and Art of the Civil Service - but it must have facilitated any interplay between their respective staffs.

The anomalous Jurassic fossils are surprisingly simply explained: they were collected from Collyweston and from Sheep End Pit, Wansford near Northampton, on 29 September 1875, the eve of Peach's 75th birthday. No doubt he was attending a family gathering in his honour and took the opportunity to collect in the area of his childhood (or, possibly, purchase them from the local quarrymen): only to be expected of such a keen fossil collector - and a birthday treat in its own right.

Localities in the Carboniferous

The Upper Carboniferous (Pennsylvanian) and Lower Carboniferous (Mississippian) are both exposed in close proximity to the city of Edinburgh (Figure 3). On modern interpretations, the Lower Carboniferous sediments of the Lothians were laid down in an extensive inland body of water known as Lake Cadell (Loftus and Greensmith 1988) whose shoreline was fringed with coal-producing swamps.

Figure 3. Locality map of Carboniferous localities from which Charles Peach collected. Lower Carboniferous localities are denoted by triangles, Upper Carboniferous by squares. Numbered localities on the map are identified as follows: 1. Addiewell, Stoneyburn, west of West Calder; 2. Bathgate, West Lothian; 3. Battery near Granton; 4. Burdiehouse Quarry; 5. Pettycur, Burntisland, Fife; 6. Camstone Quarry, Arthur's Seat, Edinburgh; 7. Currie railway cutting; 8. Camps Quarry, East Calder, West Lothian; 9. Colinton railway cutting, Edinburgh; 10. Lochend Quarry, Edinburgh; 11. Slateford railway cutting, Edinburgh; 12. Straiton, Midlothian; 13. West Hermand, West Calder, West Lothian; 14. Black Rig, Slamannan, West Lothian; 15. No. 1 Station Pit, Falkirk; 16. Brickworks, Falkirk; 17. Shieldhill Burn, Falkirk; 18.The Cleuch, Falkirk; 19. Devonside, Tillicoultry, Clackmannanshire; 20. Musselburgh Old Pit, Midlothian.



These sediments included freshwater limestones, oil shales, and at least one centre of volcanic-related hot spring activity, the East Kirkton limestone (see Rolfe *et al*. 1993) which was known from the time of Scouler in 1831 as recorded by Hibbert (1836). Upper Carboniferous sediments comprise the filling of the Midlothian coal basin, a large synclinal feature whose axis runs broadly SSW - NNE. Much collecting effort had already been concentrated on the Carboniferous in the immediate vicinity of Edinburgh by Peach's friend Hugh Miller (Anderson 2005), and other workers, as the Nature obituarist (Anon. 1886, p. 447) noted, but Peach extended discovery still further,

> "… devot[ing] himself with all his old enthusiasm to the exploration of the fossil flora of the Carboniferous rocks of that neighbourhood. Nothing seemed ever to escape his notice, and hence even from the quarries and sections where many a practised eye had preceded his own he was able to glean materials which no one but himself had noticed."

Peach visited sites such as the Granton and Craigleith quarries to the north-west and the Burdiehouse mines to the south of the city (all now within the present city boundary). Importantly, though, Peach widened his net of enquiry and palaeobotanical digging beyond the immediate vicinity of the city. This seems to have been facilitated by the growing network of railways serving the towns, industries, and extractive workings for coal, ironstone, lime and oil shale in the central belt of Scotland, for his collecting explored the area particularly to the west of Edinburgh in West Lothian. Tables 1 and 2 list these various localities and the dates on which Peach recorded collecting specimens from them.

Patterns of Collecting

The Upper and Lower Carboniferous localities can be broadly grouped into three main collecting areas namely: Edinburgh city and environs; West Lothian; and Fife and Clackmannanshire to the north of the Firth of Forth. The fossils collected from around Edinburgh are relatively easy to explain; these represent Charles Peach's home collecting patch at the time, within walking distance helped by a bus or tram. Those in West Lothian are located further away, but were still reachable by way of a short train journey from the city of Edinburgh. The Fife and Clackmannanshire fossils were also reasonably easily reached by ferry and train. Moreover, they may reflect a collecting link with his son Ben Peach. who had been tasked with mapping the coalfields of Fife. We conjectured that either his father Charles tagged along on Geological Survey fieldwork in the area (not outwith the bounds of possibility considering his previous association with Murchison), or simply that they conversed on the latest findings providing Charles Peach with an up to date knowledge of active mining in the area and possible sources of fossil plant material, as well as contacts to exploit where permission was needed. This turns out to have happened around Falkirk, Stirlingshire, where Ben "pointed out the most likely spots" and where Peach benefited from the "great kindness of all connected with the … coal-works, for so freely doing all in their power to help him in his pursuits" (Peach 1873a).

Of course, even a sprightly sixty- or seventy-something-year-old like Charles Peach would need cheap transport to get to where he could collect. With the development of the growing British railway network arrived new opportunities to investigate newly blasted and dug sections through the bedrock of the region, but - just as important - also to travel more widely without needing one's own horse or private road vehicle. Freeman (2001) describes in detail the use made of railways in the development of geology at this time (also Allen 1994). The relative smallness of Peach's pension suggested to us that this practical issue of regular and convenient access at low cost might have had a real bearing on his interest in Carboniferous fossils. Peach's collection in NMS apparently has few or none of the fossils of the Silurian inliers in the Pentland Hills to the south of Edinburgh, and it is probably no coincidence that these sites were some miles' trek from the nearest railway station, which was on a quiet branch line. By contrast, the mineral wealth of the Coal Measures, and also the limestones, and the associated growth of industry and population, ensured a dense railway network over much of central Scotland. The distribution of Peach's sites does indeed show a striking coincidence with the main line railways, right down to the furthest reaches in Fife and Clackmannan. To reach the Pettycur site in Fife, for instance, Peach only had to walk less than a kilometre from home to Scotland Street Station in north-central Edinburgh, whence he could catch the train from central Edinburgh to Dundee in those days before the opening of the Forth Bridge (Marshall 2001). This would bring Peach to Granton Harbour, and a connection with the passenger ferry steamer across the Forth to Burntisland, whence he could get to Pettycur by way of a brief ride on the connecting train to Kinghorn station and a short walk, or by a longer walk from the ferry terminal. Peach is known to have taken at least one geological holiday as when he stayed in Falkirk for "change of air, as well as for the purpose of a search in the coalfields for fossils" (Peach 1873a).

Locality	Date	Day
Addiewell	25 April 1871	Tuesday
Bathgate, West Lothian	October 1871	[no specified date]
	28 June 1872	Tuesday
Battery near Granton	16 June 1877	Saturday
Burdiehouse	17 October 1868	Saturday
	13 April 1870	Wednesday
	22 July 1876	Saturday
	1878	[no specified date]
Burntisland	20 June 1876	Tuesday
	7 October 1876	Saturday
	9 October 1876	Monday
	23 August 1878	Friday
Burntisland (Grange Quarry)	1868	[no specified date]
	1870	[no specified date]
	1872	[no specified date]
	1876	[no specified date]
	1878	[no specified date]
	12 September 1880	Sunday
Camstone Quarry, King's Park		
Currie railway cutting	15 July 1871	Saturday
Camps Quarry, East Calder	18 May 1878	Saturday
Colinton railway cutting	1874	[no specified date]
Lochend Quarry, Edinburgh	19 December 1870	Monday
Slateford railway cutting	1 September 1871	Saturday
	18 September 1868	Wednesday
Straiton, Midlothian	28 September 1868	Monday
West Hermand – West Calder	28 May 1874	Thursday
	20 June 1874	Saturday
	28 June 1874	Sunday
	20 July 1874	Monday
	10 May 1876	Wednesday
	28 June 1876	Wednesday
	6 July 1876	Thursday
	8 July 1876	Saturday
	10 July 1876	Monday
	27 July 1876	Thursday
	1 August 1876	Tuesday
	23 August 1876	Wednesday
	16 October 1876	Monday
	6 October 1876	Friday
	6 September 1877	Thursday
	18 October 1877	Thursday
	8 May 1874	Friday
	2 May 1884	Friday

Table 1: Lower Carboniferous localities visited by Charles Peach and collection dates.

Railways also, of course, provided cuttings which often had continuous stretches of exposure along their lengths, although tunnels tended to have a brick lining on the inside preventing the inquisitive geologist from collecting there - quite apart from the obvious practical problems and hazards, such as being run over like Hugh Strickland! Another hazard, for those without the access rights of the Geological Survey, was prosecution for trespass on railway company property, under the usual bye-laws obtained by the companies, and Peach would presumably need to obtain permission in advance. Peach's plant collection explicitly lists three railway localities of this kind within the (present) city of Edinburgh, namely railway cuttings at Colinton, Currie and Slateford. This combination immediately suggested that Peach was collecting from the works on the Caledonian Railway's Balerno loop line through Colinton and Currie, off its main Edinburgh-Carlisle line at Slateford (itself already on the main line, and therefore easily accessible). Peach mentions 'Currie new railway' in one paper and 'Colinton railway' in another (Peach 1879, p. 46; 1873b, p. 324). This was indeed opened in 1874 on 1 August (Shaw 1989), after a long construction period, matching the 1871 and 1874 dates on two such 'railway' specimens (see also Table 1; Slateford cutting was already in existence on the main line, it seems, hence the 1868 date). This particular line went through one tunnel and a number of cuttings. Cuttings then and now tend to be best examined just after they have been dug. With time, vegetation growth and weathering can obscure outcrop surfaces, and it is clear that Peach visited the sites when they were fresh.

To assess practicalities further would need minute investigations of the contemporary timetables (especially for day trips) and fares - though we have not so far found any family members living in the relevant areas who might provide cheap accommodation. But it is worth remembering that railway companies were obliged by Acts of Parliament to provide at least one 'Parliamentary' service a day in each direction on each line, with a fixed fare of one (old) penny a mile, as well as any other cheap fares they thought fit to offer, for instance in 'workmen's specials'.

Peach also used upcast material from diggings, at least on occasion (though this one perhaps should be

Locality	Date	Day
Black Rig, Slamman	5 September 1871	Tuesday
	15 September 1871	Friday
Devonside, Tillicoultry	21 September 1871	Thursday
Musselburgh (Old Pit)	24 August 1868	Monday
The Cleuch, Falkirk	22 August 1870	Monday
	22 September 1870	Thursday
	23 September 1870	Friday
	24 September 1870	Saturday
	3 June 1871	Saturday
	17 May 1871	Wednesday
No. 1 Station Pit, Falkirk	August 1870	[no specified date]
Brickwork, Falkirk	1870	[no specified date]
Shield Hill Burn	1870	[no specified date]

Table 2: Upper Carboniferous localities visited by Charles Peach and collection dates

filed under 'quarry' rather than 'public railway'): in May 1874 he found *Sphenopteris affinis* in the "blaes" used to make the formation for a small internal railway for a new oil-shale pit at West Hermand, near West Calder" (Peach 1878a, p. 131; see also Peach 1876b; blaes is a Scots word for hardened clay or somewhat carbonaceous shale: *Chambers Dictionary*).

The pattern of collecting is, however, mildly surprising in that it shows Peach occasionally braving the Scottish Presbyterian Sabbath to collect fossils on a Sunday. This would no doubt have shocked Hugh Miller, that staunch Free Kirker, had he still been around (Knell and Taylor 2006; Taylor 2003), although the ways of the worryingly Godless industrial districts of central Scotland were perhaps not so strict as in the stern rural North. Robert Dick did collect on Sunday, but he had no other free day, and was notably bloody-minded, as well as alienated from his Caithness community (Smiles 1878, pp. 267-269).

We do not, in fact, appear to know anything about Peach's religious views, other than a rather equivocal fragment in a letter he wrote to Charles R. Darwin on 1 May 1871:

> "I have read your last work on the 'Descent of Man' & your two former ones. My son and self possess them - we have them of our own, so that we may take our time and read, mark and crease, & inwardly digest & I am happy to say it does not hinder our digestion or make us unhappy. We take to it kindly & consequently get ourselves - at times - snubbed & even take this kindly. I find people are constantly talking 'Darwinism' (excuse the last word) and do not know it, & when I catch them at it, I quietly help them on & do not let them know that I am doing so. With the "unco guid" I've another way - I quietly ask them whether "they expect when they die, to be, far higher & more glorious etc. in the next world". "Yes of course" they say - "Well then is it more difficult for God to bring us from a lower form, than it is to make us a higher when we have done with this world". They try to shuffle, but I pin them to it & you would smile to see how puzzled they are." (CUL DAR 174)

This only really indicates Peach's views on evolution. It cannot be assumed to indicate his views on religion, given the wide variety of Christians who accepted evolution with or without natural selection - although it is pretty obvious that Peach presumably did not subscribe to the more extreme or more literally minded views of the 'rigidly righteous', to quote from Robert Burns' poem *Address to the Unco Guid, Or the Rigidly Righteous*. This is whence Peach's expression came, perhaps directly - 'unco guid' being Scots for 'uncommonly good'. Peach's biographers, including Smiles, are silent on Peach's religious views, suggesting that Peach's feelings one way or another were not notable, at least by the then conventional standards. Smiles, a Scot then safely across the border in England, was not shy of noting Dick's heterodox views on the Sabbath and how he expressed them to Peach - to whom, perhaps revealingly, Dick complained about his compatriots' views on his own country walks on Sunday (Smiles 1878, pp. 155-158, 267-269). But it should be remembered that Smiles normally refrained from discussing his subjects' religious views (Jarvis 1997). Jarvis argues, we think correctly, that Smiles' unhappy experiences of organised religion, especially the more severe end of the Scottish Presbyterian spectrum, led him to a discussion of Dick's views which was in itself unusual but did enable him to retaliate by portraying the local unco guid as Pharisees who contributed to Dick's martyrdom.

It may or may not be significant that Peach's son, the first Benjamin, was christened at the Presbyterian Higher Meeting at Sidmouth, Devon (see appendix); it may simply have reflected his wife Jemima's wishes rather than his. Peach 'though reared in an inn … abstained from liquor for the rest of his life' (Smiles 1878, p. 241; however, 'liquor' might refer only to strong drinks such as brandy and this does not necessarily exclude the temperate use of weak drinks such as ale). However, this is not in itself conclusive evidence of Nonconformism. As Smiles suggested (but declined to state outright), it may simply have been Peach's reaction to his upbringing in the Wansford village pub, where he refused drink as a child. Alternatively, we suggest that it was linked to his employment in the Revenue Coastguard Service - either a reaction to the ne'er do well characters he encountered (and sometimes fought) whilst on active duty or simply a common-sense precaution given his position and the illicit source of much of the liquor available in the countryside. But, in any case, Peach would have been born and bred into at least some of the lax ways of the English, who, as Miller sardonically noted (Taylor 2007), all too often tended to devote Sunday to fishing and lolling on the grass, and drinking ale with their plum pudding.

In the following section, we make some preliminary observations on some of the localities represented and their wider relevance to palaeobotany.

Edinburgh city and environs

Due to the subsequent development and growth of the city of Edinburgh, Peach's localities cannot all now be visited (or sometimes even accurately fixed). For example, the Craigleith Sandstone quarries are now filled in and the site of an outlet of a major supermarket chain (McMillan *et al*. 1999), while the Granton quarries were overtaken by flooding and industrial development. However, some localities associated with the seemingly eternal landscape of the city can still be visited. In particular, Peach collected fossil plant material from quarries on the flank of Arthur's Seat as well as close to the present day Holyrood Park.

o **Craigleith** - Sixteen glass-mounted ground sections (one dated 17 May 1873) from this locality are amongst the microscope slide collection. The Craigleith sandstone quarries sourced much of the distinctive building stone for the city of Edinburgh including Holyrood Palace and Edinburgh Castle (McMillan *et al*. 1999). During their operation, the workings often revealed *in situ* permineralised tree trunks and these palaeobotanical peculiarities drew attention. The fossil tree trunk which sits in the gardens directly outside the Natural History Museum, London, is today perhaps the best known example from Craigleith. Another, situated outside the buildings of the Royal Botanic Garden Edinburgh, appears to be the famous tree of 1830. When this was discovered, part went to the Garden and part to what was then the Natural History Museum of the University of Edinburgh (College Museum acquisitions register, item 26 for 1831-32, NMS Library). This latter part was moved to the new Museum somewhat belatedly in 1869, and set up on display in an outdoor enclosure at the front (*Scotsman*, Thursday 8 July 1869). Subsequently the Museum portion was moved to the Botanic Garden and reunited with the rest of the tree, apparently in late 1873 or 1874, we suspect as a direct result of the renewed interest in those trees as the result of new finds in 1873 (Anon. 1874, Christison 1874). Peach had obtained a fragment of the 1830 tree, which he subsequently polished on the 17 May 1873 [Saturday] (lowermost image, Figure 4), as part of a compara-

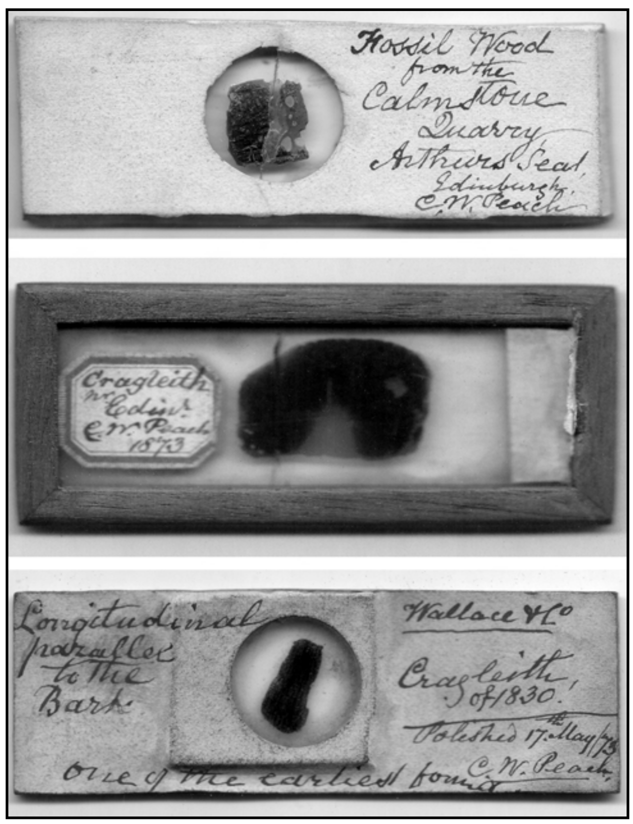


Figure 4. Three hand-made microscope slides varying in size, material of construction and labelling style assembled by Charles Peach. The upper slide is a ground section of fossil wood from Arthur's Seat in the city of Edinburgh. The middle slide has a wood frame and a characteristic handwritten ink inscription on an irregular octagonal paper label. The lower slide documents a section of fossil wood from the original 1830 tree hand polished by Charles W. Peach on 17 May 1873.

tive study of several trees from Craigleith and elsewhere in the district (Peach 1873d). This may well be one of the 'several sections' which Peach exhibited at a meeting of the Botanical Society of Edinburgh and which he had 'made from portions of the tree found in 1830, given to him by Mr Forbes, the representative of WALLACE & Co., marble masons...' (Peach 1873d). Wallace & Co. may have been involved in the work of removing the Museum section of the 1830 tree and reassembling it at the Museum in 1869, or at the Botanic Garden, or both. How Peach's other sections fit into the story - and what information they hold for modern researchers - still remain to be seen. A complication is that two trees were publicised in 1873, one originally discovered in 1854 (or 1858?) and re-excavated that year (apparently that in London), and a rather smaller second example (for this and the complex story of the Craigleith and other local fossil trees, see e.g. Anon. 1874, Christison 1874, Edwards 1932, Long 1979, and Witham 1834; Mr Graham Hardy [pers. comm. 2007] kindly advises us that the RBGE Archive also holds letters to and from Professor John Hutton Balfour concerning the Craigleith Trees, e.g. John Hutton Balfour Correspondence Volume III. Letters C109-110, C112-117, RBGE).

o **Arthur's Seat** - This dominating landmark within the city of Edinburgh is the core of a Carboniferous volcanic centre. Unsurprisingly enough for a geological feature sat so prominently in the Edinburgh skyline it has attracted the attention of numerous geologists over time and is indeed still used as a field excursion locality for undergraduates at the University of Edinburgh. Herbert (2005) noted that Charles Darwin as an undergraduate attended a practical field excursion to the area given by Professor Jameson here, and he was later to return to the site after his experiences in various South American volcanic landscapes on the 'Beagle' expedition. Three of Peach's glass-mounted thin sections of ground and polished fossil wood were derived from the environs of Arthur's Seat. A further five sections are identified as coming from Camstone Quarry (Peach variously spelled this "Camstone" or "Calmstone" as can be seen in Figure 4). Peach's interest plainly lay in the plant fossil-bearing sediments surrounding the volcanic complex rather than the igneous rocks themselves. These sediments of the Lower Carboniferous Cementstone Group often yielded permineralised plant remains (presumably as a result of circulating hydrothermal waters associated with volcanic emplacement).

o **Musselburgh Old Pit** - Coal mining in this area exploited rocks of Upper Carboniferous age. Hugh Miller's equivalently aged collections from the Musselburgh area originated from rocks on the shore section (Anderson 2005). This presumably indicates that Charles Peach was investigating a locality that was either newly opened or reopened since 1856, or that he had obtained permission and access to collect there, where others had not. Alternatively, it could just be a geographical description rather than a true locality name.

Fife and Clackmannanshire

The Fife localities are dominated in the collection by those exposures close to the south coast of the region at Burntisland and Pettycur. Here, to the present day, permineralised plant fossils associated with volcanic tuffs and ash beds outcrop on the beach.

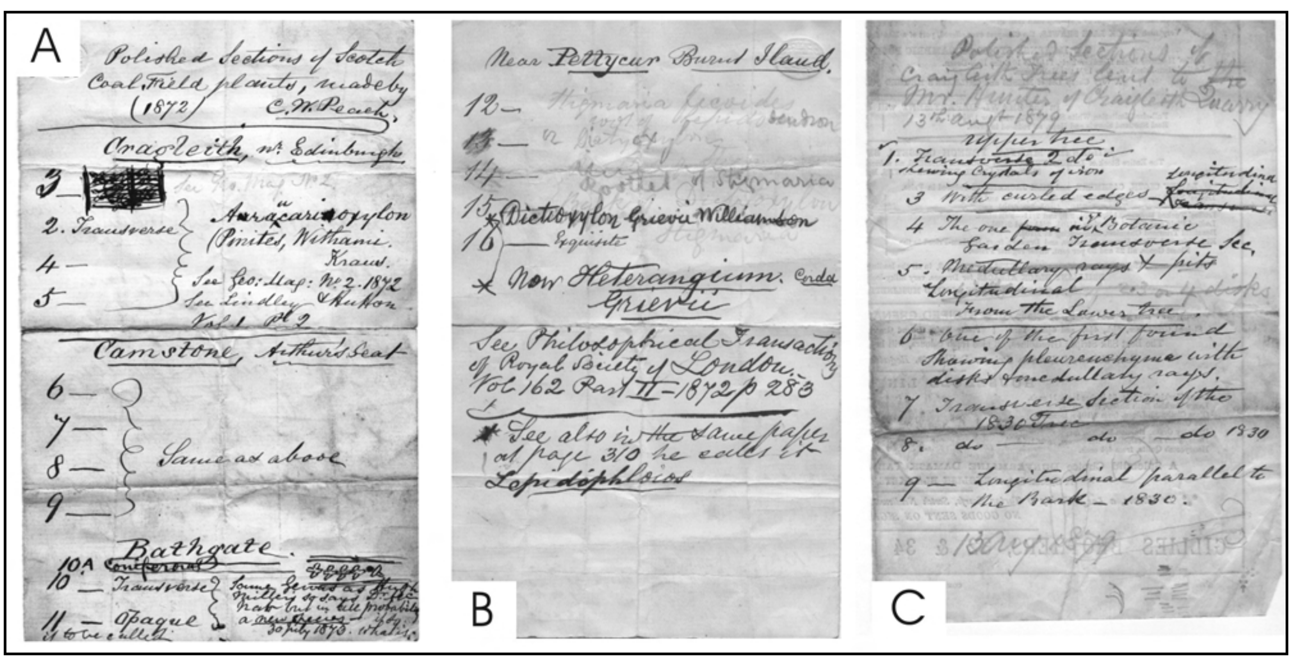
o **Pettycur** - This Lower Carboniferous (Mississippian) locality near Burntisland in Fife [GR NT261862] is now renowned for its permineralised plants preserved in volcanic ash (Gordon 1909; Rex and Scott 1987). The Peach collection contains 30 glass slides of varying shapes and sizes, and not of standard thin section dimensions (i.e. 76 x 26 x 1mm), with attached ground sections of permineralised plants (Figure 5). This suggests that they were prepared by Peach himself as either specimens or materials became available, given the 1871 date on the slides. Possibly Peach was responding to the first reports of anatomically preserved plants from Pettycur by the eminent palaeobotanist W. C. Williamson (1871) onwards. Or alternatively, he may have had a hand in the initial discovery of the site. Even within a range of the hand-made glass slides, there is variation in the naming of the locality employed varying between 'Petticur' and 'Pettycur'. Present-day maps use the latter spelling, but local use tends towards the former.

West Lothian

The West Lothian localities all appear to be on the site of active (at that time) mining activities for either coal or oil shale. For instance, Addiewell (Locality 1 in Figure 3) is where in the 1860s, James 'Paraffin' Young built a refinery to exploit the local oil shales (Butt 2004). Interestingly, the NMS register records that "Messrs. Galletly and Lumsden, oil shale works … Addiewell", presumably the managers, donated 10 fossil plants in 1875, which suggests the possible present-day location of those specimens described by Peach (1876c); this material may be, or in addition to, the collection held at 'Young's Oil Company' at Addiewell mentioned by Thompson (1880) who also figured at least one specimen from Peach's collection.

Figure 5. Above. Hand-made glass-mounted thin sections of Pettycur plants, demonstrating the variation in size and shape of the objects. The writing in ink is in Charles Peach's hand. Note also the variation in spelling of the locality name 'Pettycur'.

Figure 6. Below. Face and reverse of paper documents accompanying the palaeobotanical thin sections with Charles Peach's identifications and notes. Those confirm that the thin sections in the collection relate to Charles's handiwork.



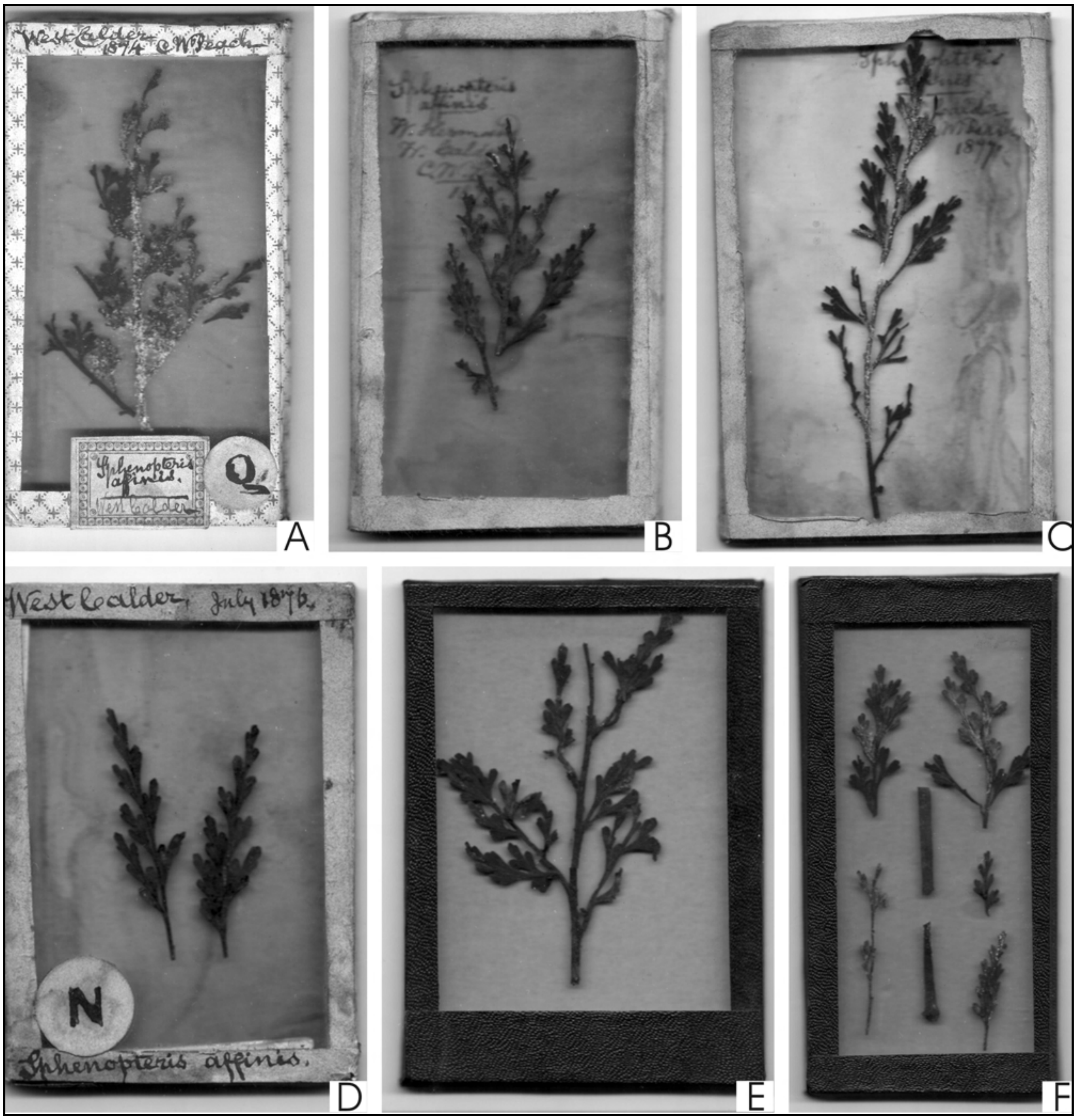


Figure 7A-F. Glass-mounted 'palaeoherbarium sheets' of Lower Carboniferous plants from West Lothian. A. NMS.G.2007.28.7; B. NMS.G.2007.28.1; C. NMS.G.2007.28.4; D. NMS.G.2007.28.6; E. NMS.G.2007.28.3; F. NMS.G.2007.28.2.

The West Hermand - West Calder localities appear to have received by far the most intensive fieldwork effort. This repaid Peach in that his efforts in the field, and the collections that he assembled, once more attracted the attention of other workers in geology and palaeobotany. In a letter to Sir Charles Lyell, the palaeobotanist William Carruthers wrote that fossil plants collected from coal at Falkirk [written in the most general of terms] by "Mr Peach" had been crucial in solving a problem of plant relationships on which he had been working (GB 0237 Sir Charles Lyell Gen. 109 Lyell 1/546-547 [NAHSTE]). Carruthers had become a fellow member of the Royal Physical Society of Edinburgh on Wednesday 24 November 1858 and was no doubt aware of Peach's activity through this avenue of contact.

Some of the West Lothian material displays a typically 'Peachian' solution to the preservation, presentation and ease of study of some of his collection. In the case of original plant cuticles from West Calder, West Lothian, he carefully lifted the plant cuticle from the surface of the rock matrix and preserved it either within two sheets of glass or with a stiff card backing (Figures 7A - F; also Peach 1878a). This technique is unfamiliar to us and we do not yet know whether this involved a strictly physical lift from the surface of the rock or a chemical process, i.e. an early experiment in acid dissolution of matrix. Dr D. M.

Martill has suggested (pers. comm. 2007) that such a chemical process could have involved transfer to a block of wax and then the melting or dissolution of the wax to leave the specimen on glass. Nor do we know how many specimens Peach ruined to achieve each success. We also wonder if this is a unique example, or if other workers also adopted this technique. But, in any case, we see here an early palaeobotanical equivalent of a herbarium sheet, but one containing Carboniferous sphenopsid ferns. The delicate tracery of the plants may have appealed to Peach's aesthetic nature, but it also had its practical value in making the microscopic study of black plant cuticle on an otherwise black rock surface possible as well as preserving the delicate cuticle. At any rate, he used specimens mounted in this way as demonstration specimens, for example of *Sphenopteris affinis* from West Hermand at the Botanical Society of Edinburgh on the 14 May 1874 (Peach 1876b, 1878a). In this case, at least, it may be that he selected this technique partly because of the friability of the original matrix (Peach 1878a, p.133):

> 'To help to set this to rights, I have taken portions of the plant out of the matrix, and placed them in glass, so that they may be well seen. In addition I send specimens in shale, to show how greatly it varies, and also what a magnificent Fern it must have been. I regret that these are so fragmentary. The "blaes," when exposed, are rendered so friable by wet and sun that they fall to pieces. How many fine and good specimens has it been my lot to see crumble to pieces in my hands when trying to secure them!'

Interestingly, Peach ascribed some of the variation in *Sphenopteris* specimens to the annual cycle, from some "showing a wintry appearance", through spring specimens in 'circinate vernation', the uncoiling of young leaves as for example in modern ferns, to fructifications in summer and autumn (Peach 1876d).

Peach and the Edinburgh scientific scene

NMS.G.1959.15.368 (a specimen of *Calamites nodosus*) is a typical Peach Collection fossil plant and is labelled as having been collected from "The Cleuch, Falkirk". The fossil is mounted on a rectangle of stiff card with Peach's usual mix of pen and pencil notes and sketches. On the reverse of the card is an invitation to the Annual Social Meeting of the 'John o' Groat Association' on the evening of Wednesday 14 January 1864 (Figure 8). This was a charitable society set up in Edinburgh to provide relief monies for the needy 'back home' in Caithness, rather than what is now (2007) understood by the same name; a club for those who have completed the journey from Land's End to John O' Groat's (the south-western and supposedly northern extremities of the British mainland) by various means! The John O' Groat Association had held its first meeting on 17 January 1863. Prior to 1877, two separate charitable institutions operated toward the same end within Edinburgh, the Edinburgh Caithness Benevolent Association and the John O' Groat Association, which joined forces in 1877. As far as we can determine from our timeline for Charles Peach, this invitation would have been made a full year before he moved house to live in Edinburgh.

Peach, however, had a number of opportunities to attend specifically scientific societies in Edinburgh and seems to have seized on them with avidity. We outline some of those known to us on the geological side, in which we can demonstrate Peach's more or less significant involvement:

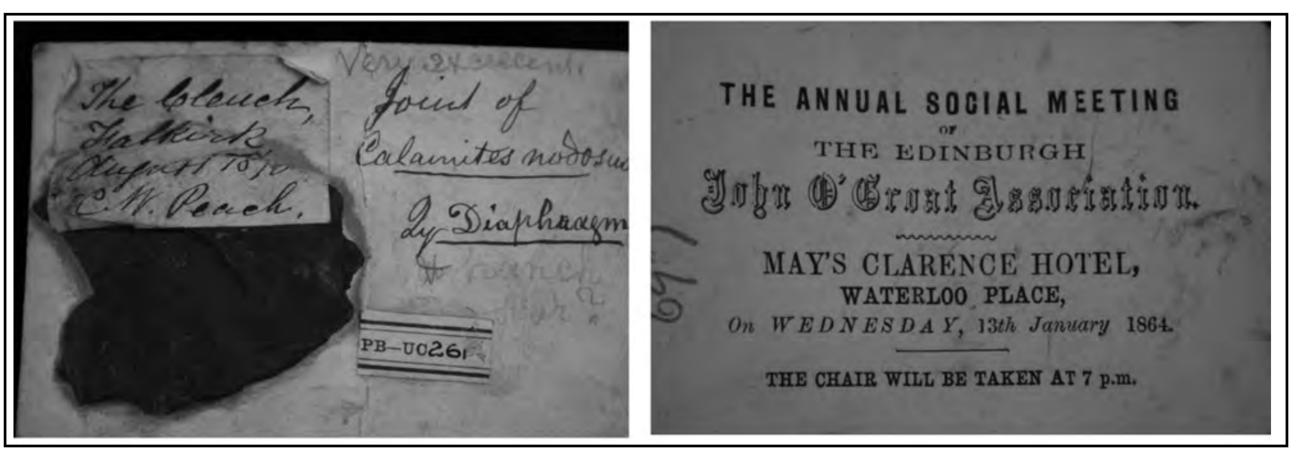


Figure 8. An invitation card to the 1864 'John O' Groat Association' Annual Social Meeting held in Edinburgh. On the back of the card, Peach affixed a fossil of* Calamites nodosus *(NMS.G.1959.15.368) collected from The Cleuch, Falkirk, in August 1876.

Edinburgh Naturalists' Field Club

A report of an outing with the Edinburgh Naturalists' Field Club (Peach 1874a) prompted us to investigate the *Transactions of the Edinburgh Naturalists' Field Club*. This revealed that Charles Peach was listed as an Honorary member of this Club along with four other gentlemen in the 1881 - 1882, 1882 - 1883 and 1883 - 1884 Sessions. The ENFC was first instituted in 1869 for the practical study of Natural History with regular field meetings in the Lothians and Borders for members being held in May, June and July. It was only after the 1879 Annual Meeting that the Council adopted the proposal to hold evening lectures during the winter months. With this switch to evening presentations came the start of published notes of the Club. We therefore cannot determine when Peach joined this club, or the extent of his activities with it, but note that he was aware of the presence of this group of individuals back in 1874, 5 years before the evening programmes began.

Botanical Society of Edinburgh

From its *Proceedings*, as attested in the reference list of the present paper, it is apparent that Charles Peach was a fairly frequent participant in the meetings of this Society, whose archives survive at RBGE. He was never a full Fellow, but was elected an Associate on 13 January 1870. Associates of the BSE are defined as follows in the *Laws and Bye-laws of the BSE, Chapter IV. Admission of Members. Section V. Associates*:

> "The Society shall have power to elect by ballot Associates from those who, declining to become Resident or Non-Resident Fellows, may have acquired a claim on the Society by transmitting specimens or Botanical communications."

What "declining" really means is that Associates were usually working men who could not afford the 12s 6d joining fee and the 12s 6d annual membership fee thereafter that were asked of Resident and Non-Resident Fellows (Mr Graham Hardy, RBGE, pers. comm. 2007). This would be entirely consistent with Peach's known low income and his status elsewhere - for instance his Associateship rather than full Fellowship of the Linnean Society of London, attested by the 'A. L. S.' routinely appended to his name in article headers.

Peach's obituarist in the Botanical Society's *Proceedings* (Taylor 1889, p. 12) noted how in the six years after his election in 1870, Peach "laid before us new finds in fossil botany, and created fresh enthusiasm for its study even among veterans like Professor John Hutton Balfour [1808-1884: professor of botany at Edinburgh: grandson of James Hutton's cousin] and Sir Robert Christison [1797-1882: professor of *materia medica* at Edinburgh but better known for his forensic pathological work in the case of Burke and Hare the serial murderers and body-sellers!]. He received much kindly encouragement from the first of these worthies in making thorough searches in those new localities for fossil plants, then just laid open by industrial enterprise around Edinburgh."

Royal Physical Society of Edinburgh

Peach was also involved in the Royal Physical Society of Edinburgh (RPSE) which provided the most widely used outlet for Peach's various geological writings immediately before and after being based in Edinburgh. This organization is now poorly known, partly because its archives regrettably cannot currently be located, and it is not yet clear how it compared to the Edinburgh Geological Society in terms of its relative attractions to geological and palaeontological folk. It does however seem to have been an important Edinburgh venue for serious natural scientists: effectively a replacement for the long-moribund Wernerian Society which it absorbed in 1858, and without the constraints posed by the selectivity of the Royal Society of Edinburgh. This was apparently so in the 1840s and 1850s (Taylor 2002) and there is no reason to believe that the Society lost any of its status in Peach's years at Edinburgh, when such as Archibald Geikie, Robert Etheridge junior, H. Alleyne Nicholson, and Ramsay Traquair, the Museum's Keeper of Natural History and vertebrate palaeontologist, all served as officers. Indeed, it is to one of these men that we need to turn for an early published history of this Society. Traquair (1903) noted that the Society had begun primarily as a forum for medical discussions, but later changed into a venue for communication of Natural History. During Peach's years in Edinburgh, the Physical held its meetings at 5, St. Andrew Square, Edinburgh. The accompanying publication which ran to three volumes from 1854 - 1866 cost the society dear, particularly in view of the "extremely small annual subscription" (Traquair 1903), and to keep afloat, the Society sold off much of its library of old medical books. Publication of the journal resumed in 1874 under a better financial climate, but interestingly, Traquair gives justification as to why the 'Physical' was able to happily co-exist with the Royal Society of Edinburgh (indeed with many members in common). As he saw it, the Physical covered those aspects of Natural History which the Royal did not to the same extent, the Royal being primarily concerned with the communication of zoological research. It was (Traquair 1903, p. 109):

> "a society to which the older working members may contribute their shorter papers, especially those of local interest, and where the younger men, meeting their elders on terms of common Fellowship, may acquire the art of writing and of demonstrating the results of their early labours."

Peach himself had, even at Wick, been elected a non-resident member in 1850, and was a regular contributor of papers to its meetings, initially *in absentia* but latterly in person, especially after he was elected a full Fellow in 1867 (Anon. 1885). He was evidently well enough regarded, for he served as one of its Presidents from 1869 to 1872. Unfortunately this coincided with the above-mentioned hiatus in the publication of the Society's *Proceedings*. But there is no possibility of confusion with his son Ben who also served as President of the Society, in 1882, for Charles' presidency is recorded in Anon. [1882], while the *Scotsman* newspaper reported that Charles gave his presidential address on "The fossil flora of the Old Red Sandstone of the North of Scotland" on his retiral from the presidency at the meeting of 27 November 1872 (Anon. 1872, also Jack and Etheridge 1877).

Royal Society of Edinburgh

Although Peach was not a Fellow of the Royal Society of Edinburgh, it handsomely acknowledged his work with the award of the Neill Medal for the 1871-74 triennial period "for his contributions to Scottish Zoology and Geology, and for his recent contributions to Fossil Botany" (Geikie 1875, p. 509). Geikie's formal presentation speech on 5th April 1875 provides additional evidence of the high esteem in which Peach was held (pp. 511, 512):

> "Within the last few years he has continued his services to fossil botany [*i.e. carrying on from his ORS work in the north*] by bringing to light new and most interesting vegetable forms from the Carboniferous strata of the basin of the Forth. He has shown, for example, the connection between the flower-like *Antholites* and the usually detached fruit, *Cardrocarpon*, and has obtained in one fossil a conjunction of microspores and miospores. … In every department of natural science to which Mr Peach has given his attention he has distinguished himself as a keen-eyed and enthusiastic collector, with an almost unrivalled shrewdness in detecting what was new, and at the same time a disinterested readiness to hand over his materials to those who had more specially studied the department of natural history to which those materials belonged. For his varied contributions to science, carried on for so long a time, with a purity of motive and a generous helpfulness towards others which have won for him the esteem of all naturalists, and with an enthusiasm which the lapse of more than threescore years and ten has left undimmed, the Council has adjudged to him the Neill prize. I beg on their part to present him to you, with the cordial wish that he may yet live for many years among us as an honoured type of the true collector and naturalist."

The medal was formally awarded for his recent work on palaeobotany and the vertebrate palaeontology of the Carboniferous rocks of the basin of the Forth. It was normally restricted to Scottish recipients, but the Council appear to have bent the rules, to treat Peach as an honorary Scot and to acknowledge also his work before the strict 5 year period of the prize!

Edinburgh Geological Society

In 1871, Peach became an Associate of the Edinburgh Geological Society (EGS) as recorded in Volume 2 of that body's Transactions (for 1869 - 1874). This was at a time when Sir Roderick Impey Murchison was the first Patron of the Society (1863 - 1871) and was soon to be followed by Sir Charles Lyell (1871 - 1875). On the 1883 Members Roll, Peach is still listed as an Associate and a comment just prior to this explains this membership status:

> "Law XVI enacts… The Society shall have the power to elect by ballot as Associates, gentlemen distinguished for their Scientific attainments, and researches, particularly in any department of geology, or who may have claims on the Society by aiding the furtherance of its objects".

Charles Peach participated in the evening lecture series and in the informal display of specimens, and also in the field excursions. His first presentation was on Thursday 16 February 1871 on "Notes on the coalfields at Falkirk", and other contributions followed. Not all became formal written papers in that particular society's published proceedings (though they may well have ended up being published elsewhere); for instance, Volume 3 of the *Transactions,* for the mid and late 1870s, records Peach giving a presentation 'On the Western Highlands of Sutherlandshire' with 'sections and fossils' on 18

March 1875, and 'On some fossil plants from the Carboniferous Sandstone around Edinburgh' on 17 May 1877, as well as one on 20 December 1877 which was formally published as Peach (1880).

A folded newspaper clipping attached to stiff card on which a fossil specimen was mounted (NMS.G.1959.15.132) details a joint excursion between the EGS and the Glasgow Geological Society:

> "On the invitation of Mr James Melvin, Bonnington, vice-president of the Edinburgh Geological Society, the fellows of that and of the Glasgow Geological Society made an excursion on Saturday to the Raws and Camps Quarries, between East Calder and Ratho, for the purpose of inspecting the section of the Burdiehouse limestone exposed in the workings there. Over fifty gentlemen responded to the invitation…" (Anon. 1878).

The specimen in question is labelled as collected on the 18 May 1878 and this indeed corresponds with the Saturday mentioned in the newspaper report (Figure 9).

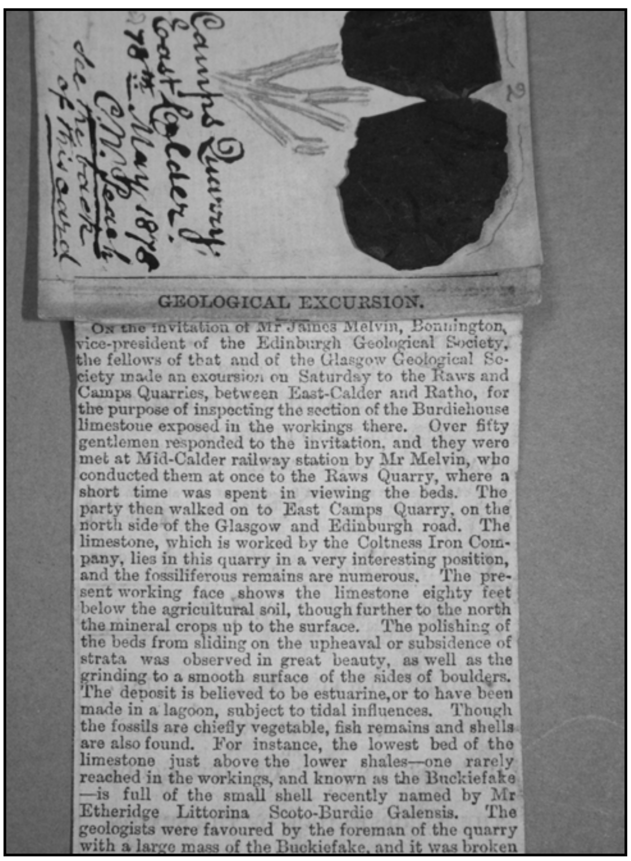


Figure 9. Newspaper clipping reporting a joint field trip of the Edinburgh and Glasgow Geological Societies attached to a specimen that Peach collected on this excursion (NMS.G.1959.15.132; the organ genus* Bowmanites carnbrensis *of the plant* Sphenophyllum*).

The British Association for the Advancement of Science

The BAAS was strictly speaking a national society but we note it here as it was one of Peach's longest-standing venues and its meetings were moreover showpieces for the local savants, and Peach attended several in or near his home ground at this time (Dundee, 1867; Edinburgh, 1871; and Glasgow, 1876), appropriately giving an account of new fossils from around Edinburgh in 1871 (Peach 1872). He himself had been a subscriber since 1847 (*Annual Report* for 1866, list of members) and often attended its meetings, successively distributed around the country, and delivered papers and showed specimens (e.g. Peach 1868, 1869, 1870a, 1872, 1877).

Peach's final years of collecting

We like to think that Peach was obviously both mentally and physically active in the field of geology even in his 78th year, as the dates on the fossils show. Indeed, given Peach's age and the ambiguity of the verb 'to collect', which can mean to collect in the field, or to amass a collection of specimens which may or may not have been found by others, we wondered whether Charles Peach was actually doing his own field collecting. Did others do it for him? For instance, was Ben collecting specimens to take home for his father? This last is unlikely, for Ben's personal collecting was almost certainly strictly controlled by his duties to the Survey which would presumably have call on any specimens he found. But it is unlikely that Peach was relying on anyone else to any great degree. The pattern of collecting dates shows repeated visits to specific localities, at any time of the week, which would only fit someone who had plenty of free time - or, indeed, was retired, like Peach himself. Peach did sometimes comment on specimens collected by others, such as *Ulodendron* and *Halonia* 'by Messrs. Galletly and Lumsden' (Peach 1876c). However, he plainly did most of his own field collecting, as testified by many others, notably his *Nature* obituarist as already quoted above, as well as Peach himself (for collecting up to at least 1876, Peach 1873b; 1878a; 1879). In another obituary, the author commented that he had known Charles Peach for over 20 years, and reflected (Taylor 1887, p. 327):

> '... many a time ... while accompanying him along crag or sea-coast, we wondered whether the lithe old man shone most as an example of the successful pursuit of knowledge under difficulties, or as a walking testimony that out-of-door natural history studies conduced to a happy old age.'

Smiles, writing probably of April 1878 (1878, p. 393), reported that Peach 'says he is not "an old man". He is still an "old boy". That is what his wife calls him. For he is cheerful, communicative, bright and lively as ever', while the RSE resume of 1882 stated that Peach "still continues to work at his favourite hobby" (Anon. [1882]). However, Peach clearly did suffer a slow decline in his health: "[h]is health has for some time past been failing", noted the *Nature* obituarist (Anon. 1886, p. 447); in the years before his death, Peach's 'natural powers gradually abated, and for over three years he had not gladdened our evening meetings [of the EGS]' (Taylor 1887, p. 327), and indeed Peach's death certificate gave 'age & debility' as the cause. One would expect Peach to have given up fieldwork some while before, if he was doing the bulk of field collecting of the specimens in his collection, and indeed the fossils' dates of collection tail off after about 1876, with a few in 1878 and only odd ones thereafter. This ties in well with Taylor's (1889) estimate of the period of Peach's palaeobotanical work as 1870-6 or thereabouts.

The later curation of the Peach Collection

Perhaps the first step in the systematic classification of the palaeobotanical collections of the then Edinburgh Museum of Science and Art was undertaken in 1882 by Mr. Robert W. Kidston (1852 - 1924) who was temporarily appointed to revise, re-label, and re-arrange the fossil plants, and completed his work during 1883 (Traquair [1883, 1884]). Kidston had attended Botany classes taught by Sir John Hutton Balfour at the University of Edinburgh in 1878 (Liston and Sanders, 2005), and would, later in his career, undertake the description and figuring of the permineralised plants from the Early Devonian Rhynie Chert with A. G. Lang (Trewin 2004). Two years previously, in 1880, Charles Peach's son, Ben Peach, had successfully approached Kidston with regard to Kidston taking an honorary position at the Geological Survey branch based in Edinburgh to deal with their collection of Palaeozoic plants (Liston and Sanders 2005; this collection was, however, confusingly also housed at EMSA!). Kidston's work in Edinburgh made him much sought after, and in 1883, the British Museum (Natural History) contracted him to revise and catalogue their Palaeozoic plants (Liston and Sanders 2005).

A later campaign of curation of the palaeobotanical collections took place in the late 1920s and early 1930s, ending with the compilation of a catalogue in 1935 (Rowatt 1936). It is not yet clear whether it was then, or in Kidston's time, that the system was instituted of labelling the palaeobotanical collections with small rectangular paper labels with printed black ink lettering following a specific format, for instance: "PB-LC XXX", where the first element refers to palaeobotany, the second element the stratigraphical level of occurrence (in this case Lower Carboniferous), and the third element the specimen number (an example can be seen in Figure 8A: PB-UC 261 [Palaeobotany-Upper Carboniferous Specimen 261]). There exists an accompanying handwritten scroll register listing these entries and to it was added in 1959 these museum objects in the general classification scheme of the Geology Department (Lot NMS.G.1959.15). However, the system was never completed.

In 1999, the microscope bought in 1844 and used by Charles Peach was offered for sale to the National Museums of Scotland as it was then (Nuttall 2004). This microscope (NMS.T.1999.40) was accompanied by an illustrated notebook and a few prepared microscope slides. However, during the course of our audit work on the pre-existing NMS collections, further, and unregistered, thin sections bearing Peach's characteristic handwritten labelling came to light. These had apparently found their way into the collections via a different route to that of the microscope purchased in 1999. This portion of the Peach collection is registered as NMS.G.2007.28.

Conclusions

This contribution marks a preliminary study of a remarkable man who in later life became one of Edinburgh's local geological heroes, even if this work is perhaps a little forgotten today by comparison to his major discoveries in Cornish and Caithnessian exile. The pattern of pioneering discovery of new fossiliferous localities which marked Peach's earlier career continued after his retirement and move to Edinburgh in 1865. Peach's workmanlike attitude to natural history is still in evidence later in his career with the hand-made production of microscope slides, his illuminating and effusive comments written on accompanying specimen labels, and his participation in the science that he loved into old age. His detailed labelling has also enabled us to tie in his collecting work with what is known of his life to a surprising degree, even in a preliminary survey. Moreover, the question of the significance of Charles Peach's collecting raises some surprisingly complex issues, and it is to those that we now turn.

Peach poses obvious problems to the historian because of the breadth of his interests across disciplines - palaeontology, marine biology, botany and perhaps even prehistory - and geographically across Britain. It is probably highly significant that, at various times in his early service, he was stationed at Norfolk, where he was said to have found important fossils of elephants from what was presumably the Cromer Forest Bed Formation (Anon. [1882]); at Lyme Regis and Charmouth (if briefly), where he was said to have encountered the local fossils at a time when they were at the height of their impact on British palaeontology, with a commensurate impact on him (1830-1, Anon. [1882]); at Beer not far away, and Torquay and Paignton also in Devon - another classic area for British geology; in Cornwall; in Aberdeenshire; and in Caithness. And each station was only a base for his official duties, so he had much opportunity to roam. In so doing, he could get his eye in on a wide variety of fossils in various states of preservation - something which Hugh Miller travelled to England explicitly to do (Knell and Taylor 2007). Very probably this wide experience was a factor in Peach's making crucial finds in unpromising rocks in Cornwall, and again in north-western Scotland. He also made a wide variety of contacts, some at first sight surprising, such as Alfred, Lord Tennyson. But this is perhaps to be expected, given the potential to meet geologists and natural historians not only on fieldwork - like Murchison in the North - but simply on holiday (often the same thing) or even at their family homes, away from the formality and crowd of the cities. And by attending British Association meetings, as well as the everyday exchange of specimens and information, he would have reinforced and extended his network.

But the problems posed by Peach's range are, strictly speaking, practical rather than fundamental (for all that they mean more work). A rather more intractable problem is how to put him in full context, given the relatively recent development of historical studies of collecting, and especially of the process of collecting (see, for instance, Knell 2000, Torrens 2006, Kohler 2007, and Taylor 2007). One could well argue that Peach expands the known diversity of collectors and their aims. Finds in the field are vital to any science, such as palaeontology, based on such collecting. But from the historian's point of view, Knell (2007b) has commented that collections of fossils are not always of much help, at least in themselves; the historian almost always relies on what the collector has written, such as labels, notes, and letters. Of course, this depends on the collection and the questions being asked by the historian: as Kohler (2007) notes, the history of collecting has often been more concerned with questions about collections - for instance, with the cultural meanings of objects - rather than the practices of gathering those collections. But that dichotomy of result versus process is also a practical problem. By its very nature a substantial collection telescopes years, and often decades, of collecting activity to give the physical results which one sees today. For instance, Hugh Miller's fossils are not usually individually labelled with their date of collection. Thus it is often not clear whether a particular fossil from, say, near Edinburgh was collected in the 1820s, when Miller was a stonemason, or the 1830s, when he was a trainee banker, or in the 1840s and 1850s in his spare time from being an editor. This is a shame, because the early development of Hugh Miller's geological activity is not well understood (Knell and Taylor 2006, Taylor 2007). By contrast, Peach's dated collection sets itself out along the dimension of time with all the informational content that that implies. For instance, one can trace his changing activities with time, as we have done here. But more could be done, such as dating the accessibility of particular fossil localities. This added temporal dimension enables, and indeed forces us, to ask questions about the process of collecting which would not have otherwise been encouraged by a look at the finished collection. But even using the word 'collection' begs an important question, for there is not, and even more to the point there never has been, any one finished and unitary Peach Collection in the sense that one can speak (more or less) of the Hugh Miller Collection.

Another major problem is the tendency of many historians to rely solely on written publications when assessing a worker's significance. This will often lead to bias: a classic example is Mary Anning junior of Lyme Regis, whose actual impact was wildly disproportionate to her nonexistent list of publications (Torrens 1995, Taylor and Torrens 1987). We suspect that such a bias is also true of Peach, who famously made fossil finds which were critically important to resolving debates in Palaeozoic stratigraphy in south-west England, and again in the North-west Highlands). Indeed, one might well come to suspect, even expect - as we do - that Peach's collecting, at any rate after the early years, was far from random (at least within his home range of the time) and was targeted, not merely at rich sites, but at specific scientific questions. Plainly Peach always had the priceless - and often forgotten - advantage of the self-supporting 'amateur': that he could work on what interested him rather than what interested his paymasters (Torrens 2006). He was not primarily a commercial collector such as, say, Mary Anning, who always had to bear in mind the needs of the market for décor fossils alongside the more scientifically interesting finds. Peach's collecting could be aimed at more purely scientific questions (except, of course, insofar as he might have had future sales to the Survey in mind). In this respect, as well as in the level of documentation and (to some extent) the sites selected, Peach's collecting might seem more comparable to that of the fossil collectors of the Geological Survey (Knell 2000, 2007a). However, the analogy breaks down in detail: those Survey fossil collectors tended to be lowly mechanics rather than specialist interpreters in the field, collecting *en masse* as instructed by the surveyors. By contrast, Peach always had the freedom to do what he wanted and to think for himself. For instance, as well as collecting to answer questions he thought were important, or just to enjoy himself, he could, and certainly did, look at fossils in the sense that they were the remains of living things in their own right, rather than the other sense - which Survey work emphasised - that they were labels for strata. It would be an interesting project to analyse how far Peach's collecting work was aimed at resolving the questions of the time - and indeed how far it generated those very questions. To our minds, this seems essential to develop a full modern assessment of the role which Peach - and his fossils - played, for example, in studies of early plants; in the mid-19th century revision of the internal stratigraphy of the Old Red Sandstone which swapped the Lower for the Middle Old Red (cf. the posthumous revisions of Hugh Miller's *The Old Red Sandstone*); and in the palaeobotany of the 1870s (until Peach's activity was seemingly cut short by increasing age).

One might well wonder also how far Peach's collecting was influenced by the changing role and function of museums, given his close association with a number of museums, both as a collector and as an occasional curator, and his personal links (as a father, and as a fellow member of local learned societies) with those who worked in, and with, the Edinburgh museums (if one bears in mind that the Geological Survey in Scotland had a museum-within-a-museum in the EMSA).

We also note that Peach interacted with his contemporaries beyond his written papers. He may, as his Botanical Society of Edinburgh obituarist commented (Taylor 1889, p. 12), have considered "brevity … a chief merit in a scientific communication [Taylor obviously meant the written variety]", and his published papers are indeed short and astonishingly chatty in tone even perhaps by the standards of the time (for instance, see Peach 1878a). But Taylor at once went on to say of Peach's Botanical Society talks that "his brief notices gave no idea of the interest excited by the large sepia drawings, as well as the neat way in which the fossils, [were] often mounted in glass cases so as to show both sides of the stem, and having the special characteristics of each specimen carefully indicated by arrows drawn on paper which was gummed to the stone. From our limited audiences several young workers were thus incited to enter this little-trod field of science." And the impression of a memorable speaker is confirmed by Taylor (1887, p. 329), this time as the Edinburgh Geological Society's obituarist, commenting that when the advance of palaeontological discovery 'treaded on his own toes, [Peach] was among the first to accept the inevitable, only beginning some new research with the old boyish enthusiasm. Thus, his discoveries in its fossil botany helped most powerfully in the recognition of the Old Red Sandstone as a lacustrine deposit. Three lecture cartoons, made at Wick, announced this in graphic fashion, to a popular audience. In the first, the old man of the sea [evidently Peach, who called himself by this name at times: Taylor, p. 327] is sailing in an ancient boat with weird crew over an universal ocean; in the second, he approaches a shallow sea-shore studded with giant fuci; while in the third, he sails into a narrowing bay, the shores of which are adorned with conifers and other trees." To extend his own metaphor, Peach was navigating his own boat, and it is plainly unsafe to assume that he was a passive collector of raw data for the metropolitan elite.

A publication-based study would also miss the distinctive ways in which fossil collections are used. One obvious issue is access for formal research. Today there is a strong, though admittedly not complete, prohibition against publishing formal research based on private collections. In those circumstances any discussion of scientific research can pretty much ignore private collections in favour of public ones, and to treat all collections as common public goods, as Kohler (2007) does. But we think that this is an oversimplification, and that it would be anachronistic to project this attitude back into the mid-19th century, where the dichotomy breaks down. For one thing, many collections which we would think of as 'public', and are now indeed today freely accessible, were effectively private, in the sense that access was only gained by payment of a fee, or by permission of a member or someone in authority, or even both (e.g. the Natural History Museum of the University of Edinburgh, Waterston 1997, pp. 81-2; the Bristol Institution, Taylor 1994). Conversely, there was, as far as we know, no modern prohibition against publishing specimens in a private collection, and some private collections were effectively open to the public in much the modern sense. Obviously, published specimens become, to some extent, public data by virtue of bring published. But the private versus public distinction still mattered, we think. One might well contrast, say, Hugh Miller to Peach. There is no doubt that eminent and not-so-eminent geologists visited Miller's private collection and examined the fossils there (Taylor 2007). But this did not only involve a trip to the outskirts of Edinburgh. It was a visit to a private collection, and this - especially to the Victorians - would always have had the overtones of a social occasion - even if Miller had a horror of social formalities, to be sure, and his museum was in the garden, detached from the house with all its overtones of Victorian domesticity and conduct (Campbell and Holder 2005). There would in any case be the unspoken implication that the collection was always first reserved to the owner's own aims and researches, even if those were put off for a later day, such as during retirement; Miller himself was a busy newspaper editor. But even then these plans might go by the board thanks to an unexpectedly early demise, as in Miller's own case. Public museums were quite different, with the free access they offered to a fully public collection in a convenient central location.

Another factor in public usage is the speed with which the collection becomes available. It seems to us that Peach's collections passed relatively rapidly from the private domain of the collector's cabinet into the public domain of the museum. Peach's fossils might not have moved as immediately as those of a commercial collector, but at least their relative speed of transition to the public domain ensured that Peach's fossils lost little if any of their freshness, which was particularly important if Peach's collecting activity was directed to topical issues. That is not to say that Miller would have been behaving unreasonably by sitting on his collection (which, in any case, he abundantly published in his own very special way). Rather, Peach's way of dealing with his collection, whether or not it was forced by his family finances, increased its scientific usage while still allowing Peach to think of himself as having a collection of his own, rather than being a mere agent for others - a subordinate role which was, in any case, refuted also by his extensive preparation and study of his finds. It will be interesting to know whether those suppositions are confirmed by more detailed study.

One might also reflect upon the practical problems of studying a collection such as Peach's. Even examining the specimens in one museum is a daunting task when they are physically merged into enormous general collections, often across organizational boundaries. And when the collection is only partly curated, it becomes harder to spot its full size and significance, as here. This is unavoidable under the stratigraphical and taxonomic combination under which any collection has to be arranged to be useful for most purposes, and is further compounded by the common curatorial lapses. For instance, the 1887 accession was never completely registered and many, at least, of the plants escaped numbering even under the Kidston system. Many of Peach's fossils therefore became part of the inherited backlog of labelled but unregistered specimens. This lack of full paper documentation meant that they could not be observed even by running one's eye down a register entry. They thus entered a limbo whereby the Peach collection as a whole could only be perceived by long-serving curators with elephantine memories, even if those researchers wanting to see specific taxa were fully satisfied. In this particular instance, an audit, initiated for the primary reasons of a collections move and the necessary tracking of specimens, has been the means of recognising a relatively unknown collection by Charles Peach and perceiving its integrity across the many taxonomic divisions into which it is now split and merged with other collections.

The ability to create such a virtual reconstruction of a now scattered collection is, of course, one key reason for a full computer catalogue. But, as this project shows, it is possible to use such simple audit work to produce useful results immediately. A listing for audit purposes will usually be a pretty barebones effort, if only for reasons of workload (for instance, to avoid the time taken in updating and standardizing stratigraphical terminology), and in the limit it only really needs enough information to identify each specimen unambiguously. But the museum number, and, as in Peach's case, the date placed on the specimen by the original collector, both contribute to that identifiability and should be recorded as two of the earliest pieces of data. In fact, even without the immediate trigger of some event such as a collections move, there is something to be said for a simple audit list to find out just what survives in a collection and where, and to spot obvious errors, anomalies and patterns (by sorting in various ways), before going on to compare this with the registers and other information and generating the full catalogue (for which, in any case, the audit list often serves as an initial skeleton).

Moreover, such a systematic and synoptic survey will familiarise the curator with the range of labelling and flag up issues and queries for further investigation - as indeed has happened here.

This study can only be a preliminary look. Specialist work would be needed in individual areas, for instance of Old Red Sandstone plants and vertebrates, and 1870s palaeobotany, to assess Peach's contributions. And more work has yet to be done on the collections themselves, at least in NMS where - quite apart from the palaeobotany collections, where our work implies there may be unknown figured and cited specimens - there are further Peach specimens in the vertebrate and invertebrate collections. Their omission here reflects, not a bureaucratic division, but simply the practical progress of the audit to date (and the scope of this paper), as well as the probable relative dominance of plants in the Carboniferous rocks which Peach worked during the period in question. Nor should we forget the Peach specimens in other museums and the British Geological Survey.

In the long run we (LIA and MAT) had intended to prepare a full online catalogue of the Peach Collection in NMS, with an introduction and discussion (for which the present paper is essentially a preliminary study). Such a catalogue is, at least for the moment, now in question with LIA's departure to other pastures. But it is clear to us that Charles Peach and his fossils are worthy of further study. And already we have gained an insight, and, we hope, encouraged a fresh look at one of the great local heroes of 19th century geology, the "genial and enthusiastic naturalist" (Anon. 1886, p. 446) who followed his own exhortation (Peach 1880, p. 149):

> "It would be well if all lovers of Old Red fossils were to make known their discoveries and place them where they might be got at … The best of mine are in Jermyn Street Geological, and British Museums, and portions also in the Museum of Science and Art in Edinburgh; and thus, I trust, safely preserved for future use."

Acknowledgements

We thank Dr Yves Candela, Dr Sarah Stewart and Mr Simon Howard (NMS) who provided great assistance in the audit work which brought this material to light, and Ms Pam Babes for discussion of documentation systems. We thank Dr Sara Stevenson (Scottish National Portrait Gallery) for assistance with reproduction of SNPG PGP HA 1761 (a Hill and Adamson calotype of Charles Peach in his coastguard uniform). Dr Alison Morrison-Low (NMS) generously provided us with access to a file of research papers relating to Charles Peach which she and Dr Bob Nuttall had assembled in relation to the study of Peach's microscope, Dr Jason Hilton (University of Birmingham and our former colleague) assisted with information on the Craigleith trees. Professor Simon Knell (University of Leicester) discussed issues concerning collecting practice, and Mr Geoff Swinney (NMS) drew our attention to other references. Mrs Christine Thompson (NMS volunteer) helpfully provided us with information on Ben Peach. Dr Suzanne Miller (formerly Keeper of Natural Sciences) encouraged and supported our research into this area of NMS collections. Mr Graham Hardy (RBGE), initially Ms Tracey Shanks and subsequently Ms Sheila Mackenzie (both NLS) provided archival information from archives in their care. Mrs Vicki Hammond (Royal Society of Edinburgh Journals & Archive Officer) provided us with information on the Neill Medal and the RSE's Council Minute Books. The excerpts used in this work are quoted by permission of the Royal Society of Edinburgh (RSE) from the RSE's Council Minute Books, January 1877 to December 1884, held on deposit at the National Library of Scotland (NLS Acc.10000/22). We also thank the librarians of NMS for their support. We thank the Syndics of Cambridge University Library for the permission to quote an excerpt of CUL DAR 174. Drs Peter Friend, David Norman and Prof. James Secord (all University of Cambridge) provided encouragement and helpful discussion of previous drafts of the manuscript. Dr David Martill (University of Portsmouth) suggested a method by which plant cuticles could be transferred to glass via wax. Figures 4 to 9 are courtesy and copyright the Trustees of the National Museums of Scotland. Mr Stan Waight provided useful information on British Coastguards such as Charles W. Peach through his website (http://www.genuki.org.uk/big/Coastguards/index.html) and email exchanges.
LIA acknowledges funding from the Isaac Newton Trust (University of Cambridge).

References

Publication dates in square parentheses […] refer to inferred, rather than positively known, dates of publication.

Some of the society *Proceedings* and *Transactions* in which Peach published were characteristically published every few years, leading to a variable but potentially substantial time lag, amounting sometimes to 3 or 4 years since the actual delivery of the original spoken paper. We have not found it necessary to deal with this issue in detail here, especially as the written form of the paper might have been revised after delivery and before publication, but it should be borne in mind during further study.

The bibliography of the annual reports of the Edinburgh Museum of Science and Art is, mercifully, explained by Swinney (2002).

The website: http://www.searchforancestors.com/utility/dayofweek.html was of great use in determining which days of the week Charles Peach had been out fossil-collecting.

ALLAN, D.A. [1951]. *Report for the year 1950 on the Royal Scottish Museum*. Scottish Education Department, Edinburgh.

ALLEN, D.E. 1994. *The naturalist in Britain. A social history*, revised edition, Princeton, New Jersey.

ALLMAN, G.J. [1867]. 2. Report of the Edinburgh Museum of Natural History, for the year 1866. Pp. 260-263 in Archer, T. C. *Report on the condition of the Edinburgh Museum of Science and Art for 1866*, published as pp. 253-263 in *Fourteenth Report of Science and Art Department, Appendix F*, and as an extract therefrom, and also as pp. 285-295 in *Parliamentary Papers* (1867) **XXIII** [3853.].

ANDERSON, J. 1865. Notes on some further remains from Keiss, near Wick. *Journal of the Anthropological Society of London*, **3**, 160-162.

ANDERSON, L.I. 2005. Hugh Miller: introducing palaeobotany to a wider audience. In Bowden, A. J. Burek, C. V. and Wilding, R. (eds). *History of Palaeobotany: Selected Essays. Geological Society, London, Special Publications* **241**, 63-90.

ANON. 1872. Royal Physical Society. *The Scotsman*, Thursday 28 November 1872, p. 4.

ANON. 1874. Notice of botanical excursions in 1873. *Transactions and Proceedings of the Botanical Society of Edinburgh* **12**, 54.

ANON. 1878. Geological excursion. The *Scotsman* , Monday 20 May 1878, p. 4.

ANON. [1882]. [Untitled MS account of the life and work of Charles Peach, apparently as part of an application for financial assistance.] National Library of Scotland MS Ac 10073/6 [see text for dating and provenance].

ANON. 1885. List of Fellows. *Proceedings of the Royal Physical Society of Edinburgh* **8**, 517-524.

ANON. 1886. Charles William Peach. *Nature* **33**, 446-447.

BUTT, J. 2004. Young, James (1811-1883). *Oxford Dictionary of National Biography*, Oxford University Press, Oxford [http://www.oxforddnb.com/view/article/30266, downloaded 27 December 2007].

CAMPBELL, I. and HOLDER, J. 2005. Hugh Miller's last house and museum: the enigma of Shrub Mount, Portobello. *Architectural Heritage* **16**, 51-71.

CHAMBERS, R. 1844. The scientific meeting at York. *Chambers's Edinburgh Journal, new series* **47**, 321-324 (23 November 1844).

CHRISTISON, R. 1874. Notice of fossil trees recently discovered in Craigleith Quarry, near Edinburgh. *Transactions of the Royal Society of Edinburgh* **27**, 203-221.

CLEEVELY, R.J. 1983. *World Palaeontological Collections*. 365pp. British Museum (Natural History), London.

CROWTHER, P.R. 2003. The Charles W. Peach (1800-1886) collection of Cornish fossils. *The Geological Curator* **7** (9), 323-328.

DAVEY, F. H. 1911. Charles William Peach, A. L. S. *Transactions of the Royal Cornwall Polytechnic Society* **1** (3), 469-499.

DAVIDSON, R.G. and NEWMAN, M.J. 2003. James Powrie, chronicler of the Scottish Lower Devonian. *Proceedings of the Geologists' Association* **114**, 243-246.

DAWSON, J.W. 1871. On new tree ferns and other fossils from the Devonian. *Quarterly Journal of the Geological Society* **27**, 269-275.

DEAN, D.R. 2004. Mantell, Gideon Algernon (1790-1852). Oxford Dictionary of National Biography 36, 559-560 [online version was used, http://www.oxforddnb.com/view/article/18004, downloaded 5 November 2007].

EDWARDS, W.N. 1932. The fossil tree trunk in the grounds of the British Museum (Natural History). *Natural History Magazine* [London] **3**(21), 164-167.

FLETT, J.S. 1937. *The first hundred years of the Geological Survey of Great Britain*. His Majesty's Stationery Office, London.

FREEMAN, M. 2001. Tracks to a new world: railway excavation and the extension of geological knowledge in mid-nineteenth century Britain. *British Journal for the History of Science* **34**, 51-65.

GEIKIE, [A.] 1875. [Award of Neill Prize to C. W. Peach.] *Proceedings of the Royal Society of Edinburgh* **8**, 509-512.

GORDON, W. T. 1909. On the nature and occurrence of the plant-bearing rocks at Pettycur, Fife. *Transactions of the Edinburgh Geological Society* **9**, 355-360.

HERBERT, S. 2005. *Charles Darwin, geologist*. Cornell University Press, Ithaca, New York.

HIBBERT, S. 1836. On the fresh-water limestone in the neighbourhood of Edinburgh, belonging to the Carboniferous group of rocks. With supplementary notes on other fresh-water limestones. *Transactions of the Royal Society of Edinburgh* **13**, 169-282.

JACK, R.L. and ETHERIDGE, R. Jnr. 1877. On the discovery of plants in the Lower Old Red Sandstone of the neighbourhood of Callander. *Quarterly Journal of the Geological Society of London* **33**, 213-222.

JARVIS, A. 1997. *Samuel Smiles and the construction of Victorian values*. Sutton, Stroud.

KNELL, S.J. 2000. *The culture of English geology, 1815-1851. A science revealed through its collecting*. Ashgate, Aldershot.

KNELL, S.J. 2007a. The sustainability of geological mapmaking: the case of the Geological Survey of Great Britain. *Earth Sciences History* **26**, 13-29.

KNELL, S.J. 2007b. Museums, reality and the material world, pp. 1-28 in Knell, S.J. (ed.) *Museums in the Material World*, Routledge, London.

KNELL, S.J. and TAYLOR, M.A. 2006. Hugh Miller: fossils, landscape and literary geology. *Proceedings of the Geologists' Association* **117**, 85-98.

KOHLER, R.E. 2007. Finders, keepers: collecting sciences and collecting practice. *History of Science* **45**, 428-454.

LISTON, J.J. and SANDERS, H.L. 2005. The 'other' Glasgow Boys: the rise and fall of a school of palaeobotany. In Bowden, A. J. Burek, C. V. and Wilding, R. (eds). *History of Palaeobotany: Selected Essays. Geological Society, London, Special Publications* **241**, 197-227.

LOFTUS, G.W.F. and GREENSMITH, J.T. 1988. The lacustrine Burdiehouse Limestone Formation - a key to the deposition of the Dinantian Oil Shales of Scotland. *Geological Society, London. Special Publications* **40**, 219-234.

LONG, A. G. 1979. Observations on the Lower Carboniferous genus *Pitus* Witham. *Transactions of the Royal Society of Edinburgh* **70**, 111-127.

McMILLAN, A.A., GILLANDERS, R.J. and FAIRHURST, J.A. 1999. *Building Stones of Edinburgh*. 2nd edition. Edinburgh Geological Society, Edinburgh.

MARSHALL, P. 2001. *Burntisland. Fife's railway port*. Oakwood Press, Usk.

MORRISON-LOW, A.D. 1992. William Nicol, FRSE c. 1771-1851 lecturer, scientist and collector. *Book of the Old Edinburgh Club New Series* **2**, 123-131.

MURCHISON, R.I. 1859. On the succession of the older rocks in the northernmost counties of Scotland; with some observations on the Orkney and Shetland islands. *Quarterly Journal of the Geological Society of London* **15**, 353-421.

MURCHISON, R.I. 1867. *Siluria. (4th Ed). A History of the Oldest Rocks in the British Isles and Other Countries; With sketches of the Origin and Distribution of Native Gold, the General Succession of Geological Formations, and Changes in the Earth's Surface*. John Murray: London, pp. 1-566, pl. 1-41.

NUTTALL, R. 2004. 'An Outdoor Man': Charles Peach and the Luminosity of the Sea. *Quekett Journal of Microscopy* **39**, 783-791.

OLDROYD, D.R. 1990. *The Highlands Controversy: constructing geological knowledge through fieldwork in nineteenth-century Britain*. University of Chicago Press.

OLDROYD, D. R. 1999. Non-written sources in the study of the history of geology: pros and cons, in the light of the views of Collingwood and Foucault. *Annals of Science* **56**, 395-415.

OLDROYD, D.R. 2004a. Peach, Benjamin Neeve (1842-1926). *Oxford Dictionary of National Biography*, 43, 232-233 [online version was used, http://www.oxforddnb.com/view/article/37839, accessed 25 Oct 2007].

OLDROYD, D.R. 2004b. Peach, Charles William (1800-1886), *Oxford Dictionary of National Biography*, 43, 233 [online version was used, http://www.oxforddnb.com/view/article/21665, accessed 25 Oct 2007].

PEACH, B.N. 1883. On some fossil myriapods from the Lower Old Red Sandstone of Forfarshire. *Proceedings of the Royal Physical Society of Edinburgh* **7**, 177-188.

PEACH, C.W. 1858a. On the discovery of calcareous zoophytes in the boulder clay of Caithness. *Proceedings of the Royal Physical Society of Edinburgh* **1**, 18.

PEACH, C.W. 1858b. On the discovery of beekite and oolitic quartz at Durness, Sutherland. *Proceedings of the Royal Physical Society of Edinburgh* **1**, 429-435.

PEACH, C.W. 1859. On the discovery of nullipores (calcareous plants) and sponges in the boulder clay of Caithness. *Proceedings of the Royal Physical Society of Edinburgh* **2**, 98-101.

PEACH, C.W.1860a. On the chalk flints of the Island of Stroma and vicinity of John o' Groat's in the County of Caithness. *Proceedings of the Royal Physical Society of Edinburgh* **2**, 159-161.

PEACH, C.W. 1860b. On the occurrence of the Argentine Anchovy, and other fishes, on the coast of Caithness; with a note on the termination of the Vertebral column in the tail of the Salmon tribe. *Proceedings of the Royal Physical Society of Edinburgh* **2**, 256-259.

PEACH, C.W. 1863a. On the fossils of the boulder clay of Caithness. *Proceedings of the Royal Physical Society of Edinburgh* **3**, 38-42.

PEACH, C.W. 1863b. Further observations on the Boulder Clay of Caithness with an additional list of fossils. *Proceedings of the Royal Physical Society of Edinburgh* **3**, 396-403.

PEACH, C.W. 1868. On fossil fishes of the Old Red Sandstone of Caithness and Sutherland, with notices of some new to those counties. *Annual Report of the British Association for the Advancement of Science, Transactions of the Sections*, **for 1867**, 72.

PEACH, C.W. 1869. On the fossil fishes of Cornwall. *Annual Report of the British Association for the Advancement of Science, Transactions of the Sections*, **for 1868**, 76-77.

PEACH, C.W. 1870a. Notice of the discovery of organic remains in the rocks between the Nare Head and Porthalla Cove, Cornwall. *Annual Report of the British Association for the Advancement of Science, Transactions of the Sections*, **for 1869**, 99.

PEACH. C.W. 1870b. On some striped stones from Hayle, near Penzance, Cornwall. *Transactions and Proceedings of the Botanical Society of Edinburgh* **10**, 446-447.

PEACH, C.W. 1872. Additions to the list of fossils and localities of the Carboniferous formation in and around Edinburgh. *Annual Report of the British Association for the Advancement of Science, Transactions of the Sections*, **for 1871**, 109.

PEACH, C.W. 1873a. On *Antholites pitcairnae* and its fruit (*Cardiocarpum*), with other fossil plants from Falkirk. *Transactions and Proceedings of the Botanical Society of Edinburgh* **11**, 108-109.

PEACH, C.W. 1873b. On fossil plants from the coal-fields of Slamannan, Falkirk, Dee-side, Tillicoultry, &c. *Transactions and Proceedings of the Botanical Society of Edinburgh* **11**, 342-343.

PEACH, C.W. 1873c. On a cone of *Flemingites gracilis* attached to its stem. *Transactions and Proceedings of the Botanical Society of Edinburgh* **11**, 356-357.

PEACH, C.W. 1873d. Note on the structure of fossil stems (*Araucarioxylon*) from Redhall and Craigleith Quarries. *Transactions and Proceedings of the Botanical Society of Edinburgh* **11**, 541-542.

PEACH, C.W. 1874a. On the discovery of *Spirorbis carbonarius* in the limestone of Burdiehouse, and of an *Estheria* in Camstone Quarry, Arthur's Seat. *Transactions of the Edinburgh Geological Society* **2**, 82-83.

PEACH, C.W. 1874b. Notice accompanying specimen of *Holoptychius nobilissimus* from the Black Hill, near Melrose, presented to the Society. *Transactions of the Edinburgh Geological Society* **2**, 400.

PEACH, C.W. 1876a. Notice of a new lepidodendroid fossil from Devonside, Tillicoultry, with remarks on other fossil plants. *Transactions and Proceedings of the Botanical Society of Edinburgh* **12**, 99-101.

PEACH, C.W. 1876b. Notes on some fossil plants from the shales of West Calder. *Transactions and Proceedings of the Botanical Society of Edinburgh* **12**, 162 only.

PEACH, C.W. 1876c. Remarks on specimens of *Ulodendron* and *Halonia*, collected by Messrs. GALLETLY and LUMSDEN, near West Calder. *Transactions and Proceedings of the Botanical Society of Edinburgh* **12**, 174-175.

PEACH, C.W. 1876d. Remarks on specimens of some fossil plants. *Transactions and Proceedings of the Botanical Society of Edinburgh* **12**, 187.

PEACH, C.W. 1877. On circinnate vernation of *Sphenopteris affinis* from the earliest stage to completion; and on the discovery of *Staphylopteris*, a genus new to British rocks. *Annual Report of the British Association for the Advancement of Science, Transactions of the Sections*, **for 1876**, 144-145.

PEACH, C.W. 1878a. On the circinate vernation, fructification, and varieties of *Sphenopteris affinis*, and on *Staphylopteris* (?) *Peachii* of Etheridge and Balfour, a genus of plants new to British rocks. *Quarterly Journal of the Geological Society* **34**, 131-136.

PEACH, C.W. 1878b. Remarks on (with a list) some of the organic remains of Cornwall, in the museum of the Royal Geological Society of Cornwall. *Transactions of the Royal Geological Society of Cornwall* **9**, 47-54.

PEACH, C.W. 1879. On fossil plants from the Calciferous Sandstone around Edinburgh. *Transactions and Proceedings of the Botanical Society of Edinburgh* **13**, 46-48.

PEACH. C.W. 1880. Notes on the fossil plants found in the Old Red Sandstone of Shetland, Orkney, Caithness, Sutherland, and Forfarshire. *Transactions of the Edinburgh Geological Society* **3**, 148-152.

REX, G.M. and SCOTT, A.C. 1987. The sedimentology, palaeoecology and preservation of the Lower Carboniferous plant deposits at Pettycur, Fife, Scotland. *Geological Magazine* **124**, 43-66.

ROLFE, W.D.I., DURANT, G.P., BAIRD, W.J., CHAPLIN, C., PATON, R.L. and REEKIE, R.J. 1993. The East Kirkton Limestone, Viséan, of West Lothian, Scotland: introduction and stratigraphy. *Transactions of the Royal Society of Edinburgh: Earth Sciences* **84**, 177-188.

ROWATT, T. 1936. *Report for the year 1935 on the Royal Scottish Museum*. Scottish Education Department, Edinburgh.

SALTER, J.W. 1858. On some remains of terrestrial plants in the Old Red Sandstone of Caithness. *Quarterly Journal of the Geological Society* **14**, 72-76.

SALTER, J.W. *In* MURCHISON, R. I. 1859. On the succession of the older rocks in the Northernmost Counties of Scotland; with some observations on the Orkney and Shetland Islands. *Quarterly Journal of the Geological Society* **15**, 353-421.

SECORD, A. 2003. "Be what you would seem to be": Samuel Smiles, Thomas Edward and the making of a working-class scientific hero. *Science in Context* **16**, 147-173.

SHARPE, T. and McCARTNEY, P.J. 1998. *The papers of H. T. De la Beche (1796-1855) in the National Museum of Wales. Geological Series no. 17*. Amgueddfeydd ac Orielau Genedlaethol Cymru/National Museums and Galleries of Wales, Cardiff.

SHAW, D. 1989. *The Balerno Branch and the Caley in Edinburgh*. Oakwood Press, Oxford.

SMILES, S. 1878. *Robert Dick baker of Thurso geologist and botanist*. Murray, London.

STACE, H.E., PETTIT, C.W.A. and WATERSTON, C.D. 1987. *Natural Science Collections in Scotland (Botany, Geology, Zoology)*. National Museums of Scotland, Edinburgh.

STEVENSON, S. 2002. *Facing the Light: The Photography of Hill and Adamson*. National Galleries of Scotland, Edinburgh.

SWINNEY, G.N. 2002. Reporting on the museum: the annual reports of the Edinburgh Museum of Science and Art. *Archives of natural history* **29**, 99-108.

SWINNEY, G.N. 2007. Granny (c.1821-1887), "a zoological celebrity". *Archives of natural history* **34**, 219-228.

TAYLOR, A. 1887. Obituary notice of Charles William Peach, A.L.S., &c., Associate. *Transactions of the Edinburgh Geological Society* **5**, 327-329.

TAYLOR, A. 1889. Obituary notices of C. W. Peach, R. Gray, Rev. W. W. Newbould, and Professor E. Morren. *Transactions and Proceedings of the Botanical Society of Edinburgh* **17**, 11-13.

TAYLOR, M.A. 1994. The plesiosaur's birthplace: the Bristol Institution and its contribution to vertebrate palaeontology. *Zoological Journal of the Linnean Society* **112**, 179-196.

TAYLOR, M.A. 2002. Man of *Vestiges* - Robert Chambers 200 years on. *Edinburgh Geologist* **39**, 32-35; also http://www.edinburghgeolsoc.org/edingeologist/z_39_07.html.

TAYLOR, M.A. 2003. [Introduction, notes, and glossary, etc.] Facsimile edition of Hugh Miller (1858) *The Cruise of the Betsey, with, Rambles of a Geologist*. National Museums of Scotland Publishing, Edinburgh.

TAYLOR, M.A. 2007. *Hugh Miller. Stonemason, geologist, writer*. NMS Publishing, Edinburgh.

TAYLOR, M.A. and HARTE, J.D.C. 1988. Palaeontological site conservation and the law in Britain. *Special Papers in Palaeontology* **40**, 21-39.

TAYLOR, M.A. and TORRENS, H.S. 1987. Saleswoman to a new science: Mary Anning and the fossil fish *Squaloraja*. *Proceedings of the Dorset Natural History and Archaeological Society* **108**, 135-148.

THOMPSON, D'A.W. 1880. Notes on *Ulodendron* and *Halonia*. *Transactions of the Edinburgh Geological Society* **3**, 341-352.

TORRENS, H.S. 1995. Mary Anning (1799-1847) of Lyme; "the greatest fossilist the world ever knew". *British Journal for the History of Science* **28**, 257-284.

TORRENS, H.S. 2006. Notes on 'The Amateur' in the development of British geology. *Proceedings of the Geologists' Association*, **117**, 1-8.

TRAQUAIR, R.H. 1883. Report of the Keeper of the Natural History Collections for the year 1882. Pp. 597-600 *in* Archer, T. C. *Report of the Director of Edinburgh Museum of Science and Art for the year 1882*, published in *Thirtieth Report of Science and Art Department, Appendix G*, and as an extract therefrom, and also as pp. 717-720 in *Parliamentary Papers* (1883) XXVI [C.3271.].

TRAQUAIR, R.H. 1884. Report of the Keeper of the Natural History Collections for the year 1883. Pp. 300-302 *in* Archer, T. C. *Report of the Director of Edinburgh Museum of Science and Art for the year 1883*, published in *Thirty-first Report of Science and Art Department, Appendix F*, and as an extract therefrom, and also as pp. 334-336 in *Parliamentary Papers* (1883) XXVIII [C.4008.].

TRAQUAIR, R.H. 1888. Report of the Keeper of the Natural History Collections for the year 1882. Pp. 238-240 *in* Smith, R. M. *Report of the Director of Edinburgh Museum of Science and Art for*

1887, published in *Thirty-fifth Report of Science and Art Department*, *Appendix F*, pp. 301-308, and as an extract therefrom, and also as pp. 280-286 in *Parliamentary Papers* (1888) XLII [C.5279.].

TRAQUAIR, R.H. and ARCHER, T.C. 1876. Report of the Keeper of the Natural History Collections for the year 1875. Pp. 7-9 *in* Archer, T. C. *Report of the Director of Edinburgh Museum of Science and Art for 1875*, published also as *Twenty-third Report of Science and Art Department*, *Appendix G*, pp. 473-481, and as an extract therefrom, and also as pp. 607-615 in *Parliamentary Papers* (1876) XXVI [C.1543.].

TRAQUAIR, R.H. 1903. Notes on the history of the Royal Physical Society. *Proceedings of the Royal Physical Society of Edinburgh* **15**, 105-109.

TREWIN, N.H. 2004. History of research on the geology and palaeontology of the Rhynie area, Aberdeenshire, Scotland. *Transactions of the Royal Society of Edinburgh: Earth Sciences* **94**, 285-297.

WATERSTON, C.D. 1997. *Collections in context. The Museum of the Royal Society of Edinburgh and the inception of a National Museum for Scotland*. NMS Publishing, Edinburgh.

WILLIAMSON, W.C. 1871. On the organization of the fossil plants of the Coal Measures. Part I. *Philosophical Transactions of the Royal Society of London* **159**, 477-510.

WITHAM, H.T.M. 1834. A description of a fossil tree discovered in the Quarry of Craigleith. *Transactions of the Royal Society of Edinburgh* **12**, 147-152.

Appendix 1: the children of Charles and Jemima Peach

This is a provisional listing based principally on the highly centralised and now accessible Scottish records, and such English records as are currently available on the internet. It has proved impracticable within the time given to do a complete search of English records, as the Peaches, unfortunately for us, started their family well before the June 1837 introduction of centralised statutory recording of births, marriages and deaths in England, and as the statutory records are not yet machine-searchable. The Peaches married on 26 April 1829 (Oldroyd 2004b), when Jemima was about 23, and were said to have had nine children, seven sons and two daughters, of whom seven survived to maturity (e.g. Davey 1911, p. 7). We have been able to trace and identify eight, including supposedly both daughters (Jemima Mary at her death was said to be the 'eldest and only surviving daughter', death notice, *Scotsman*, 2 September 1899) and the youngest sibling in the form of the second Benjamin (Oldroyd 2004a). Two children, both male, died before maturity; one was plainly the first Benjamin, and the other was presumably the child whom we have been unable to trace, and who may well have borne the same name as one of his younger siblings.

Christian names	Date and place (or registration district) of birth	Death	Comments
Charles W[illiam]	7 June 1829 – 30 March 1830, presumably at Cromer, Norfolk.	?before 1882	Middle name inferred on assumption it was after his father. Date of birth from ages of 11 in 6 June 1841 census, 21 in 30 March 1851 census. Place of birth inferred from father's station at the time (Anon. [1882]). Date of death unknown, but he was not mentioned in his father's will of 1882
Benjamin Neeve (1)	1 February 1831, presumably at Lyme Regis, Dorset or less probably Beer, Devon. Baptised 28 February 1831, Higher Meeting (Presbyterian), Sidmouth, Devon	?before 1842	www.familysearch.org for baptism data; place of birth inferred from father's station at the time (Anon. [1882]). Not present in 1841 census and presumed to be dead by 1842 birth of his brother of the same name
William Betts	24 January 1833, Torquay, Devon	?after 1898	www.familysearch.org for birth data and marriage to Caroline Phillips on 2 September 1865 at the Old Church, St Pancras, London; identification confirmed by 1881 census, when the Peaches and their children lived in Enkel St in London, and William was a clerk with H. M. Customs and also registrar for St Giles parish. Apparently still alive when sister Jemima's will was made 6 January 1899 (q.v. below).
Jemima Mary	28 December 1834, Gorran Haven, Cornwall	1 September 1899	Birth data from www.familysearch.org. Date of death from death certificate. Was 'eldest and only surviving daughter' at death (notice, *Scotsman*, 2 September 1899).
Henery [sic] Thomas	7 April 1836, at Gorran Haven, Cornwall	?before 1882	Birth data from www.familysearch.org.. Date of death unknown. Not with family in 1851 census, when he was 15 and may simply have been away from home; was not mentioned in his father's will of 1882.
Elizabeth Sarah (*or* Sara)	Ca. 1 December 1837-15 February 1838, at Gorran Haven (recorded at St Austell, Cornwall)	15 February 1897	Date of birth inferred from age of 59 on death certificate and from recording on birth returns for January-March 1838 (http://www.freebmd.org.uk/cgi/search.pl). CWP stationed at Gorran Haven between 1834 and 1845. Married George Hay, editor of the *Arbroath Guide*, in Wick on 6 December 1860 (www.familysearch.org; death certificate; death notice, *Scotsman*, 16 February 1897)
Joseph James	September 1840, at Gorran Haven (recorded at St Austell, Cornwall)	28 February 1868	Date of birth estimated from age given as '9 mths' in 1841 census, made on 6 June; and confirmed by records for St Austell at http://www.freebmd.org.uk/cgi/search.pl; CWP stationed at Gorran Haven between 1834 and 1845. Date of death from death certificate
Benjamin Neeve (2)	6 September 1842, Gorran Haven	29 January 1926	www.oxforddnb.org and death certificate; said to be the youngest sibling

IF YOUR MINERAL COLLECTION IS IN A FIRE

by Steven C. Chamberlain

Chamberlain, S.C. 2008. If your mineral collection is in a fire. *The Geological Curator* 8 (9): 427 - 435.

In 2006, an accidental fire in the storage facility for a large mineral collection provided a case study in how to approach fighting the fire, how to stabilize the collection immediately following the fire, and how to recover from the disaster as well as possible. If the curator can be present while the fire is fought, calm persistence is beneficial. Too often emphasis rests on saving the structure rather than on saving the contents, and fire fighters need to be told to emphasize minimizing unnecessary damage to the collection. Preserving the card catalogue, of course, is of particular importance.

In this instance, the fire was prevented from burning up any of the collection; however, several kinds of serious damage still occurred: cabinets were thrown out a second storey window to gain access to the fire; smoke and soot coated specimens stored very near the fire; adjacent to where the fire was fought, specimens became intermingling with charred wood, wet plaster board, melted insulation and fire-suppressing foam; and all the other specimens, labels, and cabinets suffered from water damage. These situations require different approaches, which are discussed.

In all these conditions, stabilizing the situation to prevent further damage and to permit cleanup and repair of the storage facility is the first priority and needs to be attended to immediately. Recovery of the collection takes much longer, but can proceed smoothly once the situation is stabilized. Insurance coverage must be adequate to include both repairs to the structure and stabilization and recovery of the collection.

The use of professionals who specialize in fire and flood cleanup is recommended provided they can be closely supervised by the collection's curator. Otherwise, they will probably worry about mould and mildew and throw away all wet and charred paper, including labels and records. Bringing in such a team permits successful stabilization in a shortened time if they are well supervised.

Other lessons learned include: 1) Catalogue the collection and safeguard the catalogue. Be certain numbers attached to the specimens will survive soaking in water and strong detergents (fire-suppressing foam) for days. Many mineral specimens are more durable than you think, but labels are not. Durable storage cabinets can largely protect a collection, but paper labels may be degraded. Write the specimen number on the back of old labels to enable reassociation with the specimens if things get scrambled.

3140 CEC, Center for Mineralogy, New York State Museum, Albany, New York 12230 USA. Email: sccham2@yahoo.com *Received 11th January 2008.*

Introduction

The morning of 6 October 2006 dawned cold and clear-the first really cold morning of the fall. As my wife, Helen, and I were sitting reading the newspaper at 6:45 a.m., there was a flash of lightning. Odd, we thought, for a clear morning. A second flash occurred several seconds later, and we both got up to investigate. As soon as I stepped onto the back porch, I could smell the characteristic odor of electrical sparking. As Helen checked the house, I unlocked the barn where my mineral collection resides. As soon as I opened the door, I smelled smoke. While Helen called 911, I rushed in with my trusty fire extinguisher, opened the door to the workroom, and saw it burst into flame at the site of the electric heater. I discharged my extinguisher to no particular good effect and closed the door, which damped down the fire for lack of oxygen. My workroom is well insulated and relatively air tight.

Five fire companies responded within minutes to a "barn fire" inside the village. Fortunately, the fire chief, whom I know, arrived with the first wave. I told him that the contents of the barn were irreplaceable and asked that they do everything possible to save the contents. He responded by allowing me to help supervise fighting the fire. The first good or bad decision I made was to access the workroom from the outside door instead of the inside door I had earlier opened. My thinking at the time was that firefighters could get lost in the piles of boxes and smoke. As it turned out, had they opened the inner door, the fire would have flamed up under the wooden floor and quite possibly burned down the entire 1860's structure. As it was, they had to break down a 2-inch-thick wooden door. As the door gave way, the fire shot up the outside of the building and under the eaves, igniting the roof through the soffit vents. This happened in the three seconds it took to turn on the waiting hose. The workroom fire was drowned in a matter of seconds. The fire, however, rapidly devoured the dry rafters between the roof and internal plasterboard, fueled by the air rushing from the soffit vents to the ridge vent. The Manlius Fire Department had just acquired and learned to use a thermal imaging system, so they spent the next forty-five minutes tracking the fire in the roof with the imaging system, poking through the roof from inside the building and then flooding it with water from inside.

Figure 1. Side view of the barn showing the external door to the workroom where the fire started. The charred clapboard shows where the fire flared upward when the door was broken open and ignited the roof through the soffit vents under the eaves. Destroyed portions of the roof are visible, but the dormer holding the hay doors was untouched by the fire.

Figure 2. The workroom on 6 October 2006 just after the the fire had been extinguished. Note the white fire-suppressing foam.

By the time the fire was completely out, about 30 percent of the roof had been destroyed, a hole had been cut through the second-storey floor into the workroom where they initially assumed the fire had come through the floor, a large hole had been cut in one end of the barn just under the peak of the roof, all the windows had been broken out, and seven pieces of furniture had been thrown out the window into the garden, along with about two hundred mineral specimens and quantities of soggy fiber glass insulation. Two mineral cabinets had been thrown aside to clear the area immediately over the fire, and about half of the plasterboard on the ceiling and the insulation behind it had collapsed onto the cabinets and showcases on the second floor. The first floor, except for the workroom, was largely intact except for about 16 inches of "rain" that had come through the ceiling from the three large fire hoses taken to the second

Figure 3. Bases of two upended mineral cabinets on the second floor immediately over the site of the fire in the workroom. Fortunately, the minerals housed in these cabinets were not overly fragile, and they survived.

Figure 4. Much of the second floor was covered with debris consisting of mineral specimens, labels, wet cardboard, wet fiber glass insulation, roofing shingles, burned rafter fragments, fused insulation, and wet plasterboard. A path to the hay doors on the right has been cleared, and my sorting of specimens from the debris has begun. To the left is the "Slough of Despond" and to the right is "Mount Manlius." Note the remaining two oak cabinets. The finish on both was ruined. The shorter cabinet on the left was a total loss because swelling buckled the drawer fronts and bottoms. The taller cabinet was intact and could be refinished.

floor. The heavy inner workroom door had contained the fire completely. At the end, there was fire-suppression foam over almost everything to guarantee that the the fire was out and stayed out.

On the positive side, the fire chief had run a ladder to the second-floor window just over my collection's card catalogue and tarped it even as the hoses were still being run from the hydrants, so it never even got damp. Moreover, four plastic cases of display specimens that I had just brought back from an exhibit at the New York State Museum, and which had been sitting on the furniture that was tossed out the window, were safely tucked into the corner opposite the fire and were completely undamaged. My Nikon 35-mm camera had been yanked off its tripod and put in a drawer and was completely unaffected by the fire, including the roll of partially exposed film it contained.

Figure 5. Close-up of debris showing two pieces of New York State lapis lazuli.

As I write this, almost exactly one year after the fire, the barn has been completely restored to its pre-fire state, and the mineral collection has been stabilized. The stabilization of the collection was largely complete within a month. The restoration of the building was completed on 29 December 2006; full recovery of the specimens will take years and is ongoing. The final report of the fire investigator concluded that the fire had been started by an electrical heater. This unit was UL approved and had been installed by the contractor who built the workroom almost twenty-five years before. The cold morning had turned it on for the first time since spring, and it malfunctioned. The heating element came on, but the fan did not. The newly restored workroom has no built-in heaters!

Stabilization and recovery of the specimens involved three distinct areas, with three sets of problems. The

Figure 6. Long pile of debris from the workroom piled along the back of the barn, eleven months after the fire. Rain and snow washed away much of the black soot that originally covered everything.

workroom in which there was an active fire sustained smoke, heat, water, and some physical damage. The upstairs, where the fire in the roof overhead was fought, sustained smoke damage, physical damage, and massive water damage; the downstairs sustained massive water damage.

The downstairs - water damage

The downstairs contained ten metal cabinets and hundreds and hundreds of cardboard boxes containing field-collected, newspaper-wrapped specimens that had not yet been processed. Twenty-hours after the fire, the water that came down through the floor from upstairs had fully penetrated these boxes, and everything sagged and slumped. Although I was able to get to the stairs to the second floor right after the fire was extinguished, the next day the pathway was completely blocked by collapsed stacks of soggy boxes. A quick analysis of this mess suggested that someone else could clean up the first floor while I worked on the potential catastrophe upstairs. I managed to clear a path to the stairs that day so I could start working on the second floor.

Figure 7. Close-up of debris from the workroom. Melted plastic flower pots, melted 35-mm transparencies, cardboard, and newspaper formed a matrix for mineral specimens. Immediately after the fire, all this was black.

A Serv-Pro team arrived the afternoon of the fire and put a tarp over the holes in the roof, put a huge dumpster in the driveway, and put a large metal "pod" (actually a refurbished marine shipping container) beside the dumpster. I needed to be fairly assertive from the beginning to get the Serv-Pro team to adapt to the special needs of the situation. Although thoroughly experienced and professional, they were accustomed to cleaning up in living spaces where concerns about dampness and mould are critically important. In my case, the newspaper wrapping contained the collecting date, and the outsides of the boxes were labelled with the locality. What we did was buy double-walled banker's boxes, line them with a large waterproof trash bag, and then repack the damp to soggy specimens, newspaper and all, in the plastic bag along with any panel of the original box that had writing on it. The trash bag was then closed up, and the box was closed and stacked in the metal pod. Once I had trained each member of the team to handle everything as if it were fragile-fine china wrapped in newspaper, not rocks wrapped in newspaper-the work downstairs went beautifully.

Figure 8. The day after the fire, the card catalogue stood unscathed and dry after its tarpaulin was removed. The double showcase was intact, but everything inside was drenched as as evidenced by the streaking on the rear mirror at upper right.

The metal cabinets were raised off the floor so it could dry, the tons of wet minerals were repacked in new sturdy boxes and moved to the pod, and industrial dehumidifiers were installed to dry out the first floor. The primary work was completed in about three weeks. The pod was emptied back into the barn a month later, and the new boxes were stacked on wooden pallets to give the floor ventilation. As I've been processing the material in the bags inside the boxes, I find that although things are damp, the minerals themselves are just fine.

The upstairs - a mess beyond belief

An hour after the fire was out, the fire chief took Helen and me upstairs to show us the extent of the damage and mess. What I immediately noticed under the piles of soggy plasterboard and sopping insulation was that two mineral cabinets were completely gone and a large stack of beer flats of newly catalogued specimens was slumped and buried under debris. Then there were the soapsuds (fire-suppression foam)! When Serv-Pro arrived that afternoon, I had them use a plastic snow shovel to gently clear a path from the stairs across the floor to the hay doors so we could walk without stepping on specimens. The idea that the mixture of charred rafters, melted insulation, soggy plasterboard, and mineral specimens was fragile and that each shovelful needed to be gently placed amused the team, but they followed through and did not make the situation any worse. For the next two weeks, I supervised the packing downstairs during the day and then slept right after supper for as long as I was able (typically about four or five hours) before going collecting upstairs. Initially, I gave the piles of debris names such as "The Slough of Despond" and "Mount Manlius."

Figure 9. An historic mineral cabinet, sequentially owned by Dr. Leonard G. Berry and Dr. George W. Robinson before I acquired it, did not survive the deleterious effects of the water associated with fighting the fire. This picture was taken seven months after the fire. The cabinet had dried and the drawers were no longer frozen, but many of them would not open because the drawer bottoms buckled downward when they swelled as can be seen in the middle of the cabinet. To get the mineral specimens out of this cabinet, I had to disassemble it piece by piece. Note the walls and floor are now like new.

I began by cleaning off a small portion of the floor so I had a place to stack boxes of recovered specimens. Because every piece of cardboard in the barn was now a soggy mess, I was desperate for beer flats and egg cartons. My collector friends came through brilliantly. Bill Hladysz brought from St. Johnsville a pick-up truck full of beer and soda flats and egg cartons along with the boxes that exactly hold twelve or twenty-four cartons. Mike Walter brought a truckload of flats from his home in Nicholville. John Davis, a collector friend in the village, came immediately with every empty flat he had or could scrounge from local stores. Together these people enabled me to start the recovery immediately and to work efficiently.

I soon developed a system. I would sit on a short stool and work by the bright light of a high-output pair of adjustable lights (halogen bulbs on an adjustable, yellow, tubular steel framework). I would pick out obvious specimens or labels and put them in either an egg carton or a flat. Then I would use a plastic dustpan to pick up a small amount of debris and examine it closely, picking out more specimens. Finally, I would gently drop the contents about an inch onto the wooden floor. I quickly learned to distinguish the sound of a rock hitting the wood as different from wet plasterboard, charred rafter, or fused fiber glass doing so. Once I was convinced all specimens had been removed, I dumped the debris into a tall wastebasket fitted with a trash bag. I piled the filled trash bags next to the hay doors. When the Serv-Pro team arrived in the morning, they would throw the trash bags out the window and take them to the dumpster and then work on the first floor. By this laborious, but careful process, I cleared the entire upstairs floor and recovered, I believe, all the specimens that had gotten loose from flats on the floor or from dumped cabinets. I found a few large specimens that had been broken by being walked on by large yellow and black boots. Most are repairable - a small price to pay for having the building saved.

My dozen or so wooden cabinets presented another problem. Although we sealed the upstairs quickly and installed industrial dehumidifiers, it took a long time to dry out the cabinets. Immediately after the fire, all but one of the cabinets would open. A week later, none of them would open. After consulting with several of my antique-dealer friends, I followed their advice and just allowed the cabinets to dry out slowly. As soon as the floor was cleared, the upstairs furnace, which had survived the fire undamaged, provided dry heat. The cabinets sat through the restoration work and several months thereafter before they started to open. I had removed the card catalogue from the building the day after the fire, so it never got wet, or even damp. The other cabinets survived, or did not, depending upon their construction. In some of them, the wooden drawer bottoms buckled downward, preventing the drawer, though now loose, from being removed. Four cabinets were essentially destroyed by a combination of either having been dumped during the fire or being disassembled by me to remove the specimens after they had dried because the drawers had self-destructed. Two showcases had one cracked glass pane each and were easily repaired. Five cabinets were essentially undamaged once they dried out. One cabinet protected its minerals well, but being right under the roof fire, had its finish completely ruined by the water and foam. Fortunately, all the cabinets that didn't survive were covered by my insurance policy.

As soon as I finished working through each night to clear the floor upstairs, I switched to working during the day to retrieve specimens from the pile of debris that had been thrown out the window. Before I got to it, that pile was off-limits to Serv-Pro. Once I began, I would hand the big debris to a team member who would take it to the dumpster; in a half-day we had converted the big pile of soggy debris to a much smaller, fine-grained pile just like what was upstairs, so I processed it the same way. I do not believe I missed a single specimen, and only one very large quartz crystal showed any signs of having jumped out the window - even then the spalled piece was recovered and repaired.

The workroom - collecting in a burn barrel

We left the actual site of the fire until last. Time pressure to clear out the workroom so the contractor could start the restoration encouraged me to find a solution different from the one I had used upstairs. Moreover, the debris included actual ashes, burned cardboard, melted plastic seedling pots, and all sorts of other stuff. In the end, we laid tarps on the ground behind the barn to cover a gravel garden path and the bottom of the clapboard. Then we used a plastic shovel to fill a plastic recycling bin with debris, carry it out the door and around the corner, and gently dump it on the tarps against the barn wall. In half a day, I had a cleaned out the workroom and built a mountain range of debris along the back of the barn. By then winter was imminent, and I just left things sit for six months. The rain and snow leached much of the ash to the bottom of the pile, and by late spring when I began to work on one end of the pile, things already seemed much cleaner than I expected.

Cleaning specimens - now and in the future

Because the specimens on the first floor are still wrapped in their newspaper from the field, the cleaning problems there are strictly geological and do not seem to have been altered by the brief soaking during the fire.

The specimens from upstairs were never subjected to any heat, so they are mostly just dirty from soggy plasterboard and fiberglass insulation. I have found that a vigorous swish in warm soapy water and a good rinse is generally adequate, occasionally accompanied by a brief scrubbing with a soft brush. During this process, it is important to be certain the catalogue number does not come off. Although all my numbers were unaffected by the water and foam, a few of them were loosened, and every now and then one falls off during washing. I retrieve it and reattach it when both it and the specimen are thoroughly dry.

The specimens from the workroom were a major challenge and I started on them first. After trying all the normal things I do to clean specimens from the

Figure 10. A 7-cm calcite twin, penetrant on (0001) from the Yellow Lake North road cut in St. Lawrence County, New York, was completely black like a mis-shapen charcoal briquet, when retrieved from the workroom debris,. After treatment with Purple Power and the water gun, it is none the worse for wear.

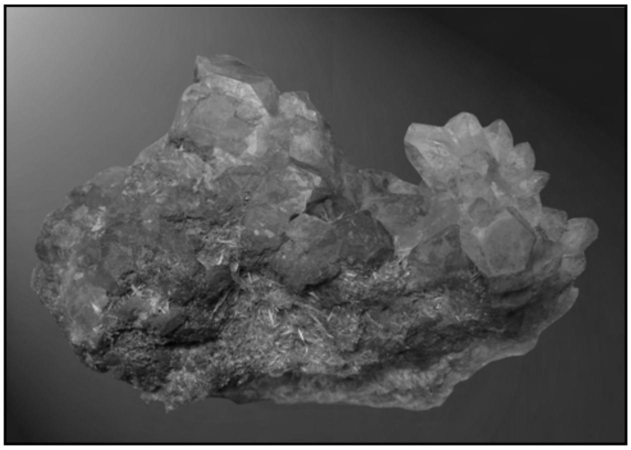


Figure 11. A 10-cm specimen of tremolite and quartz from the Valentine property near Harrisville, New York, was covered with soot when retrieved from the workroom debris. Soaking in Purple Power removed most of the soot; however, a darkened zone around the tremolite pocket is still visible. The water gun would remove this, but would also probably remove the tremolite needles.

field, I came to the realization that the black "scrud" coating on some of them was basically an organic. So I began to think along the lines of removing lichens, mosses, and hydrocarbons from field-collected material. Sudsy ammonia worked to some extent on many of the specimens, but wasn't a good enough solution. A trip to Cincinnati to give a pair of talks, led to Terry Huizing's showing me his Albatross SG-5000 electric spot-cleaning gun (http://www.albatross-usa.com). This nifty device is designed to blast cleaning fluid through stubborn spots on fabrics during dry cleaning. It works with just about any liquid imaginable. This gun worked much better than anything else I had tried. The other insight, I had on my own. Remembering my days as a motorcyclist who sometimes worked on his own bike, I went to the auto parts store to buy some industrial strength degreaser. I found a product called Purple Power (Aiken Chemical Co., Inc.; www.clean-rite.com), which doesn't smell particularly bad, is biodegradable, is inexpensive, and works like a charm. (My contractor used it to clean away the black scrud from the workroom before they rebuilt it!) My cleaning ritual for the debris from the workroom has evolved to be: (1) wash in soap and water; (2) if necessary, use the gun with soap and water; (3) if necessary, soak in degreaser and then use the gun; (4) if it still looks like a piece of junk, throw it away. Because most of the material in the workroom was self-collected material waiting to be processed, the percentage I've been throwing away is high, but largely not because I couldn't get the black scrud from the fire off of the specimens.

Catalogue numbers

I was thrilled to discover that the two main methods I'd used to produce catalogue numbers and mount them to specimens both held up under the dual assaults of water and fire-suppression foam. I'm certain there are other procedures that work equally well, but mine have been tested in a manner I do not recommend be repeated! My earliest numbers were typewritten but were too large as the numbers got higher and higher. I used Duco Cement under the number and then coated it with more Duco Cement. Those numbers also survived. I then had switched to tiny photographs but found they faded, so I replaced them with laser-written numbers on acid-free card stock. I mounted them using Sally Hansen "Hard as Nails with Nylon" in its colourless version. I put a dab on the specimen, mounted the number in it, and coated it with more. These numbers survived just fine, except where the matrix was very porous and a few came off, but the number was still readable. The downside of this procedure was that the nail polish slightly dissolved and smeared the laser written numbers, so excellent technique was required. If the number was mounted in a smooth operation, it didn't smear; however, messing around with it, could ruin it. Because of this problem, I switched to ink-jet printed numbers on acid-free card stock. The new problem, of course, is that most ink-jet inks are somewhat water soluble. So now I print a sheet of numbers, spray it with Krylon colorless protective plastic spray front and back, and when they are dry, I

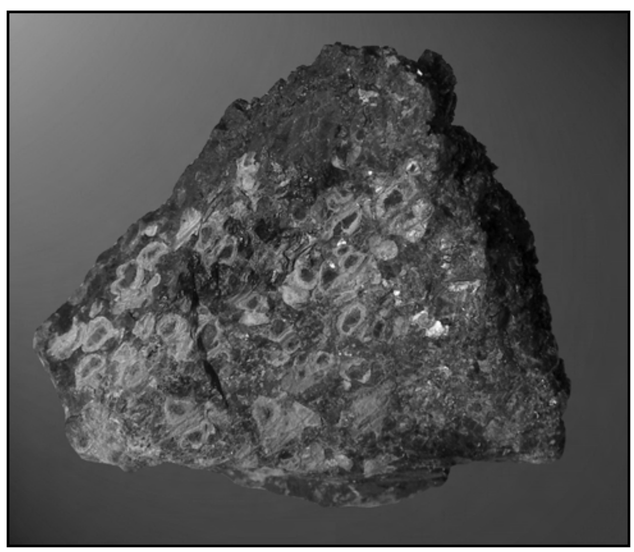


Figure 12. This 5.5-cm specimen of bird's-eye ore from the ZCA No. 4 mine at Balmat, New York had soot all over the back side, encroaching onto the side shown here at the top left and bottom right when photographed. After soaking in Purple Power and being washed with the water gun, both sides showed pink hematite eyes in gray sphalerite and no soot at all.

cut them up and mount them with the Sally Hansen nail polish. These numbers survived the ordeal of the fire just fine also. I did note that pre-existing catalogue numbers on historic specimens survived if I had coated them with nail polish, my normal procedure, but on specimens where I forgot to do that, many of the numbers faded, some completely. Henceforth, I will coat every antique catalogue number with nail polish.

Labels

The biggest hit my mineral collection took from the fire involved old labels. I can, and will, replace my labels, but since I especially have collected "used specimens" my collection contains many old labels. Fortunately, I had just finished replacing many of the most interesting old labels with color Xerox copies and donating the original labels to the Mineralogical Record archive, so most of the original labels were preserved. Nonetheless, many of the remaining labels didn't do particularly well in all the water and especially the fire-suppression foam, which seems to have some detergent properties. For the labels I was able to get to in the first several weeks, simply drying them out and preserving them in whatever state they were now in was about all I could do. Unfortunately, many specimens with old labels were trapped in the cabinets for months. When the cabinets finally opened, mould (reminiscent of video tapes from New Orleans after Katrina) was a problem on cardboard specimen trays and labels. The trays I threw out. The labels, I cleaned off with a soft cloth slightly dampened with Lysol spray disinfectant to physically remove as much mould as possible. I then exposed first the front and then the back to several days of sunlight. If the label's content remained readable, I kept it; if not, I tossed it. In the future, the condition of the label will indicate that the specimen went through the barn fire of 2006, which is now part of its history and provenance. Nonetheless, it hurts to have to toss labels that once were legible and had been preserved for many years by a series of owners of the specimen. By the way, it really helps if the specimen number is written in pencil on the back of the label so that when they are separated, they can easily be reunited!

Lessons learned and recommendations

Although I hope no reader of this article ever has an experience anything like mine, nevertheless, fires happen, and one must make the best of the deteriorated situation to minimize further loss. Below I list some lessons learned and recommendations based on my barn fire experience:

o Wherever your mineral collection is stored, be certain your insurance coverage will pay for professional cleaning and recovery assistance. In our case, we insured the barn for the same amount as the house. Otherwise, it is typically only covered for 10 percent of the total homeowners' insurance as an outbuilding. The Serv-Pro costs were nearly as great as the reconstructions costs for the structure, and just as important to the future of the collection.

o Be on site, if at all possible, to supervise fighting the fire, and be calmly assertive. Buildings full of rocks in cabinets and boxes are unusual. Fortunately, the national trend in volunteer fire department training and mission is shifting away from just putting out the fire to fighting the fire and salvaging as much of the building and its contents as possible. This is the first barn the Manlius Fire Department has ever saved. They are using the case history of our fire as a training example. Knowing the fire chief, the mayor, and the police chief, all of whom were present during the working phase of the fire, helped. When I was making suggestions, they listened. Of course, I was not hysterical (that happened later), but neither am I a trained firefighter. As it turned out, no one was injured, and the damage from the fire and fighting it was really minimized.

o Use cleaning professionals to help you stabilize the postfire mess; however, supervise them closely. Again, most such cleaning teams will never have run into anything like a mineral collection, and their standard anti-dampness, anti-mould approaches, which are perfect for living spaces, are not optimal for mineral collections. Unsupervised, they would have thrown out everything on the floor upstairs. They would have unwrapped and rewrapped every specimen downstairs, thereby destroying all information about where the specimens were from and when they were collected.

o Catalogue your collection. If you have a collection with specimens and labels but no catalogue numbers and no catalogue, a fire like mine would be catastrophic because the labels may not survive or may not be legible if they do. Safeguard your catalogue. My catalogue cabinet was under an externally accessible window by accident before the fire. Now it's there intentionally. Moreover, I continue to write my catalogue cards in pencil, which survives soapy water much better than ink.

o Divide your reaction into a stabilizing phase and a recovery phase. Take immediate action to prevent any damage already sustained from worsening or propagating. Once the situation is stabilized, you have bought time to do the recovery slowly, carefully, and methodically. If some of the dirty specimens don't get washed for a couple of years, it won't hurt them.

o Specimens are more durable than one may think. Granted, I specialize in New York State minerals, which tend to be particularly durable. Nonetheless, my millerite specimens survived as did all my thumbnails and micromounts, partly because they were sealed in plastic boxes and mostly because they were in cabinets designed and built for the specific purpose of storing them. The most damaging thing for the specimens was being walked on by large fire-fighters in big rubber boots. This only happened because I had a huge stack of flats in the middle of the room. Henceforth, I am stacking all the flats along the walls, since all of these survived fine, except for getting soaked.

A final note

Despite all my precautions, I had a fire. The fire investigator assured me that all kinds of heating devices can and do cause fires. Nonetheless, I now heat my workroom with small ceramic heaters, which I intend to replace with new ones every two years. They are not near anything flammable. I could have installed sprinklers in my barn, but had they worked, the mess would have been pretty much as great as what happened, since water damage was a major problem. What I have absolutely learned from the fire is that my plan to safeguard my collection for posterity by giving it to the New York State Museum is essential and needs to be implemented much more quickly. My leisurely approach of the preceding year has now turned into a more focused effort: Prepare the specimens, get them appraised, take them to Albany, then repeat the cycle. Do it now!

CHIROTHERIUM AND ITS DOMAIN: A DESCRIPTION OF REDISCOVERED SPECIMENS FROM NORTHWEST ENGLAND

by Mike Batty

Batty, M. 2008. *Chirotherium* and its domain: a description of rediscovered specimens from northwest England. *The Geological Curator* 8 (9): 437 - 454.

A rediscovered collection of tetrapod footprints originating from Storeton, Merseyside (and lodged in the stores of the Museum of Lancashire) is described. Chirotheroid footprints are identified using the guidelines outlined by King (1997) and compared to descriptions of accepted ichnospecies (King *et al.* 2005). The Rossendale Collection contains some well preserved but isolated sets of *Chirotherium storetonense*. A unique trackway specimen containing *Chirotherium storetonense*, *Chirotherium barthii*, small rhynchosaur footprints, and an example of *Equisetites keuperina* is described for the first time.

The lithology of the Helsby Sandstone at Storeton and the Tarporley Siltstone at Lymm is described in thin section and compared with previous lithological research based on hand specimens. Specimens from Lymm display rhombic crystals (possibly gypsum) while those from Storeton exhibit staining by iron oxides. The theory of deciphering the locality of specimens with unknown origins is tested by comparing thin section analysis. These results are used to bolster the understanding of the stratigraphy at Storeton and Lymm. The Museum of Lancashire's Storeton specimens display a paler lithology to other collections and could have originated from a slightly different locality.

The variety of fossil evidence present in the rediscovered Rossendale Collection is interpreted in conjunction with the thin section analysis and compared with previous palaeoecological research. The presence of muscovite in both the Helsby Sandstone and the Tarporley Siltstone indicates fluvial deposition. Due to the superposition of fossils, the *Chirotherium* producer, rhynchosaurs, and vegetation (such as *Equisetites keuperina*) are confirmed as existing at the same time.

Mike Batty, 75 Coppice Road, Poynton, Cheshire, SK12 1SL, UK. e-mail: michaeljbatty@ntlworld.com. *Received 11th January 2008.*

Introduction

The first British specimens of tetrapod footprint belonging to the ichnofamily Chirotheriidae were discovered in 1838 at Storeton, Merseyside. Throughout the 19th and 20th centuries further specimens of chirotheroid footprint were unearthed with the most notable British finds originating from localities in Cheshire, Merseyside, Staffordshire, Nottingham, and Leicestershire. British specimens of tetrapod footprints have been assigned to three of the four recognised ichnogenera in the ichnofamily Chirotheriidae (*Chirotherium*, *Isochirotherium* and *Synaptichnium*; see King *et al.* 2005).

Following excavation, the best specimens of footprint were distributed by local geological societies to museums and academic institutions around the country. In the majority of cases these donations were recorded with minimal detail and the failure to record the specimen's locality was not unusual. The lack of information created much confusion and resulted in the loss or misinterpretation of many chirotheroid specimens.

Most of the quarries which yielded Triassic reptile footprints are now infilled which restricts the amount of information that can be gathered about the stratigraphy and palaeoecology of these localities. Thus, previous research on *Chirotherium* has failed to place sufficient emphasis on the sedimentological aspect of this topic.

The first aim of this paper is to describe and interpret a variety of reptile footprints which have been rediscovered in the collections of the Museum of Lancashire. With the possible exception of RF 450, all of these specimens have come from the quarries at

Storeton in the county of Merseyside. A thin section of RF 450 was taken in an attempt to establish its origin. Techniques used to measure and describe the footprints are those advocated by King (1997) which were based upon earlier research by Haubold (1971, 1984), Leonardi *et al.* (1987), Sarjeant (1989) and Thulborn (1990). When possible, identification of the specimens has been based on the criteria defined by King *et al.* (2005).

An entire section is devoted to the rediscovery of a significant trackway specimen in the stores of the Museum of Lancashire (LANMS 1998.12.1521). The specimen displays similarities to the Manchester Museum specimen LL.6657 in that it contains both a broad and narrow form of chirotheroid footprint. It also displays a variety of small reptile footprints and, perhaps most significantly, the second British specimen of *Equisetites keuperina* associated with vertebrate footprints.

The final aim of this paper is to describe and analyse the lithology of these specimens and compare them with the lithology of other specimens from Storeton and Lymm. When investigating the lithology of specimens the analytical technique of thin sections has been newly combined with previous research on hand specimens by the author (Batty 2004). Thin sections were taken from specimens RF 87, RF 88, and RF 450, belonging to the Museum of Lancashire, and the Manchester Museum specimen LL.6655.b.

The Rossendale Collection

In 1902 the Rossendale Museum received a collection of shells and fossils which was donated by a Mr Gibson and formed the basis of the Rossendale Collection. During the proceeding years the collection grew to include large numbers of geological and mineralogical specimens in addition to the aforementioned shells. Notable donations were recorded with minimal detail in 1909, 1921-22, 1928, and 1936 and it is thus unknown when the vertebrate footprints were acquired. The Rossendale Collection was transferred to Blackburn Museum in 1978 and has since been lodged at several museums under the ownership of the Lancashire County Museums Service. The majority of the vertebrate footprints are temporarily stored at the Museum of Lancashire's Unit O warehouse.

In total twenty four specimens were examined (appendix 1) of which thirteen were identified as chirotheroid footprints. The remaining specimens consist of *Rhynchosauroides* and *Rotodactylus* footprints or inorganic sedimentary structures.

Description of the chirotheroid specimens

The majority of chirotheroid specimens belonging to the Rossendale Collection are poorly preserved and consist of isolated prints. Identification and interpretation of specimens proved difficult and was kept to a minimum following the guidelines of King (1997). The observations recorded for the thirteen chirotheroid specimens are detailed below and organised into groups based on the level of identification (the measurements can be found in appendix 2).

Specimens assigned to ichnospecies

(RF 83, RF 90, RF 91) Description

Specimens RF 83, RF 90 and RF 91 display the best examples of chirotheroid footprints in the Rossendale Collection and represent 3 footprint sets in total. The footprints preserved on specimen RF 90 are almost entirely obscured by a thin lamination of sandstone.

The pes are moderately-well preserved as complete, semi-plantigrade, low-medium relief casts (Figure 1a & 1b). The footprints display a slim outline with length and width falling within the ranges 146-164 mm and 103-107 mm respectively. Digits I-IV are straight and forward facing with an equal spread of low divergence angles. Combining the observations of the three specimens reveals that digits I-IV taper distally to triangular points and terminate proximally in a metatarsal-phalangeal pad. Digit V is recurved and situated proximally behind digit IV, diverging at an angle between 55-62° from the midline. An elongate metatarsal-phalangeal pad is preserved on the proximal end of the fifth digit. The 3 pes footprints display the configuration formula V:I:II:IV:III.

The manus are poorly preserved as incomplete, digitigrade, low relief casts and as a result measuring was kept to a minimum (Figure 1c & 1d). Specimen RF 91 displays the most complete manus and is considerably smaller than the pes, measuring 74 x 47 mm (excluding the missing digit I). The manus are situated directly in front of the pes and are negatively registered (-58 to -111 mm). Combining the observations of the three specimens reveals that digits II and III are forward facing whereas digit IV diverges at a greater angle from the midline. Digit V is set proximally behind digit IV and diverges at 70° from the midline and, unlike the pes, all digits are straight. Several digits taper distally to triangular points but it is unclear which, due to partial preservation.

Two small, isolated vertebrate footprints have been

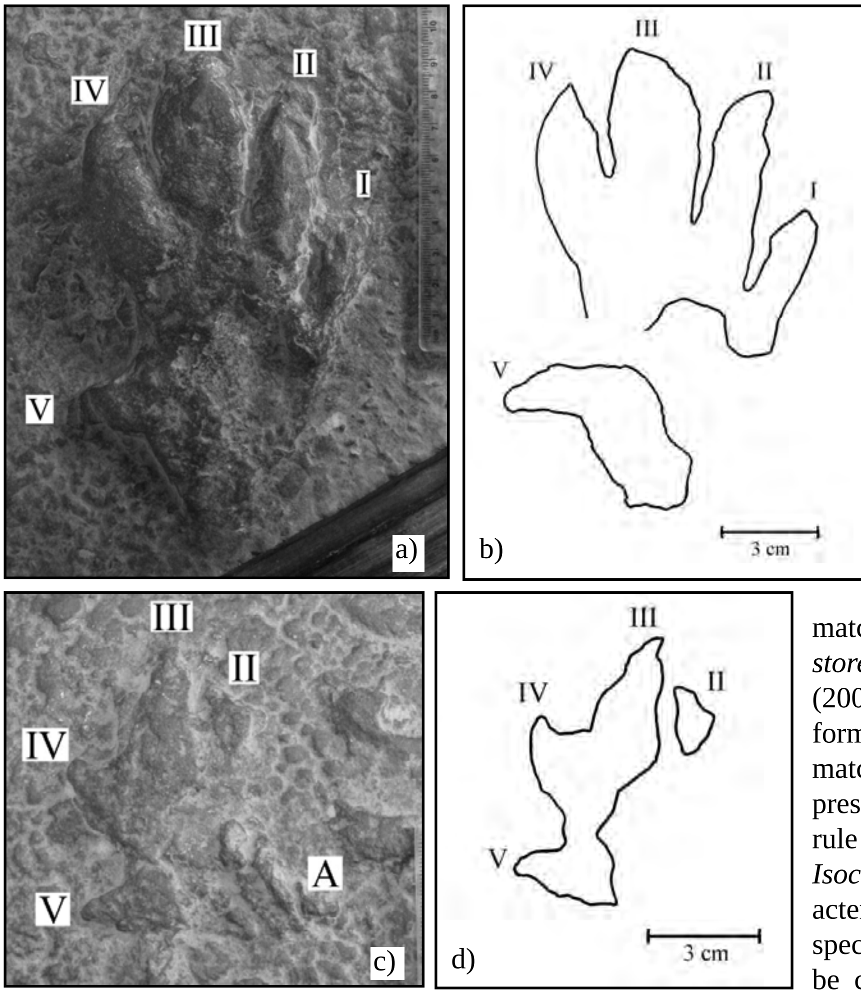


Figure 1:
a) Right pes, RF 91
b) Tracing of right pes, RF 91
c) Right manus and
Rhynchosauroides *isp. (A), RF 91*
d) Tracing of right manus, RF 91.

preserved as low relief casts on specimen RF 91. The first is situated near the chirotheroid manus and displays four forward facing, widely spaced straight digits (Figure 1c). The fourth digit has been partially obscured by the chirotheroid manus and the length of digits I-III increases numerically. Digits II and III terminate distally to curved tips and digit I narrows to a fine point. The lack of a trackway and incomplete preservation has limited identification. However, the strong rhynchosauroid characteristics displayed by the footprint enables identification up to ichnogenus level. Therefore the footprint has been classified as *Rhynchosauroides* isp..

The second footprint consists of three straight, forward facing digits but is poorly preserved. The digits are closely spaced and terminate distally to triangular points. It is clear that this footprint belongs to the morpho-family Rhynchosauroidae but incomplete preservation and a lack of detail limits identification to ichnogenus indet..

Identification

As each specimen displays a moderately preserved footprint set it makes detailed identification possible. The slim form of the footprints and length of the pes match the description of *Chirotherium storetonense* as advocated by King *et al.* (2005). Furthermore the configuration formula of the pes on each specimen matches that of *C. storetonense*. The presence of partially preserved manus rule out the broader *C. barthii*, and *Isochirotherium* lomasi, which is characterised by a small manus. As a result specimens RF 83, RF 90 and RF 91 can be confidently assigned to *C. storetonense*.

Specimens assigned to ichnogenera

(RF 82, RF 89, RF 450, RF 460, RF 463)

Description

There are five specimens which have been assigned to this section due to moderate preservation of complete footprints. In total five pes and three manus have been preserved, forming isolated footprint sets in three instances.

With the exception of RF 450, the pes are poorly-moderately well preserved, complete semi-plantigrade casts with a low-medium relief (Figure 2a & 2b). Specimen RF 450 displays a broad, poorly preserved but complete semi-plantigrade high relief cast. The length and width of the pes fall within the ranges 182-218 mm and 107-173 mm respectively. Digits I-IV are straight and forward facing with an equal spread of low divergence angles although only the distal ends have been preserved on specimen RF 463. The fifth digit varies from being weakly curved to recurved and is situated proximally behind digit IV, diverging at an angle between 47-67° from the midline. The combined observations reveal that digit

V terminates proximally with an elongate metatarsal-phalangeal pad and digits II-III taper distally to triangular points. The pes preserved on specimen RF 460 has overprinted another chirotheroid pes. Two digits belonging to the overprinted footprint can be seen to the right of the main pes (Figure 2a). With the exception of RF 82 (which has the configuration formula V:I:IV:II:III) the pes display the configuration formula V:I:II:IV:III.

The three manus are preserved as digitigrade, low relief casts (with the exception of RF 450 which displays high relief) and specimen RF 463 displays a complete footprint. The fully preserved manus measures 112 x 115 mm and displays short, straight digits. Digits I-IV are forward facing and diverge weakly from the midline whereas digit V is situated behind digit IV and diverges at 80°. The fourth digit on specimen RF 460 tapers distally to a triangular point. The manus are negatively registered (-115 mm was measured on RF 450) but it is unclear whether the manus on specimen RF 460 (Figure 2a & 2c) corresponds to the complete pes or overprinted pes.

Specimen RF 82 also displays two isolated rhynchosauroid footprints and several tail drag casts (the largest measuring 55 x 5 mm). Both footprints are incomplete with three slightly curved digits preserved. The digits are closely spaced and poorly defined, the latter limiting the identification of the footprints to ichnogenus indet..

Identification

Although the quality of preservation shown in these footprints is inferior to those described in the previous section they still display numerous chirotheroid characteristics. In addition, specimens RF 463, RF 460 and RF 450 are all isolated footprint sets which aids the process of identification (King, 1997). The presence of a manus on three of the specimens rules out the ichnogenera *Isochirotherium* and *Synaptichnium* which are characterised by a much smaller manus. However the lack of detailed preservation, especially for the manus, prevents the identification of ichnospecies. Fortunately the pes display several characteristics that represent the ichnogenus *Chirotherium* such as the average footprint length and recurved fifth digit. With the exception of RF 89, all of the pes display the configuration formula V:I:IV:II:III which is characteristic of *Chirotherium* footprints. However the pes on RF 89 does not fit the criteria of the ichnogenera *Isochirotherium* and *Synaptichnium* due to its size. Due to the majority of features which fit the criteria of *Chirotherium*, and the presence of three isolated footprint sets, specimens RF 82, RF 89, RF 450, RF 460 and RF 463 have been identified as *Chirotherium* isp..

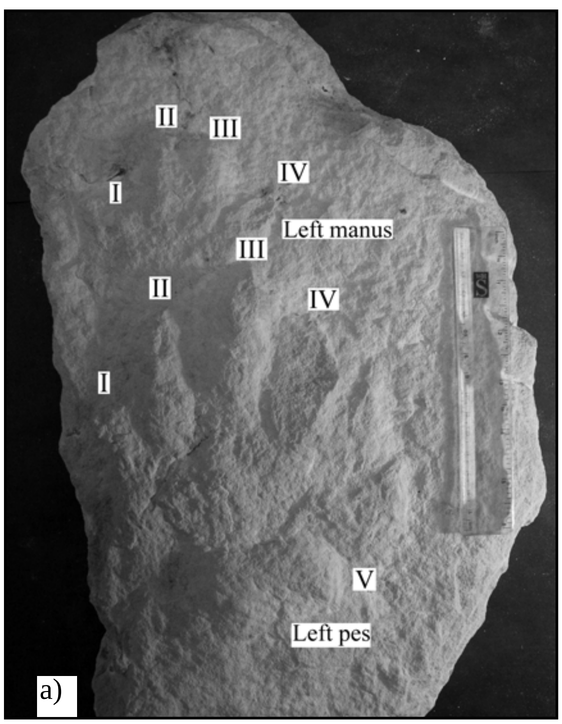
Specimens assigned to ichnogenus indet.

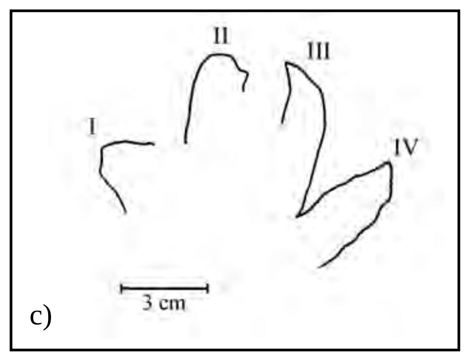
(RF 85, RF 449, CLDB:2006:000:003)

Description

Three isolated chirotheroid sets have been poorly preserved as casts, which display a range of complete and incomplete footprints.

A complete pes is preserved on two of the specimens





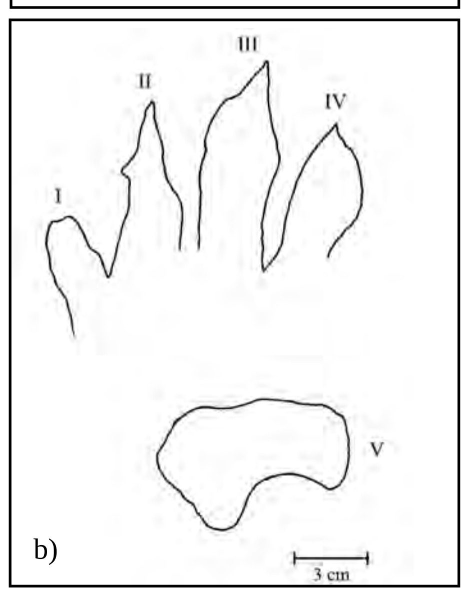


Figure 2:
a) Left pes and manus, RF 460
b) Tracing of left pes, RF 460
c) Tracing of left manus, RF 460.

and these display a poorly defined semi-plantigrade outline (Figure 3a & 3b). The pes on specimen RF 449 is preserved close to the edge and as a result digit V is missing. With the exception of CLDB:2006:000 :003 (which displays high relief) the pes are preserved as low relief casts, with the complete footprints measuring 210 x 139 mm and 210 x 149 mm. Digits I-IV are straight and forward facing with an equal spread of low divergence angles with those on specimen RF 85 displaying poorly preserved metatarsal phalangeal pads. The combined observations reveal that digits I-IV taper distally to triangular points. Digit V is recurved and set proximally behind digit IV, diverging between 44-63° from the midline. The configuration formula for the complete footprints is V:I:IV:II:III.

The manus are partially preserved as digitigrade casts which display negative registration within the range -74 to -82 mm (Figure 3a & 3c). Poor preservation limited measurements to the manus of specimen RF 85 which is 39 x 59 mm (excluding digit V). Digits I-IV are short and rounded in appearance with an even spread of divergence angles (30-35°).

Each specimen also displays several small and isolated shallow relief footprint casts. The majority are poorly preserved and often incomplete but these still display the basic outline of rhynchosauroid footprints. The digits are narrow and forward facing with either a slightly curved or straight appearance. Most digits taper distally to sharp points and it is the two outer digits which have not been preserved. These features are characteristic of the morpho-family Rhynchosauroidae but the lack of detail limits identification to ichnogenus indet..

Specimen RF 85 displays the best examples of rhynchosauroid footprint in this section (Figure 3a). Each low relief footprint cast has three digits preserved which are widely spaced and very slightly curved. The curvature is most pronounced at the distal end of the digits. Both the wide spacing of digits and distally curved tips are characteristic of the ichnogenus *Rhynchosauroides*. However, identification of these footprints has been limited to *Rhynchosauroides* isp. because they are isolated and lack fine detail.

Identification

The poor preservation shown on specimens RF 85, RF 449, and CLDB:2006:000:003 complicates the identification of the footprints. Several characteristics (such as the pes length, recurved fifth digit and grady) displayed by the footprints confirm that they belong to the ichnofamily Chirotheriidae. Unfortunately poor preservation has resulted in incomplete footprints and a lack of fine detail. Furthermore certain observations (such as the configuration formulas) do not conform to the ichnofamily of Chirotheriidae as advocated by King (1997). The footprints shown on RF 85, RF 449 and CLDB:2006:000:003 have significant variations in form and have therefore been referred to as ichnogenus indet.

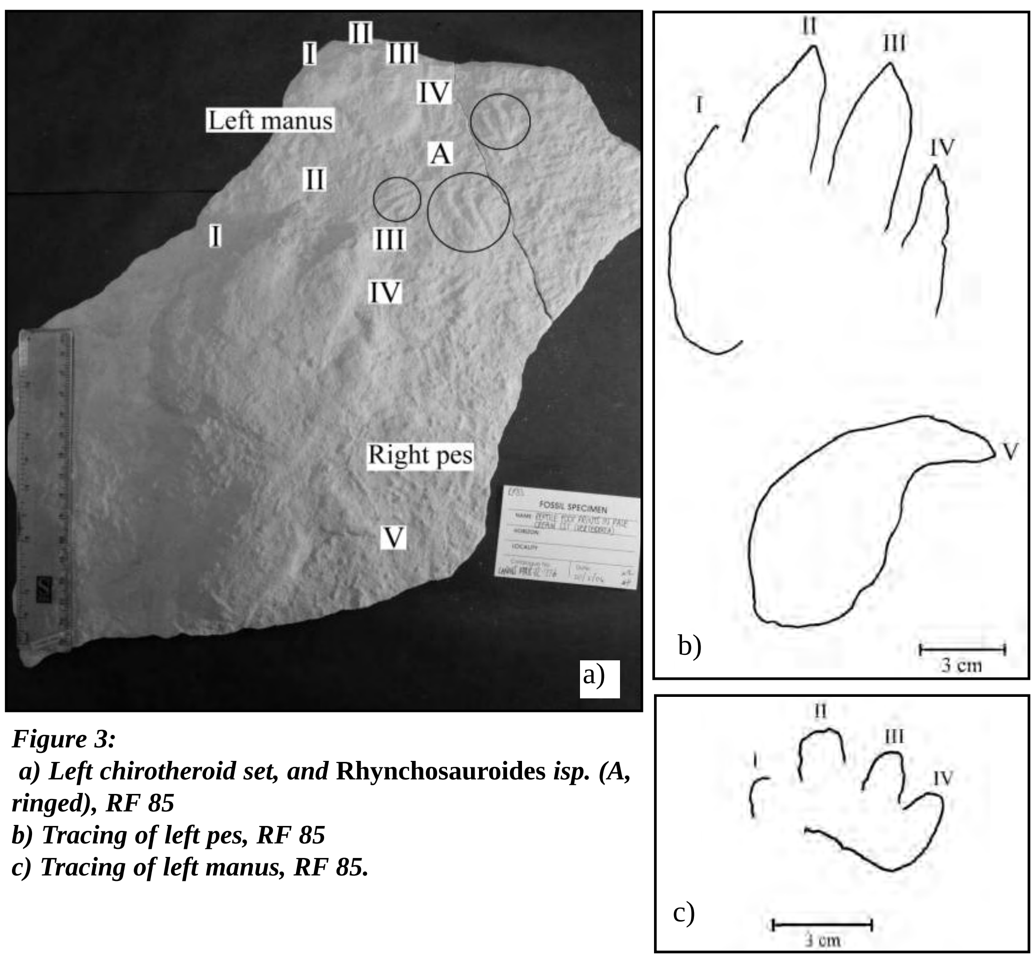


Figure 3:
a) Left chirotheroid set, and* Rhynchosauroides *isp. (A, ringed), RF 85
b) Tracing of left pes, RF 85
c) Tracing of left manus, RF 85.

Specimen assigned to ichnotaxa indet.

(RF 461)

Description

An incomplete pes is poorly preserved as a low relief mould in close proximity to the edge of specimen RF 461. An indistinct outline of four straight, forward facing digits is visible, which are difficult to distinguish from one another. Above the footprint is a separate, isolated mould which also displays low relief. As a result of poor preservation specimen RF 461 was not measured.

Identification

The poor preservation of an isolated footprint and lack of detail makes identification extremely difficult. There are no features present which are characteristic of chirotheroid footprints and as a result the trace has been identified as ichnotaxa indet..

Description of chirotheroid trackway specimen

(Specimen LANMS 1998.12.1521)

The largest specimen in the Rossendale Collection contains two chirotheroid trackways, numerous small reptile footprints, and a rare specimen of *Equisetites keuperina* (Figure 6). Such a wide range of fossils displayed on one chirotheroid specimen is rare, if not unique, and therefore LANMS 1998.12.1521 has been assigned a full section of this paper for further discussion.

Chirotheroid specimens

Description

Specimen LANMS 1998.12.1521 is similar to the Manchester Museum specimen LL.6657 because they both display the broad and slim form of chirotheroid footprint. The possibility that these specimens represent the same trackway can be disregarded because on the Preston specimen (LANMS 1998.12.1521) the slim form of footprint is represented by the left hand trackway (when facing the direction of travel) whereas the opposite is true on the Manchester specimen (LL.6657).

The left hand trackway (when facing the direction of travel) displays a right set and left pes of slim, medium relief chirotheroid footprint casts. Trackway width was measured as 245 mm and the oblique pes pace length as 575 mm.

The pes are poor to moderately well preserved as complete, semi-plantigrade casts with length and width falling within the ranges 177-202 mm and 116-120 mm respectively (Figure 4b & 4d). Digits I-IV are straight and forward facing with an equal spread of low divergence angles. The majority of these digits are damaged but moderately well preserved phalangeal pads are present on digits III and IV of the right pes, which taper distally to triangular points. Digit V is recurved with an elongate metatarsal-phalangeal pad and situated proximally behind digit IV, diverging between 49-60° from the midline. The configuration formula for the right pes is V:I:II/IV:V but was not measured for the left pes which has a damaged third digit.

The right manus is partially preserved as a digitigrade cast and has significant damage (Figure 4b & 4f). With digit I missing, the manus measures 89 x 68 mm and displays negative registration (-93 mm). Digits II-IV are forward facing, displaying low to medium divergence and tapering distally to triangular points. The second and third digits are superimposed on the specimen of *Equisetites keuperina*. All of the digits are straight with digit V situated behind digit IV and diverging at 78° from the midline.

The right hand trackway (when facing the direction of travel) includes a broad right set of complete, medium relief chirotheroid footprint casts. The semi-plantigrade pes measures 212 x 146 mm and displays the configuration formula V:I:IV:II:III (Figure 4c & 4e). Digits I-IV are straight and forward facing, displaying low divergence angles, and tapering distally to broad triangular points. The fifth digit is weakly curved and situated proximally behind digit IV, diverging at 50° from the midline. The pes overprints, and has been overprinted by, small vertebrate footprints belonging to the morpho-family Rhynchosauroidae.

The manus is moderately well preserved as a digitigrade cast and measures 103 x 111 mm (Figure 4c & 4g). Digits I-IV are straight and display an even spread of medium divergence angles. Unlike the pes, digit V is also straight and is situated behind digit IV, diverging at 73° from the midline. Faint skin casting has been preserved on digit IV and digits II and III taper distally to triangular points. Negative registration was recorded and the manus has the configuration formula V:I:IV:II:III.

Identification

Specimen LANMS 1998.12.1521 clearly displays two different forms of chirotheroid footprint. There are two slender pes and a corresponding manus which all show various features which are characteristic of *Chirotherium storetonense*. The pes are within, or just outside, the length range for this ichnospecies and the elongate fifth digit diverges relatively weakly from the midline. There is also evidence of claw casts and phalangeal pads on digits I-IV. The presence of a manus rules out the larger *Chirotherium barthii* and smaller *Isochirotherium lomasi* ichnospecies. Furthermore the placement of the manus directly in front of the pes and greater divergence of digits IV and V are indicative of *Chirotherium storetonense*. The abundance of data contained in the slim footprint trackway closely matches the description of *Chirotherium storetonense* (King *et al.*, 2005) and therefore it has been identified as this ichnospecies.

The broad footprint set is larger than the *Chirotherium storetonense* trackway and displays features which are characteristic of the ichnospecies *Chirotherium barthii*. The pes falls within the length range for this ichnospecies and digits I-IV taper to the characteristic triangular points. Furthermore the manus has five digits preserved with the first four displaying an even spread. As a result, the reasonable preservation of a complete footprint set enables the confident identification of the footprints as *Chirotherium barthii*.

Other trace fossils

A variety of small footprints have been preserved on specimen LANMS 1998.12.1521 as shallow relief casts. The footprints are numerous and isolated with some well preserved examples present. Occasionally the small footprints have overprinted, or been overprinted by, the chirotheroid footprints. There are also several invertebrate trace fossils preserved in the form of *Planolites* and looped trails.

The most numerous form of small footprint displays three to four widely spaced digits (Figure 5a). The digits are forward facing and slightly curved with digit length increasing from I-IV. Each digit terminates distally in a fine, scimitar shaped point although this is not visible on every specimen. The well preserved footprints display all of these features which are characteristic of *Rhynchosauroides articeps* (Maidwell 1911), which is synonymous with Beasley's D1 type and also Haubold's *Rotodactylus matthesi* (1967).

Several footprints with three widely spaced and slightly curved digits have also been preserved (Figure 5b). These are occasionally overprinted by the chirotheroid footprints. Digit length increases from II-IV and the digits are forward facing, terminating in straight distal points. The outer digits have not been preserved but the other features match the characteristics of Maidwell's *Rhynchosauroides rectipes* (1911), which is synonymous with Beasley's D2 form.

Occasional footprints with broad, closely spaced digits have been preserved on specimen LANMS 1998.12.1521 (Figure 5c). Three digits have been preserved which range from a straight to very slightly curved appearance. The digits taper distally to triangular points and digit length increases from II-IV. The breadth of the digits also increases in this order on some of the specimens. These footprints display the broad features which are characteristic of *Rhynchosauroides tumidus* (Morton 1897 and Maidwell 1914), known also as Beasley's type I and Haubold's *Rotodactylus tumidus* (1971).

A small and broad footprint with four short digits has been preserved close to the right *Chirotherium storetonense* pes (Figure 5d). The digits are broad and rounded with an equal spread of low divergence angles. The outline of this footprint is similar to Beasley's C type which was never fully described. For this reason the footprint has been classified as ichnogenus indet..

A pair of small footprints is preserved below the right *Chirotherium barthii* pes. Only one of the footprints has been preserved in any detail and this consists of three forward facing digits situated in front of an oval pad (Figure 5e). The digits are straight and widely spaced, tapering distally to delicate points. The footprint shows similarities to Morton's *Chelone*? *subrotundum* (1897) which is synonymous with Beasley's type F1. However, this ichnospecies has not been formally described and therefore the footprint has been identified as ichnogenus indet..

Equisetites keuperina specimen

A rare specimen of *Equisetites keuperina* has been well preserved as a low relief cast on LANMS 1998.12.1521 (Figure 6). The fossilised reed measures 340 x 11 mm and is divided into sections by five nodes. The structure of the stem is well preserved and displays four linear ridges. Digits II and III belonging to the narrow right manus have interfered with the reed's preservation and suggests that the *Chirotherium* producer crushed the plant underfoot.

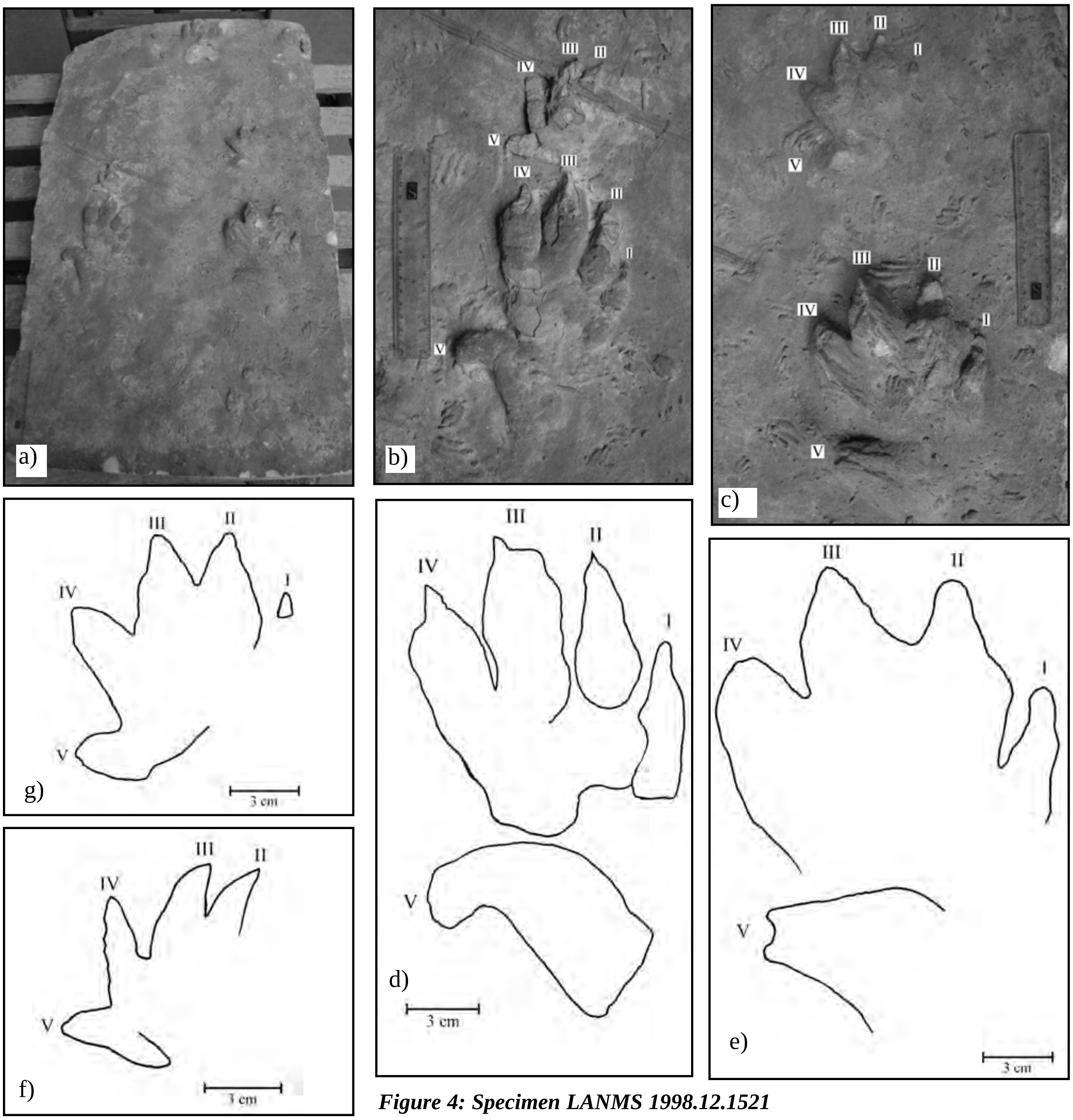


Figure 4: Specimen LANMS 1998.12.1521
a) Trackways of* C. storetonense *(left) and* C. barthii *(right)
***b) Right set of* C. storetonense**
***c) Right set of* C. barthii**
d) Tracing of right* C. storetonense *pes
e) Tracing of right* C. barthii *pes
f) Tracing of right* C. storetonense *manus
g) Tracing of right* C. barthii *manus.

Rhynchosauroidae and miscellaneous specimens

The Rossendale Collection contains at least 11 small specimens of sandstone which display a mixture of small vertebrate footprints, partial remains of possible chirotheroid footprints, small-scale tail drag casts, and numerous claw marks (see table 1). With the exception of RF 464 (which is described separately) these specimens share similar properties and have been grouped together.

The specimens are lithologically very similar to one another and also the chirotheroid specimens described earlier in this paper. Therefore the specimens may have been collected from the same layer of sandstone or in close proximity to one another. The pale cream sandstone is fine grained and well sorted with small-scale loading affecting several specimens. Quartz and occasional flakes of muscovite are visible in hand specimen with quartz being

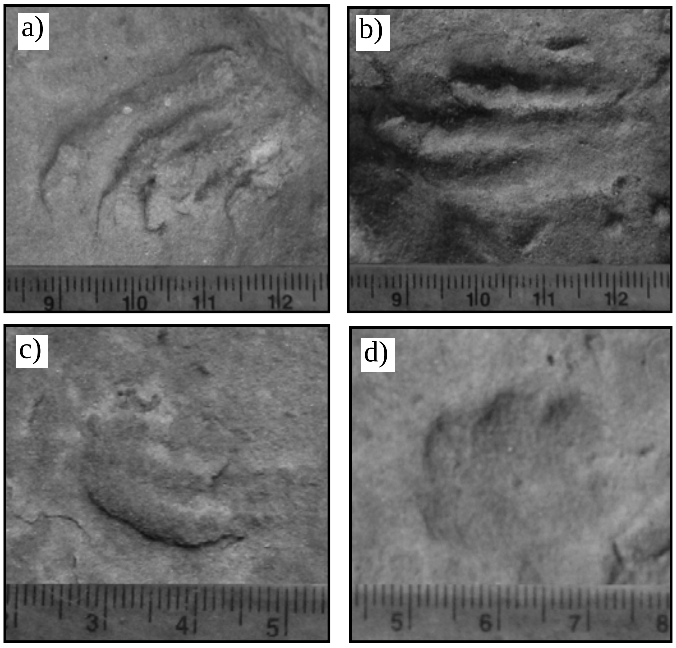


Figure 5: Small vertebrate footprints preserved on specimen LANMS.1998.12.1521
***a)* R. articeps**
***b)* R. rectipes**
***c)* R. tumidus**
d) Ichnogenus indet. (Beasley's C type)
e) Ichnogenus indet. (Morton's* Chelone*?* subrotundum*).

the most abundant mineral. The sandstone shows very little discolouration and the footprint surfaces are remarkably fresh.

Small vertebrate footprint casts are commonly preserved in this collection of specimens. These are predominantly isolated footprints which display poor to moderate preservation and low relief. Most of the footprints lack fine detail but display characteristics of *Rhynchosauroides* isp., such as widely spaced digits and the increased digit length from I through to IV.

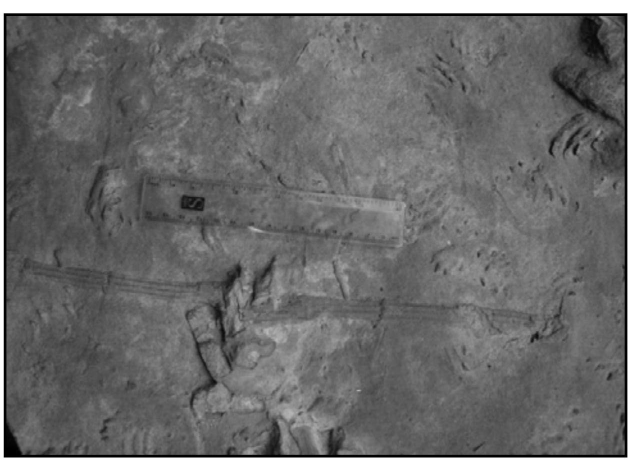


Figure 6: Stem of* Equisetites keuperina *overlain by a right* C. storetonense *manus, LANMS 1998.12.1521.

Specimen RF 84 displays a broad form of small footprint with medium relief and the preservation of three digits. The digits are broad and closely spaced with digit length increasing numerically. Each digit is straight and forward facing with relief increasing distally. The broad form is characteristic of *Rhynchosauroides tumidus*.

Specimen LANMS 1998.12.1378 contains three isolated rhynchosauroid footprints with three digits preserved in each instance. The digits are widely spaced and terminate distally to curved points. Digit length increases from II-IV but digits I and V have not been preserved. The widely spaced digits, with digit length increasing numerically, and terminating in scimitar shaped tips, are characteristic of *Rhynchosauroides articeps*.

Although several specimens display partial chi-

Feature	**Specimens**
Rhynchosauroides isp and above	LANMS 1998.12.1378, RF 74, RF 76, RF 80, RF 84, RF 87
Partial chirotheroid footprints	RF 72, RF 80, RF 81, RF 84, RF 87, RF 461
Tail drag casts	RF 74, RF 77, RF 87, RF 88

Table 1: Additional Rossendale specimens displaying various vertebrate trace fossils (excluding RF 464).

rotheroid footprints these were excluded from the previous section due to poor preservation. In many cases the chirotheroid remains consist of little more than an isolated digit, which limits identification to the level of ichnotaxa.

Specimen RF 464 (LANMS 1998.12.1754)

A variety of small vertebrate footprints are preserved as low relief casts in a fine grained and well sorted sandstone. The specimen is strongly discoloured but in places the original pale brown colour is visible. Quartz is the most abundant mineral present but occasional flakes of muscovite are also visible in hand specimen. A long tail drag cast has been preserved in addition to the footprints.

The majority of footprints are incomplete and poorly preserved but there are several which display greater detail and preservation. Specimen RF 464 displays two pentadactyl, semi-plantigrade footprints with widely spaced digits (Figure 7a). Digits II-IV are forward facing and slightly curved with digit length increasing from I-IV. Digit I and V diverge greatly from the midline and each digit terminates distally to a pointed tip. Although the footprints are isolated they display good preservation and many characteristics of *Rhynchosauroides beasleyi* (Nopsca 1923), which is synonymous with Beasley's D7 type.

Several footprints with three widely spaced digits have been preserved on this specimen (Figure 7b). The digits are forward facing and slightly curved, terminating to sharp, straight distal points. Digits I and V have not been preserved which is a common feature with rhynchosauroid footprints. The digits are widely spaced and digit length increases from II-IV. These features match those of the ichnospecies *Rhynchosauroides rectipes*.

Three small footprints with broad and closely spaced forward facing digits have been preserved (Figure 7c). The digits are straight and digit length increases from II-IV (digits I and V have not been preserved). The distal ends of digits II-IV terminate to rounded tips, possibly formed by phalangeal pads. These footprints are characteristic of the broad form known as *Rhynchosauroides tumidus*.

Specimen RF 464 displays two footprints of extremely small size with three digits preserved (Figure 7d). The digits are widely spaced and very slightly curved with digit length increasing numerically. Digits I and V have not been preserved but the size of these footprints is suggestive of Maidwell's *Rhynchosauroides minutipes* (1914).

Lithology

Lithology in hand specimen

The vast majority of Rossendale specimens display the same lithology, with RF 450 being the only specimen showing major differences. Although several specimens show discolouration, fresh surfaces reveal that the natural colour of the rock is pale cream. The sandstone is fine grained, well sorted and hand lens observations reveal that the sandstone is quartz rich with rare flakes of muscovite. Sedimentary structures are rare in such small specimens but RF 91 does display a set of small-scale asymmetrical ripple marks (wavelength and crest height being 7 mm and 1 mm respectively) in close proximity to the pes. Small-scale load structures almost entirely cover the surface of specimen RF 91 and several tool marks are also present.

The sandstone of specimen RF 450 is a pale brown/light purple colour, fine grained, and well sorted. Clay laminations obscure much of the specimen's surface which has a sugary appearance due to the abundance of muscovite. The sandstone of RF 450 is also quartz rich but unlike the other Rossendale Specimens, flakes of muscovite are more numerous, especially on the bedding plane.

Description of thin sections

Thin sections were taken from two Storeton specimens (RF 87 & RF 88, Museum of Lancashire) and a Lymm specimen (LL.6655.b, Manchester Museum) for a more detailed lithological analysis of

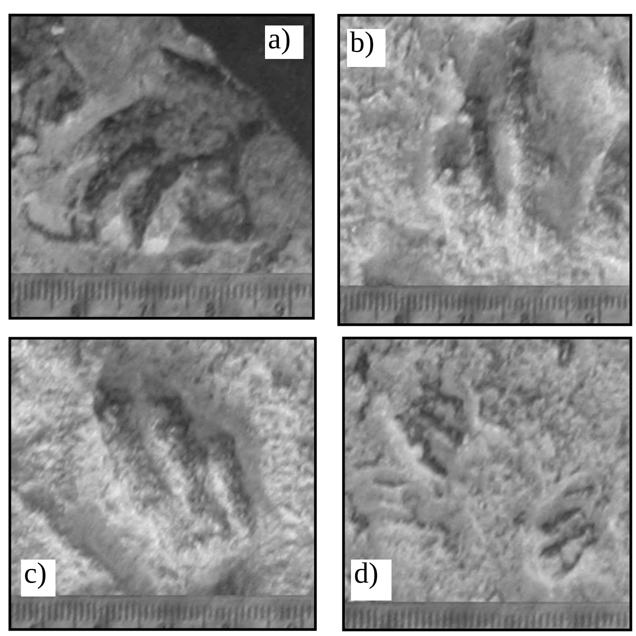


Figure 7: Specimen RF 464. Examples of:
***a)* R. beasleyi *b)* R. rectipes**
***c)* R. tumidus *d)* R. minutipes.**

these localities. Museum records detailing the locality of *Chirotherium* specimens are notoriously poor and it is hoped that the following thin section descriptions will enable a more reliable means of discerning localities. In order to evaluate this method a further thin section was made from a specimen whose locality is unknown (RF 450, Museum of Lancashire). By comparing the thin section to the descriptions of RF 87, RF 88, and LL.6655.b it was hoped that the locality of RF 450 could be ascertained. It is also possible that thin section analysis will provide a greater stratigraphical and palaeoecological understanding of Storeton and Lymm.

RF 87

The rock is fine grained (av. grain size is 0.2 mm) and well sorted with occasional bands of finer material. Quartz is the most abundant mineral with a considerable amount of what appears to be altered feldspar also present (refer to table 2 for mineralogical composition). Iron oxide staining is visible in the altered feldspar when viewed in plane polarised light (Figure 8a). The quartz forms subangular grains with a high degree of sphericity in the majority of cases. The presence of quartz cement is indicated by euhedral crystal faces but is difficult to distinguish from the quartz grains. Rare flakes of muscovite (Figure 8b) and also unaltered crystals of plagioclase are present which account for <1% of the composition.

Identification is difficult due to the amount of altered material present but if this is assumed to be altered feldspar then specimen RF 87 would be classified as an arkosic arenite.

RF 88

Specimen RF 88 is fine grained and well sorted, displaying an average grain size of 0.2 mm. Individual grains of quartz are subangular with high sphericity and comprise the majority of the rock's composition (see table 2). There is a considerable amount of altered feldspar present which has broken down to clay minerals and displays iron oxide staining in plane polarised light. Occasional grains of quartz display euhedral crystal faces which suggest the presence of quartz cement but the two are difficult to distinguish from one another. Muscovite and unaltered crystals of plagioclase and microcline comprise <1% of the composition (Figure 8c).

Specimen RF 88 has tentatively been classified as an arkosic arenite based on the assumption that the altered material represents weathered feldspar.

LL.6655.b

The rock is very fine grained and well sorted, displaying an average grain size of 0.1 mm. Quartz is the most abundant mineral (see table 2) and forms subangular grains with high sphericity. The shape of the quartz grains is hard to distinguish from the quartz cement, which forms euhedral crystal faces. A considerable amount of what appears to be altered feldspar is present and also rare unaltered crystals of plagioclase and microcline (Figure 8d). Rhombic crystals displaying one good cleavage, first order interference colours and straight extinction, comprise a small percentage of the specimen and have been tentatively identified as gypsum (Figure 8e). Rare crystals of muscovite comprise <1% of the rock's composition and are slightly larger than those seen in specimens RF 87 and RF 88.

Identification has taken into consideration the amount of altered feldspar present and specimen LL.6655.b has been classified as an arkosic arenite.

RF 450

Specimen RF 450 is very fine grained (average grain size is 0.1 mm) and well sorted with quartz forming the majority of the composition (refer to table 2). Individual grains of quartz are subangular and highly spherical in the majority of cases. Quartz cement has formed during diagenesis and is hard to distinguish from the quartz grains. As a result, the euhedral form of the cement gives the quartz grains a more angular appearance. The rhombic crystals of what appears to be gypsum are more abundant than in specimen LL.6655.b but still form a small percentage of the overall composition (Figure 8f). Altered material is again present in specimen RF 450 and is assumed to be altered feldspars. Unaltered crystals of plagioclase and microcline are present in minor amounts as are crystals of muscovite, which are slightly larger than those in specimens RF 87 and RF 88.

The amount of altered feldspar has been included in classification and as a result specimen RF 450 has been tentatively identified as an arkosic arenite.

Discussion

Interpretation of the chirotheroid footprints

The majority of chirotheroid specimens in the Rossendale Collection are poorly preserved and form

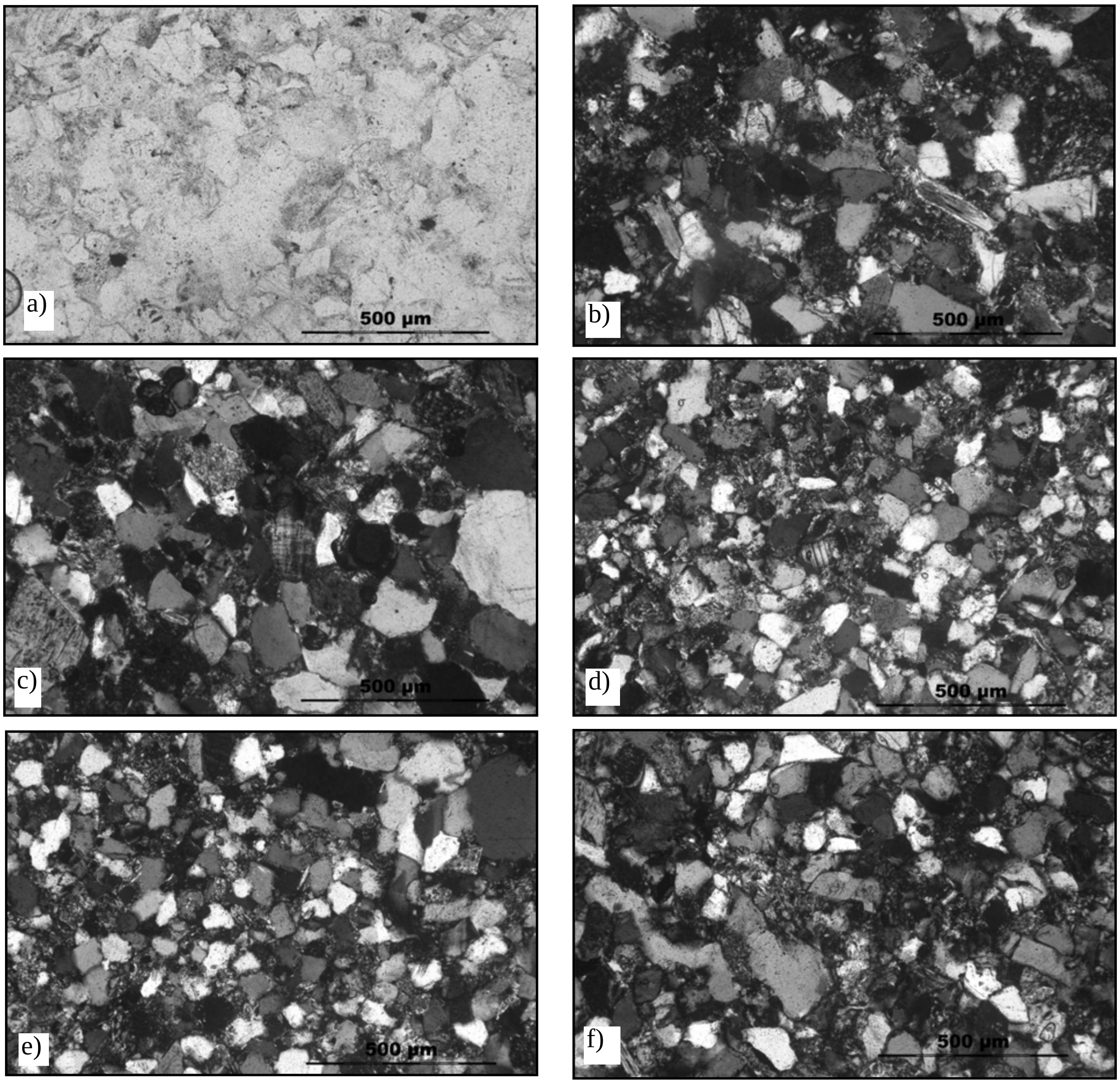


Figure 8: a) Iron oxide staining in the altered material (plane-polarized light), RF 87 b) Rare flakes of muscovite are present in RF 87 c) Rare and heavily altered microcline crystal (centre) and muscovite (below left centre), RF 88 d) Unaltered plagioclase crystals are rare in specimen LL.6655.b (centre) e) Rhombic crystals form approximately 10% of LL.6655.b (centre) f) Specimen RF 450 also contains occasional rhombic crystals (centre and top right).

isolated footprints which restricts palaeobiological interpretation. Specimen LANMS.1998.12.1521 is important because it is only the second specimen from Storeton that displays both *C. storetonense* and *C. barthii* footprints (the other specimen being LL.6657 at The Manchester Museum). It is also traversed by numerous footprints produced by rhynchosaurs and possible chelonians which represent at least part of the middle food chain. The *C. storetonense* trackway represents a unique interaction between the footprint producer and the flora, with the superposition of the manus over the reed *Equisetites keuperina*.

Most of the chirotheroid footprint casts display low relief and a lack of fine detail (such as skin casts) which is often evident in other collections (Batty 2004). Therefore, when considered together with the lighter colour of the sandstone, the Rossendale Collection may represent undertracks, which would explain the absence of rhynchosauroid footprints on many specimens. The specimens are also very fresh and there are no remnants of clay on the footprint surface with specimen RF 461 displaying a footprint mould. These features suggest that the footprints may have originated from one or more layers of sandstone

Mineral	Specimen			
	RF 87	RF 88	LL.6655.b	RF 450
Quartz	70%	70%	70%	65%
Altered feldspar	30%	30%	25%	25%
Plagioclase	Trace	Trace	Trace	Trace
Microcline	N/A	Trace	Trace	Trace
Muscovite	Trace	Trace	Trace	Trace
Gypsum	N/A	N/A	5%	10%

Table 2: Mineralogical abundance and composition of thin sections RF 87, RF 88, LL.6655.b and RF 450.

below a clay seam. If that proved correct, the impermeable clay seam would have protected the sandstone from iron oxide staining which was leached out of the upper strata and thus preserved the original pale colour.

The Rossendale specimens which have been assigned to ichnospecies confirm that *C. storetonense* was the dominant form of chirotheroid footprint at Storeton. The large semi-plantigrade pes indicate that the hind legs were powerfully muscled and supported the bulk of the producer's weight. By contrast, the smaller digitigrade manus represent weaker forelimbs that were used primarily for balance. When the animal ran it may have switched to a bipedal gait (Batty 2004). Chirotheroid tail drag casts have not been preserved on the Rossendale specimens or specimens at other museums visited by the author (Batty 2004). Therefore the tail was held above the ground and would have been used to aid balance. By comparing the Rossendale specimens to one another it becomes apparent that digits I-IV on the producer's hind feet ended in a claw. A claw on the tip of digit V has not been confirmed but thick phalangeal pads covered the underside of the digits. The forefeet were not as heavily impressed as implied by the lower relief manus casts. It is not apparent whether the digits on the forefeet ended in claws. However, digits I and V on the manus have rarely been preserved which supports the theory that the forelegs were used as props.

Stratigraphy

The quarries at Storeton (near Birkenhead, Merseyside) and Lymm (near Warrington, Cheshire) were the most important *Chirotherium* localities in Britain but have now all been infilled.

The Storeton Quarries worked the Helsby Sandstone during the 19th and early 20th centuries and comprised the South Quarry (the original Storeton Quarry, which closed in the 1880s), North Quarry (opened in 1840 and closed during the 1880s), Bullock's Quarry (small quarry reopened as Bullock's Quarry in the 1890s and closed in 1905), and Higher Bebington Freestone Quarry (purchased by Charles Wells in 1905 and closed in the early 1920s) (King *et al.* 2005). It was the South Quarry which yielded the first British *Chirotherium* specimens in 1838 and the 20th century discoveries originated from the Higher Bebington Freestone Quarry.

The South Quarry and Higher Bebington Freestone Quarry had approximately 30 m high faces. Three clay seams ran horizontally at 0.6 m intervals approximately 12 m below ground level (Tresise 2003). Above each clay seam was a layer of sandstone which broke into thin slabs and formed the three footprint beds (which were not always visible during the period of quarrying). The uppermost footprint bed yielded the vast majority of chirotheroid footprints at the South Quarry during the time of the 1838 discoveries. When quarrying focused on the Higher Bebington Freestone Quarry during the early 20th century, it was in the middle footprint bed where most of the chirotheroid specimens were discovered (Tresise and Sarjeant 1997).

At the Storeton Quarries, the Helsby Sandstone was predominantly fine grained and a pale cream or yellow colour, stained brown by iron oxides (Tresise 1993a). The pale cream coloured Rossendale specimens display minimal staining by iron oxides when compared to the stronger yellow/light brown coloured Storeton specimens from other collections (Batty 2004). Beasley noted that the sandstone quarried at the Higher Bebington Freestone Quarry was white or cream coloured (1908). The 1909 additions to the Rossendale Collection coincided with this period of quarrying and raise the possibility of the Rossendale specimens originating from this quarry. Although this is speculative, the pale colour confirms with almost certainty that the Rossendale Collection originated from a slightly different locality to the majority of the Storeton specimens.

There were three quarries at Lymm which worked the Tarporley Siltstone (Rawlinson 1853) and yielded footprints during the early 1840s. The Lymm Quarries were an important source of chirotheroid footprints but were relatively short lived and had been infilled by the 1870s (Tresise and Sarjeant 1997). It was the Windmill Field Quarry which yielded most, if not all, of the Lymm specimens (Tresise 1993b) and Hawkshaw (1842) noted the following stratigraphy:

Ground level	
Soil	- 1 foot
Red marly shale	- 5 feet
Blue and yellow shale	- 9 feet
Red rock in beds varying from 3-12" thick	- 8 feet

It was the red sandstone at the base of the quarry face which yielded the chirotheroid footprints, again on the underside of beds lying directly above clay seams. The footprint bearing beds consisted of a deep red/purple fine grained sandstone, with abundant muscovite on the basal surface, and commonly displayed mudcracks and evaporite holes (Batty 2004). The locality of the Rossendale specimen RF 450 has not been recorded but its lithology matches that of Lymm in hand specimen.

The two Storeton thin sections taken from specimens RF 87 and RF 88 are identical to one another. Both sections are fine grained (0.2 mm average grain size) and contain approximately the same amount of clay material, which is assumed to be altered feldspar grains. Quartz is the most abundant mineral present and there are also flakes of muscovite which are a little smaller than in sections LL.6655b and RF 450. The considerable amount of altered feldspar present (approximately 30%), together with occasional grains of unaltered feldspar and muscovite, indicate a relatively immature sandstone such as an arkosic arenite. The iron oxide staining is a significant characteristic of the Storeton sections and is absent in thin sections LL.6655.b and RF 450.

The Lymm thin section from the Manchester Museum (LL.6655.b) and the possible Lymm section from the Museum of Lancashire (RF 450) are very similar. As with the Storeton thin sections there is a considerable amount of clay material and rare crystals of unaltered plagioclase and microcline. A small amount of muscovite (<1%) is again present and forms slightly larger crystals. The bedding surface of specimen RF 450 contains significantly more muscovite than on specimens RF 87 and RF 88. The lack of muscovite in thin section RF 450 is due to the section being made perpendicular to the bedding surface. Rhombic crystals form a small percentage of sections LL.6655.b and RF 450 (5 and 10% respectively) but are not present in RF 87 or RF 88. The proportion of altered feldspar (approximately 25%), minor amounts of unaltered feldspar, and flakes of muscovite, indicate that sections LL.6655b and RF 450 represent an immature sandstone such as an arkosic arenite. The similarity of these thin sections, and lithological observations in hand specimen, indicate that specimen RF 450 originates from Lymm.

The four thin sections are very similar to one another with only slight differences between the Lymm and Storeton specimens. Apart from a minor variation in grain size, the only differences are that the Lymm specimens display rhombic crystals (possibly gypsum) and the Storeton specimens have been stained by iron oxides. Both of these features could have occurred diagenetically and, until more thin sections have been examined, caution should be exercised when determining the place of origin.

Palaeoecology

The palaeoenvironment of Storeton has been a source of debate since the first chirotheroid footprints were discovered in 1838. At that time Cunningham believed the footprints were covered by windblown sand on the margins of a receding lake or floodplain whereas Buckland favoured an intertidal setting. A compromise was made and elements of both Cunningham's and Buckland's theories were published (Cunningham 1838). Recent work has favoured Cunningham's original theory, suggesting an arid to semi-arid desert with occasional flash floods producing temporary lakes. Reptiles proceeded to leave their footprints in mud exposed by evaporating lakes before it was covered by aeolian sands (Tresise and Sarjeant 1997).

The Storeton thin sections reveal an immature sandstone with remnants of feldspar, occasional muscovite crystals, and unaltered feldspar grains. The quartz grains are subangular which, together with the altered feldspar and muscovite, suggests a fluvial rather than aeolian depositional environment for the sandstone. Small-scale ripple marks are rare and together with the fine grain size suggest a low energy environment of deposition such as the outer margins of a flood plain. Mudcracks are rare in Storeton specimens (Batty 2004) and thus indicates that the clay seam (which represents the original footprint surface) was exposed for only a short period of time. The cyclothem of three footprint beds and clay seams at the Storeton Quarries represent repeated transgression and regression of braided rivers.

Climatic conditions varied from seasonal monsoonal and dry periods that were possibly controlled by Milankovich factors (Clemmensen *et al.* 1994). The Helsby Sandstone Formation represents the monsoonal season where animals gathered around dwindling pools of water. Pseudosuchians and rhynchosaurs left their footprints which are represented by the ichnofamilies Chirotheriidae and Rhynchosauroidae respectively. Possible chelonians are represented by rare *Chelone*? *subrotundum* footprints and an invertebrate fauna left *Planolites* burrows and looped trails. The flora consisted of horsetails and ferns (King *et al.* 2005) with rarely preserved specimens of the reed *Equisetites keuperina*. Specimen LANMS 1998.12.1521 displays a rare interaction between the *Chirotherium* producer and the flora as the *E. keuperina* specimen has been crushed beneath the manus of *C. storetonense*.

The lithology of the Tarporley Siltstone at Lymm is very different to that of the Helsby Sandstone quarried at Storeton. These differences are attributed to the change in palaeoenvironment caused by marine transgression. It is widely acknowledged that the Tarporley Siltstone at Lymm was deposited in an intertidal environment which bordered on sabkha conditions. Playa lakes, sinuous rivers, and estuaries could be found across the coastal plain (King *et al.* 2005). Mudcracking and evaporite holes are a common feature of specimens from Lymm (Batty 2004) and hopper pseudomorphs have also been recorded in the Tarporley Siltstone Formation (Thompson 1970). These features indicate that the climate had become more arid with the evaporation of saline lakes and estuaries during cycles of marine transgression and regression. The presence of gypsum in the Lymm thin sections tentatively supports the other evidence for sabkha conditions. However, the gypsum may have formed diagenetically and must be interpreted with caution until more thin sections are studied.

The fauna and flora at Lymm was considerably different to that of Storeton with an abundance of *C. barthii* prints and rare *C. storetonense* prints. At Storeton the opposite is true although trackways of both *C. barthii* and *C. storetonense* have been recorded (Museum of Lancashire specimen LANMS.1998.12.1521 and Manchester Museum specimen LL.6657). The bias of chirotheroid ichnofauna was first noted by O.W Jeffs and has subsequently been reiterated (Tresise 1993a) but the cause is a source of much debate. A difference in substrate, sexual dimorphism (Tresise 1996), differing behaviour, and the possibility of one (or both) ichnospecies representing undertracks could all account for the geographical distribution of the ichnospecies.

The fauna of small vertebrates at Lymm is similar to Storeton with the presence of both rhynchosaurs and chelonians represented by trace fossils (Batty 2004). At both localities the small vertebrate footprints overprint (and are overprinted by) the chirotheroid footprints and thus indicates that both rhynchosaurs and pseudosuchians were visiting the same spot within a short space of time. There almost certainly would have been a variety of vegetation to support the herbivorous rhynchosaurs but there has been no fossil evidence discovered at Lymm.

Conclusion

The absence of chirotheroid skeletal remains and original localities will always restrict interpretation of the footprints. As Beasley concludes, 'How far the different forms represent different species of animals is not absolutely certain… It is still necessary to deal with them as prints only' (1910). However work by King *et al.* (2005) has proved that given well preserved specimens, the footprints can be assigned to known ichnospecies as confirmed by specimens RF 83, RF 90, RF 91, and LANMS.1998.12.1521.

Thin section analysis can aid attempts to rediscover the original locality of chirotheroid specimens. There is potential to improve this method by examining thin sections from further specimens. For example, thin sections of known Storeton specimens from South Quarry (e.g. Bootle Museum Specimen 10) and Higher Bebington Freestone Quarry (e.g. LIVCM 1986.206.A) could be compared. It cannot be confirmed whether or not certain features (such as iron oxide staining and gypsum crystals) are diagenetic until further thin sections are examined which limits palaeoecological analysis.

Examination of the Rossendale Collection has broadened the view of Storeton's fauna and flora during the Middle Triassic. Medium-large sized pseudosuchians filled the niche of top carnivore with small herbivorous reptiles such as rhynchosaurs bolstering the middle food chain. The extent of vegetation present is unclear but is confirmed by rare specimens of the reed *Equisetites keuperina*. The Middle Triassic environment was harsh and not conducive to preservation. Therefore palaeontologists continue to focus their research on trace fossils, the only common evidence of this ancient ecological niche.

Acknowledgements

My thanks go to Heather Davis and Robin Green for their kind hospitality during my visits to the Museum of Lancashire. I also wish to thank Sandra Cruise of Clitheroe Museum for providing information on the history of the Rossendale Collection. I am extremely grateful to David Gelsthorpe of The Manchester Museum for arranging the thin sectioning of a Lymm specimen, and to Harry Williams of The University of Manchester for producing the thin sections. My thanks go to Geoffrey Tresise of World Museum Liverpool and Tony Adams, Mandy Edwards, Merren Jones and Dave Plant of The University of Manchester for their invaluable advice. Finally, I wish to thank John Nudds of The University of Manchester for giving his time freely to oversee the completion of this paper in the role of supervisor. His patience, advice and friendship throughout this research made the writing of this paper a very enjoyable experience.

References

BATTY, M.J. 2004. *The elusive hand beast*. Unpublished undergraduate thesis, The University of Manchester. 68 pp

BEASLEY, H.C. 1908. Report on footprints from the Trias, Part 5. *Report of the British Association for the Advancement of Science* (Leicester 1907), 300-304.

BEASLEY, H.C. 1910. Report on the footprints of the Trias, Part 6. *Report of the British Association for the Advancement of Science* (Winnepeg, 1909), 151-155.

CLEMMENSEN, L.B., OXNEVAD, I.E.I., and De BOER, P. L. 1994. Climatic controls on ancient desert sedimentation; some late Palaeozoic and Mesozoic examples from NW Europe and the western interior of USA. *Special publication of the International Association of Sedimentologists* **19**, 439-457.

CUNNINGHAM, J. 1838. An account of the foot-steps of the *Chirotherium*, and other unknown animals lately discovered in the quarries of Storeton Hill, in the peninsular of Wirrall between the Mersey and the Dee. *Proceedings of the Geological Society of London* **3**, 12-14.

HAWKSHAW, J. 1842. Notice of the Fossil Footsteps in the New Red Sandstone Quarry at Lymm, in Cheshire. *British Association for the Advancement of Science Transactions* 56-57.

HAUBOLD, H. 1967. Eine Pseudosuchier-Fahrtenfauna aus dem Buntsandstein Sudthuringens. *Hallesches Jahrbuch für Mitteldeutsche Erdgeschichte* **8**, 12-48.

HAUBOLD, H. 1971. Die Tetrapodenfahrten des Buntsandsteins in de Deutschen Demokratischen Republik und in Westdeutschland und ihre aquivalente in gesamten Trias. *Paläontologische Abhandlungen, Berlin* **4**, 397-548.

HAUBOLD, H. 1984. *Saurierfahrten. Wittenberg Lutherstadt, "Die Neue Brehm-Bucherei"*, A. Ziemsen Verlag, Dresden, 231 pp.

KING, M.J. 1997. *Triassic vertebrate footprints of the British Isles*. Unpublished Ph.D. Thesis, University of Bristol, Bristol, 241 pp.

KING, M.J., SARJEANT, W.A.S., THOMPSON, D.B., TRESISE, G.R. 2005. Return of the "hand beast": a Revised Systematic Ichnotaxonomy and Review of the Vertebrate Footprint Ichnofamily Chirotheriidae from the British Triassic. *Ichnos* **12**, 241-299.

LEONARDI, G. (Ed.) 1987. *Glossary and manual of tetrapod footprint palaeoichnology*. Departmento Nacional da Producao Mineral, Brasilia, 1-75.

MAIDWELL, F.T. 1911. Notes on footprints from the Keuper of Runcorn Hill, Cheshire. *Proceedings of Liverpool Geological Society* **11**, 140-152.

MAIDWELL, F.T. 1914. Notes of footprints from the Keuper, II: the 'Fereday Smith' footprint slab in the Manchester Museum. *Proceedings of Liverpool Geological Society* **12**, 53-71.

MORTON, G.H. 1897. *The Geology of the country around Liverpool, including the north of Flintshire* (3rd edition). Philip, London, 319 pp.

NOPSCA, F. (von). 1923. Die fossilen Reptilien. *Fortschritte der Geologie und Paläontologie* **2**, 1-210.

RAWLINSON, R. 1853. On Foot-tracks found in the New Red Sandstone at Lymm, Cheshire. *Quarterly Journal of the Geological Society of London* **9**, 37-40.

SARJEANT, W.A.S. 1989. 'Ten Paleoichnological Commandments': A standardised procedure for the description of fossil vertebrate footprints. *In* Gillette, D.D. and Lockley, M.G. (eds.), *Dinosaur Tracks and Traces*. Cambridge University Press, New York, 369-370.

THOMPSON, D.B. 1970. The stratigraphy of the so-called Keuper Sandstone Formation (Scythian - ?Anisian) in the Permo-Triassic Cheshire Basin. *Quarterly Journal of the Geological Society of London* **126**, 151-181.

THULBORN, R.A. 1990. *Dinosaur Tracks*. Chapman & Hall, London , 410 pp.

TRESISE, G.R. 1993a. Triassic vertebrate footprints from Cheshire, England: localities and lithologies. *Modern Geology* **18**, 407-417.

TRESISE, G.R. 1993b. Triassic footprints from Lymm quarry, Cheshire in the collections of Warrington Museum. *Archives of Natural History* **20** (3), 307-332.

TRESISE, G.R. 1996. Sex in the footprint bed. *Geology Today* **12**, 22-26.

TRESISE, G.R. AND SARJEANT, W.A.S. 1997. *The tracks of Triassic vertebrates: fossil evidence from north-west England*. National Museums & Galleries on Merseyside, Liverpool, UK, 204 pp.

TRESISE, G.R. 2003. *Chirotherium* and the Quarry Men: The 1838 Discoveries at Storeton Quarry, Cheshire, UK. *Ichnos* **10**, 77-90.

APPENDIX 1

Specimen number	Description	Locality	Lodgement
CLDB:2006:000:003	Left set of chirotheroid prints. Ichnogenus indet. + rhynchosauroid prints	Storeton	Clitheroe Museum
LANMS 1998.12.1378	Footprints of *Rhynchosauroides rectipes*		Preston Museum Unit O
LANMS 1998.12.1521	Trackway of *C. storetonense* (3 prints), right set of *C. barthii*, rhynchosauroid prints, *Equisetites keuperina*		
RF 72	Partial chirotheroid print		
RF 74	Footrpints and tail drag marks of *Rhynchosauroides* isp.		
RF 76	Footprints of *Rhynchosauroides* isp.		
RF 77	Rhynchosauroid tail drag mark		
RF 80	Footprints of *Rhynchosauroides* isp. + partial chirotheroid print		
RF 81	Partial chirotheroid print		
RF 82	Left pes of *Chirotherium* isp. + rhynchosauroid prints and tail drag marks		
RF 83	Left set of *C. storetonense* prints		
RF 84	Footprint of *Rotodactylus matthesi*? + partial chirotheroid print		
RF 85	Left set of chirotheroid prints. Ichnogenus indet. + rhynchosauroid prints		
RF 87	Footprints of *Rhynchosauroides rectipes* + tail drag mark and partial chirotheroid print		
RF 88	Rhynchosauroid tail drag mark		
RF 89	Left pes of *Chirotherium* isp.		
RF 90	Left set of *C. storetonense* prints		
RF 91	Right set of *C. storetonense* prints + rhynchosauroid prints		
RF 449	Partial left set of chirotheroid prints + rhynchosauroid prints		
RF 450	Right set of *Chirotherium* isp.	Lymm	
RF 460	Left set of *Chirotherium* isp. + overprinted chirotheroid footprint	Storeton	
RF 461	Partial chirotheroid natural pes mould. Ichnotaxa indet.		
RF 463	Right set of *Chirotherium* isp.		
RF 464	Footprints of *R. rectipes*, *R. minutipes*, *R. beasleyi* and *Rotodactylus mathesi* + tail drag mark		

APPENDIX 2

Measurements for the chirotheroid

*These footprints have been partially preserved

Specimen	Footprint	Foot print length	Foot print width	Depth/ Relief	Grade	Configuration formula	Registration	Digit 'lengths' I	II	III	IV	V	Divarication I-II	II-III	III-IV	IV-V	I-III	III-V	TD	Configuration angles IV-V	IV-III	IV-I	IV-II	II-I	II-III	II-V
RF 82	Left pes	200	131	9	Semi-plantigrade	V:I:IV:II:III		150	197	200	162	97	12	10	13	34	21	47	69	14	42	84	122	38	80	109
RF 83	Left pes	163	103	5	Semi-plantigrade	V:I:II:IV:III	-58	108	152	163	158	59	15	15	14	46	30	59	88	55	77	113	143	30	67	88
RF 85	Left pes	210	139	12	Semi-plantigrade	V:I:IV:II:III	-82	179	210	210	180	112	10	8	9	35	18	44	62	9	40	95	126	32	87	118
	Left manus*	39	59	3	Digitigrade	I:IV:III:II		42	44	37	32		35	33	33		67				59	121	149	38	90	
RF 89	Left pes	182	107	18	Semi-plantigrade	V:I:II:IV:III		139	166	178	172	64	10	13	10	43	23	52	75	53	73	119	137	18	65	85
RF 90	Left pes	164	107	4	Semi-plantigrade	V:I:II:IV:III	-76	110	148	164	150	59	15	15	15	48	29	62	91	42	63	101	123	23	60	81
RF 91	Right pes	146	104	12	Semi-plantigrade	V:I:II:IV:III	-111	100	132	146	136	66	13	16	11	45	28	55	84	40	68	108	131	24	64	90
	Right manus*	74	47	2	Digitigrade	V:IV:II:III			61	74	52	23		16	30	48		77		24	42		92		50	168
RF 449	Left pes*	105	97	3		I:IV:II:III	-74	64	91	105	87		29	27	24		56				55	93	116	23	60	
RF 450	Right pes	209	173	45	Semi-plantigrade	V:I:II:IV:III	-115	146	189	209	191	97	14	22	16	46	36	62	97	40	68	112	135	24	68	96
	Right manus*	51	103	22	Digitigrade	V:II:IV:III			48	51	53	60		49	47	40		62		16	68		129		61	113
RF 460	Left pes	190	139	8	Semi-plantigrade	V:I:II:IV:III	-79	130	170	190	173	68	18	15	11	56	33	67	100	38	59	100	117	18	58	79
	Left manus*	65	100	6	Digitigrade	I:IV:II:III		66	70	59	51		46	30	40		76				59	114	151	37	93	
RF463	Right pes	218	162	8	Digitigrade	V:I:II:IV:III		158	195	218	205	100	14	14	15	46	28	60	88	41	68	101	126	15	58	85
	Right manus	112	115	4	Digitigrade	V:I:IV:II:III		73	113	112	96	73	16	18	25	56	34	80	113	24	60	98	146	47	86	122
CLDB:2006 :000:003	Left pes	210	149	33	Semi-plantigrade	V:I:IV:II:III		135	183	200	175	66	15	11	19	44	27	63	89	40	60	97	120	23	60	119
Trackway	Right pes (L)	202	120	19	Semi-	V:I:II/IV:III		157	191	202	191	79	12	12	11	39	22	49	71	46	67	113	135	23	70	91
	Right manus	89	68	15	Digitigrade	V:IV:III:II			92	86	69	35		14	29	49		78		30	52		152		100	122
	Left pes (L)*	177	116	14	Semi-plantigrade	V:I:II:IV		140	162		178	70	10	12	14	47	22	60	82							
	Right pes (R)	212	146	19	Semi-plantigrade	V:I:IV:II:III		165	203	212	184	80	15	16	16	34	31	50	100	34	56	105	127	23	73	94
	Right manus	103	111	13	Digitigrade	V:I:IV:II:III		79	100	103	93	64	20	18	29	45	39	73	112	28	65	114	139	25	76	112

GALLERY REVIEW

A VISIT TO THE CREATION MUSEUM, KENTUCKY, USA

by Helen Kerbey

The Creation Museum (creationmuseum.org) cost $27 million to build and opened in May 2007. It is located just South of Cincinnatti, in Kentucky in a 60,000 square foot building. The publicity the museum has been getting has certainly added to its visitor figures with a large number of reviews appearing in journals and on the internet. Many are from skeptical visitors, but the exact number of people visiting out of curiosity rather than belief is difficult to ascertain. So far the museum can regard itself as successful in terms of visitor figures with the 100,000th guest arriving on July 23rd 2007, daily queues, and an application in to expand the car park.

The basic premise behind the museum is that everything, that is *absolutely everything*, can be explained by the Bible and in particular that Genesis - the first book, is completely infallible and describes events in history. The museum is run as part of an organisation called 'Answers in Genesis' that was founded by the Australian Ken Ham. The main premise of this is that it means that the earth is only 6006 years old and this is what the museum sets out to prove. There are many people who know little about the exact words of Genesis so this review starts with a summary of the contents and the explanations given by the museum, with the comment left until the end.

The pull of dinosaurs in attracting visitors to the museum was clearly not missed as they are everywhere from the entry gates to large reconstructions outside the main entrance and the words 'Prepare to Believe'. Once inside after a hefty fee of $19.95 and after having your photo taken in front of a green screen (apparently to have a dinosaur attached, we never went back) you started on a tour of the "Seven C's of History" taking you through the museum. The first few rooms contain introductory displays summarising information that is explained in more details later in the rest of the museum. An animatronics dinosaur stands alongside a women, and the first display has some examples of fossils which have living representatives, implying that the fossils do not seem to be very old. The next few displays con-

Figure 1. The entrance to the Creation Museum, Kentucky, USA.

Figure 2. Two presented theories of evolution.

tained finches showing that some of them interbreed with each other, bacteria that is too complicated to have evolved, poisonous frogs that only became poisonous after Adam's fall (when he ate the apple), and a chameleon with its complicated eye.

After this is the Canyon room which touches on the formation of the Grand Canyon, and explains that the explosive eruption of Mt St Helens carved out a large channel in very little time. Then one moves into the 'Dinosaur Dig' room. Here someone explains how they think the dinosaur died in geological terms, then another person says that if you start with the bible it can be explained in a different way that 'makes sense' i.e. it was drowned in the flood. A sapphire grown in a lab in three weeks is also here showing that minerals don't need millions of years to form. There are also some trilobite *Cruziana* tracks with a question asking you to consider whether the animals were wandering around or look like they were running for their lives.

The next few rooms cover more recent history with timelines containing people who developed theories on evolution, the age of the earth, and those who still believe in Genesis. Then one moves through a tunnel containing newspaper cuttings of horrific events around the world, teenagers taking drugs, homeless people, people not going to church. After this it was into the theatre for a video showing what was created by God on each of the six days. (Trilobites were created on day 5, and dinosaurs on day 6. Trilobites are mentioned quite frequently in the museum.) This leads you into the first C: Creation and the displays start in more detail.

When Adam and Eve were first created everyone lived happily in the garden of Eden, (including dinosaurs) and there were no poisonous animals, no thorns, and no one ate meat (including the animals). It is stated in Genesis that God created 'kinds' of animals and so in order to explain all the different species in existence today it is suggested that kinds relates to ancestral animals that have since evolved into more species - a sort of microevolution. For example: there was only one 'kind' of elephant that later gave rise to the Indian and African and presumably fossil species. This useful interpretation means that when Adam had to name all the animals (as written in Genesis) he only had about 200 to do, and that


Figure 3. Vegetarian dinosaurs

Figure 4. The animals going onto the ark.

also when Noah filled his ark, there were a much reduced number of animals needing to be rescued than are around today. The total belief in the truth of Genesis goes even further in a special display explaining who Adam and Eve's children married. They married their siblings, however as long as they remained faithful this was approved by God.

After this section is the third C: Catastrophe. Noah builds his ark and the earth is covered by water. This is where all of geological history is created. A model shows Noah taking his animals, including dinosaurs, onto the ark two by two (apart from some 'clean' animals that were allowed in in fives). Most of the animals were young and so were not very large. They would have been able to survive for short periods of time on a vegetarian diet. Insects, as apparently stated in Genesis, were left to fly and were not included. The processes causing the flood were severe enough to completely change the positions of the continents in several steps, from Rodinia to Pangea to the Present day and thus plate tectonics began. Many rocks show evidence of the flood with ripple structures, and aligned fossils.

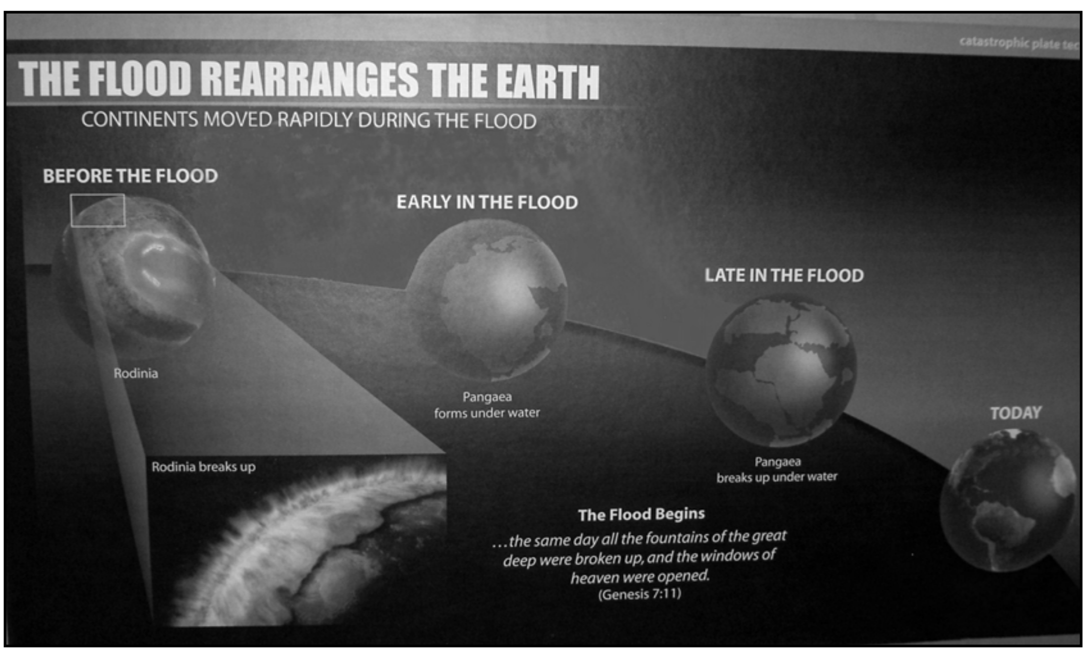


Figure 5. Plate tectonics during the flood.

The flood laid down vast quantities of sediment which changed over time. A diagram showed that since coral reefs would be reached by flood water before coastal forests, one would naturally expect to find Vendian fossil reefs before Pennsylvanian coal measures, before Permian

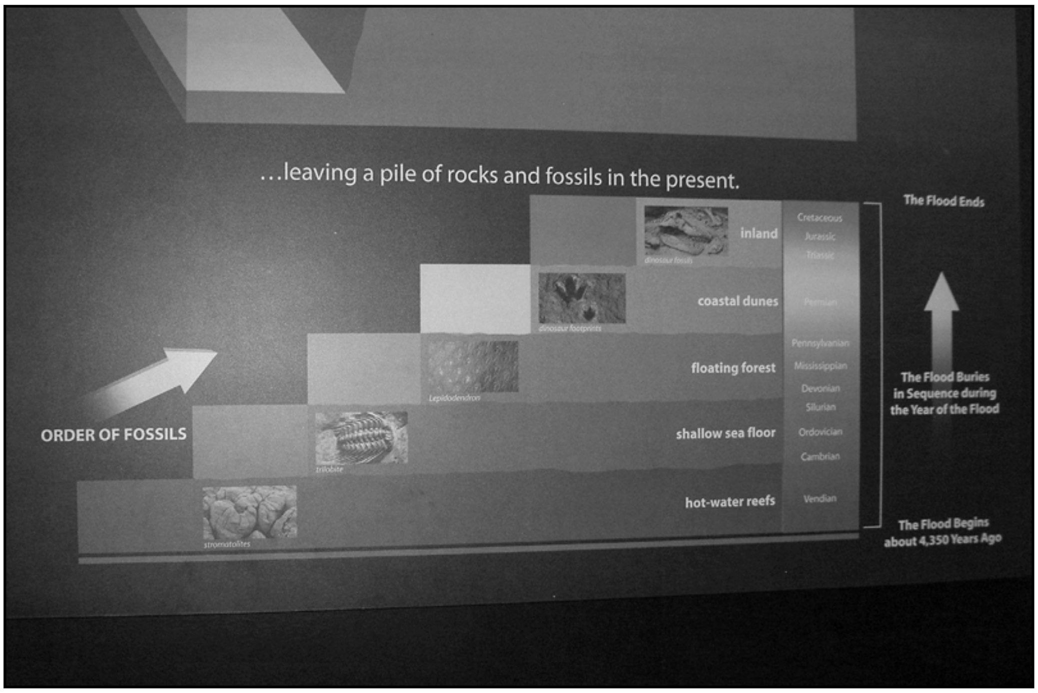


Figure 6. One year of the flood lays down all the sediments from the Pre-Cambrian to the present!

coastal dunes and before land animals found in Cretaceous rock (like Dinosaurs) in the resulting sequence of sediments. Even geology it was explained confirms that many rocks were deposited catastrophically, and palaeontology confirms that fossils are buried rapidly. Further, coal was formed from the floating masses of forests ripped up by the flood, and slowly sinking. This would explain examples of upright trees, flat coal seams, and a lack of roots beneath seams. Modern swamps simply don't provide any clues to the formation of these coal layers. So much of the present can not explain the past, however with God we can say that God's word is the key to the past, present, and future.

During and after the flood various animals died. There is evidence to show that dinosaurs are likely to have hung around for a while and, as overheard by a visitor "I think there is probably one still hiding out there ". Animals that have unfortunately died out were chosen to by God. Many people died in the flood but their lack of bones alongside dinosaur bones is to be expected since humans live with crocodiles in the present day yet their bones are not

Figure 7. The Dinosaur gallery containing fossils that it is claimed died in the flood 2800 BC.

found together. A fossil thorn is shown proving that it must be less than 6000 years old since thorns did not exist before Adam's fall.

Adam and Eve were the first people and there is DNA evidence to show that we are all related. People can have quite different levels of melanin in their skin even from darkly coloured parents. Adam and Eve were probably 'middle brown' thus giving the possibility of many differently coloured offspring in the future. Human ancestors such as the Neanderthals and Cro Magnon man were simply tribes split up by God during the Tower of Babel incident - when God made everyone speak a different language as a punishment.

After watching a video about Jesus (covering the last few C's of creation which we were recommended not to miss despite the 15 min wait) we were able to go into the Dinosaur Den, a room containing many large dinosaur fossils. Each was labelled in detail with their name and location and geological age - however after each geological age was the date 2800BC - the date of the flood.

As a museum the Creation Museum has everything you would expect: a huge shop at the exit, interactives and animatronics that all worked, a cafe, dinosaurs etc. The place was packed and many people drive for hours to reach it. It is difficult to find specific errors in a museum that uses so little geological fact in its displays, and explains complicated issues in terms of God's will. You can not argue with facts that sediments can be laid down quickly, that rapid burial is best for preservation, or that Mt St Helens erupted explosively. However, it was clear that the examples used were very narrow, and that there is still so much more to say in geological science than the evidence presented. There was little if anything on radiometric dating, only the Grand Canyon was discussed for rapid deposition of sediments, only one long flat coal seam was shown, nothing on deposition of chalk, formation of kaolinite, meteorite impacts, the KT boundary, polar reversal, Carboniferous reef limestones, tertiary volcanics, Devonian aeolian sandstones etc. In other words there was very little detail about any stratigraphy. It is explained that coal seams are layered because the floating masses took different times to sink, but what about the actual sequences of sandstones, shale, seat earth, coal and the occasional ironstone and limestone bands and how long does it take to actually form coal and other petroleum products? What about other major extinction events and the massive amount of evidence in biostratigraphy against a young earth? Have any of these people actually been out in the field to look at any of these sequences ?

In some ways it is change to have a creationist museum that does not deny that these objects exist (are fakes or are put there as a distraction to test us) but the interpretation so far is incredibly shallow and misleading and the section on humanity falling apart through lack of belief (presumably) in creationism seemed a bit of a cheap shock tactic. It should be remembered that this museum is not just about believing in a God or about believing in 'creationism' per se but is primarily about geology, geological processes, and evidence for a young earth. Over 100,000 people have been to this museum and many, many more believe in a young earth. It is important as advocates for geology that we are aware of their arguments and can provide alternative examples and that the people responsible for spreading these narrow extreme views do not have a louder voice than ourselves.

There have been other reviews in the literature and comment posted on the web. See :Skeptic magazine (http://www.skeptic.com/eskeptic/07-05-23.html) and Museum Journal (Issue 107/9, p18-19, September 2007) for examples.

Helen Kerbey, 2237 Old Creek Road, Montgomery, Alabama, AL36117, USA. e-mail: Helen.Kerbey@tesco.net

BOOK REVIEWS

AG Tindle 2008 Minerals of Britain and Ireland. Terra Publishing, 624 pages, Hardback £95.00
ISBN (10): 1 903544 22 X
ISBN (13): 978 1 903544 22 8

More than 15 years in the making, and delayed more than once, Tindle's attempt to thoroughly catalogue all British and Irish mineral species is finally complete.

The vast majority of the book, more than 500 pages, is taken up with the alphabetical listing of mineral species. There is an introduction covering primary orefields and zones of mineralisation, but it is this vast reference section that will have curators parting with nearly 100 pounds. And I'd have to say it's worth the investment.

Every species, including many synonyms and varieties, is listed with group affiliations, chemical formulae, description, type locality and other known localities. For some common species, this means several pages dedicated to localities. Details such as fluorescence, local names and mineral associations are also covered.

The locality sections also cover specific forms, which will be appreciated by collectors and curators (very useful for checking validity of localities associated to old specimens). All localities are referenced where possible. The book is illustrated throughout with colour photographs, thin sections and SEM images from all over the country.

There is an appendix dealing with the source of names, type specimens, names associated to British and Irish locations and collectors. There is also an appendix briefly describing mineral collections held in museums (this is not thorough, relying upon the curators that have responded). There is also thorough Glossary and equally thorough bibliography.

The nature of mineralogy means no such volume can ever be truly comprehensive. The discovery of new species, the re-classification of existing species, the flitting between valid and invalid species, means there will be small errors, some of which are covered in a hastily-added page of the introduction. But to focus on this would be petty.

The book is clearly an immense achievement, and Tindle is to be thanked and congratulated for his labour of love (the line between love and madness being necessarily fine). I know there were issues with publishers, so Terra should also be mentioned for taking the project on.

Any curator with mineral collections under their care should consider this a necessary purchase.

David Craven
Bolton Museum and Archive Service October 2008

RF Symes and B Young 2008 Minerals of Northern England. NMS Enterprises Ltd - Publishing, 208 pages, paperback £30.00
ISBN(10): 1 905267 01 0
ISBN(13): 978 1 905267 01 9

Following on from Alec Livingstone's Minerals of Scotland, this volume looks at the sites and common minerals of Northern England.

In this case, Northern England primarily refers to Cumbria, Northumberland and County Durham, plus a bit of Lancashire and Yorkshire. The book opens with a brief geological history of the region. There is then a chapter addressing the three main orefields that feature; the Lake District, the Northern Pennine and the West and South Cumbrian. This gives a broad overview of the main phases of mineralisation.

The next chapter, one that will be of most interest to many readers, is on the mines and minerals. This covers all the main localities and provides some brief history for the workings. There are good photos of the localities, along with some archival images of mine workers and mines. Type specimens (including brianyoungite) are discussed in this section.

We then get a chapter on mineral collectors, collections and dealers. Some of the most prominent collectors, such as Sir Arthur Russell, are discussed in this chapter. This chapter also talks about writers, poets and artists that have observed mines and minerals in the region. The biographies are not thorough, and this is not a comprehensive list, but it's a good introduction.

Most non-specialists will be buying this for mineral images, and it's the next chapter that will satisfy in this regard. Introduction to the Minerals covers the most common, and significant, species from the region: Calcite, Barite, Fluorite, Hematite, Witherite, Alstonite and Barytocalcite. There are then 92 photographed and described specimens, again covering prominent mineral species, primarily from the collections of the Natural History Museum, London.

There is a selected bibliography, which again will suit the interested amateur. Some readers may be disappointed that the book is not a comprehensive guide to the region, such a text is not practical and would never be finished. This instead provides a well-illustrated introduction to the region. It is well-written in a very readable style. It's an ideal gift for the enthusiastic amateur, though probably not for the most dedicated collector.

David Craven
Bolton Museum and Archive Service October 2008

Nudds, J.R. & Selden, P.A., 2008. *Fossil ecosystems of North America. A guide to the sites and their extraordinary biotas*. London: Manson Publishing, 288pp. ISBN 978 1 84076 088 0, paperback, £24.95.

John Nudds and Paul Selden have produced a follow-up to their successful 2004 book, *Evolution of fossil ecoosystems*, but this time, as the title shows, focussing on Fossil-Lagerstätten of North America. Each of the book's 14 chapters, in stratigraphic order, deals with one deposit, from the Proterozoic Gunflint Chert to the Pleistocene of the Rancho La Brea tar pits. They include the famous fossils of the Green River, Hell Creek and Morrison formations, and the Cambrian Burgess Shale, as well as less well-known deposits such as Gilboa, Bertie Waterlime and Beecher's trilobite Bed. Some, such as Mazon Creek and its distinctive fossil-bearing nodules are familiar to geological curators as they are common in museum collections. Other deposits included are the Triassic Chinle Group of the southwest USA, the Ediacaran biota of Mistaken Point in Newfoundland, Florissant in Colorado, and amber from the Dominican Republic. Four of these chapters (the Burgess Shale, Mazon Creek, the Morrison Formation, and Rancho La Brea) are taken directly from Selden and Nudds' 2004 book.

This book is in a smaller format to that of the authors' previous book and is more the size of a field guide such as a recent one on sedimentary rocks from the same publisher. Its 288 pages of good-quality paper, give it a hefty, substantial feel. Like other geology books from Manson over the last few years, this volume is packed with high quality illustrations - over 300 (mainly colour) photographs, diagrams, maps, sections and reconstructions. However, the small format of the book limits the layout of the illustrations which, at times, look unbalanced on the page.

Each chapter includes a history of the discovery of the deposit, an account of its stratigraphic setting, a description of the biota and its palaeoecology, and a comparison with other biotas of the same period. Lists of further reading conclude each chapter (with Selden and Nudds' earlier book listed in 9 of the 14!).

The final chapter describes access to the localities where the various Fossil-Lagerstätten can be seen in the field, and lists museums and visitor centres where material from these deposits is displayed. Unsurprisingly, most of the museums listed are in North America, but a few UK and European institutions do feature. The book is unashamedly aimed at the North American market, adopting American spellings (eg 'mollusks') and units, with stratigraphic thicknesses given in miles as well as in kilometres.

The number of pages given over to each deposit various from 14 for the Gunflint Chert to 28 for Florissant, with only 15 for the Burgess Shale but 26 for Dominican Amber. The coverage, therefore, is slightly unbalanced, with the longest chapters with the most illustrations given over to fossil arthropod sites (eg Bertie Waterlime, Gilboa, Mazon Creek, Florissant and Dominican amber), no doubt reflecting the particular interests on one of the authors.

Overall, this is an excellent book, but at nearly £25, it is a bit pricey, especially bearing in mind that if you already own *Evolution of fossil ecosystems*, you've already got four of the fourteen chapters. However, like the other book by these authors, this is an attractive little volume, of value to students and amateur geologists alike. Some of the localities described in it are on the southwest USA tourist trail (eg Petrified Forest National Park in the Chinle Group and Dinosaur National Monument in the Morrison Formation), so if you ever plan to visit the region, then you should definitely pack this book.

Tom Sharpe, Department of Geology, National Museum of Wales. 12 May 2008

Nigel H Trewin 2008 *Fossils Alive! or New Walks in an Old Field*. Dunedin Academic Press Ltd, 230 pp, Hardback £19.95. ISBN: 978 1 903765 88 3

When I was much younger, I used to read dinosaur books to my little brother, using the illustrations to pretend we were on a magic carpet, sweeping back in time to see what once lived. He loved that vivid sense of the past come to life, and I always thought it was an idea that would make a good book. So I was delighted to see Nigel Trewin has had much the same idea.

In this entertaining and informative book, Prof. Trewin sets out on 10 excursions into Scotland's geological past. In each of these trips (by bus, not carpet) he looks at the environment, natural history, and geology. Starting in the early Devonian at Tillwhandland, Nigel moves forward through time visiting localities such as Rhynie, Caithness, Edinburgh and Skye.

The text is illustrated with colour photographs of localities and fossils, along with hand-drawn reconstructions. These hand-drawn illustrations are not the high-tech images you find in most modern books on fossils, rather they are slightly more elegant versions of what you'll find in a typical notebook. This adds to the sense of a field trip.

The bus is not a lonely place, and Trewin has included numerous colleagues, allowing information to be drawn out in conversational style. The descriptions bring the landscape to life, drawing out significant events that have produced important aspects of Scotland's geological history.

The different trips are well-chosen and serve to provide a good overview of Scotland's geological history. Unlike my childhood fancies, there is a good amount of technical detail, though not so much as to be overwhelming for the amateur.

This is not a curatorial or academic book, it's instead a very entertaining way to introduce geological concepts.

Whether driving along Devonian deltas, or snorkelling in Jurassic seas, everything is drawn from real geological material. It should inspire ideas for working with the public, bringing collections to life. It's a very enjoyable read and, as such, highly recommended.

David Craven
Bolton Museum and Archive Service October 2008

Jane P Davidson 2008 *A History of Paleontology Illustration*. Indiana University Press, 217pp. Hardcover, £27.99. ISBN-10: 0253351758 ISBN-13: 978-0253351753.

Palaeontology and illustration have always had an integral relationship: illustration is clearly vital for the portrayal of fossils in scientific and popular literature. *A History of Paleontology Illustration* by Jane P. Davidson is an historical exposition of this intriguing topic. It contains a moderate emphasis on fossil restorations, the representation of prehistoric creatures as they were in life, but the main focus of the volume concerns the illustration of actual fossils and the key historical figures involved with the profession.

Considered as a specific and valid genre of art, Davidson's thesis is that palaeontology illustration can be explained by an aesthetic, that of realism. She convincingly demonstrates that palaeontology illustrators have consistently strived to depict fossils as accurately as possible, their work representing the next best thing to seeing the specimens in person.

The book is structured chronologically beginning in the fifteenth century when the first artists began to include fossils in their paintings, mostly as curiosities, and brings us chapter by chapter to the present day. This historical narrative allows palaeontology illustration to be contextualised in terms of the contemporary culture. It also allows the artworks to be appreciated in the context of the techniques and technologies available to the artists at the time. Notably, we pass through revolutions in the portrayal of fossils brought about by the use of colour in mass-produced illustrations and the invention of photography.

Due to the tremendous volume of artwork and number of artists associated with palaeontology illustration in general, in this volume Davidson resolves to select and discuss representative and key examples of artists and works of art. Along the way we are given insights into persistent motifs, ichthyosaurs spurting water and depictions of specific trace fossils with trace makers provide fascinating examples. These depictions became iconic and much imitated by subsequent artists, frequently in the face of contradicting evidence; such was the impact of palaeontology illustration on popular culture. We also discover other interesting trends, there is frequently a strong relationship between the palaeontologist and palaeontology illustrator; the famous works of Benjamin Waterhouse Hawkins and Charles Knight are testament to such collaboration. Furthermore, a large number of palaeontologists were (and are) artists themselves. One chapter investigates the common occurrence of palaeontologists shown posing alongside their discoveries; these depictions indicate to observers that there is a story behind the fossils too (and offer the familiar figure of a human as a handy scale bar).

Given the visual nature of the topic it should be expected that the volume be thoroughly illustrated throughout; the book delivers with plenty of black and white figures and a selection of several colour plates. Some of the figures are better quality than others, however, and some are crudely cropped. Also, a large proportion of the works discussed in the text are sadly not figured. In conclusion, the volume is engaging and enlightening, if a little brief in places, and presents an enjoyable overview of palaeontology illustration from an historical perspective.

Adam Stuart Smith, Department of Geology, Museum Building, Trinity College, Dublin 2, Ireland. 24th November 2008.

LOST & FOUND

Enquiries and information, please to Matthew Parkes, (National Museum of Ireland - Natural History, Merrion Street, Dublin 2, Ireland; e-mail: mparkes@museum.ie). Include full personal and institutional names and addressess, full biographical details of publications mentioned, and credits for any illustrations submitted.

The index to 'Lost & 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:

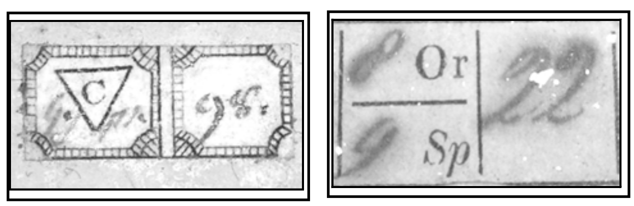
CLEEVELY - Cleevely, R.J. 1983. *World Palaeontological Collections*. British Museum (Natural History() and Mansell Publishing Company, London.
GCG - *Newsletter of the Geological Curators' Group*, continued as *The Geological Curator*.
LF - 'Lost & Found' reference number in GCG.

261. John St. Aubyn mineral collection

Jess Shepherd, St. Aubyn Project, Plymouth City Museum and Art Gallery, Drake Circus, Plymouth, PL4 8AJ, UK; Tel: 01752 30 4774; e-mail: st.aubyn@plymouth.gov.uk

Plymouth City Museum and Art Gallery are currently undertaking a large project on a collection previously owned by Sir John St. Aubyn, the 5th Baronet (1758 to 1839). Recently we secured a grant from the Esmée Fairbairn Foundation to enable the museum's natural history department to conduct a variety of work on this collection. Currently, there is much interest in the 'missing' elements of the mineral collection and the journey to their respective resting places. After his death, Sir John St. Aubyn's collection was split by the mineral dealer Isaiah Deck (1792-1853), and although an extensive collection was arranged for the Civil Military Library at Devonport (now at Plymouth City Museum), the remaining minerals were auctioned.

As part of the project, Plymouth City Museum and Art Gallery is trying to locate other specimens from Sir John's mineral collection. We hope to locate as many specimens as we can so that Sir John's collection is fully documented. Our wish is to authenticate and photograph every specimen both in the museum and in other collections so that we can create an online digital database. Above is an example of two of the oldest and most frequently occurring labels associated with St. Aubyn's mineral specimens. If you think you may have a Sir John St. Aubyn specimen or you have any information about the history of this collection, please contact Plymouth City Museum. We understand that you may not want to participate in this project, but we would like to reassure you that we would only want to authenticate and photograph your specimen. For more information about Sir John, his collection and the labels associated with his minerals, please contact Plymouth City Museum and Art Gallery on 01752 304765 or email st.aubyn@plymouth.gov.uk. You can also visit our website http://www.plymouth.gov.uk/museumstaubyncollection.



N.B. labels illustrated are not to scale.

262. Flatters & Garnett Ltd Petrological thin sections.

Dr Mike Howe, Chief Curator, British Geological Survey, Keyworth, Notts, NG12 5GG, UK; Tel: 0115 9363105; e-mail:mhowe@bgs.ac.uk

I am currently investigating a collection of approximately 200 thin sections with Flatters & Garnett Ltd labels. They represent a variety of rock types and localities (including UK, Europe and world-wide). They all have registration numbers/catalogue numbers of the form U.2077 (which is a hornblende lamprophyre (vogesite) from Andlautal, Vosges, France) and U.2096, (a spherulitic trachy-andesite from Allt A Choire, Chatachan, Isle of Skye.)

I know that Flatters & Garnett were an important supplier of microscopical equipment and preparations for educational use from the early 1900s until

1967. I believe these sections probably date from the 1950's.

I am interested in hearing whether anyone knows if the U.2077 type numbers were their standard catalogue numbers, indicating products which anyone could order, or if they were individual reference numbers for samples supplied for sectioning by their customers.