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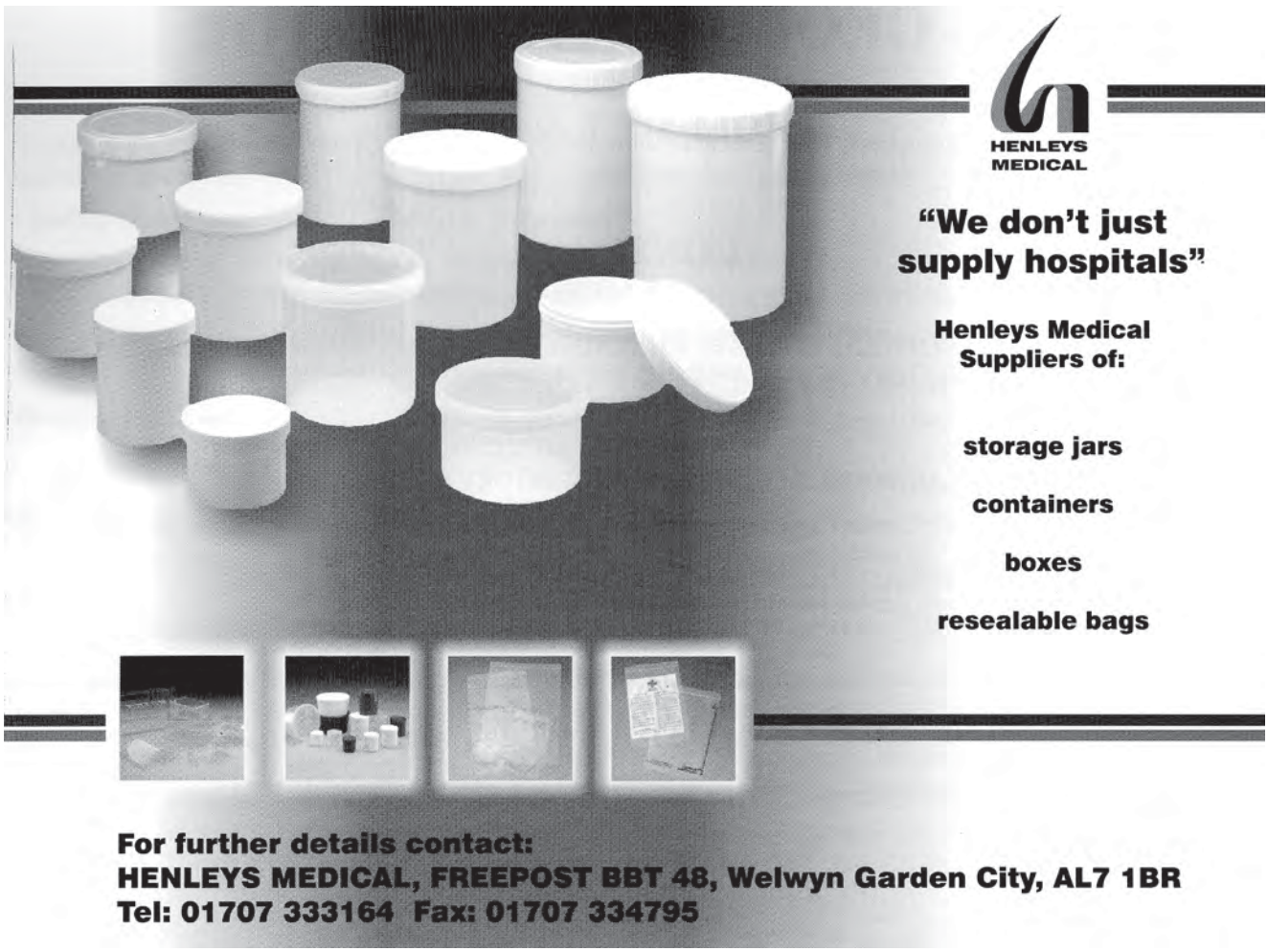

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3rd March 2000
Julie Rhodes

TRIASSIC FOOTPRINTS: THE FIRST ENGLISH FINDS

by Geoffrey Tresise and Jonathan D. Radley

Tresise, G. and Radley, J.D. 2000. Triassic footprints: the first English finds. *The Geological Curator* 7(4): 135-140.

Fossil footprints were recognised in Scottish rocks over a decade before they were first discovered in England. Then, in 1838, footprints of the "hand animal" *Chirotherium* were found in the quarries at Storeton Hill in Cheshire. This discovery was reported, first to the British Association for the Advancement of Science, then to the Geological Society of London, by William Buckland. These Cheshire finds have been assumed to predate the discovery of Triassic footprints elsewhere in England. However, a footprint-bearing slab figured by Murchison & Strickland (1840) had been presented to the Warwickshire Natural History & Archaeological Society (WNHAS) in 1837. These footprints, from Shrewley Common in Warwickshire, were thus the first to be recognised in England. Dr George Lloyd was Secretary of WNHAS and may have been unintentionally instrumental in helping to publicise the rival Cheshire discoveries. His scientific interests and the subsequent dispersal of his collections are outlined.

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The Footsteps from Cheshire

The minutes of the meeting of the Liverpool Natural History Society (LNHS) held on Tuesday 3rd July 1838 conclude:

> "Mr Cunningham, assisted by Dr Sutherland, proceeded to lay before the meeting an account of the discovery of the traces of footsteps in the sandstone of Storeton Hill quarry in Cheshire. It was stated that these impressions were identical with those described by Dr Buckland in his Bridgewater Treatise and first noticed by Professor Kaup as occurring in the New Red Sandstone of Hilburghausen in Saxony.
>
> Resolved:
>
> That the Society deem it desirable that an account of this discovery be published along with a lithographic drawing of the slabs, and that the Council conduct the publication of it...
>
> The Secretary exhibited a lithographic drawing of footsteps, found on a slab of Keuper Sandstone from Shrewley Common near Warwick and presented to the Society by Dr Lloyd of Leamington.
>
> Resolved:
>
> That the thanks of this meeting be returned to Dr Lloyd."

In 1838 the study of fossil footprints was in its infancy. The first British discovery had been in 1824, when a fossil trackway was recognised in Permian sandstones being quarried at Corncockle Muir in Dumfriesshire. Slabs were acquired by the Reverend Henry Duncan, Minister of Ruthwell, who sent plaster casts of the clearest tracks to William Buckland at Oxford University.

Buckland was not a man to theorise when he could experiment. He wrote back: "I made a crocodile walk over soft pye crust, and took impressions of his feet, which shew decidedly that your sandstone footmarks are not crocodiles." He then repeated the experiment with tortoises "of three distinct species" and concluded that the tracks from Corncockle Muir were indeed the footprints of tortoises (see Sarjeant 1974: 268-269).

Ten years later came a more dramatic discovery from Germany – more dramatic since the prints found in Triassic sandstones at Hildburghausen in Thuringia resembled "a large man's hand in a thick fur glove". No living animal, nor any in the then sketchily – known fossil record, could have left such prints. The identity of *Chirotherium* – the 'Hand Animal' as it was named – was to remain a mystery for well over a century (Tresise 1969).

Figure 1. *Chirotherium* trackway found at Storeton quarry, Cheshire, June 1838. (Natural History Museum specimen R. 729)

The British Museum purchased one of the finest of the slabs from Hildburghausen and, when William Buckland contributed two volumes to the Bridgewater Treatise series in 1836, he described and illustrated these hand-like footprints. Having read Buckland's account, John Cunningham (a Scottish-born architect working in Liverpool) immediately recognised the very similar footprints found at Storeton in June 1838 (Figure 1).

The discovery was fortunately timed, since in August Buckland was to travel north to attend the annual meeting of the newly-formed British Association for the Advancement of Science (B.A.A.S.) at Newcastle-upon-Tyne. Having learned of the Storeton Hill finds, he made a detour on his outward journey in order to visit the quarry in Cunningham's company. He was thus able to carry news of the find to the B.A.A.S. meeting, confirming that the tracks were indeed those of *Chirotherium*. He also suggested that Cunningham should prepare a paper for submission to the Geological Society of London. Cunningham, doubtless flattered by the proposal, agreed to do so. He drafted a paper which Buckland read to the Society on 5th December 1838, albeit not quite in the form that Cunningham intended. Buckland seems to have had no compunction about substituting his own views whenever he disagreed with Cunningham's conclusions (see Tresise 1991).

Thus, within six months of their discovery, the Storeton footprints were described to both the B.A.A.S. and the Geological Society by one of the foremost scientists of the day. It was no doubt because of Buckland's promotion, that most later workers have assumed that these were the first footprints to be found on the English side of the border.

It was left to Sarjeant, in his seminal overview of the British finds published in 1974, to sound a note of caution. He pointed out that 1838 had also seen the discovery of footprints in both Shropshire (reported to the B.A.A.S. in Birmingham the following year by T. Ogier Ward) and Warwickshire. His caution was amply justified. At the very meeting at which the Storeton discoveries were first reported to the Liverpool Natural History Society (LNHS), a lithograph illustrating "footsteps found on a slab of Keuper Sandstone from Shrewley Common near Warwick" (Figure 2) lay on the table. The finds from Warwickshire must therefore have predated those at Storeton and it was "Dr Lloyd of Leamington" who so inconveniently provided the Liverpool society with the proof of this.

The Footsteps from Warwickshire

Dr George Lloyd was one of the founder members of the Warwickshire Natural History and Archaeological Society (WNHAS) in 1836 and was Honorary Curator of their geological collections until 1855. In the autumn of 1837 (the year before the discoveries in Cheshire), he lectured to the WNHAS on the geology of Warwickshire, illustrating his talk with a specimen showing "the footsteps of Saurian animals". In the

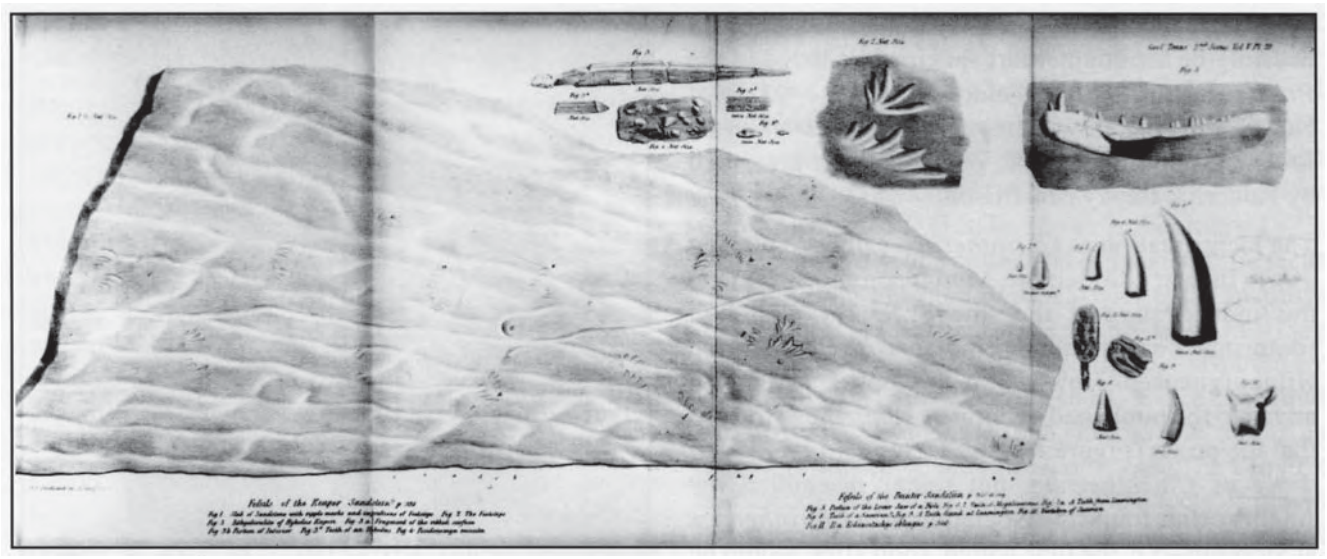

Figure 2. Lithograph of a slab with *Rhynchosauroides* footprints from Shrewley Common, near Warwick (from Murchison and Strickland 1840).

Society's Annual Report for 1837/38, he noted that the footprints had been "discovered in a quarry on Shrewley Common by the acute observation of Mr Strickland, to whom the society is indebted for the specimen".

The slab (now Warwickshire Museum specimen G10873, Figure 3) would subsequently be figured by Murchison and Strickland. Their memoir, published by the Geological Society of London in 1840 but based on a paper they read in June 1837, dealt with the 'Upper Formations of the New Red Sandstone in Gloucestershire, Worcestershire and Warwickshire'. It was of particular importance since it correlated these beds with the Keuper and Bunter subdivisions of the type Triassic system of Germany. The slab from Shrewley Common (some 4 miles west of Warwick) came from the 'Keuper Sandstone'; today this would be classed as Arden Sandstone – a local subdivision of the Mercia Mudstone Group.

It is clear that, when Murchison and Strickland delivered their lecture, they had brought the relevant specimens to illustrate it: "Our proofs of the existence of probably a Batrachian in this rock are...the impressions of the feet of animals. The slabs which we lay before the Society... we found in the sandstone of Shrewley Common. They afford the same proofs as those which were insisted on in the case of the footsteps of tortoises in Dumfries-shire... Plate XXVIII, fig. 1, represents a large slab, now in the Warwick Museum, the counterpart of which we have presented to the Society."

The reference to a counterpart in the Geological Society Museum is puzzling. It was Society practice in the 1830s to record all donations to the Museum in

Figure 3. Triassic sandstone from Shrewley Common, near Warwick showing prints of *Rhynchosauroides rectipes* Maidwell. (Warwickshire Museum specimen G 10873).

their Annual Report. The only donation that could possibly be the counterpart specimen is listed in the *Proceedings* for 1839 (Volume 3, p. 46) : "Mass of New Red Sandstone with impressions of *Chirotherium* footsteps from Birksbeck, Warwickshire; presented by Roderick Impey Murchison".

The identification as *Chirotherium* can be explained away. In their 1837 lecture, Murchison and Strickland did indeed suggest that the Shrewley Common footprints bore some resemblance to those from Hildburghausen. However, in the caption to Plate 28 added to the published version of 1840, they stressed that the prints (Figure 4) were no longer regarded as those of *Chirotherium*, but rather resembled the smaller prints found in association with *Chirotherium* at Storeton – i.e. the type which, soon after, would be suggested to be the prints of Rhynchosaurs (Owen 1842).

'Birksbeck', however, cannot be so easily explained since this locality is not mentioned in Murchison and Strickland's memoir. Gazetteers list no Birksbeck in Warwickshire, nor is it shown either on current Ordnance Survey maps or on the first edition map of 1831. If this was indeed the counterpart specimen, there seems no logical reason why the locality should not have been recorded as Shrewley Common, as it is in the memoir. This uncertainty would, of course, be resolved if the specimen itself could be examined. Unfortunately, as Sarjeant (1974) reported: "[It] is not in the Geological Survey Museum, to which the bulk of the Geological Society's British collections were later transferred, and its whereabouts is unknown."

It thus appears that Murchison and Strickland discovered the Shrewley Common footprints in the course of their researches and used them to illustrate their lecture on 14th June 1837. The best specimen was presented to Warwick Museum and was subsequently used by George Lloyd to illustrate his talk to the WNHAS in the autumn of 1837. The counterpart to this specimen was presented to the Geological Society Museum – presumably the "Birksbeck" specimen.

When Murchison and Strickland prepared their paper for publication, they decided to include a plate illustrating the Shrewley Common slab along with other Triassic fossils, mostly from the Warwick Museum collections. There is no date on this lithograph but it seems clear that it had been printed by the spring of 1838. A batch of complimentary copies was then, it can be presumed, sent to Dr Lloyd who had supplied the original drawings of some of the fossils illustrated.

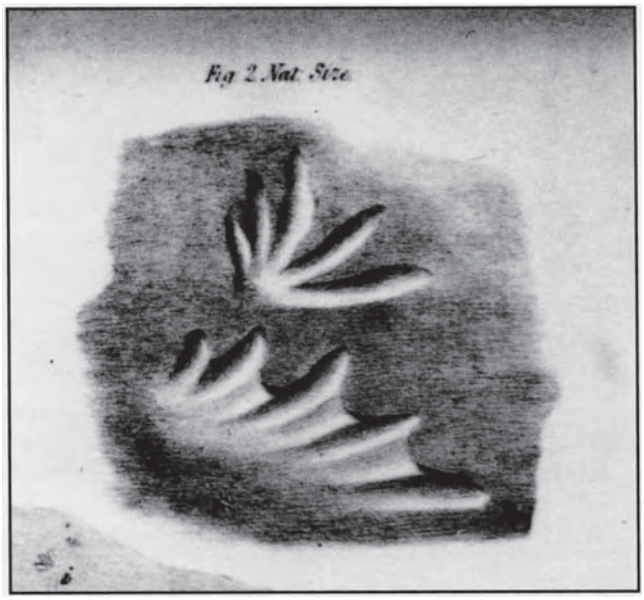

Figure 4. Detail from Murchison and Strickland lithograph, 1840. Footprints of this type were named *Rhynchosauroides rectipes* (Maidwell 1911) on the assumption that they were the prints of rhynchosaurs. Following Peabody (1948) such prints are now believed to be those of sphenodonts (the ancestors of the 'living fossil' *Sphenodon* – the tuatara of New Zealand).

It must have been one of these advance copies which he passed on to the LNHS in June 1838. The unforeseen consequences of this are noted below. Two years later, Murchison and Strickland finally published their paper (Murchison and Strickland 1840).

The extensive caption to Plate 28 compared the footprints from Shrewley Common to those found at Storeton and so helped to give the misleading impression that the Cheshire discovery predated that from Warwickshire.

But the damage had already been done. The fact that the lithograph of the Shrewley Common slab lay on the table in front of them must surely have influenced the decision of the LNHS to publish a lithograph of their own more spectacular finds from Storeton. In fact the Society published a set of four lithographs, three showing *Chirotherium* trackways, the fourth the range of smaller footprints found in association with them (see Tresise 1989, Tresise and Sarjeant 1997). These lithographs were printed in the autumn of 1838, thirty sets being set aside for distribution to public institutions and eminent scientists. Plaster casts of the footprints were also made and in March 1839, the Secretary reported that the distribution of plates and casts to other societies was now complete. The WNHAS was among the recipients; their fourth Annual Report (1840) records: "The Liverpool Natural History Society has kindly presented two casts and four engravings of footsteps of fossil animals,

discovered in the new red sandstone of Storton Hill in Cheshire, and preserved in their Museum."

Regrettably, the LNHS lithographs also popularised the spelling 'Cheirotherium'. J.J. Kaup had named the German prints *Chirotherium* and Buckland retained this spelling in his Bridgewater Treatise volumes published in 1836. However, in that same year, Friedrich Sickler, another German scientist, "corrected" the spelling on the grounds that 'Cheir' would be a more accurate rendering of the Greek root (Sickler 1836). Buckland clearly accepted Sickler's argument since his report to the B.A.A.S. in August 1838 referred to *Cheirotherium* (Buckland 1839). Buckland had visited Storeton en route to the Newcastle meeting and must have recommended the change in spelling to the LNHS, whose lithographs were then in preparation. This is borne out by the fact that the LNHS minute books, which referred to *Chirotherium* in July, changed to *Cheirotherium* in September following Buckland's visit.

What seems beyond doubt is that the Society's zeal in distributing its lithographs to all interested parties helped to ensure that the spelling "Cheirotherium" was generally used in Britain throughout the nineteenth century and is still sometimes found today.

Dr Lloyd's Legacy

Dr George Lloyd (1804–1889) was born in Albrighton, Shropshire; he gained his M.D. (Edinburgh) in 1826 and his M.A. (Cambridge) in 1833. In addition to taking charge of their geological collections, he was Secretary of the WNHAS from 1838-55 and Vice-President from 1855-85. He was elected F.G.S. in 1838 and became a life member of the B.A.A.S. in 1844. He read two papers to the British Association: on the geology of Warwickshire (Lloyd 1840) and on a new species of *Labyrinthodon* (Lloyd 1850). He also read a paper on the plant fossils from Meriden, Warwickshire to the Geological Society of London in 1852, but this was not published. In 1864 he left Warwick for Birmingham where he lived until 1888. He then moved to Berkhamsted, Herts, where he died the following year.

Dr Lloyd's name appears twice in Murchison and Strickland's memoir. In the main text (p. 344) he is credited with supplying the illustrations of three teeth from Coten End (Warwick), which were reproduced as figures 6, 7 and 8 of Plate 28. He is also cited in a footnote (p. 336) as the source "of much valuable information on the geology of Warwickshire".

On 3rd July 1838, the LNHS resolved "that the thanks of this meeting be returned to Dr Lloyd". The Society had good reason to be grateful to him, but so did other institutions, both local and national. He made numerous donations of geological and botanical specimens to the Warwick Museum in its early years. His geological interests were shared by his eldest son, Thomas G.B. Lloyd (1829–1876), a civil engineer who was elected F.G.S. in 1864. In February 1873, Thomas Lloyd sold a collection of fossil reptile teeth from the Trias of Coten End, Warwick to the Institute of Geological Sciences (I.G.S.) in London (see Cleevely 1983). These included the teeth figured by Murchison and Strickland in 1840. Since Dr Lloyd was still alive, it may be that Thomas was acting as his father's agent in the sale. Conversely, Dr Lloyd's herbarium, consisting of some 1250 sheets of plants mostly collected between 1825 and 1843, is now part of the herbarium of the Royal Botanic Gardens at Kew. It was donated in 1923 by a Mrs Lloyd (perhaps an elderly daughter-in-law) via the Bournemouth Natural History Society.

When Strickland presented the Shrewley Common footprints to Warwick Museum in 1837, they would have come into the care of Dr Lloyd as Honorary Curator of the geological collections. Lloyd did not fail to note that "there seems to be no [previous] instance recorded of their discovery in England". It is ironic that, by sending an advance copy of the Murchison and Strickland lithograph to the Liverpool Natural History Society, Dr Lloyd may inadvertently have catalysed the events which would publicise the Storeton finds at the expense of the Warwickshire specimens in which he had such a close interest.

The first British *Chirotherium* footprints were indeed discovered at Storeton. However, the first Triassic footprints ever found in England – less spectacular and less astutely publicised – came from Shrewley Common in Warwickshire.

Acknowledgements

In the early stages of research, crucial information on Dr Lloyd and his collections was provided by Martyn Bradley and Pam Copson of Warwickshire Museum. Mrs Valerie Gough of Shrewley also helped with on-the-spot researches and tried, valiantly but vainly, to track down the mysterious locality 'Birksbeck'. Information on Dr Lloyd's herbarium was provided by Sylvia FitzGerald of the Royal Botanic Gardens, Kew. Professor William A.S. Sarjeant of the University of Saskatchewan read an early draft of the text and suggested a number of useful amendments which have been incorporated. Our sincere thanks to all the above.

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THE BURGESS SHALE FOSSILS AT THE NATURAL HISTORY MUSEUM, LONDON

by D. García-Bellido Capdevila

García-Bellido Capdevila, D. 2000. The Burgess Shale fossils at the Natural History Museum, London. *The Geological Curator* 7(4): 141-148.

The fossils from Burgess Shale (British Columbia) and other exceptionally preserved Cambrian faunas have been the focus of intensive research in the last couple of decades. They reveal insights into a time and into a world where animals began to thrive more than 500 million years ago. They give palaeontologists a more complete picture of the diversity of the Middle Cambrian biota, where soft-bodied animals were surprisingly more numerous than shelly organisms. The Natural History Museum, London contains important palaeontological reference collections of worldwide significance. Among these were found and studied sixty-four specimens that came from the Burgess Shale site.

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Introduction

The renowned Burgess Shale fossil locality, which is facing Mount Burgess (with the recently designated Walcott Peak), is actually on the slope between Wapta Mountain and Mount Field, at about 2,300 m of altitude, surrounded by the breathtaking landscape of the Rocky Mountains in British Columbia (Canada) (Figure 1). Its importance comes from the quality and quantity of its fossils, as well as from the moment in animal history it represents, 505 Myr ago, which is shortly after the end of the so-called Cambrian "explosion". The Burgess Shale has produced, and continues to yield, fossils that belong to most of the extant animal phyla – major taxonomic groups – as well as other metazoans now extinct, most of which lack hard parts. Regarding the quality of preservation we should stress that some structures that are very rarely found in the fossil record, such as eyes, gills, alimentary canals, tentacles, etc, are here exquisitely preserved. The quantity and diversity of species represented at the Burgess Shale allows for unusually detailed taphonomic and palaeoecological analyses (Conway Morris 1986). For these reasons, among others, the fossils of the Burgess Shale are worthy of the most detailed and rigorous study.

Material and methods

As an ERASMUS-exchange student of Geology in Birkbeck College, University of London, I volunteered to work in the Department of Palaeontology at The Natural History Museum (NHM), London. I had experience with fossils from the Burgess Shale since I spent the summer months of 1995 excavating the type locality with the Royal Ontario Museum (Toronto) team directed by D.H. Collins. This gave me a certain familiarity with these fossils, and was also useful in obtaining permission to study the collection of Burgess Shale fossils held at the NHM.

The curators of the different taxonomic groups kindly brought out the specimens from their respective collections that came from the Burgess Shale. These are kept in different areas of the Department of Palaeontology, because the collections are organized according to the different groups of animals represented. The only strictly non-Phyllopod Bed material studied here comprises a few specimens from the Mt. Stephen Trilobite Beds (a.k.a. *Ogygopsis* Shale), across the Kicking Horse valley from Mt. Field. These beds are somewhat older stratigraphically and have inferior preservation, in comparison with the most productive level of the Burgess Shale, the famous Phyllopod Bed.

The origin of most of the sixty-four samples is well documented: two of them (from Mt. Stephen) were presented by the famous mountaineer Edward Whymper on the 23rd December 1902 (the first Phyllopod Bed fossils were not discovered until the

Figure 1. The Burgess Shale quarries (arrow), on the slope of Fossil Ridge, with Wapta Mountain on the left. Photograph taken by the author in August 1997.

summer of 1909 by Charles D. Walcott). Thirty-five samples once belonged to the U.S. National Museum (USNM), now the National Museum of Natural History within the Smithsonian Institution, and came to the NHM by donation from Dr Walcott himself in February 1920 (ten samples) and through exchanges made in December 1924 and February 1933. Almost a dozen were purchased from Ward's Natural Science Establishment (Rochester, New York) in February 1920, which, in turn, came from exchanges with the USNM (Yochelson 1996). The labels of forty-six samples bear Walcott's original USNM locality designation: "35k = N.E. of Burgess Pass, above Field, British Columbia", which corresponds to the Phyllopod Bed. The reference to Burgess Pass probably relates to the fact that Walcott's camp was situated there, where much of the early work associated with collecting these fossils (splitting, trimming, packing and possibly cataloguing) was done. This unit was given the name of "the Burgess Shale of the Stephen formation" by Walcott within his description of *Eldonia ludwigi* (Walcott 1911: 51–52). The name has recently been formalized (Fletcher and Collins 1998). One piece was bequeathed to the NHM by C. T. Trechmann in February 1964. Dr Richard A. Fortey collected several specimens from Mt. Stephen and the Burgess Shale, which were gathered when visiting the area with the field trip of the International Geological Congress held in Montreal in 1972.

The specimens were studied using a binocular microscope, looking at both sides of the slabs, making sure that the whole exposed surface of the rock was examined. This study revealed numerous new specimens: some too small to be recognized without magnification, others, due to the special nature of these fossils, only distinguishable by more experienced eyes. Playing with the angle of light to bring out the most reflective areas of the fossils is of paramount importance. In a few cases preparation with a percussion needle was needed for a correct identification of the specimens. Taxonomic determination of fossils was based mostly on Briggs *et al*. (1994), who also include the complete list of authors on the subject.

Specimens from the Burgess Shale at the Natural History Museum, London

The following is a list of the catalogue numbers with the specimens and a short description of their grade of preservation and relative quality. The first species of each sample corresponds to the one originally labelled. The sign † indicates specimens belonging to species identified for the first time in this collection.

A 1948: ***Ottoia prolifica*** Walcott, (priapulid) proboscis, gut trace and contents (3 undetermined brachiopod shells) recognizable.

A 1949: ***Selkirkia major*** Walcott, (priapulid) tube only.

Reverse side of slab:

†***Wiwaxia corrugata*** (Matthew), (sclerite-bearing animal) individual sclerite.

A 1950: ***Canadia spinosa*** Walcott, (polychaete annelid) neuropodia, notopodia, cirrus and gut trace preserved.

A 2624: ***Ottoia prolifica*** Walcott, very good specimen, proboscis completely extended (stage 6 of Conway Morris 1977).

†***Wiwaxia corrugata*** (Matthew), long dorsal sclerite.

Reverse side of slab:

†***Tuzoia retifera*** Resser, (arthropod) incomplete carapace.

Lingulella waptaensis Walcott, (brachiopod) separated valves.

†***Pagetia bootes*** Walcott, (trilobite) under *Tuzoia* carapace.

A 2625: ***Pollingeria grandis*** Walcott, (*incertae sedis*), several specimens.

A 9795 (**E 17256-H 5087**): ***Ottoia prolifica*** Walcott, (x3) (Figure 2).

Figure 2. *Ottoia prolifica*, **A 9795** (**E 17256-H 5087**).

Eldonia ludwigi Walcott, (holothurian echinoderm) (x3).

Reverse side of slab:

†Unidentified organism, several fine shiny strings, up to 3cm in length and 1mm in width, with short trabeculae perpendicular to the axis extending from the same side at regular intervals. According to Conway Morris (pers. comm. 1996) it is similar to some structures found associated with the Burgess Shale organism *Banffia constricta*. It also vaguely resembles the structure of the sponge *Falospongia falata* (Rigby 1986).

B 41285: ***Diraphora bellicostata*** (Walcott), (brachiopod) complete, previously labelled as *Nisusia alberta*.

B 41286: ***Lingulella waptaensis*** Walcott, (brachiopod) (x4), previously labelled as *Micromitra pannula*.

Canadaspis perfecta (Walcott), (arthropod) carapace in lateral view.

Reverse side of slab:

Haplophrentis carinatus (Matthew), (hyolith) incomplete.

B 84048: ***Diraphora bellicostata*** (Walcott), complete negative relief of shell.

B 84049: ***Diraphora bellicostata*** (Walcott), complete positive relief.

B 84050: ***Diraphora bellicostata*** (Walcott), complete negative relief.

B 84051: ***Diraphora bellicostata*** (Walcott), complete positive relief.

B 84150: (Figure 3) ***Nisusia burgessensis*** Walcott, (brachiopod) (x5) broken and partially buried.

Haplophrentis carinatus (Matthew), (x5).

†***Scenella amii*** (Matthew), (monoplacophoran mollusc).

Ptychagnostus praecurrens (Westergård), (trilobite) cephalon.

Marrella splendens Walcott, (arthropod) decayed.

Selkirkia major Walcott, tube only, apparent only after preparation.

†Unidentified worm (Figure 4), incomplete specimen, presents a tapering annulated body 3 mm long and a maximum width of 0.6 mm. Each ring is c. 25 mm long. Could be the larval stage cuticle of a priapulid worm. Other specimens are known in the Smithsonian Institution collections, but have not been described so far (Conway Morris pers. comm. 1996).

B 84151: ***Nisusia burgessensis*** Walcott, (x3) broken.

Haplophrentis carinatus (Matthew), (x2).

B 84152: ***Nisusia burgessensis*** Walcott.

Haplophrentis carinatus (Matthew).

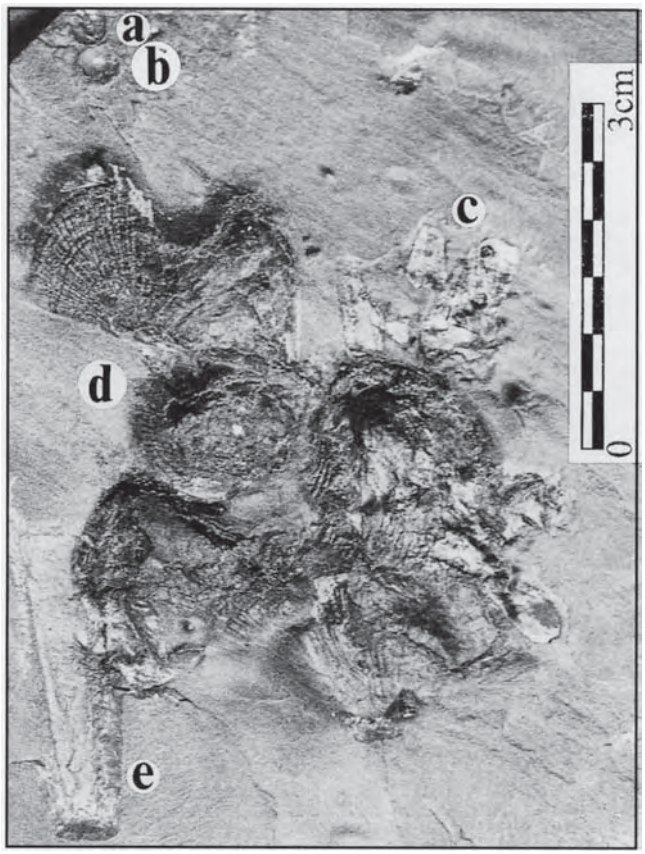

Figure 3. A significant example of the density and diversity of fossil organisms found together in the Burgess Shale; **B 84150**. (a) *Ptychagnostus praecurrens*, (b) *Scenella amii*, (c) *Haplophrentis carinatus,* (d) *Nisusia burgessensis*, (e) *Selkirkia major* (NHM Photo Unit).

Diraphora bellicostata (Walcott).

BB 73419: ***Diraphora bellicostata*** (Walcott), incomplete.

Reverse side of slab:

Incomplete brachiopod and part of a trilobite.

BB 73420: ***Nisusia burgessensis*** Walcott, incomplete, partially buried.

E 12740-H 5086: ***Eldonia ludwigi*** Walcott, good specimen.

?***Ottoia*** superimposed.

G 24664: ***Haplophrentis carinatus*** (Matthew), shell and operculum.

I 4763: ***Anomalocaris canadensis*** Whiteaves, (arthropod) claw .

I 4933: ***Anomalocaris canadensis*** Whiteaves, claw [as stated on its label, this specimen is described and figured in Woodward (1902: 542)].

†***Chancia palliseri*** (Walcott), (trilobite) free-cheek only.

Reverse side of slab:

†***Chancia palliseri*** (Walcott), small and damaged. [Samples **I 4763** and **I 4933** were presented by E. Whymper with the label "6,500 feet on Mt. Stephen, British Columbia"].

In 19140: ***Marrella splendens*** Walcott, part and counterpart, dorsal view.

In 19141: ***Marrella splendens*** Walcott, ventral view.

In 19142: ***Marrella splendens*** Walcott, dorsal view, clear difference between inner and outer branches of the appendages.

In 19143: ***Marrella splendens*** Walcott, dorsal view, well preserved but incomplete.

In 19144: ***Marrella splendens*** Walcott, interesting transverse features in last left side appendages.

In 19145: ***Marrella splendens*** Walcott, dorsal view, fine detailed antennae.

In 19146: ***Marrella splendens*** Walcott, frontal and slightly lateral view, inner and outer branches clearly discernible at front.

In 19147: ***Marrella splendens*** Walcott, ventral view, small but almost complete.

In 19148: ***Marrella splendens*** Walcott, dorsal view, very finely preserved antennae, posterior part buried.

In 19149: ***Marrella splendens*** Walcott, dorsal view, uncommon posterior feature (gut?).

In 19241: ***Burgessia bella*** Walcott, (arthropod) poorly preserved, only diverticula visible.

In 19242: ***Burgessia bella*** Walcott, body with diverticula and telson.

Figure 4. SEM picture of the unidentified worm in **B 84150**.

Figure 5. *Waptia fieldensis* (right) and *Canadaspis perfecta*, **In 24113**.

In 19243: ***Naraoia compacta*** Walcott, (trilobite) dorsal view.

In 19244: ***Canadaspis perfecta*** (Walcott), (crustacean arthropod) dorsal view, carapace and tail, relief of some appendages visible through carapace.

In 24108: ***Canadaspis perfecta*** (Walcott), (x13) some with tails and legs.

In 24109: ***Canadaspis perfecta*** (Walcott), dorsal view of carapace, tail and one antenna, digestive track with contents.

Naraoia compacta Walcott, dorsal view.

In 24110: ***Canadaspis perfecta*** (Walcott), dorsal view of carapace.

In 24111: ***Isoxys acutangula*** Walcott, (bivalved arthropod) lateral view of carapace.

Ptychagnostus praecurrens (Westergård).

In 24112: ***Hurdia victoria*** Walcott, (anomalocarid arthropod) lateral view of carapace.

Ptychagnostus praecurrens (Westergård).

Lingulella waptaensis Walcott, superimposed on *Hurdia*.

†***Hallucigenia sparsa*** (Walcott), (onychophoran) partially decayed body and 6 pairs of spines visible.

In 24113: (Figure 5) ***Waptia fieldensis*** Walcott, (arthropod) excellent specimen, only telson missing.

Canadaspis perfecta (Walcott), small and partially buried.

In 24114: ***Waptia fieldensis*** Walcott, one antenna and six gills visible, segmented telson absent.

In 24115: ***Naraoia compacta*** Walcott, semilateral view, no diverticula or appendages.

In 24116: ***Naraoia compacta*** Walcott, folded (anterior under posterior shield), diverticula clearly visible.

Sidneyia inexpectans Walcott, (arthropod) incomplete, poorly preserved

†***Takakkawia lineata*** Walcott, (sponge) (x2) almost complete specimens.

In 24117: ***Burgessia bella*** Walcott, diverticula visible.

Reverse side of slab:

Marrella splendens Walcott.

In 24118: ***Burgessia bella*** Walcott, antennae, base of telson and diverticula visible.

Polychaete, incomplete and unrecognizable.

In 24119: ***Burgessia bella*** Walcott, diverticula and antennae preserved.

In 24120: (Figure 6) ***Sidneyia inexpectans*** Walcott, complete specimen: antennae, forelimbs, tail and gut contents. Label states that it is the "counterpart of the Walcott holotype", but David Bruton (pers. comm. 1999) rejects this, and recognizes its part at the Smithsonian Institution under catalogue number USNM 139682.

†***Pagetia bootes*** Walcott.

Canadaspis perfecta (Walcott), partial carapace.

Reverse side of slab:

Canadaspis perfecta (Walcott), carapace.

†***Protospongia hicksi*** Hinde, (sponge) superimposed on *Canadaspis*.

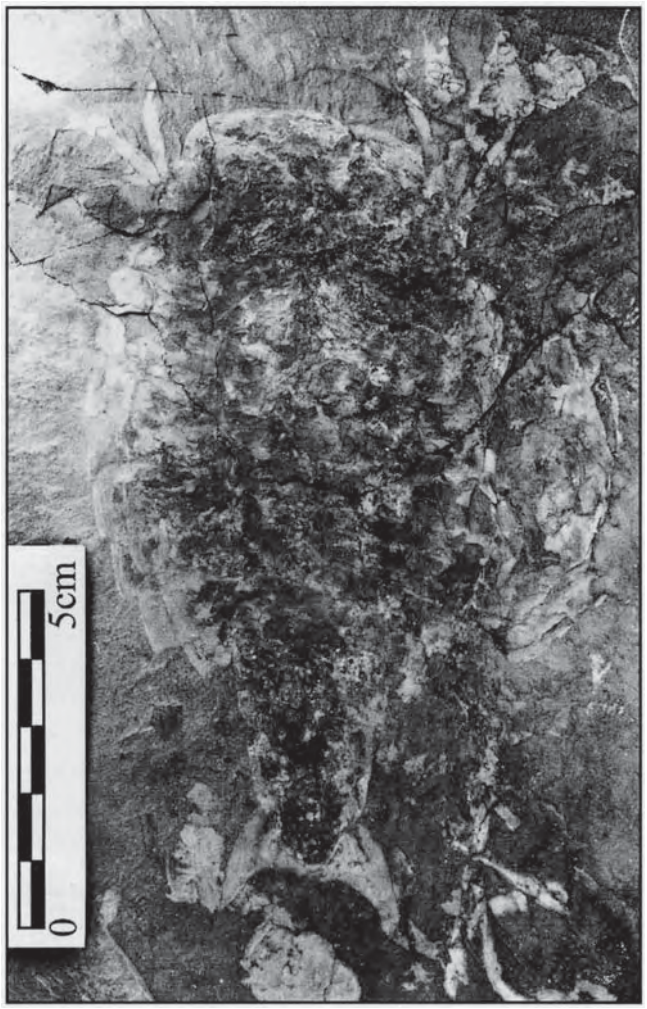

Figure 6. *Sidneyia inexpectans*, **In 24120**.

†***Micromitra burgessensis*** Resser, (brachiopod) broken.

Diraphora bellicostata (Walcott), complete.

†***Scenella amii*** (Matthew).

In 24121: ***Sidneyia inexpectans*** Walcott.

Ptychagnostus praecurrens (Westergård), some complete specimens, some cephalons.

†***Scenella amii*** (Matthew), partially buried.

In 24122: ***Marrella splendens*** Walcott, dorsal view.

Marrella splendens Walcott, dorso-frontal view.

Marrella splendens Walcott, head shield on lateral view.

In 24123: ***Marrella splendens*** Walcott, dorsal view. Undetermined reflective body. Reverse side of slab:

Marrella splendens Walcott, exceptionally well preserved specimen, ventral view.

In 24124: ***Marrella splendens*** Walcott.

It 1729: ***Burgessia bella*** Walcott, antennae faintly visible, clear diverticula.

Marrella splendens Walcott.

It 3562: ***Ptychagnostus praecurrens*** (Westergård), (13 specimens on separate individual blocks).

It 3563: ***Ptychagnostus praecurrens*** (Westergård).

†***Pagetia bootes*** Walcott.

It 3564: ***Anomalocaris canadensis*** Whiteaves, claw, some unrecognizable trilobite fragments.

It 3565: ***Anomalocaris canadensis*** Whiteaves, claw. [Samples **It 3562** to **It 3565** present the lithology typical of Mt. Stephen Trilobite Beds, but the origin is not indicated in their labels].

It 13333: ***Marrella splendens*** Walcott, (x2) dorsal views, superimposed.

It 13333a: ***Marrella splendens*** Walcott, (x2) counterpart of **It 13333**.

It 13334: ***Marrella splendens*** Walcott, small incomplete specimen.

It 13335: ***Marrella splendens*** Walcott.

?***Waptia***, partially decayed specimen, dorsal view without carapace.

S 3071: ***Vauxia gracilenta*** Walcott, (sponge) specimen with several ramifications.

†***Micromitra burgessensis*** Resser, (x4), attached or close to *Vauxia*.

V 16857: ***Marpolia spissa*** Walcott, (cyanobacteria) several strands in both sides of slab.

V 16858: ***Morania fragmenta*** Walcott, (cyanobacteria) preserved as a yellowish-grey amorphous lamina.

Results

This work sheds new light on a particular part of the fossil collection at The Natural History Museum in London, highlighting its value and facilitating future research. New labels have been made for specimens of taxa that were redescribed and renamed since they arrived in the NHM, as well as for those that had been previously misidentified. In those cases where significant fossils of different phyla (*e.g.* arthropods and brachiopods) co-occur on the same slab, I have made cross-reference labels to help their localisation on the various collection sectors. Some samples have specimens partially covered by matrix, others have up to seven different species on the same slab. For all these, a sketch with the position of the fossils in the slab was drawn and is kept with the label.

The present list of fossils shows more than 170 fossil specimens, which, compared with the original number of 64 labelled specimens, is an increase of 166%. Also regarding the species total, there has been a substantial increase: originally there were 22 labelled species, compared with the actual number of 33. This amounts to a total of 11 new taxa, which is a 50%

increase. There are two unidentified organisms (see Figure 3), so far unnamed, that can only be briefly described here and certainly need deeper analysis.

The species newly recognised in the NHM collections are:

2 sponge species: *Takakkawia lineata* Walcott, 1920; *Protospongia hicksi* Hinde, 1887

1 brachiopod species: *Micromitra burgessensis* Resser, 1938

1 monoplacophoran species: *Scenella amii* (Matthew, 1902)

1 onychophoran species: *Hallucigenia sparsa* (Walcott, 1911)

1 arthropod species: *Tuzoia retifera* Resser, 1929

2 trilobite species: *Chancia palliseri* (Walcott, 1908); *Pagetia bootes* Walcott, 1916

1 sclerite-bearing species: *Wiwaxia corrugata* (Matthew, 1899). The taxonomic position of this species is still being debated.

The study shows that the NHM collection of Burgess Shale fossils comprise a good representation (Figure 2) of all the major groups found in this locality: cyanobacteria, sponges, brachiopods, molluscs, hyoliths, priapulids, annelids, onychophorans, arthropods (both trilobites and soft-bodied groups), echinoderms, anomalocaridids, and sclerite-bearing animals (included within the Coeloscleritophora by Bengtson and Missarzhevski 1981). This collection is also palaeoecologically rich, since there are several samples belonging to most of the different life habits recognized in the Burgess Shale fauna by Conway Morris (1986):

Infaunal organisms: Priapulids (*e.g. Ottoia*, *Selkirkia*).

Sessile epifauna: Sponges (*e.g. Vauxia*) and brachiopods (*e.g. Nisusia, Micromitra*).

Vagrant epifauna: Arthropods (*e.g. Marrella*, *Burgessia*, *Canadaspis*), including trilobites (*e.g. Naraoia*), and onychophorans (*e.g. Hallucigenia*).

Nektobenthos: Swimming polychaete annelids (*e.g. Canadia*), echinoderms (*e.g. Eldonia*, although considered pelagic by other authors) and some animals not assigned to major groups (*e.g. Anomalocaris*).

Pelagic animals: Agnostoid (*e.g. Ptychagnostus*) and eodiscoid (*e.g. Pagetia*) trilobites.

Conclusions

The Natural History Museum's collection of Burgess Shale fossils can now be considered one of the most complete as far as major groups are concerned. It is only rivalled by such collections as those held at the Smithsonian Institution (Washington), the Royal Ontario Museum (Toronto), the Museum of Comparative Zoology (Harvard), and the Geological Survey of Canada (Ottawa). The importance of these fossils for the understanding of the early evolution of the metazoans, as well as for their exquisite preservation, diversity and intrinsic beauty, would merit making them available for scientific study.

Acknowledgements

I wish to thank the Department of Palaeontology of The Natural History Museum, London and its curators for letting me have access to the collections and equipment, and especially to Jill Darrell and Brian Rosen for all their suggestions and patience. Many thanks to Simon Conway Morris (Cambridge), Des Collins (Toronto) and Ellis Yochelson (Washington) for helpful criticism of the various versions of the manuscript. Thanks to the NHM Photo Unit, who kindly let me use one of their pictures and to Antonio Perejón and Enrique Bernárdez (Madrid) for their help with the figures. My visit to the University of London was partially supported by ERASMUS Inter-University Cooperation Programme grant P-95-1028/07.

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THE PRINTING WOOD BLOCK COLLECTION OF THE GEOLOGICAL SURVEY OF IRELAND

by M.A. Parkes, P. Coffey and P. Connaughton

Parkes, M.A., Coffey, P. and Connaughton, P. 2000. The printing wood block collection of the Geological Survey of Ireland. *The Geological Curator* 7 (4): 149-156.

The 19th century Memoirs of the Geological Survey of Ireland used standard printing technology of the period for illustrations, where a wood block was drawn upon and the wood carved away to provide a relief which transferred the ink to paper in the press as did the metal type for text characters. A collection of many hundreds of wood blocks has been 'rediscovered' within the Geological Survey of Ireland. The nature, condition and treatment of the wood block collection are described; the cataloguing has shown the majority of wood blocks for the 19th century memoir figures are still extant. Several wood blocks in different stages of development for unfinished memoirs illustrate the full process, and exemplify the artistry and skill required.

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Introduction

The resurrection of the printing wood block collection into the formal archive collection of the Geological Survey of Ireland (GSI) is the result of several chance events, which co-incidentally brought the authors together in a shared concern for the previously neglected collection. Parkes had been aware of a wooden crate of the some of the wood blocks from earlier work reorganising the GSI collections within their basement storage. Coffey had been actively researching the life and works of George Victor Du Noyer, a GSI Geologist who was responsible for drawing and engraving many of the wood blocks. Connaughton had been holding a large part of the total collection, which he had sent to the National Print Museum (housed in the former chapel of the Beggars Bush barracks where the GSI dwells). Here they had been cleaned and printed, in a bound volume, providing a selection of images which could be scanned and reused in GSI publications such as the 1998 Annual Report.

Having realised each authors interests in the same collection of wood blocks, and brought the entire collection together, it was decided to catalogue them in a digital format, so that information about them could be accessed easily, and so the full complement of wood blocks could be known. This cataloguing work (mainly done by P. Coffey) is now complete and this paper is intended to summarise the key facts about the collection, and possibly provide useful information for any other museum or institution which may hold such wood blocks within their collections.

The GSI Memoirs

The GSI was formed in 1845, and throughout the rest of the century undertook a programme to map the geology of Ireland at a scale of six inches to the mile, leading to publication of 201 map sheets at one inch to the mile scale. Whilst some of the printed memoirs which accompanied the one inch maps covered several sheets with similar geology, each sheet was covered within at least one memoir and many were issued in a second edition, often after geological revision, rather than just a reprint. Herries Davies (1983) provides the fullest available accounts of the geological mapping of Ireland, and of the GSI's history in particular (1995). Although the one inch map series was concluded in 1890, several other memoirs focused on a city or a location were published into the early 20th century, often reworking earlier sheets around a new locus. These memoirs, produced by a much reduced GSI, were centred on cities such as Dublin (1903), Limerick (1907), Belfast (1904), Londonderry (1908), Cork (1905) or on specific districts such as Clare Island (1914) or Killarney and Kenmare (1927).

The wood block printing method

The basic method is a simple relief printing technique, and although such technology has now become largely redundant with computerisation of printing, it was still operated until relatively recently. Typesetters would place small units of metal, moulded with the letters on them in rows on a press. The wood blocks were placed within the page set up or forme, where required and the whole clamped tightly by use of quoins. Then, ink rolled across the page would rest on the relief surfaces and be transferred to the paper page when it was placed on the press. The method at its simplest is still used by infants in playgroups or early art classes, where shapes cut out of potatoes are used as print blocks. In the days of illustrated newspapers, before photographs became commonplace, the illustrations were all done by the wood block method.

Changes in printing methods

The younger memoirs are instructive in recording some of the changes in printing methods. All the younger memoirs include a number of photographs as plates within the publication, but also include numerous line illustrations such as sections and sketches. The case of the memoir for Dublin - Sheet 112 (Lamplugh *et al*. 1903) illustrates the points. Whilst several photographs are included as plates, the wood blocks from several of the original memoir (Jukes *et al*. 1861) for sheets 102 and 112 are reused exactly as previously published, as are some of *Oldhamia* fossils from Bray Head in the memoir for Sheet 121 and 130 (Jukes *et al*. 1869). However a new emphasis on the Quaternary geology of the region required many new illustrations. These were done in a different fashion, using metal plates mounted on wood. In one case a block is present in the collections, of a Quaternary section which when compared to the illustration in the memoir is about two thirds of the length of the figure. It is presumed that the figure was deemed too small after initial printing and the image was used in a different printing process for a full page length format rather than a page width size as probably originally expected.

A second example (Figure 1) illustrates changing methods. The bound library copy of GSI Memoir for Sheet 173 has a section of page neatly cut out from page 23. Examination of another copy of the memoir indicates that a figure has been removed. This figure, of waterworn caves on the shore of Lough Leane occurs in the memoir for Killarney and Kenmare (Wright *et al*. 1927), but is approximately 1.47 times bigger than the original. It is likely that the original wood block was mislaid and it was decided to use the excised figure from the GSI library copy as 'camera ready copy'.

A further change that is evident is that a switch from wood blocks to metal mounted on wood took place towards the end of the 19th century. The earliest use of metal on wood in the GSI memoirs was in 1885. However wood was still preferred for numerous illustrations in memoirs published in 1891. In a contemporary memoir of the Geological Survey of the United Kingdom (Fox-Strangeways 1892: iv), the preface by the Director General, Archibald Geikie mentions specifically the "photo-zincographic reproductions of drawings", indicating the newness of the technique, which was a photo-chemical method, far removed from the engraving of wood. About 37 out of the total collection are made in this fashion. The metal is normally zinc, although one lead plate is present. The metal is simply nailed to the wood block for stability. The metal on wood blocks are nearly all figures for the memoirs such as Cork and Dublin, completed in the early 20th century.

The artistry of George Victor Du Noyer

George Victor Du Noyer (1817–1869), a man of very wide interests and an accomplished artist was employed by the Ordnance Survey from 1835–1840 and then from 1847 by the GSI (Coffey 1993*a*,*b*, 1996). He was trained as an artist from a very young age by George Petrie. He certainly drew many of the figures used to illustrate the memoirs, but it is very likely that he engraved some as well. Many of the figures are signed or initialled by him. Although many were also initialled by the engraver C.M. Grey, it might be reasonable to assume that many of those

Figure 1. The limestone caves marking a shore-line now abandoned by the waters of the Lower Lake, Killarney. The wood block for this print is missing and the GSI library copy was dismembered to provide the illustration for a special Killarney Memoir (Wright *et al*. 1927).

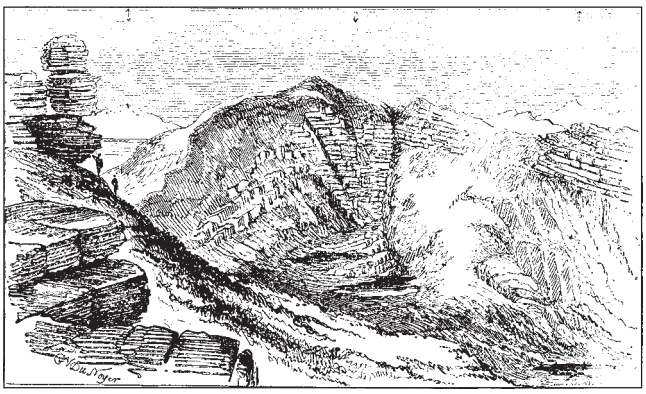

Figure 2. GSI:WB397. Head of Derrymore Glen, looking West, Co. Kerry. From Memoir Sheets 160, 161, 171, 172, 1863.

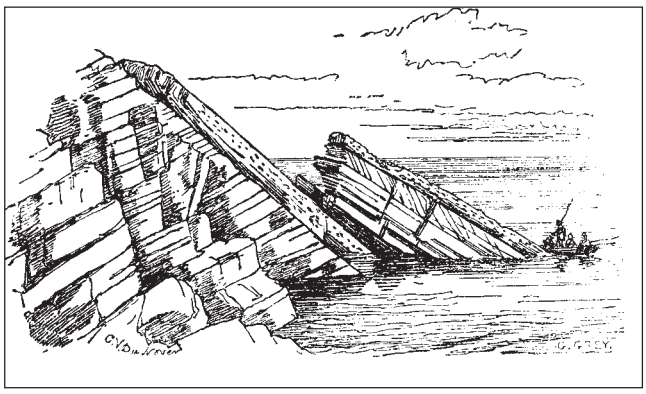

Figure 3. GSI:WB403. Western end of the Inch conglomerate and oblique lamination in the Old Red sandstone cliffs, west of Minard, Co. Kerry. From Memoir Sheets 160, 161, 171, 172, 1863.

without Grey's name were probably also cut by Du Noyer. Always at his best as a miniaturist, his early attempts at engraving were called 'barbarous cuts' by Larcom of the Ordnance Survey (NLI MS7563; a letter from Larcom to Petrie 9th September 1836).

Du Noyer obviously made rapid improvement, since in 1846, Thomas Oldham, Director of the GSI, described Du Noyer as 'possessing powers as a draughtsman, especially of objects of Natural History, which I have never seen excelled' (Coffey 1996). However, a letter (dated May 16th 1868) in the GSI Archive Letterbooks, from J.B. Jukes to Du Noyer, provides an insight. Jukes says "I have consulted with Mr Grey [the engraver] concerning your sketches, and he tells me that he could not engrave some of them for less than £3 a piece and that for wood engraving your style of minute shading and finish makes the wood engraving excessively troublesome, while a better effect could be produced by a slighter and broader treatment. This has always appeared to me to be the case." It suggests that those surviving Du Noyer drawn blocks which were not engraved (see below in relation to the exhibition) may have actually been rejected as being too fussy and therefore too expensive to include. The letter from Jukes continues the argument by comparing the sketch made of a quarry with the simple diagram drawn on the back of the fieldsheet. This has not been traced but a figure of Derrymore Glen in Co. Kerry (Figure 2) though dramatic, is perhaps an example of this over elaborate detail. Figure 3 shows how a simpler block can be of equal effect.

All 38 plates of Portlock's (1843) work were drawn by Du Noyer. In M'Coy (1844) Plates II, V and XIX are 'drawn on stone by G. du Noyer'. Du Noyer's talents went largely unremarked in his day, but the 1995 anniversary of GSI 150 years included an exhibition of his work at the National Gallery. The accompanying catalogue (Croke 1995) provides a full account of his skills, of which the wood blocks comprise but one small part. The Du Noyer wood blocks tend to be the more elaborate landscape views and detailed sketches of exposures to elucidate structural points.

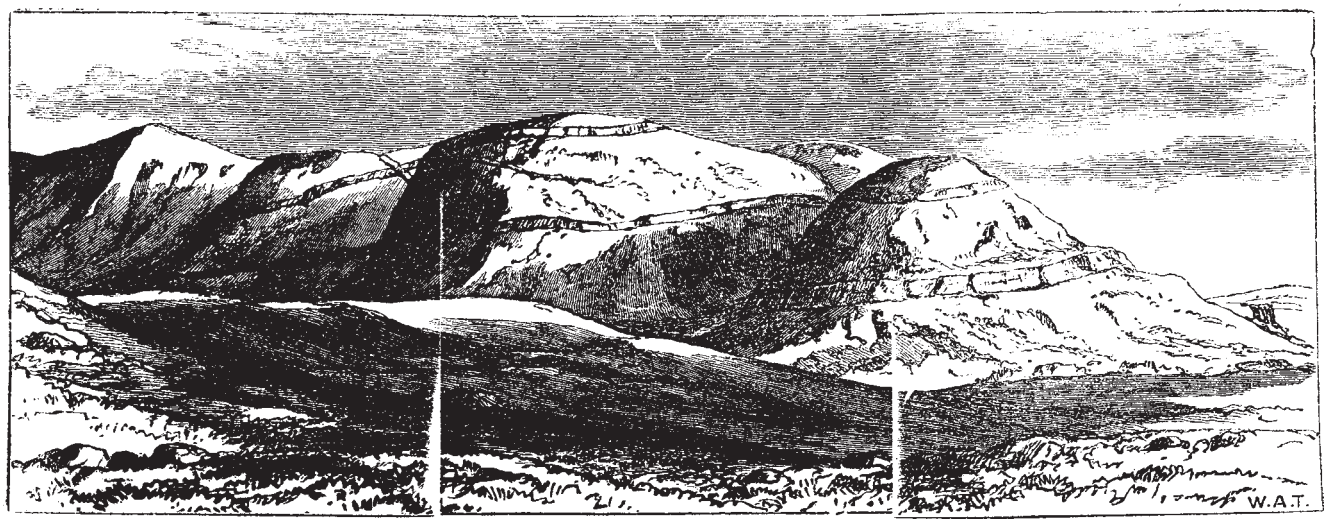

Figure 4. GSI:WB48. Benmore (1,155 feet) Co. Mayo, showing the Sheets and Dykes of Trap penetrating the Metamorphic Rocks. From Memoir Sheets 39, 40, 51, and 62, 1881.

Figure 5. GSI:WB63. Configuration of ground N. of Lough Doon (Lough-a-Doon) about Fawlion, Cos. Sligo and Leitrim. From Memoir Sheet 55, 1885.

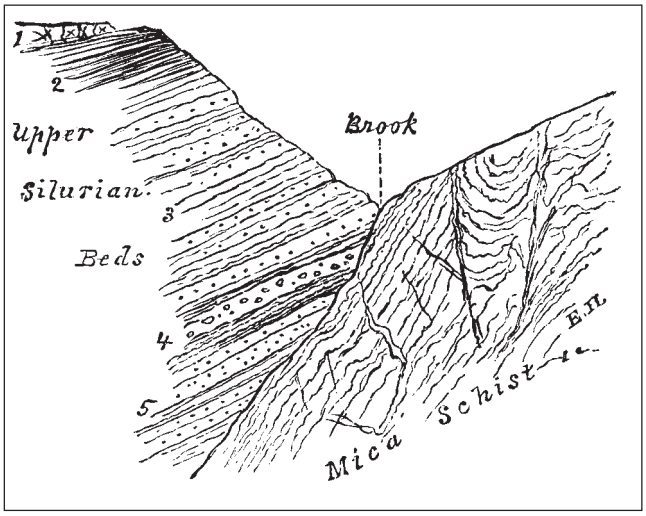

Figure 7. GSI:WB121. Section showing junction of Llandovery Beds and Metamorphic Schists, on flank of Lettershanbally, Co. Galway. From Memoir Sheets 93, 94, 83, 84 and 103.

In many cases we do not know who the artist or the engraver were for some blocks. Others are signed or initialled with William Hellier Baily completing many of the fossil illustrations, and other geologists such as Frederick Foot, Arthur Beavor Wynne, Alexander McHenry, Edward Hull, George H. Kinahan, William Traill (Figure 4) and Edward Hardman all contributing some. Figures 5–7 are examples of different illustration styles.

The digital catalogue

The catalogue was simply done as an Excel spreadsheet. It is intended in due course to transfer this to a database within the overall GSI database model, using Oracle, with Visual Basic user interfaces. This work awaits a place in the operation. Fields recorded include the: County; year; one inch memoir; figure number; page; caption; style; artist (if known); engraver; Print Museum catalogue number; page number of image in Print Museum catalogue; material; condition; GSI Fossil number if of a specimen; archive storage location and comments. The style field is restricted to several categories: landscape; sketch; section; cross section; map or fossil.

The wood blocks

Box, Cherry, Beech and Hornbeam are suitable timbers used for this purpose. They have a fine grain, dense structure and allow an even polished smooth surface which can be drawn upon and then carved, in very fine detail. The small size of many of the blocks would suggest that they are Box wood as this is not a large tree. The furniture conservator, David Marshall, has confirmed for us that end grain Box is the primary wood type used in the collection. He informs us that Box (*Buxus sempervirens*) was grown commercially for such uses, in places such as Box Hill in Surrey, England. One piece he examined was about 190 by 135mm in size, which is unusually large for such wood. Interestingly, he has also identified the wood for the zinc plates as best mahogany from Honduras, and dating to around 1840 and some walnut timber. This would indicate that perhaps the suppliers of the plates were using scraps of old wood from their workshops.

Many of the larger blocks are composed of two or three blocks glued together (Figure 4 illustrates the joins). These all have a slot cut perpendicular to the join which invariably has a thin batten of a dark wood, probably mahogany, filling the slot. This was presumably a technique to ensure a tight join. Although in many cases either or both artist and

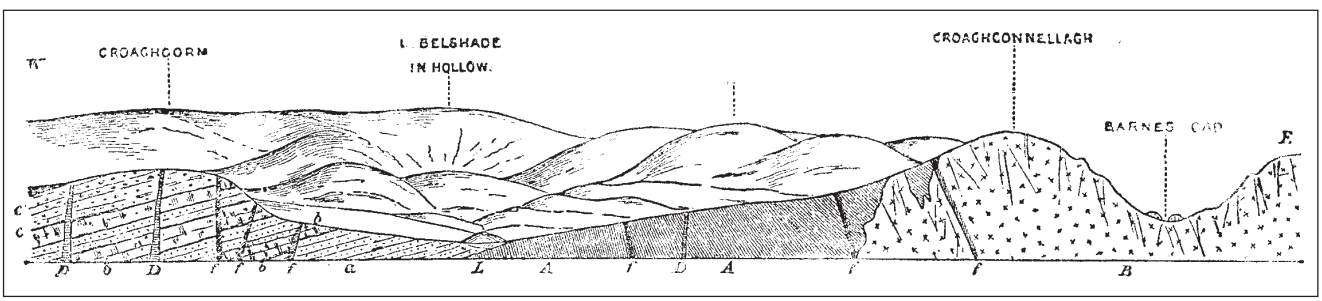

Figure 6. GSI:WB43. Section through Banagher Hill and Croaghconnellagh, Counties Donegal and Tyrone. From Memoir Sheet 24, 1888. This cross section is unusual in having a landscape perspective shown above it.

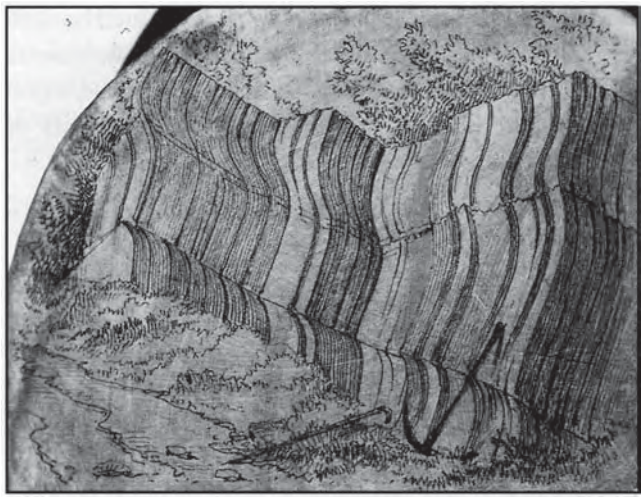

Figure 8. Drawn wood block of contorted cleavage in Old Red Sandstone, Dunmanway, Co. Cork. Artist unknown, but probably Du Noyer.

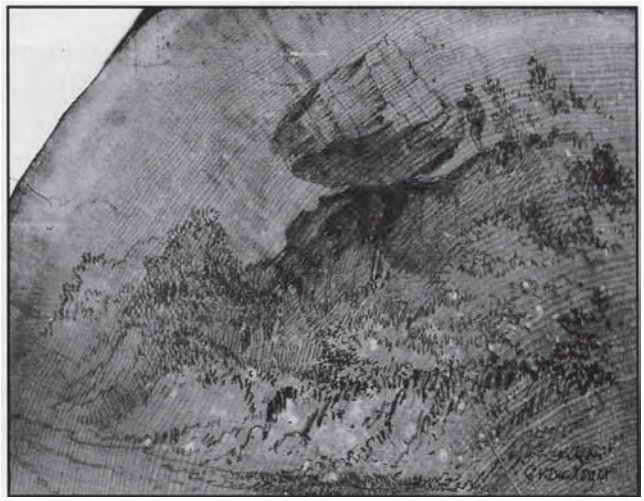

Figure 9. Drawn wood block of a perched boulder, Old Red Sandstone north of Dunmanway, Co. Cork. 1" Sheet 193. Drawn by George Victor Du Noyer.

engraver have included their initials or signature as part of the carving, and often limited text labels, it was more often the case that lettering, say to label points on a cross section, was added around the wood block in conventional fashion. This explains why many of the wood blocks have slots cut in them which apparently have little purpose until the block print is compared to the original memoir figure.

In addition to the one inch memoirs, the GSI collection includes a small number of wood blocks that provided illustrations in the early *Scientific Proceedings of the Royal Dublin Society*. A further small collection of copper plates (mounted on wood blocks) are present, with a variety of images of Dublin and rural Ireland. The significance of these and their provenance is unknown but is being investigated. Six of the copper plates have been correlated with plates in the Clare Island Memoir (Cole *et al*. 1914). These are half tone illustrations (with the appearance of photographs). In the Dublin memoir (Lamplugh *et al*. 1903: Plate 2) a photograph of The Dingle near Carrickmines is matched to a copper plate but the image again appears at a larger size.

Condition

Prior to this project, the wood blocks were stored in poor conditions. They were crammed into old wooden ammunition boxes, which were also used for all the fossil and rock collections of the GSI when they were summarily evicted from the Curved Corridor connecting the National Museum to Leinster House, in 1924, when the new post Independence and post Civil War Government required office space (see Herries Davies 1995, Chapter 10). The wood blocks were packed solidly so that each printing face was rubbing against another surface, and paper labels identifying the one inch sheet, figure and page number in the Memoir were also suffering. They were very

Figure 10. Drawn wood block of Gougane Barra. 1" Sheet 193. Drawn by George Victor Du Noyer.

dirty, with what was apparently both original ink residues and dense coatings of particulate matter (sooty pollution). After cleaning (see below) it was apparent that most blocks are faintly labelled in pencil with the figure, page and memoir number.

Subsequent to the movement from their original home either in the GSI Museum, or within 14 Hume Street, the wood blocks have almost certainly been subjected to a variety of environmental conditions, since the GSI occupied a number of premises in succession, and at the same time, before it moved into the purpose built headquarters at Beggars Bush in 1983. These premises included a former biscuit factory and other sites, that probably subjected the blocks to fluctuations of temperature and relative humidity (RH).

Most of the wood blocks are actually in quite good condition considering the rigours they have most likely suffered, and only a very few thin blocks show slight warping, or have suffered serious damage. A very few blocks have started to crack slightly on natural grain in the wood, although many larger pieces show some separation of wood blocks at joins. The zinc plate blocks have suffered however, and the majority are corroded to some degree, primarily around the nails attaching them to the wood blocks, with a resultant white coating.

Treatment

The two thirds of the total that were sent to the National Print Museum for printing were cleaned simply using diluted white spirit before they were reprinted. Each block was given a number according to the cardboard box they were supplied in. This was marked on the blocks and forms a cross reference to the printed image in the catalogue supplied to GSI by the Print Museum. The remainder of the blocks were likewise lightly cleaned with white or surgical spirit. All loose or separated paper labels were glued back to their blocks using Paraloid B adhesive. New, unique GSI archive numbers have been applied to the wood blocks after investigations into the whereabouts of missing specimens were completed.

Current storage

All blocks are now housed in single layers on a 3mm layer of Alveolit (inert polyethylene foam like Plastazote) within small drawers in coated metal storage cabinets. They are organised by the original one inch to the mile memoirs in which they were used. The four cabinets containing the 574 specimens (plus some other unidentified geological blocks) are now housed within a fireproof National Archive storage room. Here buffering by the room location maintains acceptably even temperatures and nearly constant RH of about 40–45%. The zinc plates will be stored in a more appropriate micro-environment of lower RH in order to try and prevent further corrosion.

The Northern Ireland wood blocks

Herries Davies (1995: 151) records a visit by Mr Crowe of the Northern Ireland Ministry of Agriculture on the 18th July 1923, soon after Partition of Ireland, to the GSI. He removed all the materials relating to the geology of the six counties of Northern Ireland. This included "all the surviving zincplates and woodblocks for the illustrations in the Northern one-inch sheet memoirs". These were later, in 1995, donated by the Geological Survey of Northern Ireland (GSNI) to the Ulster Museum. The list of these (Geology Day Book No. DB2632/ UM Entry Form 1053/ Geology File 145) numbers 86. The combination of information about these into the GSI catalogue shows that the majority of all the one inch memoir wood blocks do survive. Three relating to the Northern Ireland sheets

Figure 11. Drawn wood block of the Pass of Keamaneigh, Co. Cork. 1" Sheet 193. Drawn by George Victor Du Noyer.

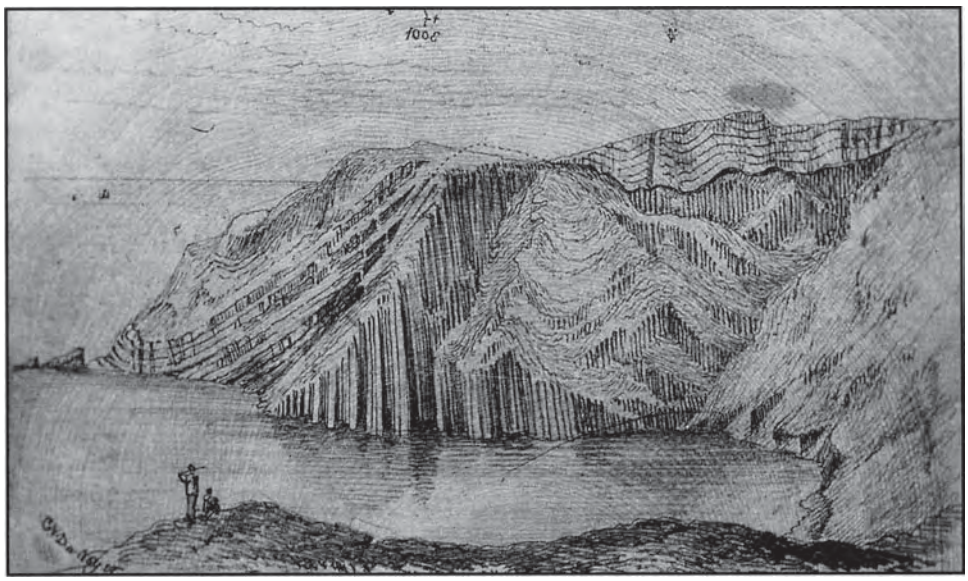

Figure 12. Drawn wood block of unconformable Old Red Sandstone at Sauce Creek, Co. Kerry. 1" Sheet 161. Drawn by George Victor Du Noyer.

that were presumably overlooked have been donated to the Geological Survey of Northern Ireland, and transferred to the Ulster Museum in order to complete the sequence for the relevant sheets.

The Booth Brothers

A very few of the blocks are engraved with the name Booth, who were probably a family business of Dublin timber merchants during the mid 1800s. Petra Coffey has traced their various permutations and addresses in directories of Dublin businesses. No Booths were listed in 1820, but from 1826 to 1870 there are numerous entries for Joseph Booth and then presumably his sons Richard and James Booth, as "Timber stores and artists warehouse".

The Geological Survey of the United Kingdom wood blocks

Although the Memoirs of the Geological Survey of the United Kingdom were illustrated with sketches, cross sections, fossils and landscapes in comparable fashion, it would appear that the wood blocks for them no longer exist. Graham McKenna, the Archivist of the British Geological Survey suspects that they may have been disposed of early in the 1900s when space at Jermyn Street was at a premium, along with other items (*pers. comm.* February 2000). They do however possess a large collection of copper plates for printing maps and sections which came from the Ordnance Survey in the 1950s.

Illustrating Irish Geology Exhibition

The curation of the wood blocks, and in particular 19 unfinished blocks, prompted the authors' organisation of a temporary exhibition (opened in GSI on September 9th as part of Heritage Week) based primarily on the wood blocks. Although other 19th century illustrative methods are explored in the exhibition the centre piece is the selection of drawn but not engraved blocks (Figures 8–13 are a selection). There are also partly and fully engraved blocks which were never printed. It is a matter of speculation as to why they survived, but were not used, but presumably second, revised editions of some memoirs were

Figure 13. Drawn wood block of Eskers 1 mile north of Streamstown. 1" Sheet 99. Drawn by Frederick J. Foot.

planned but not completed. The exhibition does not have a planned termination date, and should be available to view for at least six months.

Conclusion

The National Print Museum, adjacent to the GSI Office possesses a large number of diverse wood blocks as part of their collections but they are largely unrelated to original publications in which they were used. Most of their blocks are actually of zinc plates mounted on metal, and therefore of more recent origin. It is not known how many other such collections of carved wood blocks are extant in different museums and establishments. The incomplete but extensive GSI collection described is of considerable note in being tied in detail to its original publication series, which may be an unusual feature of printing wood block collections. It is also important as a surviving collection of directly engraved wood blocks, which are uncommon, since they were normally ephemeral items, in that once printed they were no longer required. The authors would be interested to learn of other geological printing wood block material, or any that were drawn or engraved by George Victor Du Noyer, William Hellier Baily or any other GSI geologists.

Acknowledgements

Derval O'Carroll, Mairead White, Tommaso Ortolani of the National Print Museum are thanked for assistance with this work. Frances Magee, Archivist at the National Archives is also thanked for assistance. Graham McKenna, Archivist of the British Geological Survey kindly answered our enquiry. Dr Peter Crowther supplied information on the Ulster Museum blocks. Dr Ralph Horne and Dr John Morris of the GSI, and Chris McDonnell and Clive Murray of the GSI Central Technical Services also provided valuable help. Elaine Roche contributed greatly to the exhibition work. David Marshall, the Furniture Conservator is thanked for assessing and commenting upon the timbers used, for us, and providing samples of box wood for the exhibition.

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LOST & FOUND

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

Abbreviations:

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

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

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

254. Commander Charles Morton, R.N.

Kenneth James, Department of Geology, Ulster Museum, Belfast BT9 5AB, U.K. (Tel: 028 90 383135; e-mail: kenneth.james.um@nics.gov.uk) writes:

I recently came across in this department's files, a photocopy of an undated, anonymous pamphlet entitled *New Geological Theory respecting the Basaltic Columns of the Giant's Causeway and of Staffa,: rendering it probable that they are not of volcanic but of vegetable origin*. This reported the theory of Commander Charles Morton, R.N., that the columns at the Giant's Causeway and Staffa are fossilized giant bamboo shoots and not volcanic in origin.

Edward Baines and Sons, Printers, Leeds published the pamphlet, a four-page account on two sides of paper. It summarizes Morton's fossil bamboo theory, which it states, was originally published in several essays in The Jamaica Times "within the last two years". The style and content of the pamphlet suggests an 1830s date. It is definitely post-1825, for it refers in the text to "Iguanodon", a word coined by Mantell in that year; and it is probably pre-1841, as it describes the Iguanodon as an "antediluvian lizard" and not a "dinosaur", a term introduced by Owen in that year.

I have ascertained a little about Commander Morton. Born in London, he came from "a family seated for some centuries in the West Riding of Yorkshire". He joined the Royal Navy in 1807, was Midshipman in 1811 and promoted Commander in 1827. He married in 1829, "Elizabeth, only daughter of the late John Thompson, Esq., of Hanover, Jamaica". Geology was not Morton's only interest, for he also wrote *An Essay on the Electrical Formation of Hailstones, in opposition to the absurd Theories of the learned Philosophers* and was "the inventor of a plan for increasing the power and rapidity used in the art of swimming". He was still alive in 1849, when these details were recorded in W. O'Byrne: A naval biographical dictionary (my thanks to Mrs Wareham, Librarian, Royal Naval Museum, Portsmouth for this reference).

Whilst Commander Morton may be regarded as a fully paid-up member of The Society for Lost Causes, it is clear that he had a good geological knowledge and a lively mind and I would love to know more about him and the circumstances surrounding the publishing of this pamphlet. Can anyone help?