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Geological Museums and their Collections: Rich Sources for Historians of Geology

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Summary

Many millions of geological specimens are contained in geological museums throughout the world. These collections, some of which date back to the sixteenth century, constitute a rich resource for historians of the geological sciences. The utilization of this resource has been uneven, due to a number of factors, including the background of the researcher, and the state of the collections. In the past two decades major strides have been made in the documentation of collections held in British museums, and compendia, including those for collections in other countries, are now available. Geological collections provide quality primary source material, and can shed light on a range of interesting topics including the nature and scope of geological travels, the often complex relationships between geologists and collectors, and the rationale behind the formulation of geological theories by earlier geologists.

Contents

1. Geological museums and collections: development of a resource

Simon Knell recently produced a detailed and cogent outline of the development of geological museums in Great Britain in which he documented four periods of contrasting fortunes.[1] Knell's periodization offers a starting point for an effort to gain perspective on the uses of museums and collections for investigators in the history of geology. For various reasons museums and collections have tended to be underutilized in such historical research. Drawing on examples from British and Irish geology, I shall illustrate some of the ways the work of historians of geology can be enriched through materials in geological collections.

[1] S. Knell, 'The roller-coaster of museum geology', in *Exploring Science in Museums*, edited by Susan Pearce (London and New Jersey, 1996), 29–56.

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The earliest geological collections date from the sixteenth century when collectors were primarily concerned with acquiring mineralogical specimens.[2] The largest collections, and thus often the most significant, were developed by members of the numerous royal houses across Europe, and by members of the aristocracy or the diplomatic corps. While many individuals purchased their specimens from dealers, others travelled widely in order to collect fine geological specimens for their cabinets. These were largely held in domestic museums.

Public museums on the scale with which we are now familiar emerged in the late 1700s, which marked the beginning of the golden age of collecting and which continued largely unabated into the late decades of the nineteenth century. From the 1820s onwards, in Britain geology had become an important subject for study on account of the development of industry and thus the necessity to find raw materials and fuels. New and wondrous fossils were being discovered and described, and the basis of stratigraphical geology was being laid down by several British geologists. The first rise of importance for geological museums began, according to Knell, during this 'heroic age' of geology, at a time when geologists and their finds created 'perpetual excitement' amongst the press and hence the general public. Throughout the British Isles, and no doubt elsewhere, many public-spirited city-based philosophical, literary and scientific institutions and societies emerged, and many of these established geological museums for the benefit of their members or for the public at large.[3]

These institutions, often concerned with technological and agricultural development as well as with public education, acquired geological collections. The holdings of these foundations, which included the Dublin Society (1731), the Bristol Institution (1809), the Yorkshire Philosophical Society (1822), and the Cheltenham Literary and Philosophical Institution (1833)[4] to name but four, formed the basis of many significantly important geological collections still available for study. At the same time specialist geological societies emerged after the lead given by the Geological Society of London in 1807. It was followed by the Royal Geological Society of Cornwall (1814), the Geological Society of Dublin (1831) and Geological Society of Edinburgh (1834) and others in provincial Britain. However by the 1850s geological studies had become more specialized and geology fell from public attention and favour. Many societies which had formed on the crest of geological popularity three decades earlier were now in severe financial difficulties and their collections were reduced in size (such as those of the Tunbridge Wells Literary and Scientific Society)[5] or taken over by other institutions; those of the Geological Society of Dublin were given to Trinity College Dublin in 1848.[6] As a result geological museums in general declined in importance at this time.[7]

However, the trough into which geology had descended was upturned a decade

[2] H. Torrens, 'Early collecting in the field of geology', in *The Origins of Museums*, edited by Oliver Impey and Arthur MacGregor (Oxford, 1985) 204–13; and W. E. Wilson, 'The history of mineral collecting', *Mineralogical Record*, 25 (1994), 1–243.

[3] J. Morrell, 'Perpetual excitement: the heroic age of British geology', *The Geological Curator*, 5 (1994), 311–17.

[4] See H. S. Torrens and M. A. Taylor, 'Geological collections and museums in Cheltenham 1810–1988: a case history and its lessons', *The Geological Curator*, 5(5) (1990), 175–213.

[5] See M. A. V. Gill and S. J. Knell, 'Tunbridge Wells Museum: geology and George Abbott (1844–1925)', *The Geological Curator*, 5/1 (1988), 3–16.

[6] G. L. (Herries) Davies, 'The Geological Society of Dublin and the Royal Geological Society of Ireland 1831–1890', *Hermathena*, 100 (1965), 66–76; P. N. Wyse Jackson, 'The Geological Collections of Trinity College, Dublin', *The Geological Curator*, 5 (1992), 263–74.

[7] S. Knell (note 1), 34–5.

later as Victorians in Britain and Ireland were gripped by the fascination for all aspects of natural history.[8] Fern and fossil collecting amongst other hobbies became popular with the masses and natural history museums (which included geology as an essential component) and zoological gardens became regular places to visit.[9] In the British Isles, this upsurge in popularity for natural history resulted in the genesis of the field club movement, which in turn helped sustain it. In Ireland at least five field clubs were active, two of which—Dublin and Belfast—are still extant.[10] However, geological museums went through another decline after the end of the First World War when geological collections were either seriously neglected or—all too often—simply disposed of.

Within the British and Irish universities geology as an academic subject was formalized in the mid-nineteenth century and teaching of geology was often through the medium of the museum and its holdings. Many universities assembled major collections: Oxford, Cambridge, King's College, London, and Trinity College, Dublin all had important museums. Typically the specimens students were expected to recognize were displayed in regimented rows of polished oak or mahogany glass-topped cabinets. In the 1950s in the British Isles considerable philosophical changes in the methods of instruction in geology saw a shift from museum-based studies to laboratory and field-based studies, where students handled specimens for themselves, although such methods had been advocated earlier by Thomas Huxley (1825–95), and implemented earlier elsewhere by teachers such as Baron Cuvier (1769–1832) in Paris, and Louis Agassiz (1807–73) at Harvard. This resulted in a decline in the use of university museums, some of which came to be viewed as expensive white elephants. In Trinity College, Dublin the fine museum gallery designed by the noted Ruskinian architect Benjamin Woodward was converted in 1954 into laboratories, and many, but fortunately not all, specimens collected by many pioneers of nineteenth-century geology such as Richard Griffith (1784–1878), Thomas Oldham (1816–78) and John Phillips (1800–74) were discarded.[11] While some downgrading of university collections did occur from the 1950s onwards, many collections were saved, either through the considerable efforts of a few individuals or, ironically, as a result of sheer neglect and indifference. In the last decade in Britain geology at university levels has undergone radical review, and some departments have been shut down on the recommendations of the Oxburgh report. Nevertheless in the face of such difficulties many collections are relatively safe, and the future for some selected university collections is more secure with funding provided by the Universities Funding Council for storage and curatorial cover in five of the largest university geology departments.[12]

At the present time knowledge of the holdings and needs of geological museums

[8] D. E. Allen, *The Naturalist in Britain: a Social History* (London, 1976) and L. Barber, *The Heyday of Natural History* (New York, 1980)

[9] A contemporary survey of 168 rate-supported, subscription-supported, government-supported and university museums published by T. Greenwood, *Museums and Art Galleries* (London, 1888) shows that the majority contained geological specimens. This listing is reproduced in *The Geological Curator*, 3/5 (1982), 327–30. The museum in Birmingham claimed to attract 18000 visitors a week.

[10] See Dublin Naturalists' Field Club, *Reflections and Recollections*, (Dublin, 1986) for an account of the history of the Dublin Naturalists' Field Club founded in 1885.

[11] P. N. Wyse Jackson (note 6), 267.

[12] The geology departments that were selected for such funding were Birmingham, Cambridge, Glasgow, Manchester and Oxford. See M. A. Taylor, 'What will happen to the universities' geological collections in the post-Oxburgh world?', *Geology Today*, 4 (1988), 119–20; M. A. Taylor, 'The irrationalization of university geological collections', *Geology Today*, 6 (1990), 9–10; M. A. Taylor, 'The irrationalization of university geological collections—a postscript (no thanks to the UFC)', *Geology Today*, 6 (1990), 54.

is greater that at any time in the past. In the UK public awareness and appreciation of geological museums continues to rise, and much of this has to do with the efforts made by the museum profession itself and with the establishment of the Geological Curators' Group in 1974 (see below). In 1981, in his landmark survey of 569 museums in the UK, Philip Doughty conservatively estimated that 283 of these housed between 25 and 30 million geological specimens, and that the Geological Survey collections and those in the Natural History Museum, London were the most numerous with approximately 10 million specimens each. At that time only 16% of the museums employed full-time professional staff.[13] In a more recent survey more comprehensive information pertaining to geological holdings was gathered for 100 public or university museums in the British Isles,[14] and it was found that perhaps only half of these institutions employed a specialist geological curator. Clearly many collections are without specialist care, and it is these collections, recently termed 'orphan collections',[15] which may be at greatest risk of being broken up, dispersed or disposed of during times of financial tightening in the museum and university sector.

2. Geological collections and geological historians: use or non-use?

Are geological collections used by historians of geology as sources of information? Naturally there are examples of when they have been utilized, and others of when they have not. To attempt a quick answer to the question, I rapidly scanned the listings of sources given in several reputable volumes on the history and philosophy of geology published in the last two decades. I found that while all the books consulted listed manuscript or printed sources, no authors documented which geological collections and specimens, if any, they had examined. (Detailed examination of the texts may, however, reveal the use of specimen-derived data.[16]) Without presuming to question the value of these studies, or to undermine the scholarship of the authors involved, I do wonder whether a systematic effort to utilize collections and specimens might have contributed significantly to the strengthening and improvement of these excellent studies. While this is difficult to determine in every individual case, it is the conjecture of this geological curator that such use of collections may add to the overall picture, and might influence the conclusions reached. Indeed, one need not claim a comprehensive knowledge of the literature in history of geology to observe, as I believe few would deny, that historians of geology have tended overwhelmingly to rely on published works—papers and books, as well as maps—and not uncommonly also on manuscripts, as their primary source material. It is my contention, of course, that geological specimens, although often overlooked, are primary sources of valuable information too. D. T. Moore, in an introduction to his

[13] P. S. Doughty, 'The state and status of geological collections in the UK', *Geological Society Miscellaneous Paper*, 13 (1981), 1–118.

[14] J. R. Nudds (ed), *Directory of British Geological Museums* (London, 1994) details information for 88 museums and lists another 83 that contain geological collections. These constitute approximately 50% of museums in the British Isles with some geological specimens.

[15] C. Collins, J. A. Cooper, R. Roden, M. Simmons, S. Timberlake and S. Thompson, 'The BCG/GCG orphan collections working party report', *The Geological Curator*, 6 (1996), 271–3.

[16] Books examined were R. Porter, *The Making of Geology: Earth Science in Britain 1660–1815*, (London, 1977); M. T. Greene, *Geology in the Nineteenth Century* (Ithaca, 1982); M. J. S. Rudwick, *The Great Devonian Controversy* (Chicago, 1985); J. A. Secord, *Controversy in Victorian Geology: the Cambrian–Silurian dispute* (Princeton, 1986); R. Laudan, *From Mineralogy to Geology* (Chicago, 1987); and D. R. Dean, *James Hutton and the History of Geology*, (Ithaca, 1992).

catalogue of rock collections in the Natural History Museum acquired before 1918, acknowledges the historical importance of rock specimens.[17] But how often has his valuable paper been trawled by geological historians in the search for specimens? Might we not expect researchers to utilize the full range of geological resources that remain, in order to produce a comprehensive treatment and synthesis of the subjects under examination?

Certainly there have been historical papers that make reasonable use of geological specimens in their development—but the percentage of such publications is small when measured against the total published works within the sphere of the history of geology. A recent paper by N. T. Monaghan and E. Vaccari is an excellent example of historical research that makes use of a collection of mineralogical specimens—in this instance to confirm an eighteenth-century exchange of geological specimens between the Italian scientist Giovanni Arduino (1714–95) and the German Nathanael Gottfried Leske (1751–86).[18] Similarily, recent rediscovery of an important collection of Jurassic and Cretaceous fossils was the stimulus for publication of a valuable paper, by E. E. Spamer, A. E. Bogan and H. S. Torrens, about its owner Etheldred Benett (1776–1845), her scientific correspondents, and her own publications.[19]

These honourable instances notwithstanding, the overwhelming majority of papers and books on geology's history make little or no reference to actual geological collections. Why should this be? How can historians of geology truly understand the significance made by their subject to the development and understanding of the science, if they access their published record only, and do not examine all available sources of data? Why has there been a tendency to ignore what historical information geological specimens can yield? Perhaps it is due to a number of factors:

2.1. *State of geological collections*

It is undeniable, unfortunate, that many geological museums worldwide do not have the required resources to house their collections in a manner to their liking; commonly curatorial staffs are thin, and some museums have no curators at all. In 1974 a number of concerned geological curators in the UK established the Geological Curators' Group (GCG) in order to foster a greater awareness of geological collections, and to act as a forum and focus for those in the profession, and this group has now attracted a worldwide membership. The GCG has been emulated by other organizations, such as the Society for the Preservation of Natural History Collections (SPNHC) of North America, with similar concerns for geological collections; these bodies have done much in the past twenty-five years to highlight the plight of collections, and have promoted the revival of good curatorial methods and collection documentation, and have promoted research on the history of collections and collectors. In some cases neglect, often benign, is not actually a bad thing: certain

[17] D. T. Moore, 'An account of those described rock collections in the British Museum (Natural History) made before 1918; with a provisional catalogue arranged by continent', *Bulletin of the British Museum* (*Natural History*) (*Historical Series*), 10 (1982), 141–77.

[18] N. T. Monaghan and E. Vaccari, 'I minerali di Giovanni Arduino nella collezione geo-mineralogica di Nathanael Gottfried Leske: verifica di un caso di comunicazione scientifica nell Europa del tardo settecento', *Geologica Romana*, 29 (1993), 547–65.

[19] E. E. Spamer, A. E. Bogan and H. S. Torrens, 'Recovery of the Etheldred Benett Collection of fossils mostly from Jurassic–Cretaceous strata of Wiltshire, England, analysis of the taxonomic nomenclature of Benett (1831), and notes and figures of type specimens contained in the collection', *Proceedings of the Academy of Natural Sciences of Philadelphia*, 141 (1989), 115–80.

collections are still in their original state and have not been recatalogued, relabelled, or rehoused—processes which often lead to serious loss of historical data.

Examination of the journal *The Geological Curator*, published by the GCG, attests to the efforts made to make geological specimens more relevant in historical studies: frequently important specimens thought to be lost are tracked down and their significance highlighted.

Other important initiatives include the publication of directories of collections. C. D. Sherborn's 1940 volume was the pioneer; today R. J. Cleevely's *World Palaeontological Collections* and P. C. Zwann, O. V. Petersen and M. Hooker's *World Directory of Mineral Collections* are the main standards.[20] These are essential (but unfortunately rapidly dating) sources for specimen information, as are the many catalogues of museum specimens, especially of type and other status material.[21] Considerable data on collections in the UK were assembled during the Federation for Natural Science Collection Research (FENSCORE) project of the 1970s and 1980s, and this made available a number of valuable reports which together constitute a rich source of information for historians of geology.[22] Additionally volumes such as J. R. Nudds's *Directory of British Geological Museums* (n.14) are useful starting points for tracking specimens. Collections in the British Isles are now well documented. The methods and lessons learned from these initiatives need to be taken on board by the geological and historical community in other countries so that more data pertaining to the state and status of geological collections worldwide are forthcoming.

2.2. *Geologists vs historians*

The study of the history and philosophy of geology is undertaken by both historians and geologists, who by the nature and background of their training may approach the subject in often different ways. There are of course notable instances of scholars with strong formal backgrounds, or extensive practical experience, in both history and the earth sciences; but these are comparatively rare cases. Geologists are trained to be objective and to infer conclusions from the study of specimens and landscapes, whereas historians tend to be more analytical in their approach. Geologists are not trained to ingest copious amounts of textual material, which often requires deep and long consideration in order to arrive at its meaning.

Historians tend to be more familiar working with paper sources—printed as well as manuscript—and may reach a greater understanding of and from these sources than can many geologists. It is therefore natural that historians should be more reliant

[20] C. D. Sherborne, *Where is the ____ Collection? Account of the Various Natural History Collections which have come under the Notice of the Compiler* (London, 1940); R. J. Cleevely, *World Palaeontological Collections* (London, 1983); P. C. Zwaan, O. V. Petersen and M. Hooker, *World Directory of Mineral Collections* (Leiden, 1974; revised ed 1977).

[21] M. G. Bassett, 'Bibliography and index of catalogues of type, figured and cited fossils in museums in Britain', *Palaeontology*, 18 (1975), 753–73; V. K. Deisler and M. G. Bassett, 'Bibliography and index of catalogues of type, figured and cited fossils in museums in Great Britain and Ireland (Supplement 1975–1996)', *Palaeontology*, 40 (1997), 597–617.

[22] The reports produced by the FENSCORE initiative are: E. G. Hancock and C. W. Pettitt (eds), *Register of Natural Science Collections in North West England* (Manchester, 1981); P. Davis and C. Brewer, *Register of Natural Science Collections in North-East England* (North of England Museum Service, 1986); M. M. Hartley, A. Norris, C. W. Pettitt, T. H. Riley and M. A. Stier (eds), *Register of Natural Science Collections in Yorkshire and Humberside*, (Leeds, 1987); H. E. Stace, C. W. Pettitt and C. D. Waterston, *Natural Science Collections in Scotland* (Edinburgh, 1988); G. P. Walley (ed.), *Register of Natural Science Collections in the Midlands of England* (Nottingham, 1993); and J. Bateman and G. McKenna (eds), *Register of Natural Science Collections in South East Britain* (Cambridge, 1993).

for source information on printed and archival materials as their primary sources of information. On the negative side historians often lack the expertise necessary to analyse available geological specimens. It may be observed, however, that in some circumstances the historian's technical ignorance can actually be an asset: unlike their geological counterparts, historians without scientific training may sometimes more easily escape the influence of modern geological ideas and thus more readily approach the mindsets of early geologists.

Modern geological papers frequently present the results of experimental or field results which to geologists make easy reading. But modern scientific training may actually contribute to some difficulty in understanding papers authored by the geological pioneers of the eighteenth and nineteenth centuries, which are frequently long, verbose and based on fewer observational and experimental data than their modern equivalents or on data reported in a fashion puzzling to those accustomed to current standards of scientific practice. Again, the historian may sometimes have an advantage through an accustomed adaptability to past conceptual and verbal habits.

It is important, however, that both historians and geologists work together on problems and projects in the history of geology. Such collaboration will allow for fuller and more complete analyses and can be expected to yield conclusions more incisive than if this work was undertaken by one or the other group in isolation.

In recent years historians and geologists interested in the history of geology have developed closer working ties through the existence of a number of international and national bodies. The International Commission on the History of Geological Sciences (INHIGEO) acts as a global umbrella organization, and national bodies such as the History of Geology Group of the Geological Society in the UK and the History of Geology Division of the Geological Society of America, and specialist societies including the Society for the History of Natural History, all promote study into the history of geology, which has led, amongst some aficionados, to re-examination of geological museum holdings.

2.3. *Attitudes of modern geologists to the work of their predecessors*

Many geologists carrying out research today cannot accept that research carried out in the past in their specialist fields has any significance for them. In their view, such work by their pioneers is simply out-dated, outmoded and old-fashioned. If interpretation of specimens from the past is usually beyond the competence of historians, many geologists in possession of the necessary expertise frequently see little point in the exercise. This 'cultural barbarism' (an expression coined by P. Medawar in 1979)[23] is arrogant and illogical. A fundamental tenet in science is the need for viable checking and reproducibility of results. Reanalyses may not be undertaken for some time after the original research, but require preservation of the original material worked on in order to be of any value.

Palaeontologists are all too aware of the importance of preserving type material—this allows confirmation of the original diagnoses of fossil species erected in the past. For instance, it is not unusual for workers on Carboniferous faunas to consult the specimens described by Frederick M'Coy (1823–99) in his monographs of 1844 and 1846, specimens housed in the National Museum of Ireland.[24]

[23] P. B. Medawar, *Advice to a Young Scientist* (London, 1979), 29–30.

[24] P. N. Wyse Jackson and N. T. Monaghan, 'Frederick M'Coy: an eminent Victorian palaeontologist and his synopses of Irish palaeontology of 1844 and 1846', *Geology Today*, 10 (1994), 231–2.

Similarily, stratigraphical conundrums that appear in the literature can often be answered by means of examination of the original fossils collected by the original workers. Incorrect original taxonomic determinations often lay at the root of problems which frequently disappeared in the light of new determinations. *Trinucleus*, a small fringed trilobite, is thought to be diagnostic of Ordovician strata. However, in Ireland several records of the trilobite from Silurian sediments were published at the turn of the twentieth century. Recently some of the specimens were traced and shown to have been misidentified, being either other trilobite taxa or rugose corals, or being contained in reworked or transported blocks of older sediments.[25]

At the beginning of the present century measurement of the radioactivity of various rocks was carried out by several scientists, including R. J. Strutt and John Joly (1857–1933). Joly measured the volume of radium in a large suite of rocks including specimens from the Indian Deccan plateau, the volcanoes of Italy and the granites of the British Isles, and showed that the quantity of radium was greatest in recently erupted lava.[26] Joly recognized that radioactivity might hold the key to determining the age of the Earth, but it was the English geologist Arthur Holmes (1890–1965) who, in 1911, produced the timescale that we are now familiar with. Is Joly's work worth re-examination? How accurate were Joly's quantitative methods? With modern analytical equipment would similar results be forthcoming from his material? Unfortunately it would prove impossible to recollect from some of his sources, so redeterminations would have to be carried out on Joly's original material.

Considerable insights into the foundations of geology, and the background to geological theory, may be gathered by historians of geology and by geologists researching today through detailed examination of the printed, manuscript and object-based contributions of former geologists. Cultural barbarism has no place in the modern research library or laboratory—research has only progressed to the stage reached today through the endevours of our research ancestors and their legacy is valuable and should be enjoyed, utilized and understood by contemporary historians and geologists.

3. The value of geological collections for the study of the history of geology

The close study of minerals, rocks, fossils and other geological materials can reveal much about their history and their significance to past geological research. They allow for testing and reproducibility of original results and observations, for comparison of modern and older classification schemes. Most significantly, they can suggest to modern researchers the reasons why certain ideas originated in the minds of the early geologists.

The perceived and accepted significance of collections may wax and wane with time. Some collections have suffered damage or neglect because they were deemed at the time to be of low significance and thus of low priority when it came to allocating time to their curation and adequate facilities for their storage. All geological specimens were acquired for particular reasons, but perhaps due to a combination of poor collecting or curatorial practices much significant information pertaining to the collection may have been either not originally available or subsequently destroyed.

[25] M. A. Parkes and A. W. Owen, 'Anomalous records of trinucleid trilobites in Irish Silurian rocks', *Irish Journal of Earth Sciences*, 13 (1994), 59–63.

[26] J. Joly, *Radioactivity and Geology* (London, 1909), 42–4.

This radically decreases the value of the collection. However, possible rehabilitation of collections is not impossible, although this may entail laborious and time-consuming research by museum curators or geological historians.

Collections which can be of greatest use to historians of geology are those with good documentation. Thus original attached specimen labels, tray labels, original field sheets and notebooks, manuscript catalogues and even original packing materials can all be vitally important. Equally, newer labels and other associated items can be important in tracing the history of collections. An undocumented and unidentified piece of granite is simply that: perhaps attractive but worthless in terms of scientific history.

Research on collections in geological museums should concentrate in two areas: first, the extant collections, if in a disorganized state, should be rehabilitated. Specimens should be cleaned, identified, reboxed and catalogued, and all available documentation (old labels, tray cards, catalogues etc) sorted, matched with specimens and conserved. Second, if material has been discarded in the past, then an attempt should be made to determine precisely what this was. Examination of manuscript and printed records might allow for this to be done successfully. Once rehabilitation of specimens and/or collections is complete, then it is more probable that their significance to the development of geological thought will be recognized.

Below are some case studies where the study of extant specimens or documentation relating to lost geological collections has led to a greater understanding of the collector's geological research and output, and also to an awareness of some cultural and social factors that marked their history.

3.1. *Case study 1: George Graydon and tracing lost collections*

Frequently large portions of collections are lost, and it is often difficult to work out their original composition. Nevertheless it is a worthwhile exercise attempting to ascertain how collections were dispersed, as this may give reasons for their loss, and may also reveal unknown links between institutions and individuals.

In 1790–1 the Dublin cleric George Graydon (*c.* 1753–1803) travelled to Italy to collect volcanic specimens from Vesuvius, and more unusually from the region of extinct volcanoes in the north-east of the country.[27] He did this to allow his colleagues in the Royal Irish Academy to compare the Italian specimens with material from north-east Ireland around which much debate centred concerning the origins of some igneous rocks. Graydon returned with over 3500 specimens, but today only nine have been traced. Fortunately his catalogues exist in Trinity College, Dublin, allowing researchers to determine the composition of his collection. These give some indication of his thoughts on the nature of basalt in north-east Ireland.

In 1794 Graydon presented the choicest specimens (about half the total number) to the Royal Irish Academy for their museum, and retained the rest for himself. What effect did these collections have on the members of the Academy? Little, it would appear. Some members, such as the Reverend William Hamilton (1755–97)—a Fellow of Trinity College Dublin, author of the celebrated *Letters concerning the northern coast of the County of Antrim* (1790)—accepted that the basalts were the products of volcanoes and other igneous phenonema. Others, such as Richard

[27] P. N. Wyse Jackson and E. Vaccari, *The Reverend George Graydon (c. 1753–1803): Cleric and Geological Traveller* (Dublin, 1997).

Kirwan (1733–1812)—chemist and later President of the Royal Irish Academy—and the Reverend William Richardson (1740–1820)—a Fellow of Trinity College, Dublin—followed the teachings of Abraham Gottlob Werner (1743–1817) on the origin of basalt and volcanoes, and refuted their volcanic origin. While Kirwan praised Graydon's efforts in acquiring the specimens, it is surprising that in his and Richardson's papers which deal with igneous phenonema, and were published by the Royal Irish Academy, no mention is made of Graydon's collection.[28] Graydon had seen that the recent lavas that he had himself collected from the slopes of Vesuvius bore a close similarity to the ancient Antrim basalts, and while he did not voice an opinion one must assume that he considered that the latter were similarly the products of volcanic activity, rather than precipitates from water.

In 1801 Graydon's specimens were transferred from the Royal Irish Academy to the Dublin Society. The Dublin Society collections later formed the bulk of those in the National Museum of Ireland, where today six fossil fish collected by Graydon from the Eocene of Bolca, north-east Italy, are still extant.[29] Of the half of his collection which Graydon retained, some he gave away to personal contacts, while the remainder was sold to Trinity College by his widow Elizabeth soon after his death. At the same time a small suite went to the Royal Dublin Society. The Swiss geologist J. F. Berger (1779–1833) who worked in north-east Ireland,[30] and who published some of Graydon's findings on Monte Somma in 1816, was given eleven specimens from Trinity College in about 1811, and these made their way to the Geological Society of London and later to the Natural History Museum in London where only one specimen remains. The whereabouts of the remaining specimens formerly in Trinity College Dublin is unknown.

Study of the fate of missing collections can reveal unexpected information concerning the priorities of museums, the attitudes of users, and contemporary perceptions of value.

3.2. *Case study 2: Robert Jameson and understanding early geological terminology*

Correct understanding of early geological printed works and manuscripts can be difficult to achieve when lithological and mineralogical terminology unfamiliar to the reader is used. This is a prevalent problem in early texts when mineralogical and lithological names had not become standardized; in many cases names were descriptive in terms of the mineral habit and constituents (e.g. ruin agate, roe stone, or copper foam). For historical purposes the work of A. H. Chester on mineral names is important, as is the recent revision of M. H. Hey's *Index of Mineral Species* ....[31] W.

[28] Papers on the topic include R. Kirwan, 'Examination of the supposed igneous origin of stony substances', *Transactions of the Royal Irish Academy*, 5 (1793), 51–81 W. Richardson, 'Account of the whynn dykes in the neighbourhood of the Giants Causeway, Ballycastle, and Belfast', *Transactions of the Royal Irish Academy*, 9 (1803), 21–43; and W. Richardson, 'On the Volcanic Theory. Part 3. Arguments against the volcanic origin of basalt, derived from its arrangement in the County of Antrim, and from other facts observed in that country', *Transactions of the Royal Irish Academy*, 10 (1806), 87–107.

[29] E. Vaccari and P. N. Wyse Jackson, 'The fossil fishes of Bolca and the travels in Italy of the Irish cleric George Graydon in 1791', *Museologia Scientifica*, 12 (1995), 57–81.

[30] C. W. P. MacArthur, 'Dr Jean-François Berger of Geneva (1779–1833): from the Travelling Fund to the Wollaston Donation', *Archives of Natural History*, 17 (1990), 97–119.

[31] A. H. Chester, *A Dictionary of the Names of Minerals including their History and Etymology*, (Chichester, 1896); A. M. Clark, *Hey's Mineral Index: Mineral Species, Varieties and Synonyms* (London, 1993).

J. Arkell and S. I. Tomkeieff's *English Rock Terms*, and Tomkeieff's later *Dictionary of Petrology*, are equally valuable, but the historical usages these works treat are principally of vernacular terms, not based on prevalent scientific knowledge. While nevertheless valuable, these pioneering works were largely bibliographic and etymological in nature, and it is suspected that the authors did not always examine actual material to which these early names had been given.[32] V. Berg-Madsen discussed the problem of terminology in relation to the dark bituminous limestones of Scandinavia which have been given synonymous names including stinkstone, anthraconite and orsten.[33] While orsten is still used for these limestones in northern Europe, she showed that modern interpretations of the terms deviate markedly from the original meaning. Throughout early texts terms are used which may not be known to latter-day geologists or historians of geology, or else terms are used today which are at variance with past usage. For historians of geology this is a perpetual problem, because without complete understanding of geological terminology, past and present, it is impossible fully to understand geological theory. One solution to this problem would be for researchers to examine collections of minerals and rocks assembled by authors of early geological texts, determine the old published names, and correlate these with the modern mineralogical and petrological names applicable to the specimens.

Robert Jameson (1774–1854), Professor of Natural History at the University of Edinburgh from 1804, studied mineralogy under Werner at Freiberg. On his return to Scotland he published many volumes on mineralogy including the three-volume work *System of Mineralogy*, which went to three editions. In 1821 Jameson's *Manual of Mineralogy* appeared, a book which is of interest here on two counts. First, it gives the original German names coined by Werner, and their English equivalents. Second, it contains a section in which Jameson gives a description of mountain rocks which are arranged to allow the reader a geognostical or structural and compositional view of the Earth. It is accompanied by a listing of 120 rock specimens from the Hartz Mountains of central Germany, which are catalogued under three categories: (1) primitive rocks, which include granite, gneiss, horn-rock and quartz-rock; (2) transition rocks, which include limestone, ironshot, greywacke, jasper and blisterstone; and (3) floetz rocks, including conglomerates, marls, and muschelkalk. While most of these lithologies are familiar, some such as blisterstone may prove to be new terms to most geologists and historians, given that it does not appear in a number of modern dictionaries or glossaries of geology.[34] What is blisterstone in terms of modern nomenclature? In the Geological Museum, Trinity College, Dublin is stored a set of these Hartz Mountain rocks, and close examination of specimen number 82—blisterstone—reveals it to be an amygdaloidal basalt. The overriding value of collections such as the Trinity College suite is that they illustrate lithological classifications formerly used and they allow for correlation and understanding of terminologies used in the past and at the present time.

[32] W. J. Arkell and S. I. Tomkeieff, *English Rock Terms chiefly as used by Miners and Quarrymen* (Oxford, 1953); S. I. Tomkeieff, *Dictionary of Petrology* (Chichester, 1983).

[33] V. Berg-Madsen, 'Origin and usage of the geological terms orsten, stinkstone and anthraconite' *Archives of Natural History*, 16 (1989), 191–208.

[34] S. I. Tomkeieff (note 32); D. G. A. Whitten with J. R. V. Brooks, *The Penguin Dictionary of Geology* (London, 1972); S. E. Stiegeler, *A Dictionary of Earth Sciences* (London, 1976); A. Wyatt (ed.), *Challinor's Dictionary of Geology* (Cardiff, 1986); D. F. Lapidus, *Collins Dictionary of Geology* (London and Glasgow, 1990).

3.3. *Case study 3: Social interaction between collectors in Dublin in the 1800s*

Prosopography is the study of collective characteristics of people by way of studying their lives; this approach has been attempted in a limited fashon in the history of science.[35] D. E. Allen[36] has argued that in applying the technique to the study of the history of natural history much hitherto hidden can be gathered. M. J. S. Rudwick in studies on the history of geology (as noted by Allen), L. Ciancio on members of the Geological Society of London, and M. R. S. Creese and T. M. Creese on women geologists in the nineteenth century, can be said to have used this prosopographical method.[37] As time passes it becomes increasingly difficult to detect or decipher cultural and social patterns. Looser geological prosopographical studies include many of the recent scientific biographies,[38] institutional histories,[39] and investigations of past controversies;[40] all contain valuable social and scientific insights. While prosopography strictly refers to the study of people a similar method can be applied to geological collections and collectors, and occasionally these cultural and social patterns become evident through their examination.[41]

Richard Kirwan was instrumental in the Dublin Society's acquisition of the Leskean mineral collection in 1792. This collection, which numbered several thousand specimens, was assembled by Nathanael Leske between 1782 and 1786.[42] The presence of the Leskean collection in Dublin fostered interest in the science;

35 For example J. Morrell and J. Thackray, *Gentlemen of Science: Early Years of the British Association for the Advancement of Science* (Oxford, 1981); S. J. Livesey, 'De viris illustribus et mediocribus: a biographical database of Franciscan commentators on Aristotle and Peter Lombard's Sentences,' *Franciscan Studies*, 56 (1998), 203–37; S. Shapin and J. Thackray, 'Prosopography as a research tool in the history of science: the British scientific community, 1700–1900', *History of Science*, 12 (1974), 1–28; and L. Pyenson, '"Who the guys were": prosopography in the history of science', *History of Science*, 15 (1977), 155–88.

36 D. E. Allen, 'Arcana ex multitudine: prosopography as a research technique', *Archives of Natural History*, 17 (1990), 349–59.

37 M. J. S. Rudwick, 'A year in the life of Adam Sedgwick and company, geologists', *Archives of Natural History*, 15 (1988), 243–68; L. Ciancio, 'The correspondence of a virtuoso of the late Enlightenment: John Strange and the relationship between British and Italian naturalists', *Archives of Natural History*, 22 (1995), 119–29; M. R. S. Creese and T. M. Creese, 'British women who contributed to research in the geological sciences in the nineteenth century', *British Journal of the History of Science*, 27 (1994), 23–54.

38 For example Richard Owen, Thomas Henry Huxley and Richard Griffith to name but three: N. A. Rupke, *Richard Owen: Victorian Naturalist* (New Haven, 1994); A. Desmond, *Huxley: the Devil's Disciple* (London, 1994) and *Huxley: Evolution's High Priest*, (London, 1997); G. L. Herries Davies and R. C. Mollan (eds), *Richard Griffith 1784–1878* (Dublin, 1980).

39 Many historical accounts of geological institutions exist. For the Geological Survey of Ireland, the British Geological Survey, the Geological Society of London, and the University of Oxford for example, see G. L. Herries Davies, *North from the Hook: 150 Years of the Geological Survey of Ireland* (Dublin, 1995); J. S. Fleet, *The First Hundred Years of the Geological Survey of Great Britain* (London, 1937); H. E. Wilson, *Down to Earth*, (Edinburgh, 1985); H. B. Woodward, *The History of the Geological Society of London*, (London, 1908); and E. A. Vincent, *Geology and Mineralogy at Oxford, 1860–1986: History and Reminiscence* (Oxford, 1994).

40 See M. J. S. Rudwick, *The Great Devonian Controversy* (Chicago, 1985); J. A. Secord, *Controversy in Victorian Geology: the Cambrian–Silurian dispute* (Princeton, 1986); and D. R. Oldroyd, *The Highlands Controversy* (Chicago, 1990) and B. M. Hamilton, '"A geological blunder", 1893: a scientific storm in a journalistic teacup', *Notes and Records of the Royal Society of London*, 45 (1991), 63–77 for detailed analyses of three major episodes of geological debate in Britain. Similarily R. Wilding, 'Scrope vs. Mallet—a battle of heavyweights', *Geology Today*, 12 (1996), 110–4 recounts a personal clash between geologists who differed on the nature of volcanic phenonema, and J. A. Diemer, 'Old or New Red Sandstone? Evolution of a nineteenth century stratigraphic debate, northern Scotland', *Earth Sciences History*, 15 (1996), 151–66 outlines the arguments relating to the age of some Scottish sandstones.

41 See D. A. T. Harper and M. A. Parkes, 'Geological Survey donations to the Geological Museum in Queens College Galway: 19th century inter-institutional collaboration in Ireland', *The Geological Curator*, 6 (1996), 233–6 for a good example of specimen exchange.

42 N. T. Monaghan and E. Vaccari (note 18).

many people and institutions, including Trinity College, began to amass mineral collections. One such collector was the Honourable George Knox (1765–1827), a member of parliament for the University of Dublin. In 1827 his alma mater paid £500 to purchase his extensive collection of specimens from Europe, Greenland and North America. Examination of the specimens and accompanying hand-written catalogues shows that Knox arranged his collection using a classification similar to that of Werner, and provides answers to some questions about the way it was assembled. How did Knox acquire the specimens from Greenland? Could he have received them from the Greenland explorer Sir Charles Lewis Giesecke (1761–1833) who had secured appointment in 1813 as Professor of Mineralogy to the Dublin Society? Study of all the extant Greenland material in Trinity College has shown that it belonged previously to two collectors—to Knox and to another. The mineral species present included Cryolite and Sappharine, unknown in Europe before their discovery by Giesecke. Confirmation that Knox had been given the material by Giesecke came in an entry in his hand-written catalogue. Could the rest of the Greenland specimens in Trinity have come from Giesecke himself? It is known that he donated a great deal of material to museums across Europe, so why not to Trinity? Recent discovery of a hand-written list of specimens, in Giesecke's hand, confirmed that the source of the second suite of Greenland specimens was indeed Giesecke.[43]

The Geological Society of Dublin was established in 1831 and was granted a royal charter in 1864 from whence it was styled the Royal Geological Society of Ireland.[44] For nearly 60 years it served as an important forum for geological debate. In order to familiarize its members with geological material it began to assemble a museum soon after its inception, and soon it contained rocks from north east Ireland, as well as other regions, including the volcanic districts of the Rhine. Donors to the collections included John Phillips and the Earl of Enniskillen (1807–86). The museum contents were held from 1848 in the collections of Trinity College Dublin. The passage of generations has obscured the identity and provenance of some of these items on display in Trinity College, yielding puzzles which can, it turns out, be solved through research. Examples include some wall-mounted marine reptile specimens whose identity was long unknown; a recent close examination showed them to be copies of a plesiosaur scapula and sternum from England first described by Thomas Hawkins (1810–89). Why are they in Dublin? Subsequent perusal of the *Journal of the Geological Society of Dublin* revealed that Hawkins offered the replicas as a gift. Why? Could it have been for reasons of self-aggrandisement—certainly a possibility? Could Hawkins have had contacts in Dublin? Yes, apparently so. He was friendly with a Robert Hutton (1784–1870), a Dublin merchant and Member of Parliament, who had presented the society a year earlier with a replica of a complete plesiosaur skeleton—one originally illustrated by Hawkins.

Use of archival and specimen data helped sort out the provenance of the Greenland specimens, while tedious taxonomic identification allowed the puzzle of the provenance of the plesiosaur bones to be untangled and solved. Hidden cultural and social interactions and bonds, as have been illustrated above, can be revealed through the unfashionable study of geological specimens.

[43] This catalogue is in the archives of the Trinity College Geological Museum; see P. N. Wyse Jackson, 'Sir Charles Lewis Giesecke (1761–1833) and Greenland: a recently discovered mineral collection in Trinity College, Dublin', *Irish Journal of Earth Sciences*, 15 (1996), 161–8.

[44] A history of the Geological Society of Dublin and the Royal Geological Society of Ireland is given in G. L. (Herries) Davies (note 6).

3.4. *Case study 4: Geological travellers*

On account of the nature of the subject it has always been necessary for geologists to travel widely. While some geologists are known to have made few expeditions, others such as Sir Charles Lyell (1797–1875) made long trips to exotic locations including North America;[45] trips which moulded their thinking on geological matters. The American geomorphologist W. M. Davis (1850–1934) spent a great deal of time examining the landscape viewed from trains traversing the North American continent. Others walked, or by the beginning of this century bicycled. S. S. Buckman (1860–1929), the English palaeontologist who specialized in the study of Jurassic ammonites, was a keen bicyclist.

One of the major sources of information on geologists' itineraries is the notebooks, diaries, letterbooks, commonplace books and sketchbooks kept by these travellers.[46] Additionally, draft and printed maps are rich sources of data about geologists' travels, as are photographic collections. From the geological specimens housed in museums it is possible, even if admittedly difficult, to reconstruct the itineraries of geological expeditions and individuals.

Another lesser-known cyclist was Grenville Cole (1859–1924), Professor of Geology at the Royal College for Science in Dublin from 1890 until 1924, who worked on igneous and metamorphic geology.[47] Cole had trained under John Judd (1840–1916) in London, and shared his mentor's appreciation of the merits of fieldwork. Cole travelled widely across Europe on a tricycle and later on a bicycle, combining pleasure and geological reconnaissance, which were written up in papers on the volcanic rocks of Lipari, the Vosges, and parts of central France. From two travelogues it has been possible to reconstruct some of the routes taken by Cole.[48] Recently some of his rock collections, still wrapped in annotated newspaper fragments, have been discovered in Dublin, and initial analysis of these specimens adds to his touring record on the Continent. In this way we not only glean additional details about Cole's extensive fieldwork, we also recover supplementary information bearing on his abilities and interests; among other things we learn that Cole could read French and German, and that he relaxed reading *The Liverpool Courier*, *The Daily News*, *The News of the World*, and *The Tricyclist*.

As has been eloquently shown by David Oldroyd, it is necessary to revisit the sites examined by geologists in the past if an accurate appreciation of their work is to be gained.[49] Confining ourselves to the reading of published papers provides an

[45] R. H. Dott, Jr., 'Lyell in America—his lectures, field work, and mutual influences, 1841–1853', *Earth Sciences History*, 15 (1996), 101–40.

[46] Thomas Russell, a United Irishman who was executed in 1803, kept diaries of various collecting trips in the north of Ireland, see C. J. Woods (ed.), *Journals and Memoirs of Thomas Russell: 1791–5* (Dublin, 1991). George Victor Du Noyer, a geologist with the Geological Survey of Ireland, kept notebooks in which he recorded aspects of Irish geology, antiquities, and everyday life, see P. Coffey, 'George Victor Du Noyer: a recorder of life', in *George Victor Du Noyer 1817–1869: Hidden Landscapes*, edited by F. Croke (Dublin, 1995), 45–7.

[47] For an account of Grenville Cole's life and geological work see P. N. Wyse Jackson, 'On rocks and bicycles: a biobibliography of Grenville Arthur James Cole (1859–1924) fifth Director of the Geological Survey of Ireland', *Geological Survey of Ireland Bulletin*, 4 (1989), 151–63.

[48] Grenville Cole wrote two travelogues; the first, *The Gypsy Road* (London, 1894), describes a journey from Krakow to Coblentz, while the second, *As We Ride* (Dublin, 1902), co-authored with his wife Blanche, describes several routes including some in the Balkans. See P. N. Wyse Jackson, 'The cycling geologist', *Cycle Touring and Campaigning*, (1991, June–July), 26–7.

[49] David Oldroyd has developed this technique of revisitation of earlier geologists field locations to such an extent that his interpretations of observations made by them are first rate. See D. R. Oldroyd, *The Highlands Controversy: Constructing Geological Knowledge through Fieldwork in Nineteenth-century Britain* (Chicago, 1990).

incomplete view; examination of particular exposures or landscapes can illuminate why certain conclusions were drawn from them. Field notebooks and other manuscript sources are important sources of information for reconstructing fieldwork schedules but so too are geological collections.

4. Conclusion

Interest in the history of geology has begun to influence the way geological collections are perceived, although their value is still underrated by many. The work of groups such as the Geological Curators' Group has played an important role in fostering good museum management and collection documentation, which should have beneficial spin-off effects for historians of geology.

Geological collections are primary source materials and can give valuable information about geological localities, the collectors of material, relationships between collectors, institutions, museums and places of learning, and cultural and social factors. Study of geological material can also reveal interesting details relating to the development of geological methods, such as thin section making, which are still important in everyday geological investigation.

Most important of all, examination of geological specimens held in museums in tandem with printed sources may significantly enhance our understandings of the complexities of the development of geological thought.

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