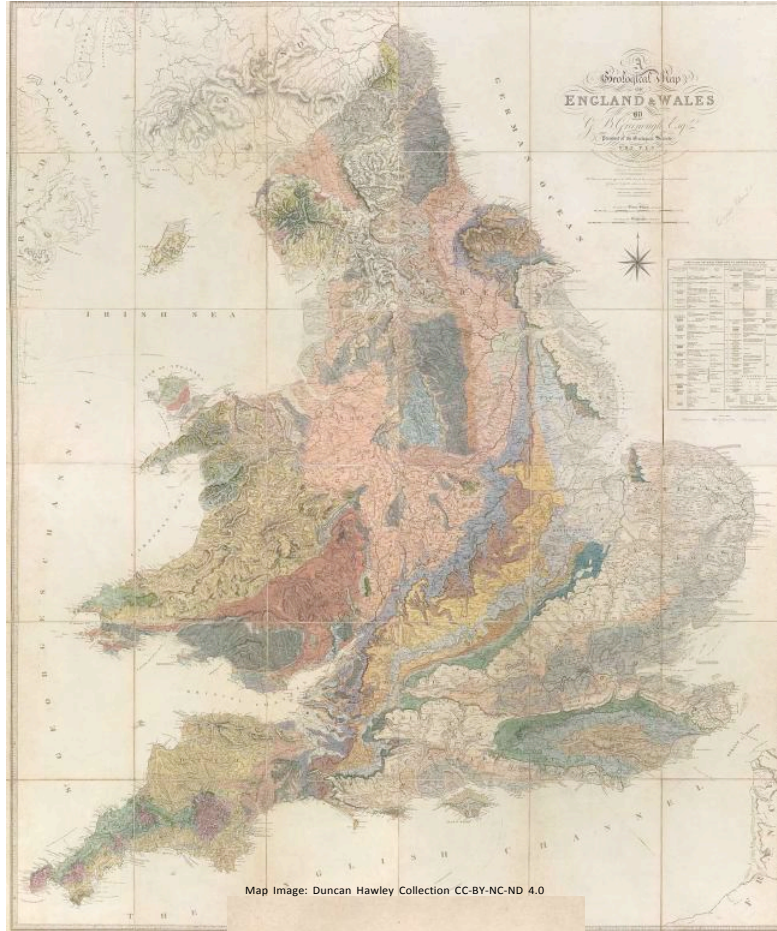


# The Geological Society's Map: understanding George Bellas Greenough and his 1820 geological map project

HOGG Online Conference Wednesday 6<sup>th</sup> May 2021



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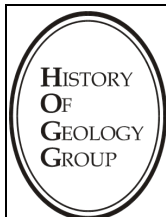


Image: Drawing by Maxim Gauci, engraving by Swan Electric Engraving Co Ltd.  
Source: Woodward, H.B. The History of the Geological Society. Facing page 12.

## PROGRAMME AND ABSTRACTS



University College London,  
Department of Earth Sciences  
Greenough Club and alumni



**The Geological Society's Map:  
understanding George Bellas Greenough and his 1820 geological map project**



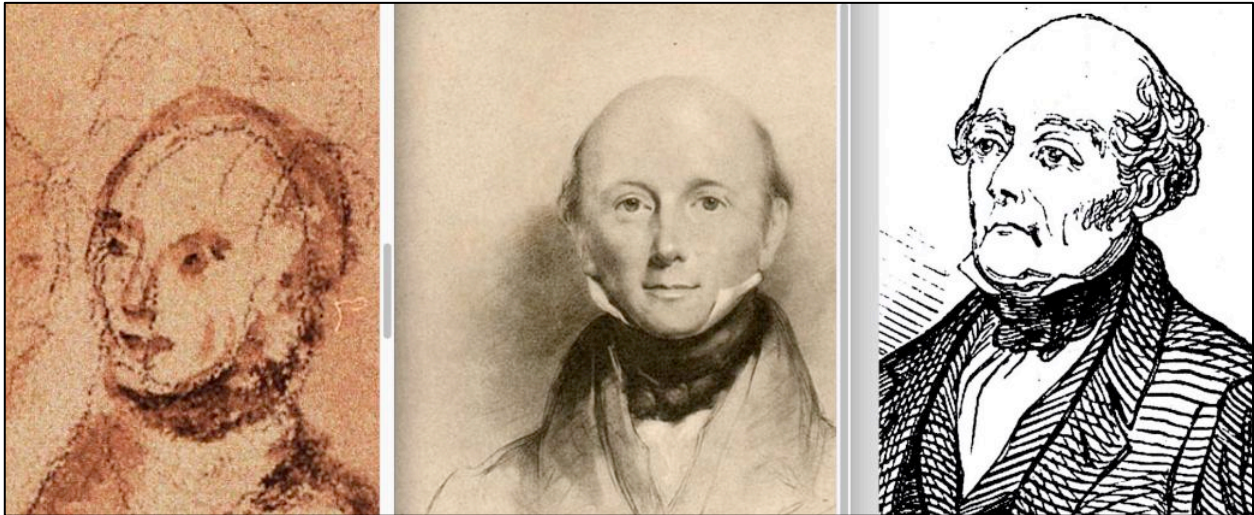
**Online Conference: Wednesday 12th May**

Time	Title	Presenter
10.45-11.10	Welcome and Introduction: The lives of G.B. Greenough - childhood, family, domestic, political and social.	Duncan Hawley Chairperson HOGG
11.10-11.35	Göttingen: the birthplace of Greenough's lifelong passion	Dr Maximiliaan van Woudenberg (Life Member of Clare Hall, Cambridge)
11.35-12.00	Greenough's aesthetic cultures of science	Dr Allison Ksiazkiewicz
<b>12.00-12.15</b>	<b>Comfort/Refreshment Break</b>	<b>Wonder Room chat</b>
12.15-12.40	Geological connections: Greenough and the Oxford Geological Club	Peter Lincoln
12.40-13.05	Greenough's objectives in his 1819 book 'First Principles' and his 1820 Geological Map and Memoir	Dr Geoffrey Walton & Prof Hugh Torrens
<b>13.05-13.50</b>	<b>Lunch Break and chat rooms</b>	<b>Wonder Room</b>
13.50-14.15	The building blocks: illustrations of Greenough's source maps and annotation	Duncan Hawley
14.15-14.40	The production and distribution of Greenough's 1820 geological map with a short history of later issues	Tom Sharpe
<b>14.40-14.55</b>	<b>Comfort/Refreshment Break</b>	<b>Wonder Room chat</b>
14.55-15.20	George Bellas Greenough's Legacy as a Geological Map Designer	Dr. Karen Severud Cook (Librarian Emerita, University of Kansas)
15.20-15.45	Greenough's influence on the colours employed on early Geological Survey maps	David G. Bate (British Geological Survey)
<b>15.45-16.00</b>	<b>Comfort/Refreshment Break</b>	<b>Wonder Room chat</b>
16.00-16.25	Manifestations of Greenough's 1820 geological map: a 'standard' for subsequent geological maps?	Duncan Hawley
16.25-16.50	George Bellas Greenough's General Sketch of the Physical and Geological features of British India (1854, 1855): its production, Distribution, variants and survivorship	Dr Christopher Toland (Oolithica Geoscience Ltd.)
16.50-17.00	Plenary and Closing Remarks	Duncan Hawley Chairperson HOGG

**George Bellas Greenough, born 18 January 1778, died 2 April 1855**

## **A short biography**

*Duncan Hawley*



Three portraits of George Bellas Greenough.

The most well-known image of Greenough, in the centre, is by portraitist Eden Uton Eddis (1812-1901) and probably drawn in the mid-1830s when Greenough was in his 50s, although the exact date is unknown.

The drawing on the left is taken from a sketch by H.T. De la Beche, of a Geological Society meeting taking place in Somerset House, probably in 1830.

The etching on the right is taken from the London Illustrated News drawing of geologists attending the 1846 meeting of the BAAS in Newcastle-upon-Tyne, when Greenough was 68 years old.

Greenough was born in London, as George Bellas, named after his father, George Bellas, who had a profitable business in the legal profession as a proctor in Doctor's Commons, St Paul's Churchyard Doctors' Commons. His mother was the only daughter of the apothecary Thomas Greenough, whose very successful business was located on Ludgate Hill near to St Paul's. A younger brother died in infancy.

At the age of six he was orphaned with his father dying first, and the cause, recorded by Greenough in a biographical sketch, was "By neglect of business, by carelessness, extravagance, dissipation and by party zeal, my father's fortune was soon squandered away - family dissention followed; his constitution was broken, his prospects blighted and he died of decline at Clifton in July 1784" (UCL Greenough Papers 24/1). Contemporary newspapers report his death at Hot Wells he was buried in Clifton. In September of that same year his mother also died, leaving the boy an orphan. Sarah was memorialised in a floor tablet in St Mary's Church, Hornsey, Middlesex. (now Haringey, Greater London).

The boy was adopted by his maternal grandfather, Thomas Greenough, who had made a fortune through selling popular preparations, the most popular of which were "Pectoral Lozenge from Balsam of Tolu", for coughs and colds, and various tinctures for cleaning teeth and gums and curing tooth ache. (Burnby, 1988, National Archive, 1744, London Chronicle, 1769, Public Advertiser 1769).

In 1790 Greenough inherited his father's estate lands in Surrey (on the border with Hampshire) together

with houses in London, this worth £4329 3s. 11d. In 1795 he received a further inheritance of £513 via a Great Uncle (Robert Bellas), with freehold lands in Essex and leasehold property in Deptford.

His grandfather sent him to Mr Cotton's school at Salthill near Slough and then to Eton at the age of ten. He stayed there only one year, and it has been suggested he was perhaps too delicate a child for the robust life at the boarding schools of the day. (Kölbl-Erbert 2003). However, in September 1789 he entered Dr Thompson's School at Kensington, and he seems to have been happy and thriving studying here for the next six years. At the end of his schooling, took the name Greenough, at the request of his grandfather who died in 1795.

He left school in that year and went up to Pembroke Hall, Cambridge (now Pembroke College, Cambridge) to study law for three years, However he did not take a degree because he was not able to bring himself to swear an oath to the 39 Articles of the Church of England that at that time was required to take a degree. He debated the issue with himself in a letter to his appointed guardian, Mr Hunt, stating he "had yet no opportunity of studying with the attention but am told that some of them are now wholly exploded from the creed not only of all sensible layman also many dignitaries in the church." (Venn & Venn, 1922-58, UCL Greenough Papers 29/1). Greenough qualified for subscription to the 39 Articles, he was brought up in the Church of England and his aunts were married to Anglican clergymen. The common claim that did not take his degree because he was a dissenter is not wholly accurate, in the sense of the commonly accepted understanding of a dissenter being a non-conformist.

In September 1798, he went to the University of Göttingen to continue his legal studies, thinking that the lectures would be in Latin, but found instead they were all in German. In order to improve his language skills Greenough attended the lectures of Johann Friedrich Blumenbach on natural history and these inspired a passion for mineralogy and geology. At Göttingen Samuel Coleridge was one of his closer friends. A few years later Greenough was instrumental in securing a government post for Coleridge during his period in Malta (Sultana 1969). In 1799, Greenough made at least two tours of the Harz; one in the Easter vacation with Clement Carlyon and Charles and Frederic Parry; and the other in the late summer with Carlyon and Coleridge. These tours were mainly to collect minerals, but he also studied geological collections in the towns he visited. Coleridge punned these tours as 'Parrygreenations'.

In 1801, Greenough returned to England and his interest in geology deepened when he toured England with Carlyon and met Humphry Davy in Penzance. Later he attended Davy's lectures at the Royal Institution in London. The following year he travelled to France and Italy and "noted what I saw of geology on my way"(UCL Greenough papers 24/1). He went on a geological tour of Scotland with James Skene in 1805 (Rudwick, 1962) and of Ireland with Davy in 1806. On the Ireland tour he also made a study of social conditions which aroused a deep interest in political questions.

1807 was a significant year for Greenough. He was elected member of parliament for the borough of Gatton, continuing to hold this seat until 1812, although Hansard does not record he made any contributions to the House. In this year his interest in science in general, and geology in particular, increase; he joined a number of eminent scientific and cultural societies and he was elected fellow of the Royal Society. He also became associated with a group of mineralogists to which Davy referred in a letter to William Pepys, dated 13 November 1807, when he said 'We are forming a little talking Geological Club'. This club rapidly developed into a learned society devoted to geology and Greenough became the chief founder with others of the Geological Society of London. He was the first chairman of that Society, and in 1811, when it was more regularly constituted, he was the first president. In this capacity he served on two subsequent occasions, and did much to promote the advancement of geology (Herries-Davies 2007).

During the time he helped to found and forge the Geological Society, Greenough served in the militia in the Light Horse Volunteers of London and Westminster. This was a corps of volunteers, originated by a group of city businessmen, and rather than being paid for their services members had to pay to join and maintain an annual subscription. The unit has an obligation to be called out in support of the civil power when necessary. It was rather different to other regiments in organising itself democratically through a committee. All prospective members had to be proposed by one of the committee and if admitted all served as private soldiers, with officers elected by ballot. Greenough enlisted as a private soldier in 1803, but in 1808 he was elected a commissioned officer with the rank of Lieutenant and he served for the next 11 years. Greenough resigned his commission in 1819 as a matter of principle following the Peterloo massacre in Manchester, which he regarded as an abuse of military power for political ends. He published his resignation letters in *The Morning Chronicle* and *The Times*. Clearly, Greenough was a man of conscience (Rose 2000).

In the early 1800s Greenough lived in Bedford Street, Covent Garden, but by 1804 he had moved to 2, Parliament Street, near to the Houses of Parliament, and he lived here until purchasing a lease on land on the edge of Regent's Park to build a villa designed by his friend Decimus Burton in 1822. Later, Greenough invested in Burton's property schemes on the south coast at in St. Leonard's. Grove House is a classical Doric villa, in a commanding location on the banks of the Regent's Canal had the largest area of gardens in London and the building was considered the best of its style in London. Here Greenough entertained his friends and colleagues in purpose-built library, map room and mineral room. However, the bedrooms were long and high but narrow, so could not have accommodated a double bed. Clearly Greenough only though in bachelor terms! (Williams, 1990).

In 1819, Greenough published '*A Critical Examination of the First Principles of Geology*' (Greenough 1819) a work which was useful mainly in refuting erroneous theories. The book received mixed reviews.

In May 1820 his famous Geological Map of England and Wales, in six sheets was published; of which a second edition was issued in 1839 and a third edition in 1865. This map was the culmination of a major cooperative project of the early Geological Society, who had established a Committee of Maps in April 1809, led by Greenough. Members of the Society out in the provinces of England and Wales submitted details of local rocks and strata which were collated by Greenough, entered in his notebooks and plotted on a topographical map. Greenough was an inductivist in the Baconian tradition, so he eschewed 'theory' and systematically collected information and details with the aim of discovering the distribution of rocks (Lauden 1987). Greenough received assistance in the collection of his geological facts chiefly from William Buckland, Reverend W. D. Conybeare, Henry Warburton, and Thomas Webster, and amongst others from Henry Thomas De la Beche, John Farey, the Rev. J. Hailstone, David Mushet, Thomas Biddle and Arthur Aikin (Memoir 1820, Woodward 1906). Many of these individuals supplied Greenough with regional geological maps – the results of their own surveys.

A first draft of the geological map was presented to the Geological Society as early as 1812, but there was dissatisfaction with the quality of the engraving of the topographical map, resulting in the base map not being ready until 1814. In 1815, William Smith published his famous geological map and when Greenough finally published his map five years later it was clear he was heavily indebted to Smith's work in delineating strata, although not acknowledged until the 1865 edition.

Nevertheless Greenough's map contained more geological detail and was better cartographically.[14] Smith had relied on a theory about the linear arrangement of strata identified by characteristic fossils to extrapolate from his observations (Smith himself was indebted to John Strachey's theory of strata for his

ideas[15]), and so was able to map out the distribution of strata across the country. Greenough, on the other hand, did not go by theory, and it was probably this aversion that delayed the preparation of his map. It has been claimed that Greenough and the Geological Society failed to work with William Smith in the production of a geological map due to snobbishness, Winchester (2001) but Rachel Lauden argues that a more compelling reason is that Greenough did not consider that fossils could reveal anything about the nature of rocks. (Lauden 1977). Greenough considered that fossils had been very overrated in their usefulness, as fossil species were different from modern species, so fossils could not be used to 'theorise' about or deduce the relative age and the conditions of deposition of the rocks. Indeed, he was suspicious of the concepts of 'stratum' and 'formation', much used by Smith. For this reason Greenough wanted to dissociate himself and the Geological Society map from the man who was using fossils to identify strata. Seemingly, Greenough had intellectual reasons rather than primarily social reasons for not collaborating with Smith (Lauden 1977). Knell (2009) charts the tricky relationships between geologists involved in the both Smith's and Greenough's map, recognizing that maps are palimpsests or cumulative achievements, and, at a time when respect and codes for intellectual property were not as it is today, not all those involved in contributing were credited or seen to be necessary.

In 1843, Greenough started to prepare a geological Map of British India. In 1852 he produced a series of maps of Hindustan, mainly hydrographical, defining all the important elements of the ten water basins of the Indian Peninsula (for the Asiatic Society), and in 1854 a large-scale geological map of the whole of British India, published as a 'General Sketch of the Physical and Geological Features of British India' (Greenough 1854). Greenough never visited India but much as he had done for his earlier maps of England and Wales, he compiled his map from scraps of information gathered from many observations of individuals recorded in scattered sources, demonstrating one of Greenough's key strengths - his assiduous ability to collect and collate information for his empirical cause.

In 1826 Greenough was a proprietor of the newly formed University of London - later University College London and was present at the ceremony of the laying the first stone of the building in Gower Street, in April 1827 (Statement by the Council of the University of London 1827). Several other Geological Society friends and colleagues were involved with the establishment and early governance of UCL, notably Henry Warburton and Leonard Horner (father-in-law to Charley Lyell). Greenough served on the Council of the new University from 1835 to 1844. From its inception Greenough desired that UCL establish a Chair of Geology, but insufficient interest and demand from students meant this was not possible until 1841 when Greenough was part of the committee that appointed Thomas Webster to the first Chair of Geology at UCL. Greenough bequeathed his fossil collection to the Geology Department at University College London (UCL) and his notebooks are in the Greenough Papers collection held at UCL Library Arcvhives. The student geological society at UCL is named after Greenough.

Greenough was an active supporter of many important learned scientific societies existing in the first half of the nineteenth century. In 1831 he was one of the prime movers in establishing the British Association for the Advancement of Science (now the British Science Association). He helped found the Geographical Society of London in 1830 (later to become the Royal Geographical Society), being elected to its first council and serving as President from 1839-1841. Greenough was an early advocate for physical geography and the accurate delineation of physical features thereby "endeavouring to give a more scientific character to the proceedings of the Royal Geographical Society" (Sharpe 1856).

Greenough's connections and travels with Romantics of the period led to him realizing that artistic representations of physical features were imbued with emotional responses and representation which did not mix well with accuracy. On a trip through Switzerland in 1802 he noted that Mont Blanc is very difficult

to reproduce artistically. He wrote: "A list of facts drawn up by a simple cold-blooded mathematician who has travelled through the country with his quadrant in his hand! may be better than a painter's sketch." Nevertheless the influence of the Romantic poets is evident in his travels as his notebooks show how Greenough also found pleasure in allowing imagination and emotion to colour his response to grand landscapes (Wyatt 1985).

Greenough travelled on journeys to the continent throughout his life and at the age of 76 he set off for Italy and the East with a view of connecting the geology of his researches on the geology of India with that of Europe, but he was taken ill en route with oedema, probably caused by cardiac problems, and died at Naples on 2 April 1855.

He is buried in Kensal Green Cemetery, North London.

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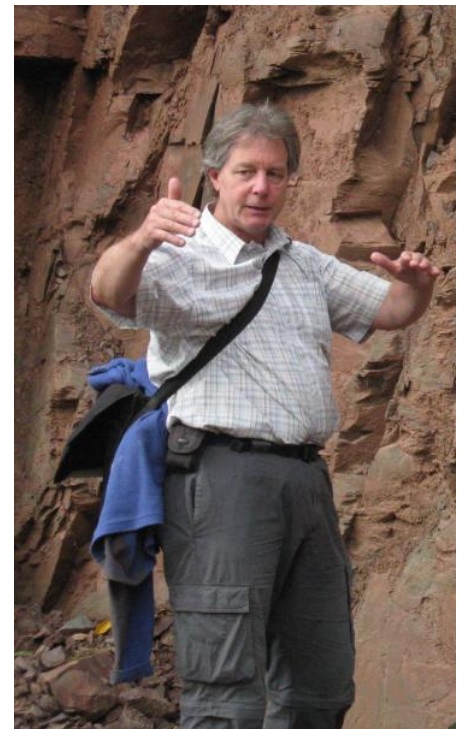
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## **Duncan Hawley**

Duncan is the current Chairperson of HOGG. He is a graduate in geology from UCL, where in his final year he was Chairman of the Greenough Society, and that spawned an interest in the life of Greenough and his maps.

Duncan has enjoyed a varied career in education, teaching geography and geology in both state and independent schools, at a field centre in the Forest of Dean and at university in Swansea. Duncan contributed to the latest BGS maps for Brecon, Talgarth and Hay-on-Wye.

He is active in geo-conservation and is the current Chair of Sheffield Area Geology Trust. He has explored the work of geological pioneers in mid-Wales, and traced the footsteps of Murchison to discover the location of 'The first true Silurian' (in the Wye Valley). Duncan has particular interests in the development of early geological maps and ideas in geomorphology.





## Greenough and Göttingen: a closer look at the birthplace of his lifelong passion

*Dr Maximiliaan van Woudenberg*

During the last quarter of the eighteenth century, Romantic-era figures such as Samuel Taylor Coleridge, Thomas Young, and George Bellas Greenough attended what was arguably the most celebrated university in Europe at the time: the University of Göttingen. While it is well known that Greenough discovered his lifelong passion for geology and mineralogy during his studies at the University of Göttingen, many of the details shaping this formative period in his life have remained obscure.

The aim of this paper is to highlight some of the most significant interactions and exchanges Greenough encountered at Göttingen on his journey from matriculating as a law student in 1798 to his lifelong interests in geology and mineralogy in 1800. The paper begins with an exploration of Greenough's student life against the backdrop of the Göttingen milieu. The lectures of Professor Blumenbach, the renowned Göttingen Library, the famous tour of the Harz Mountains with Coleridge and Charles Parry in 1799, and his interaction with various circles, were all essential aspects in Greenough's education and development in Germany. The second part of the paper examines some of the applications of Greenough's Göttingen studies on his immediate return to England, and his life and work generally. The paper concludes by sketching some of the implications of Greenough's Anglo-German knowledge-exchanges during the Romantic Period.



Unicorn's Cave visited by Greenough on the Harz Tour in 1799.  
This drawing is from Buckland's *Reliquiae Diluvianae* (1823).

Image source: Duncan Hawley Collection

## Maximiliaan van Woudenberg

Dr. Maximiliaan van Woudenberg is a Life Member of Clare Hall, Cambridge.

He is the author of *Coleridge and Cosmopolitan Intellectualism 1794–1804: The Legacy of Göttingen University* (2018), as well as articles and chapters on Romanticism, book history, library and reception history, Anglo-German print culture, and such Romantic-era figures as Austen, Beddoes, Byron, Coleridge, and Mary Shelley. Along with Professor Anthony Mandal, Maximiliaan is a co-editor of the online journal *Romantic Textualities: Literature and Print Culture, 1780-1840*. His current research interests focus on British and German print culture and sites of information interchange and knowledge networks in the nineteenth century.



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## Greenough's aesthetic cultures of science

*Dr Allison Ksiazkiewicz*

While romantic landscapes and wilds of nature characterized the remote regions in which geological travellers observed the structure of the earth, the city of London, in which the young Geological Society met, debated and published their observations and theories, was a world dominated by aesthetic sensibilities and fashions. Buildings that hosted centres of intellectual and scientific engagement projected ideas of progress and identity through visual references to ancient cultures of art and science. Somerset House in London, which housed the Royal Society, the Society of Antiquaries and later the Geological Society of London, was designed with ancient sources in mind. The homes of private individuals likewise projected the public persona of their 'cultured' owners through design. The Neoclassical-inspired residence of George Bellas Greenough (1778–1855) doubled as a domestic space and as a site for gatherings and meetings dealing with the young Geological Society. Grove House, as it is called, was constructed on the lush grounds of Regent's Park, a playground for urban gentility. As geology developed within private and public topographies of good taste in the early nineteenth century, a question remains: how did the new science embody these aesthetic sensibilities? Focusing on the life and scientific contributions of George Bellas Greenough, this talk will look at how art and sensibility influence geology.



Drawing of Fingal's Cave, 'Staffa', Inner Hebrides, Scotland by James Skene. Greenough's toured Scotland in 1805, accompanied by Skene for much of the journey). Skene, whom he had met at Göttingen, was a lawyer, amateur geologist and accomplished artist. He frequently made drawings for Greenough of geological phenomena.

Image source: © The Geological Society LDGSL/400/6, with permission.

## Dr Allison Ksiazkiewicz

Bringing together a background in fine arts and history of science, Allison Ksiazkiewicz's research practice considers the relationship between history and aesthetic sensibilities in the making of cultural identities and the history of the earth sciences. Before arriving in England for postgraduate and doctoral studies in History of Science at University of Cambridge (2008 and 2013), she earned a BFA from Mount Allison University (2002), specializing in drawing and printmaking, and a MA in Art History from York University (2007), focusing on natural history dioramas in Canadian museums.



In 2015 she was awarded a postdoctoral fellowship at the Paul Mellon Centre for Studies in British Art to conduct new research for her book *Archetypes of Nature: Visualizing Geological Landscape during the British Enlightenment* (forthcoming). Ksiazkiewicz curated the exhibition *Landscapes Below: Mapping and the New Science of Geology* held at the Milstein Exhibition Centre, Cambridge University Library between November 2017 and March 2018, which directly resulted from PhD work on George Bellas Greenough and the activities of early members of the Geological Society of London.

She has published in the journals *History of Science*, *Cartographia*, and *Journal for Eighteenth-Century Studies*, and has contributed to the edited volume *Enlightenment travel and British Identity* (2017), and the *Encyclopedia of Early Modern Philosophy and the Sciences* (forthcoming 2020).

## Geological Connections - George Bellas Greenough and the Oxford Geological Club

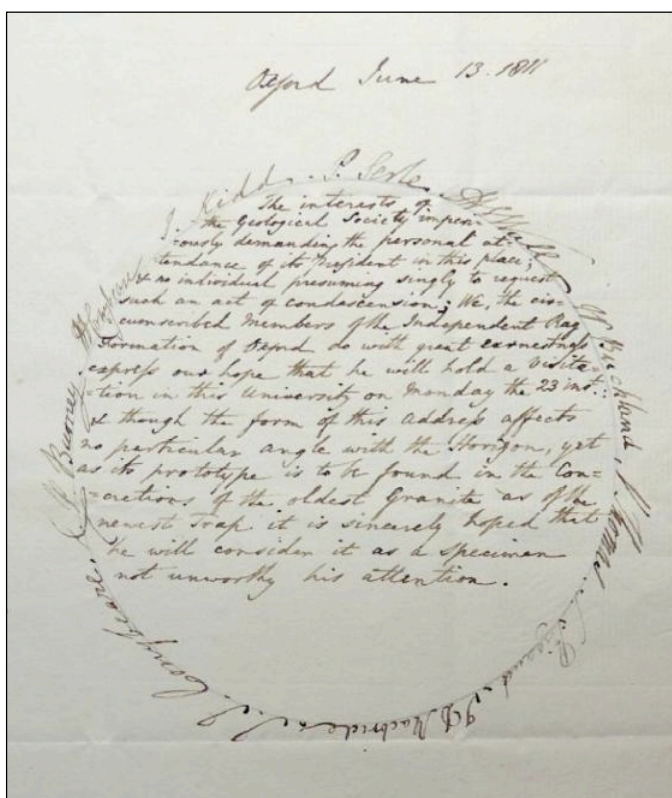
*Peter Lincoln*

When George Greenough visited Oxford in 1810 he became acquainted with a small group of university men who, like himself, were absorbed in the study of the newly developing science of geology. The group included established professors and newly matriculated undergraduates – all brought together through attendance at the series of mineralogical lectures given by the professor of chemistry, Dr John Kidd.

Enjoying the fellowship that derived from the pursuit of a common interest, these men saw themselves as an informal geological club. Some went on to make significant contributions to the science; for others geology was little more than a passing interest. George Greenough, the gentlemanly president of the recently formed Geological Society of London, was an attractive figure whose intimate acquaintance they sought to nurture. This paper charts what might be termed the Oxford men's 'courtship' of Greenough and the mutually beneficial, if occasionally troubled, relationship to which it led. The letters on which this study is based (from the UCL Greenough Collection, ex CUL Add MSS 7918) were written by two of the more geologically active of the Oxford men: William Buckland who, in 1813, succeeded Kidd as mineralogical lecturer, and William Daniel Conybeare. Both these men had quickly formed a close bond with the slightly older Greenough and each repeatedly sought to persuade him to join them in their geological endeavours. However, Greenough's busy social life and his duties as both an MP and president of the Geological Society meant that they were to be repeatedly disappointed.

Undeterred, Buckland and Conybeare supplied detailed accounts of their own fieldwork and information gathered from other reliable sources for inclusion

in the great mineralogical map that Greenough was putting together under the aegis of the London Society. In 1815 Greenough first attended one of the Whitsuntide gatherings which, between 1813 and 1819, were a regular feature of geological life in Oxford. What began as an



The 'round-robin' invitation sent to George Greenough requesting his attendance at a meeting of the 'Independent Rag Formation of Oxford' on 23<sup>rd</sup> June 1811, written by W.D. Conybeare and signed by him and nine others.

Source: Greenough Papers, Part B, UCL Archives( MSS 7918) 432

Photo by Peter Lincoln.

opportunity for the Oxford men to demonstrate to a wider audience their expert knowledge of the local area gradually became geological jamborees ventured further afield. These meetings were an important and influential point of intersection between leading geologists from Oxford and London.

### **Peter Lincoln**

After a working life that included surveying supertankers on the Tyne and teaching science to Suffolk schoolchildren, Peter Lincoln became fascinated by history, and in particular, the history of scientific ideas.

Following the completion of degrees in the History & Philosophy of Science at UCL and Biography and Creative Non-Fiction at UEA, Peter is currently engaged on a biographical study of William Buckland, for which he hopes, one day, to earn a PhD.

Peter currently serves as a lay (i.e. non-geologist) member on the HoGG Committee and is editor of the HOGG magazine, GeoHistories.



## Thoughts on Greenough's objectives in his 1819 First Principles and his 1820 Geological Map and Memoir.

Professor Hugh Torrens & Dr Geoffrey Walton

This paper reviews the content and reception of George Bellas Greenough's early publications and the relationships between the two documents.

Greenough's agreement with his book publisher Longman's, was dated 24 June 1818 and its completion may have delayed his geological Map. Its title was to be "Essays on the Elements of Geology" and it exists in 3 states, as printed, as a cancellans sheet after complaint by John Farey and the whole reprinted. The book was widely, but variously, reviewed; we consider five of them. The *British Critic* and the *Monthly Magazine* generally approved. Two were by geognostic reviewers; that by John Fleming said it was not 'calculated to advance his own reputation or promote the interests of geology'. Robert Bakewell's, published in London and later in Paris, thought it was baffling to understand, given the confused use of facts. Some have seen it as a vituperative, late argument against the work of Hutton and to sideline that of William Smith by concentrating on the use of fossils to identify rocks. Did he want a theory-free philosophy?

George Bellas Greenough's shortly to be published map was not mentioned in the book. Nowhere does the 'First Principles' refer to an English sequence of strata in the way that he does sequences elsewhere even though he had significant English data. For Greenough's map to have any reliability, this established order had to be used. This, with the vital help of Buckland and Conybeare, is exactly what Greenough attempted in his mapping by committee. We will compare the Order of Strata that Greenough used with the Orders shown in the eight different versions, which Buckland produced in five years up to 1818, all of which may have helped with the map. However, Greenough refused to record characteristic fossils in the final tabulations on the map.

**ORDER OF SUPERPOSITION OF STRATA IN THE BRITISH ISLANDS.**  
By Rev. W. BUCKLAND, B.D. F.R.S. M.G.S. Fellow of C.C.C. and Professor of Mineralogy in Oxford.

FORMATIONS.	NAMES.	CHARACTER.	LOCALITIES.	First observed (Reference in text).
<b>CLASS I.—Alluvium.</b>				
<i>Superficial Deposits composed irregularly of the Debris of all Formations.</i>				
No. 1. Alluvium.	Post-diluvian Detritus.	Blown Sand.	Perran-Zabulo, Bude, and Porth Cornwall; Newbiggen, North Devon; land.	
		Fluvatile Detritus.	Mod Sand and Silt. Gravel Sand and Mud from the neighbouring hills.	Detritus at the mouth of rivers. Island Channels of torrents and rivers.
	Diluvian Detritus.	Sand Clay and Gravel composed of fragments both of neighbouring hills and of distant rocks, containing bones of the Elephant, Rhinoceros, Ox, Deer, Hippopotamus, &c. not mineralized.	Every where in valleys, often on the slopes of hills and on elevated spots. Walton; Essex; Harwich; (London); Boreford; Oxford; Gloucester.	
<b>CLASS II.—Trap Rocks.</b>				
<i>Intruding themselves into all formations (except Class I) in irregular beds, masses, and dykes.</i>				
No. 2. Trap Formation.	Flötz Trap. Whin Dykes.	Basalt, Wacke, Amygdaloid, Greenstone, Chalk-Stone, Trap-Tuff, Pitselstone, Oolite, &c.	Giants' Causeway, Antrim; and Conybeare, Derry; in beds above Chalk. Campery and Ockhill Hills, Somerset; White Dykes, Passin; coast of Antrim; Isle of Arran; Cockfield Dyke, Durham; Vale of Berkeley, Gloucestershire.	1050
<b>CLASS III.—Secondary Rocks.</b>				
<i>Containing abundantly Organic Remains and Fragments of older Rocks.</i>				
<b>ORDER I. HORIZONTAL.</b>				
<i>Strata regular and nearly horizontal, made up of alternations of Clay, Marl, Pebbles, Sand, and Limestone.</i>				
Upper Freshwater Beds.	Upper Marine Beds.	Yellow argillaceous Limestone with Clay and Sand (contains Freshwater Shells).	Headon Hill, and Bembridge-Loze, Isle of Wight.	122
		Clay and Marl (with Marine Shells).	Headon Hill.	35
Lower Freshwater Beds.	London Clay.	Sandy and argillaceous Limestone (contains Freshwater Shells).	Headon Hill.	63
		Lead-coloured Clay with Septaria. Calcareous Sandstone, containing Green Earth.	Sheppy Island, Kent. Bognor Rocks, Sussex.	550
Plastic Clay.	Plastic Clay.	Clay, containing Fossils, the same with those of the Calcaire grossier of Paris.	Hordwell Cliff, near Christchurch, Hants. Highgate Hill, Richmond Hill.	
		Potters Clay, white, blue, and red, alternating with beds of Sand containing Green Earth, and of Gravel made up of rolled Chalk Flints.	Blackheath, Kent; Reading, Berks; Corfe Castle; Alum Bay, Isle of Wight.	1131

William Buckland's Table of the order of British strata, published in 1818, in William Phillip's 'A Selection of Facts... as to form an outline of the geology of England and Wales.

Image source: Duncan Hawley Collection

### **Professor Hugh Torrens**

Hugh is an emeritus professor at Keele University and a leading authority on William Smith and his contemporaries. With many books, papers, and articles to his credit, he has published his research widely across both geology and history including the life and accomplishments of many of Greenough's contemporaries.

In 2012 he was awarded the inaugural V.V. Tikhomirov Medal for his work, one of the International Union of Geological Sciences awards, established to reward outstanding original contributions to the earth sciences.



### **Dr Geoffrey Walton**

**Geoffrey** has a PhD in mining engineering and initially worked for the Opencast Executive of the NCB; subsequently he set up the consultancies of GWP and DustScanAQ.

From 1993 to 2003 he was on the advisory Board of the BGS and for 20 years until 2015 he was visiting Professor of Mining at Leeds. He is interested the history and development of applied/industrial geology.





## The building blocks: illustrations of Greenough's source maps and annotation.

*Duncan Hawley*

From the outset the Geological Society's map was a collaborative effort. It was always intended to be a Society project, started with Society's first publication 'Geological Inquiries' in 1808. A key objective of 'inquiries' was "that Mineralogical maps of districts, which are now so much wanting, may be supplied". These maps were to illustrate observations of "metallic productions, the rocks, the strata, the coal of any district; or to the appearances and forms of mountains, the direction of rivers, and the nature of lakes and waters".

In 1809 a map committee was formed and settled on the preparation of a single geological map of England and Wales. From the outset the project was a collaborative effort. Observations were collected from Society Fellows, associate members and "persons in every situation in life" who had expert knowledge of the areas where they lived or frequently visited.

The resultant information was collated by Greenough, who also added details collected during his travels. In the accompanying map memoir, Greenough wrote: "Care has been taken to insert the names of all places geologically curious, or noticed by geological writer." These can be seen as annotations on the map and are especially clear around the coast.



Draft coloured map of north Somerset between Brean Down and Bristol, on an 1803 topographical map chiefly with notes and colouring by William Buckland, but also showing annotations in other hands, and least one note by Greenough.

Image source: © The Geological Society LDGSL/56.3/4, with permission.

This presentation will highlight some of the maps supplied by members to Greenough and attempt to illustrate some of Greenough's working methods in compiling the 1820 geological map. It will also consider the form and style of annotations around the map, including some comments in draft form marked on draft or proof copies of the 1820 map and evaluate the extent to which they fulfilled the original goals set out in 'Inquiries'.

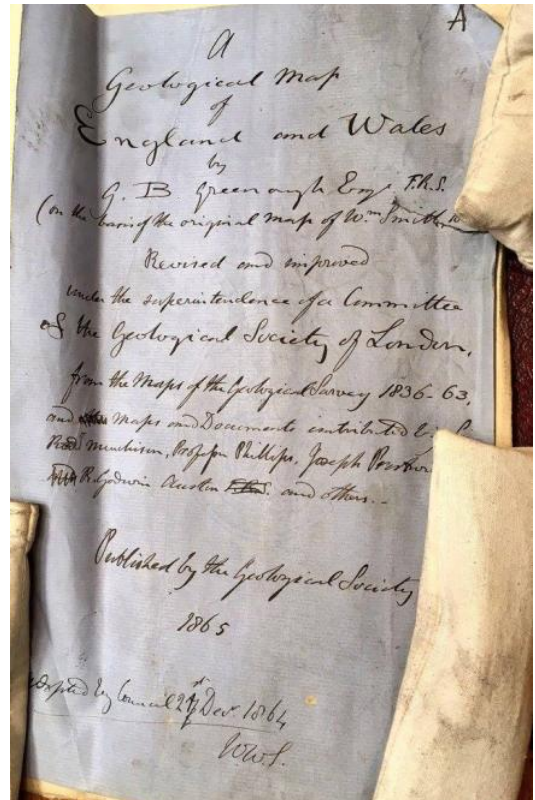
## The production and distribution of Greenough's 1820 map with a short history of later editions.

Tom Sharpe

The gestation of Greenough's 1820 geological map of England and Wales was almost as long as that of William Smith's famous map of 1815: twelve years compared with Smith's fourteen. Using a new topographical base map drawn by Thomas Webster between 1814 and 1817 at a cost of about £200, the six-sheet map was engraved by S.J. Neele & Son and published for the Geological Society by the then long-established publishers of Paternoster Row, Longman. Geological colouring of the maps was also mostly by Webster, with some by the map-maker William Ebdon. Coloured maps sold to the public for six guineas and to Geological Society members for five guineas, so it is not that case that the map was priced to undercut that of Smith. Uncoloured sets sold for £4 15s, and were also available 'without mountains' for four pounds or with 'rivers only' for one guinea.

About 370 sets were printed, of which about 290 were coloured. About 280 sets were distributed, either by sale by the Society directly, through sale by Longman or by gift. Most direct sales took place in May and June 1820 (35 and 14 copies respectively) and only 19 copies in remainder of that year. From 1821 to 1827, only 32 further copies were sold directly. Most copies are numbered, although an unnumbered batch of 36 copies was sold through Longman.

A second, revised, edition of the map was published by the Geological Society itself on 12 September 1840, the Society having declined Longman's terms for publication. Copies sold for four pounds to Fellows and for five pounds to the public. Some of the main changes in this edition resulted from the work of Murchison, Sedgwick and De la Beche in Wales, Devon and Cornwall. About 220 copies of this edition seem to have been produced, the printing and colouring mainly by John Arrowsmith and James Gardner.



Handwritten draft wording for the title of the 1865 3<sup>rd</sup> edition, adopted by Council in December 1864, signed by the Secretary, WWS, (Warrington Wilkinson Smyth). An earlier draft exists, in the hand of John Phillips - the main driving force behind the third edition. A further change was made at proof stage, adding 'of London' to 'Published by the Geological Society'.

Source: Geological Society Archives.

Photo credit: Duncan Hawley

Twenty years later, the minutes of the Society's Map Committee refer to a third edition of 1860, which was effectively the second edition but with revised Sheets 3 (Wales) and 5 (SW England), but another edition published on 1 August 1865 is generally regarded as the third edition of the map.

Revisions for this 1865 edition, which incorporated the work of the Geological Survey, began under the presidency of John Phillips, William Smith's nephew, and this issue is the first to acknowledge the work of Smith.

Further revision of the Society's map was considered in 1883, but Archibald Geikie, then Director of the Geological Survey, signalled the intention of the Survey to publish a map on a scale of four miles to the inch within three years, effectively bringing the Society's publication of the map of England and Wales to an end.

### **Tom Sharpe**

Tom Sharpe was formerly Curator of Palaeontology and Archives at the National Museum of Wales.

He is a past Chair of the Geological Curators' Group and HOGG (History of Geology Group) and a trustee of Lyme Regis Museum.

His latest book publications include a chapter in 'Strata: William Smith's Geological Maps' (Thames & Hudson) (Chapter IV Cartographer) and 'The Fossil Woman. A Life of Mary Anning' (Dovecote Press).

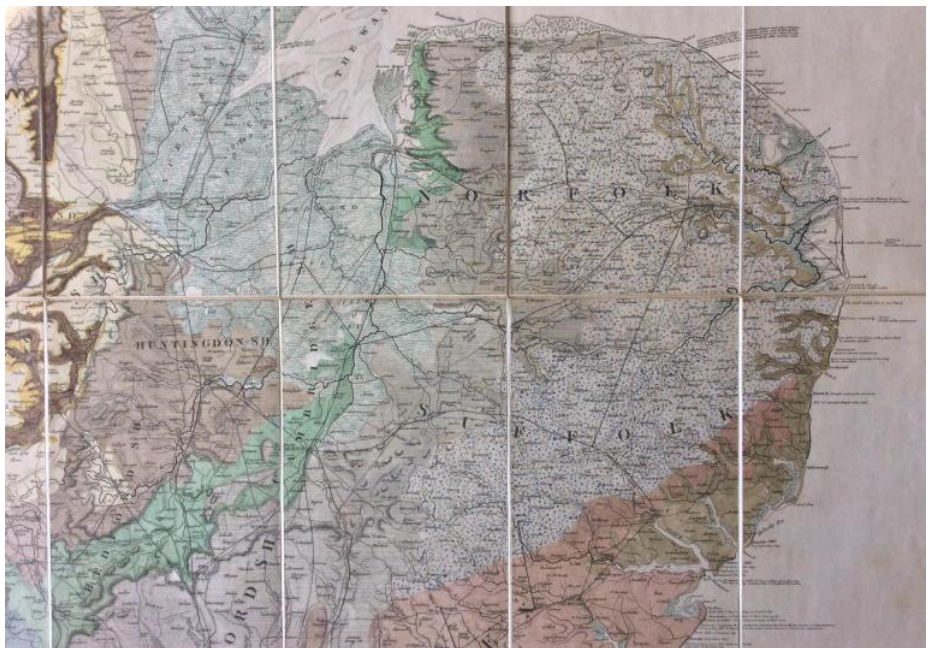


## George Bellas Greenough's Legacy as a Geological Map Designer

*Karen Severud Cook*

The geological map of England and Wales for which George Bellas Greenough is known appeared in three editions. In the first edition's *Memoir* (1820) Greenough discusses his map's geological content but barely mentions its symbolization. Map design first assumes a major role in the second edition's *Memoir* (1840), where several pages advocate using area colours and patterns "to make the tints of a geological map speak to the mind as well as to the eye" (p. viii-xi). The map's posthumous third edition (1865), revised by a Geological Society of London committee, appeared without a memoir, but its design features, some retained and others altered, are revealing indicators of George Bellas Greenough's design legacy.

Between the first and second editions of his map Greenough responded to criticisms of the readability of his map, proposals for developing uniform geological symbols, and the need to depict newly named geological systems. His archived papers record 75 information sources consulted while seeking ideas for better map design. He met, corresponded with, and read the publications of artists, colour scientists



East Anglia, part of (Sheet 4) displaying colouring from the second edition map (1840) coloured on a first edition topographic base.

Source: Duncan Hawley Collection

and manufacturers, and of fellow geologists and natural scientists. He combined the idea of matching map colours to mineralogy with concepts taken from art and colour science, such as juxtaposing harmonious and contrasting colours, reserving strong colours for small areas, and colouring groups of formation brightest in the center and duller outward. He also proposed varying the tone of hues by superimposing black line and dot patterns to differentiate related formations. He sought to incorporate these design improvements in his second edition but was hampered by his allegiance to associative colour, aversion to unit labels, and overly fine-textured black area patterns. However, study of the third edition reveals that some of Greenough's design ideas survived and were more successfully expressed by the committee responsible for it.

## **Karen Severed Cook**

Dr Karen Severed Cook is Librarian Emerita, University of Kansas.

Starting with an academic background in art history and geography (specializing in cartography and its history) Karen's PhD dissertation research was about the role of colour on lithographic maps in 19th-century geographical journals.

Thereafter, experience as a geological cartographer followed by employment as a curator in the British Library Map Library led to study the transition from hand to printed colour on 19th-century geological maps.

At the Spencer Library at the University of Kansas, she curated illustrated manuscripts and books, among which the colour-illustrated 18th- and 19th-century ornithological books have become a particular interest.

Karen retired from many years service as Special Collections Librarian in Spencer Library at the University of Kansas in December 2020, but retains and active interest in knowledge and research on geological cartography. She now lives in upstate New York in her hometown village located in at the foot of Otsego Lake in the lovely Appalachian foothills.



## **Greenough's influence on the colours employed on early Geological Survey maps**

*David G. Bate (British Geological Survey)*

Henry Thomas De la Beche (1796–1855), future founder and first Director of the British Geological Survey, was 24 years of age when Greenough's *Geological Map of England & Wales* appeared in May 1820. Elected to the Geological Society in 1817, he read his first paper, on the geology of part of the Devon and Dorset coast, in March 1819. This paper, accompanied by a geological map and coastal sections, was published in the Society's Transactions in 1822. The colouring of De la Beche's map and sections, and of others that were to follow, generally conforms with those employed on the Greenough map. Indeed, De la Beche is credited in the *Memoir* as being one of those who had assisted Greenough in the compilation of his map. These colours were largely chosen to match the prevalent tints of the rocks themselves, a practice recommended by Abraham Werner and advocated in Britain by Robert Jameson. William Smith, as stated in the Memoir that accompanies his 1815 map, likewise chose colours that 'are in some degree assimilated to the colour of each stratum, except the chalk, which, being colourless, seemed best represented by green'.

In May 1832, De la Beche secured a three-year grant of funding from the Board of Ordnance to add geological information to the eight sheets of the one-inch Ordnance map of Devon, an initiative that would lead in 1835 to the formal establishment of the Geological Survey. One condition of this grant was that the index of colours should be referred to the Council of the Geological Society for their approval. Greenough was then engaged in preparing a second edition of the *Geological Map*, but had not yet come to a firm decision on his final choice of colours. A small subcommittee was formed to consider the matter, which in addition to Greenough included Roderick Impey Murchison, President of the Society. A scheme of 16 formation colours was approved on 16 May 1832. Subsequently the agreed table of colours proved inadequate and had to be expanded and amended as fieldwork progressed.

De la Beche died in April 1855 and was succeeded as Director of the Geological Survey by Murchison. One of Murchison's first acts was to revise the scheme of colours employed on Survey maps. Thus: 'All rocks of igneous origin are now represented in various tints of the same bright red colour, and each great division [=System] of the sedimentary rocks has its own peculiar colour'. In the process, the colours of the Geological Survey map of Britain came to resemble more closely those employed by William Smith in 1815. Thus, the Cretaceous System is still today represented predominantly by shades of green, inspired no doubt by the Upper and Lower Greensands and by Smith's choice of green to represent the Chalk. Interestingly, by 1851 De la Beche had come to recognise the desirability of employing 'given colours to represent certain divisions of the geological series'.

1832



*Colours to be employed in Colouring Geologically  
Sheets 21, 22, 23, 24, 25, 26, and 27  
of the Ordnance Map of Great Britain,*

Alluvium		Tint of Van Dyke Brown	Red Marl Sand - stone & Conglomerate		Venetian Red
Bony Coal Deposit		Brown Pink	Grauwacke		Newman's Purple & Antwerp Blue
Chalk		Colourless	Red Grauwacke		Do dotted with Light Red
Green Sand		Emerald Green with Tint of Yellow Ochre	Altered Grauwacke		Do dotted with Green
Compound Great Oolite, Greenish to Blue or Earth inclusive -		Buman Yellow	Grauwacke or Trans <sup>n</sup> Limestone		Cobalt Blue
Inferior Oolite		Van Dyke Brown & Burnt Sienna	Argillaceous Slate or Millas		Roman Ochre & Antwerp Blue
Liass		Tint of Sepia	Micaceous Schist, Hornblende Schist &c.		Scarlet Lake striped with Purple
Traffean Rocks		Indian Yellow & Indigo	Granite		Scarlet Lake

*These Colours are copied from those deposited in this Office by H. De la Beche Esq<sup>r</sup> after they had received the sanction of the Council of the Geological Society of London on the 16 May 1832. They are the same as those at present adopted by G. B. Greenough Esq<sup>r</sup> for the 2<sup>nd</sup> Edition of his Geological Map of England & Wales, preparing for publication.*

*A. W. Noble Capt. R. E.  
22<sup>nd</sup> June 1832.*

*Ordnance Map Office, War.*

*L. R. I. Murchison Esq<sup>r</sup> P. G. I.*

*de — de — de*

Table of colours agreed between Henry De la Beche and the Council of the Geological Society for colouring the proposed one-inch to the mile geological maps of Devon, as approved 16 May 1832. These colours 'are the same as those at present adopted by G. B. Greenough Esqr for the 2nd Edition

## David G. Bate

David joined the Institute of Geological Sciences (now the British Geological Survey) in June 1971, as an Assistant Scientific Officer in the Library of the Geological Museum at South Kensington, London. His love of books, maps and archives led him to forget his original desire to pursue a career either as a mapping geologist or palaeontologist.

While working, he took his BSc in geology at University of London Birkbeck, and has ever since been trying to complete his mapping of the geology of the western closure of the Llŷn Syncline, NW Wales.



In 1980 he transferred to the Mineral Intelligence section of the Mineral Resources Division of IGS, and in 1985 was moved to Keyworth. He worked successively in the National Geoscience Data Centre (scientific enquiries desk), Mineral Statistics, Central Directorate Support, and International Division. The last-named position involved business development and documenting BGS's overseas experience in support of bid proposals.

His present position at BGS is Honorary Research Associate (keeper of overseas legacy) and self-appointed BGS historian. He joined HOGG in 2017.



## Manifestations of Greenough's 1820 geological map: a 'standard' for subsequent geological maps?

*Duncan Hawley*

The Geological Society's map of 1820, compiled and edited by George Bellas Greenough, inspired, influenced and was replicated in a variety of guises across a range of published geological maps in the 19th century, including maps beyond England and Wales. The most obvious manifestations are those where Greenough is acknowledged directly, as in the second and third editions, whilst for a number of others it is key aspects of a map's details that demonstrate origin in the 1820 map.

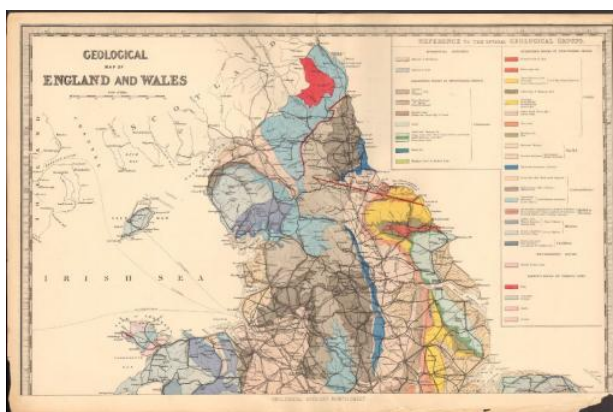
Analysis of colouring, classification of rock types/stratigraphic units, style (topographic base, labelling, annotation) and geological details help to identify the derivative maps and indicate the extent to which each of these owe their own lineage to Greenough's map, providing insight into how and why one or more of the features of Greenough's map was adopted. Using this approach it has been possible to identify at least fifteen derivative maps. This presentation attempts to evaluate the legacy of Greenough's 1820 map and to what extent it might be considered a 'standard' for subsequent geological maps.



1



2



3

Three manifestations of Greenough's 1820 map:

1. 1824 Carte Geologiques du Cornouilles
2. 1826 Map reduced by permission of the Geological Society
3. C. 1880 Geological Map of England and Wales in G.Bacon New Large Scale Ordnance Atlas of the British Isles

Source: Duncan Hawley Collection

## **George Bellas Greenough's *General Sketch of the Physical and Geological Features of British India* (1854, 1855): its production, distribution, variants and survivorship**

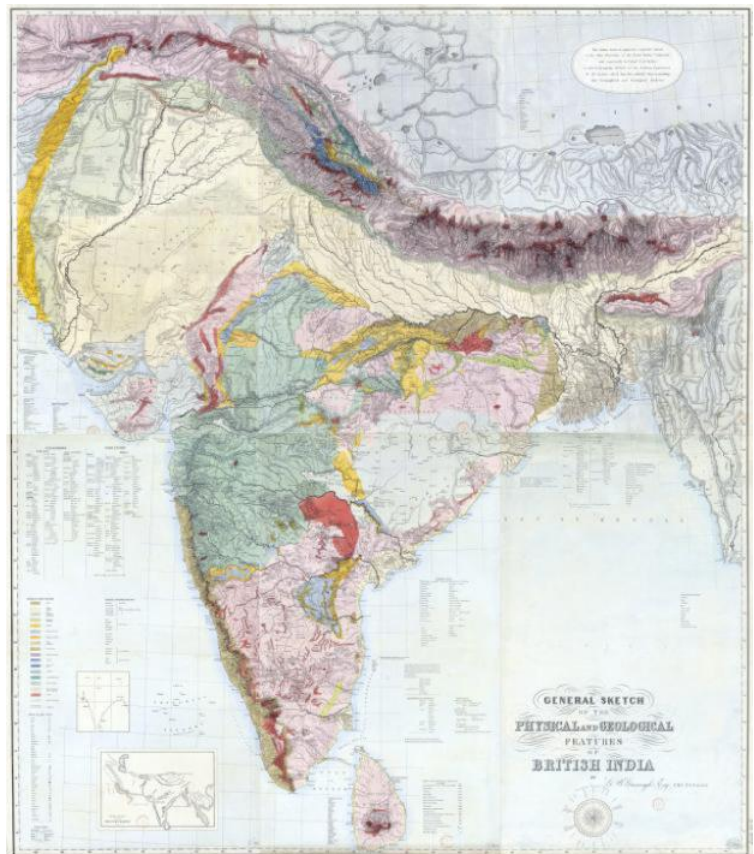
*Dr Christopher Toland*

George Bellas Greenough is, today, best remembered for his *Geological Map of England and Wales*, the first edition of which was dated November 1819 (but not actually issued until May 1820). What is less well known is that Greenough also published a large-scale geological map of the Indian sub-continent in 1854, this map being the major occupation and achievement of his later years.

Greenough's India map is a work of extraordinary compilation, undertaken over a period of 11 years, commencing in or about 1843 (i.e. shortly after publication of the 2<sup>nd</sup> edition of his *Geological Map of England and Wales*). It is significant in being the first detailed, and to this day the largest, geological map of the entire sub-continent.

The map depicts the main lithological divisions of the Indian rock record and captures many of the key elements of Indian geology including:

1. the five main Archaean cratons that make up the Indian Plate,
2. the surrounding Proterozoic mobile belts,
3. the main Mesozoic and Tertiary intercontinental rift systems,
4. a trans-continental megasuture,
5. the Deccan Trap province,
6. the Himalayan suture and foredeep



**Greenough's *General Sketch of the Physical and Geological Features of British India* (1854)**

Dimensions: 195x162cm

In this talk I will discuss the construction of Greenough's India map, its engraving and printing, data sources, and the (three) main variant map states. I will also outline its distribution and survivorship (of 200 copies produced, 24 complete and four incomplete surviving copies have been located in a recent survey), and reasons why an intended revised edition never appeared.

Greenough's India map was arguably a far more ambitious undertaking than his England and Wales map, and one of no less pioneering status. It deserves to be better known.

## **Christopher Toland**

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Chris is an internationally acknowledged geoscience consultant with over 30 years experience, specialising in carbonate sedimentology, sequence stratigraphy and cutting edge stratigraphic dating techniques. He is actively involved in carbonate research, and is particularly interested in the Jurassic of the Arabian Plate.



His other geological passion is the history of geology, and in particular collecting and researching the history of geological maps. His most widely acknowledged work is detailing of the popular mid-19<sup>th</sup> century geological maps produced by itinerant geologist J.A. Knipe (Earth Sciences History, 2013, co-authored with Hugh Torrens and Kevin Ryder).

