HISTORY
OF
GEOLOGY
GROUP

PROGRAMME

Thursday 23 April 2015

09:30	***Registration***		
10.10	John Henry	Welcome	Chair HOGG
		Keynote lecture	
10.15	Hugh Torrens	William Smith's search for a money-earning career.	Professor Emeritus, Keele University
11.15	***Comfort break***		
		William Smith's career	
11:30	Owen Green	William Smith's visits to East Anglia: the legacy of a sea defence and drainage engineer.	Department of Earth Sciences, University of Oxford.
12.00	Peter Riches	A breach too far? East Norfolk's place in Smith's search for success.	Independent Scholar
12.30	John Mather	William Smith, the principles of stratigraphy and their impact on the search for underground water supplies.	Independent Scholar
Lunch	***13.00-14.30***		
		William Smith's career cont.	
14.30	Richard Irving	William Smith and Combe Down: the story of a geologist and his 'cherished' home.	Kwansei Gakuin University, Japan
15.00	Cherry Lewis	David Mushet, John Farey and William Smith – geologising in the Forest of Dean.	Honorary Research Fellow, University of Bristol
15.45	***Tea Break***		
		Practical aspects of William Smith's maps	
16.15	Tom Sharpe	William Smith's 1815 map: its production, distribution and survival.	Lyme Regis Museum
16.45	Karen Cook	Cartographic innovation and tradition in William Smith's geological maps.	University of Kansas
17.15	John Henry	William Smith, the maps supporting his published maps.	Independent scholar
17.45	Exhibition in Upper Library		
18.00	***Wine Reception***		
19.00	***Dinner in Lower Library***		

Friday 24 April 2015

William Smith's contemporaries in Europe

09.30	Pierre Savaton	The first detailed geological maps of France	Associate Professor, Université de Caen, France
10:00	Ezio Vaccari	The 'practical' roots of stratigraphy and geological mapping in Italy during the early decades of the 19th century.	Professor, Università dell'Insubria, Italy
10.30	Peter Schimkat	William Smith's contemporaries in Europe: geological(?) maps in Germany 1778-1854	Independent Scholar, Germany
11:00	***Coffee Break***		

Revealing William Smith's Maps

11:30	Patrick Wyse Jackson	William Smith and Ireland: sources of Irish geological Information on his geological maps.	Associate Professor, Trinity College, Dublin
12.00	Martyn Pedley	New light on the 1824 William Smith Northumberland County map.	Professor Emeritus, University of Hull
12:30	Duncan Hawley	William Smith's error in South Wales.	Independent Scholar

Lunch 13:00 – 14:30

William Smith today

14:30	Kate Santry	William Smith online: the impact of re-curating the William Smith Archive.	Oxford University Museum of Natural History
15:00	Peter Wigley	William Smith: from Fuller's Earth to Google Earth.	Independent Scholar
15.30	***Tea Break***		

Keynote lecture

16.00	Simon Knell	William Smith: the coming of the Father.	Professor of Museum Studies, University of Leicester
17.00	Panel discussion		
17.30	**Close**		

ABSTRACTS
Day 1

William Smith's 1815 map: its production, distribution and survival

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William Smith's 1815 great map, *A Delineation of the Strata of England and Wales, with part of Scotland … ,* is rightly regarded as an icon of geology, its attractive colouring demonstrating Smith's clear understanding of the subsurface geology of much of southern Britain and bearing comparison with the modern '10-mile' maps of the British Geological Survey. As such, it is now highly collectible and much sought-after, with good copies commanding prices well in excess of £50,000. Despite this, its rarity has never been clearly defined; we know neither how many copies were originally produced, nor how many survive.

In September 1815, Smith indicated to his publisher, John Cary, that he envisaged a print run of 750 copies, despite having subscribers for only 414 copies as of 20 August 1815 when the subscription list, as published in Smith's *Memoir* accompanying the map, was apparently finalised.

The map itself carries in its title a publication date of 1st August 1815, but although copies had been produced early in 1815 for presentation to the Society of Arts and for demonstration to the Board of Agriculture, the first maps became available for distribution only in late September 1815 when Smith examined thirteen copies, and a further five copies a month later. At some point soon after this, Smith decided to begin numbering the maps as he received them from Cary. Between 2nd November 1815 and 23rd February 1816, Smith examined and numbered 246 maps in three numbered series (1 to 100, a1 to a100, b1 to b46), and at least a further 29 'b' series maps, probably later in 1816.

An examination of 27 copies of Smith's 1815 map by Joan and Victor Eyles in the 1930s recognised that, in addition to the three numbered series and the early unnumbered series, there was an additional unnumbered series of maps which, although postdating the last of the numbered maps, were likely to date from no later than January 1819. They also classified the five series of maps into four issues, based on changes to the geology shown on the map.

A recent survey of a larger sample of the 1815 map confirms the Eyles' recognition of five series and suggests a fifth issue, but also shows that, contrary to expectation, production of the late series of the map continued until at least 1836, the latest known being that which has been on display in the Geological Society's apartments in Burlington House since 1932. From 1 May 1820, Smith's great map faced competition from that edited by G.B. Greenough on behalf of the Geological Society, and in the early 1820s Smith's and Cary's focus seems to have been on the production of the county geological maps and on a reduced scale map, *A New Geological Map of England and Wales…* , so it seems surprising that *A Delineation of the Strata of England and Wales, with part of Scotland…* either continued in production or was reissued at some point.

The complexities of the geological colouring meant that production of Smith's great map was slow, and although Cary employed additional colourists to expedite the job, the quality of work of some of them did not meet with Smith's approval. Although he numbered the maps whose colouring he considered to be 'inferior', it appears that Smith did not lend his signature to them. The absence of any numbering or signature on the late issue maps raises the question of the extent of Smith's involvement in their production.

Cartographic Innovation and Tradition in William Smith's Geological Maps

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William Smith's innovative colouring of geological formations in different hues, each graded darker to indicate the base of the formation, has been generally accepted as his unique invention. Could Smith's treatment have been inspired in part by Abraham Gottlob Werner's recommendations for colouring rock types on geognostical maps, as published by Robert Jameson in the *Memoirs of the Wernerian Natural History Society* in 1811 (vol. 1, 149-161)? My suggestion is that the origins of this and other cartographic features of Smith's geological maps merit closer scrutiny.

Although he stands out as a pioneer of geological science, Smith and his publisher, John Cary, were also the beneficiaries of centuries of cartographic design, production, and publishing in Europe, as well as of more recent practices of depicting information about rocks and soils on maps. The first half of the nineteenth century was a period of great innovation in thematic symbolization on varied types of maps. It is important to understand how their work reflected these precedents and trends in order to fully appreciate the respects in which they departed from tradition.

The cartographic features of their joint map products are hidden in plain sight as it were, having become so customary that the modern viewer takes them for granted. I propose to place the Smith maps under the cartographic microscope, examining their various features and the techniques employed to create them. My discussion will place them in the context of the history of cartography by seeking to answer the following questions. What, if any, were their sources for doing this? To what extent was their treatment traditional or innovative? As well as evidence of independent invention, the adoption of new methods innovated by others and the innovative adaptation of traditional methods will be considered.

Cartographic features discussed here will include the base map, title cartouche, legend, profile views and cross sections, lettering and labels, and point, line, and area symbols. Production techniques considered will be copper engraving and associated intaglio printing techniques, as well as hand colouring using watercolours. The history of map publication in sheet versus atlas formats will also be considered.

Innovative aspects, such as the following, will receive particular attention. Findings about the representation of geological formations by area symbols, mentioned above, may question the accepted view. The significance of the use of the aquatint intaglio technique to indicate coal formations will be pointed out. Lastly, the question whether Smith's body of cartographic publications can be considered to be an early geological atlas, in spirit if not in fact, will be explored. Concluding comments will relate William Smith's achievements to patterns of innovation in nineteenth-century cartography.

William Smith, the maps supporting his published maps

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We are familiar with William Smith published maps, but how did he arrive at the finished product? Two aspects to this question are considered: the large scale mapping available to Smith for his field work and John Cary's fundamental contribution. Smith wrote that he realised very early on that it was vital to record on a large scale in order to draw accurately on a smaller scale map of the whole country. Smith worked before the advent of the highly accurate maps of the Ordnance Survey; yet, over 80% of England had one inch to the mile scale county mapping of variable quality by several independent surveyors and publishers. This paper looks at Smith's options. In 1812, John Cary offered to assist Smith in the realisation of his ambition to publish a map of the geology of the England and Wales. The early probable connections between John Cary and Smith and Cary's contribution to Smith's 1815 map and his continuing support afterward with the county geological maps and the 1820 map are explored.

William Smith Online: The impact of re-curating the William Smith Archive

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In March 2014, ahead of the bicentenary the Oxford University Museum of Natural History launched *William Smith Online*, an interactive online catalogue and website illustrating the William Smith archive held by the Museum.

The project saw the majority of the William Smith collection digitised and catalogued, to be made available online, including all of his maps, geological sections, diaries, correspondence and some of his personal papers. In spite of some technical hiccups in the launch of the project, the impact of its availability online and the production of an archival catalogue, which provides a hierarchical view of the collection, have opened the William Smith archive to a significantly wider audience than it has ever been accessible to.

The re-curation of Smith's collection is proving to have a significant impact on the research conducted on William Smith and his work. The breadth of his observations on topics, such as palaeontology and economic geology, are more apparent now that they have been included in the catalogue, and offer the potential for developing a more in-depth understanding of Smith's role in the development of geology as both an academic discipline and as an industry. Contributions beyond the geological importance of Smith's archive are also being recognised, including the influences of his professional work on the industrial revolution and social history more broadly, as well as the influence of the times on Smith himself, including his attempts at creating poetry with clear Romantic nuances.

The paper will include an in-depth comparison of the collection, both before and after re-curation, particularly focusing on the potential gaps in research which were caused by the lack of archival catalogue. It will also highlight some of the new research which has developed since the project's completion, and identify potential areas of the collection which may prove worthy of further study.

William Smith – From Fuller's Earth to Google Earth

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William Smith's geological mapping of England and Wales provided a remarkable geological legacy which is still relevant two hundred years after the publication of his map. Over the past decade the author has used modern digital cartographic techniques to view Smith's maps in the modern world.

Only limited numbers of projections were available for late 18th century and early 19th century maps; Smith's maps were compared against these projections and best-fits were obtained for those of Bonne and Cassini. Using these projections, together with georeferenced locations of towns and villages, Smith's maps (which used John Cary's bases) were converted into modern coordinates. This process allowed several contemporaneous examples of the maps to be compared with one another and also to be overlain on modern datasets including BGS geology and Google Earth. To students of William Smith's maps it is apparent that he had an incredible ability to visualize the geology and stratigraphy of the English countryside in three dimensions. By using digital elevation data it has been possible to drape his maps on an elevation model and to view them in 3D, possibly giving an impression of English geology and stratigraphy as originally seen and conceived by Smith. The culmination of these recent studies has been the establishment of a permanent website dedicated to the maps of William Smith.

William Smith (1769-1839)'s searches for a money-earning career.

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This lecture will concentrate on Smith's, highly complex, early 'career paths'. His first employment was as 1) a land surveyor. Then in 1793 he became both, 2) canal surveyor, and 3) engineer, to the Somerset Coal Canal (SCC). These had guaranteed him a regular, and known, income. But this suddenly changed, when he was successively dismissed, first as surveyor, then as engineer, in 1799. He now had to find some other means of supporting himself, and the geological revelations, which he knew were so important, that he had uncovered in Somerset. In the mid 1790s, he had done some 4) land drainage and irrigation work, for the chairman of the SCC, and immediately after his dismissals, was able to generate an adequate living from such work around Bath, during a period of very high rainfall. Some of this work took him to Tytherton in Wiltshire. Here he first encountered a new rock unit (the Kellaways Rock) and it was here that Thomas Coke of Norfolk was able to study Smith's skills with water. News of this competence quickly passed throughout an agricultural community, then desperate to increase food production, during a long period of wartime crisis. Smith's water drainage, and irrigation, work were now widely taken up, first by the Dukes of Manchester and Bedford, in Bedfordshire, and then by Coke and his relatives, both in Staffordshire and Norfolk, and then by Coke himself and his many tenants in Norfolk. On top of this, Smith's skills as an engineer meant he was in high demand also as 5) a Sea Breach Engineer, in attempts to keep the German Ocean (now the North Sea) out of The Broads. But war time conditions were harsh, and bills often not swiftly paid (or even paid at all). So Smith now tried new careers as 6) a consultant mineral surveyor, or 7) as a failed author, on both Irrigation, and on Norfolk. But throughout this period, Smith's obsessive attempts to publish his geological discoveries, or to find support for such a novel publication, were thwarted, by the bankruptcies of others, and proved to no avail. This lecture will try and survey, for a first time, Smith's complex, and fluctuating, financial situations, over the period 1793 to 1819 (when he entered a debtors prison). His 'knight in shining armour' is undoubtedly the cartographer John Cary (1755–1835) who, in 1812, at last agreed to publish his great 'geological' map. Thus was accomplished by "the enterprise of a private tradesman..., [what] had been in vain expected from princely patronage and the sanction of national boards".

William Smith and Combe Down: a Story of a Geologist and his 'Cherished' Home

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Tucking Mill, the 'cherished property' where William Smith lived when his geological survey was published in 1815, is today located in the village of Combe Down. Although 2015 marks a year for celebration of his map, and other achievements, associations with Combe Down tend to bring reminders of a time in his life when things went badly wrong. Smith held title to Tucking Mill from 1798 to 1819 - a third of his lifetime. Although he did not live there all those years the quarrymen and quarrywomen of Combe Down provided the inspiration for his ambitious attempt at 'stone manufacture', and Tucking Mill was the focal point of this dream. Inevitably this paper must describe the real story of his venture, and the reasons for its failure. It will seek a balance, however, with presentation of the very positive achievements made by Smith in his attempt to quarry, transport, shape, and ship Bath stone to London and the national market. The paper will argue that William Smith played a crucial role in making Bath stone accessible to the nation, taking forward the dream of Ralph Allen, and setting a course for the ultimate success of Combe Down quarrymaster and builder Philip Nowell to follow in the 1820s.

William Smith, the principles of stratigraphy, and their impact on the search for underground water supplies.

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In antiquity, groundwater was generally extracted from dug wells, the construction of which was an expensive and time consuming task. Boring technology was introduced from continental Europe by the 16th century, when the method used consisted of raising and lowering a chisel, suspended by a rope. By the 18th century, iron or wooden rods had replaced the rope and a variety of augers and chisels were used. 1723 saw wells in the London Clay deepened to 85 m, into underlying sands, using an auger, and later in the century methods used in Flanders were publicised in England by the French industrial spy Le Turc and equipment manufactured in London. Thus technology was available by the end of the 18th century but exploration for potable water was hampered by archaic ideas on the origin of groundwater. Although shallow wells were considered to be sustained by rain and snow melt, many still believed that the origin of groundwater deeper beneath the surface was the sea and that, by some process of distillation and subsequent condensation in the bowels of the earth, water could be filtered and transferred by passages and cavities to sustain the flow of deep wells and boreholes. Thus boreholes were drilled to find these underground waterways through which water flowed and the layers of sand and limestone into which it had spread on its passage from the sea.

It was John Farey, William Smith's pupil, writing in 1807, who pointed out that Smith's as yet unpublished work showed that every stratum, which is penetrated in sinking a well, forms an extended inclined plane which, at some distance from the well, crops out at the surface. The porous strata are recharged at their outcrops with water which then percolates down dip. He used as an example the deep wells beneath London, where the thick stratum of sand supplying wells north of the River Thames could be traced to their outcrop some 15 miles away. Thus knowledge of the stratification could be used to predict the likelihood of finding water at a particular place, the depth at which it might be found and the expense likely to be involved. The search for underground water supplies was immediately given a scientific framework and no longer relied on seeking bodies of water fed by hypothetical streams originating from the sea.

Smith applied his stratigraphic principles in his own practice, advising on groundwater supplies in towns and villages such as Newton Longville (Buckinghamshire), Swindon (Wiltshire), Bath (Somerset) and Scarborough (Yorkshire). The latter study, published in 1827, has been quoted by historians as one of the early applications of geology to the solution of hydrologic problems. However, his description of a method for supplementing Scarborough's summer water supply, is of minor importance in comparison to the enormous benefits which led from the application of his work on stratigraphy. In 1877, his successor Joseph Lucas, who in 1874 first used the term hydrogeology in its modern context, commenting on those qualified to undertake hydrogeological work, noted that "William Smith knew more than any geologist who has followed him". In contrast in the modern world, where the hydrogeological contributions of the engineers Henry Darcy and Oscar Meinzer are justly celebrated, the seminal contributions of William Smith and his pupils are largely forgotten.

A breach too far? East Norfolk's place in Smith's search for success.

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At the end of the Eighteenth Century many Norfolk landowners were seeking to implement enclosures and improve the agricultural productivity of their land. It was in this climate of agricultural revolution that Thomas Coke of Holkham, a celebrated agricultural reformer, brought William Smith to Norfolk in 1801 to implement water meadows on his estate. Smith was much in demand by landowners across the county as a result of Coke's patronage, private recommendation and public praise. He spent much of his time between 1803 and 1809 working on marsh drainage and the repair of sandbanks that protected the east Norfolk marshland from North Sea encroachment.

Two issues will be examined using material from the archives in: the Norwich Record Office, the Oxford Museum of Natural History and contemporary newspaper reports.

The first topic to be covered will be Smith's involvement with and influence on landowners, Inclosure Commissioners and the Commission for Sewers (informally termed 'Sea Breaches') who initiated and funded his work on sea bank repair. Smith's work, his reports and responsibilities will be discussed in relation to the procedures and politics of the Commission for Sewers. His responsibilities included: the design of the sea bank repairs and the technical and contractual management of this work. Smith also determined the criteria used for the assignment of rates levied on landowners to cover the cost of the sea bank repairs.

The second area of this talk will be an evaluation of how successful his work was in the prevention of further flooding of the marshes. This section which will include an outline of the structure of Smith's design for his sea bank repairs. Smith's nephew, Phillips and others have eulogized about his success in the prevention of further flooding of these marshes. Detailed study of the records call into question both the accuracy of Phillip's description of Smith's work in *Memoirs of William Smith* and the extent of his achievement in preventing further flooding. Despite claiming to have solved the flooding problem in 1805, Smith continued to work on Sea Bank repairs until 1809. Smith's design for the slope of the banks facing the sea was a valuable innovation in mitigating, but not preventing, the erosion of the sea banks. However, his design for the internal structure of the banks was not perpetuated in later repairs.

During the nineteenth century, there was progressive erosion of the east Norfolk coast and some sea banks migrated landwards. The records of the sea breaching the sand banks and flooding the marshes indicate that such occurrences are infrequent extreme events related to the state of the tides and weather rather than the quality of Smith's engineering. However, Smith's high reputation and his sea breach repairs undoubtedly gave landowners sufficient confidence to proceed with enclosure and marsh drainage in order to create productive and valuable land.

William Smith's visits to East Anglia: the legacy of a sea defence and drainage engineer

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William Smith is known to have been a frequent visitor to East Anglia during the first two decades of the nineteenth century. His visits provided an opportunity to extend his geological knowledge of surface and sub-surface features. His field observations formed the basis of his geological sections (published in 1807), the large scale map of England (1815) and the County map series (Norfolk January 1819, Suffolk September 1819, Essex February 1820, and Huntingdonshire in 1822) covering East Anglia. Fossils collected from the Chalk and Crag deposits of East Anglia were illustrated by Smith in *Strata Identified by Organized Fossils* (1816), and then catalogued and listed systematically in *A Stratigraphical System of Organised Fossils* (1817).

Opportunities for employment within the area helped finance his explorations, commencing in 1800 when he was contracted by Thomas Coke (First Earl of Leicester and Holkham, seventh creation) of Holkham Hall, the British politician and agricultural reformer, to assist in land drainage. The following year he visited the Duke of Bedford at Woburn to offer advice on the drainage of his estate. Smith returned to Norfolk in 1802, and was a frequent resident of Norwich until 1807. During this time he wascommissioned as a civil engineer to repair the sea defences along the east Norfolk coast where flooding and the encroachment of the German Ocean (North Sea) was a common occurrence during the eighteenth and early nineteenth centuries. His careful observations of the composition and modification of natural dunes during the seasons was fundamental in influencing Smith on the construction of natural sea defences, abandoning the established practice of clay banks reinforced with stone and timber.

Smith's initial simple plan was ridiculed and almost rejected, until he pointed out how ineffectual solid constructions had been. The sea-defences between Winterton and Happisburgh were completed during 1805, resulting "in the expulsion of the sea from 74 parishes in Norfolk and 16 parishes in Suffolk" and fulfilled "The Norfolk and Suffolk Sea Breach Act" of 1610 passed under James I. Further down the coast at the Minsmere Levels, south of Dunwich in Suffolk Smith was initially consulted in 1808, and eventually reported in 1812, recommending the construction of a new sluice. Work commenced in May of that year with the construction of mills for pumping the water into the adjacent rivers. His novel methods of sea-defence engineering complemented those of nature.

A further legacy is from his unpublished manuscript (circa 1807) on *Norfolk, its soil and substrata* which provides a rare insight into early nineteenth century life into the county whose principal city (Norwich) was slowly going into decline as the manufacturing industries associated with the industrial revolution centred on London, the midlands and the north of the country.

Day 2

The 'practical' roots of stratigraphy and geological mapping in Italy during the early decades of the 19th century

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Towards the end of the 18th century the heritage of mineral investigations in the Italian northern regions, well represented by the work of Giovanni Arduino (1714-1795), also allowed the development of mineralogical, lithological and early stratigraphical original research in the field. The awareness of the complexities of a new science based on the analytical study of rocks, strata and their content was therefore increased and enriched, besides the personal investigations of individual scientists, by the possibilities offered by the statistical mining investigations promoted in the early 19th century by technical state bodies such as the Council of Mines of the Napoleonic Kingdom of Italy (*Regno Italico*), established in 1808 in Milan and modelled on the French Corps des Mines. Some of the best geologists and mineralogists of the early decades of the 19th century, mainly from Lombardy and Veneto - Ermenegildo Pini (1739-1825), Carlo Amoretti (1741-1816), Giambattista Brocchi (1772-1826), Giovanni Maironi da Ponte (1748-1833), Giuseppe Marzari Pencati (1779-1836) and others - were employed and trained as officials in the Council of Mines, which remained active until 1816. The geological research of these scientists was thus stimulated and facilitated by the practical activities of the institution. These were focused on a 'statistical' investigation of the territory (which included a first concept of geological survey) in order to add to the knowledge about the mineral resources and also determined various attempts at producing a litho-mineralogical map on a regional scale. Memoirs and accounts of travels to the various Departments of the Italian Kingdom were also drafted. The new geologists were in fact able to utilize the need to organize the particular data collected in the mineralogical and mining fields to add new wedges to the great mosaic of reconstruction of the geological history of the terrains which were ever vaster and ever more correlated among themselves. Although in the first half of the 19th century only occasional references to the work of William Smith may be found in the writings of Italian scientists (in particular academic geologists interested in the study of fossils within strata and formations), it is still very little known the possible knowledge of Smith's works about surveying and mapping within the 'practical' milieu of mining and geological surveyors who contributed to the development of early stratigraphical researches in Italy.

The first detailed geological maps of France : between individual plans and national plan

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When Smith's map was published in 1815, France had only the geognostical map of Paris of Georges Cuvier and Alexandre Brongniart published in 1811. But, if it marked the beginning of modern French geological cartography, by its break with mineralogical type of map of Guettard and its introduction to a new stratigraphical dimension, it remained limited to a small surface of France. Sketch map of Basin of Paris, at 1:1 800 000, published in 1816 by Omalius d'Halloy in the Annales des mines, suffered the same limits. France at the end of 1810 didn't have whole geognostical map of its territory.
In 1811, Brochant de Villiers presented a first project aiming to establish a geological map of France to the Count of Laumond, general manager of the French mines, but the project was dropped. It was just after the reception of Greenough' map in 1820, that Becquey, general manager of the Department of

Civil Engineering and Mining, decided to support the map making project of Brochant de Villiers and set him in charge to do it. This project was particularly ambitious both intellectually and materially. Expressed in a few ground lines, a whole program of geological map-making of the French territory was launched. It consisted in a two sections plan: at first to carry out a general geological map of the French territory and then to be followed by a detailed geological map-making of the eighty three French administrative divisions, called "départements". Two other mining engineers Armand Dufrénoy and Léonce Elie de Beaumont were appointed to help Brochant. In the beginning of 1823, the three men traveled to England to become acquainted with the English Jurassic and Cretaceous formations and to get in contact with Smith and Greenough. The English example was a great source of inspiration regarding the outstanding work done on secondary formations. The French territory was mapped during five campaigns lasting from 1825 to 1829 and the first geologic observations were published as soon as 1827 in the Annales des Mines. The drawing of the map was completed in 1835, but it was finally published only in 1841. Detailed geological maps were supposed to be drawn after the general map was issued as it was meant to be some kind of large triangulation to which each local geologic map could later be joined. But, this second part of the original project did not have to wait until after the general canvas was established, to be started. The first geologic maps of French "counties" (départements) were surveyed in parallel to the project carried by the general management of the mines by scientists better known on a local level rather than on a national plan and with very strong local settings.
These geological maps published from 1820s are the first geological French maps after those of Guettard, Cuvier and Brongniart. Their studies allow us to discuss of the emergence of a geological cartography of details in France and, to discuss their intellectual origins and links with the previous French maps or the maps of Smith and Greenough.

Contemporary Geological Mapping in Germany

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The talk will emphasize and visualize the difference between doing geology in Britain and Germany, by means of focusing on what (from a transnational perspective) are characteristic features of influential German maps from a certain time period, probably between 1778 and 1854.

New Light on the 1824 William Smith Northumberland County Map

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Smith's geological map of Northumberland was part of the sixth issue of his county map series published in 1824. The map represents a considerable improvement on Smith's original 1815 geological map of England and Wales in that it marks 'trap' outcrops including parts of the Great Whin Sill and the Cheviots igneous complex. It also subdivides the Carboniferous strata and indicates mineralisation within the Carboniferous Limestone.

Significantly, however, neither the 1815 map nor the 1824 Northumberland County map record inland outcrops of the Whin Sill between the Roman Wall near Hexham and the coastal outcrops east of Belford and at Dunstanburgh. This is unexpected as the 1820 (second edition) of Smith's map of England and Wales shows inland continuations of the Whin Sill outcrops between those areas, this information probably being obtained by Smith from Winch (1816) according to Eyles and Eyles (1938). There is, however, established evidence that much of the Northumberland map had been compiled by Smith's young nephew and field assistant John Phillips.

New light on the development of the Northumberland map comes from a manuscript geological map of Northumberland, in an unknown hand, which was drawn onto a previously mounted and folded Cary Northumberland map dated January 1st 1821. This shows an interim version of the 1824 Northumberland geology which is complete in central and eastern areas but lacks details of the Coal Measures 'containing inferior seams of coal' in the west and north. Significantly, the locations of the geology missing on the 1821 map conform closely to Phillip's field mapping route of 1821 which is outlined in Phillips (1836; 1844). There are also differences in the coastal limestone outcrop patterns in the vicinity of Belford and Holy Island on the 1824 published map. This map was to become the first geological map containing a significant contribution by Phillips.
Evidence derived from the 1821 manuscript map suggests that it may be an accurate copy of an unknown earlier Smith manuscript map. It was drawn up between January and September 1821, possibly to provide Phillips with a reliable guide while traversing Northumbrian field lines later that year.
1. The new find of an 1821 manuscript map confirms that Phillips rather than Smith compiled the published version of the 1824 Northumberland County map which was close to completion by late 1821.
2. Phillips route during his 1821 field visit did not traverse the inland outcrops of the Great Whin Sill, consequently, they are absent on the published 1824 Northumberland map.
3. The omissions of inland Whin Sill outcrops on the manuscript map suggest that Smith did not proof read this map although geological text captions on the 1821 manuscript map have been modified and extended on the published 1824 map.

William Smith's error in South Wales

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The geological map produced by William Smith has often been remarked upon as a notably close match to the modern-day geological map of England and Wales – a fact made even more remarkable by it being the first to be attempted at this scale and detail. However, it is also acknowledged that areas in the far west of England and in Wales are the least accurate regions on his map. More particularly, Smith made a significant error in charting the strata of South Wales, which was sustained in subsequent editions of his map. Smith is known to have traversed across South Wales on at least two occasions to undertake substantial coastal surveying and improvement works at Laugharne and Kidwelly in 1803 and 1811. However, he misjudged the geology in the Vale of Glamorgan and on Gower, mistaking 'Derbyshire Limestone' (Carboniferous, Dinantian Limestone), for 'Magnesian Limestone' (Permian, Zechstein Group, Dolomitised Limestone) and failed to observe, note or gain intelligence on the presence of 'Red Marl, Millstone and Brecciated Limestone', (Triassic, Mercia Mudstone Group) and 'Blue and White Lias Limestones' (Triassic/Jurassic, Lias Group) – a particularly surprising error or omission as these strata are readily exposed on the South Glamorgan coast. Finally, Smith marked the junction between the 'Derbyshire Limestone' and the 'Magnesian Limestone' strata in the Vale of Glamorgan as an abrupt abutment of one against the other, with apparent disregard for or understanding of the relationship between the two strata.

An analysis and field examination of exposures that Smith might have encountered, or very similar locations to those he likely observed on his visits or travels through the district together with a consideration of contemporary studies, sources and accounts of the character and distribution of strata and soils in the region enable a discussion of how and why Smith made such a misinterpretation and throws light on his working methods and understanding. The study also suggests how Smith made possible compromises, in South Wales and elsewhere in England, in order to ensure his map was published in 1815, albeit not accurately completed to his full satisfaction.

William Smith and Ireland: sources of Irish geological information on his geological maps
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William Smith visited Dublin in 1835 when he was conferred with a doctoral degree by the University of Dublin (Trinity College). Subsequently his nephew and geological protégé John Phillips was appointed by this institution to the Chair of Geology in 1843. William Smith's 1815 geological map shows the eastern-margin of Ireland, but it is devoid of geological information. The scaled-down version published in 1820 provides a rudimentary representation of Irish geology with the granite regions of the Mourne and Wicklow Mountains prominent. This presentation will discuss the state of Irish geology and geological cartography in the first two decades of the 1820s and will attempt to determine the sources of the Irish geological information that Smith utilized for his geological map of 1820.

William Smith, family man
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A series of 51 personal letters written by William Smith to his niece Anne Phillips (1803- 1862) and to his nephew, the geologist John Phillips (1800-1874) between 15 January 1819 and 12 August 1839 – just a few days before Smith's death – shed light on the personal side of Smith's domestic and scientific life. The letters are preserved in the archive at the Oxford University of Museum of Natural History (OUMNH), one of the most extensive archives of Smith material in the world. This archive is now being made available on-line at: www.williamsmithonline.com .

In the letters, Smith – a part time farmer – delights in the success of his livestock and vegetable garden, discusses his frustration at the lack of recognition of his own achievements and, in a vivid letter to Anne, describes his absolute joy and excitement on receiving the first Wollaston medal. He also expresses his great pleasure at the progress of John's career, discusses his constant financial difficulties, touches on scientific, political and family gossip, drops hints about his life with the mysterious Mrs Smith, and speculates on complicated schemes to claim both recognition and financial recompense for his work. But above all, these letters reveal the close and loving relationship he maintained with his niece and nephew until his death.

John Farey (1766-1826) Pioneer geologist and an advocate of Smithian methods.
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John Farey (1766-1826) was one of the pioneering geologists of the early nineteenth century. He spent ten years working as a Land Surveyor on the 5th Duke of Bedford's estates at Woburn. During this time he developed his skills in land surveying, evaluation of soils and underlying rocks. Much of his early work involved land drainage and it was during this period that he first came across William Smith. Smith and Farey met in 1801 where Smith explained his principles of stratigraphic succession.

In 1806 Farey gave Smith's rules as he understood them 'for identifying each particular stratum, either by the knowledge of its relative position with other known strata in its vicinity, by the peculiar recognised remains imbedded in it, and not found in the adjoining strata, or by the peculiar nature and properties of the matter composing the strata itself.

Farey also laid down rules for the scientific collection and curation of specimens that would enhance their value to furthering the understanding of geology. The advice he laid down in 1815 and 1817 still stands as sound today as when it was written. Many a curator and field geologist in our modern time has failed to follow the basic collection rules he laid down based upon Smith's ideas, much to the detriment of modern collections and their scientific value.

Utilising Smithian principles Farey exhibited a drawing of the geology of Derbyshire in 1808 at the 2nd meeting of the Geological society. This was a precursor to his monumental *General View of Agriculture and Minerals of Derbyshire* published in 1811. This is arguably the first British geological memoir of significant stature!

Farey became a strong exponent of Smith's methods and used the *Philosophical Magazine* as a vehicle for the defence of Smith and an explanation of his method. There was friction between the practical men and the gentlemen geologists of the newly formed Geological society, as a consequence Farey became known as Smith's 'terrier' as he reacted against what he referred to as the society's 'Anti-Smithian Association'. Perhaps his defence of Smith was too vehement for his own good as he was regarded as being rather meddlesome and may go some way to explain why the practical men of geology were treated in a sceptical manner by Greenough and his gentlemen mineralogists. Was this an expression of social status, or a Geological Society battle for intellectual territory?

David Mushet, John Farey and William Smith – geologising in the Forest of Dean

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A recently discovered hand drawn and coloured geological cross-section of the Forest of Dean has proved to be the work of the ironmaster David Mushet (1772-1847). Probably created in 1811-12, he gave a copy to the Geological Society in 1815, and it was reproduced by Buckland and Conybeare in their paper *On the South-western Coal District of England* (*Transactions*, 1824).

Famous for his assaying experiments with iron, in 1801 Mushet identified the 'Black-band Ironstone' as an excellent iron ore which revolutionised the Scottish iron industry. Having established its stratigraphic position as being in the Upper Carboniferous, Mushet further demonstrated his knowledge of geology by leasing large tracts of land where he knew the ore could be readily accessed. Such was his knowledge of geology that in January 1808 he was one of the 42 gentlemen invited to become an Honorary Member of the newly-formed Geological Society.

While working as manager of the Alfreton Iron Works in Derbyshire (1805-1810), Mushet met William Smith's pupil, John Farey (1766-1826). Mushet performed many assays for Farey's work on the *Agriculture and Minerals of Derbyshire* (1811), and it seems likely that Farey introduced Mushet to William Smith's principles of geology during this period. In 1808 Mushet was approached by a London stockbroker, Thomas Halford, who required Mushet's advice regarding the Whitecliff Iron Works that Halford owned in the Forest of Dean. Halford was keen for Mushet to bring his superior smelting techniques to the works, so early in 1810 Mushet moved with his family to Coleford.

In October that year Farey visited 'his able friend' in the Forest and they spent two days together examining the Dean's geology. Mushet had already compiled a stratigraphic column of the area, a copy of which he gave to Farey, eventually presenting a fair copy to the Geological Society in 1812.

Meanwhile in London Halford frequently consulted William Smith regarding his various investments, and in December 1811 Smith spent a week in the Forest of Dean evaluating Halford's collieries. Here he met Mushet who gave him a copy of his stratigraphic column of the Forest's coalfield. Halford owned the Bixslade colliery which he was anxious to sell in order to recoup some of his very considerable investment in the Whitecliff Iron Works which had proved disastrous, and he charged Smith with finding a buyer. Mushet's remarkable

geological cross-section traverses the main Forest of Dean coal basin in an east-west direction. It features the Bixslade mine and was probably compiled as a prospectus for potential buyers being approached by Smith, thus it is highly likely that Smith also owned a copy.
This paper will explore how, during the first decade of the 19th century, William Smith's ideas about geology spread 'virus-like' through the geological community, due largely to the efforts of his 'bulldog', John Farey. But just how much was this a two-way process, with individuals such as Mushet also enlightening Smith and Farey?

William Smith: the coming of the father

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Almost immediately upon leaving debtor' prison in 1819, everything for William Smith changed. Escaping to the North, to Yorkshire, the last twenty years of his life were a period of approbation. Far from being a tragic figure, this 'happy farmer', as John Phillips once described him, now set about converting aspiring communities across the north of England to Smithian geology. With the help of Phillips, his young, sociable and eloquent nephew and ward, Smith would reveal in the field and in public lectures a concealed geological logic and pattern that local audiences had failed to observe. Composed of men hoping for fame and for social elevation, these audiences were converted over night. Smith and Phillips were a sensation. Understanding that Smith's reputation was his greatest inheritance, Phillips would in 1829 prove the unrivalled power of his uncle's ideas. These ideas had already began to seep into more resistant minds in London, where a group of self-appointed gentlemen were thought to be inventing English geology. Eventually, Smith would be admitted into this world as a political pawn, not just in the internal politics of the Geological Society but also as a defence against the encroachments of the French. From 1815, chauvinistic commentators had warned against French appropriation of British discoveries. One discovery that seemed rather muddled in the late 1810s, concerned that claim by Smith. It was challenged by earlier British work and by those who believed Smith's geology as actually French. In the last decade of his life, Smith's life became historicised, a history shaped into a national myth by Adam Sedgwick, who sought to make Smith the inventor and mascot of English Geology. Smith became immortalised as the Father of English Geology. In time, however, this notion would be misunderstood by historians who had come to think of the very notion of scientific parentage as ridiculous. But in their attempts to adopt greater historiographic rigour, they failed to observe that 'English Geology' did not refer to the national practice of this science but to something quite particular. 'English Geology' described what we might understand today as fossil-based stratigraphy, though even this is a reductive notion; Smith's method was not limited to the use of characteristic fossils. A more precise definition is: English Geology = Smith's Geology. When geologists referred to English Geology in the 1830s and beyond they were applying this term in this narrow sense. By definition, then, if we understand the term correctly, Smith was and is the Father of English Geology.

Posters

William Smith and the Trans-Wealden Extension of the Upper Ouse Navigation
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East Sussex Records Office holds an historic document of considerable significance to the History of Geology: a large-scale, meticulous survey of the proposed Trans-Wealden extension of the Upper Ouse Navigation, undertaken in summer 1810. It is recorded in volume 87 (2003) of the Sussex Record Society, with 'Surveyor not stated': it is believed that William Smith supervised the surveying of this project.
During the opening decade of the 19th century William Smith had to earn his living as a freelance, itinerant Surveyor. Upon the death of the previous Surveyor of the Upper Ouse Navigation, reputable and experienced William Smith was appointed, in May 1808, to the position on a retainer basis, and visited Sussex regularly over the next 4 years. One of his early duties was to prepare plans to link the Upper Ouse Navigation with Sir John Rennie's grandiose Grand Southern Canal, from the Medway to the Arun.
Although William Smith explicitly wrote, in a 1839 Letter to John Phillips, that he 'took the levels for a line to connect this [Rennie's Canal] with the Ouse navigation up the Balcombe Valley, by a tunnel through the forest ridge, and spent some time unprofitably in preparing a plan of it, which was deposited with the Clerk of the Peace at Lewes', (which is confirmed on the document itself), it would appear, from his correspondence of the time, that he only masterminded the surveying and later verified the details and draughtmanship of the Plan before submission. William Smith was, nevertheless, responsible for this legal document.
This 1810 Survey lists riparian landowners along the 22 miles of the proposed canal, which would have needed 18 locks, a long tunnel and an extensive watershed reservoir. The route is marked on a modern version of contemporary maps for 1813-19.
William Smith relinquished his role as Surveyor in April 1812, just when John Cary, accomplished mapmaker, indicated his willingness to proceed with Smith's grand project.

William Smith Collections of Fossils and Rocks at The Natural History Museum, London
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It is not widely known that William Smith's collections of more than 1600 fossils and 107 rock samples now resides in the collections of the former Department of Palaeontology, recently incorporated into the new Department of Earth Sciences, at the Natural History Museum, London. The Collections were acquired by the Museum (then part of the British Museum) between 1816 and 1818 when Smith sold them to help pay off his debts. Unlike most of the NHM collections, which are stored taxonomically, the William Smith Collections, as with a number of other historically important collections, are kept intact, under the collector's name. Smith's fossils are stored stratigraphically, according to his 'Order of Strata'. One particular aspect of interest is Smith's Cataloguing System. He marked many of his fossils in black ink with a code of Roman capitals for genera, followed by numbers for species, and then by lower case letters for localities. Hugh Torrens has suggested to me that Smith's System, devised with the help of his nephew John Phillips, was the first to use a numbering system that signified scientific attributes of the specimens.

15 Buckingham Street and its Environs in William Smith's time

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This poster is being prepared for the reception following the unveiling of the green plaque memorialising the location of the house that was William Smith's London base and home for 15 years. The original building was demolished c.1906.

William Smith leased 15 Buckingham Street from 1804 to 1819. He had lodged nearby frequently in the previous year and so knew the neighbourhood well. Buckingham Street was on the west edge of the area then known as the Adelphi. It was a smart residential and professional neighbourhood recently developed by the Adams brothers and occupied by engineers, surveyors, draftsmen, printers, cartographers and map sellers. It was between and within a short walk of the City and Whitehall. No.15 overlooked the river at York Watergate where boatmen waited to ferry clients along and across the river. It is where his nephew John Phillips joined him aged 15. Smith chose the location for its professional support, proximity to clients and its prestigious address. Following Smith's bankruptcy and the termination of his lease, the subsequent lessee of 15 Buckingham Street was the nascent Institution of Civil Engineers taking up its first official home.

Smith lived here before the advent of railways, and the construction of the Embankment Gardens, Charing Cross Bridge and station and Trafalgar Square. However, apart from the modern building presently at no. 15, the immediate neighbourhood – the rest of Buckingham Street, the steps down to the narrow terrace and the watergate remain very much as they were in Smith's time.

With reproductions of a contemporary street plan, and paintings, sketches and photographs, this poster will show the location of supporting professions and images of the riverside environs and the exterior and interior of the house that was William Smith's base and home for 15 critical years.