Elias Hall, pioneer mineral surveyor and geologist in the Midlands and Lancashire

Hugh S. Torrens and Trevor D. Ford

Abstract: Elias Hall (1764-1853) was a pioneer Midlands and Lancashire geologist. Two significant influences allowed this man of humble origins to make original contributions to geology. The first was the arrival in Derbyshire in 1807 of John Farey, William Smith's most important pupil, who opened local eyes to the realities of Smith's stratigraphy. The second was the later establishment of the British Association for the Advancement of Science, with which Hall was involved from its beginning in 1831. But attitudes to the low historical importance of practical geology have since meant that Hall's work has been too long forgotten.

A gravestone, erected in 1861, in the southeast corner of Castleton churchyard bears homage to Elias Hall (Fig. 1). It was erected seven years after Hall's death, under the leadership of Edward William Binney (1812-1881), a Manchester solicitor and geologist who regarded Elias Hall as *the father of Lancashire geology* (Binney, 1862). Binney, who had arrived in Manchester in July 1835, had a social conscience, and took a great interest in the many working men's societies then active in Lancashire (Binney, 1912), to which he was first taken by Hall's fellow artisan fossil collecting friend and collaborator, the Chartist, Francis Looney. Binney felt that *both Hall and his labours had been forgotten in Castleton* (1862, p. 95). Hall's 1834 map included a small part of northwest Derbyshire, and followed the work of Whitehurst (1778, 1786), Farey (1811-1817) and Watson (1811).

Hall evidently had a devoted following, particularly in Lancashire, yet later he became little known among historians of geology. His map of the Lancashire coalfield was rather later than the county series compiled by William Smith (1769-1839), but never completed for financial reasons. Smith's county maps did not include Lancashire, but Hall adopted his methods, having been introduced to them by Smith's pupil Farey, and he produced models, then sections, and finally maps of the Lancashire coalfield and surrounding areas, of which only few copies survive. Hall's coalfield map was the first geological map of a large part of Lancashire.

Elias Hall's family history

Elias was the third child of Abraham (1728-1803) and Martha Hall (1739-1769 - née Royse), daughter of Daniel and Hannah Royse, one of the many Royses involved in the lead mining industry around Castleton. Abraham was described as a yeoman, so he had a small estate and was middle class; his father was another Elias, born in Hope in 1691 and died in Castleton in 1749. Abraham and Mary were married there, by licence, on 4 September 1759. The International Genealogical Index wrongly renders her maiden name as Rose. Elias' elder sisters were Nancy (baptised 12/7/1760) and Hannah (6/1/1762), and his younger brothers were Joseph (23/9/1766) and Micah (15/1/1769). Elias Hall was born in Castleton on 6th January 1764; he was baptised the next day.

In Memory of Elias Hall, the geologist, who died on the 30th day of December 1853 aged 89 years. Born of parents in humble life and having a large family to provide for, yet he devoted himself to the study of geology for 70 years with powers of originality and industry rarely surpassed. To mark the last resting place of one who had worked so long and so hard for the public, a few of his friends and admirers living at a distance have placed this stone.

***Figure 1**. The inscription on Elias Hall's gravestone.*

***Figure 2**. Elias Hall, in his later years.*

A different paternity, and thereby a false relationship between Elias Hall and other contemporary Derbyshire mineralogists, was wrongly recorded by Maxwell

Craven (1996). Those he named were John Mawe (1766-1829) and a (John) Tatlow Tissington (born 1757). This was in fact, John (Tissington) Tatlow (1757-1824), whose son Anthony Tissington Tatlow (1789-1828) married Mawe's daughter in 1815. All this also confused Cooper (2006), who rightly pointed out the historical problem of exactly which Hall had guided the French geologist Barthelemy Faujas de St Fond (1741-1819) around Castleton and Peak Cavern in 1784; St Fond consistently called him *J. Hall... who gains a subsistence by conducting strangers into the cave* (Geikie, 1907). Later writers (Binney, 1862; Andrews, 1880; Croston, 1889) repeatedly claimed this had been Elias, who would then have been aged only 20. This may be what is now called an urban myth, created by Binney years after Elias had died.

The problem is that many Hall families then lived in Castleton and elsewhere in Derbyshire. Possibly all might be distantly related: the parish registers list nearly 200 Halls buried in Castleton churchyard alone. A Joseph Hall of Castleton had supplied Blue John fluorspar to Richard Brown & Sons marble works in Derby from around 1769; clearly this was not Elias's son, who was born, and died in the same month, in 1789, so any connection with Elias is unknown. Joseph Hall and family ran both Peak Cavern and the Peveril Museum in Castleton (thought to be the last house on the right going up Peak Cavern walk), but it is not known if Elias was then involved. Among the other Hall families in Castleton was Robert Hall, who was also described as a mineral surveyor and *as the first practical geologist of the Peak* about 1770 (Adam 1843, p. 363). An Ellis Hall, mineral surveyor, was later listed in both Glover's and Pigot's Lancashire Directories of 1828-9, and this variant of the name is found in the Castleton parish records as a son of Thomas Hall and Ann, born there October 1764. Elias Hall was baptised earlier in that same year.

Elias Hall

An engraving of Elias Hall in old age (Fig. 2) is dated February 1866, and was produced four years after Hall's gravestone had been erected, as a result of Binney's re-evaluation of Hall's importance. It is now in the Tilley collection at Derby Local Studies Library.

Elias Hall, then of St Michael's Parish, Derby, married Martha Holmes at St Werburgh's Church in Derby, on 21st June 1787 (Derbyshire Record Office) although her background remains unknown. Elias and Martha had twelve children (Fig. 3). Epitaphs to Esther and her daughter Harriet were added to Elias's gravestone c.1883. Three of these children (including Joseph and both Abrahams) died in infancy. Elias last appeared in Derby Directories in 1787, and must have moved back to Castleton thereafter (Cooper, 2006).

Martha, 10/1/1788; Joseph, 6/12/1789; John, 13/9/1791; Abraham, 20/8/1793; Abraham, 1/12/1794; Ann, 19/10/1797; Mary, 21/4/1800; Elias, 22/5/1802; Hannah, 31/8/1804; Esther, 2/9/1804; Harriet, 16/10/1806; Catherine, 18/3/1805.

***Figure 3**. The children of Elias and Martha Hall (after Robert Rainford, based on an 1826 sampler made by Elias' daughter Esther, now in the family in Canada).*

Elias Hall's marriage record noted he was then a "Petrifaction Worker" in Derby. Later he was variously recorded as fossilist, mineralist, mineral collector, geologist or mineral surveyor in Castleton. His home there was a cottage in Cross Street next to the Nags Head (Shawcross, 1903), later much altered and now the Greystones shop.

Nothing is known of Elias Hall's education, though he is referred to in obituaries as self-educated. His schooling appears to have been above the standard for the time, but his spelling was highly idiosyncratic. The first indication of any interest in what was later called geology may be when Elias Hall's name is found written against the 3 February 1800 diary entry of White Watson (1760-1835) of Bakewell (Meeke, 1996). That they were already in contact is demonstrated by Watson's cash book (Meeke, 1997) which recorded dealings with "Elias Hall, Castleton stone dealer" from 29 July 1796. Watson was a petrifactionist and marble worker, who took a great interest in geology (Torrens, 2002).

From August 1807, the London polymath John Farey (1766-1826), who had become William Smith's most significant pupil from 1802, had been commissioned to undertake two projects in Derbyshire. The first, from late summer 1807, was for Sir John Sinclair (1754-1835), President of the Board of Agriculture, who commissioned Farey to undertake an extensive survey of the agriculture and minerals of Derbyshire (Farey, 1811-1817). The other was a private commission from the President of the Royal Society, Sir Joseph Banks (1743-1820), who owned an extensive estate at Overton, near Ashover, whose minerals he wanted surveyed by Farey; the map and report were not published (Torrens, 2002). Farey's work changed the views of both Watson and Hall as to the significance, and economic potential, of the serious study of stratigraphy in Derbyshire.

From 1808, Hall helped John Farey by showing him round the Castleton area while Farey was compiling his three volume work on the Minerals and Agriculture of Derbyshire for the Board of Agriculture (Farey, 1811-1817). The first printed notice of Hall's geological work appeared in July 1809 in Tilloch's Philosophical Magazine, volume 34, no. 135. This was clearly inserted at John Farey's suggestion, who was then a prolific contributor to that journal. It reads: *Elias Hall, opposite the Inn, at Castleton, Derbyshire, Manufacturer of Ornaments of every description, in Fluors and other Spars, (usually called Petrifactions,) in Gypsum, Marble, etc, takes this opportunity of informing his Friends and the Public, particularly such as are travelling the High Peak of Derbyshire, with a view to the Geological and Scientific Information which that interesting and astonishing District is calculated to afford, that he has a large Collection of Specimens*

of Native Fossils [minerals]*, Minerals and Toadstone Strata constantly on Sale; as well of the Rocks, Spars, and Metallic Ores, as of the interesting organic Remains* [fossils] *of the Animal Kingdom peculiar to these Strata: which Specimens being collected by himself, he will be able to point out to Collectors, the local and relative Situation of each in the Stratification of the District.*

"Opposite the Inn" may refer to the Castle Hotel, and the opposing property later became Needham's Museum and spar shop. Hall's family connection with the Inn here is confirmed by Farey (1813) who listed his relative *Isaac Hall of the Inn, Castleton* as another who had given him information. This notice shows that Hall still continued here as a maker of Derbyshire Ornaments. The notice then continues: *By a reference to a model of the County of Derby, which Elias Hall has executed, by Permission, agreeably to the Mineralogical Map which Mr John Farey of London is executing of the whole County of Derby, he hopes to be able to explain fully to the Scientific Gentlemen or Ladies, who may do him the Honour to inspect his Factory and Collections, or take him out with them, in addition to the ordinary Guides, in their Excursions in the Neighbourhood, the Nature and Relations of every Particular worthy of Observation, respecting the Rocks, Caverns, Mines, Stratification, Dislocation of the Strata and extraneous Fossils of the District, according to the most recent Discoveries on the Subject; which, from their Importance and Novelty, cannot fail of giving much Satisfaction to the Curious. N.B. Orders for Ornaments punctually executed, Wholesale or Retail, and Ornaments restored, cleaned etc.*

The close connection between John Farey and Elias Hall is again revealed in Hall's first manuscript letter known to have survived. This letter (in the Bagshaw Collection at Sheffield Public Library, ref. Bag. C 587 69) is dated Castleton, 16 September 1810. In it Hall asked a Mr Birds for help with a series of mainly mineralogical questions which Farey had recently asked. Hall's letter ends *these are all or part requested by Mr John Farey, the remainder of his requests are in my Neighbourhood*. Mr Bird or Birds was another of Farey's contacts in Derbyshire, whom he recorded (1811) as *Thomas Bird, Mine owner and lead smelter of Eyam, near Stoney Middleton, Mineral Collector*.

This was the antiquarian Thomas Birds Esq. (1752?-1829), who had been a great collector of books, prints, paintings and china. These were auctioned after his death when his *Cabinets of valuable and rare Fossils* were to be sold separately. It was noted how his *well known and truly valuable Collection of FOSSILS is on sale by Private Contract, and consists of from fifteen thousand to twenty thousand specimens, chiefly English, has been one hundred years in collecting, and contains some of the finest and rarest specimens in the kingdom* (Liverpool Mercury, 24 July 1829). The word *Fossils* is here clearly still being used in its old sense; i.e. anything dug up, both minerals and fossils. Sadly the fate of this obviously extraordinary collection is unknown. It is possible that it passed into the collection of his collateral descendant James Adey Birds (1831-1894) who later died in Bournemouth (Anon., 1895). This collection was bequeathed to Derby Museum, where it is little recognised (Stanley, 1976).

Elias Hall's Models

Several of Hall's later publications carry notes or advertisements of models he had made to illustrate geology. The first notice of this had appeared in 1809. Farey (1813) wrote: *Elias Hall, Fossilist and Petrifaction-worker of Castleton, who, after revising my Mineral Observations with great labour, on all the great Limestone Tract north of Winster, and in some of the adjoining Shale and Grit Tracts, has completed several exact Models of this District, which exhibit the face of the Country, the Stratification, Mineral Veins, Faults etc in a very natural and perfect manner; some of which Models, in return for the kind services of this ingenious and deserving Individual, I have undertaken to show at my [London] House; or they may be seen at Castleton, together with a series of the several Minerals of this curious District. Adequate encouragement to Mr. Hall, in the disposal of these Models and his Fossils might perhaps induce him to examine the southern half of the Limestone District, with equal industry and care, and to include the same in one or in a separate Model*.

A reprint of the original flyer Farey produced to advertise Hall's models, which gave full details, appeared in March 1813 in Nicholson's Journal (Anon., 1813a). This recorded that Hall's first model, carved from wood, had been made under the patronage of both the Duke of Devonshire and Sir Joseph Banks. It noted how Hall had followed the same colouring Farey was using in his Surveys and listed those of the 11 lowest strata of the rocks depicted, of which samples were arranged on the east side of the model. This notice ended that Hall had made his own examination of this area, and had then compared it with Farey's report and manuscript maps. It ended that Hall sold labelled collections of the mineral productions of the Peak Hundreds, and that Farey from *a desire to promote mineral science and to serve Mr. Hall* kept some of Hall's models at his London home for inspection and sale at eight guineas each. Summaries were also inserted by Farey in other journals (Anon., 1813b, 1813c), and confirmed that Elias Hall had: *carved out a Model of [Derbyshire's] curious and rugged surface. The superficial scale is one inch and a quarter to the mile*.

These notices immediately attracted the former President of the Geological Society of London, George Greenough (1778-1855). Farey sent him his flyers on 9 March 1813: *If you will take such methods of distributing the Bills of Mr Hall's Models sent herewith, at the Geological Society or otherwise, as are most likely to serve Mr. Hall, it will greatly oblige me* (Greenough Archive, University College London). Farey soon

noted, as his annotation to Greenough's copy of Joseph Townsend's book "The Character of Moses", how: *Mr Elias Hall discovered in the beginning of 1813 that the great fault bears ye course here mentioned at Lindale and near ----- and wet rake veins, as shown in his models, and that it is an inferior fault that proceeds through Bradwell and Great Hucklow and which turns along Hucklow Vein East and thence to Eyam and Stoney Middleton*.

Hall was soon also in contact with Banks, to whom he reported how he had, in the spring of 1814, extended his survey northwards, with a new *Model of the Strata of the Grand Ridge and the adjacent county east and west of it, almost as far as Westmorland* (Farey, 1814).

But Greenough was soon involved in a vicious dispute over whether or not his Geological Society should publish some of Farey's extraordinarily detailed geological work in Derbyshire. It did not, and so remains largely lost. So, in June 1816, Farey could now write: *I am sorry to add, that the very meritorious exertions of my friend Mr. Elias Hall have met just a similar fate* [as I]*, through the same Party; - no sooner was one of his Models shown, before several of its Leaders, than without waiting to examine a single particular of its laborious details, advantage was taken, of an injudicious use of rather too glaring colours, in Mr. Hall's first attempt, to raise a laugh, by the far-fetched and contemptible joke, that "a tray of Guts and Garbage in a Fishmonger's or Poulterer's Shop", rather than any thing else was called to the mind, by viewing this elaborate Model of the Stratified Hills and Dales, of a tract of Country! Such was the conduct of the Heads of a Geognostic Society* [i.e. the Geological Society of London, which Farey was later to name The Anti-Smithian Association]*, and such the reward of meritorious labours, out of its pale; and my Friend remains, and is likely to do, a considerable loser by what he has done* (Farey, 1817, v. 3, p. viii).

Joseph Banks was much more sympathetic towards such detailed stratigraphic work, because of the financial advantages it gave local land owners like himself. This connection also explains why the British Museum's curator of minerals, Charles Koenig (1774-1851), when he took a month's vacation in Derbyshire, in 1819, visited Hall in Castleton. There he ordered *two of Hall's models of the topography of Derbyshire and Cumberland (probably for his planned exhibit of British minerals arranged by counties)* (Smith, 1969, p. 255). Koenig's diary confirms that *on 24 September 1819 he paid into Farey's hand £11.3.0 for Elias Hall* for these. Sadly they too seem not to have survived.

Another geologist who was intrigued by Hall's models was the former Lunar Society member Jonathan Stokes (1754-1831) of Chesterfield (Torrens, 2010). On 20 March 1821 he wrote to Nathaniel John Winch (1768-1838) how a friend had *sent me a coloured geological map of the Lakes constructed from a model made by Mr Hall of Castleton, who I learn from Nicholson's Journal has extended his model of Derbyshire to the Lakes* (Linnean Society, Winch Archive 4:112). This must be from a later model that had extended Hall's work north to the Lakes. Hall's 1824 published section has a note in the margin which confirms that he had *constructed and Sells at Castleton, Models of the Strata of the High Peak, and others of the Mountains, Northward to the Lake District of Cumberland*.

The obituary notice by Binney recorded that *Elias Hall, fossilist and petrifactioneer, has completed several exact models of this [Peak] district which exhibit the face of the country, the stratification, mineral veins, faults etc*. Binney also noted *a model of the neighbourhood of Manchester, then housed in the Museum of the Natural History Society in Peter St.*, Manchester (Binney, 1862, p. 93-94). A model of the Lake District was also mentioned.

Models were also mentioned in the later appreciations of Hall's life's work by Croston (1868), Cash (1873), Wood (1987) and Cooper (2006). Appeals for information on Hall's models have failed to uncover any survivals (Torrens & Ford, 1977). A comparable model, attributed to F.A. Carrington 1848, was said to be in the Manchester Museum (the late Michael Eagar, pers. comm. 1977), but he then wondered if it had been confused with one of Elias Hall's. Again it could not be found after a recent enquiry. So, regrettably none of Hall's models have been located, though it is still possible that some languish in museum storerooms unsigned or unrecognized.

Without being able to examine Hall's models one can only speculate on what they might have shown. A reasonable guess is that they were block models with the strata painted on as with his later sections and maps. The first were certainly carved from wood, while later ones might have been cast in plaster. The latter would be more likely if multiple examples were to be available for sale: wooden models would have had to have been individually carved and painted. A boxed set of 26 wooden models of Farey's fault types (out of 56 illustrated by Farey in 1811) survives in the Geological Society's Library (Dearman & Turner, 1983) but it is not known either who made them, or when. They are made from various coloured wood sheets glued together. The Geological Society acknowledged Greenough's presidential donation of this *series of Farey's models* in 1841, but as Farey had died fifteen years earlier, it is possible these had been made earlier by Hall.

Elias Hall's Sections

Hall published several long geological sections, copies of which have survived. The earliest was *A Vertical Section of the Strata, published as the Act directs January 1 1824 by Wm. Phillips, Lombard St., London*. Phillips had previously been the Geological Society's Quaker printer and publisher, despite making a considerable loss. In 1824 he published an appeal for more philanthropy (Torrens, 2009) and this suggests

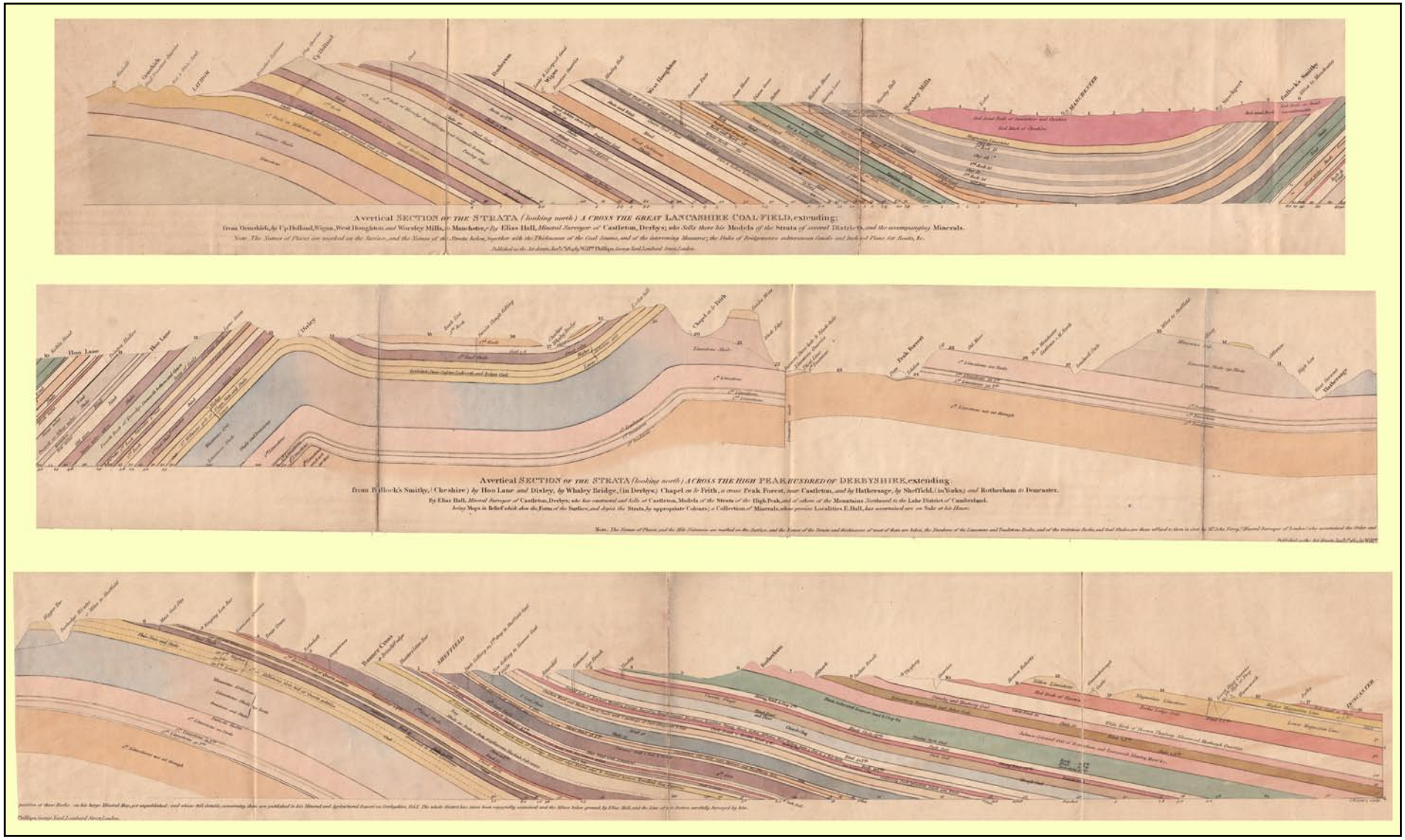


Figure 4. *Elias Hall's geological section across the Pennines, in its first state (edition).*

a likely reason why he then published Hall's section. It was by Elias Hall, now calling himself a mineral surveyor, following Farey's lead (Torrens, 2001).

The first notice of this section, in the Monthly Magazine of 1 July 1823 (p. 551), read: *Elias Hall, of Castleton, who in 1813 distinguished himself by preparing numerous stratigraphical models or maps in relief ... has since modelled the contour and strata of the grand ridge of hills, extending from Derbyshire to the lake hills of Cumberland. [He] has now in the hands of Mr. Lowry, the engraver, two vertical Sections of the Strata. The thicknesses of the several coal-seams and thicknesses of measures (of rock, shale etc) between them will be set down*. This shows that Hall's 1824 section was almost the last work produced by the most famous scientific engraver of his day, Whitehaven-born Wilson Lowry (1760-1824). He had long been interested in geology and been elected an early member of the Geological Society of London in 1808 and to the Royal Society in 1812. He was a close friend of both William Smith and John Farey, the last of whom must have organised this collaboration. Its publication was noticed after Lowry had died (Anon., 1824).

The section (Fig. 4) has two captions. The first shows the strata *across the Great Lancashire Coalfield* from Ormskirk through Manchester. The second shows those across *the High Peak of Derbyshire* from Bullock's Smithy through Chapel-en-le-Frith, Hathersage and Sheffield to Doncaster. It records that: *The names of the Strata and thicknesses of most of them are below. The numbers of the* [succession of four] *Limestone and* [three] *Toadstone Rocks, and of the Gritstone Rocks, and Coal Shales, are those affixed to them in 1808 by Mr. John Farey... who ascertained the Order and Position of these Rocks, on his large Mineral Map, yet unpublished. The whole District has since been repeatedly examined and the Mines below ground, by Elias Hall, and the Line of this Section carefully surveyed by him*. It clearly shows that Hall understood the stratigraphy and structure of the South Pennines and adjacent coalfields. The Duke of Bridgwater's underground canal to his coal mines at Worsley was shown. Manchester is in a syncline of Red Marls and Sandstone. A single fault (vertical) is shown at the contact of Limestone and Limestone Shale (Edale Shales) at Barmoor Clough and Doveholes, north of Buxton, where the contact is now regarded as an unconformity.

The section is known in two forms: one is a folded linen-backed strip 2 metres long by 13 cm high, made up of the segments glued together, in an original slip case with a printed red paper label; the other is an uncoloured sheet, 80 by 63 cm, with the three sectors of the strip one above the other. A partly comparable section was included along the southern margin of Hall's 1834 map of the Lancashire Coalfield. Chris Toland of Cheltenham has two versions; one is as above, but a later one has both brighter colours and additional engraved details.

A second group of sections (Fig. 5) is on a sheet entitled *A Geological Section exhibiting the Strata across the Coalfield of Lancashire, extending from Manchester ... to Clithero* by *Elias Hall, Mineral Surveyor. Castleton, Derbyshire and No. 20 Ridgefield, Manchester*. Dated 1831, this sheet measures 58 by 45 cm and was printed with colours and a scatter of figures added by hand. The sheet has three partly parallel sections with considerable detail of the sequence of coal-bearing strata with thicknesses in the collieries and their depths superimposed. The top section has Gypsiferous Marls capping the succession at Manchester. The middle section shows undulating Coal Measures and a single fault close to Oldham, labelled Red Tom Nook. The third section from near Rawtenstall to Clitheroe shows a synclinal arrangement with the Calder River and Padiham in the core. Some detail of the Millstone Grit sequence is shown, with Pendle Shale (broadly equivalent to the Bowland and Edale Shales) at the base, and the Carboniferous Limestone of Skipton and Clitheroe at the extreme right with Clitheroe Castle on the top. Curiously, a small sketch of Peveril Castle and Peak Cavern at Castleton has been drawn within the Carboniferous Limestone below Clitheroe Castle.

A later section, from after 1834 and still unlocated, was compiled *from the Irish Sea to the German Ocean* [North Sea] (Binney, 1862; Anon., 1900). This could have been an extended version of that from Ormskirk to Doncaster. Finally an undated, hand-coloured *Section of the Strata of the Earth extending from Conisbro, Rotherham, Sheffield in Yorkshire, Hathersage, Castleton, Peak forest, Buxton in Derbyshire to Macclesfield in Cheshire by Elias Hall of Castleton* survives in the William Smith collection at Oxford. An annotation by Smith concerns his Pontefract Rock, which was later called the Magnesian Limestone, and which he had first shown on his wonderful County Map of Yorkshire of 1821 (Phillips, 1844), which may help date this section.

Elias Hall's 1834 Lancashire Map

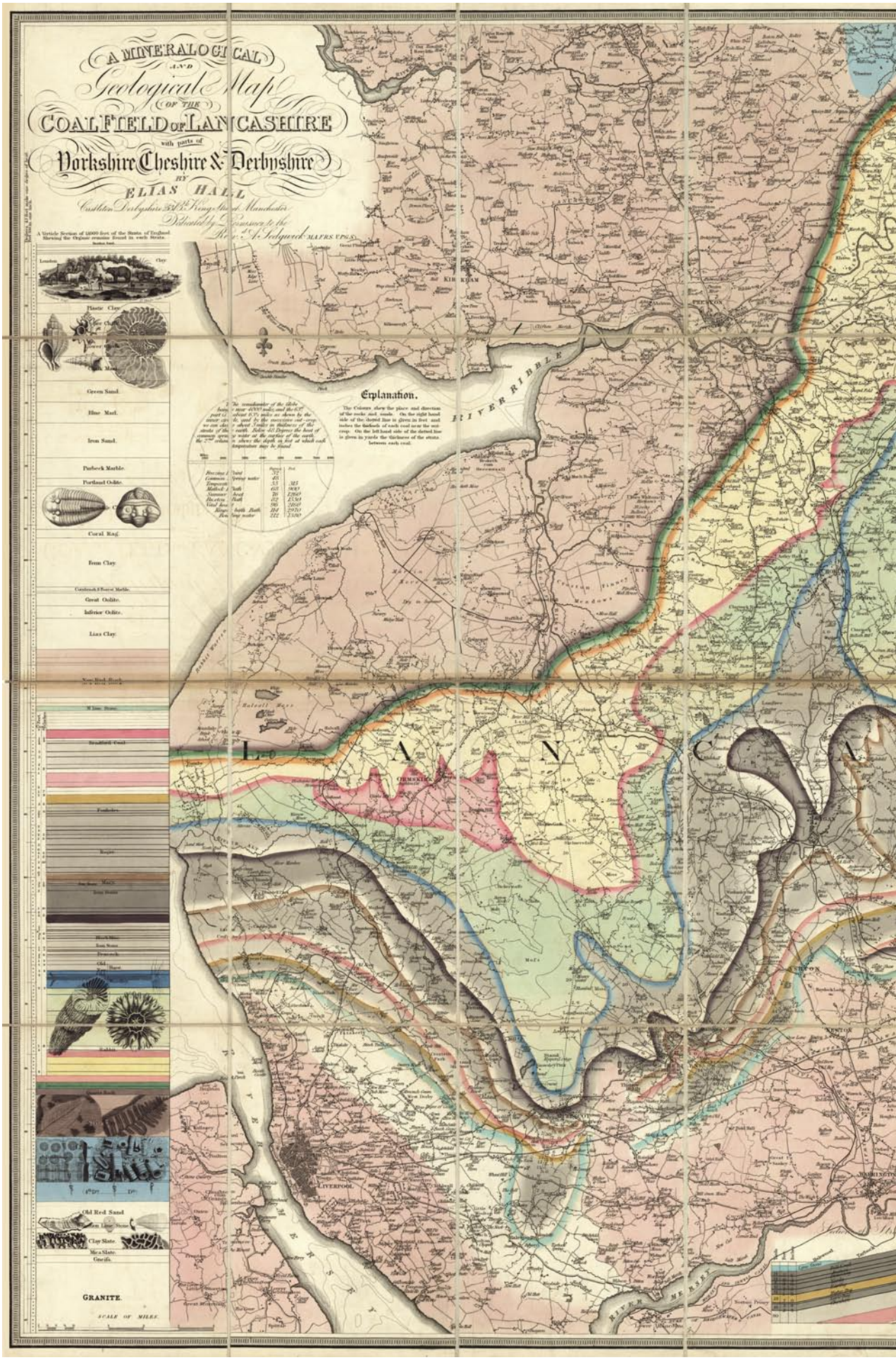
At some stage between 1824 and 1831, Elias Hall became involved in the coal-mining industry in Lancashire, and maintained an office in Manchester (at 20 Ridgefield in 1831; 53 Back King St. in 1834).

The best known of Hall's maps is his 1834 map of the Lancashire coalfield (Fig. 6). It is undated but is dedicated to Adam Sedgwick when he was Vice President of the Geological Society of London. The British Library dates it 1830; Whitaker & Tiddeman (1875) say 1831; while the Natural History Museum Catalogue and the Museum of Practical Geology Library Catalogue both give 1832. But copies of the Prospectus dated September 1833 survive in the Durham Record Office and at the Linnean Society, London (Fig. 7).

A letter to Greenough dated 11 January 1834 survives in the Greenough archive (University College London) from Richard Potter (1799-1886). It notes:

Figure 5. *Elias Hall's geological sections through the Lancashire coalfield.*

(next pages) Figure 6. *Elias Hall's 1834 geological map of Lancashire.*


A MINERALOGICAL AND Geological Map OF THE COALFIELD OF LANCASHIRE with parts of Yorkshire Cheshire & Derbyshire
BY ELIAS HALL
Castleton Derbyshire & 12 King Street Manchester
Dedicated by Permission to the Rev. A. Sedgwick MA FRS VPGS
Explanation.
The Colours shew the place and direction of the rocks and coals. On the right hand side of the dotted line is given in feet and inches the thickness of each coal near the outcrop. On the left hand side of the dotted line is given in yards the thickness of the strata between each coal.
London Clay
Plastic Clay
Green Sand.
Blue Marl.
Iron Sand.
Purbeck Marble.
Portland Oolite.
Coral Rag.
Firm Clay.
Great Oolite.
Inferior Oolite.
Lias Clay.
Old Red Sand
Clay Slate.
Mica Slate.
Gneiss.
GRANITE.
SCALE OF MILES.
LANCASHIRE
LIVERPOOL
RIVER RIBBLE
RIVER MERSEY


BLACKBURN
HASLINGDEN
ROCHDALE
MIDDLETON
ALTRINCHAM
S H I R E
C H E S H
YORKSHIRE
DERBYSHIRE
from Tarbock to Lathom the Coal in Feet & Inches below the base line the other Strata in Yards above the base line
Whiston
Railroad
Hall
Rock
PRESCOT
Stand
Rainford
Quartz Rock
Bickerstaff
Lathom Hall
Leeds Canal
Millstone grit
Slate Clay
Limestone

Adam Sedgwick (1785-1873), Cambridge professor of geology.
William Buckland (1784-1856), Oxford professor of geology.
George Greenough (1778-1855), Geological Society founder.
Philip Egerton (1806-1881), fossil collector, landed gentleman.
John Dalton (1766-1844), Manchester chemist.
William Henry (1774-1836), Manchester chemist.
William Smith (1769-1939), stratigrapher.
G W Wood (1781-1843), merchant, MP for South Lancashire.
Mark Phillips (1800-1873), merchant, MP for Manchester.
Thomas Gisborne (1794-1852), MP for North Derbyshire.
Christopher Rawson (1777-1849), landed gentleman, president of the Halifax Literary and Philosophical Society.
Edward Holme (1770-1847), Manchester physician/scientist.
John Phillips (1800-1874), geologist and Smith's nephew.

***Figure 7**. A list (perhaps incomplete) of subscribers to the 1833 Prospectus.*

the Bearer Mr Hall is now about setting off to London to get printed and coloured his geological map of the coal-field of South Lancashire and I avail myself of the kind permission you gave me when we met last in Cambridge [at the BAAS meeting in June 1833] to introduce him to you. So it is clear that Hall's map was published after January 1834.

The map was referred to as "yet unpublished" on the lower margin of Hall's 1824 section. There are at least three different editions (known as *states*) of the map. Greenough (1835) announced the publication of this first state at the Geological Society AGM on 20 February 1835, as of: *a county hitherto comparatively neglected. Mr. Hall is entitled to great praise for his intrepidity and perseverance; had he not possessed these qualities in an eminent degree, he never would have entered, as it were alone and single-handed, on so irksome and laborious an investigation. That the work is in many respects imperfect must be admitted, but considering the apparent disproportion of his means to his end, it is surprising that the author should have achieved so much: what he has left incomplete or inaccurate will be readily supplied*.

The engraver was George Bradshaw, St Mary's Gate, Manchester, but who the printer was and how many copies were printed are unknown, and only a few are known to exist in libraries and other collections. The map was on a scale of 1 inch to 1 mile and measures 120 by 90 cm. It was printed in black ink and hand-coloured in the style of William Smith's 1815 map of England and Wales, with dense colours marking the lower outcrops (bassets) of the coal seams and other units, and with the colour then fading down dip.

A verticle (sic) column of 15,000 feet of the strata then known (with names taken largely from Smith and Farey) is on the left-hand margin with units ranging from the Bagshot Sand [Eocene] down to the Old Red Sandstone [Devonian] and Transition Limestone [Silurian], with Mica Slate, Gneiss and Granite beneath. The sequence of coals is fairly accurate, but there are minimal details of the Millstone Grit and Carboniferous Limestone. Some sketches of typical fossils were superimposed in the column. The London Clay has a sketch of an elephant, horse, rhinoceros, giraffe and two humans, which are now assigned to the then unrecognised Quaternary. In the first edition, some fossils were engraved in wrong places. The first has a misplaced engraving of the Silurian *Calymene* trilobite in the Kimmeridge Clay. The second edition corrected this, added Highgate Sands to the Bagshot Beds unit, and added many place names to the still misspelt *Verticle Section*.

A remarkable omission is that no faults are shown: these are so common in the Lancashire Coalfield that they must have been well known to Hall as a mineral surveyor. Since Hall was familiar with Farey's analysis of different types of faults (Farey, 1811), it is surprising that Hall did not show any on his map. This is all the more mysterious when, from well before 1831, Hall had been in contact with Adam Sedgwick of Cambridge, who by 1831 regarded him as an authority on this matter (see below). Bagshaw (1846, p. 454) seems to have been the first to record how, at Castleton: *E. Hall has for the last 65 years been a practical geologist, pursuing his favourite study with vigour ... Professor Sedgwick was a pupil of Mr. Hall's in the early part of his geological researches*. Binney noted that: *Hall had been one of the teachers of Professor Sedgwick, who has said that some of his first lessons in geology were from Elias Hall* (Taylor 1862, p. 84). Sedgwick was infamously ignorant of geology when elected to the Woodwardian chair at Cambridge early in 1818 and so set off to educate himself, on his first field excursion, on 30 July 1818. His first destination was Matlock, where he stayed about five weeks, then on foot to Ecton in Staffordshire, then a fortnight at Buxton (Clark & Hughes, 1890). It was surely then that he took these his lessons from Hall, with whom he clearly remained on good terms thereafter.

Elias Hall and the scientific societies

The publication of Hall's Lancashire Map brought him into contact with a wide range of geologists. But he had long before made contact with Sedgwick, who was a corner stone of early activities at the British Association for the Advancement of Science (BAAS). After the first BAAS meeting in York in 1831, the BAAS leaders suggested that Elias Hall be included in an expert group *to collaborate in testing De Beaumont's theory that lines of dislocation of strata* [i.e. faults] *of the same age were parallel* (Morrell & Thackray, 1981, p. 502). In August 1834, Hall wrote to John Phillips, then a leader of the BAAS: *Mr Potter informed me of the meeting of the British Association to be held on the 8th of September in Edenborough* [Edinburgh]. *When and where I intend to produce a plan of the Derbyshire Toadstones, pipe and rake Veins etc and the depth at which the Toadstone is found in the sinkings at different mines. And to speake further on my Geological Map of Lancashire if necessary*. Clearly his Lancashire Map was published by 1834.

On 16 August 1836 Binney went into the field with "Mr. Elias Hall to see the New Red Sandstone rock on the banks of the Medlock" (Binney MSS Notebook p. 22, Torrens Collection). Hall was soon a friend of Binney. In 1837 physician James Black (1788-1867) published a pioneering paper and map of the geology of the Bolton area, which had clearly been inspired in part by Hall's work (Black, 1837).

In 1811 Farey already regarded toadstones as of volcanic origin. But when Hall gave his talk to the British Association at their Liverpool meeting in 1837, he described very minutely the geological development of Derbyshire and exhibited an indented map, cut by himself and suspended from a wall near to a similar map of Lancashire. His abstract stated that *from their regular continuity, it was improbable that the beds of toadstone could be of volcanic origin* (Hall, 1838).

Hall also spoke at the BAAS meeting in Birmingham in 1839, when he exhibited a map of the Central Coal District. Hall gave further papers at the Manchester meeting 1842, when he read *Notices of the Geology of Derbyshire and Neighbouring Counties*, by presenting his models, maps and sections, and at the Cork meeting in 1843 when he exhibited his Map and Sections illustrating Lancashire, and again at York in 1844 when he spoke on *The Midlands Coal Formation*, where he was deservedly complimented by Prof. Sedgwick. In Cambridge in 1845, he gave another *Notice of the Toadstones of Derbyshire*. Of these talks, usually only titles or short abstracts were published by the BAAS, but the antiquary Llewellynn Jewitt (1816-1886) noted at Cambridge that: *Mr Elias Hall of Castleton in our old County, gave a lecture, or rather, read a paper on Derbyshire Toadstone, Whin etc. He is a queer-looking old man, with white hair and lame, and has no notion of lecturing, and he likewise speaks very broad High Peak* (S.C. Hall, 1889, p. 71). It is clear from Hall's comment, *some persons have supposed these toadstones to have been a subsequent formation*, that he still did not understand their true origin.

In 1838 the Manchester Geological Society (MGS) was founded by many of those who had subscribed to Hall's 1834 map. He soon became active at their meetings, reading two papers on the Great Lancashire Coal Field on 31 October 1839. Elias Hall was soon made an honorary member of the Society (Wood, 1987) and gave several further lectures. In 1843 he donated his *Map of Lancashire and a section of the Coal Measures at Gorton Brook*; in 1844 he spoke on the *Coalfields of Yorkshire, Derbyshire, Leicestershire, Lancashire and North Wales*; in 1845 on *The Geology of the Valleys extending from Manchester to Bolton and Bury* (Wood, 1987); in 1846 he lectured on *An Exhibition and Description of a model with an account of the various Strata*; in 1847 he gave *An Account of the Coalfields of Derbyshire and Yorkshire, illustrated by a Geological Map and Sections*. Finally in 1849, presumably using knowledge he had gained at the 1843 Cork BAAS meeting, Hall read *Notes on the Coal Districts of Munster and Tyrone*. No texts of these lectures have been found, though Binney was later able to add much further detail to Hall's knowledge of the Lancashire coalfield.

Hall's Memoir to the Lancashire Map

In 1836, Hall published a 28-page memoir entitled *Introduction to the Mineral and Geological Map*. In it he listed 24 stratigraphic units numbered upwards from the Lowest Millstone Grit Rock to the Magnesian Limestone of Ardwick etc; neither the underlying Limestone Shale and Limestone nor the overlying Red Marls was numbered. Each unit has a brief description and a list of localities of outcrops, and there is a folding chart of eight measured sections of the Coal Measures (Fig. 8); the memoir and sections together demonstrate Hall's intimate knowledge of the coalfield. The printed memoir included comments on faults, which he regarded as helpful in bringing parts of coal seams closer to the surface and reducing inflows of water, but the faults are not shown on his map. Hall continued with calculations of the potential coal resources of Lancashire. The final pages have a list of fossils from the various units compiled by his friend Francis Looney; this includes notes on the superficial gravels and their fossil mammals, both of which Hall had omitted. Binney's surviving notebook for 1835-1840 (Torrens Collection) shows how indebted he then was to Hall's work; this summarises Looney's fossil list, and repeats Hall's stratigraphic column with 25 numbered units, now including the Red Marl.

A third edition of Hall's map was also announced in his *Introduction*. In this, now dedicated to Buckland, Elias Hall advertised copies of his map available for purchase at places in Manchester and London. Prices were £3-3-0 in coloured sheets, £3-13-6 mounted on cloth with bound edges and folded in a case, £4-4-0 on mahogany rollers and varnished, £5-5-0 mounted on a spring roller, plus 5s 0d for the introductory memoir and lithographed key. Hall finally offered his services to *Gentlemen desirous to ascertain the probable value of Coal, Flag, Slate or Ironstone in their estates*.

A second edition of the *Introduction* was published in 1850, with ten pages of a geological appendix to the 1836 version. Hall started with a quotation from a Mr Stewart concerning the volcanic rocks of Hawaii, whose igneous origins Hall compared with the basement rocks of granite, gneiss and mica schist beneath his stratified rocks. This was quoted from Charles Samuel Stewart's book on the Sandwich Islands and his travels in the Pacific, when he visited Hawaii (Stewart, 1828). Hall next listed fossils from the Clay Slate (Silurian) but he confused the fossils of the Transition Limestone (Silurian) with those of the Carboniferous Limestone. Hall discussed the nature of crinoids, and finished with a brief account of fossil reptiles from the Lias and Kimmeridge Clay. A footnote listed fossils from

other Mesozoic strata – including a human skeleton in the Chalk! An appendix gave notice of a map he had prepared of the railways of Lancashire. Hall would have been aged 86 when this was published, so perhaps any confusion was age-related.

In a letter to Sedgwick in 1851, Hall noted *having aded a second adition to my Lancashire Geological Map of the coalfield, I thought you would like to have the 2nd addition, if so remit the price by a poast office order*. Any such fourth edition has not been located, but copies may survive in Cambridge, as Sedgwick certainly sent in such an order. After Hall's death, Binney noted how *a good many maps and sections of Elias Hall's are on sale at John Heywood's in Manchester at moderate prices*, nine years after his death (Taylor, 1862, p. 84).

Elias Hall's other maps

Two other maps are thought to have been compiled by Elias Hall. One was of the High Peak of Derbyshire and may have been comparable in part to Farey's unpublished map in the Joseph Banks Collection at the Sutro Library, San Francisco. No example of this map has been located. A Hall map of the Midland Coalfields is also mentioned (Bulmer, 1895), but Croston (1862) said that he was still working on this shortly before his death. It apparently was to include the whole of the South Pennines and all the flanking coalfields. It now seems that Hall may never have completed such a map.

Two letters from Hall to Sedgwick, dated 12 and 21 May 1851 (Cambridge University Library), shed more light. On May 12, Hall wrote: *I have been very busy with my Derbyshire Geological Map since I saw you in Cambridge at the meeting. I have commenced my Survey near Marsden in the N.W. corner of Derbyshire, thence by Greenfield in Saddleworth and Mottram, Hayfield, Buxton, Leek in Staffordshire and Ashburn in Derbyshire, Kirkburton, High-Hoyland, Silkstone, Dodworth, near Barnsley, Sheffield, Chesterfield, Alfreton, Ashover, Matlock, Crich to Bilper, Little Eaton near Duffield, near Derby. This map was the idol of Mr. John Farey, Mineral Surveyor. A section is intended to accompany this map of the coalfield from Ormskirk to Doncaster. If you can give me any information respecting a good Derbyshire map I should be very glad. The Government map of 1 inch to the mile is spoild with shading*. Then on 21 May he wrote: *Respecting my Derbyshire map it has been a long while on hand and I find it difficult to get a Derbyshire map of proper size to lay my manuscript on. It includes parts of Cheshire, Staffordshire, Yorkshire and Derbyshire ... I am very anxious to get the Geology of Derbyshire on paper, before time cloases my carear feeling myselfe decline I cannot expect to remain in vigour long, being eighty six years old on the 6th of January last past*. It seems certain that there was only one such map, which was not finished when old age overtook Hall.

The 1851 census, taken on 30 March, recorded that Elias was then visiting his son John at 35 Radnor St., Hulme, Manchester. But his letters to Sedgwick were sent from Castleton in May 1851. He died there on 30th December 1853. Though so little documentation has survived, he must, latterly have earned a living as a consultant to the many coal owners in Lancashire and so gained his comprehensive knowledge of that coalfield during his professional visits. As a Mineral Surveyor he would have estimated the coal reserves for the colliery operators as well as valuing them for royalty payments to landowners. Most of his publications date from the 1830s when he was aged around 60.

Elias Hall's publications

1824. *A Vertical Section across the great Lancashire coalfield and across the High Peak of Derbyshire.* W. Phillips: London.

1831. *A Geological Section of the Strata across the Coalfield of Lancashire.* [published by Hall?]

1834. *A Mineralogical and Geological Map of the Coalfield of Lancashire with parts of Yorkshire, Cheshire and Derbyshire*. (with later revised 'editions' 1836 to 1851).

1836. *Introduction to the Mineral and Geological Map of the Coalfield of Lancashire.* Love & Barton: Manchester, 28 pp, (with a chart of *Eight Geological Sections and Key to Elias Hall's Geological Map of the Coalfield of Lancashire*).

1838. Abstract: Hall on his Mineral Map of Derbyshire. *Reports and Transactions of the BAAS, Seventh Report (for 1837)*, 91.

1850. *Introduction to the Mineral and Geological Map of the Coalfield of Lancashire.* Slater: Hyde, 10pp.

1850. *Map of the Railways in Lancashire*.

Elias Hall's achievement

Apart from the appreciative remarks made by Binney (1862), others were made by Croston (1868), Cash (1873), Wood (1987) and Cooper (2006); an appreciation also appeared in the High Peak News of August 25th 1900 (Anon., 1900). Hall owed much to Binney. During the MGS meeting on 26 March 1861, Binney was in the chair, when Mr John Taylor junior read a paper on the geology of Castleton. This led the Society to hold an excursion there, and *The Chairman said that this opportunity would be a good one to pay a tribute of respect to the memory of the late Mr. Elias Hall* (Taylor, 1862). In November, Binney was able to announce (Manchester Times, 30 November 1861) that Hall's new gravestone had been erected. Binney next gave a paper on Hall on 30 April 1862, and confirmed that Hall could not have had a memorial tablet in Castleton church, as there was a ten guinea fee for this (Binney, 1862); so instead a gravestone had been placed over his unmarked grave (to which Sedgwick had subscribed).

Elias Hall should be remembered as a pioneer geologist both in Derbyshire and the coalfields of Lancashire.

But he also left records of hitherto unlocated maps, sections and models of the Peak District and Midland coalfields. If any reader has any knowledge of these, please contact the authors.

References

Adam, W., 1843. *Gem of the Peak.* 4th edition, Mozley: Derby.

Andrews W., 1880. *The Derbyshire Gatherer or Archaeological, Historical, Biographical Facts, Folk Lore etc.* Advertiser Office: Buxton.

Anon., 1813a. Notice of model. *Nicholson's Journal,* 34, 226-228.

Anon., 1813b. Notice of model. *Monthly Magazine,* 35, 151.

Anon., 1813c. Notice of model. *Universal Magazine,* 19, 227.

Anon., 1824. Notice of Elias Hall's vertical section. *Monthly Magazine,* 58, 252.

Anon., 1895. Obituary of James Adey Birds (1831-1894). *Geol. Mag.*, 2, 192.

Anon., 1900. Elias Hall of Castleton (Founder of Derbyshire Geology). *High Peak News*, 25th August 1900.

Anon., 1930. *Halifax Literary and Philosophical Society, 1830-1930, Centenary Handbook*. Stott Bros.: Halifax.

Bagshaw, S., 1846. *History, Gazetteer and Directory of Derbyshire*, Bagshaw: Sheffield.

Binney, E.W., 1862. The late Mr. Elias Hall, the geologist. *Trans. Manchester Geol. Soc.,* 3, 92-96 & 146-147.

Binney, J., 1912. *The Centenary of a Nineteenth Century Geologist: Edward William Binney, FRS.* Barnicott & Pearce: Taunton.

Black, J., 1837. A medico-topographical, geological, and statistical sketch of Bolton and its neighbourhood. *Trans. Provincial Medical & Surgical Assoc.*, 5, 125-224 (with map and sections).

Bulmer, T. *et al*., 1895. *History and Directory of Derbyshire.* Snape: Preston.

Cash, J., 1873. *Where there is a will there is a way, or Science in the Cottage.* Hardwick: London.

Clark, J.W. & Hughes, T.M., 1890. *The Life and Letters of the Reverend Adam Sedgwick.* Cambridge University Press.

Cooper, M., 2006. *Robbing the sparry garniture: a 200 year history of British mineral dealers, 1750-1950.* Mineralogical Record: Tulsa.

Craven, M., 1996. *John Whitehurst of Derby: Clockmaker and Scientist 1718-1788.* Mayfield: Ashbourne.

Croston, J., 1862. *On foot through the Peak.* Heywood: Manchester.

Dearman, W.R. & Turner, S., 1983. Models illustrating John Farey's figures of stratified masses. *Proc. Geol. Assoc.* 94, 97-104.

Farey, J., 1811-1817. *A General View of the Agriculture and Minerals of Derbyshire.* Board of Agriculture: London, v1, 1811; v2, 1813; v3, 1817.

Farey, J., 1814. Mr Farey's Notes on Mr Bakewell's geology postscript re 29 April 1814 letter from Hall to Banks. *Tilloch's Philosophical Magazine,* 43, 340-341.

Geikie, A., 1907. *A Journey through England and Scotland to the Hebrides in 1784 by B. Faujas de Saint Fond.* Hopkins: Glasgow.

Greenough, G.B., 1835. Presidential address. *Proc. Geol. Soc.,* 2, 152.

Hall, S.C., 1889. *The life and death of Llewellynn Jewitt.* Gray: London.

Kargon, R.H., 1977. *Science in Victorian Manchester.* Johns Hopkins University Press: Baltimore.

Meeke, E.R., 1996. *White Watson, Revised Sources, v1 Diaries*. Author: Sheffield.

Meeke, E.R., 1997. *White Watson, Bakewell's only Famous Man*. Author: Sheffield.

Morrell, J. & Thackray, A., 1981. *Gentlemen of Science: Early years of the British Association for the Advancement of Science.* Clarendon: Oxford.

Phillips, J., 1844. *Memoirs of William Smith, LL.D.*, Murray: London (reprinted 2003, Royal Literary and Scientific Institution: Bath).

Shawcross, W.H., 1903. *Castleton and its Old Inhabitants.* Turner: Hemsworth.

Smith, W. & Campbell., 1969. A history of the first 100 years of the mineral collection in the British Museum. *Bull. British Museum (Natural History), Historical Series*, 3, pp. 235-259.

Stanley, M., 1976. Geological collections and collectors of note, 13: Derby Museums and Art Gallery. *Newsletter Geological Curators Group*, 1, 392-409.

Stenton, M., 1976. *Who's Who of British Members of Parliament, volume 1, 1832-1885.* Harvester: Hassocks.

Stewart, C.S., 1828. *Journal of a residence in the Sandwich Islands during the years 1823, 1824, and 1825.* Fisher, Son & Jackson: London (reprinted 1970, University of Hawaii Press).

Taylor, J., 1862. Geology of Castleton. *Trans. Manchester Geol. Soc.*, 3, 73-84.

Torrens, H.S. & Ford, T.D., 1977. Elias Hall (1764-1853) of Castleton. *Geological Curators Group Newsletter,* 1, 452-3, & *Newsletter of the Society for the Bibliography of Natural History*, May, 4-5.

Torrens, H.S., 2001. Timeless order: William Smith (1769-1839) and the search for raw materials 1800-1820. Geol. Soc.Spec. Publ., 190, 61-83.

Torrens, H.S., 2002. *The Practice of British Geology 1750-1850*. Ashgate: Aldershot.

Torrens, H.S., 2009. Dissenting science: the Quakers among the Founding Fathers. Geol. Soc., Spec. Publ., 317, 129-144.

Torrens, H.S., 2010. Another Quaker "Lunatick": the Worcester origins of Jonathan Stokes, junior (1754-1831). *Journal Friends Historical Society*, 61, 196-220.

Watson, W., 1811. *A Delineation of the Strata of Derbyshire.* Todd: Sheffield (reprinted 1973, Moorland: Hartington).

Whittaker, W. & Tiddeman, R.H., 1875. List of works relating to the geology of Lancashire. 188-218 in *Geol. Surv. Mem., the Burnley Coalfield.* HMSO: London.

White, F., 1857. *History and Gazetteer of the County of Derby.* White: Sheffield.

Whitehurst, J., 1778. *An Inquiry into the Original State and Formation of the Earth.* Author and Brent: London.

Wood, K., 1987. *Rich Seams: Manchester Geological and Mining Society 1838-1988.* Institute of Mining Engineers.

Hugh S. Torrens,
Lower Mill Cottage, Furnace Lane, Madeley, Crewe CW3 9EU

Trevor D. Ford,
Geology Department, University of Leicester, LE1 7RH