Sir Henry Thomas De la Beche and the founding of the British Geological Survey

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Abstract. The founding of the Geological Survey by Henry De la Beche in 1835 is a key event in the history of British geology. Yet the Survey's initiation actually began three years earlier when De la Beche secured financial assistance from the Board of Ordnance to map the geology of Devon at a scale of one inch to the mile. The British Geological Survey has thus been in existence for at least 175 years and can justly claim to be the world's oldest continuously functioning geological survey organisation. There were early government-funded geological surveys also in France, the United States, Ireland and Scotland. De la Beche's notable success both in launching and sustaining the Geological Survey demanded a good deal of diplomacy, determination and deviousness! Even so, the Survey was nearly brought to an untimely end in 1837 when De la Beche was publicly criticised for his interpretation, based on lithology and field relations, of the difficult Culm strata of north Devon. The resolution of the 'Devonian Controversy' led to a fundamental change in geological practice, in which the value of fossils as stratigraphic markers, founded on an acceptance of organic change over time, was established beyond question. Fortunately the Survey survived its early trauma and De la Beche went on to extend his influence with the expansion of the Museum of Economic Geology (also formed in 1835), and the establishment of the Mining Record Office and the School of Mines.

The British Geological Survey has often been described as the world's first official geological survey organisation. While this statement may not be strictly accurate, the British Survey can claim to be the oldest such undertaking to have functioned continuously since its inception in May 1832 and formal establishment on 11 July 1835. For this we must thank the Survey's founder and first Director, Henry Thomas De la Beche (Fig. 1), whose single-minded determination succeeded in placing the British Survey on a more permanent footing than earlier but short-lived government-funded geological surveys in France and the United States. The Geological Society of London (founded 1807) also played an important part in assisting the establishment of the Survey, while the support of Thomas F. Colby, Superintendent of the Ordnance Trigonometrical Survey (under the Board of Ordnance), was a critical factor in its initial success and ultimate survival.

This account charts the origin of the Geological Survey and its progress up to the year 1839 — a significant turning point which saw the publication of the Survey's first geological memoir and the appointment of the first Geological Assistants. This latter measure effectively laid the foundation for a permanent organisation — something by no means envisaged by the British government at that time! No account will be given here of the Museum of Economic Geology (now the Earth Galleries of the Natural History Museum) which De la Beche established in the same year that the Survey was founded, initially as a separate entity funded by the Board of Public Works. Neither will reference be made to his other two creations: the Mining Record Office (established adjacent to the Museum in 1839), and the Government (later Royal) School of Mines (established 1851).

Private enterprise and geological mapping

In Britain the politics of *laissez-faire* ensured that the earliest attempts at geological mapping on a national scale were left to private enterprise. Among the early forerunners pride of place goes to William Smith, the 'Father of English Geology' (Sedgwick 1831), whose now famous map, *A Delineation of the Strata of England and Wales, with part of Scotland*, appeared in 1815 at a scale of five miles to the inch (Eyles & Eyles 1938; Eyles 1969). This map is a landmark in the history of British geology and a remarkable achievement for a

Figure 1. *Sir Henry Thomas De la Beche, by William Brockedon, 1842 (© National Portrait Gallery, London).*

single individual, undertaken moreover with limited means of support. Unfortunately for Smith his map was eclipsed in 1820 by the quite independent production of *A Geological Map of England & Wales* under the direction of George Bellas Greenough, founding President of the Geological Society of London. This new map, at a scale of about six miles to the inch, owed much to the 1815 map (though this was only acknowledged many years later), but it benefited from the efforts of the élite membership of the Geological Society (which included an aspiring young De la Beche) and was thus more accurate and more detailed. Its arrival in France in 1820 prompted the French government to initiate a similar undertaking at public expense.

Greenough also encouraged Richard Griffith, another celebrated pioneer, to embark upon the construction of a geological map of Ireland. Griffith began work in 1811, but the difficulty he experienced in procuring an accurate topographical base-map delayed publication of his *Geological Map of Ireland* until 1838. Even then it was issued only in provisional form, at a scale of about ten miles to the inch, to accompany a report of the Railway Commissioners. A more detailed map at four miles to the inch (1:253,440) appeared in the following year. Both of these maps were published at government expense thanks to Griffith's fortuitous appointment to the Railway Commissioners Ireland in 1836. He succeeded in convincing his fellow commissioners of the need to publish a geological map to assist the expansion of railway communications. This included the compilation, under the charge of the Ordnance Survey, of the all important topographical base-map. Much of the geological fieldwork was actually undertaken by unacknowledged assistants employed by Griffith on various commissions under his direction, such as the Boundary and Valuation Surveys. The utilisation of these assistants in the pursuit of geological investigation was effected without official sanction, but their efforts enabled Griffith to realise his personal ambition to publish the first geological map of Ireland (Herries Davies 1983; Archer 1980).

Had things turned out differently, William Smith might have become the first government geologist. He had earlier produced a small outline geological map of England and Wales in June 1801 which, though rudimentary in detail, was the first such map of its kind. This and subsequent embryonic maps, together with his tabulation of the British strata, were displayed at annual agricultural meetings between 1801 and 1807. Sir John Sinclair, sometime President of the Board of Agriculture, was sufficiently impressed with Smith's credentials to attempt in 1805 to have him attached to the government Trigonometrical Survey (under the Board of Ordnance) for the purpose of connecting his 'survey of the strata' with the official one-inch topographical mapping then in progress (Phillips 1844). Nothing came of this proposal, nor indeed of a separate attempt by R. I. Murchison at the end of 1831 to have Smith appointed as 'Geological Colourer of the Ordnance Maps' (Geikie 1875, vol. I, 131-2). It was left to De la Beche to successfully secure this role for himself just months after Murchison's failed initiative. Murchison was one of Smith's keenest advocates, and as such was to play a key role as De la Beche's adversary in the Devonian controversy that would erupt late in 1834.

Early government-funded geological surveys

The claim has often been made to the effect that the British Geological Survey was the first of its kind in the world. This claim has been rightly contested by several writers (e.g. the Survey's own Victor Eyles 1937, 1950, and Harry Wilson 1985) who describe or allude to earlier government-funded geological surveys in France, the United States, Ireland and Scotland.

France

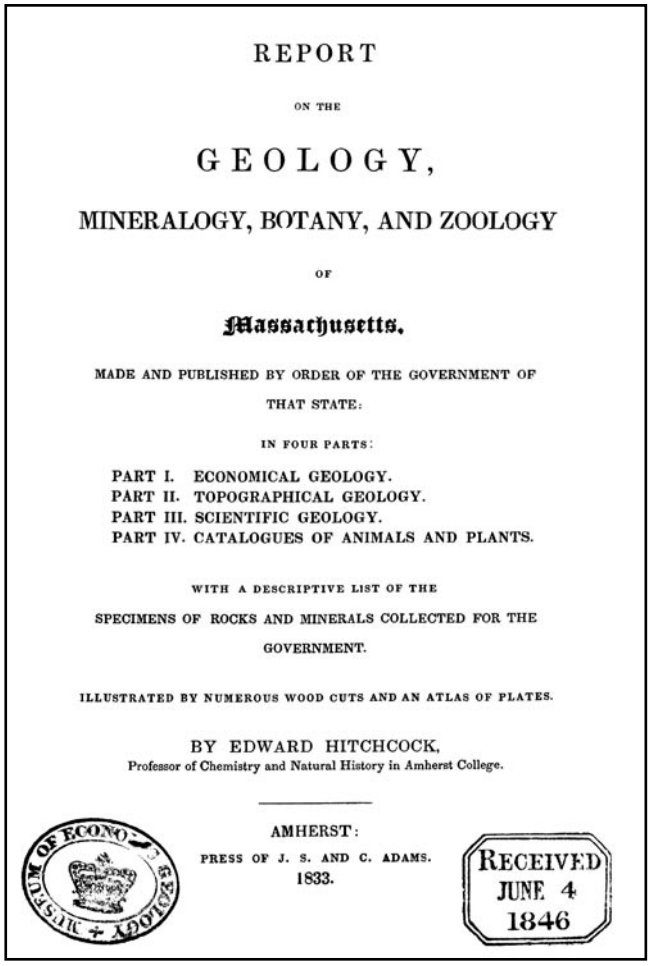
To France belongs the honour of having undertaken the world's first official geological survey on a national scale (Eyles 1950). A plan for preparing a geological map of the country along systematic lines was formulated by the government *Corps des mines* in 1822 and placed under the supervision of the *École des mines* (School of Mines). Two of its mining engineers, Léonce Élie de Beaumont and Armand Dufrénoy, under the direction of André Brochant de Villiers, were given the task of undertaking the survey. For this purpose they looked to England to provide a model of how such an undertaking should be attempted. Although French geologists were aware of William Smith's map, it was Greenough's more detailed map which they now aspired to emulate. The three men began in 1823 by spending six months on a fact-finding mission in England to learn something of the methods of geological mapping employed by Greenough's collaborators. The following year was devoted to writing up their observations and classifying their many collected specimens. Work on an initial *Carte géologique générale* began in 1825 and was completed by 1835 (Brochant de Villiers 1835). However, delays caused by the need to engrave a special topographical base-map meant that publication, in six sheets at a scale of 1:500,000, was not achieved until 1841.

It was further proposed that more detailed geological mapping should be funded by the regional *Départements*, preferably under the supervision of local mining engineers from the School of Mines. In practice, however, the maps that were produced lacked unity, being issued at a variety of cartographic scales, while the grouping, definition and representation of rock formations were frequently inconsistent. After 1845 the project lost momentum as Departments became less inclined to allocate the necessary funds for surveying and publication. The establishment of the Geological Survey of France in 1868, under the directorship of Élie de Beaumont, was in large measure prompted by the failure of the Departmental mapping project. The involvement of local government in geological mapmaking had proved ineffectual (Savaton 2007).

United States

In the USA eight state-funded geological surveys were initiated between 1823 and the middle of 1835, although these were of short duration. The first was undertaken in North Carolina in 1824-28 (the authorising Act being dated 31 December 1823). Other early state surveys were those of South Carolina (1825-26), Massachusetts (1830-33), Tennessee (1831-50), Maryland (1833-41), New Jersey (1835-40), Virginia (1835-42), and Connecticut (1835-42). In Pennsylvania there had been regular but unsuccessful submissions to the legislature to provide for a geological survey of the state from 1832, but approval did not come until 1836. The oldest continuously functioning state Survey is said to be that of New York, established in 1836, although its status after 1843 is questionable. (Sources: Clark 1897, Merrill 1920, Socolow 1988, Stuckey 1965; Hendrickson 1961 provides a useful overview focusing on the role of government).

Among early state surveys, that of Massachusetts is of special significance because it was the first to be formally published and widely disseminated. The state geologist was Edward Hitchcock, who despatched a copy of his full report (Fig. 2) to Henry De la Beche on 28 December 1833 as a mark of appreciation for the value he had derived from reading the latter's *Geological Manual* published in 1831 (letter in Sharpe & McCartney 1998, item 690). A renewal of the survey of Massachusetts, with emphasis on agricultural benefit, was enacted in 1837. The commission included the laudable instruction that 'that which is practically useful will receive a proportionally greater share of attention than that which is merely curious; the promotion of comfort and happiness being the great end of all science' (Merrill 1920, 155).



REPORT

ON THE

GEOLOGY,

MINERALOGY, BOTANY, AND ZOOLOGY

OF

Massachusetts.

MADE AND PUBLISHED BY ORDER OF THE GOVERNMENT OF THAT STATE:

IN FOUR PARTS:

PART I. ECONOMICAL GEOLOGY.
PART II. TOPOGRAPHICAL GEOLOGY.
PART III. SCIENTIFIC GEOLOGY.
PART IV. CATALOGUES OF ANIMALS AND PLANTS.

WITH A DESCRIPTIVE LIST OF THE SPECIMENS OF ROCKS AND MINERALS COLLECTED FOR THE GOVERNMENT.

ILLUSTRATED BY NUMEROUS WOOD CUTS AND AN ATLAS OF PLATES.

BY EDWARD HITCHCOCK,
Professor of Chemistry and Natural History in Amherst College.

AMHERST:
PRESS OF J. S. AND C. ADAMS.
1833.

MUSEUM OF ECONOMIC GEOLOGY

RECEIVED
JUNE 4
1846

Figure 2. *Title page from De la Beche's copy of Edward Hitchcock's 1833 geological survey of Massachusetts.*

It is worth noting that Henry Darwin Rogers, the first state geologist of both New Jersey and Pennsylvania, received field instruction from De la Beche in the spring of 1833 during a visit to England. De la Beche was at that time engaged in a geological survey of Devonshire with financial assistance from the Board of Ordnance. Rogers, who up to then had been unsure about the future course of his career, was inspired to set about conducting a state geological survey on his return home. When it became clear towards the end of 1834 that the New Jersey legislature was considering such a survey, Rogers made known his interest, ensuring that the governor of New Jersey was made aware of his qualifications for undertaking 'field research of a scientific kind such as I have witnessed with De la Beche' (Gerstner 1994, 44-7).

Mention should also be made of William Maclure (1763–1840), at one time called 'the father of American geology' (Dean 1989), and George William Featherstonhaugh (1780–1866), 'the first U.S. government geologist' (Berkeley & Berkeley 1988). The former, born at Ayr in Scotland, published his 'Observations on the geology of the United States' in 1809, with a coloured geological map of the regions east of the Mississippi River, surveyed and financed by himself. This map, though highly generalised, later earned him a reputation as the 'William Smith of America'. The other notable pioneer of American geology was English by birth, reputedly related to the Fetherstonhaughs of Fetherston Castle (there are variant spellings) in Northumberland. In December 1832 he made an approach to the U.S. government requesting financial support for a complete geological survey of the United States. In the event he received commissions to undertake reconnaissance surveys over the eastern states from 1834 to 1838. He afterwards returned to England and was appointed in 1844 as British Consul at Havre. During the revolution in France in 1848 he smuggled King Louis Philippe to England by disguising him as Mr William Smith, a half blind uncle!

Ireland

In 1825 the Ordnance Survey, under the direction of Lieutenant-Colonel Thomas Frederick Colby, began the daunting task of mapping Ireland topographically at a scale of six inches to the mile (1:10 560). As a long-standing member of the Geological Society of London, Colby was well aware of the economic value that would accrue from making a 'Geological and Mineral Survey'

in parallel with the topographical survey of Ireland (Herries Davies 1983, 87). Thus, on 14 November 1826 he appointed Captain J. W. Pringle to superintend the geological survey, and in March of the following year Pringle issued instructions for making geological and mineralogical observations. Only limited progress was made owing to a lack of enthusiasm among the topographical field-parties, who for the most part had little interest in geology and no formal training in the subject. Indeed, its unpopularity and the fact that the geological survey was not officially sanctioned by the Board of Ordnance led to the suspension of geological activity in September 1828. This activity, conducted in the counties of Antrim and Londonderry, had amounted to little more than the collection of rock samples (noted in official correspondence from September 1826), with their locations plotted onto a crudely coloured six-inch map, and the drawing of two geological panoramas (Herries Davies 1983, 88-95; Andrews 1975, 67). Despite this setback, Colby was eventually given approval to appoint Lieutenant (soon to become Captain) Joseph Ellison Portlock to resume the geological survey in January 1830.

Portlock had good geological credentials, but he was too pre-occupied with the primary triangulation of Ireland to give much attention to geological matters until late in 1832 (Portlock 1843). It was about this time that Portlock set about establishing a geological branch of the Ordnance Survey of Ireland. In 1834 he was asked to contribute to an Ordnance Survey memoir describing the parish of Templemore, which includes most of the city of Londonderry. A provisional edition of this memoir was printed in 1835 for the annual meeting of the British Association for the Advancement of Science, which took place at Dublin in August of that year. The memoir included a hand-coloured plate depicting the geology of the parish of Templemore at a scale of one inch to the mile, being the first official geological map to be published for any part of Ireland (Fig. 3). Formal publication of the memoir did not follow until 1837 (Colby 1837). In this same year Portlock was able to set up an office, museum and soils laboratory at Belfast, thus establishing the Geological Branch for the first time as an organised entity (Andrews 1975, 155; Herries Davies 1983, 100).

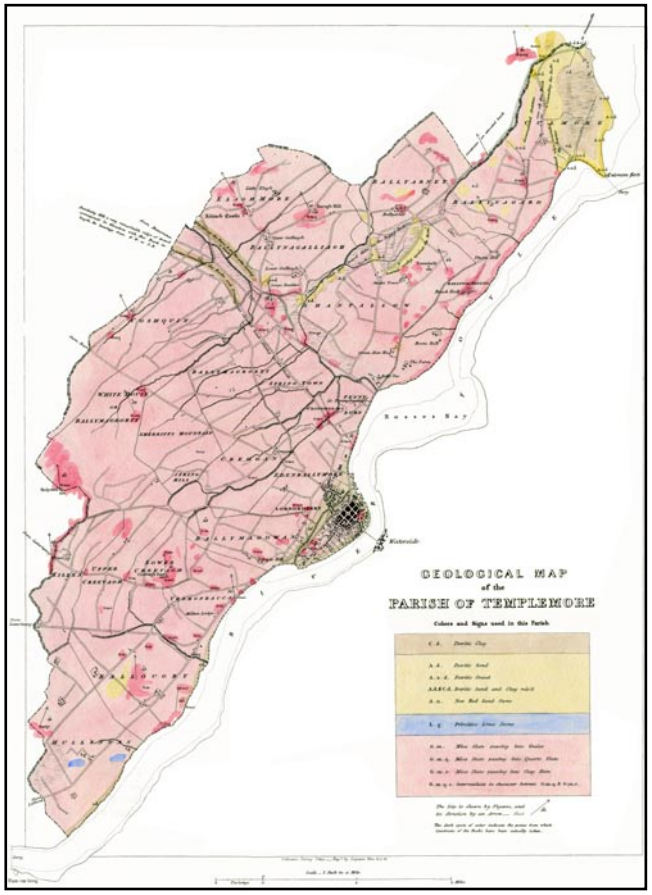


Figure 3. *Geological map of the parish of Templemore, by J. E. Portlock, from the 1837 edition of* Ordnance Survey of the County of Londonderry.

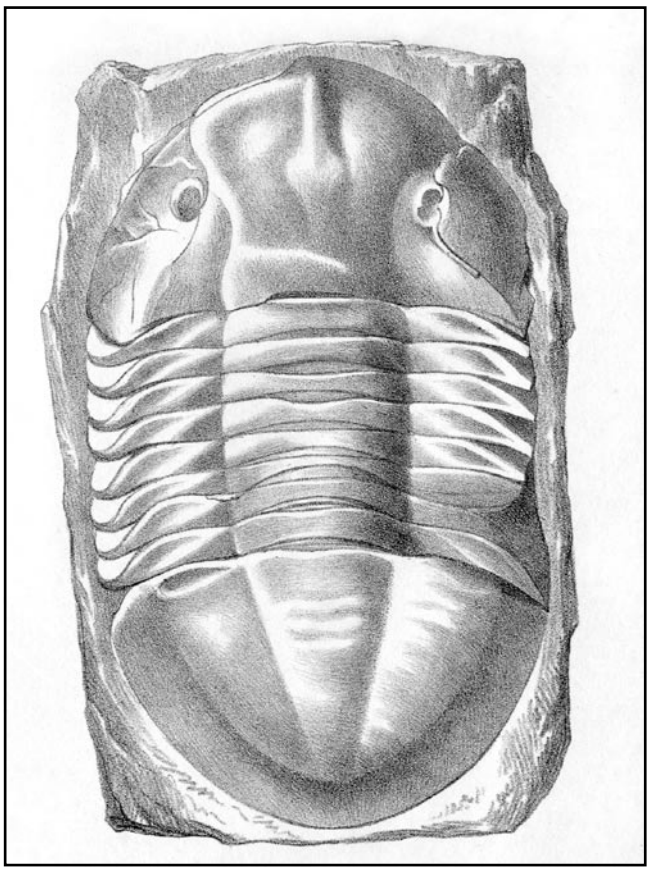


Figure 4. *One of the many fine illustrations (by G. V. Du Noyer) from Portlock's* Report on the Geology of the County of Londonderry, *etc. 1843: a trilobite identified by Portlock as* Isotelus powisii *Murchison.*

Financial and other considerations unfortunately led to the closure of Portlock's department in February 1840, although he was given time to complete his monumental *Report on the geology of the county of Londonderry and of parts of Tyrone and Fermanagh*, published in February 1843 (Fig. 4). Official geological activity in Ireland thus effectively came to an end for the second time, although Colby did not give up without a struggle (Herries Davies 1983, 106-22). The Irish geological

survey was not to be formally reinstated until the passing of the Geological Survey Act of 1845, which established the Geological Survey of Great Britain and Ireland under the general directorship of Henry De la Beche. Portlock's *Report*, accompanied by a fold-out geological map at a scale of half an inch to the mile, and his contribution to the Templemore memoir, were the only published products of this early attempt at an official geological survey of Ireland.

It should not be forgotten that Richard Griffith published his geological map of Ireland in 1838 and 1839 utilising a topographical base specially prepared by the Ordnance Survey. From the very beginning he had kept a close watch on the activities of the Survey in Ireland, but maintained a self-interested scepticism of its ability to produce geological maps of a quality comparable to his own (Herries Davies 1983, 48, 91-2).

Scotland

In 1814 John MacCulloch was appointed geologist to the Trigonometrical Survey (as the Ordnance Survey was then called) with orders to locate areas in Scotland where the geology might cause abnormal deflections of the plumbline, so that they could be avoided in the geodetic measurements to establish a meridian for the construction of the one-inch map. At the same time he was asked to discover a mountain more suitable than Schiehallion in Perthshire for determining the mean density of the Earth (Flinn 1981). MacCulloch used this opportunity to carry out a more wide ranging geological survey of the country in furtherance of observations begun by him in 1811 while employed by the Board of Ordnance as chemist (Cumming 1984). According to his own testimony much of this work was done in his own time and at no additional expense to the Ordnance. In June 1821 he submitted a proposal to the Board for completing and publishing a 'mineralogical map' of Scotland. Nothing came of this, notwithstanding an earlier show of melodrama, made in the presence of T. F. Colby, in which he had talked of hanging and shooting himself if he were not permitted to finish the map! (Fig. 5; Flinn 1981). In 1826 he was encouraged to apply directly to the Treasury for financial support, and in this he was successful. On 4 July the Treasury issued a minute sanctioning the continuation of the survey and expressing the view that such a map 'must prove, not only highly interesting in a scientific point of view, but of considerable practical utility to many branches of industry connected with the mineral kingdom' (Eyles 1937).

MacCulloch's survey appears to have been finished by about 1832 (having thus taken at least 18 years to complete), but it required a memorial from the Highland and Agricultural Society of Scotland before the Treasury could be induced to publish the map. A principal hindrance had been the inadequacy of the topographical base published by the firm of Arrowsmith, upon which MacCulloch had been obliged to plot his geological lines, and about which he made continuous complaint (the Ordnance Survey did not begin systematic topographical mapping in Scotland until 1846, having abandoned its earlier attempt in 1828). MacCulloch's geological map was eventually published by Arrowsmith in 1836, a year after its author had died following a carriage accident while on his honeymoon, aged nearly 62. The map (Fig. 6), accompanied by a memoir (MacCulloch 1836), is an impressive achievement, being at the scale of four miles to the inch, but seems not to have had a very lasting impact (Judd 1898). MacCulloch's all too characteristic contempt for fossil evidence (as for much else) made the result less useful to the stratigrapher than it might otherwise have been. (For a more generous assessment of MacCulloch's legacy, see Bowden 2009).

MacCulloch's travel expense claims for his 'mineralogical' survey proved to be so exorbitant that the Treasury was induced to undertake a detailed enquiry, the results of which appeared in a Parliamentary Paper in 1831 (Eyles 1937). The memory of this injury to the public purse was to resurface in December 1839 when De la Beche asked the Board of Ordnance for permission to spend the winter months in London for the purpose of arranging his notes. The Board stipulated that De la Beche's travel allowance be suspended for the period of his residence in London, and in adverting to 'what occurred in respect to the Scotch Geological Survey,' desired that 'special care may be taken to prevent the occurrence of a similar fault in the English Survey' (BGS Archives GSM 1/68, 320; North 1936, 82-5).

Figure 5. *Self portrait by John MacCulloch: in April 1821 he talked of hanging and shooting himself during a stormy meeting with Thomas Colby (Reproduced courtesy of the Geological Society of London).*

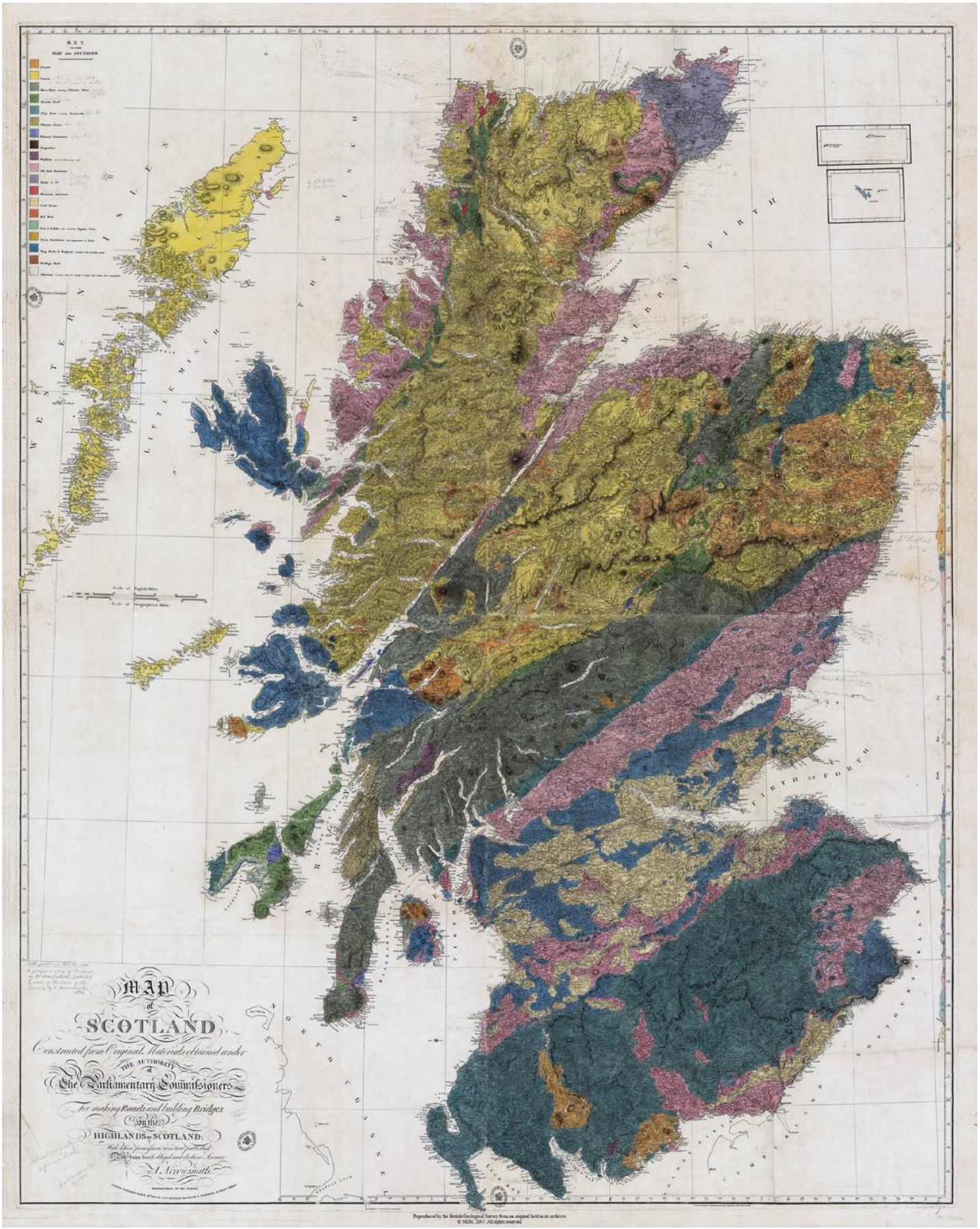


Figure 6. *John MacCulloch's* Geological Map of Scotland *1836; this edition reissued 1840 or later (published BGS facsimile, 2007, © NERC).*

Enter Henry De la Beche

Such, as outlined above, was the climate of officially-sanctioned geological survey activity into which De la Beche was to make his own entrance in the early 1830s. In Britain this was a period of political and social revolution: the Age of Reform, in which for the first time there was a growing recognition of the possibility of improvement for the generality of the population. The 1830s witnessed the Reform Act of 1832, the Abolition of Slavery Act of 1833, the New Poor Laws of 1834, and the growth of the railways leading to a greater demand for coal and a significant increase in the trading of metals. The creation of a Geological Survey, with a remit to make systematic and detailed geological maps for the use of the mineral developer, civil engineer and agriculturalist, would thus appear natural and appropriate in an age where industrialisation, improvement and self-help were the dominant themes. Yet the establishment of the Survey seems to have been the result merely of an accident in the events of De la Beche's life. A few words therefore must now be said about De la Beche himself.

Early years

Henry Thomas De la Beche (pronounced Beach) was born at St Marylebone in London on 10 February 1796. His father, born Thomas Beach (1755–1801), had the family name changed to De la Beche in 1790 on the strength of a tradition that they were descended from an ancient family of that name from Aldworth in Berkshire (Chubb 1958). Henry's grandfather, also called Thomas (1715–1774), had been Attorney General and Chief Justice of Jamaica, and through marriage acquired the estate of Halse Hall in the parish of Clarendon, which included a sugar plantation. Henry was only five years of age when his father died in June 1801 while the family were visiting their Jamaican estate. He returned to England with his mother, and after various moves, mostly in the south-west of England, came to reside at Lyme Regis in Dorset in 1812. Prior to this, in 1810, he had entered the Royal Military College at Great Marlow, where it seems he acquired the skills of surveying and perspective landscape drawing that were to serve him well in later life. He was, however, dismissed from Marlow in the following year for insubordination, bringing to an end any prospect of following in the footsteps of his father who had been a Lieutenant-Colonel in the cavalry (McCartney 1977). At Lyme Regis he made the acquaintance of Mary Anning, the celebrated fossil collector. It is usually thought that his active interest in geology developed at this time, although new evidence suggests that he had an interest from his schooldays (pers. comm., Tom Sharpe).

Geological apprenticeship

De la Beche inherited his father's Jamaican estate, which provided him with a comfortable living (about £3,000 per year) and enabled him to pursue his interest in geology and to become a Member of the Geological Society in 1817, at the age of just twenty-one. His first paper, 'Remarks on the geology of the south coast of England, from Bridport Harbour, Dorset, to Babbacombe Bay, Devon' (Fig. 7), was read before the Society on 5 March 1819 and subsequently published in the Society's *Transactions* in 1822 (see Sharpe & McCartney 1998 for a full list of De la Beche's publications). He followed this in 1821 with the reading of a paper describing the geology of the north coast of France around Caen in Normandy, which he successfully correlated with the sequence observed in southern England. The French geologist Dufrénoy, who, it will be remembered, was one of the principal authors of the 1841 *Carte géologique de la France*, was later to describe this paper as the foundation stone of the study of geology in France (Sharpe & McCartney 1998, item 473: letter to De la Beche dated 25 January 1843).

In 1818 De la Beche married Letitia Whyte at Bristol, the daughter of Captain Charles John Whyte of Loughbrickland, county Down, Ireland (Sharpe 2008). This was followed in the summer of 1819 by a tour of the Continent which lasted a year and included a period of residence in Switzerland. His daughter Elizabeth, always referred to as 'Bessie', was born at Geneva on 2 December 1819. During the course of this tour he made detailed geological notes, established contact with leading geologists and natural historians (such as Georges Cuvier and Alexandre Brongniart) and visited museums and private collections in France, Italy and Switzerland (McCartney 1977). On 23 December 1819 he was elected a Fellow of the Royal Society.

Figure 7. *Fossils from the Lias of Lyme Regis and Axminster, illustrating De la Beche's account of the coast of Dorset and Devon (from* Transactions of the Geological Society, *1822*).

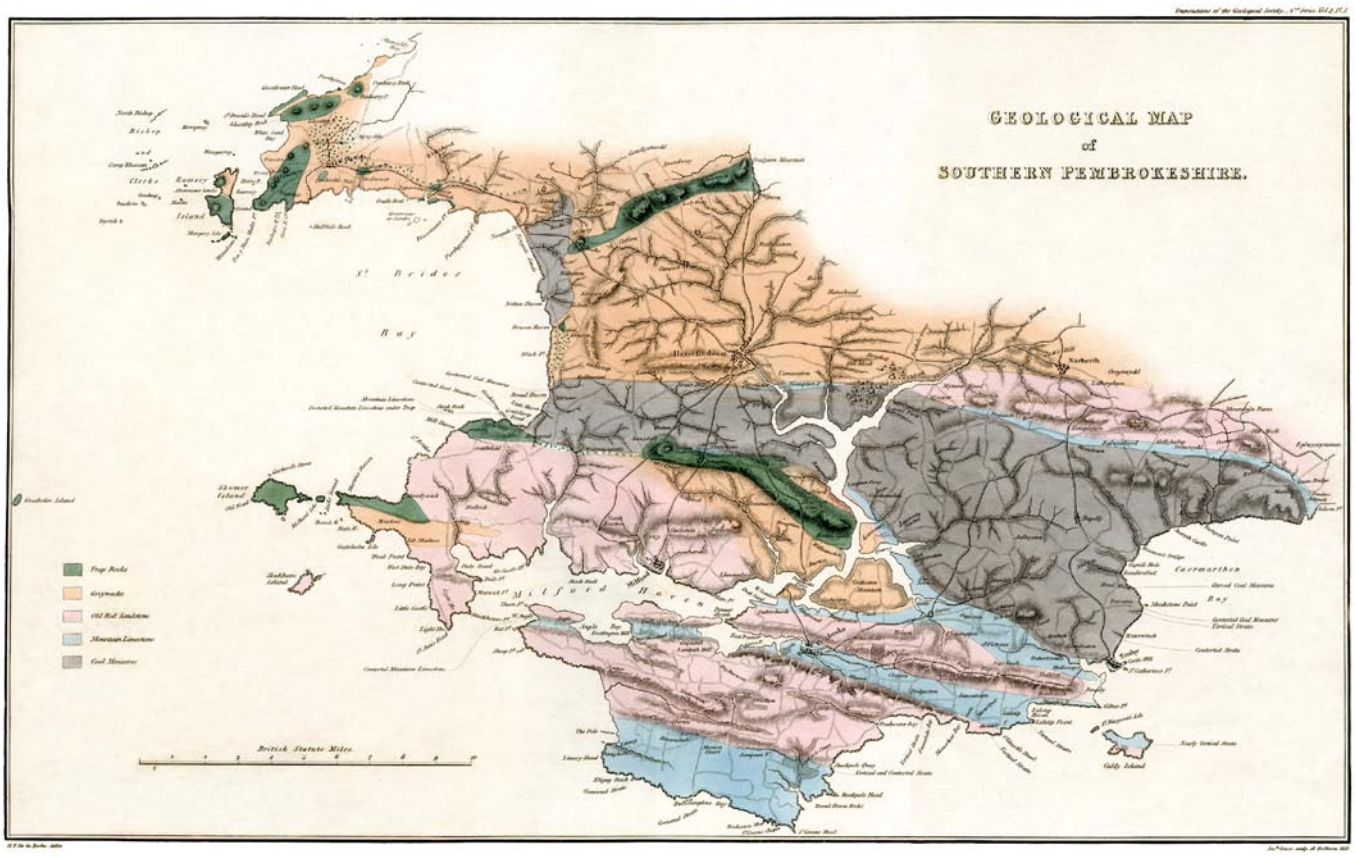
Map of Pembrokeshire, 1822

De la Beche decided to spend the summer of 1822 mapping the geology of south Pembrokeshire, the results of which were published in the Geological Society's *Transactions* in 1826. A great difficulty generally experienced at this time was the need to secure an adequate topographical basis for geological maps. The frustration felt by MacCulloch in Scotland on account of this inadequacy has already been mentioned, while the publication of Griffith's geological map of Ireland was delayed many years for want of a reliable base-map. In England and Wales the situation only began to be remedied following the establishment in 1791 of the Trigonometrical Survey, under the Board of Ordnance, which instituted a programme of topographical mapping for publication at a scale of one inch to a mile (1:63 360). The first map, covering Kent, appeared in 1801, but the systematic series, now better known as the Old Series one-inch maps, commenced publication in 1805. When De la Beche came to map south Pembrokeshire, evidently with the encouragement of his good friend, the Reverend William Daniel Conybeare, he was able to utilise the newly published one-inch Ordnance maps for Pembroke (1818) and Haverfordwest (1819). He records how Conybeare had earlier been defeated in his attempt to geologically survey the region for want 'of any thing deserving the name of a map'. With respect to the Ordnance maps, De la Beche felt bound to state that 'it is scarcely possible to appretiate too highly the assistance which this and the other parts of that splendid survey of England are calculated to afford to the geologist' (De la Beche 1826). The geological map that accompanies his paper (Fig. 8) is at a scale of just over two miles to the inch, and uses as its basis a redrawn and simplified version of the Ordnance map. Many years later, on the occasion of De la Beche being awarded the Wollaston Medal, the President of the Geological Society, W. J. Hamilton, was to commend this map 'in which I think we may trace the commencement of that system of geological illustration which he has subsequently perfected in the maps of the Ordnance Geological Survey' (Hamilton 1855).

Trouble in Jamaica ... and at home

In November 1823 De la Beche visited his estate in Jamaica, prompted perhaps by British government recommendations made earlier that year for ameliorating the condition of slaves employed in the British West Indian sugar plantations (Deerr 1950, 303). The government's ultimate aim was the gradual abolition of slavery, so it was unsurprising that its proposals were violently resisted by the West Indian planters, leading in turn to unrest among the slave population. De la Beche may be seen as one of the more enlightened plantation owners, attending to the education and good treatment of his slaves. He published a small book on the subject, pointing out that 'the accidental circumstance of inheriting West Indian property' should not be taken to imply that he supported slavery (De la Beche 1825; Sharpe 2008). He was there for just over a year, while his wife and child remained in England.

Figure 8. *Geological map of southern Pembrokeshire, surveyed by De la Beche in 1822 (from* Transactions of the Geological Society*, 1826).*



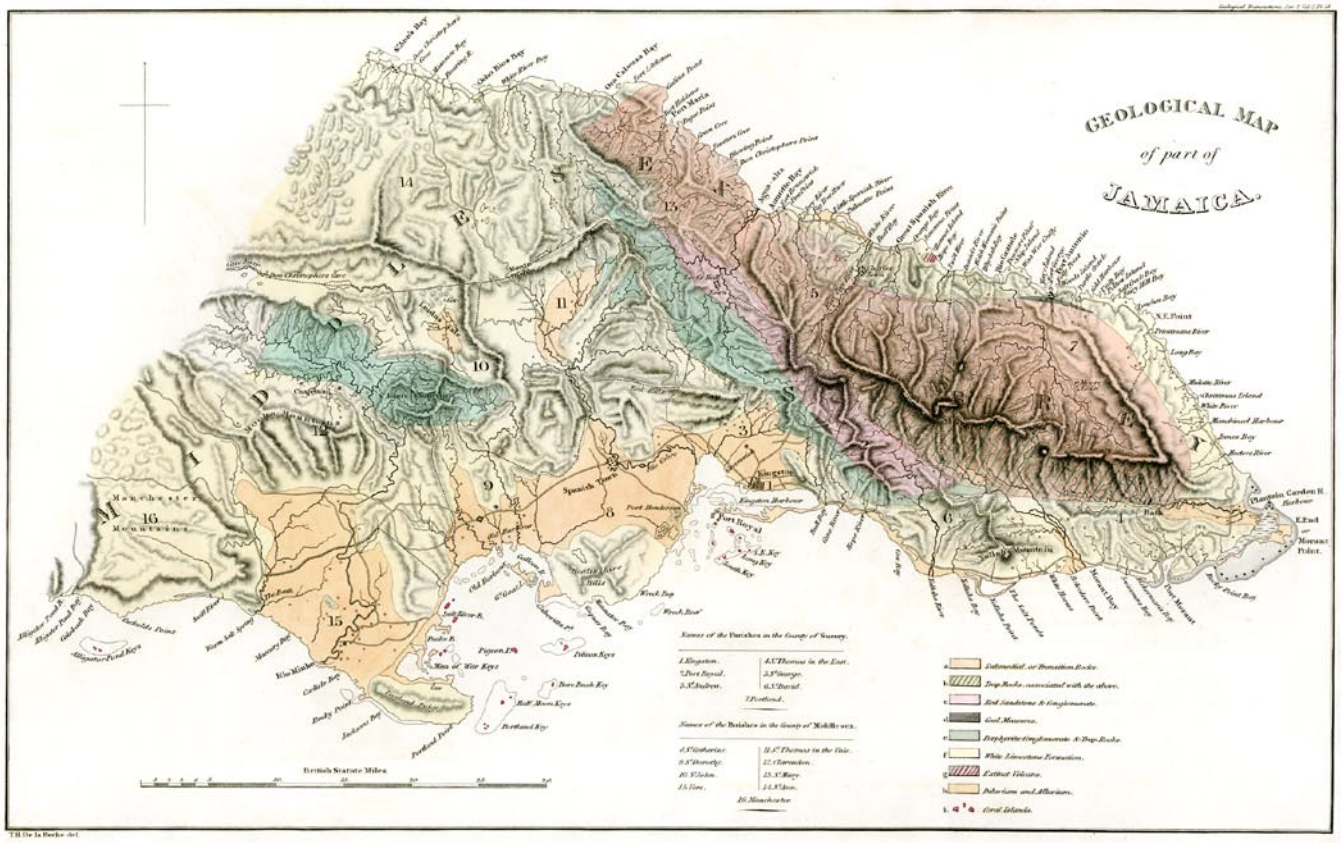


Figure 9. *Geological map of the eastern part of Jamaica, surveyed by De la Beche in 1824 (from* Transactions of the Geological Society*, 1827).*

In between attending to his business affairs and the welfare of his workforce, De la Beche took time out to study the geology of the island (Chubb 1958), the result of which was a detailed memoir in the Geological Society *Transactions* (De la Beche 1827). It stands as the first systematic account of the geology of any part of Jamaica and is accompanied by a geological map of the eastern half of the island (Fig. 9). In later years De la Beche came to be an authority on scientific matters relating to the island and is today celebrated as the father of Jamaican geology. Some months after his return to England, in 1825, he was confronted by a request from his wife for a legal separation, and in the following year he obtained a divorce in the ecclesiastical court. It appears that De la Beche had not placed sufficient trust in Letitia and had used 'hasty expressions ... being such as to render it impossible for her to live with him' (McCartney 1977, 26). Their daughter Bessie remained in her father's care and lived with her grandmother at Lyme Regis when De la Beche was away.

Despite his domestic troubles, De la Beche conducted further geological investigations of the Dorset and Devonshire coast. He subsequently read two papers before the Geological Society. The first, in December 1825, discussed the Chalk and Upper Greensand in the vicinity of Lyme Regis and Beer; it was followed in November 1827 by a paper 'On the geology of Tor and Babbacombe bays, Devon' (Fig. 10). The latter, as published in the *Transactions* (De la Beche 1829), includes a small geological map at a scale of about two miles to the inch, the topographic base for which was redrawn from part of Ordnance one-inch sheet 22.

During 1827 De la Beche suffered a decline in his health, possibly brought on by the strain of separation and divorce. To escape the northern European winters, he undertook two further tours of the Continent, the second of which was concluded in June 1829 (McCartney 1977, 26-7). Over the next two years he published numerous papers and several books, including his widely acclaimed *A Geological Manual* (1831). This book went into three English editions, followed quickly by French, German and American editions. These successes, however, were to be overshadowed by further problems in the West Indies which would oblige De la Beche to relinquish his status as a gentleman of independent means and assume the role of a government employee.

Figure 10. *Sketch by De la Beche showing folded Carboniferous Limestone near Torquay, south Devon (from* Transactions of the Geological Society, *1829).*

Beginnings of the Geological Survey

In 1830 De la Beche began a more systematic geological examination of south Devonshire utilising the Ordnance one-inch map as a base. His detailed notes, together with sections, may be found in a notebook preserved in the Library of the British Geological Survey (GSM 1/123). The region covered by these recorded observations is confined largely to Ordnance sheets 22 and 23 (see Fig. 15 below). The area previously mapped around Tor and Babbacombe bays was now revisited and fleshed out in greater detail. This was for De la Beche a recreational activity that depended on his receiving a regular income from his plantation in Jamaica. But by 1831 this was in jeopardy. For some years the price of sugar had been declining steadily, due in large part to overproduction. This excess was most notable in Cuba, where sugar production more than doubled in the years between 1829 and 1836. In 1831 the average price of raw sugar fell to a lower level than at any time previously. Many plantations in the English colonies, including De la Beche's, were by this time heavily mortgaged, causing yet more distress to the owners (Deerr 1949-50).

It remains unclear whether, as De la Beche was to claim, he began the geological mapping of whole Ordnance map sheets purely for his own recreation, or whether this was done from the start with an eye to selling the idea to the Ordnance Survey. He was in regular correspondence with Élie de Beaumont, who at this time was engaged in mapping the geology of France at government expense. Thus the French geologist wrote to him in May 1830 with the news that he was then engraving the map of France (Sharpe & McCartney 1998, item 492). Whatever his reasons, the year 1831 saw De la Beche pressing ahead with his fieldwork in south Devonshire, driven by a sense of urgency that kept him there through the rainy months of late autumn.

Mapping Devonshire, 1832-35

On 28 March 1832, De la Beche addressed a letter to the Master General of the Board of Ordnance with a proposal 'for supplying the data for colouring Geologically eight Sheets of the Ordnance Map of England, viz. Nos. 20, 21, 22, 23, 24, 25, 26 & 27, comprising Devonshire, with parts of Cornwall, Somerset, & Dorset' (GSM 1/68, 44-8). De la Beche took care to address his proposal from the offices of the Geological Society, of which he was then Secretary, thereby ensuring that it would receive serious consideration. The proposal ran as follows:

'Having applied myself to the Study of Geology for many years and having directed much of my attention to the Geological relations of this my native country … and being convinced of the great practical utility of what I am about to propose, I offer no apology for intruding myself on the notice of your Hon^{ble} Board with a view to obtain the completion of an undertaking which has for some time past occupied much of my time and attention; one that I had set out with the intention of accomplishing at my own proper cost, but in which I am defeated by the failure of certain funds I had intended to apply to that purpose. I am induced therefore to offer to your Hon^{ble} Board the fruits of my labours at a price that I am well assured will be considered *very moderate* knowing as I do that it will be much below the sum they will have cost me when completed. ... For the sum of £300, I undertake, within two years from the present time, accurately to determine for the use of the Ordnance solely the Geological structure of the district comprised within the eight sheets specified above and to lay down the detail accurately to scale and properly coloured upon each of those sheets, in so clear and intelligible a manner as to admit of its being readily transferred upon the Ordnance Copper Plates. I will also attach to the margin of each sheet an index scale of colours descriptive of the rocks and beds comprised within it.'

De la Beche followed this with a detailed cost benefit analysis. Thus, for an Ordnance sheet currently retailing at 12 shillings, the addition of geological data would increase the selling price by a further 2 shillings. He had little doubt that the Ordnance would fully recover its costs on the sale of these maps, and saw every prospect that the work would confer 'a great benefit on a Science that is every day increasing in interest and importance', while the resulting maps 'would be of great practical utility to the Agriculturalist, the Miner, and those concerned in projecting and improving the Roads, Canals, and such other public works, undertaken for the benefit and improvement of the Country.'

De la Beche had already completed the geological mapping of Ordnance sheet 22 (Fig. 11) at the time of writing his proposal. It was probably this sheet also that he despatched to Élie de Beaumont, who thanked him in a letter dated 8 April 1832, expressing the hope that this initiative would lead to the completion of the remaining sheets (Sharpe & McCartney 1998, item 497). Clearly, De la Beche must have been confident of a successful outcome.

The Board forwarded the proposal to Lt-Col. Thomas Colby, Superintendent of the Ordnance Survey (Fig. 12), for his opinion. De la Beche's proposal fitted well with Colby's ambition to increase the utility of Ordnance maps by the addition of geological information as was already being tried, albeit with limited success, in Ireland. Colby was also cautiously encouraging his English surveyors to include geological observations on their maps, so long as it did not impede the progress of the topographical survey (Harley 1971; Murchison 1833, 446-7). He had even issued a 'Table of Letters and Colors by which the Rocks and Strata of most ordinary occurrence will be expressed' (Colby 1830). It therefore comes as no surprise that in his reply to the Board, dated 9 April, Colby acceded to the proposal, though on certain conditions: firstly, that the index of colours to be used should be referred to the Council of the Geological Society for their decision; secondly,

that De la Beche 'shall undertake, at his own cost and risk to publish all these indexes of Colors, Geological Sections, Memoirs, and other matters which may be necessary to illustrate the use of the Map where Geologically colored.' The sum of £300 would be paid in eight instalments of £37 10s upon delivery of a sheet geologically coloured for engraving (GSM 1/68, 52-3).

On 2 May De la Beche was formally invited to accept the Board's offer subject to the above conditions. In his reply to Colby he quibbled only at the necessity of referring his index of colours to the Council of the Geological Society, warning that a speedy decision would be unlikely and could only delay matters. Some formal consultation with the Society did however take place, and De la Beche discussed the matter privately with G. B. Greenough (a close friend and future ally) who was then preparing a second edition of his *Geological Map of England & Wales*. The two of them agreed a provisional scheme of colours, which De la Beche then applied to the finished sheet 22. This sheet he delivered to the Ordnance Map Office at the Tower of London on 9 May, the same day on which he formally accepted the Board's offer (GSM 1/68, 56-65, 83). Although impatient to begin fieldwork, he delayed his departure in order to attend a meeting of Council on 16 May, at which an agreement by committee was reached on the

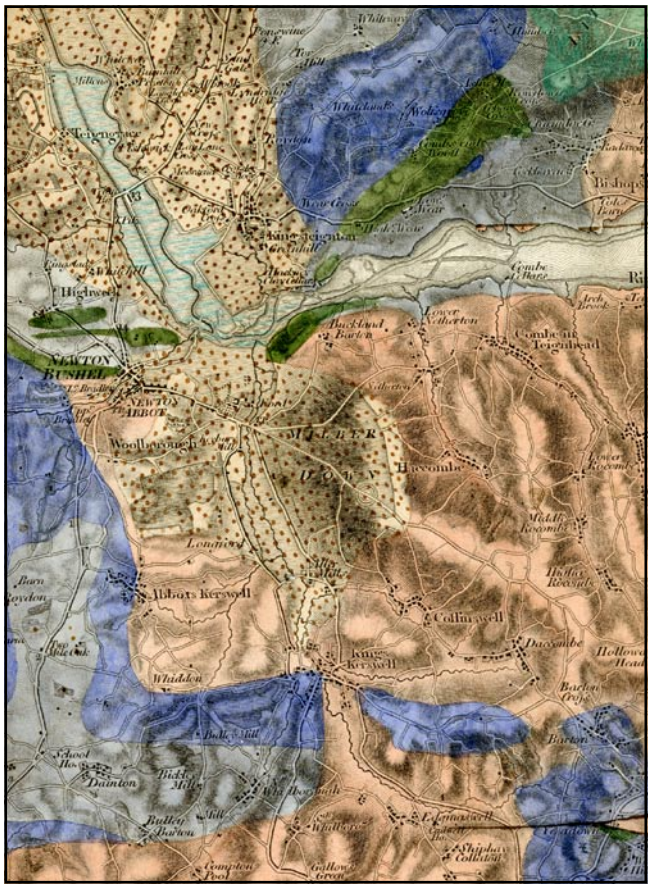


Figure 11. *Detail (Newton Bushel) from old series one inch geological sheet 22, south-east Devon, surveyed 1830-31, published 1834: the first Geological Survey map to be submitted for engraving (from De la Beche's own copy, BGS Library AM 1112 S, set A).*

Figure 12. *Thomas Frederick Colby, Superintendent of the Ordnance Survey, by William Brockedon, 1837 (© National Portrait Gallery, London).*

scheme of colours, as appears from a manuscript table of 16 colours preserved in the Library of the British Geological Survey (GSM 1/85; Woodward 1908). These colours were chosen to match the prevalent tints of the rocks themselves, a practice recommended by Abraham Werner of the Freiberg Mining Academy in Saxony, and advocated in Britain by Robert Jameson (Jameson 1811). William Smith had applied the same general principal in colouring his maps (Smith 1815).

Further deliberation on the scheme of colours appears however to have taken place during the winter of 1832, evidently because De la Beche discovered a need for additional colours during the course of mapping. The Council sought the advice of the sculptor and painter, Francis (later Sir Francis) Chantrey, a member of the Society well regarded for his experience in the applied arts (Cook 1987). The subsequent colour indexes issued by De la Beche may therefore owe something both to the Wernerian principal and to Chantrey's design sense, although the scheme would evolve in the years to come as more geological formations were identified and additional colours and patterns needed (Fig. 13).

No official correspondence survives from the two-and-a-half-year period during which De la Beche worked on the Devonshire sheets. However, in his February 1834 presidential address to the Geological Society, Greenough was able to report that 'Mr. De la Beche, one of our Vice-Presidents, acting under the direction of the Board of Ordnance, has produced a geological map of the county of Devon, which, for

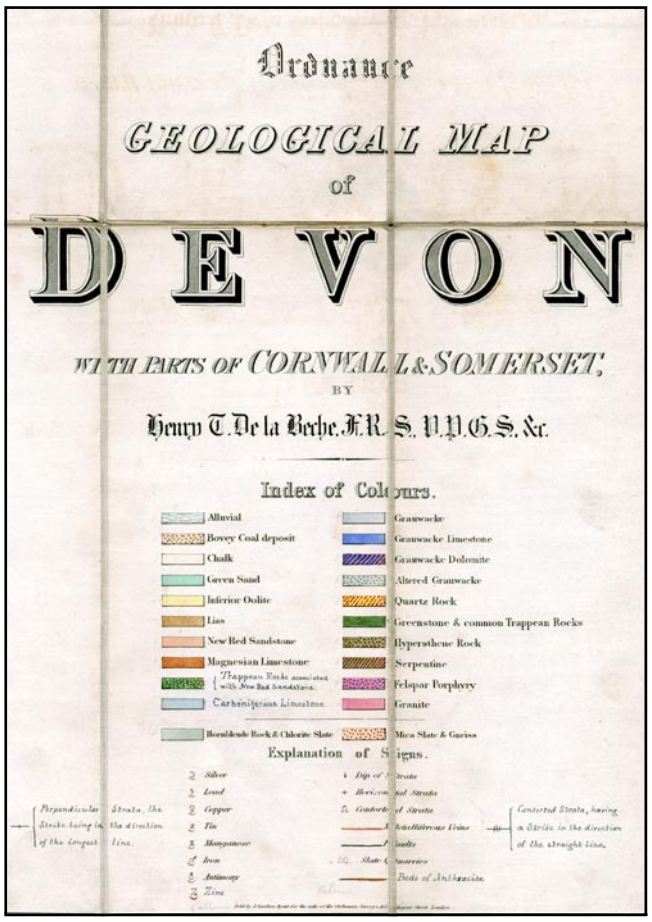


Figure 13. *First Index of Colours and Signs, pasted onto sheet 23 of the* Ordnance Geological Map of Devon *1834-5. This copy includes MS additions by De la Beche, made probably in the light of his re-examination of Devonshire in 1837 (BGS Library AM 1112 S, set A).*

extent and minuteness of information and beauty of execution, has a very high claim to regard' (Greenough 1834, 51). In his next address the following year we learn that 'The researches of your Vice-President in the counties of Devon and Somerset have been carried on this year [1834-35] with increased energy. Of the eight sheets of the Ordnance Map upon which he has been engaged, four were published last spring [probably sheets 22-25], three others are complete, the eighth is nearly complete, and an explanatory memoir with sheets of sections applying to the whole are to be published before our next anniversary.' Greenough had been carefully primed by De la Beche, and he ended with the plea: 'Let us hope that this work so admirably begun may not be suffered to terminate here' (Greenough 1835, 154; Rudwick 1985, 123-4).

The Ordnance Geological Survey, 1835

From the very start of De la Beche's survey there was an understanding that it might in due course be extended to other parts of the country. This understanding is reflected in the 1832 correspondence recorded in the Ordnance Survey letter books. It was also widely reported, prompting at least one provincial geologist to recommend his mapping skills to the Board of Ordnance. Thus, Dr Henry L. Boase of Penzance wrote to the Board on 30 June 1832 offering his services to 'delineate on your Map, the various rocks and the principal metalliferous veins of *Cornwall*' (GSM 1/68, 80-2). Colby advised the Board that it would be wise to defer a decision on Dr Boase's offer until the Devonshire survey had reached a more advanced state. In the event, nothing further seems to have transpired respecting this offer. Dr Boase's competency as a geological observer was brought into disrepute in 1834 following the publication of an ambitious *Treatise on Primary Geology* and the reading of a paper at the British Association meeting in Edinburgh, where he showed himself to be ill-informed about the difficulties of interpreting the older rocks of south-west England (Rudwick 1985, 88-9).

On 25 May 1835, De la Beche wrote to the Board to announce 'that the Geological Map of Devonshire, with portions of the adjoining counties ... executed in compliance with the order of the Honble. Board of the 2nd May 1832, is now completed...' In concluding his letter he expressed the hope 'that the Honble. Board will be pleased to examine the result of my labors; and if they shall find that it is desirable to continue the Geological Survey, I would willingly devote my time to the Geological examination of another portion of country' (GSM 1/68, 93). The Board wasted no time in calling upon the President of the Geological Society (at that time Charles Lyell), and two of its most prominent and respected members, William Buckland and Adam Sedgwick, to report on De la Beche's work and on the expediency of extending the survey to other parts of the country.

The Society's report, dated 12 June, was full of praise: 'Our opinion is that the execution of the geological survey of Devonshire is the result of great labour combined with great skill, and that no geological Map of such extent has been published in Europe equal to it in the minute accuracy of its details. We regard its publication as reflecting great honor on the Board of Ordnance, with whom it originated, and at the same time as a benefit to European Science. We are further of opinion, from this evidence, but still more from our personal knowledge of the unusual combination of qualifications which are united in Mr. De la Beche, that it would be highly honourable and useful to the Nation to continue his services, in the extension of a geological survey on one uniform system over other parts of Great Britain' (GSM 1/68, 98).

The report goes on to examine the economic advantages of good geological maps — these are: (1) to aid the search for coal and metals, and thereby reduce wasteful speculation; (2) to locate the best materials for making and repairing roads; (3) to indicate the situation in which water may be obtained at the least expense in sinking wells; (4) to assist in the construction of canals, rail-roads and tunnels; (5) to indicate where good limestone, brickearth and building stone may be

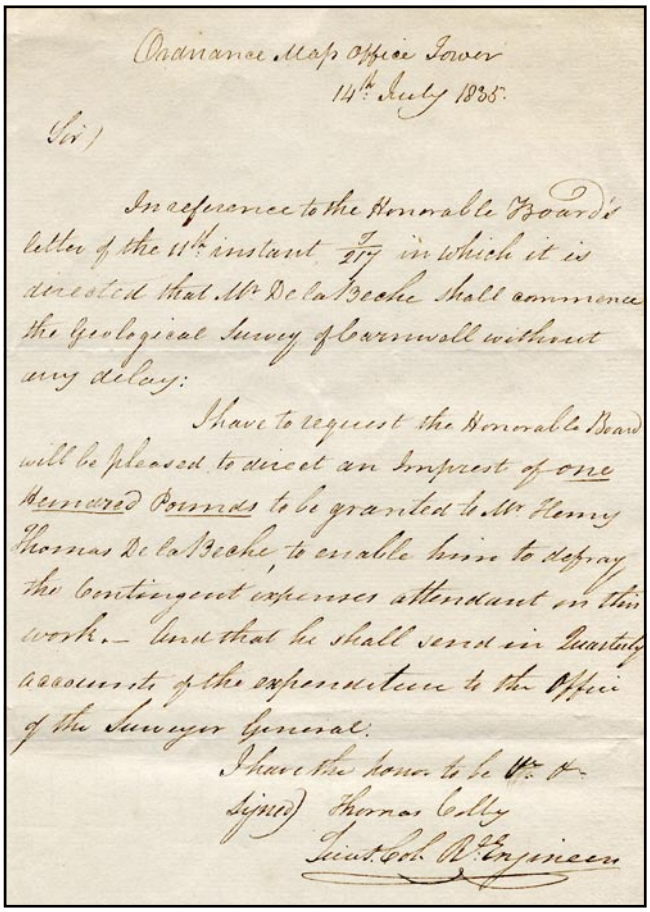
encountered; and (6) to support agriculture by pointing to the occurrence of lime, marl, gypsum and other materials for the artificial improvement of soils. The foregoing is expressed in similar terms to that of an undated note written by De la Beche some time before 1835 (North 1936, 47-8).

In terms of organisation, the report advised the establishment of a subordinate branch of the Ordnance Survey under the control of Thomas Colby, consisting of De la Beche and any assistants that might be considered expedient. It was recommended (on the advice of Colby) that De la Beche receive a salary of £500 per annum, together with £1000 to cover the appointment of assistants and for defraying other contingent costs. On 18 June the Master General of the Board of Ordnance gave approval for the recommendations to be carried forward for Treasury authorisation. The Treasury responded favourably on 30 June, stating that 'they will cheerfully give their sanction to any measure which may facilitate so desirable a result, if it can be obtained at a moderate expense.' With this last consideration in mind the Treasury not unreasonably asked the Board for an 'Estimate of the *time* which they consider will be required for the entire completion of the whole undertaking' (GSM 1/68, 107). The question was therefore referred to De la Beche, who replied on 4 July that 'In answer to your question respecting the *time* required to complete the Geological Survey of Great Britain, I beg to state ... that depending as it must do upon the amount of competent aid which I may receive ... I consider that the Geological Map will keep pace with the Geographical Map, and consequently that both Maps will be completed at the same time' (GSM 1/68, 113).

Unsurprisingly, the Lords Commissioners of the Treasury were not about to be disarmed by a cleverly evasive response. Francis Baring, Secretary to the Treasury, asked De la Beche privately for an estimate of the time required 'to perfect the Geological Survey of that part of England and Wales which has already been completed by the Ordnance.' De la Beche replied that it would take 21 years to survey the current 66 Ordnance sheets, assuming that he worked singly and was unassisted. If, however, he received the aid of two or three competent assistants, as was envisaged, and was able to purchase local information as occasion might require, he could complete the geological mapping of the published part of the Ordnance Map in only seven years. On this basis he estimated that, with the necessary aid, 'the Geological Map of England and Wales may be completed in about 10 years' (GSM 1/68, 119-20). It would be surprising if De la Beche believed this to be a realistic estimate, and he certainly changed his mind a few years later.

Behind the scenes, De la Beche was doing everything he could to ensure a successful outcome to the Treasury decision. He asked Sedgwick to use his personal influence with both the Marquis of Lansdowne, Lord President of the Council and a prominent supporter of science, and Thomas Spring-Rice, Chancellor of the Exchequer. His financial situation had worsened during 1833-34 owing to a further decline in the value of West Indian property, while his fee for the Devonshire survey had not even covered his expenses (Rudwick 1985, 103, 125). De la Beche's livelihood was now very much in the balance.

Relief arrived when De la Beche was forwarded a written communication from the Board of Ordnance, dated 11 July 1835 and addressed to the Inspector General of Fortifications (under whose control the Ordnance Survey resided), which informed him that the Treasury had sanctioned a 'Geological Survey of Cornwall.' The Lords Commissioners still felt that his estimate of expenditure for the whole survey was 'insufficiently ascertained', but hoped that a better estimate of the annual rate of progress and expense might be obtained following the completion of the Cornish survey (GSM 1/68, 117-8). With this letter of appointment the Geological Survey as an institution may be said to have been born (Fig. 14). As a branch of the Ordnance Trigonometrical Survey it assumed the title of 'Ordnance Geological Survey,' under the overall control of Lt-Col. Thomas Colby.



Ordnance Map Office Tower
14th July 1835.

Sir,

In reference to the Honorable Board's letter of the 11th instant No 917 in which it is directed that Mr De la Beche shall commence the Geological Survey of Cornwall without any delay:

I have to request the Honorable Board will be pleased to direct an Imprest of one Hundred Pounds to be granted to Mr Henry Thomas De la Beche, to enable him to defray the contingent expences attendant on this work. — And that he shall send in Quarterly accounts of the expenditure to the Office of the Surveyor General.

I have the honor to be &c &c

Signed Thomas Colby
Lieut Col. R.E. Engineers

Figure 14. *De la Beche's copy of a letter from Colby to the Office of Ordnance, requesting an imprest of £100 to be granted to De la Beche in respect of his appointment on 11th July 1835 (Reproduced courtesy of the Department of Geology, National Museum of Wales, NMW 84.20G.D.261).*

Controversy and consolidation

Henry Thomas De la Beche, at 39 years of age, now saw himself set on a course that would lead ultimately to a 'Geological Survey of Great Britain' (GSM 1/68, 121). Yet the future of the fledgling Survey was by no means assured, for the seeds of future trouble had already been sown several months earlier. Between 1834 and 1839 De la Beche became embroiled in a major scientific controversy that would have far-reaching repercussions.

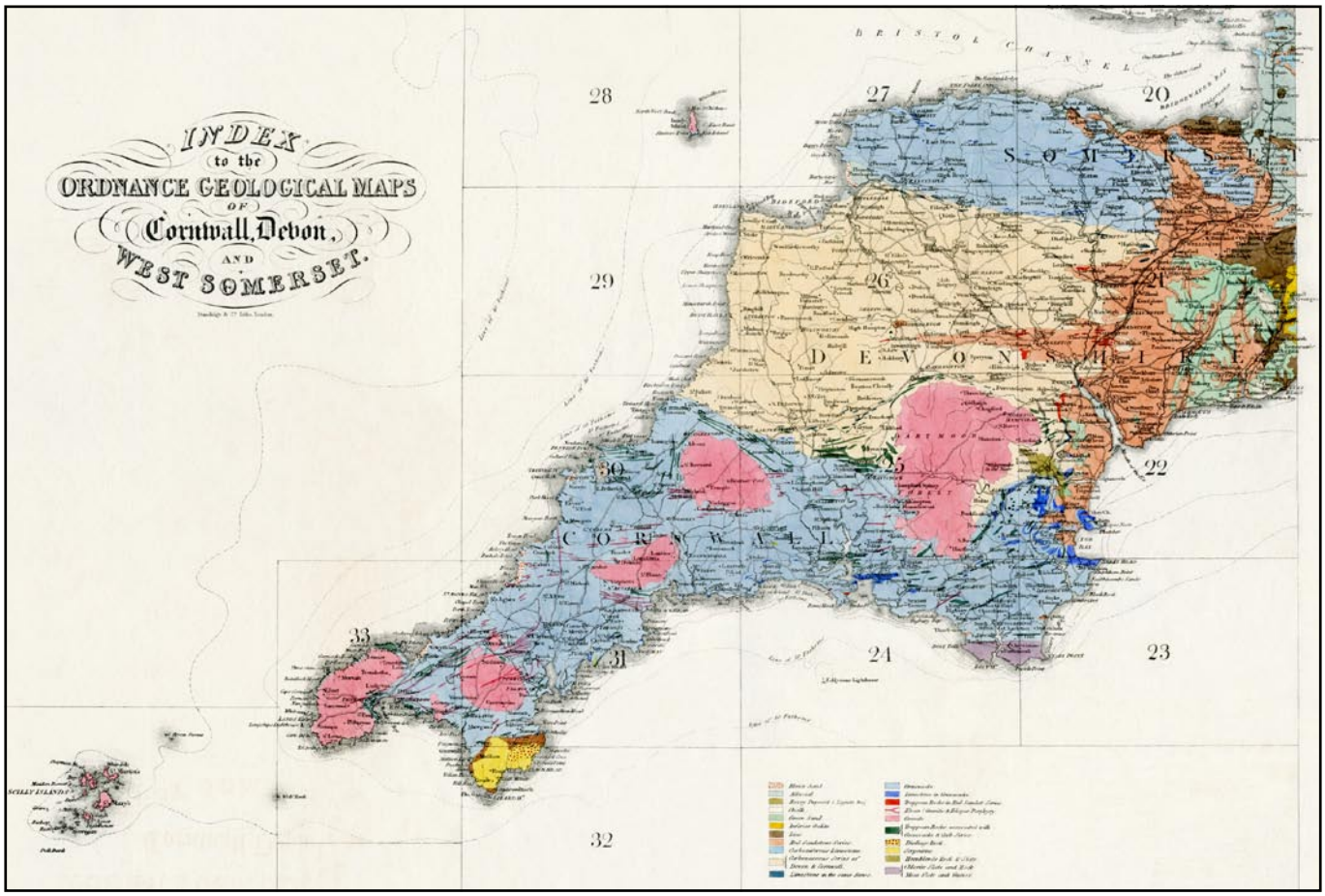
In the late summer of 1834, while working on sheet 26 of the Devonshire survey (Fig. 15), De la Beche collected some fossil plants in strata closely associated with culm, an inferior coal, near Bideford in north Devon. He arranged for these to be identified by John Lindley, then the foremost authority on palaeobotany, who pronounced them all to be of plant species well known in the Carboniferous Coal Measures. This surprised De la Beche, who expected only a rough affinity, for in his view the immense thickness of otherwise poorly fossiliferous slaty mudstones and sandstones within which the coal seams occur could only belong to the so-called Transition or Greywacke strata below the Old Red Sandstone, and thus well below the Carboniferous.

Figure 15. *Index map from De la Beche's* Report on the Geology of Cornwall, Devon, and West Somerset, *1839, showing the constituent one-inch sheets.*

Devonian Controversy

De la Beche arranged for a short notice of his findings to be read at a meeting of the Geological Society in December of that year (De la Beche 1834). His contention that the plant remains came definitely from the Greywacke, and were thus pre-Carboniferous, caused heated debate. In opposition to this, Roderick Murchison, whose view was supported by Charles Lyell, insisted that the fossil evidence established a clear correlation between the 'Culm' strata and the Coal Measures. In accepting the value of 'characteristic fossils' as a means of determining the relative age of rock formations, Murchison was unconditionally advocating the precepts laid down by William Smith. Yet Smith's views were far from being widely accepted at that time.

The significance of this argument, which dragged on for several years, was not only of academic interest, but had important economic implications. Murchison was keen to demonstrate that land plants, the raw material of coal, did not exist before the Old Red Sandstone, and thus it was futile to search for coal deposits in rocks of Transition or Greywacke age. De la Beche's insistence on the existence of Greywacke plants undermined this argument. However, even Murchison was not prepared initially to regard the whole of the Culm succession as Carboniferous in age, and was convinced that De la Beche had somehow overlooked a major unconformity.



At the annual meeting of the British Association at Bristol in August 1836, Murchison, with Adam Sedgwick, put forward a fundamentally different interpretation of the structure and position of the Culm strata of Devonshire. It was a severe blow to De la Beche's integrity as a field observer. Furthermore, some influential figures were present at the meeting, including Spring-Rice, the Chancellor of the Exchequer. De la Beche now became concerned that this public criticism of his work might prejudice the future of the Survey. In a letter to Sedgwick he expressed his fears that the government's continuing patronage of science, and in particular of geology, was a sensitive point because 'they have been so often jobbed, and infernally jobbed, under the old systems, that they are always afraid of being jobbed again' (Rudwick 1985, 175). He may have had John MacCulloch's recently published *Geological Map of Scotland* in mind (Fig. 6), a map whose compilation had cost the Treasury an exorbitant sum of money. De la Beche's depressed state of mind at this time is conveyed in a sketch that he sent to his daughter, Bessie (Fig. 16).

The Survey under attack

In February 1837, following some further acrimony between De la Beche and Murchison, the latter began to put about that he considered De la Beche to be grossly incompetent as a government surveyor (Rudwick 1985, 202). These accusations reached official ears, with the result that on 3 April Colby despatched a letter to De la Beche informing him that 'extremely unpleasant but not tangible reports of the inaccuracy of your Geological Survey are in circulation' (GSM 1/68, 198-9). As things stood, the geological survey of Cornwall was due to be finished by the end of June 1837, and De la Beche had already submitted cost estimates and received approval from the Treasury for an extension of the survey into the South Wales coalfield — curiously, the Treasury made no allusion to the unresolved question of the total expenditure and time that would be required to complete the geological survey of Great Britain, although the matter would resurface in 1839. Colby now recommended that priority be given to the publication of a full report on the geology of Devon and Cornwall, De la Beche having so far delayed publishing anything on the former until he had completed his mapping of the latter.

In his reply to Colby, De la Beche could only complain that 'I have personal enemies, and unfortunately it is equally clear that they are actively employed against me. While I toil day after day without rest, endeavouring to do my duty to the public and to return zeal and the best use I can make of my abilities for the confidence reposed in me, they can, and it appears do, buzz their accusations about, not neglecting the quarters when they conceive they can do me the most mischief, so that do what I will I have no chance' (GSM 1/68, 200-1). His letter finished on an ominous note: 'My feelings tell me I should resign, but I would prefer an inquiry' (his threat of resignation was omitted from the Ordnance Survey letter book, probably at Colby's request, but the original letter survives: NMW 84.20G. D.378). Close allies advised De la Beche not to think of resigning, and he was soon urging his good friend Greenough to lobby in influential quarters on his behalf (Rudwick 1985, 203-4). This potential threat to De la Beche's livelihood quickly subsided, thanks in part to the efforts of Greenough. Indeed, the episode had a beneficial outcome, since Colby now conceded that the memoir on Devon and Cornwall should be published by the government and not at De la Beche's personal expense as originally proposed (GSM 1/68, 203).

De la Beche spent about a month in the autumn of 1837 re-examining parts of Devonshire in order to resolve some of the issues raised by the Devonian controversy. In December of that year he moved his base of operation to Swansea in the South Wales coalfield. February 1839 saw the publication of the Survey's much-awaited first memoir: *Report on the Geology of Cornwall, Devon, and West Somerset*, a substantial work of 648 pages with folding map, sections and plans (it was without a detailed index, this being issued separately in 1903). A revised version

Figure 16. *Sketch by De la Beche in a letter to his daughter, Bessie, dated Jan 1837. He shows himself looking disconsolately out of the window of his lodgings in Cornwall, while outside the heavy winter rain pours down. Note the picture on the wall, and another above his head, both of which show two figures boxing –an allusion no doubt to the Devonian controversy. The meaning of the two mice is less clear! (Private collection, reproduced courtesy of the Department of Geology, National Museum of Wales).*

of the eight sheets of the one-inch geological map of Devonshire appeared in the same year. De la Beche had by this time conceded to the separation of the Culm from the remainder of the 'Grauwacke' (he employed the original German form of the word), but was still unprepared to accept a Carboniferous age, preferring instead to designate the Culm lithologically by the term 'Carbonaceous Series.'

Resolution

Despite De la Beche's reservations (or stubbornness!) a Carboniferous age for the Culm became increasingly difficult to deny as more 'characteristic' fossils came to light towards the end of the 1830s. In March 1839 Murchison resolved the difficulty of accommodating the great thickness of associated Greywacke, which he had wrongly assumed to be unconformable with the Culm, by correlating it with the Old Red Sandstone whose lithology and organic remains is otherwise quite dissimilar. In a joint paper with Adam Sedgwick, Murchison grouped these two series into a newly erected Devonian System. In the Welsh Borders it was clear that the Old Red Sandstone lay between the Carboniferous Limestone above it and the formations of Murchison's recently erected Silurian System below. But the similar age of the Devonshire Greywacke only became apparent because its fossils exhibited affinities that were intermediate in character between those of the Carboniferous and Silurian Systems.

Charles Lyell considered 'the culm question' to be one of the most important theoretical issues ever to be discussed at the Geological Society (Rudwick 1985, 195-6). The resolution of the Devonian controversy proved to be of global geological significance. It firmly established the value of fossils as stratigraphic markers, founded on an acceptance of organic change over time, although the manner and mechanism of this change had yet to be explained in terms of Darwinian evolution — that particular controversy was still to come!

Consolidation

Immediately following the publication of his *Report* in early February 1839, De la Beche made an application to the Board of Ordnance for the appointment of Geological Assistants. Since 1835 he had worked largely on his own, with some limited assistance from two geologically-minded Ordnance Surveyors (Henry McLauchlan and Henry Still). The Geological Society's generous recommendation of a contingency fund for the employment of assistants, made in its 1835 report, had never been fully acted upon. The Board responded testily, and once again pressed De la Beche for an estimate of the total cost and time involved in completing the whole survey. In his reply, De la Beche attempted to explain the difficulty of making such an estimate, given the varied geological complexity and economic development of the different regions of the country. Though exasperated at De la Beche's unwillingness to provide the required information, the Board nevertheless felt compelled to accede to his request, though only after further prompting from Colby. With respect to the annual allocation of funding, it was simply agreed 'from year to year to take such a sum as may be deemed advisable' — and so it was left at that! (GSM 1/68, 282-98). On 17 April 1839, David Hiram Williams was appointed as the first Geological Assistant, soon to be followed by others. From this moment onward, De la Beche had effectively secured the long term future of the Geological Survey.

De la Beche was knighted in 1842, and died while still in service in 1855. Ironically, the person who succeeded him as Director-General of the Geological Survey was his old former adversary, Sir Roderick Impey Murchison, whose accession was to mark another impressive chapter in the Survey's history.

Acknowledgments

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