WILLIAM SMITH IN BATH - THE CRADLE OF GEOLOGY

Peter Wigley

The geology and landscape of the Bath area can arguably be considered to have been the cradle of geology, (specifically stratigraphy) due to the pioneering work of William Smith. Smith (1769–1839), was a geologist, surveyor and map maker; he was born on 23rd March 1769 at the Forge, Churchill, Oxfordshire, the son of John Smith (1735–1777), the village blacksmith, and his wife, Ann (1745–1807). He was educated at the village school, which he attended until about 1780.

In 1787 Smith became assistant to the land surveyor Edward Webb (1751–1828) at Stow on the Wold, learning to measure and value land. In 1791 the 22 year old Smith was directed by his employer to survey an estate near High Littleton in Somerset belonging to Lady Elizabeth Jones. He made the journey on foot from his employer's house in Stow on the Wold down to Stowey in Somerset, a distance of over 80 miles. During his assignment he lodged with a hospitable farmer at Rugbourne in the village of High Littleton (*see figure 1*).

Smith's first task on arriving in Somerset was to make a map of High Littleton, which is one of his earliest surviving maps. Lady Elizabeth Jones was a shareholder in the Mearns colliery which was very close to his lodgings at Rugbourne. His next task was to take him underground to make a survey and to value her investment (5/16 share) in that colliery. In 1792, he produced *A Sketch of the Land in H. Littleton about the Coalworks*. On this sketch he showed land owners, shaft locations, levels and inclines and on another map *Original Sketch and Observations of my first Subterranean Survey of Mearns Colliery* he depicted a more detailed survey of a particular shaft and incline.

The Mearns Pit was 300 feet (90 m) deep with steep inclines descending to 500 feet (152 m). Smith showed standings, (places where it was possible to stand upright), guggs (roadways), a twinway (two narrow parallel tunnels) and two additional shafts to the Little Vein at the base of the incline. The main incline follows the dip (slope) of the Great Vein coal seam. Smith's description of the workings gives a flavour of just how difficult conditions must have been. Coal bushels were winched up the steeper guggs, but along the twinway the tunnels were no more than 4 feet high and miners/boys had to negotiate them on hands and knees, dragging bushel-carts of coal chained to their waists. At the foot of the shaft the coal bushels were winched to the surface by a horse-drawn windlass. Smith was a well-built man so clambering about in the dark, wet tunnels must have been a challenge—this was geology down and dirty! At this time, it is fair to assume that Smith had little knowledge of coal seams and their associated strata but he seems to have learned quickly. He was greatly aided by the work of John Strachey (1671-1743) who, seventy years previously, had prepared some very astute geological cross-sections of the Stowey coal mines. The knowledge he gained in the Mearns Pit was to serve him well when he was later consulted on a number of mining enterprises including the Batheaston Pit to the east of Bath.

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Smith learned much from his experience at Mearns but it was later when surveying the course of the Somersetshire Coal Canal that he was to develop his pioneering geological concepts. The twin-branched Somersetshire Coal Canal was a summit level canal and for much of its course it maintained a constant level. Smith observed that along this level, strata were gently inclined to the east or southeast. Smith's nephew John Phillips tells us that Smith used the analogy of superposed slices of bread and butter to describe this (*see figure 2*) and records that "for in each of his leveled lines the strata of red ground, lias, and freestone came down in an eastern direction and sunk below the level, and yielded place to the next in succession". This observation became fundamental to Smith's concept of the strata and their order. *Figure 3* is part of a cross-section Smith published later in 1819 showing the strata in the vicinity of Bath.

In 1799 Smith left the Canal Company and at that time was living at Tucking Mill, a property he had purchased the previous year. He set up, in partnership with Jeremiah Cruse (1758–1819), as a land surveyor in Trim Bridge, Bath. Bath proved a fortunate location for the business, since so many of the landed gentry holidayed there. Between 1802 and 1805, his Bath shop was also the venue where his fossil collections were publicly displayed to fashionable visitors. In the 18th and early 19th centuries fossil-collecting was a popular pursuit but for Smith fossils were not just curiosities, his genius was that he realised that individual rock strata could be differentiated according to the fossils they contained. To quote his own words there was a "wonderful order and regularity with which Nature has disposed of these singular productions [fossils], and assigned to each class its peculiar stratum". Smith had developed a general law that the "same strata were found always in the same order of superposition and contained the same peculiar fossils". Based on this, Smith was able to construct a table of the strata according to their order of succession starting initially with the chalk and numbering them, in a continuous sequence, down to the coal. Smith later refined the table; part of a later iteration published in 1819 together with fossils engraved by James Sowerby is shown in *figure 4.* The original tabulation was dictated by Smith to his friends the Rev. Benjamin Richardson (1758-1832) and the Rev. Joseph Townsend (1739-1816) one evening after dinner at 27, Great Pulteney Street, Bath.

Armed with these fundamental concepts, Smith started to map the geology around Bath. His first attempt in 1799 used a circular map published by Taylor and Meyler as a base map. Smith coloured the map geologically showing the Oolitic limestone, Lias (Jurassic) and Red ground (Triassic). Although simple, the depiction of the geology is fairly accurate and, for the first time, Smith's use of graded tints for outcrops is evident (*see facsimile map, figure 5*). On a second circular map which is probably from around 1800, Smith clearly differentiated the Upper Oolite limestone from the Inferior Oolite limestone.

Smith went on to make a more detailed geological map of the county of Somerset using a one inch to one mile map by Day and Masters (1782) and later maps of other English Counties. However in 1815, Smith produced *A delineation of the strata of England and Wales, with part of Scotland*. This gargantuan undertaking was considerably aided by John Cary (1754-1835). Cary worked from London as a mapmaker, engraver and publisher; he produced the base map which Smith used and also published the completed map. The map was at a scale of 5 miles to 1 inch and published in 15 sheets, each of which were individually hand coloured. Smith used a graded shading technique to represent the individual strata which gave an almost three-dimensional quality to the map (*see figure 6*). The colouring technique was both time consuming and costly; Smith, much to the annoyance of Cary, rejected many of the efforts of his colourists. The 150 or so 1815 maps in existence show a number of variations both in tinting and geologic content (*see figure 7*). Smith's map was liberally plagiarised by the first President of the Geological Society, George Bellas Greenough (1778-1855) who published a similar geological map in 1819.

Sales of Smith's own map were poor, in part due to the competing Geological Society map. Smith's financial position was always precarious, mostly due to his investment in a quarry at Kingham Fields and a rail-road he had constructed to bring stone down to a sawmill close to Tucking Mill. In an attempt to raise money he sold his fossil collection to the British Museum but in spite of this he was ultimately imprisoned for debt.

Figure 1

Figure 2

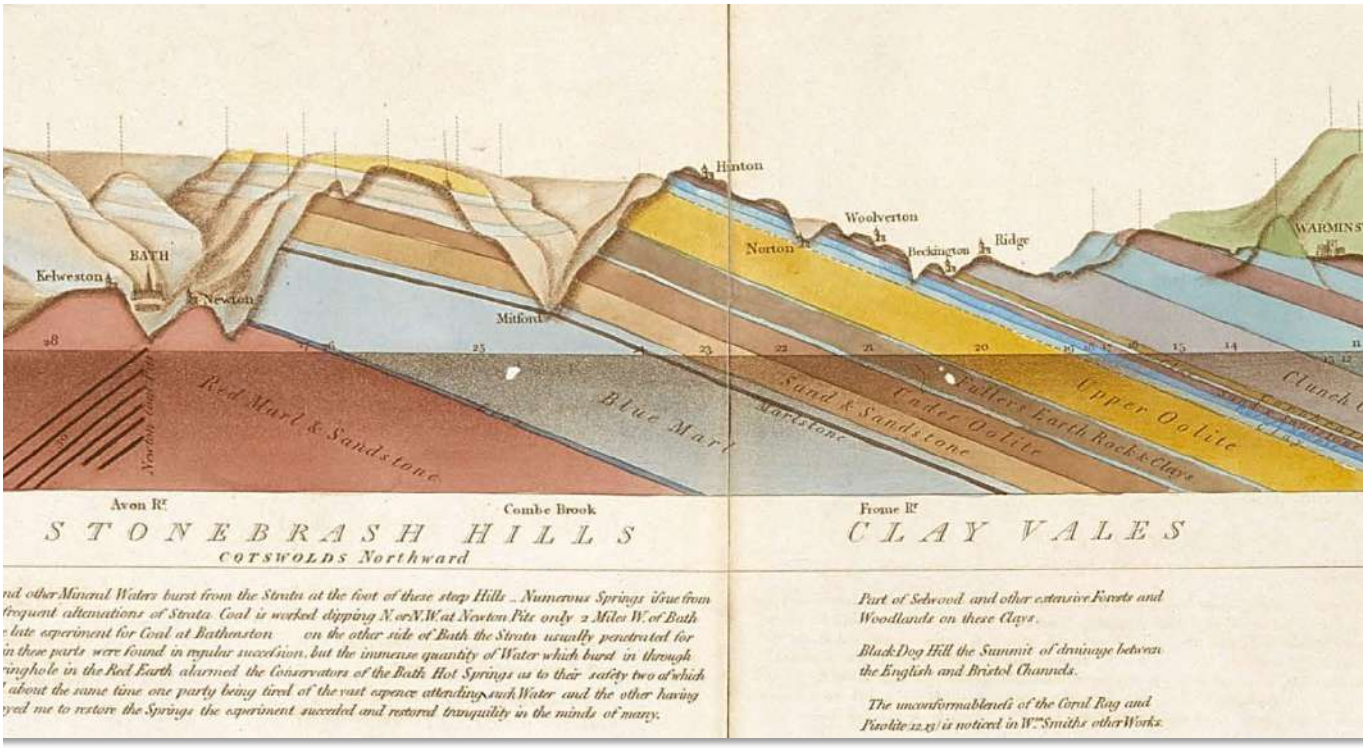


Figure 3

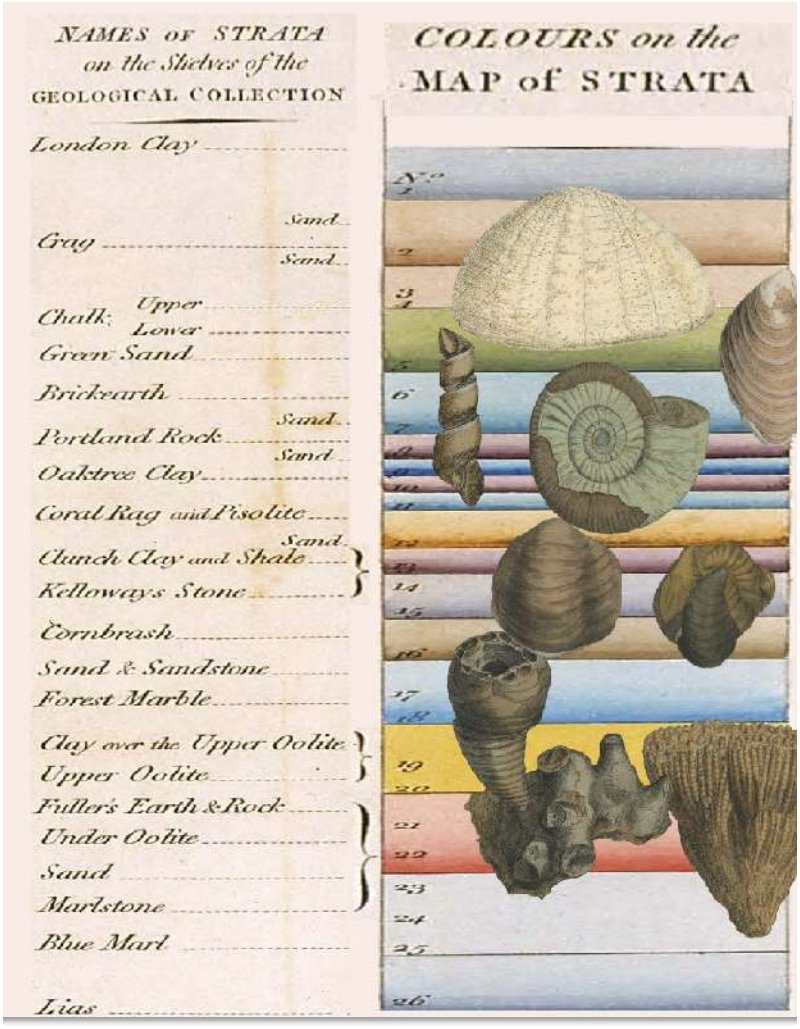
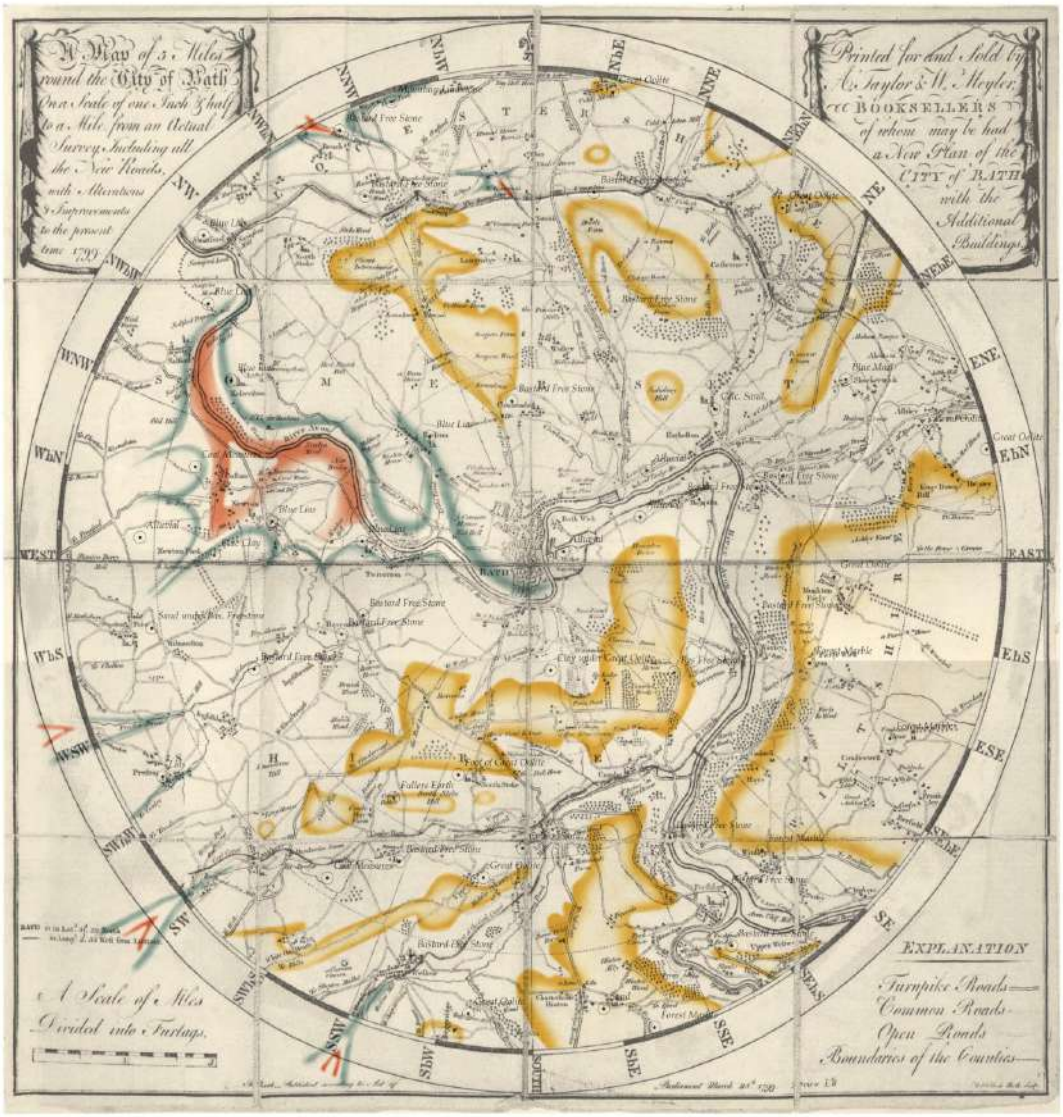


Figure 4



(Facsimile by P Wigley)

Figure 5

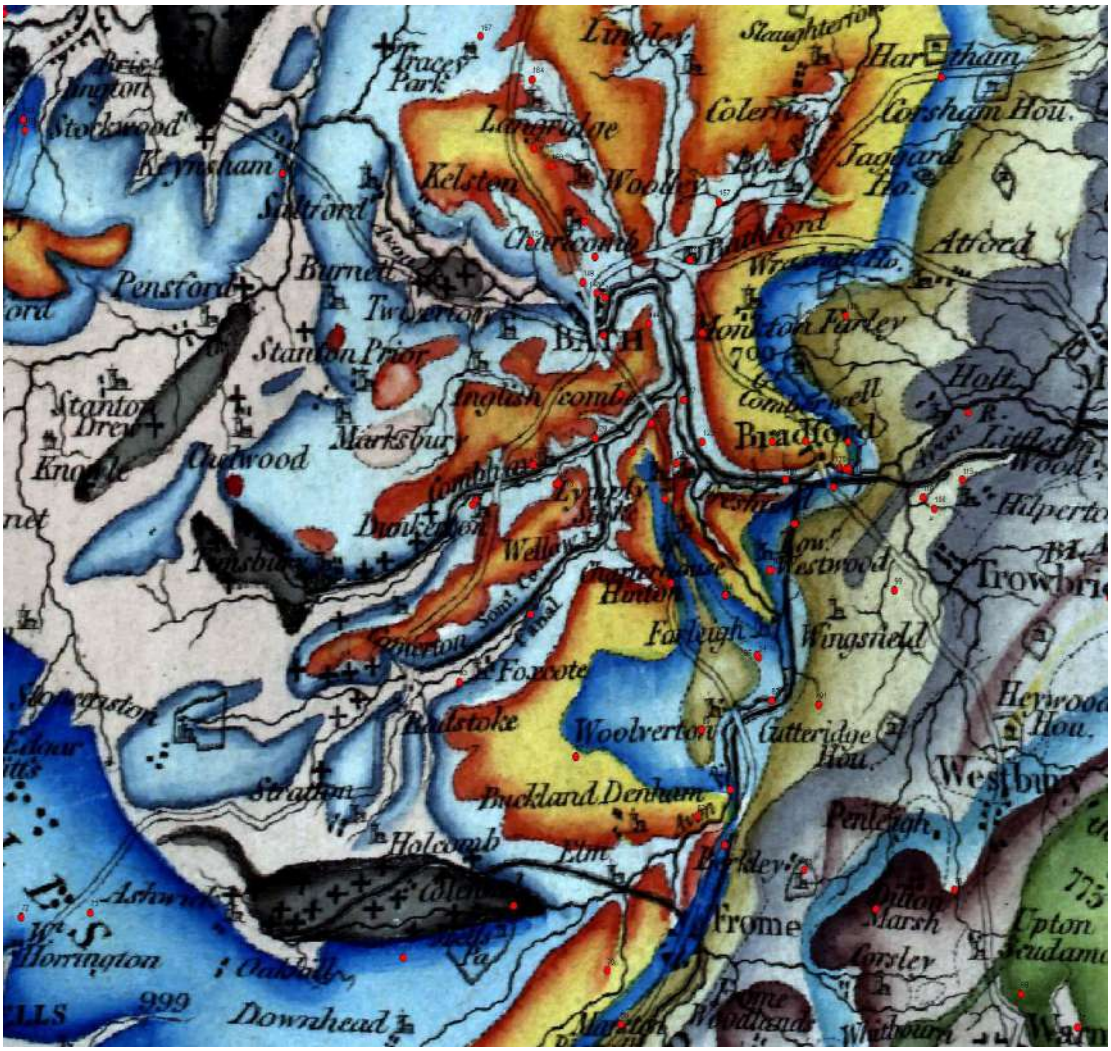


Figure 6

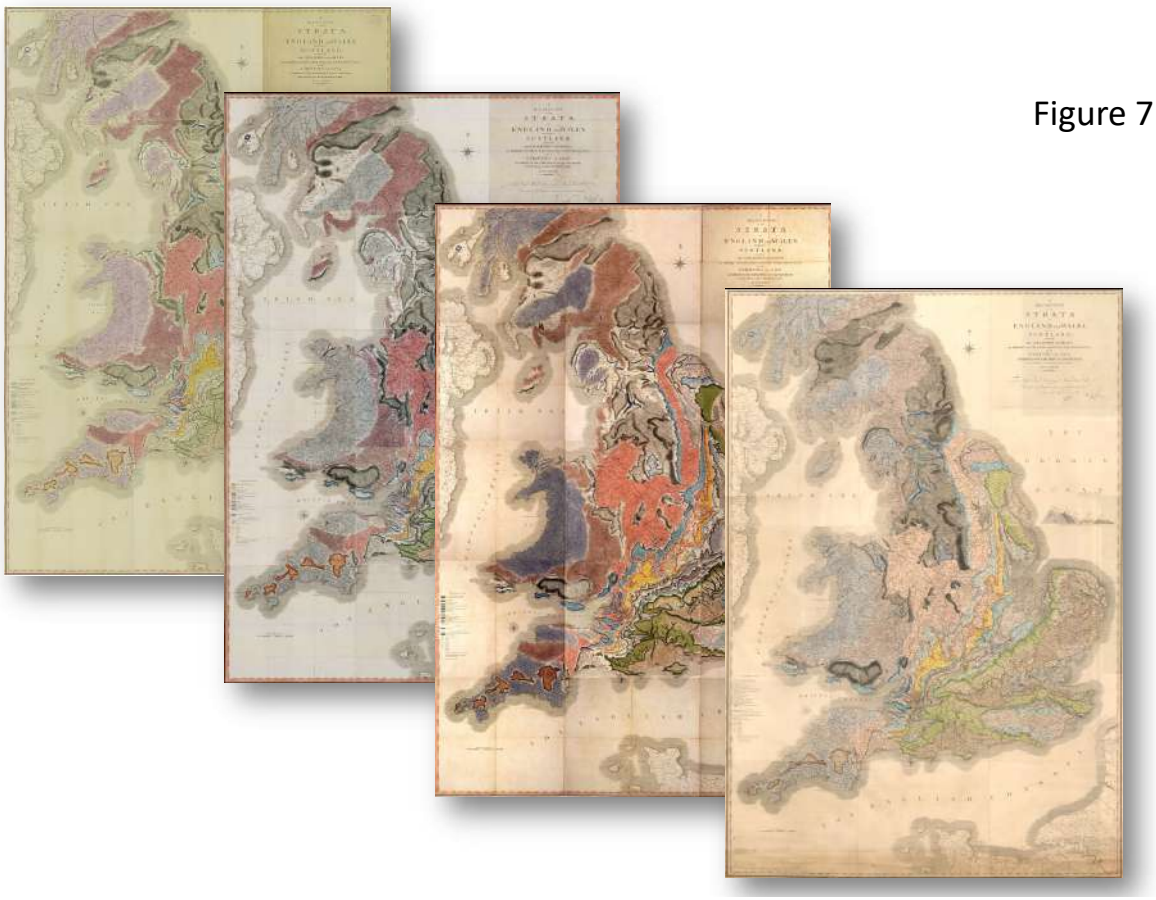


Figure 7

It is worth remembering that although Smith was a great geologist, geology did not always pay the bills and Smith often had to earn a living in other ways in order to subsidise his first love. In 1799, the weather was unseasonably wet and caused numerous landslips in the Bath area. This afforded Smith the opportunity to supplement his income by advising on slippage and subsidence. Smith's friend the Rev. Richard Warner (1763–1857) had a house on the east side of Lyncombe Vale. The house had previously been called Hanging Lands House because of its precarious situation on the steep slope under the scarp. Warner had enlarged the house but because of its location and the fact that it was on the Fuller's Earth (an unstable clay), the house experienced slippage and subsidence which Smith sought to correct. Smith realised that springs in the Fuller's Earth immediately beneath the Upper Oolite limestone were often the cause of slippage. In an uncompleted preface to a proposed 1801 publication Smith says "Many of these slips, containing more than an acre of ground (in consequence of the late rainy seasons), have put on appearances rather alarming to some of the possessors of land and houses in the neighborhood. I have seen new buildings in the neighborhood of Bath which have been cracked from top to bottom in consequence of these movements." He goes on to chastise house owners for choosing a charming view for their houses over a house foundation on solid ground. Smith also described another example at Combe Grove where buildings were in a dangerous state due to slippage. In this case the building was on the Upper Oolite and he says "I am of opinion, that the whole of this beautiful place, in a few years, must inevitably fall a sacrifice to the irresistible pressure of the rocks moving down upon it". In what may be a description of the same building, again, in his incomplete preface, he says that he put sticks into the cracks in the building in order to measure how fast the cracks were enlarging.

His solution was to tunnel into the hill and intercept the springs which apparently stopped any further damage. Smith's other activities included land drainage and improvement, sea defences and sinking wells.

Smith achieved much during his time in Bath. The Mearns experience had given him an understanding of strata, their attitude—dip and strike—and the importance of faulting. The Somersetshire Coal Canal afforded an opportunity to further develop his concept which resulted in his Table of the Strata and, most importantly of all, to geological maps, firstly in Somerset and later covering much of the United Kingdom.

Further Reading

Memoirs of William Smith by John Phillips, John Murray, 1844. (The 2003 reprint by the Bath Royal Literary and Scientific Institution, contains additional material by Hugh Torrens including his seminal lecture entitled Timeless order: William Smith (1769-1839) and the search for raw materials).

Strata. William Smith's Geological Maps, Thames and Hudson, 2020

William Smith's Fossils Reunited compiled by Peter Wigley and others, Halsgrove, 2018

The Map that changed the World by Simon Winchester, Viking, 2001

William Smith Smith's Maps-Interactive Website http://www.strata-smith.com

ABOUT THE AUTHOR

Peter Wigley is a geologist who has worked in the oil and gas industry for over 40 years. He has a long-standing interest in William Smith.