

Book Review: Winchester, S. (2009). *The Map That Changed the World: William Smith and the Birth of Modern Geology*. United States: HarperCollins

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Writers have their own storytelling techniques to attract their readers, and Simon Winchester is no exception. The author is known for a unique interest in anecdotes dealing with the transmission of knowledge from one source to another and finally to the human mind, with its own inquisitive spirit. *The Map That Changed the World* is a perfect example of an author's unerring ability to combine a character's drama with historical facts and encyclopedic information. The book is a tribute to the achievement of a self-taught and extremely practical blacksmith's son, named William Smith, and his famous map that paved the way for the science of geology to become part of the acknowledged scientific culture of the 18th century and beyond. Organized in 17 chapters, with a prologue and an epilogue, the whole project also contains valuable data that would enchant the readers' eyes with geological terms to facilitate the journey of a pleasant awakening to the beauties of fossils, layers of rock, and excavations. And this all started in 1793, when the eight-year-old boy William Smith made a startling discovery: circular pound-stones used by dairymaids (like his aunt) to operate their butter-scales.

Book reviewers follow a well-beaten path when they delve into the intricacies of a literary masterpiece without sharing too much information and, at the same time, staying true to the inherent quality of the piece of writing in question. In this case, Simon Winchester delivers so much of his expertise, himself being trained in geology, that sifting through the plethora of scientific material might easily turn into a battle for competent analysis of an honest human being – William Smith – fighting for what he deems to be his legacy. Although William Smith was not first recognized for his practical knowledge and hard work that eventually produced the beautiful hand-painted map tourists and other curious visitors can find within the eastern wing of Burlington House, not far away from London's Piccadilly. Right behind a pair of huge blue-sky velvet curtains is displayed "an enormous and magnificent map of England and Wales, engraved and colored – in sea-blue, green, brightly yellow, orange umber – in a beguiling and unfamiliar mixture of lines and patches and stippled shapes." (p. 1) The culmination of twenty-two years of study is a chart of the hidden underside of the earth that was created by William Smith and meant to expose the landscape's secret fourth dimension.

A careful look at the map will reveal its copperplate description:

A Delineation of the Strata of England and Wales with part of Scotland; exhibiting the Collieries and Mines; the Marshes and Fen Lands Originally Overflowed by the Sea; and the Varieties of Soil according to the Variations in the Sub Strata; illustrated by the Most Descriptive Names. (p. 2)

We also get to see a signature:

By W. Smith and a date: Aug 1, 1815. Such an accomplishment, being the first true geological map of anywhere in the world, “laid the foundations of a field of study that culminated in the work of Charles Darwin.” The author goes on and clarifies that “It is a map that had an importance, symbolic and real, for the development of one of the great fundamental fields of study – geology – which, arguably, like physics and mathematics, is a field of learning and endeavor that underpins all knowledge, all understanding.” (p. 2)

The ambitious scientist, who started as a canal digger, who performed Herculean labors to map “the imagined underside of an entire country,” had to do his solitary endeavor, stubborn and visionary as he was to the outside world, to receive the much-needed support and accolades in 1831, when he received the Geological Society of London’s highest award. King William IV also offered a lifetime pension to the single-minded person we now know as the father of modern geology.

Strewn throughout the book are encyclopedic bits and pieces that blend beautifully the scientific facts and the folklore of the British Isles. “It has long been said that the people of England could never be poor, since they lived on an island made of coal, and surrounded by fish.” (p. 49) The ever-growing coal-mining industry of the island supplied enough coal for the local population, but, in time, turned into a profitable source of energy and heat that could be exported. As mentioned in the book, around 1800, coal mines were producing a million tons of a variety of types of coal, each year.” (p. 50) What precious stones like emeralds and silver and diamonds meant for other places on earth, coal was the English substitute. The knowledge that huge seams of these dark rocks were to be found all over the place, if dug out properly, created a need for mapping – not only locally, but in places like Silesia and Westphalia, France, Belgium, and even Russia.

The thought-provoking concept of building canals led the Parliament in 1792 to pass the Monmouthshire Canal Act, which meant that, almost overnight, coal became available and could be transported easily across vast areas. The building of canals was somehow related to surveying and here comes the sharp-razor portrait of William Smith into view with his own fascination with rocks. As a young man, he managed to acquire a volume entitled *The Art of Measuring* by a man named Daniel Fenning, and it was this book “that introduced the young man to the skill and would become central to him for the rest of his adult life – the basic principles of surveying.” (p. 58)

From the diary William Smith kept, which is now in the library of the University Museum in Oxford, we get a glimpse of the real scientist, with his concerted effort and determination, and his desire “to learn how to use the pantograph and the theodolite, the dividers and the great steel chain.” (p. 58) His fondness for travel, as well as his love of nature, brought in him a talent for simple but captivating descriptions:

... after crossing the naked hills from Stow, joyously with the thoughts of being trusted to survey an estate myself, I saw from the edge of Broadway Hills what appeared to me one of most glorious sights in the world, and I well remember standing some time to gaze over the immense extent of the rich country below. The day was fine and the Vale of Evesham lay below me spread out like a map, the fruit trees and hedges being all whitened with the finest blossom that ever was known. (p. 60)

Stratification is one the first terms he used in his first writings, obviously derived from the Latin *strata*, “the study of which would so dominate his life as to become his nickname.” (p. 68) According to his contemporaries, he was known as Strata Smith, and he was the first to use another word, stratigraphical, for the first time in 1817. Gradually, the young scientist is beginning to build his wide-ranging knowledge, which turned out to be extremely useful when, thanks to “connections and coincidence,” Smith found himself in the position of the Somerset Coal Canal’s first surveyor.

Building the canal, according to the author of this book, also included choosing the route, and this offered Smith a rare opportunity to view the country. For him, the survey of the canal and the making of a route led him to a surprising discovery:

In a sense the fact that he was making a new canal became eventually almost incidental to his own self-allotted main task – which was to find out why the landscape was the way it appeared to be, and whether any of the lessons he had learned in the coal mines, and which the miners insisted belonged to mines alone, could apply out in the wider geological world as well. (p. 88)

As we continue reading, we encounter the indelible portrait of William Smith as a collector of notes, sketches, and drawings that make up the cartography of the Somerset Canal in those days, albeit not necessarily good enough to constitute a map. “He noticed things, drew conclusions and laid plans.” (p. 93) This gave him a feeling that he knew enough he could draw a map of North Somerset, and in time, why not, a similar map of England. To accomplish this huge task, he would also need some inspiration from fellow contemporary scientists. Two names are mentioned in this respect: John Whitehurst and his book entitled *An Inquiry into the Original State and Formation of the Earth*, published in two editions in 1778 and 1786, and Reverend John Michel’s article entitled *The Course and Phenomena of Earthquakes*, published in 1760.

Smith’s diaries, as stated in the book, provide an irresistible source of trivial notes, but also eloquent and profound ideas that invigorated the scientist’s mind during his future endeavors. Over the next years, we find him in various locations, obsessed with one idea: “to make an accurate delineation of the stratification throughout England.” (p. 104) According to a 1926 plaque unveiled in Bath, William Smith was a resident of the city. One local quotation explains why they were so proud of the “engineer, surveyor, a man of minerals, and of great scientific ideas.” They went on to clarify: “Of all the countries with which I am acquainted, no one is so interesting to the geologist as the vicinity of Bath, because in no other are so many strata exposed to the view.” (p. 105) Smith’s headquarters in the area gave him a chance to have a propitious place to work and to house the collection of fossils he had accumulated and which now was becoming central to all his activities.

Interwoven in the heart of the book are not only relevant bits and pieces of information regarding the geologist's private life; general arguments supporting the culture surrounding him are also carefully analyzed and this contributes to the uniqueness of the author's approach. We are gently reminded that the eighteenth-century Britain was characterized by "refinement and good taste to own and to display a collection of fossils." (p. 110) One of the best examples to describe the cultural background would be *The Dictionary of National Biography*, where we can find the word 'fossils' 293 times.

Traveling, competitiveness, and a thirst for knowledge might be some of the elements defining our contemporary world today, but that was also the case in those times. Drawing rooms, as the author explains, became places where people showed off their works of art and other materials collected from journeying through space and time. Amateur collectors included names like The Reverend George Young, a theologian very much in love with fossils, who "came to prominence in 1819 with the discovery, in Yorkshire, of a gigantic reptile ichthyosaur since identified as *Leptopterygius acutirostis*." (p.115). Furthermore, heritage is also brought into our discussion when William Smith was introduced to William Cunnington's family known for his traditions and fascinated with collections of sponges and corals. We are just one step away from the moment when William Smith switched his "keenly intelligent interest" from rocks to fossils too.

In the same context, the author places high value on these notions and concepts in the pages dedicated to *palaeogeography*, defined as "the study that involved the constant remembrance of time and space, as well as all the physical conditions in which a particular rock type may be laid down – meaning that at any one time several different rock types may be being deposited or created at different places." (p. 120) This idea was processed in William Smith's mind and led him to discover that "certain beds and had certain fossils, that they were unique and peculiar to that bed and to that period of time in geological history." (p. 122).

What originally was thought to be great curiosities, collected and treasured by individuals with great expense because it produced pleasure, now it was time for science to take a good look and identify how fossils were organized and imbedded. A glimpse into the inquisitive mind of the scientist might very well give us a clue:

He noticed that the rocks he was excavating were arranged in layers; more important, he could see quite clearly that the fossils found in one layer were very different from those found in another. And out of that realization came an epiphany: that by following the fossils, one could trace layers of rocks as they dipped and rose and fell – clear across England and, indeed, clear across the world. Determined to publish his discovery by creating a map that would display the hidden underside of England, he spent twenty years traveling the length and breadth of the kingdom by stagecoach and on foot, studying rock outcrops and fossils, piecing together the image of this unseen universe.

<https://www.harpercollins.com/products/the-map-that-changed-the-world-simon-winchester?variant>

Undaunted courage and determination to succeed made those twenty years of traveling a success in a saga of well informed decisions based on instinct, facts, and of course, much-needed financial support.

Two names add a special touch to the whole story: John Billingsley and Thomas Davis, fossil collectors and "travelers in the circle of the fashionable," who introduced Smith to the notion of making maps. In 1798, after reading the latest edition of the *Somerset County Agricultural Report*, he noticed "the geographical extent of each of the various soils and types of vegetation that were known in the countryside around Bath." (p. 129) What caught his eye instantly was the fact that the maps were detailed and colored. The possibilities seem endless. If ordinary people like Billingsley and Davis were able to make such maps, William Smith felt quite comfortable that he "could draw a chart of what could not be seen. And, in doing so, he could create what had never been created before – a true geological map." (p. 130)

By using earlier hand-coloring techniques, he proceeded to combine colors like yellow, dirty-blue, and brackish-red and consequently he designed a map that can be found in the apartments of the Geological Society of London in Piccadilly. Clearly marked was the date: *Presented to the Geological Society, February 18th, 1831. Wm. Smith, Coloured Geologically in 1799.* (p. 133)

Stoicism, persistence, and hard work fueled his next project, even more ambitious than his earlier attempts at historical novelties. William Smith is now treading lightly on new territory, and using a copy of John Cary's *New and Correct Atlas of England and Wales*, published in 1794. He minutely designed his new project to include the extents of a number of geological formations and by giving names to certain rocks that are now known as the Cornbrash, the Forest Marble, or the Lias – already known – to which he added something else: the horizon that is now known as the Oxford Clay was in Smith's notes called the Clunch Clay.

Besides the simple fact of coloring, he added a further device meant to make a greater impression on the human eye: "He shaded each of the colors away from the lowest part of their outcrop – so that at the base [...] the color is bold, and fades slowly away until the junction with the rock stratum above it, which is similarly boldly colored, and fades away." The work was completed. He added to Cary's engraved phrase 'General Map' the words 'of strata in England and Wales, and signed his work 'by W. Smith, 1801.' (p. 147)

This dramatic-looking map was later on criticized, analyzed, and many even doubted its accuracy. From several perspectives, William Smith's first national map proved to be an astonishing achievement. As the author continues,

The fact that one half-educated Oxfordshire yeoman working alone, with compass and notebook and clinometer and an abiding appreciation of the beauty and importance of fossils, could surmise with such accuracy what a thousand surveyors and professional geologists in the decades since have really only succeeded in confirming, is little short of a miracle. (p. 149)

A significant amount of information that was collected by William Smith over the years convinced him to look more carefully and try to decipher their exquisite appearance was somehow connecting fossils with the canal mania that was invading the farmers' world. The experience accumulated during the time of the 'improving farmer' reinforced his conviction that "canals are essentially enormous and elongated repositories of water." While Smith had already been known for his skills as a surveyor and a cartographer, but now it was time to add the abilities of a drainage engineer. As such, he was paid good money to drain, dredge, and dike fields where he unearthed, literally and figuratively, horizon after horizon of a sandstone containing a fossil called *Sigaloceras*, which he gladly added to his ever-growing collection of strata, and which he called *Kellaway's Stone*. "The horizon was later to be called Kellaway's Beds, and the name of a geological stage, Callovian, was derived from it – the one name that Smith has bequeathed to a major period of earth history. He also gave the name Cornbrash to the limestone immediately below, using the quarrymen's term 'brash,' and adding to it the fact that corn seemed to grow well in the fields above its outcrop." (p. 155)

During the author's travels through the countryside to follow the geologist's journey, he happened to meet Denys Brunsden, an internationally renowned expert in the physics of landslips, a pleasant surprise came to be a coincidence that made his journey worthwhile. *The Geological Society of London* had just awarded the local scientist The William Smith Medal, which is beautifully displayed in the book with its two engraved sides: *William Smith (1769-1839)* on its face, and, on its reverse, a scene from his canal excavations, with a simple notation: *Geological Society of London, 1807, for applied geology*.

Among many other places of interest, the book praises the area around Bath, where the geologist conducted many of his studies. What attracted him were not only the locals with their interesting personalities and social events, but also the area's "immense geological mosaic" with its "great diving lines of world geology," which even today would make a traveler's visit memorable.

What the author found in and around Bath was somehow related to the rock types discovered elsewhere. The case of the Cotswold Stone should be mentioned in this context, mainly because it "has a reputation worldwide and well deserved: the stones are solid, easy to work, more than amenable to simply carving, perfect for bearing large loads." (p. 187) When analyzed in detail, the same stones proved their magic obviously perceived through the eyes of a scientist and marked as weathering and simple durability. These were the same places that William Smith traveled through, wandering from one stop to the other, but simultaneously mapping and surveying the enchanting part of the countryside.

To create the map that changed the world, as the author continues his narrative, required a special kind of vision and patience, both of which revealed a unique "ability to imagine a world possessed of an additional fourth dimension, a dimension that lurked beneath the purely visible surface phenomena of the length, breadth and height of the countryside, and that, because it had never been seen, all customary cartography ignored." (p. 195) There were no teachers and no guidebooks, and that is why it took fourteen years to complete. And then, surprisingly, the map was stolen, copied, used and reused without permission, sometimes ignored or forgotten. But eventually the effort proved worthwhile and was appreciated for its unique value.

Gradually, some of William Smith's contemporaries became aware of the historical significance of this event that ended the 18th century with a boom. Sir Joseph Banks, the President of London's Royal Society at that time, was one of the mediators who helped the geologist, by explaining why he thought about the historical importance of the event, and why Smith had made two great advances:

He was able to document the *sequential* order of British rocks; and he was able to *identify* the rocks that made up the sequences, by examining the fossils found within them. Smith, to put it more simply, could both tell *where* rocks were, and *what* they were: and, by dint of an energetic systematic program of observing and surveying and measuring and marking, he could draw – as indeed he was now in the middle of drawing – a proper, detailed and accurate geological map of the nation. (p. 204)

These seemingly debatable details about the scientist's abilities were in fact proven factual and compelling when we consider his decision-making process of selecting what was absolutely necessary in observing, surveying, measuring, and marking that eventually led to the drawing and the creation of the map.

The scholarly research combining all the necessary elements of a moving story takes us to the year 1815, when William Smith personal problems, exacerbated by envy, competition, and many ways pure ignorance, came to a happy conclusion. The reader is finally in a position to relish three moments of crowning achievements. The first one was the Prime Minister's visit to Buckingham Street to inspect the map and congratulated Smith personally. Next came in the spring of the same year, during a visit to the Society of Arts, when Smith presented his map for inspection and was very happy to report in his diary an entry dated 16 June: "Received from Dr. Taylor, Secretary of the Society of Arts, their premium of £52.10s0d for my Mineralogical Map of England." (p. 222) The crowning moment was added on August 1, 1815, the date when the map was published, distributed to subscribers, and offered to bookshops all over the country.

His first biographer, John Philips, was ready to proclaim that "From that hour the fame of its author as a great original discoverer of English geology was secured." (ibid.) Priceless as the four hundred copies of the printed map were, when they were numbered and signed, historians venture to say that they were valuable beyond price.

When the readers take a quick moment to catch their breath, the author of this historical detective story summarizes the geologist's portrait: "Smith was the epitome of the practical man, always grubbing about in the earth, draining fields, building watermills, corresponding with engineers about pumping projects, descending deep into coal mines." (p. 234)

What better way to continue such a legacy than to mention the Scarborough City Museum, with its building finished in 1829, where the Doric style of the construction with its spiral staircase that allowed “thousands of fossils to be arranged on shelves around the outer walls, all in their proper relative positions?” (p. 274)

When we check Smith’s final notes, one diary entry may speak for itself:

Thus calmly to enjoy retirement with the never failing resources of a well-store mind is the sweetest pleasure of a full-aged man. (p. 291)

We can only surmise that, in his golden years of retirement, William Smith may have enjoyed this fairy-tale twist of fate, when finally, he was hailed as a genius.

We should also remember the Welsh poet, Dylan Thomas, who was buried at Laugharne, where Smith built the embankments: one of his finer early poems was entitled *The Map of Love*. The same love of letters and history and language that makes Simon Winchester the master of suspense, wit, and encyclopedic knowledge, which deliver a jewel of a book and a delightful pleasure to readers and book lovers.

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