

1: Smith Honoured

Green is the colour William Smith chose to represent chalk on his 1815 map, and you can see it stretch from southwest to northeast, from Wiltshire to Norfolk, from the south coast to the Wash; with more running seams around rivers of coal down into Hampshire and over into Kent. The coal is black and there are shades of pink. The colours used by geologists now are the ones Smith chose and not those of rivals who tried to trump and upstage him later. Their map hangs opposite his on a wall at the foot of stairs in a towering space, as it needs to be for these enormous surfaces, the same size as each other, with the same intricate contours to coloured masses, filigrees of indentations like Norway's, that frizz of fjords like a poodle's curls. The second map has some added detail – correspondents sent tesserae from places Smith could only guess about to be tipped in to the mosaic assembled there in London. The Geological Society had been formed in 1807 and it was they, mainly in the person of their president, George Bellas Greenough, gentleman amateur, who made the second map. They did not acknowledge Smith's pioneering status, the way his work underlay and incited theirs.

But Smith lived to be publicly honoured, almost a happy ending. Now his bust and portrait are given pride of place in the vestibule. A strong face, a strong head like a limb, a sure sign of a strong mind and body; not a refined gentleman's Norman features but rounded, vigorous, a practical man, keen-eyed, with a determined mouth.

He and his great map focused it all, setting it on a new, secure foundation, this revolution in understanding: geological time, not Bishop Ussher's; fossils in different strata from different ages, millions of years apart and in extent. The realisation that species vanish. Evolutionary theory is built on Smith's work. So, whether we like it or not, is drilling for oil. Coal mining, which the Romans had practised and which was increasing in Smith's youth was, thanks to him, transformed and scaled up.

2: Strata Smith

We don't know what they ate or drank. Three men in a private room on a June evening, the glass and china cleared from the table. One man spoke, a second wrote, having ruled a horizontal and four verticals on a very large sheet of paper. The one dictating went through, in order, with names some of which he had improvised himself, the twenty-three layers of various stuff, including chalk, sand, clay, and fuller's earth, always in the same sequence underground. Each man took a copy before they parted.

Nobody had ever seen this before. There had been no understanding of what lay, lies, beneath their feet and ours. Not even Smith understood how old everything was, how long it was since the lower levels were laid down. Nothing but plant fossils below one divide, nothing but animal fossils above it – this he knew, and emphasised that evening to Benjamin Richardson and Joseph Townsend. Three men in 1799, in a room, when the days were getting longer and longer, that time of year when it seems light will go on filling the whole world more and more brightly.

3: Smith Obstructed

There's a ridge running across England in a diagonal from Dorset to Lincolnshire. It's not as neat as that, not a straight line marked as with a ruler and pencil, more like a curved spinal column, but it's there. Coloured maps show it as a boundary between darker and lighter. The high rolling country of the ridge softens as the land dips eastwards. Below it to the west are the clays and shales of fertile river valleys lying in its morning shadow. Geological time zones separated by millions of years. The ridge marks the western boundary of the oolitic limestone of the Middle Jurassic, which gives their character to Cotswold villages, the city of Bath, and many Oxford colleges. Other people had noticed this, but it was William Smith, his mind charged with images of the rock strata through which the Somerset Coal Canal had been cut, who articulated it and mapped it, using the colour-coding his descendants - for he is the daddy of them all, the father of geological cartography - use today.

Key moments in his journey of discovery: in his Oxfordshire farm childhood noticing the stones used in the dairy, pound-stones – they were of almost uniform weight, twenty-two ounces, the 'long pound' locally in use – which were fossilised sea-urchins, though he didn't know it. Someone living by the sea in Sussex had seen it, in the previous century, noticing the similarity of such stones to living creatures found on the shore, and even more to specimens only recently dead, divested of their spines, revealing graceful patterns which made the shells arresting to behold; the same as on the fossils that he picked up

on his ramblings. The news hadn't reached anyone around Smith. For the time being he just saw and wondered.

Then, trained up as a young surveyor, he went down ladders and ropes, and on a chain rope powered by a Newcomen steam engine, into the Mearns colliery in Somerset and saw his lamp illuminate, as the miners round him were used to seeing, layers in the rock; and what was striking, layers always in the same order, no matter which shaft he went down, like a child's game, *salt, mustard, vinegar, pepper, salt, mustard ...* or in this case, Sandstone, Siltstone, Mudstone, Non-marine Band, Marine Band, Coal, Seat-earth, and then again Sandstone. Coal was always found on top of a base level fallen forests grew from. There were different fossils in different layers, not only of the coal but of the other rocks. You could tell the age of similar kinds of stone by the difference of the fossils in them. Each seam of coal had its own character and they always occurred in the same order, no matter which shaft you went down into the coalfield. And if these rocks and seams were always in the same order, other rocks might be in the same order nearby, further afield, and all over the world.

These understandings grew from inklings to hunches, to theories to be tested, to almost complete certainties by stages. Recognition within his own mind emerged from an ocean of doubt, till it lay like a landscape with outcrops from deep strata. But it needed recognition without to mark its final stage of evolution.

First he had to be sure. It seems almost too good to be true that he was asked to dig a canal through Somerset to transport the coal, enabling him to observe the strata along the length of it;

and then that the canal-owners sent him with two others on a coach-journey to survey canal-building over a large part of the rest of England. These were as if heaven-sent opportunities to observe the lie of the land, the strata in and under the country.

But as the old century ticked over into the new one, everything seemed determined to obstruct him – stupidity, social snobbery, his own procrastination and unwise decisions. That recognition he craved took an age, in which time he was slighted, denied rewards, plagiarised, and went to debtors' prison; came out embittered and disgusted; quit the metropolis and went to live in Yorkshire, still working, but some of the stuffing knocked out of him. Then the tide turned. Benefactors and well-wishers emerged and set things in train for his Indian summer. His last achievement was to have a marvellous rotunda built where fossils could be seen from a spiral staircase in the order in which they lie under our feet, most recent at the top, oldest below. The rotunda is still there, in Scarborough. For a long time the fossils were missing and the whole place became a little seedy. It's been restored since the millennium, the turn of the century after the next. Here it is in the mind, also, a spiral wall display of all the living forms that have left traces in the earth before us, showing how old it is, how young we are, and what a new world we have entered thanks to the understanding of its changes we owe to William Smith and his great map, printed, to small acclaim, in 1815.