Romancing the Stone: Coleridge and Geology

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ONE AUGUST DAY IN 1802 Coleridge came down into the kitchen of Greta Hall, his home in Keswick, stripped all the besoms off the house broom, and took the stale for a walking stick. Then he did something extraordinary—something no self-respecting gentlemen did: he took to the fells and scrambled up and down the jagged rocks normally visited only by ravens, sheep and the occasional shepherd. A week later he was on Scafell, completing the first recorded ascent of that rugged peak, and facing a dilemma that still vexes fellwalkers today. Faced with a terrifying drop as he descended, yet too exhausted to retrace his steps, he

> passed down from Broadcrag, skirted the Precipices, and found myself cut off from a most sublime Crag-summit, that seemed to rival Sca Fell Man in height, & to outdo it in fierceness. A Ridge of Hill lay low down, & divided this Crag (called Doe-crag) & Broad-crag-even as the Hyphen divides the words broad & crag. I determined to go thither; the first place I came to, that was not direct Rock, I slipped down, & went on for a while with tolerable ease—but now I came (it was midway down) to a smooth perpendicular Rock about 7 feet high—this was nothing—I put my hands on the Ledge, & dropped down / in a few yards came just such another / I *dropped* that too / and yet another, seemed not higher—I would not stand for a trifle / so I dropped that too / but the stretching of the muscle[s] of my hands & arms, & the jolt of the Fall on my Feet, put my whole Limbs in a *Tremble,* and I paused, & looking down, saw that I had little else to encounter but a succession of these little Precipices it was in truth a Path that in a very hard Rain is, no doubt, the channel of a most splendid Waterfall.—So I began to suspect that I ought not to go on / but then unfortunately tho' I could with ease drop down a smooth Rock 7 feet high, I could not climb it / so go on I must / and on I went / the next 3 drops were not half a Foot, at least not a foot more than my own height / but every Drop increased the Palsy of my Limbs—I shook all over, Heaven knows without the least influence of Fear / and now I had only two more to drop down / to return was impossible—but of these two the first was tremendous / it was twice my own height, & the Ledge at the bottom was [so] exceedingly narrow, that if I dropt down upon it I must of necessity have fallen backwards & of course killed myself. My Limbs were all in a tremble—I lay upon my Back to rest myself, & was beginning according to my Custom to laugh at myself for a Madman, when the sight of the Crags above me on each side, & the impetuous Clouds just over them, posting so luridly & so rapidly northward, overawed me / I lay in a state of almost prophetic Trance & Delight—& blessed God aloud, for the powers of Reason & the Will, which remaining no Danger can overpower us! O God, I exclaimed aloud—how calm, how blessed am I now / I know not how to proceed, how to return / but I am calm & fearless & confident / if this Reality were a Dream, if I were asleep, what agonies had I suffered!

what screams!—When the Reason & the Will are away, what remain to us but Darkness & Dimness & a bewildering Shame, and Pain that is utterly Lord over us, or fantastic Pleasure, that draws the Soul along swimming through the air in many shapes, even as a Flight of Starlings in a Wind.—I arose, & looking down saw at the bottom a heap of Stones–which had fallen abroad – and rendered the narrow Ledge on which they had been piled, doubly dangerous / at the bottom of the third Rock that I dropt from, I met a dead Sheep quite rotten—This heap of Stones, I guessed, & have since found that I guessed aright, had been piled up by the Shepherd to enable him to climb up & free the poor creature whom he had observed to be crag-fast—but seeing nothing but rock over rock, he had desisted & gone for help—& in the mean time the poor creature had fallen down & killed itself.—As I was looking at these I glanced my eye to my left, & observed that the Rock was rent from top to bottom—I measured the breadth of the Rent, and found that there was no danger of my being *wedged* in / so I put my Knap-sack round to my side, & slipped down as between two walls, without any danger or difficulty the next Drop brought me down on the Ridge called the How / I hunted out my Besom Stick, which I had flung before me when I first came to the Rocks.[1]

Fig.1: Broad Stand, Scafell

It was wise of him to remember the broomstick, if he didn't want a hostile reception when he got home. In fact, the broomstick shows Coleridge making a more serious point about presence of mind. The mental powers of Reason and Will and Memory allow one to remain calm in the face of a rocky death—to rise above the physical exhaustion and tremors of terror. Coleridge

[1] *The Collected Letters of S. T. Coleridge*, ed. E. L. Griggs, 6 vols (Oxford: Oxford University Press, 1956-71), II, 842. Henceforth cited in the text as CL.

discovers something about the conscious mind and unconscious sleeping mind as he prepares to fall off Broad Crag. Wordsworth too, overwhelmed by the black drizzling crags of an Alpine pass, discovers in the very moment of being awestruck that his mind is free: it can soar above the terrifying cliffs, imagine other places: it is still vaster and greater than the sublime mountains that overawe him. As Immanuel Kant might have written—it's the mind's freedom from the flesh and the senses that distinguishes men from (dead) sheep.

Coleridge and Wordsworth were not the only unlikely rock scramblers looking for truths in the mountains. Another class of gentlemen were also excitedly clambering on the crags—men for whom there was as yet no name, so new was their pursuit—men whom we now call geologists. Some of them were Coleridge and Wordsworth's friends: George Greenough (1778-1855), founder of the Geological Society, first explored the mountains in 1799 on an exhilarating walking tour of Germany with the endlessly talking Coleridge. Adam Sedgwick (1778-1873), a fellow member, became Wordsworth's collaborator, writing a section on rocks for the 1842 edition of Wordsworth's *Guide to the Lakes*. For a generation of active intellectual men, the romance of finding oneself in the wild, in sublime scenery, one's hammer in one's hand, fed one's passion to explore the nooks and crannies of the landscape. Geology was a pursuit for the rugged male not content with a life in the vestry, study or counting house, as is shown by this description of what it was like to be an early geologist on the hunt for evidence:

> the road was this way nearer, easier and far more expeditious; but this was not our object; for now the rocky shore appeared, and we had every reason to expect to find something interesting in this critical spot. We therefore left the chaise, which we had for a long way attended on foot, to find its way up the hill, while we ran with some impatience along the bottom of the sandy bay to the rocky shore which is washed by the sea. …We saw the place nearly where the granite and the schistus must be united; but this place was bushy; and thus our fears and expectations remained for a moment in suspense. But breaking through the bushes and briars, and climbing up the rocky bank, if we did not see the apposition of the granite to the side of the erected strata so much as we would have wished, we saw something that was much more satisfactory….for here we found the granite interjected among the strata…[2]

This time the excited scrambler running along the sand and breaking through the briars was not a poet but a man of science: James Hutton. Getting in among the rocks, crags and caves was essential to romantic science as well as romantic poetry. It was a defining characteristic of a new era—a new way of

[2] James Hutton in 1786 at Sandyhills Bay, Solway Firth, quoted in Donald B. McIntyre and Alan McKirdy, *James Hutton, the Founder of Modern Geology* (Edinburgh: the Stationery Office, 1997), pp. 35-36.

being, knowing and expressing the self: it also led to a revolution in science and religion with which we are still living — the discovery of the immense age of the earth, of extinct animals—dinosaurs—and later, of evolution and natural selection—the world of Darwin.

In what follows I'm going to explore the men who shaped the era and look at Coleridge's response to them. Essentially, I take a tour of Romantic geology, in the field as well as in books, and show how a Romantic science was pioneered—the men opening immense new vistas of time and space as, sweat-stained and covered in dust, they scaled the cliffs and penetrated the caves. Geology was culturally male, a rough science in which men bonded in groups, following their leader beyond the restricting venues of polite culture—the drawing room, the assembly room. Unlike botany, it was not culturally open to gentlewomen (with the exception of a few eccentrics), seeming too dangerous and dirty. The labouring-classes were not subject to these restrictions, however, and I'll be discussing the extraordinary woman who despite constricting clothes and restricting gender roles, paced the beach and searched the rockfalls, the waves lashing around her, at Lyme Regis: Mary Anning (1799-1847), the person who found more fossils than anyone else.

Before the Romantic era few people had investigated the depths of the earth. In the late eighteenth century most people, even university-educated people, thought of the earth as no more than a few thousand years old. In 1658 Archbishop James Ussher had dated the Creation: "In the beginning", he wrote, "God created Heaven and Earth. Which beginning of time fell upon the entrance of the night preceding the twenty-third day of Octob. in the year 4004".[3] Usher's date had been added to the King James Bible and viewed as part of Holy Writ: even Charles Darwin did not realise it was a seventeenth century addition to the Hebrew text until after he had written *The Origin of Species*. For most, the Bible was still the guide to the earth's history: at best, the days of Genesis were interpreted as eras, as by Bishop Thomas Burnet, who had speculated in 1681 that the biblical Flood itself had not been caused by forty days and nights of rain, but rather had occurred when "by Divine Providence […] the frame of the Earth broke and fell down into the *Great Abysse*."[4] Mountains and oceans appeared as the earth's smooth crust broke up and crashed into the water beneath. The Earth is a "broken globe", a "great Ruine", a "little dirty Planet", "a World lying in its Rubbish", the product, literally, of a fall.[5] Burnet fascinated Coleridge, who wanted to translate his Latin prose into English verse and valued him for his "Tartarean fury and turbulence."[6] But he was not an experimentalist—his vision of the world was just a vision—and did not explain why rocks were piled in layers, or why fossils

[3] James Ussher, *The Annals of the World Deduced from the Origin of Time* (London, 1658), p. 1.

[4] See Burnet's own English translation of his original Latin treatise *Telluris Theoria Sacra* (1681-89), *The Sacred Theory of the Earth* (1697), p. 47.

[5] Burnet, *Sacred Theory*, globe p. 104; ruine p. 166; planet p. 104; rubbish p. 75.

[6] *Coleridge's Miscellaneous Criticism*, ed. T. M. Raysor (London: Constable, 1936), p. 291.

of sea creatures were found at the top of peaks. And nor did anyone else: for a long time fossils were viewed as divine jokes—God's foibles, imitating one lifeform in another medium. Some were collected as curiosities, but nobody understood their age, nor that they offered a key to unlock the events of the remotest past.

Nobody, that is, until a new generation of empiricists arose, their practical engagement with rocks outweighing their remaining allegiance to Genesis. These were men of the enlightenment, trained to see God as the creator of a mechanism, readable in the machine of nature more than in the Bible. Reading nature was their job, for they served the enlightenment culture of manufacture and commerce. Abraham Werner (1749-1817), for instance, was a tutor at the Mining Academy of Freiberg, Germany. He studied rocks to help predict where to find wealth underground, and saw so many strata that he noticed how their sequence seemed the same in different places. A good empiricist, he collected evidence at first hand and then built his generalisations: in his book of 1787, *A Short Classification and Description of Rocks,* he classified the earth's crust into four categories of rock, always in the same order. This was a conceptual breakthrough: Werner's classification made sense of strata all over Europe, and created a chronological order, allowing a map of space and time to be made. In Britain it was a quarrying and canal surveyor—significantly a man with years of practical experience of examining rock faces and soil layers—who set out to construct such a map: William Smith. This approach was do for the earth itself what Linnaeus's great classificatory scheme did for plants and animals—create universal standards for measuring the variety of nature and fitting it into one scheme. An enlightenment project.

Werner's classification led him to ideas about the earth's formation. Why were the rocks in the same sequence everywhere? How had they been formed? Why did some of them contain fossils of sea creatures, and others none? Now that a stable classification existed, fossils began to make sense—no longer just strange jokes of nature, but keys to working out different eras in the history of the earth. Werner was what was called a Neptunist: he argued that nearly all rocks had been deposited by debris drifting to the bottom of a universal ocean. The earliest had been laid down before marine life existed: crystalline rocks such as granite, gneiss and schist were primary rocks, containing no fossils. Above them were Transition rocks—slates, limestone—with a few fossils. The higher, the Secondary period, had strata upon strata of sandstones, limestones, gypsum, and fossils galore. On top of them and most recent were gravels, sand, clays — the Tertiary period. Instead of Bishop Ussher's 6000 year-old earth, Werner reckoned a million years would have been required for all these layers to have been deposited on top of each other.

Coleridge encountered Werner's ideas in his life-changing period of study in Germany. In 1799 at the University of Göttingen, he was exposed for the first time to the latest German thought in Bible studies, philology and natural history. His favourite lecturer and mentor J. F. Blumenbach was one of

Europe's most eminent natural historians: he taught Coleridge that the earth was far older than previously thought but not necessarily inconsistent with a symbolic interpretation of Genesis in which the seven "days" of creation were in fact epochs, divided by catastrophes, after which the earth was remade. In this scheme floods were essential in the laying down of strata albeit, for Werner, not a sudden catastrophic flood but a widespread ocean. Coleridge was struck by Blumenbach's "enormous knowledge" and his power of arrangement; he returned to England determined to be guided by the latest systematic German thought (CL, I, 590).

German thought was itself a response to the Scottish enlightenment—the sceptical and empiricist enquiry into history, society and nature pioneered by deists such as David Hume, Adam Smith and Joseph Black. And this German response prompted further enquiry in Scotland: it was a friend of Black's who built on Werner's geology to create the account of the earth we still accept today. James Hutton (1726-97) was a farmer—an improving agriculturist used to applying scientific reasoning to practical problems of the earth. He also a brilliant natural philosopher, an empiricist in a way Burnet and Coleridge never were. He rode and walked all over Scotland observing the order of strata set out by Werner, only to conclude that Werner had made a serious error which invalidated his whole theory that the earth was created by ocean deposits.

The error was about granite. Werner argued it was one of the oldest rocks, laid down before sea creatures abounded—that's why it has few fossils. Hutton disagreed, seeing granite as a rock created later than most of the sedimentary rocks, when molten material was forced up into the marine strata by heat from below. It was in search of such interjections that he was running along the beach towards the rock face at Sandyhills Bay in the passage I quoted above. Whereas Werner's creation was gentle—the gradual consolidation of layers of debris on the floor of a universal ocean, Hutton's was violent. Strata were folded and faulted—buckled, turned on end or even upside down, by upheaval under pressure. Mountains were raised by volcanoes, by earthquakes, by gradual uplift—all driven by heat; then the rain, wind and frost broke them up and rivers carried the fragments down to the sea where they were deposited as layers on the seabed; heat then consolidated the sediment into stone, and uplifted it into new lands, and so the cycle turned again. The rocks, it turned out, were petrified records of huge turbulent forces, which had occurred again and again and still did, but also of slow gradual ones, still occurring—for how long could it take rain, frost and ice to erode a mountain and lift up a new one? Give nature long enough, Hutton reasoned, and these ordinary processes, in perpetual cycle, could accomplish our world: there was no need to imagine miraculous or catastrophic causes. Those we saw at work today had done the job, but over many millions of years. Time was deep; the earth was inconceivably older than Bishop Usher's 6000 years.

Empiricism is often more local than its general conclusions suggest. It's a question not only of what you see, but also where and how you see it—you

have to be somewhere there is a lot of rain and frost to conclude that they are adequate to erode mountains to the sea. Hutton's geology was very Scottish—Scottish in its cragginess as well as its dampness: he travelled far and wide to examine places where the strata had been forced up and where basalt and granite had flowed in among older rocks. But you also needed vision as well as location, and, like Coleridge, Hutton found that the sublime scenery of the peaks inspired him to imagine, to take a wider view. It was the combination of a liberal education and a back-to-nature inspiration that enabled his discoveries. As he said,

> [t]he shepherd...thinks the mountain, on which he feeds his flock, to have always been there. But the man of scientific observation who looks upon the chain of physical events connected with the present state of things, sees great changes that have been made, and foresees a different state that must follow in time, from the continued operation of that which actually is in nature…Go to the mountains to read the immeasurable course of time that must have flowed during those amazing operations which the vulgar do not see, and which the learned seem to see without wonder![7]

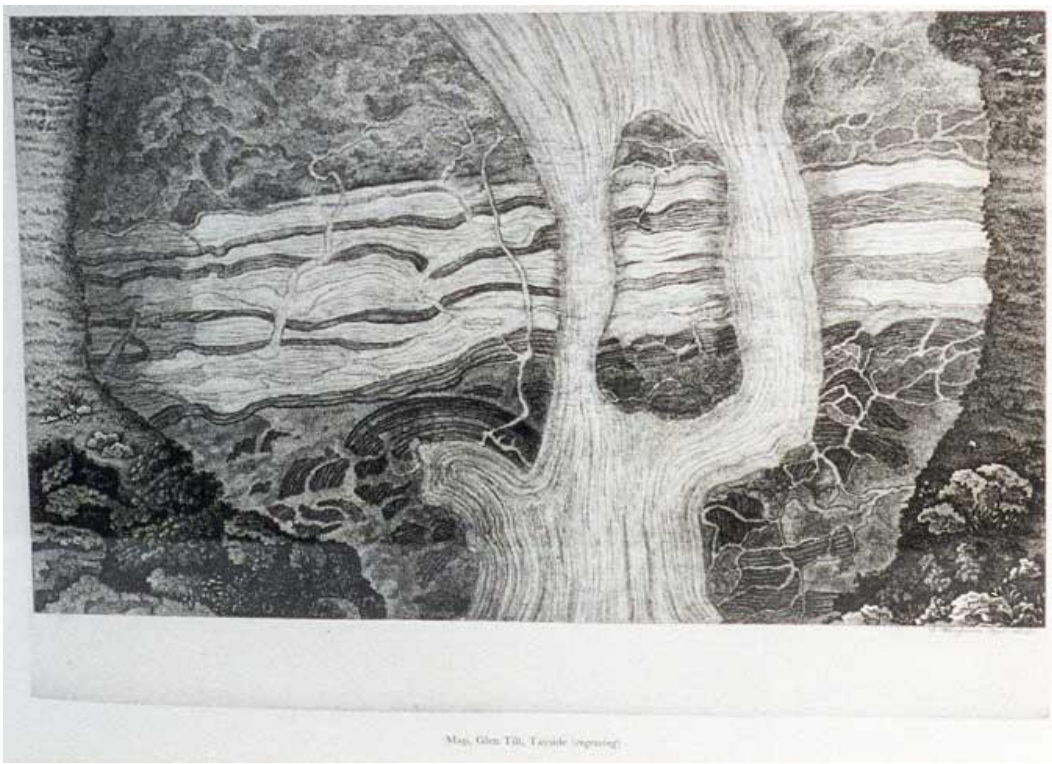

Fig. 2: John Clerk of Eldin, map of igneous intrusion at Glen Tilt, Scotland

[7] Quoted in Macintyre and McKirdy, *Hutton*, p. 7.

Hutton went to the mountain valley Glen Tilt and saw, with his friend John Clerk, where molten granite had been intruded into older rocks; he also went to the coast, as did Coleridge too. On Kilve Beach a few miles from Coleridge's cottage at Nether Stowey the sea exposes the sedimentary strata—you can sit painfully on a broken rock, look down, and find an ammonite, scores of millions of years old, still encased in stone. I've done so myself and felt a little of what Hutton must have felt as I came face to face unexpectedly with that fossil—a shiver of amazement as the rock opened the past to me revealing deep time, a sense of my own smallness in face of the immense age of the earth, and the forces which turn living beings to stone. The geologist is a Romantic: out there in nature his sense of self is profoundly jolted not just by what he sees but by what his imagination shows that sight to mean. Stone is no longer static but in flux—albeit very slow flux—a sort of natural rock and roll, or as Wordsworth put it, we are "rolled round in rocks and stones and trees". This line, imagining natural and human interaction, could not have been written before Hutton's geology opened up new vistas about self and dynamic earth. Here's Hutton again:

> From the top of the mountain to the shore of the sea, everything is in a state of change: the rock dissolving, breaking, and decomposing, for the purpose of becoming soil, the soil travelling along the surface of the earth, in its way to the shore; and the shore wearing and wasting by the agitation of the sea. Without those operations, which wear and waste the coast, there would not be wind and rain; and, without those operations which wear and waste the solid land, the surface of the earth would become sterile.[8]

Hutton's geology was frightening as well as awe inspiring. It showed an earth not only vastly ancient, but without humans or animals—there are no fossils in granite, even though it is a newer rock than most. It showed therefore that there was no neat progression towards the creation of man in the earth's history: it didn't fit with Genesis, or even with expanded versions of Genesis which made the six days of creation equivalent to eras but still saw man as the culmination of God's creativity. Hutton offered a cycle rather than a teleology, casting man away in a world in which he suddenly felt very small and very recent. Like Coleridge on Broad Stand, however, he also, paradoxically, felt powerful, in that he realised it was by his own imagination that he had read the rocks aright and understood the earth he looked at. And if imagination offered terrifying prospects, reason, he discovered, stopped him panicking—kept his feet on the ground—even if that ground now seemed less solid. Hutton's disciple John Playfair (1748-1819) described what it was like to stare at a rock face with the great geologist:

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[8] Quoted in Macintyre and McKirdy, *Hutton*, p. 21.

> We felt ourselves necessarily carried back to the time when the schistus on which we stood was yet at the bottom of the sea, and when the sandstone before us was only beginning to be deposited, in the shape of sand or mud, from the waters of a superincumbent ocean. An epoch still more remote presented itself, when even the most ancient of these rocks, instead of standing upright in vertical beds, lay in horizontal planes at the bottom of the sea, and was not yet disturbed by that immeasurable force which has burst asunder the solid pavement of the globe. Revolutions still more remote appeared in the distance of this extraordinary perspective. The mind seemed to grow giddy by looking so far into the abyss of time, and while we listened with earnestness and admiration to the philosopher who was now unfolding to us the order and series of these wonderful events, we became sensible how much further reason may sometimes go than imagination may venture to follow.[9]

Fig. 3: Siccar Point, eroded gently sloping Devonian Old Red Sandstone layers forming capping over conglomerate layer and older vertically bedded Silurian greywacke rocks. (Dave Souza, 2008)

The earth opens up before them: it's an abyss; solid rock is now a revolutionary violence of force and flow, water and fire, a thing to reason about rather than imagine too vividly—simply too dizzying because, as Hutton

[9] Quoted in Macintyre and McKirdy, *Hutton*, p. 40.

famously concluded the world revealed "no vestige of a beginning,—no prospect of an end".[10] The cycle is too big and too long for us to discover its origins—let alone our own origins. In the beginning was the Word? For Hutton, the beginning was simply a question that our world gave us no grounds to answer.

Hutton was a man before his time. Other intellectuals were not ready for so uncompromising a departure from the Bible. Moreover, although he collected fossils, Hutton did not make them central to his argument. In the years after his death a new generation did, partly because they could get bigger and better fossils than ever before, and partly because they had developed the skills to assess them. They got the fossils because of a brilliant and heroic woman—Mary Anning. Born in 1799, Anning was left fatherless aged ten, and to support her family hawked fossils from an open-air table next to the coach stop at Lyme Regis. She took these from the seashore cliffs, part of a geological formation known as the Blue Lias, consisting of alternating layers of limestone and shale, laid down as sediment on a shallow seabed 200 million years ago. The cliffs were dangerous, for it was necessary to hunt fossils after landslides caused by storms exposed new rock. Anning, driven by poverty and pride, was daring and indomitable—despite having to wear full length dresses.

Figure 4: Henry de la Beche, Sketch of Mary Anning at work.

On one occasion she just escaped death in a slide that did kill her dog. Over years of expeditions, Anning developed an intuitive, hands-on knowledge not

[10] Hutton, *Theory of the Earth, with Proofs and Illustrations*, 2 vols (Edinburgh, 1795), I, 200.

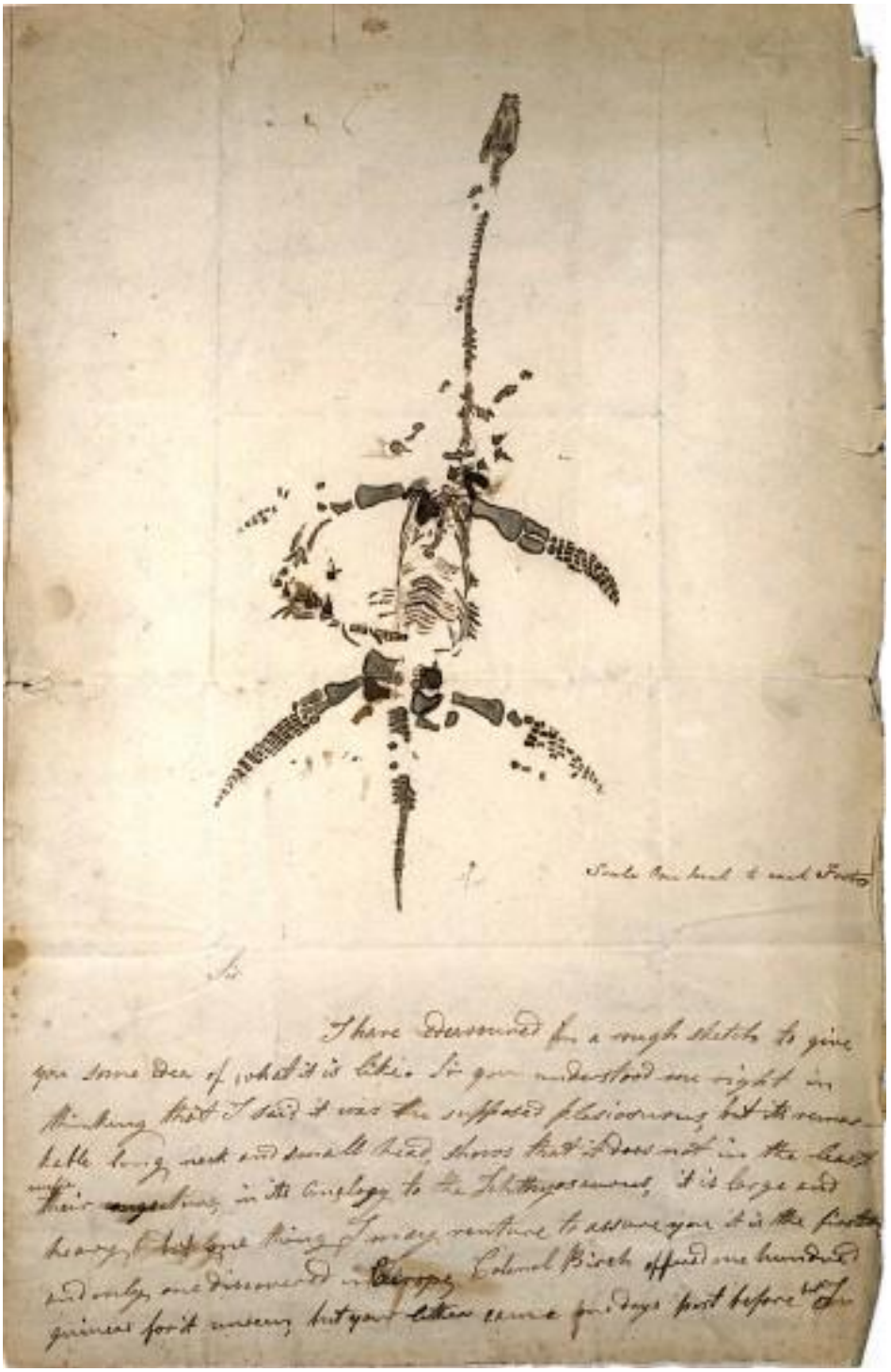

Fig.5: Mary Anning, Autograph letter concerning the discovery of plesiosaurus.
(Wellcome Trust)

just of the cliffs but also of the fossils they contained. She was able to perceive fossils in the rock when only a small fragment was visible, and to infer the correct skeletal structure from a few twisted and crushed bones. This ability brought her fame and ended her poverty: she discovered the skeletons of extraordinary creatures that were like nothing that still existed—a window a world of beings long extinct. Strange, massive fish-like animals had, she revealed, once swum the seas off England's coast. She found the first ichthyosaur skeleton to be correctly identified, the first two plesiosaur skeletons, the first pterosaur-skeleton located outside Germany. Word spread among the young men of science: the founders of the Geological Society became her clients and supporters; they bought her fossils and wrote them up in journals. But Anning was not just a supplier of material that the university men interpreted: she read their works and, despite having had only a rudimentary education, grasped their arguments. In the words of Lady Harriet Silvester, visiting Lyme in 1824,

> the extraordinary thing in this young woman is that she has made herself so thoroughly acquainted with the science that the moment she finds any bones she knows to what tribe they belong. She fixes the bones on a frame with cement and then makes drawings and has them engraved . . . It is certainly a wonderful instance of divine favour—that this poor, ignorant girl should be so blessed, for by reading and application she has arrived to that degree of knowledge as to be in the habit of writing and talking with professors and other clever men on the subject, and they all acknowledge that she understands more of the science than anyone else in this kingdom.[11]

Anning published once in the scientific literature, writing to the Magazine of Natural History in 1829 to correct an article on fossil sharks. But her main influence came via leading—in a significant gender and class reversal—the gentlemen geologists on collecting expeditions. In this way, many of the men whose names would go down in scientific history were her disciples—Roderick Murchison, Sedgwick, Louis Agazziz, William Buckland. This was an exception to the male gendering of geology, but an exception that proved the rule. Anning took the male geologists' wives on collecting expeditions, but with women excluded from university and scientific societies and limited in active outdoor life, no generation of female geologists was able to arise.

Of all the English geologists, William Buckland (1784-1856) was the nearest in temperament and intellectual outlook to Coleridge. An Oxford don and a clergyman, Buckland was an enthusiast for natural history and for the Anglican church. Bypassing Hutton's theories, he wanted to reconcile the evidence of the rocks with the evidence of scripture. Buckland wanted to know what fossils

[11] Quoted in Shelley Emling, *The Fossil Hunter: Dinosaurs, Evolution, and the Woman whose Discoveries Changed the World* (Basingstoke: Palgrave, 2009), p. 26.

showed about the age and creation of the earth, about its history, about the God who let whole species become extinct. In his Oxford rooms, he set candles in the vertebrae of ichthyosaurs, had snakes and frogs in cages, and guinea pigs on the loose. Walter Stanhope, another don, described an evening chez Buckland: "I took care to tuck up my legs on the sofa, for fear of a casual bite from a jackal that was wandering around the room. After a while I heard the animal munching up something under the sofa and was relieved that he should have found something to occupy him. I told Buckland. 'My poor guinea pigs!' he exclaimed, and sure enough, four of the five of them had perished."[12]

Buckland made natural history a glamorous subject for eager young undergraduates in stuffy, religious Oxford: one of them, Charles Lyell (1797-1875), would later go on to establish Hutton's theories beyond doubt and inspire Charles Darwin's theory of natural selection. He remembered being introduced at the Botanic Gardens to Buckland's bear, a pet named Tiglath Pileser, after the founder of the Assyrian Empire in the Old Testament, who was dressed up as a student complete with cap and gown. "Tame and caressing", Tig was formally introduced to senior figures at the university. "It was diverting to see two or three of the dons not knowing what to do for fear their dignity was compromised."[13]

Buckland was not just a hands-on student of the natural realm, but a lips, tongue and teeth-on connoisseur: "I recollect various queer dishes which he had at his table," recalled his friend, Hutton's editor Playfair: "The hedgehog was a good experiment and … I thought it good and tender. On another occasion I recollect a dish of crocodile, which was an utter failure … though the philosophers took one mouthful, they could not be persuaded to swallow it and rejected the morsel with strong language."[14] John Ruskin always regretted a day on which he had a prior engagement and "missed a delicate toast of mice."[15] Buckland was seductive: he attracted to geology a new generation of young men because, sharing his humour and his uncouth taste, they could make hearty common cause against stuffy, protocol-bound, clerical Oxford.

Given this consuming desire—or rather desire to consume—it was entirely fitting that it was Buckland who got first chance to explore a sensational discovery made by two Yorkshire quarrymen in 1821. A tiny aperture in a hillside in Kirkdale led them into a cave with passages 200 feet long. When Buckland arrived he thought nothing of crawling on hands and knees through mud to find, half hidden in silt and slime, hundreds of fossilized bones—broken and chewed and seemingly from different animals that never live together in the wild: tigers and deer, bears and horses, in addition to extinct species of elephant, rhinoceros, hippopotamus and hyenas. Clearly, like his

[12] Quoted in Deborah Cadbury, *The Dinosaur Hunters: A True Story of Scientific Rivalry and the Discovery of the Prehistoric World* (London: Fourth Estate, 2000), p. 61.

[13] Quoted in Cadbury, *Dinosaur Hunters*, p. 61.

[14] Ibid.

[15] Ibid.

Oxford rooms, the cave was a den of a creature that liked to eat as many species as it could—perhaps, from the teeth marks, a hyena.

When he returned to Oxford, Buckland, as a good empiricist, had a hyena imported from Africa. He called it Billy and wrote, with the respect due from one experimentalist carnivore to another: "Billy has performed admirably on

Figure 6: William Conybeare, sketch of William Buckland at Kirkdale Cave, 1822.

shins of beef, leaving precisely those parts which are left at Kirkdale and devouring what are there wanting . . . So wonderfully alike were these bones in their fracture . . . that it is impossible to say which bone had been cracked by Billy and which by the hyenas of Kirkdale!"[16] Whether Buckland ate Billy when he had proved his point is not recorded—by teeth marks or in writing.

The Kirkdale cave was science at its most sensational. Its hidden treasures suddenly revealed, like a Pharoah's tomb, treasures of the past. And these treasures were paradigm changing: they showed the public in graphic form what geologists had been arguing for a few years—that whole species had become extinct, that ancient animals were far bigger than their modern counterparts, that a tropical climate had once prevailed. Elephants and hippos, large and pygmy, had once lumbered over England's green and pleasant land. Becoming prey to hyenas, they had been dragged back into the cave and devoured. This, of course, did not conform to the Biblical record—neither the

[16] Quoted in Cadbury, *Dinosaur Hunters*, p. 74.

extinction, nor the timescale.

Unlike Hutton, however, Buckland was a clergyman, and he was intellectually bound to the Bible text. When he presented his ideas to the Royal Society he found a way to reconcile the Kirkdale hyenas with Genesis. They lived, he said, in the "Ante-diluvian period, immediately preceding the Deluge",[17] and had been destroyed, along with the other species whose bones were in the cave, suddenly during the biblical flood. From the stalagmites present he calculated that this event took place six thousand years ago. In 1823, Buckland published a book on the subject, *Reliquiae Diluvianae, or Relics of the Deluge*, in which he further explained his theory that the Biblical flood had wiped out the animals, and shaped the earth on which we live. The flood, he argued, was a brief tsunami, leaving the land in the same place as before, but moving gravel up and about—thus silting up the hyena den. It had happened all over the known world, as the fossil record showed. Thus where Hutton's earth was shaped by natural processes that still operate—rain, frost, wind, vulcanism—over deep time, Buckland had thousands of years and a catastrophe based on the biblical intervention that was Noah's flood. His fellow geologists, even those who accepted that catastrophic floods might have wiped out species and deposited strata, scoffed at so crude an attempt to fit what the earth disclosed with what the Bible said. Buckland, however, already had the Royal Society's Copley Medal in his pocket, the first scientist from the fledgling science of geology to win it. He had not frightened the horses of respectable opinion.

Or had he? While enlightened men of science rewarded the Kirkdale research, whatever they thought of the attempt to square it with Genesis, many of Buckland's fellow priests were appalled. Buckland's flood was too gentle for them; his vision of extinction, and of long epochs occurring before the flood, was too heterodox. To such men, the far more ancient fossil fish and pterosaurs that Buckland bought from Mary Anning were even more puzzling: they would not accept that what we now call dinosaurs had lived millions of years ago since to do so meant sacrificing the Bible. It would not be until Buckland's student Charles Lyell, in the 1830s and 1840s, united the fossil evidence with Hutton's understanding of granite and of vulcanism, that opinions would slowly change. Darwin founded *The Origin of Species* on Lyell's work, introducing his famous book with the comment "He who can read Sir Charles Lyell's grand work on the Principle of Geology, which the future historian will recognise as having produced a revolution in natural science, and yet does not admit how vast have been the past periods of time, may at once close this volume".[18]

Darwin delayed publication, so afraid was he of a religious backlash. *The Origin of Species* did not appear until twenty five years after Coleridge's death. But Coleridge was an advanced thinker familiar with the latest research:

[17] Quoted in Cadbury, *Dinosaur Hunters*, p. 76.

[18] Quoted in Macintyre and McKirdy, *Hutton*, p. 47.

Humphry Davy, his friend and President of the Royal Society, had been in Kirkdale cave with Buckland, while Hutton's ideas had been discussed by Blumenbach in Germany. And Coleridge's response to Buckland, as to Hutton, shows the continuing influence of his Göttingen studies. He regretted illiberal clerical attacks on Buckland's interpretation of scripture but viewed that interpretation as being too literalist. In Göttingen he had learned to view the Bible text as a symbolic human interpretation of divine revelations—a guide to but not an accurate record of the history of the earth. He had also heard there of a longer history and more frequent inundations than Buckland's interpretation allowed for. Blumenbach had shown him that fossils revealed mass extinctions and dated the rocks in which they were found to particular epochs. And Blumenbach had also passed down the theory accepted by many European natural historians, which viewed the earth's history as a succession of eras interrupted by global catastrophes, after each of which life was renewed in different forms by the creative power. For Blumenbach, it was not a universal Noah's flood that devastated the earth since not even the most recent catastrophe equated with the Bible account. The most likely cause was global climate change, the effects of which could be seen in every fossil-bearing rock: "Every paving stone in Göttingen … is a proof that species, or rather whole genera, of creatures must have disappeared".[19]

In Germany, Coleridge had tried out his new geological knowledge right away, walking in the mountains and observing strata with Greenough and with Blumenbach's son. He had then brought geology home with him to England—his new interest was one reason that he was climbing down Broad Stand in 1802. He depicted the Lake District soil as mould lying on clay over a "foundation of Rocks, which often break through both Strata, lifting their back above the surface"—suggesting he understood Hutton's idea of earthquakes and internal heat forcing rocks upwards, to buckle and break.[20] In 1807 he imagined the sublimity of the Huttonian earth: "Our mortal existence … a stoppage in the blood of Life—a brief eddy in the overflowing Ocean of pure Activity, from wind or concourse of currents—who beholds Pyramids, yea, Alps and Andes, giant Pyramids the work of Fire, raising monuments like a generous Victor, o'er its own conquest, tombstones of a world destroyed—yet, these too float down the Sea of Time, & melt away, Mountains of floating Ice" (CN, II, 2912).[21]

As he aged, Coleridge grew more remote from the mountains, whether the fells of the Lake District or the volcanoes he had seen in Italy. By 1829 the excitement of physical contact with the crags was long gone. Instead, he was sitting in his study in Highgate, reading and theorising. While he accepted that

[19] Dennis R. Dean (ed.), *Coleridge and Geology* (Ann Arbor MI: Scholars' Facsimiles and Reprints, 2004), p. 39.

[20] *The Notebooks of S. T. Coleridge*, ed. Kathleen Coburn, 5 vols (London and Princeton, Routledge and Kegan Paul and Princeton University Press, 1957-2002), I, 926. Henceforth cited in the text as CN.

[21] See Dean, *Coleridge and Geology*, p. 32. I am indebted to Dean's account.

Hutton might be right about the making of landforms by fire and ice, he preferred to develop the more general implications of Blumenbach's teaching. As a Christian and a philosopher he wanted a teleological earth and a scientific discourse that related the material world to its immaterial causes. Hutton, a deist, left these out of the picture. For Coleridge this was to limit and half-blind us: the essential question was, what caused the forces of fire and water that led to upheaval and denudation? And so he aimed to "collect the facts that have been observed and recorded by our Geologists and Mineralogists of best repute",[22] hoping to create a comprehensive theory of life that properly related the world, the mind and the divine creativity. And though he never finished his grand theory, he left scattered fragments in which he tried to correlate the forces revealed by geology with forces such as gravity and magnetism in creative interaction. Gathering these fragments together, one sees that Coleridge adapted the view he had first encountered in Göttingen. He thought that extinction showed there had been several catastrophic events, each ending an epoch, after which only the highest lifeforms of the previous epoch were carried over into the next, and the world was renewed by the creative force whose ultimate origin was immaterial and divine. On this scheme the world was evolving, after each catastrophe, to a higher level: the history of the earth was a preparation for the creation of man, occurring late in the day. The Bible, therefore, was a symbolic, corrupted, account of what had been revealed in Moses' visions—an account that geology might confirm. The days of creation in Genesis might be symbolic records of huge eons of time. As late as 1829 Coleridge wrote that the "five great Epochs <enumerated by Moses, as> preceding the creation of Man" were "rendered highly probable by the recent investigations of geologists".[23] Here he implicitly rejected Buckland's theory that a recent universal deluge—Noah's flood—accounted for extinction and fossil distribution. Buckland's was too forced an equation of the evidence of bone and Bible. His own interpretation, however, still retained an emotional affiliation to the numerical scheme disclosed in the Old Testament. In this respect he was opposed to Lyell's uniformitarianism—a theory descended from Huttonian ideas that established the ground on which Darwin would build. Coleridge retained something of the methodology of an eighteenth-century intellectual trained for the clergy, albeit one whose exposure to German thought led him to see that this methodology would not suffice if it were not revised. His grand theory can be seen as a *tour de force* attempt to make this revision, to save scripture as a source of truth about the world as well as a moral and spiritual guide to the scientific enquirer.

We have come a long way from a young man tumbling down Broad Stand with a broom stick, and so had geology in the thirty years between that fell-

[22] A notebook entry of 1820, quoted in Trevor H. Levere, *Poetry Realized in Nature: Samuel Taylor Coleridge and Early Nineteenth-Century Science* (Cambridge: Cambridge University Press, 1981), p. 168.

[23] S. T. Coleridge, *Marginalia*, ed. George Whalley and H. J. Jackson, 6 vols (London and Princeton: Routledge and Kegan Paul and Princeton University Press, 1980-2001), III, 60.

walking expedition and Coleridge's last years of theorising. It had established itself as perhaps the crucial new science, establishing a viable theory of the earth's formation, working out its history and sensing its immense age. It had begun to understand fossils and to ponder their significance. It had laid the foundation for Darwin, himself a muscular and Romantic geologist who collected rocks in the remotest regions of the world. Although Coleridge played little part in its rapid development, he retained one important thing from his days of wandering the mountains—he knew that the face-to-face encounter with nature, however close-up and exhilarating, was, although vital, not enough in itself. Science must be guided by the mind's ability to reflect on its own experience: as he told the British Association for the Advancement of Science in 1833, natural philosophy could not understand the world by the exercise of reason until, by reason, it questioned its own shaping of facts by its independent thought-processes. Imagination, synthesising the evidence and reflecting on the synthesis it created, was required, and in this science was a moral and spiritual, as well as empirical activity. In asserting this he was a true heir of James Hutton and a true Romantic man of science: for both men, and for Blake too, the point was not just to look but to *see* the universe in a fragment of rock, or a grain of sand.