



*'O! pray! move on, Sir, said she,
this is amazingly fine: I fancy
myself travelling along with that
little earth in its course round the
gilded Sun . . .'*

'The Grand Orrery', and a quotation from John Harris, *Astronomical Dialogues*, 1719

PROLOGUE: 'SURPRISE THE WORLD'

The earth turns and the curving shadow sweeps round the globe. The sun sets, the moon rises, and all that is familiar feels suddenly strange. In an age before street lights, link-boys carry torches to see city-dwellers home, while in the countryside starlight and moonlight are the only guides. The footpads are out, a darker blackness against shadow, so for safety's sake men walk together when they roll back from the coffee-house, the tavern and the club. And in the eighteenth century clubs are everywhere: clubs for singing, clubs for drinking, clubs for farting; clubs of poets and pudding-makers and politicians. One such gathering of like-minded men is the Lunar Society of Birmingham. They are a small, informal bunch who simply try to meet at each other's houses on the Monday nearest the full moon, to have light to ride home (hence the name) and like other clubs they drink and laugh and argue into the night. But the Lunar men are different – together they nudge their whole society and culture over the threshold of the modern, tilting it irrevocably away from old patterns of life towards the world we know today. That is why I wanted to write about them.

Amid fields and hills the Lunar men build factories, plan canals, make steam-engines thunder. They discover new gases, new minerals and new medicines and propose unsettling new ideas. They create objects of beauty and poetry of bizarre allure. They sail on the crest of the new. Yet their powerhouse of invention is not made up of aristocrats or statesmen or scholars but of provincial manufacturers,

professional men and gifted amateurs – friends who meet almost by accident and whose lives overlap until they die.

So who are they?

First to enter is Erasmus Darwin, doctor, inventor, poet and – half a century before his grandson Charles – pioneer of evolution. (Enormously gifted and enormously fat, eventually he has to cut a semi-circle in his dining table to fit his stomach.) Then comes Matthew Boulton, flamboyant chief of the first great ‘manufactory’ at Soho, just outside Birmingham, followed by his anxious Scottish partner James Watt, of steam-engine fame. Another member is the ambitious young potter Josiah Wedgwood, and eventually, in 1780, Joseph Priestley arrives, the preacher with the stuttering voice and flowing pen, the chemist who isolates oxygen and becomes the visionary leader of Rational Dissent.

This quintet forms the core. But around them weave other stories, a string of names that take on shape as they turn up in their top-coats and breeches, driving newfangled carriages, talking of freedom, of riots and reform, love and laughing-gas. Among them are the Scots chemist James Keir, reliable as a rock; the clockmaker John Whitehurst, who works with minutes but dreams of millennia, the age of the earth itself. Then come the doctors: the diplomatic William Small who seals their early friendships, and the austere William Withering, who brings digitalis into mainstream medicine. And a wilder note sounds with the arrival of two young, idealistic followers of Rousseau, Richard Lovell Edgeworth and Thomas Day.

Ten of these men became Fellows of the Royal Society but only a few had a university education and most were Nonconformists or freethinkers. This placed them outside the Establishment – an apparent disadvantage which proved a real strength, since they were unhampered by old traditions of deference and stuffy institutions. They came from varied backgrounds but when they edged towards rows they agreed to differ, turning back to the things they shared. ‘We had nothing to do with the *religious* or *political* principles of each other,’ wrote Priestley. ‘We were united by a common love of *science*, which we thought sufficient to bring together persons of all distinctions, Christians, Jews, Mohametans, and Heathens, Monarchists and Republicans.’¹ Like a living unit, the group stretched to encompass the awkward and odd: only rarely was there an absolute impasse. Their passionate common exchange and endeavour was of a type that would never be possible again – until today, with the fast, collaborative intimacy of the Internet.

To begin with they came together simply through the pleasure of playing with experiments, what Darwin called ‘a little philosophical laughing’.² They caught at discoveries with delight, sure that every find could help them to crack the elusive codes of nature. And Nature, on every hand, offered herself for investigation. The great vogue for collecting that had grown through the previous century now reached

new peaks. Sometimes the collections were ‘evidence’ in an argument, like the unsurpassed collection of minerals and fossils amassed at the start of the century by geologist John Woodward, to prove the revolutionary thesis that fossils were indeed the remains of ancient organisms, not patterns in rocks, or mysterious designs placed there by God.³ At other times, the whole of the natural world suddenly became ‘collectible’, as if knowledge were conveyed directly, visibly, tangibly by the objects in a cabinet of curiosities. When Peter the Great asked the philosopher Leibniz in 1708 what he should collect, the answer, it seemed, was ‘everything’:

Such a cabinet should contain all significant things and rarities created by nature and man. Particularly needed are stones, metals, minerals, wild plants, and their artificial copies, animals both stuffed and preserved ... Foreign works to be acquired should include diverse books, instruments, curiosities and rarities ... In short, all that could enlighten and please the eye.⁴

However, Peter’s daughter-in-law Catherine the Great (another great collector) disparaged this old, baroque style of freakish accretion: ‘I often quarrelled with him’, she wrote, ‘about his wish to enclose Nature in a cabinet – even a huge palace could not hold Her.’⁵

Nature would not be confined. In the mid-eighteenth century, across Europe, in Britain and in America, ordering the vast and complex riches of Nature became a priority. This was the age of great scientific expeditions. When the naturalists Joseph Banks and Daniel Solander travelled with Captain Cook on his voyage to the South Seas from 1768 to 1771, they brought back 1,000 new species of plants, 500 fish, 500 bird skins, numberless insects and hundreds of drawings. It was against this background that Erasmus Darwin translated Linnaeus, wrote his epic poem *The Botanic Garden* and developed his own controversial theories of evolution.

In exploring such matters Darwin and his friends were part of the great spread of interest in science that extended from the King and the Royal Society to country clergymen and cotton-spinners. When people talk of eighteenth-century culture this is the swathe that is often missed out: the smart crowds thronging to electrical demonstrations; the squires fussing over rainfall gauges; the duchesses collecting shells and the boys making fire-balloons; the mothers teaching their children from the new encyclopaedias with their marvellous engraved plates of strange animals and birds and plants.



The Kentish Hop Merchant and a Lecture on Optics, satirical engraving

Science was popular because it was ‘gentlemanly’ and cultured, and like all crazes it produced its share of jokes. But it was also a great spur to industry, helping Britain to surge ahead of other European nations.⁶ As professors and savants brought their improved mathematics and theoretical knowledge of chemistry, minerals, heat or hydraulics to bear on the *ad hoc* wisdom of old crafts, so the artisans developed new processes and technologies at an astonishingly accelerated rate. The manufacturers among the Lunar men pounced on the new findings. Their ambitions were unbounded: ‘I hate piddling, you know,’ wrote Wedgwood, who also declared that he would ‘surprise *the World* with wonders’.⁷

But the idealists among them, particularly Priestley, wanted to surprise the world in a different way. Their technocratic fix, they thought, could bring paradise on earth: just as chemists could make ‘pure’ air to cure diseases, so knowledge could light the fuse of democratic change. Anything seemed possible – steamships, manned flight, diving bells. Darwin speculated quite seriously about changing the windflow over Britain, and suggested that European governments, ‘instead of destroying their seamen and exhausting their strength in unnecessary wars’, should use their navies to tow icebergs to the Equator to cool the tropics and ease the northern winters.⁸

There was no man-made Georgian global warming – but what happened in Britain was dramatic. In two generations, roughly from 1730 to 1800, the country changed from a mainly agricultural nation into an emerging industrial force. By the time these friends died, iron and coal and cotton were king and the provinces no longer looked automatically to London to lead the way.⁹ The ‘universal ferment’ that accompanied this shift was as potent as any political revolution, affecting the lives of millions, opening the way to the factory age, the railway, the forging of empire. Although there was no sudden, sharply datable ‘industrial revolution’, for all the makers and merchants the late eighteenth century was a cluttered, cut-throat world, different to that which their fathers had known. They now had to appeal to the affluent ‘middling classes’ who were rushing to buy new domestic goods: clocks, prints, earthenware, curtains and cutlery and carpets.¹⁰ The country was driven to rethink the whole relationship of ‘luxury’ to culture and such issues were argued over not only by philosophers but also by smart consumers such as Lady Caroline Lennox, who declared stoutly that shopping was not only fun but a ‘rational exercise, a commitment to the civilising powers of trade’.¹¹

Caroline’s word ‘rational’ is the key. When she was growing up the nation prided itself on its open, rational outlook. In the early years of the century, Continental philosophers such as Voltaire saw Britain as a model of freedom, with its balanced constitution and religious tolerance and its openness to public discussion. Many thinkers were convinced that the light of reason would dispel the shadows of superstition.¹² Yet here too, change was slow: when the murrain decimated herds of Midlands cattle in the 1740s, an educated boy still prayed, ‘God grant that the people of the land may turn away the wrath of God by true repentance, and that we may *sin no more lest a worst thing come upon us.*’¹³ And new discoveries themselves often seemed to defy reason – the idea that seas of fire rolled beneath the solid earth, or that chalk contained gas ‘fixed’ into it, which could be freed into the air like a genie from a lamp.

Contradictions abound. The age of progress was also one of retrospection, in which people hunted endlessly for ‘origins’. The age of reason was also one of sensibility, whose gurus stressed the power of the passions and senses as much as the mind. Science itself was intensely physical: medicine was a saga of bleeding and blisters; chemistry a matter of green fumes and red fumes, of the tang of acid on the tongue, of sneezing and choking and watering eyes. And this sensual bias was embedded in the terms they used: as chemical substances proved mysteriously choosy, reacting with some substances and repelled by others, so chemists hunted for ‘affinities’, patterns of union as binding (and baffling) as choices in love. The language of science rippled with the suggestiveness of sex and the human body itself became a source of fascination. Was it a machine or a bundle of vibrating nerves? How did we feel sensations? How did we register them in our minds?

These were key questions not only for medicine but for education and artistic taste. In the time of the Lunar men science and art were not separated: you could be an inventor and designer, an experimenter and a poet, a dreamer and an entrepreneur all at once without anyone raising an eyebrow. In 1772, when the young British Museum bought the first great collection of antiquities belonging to Sir William Hamilton, ancient bronzes and vases and specimens of natural history all found a place together, in the 'Department of Natural and Artificial Productions'. Constantly the different realms overlapped. As botanists listed plants, so flowers bloomed across teapots and plates. As scholars compiled tables of minerals, so manufacturers printed catalogues and grouped their goods in families and types. As geologists argued about rock formations and volcanoes, so artists and poets began to show wild regions not as deformed but as 'sublime'. At the same time, factories joined ruins on the tourist trail. In 1781, the Hon. John Byng advised that the best way to enjoy Tintern Abbey was 'to bring wines, cold meat, with corn for the horses':

Spread your table in the ruins; and possibly a Welsh Harper may be obtained from Chepstow. I next visited several of the iron works up the stream, and with wonder observed the gradations of the iron from the smallest wire to a large cannon.¹⁴

Yet if optimists like Priestley genuinely believed a peaceful millennium was on the way there was always a darker side. Enclosures emptied villages. Factories and machines could turn workers into cogs. Quaker anti-slavery campaigners sold guns to Africa. Some people already suspected that progress might create a hell instead of a heaven on earth and a counter voice fought to make itself heard, through writers such as Kit Smart and William Blake, who asked us not to trust in 'Reason' but to look within for the divine, the springs of creation.

This book smells of sweat and chemicals and oil, and resounds to the thud of pistons, the tick of clocks, the clinking of cash, the blasts of furnaces and the wheeze and snort of engines but it also speaks of bodies, courtships, children, paintings and poetry. The excitement of science and manufacturing went side by side with experiments in living which aroused horror in the icy evangelical respectability that followed. (When Charles Darwin wrote his grandfather's biography, his daughter Henrietta took the proofs and firmly scored out any hint of Erasmus's shocking 'atheism'.) The Lunar men shared the praise and the abuse together, and although over the years the dynamic of their friendships changed, they remained remarkably close and influential. We know so little about their work together in comparison, say, with the Romantics – yet once we do know them it is impossible to read Romantic poetry in quite the same way. As their glow fades, so the cloudy moon of Coleridge and Shelley sails into the sky, both reflecting and rejecting the old Lunar ideals.

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I realize that I am looking at these men through the spectacles of my own time and interests, and have shaped the facts according to my own guiding images: the Lunar tides driving up the beach, with each wave curling back to let the next one break; or the ancient elements – Earth, Water, Air and Fire. The elements both offer a map of the group’s preoccupations and suggest their story’s form: the physical and intellectual earth from which they grow; the way that their lives flow together; their airy ascent, and their final, fiery, revolutionary years. And the old Aristotelian names also signal the slow but profound change in scientific thinking over the century, until in the late 1780s the new ‘French chemistry’, with its new terms, began to hold sway.

From then on we spoke a new language. Feeling some disloyalty to the Lunar men, I have often used modern terms such as ‘sulphuric acid’ or ‘hydrogen’, because they are easier to understand than ‘vitriol’ or ‘inflammable air’. And I have called people ‘scientists’ because that expresses what they were doing in our modern terms, although the word was not even coined until the 1830s. Yet such translation marks the mental gap between our time and theirs, since language is a key to a whole way of thinking. At the time, ‘science’ meant knowledge; interest in the material world was ‘natural philosophy’. And when people spoke of the ‘arts’, they did not mean only the fine arts but also the ‘mechanic arts’, the skills and techniques in agriculture, say, or printing. So the relationship of philosophy to the arts could mean the usefulness of natural knowledge to industry – almost the opposite of what we mean today.

We have to wrench our minds round, abandoning divisions, to think back into this age, but for me that mind-shift has been revealing. I now marvel at the way the history of technology underpins the simplest things in our lives, such as the coins in our pocket, the plate on the breakfast table and the newspaper beside it, let alone the toaster or kettle. And science has given us the great modern narrative whose stories mutate like the variants of myths. Driven by curiosity, we build and rebuild explanations for mysteries we cannot fully understand – from the spinning of the cosmos to the growth of a cell. No wonder the Lunar men seemed so powerfully seductive in their day, and so dangerous to the entrenched *status quo*. Fallible and extraordinary at once, they were, without a doubt, men who changed the world.

Notes – PROLOGUE: ‘SURPRISE THE WORLD’

1 JP, *Experiments on the Generation of Air from Water* (1793), Dedication. Membership of the Lunar society is uncertain, sometimes including Baskerville, sometimes excluding Wedgwood, although he was central to their work. See, for example, Eric Robinson, ‘The Lunar society: its membership and organisation’, *Transactions of the Newcomen Society*, xxxv (1962–63).

2 ED to MB 11 March 1766.

- [3](#) John Woodward, *Essay Towards a Natural History of the Earth* (1695).
- [4](#) Rosamond Wolff Purcell and Stephen Jay Gould, *Finders, Keepers: Eight Collectors* (1992) 17.
- [5](#) Ibid.
- [6](#) R. Porter, 'Science, provincial culture and public opinion in Enlightenment England', *BJECS*, 3 (1980). also Golinski, and Larry Stewart, *The Rise of Public Science: Rhetoric, Technology and Natural Philosophy in Newtonian Britain, 1660–1750* (Cambridge, 1992). For a different perspective on the 'Industrial Enlightenment' and birth of the knowledge economy, see Mokyr; and for a reading of the 'Radical Enlightenment', see Israel.
- [7](#) JWe to TB 31 October 1768, W. E25–18212.
- [8](#) *BG: Ec. Veg.* 1. 529 note. The suggestion was first made by William Small in correspondence with James Watt in the early 1770s.
- [9](#) See D. Read, *The English Provinces, c. 1760–90* (1964) and P. Borsary, *The English Urban Renaissance Culture and Society in the Provincial Town, 1660–1770* (Oxford, 1989).
- [10](#) See John Styles, 'Manufacturing, consumption and design in eighteenth-century England', in John Brew and Roy Porter (eds), *Consumption and the World of Goods* (1993) 536–8.
- [11](#) Stella Tillyard, *Aristocrats: Caroline, Emily, Louisa and Sarah Lennox, 1740–1832* (1995) 171. See also Maxine Berg and Helen Clifford (eds), *Consumers and Luxury: Consumer Culture in Europe 1650–1850* (Manchester, 1998).
- [12](#) See *Enlightenment*, and David Spadaforda, *The Idea of Progress in Eighteenth-Century Britain* (Newham and London, 1990).
- [13](#) *Weather Journals* 24.
- [14](#) David Souden (ed.), *Byng's Tours: The Journals of the Hon. John Byng 1781–1792* (1991) 23.