Rocks of ages

Tim Radford ponders what lies beneath the grass roots*

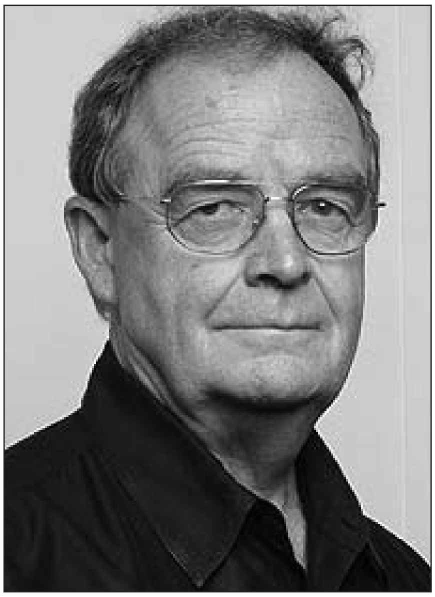
You could make a world of claims for geology, including, of course, the ground upon which we stand. Geology may be a downward-looking science, but it secures our wealth, our bricks and mortar, our energy and indirectly our health as well. It helped explain how we got here, how long we might stay, and why our leasehold looks a bit doubtful right now. The great human adventure began with geology: the first cutting-edge technology was hammered from flint or obsidian at least two million years ago; civilisation grew from the systematic cultivation of the weathered sedimentary deposits 10,000 years ago; geometry – the clue is in the word itself – was fashioned almost 4,000 years ago as a way of measuring terrain.

Paradoxically, geological science is relatively new and first emerged from the shadow of theology. A text dating from 1690 was called "Geologia: or a Discourse concerning the Earth before the Deluge" but according to the Oxford English Dictionary it was not until 1795, two years before his death, that the great James Hutton used the words "geology" and "geological" in the modern sense of systematic investigation of the Earth's crust. Hutton was the man who looked at the epic story told in the rocks and reported that he saw "no vestige of a beginning, no prospect of an end."

Since then, geologists have tried to read the Earth like a book, with some difficulty. The storyline is patchy, the plot contorted, the authorship in permanent dispute. Pages have been torn from the text, the rest are foxed or watermarked. Whole chapters are lost for ever. Characters appear from nowhere, and disappear as mysteriously. The script is disputed, and there are still arguments about the lexicon or the grammar. But somewhere in the lapidary prose of the Earth's crust is the story of the making of a planet, with its rocks, its oceans and its atmosphere and its almost imperceptible alteration over billions of years by the life that colonised it.

Much of this great detective story is told in the papers of the Geological Society of London, now online in the form of the Lyell Collection, and the papers of Charles Lyell, the great Victorian geologist who served as mentor and friend to Charles Darwin, are a reminder of the complexity of the challenge and the thoroughness with which scientists tried to meet it, everywhere in the world.

In 1845, for instance, Charles Lyell reports on the Miocene strata of a 400 mile tract of American landscape running from Maryland to South Carolina, extending from Delaware Bay to the Cape Fear River, and what he sees reminds him of beds of rock in Suffolk, and in the Touraine of France. "On the right bank of the James River, at City Point, Virginia, about twenty miles below Richmond, in a cliff about thirty feet high, I observed the yellow



and white Miocene sands resting on dark green earth and marl of the Eocene formation, just as the yellow sands of the crag rest on the blue London clay in some parts of the coast of Suffolk and Essex," Lyell writes. In Wilmington, North Carolina, he examines the beds of shells and notes similarities with formations on the other side of the Atlantic, and in other parts of the US, but adds with a note of caution "As, however, it would be very rash to assume that all the Miocene deposits of the United States, especially in countries as far apart as Maryland and South Carolina, were of strictly contemporaneous origin, the fossil faunas of each region should be carefully distinguished, and considered separately."

There you have geological science: simultaneously sweeping and non-committal; spanning continents and fretting about the occurrence of univalves; making connections but trying not to make too much of them. The surprising thing, surprising because when Lyell wrote, the science was in its infancy and the Earth still a profound puzzle, is how much of the language of geological science was already confidently in place; and how eagerly the first geologists were using it to describe the four corners of the globe. In 1859, my homeland of New Zealand had been a British colony for just 19 years, and my home city of Auckland was just a tiny settlement, but I'd recognise it immediately from Charles Heaphy's description in the Proceedings of the Geological Society: "The isthmus may be considered as a basin of Tertiary rock. Through it have burst up, dotting its surface, as many as sixty-two separate volcanos (sic); showing in nearly every instance a well-defined point of eruption – generally a cup-like crater, on a hill about 300 feet high above the plain." Actually, according to a recent issue of Geophysical Research Letters the latest count is 49 basaltic volcanoes, and the Auckland sediments are Quaternary-Miocene, but today's geologists have more time, better techniques and equipment beyond the wildest dreams of Lyell's contemporaries.

The Geological Society of London is 200 years old this year, and its two centuries of existence describe a trajectory of understanding in the Earth sciences as a whole. What began as a detailed attempt to understand the relationship between the passage of time and the visible rocks, became an attempt to tell the whole story of the Earth, from its hellish beginnings 4.5 billion years ago to its present extraordinary condition as the only known home for life in the vastness of the universe. Lyell's inheritors still sample, examine and make guesses about the origins of rocks on Earth, but they have also stood on the Moon, and with help from sophisticated automata explored the terrain of Mars and even Saturn's moon Titan. Geology has spawned, stimulated or triggered a cascade of now-separate sciences: palaeontology, archaeology, oceanography, atmospheric science, climatology, volcanology, seismology and geophysics all begin from geology, and feed back into it.

In less than one human lifetime, Lyell's inheritors devised, tested and confirmed a revolutionary theory of plate tectonics that now explains why mountains grow, why continents move, why precious minerals concentrate in certain formations, and why volcanoes and earthquakes are not just inevitable, but helpful in the long run, in renewing and reshaping life's only home. Its members were among the giants, but it would be wrong to suggest that the Geological Society of London was always at the cutting edge of the great scientific revolutions of the last two centuries. The presidential addresses of 1859 and 1860 are remarkable for what they do not say about Darwin's theory of evolution, even though Charles Darwin was an honoured member. Gordon L Herries Davies, in "Whatever Is under the Earth", the official history of the Geological Society of London, recalls a leading figure saying "I've been reflecting on what the Society did in the 1960s for the establishment of Plate Tectonic Theory. The answer seems to be almost nothing."

But learned societies have a way of learning from their own mistakes: that's why they survive. The Society, which began from a casual meeting of 13 men in a London alehouse in 1807, will stage a bicentenary conference at the QEII conference centre in London September 10-12, to emphasise just how much the modern Earth sciences can contribute to the modern world. On the final day, the President of the Royal Society, Lord Rees of Ludlow, Richard Fortey, President of the Geological Society, and others will confront the challenges of climate change, dwindling mineral and carbon resources, natural hazards and the struggle to find water for increasingly thirsty continents. There will, of course, be pure science as well: at least one speaker will address the recent discoveries of more than 150 extra-solar planets: that is, planets that orbit distant suns. No-one has ever seen one of these objects: their existence has been inferred from subtle observation of their parent stars, but astronomers and planetary geologists are preparing experiments that could one day directly detect their reflected light and read the chemistry of their atmospheres. The research is worth doing for its own sake, but of course everyone knows what the real prize would be: the discovery of another blue planet 25 or 50 light years away, a distant world with liquid water on its surface, and oxygen and methane in its atmosphere.

This chemical mix would be evidence not just of a habitable planet, but of an already inhabited planet, a home to extraterrestrial life. That's some pay-off for a science that began by looking at the ground beneath our feet, to discover neighbours far beyond the nearest stars.

http://www.geolsoc.org.uk/lyellcentre

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