

Core caper

Journey to the Center of the Earth

Film directed by Eric Brevig
In UK and US cinemas now

When Jules Verne wrote *A Journey to the Centre of the Earth* in 1864, science was still coming to terms with the planet's extreme age, and Verne's story of a swiss-cheese globe containing vast seas and prehistoric creatures had a satisfying ring of plausibility. The novel's eccentric scientist, Otto Lidenbrock, invokes real-life researchers from Humphry Davy to Joseph Fourier, and the thrilling plot is regularly punctuated by scientific musings that were then cutting-edge.

The book may have inspired many to become geologists, but for recent generations of readers, the obvious impossibility of the subterranean voyage has detracted from its allure. It was even "too fantastic" for David Stevenson of the California Institute of Technology, Pasadena, who proposed an unmanned mission to probe Earth's core in this journal in 2003.

So this 2008 cinematic visit to Verne's strange subterranean world is more akin to fantasy than science fiction. *Journey to the Center of the Earth*, the new 3D film by special-effects guru Eric Brevig, is silly — in a good way. And within its imaginary world, the film holds science and fact in high regard.

The film is not an exact remake of the novel. Rather, it imagines a world where a few present-day maverick geologists called Vernites believe the novel to be fact not fiction. The action follows a geologist, played for broad comedy by Brendan Fraser, his sullen teenage nephew



S. RAYMOND/NEW LINE CINEMA

Jules Verne dismantled: *Journey to the Center of the Earth* is silly, but holds science in high regard.

(Josh Hutcherson) and the Icelandic daughter of a missing Vernite (Anita Briem).

A sleight of hand with the science — a few "seismic readings" on a computer screen — gets the trio to the centre of Earth. But once underground, science saves the day as Fraser's character shows expert knowledge of mineral properties that rescues them from lava, dinosaurs and the like.

The film's tough scientist hero and its exciting caverns and formations might even have the effect on young audiences that the novel presumably had on previous proto-geologists. It vividly portrays the geological world of rocks and lava as diverse, dynamic and cool. It also

pokes fun at the maverick scientist trope, with deadpan lines like "Although [he] was ridiculed by the scientific community, he was eventually found to be correct."

That said, the movie is pretty mindless. It has the standard comedic patter in the face of danger, with punchlines you can see coming all 6,400 kilometres from the centre of Earth. Mandatory shots take advantage of the 3D to make the audience jump. Happily, it doesn't take itself too seriously: "Eat your trilobite son; you've got to keep your strength up." And its new and improved 3D effects are a lot of fun to watch. ■

Emma Marris is a correspondent for *Nature*.

Geological history turned upside down

Worlds Before Adam: The Reconstruction of Geohistory in the Age of Reform

by Martin J. S. Rudwick

University of Chicago Press: 2008. 614 pp.
\$49.00

Geologists study Earth by applying principles borrowed from more fundamental sciences. Yet geology also has its own set of attitudes that have accrued during the discipline's long history. The nature of geological inquiry, involving a synthesis of historical and philosophical reasoning, lies at the heart of Martin Rudwick's fine new book.

Worlds Before Adam shows that the emergence of modern geology was comparable in its

cultural impact with that of relativity or Darwinian evolution. Rudwick, an influential historian of Earth science, emphasizes geology's historical and causal approaches to understanding, complementing his magisterial book *Bursting the Limits of Time* (University of Chicago Press, 2005). This earlier work covered the period between 1787 and 1822, when French savant Georges Cuvier and his fellow continental geologists gave meaning to signs of the past, such as fossils and strata, in the same way as historians and archaeologists use monuments and archives to map human history. *Worlds Before Adam* looks at how the ideas generated by Cuvier and others came together with more theoretical concepts between 1820 and 1845.

Rudwick's books are myth-busters, of which writers of introductory geology texts and popularizations should take note. In both volumes he counters the Anglocentric view that James Hutton, William Smith and Charles Lyell were the founders of modern geology who shone their British intellectual light onto the darkness of continental musings. To a large degree, he argues, the reverse was the case.

Controversially, Rudwick challenges the view that geology's development is a story of secular progress. He shows that the founders of geology were almost all men of faith. Yet they often engaged in fierce debates with pseudo-scientists who ascribed absolute authority to readings of the Bible. Theologians have discredited such

views for centuries, but they still persist, with geologists continuing to refute them.

If contemporary lists of the greatest scientists feature a geologist at all, it is usually Lyell, a central figure in *Worlds Before Adam*. Lyell intended the title of his great multi-volume opus *Principles of Geology* (first published in 1830–1833) to recall Isaac Newton's *Principia*. He sought to recast geology on firm foundations, just as Newton had done for physics. Following his geologist contemporaries and predecessors, Lyell used the understanding of present-day causes to interpret the deep past — a principle termed actualism. Rudwick explains that Lyell's excellent descriptions of current geological processes, embellished with observations from his own geological excursions, derived from an original listing by the eighteenth-century German scholar Karl Ernst Adolf von Hoff. Lyell greatly extended the actualistic method by making pronouncements about how the complex geological processes of the past occurred through the progressive action of small-scale procedures that were still in operation, and by prescribing how geologists should reason about these past processes.

Rudwick shows that Lyell's ideas met with almost universal criticism. This was not caused

by his advocacy of actualism, which was widely used, nor was any serious denunciation forthcoming from the biblical literalists, who were considered anti-scientific by Lyell and by his critics. Instead, the geological facts themselves seemed contrary to Lyell's vision of uniform action by small-scale processes operating over a long time. Examples include evidence for sudden mass extinctions from records in various 'bone caves', the existence of huge blocks sitting erratically out of geological place in the Alps and northern Europe, and deep U-shaped valleys containing streams too small to account for their excavation. Lyell's critics held that one should inquire into nature through evidence, rather than through privileged reasoning.

The great Cambridge polymath William Whewell named the two sides in the debate. Lyell's advocates he labelled 'uniformitarians'; their opponents he called 'catastrophists'. It is an irony of subsequent developments in geology, and a testimony to the success of Lyell's advocacy, that catastrophism came to be regarded as unconventional. This perverted Whewell's original intention, which was to show that the uniformitarians and Lyell were extreme in thinking that geologists should say in advance how nature works, through slow and uniform

processes, before interpreting the evidence.

Worlds Before Adam concludes with the development of glacial theory, popularized in the nineteenth century by Cuvier's disciple Louis Agassiz, perhaps the greatest of the catastrophists. Agassiz's theory of the great spread of ice sheets during relatively recent geological time gained rapid acceptance among catastrophists because it accounted for many anomalous features originally ascribed to huge floods or tsunamis. However, Lyell resisted, remaining true to his epistemological project.

As we enter an era of global crises about water, energy and the environment, and as we seek to understand the development of our species among others in one corner of the Universe, geologists' perspectives give a means for both understanding and coping. In showing how these perspectives arose, Rudwick highlights an underappreciated, glorious advance in human thought, the documentation of which is a rather glorious achievement in itself. ■

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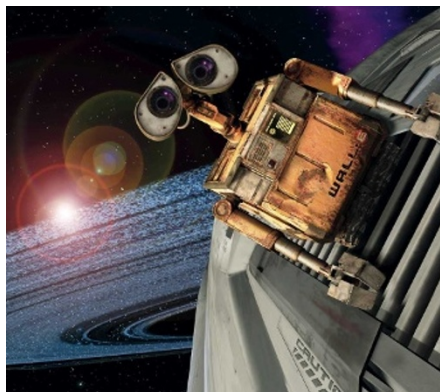
Romance among robots

WALL·E

Film directed by Andrew Stanton
In UK and US cinemas now

A few years ago, at the Massachusetts Institute of Technology's artificial intelligence lab, I met an android. Her conversation was perfunctory, mostly simple responses to my equally simple words, but her eyes, widening, narrowing and subtly changing angle, made a genuine emotional connection. That robot had me at "Hello". So it is with WALL·E (pictured), the eponymous hero of Disney–Pixar's new animated film. Part Mars rover, part Andy Hardy, WALL·E charms us every step of the way as he saves a planet while pursuing chaste robotic love.

The movie opens on a bleak future, reminiscent of films by director Ridley Scott at his dystopian best. Earth, abused and then abandoned by a population that never heeded Al Gore, lies grey and silent beneath the refuse of civilization. Punctuating the stillness is a small buzz of activity. WALL·E, a computerized rubbish compactor, perhaps descended from those robotic vacuum cleaners, dutifully pursues work he was programmed to do hundreds of years earlier, before humans gave up on the



dream of refurbishing the planet. It's not a bad existence, but as he considers the oddments he has scavenged over time, particularly an old video tape of the film *Hello, Dolly!*, WALL·E recognizes that something is missing. That something soon materializes in the form of a robotic scout, sent to Earth to search for signs of photosynthesis. The scout is named EVE and ... well, you can see where all this leads.

Movie buffs will enjoy WALL·E's film references — from *2001: A Space Odyssey* (of course) to *Modern Times*. Science nerds will appreciate how both the story and the animation are

informed by NASA and research into artificial intelligence. Pixar animators have mastered the literature on non-verbal communication; they have studied in detail the workings of robots from Mars rovers to assembly lines, and have internalized the stunning images from the Hubble and Spitzer space telescopes.

The animation in *WALL·E* is astonishing, but Pixar recognized long ago that technology alone does not fill cinemas. Stories do, and *WALL·E*'s creators are master storytellers. Sci-fi master Robert Heinlein maintained that there are only three plots in science fiction. All figure here: a sweet love story, the triumph of plucky stowaways over a power-hungry computer (remember HAL?), and a plea for planetary redemption. Moreover, the movie is funny. Eight-year-olds and octogenarians alike laughed throughout the screening, usually at the same time.

So, for animated sci-fi that honours both the science and the fiction, steal away to *WALL·E*. And, if you work at NASA's Jet Propulsion Laboratory in California, go and see it twice. When a future Mars rover angles its soulful head-lamps while asking for more funding, who at NASA will be able to refuse? ■

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