

Retrospective

James Lovelock (1919-2022)

Father of Earth system science

James E. (“Jim”) Lovelock died on 26th July, his 103rd birthday. An independent scientist and prolific inventor, Jim transformed our view of the Earth and human impact upon it. His Gaia hypothesis revealed that the thin film of life, air, water, soil, and sediments at the planet’s surface is a remarkable, self-regulating system. Jim also showed how we are disrupting that system, discovering important trace gases with his own instruments – including ozone-depleting chlorofluorocarbons (CFCs). He was the original Earth system scientist.

Born in Letchworth, England in 1919 and raised in Brixton, Jim hated doing homework but loved scientific books and nature walks with his father. While attending Birkbeck College at night, Jim learned his craft as an apprentice chemist for a consulting firm. War took him to Manchester University where he earned his bachelor’s in chemistry in 1941. A conscientious objector, Jim joined the National Institute for Medical Research at Mill Hill. He received a PhD in Medicine from the London School of Hygiene and Tropical Medicine in 1948 and a DSc in Biophysics from the University of London in 1959. In 1961, an invitation to consult for NASA inspired him to ditch tenure and spend his life as an independent scientist.

Jim made deep and diverse contributions to science, with a passionate disregard for conventional disciplinary boundaries. At Mill Hill he gained a reputation as a master inventor of precision instruments – most notably the exquisitely sensitive electron capture detector. He was a pioneer of cryobiology, including freezing and resuscitating small mammals, which gave him a keen sense of the resilience of life.

Working for NASA at the Jet Propulsion Laboratory in 1965, Jim was tasked with detecting whether there was life on Mars. He reasoned that the presence of abundant life on any planet would show up as a remotely detectable disequilibrium in the chemistry of its atmosphere (a method still foundational to contemporary efforts to detect life on exoplanets). A predominance of atmospheric carbon dioxide strongly suggested Mars was lifeless. Looking at Earth’s atmosphere, Jim saw an extraordinarily improbable, yet remarkably stable chemical cocktail created by life. He realized that life must play a role in regulating the composition of both the atmosphere and the climate. Later he teamed up with evolutionary biologist Lynn Margulis, who put microbiological flesh on the chemical bones of the hypothesis, which novelist William Golding named “Gaia.”

In the early 1970s, Jim predicted that oceanic life would make volatile substances to return essential elements to the land. Using his own instruments, he discovered the biogenic gases methyl iodide and dimethyl sulfide (DMS) in the remote marine atmosphere. He also discovered CFCs everywhere, providing critical evidence that they threatened the ozone layer. Subsequently, Jim realized that DMS produced by marine algae oxidized to form cloud condensation nuclei, that more small water droplets make clouds brighter, and that the resulting cooling of the surface would affect the algae producing DMS. Such linking of biology, chemistry, and physics in feedback loops gave us a new understanding of Earth as a dynamic system.

Gaia provoked strong reactions, particularly after Jim’s first popular book in 1979. Evolutionary biologists argued that global regulation required consciousness and that natural selection could never produce it. In response, Jim invented “Daisyworld” – a model parable that demonstrated how feedbacks involving life could give rise to automatic climate regulation at a planetary scale. It also showed that when regulation breaks down, it does so catastrophically. Daisyworld influenced a generation of climate modelers and informed Jim’s second book, *The Ages of Gaia*, which gave a

new view of Earth history as a series of distinct regulatory regimes interspersed by periods of turmoil.

In 1992, at age 18, I wrote to Jim to answer his call for “practitioners of planetary medicine.” He had the humility to invite me to visit his home and laboratory at Coombe Mill, where we walked the grounds at his signature breakneck speed. I marveled at his laboratory in a converted barn, which upstairs housed the homemade dilution chamber he used to calibrate his instruments. Jim became my mentor, unofficial supervisor, and close friend. His wicked sense of humor was always testing people’s limits. On one memorable visit to the lab, he opened an old ice cream tub to reveal a grey putty-like substance, asking me what I thought it was. “Plasticene?” I ventured. “Semtex!” he replied. Jim was regularly employed by the Ministry of Defense, in this case to improve methods of sniffing out explosives. He was proud to have worked with explosives like Semtex throughout his life and still be in possession of his fingers, a tribute to his care in the lab, despite a professed loathing for “health and safety.”

Jim had an incredible intuition for how things worked, often arriving at a working solution or invention without knowing how he got there. He was also an incredibly creative thinker who could make connections that no one else saw. Although wonderfully generous to his friends, Jim took a dim view of humanity’s collective potential, writing “I would sooner expect a goat to become a gardener than humans to become responsible stewards of the Earth.” After sparking the environmental movement, Jim warned of the existential risk of climate change with his book *The Revenge of Gaia*. He was made a Companion of Honor in 2003.

The world has lost a genius and iconoclast of immense intellectual courage. Never afraid to lambast the establishment and challenge convention, Jim Lovelock transformed our view of the world, started the new field of Earth system science, and inspired generations of researchers. As we are confronted by complexity and volatility, from the pandemic to climate extremes, we need his unique perspective more than ever before.

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