

Freeman J. Dyson 1923–2020: Legendary physicist, writer, and fearless intellectual explorer

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Freeman J. Dyson, one of the foremost minds of the 20th century, passed away on February 28, 2020 at the age of 96. An astute explorer of the natural world, Dyson's contributions transcended preconceived boundaries and created bridges between the sciences and the humanities. As an author, Dyson brought stunning clarity to the beauty and complexity of the universe and human experience.

Trained as a mathematician, Dyson gained early fame in the world of theoretical physics, proving the equivalency of two theories of quantum electrodynamics to describe how light and matter interact. Claiming to have a short attention span, Dyson took pleasure in jumping from one field to the next. His journey led to breakthrough advances in the design

of safe nuclear reactors, nuclear-powered space travel, solid-state physics, ferromagnetism, astrophysics, biology, and applied mathematics. An eternal optimist and unflinching advocate for the future of human civilization, Dyson was a leading voice for nuclear disarmament and fostering intellectual diversity.

During the Second World War, Dyson worked as a civilian scientist for the Royal Air Force's Bomber Command, an experience that made him a life-long pacifist. In 1941, as an undergraduate at Trinity College, Cambridge, United Kingdom, he found an intellectual role model in the famed mathematician G. H. Hardy, who shared two ideas that came to define Dyson's trajectory: "A mathematician, like a painter or a poet, is a maker of patterns," and "Young men

should prove theorems; old men should write books."

Early in his career, Dyson published papers on number theory, analysis, and algebraic topology. In 1947, he was awarded a Commonwealth Fellowship, bringing him to Cornell University in Ithaca, NY, where he focused his mathematical acumen on theoretical physics. Here Dyson joined a group of brilliant young American physicists, including Richard Feynman, who had returned from Los Alamos and now set their minds to resolving the mysteries of quantum field theory. At that time, Julian Schwinger at Harvard University in Cambridge, MA, had developed a complicated scheme of calculations that was comprehensive, but which few understood. Feynman had posited a deceptively simple set of diagrams that described the interactions of particles in terms of their trajectories through space and time. In the summer of 1948, while traveling by Greyhound bus from San Francisco to Princeton, Dyson had an epiphany that united the two: Feynman's diagrams elegantly captured Schwinger's calculations.

At the invitation of J. Robert Oppenheimer, Dyson joined the Institute for Advanced Study in Princeton, NJ, in 1948, and in 1953 was appointed to the permanent faculty, joining a group of the century's top physicists and mathematicians, including Albert Einstein, Hermann Weyl, and John von Neumann. The Institute remained his academic home for more than 60 years, until his death. Dyson would walk to his office every morning.

In 1956, Dyson began a three-year association with General Atomic, working to design an inherently safe nuclear reactor. The TRIGA (training, research, isotopes, general atomics) reactor is still in production today and used mostly by hospitals. In 1958, Dyson joined "Project Orion" to design an atomic spaceship capable of riding a wave of controlled nuclear pulses into deep space, targeting Saturn and even beyond, to the nearest star. Dyson was one of the few who were thoroughly disappointed by the limited ambition of putting a man on the Moon. He recalled the 15 months spent on the short-lived project as "the



Freeman J. Dyson. Image credit: Andrea Kane (Institute for Advanced Study, Princeton, NJ).

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most exciting and in many ways the happiest of my scientific life.”

In 1960, Dyson was elected to the council of the Federation of American Scientists and selected as its chair two years later. From this post, Dyson became an effective advocate for the creation of the Arms Control and Disarmament Agency and Nuclear Test Ban Treaty.

Dyson was a frequent contributor to popular scientific publications on a wide variety of topics, from the relation of science to religion to the search for extraterrestrial life. He speculated that an advanced civilization could harness a significant fraction of a star’s energy output by surrounding it with orbiting structures that would be observable through infrared radiation signals. This concept famously came to be known as a “Dyson sphere.” He also fantasized about the colonization of the cosmos by self-replicating robots or a “space ark” carrying the genetic material of all terrestrial organisms.

Dyson was a pioneer of computational climate models in the 1970s. Later criticized as a skeptic, Dyson never denied the role of humans in the warming of the

Earth, but he did question the perceived understanding of long-term climate evolution, to the dismay of some of his colleagues.

Heeding the advice of his undergraduate mentor, Dyson returned to his first love of writing. He became well-known to a wide audience by his books *Disturbing the Universe* (1979) (1) and *Infinite in All Directions* (1988) (2), and his many beautiful essays for *The New Yorker* and *The New York Review of Books*. In 2018, he published his autobiography, *Maker of Patterns* (3), largely composed of letters that he sent to his parents from an early age on.

Even though he received more than 20 honorary doctorates, Dyson never obtained an official doctorate of philosophy. As an eternal graduate student, a “rebel” in his own words, Dyson was unafraid to question everything and everybody. It is not surprising that his young colleagues inspired him the most. Not only was Dyson perfectly happy to be friends with people who disagreed with him, he proved at every stage of life to embrace the curiosity and idealism of youth. Perhaps he understood better than most that progress stems from disagreement more than agreement.

1 F. Dyson, *Disturbing the Universe* (Harper and Row, New York, 1979).

2 F. Dyson, *Infinite in all Directions* (Harper and Row, New York, 1988).

3 F. Dyson, *Maker of Patterns: An Autobiography through Letters* (W. W. Norton, New York, 2018).