

The Civil Heretic

Eugene Richards for The New York Times

The Whimsical Gaze *Dyson still travels widely, giving talks at churches and colleges, reminding people how dangerous nuclear weapons are.*

*By NICHOLAS DAWIDOFF
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FOR MORE THAN HALF A CENTURY the eminent physicist Freeman Dyson has quietly resided in Princeton, N.J., on the wooded former farmland that is home to his employer, the Institute for Advanced Study, this country's most rarefied community of scholars. Lately, however, since coming "out of the closet as far as [global warming](#) is concerned," as Dyson sometimes puts it, there has been noise all around him. Chat rooms, Web threads, editors' letter boxes and Dyson's own e-mail queue resonate with a thermal current of invective in which Dyson has discovered himself variously described as "a pompous twit," "a blowhard," "a cesspool of misinformation," "an old coot riding into the sunset" and, perhaps inevitably, "a mad scientist." Dyson had proposed that whatever inflammations the climate was experiencing might be a good thing because carbon dioxide helps plants of all kinds grow. Then he added the caveat that if CO₂ levels soared too high, they could be soothed by the mass cultivation of specially bred "carbon-eating trees," whereupon the [University of Chicago](#) law professor Eric Posner looked through the thick grove of honorary degrees Dyson has been awarded — there are 21 from universities like Georgetown, Princeton and Oxford — and suggested that "perhaps trees can also be designed so that they can give directions to lost hikers." Dyson's son, George, a technology historian, says his father's views have cooled friendships, while many others have concluded that time has cost Dyson something else. There is the suspicion that, at age 85, a great scientist of the 20th century is no longer just far out, he is far gone — out of his beautiful mind.

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Freeman Dyson

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Drawings by Freeman Dyson. Photographs from George Dyson.

The Apprentice Scientist *“An Essay at Natarril History,”* age 6; the last page of a three-page treatise on *“Astronomy,”* age 5; and a sketch of a passenger-bearing spaceship from the unfinished science-fiction story *“Sir Phillip Roberts’s Erolunar Collision,”* age 9.

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Left: Michael Treshow/Courtesy George Dyson. Right: Jaromir Astl.

Big Bangs Dyson, far right, helped design an American spacecraft that would be powered by exploding atomic bombs — a secret Air Force project known as Orion. He says he “thought of Orion as the solution to a problem. With one trip we’d have got rid of 2,000 bombs.”

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An Inconvenient Film Freeman Dyson and his wife, Imme, differ on Al Gore's movie. She wants a Prius. He questions the consensus on climate change.

But in the considered opinion of the neurologist [Oliver Sacks](#), Dyson's friend and fellow English expatriate, this is far from the case. "His mind is still so open and flexible," Sacks says. Which makes Dyson something far more formidable than just the latest peevish right-wing climate-change denier. Dyson is a scientist whose intelligence is revered by other scientists — William Press, former deputy director of the [Los Alamos National Laboratory](#) and now a professor of computer science at the [University of Texas](#), calls him "infinitely smart." Dyson — a mathematics prodigy who came to this country at 23 and right away contributed seminal work to physics by unifying quantum and electrodynamic theory — not only did path-breaking science of his own; he also witnessed the development of modern physics, thinking alongside most of the luminous figures of the age, including Einstein, Richard Feynman, [Niels Bohr](#), Enrico Fermi, Hans Bethe, [Edward Teller](#), J. Robert Oppenheimer and Edward Witten, the "high priest of string theory" whose office at the institute is just across the hall from Dyson's. Yet instead of hewing to that fundamental field, Dyson chose to pursue broader and more unusual pursuits than most physicists — and has lived a more original life.

Among Dyson's gifts is interpretive clarity, a penetrating ability to grasp the method and significance of what many kinds of scientists do. His thoughts about how science works appear in a series of lucid, elegant books for nonspecialists that have made him a trusted arbiter of ideas ranging far beyond physics. Dyson has written more than a dozen books, including "Origins of Life" (1999), which synthesizes recent discoveries by biologists and geologists into an evaluation of the double-origin hypothesis, the possibility that life began twice; "Disturbing the Universe" (1979) tries

among other things to reconcile science and humanity. "Weapons and Hope" (1984) is his meditation on the meaning and danger of nuclear weapons that won a National Book Critics Circle Award. Dyson's books display such masterly control of complex matters that smart young people read him and want to be scientists; older citizens finish his books and feel smart.

Yet even while probing and sifting, Dyson is always whimsically gazing into the beyond. As a boy he sketched plans for English rocket ships that could explore the stars, and then, in midlife, he helped design an American spacecraft to be powered by exploding atomic bombs — a secret [Air Force](#) project known as Orion. Dyson remains an armchair astronaut who speculates with glee about the coming of cheap space travel, when families can leave an overcrowded earth to homestead on asteroids and comets, swooping around the universe via solar sail craft. Dyson is convinced that our current "age of computers" will soon give way to "the age of domesticated biotechnology." Bio-tech, he writes in his book, "Infinite in All Directions" (1988), "offers us the chance to imitate nature's speed and flexibility," and he imagines the furniture and art that people will "grow" for themselves, the pet dinosaurs they will "grow" for their children, along with an idiosyncratic menagerie of genetically engineered cousins of the carbon-eating tree: termites to consume derelict automobiles, a potato capable of flourishing on the dry red surfaces of [Mars](#), a collision-avoiding car.

These ideas attract derision similar to Dyson's essays on climate change, but he is an undeterred octogenarian futurist. "I don't think of myself predicting things," he says. "I'm expressing possibilities. Things that could happen. To a large extent it's a question of how badly people want them to. The purpose of thinking about the future is not to predict it but to raise people's hopes." Formed in a heretical and broad-thinking tradition of British public intellectuals, Dyson left behind a brooding England still stricken by two bloody world wars to become an optimistic American immigrant with tremendous faith in the creative imagination's ability to invent technologies that would overcome any predicament. And according to the physicist and former Caltech president Marvin Goldberger, Dyson is himself the living embodiment of that kind of ingenuity. "You point

Freeman at a problem and he'll solve it," Goldberger says. "He's extraordinarily powerful." Dyson seems to see the world as an interdisciplinary set of problems out there for him to evaluate. Climate change is the big scientific issue of our time, so naturally he finds it irresistible. But to Dyson this is really only one more charged conundrum attracting his interest just as nuclear weapons and rural poverty have. That is to say, he is a great problem-solver who is not convinced that climate change is a great problem.

Dyson is well aware that "most consider me wrong about global warming." That educated Americans tend to agree with the conclusion about global warming reached earlier this month at the International Scientific Conference on Climate Change in Copenhagen ("inaction is inexcusable") only increases Dyson's resistance. Dyson may be an Obama-loving, Bush-loathing liberal who has spent his life opposing American wars and fighting for the protection of natural resources, but he brooks no ideology and has a withering aversion to scientific consensus. The Nobel physics laureate Steven Weinberg admires Dyson's physics — he says he thinks the Nobel committee fleeced him by not awarding his work on quantum electrodynamics with the prize — but Weinberg parts ways with his sensibility: "I have the sense that when consensus is forming like ice hardening on a lake, Dyson will do his best to chip at the ice."

Dyson says he doesn't want his legacy to be defined by climate change, but his dissension from the orthodoxy of global warming is significant because of his stature and his devotion to the integrity of science. Dyson has said he believes that the truths of science are so profoundly concealed that the only thing we can really be sure of is that much of what we expect to happen won't come to pass. In "Infinite in All Directions," he writes that nature's laws "make the universe as interesting as possible." This also happens to be a fine description of Dyson's own relationship to science. In the words of Avishai Margalit, a philosopher at the Institute for Advanced Study, "He's a consistent reminder of another possibility." When Dyson joins the public conversation about climate change by expressing concern about the "enormous gaps in our knowledge, the sparseness of our observations and the superficiality of our theories," these reservations come from a place of

experience. Whatever else he is, Dyson is the good scientist; he asks the hard questions. He could also be a lonely prophet. Or, as he acknowledges, he could be dead wrong.

IT WAS FOUR YEARS AGO that Dyson began publicly stating his doubts about climate change. Speaking at the Frederick S. Pardee Center for the Study of the Longer-Range Future at [Boston University](#), Dyson announced that “all the fuss about global warming is grossly exaggerated.” Since then he has only heated up his misgivings, declaring in a 2007 interview with Salon.com that “the fact that the climate is getting warmer doesn’t scare me at all” and writing in an essay for The New York Review of Books, the left-leaning publication that is to gravitas what the Beagle was to Darwin, that climate change has become an “obsession” — the primary article of faith for “a worldwide secular religion” known as environmentalism. Among those he considers true believers, Dyson has been particularly dismissive of [Al Gore](#), whom Dyson calls climate change’s “chief propagandist,” and [James Hansen](#), the head of the [NASA](#) Goddard Institute for Space Studies in New York and an adviser to Gore’s film, “An Inconvenient Truth.” Dyson accuses them of relying too heavily on computer-generated climate models that foresee a *Grand Guignol* of imminent world devastation as icecaps melt, oceans rise and storms and plagues sweep the earth, and he blames the pair’s “lousy science” for “distracting public attention” from “more serious and more immediate dangers to the planet.”

A particularly distressed member of that public was Dyson’s own wife, Imme, who, after seeing the film in a local theater with Dyson when it was released in 2006, looked at her husband out on the sidewalk and, with visions of drowning polar bears still in her eyes, reproached him: “Everything you told me is wrong!” she cried.

“The polar bears will be fine,” he assured her.

Not long ago Dyson sat in his institute office, a chamber so neat it reminds Dyson’s friend, the writer John McPhee, of a Japanese living room. On shelves beside Dyson were books about stellar evolution, viruses,

thermodynamics and terrorism. "The climate-studies people who work with models always tend to overestimate their models," Dyson was saying. "They come to believe models are real and forget they are only models." Dyson speaks in calm, clear tones that carry simultaneous evidence of his English childhood, the move to the United States after completing his university studies at Cambridge and more than 50 years of marriage to the German-born Imme, but his opinions can be barbed, especially when a conversation turns to climate change. Climate models, he says, take into account atmospheric motion and water levels but have no feeling for the chemistry and biology of sky, soil and trees. "The biologists have essentially been pushed aside," he continues. "Al Gore's just an opportunist. The person who is really responsible for this overestimate of global warming is Jim Hansen. He consistently exaggerates all the dangers."

Dyson agrees with the prevailing view that there are rapidly rising carbon-dioxide levels in the atmosphere caused by human activity. To the planet, he suggests, the rising carbon may well be a MacGuffin, a striking yet ultimately benign occurrence in what Dyson says is still "a relatively cool period in the earth's history." The warming, he says, is not global but local, "making cold places warmer rather than making hot places hotter." Far from expecting any drastic harmful consequences from these increased temperatures, he says the carbon may well be salubrious — a sign that "the climate is actually improving rather than getting worse," because carbon acts as an ideal fertilizer promoting forest growth and crop yields. "Most of the evolution of life occurred on a planet substantially warmer than it is now," he contends, "and substantially richer in carbon dioxide." Dyson calls ocean acidification, which many scientists say is destroying the saltwater food chain, a genuine but probably exaggerated problem. Sea levels, he says, are rising steadily, but why this is and what dangers it might portend "cannot be predicted until we know much more about its causes."

For Hansen, the dark agent of the looming environmental apocalypse is carbon dioxide contained in coal smoke. Coal, he has written, "is the single greatest threat to civilization and all life on our planet." Hansen has referred to railroad cars transporting coal as "death trains." Dyson, on the other hand, told me in conversations and e-mail messages that "Jim

Hansen's crusade against coal overstates the harm carbon dioxide can do." Dyson well remembers the lethal black London coal fog of his youth when, after a day of visiting the city, he would return to his hometown of Winchester with his white shirt collar turned black. Coal, Dyson says, contains "real pollutants" like soot, sulphur and nitrogen oxides, "really nasty stuff that makes people sick and looks ugly." These are "rightly considered a moral evil," he says, but they "can be reduced to low levels by scrubbers at an affordable cost." He says Hansen "exploits" the toxic elements of burning coal as a way of condemning the carbon dioxide it releases, "which cannot be reduced at an affordable cost, but does not do any substantial harm."

Science is not a matter of opinion; it is a question of data. Climate change is an issue for which Dyson is asking for more evidence, and leading climate scientists are replying by saying if we wait for sufficient proof to satisfy you, it may be too late. That is the position of a more moderate expert on climate change, William Chameides, dean of the Nicholas School of the Environment and [Earth Sciences at Duke University](#), who says, "I don't think it's time to panic," but contends that, because of global warming, "more sea-level rise is inevitable and will displace millions; melting high-altitude glaciers will threaten the food supplies for perhaps a billion or more; and ocean acidification could undermine the food supply of another billion or so." Dyson strongly disagrees with each of these points, and there follows, as you move back and forth between the two positions, claims and counterclaims, a dense thicket of mitigating scientific indicators that all have the timbre of truth and the ring of potential plausibility. One of Dyson's more significant surmises is that a warming climate could be forestalling a new ice age. Is he wrong? No one can say for sure. Beyond the specific points of factual dispute, Dyson has said that it all boils down to "a deeper disagreement about values" between those who think "nature knows best" and that "any gross human disruption of the natural environment is evil," and "humanists," like himself, who contend that protecting the existing biosphere is not as important as fighting more repugnant evils like war, poverty and unemployment.

Embedded in all of Dyson's strong opinions about public policy is a dual spirit of social activism and uneasiness about class dating all the way back to Winchester, where he was raised in the 1920s and '30s by his father, George Dyson, the son of a Yorkshire blacksmith. George was the music instructor at Winchester College, an old and prestigious secondary school, and a composer. Dyson's mother, Mildred Atkey, came from a more prosperous Wimbledon family that had its own tennis court. Together they raised Dyson and his sister, Alice, in what Dyson calls a "watered-down Church of England Christianity" that regarded religion as a guide to living rather than any system of belief. The emphasis on tolerance, charity and community — and the free time afforded by the luxury of four servants — led Mildred to organize a club for teenage girls and a birth-control clinic. These institutions meshed uneasily with her patrician Victorian sensibilities. The girls were never, Dyson says, "considered equals," and Mildred told him with amusement about the young mother who walked in carrying a red-headed infant. "What a beautiful baby," Mildred reported saying. "Does he take after his father?"

"Oh, I couldn't tell you, Mum," came the reply. "He kept his hat on."

Winchester is a medieval town in which, Dyson writes, he felt that everyone was looking backward, mourning all the young men lost to one world war while silently anticipating his own generation's impending demise. He renounced the nostalgia, the servants, the hard-line social castes. But what he liked about growing up in England was the landscape. The country's successful alteration of wilderness and swamp had created a completely new green ecology, allowing plants, animals and humans to thrive in "a community of species." Dyson has always been strongly opposed to the idea that there is any such thing as an optimal ecosystem — "life is always changing" — and he abhors the notion that men and women are something apart from nature, that "we must apologize for being human." Humans, he says, have a duty to restructure nature for their survival.

All this may explain why the same man could write "we live on a shrinking and vulnerable planet which our lack of foresight is rapidly turning into a slum" and yet gently chide the sort of Americans who march against coal in

Washington. Dyson has great affection for coal and for one big reason: It is so inexpensive that most of the world can afford it. "There's a lot of truth to the statement Greens are people who never had to worry about their grocery bills," he says. ("Many of these people are my friends," he will also tell you.) To Dyson, "the move of the populations of China and India from poverty to middle-class prosperity should be the great historic achievement of the century. Without coal it cannot happen." That said, Dyson sees coal as the interim kindling of progress. In "roughly 50 years," he predicts, [solar energy](#) will become cheap and abundant, and "there are many good reasons for preferring it to coal."

THE WORDS COLLEAGUES COMMONLY use to describe Dyson include "unassuming" and "modest," and he seems the very embodiment of Newton's belief that a man should strive for simplicity and avoid confusion in life. Dyson has been in residence at the institute since 1953, a time when [Albert Einstein](#) shared his habit of walking to work there, which Dyson still does seven days a week, to write on a computer and solve any problems that come across his desk with paper and pencil. (In his prime, legend held that he never used the eraser.) He and Imme have spent 51 happy years together in the same house, a white clapboard just over the garden fence from the stucco affair once inhabited by their former neighbors, the Oppenheims. On some Sundays the Dysons pile into a car still decorated with an Obama bumper sticker and drive to running races, at which Dyson can be found at the finish line loudly cheering for the 72-year-old Imme, a master's marathon champion. On many other weekends, they visit some of their 16 grandchildren. During the holiday season the Dysons routinely attend five parties a week, cocktail-soiree sprints at which guests tend to find him open-minded and shy: when friends' wives give him a hug, he blushes. One of Dyson's daughters, the Internet vizier [Esther Dyson](#), says her father raised her without a television so she would read more, and has always been "just as interested in talking to" the latest graduate student to make the pilgrimage to Princeton "as he is the famous person at the next table." Oliver Sacks says that Dyson has "a genius for friendship."

But the truth is that Dyson is an elusive particle. To Edward Witten it is clear that Dyson has little use for string theory, the cutting-edge "theory of

everything" that links quantum mechanics and relativity in an effort to describe no less than the nature of all things. Even so, Witten admits that there is a fever-dream quality to his conversations with Dyson: "I don't always know what he disagrees with entirely. His attitudes are complicated. There are many layers." Other people can be similarly intrigued and baffled. When I began spending time with Dyson and asked who his close friends are, the only name he mentioned was John McPhee's, which surprised McPhee since he said he doesn't often speak with Dyson even though McPhee teaches nearby at [Princeton University](#). All six of Dyson's children describe him as a loving, intensely devoted father and yet also suggest that this is a parent with, in the words of his son, George, core parts of him that have always seemed "remote." William Press said he finds Dyson to be both a "deep" and "magnificently laudable person" and also mysterious and inscrutable, a man with contrarian opinions that Press suspects may be motivated by "a darker side he's determined the world isn't going to see." When I asked Sacks what he thought about all this, he said that "a favorite word of Freeman's about doing science and being creative is the word 'subversive.' He feels it's rather important not only to be not orthodox, but to be subversive, and he's done that all his life."

Dyson says it's only principle that leads him to question global warming: "According to the global-warming people, I say what I say because I'm paid by the oil industry. Of course I'm not, but that's part of their rhetoric. If you doubt it, you're a bad person, a tool of the oil or coal industry." Global warming, he added, "has become a party line."

What may trouble Dyson most about climate change are the experts. Experts are, he thinks, too often crippled by the conventional wisdom they create, leading to the belief that "they know it all." The men he most admires tend to be what he calls "amateurs," inventive spirits of uncredentialed brilliance like Bernhard Schmidt, an eccentric one-armed alcoholic telescope-lens designer; Milton Humason, a janitor at Mount Wilson Observatory in California whose native scientific aptitude was such that he was promoted to staff astronomer; and especially Darwin, who, Dyson says, "was really an amateur and beat the professionals at their own game." It's a point of pride with Dyson that in 1951 he became a member of

the physics faculty at [Cornell](#) and then, two years later, moved on to the Institute for Advanced Study, where he became an influential man, a pragmatist providing solutions to the military and Congress, and also the 2000 winner of the \$1 million Templeton Prize for broadening the understanding of science and religion, an award previously given to [Mother Teresa](#) and [Aleksandr Solzhenitsyn](#) — all without ever earning a Ph.D. Dyson may, in fact, be the ultimate outsider-insider, “the world’s most civil heretic,” as the classical composer Paul Moravec, the artistic consultant at the institute, says of him.

Climate-change specialists often speak of global warming as a matter of moral conscience. Dyson says he thinks they sound presumptuous. As he warned that day four years ago at Boston University, the history of science is filled with those “who make confident predictions about the future and end up believing their predictions,” and he cites examples of things people anticipated to the point of terrified certainty that never actually occurred, ranging from hellfire, to [Hitler](#)’s atomic bomb, to the Y2K millennium bug. “It’s always possible Hansen could turn out to be right,” he says of the climate scientist. “If what he says were obviously wrong, he wouldn’t have achieved what he has. But Hansen has turned his science into ideology. He’s a very persuasive fellow and has the air of knowing everything. He has all the credentials. I have none. I don’t have a Ph.D. He’s published hundreds of papers on climate. I haven’t. By the public standard he’s qualified to talk and I’m not. But I do because I think I’m right. I think I have a broad view of the subject, which Hansen does not. I think it’s true my career doesn’t depend on it, whereas his does. I never claim to be an expert on climate. I think it’s more a matter of judgement than knowledge.”

Reached by telephone, Hansen sounds annoyed as he says, “There are bigger fish to fry than Freeman Dyson,” who “doesn’t know what he’s talking about.” In an e-mail message, he adds that his own concern about global warming is not based only on models, and that while he respects the “open-mindedness” of Dyson, “if he is going to wander into something with major consequences for humanity and other life on the planet, then he should first do his homework — which he obviously has not done on global warming.”

When Dyson hears about this, he looks, if possible, like a person taking the longer view. He is a short, sinewy man with strawlike filaments of excitable gray hair that make him resemble an upside-down broom. Every day he dresses with the same frowzy Oxbridge formality in L. L. Bean khaki trousers (his daughter Mia is a minister in Maine), a tweed sport coat, a necktie (most often one made for him, he says, by another daughter, Emily, many years ago “in the age of primary colors”) and wool sweater-vests. On cold days he wears a second vest, one right over the other, and the effect is like a window with two sets of curtains. His smile is the real window, a delighted beam that appears to float free from his face, strangely dynamic with its electric ears and quantum nose, and his laugh is so hearty it shakes him. The smile and laughter have the effect of softening Dyson’s formality, transforming him into a sage and friendly elf, and also reminding those he talks with that he has spent a lifetime immersed in efforts to find what he considers humane solutions to dire problems, whose controversial gloss never seems to agitate him. His eyes are murky gray, and whatever he’s thinking beyond what he says, the eyes never betray.

A FORMATIVE MOMENT in Dyson’s life that pushed him in an apostatical direction happened in 1932, when, at age 8, he was sent off to boarding school at Twyford. By then he was a prodigy “already obsessed” with mathematics. (His older sister Alice, a retired social worker still living in Winchester, remembers how her brother “used to lie on the nursery floor working out how many atoms there were in the sun. He was perhaps 4.”) At Twyford — like [George Orwell](#), who was flogged, starved and humiliated by masters and bigger boys at St. Cyprian’s — Dyson says he felt brutalized by a whip-wielding headmaster who offered no science classes, favoring Latin, and by a clique of athletes who liked to rub sandpaper on the faces of the smaller children. “In those days it was unthinkable that parents would come to see what was going on,” Dyson says. “My parents lived only three miles away. They never came to visit. It wasn’t done.” Dyson took comfort in climbing tall trees, reading “The Wonderful Wizard of Oz,” which gave him a first sense of America as a more “exciting place where all sorts of weird things could happen,” and [Jules Verne](#)’s comic science-fiction descriptions of more “crazy Americans” bound for the [moon](#). His primary consolation, however, was the science society he founded with a few

friends. Dyson would later reflect that from then on he saw science as “a territory of freedom and friendship in the midst of tyranny and hatred.”

Four years later he entered Winchester College, well known for academic rigor, and he thrived. On his own in the school library, he read mathematical works in French and German and, at age 13, taught himself calculus from an Encyclopedia Britannica entry. “I remember thinking, Is that it?” he says. “People had been telling me how hard it was.” Another day in the library he discovered “Daedalus, or Science and the Future,” by the biologist J. B. S. Haldane, who said that “the thing that has not been is the thing that shall be; that no beliefs, no values, no institutions are safe,” an appealing outlook to Dyson, who had found his muse. “Haldane was even more of a heretic than I am,” he says. “He really loved to make people angry.” It wasn’t all science. On trips into London he spent entire days in bookstores where William Blake “got hold of me. What I really liked was he was a really rebellious spirit who always said the opposite of what everybody else believed.”

That defiant sensibility hardened further when the second war with Germany began. Dyson says he can “remember so vividly lying in bed at age 15, absolutely enjoying hearing the bombs go off with a wonderful crunching noise. I said, ‘That’s the sound of the British Empire crumbling.’ I had a sense that the British Empire was evil. The fact that I might get hit didn’t register at all. I think that’s a natural state of mind for a 15-year-old. I somehow got over it.” At Cambridge, Dyson attended all the advanced mathematics lectures and climbed roofs at night during blackouts. By the end of the school year in 1943, which Dyson celebrated by pushing his wheelchairbound classmate, Oscar Hahn, the 55 miles home to London in one 17-hour day, Dyson was fully formed as a person of strong, frequently rebellious beliefs, someone who would always go his own way.

During World War II, Dyson worked for the Royal Air Force at Bomber Command, calculating the most effective ways to deploy pilots, some of whom he knew would die. Dyson says he was “sickened” and “depressed” that many more planes were going down than needed to because military leadership relied on misguided institutional mythologies rather than

statistical studies. Even more upsetting, Dyson writes in "Weapons and Hope," he became an expert on "how to murder most economically another hundred thousand people." This work, Dyson told the writer Kenneth Brower, created an "emptiness of the soul."

Then came two blinding flashes of light. Dyson's reaction to Hiroshima and Nagasaki was complicated. Like many physicists, Dyson has always loved explosions, and, of course, uncovering the secrets of nature is the first motivation of science. When he was interviewed for the 1980 documentary "The Day After Trinity," Dyson addressed the seduction: "I felt it myself, the glitter of nuclear weapons. It is irresistible if you come to them as a scientist. To feel it's there in your hands. To release the energy that fuels the stars. To let it do your bidding. And to perform these miracles, to lift a million tons of rock into the sky, it is something that gives people an illusion of illimitable power, and it is in some ways responsible for all our troubles, I would say, this what you might call 'technical arrogance' that overcomes people when they see what they can do with their minds."

Eventually, Dyson would be sure nuclear weapons were the worst evil. But in 1945, drawn to these irreducible components of life, Dyson left mathematics and took up physics. Still, he did not want to be another dusty Englishman toiling alone in a dim Cambridge laboratory. Since childhood, some part of him had always known that the "Americans held the future in their hands and that the smart thing for me to do would be to join them." That the United States was now the country of Einstein and Oppenheimer was reason enough to go, but Dyson's sister Alice says that "he escaped to America so he could make his own life," removed from the shadow of his now famous musical father. "I know how he felt," says Oliver Sacks, who came to New York not long after medical school. "I was the fifth Dr. Sacks in my family. I felt it was time to get out and find a place of my own."

In 1947, Dyson enrolled as a doctoral candidate at Cornell, studying with Hans Bethe, who had the reputation of being the greatest problem-solver in physics. Alice Dyson says that once in Ithaca, her brother "became so much more human," and Dyson does not disagree. "I really felt it was quite amazing how accepted I was," he says. "In 1963, I'd only been a U.S. citizen

for about five years, and I was testifying to the Senate, representing the Federation of American Scientists in favor of the nuclear-test-ban treaty."

After sizing him up over a few meals, Bethe gave Dyson a problem and told him to come back in six months. "You just sit down and do it," Dyson told me. "It's probably the hardest work you'll do in your life. Without having done that, you've never understood what science is all about." This smaller problem was part of a much larger one inherited from Einstein, among others, involving the need for a theory to describe the behavior of atoms and electrons emitting and absorbing light. Put another way, it was the question of how to move physics forward, creating agreement among the disparate laws of atomic structure, radiation, solid-state physics, plasma physics, maser and laser technology, optical and microwave spectroscopy, electronics and chemistry. Many were working on achieving this broad rapport, including Julian Schwinger at [Harvard University](#); a Japanese physicist named Shinichiro Tomonaga, whose calculations arrived in America from war-depleted Kyoto on cheap brown paper; and Feynman, also at Cornell, a man so brilliant he did complex calculations in his head. Initially, Bethe asked Dyson to make some difficult measurements involving electrons. But soon enough Dyson went further.

The breakthrough came on summer trips Dyson made in 1948, traveling around America by Greyhound bus and also, for four days, in a car with Feynman. Feynman was driving to Albuquerque, and Dyson joined him just for the pleasure of riding alongside "a unique person who had such an amazing combination of gifts." The irrepressible Feynman and the "quiet and dignified English fellow," as Feynman described Dyson, picked up gypsy hitchhikers; took shelter from an Oklahoma flood in the only available hotel they could find, a brothel, where Feynman pretended to sleep and heard Dyson relieve himself in their room sink rather than risk the common bathroom in the hall; spoke of Feynman's realization that he had enjoyed military work on the Manhattan Project too much and therefore could do it no more; and talked about Feynman's ideas in a way that made Dyson forever understand what the nature of true genius is. Dyson wanted to unify one big theory; Feynman was out to unify all of physics. Inspired by this and by a mesmerizing sermon on nonviolence that

Dyson happened to hear a traveling divinity student deliver in Berkeley, Dyson sat aboard his final Greyhound of the summer, heading East. He had no pencil or paper. He was thinking very hard. On a bumpy stretch of highway, long after dark, somewhere out in the middle of Nebraska, Dyson says, "Suddenly the physics problem became clear." What Feynman, Schwinger and Tomonaga were doing was stylistically different, but it was all "fundamentally the same."

Dyson is always effacing when discussing his work — he has variously called himself a tinkerer, a clean-up man and a bridge builder who merely supplied the cantilevers linking other men's ideas. Bethe thought more highly of him. "He is the best I have ever had or observed," Bethe wrote in a letter to Oppenheimer, who invited Dyson to the institute for an initial fellowship. There, with Einstein indifferent to him and the chain-smoking Oppenheimer openly doubting Dyson's physics, Dyson wrote his renowned paper "The Radiation Theories of Tomonaga, Schwinger and Feynman." Oppenheimer sent Dyson a note: "Nolo contendere — R.O." If you could do that in a year, who needed a Ph.D.? The institute was perfect for him. He could work all morning and, as he wrote to his parents, in the afternoons go for walks in the woods to see "strange new birds, insects and plants." It was, Dyson says, the happiest sustained moment in his life. It was also the last great discovery he would make in physics.

Other physicists quietly express disappointment that Dyson didn't do more to advance the field, that he wasted his promise. "He did some things in physics after the heroic work in 1949, but not as much as I would have expected for someone so off-the-scale smart," one physicist says. From others there are behind-the-study-door speculations that perhaps Dyson lacked the necessary "killer instinct"; or that he was discouraged by Enrico Fermi, who told him that his further work on quantum electrodynamics was unpromising; or "that he never felt he could approach Feynman's brilliance." Dyson shakes his head. "I've always enjoyed what I was doing quite independently of whether it was important or not," he says. "I think it's almost true without exception if you want to win a [Nobel Prize](#), you should have a long attention span, get ahold of some deep and important problem and stay with it for 10 years. That wasn't my style."

DYSON HAD ALWAYS wanted “a big family.” In 1950, after knowing the brilliant mathematician Verena Huber for three weeks, Dyson proposed. They married, Esther and George were born, but the union didn’t last. “She was more interested in mathematics than in raising kids,” he says. By 1958, Dyson had married Imme — he has the brains, she has the legs, the Dysons like to joke — and they settled “in this snobbish little town,” as he calls Princeton. They had four more daughters. All six Dysons describe eventful childhoods with people like Feynman coming by for meals. Their father, meanwhile, was always preaching the virtues of boredom: “Being bored is the only time you are creative” was his thinking. George recalls groups of physicists closing doors and saying, “No children.” Through the keyhole George would hear words that gave him thermonuclear nightmares. All of them remember Dyson coming home, arms filled with bouquets of new appliances to make Imme’s life easier: an automatic ironing machine; a snowblower; one of the first microwave ovens in Princeton.

Beginning in the late '50s, Dyson spent months in California, on the La Jolla campus of General Atomics, a peacetime Los Alamos, where scientists were seeking progressive uses for nuclear energy. After a challenge from Edward Teller to build a completely safe reactor, Dyson and Ted Taylor patented the Triga, a small isotope machine that is still used for medical diagnostics in hospitals. Then came the Orion rocket, designed so successions of atomic bombs would explode against the spaceship’s massive pusher plate, propelling astronauts toward the moon and beyond. “For me, Orion meant opening up the whole solar system to life,” he says. “It could have changed history.” Dyson says he “thought of Orion as the solution to a problem. With one trip we’d have got rid of 2,000 bombs.” But instead, he lent his support to the nuclear-test-ban treaty with the U.S.S.R., which killed Orion. “This was much more serious than Orion ever would be,” he said later. Dyson’s powers of concentration were so formidable in those years that George remembers sitting with his father and “he’d just disappear.”

One idea pulsing through his mind was a thought experiment that he published in the journal *Science* in 1959 that described massive energy-collecting shells that could encircle a star and capture solar energy. This

was Dyson's initial response to his insight that earthbound reserves of fossil fuels were limited. The structures are known as Dyson Spheres to science-fiction authors like Larry Niven and by the writers of an episode of "Star Trek" — the only engineers so far to succeed in building one.

This was an early indication of Dyson's growing interest in what one day would be called climate studies. In 1976, Dyson began making regular trips to the Institute for Energy Analysis in Oak Ridge, Tenn., where the director, Alvin Weinberg, was in the business of investigating alternative sources of power. Charles David Keeling's pioneering measurements at Mauna Loa, Hawaii, showed rapidly increasing carbon-dioxide levels in the atmosphere; and in Tennessee, Dyson joined a group of meteorologists and biologists trying to understand the effects of carbon on the Earth and air. He was now becoming a climate expert. Eventually Dyson published a paper titled "Can We Control the Carbon Dioxide in the Atmosphere?" His answer was yes, and he added that any emergency could be temporarily thwarted with a "carbon bank" of "fast-growing trees." He calculated how many trees it would take to remove all carbon from the atmosphere. The number, he says, was a trillion, which was "in principle quite feasible." Dyson says the paper is "what I'd like people to judge me by. I still think everything it says is true."

Eventually he would embrace another idea: the notorious carbon-eating trees, which would be genetically engineered to absorb more carbon than normal trees. Of them, he admits: "I suppose it sounds like science fiction. Genetic engineering is politically unpopular in the moment."

In the 1970s, Dyson participated in other climate studies conducted by Jason, a small government-financed group of the country's finest scientists, whose members gather each summer near San Diego to work on (often) classified (usually) scientific dilemmas of (frequently) military interest to the government. Dyson has, as he admits, a restless nature, and by the time many scientists were thinking about climate, Dyson was on to other problems. Often on his mind were proposals submitted by the government to Jason. "Mainly we kill stupid projects," he says.

Some scientists refuse military work on the grounds that involvement in killing is sin. Dyson was opposed to the wars in Vietnam and Iraq, but not to generals. He had seen in England how a military more enlightened by quantitative analysis could have better protected its men and saved the lives of civilians. "I always felt the worse the situation was, the more important it was to keep talking to the military," he says. Over the years he says he pushed the rejection of the idea of dropping atomic bombs on North Vietnam and solved problems in adaptive optics for telescopes. Lately he has been "trying to help the intelligence people be aware of what the bad guys may be doing with biology." Dyson thinks of himself as "fighting for peace," and Joel Lebowitz, a Rutgers physicist who has known Dyson for 50 years, says Dyson lives up to that: "He works for Jason and he's out there demonstrating against the Iraq war."

At Jason, taking problems to Dyson is something of a parlor trick. A group of scientists will be sitting around the cafeteria, and one will idly wonder if there is an integer where, if you take its last digit and move it to the front, turning, say, 112 to 211, it's possible to exactly double the value. Dyson will immediately say, "Oh, that's not difficult," allow two short beats to pass and then add, "but of course the smallest such number is 18 digits long." When this happened one day at lunch, William Press remembers, "the table fell silent; nobody had the slightest idea how Freeman could have known such a fact or, even more terrifying, could have derived it in his head in about two seconds." The meal then ended with men who tend to be described with words like "brilliant," "Nobel" and "MacArthur" quietly retreating to their offices to work out what Dyson just knew.

These days, most of what consumes Dyson is his writing. In a recent article, he addressed the issue of reductionist thinking obliquely, as a question of perspective. Birds, he wrote, "fly high in the air and survey broad vistas." Frogs like him "live in the mud below and see only the flowers that grow nearby." Whether the topic is government work, string theory or climate change, Dyson seems opposed to science making enormous gestures. The physicist Douglas Eardley, who works with Dyson at Jason, says: "He's always against the big monolithic projects, the Battlestar Galacticas. He prefers spunky little Mars rovers." Dyson has been hostile to the Star Wars

missile-defense system, the Space Station, the Hubble telescope and the superconducting super collider, which he says he opposed because “it’s just out of proportion.” Steven Weinberg, the Nobel physics laureate who often disagrees with Dyson on these matters, says: “Some things simply have to be done in a large way. They’re very expensive. That’s big science. Get over it.”

Around the Institute for Advanced Study, that intellectual Arcadia where the blackboards have signs on them that say Do Not Erase, Dyson is quietly admired for candidly expressing his doubts about string theory’s aspiration to represent all forces and matter in one coherent system. “I think Freeman wishes the string theorists well,” Avishai Margalit, the philosopher, says. “I don’t think he wishes them luck. He’s interested in diversity, and that’s his worldview. To me he is a towering figure although he is tiny — almost a saintly model of how to get old. The main thing he retains is playfulness. Einstein had it. Playfulness and curiosity. He also stands for this unique trait, which is wisdom. Brightness here is common. He is wise. He integrated, not in a theory, but in his life, all his dreams of things.”

IMME DYSON REPORTS that her husband “recently stopped climbing trees.” Dyson himself says he’s resigned to never finishing “Anna Karenina.” Otherwise he still lives his days at mortality-ignoring cadence, aided by NoDoz, a habit he first acquired during his R.A.F. days. He travels widely, giving talks at churches and colleges, reminding people how dangerous nuclear weapons are. (“I think people got used to them and think if you leave them alone, they won’t do you any harm,” he says. “I always am scared. I think everybody ought to be.”) He has visited both the Galápagos Islands and the campus of Google and attended “Doctor Atomic,” the [John Adams](#) opera about Oppenheimer, which disappointed him. More fulfilling was the board meeting of a foundation promoting solar energy in China. Another winter day found him answering questions from physics majors at a Christian college in Oklahoma. (“Scientists should understand the human anguish of religious people,” he says.)

Lately Dyson has been lamenting that he and Imme “don’t see so much of each other. We’re always rushing around.” But one evening last month they

sat down in a living room filled with Imme's running trophies and photographs of their children to watch "An Inconvenient Truth" again. There was a print of Einstein above the television. And then there was Al Gore below him, telling of the late Roger Revelle, a Harvard scientist who first alerted the undergraduate Gore to how severe the climate's problems would become. Gore warned of the melting snows of Kilimanjaro, the vanishing glaciers of Peru and "off the charts" carbon levels in the air. "The so-called skeptics" say this "seems perfectly O.K.," Gore said, and Imme looked at her husband. She is even slighter than he is, a pretty wood sprite in running shoes. "How far do you allow the oceans to rise before you say, This is no good?" she asked Dyson.

"When I see clear evidence of harm," he said.

"Then it's too late," she replied. "Shouldn't we not add to what nature's doing?"

"The costs of what Gore tells us to do would be extremely large," Dyson said. "By restricting CO2 you make life more expensive and hurt the poor. I'm concerned about the Chinese."

"They're the biggest polluters," Imme replied.

"They're also changing their standard of living the most, going from poor to middle class. To me that's very precious."

The film continued with Gore predicting violent [hurricanes](#), typhoons and tornados. "How in God's name could that happen here?" Gore said, talking about [Hurricane Katrina](#). "Nature's been going crazy."

"That is of course just nonsense," Dyson said calmly. "With Katrina, all the damage was due to the fact that nobody had taken the trouble to build adequate dikes. To point to Katrina and make any clear connection to global warming is very misleading."

Now came Arctic scenes, with Gore telling of disappearing ice, drunken trees and drowning polar bears. "Most of the time in history the Arctic has

been free of ice," Dyson said. "A year ago when we went to Greenland where warming is the strongest, the people loved it."

"They were so proud," Imme agreed. "They could grow their own cabbage."

The film ended. "I think Gore does a brilliant job," Dyson said. "For most people I'd think this would be quite effective. But I knew Roger Revelle. He was definitely a skeptic. He's not alive to defend himself."

"All my friends say how smart and farsighted Al Gore is," she said.

"He certainly is a good preacher," Dyson replied. "Forty years ago it was fashionable to worry about the coming ice age. Better to attack the real problems like the extinction of species and overfishing. There are so many practical measures we could take."

"I'm still perfectly happy if you buy me a Prius!" Imme said.

"It's toys for the rich," her husband smiled, and then they were arguing about windmills.

Nicholas Dawidoff, a contributing writer for the magazine, is the author of four books, most recently "The Crowd Sounds Happy."