Wintry Doom

Visions of climate catastrophe drew upon a widespread fear that nuclear war could wreck the global environment. Scientific calculations, publicized in 1983, suggested that the bombs could pollute the air with enough dust and chemical smog to severely cool the planet—a "nuclear winter." The lesson about the atmosphere's fragility was meanwhile reinforced by evidence that such a climate catastrophe had actually happened long ago. Something, perhaps a single asteroid-bomb, had caused an atmospheric change that exterminated the dinosaurs.

In the 1950s, as the world's arsenals filled with hydrogen bombs, people worried about how a thermonuclear war might injure the entire global environment. Poignant novels and movies showed radioactive dust, borne on the winds, extinguishing all life on Earth.[1] Experts dismissed the scenarios as impossible. But secret studies supported by the U.S. military suggested that a war's effects on the atmosphere could be quite serious. In an openly published, but little noticed, 1958 review of climatology, a leading expert wrote that a nuclear war could throw up enough dust to alter the climate for a few years.The U.S.Weather Bureau had gone farther in an unpublicized 1956 study, saying it was conceivable that enough dust might be thrown into the stratosphere to launch a new "ice age." In the 1960s a few scientists tried to publicize the threat. The public scarcely noticed it, amid countless apocalyptic warnings about how nuclear weapons could bring the end of civilization or even all life on Earth.[2]

Most experts agreed that the effects of a nuclear war on climate deserved little attention. A National Academy of Sciences panel that reviewed the issue in 1975 concluded that a war could kick up as much dust and smoke as a large volcanic eruption. Scientists suspected that such eruptions in the past had cooled the Earth a degree or so for a year or two. Whatever happened,

---

[1] Weart (1988), chap. 12, Weart (2012). Warning of a "Fimbulwinter" caused specifically by dust that blocked sunlight appeared on p. 68 of Poul Anderson and F.N.Waldrop, "Tomorrow's Children," *Astounding Science-Fiction,* March 1947, pp. 59-79, reprinted as first part of Poul Anderson, *Twilight World* (NY: Torquil, 1961), according to Bartter (1988), pp. 220-21. On nuclear winter see also Masco (2010); Hamblin (2013) , pp. 237-41.

[2] Landsberg (1958); for classified studies in the 1950s and 1960s see Dörries (2011), pp. 202-05; Hecht and Tirpak (1995), p. 375. Weather Bureau study: Hewlett and Holl (1989), p. 369, referencing Atomic Energy Commission, Division of Biology and Medicine, "Summary Discussion of Effects on Humans, Agricultural Products, and Weather of a Projected Nuclear War," Oct. 9, 1956 (Washington, DC: AEC). Warnings: Lapp (1962), pp. 102-103; Commoner (1966), pp. 76-77, referencing Hudson Institute, "Special Aspects of Environment Resulting from Various Kinds of Nuclear Wars," Part II, H1303-RR, Jan. 8, 1964 (Harmon-on-Hudson, NY: Hudson Institute); Ehrlich and Ehrlich (1970), p. 192, speculating about smoke as well as dust. On nuclear apocalypse see Weart (1988), Weart (2012).

the authors concluded that the effects "would probably lie within normal global climatic variability," and it seemed like a minor problem next to the other horrors of a nuclear war. The panel also pointed out that the nitrogen compounds (NO_x) created by the fireballs could sharply reduce the Earth's ozone layer, but again the damage would be only temporary. The authors did admit that little was known about climate, so that "the possibility of climatic changes of a more dramatic nature cannot be ruled out." A few scientists criticized the report for brushing aside possible calamities. Some pointed to the vast firestorms that a war could ignite, exclaiming that might pollute the atmosphere so severely as to "force *Homo sapiens* into extinction."[1] These scientists were in tune with a public attitude that grew strong during the 1960s and 1970s. For the first time, many people found it plausible that we could bring about an atmospheric catastrophe so terrible that it would destroy the human race.

This commonly held attitude may have helped scientists to admit into their thinking a new answer to an old puzzle. Geologist Walter Alvarez and his physicist father, Luis Alvarez, proposed that the fall of a huge asteroid had caused the extinction of the dinosaurs some 65 million years ago. They figured that the dust thrown into the air by an impact could have obscured sunlight long enough to kill much of the Earth's plant life through simple darkness, so that the dinosaurs perished of starvation. Stephen Schneider recalled that when he heard Luis Alvarez explain the new idea in a 1979 lecture, "I commented from the floor that such a cloud could have climatic effects, particularly a sharp, but short-term climatic cooling on land." Schneider was just then involved in studies that emphasized how smoke, smog, and other aerosols could cool the atmosphere and perhaps even precipitate an ice age. Calculations soon confirmed that an asteroid strike could indeed have brought on a global cooling severe enough to kill off the dinosaurs directly.[2]

Other scientists scoffed at the idea, especially geologists and paleontologists who stuck to their old theories about dinosaurs. These theories, however, failed to fit observations of world-wide peculiarities preserved in rock layers 65 million years old. Some geologists proposed that the damage to the atmosphere had not been caused not by an asteroid strike, but by carbon dioxide (CO_2) and poisonous gases from a "paroxysmal" spate of enormous volcanic eruptions. There was evidence of just such a volcanic outpouring at about the right time. Either way, the killer had been a shocking atmospheric change.[3]

---

[1] National Academy of Sciences (1975), quotes p. 7; criticism, extinction: Ehrlich et al. (1977), pp. 690-91. Ozone effects were announced in 1974, see *New York Times,* Sept. 6, 1974, p. 1; Nov. 12, 1974, p. 38. See also Dörries (2011) for developments to 1983.

[2] Schneider and Londer (1984), p. 205n; Alvarez et al. (1980); cooling of up to 40°C for up to a year over continents was calculated by Pollack et al. (1983).

[3] McLean (1981); McLean (1985); Officer et al. (1987) ("paroxysmal" in their title); for the controversy, see Glen (1994); for a general discussion of issues, Palmer (1999); for a short summary, Huggett (1990), pp. 171-78.

The dinosaur-extinction debate became passionate, sometimes personal and embittered, carrying forward a tradition of geological controversy that stretched back to the 18th century. On one side had been traditional "catastrophists," whose historical roots connected them with Bible fundamentalists and Noah's Flood. They had argued ardently that vast cataclysms in the past had suddenly extinguished entire sets of species. By the late 19th century these views had been driven from the field of professional scientific discussion by the views of so-called "uniformitarians" (a more precise term would have been "gradualists.") These scientists had amassed convincing evidence that evolution acted over millions of years, responding to the slow rise of mountain chains or the parting of continents. By 1980, however, some paleontologists were beginning to be persuaded that species could evolve in a "punctuated" pattern. In short, the catastrophist viewpoint was raising its head again. Anyway that was how the opponents caricatured the movement; the actual scientific arguments were of course more complex.[1] Underneath the science, what mattered was a picture in which dinosaurs did not decline gradually over eons, but fell in their prime, struck down swiftly by a random doom. (It remained uncertain how much was due to the asteroid strike and how much to volcanoes. But in later decades, as scientists investigated other extinction events in the geological record, they found all of the great catastrophes had been caused by injection of gases into the atmosphere.) The unspoken and repugnant implication was that a spoiled atmospheric could extinguish entire species—maybe even our own.

The most likely way that could happen was through nuclear war. The effect of bombs on climate had been taken up again in 1981 by Paul Crutzen. A Dutch scientist interested in aerosols, Crutzen had helped set off the stratospheric transport controversy of the early 1970s by showing how airplane emissions could destroy ozone. After working at the Air Quality Division of the U.S. National Center for Atmospheric Research and was now employed in Germany. Crutzen had recently been in Brazil, collecting samples of smoke to check the contentious claim that slash-and-burn destruction of forests was a major source of atmospheric CO_2. Reviewing the 1975 National Academy report, Crutzen worried that the study group had focused on dust without taking full account of how much smoke, NO_x, and other smog could arise from the firestorms of industrial centers and forests torched by bombs. People had known for many decades that the smoke from great forest fires could dim the sunlight thousands of miles downwind. Crutzen concluded that nuclear war, much like the Alvarez asteroid, could send the world into a frozen twilight.[2]

Atmospheric scientists were well-placed to take up the question of smoke from a nuclear war. Measurements like Crutzen's of the effects of soot and the like had greatly advanced since the 1975 study. Richard Turco and others, working on the dinosaur extinction problem, had developed a computer model of a haze-filled atmosphere, and it had occurred to them that dust lofted by the explosions of a nuclear world war might have effects comparable to the dust from

---

[1] Huggett (1990); Palmer (1999).

[2] Crutzen and Birks (1982); on the history, see Levenson (1989), pp. 214-18; Davidson (1999), pp. 360-71.

an asteroid impact. Meanwhile the surprising observation that a giant dust storm was cooling the atmosphere of Mars had inspired two more scientists, James Pollack and Brian Toon, into new calculations of dust effects. This led them into work with Carl Sagan on how the aerosols emitted by volcanic eruptions could affect climate. Now these scattered scientists joined forces to calculate the consequences of an exchange of hydrogen bombs. Their ominous conclusion wa that the sooty smoke from burning cities could bring on a "nuclear winter"—months or even years of cold so severe it would gravely endanger living creatures.[1]

The scientists did this work mainly for public consumption. When they announced their results in 1983, it was with the explicit aim of promoting international arms control. Surely the likelihood that that starting an all-out nuclear war was literally suicidal, even if the other side did not retaliate, would persuade nations to reduce their arsenals? As a side effect, the studies helped to improve scientific understanding of how aerosols could affect climate.[2]

The computer models were so simplified, and the data on smoke and other aerosols were still so poor, that the scientists could say nothing for certain. Critics, mostly people opposed to nuclear disarmament, quickly pointed out the deficiencies. In the mid 1980s, detailed studies confirmed that a nuclear war would probably alter global climate temporarily. But as Schneider and a coauthor explained in a widely read article, it was not likely to bring an apocalyptic winter— just a ruinous "nuclear fall." (The far more advanced computer models of the 21st century found that a full-scale war would devastate the planet with years of frozen summers and radical drought, killing perhaps half of humanity, and even a limited, regional war would probably dim sunlight with enough smoke to kill many more people through starvation than would die directly under the bombs.)[3]

The vociferous dispute over nuclear winter (along with dinosaur extinction) made scientists and the public more sensitive to the idea that stuff we emitted into the air could provoke a severe climate change. An asteroid strike, however, told us little about greenhouse warming. The controversy did provoke studies by geologists who would eventually show that the other great extinctions of the past, some even worse than the doom of the dinosaurs, had been caused by massive injections of greenhouse gases from volcanic outbursts—an all too relevant demonstration of the power of the gases.

---

[1] A one-dimensional radiative-convective model. Turco et al. (1983). The paper is known as TTAPS from the initials of Turco, Toon, Thomas P. Ackerman (who collaborated with Toon), Pollack and Sagan. For full details see Badash (2009) Biological consequences were discussed by Ehrlich et al. (1983), a paper whose prestigious authors included Carl Sagan, George Woodwell, Stephen J. Gould, Ernst Mayr, etc.

[2] Poundstone (1999), pp. 292-319; Badash (2001).

[3] Thompson and Schneider (1986). See Sagan and Turco (1990); Schneider (2009), pp. 95-108. More recent work: Toon et al. (2008), Robock and Toon (2010), Coupe et al. (2019), Xia et al. (2022).

The nuclear winter warnings probably influenced some government policy-makers, but only some. Most people already believed that nuclear war was too horrible to consider as an actual option. Others, who did think it was possible to "win" a nuclear war, scoffed at the shaky science and strident polemics of nuclear apocalypse. It was an old debate in nuclear policy, but remarkably similar to another debate that was just then getting underway: how should we address global warming from the greenhouse effect?

In 1939 the physicists Leo Szilard and Enrico Fermi had joined forces to see if they could create a chain reaction that would release the nuclear power in uranium. "Fermi thought the conservative thing was to play down the possibility," Szilard later recalled, "...and I thought the conservative thing was to assume that it would happen and take the necessary precautions." As the historian Lawrence Badash remarks, "Fermi was thinking of a scientific phenomenon, while Szilard had progressed to the political consequences." The same divergence on what it means to be "conservative" permeated the debate about controlling greenhouse gases. As with nuclear winter, so with global warming, scientists were estimating the size of the problem by using computer models, standing on a pile of uncertain assumptions. As with nuclear winter, so with global warming, many people thought it would be foolish to introduce radically new policies just because a bunch of scientists had come up with a hypothesis as unlikely-sounding as anything in science fiction. Only a few scientists were prepared to reply that the *scientific uncertainty itself* was an argument for action. As Sagan said in reference to nuclear war, injuring the atmosphere was "an experiment that can be performed once, at most."[1]

Related:
The Public and Climate

[1] Szilard and Sagan quoted by Badash (2009) pp. 303, 61.