

Lesson 8 Book Excerpt**Managing the Sun**

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After dinner, consumed under towering oil paintings of plump-faced men in silver wigs, the delegates are invited to the wood-paneled library. There, about thirty scientists, lawyers, environmentalists, and policy wonks gather for the opening “technical briefing” on the different geoengineering schemes under consideration. A Royal Society scientist takes us through a slide show that includes “fertilizing” oceans with iron to pull carbon out of the atmosphere; covering deserts with vast white sheets in order to reflect sunlight back to space; and building fleets of machines like the ones competing for Richard Branson’s Earth Challenge that would suck carbon out of the air.

The scientist explains that there are too many such schemes to evaluate in depth, and each presents its own particular governing challenge. So for the next three days, we will zero in on the geoengineering methods the scientists here consider most plausible and promising. These involve various means of injecting particles into the atmosphere in order to reflect more sunlight back to space, thereby reducing the amount of heat that reaches the earth. In geoengineering lingo, this is known as Solar Radiation Management (SRM)—since these methods would be attempting to literally “manage” the amount of sunlight that reaches earth.

There are various possible sun-dimming approaches. The most gleefully sci-fi is space mirrors, which is quickly dismissed out of hand. Another is “cloud brightening”: spraying seawater into the sky (whether from fleets of boats or from towers on shore) to create more cloud cover or to make clouds more reflective and longer lasting. The most frequently discussed option involves spraying sulfate aerosols into the stratosphere, whether via specially retrofitted airplanes or a very long hose suspended by helium balloons (some have even suggested using cannons).

The choice to focus exclusively on SRM is somewhat arbitrary given that ocean fertilization experiments have been conducted on several occasions, including a heavily reported “rogue” test off the coast of British Columbia in 2012. But SRM is attracting the lion’s share of serious scientific interest: sun blocking has been the subject of over one hundred peer-reviewed papers, and several high-level research teams are poised to run open-air field trials, which would test the mechanics of these schemes using ships, planes, and very long hoses. If rules and guidelines aren’t developed soon (including, as some are suggesting, banning field tests outright), we could end up with a research Wild West.

Spraying sulfate into the stratosphere is often referred to as “the Pinatubo Option,” after the 1991 eruption of Mount Pinatubo in the Philippines. Most volcanic eruptions send ash and gases into the lower atmosphere, where sulfuric acid droplets are formed that simply fall down to earth. (That was the case, for instance, with the 2010 Icelandic volcano that grounded many European flights.) But certain, much rarer eruptions—mount Pinatubo among them—send high volumes of sulfur dioxide all the way up to the stratosphere.

When that happens, the sulfuric acid droplets don't fall back down: they remain in the stratosphere, and within weeks can circulate to surround the entire planet. The droplets act like tiny, light-scattering mirrors, preventing the full heat of the sun from reaching the planet's surface. When these larger volcanic eruptions occur in the tropics, the aerosols stay suspended in the stratosphere for roughly one to two years, and the global cooling effects can last even longer.

That's what happened after Pinatubo. The year after the eruption, global temperatures dropped by half a degree Celsius, and as Oliver Morton noted in *Nature*, “Had there not been a simultaneous El Niño, 1992 would have been 0.7 degrees cooler, worldwide, than 1991.” That figure is notable because we have warmed the earth by roughly the same amount thus far with our greenhouse gas emissions. Which is why some scientists have become convinced that if they could just find a way to do artificially what those large eruptions do naturally, then they could force down the temperature of the earth to counteract global warming.

The scientist leading the briefing starts with the pros of this approach. He observes that the technology to pull this off already exists, though it needs to be tested; it's relatively cheap; and, if it worked, the cooling effects would kick in pretty quickly. The cons are that, depending on which sun-blocking method is used and how intensively, a permanent haze could appear over the earth, potentially making clear blue skies a thing of the past. The haze could prevent astronomers from seeing the stars and planets clearly and weaker sunlight could reduce the capacity of solar power generators to produce energy (irony alert).

But the biggest problem with the Pinatubo Option is that it does nothing to change the underlying cause of climate change, the buildup of heat-trapping gases, and instead treats only the most obvious symptom—warmer temperatures. That might help control something like glacial melt, but would do nothing about the increased atmospheric carbon that the ocean continues to soak up, causing rapid acidification that is already taking a heavy toll on hard-shelled marine life from coral to oysters, and may have cascading impacts through the entire aquatic food chain. On the other hand, we hear, there could be some advantages to allowing atmospheric carbon dioxide levels to increase while keeping temperatures artificially cool, since plants like carbon dioxide (so long as it's not accompanied by scorching heat and drought) and they might well do better in what would essentially become an artificial global greenhouse.

Oh, and another con: once you start spraying material into the stratosphere to block the sun, it would basically be impossible to stop because if you did, all the warming that you had artificially suppressed by putting up that virtual sunshade would hit the planet's surface in one single tidal wave of heat, with no time for gradual adaptation. Think of the wicked witches of fairy tales, staying young by drinking ill-gotten magical elixirs, only to decay and wither all at once when the supply is abruptly cut off.

One solution to this "termination problem," as our British guide politely describes it, would be to suck a whole lot of carbon out of the atmosphere while the shade was still up so that when the particles dissipate and the sun beams down full bore, there is less heat-trapping gas in the atmosphere to augment the warming. Which would be fine except for the fact that we don't actually know how to do that on anything close to the required scale.

Listening to all this, a grim picture emerges. Nothing on earth would be outside the reach of humanity's fallible machines, or even fully outside at all. We would have a roof, not a sky—a milky, geoengineered ceiling gazing down on a dying, acidified sea.

And it gets worse, because our guide has saved the biggest con for last. A slide comes up showing a map of the world, with regions color-coded based on projections showing how severely their rainfall will be affected by injecting sulfur dioxide into the stratosphere. Precipitation in Europe and North America appears minimally changed, but Africa's equatorial region is lit up red, an indication of serious drought. And though the borders are hazy, parts of Asia appear to be in trouble as well because the drop in land temperature caused by a weaker sun could also weaken the summer monsoons, the main source of rainfall in these regions.

Up to this point, the audience has been quietly listening, but this news seems to wake up the room. One participant interrupts the presentation: "Let's put aside the science and talk about the ethics," he says, clearly upset. "I come from Africa and I don't like what I'm seeing with precipitation." Indeed, one of the society's own reports on geoengineering acknowledges that Solar Radiation Management "could conceivably lead to climate changes that are worse than the 'no SRM' option."

The African delegate shakes his head. "I don't know how many of us will sleep well tonight."