



# TIME Space Newsletter

September 10, 2019

Dear readers,

Not a lot of people would want to go back to the Paleocene Epoch. For one thing, the dinosaurs were only beginning to die out, and while they'd be nifty to see, they were murder on mammals. It would be a good 65 million years before humans got a literal toe-hold on the world. The Eocene wouldn't be much better. It was around that time that what is now the Indian subcontinent crashed into Asia, and while all that produced some lovely mountains, there was a lot of slo-mo violence of clashing plates before things settled down.

As far as epochs go, the Holocene is everyone's favorite. It started close to 12,000 years ago, as the last Ice Age was ending, and produced the conditions that allowed all the species we love best—ourselves, and charismatic megafauna like the bald eagle, the panda and the tiger—to thrive.

From humanity's perspective, it would be perfectly fine if the Holocene went on forever. But it won't. It's ending now—it may have already ended in the 1950s, according to some scientists—to be replaced by the Anthropocene. The name says it all: it's an epoch in which one species—ours, *anthro*—became the leading driver of the state of the planet, more powerful, at least in the short-term, than the larger forces of geology, meteorology, even biology.

We have, of course, abused that power, fouling the air, annihilating species, wiping out forests and distorting the climate. We were born in a garden, and we're turning it into a wasteland. For an example of where that can lead, we need look only at Mars, which was watery, warm and possibly life-providing for the first billion of its four billion years—and is nothing like that now.

Planets can be reborn, in theory, effectively terraformed to a biology-friendly state. In the early 1990s, when I was working for Discover Magazine, I interviewed astro-geophysicist Christopher McKay, of NASA's Ames Research Center; Brian Toon, then of Ames and now of the University of Colorado, Boulder; and atmospheric scientist James Kasting, of Penn State. I was working on a story about a thought-experiment paper the three of them had published on what it would take—given unlimited funds and unlimited time—to do just that to Mars.

The job, no surprise, would be massive. Greenhouse gases, especially chlorofluorocarbons—which are so unfriendly on Earth but would be essential for warming a cold, dead planet—would have to be poured into the Martian skies. The elemental components, including chlorine, fluorine, carbon and hydrogen, could be found on-site in the Martian soil and

combined, but it wouldn't be easy. Then, when the temperature warmed from about -75° F (-60° C) to -22° F (-30° C), another greenhouse gas, CO<sub>2</sub>, trapped in Martian soil and ice caps, would begin to boil out, warming things up further. This would speed melting of residual water ice, which would add water vapor, one more greenhouse gas, to the mix.

Much more would still need to be done, including releasing Earthly micro-organisms into the Martian soil, to consume nitrates and then release the nitrogen needed to support eventual plants. (This would be a direct violation of NASA's Planetary Protection protocols, which aims to prevent contamination of other planets with Earthly life, but in Thought-Experiment Land none of that matters.) Then those plants would have to thrive all over the planet and begin producing the oxygen that would support the human species responsible for the global gardening.

The entire exercise would take 100,000 years or more, assuming it worked, and none of that would address whether we should be presuming to do such intrusive work. "We can't do this just because we've made Earth so unpleasant that we don't want to live here anymore," Toon told me.

Space.com has a piece this week on an improbable partnership made up of San Francisco-based conceptual artist Jonathan Keats and others involved with San Francisco's Modernism Gallery, and a group of activists, to terraform our own planet, not to bring it back to life, but to prevent it from sliding toward ruin at our hands.

The project, called Pioneers of the Greater Holocene, makes the case that we should very much want to keep living on Earth, and should work to ensure it remains habitable. Their methods are modest: an exhibit at the museum, which opened on Sept. 5, that is essentially a catalogue of the places in and around San Francisco that are "still in the Holocene's grip," as Space.com put it, from redwood forests to cracks in urban sidewalks through which weeds defiantly poke. The group will also be handing out seed packets to pedestrians to encourage them to do their own small bit to spread the Holocene magic.

"I'm not trying to bring back the Holocene; I'm trying to *stay* in the Holocene," Keats said. "And I think we all should be doing that."

Realistically, none of this will make a remotely measurable difference in the approach of the Anthropocene. Earth is being grievously hurt and human fingerprints are all over the crime scene. But we can erase those prints if we want. The dying parts of our own world are a stark sign of our destructive power. And the seven dead planets in our own solar system are a local reminder of the great good fortune of of calling the single living one home.

—Jeffrey Kluger