Anything Can Happen at the End of the World

RB

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a review of

The Ends of the World: Volcanic Apocalypses, Lethal Oceans, and Our Quest to Understand Earth's Past Mass Extinctions by Peter Brannen. Echo Press, 2017.

What is the best way to kill off most life on Earth? Forget those Hollywood asteroids and simply disrupt CO_2 equilibrium in the atmosphere. The rest will take care of itself.

The chemistry is simple. If concentration of this crucial gas draws down too far, the planet becomes a snowball; if it builds up excessively, Earth becomes a hothouse. These outcomes are not just the result of sophisticated computer modeling, according to longtime science writer, Peter Brannen.

In his *The Ends of the World*, Brannen argues that although our planet's CO_2 concentration is usually stable, occasional drastic variations recur during its history. According to Earth's fossil record, haywire CO_2 has twice frozen out life, and burned it out thrice more, each time leaving behind shattered ecosystems with only a few hardy holdout survivors.

Following these gigantic die-offs, atmospheric equilibrium is slowly reestablished and descendants of the holdouts eventually flourish in an explosion of speciation, as the cycle plays out once more.

In this very readable yet scientific study, Brannen takes us from life's commencement through its arduous evolutionary journey until today. To drive his narrative, he focuses on five major disruptions in life's expansion.

These are the Big Five, Earth's most massive extinction events that end geologic periods and wipe out entire phyla. Brannen reports the work of leading researchers and outlines current consensus theories for their causation. (Spoiler alert: It's not asteroids.) He also interviews colorful experts, each a specialist in a particular extinction.

As it turns out, fossil clues from ancient cataclysms always point toward CO_2 disruptions as the cause. Even the Cretaceous Period's exciting finale—when a killer asteroid zapped the dinosaurs—had a crucial CO_2 component.

As Brannen points out, when this famous extraterrestrial rock impacted in Mexico, something on the other side of the planet called the Deccan Traps was releasing volcanic CO_2 on a colossal scale. These eruptions went on for thousands of years in what is today India, before and after the asteroid, exacerbating its effects and converting what could have been a regional extinction into a worldwide catastrophe.

Which brings us to our current uncontrolled fluctuation of CO_2. It is now concentrated at well over 400 parts per million and rising fast. The rate of increase is gaining each year, even as human CO_2 inputs level off. That indicates a feedback loop. This wild swing upward of atmospheric CO_2 diverges from Earth's past in two components, origin and rate.

Its origin is animal-induced rather than resulting from a geological process. The human innovation of industrial civilization is burning through millions of years of stored solar energy in just a few centuries. By rapidly firing so much coal and oil we release billions of metric tons of CO_2 into the atmosphere, which by itself is not an unprecedented occurrence.

Brannen informs us that huge CO2 dumps have happened before, in earlier more volcanic epochs. Even our current practice of igniting underground coal deposits by the megaton has occurred before, during the Permian Period. What happened after that?

As Brannen faithfully relates, the planet warmed enough to thaw frozen methane hydrates on the polar sea floor. Methane gas has a greenhouse effect worse than CO2, so when those hydrates off-gassed into the atmosphere, it jacked up the temperature even further. Feedback.

This final increase caused the most lethal mass-extinction event ever, one that killed off 96 percent of marine animals and 70 percent of terrestrial ones. The Permian event was the only mass-extinction to affect insects as well.

Which brings us to rate. Melting methane hydrates or the increase of CO2 concentration even as human inputs level off indicate positive feedback loops. They are popularly called tipping points, and they are followed by runaway global warming that is no longer responsive to human control.

The Paleolithic coal and volcanic burnings happened over millennia, while our current funeral pyre of carbon-rich fuels has only taken centuries. Brannen's research informs us that even the slower paleo-rate caused big problems, which does not bode well for our speed-burning similar quantities of stored carbon.

Although extinction might be considered a depressing subject, Brannen's conclusions about the past can also be reassuring, in a cosmic sort of way. Our planet is resilient.

All ecological havoc that humans wreak upon Earth as we exit life's stage will be erased and reabsorbed into whatever comes next. It may take hundreds of thousands of years to repair our damage, but atmospheric equilibrium will eventually reassert itself, as it always has.

Continents will continue to move and collide, creating new mountain ranges. Such geologic action will draw down CO2, as it always does, and eventually the poles will refreeze.

If even one scrap of algae survives us, it provides sufficient material to start the whole process once more. The last five times total extinction threatened Earth's biological existence, ever-tenacious life persisted. It will outlast humanity as well.

Enough time remains in Earth's life-cycle for three or four more geologic periods to play out before our sun goes into its supernova phase. That means yet more unfathomable passages of eons, punctuated by occasional mass-extinction events.

Brannen's work indicates that each of these future "ends of the world" will devastate land and ocean just as humans are doing now, and each time the ruptured ecosystems will slowly rebuild. Holdout survivors will produce another wave of speciation.

This is our dynamic planet. It grows marvelous plants and animals and then periodically wipes most of them out, using the survivors' DNA to create ever more life forms.

Since Earth is only about halfway through her existence, it becomes clear that human destiny is to flow through the stream of life only temporarily, and not be its end-product.

Regarding climate change, the promise has become the event and we're in a bad spot. Worst-case global warming scenarios of the 1990s are now actuality, and much more is on the way. There is no visible scientific way out of the environmental trap we have fashioned. Even extreme measures backfire.

For example, if all CO2 emissions stopped tomorrow, that would within weeks induce a global temperature rise of about 2.5C, since particulate matter emitted from smokestacks actually screens us from even worse solar heat.

This is referred to as the "aerosol masking effect." Added to what we've already baked into our CO2 cake, terminating the aerosol masking effect would probably set off feedback guaranteeing that frozen methane hydrates at the bottom of the Arctic Ocean will thaw and seal our fate.

In other words, the very act of trying to escape the trap will likely snap its spring-arm shut even sooner.

The upcoming collapse of industrial civilization will be followed by our extinction, but that will take a little while. Prior to annihilation, some interesting social possibilities could open up.

One expects brutal dystopic coercion to emerge, but perhaps there could also be a radical egalitarian response as well, somewhere. The old rules will no longer apply.

Humanity might even produce a great moment of social revolution during its death throes, something glorious on our way out the door.

Why not? Anything can happen.

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