Riding the Rails to Omaha With Rudolf Clausius

Ward Chesworth

If someone points out to you that your pet theory of the universe is in disagreement with Maxwell's equations — then so much the worse for Maxwell's equations. ... But if your theory is found to be against the Second Law of Thermodynamics, I can give you no hope; there is nothing to do but to collapse in deepest humiliation.

– Sir Arthur S. Eddington

In its street clothes, the Second Law of Thermodynamics says that the mess in a pigpen tends to get messier with time. It is a Stoic's law that tells you it's no use crying over spilt milk. We hear it first in nursery school where the tragedy of Humpty Dumpty teaches us that, despite the help of all the king's horses and all the king's men, we can't unscramble an egg.

It was the German physicist Rudolf Clausius who, in 1850, dressed the Second Law in a tuxedo to show us that the pigpen was infinite. He said, "the entropy of the universe strives to reach a maximum." That is a beautifully concise vision of our fate with the clear message that in the grand scheme of things, there is no escape. We're all doomed and can do nothing about it. All order in the universe will degenerate into chaos.

A far future when entropy would reach this mandated maximum gave the Victorians nightmares. There wouldn't be enough usable energy left to do the work of maintaining order. The name they gave their worst dream — "The Heat Death of the Universe" — sounds like a blockbuster movie to modern ears. In the 1890s, H.G. Wells gave us a preview when he sent his time traveler to surf across billions of years to witness the actual event. On the verge of freezing in the dark, the hapless surfer reversed his time machine and fled back to the safety of a gas-lit London and the warmth of a coal fire.

At this point you may be yelling "enough already." The whole of human history teaches the precise opposite. Didn't we create a complex civilization out of the mess and confusion of prehistory? Haven't we tamed chaos by inventing written language, social structures, great cities, art, science and technology? As for unscrambling an egg, Myron Tribus, the MIT engineer who in 1962 coined the term "thermoeconomics," told us how to do it: feed it to a chicken. Congress might just as well repeal the Second Law of Thermodynamics, right?

Wrong. Our civilization is a tiny, gated community that we've tried to wall off from the rest of an indifferent universe. We suck up energy and materials from all around and flush the wastes away. "Away" gets ever messier, with the total effect that chaos increases as the Second Law says it should. Ultimately, there's no gate strong enough to keep the chaos out.

So, is there any joy at all for suffering humanity? Not really, said Fred Hoyle, the English astrophysicist who dismissed the notion of the "Big Bang" while giving it its name. To the question in hand he replied, "It has often been said that, if the human species fails to make a go of it here on earth, some other species will take over the running. This is not correct. We have, or soon will have, exhausted the necessary prerequisites so far as this planet is concerned. With coal gone, oil gone, high-grade metallic ores gone, no species, however competent, can make the long climb from primitive conditions to high-level technology. This is a one shot affair."

One kick at the can! We're rubbish at hearing that kind of message — our ears don't work in that register. We're like the man in the smoker car on poet Carl Sandburg's limited express train:

Hurtling across the prairie
into blue haze and dark air go
fifteen all-steel coaches holding a
thousand people.
(All the coaches shall be scrap and
rust and all the men and women
laughing in the diners and
sleepers shall pass to ashes.)
I ask a man in the smoker where
he is going and he answers:
"Omaha."

We're also rubbish at stoicism; we believe in hope. In which case, maybe agronomist Wes Jackson, a founder of sustainable agriculture, and his colleagues at the Land Institute in Salina, Kan., are the collective messiah we've been waiting for. Their hope for civilization starts with a farming system that mimics nature as closely as possible. They say that if we merge a mature knowledge of ecology and evolutionary biology and learn how the tall grass prairie sustained itself before we came along, we could design a system that would produce food far more sustainably than industrial-scale agriculture does now. And greater sustainability in agriculture is the necessary prerequisite for greater sustainability in other sectors of society. If we get it right, they say, we could possibly win another 10,000 years of civilized life.

In the train's parlor car, hurtling towards Omaha, I raise a glass to the Land Institute. They can't negate the iron rule of Rudolf Clausius completely, but they can give humanity the hope of keeping chaos at bay for a few more millenia yet.

Chesworth is professor emeritus at the University of Guelph, Canada, and Fellow of the Geological Society of America. He thinks, therefore, he hammers. Email: wcheswor@uoguelph.ca.

Credit: Antonio Martinez Cortizas