

A
SYMPHONY
OF
SMITHEREENS

★
HOW OUR UNIVERSE
COMPOSES ITSELF

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BOOKS BY PETER BARNES



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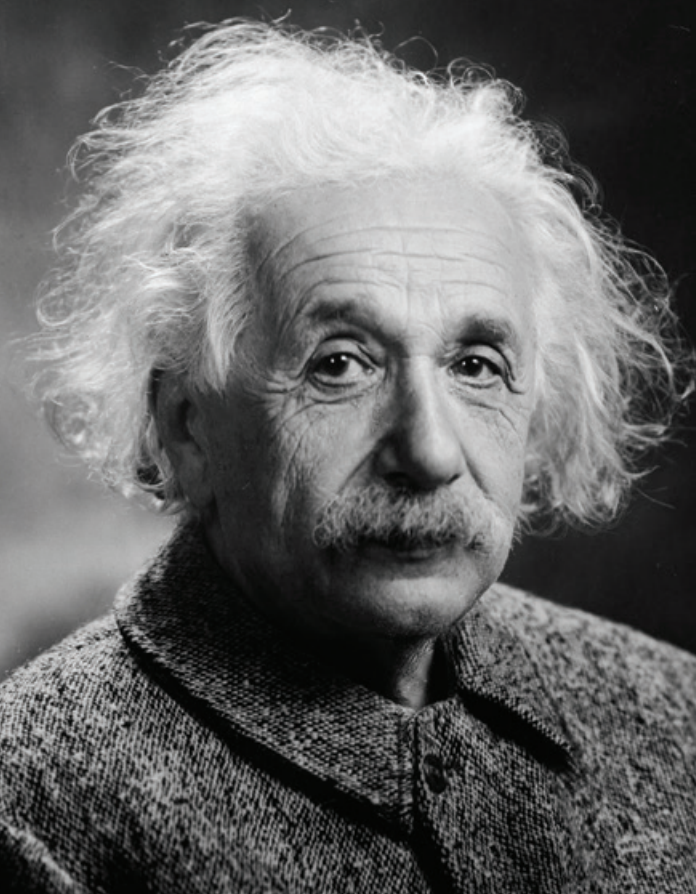
With Liberty and Dividends For All

Ours: The Case for Universal Property



AN HOMAGE TO
PYTHAGORAS AND EINSTEIN

AUDACIOUS
IMAGINERS BOTH



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In the Beginning



cover your eyes and ears and imagine a ground-shaking explosion with debris flying everywhere. How likely is it that the rubble will spontaneously arrange itself into large, synchronized chunks? I'd call it highly improbable. Normally, when things explode, they don't reassemble on their own.



Now think back to the Big Bang, the spectacular eruption that gave birth to our universe. Seconds before, all that existed was an unimaginably hot and dense blob about the size of an acorn. Then, a split second later, smithereens. Specks so infinitesimal they could be detected only by each other, yet so strong they could never be split.

The premise of this book is that our universe, from this violent beginning, built and organized itself into its present form. This is my premise because, if you choose not to believe in a divine designer, self-creation followed by self-organization is the only option left.

According to the Oxford English Dictionary, *smithereens* was first recorded in the early 1800s and is related to the vernacular *smithers*, meaning tiny pieces. It contains the suffix *-een*, similar to the Irish *-ín*, which is also used to emphasize small size. Interestingly, the word is always used in the plural form. In this book I use it as a synonym for *subatomic particles* or *quanta*, the Latin term first used by Max Planck in 1900 to refer to the smallest possible specks of matter. I use it as a complement to those terms because it conveys extreme smallness as well as an initiating explosion.



How did inchoate smithereens transform themselves into today's astonishing assemblage of stars, galaxies and living beings, all moving in some kind of synchrony and obeying what appear to be universe-wide laws? It's a question humans have pondered for as long as we've been part of the swirl. We've entertained hypotheses from mystics, poets, philosophers and scientists, but as yet have found no full or verifiable explanation.

To say that our universe is self-organizing doesn't mean that everything in it is pre-ordained; there's still plenty of room for chance and

free will at the individual level. What it means is that the pieces of our universe interact with each other in such ways that complexity, harmony and life arise naturally.

Following this line of thinking, the original specks of cosmic debris did their various things, and *voilà*, about fourteen billion years later, here they and we are, still doing similar things. But just *saying* that our universe organizes itself doesn't tell us *how* it pulls off this miraculous feat. What's behind the magic? How does our universe actually work? That's the question I set out to answer after I turned 80.

Why did I choose such an audacious late-life quest? Up to that point I'd been a journalist, entrepreneur, father and husband. I'd written books about capitalism and how to fix it, so occasionally I'd posed as an economist. But I have no degree in science, and I've never worked in a lab. I'm also comfortably retired. So why on Earth would I embark on a cosmological quest that, in the end, *has* no end?

My short answer is, I don't play golf—I needed a challenge to keep myself, well, challenged. My longer answer has two parts: Albert Einstein and capitalism.

Nearly everyone has a personal demigod, and from an early age mine was Einstein. Not because I understood his general theory of relativity and appreciated its magnificence. I wish I could make that claim, but I can't. Rather, Einstein inspired me because he challenged prevailing ways of thinking and found better ones.

In 1905, while working as a clerk at the Swiss patent office, Einstein published four ground-breaking papers. One predicted the existence of photons as discrete blips of light, another explained the haphazard motion of particles suspended in gas, a third demonstrated mass-energy equivalence, and the fourth introduced the theory of special relativity. Not bad for a 26-year-old with no staff or lab equipment.



Albert Einstein circa 1905

He called his methodology *Gedankenexperiment*, or thought experiment, and used it all his life.

I was first drawn to Einstein in my teens when I attended the Bronx High School of Science, a nest for nerds that has graduated more Nobel Prize winners than any other U.S. high school. Like Einstein, I

was a young iconoclast. I was also drawn to math, feeling in my bones that it was connected to truth and beauty. And when, during a brief exposure to math at Harvard, I witnessed a professor prove on a blackboard that $e^{i\pi} + 1 = 0$, I was gob smacked.¹ How could three seemingly unrelated non-whole numbers possibly combine with the most fundamental integer of all to equal zero? Surely either God exists and is a mathematician or the universe has organized itself according to invisible mathematical laws. If only I could muster the brain power to discern those laws! Alas, I couldn't come close, so I switched my major to history and after graduating became a journalist.

What's behind the magic? How does our universe actually work?

Fifteen years later I made another life change. Tired of writing about what others did, I decided to do something myself that could make a difference. What might that be? During my years as a journalist I'd observed how persistently capitalism widens inequality and destroys nature. Could modern markets do better, I wondered, and if so, could I demonstrate *how*?

With that in mind I co-founded a series of experimental businesses: a solar energy company owned by its workers, a socially-screened mutual fund (Working Assets), and a phone company (Credo Mobile)

¹ In the formula, e is the base of natural logarithms, i is the imaginary square root of -1 , and π is the ratio of a circle's circumference to its diameter. The obscure relationship between the three was discovered by Swiss mathematician Leonhard Euler in 1748.

that automatically donates one percent of its revenue to progressive non-profits. After twenty years I came to the conclusion that, while socially responsible businesses can do some good (Credo has donated almost \$100 million and is still going strong), they can't by themselves fix capitalism's tragic flaws. To do that, we must change our economy at the level of the entire system.

This led me to ponder *how* major change at that level could be achieved. My practical conclusions can be found in *Ours: The Case for Universal Property*, and elsewhere. My point here is that, while I was wrestling with the conundrums of capitalism, the ghost of Albert Einstein reminded me that markets have a lot in common with our universe.

In both realms there is no central authority or master plan, just lots of autonomous agents making decisions based on external conditions and internal calculations. Both realms exhibit a permanent tension between creativity and destruction. And both are guided by what Adam Smith, in 1776, called an 'invisible hand.' In markets, that 'hand' converts individual self-seeking into widespread, if not universal, gain. In our cosmos, several invisible hands convert repetitive interactions among smithereens into macro-level complexity, rough equilibria, and eventually, life. Perhaps my decades in the maw of markets prepared me for the cosmic mysteries I was now pondering. That, at least, was my hope.

Thinking further about Einstein, I was especially intrigued by the fact that, after his astonishing early breakthroughs, he spent the rest of his life unsuccessfully searching for a 'theory of everything.' Such a theory would not only resolve the inconsistencies between large-scale relativity and subatomic quantum mechanics; it would also shed light on such mysteries as whether the emergence of life was inevi-

table, an improbable accident, or a divine gift. I realized that if Einstein couldn't crack these conundrums, there was zero chance that I could. However, I fancied I might be able to conjure a hypothesis about how our universe composed itself after the Big Bang. That hypothesis would be consistent with known observations and laws, and be understandable to non-scientist readers. This book is my attempt to do that.

A hypothesis is a proposition that can be proven or disproven through real-world observation or experiment; it is a step prior to a *theory*, which is a hypothesis that has been verified by reality. The hypothesis I will offer will not explain everything. It won't explain what preceded the Big Bang, or whether there are other universes besides ours. Nor will it reconcile relativity with quantum mechanics or solve the enigma of consciousness. What it *will* do is unravel the mystery of how our universe got from its very first moments to what it is today. That, to me, is the most intriguing of the many cosmic mysteries, and one that is potentially explainable by *homo sapiens* alive today.

What makes this challenge particularly alluring is that it seems to violate one of modern science's most venerable commandments, the Second Law of Thermodynamics. The Second Law says that disorder, not order, is the dominant urge of our universe. Things will fall apart; centers will not hold. We and everything else will age, get colder and disintegrate. It's only a matter of time. But while the Second Law of Thermodynamics is powerful, it is not *all*-powerful. It seems to have an antithesis that nudges our universe toward order, complexity and, on at least one planet, life. What is that antithesis? And how does it work?

My exploration followed three paths: reading scores of books by people at the frontiers of science, interacting frequently with Chat-

GPT and YouTube, and taking long walks in the Point Reyes National Seashore that sparked my imagination. In all these excursions, I was guided by the adage, ‘As below, so above,’ or in fancier words, the idea that our universe is a macrocosm of a microcosm and vice-versa. While this idea may not be true in every case, it is a good approximation. It is based on considerable evidence that matter, energy and information flow in similar patterns at all scales. That is why we can learn much about our universe by examining an economic system, an ecosystem, an orchestra and even a computer game. And the same is true in reverse.

I am an admirer of order and complexity wherever they occur. I am dazzled, for example, by any city that every day synchronizes the flows of people, energy, water, goods, wastes and countless other things. How does it do all that? At the same time, in my personal life and writing, I value simplicity. Simplicity in writing means using everyday words, short sentences and brief chapters. As those who have worked or lived with me know, I have little patience for long-windedness. My fondest aphorisms include “Get to the point,” “Cut to the chase” and “Less is more.” This book is written in that spirit. It eagerly adheres to Einstein’s admonition that “everything should be made as simple as possible, but not simpler.”

Throughout the book, I make an important assumption: that human brains contain two distinct neural systems, one that is primarily factual and rational and another that is mostly intuitive and imaginative. Because most of our universe is invisible to us, we must necessarily use both systems to understand it. There is no other way.

The structure of the book is as follows. First I introduce the tools I used to pursue my inquiry: imagination, mathematics and a new ap-

preciation of magic. Then I summarize what we know about our universe’s essential ingredients and hidden forces. This sets the stage for the final part, in which I fit the pieces together.

Everything should be made
as simple as possible,
but not simpler.

One last introductory point. You may have noticed that I speak of *our* rather than *the* universe. I do this for two reasons. One is that there may be more than one universe, in which case *our* would distinguish the one we inhabit from the others. The other is that we humans have a special relationship with our universe: it is our home, and we are its children. We therefore owe it, at a minimum, awe, gratitude and a duty of care. ★