

YET MORE LESSONS FROM COMPLEXITY

Unity: The Key of Peace

Carlos E. Puente

Department of Land, Air and Water Resources

University of California, Davis

<http://puente.lawr.ucdavis.edu>

cepuente@ucdavis.edu

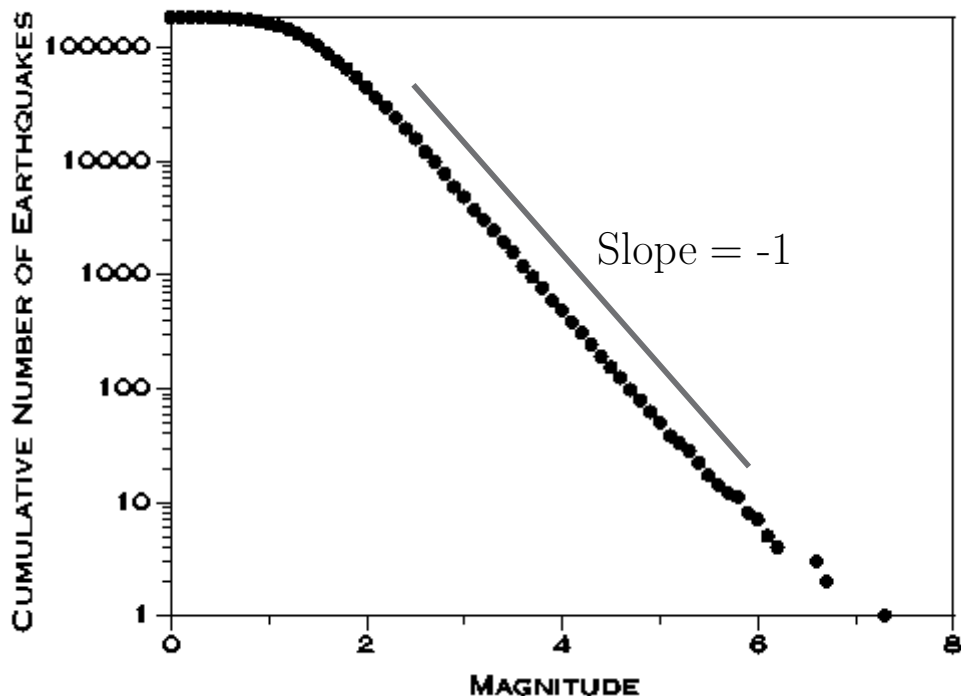
The last few decades have witnessed the development of a host of ideas aimed at understanding and predicting nature's ever present complexity.¹ It is shown that such a work provides, through its detailed study of order and disorder, a suitable framework for visualizing the dynamics and consequences of mankind's ever present divisive traits. Specifically, this work explains how recent universal results pertaining to power-laws, self-organized criticality, and space-filling transformations provide additional and pertinent reminders that point us to unity as an essential element for our peace.

Power-Laws Everywhere

The tails of probability distributions of a host of geophysical phenomena associated with natural hazards have been recently found to exhibit power-laws,²

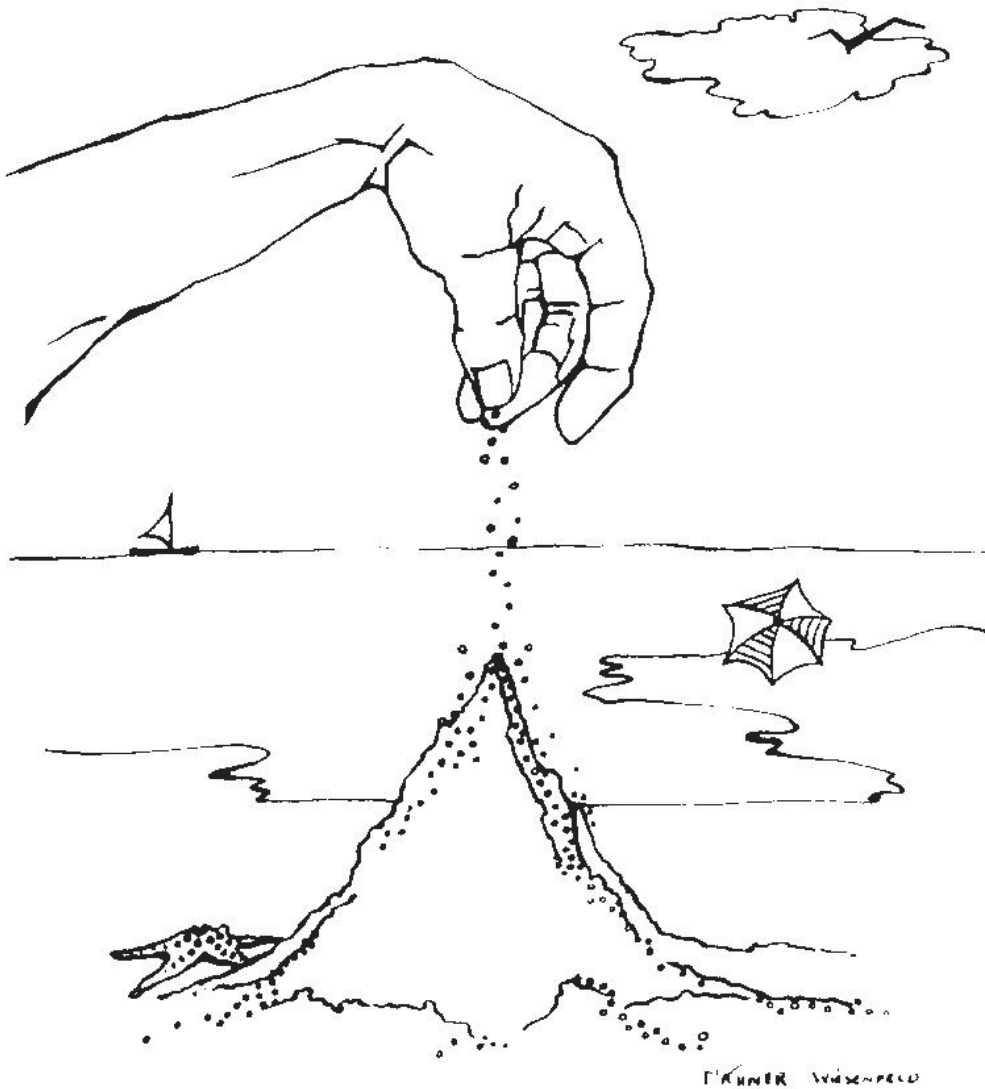
$$P[X \geq x] \sim x^{-c},$$

Earthquakes, floods, avalanches, volcanic eruptions, forest fires, etc., despite their extraordinary complexity and utter dependency to details, yield rather simple and accurate “linear” fits in log-log scales, ubiquitous “heavy tails” which indicate that such processes lack a characteristic scale, as also encountered geometrically on fractal sets.¹



Gutenberg-Richter magnitude frequency distribution for earthquakes in Southern California. After Southern California Earthquake Center.

As such behavior about nature's wrath has piled up, their potential **universality** has led to an effort to understand the genesis of such a surprisingly simple scaling. Amongst the ideas proposed stands the notion of self-organized criticality, SOC, which asserts that power-laws may be obtained via small accumulations of energy that drive a system towards a "critical state," always away from equilibrium and always on the verge of disintegration.^{1,2}

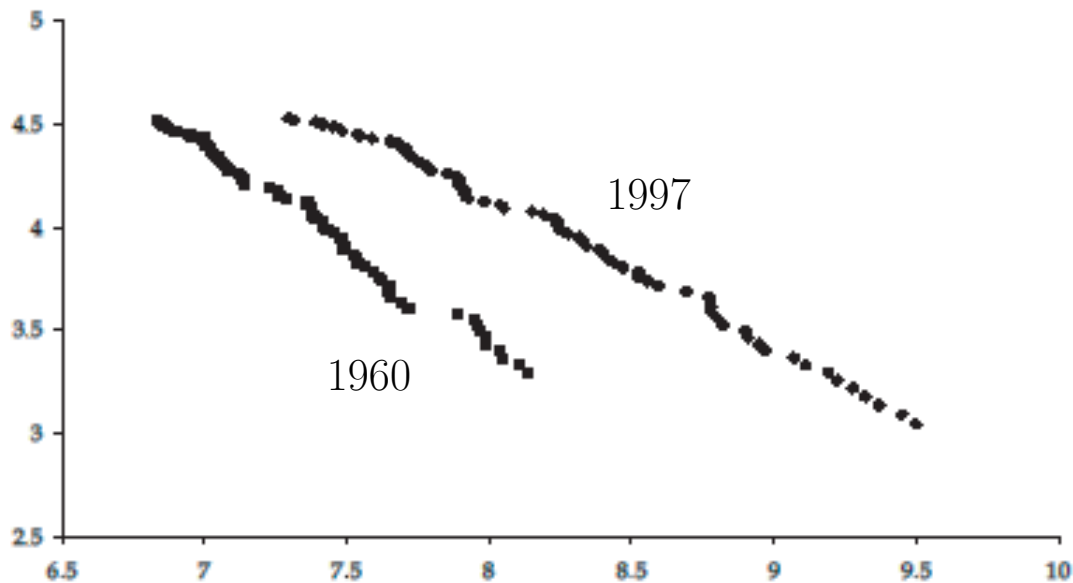


A hand growing a SOC sand pile. After Bak.¹

Given that power-laws are also conspicuously present in several situations associated with human behavior, here I shall try to argue that we, as conscious moral beings, may learn from complexity in order to achieve what really matters to us all, that is, lasting and true peace.³

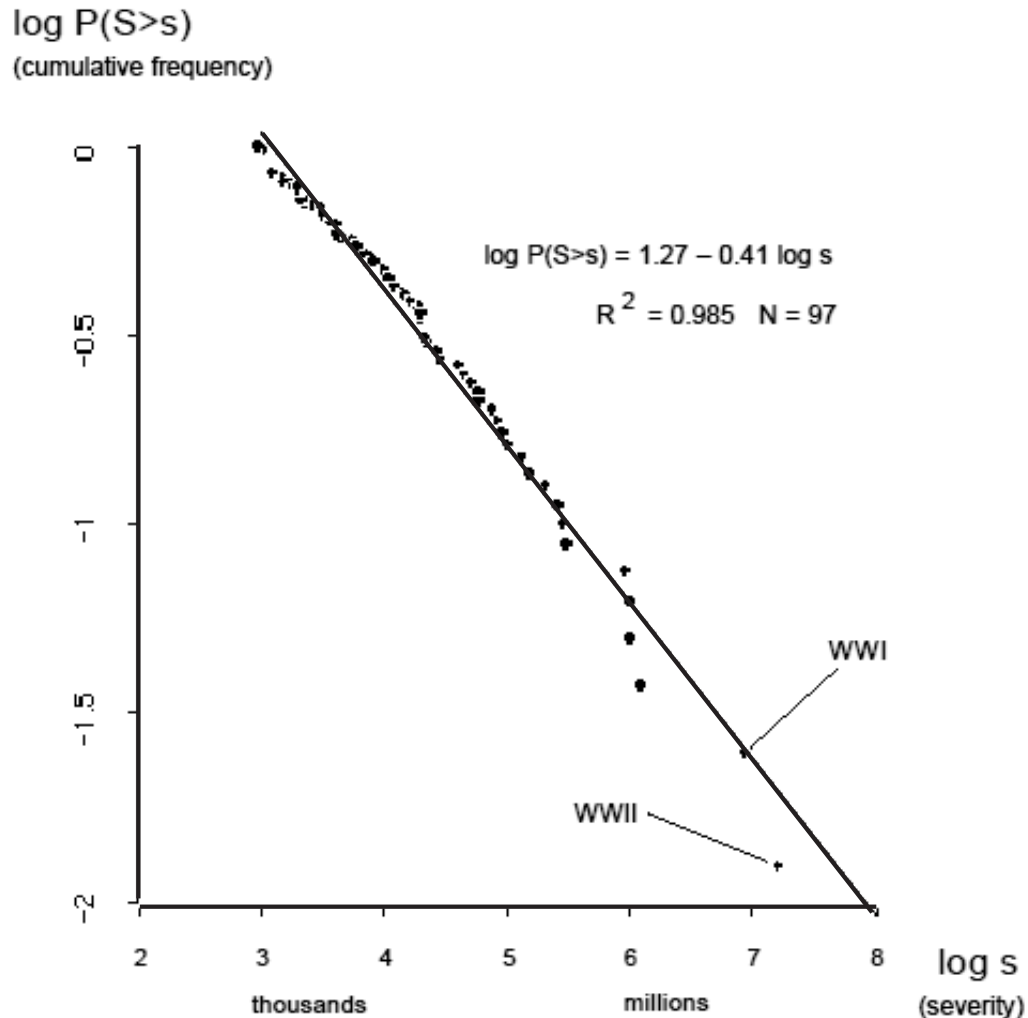
Power-Laws and Our Quest for Peace

As first studied by V. Pareto and L. F. Richardson, income inequalities and casualties from gangs to wars, are, surprisingly but perhaps not so, quite notorious power-laws.



30th to 85th percentiles of the world income distribution (GDP per capita). Plotted is the formula $\ln i = \ln M + \ln (1 - F(x_i))$, where i is the nation's rank, M is the number of nations, and $F(x_i)$ is the cumulative distribution function.

After C. Di Guilmi, E. Gaffeo, and M. Gallegati, "Power law scaling in the world income distribution," *Economics Bulletin*, Vol. 15, 2003.



Cumulative distribution of severe interstate wars. After L.-E. Cederman, “Modeling the Size of Wars: From Billiard Balls to Sandpiles,” *American Political Science Review*, 97, February 2003.

Although our natural bliss in “nailing” yet another power-law, and hence understanding a bit more about how nature works, is justified, it is pertinent, I think, for us not to lose sight of the ample havoc and misery produced by natural and man-made hazards that affect not only the fragile environment of our world, but also many real people, folks with flesh and bones, just like you and me.

The intrinsic fury and division in power-laws exposes, I believe, the worst traits present in all of us and reminds us of the inescapable cosmic battle of good and evil that engulfs us. For despite our intrinsic **normal** tendencies for love and friendship, history, in its unflappable truth, justly records our choices and, unfortunately, our many failings. All power-laws mentioned herein help us appreciate our wrong options, for despite their high determination coefficients, such are just false and incomplete illusions of straightness, remarkable but ugly regressions to dissipation and terror that in no way resemble the immaculate and real rectitude to which we are all called.

If we dare to use the yardstick that makes us human and recognize **love** as key and in addition translate love's eternal invitation to unity as "*integration without differentiation,*" we may recognize other important reminders. There, we may appreciate the exponential function, with *unity* as its internal derivative, as the antithesis of the *log*,⁴ and right there we may fully realize, face to face, in the unmerciful minimization of energy, how the untamed selfishness in power-laws is a plain manifestation of evil.

Simply put, violent power-laws potently symbolize what happens to us, individually and collectively, when we lose track of our inherent scales and misuse or abuse our prescribed powers. The lesson is consistent and straight forward: if we abandon our human consciousness, the laws of nature simply take over and we pay the justly appointed consequences of

our cascading avalanches.⁵ For even if we are prone to the pervasive accumulation of little effects, as it happens in self-organized criticality,⁶ and also in the other mechanisms that yield power-laws, such as preferential attachments, multiplicative processes, highly optimized tolerance,⁷ and self-organized complexity, at the end (and there is such) it is only up to us to recognize our crooked hands in the mirror of reality, to stop blaming others, even the devil, and to mend what is broken.

These ancient notions are indeed pertinent in this day and age when we have come to accept the indifference of the divisive winds as normal,⁸ when aggressiveness has increased due to false dogmas of competition, domination and the “survival of the fittest,” and when the natural stresses and superfluous distractions in our busy lives have obscured the very reason of our existence. Aren't we playing with fire not paying attention to the tried metaphor, explicit in power-laws, that conflagrations do not know how big they will become before they start?²

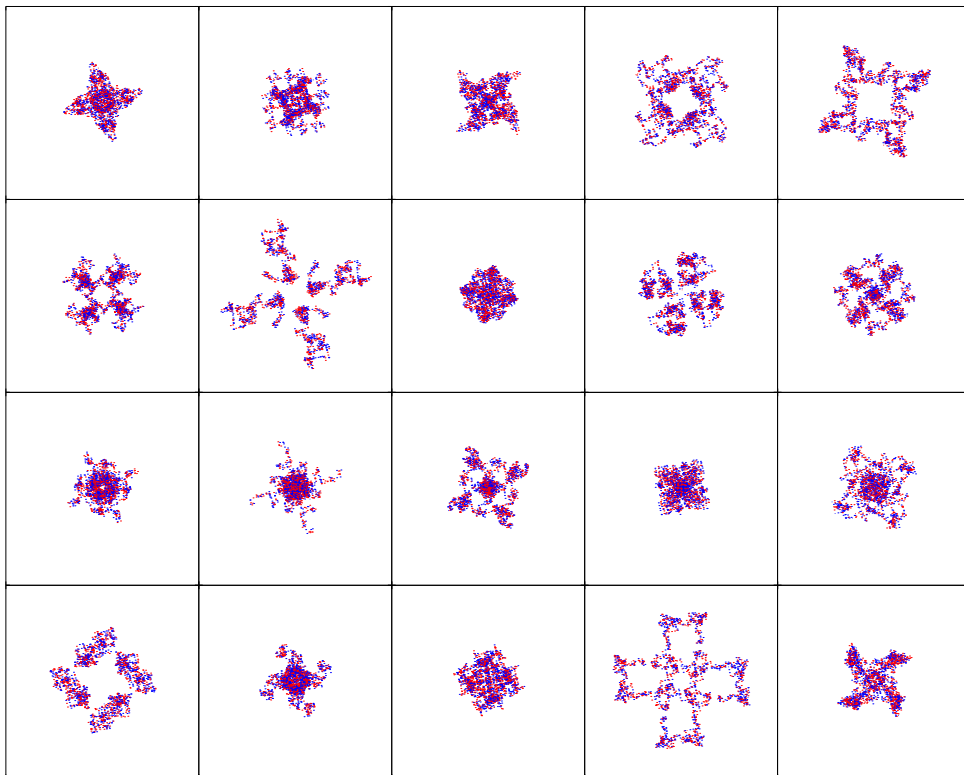
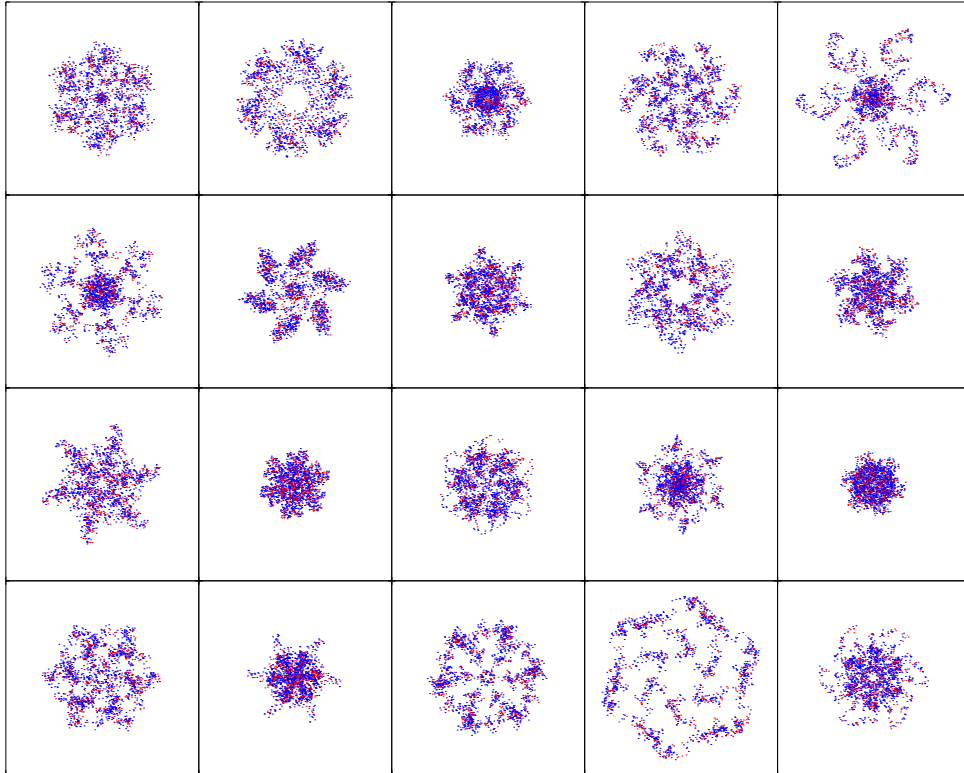
I believe that much can be learned from power-laws, very relevant lessons indeed, for although we may be told, again and again, that there is an “axis of evil” out there in the world, such passes, instead, by our very core and hence true peace and prosperity shall not happen unless we all collectively defeat our power addictions.⁹ For irrespective of the academy of thought to which we belong, the proper scale, not easily accessible to measurement when we cloud it with pride, lies, undeniably, within each one of us.

A Transformation to Friendship

There is only one solution and we know it: to mend our fractal world we ought to let go of the destructive power in the power-laws and accept the ultimate power of *powerlessness*.¹⁰ There is no other way: we have to become “childlike” growing our determination to **unity**, maximizing our energies, so that we all may become **friends** and play together. For as recently found in studying a host of social networks, friendship, even if loosely defined, avoids the heaviness of tails, as it rather aligns with exponential or Gaussian, **normal**, behavior!¹¹

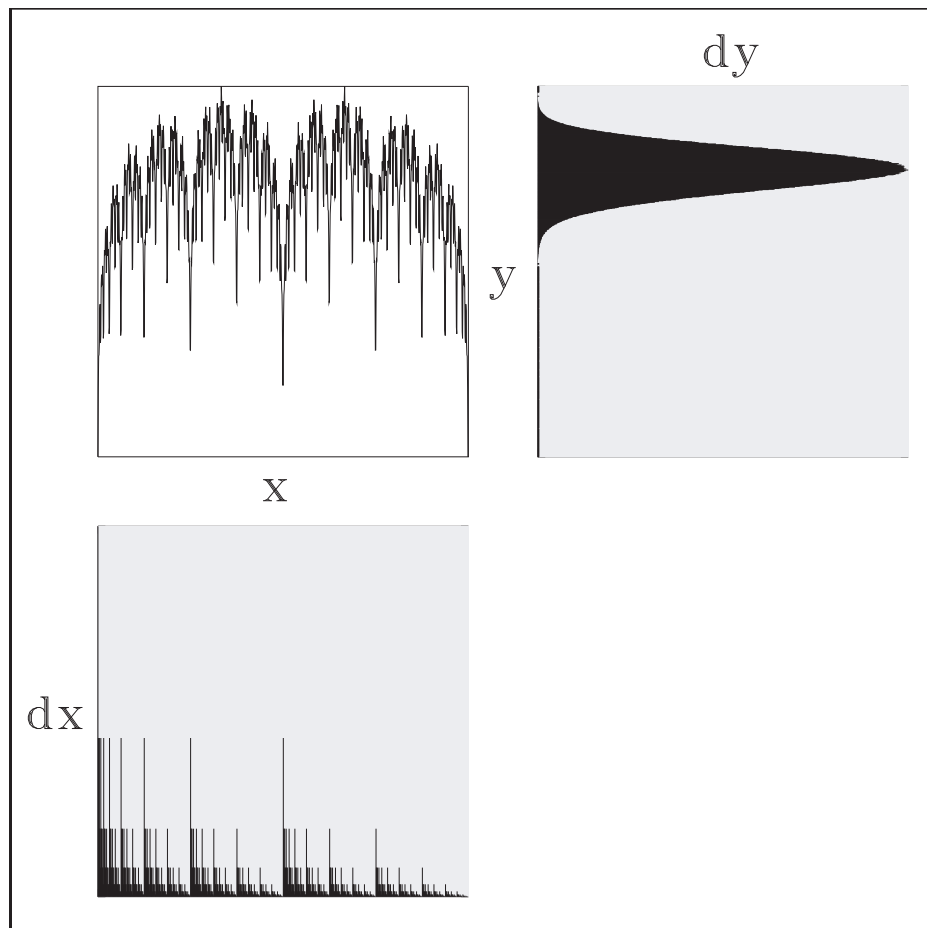
In this regard, it is good to know that there exist rather simple space-filling mathematical transformations capable of universally transfiguring arbitrary spiky sets, with associated power-law distributions and devil’s staircases, into smooth and harmonic bells. It is also relevant to know that inside such beacons of freedom lie boundless almanacs of beautiful designs, that, in their exquisite and playful dynamics, invite us to plenitude.¹²

These are indeed good news for such results reaffirm that truth, beauty and love co-exist, for such remind us that the origins of order lie within a central limit. Such surprising results point us also to our very essence and purpose, for they shows us how, in the embracing affinity of love, advection and dissipation are transmuted into diffusion and conduction. These notions also pierce our egos as they remind us that our best options are always guided by our hearts.



Treasures inside the bell found iterating simple affine maps.¹²

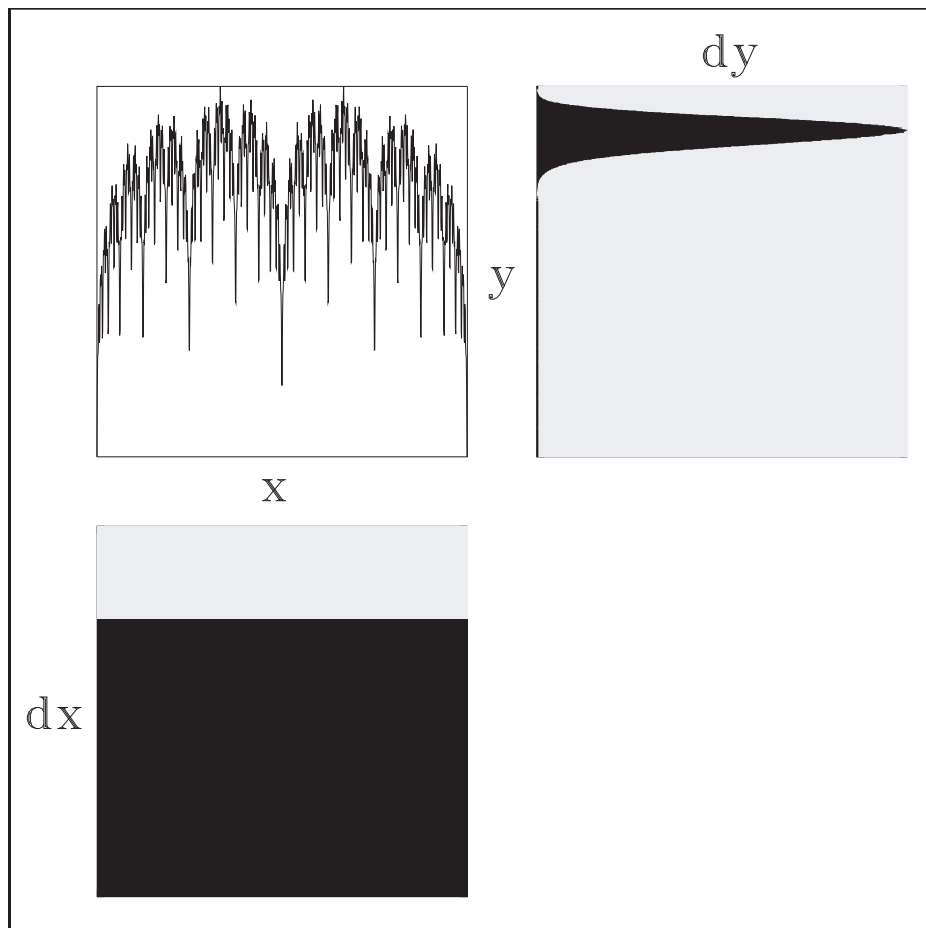
Natural hazards scare us for they reflect the madness of untamed violence and terror and for they expose the ultimate enemy of death that lurks around us and falsely tells us that there is no escape. To this end, it is very soothing to know that there is a space-filling transformation, built by successive midpoint *positive additions* of geometric powers of z tending to 1, a remarkable mirror in which to see our souls, that raises even spiky sets over Cantor dusts into a resounding bell without entropy and concentrated at infinity!



From an arbitrary multifractal measure to an amazing bell.

As $z \rightarrow 1$, $\mu \rightarrow \infty$, $\sigma^2 \rightarrow \infty$, but $\sigma/\mu \rightarrow 0$.

This is a rather powerful concept for it allows us to visualize the universal antidote against chaos and disorder, a mighty promise that rightfully sustains our dreams. How wonderful it is to see, in the exquisite joy of cloud 9,¹³ the final defeat of power-laws in the connectedness of serenity and equality, for in such a case one may comprehend why the ancient and improbable Trinitarian story rings a bell, and why, in the light that triumphs over darkness, it is forever proclaimed “glory to God in the highest and peace on earth to all people!”



Mighty symbols. From equilibrium to a bell at infinity.

Choices

<i>Powerlessness</i>	<i>Power-laws</i>
<i>Meekness</i>	<i>Stubbornness</i>
<i>Normality</i>	<i>Criticality</i>
<i>Conduction</i>	<i>Dissipation</i>
<i>Plenitude</i>	<i>Solitude</i>
<i>Light</i>	<i>Darkness</i>
<i>Maximize</i>	<i>Minimize</i>
<i>Love</i>	<i>Else</i>

REFERENCES AND NOTES

1. For instance, B. B. Mandelbrot, *The Fractal Geometry of Nature*, (Freeman, 1982); P. Bak, *How Nature Works*, (Copernicus, 1996); and S. Wolfram, *A New Kind of Science*, (Wolfram Media Inc., 2002).
2. See for example, D. L. Turcotte, *Fractals and Chaos in Geology and Geophysics*, (Cambridge University Press, 1997); D. Sornette, *Critical Phenomena in Natural Sciences*, (Springer, 2004); B. D. Malamud, Tail of Natural Hazards, *Physics World*, August 2004; and M. Buchanan, *Ubiquity*, (Crown Publishers, 2001).

3. C. E. Puente, “Lessons from complexity. The hypotenuse: the pathway of peace,” AGU Fall Meeting, December 2001; C. E. Puente, “More lessons from complexity. The origin: the root of peace,” AGU Fall meeting, December 2002.
4. To log means to cut down but not just trees, and the log is not just a cylindrical piece of wood but, quite accurately, what we commonly have in our eyes that prevents us from helping each other.
5. How **natural** it is to strike back rather than turning the other cheek!
6. I say that SOC when applied to us humans should be named SOS, self-organized stupidity, for such exposes our silliness and reminds us that we do need help.
7. The implied greed in playing the “markets” of money and sex appear to be *hot*, but such power-laws bring with them awful consequences. For a case study on sexual promiscuity see F. Liljeros, C R. Edling, L. A. N. Amaral, H. E. Stanley, and Y. Aberg, “The web of sexual contacts,” *Nature*, Vol. 411, June 2001.
8. How pervasive are power-laws and what an awful selfish spiral captures the degree of disconnectedness induced by the “invisible hand.”
9. Cutting the word Pareto in Spanish and reading it with a Caribbean accent means “stop it all.” Isn’t that what we all should just do?
10. The required algorithm for abandonment to outer (irrational) love, symbolized by $e = \lim_{x \rightarrow \infty} (1 + 1/x)^x$, is found in Jesus’ famous allegory regarding the vine and the branches, as recorded in the 15th chapter of the Gospel according to John.
11. L. A. N. Amaral, A. Scala, M. Barthélemy, and H. E. Stanley, “Classes of small-world networks,” *PNAS*, Vol. 97, No. 21, October 2000.
12. C. E. Puente, *Treasures inside the bell. Hidden order in chance*, (World Scientific, 2003).
13. Notice how 9 contains the same outer movement of e and how its poetry in motion helps us visualize a fully grown web and a maximally unified cluster, $1 = 0.999 \dots$.

THE AMAZING BELL

(Carlos E. Puente)

*By the mystery of science
graciously shines a state,
an all-embracing alliance
adding liberty a shape.*

*One day, as if by chance,
boldly there was such gem,
as the shadow off a wire
that fills completely space.*

*As the ideas hint above
enduring a lasting zest,
here is probable code
in the ever precious bell.*

The bell peals silent, oh oh
reflecting its peace,
and inside it gathers
lovely masterpiece.

Symmetric pure beauty, oh oh
oh mighty delight,
this limit in fullness
stores life's designs.

Such vessel contains, oh oh
alephs of all tastes,
diatoms and crystals
including DNA.

But there is a case, oh oh
reason to this song:
the forward selection
that raises it all.

There is clear choice
that rotates the 8.

**By loving sincerely
we surely converge.**

Notice, this is cogent:
the bell's central theme.

**By living in freedom
one fulfills the dream.**

There is transformation
that kindles the heart.

**By loving in plenitude
we become smart.**

For love mends the spiky
and takes to the clouds.

**By living the present
one joins blessed crowd.**

Oh see, this is truthful:
the plus all the way.

**By loving the enemy
we learn how to play.**

Dimensional growth,
oh essence of life.

**By living in harmony
one nails normal plan.**

Oh notice the symbols,
oh irrational might.

**By loving simplicity
we experience the light.**

Oh listen, you colleague,
let's go out the cave.

**By living in unity
we all shall prevail.**

Oh notice, my friend,
the plea from a bell.

**By loving and loving
joy will have no end...**

