REFLECT ON COMPLEXITY AND TAKE IT EASY

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In honor of **Rafael L. Bras**
March 29, 2009

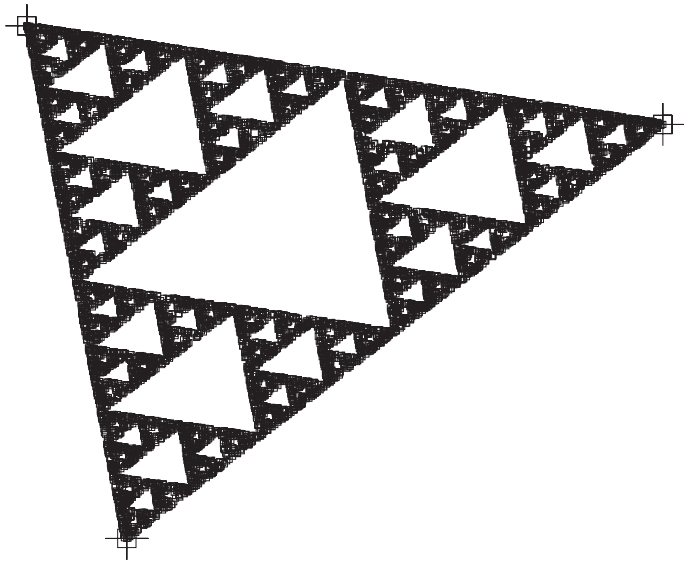
Iteration of simple maps

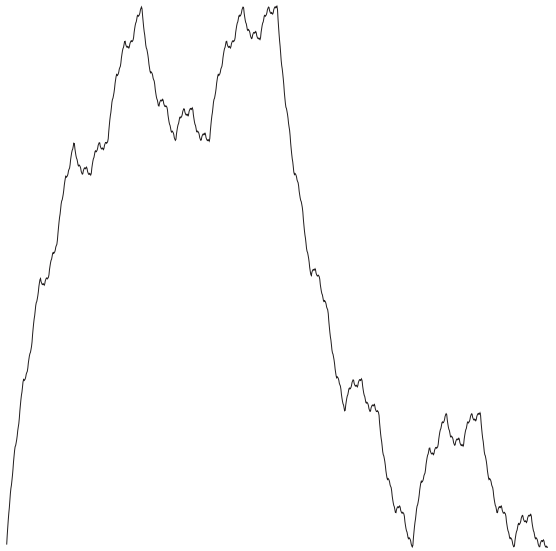
(Barnsley, 1988)

$$w_n(x,y) = (\tfrac{x+x_n}{2},\ \tfrac{y+y_n}{2}) \qquad n = 1,2,3$$

$$w_1(x,y) = (x/2,\ x + z \cdot y)$$

$$w_2(x,y) = (x/2 + 1/2,\ 1 - x - z \cdot y)$$

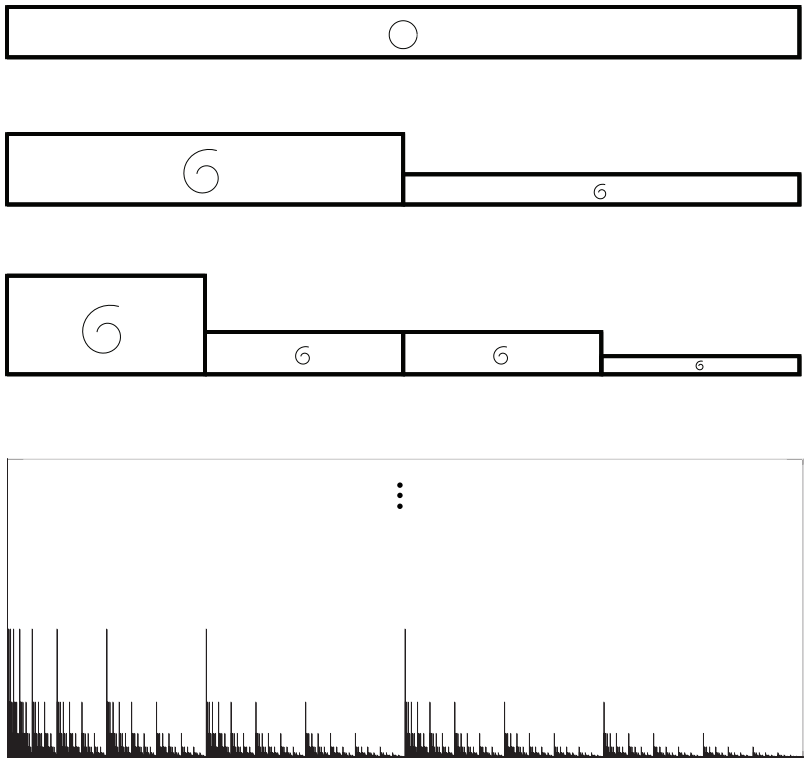




generalize to a mountain surface to study network evolution?

Fully developed turbulence

(Meneveau and Sreenivasan, 1987)



eddies $Re = v \cdot L/\nu \gg 1$

70% 30%

thorns **dust**

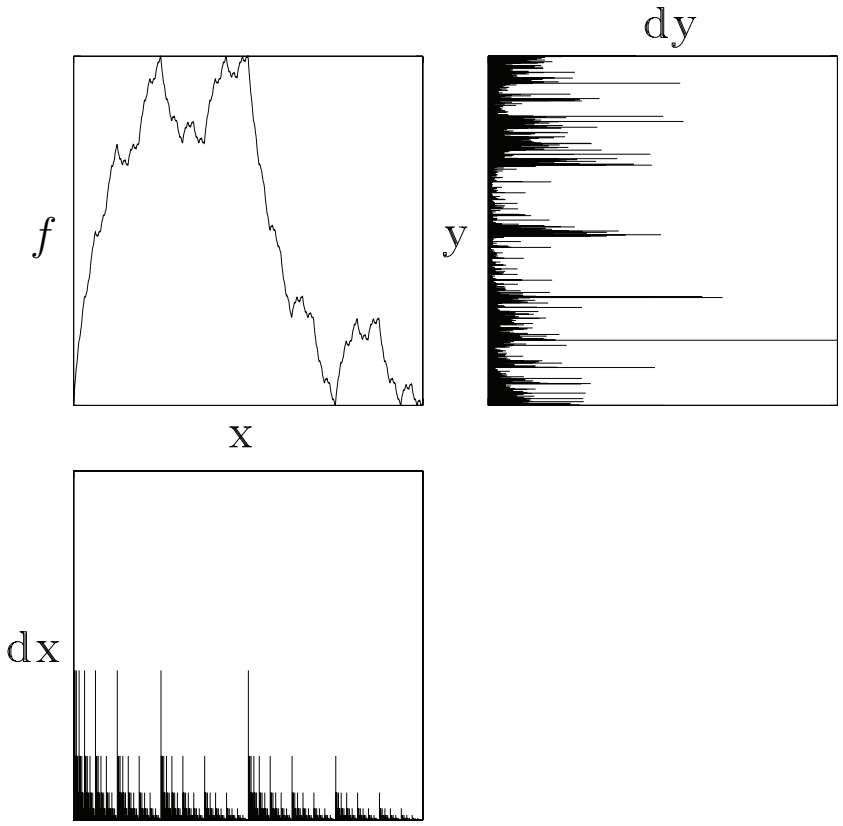
universal energy layers in one-dimensional turbulence

eventual **dissipation** in atmospheric, boundary layer, etc.

$w_1(x) = x/2$, $w_2(x) = x/2 + 1/2$ via biased coin give **multifractal**

A Platonic approach to complexity

(Puente, 1992, 1994)



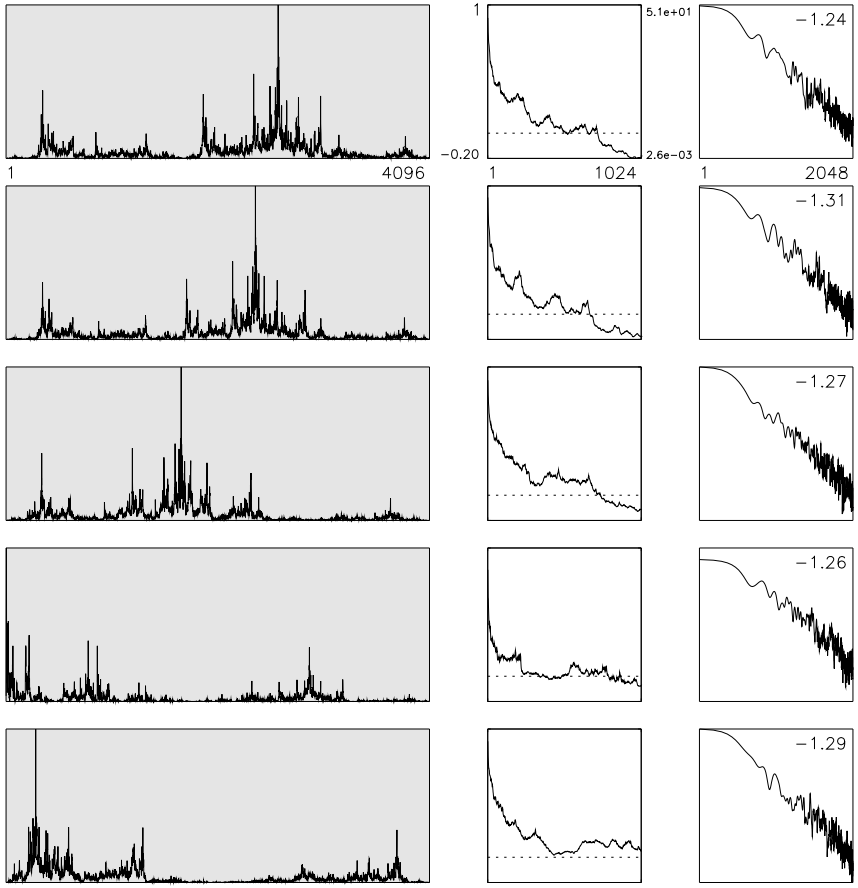
rainfall as a **transformation** of turbulence?

dy is **derived distribution** of dx via fractal function f

"shadow" dy appears **random** but is **deterministic**

A universe of projections

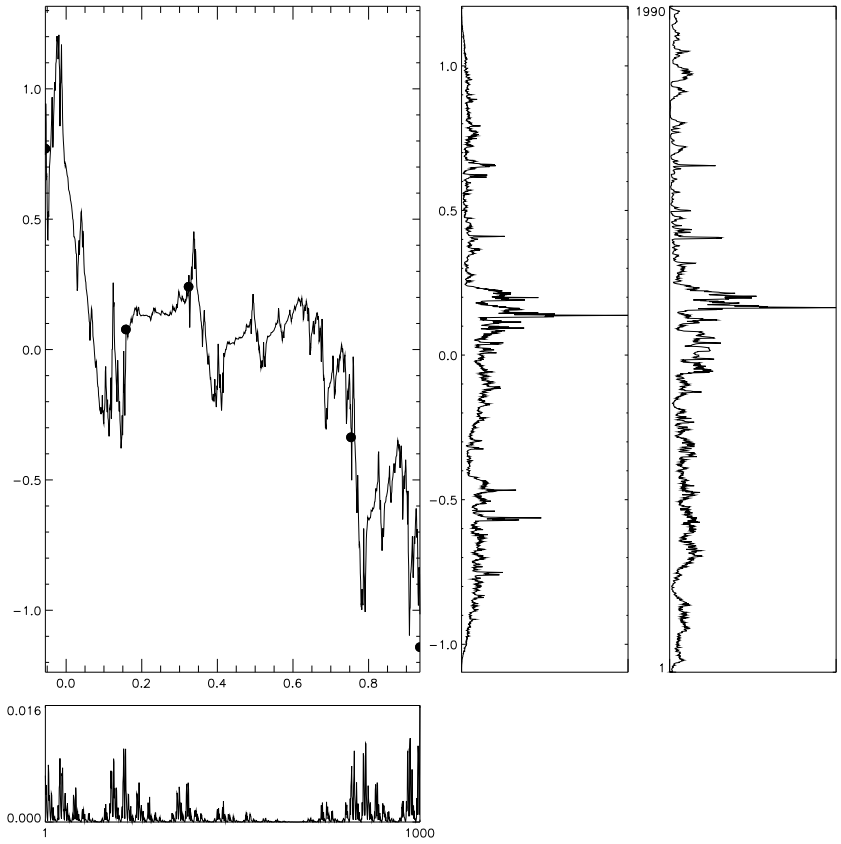
(Puente, 2004)



just varying **fractal** function and **multifractal** parameters sets have autocorrelations and spectra as in **natural data**

A detailed storm in Boston

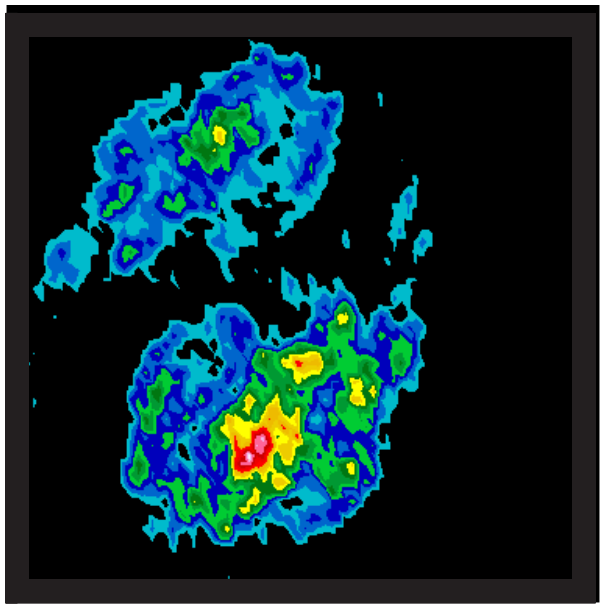
(Puente and Obregón, 1996)

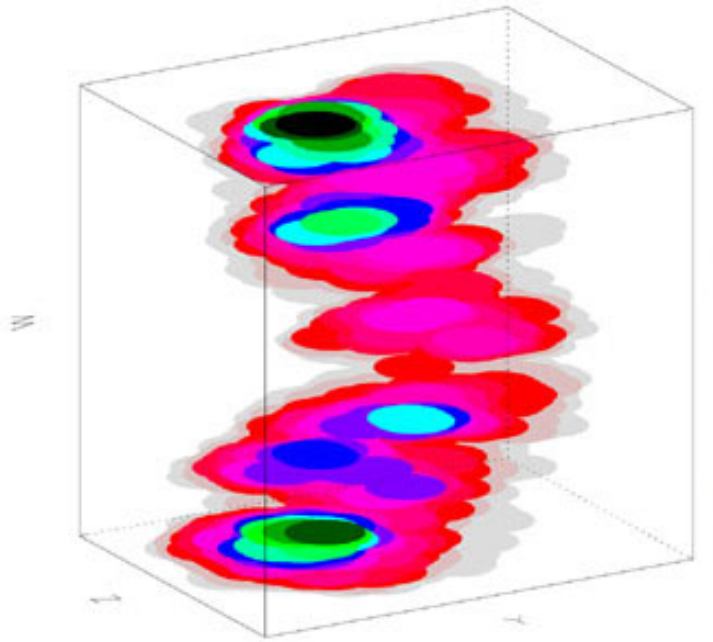


iterating four maps while fitting moments and multifractality model also preserves **spectra** and **chaotic nature** of data

Extensions to higher dimensions

(Puente, 1994)

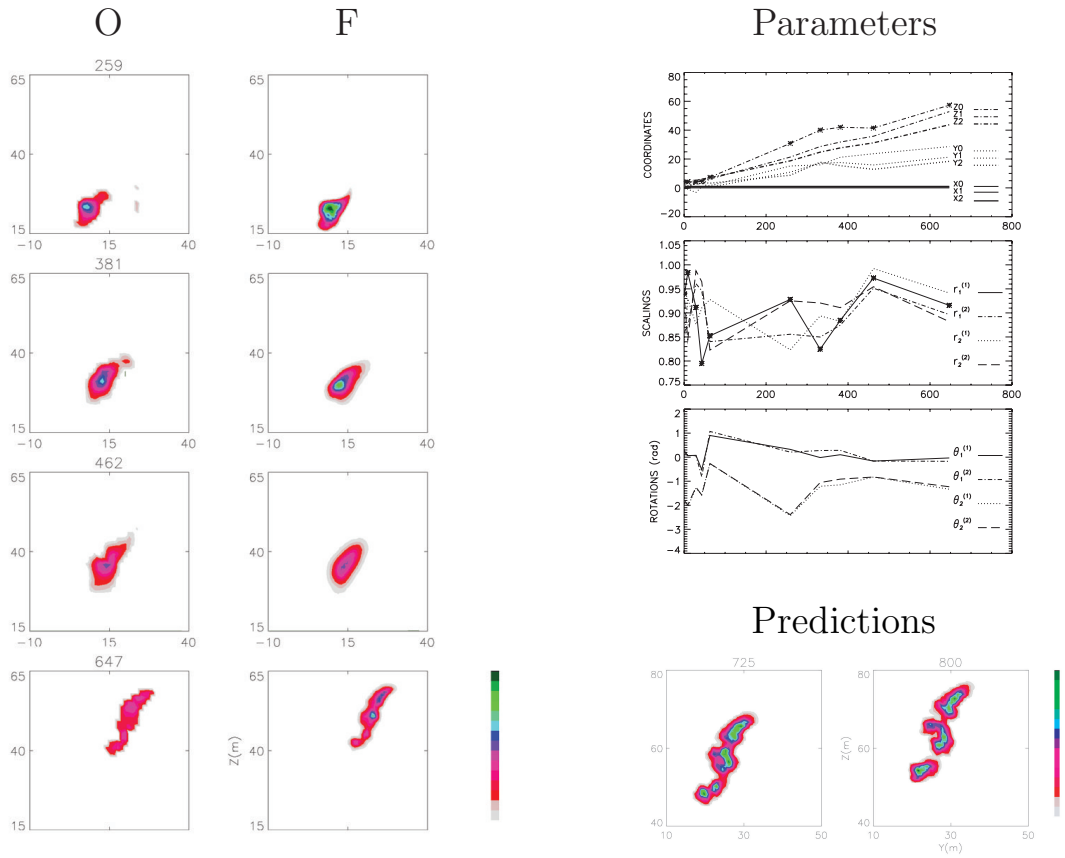




from similar simple **affine** maps defining functions in 3D and 4D
a multifractal illumination is transformed into "natural sets"
the underlying **complexity** is captured via few parameters

Pollution dynamics from geometry

(Puente et al., 2001a,b)

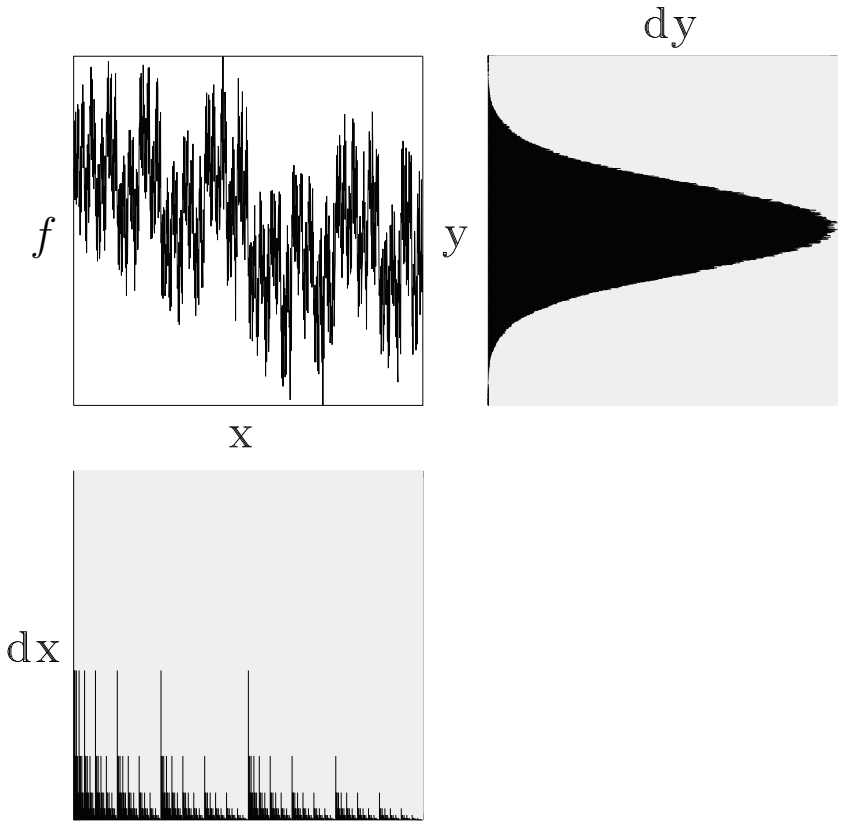


plume is tracked via successive fractal functions

trends allow computing reasonable **predictions**

The surprising space-filling limit

(Puente et al., 1996)



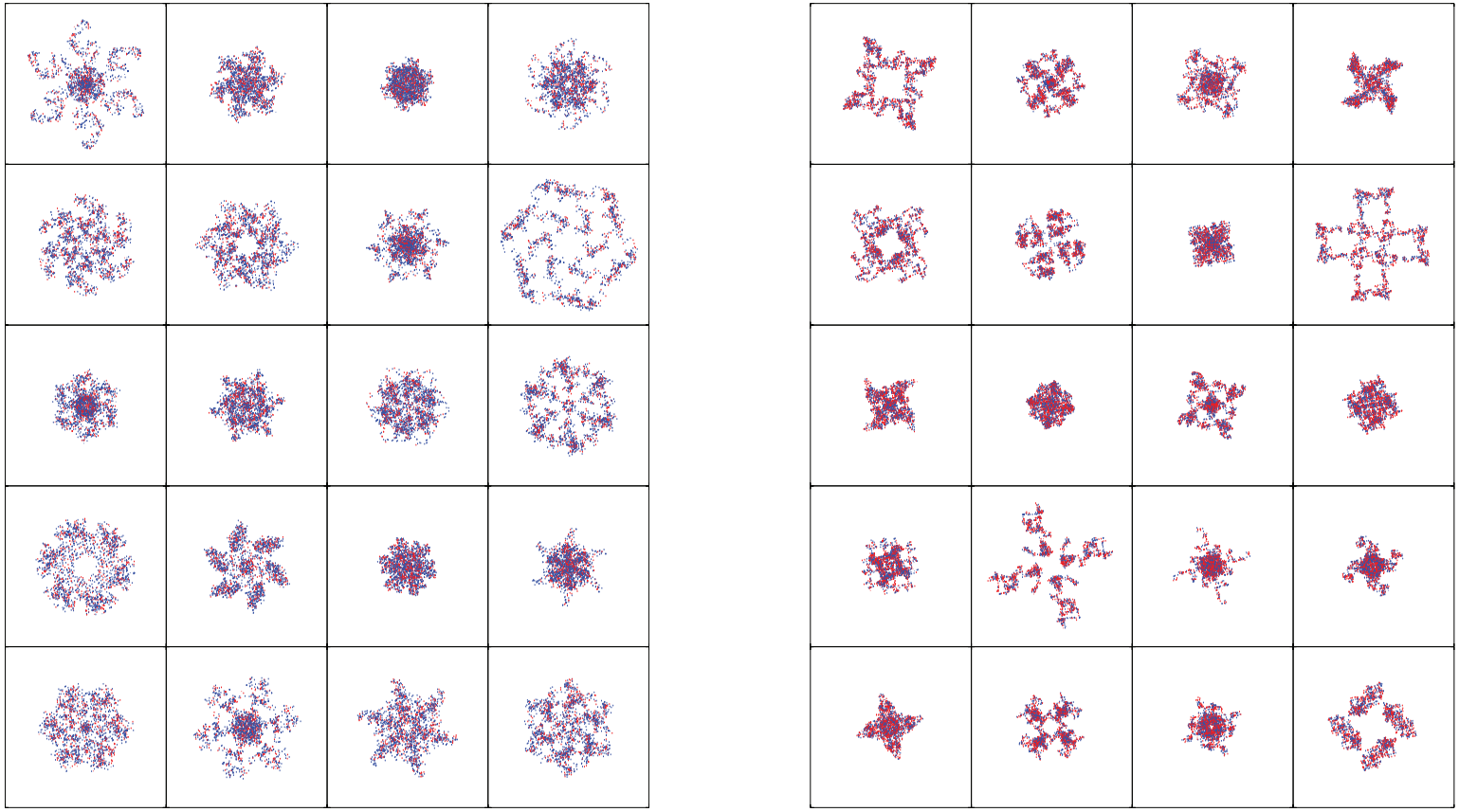
a transformation from **dissipation** to **conduction**

dy is **Gaussian** irrespective of non-discrete dx

the result extends to higher dimensions, e.g., bivariate bells

Exotic decompositions of the bivariate circular bell

(Puente, 2003)

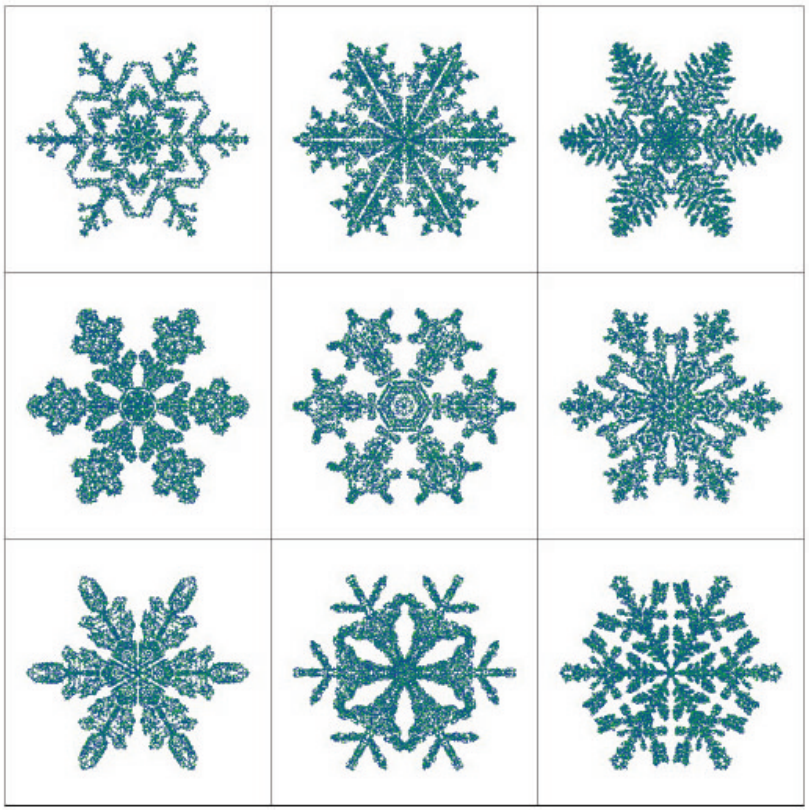


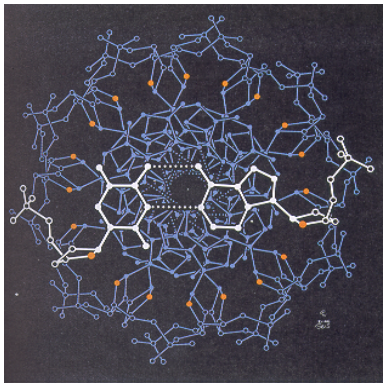
superposition of many lovely patterns give **perfect circles**

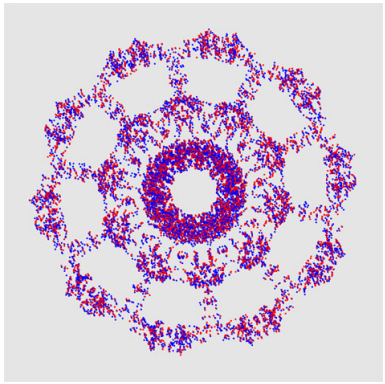
in the **space-filling** limit there is hidden **order** in **chance**

Relevant designs inside the bell

(Puente, 2003)





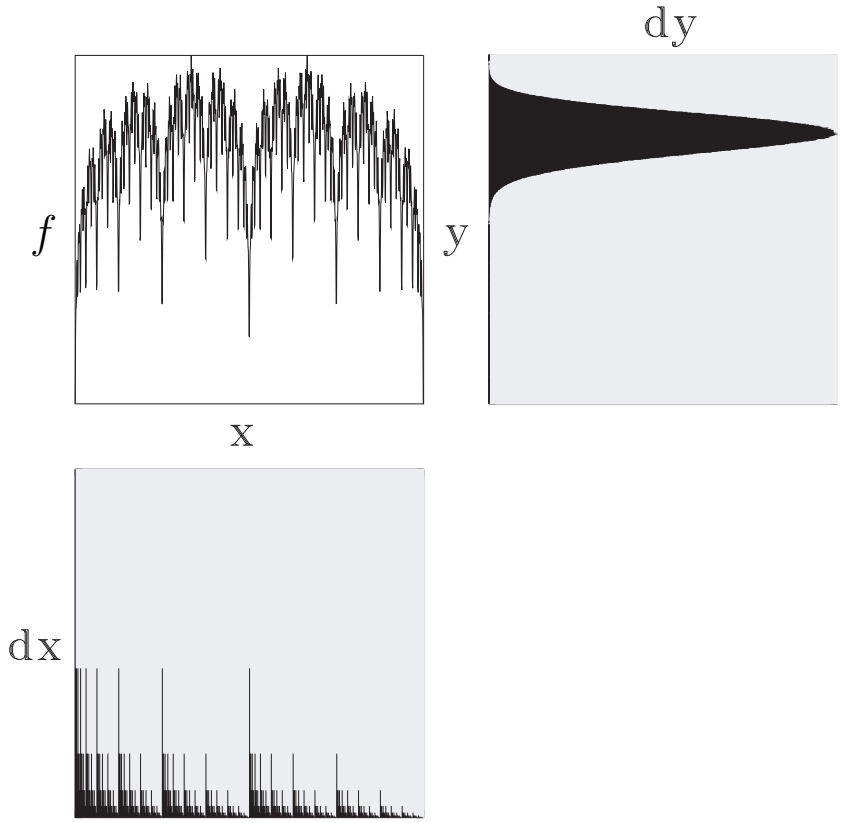


suitable iterations of simple maps yield arbitrary **ice crystals**

the rosette of **DNA** is coded via the binary expansion of π

A mystical bell centered at infinity

(Puente, 2006a)



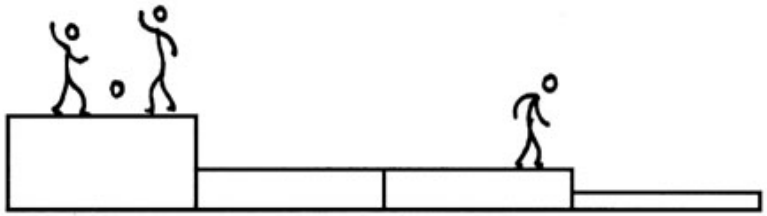
$$w_1(x,y) = (x/2,\ x + z \cdot y),\ w_2(x,y) = (x/2 + 1/2,\ 1 - x + z \cdot y),\ z \to 1$$

a mighty **positive** filter of any disorder, including mine

from **entropy** to **plenitude**, what a treat!

Lessons from cascades for our turbulent times

(Puente, 2006b,c)



competition

inequalities

cynicism

discrimination

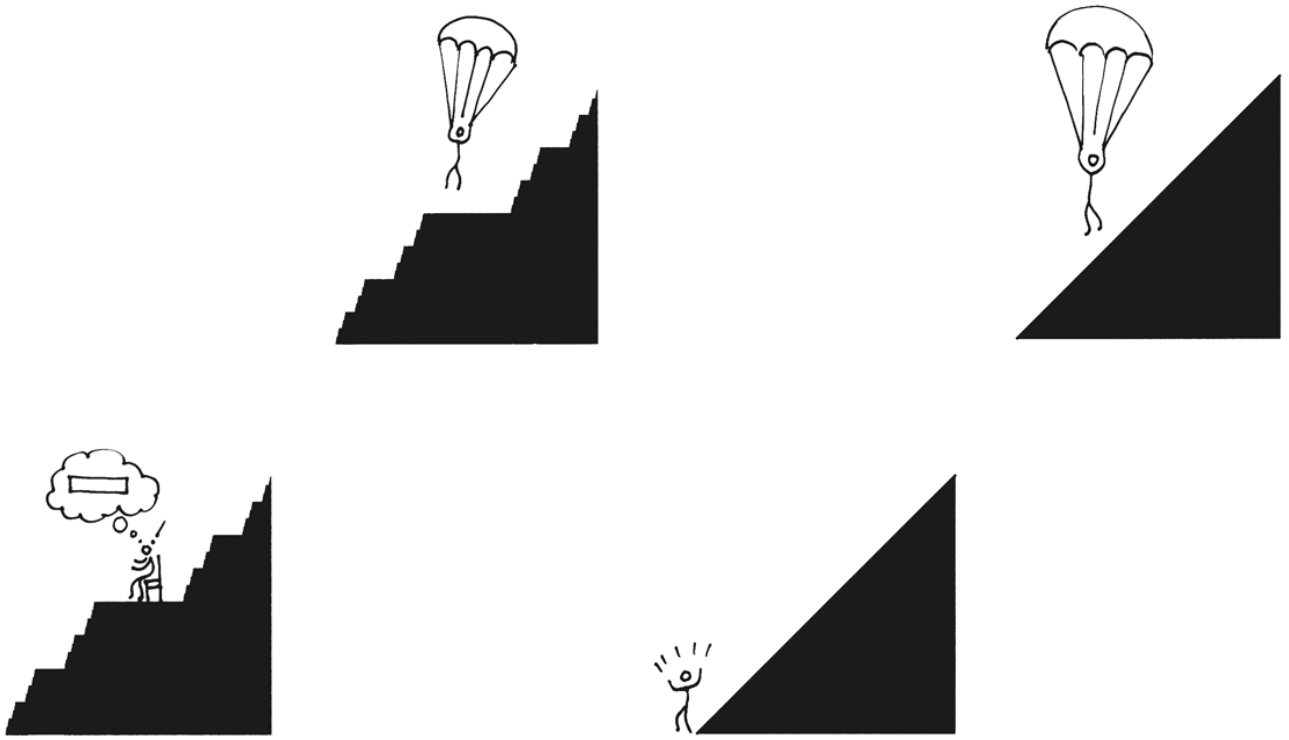
forced equality

distrust

oh collective **selfishness** in negative spirals, i.e., **2/3 = 0.666**...
2/3 in poverty today and 6,000 kids **die** a day for lack of **water**
violence and **terror** happen when **thorns** and **dust** grow
competitive cascade "nicely" fits wealth in the **USA**, oops!
... it is imperative to return to the all inclusive **uniform**

The crossroads of cumulative distributions

(Puente, 2006b,c, 2007)



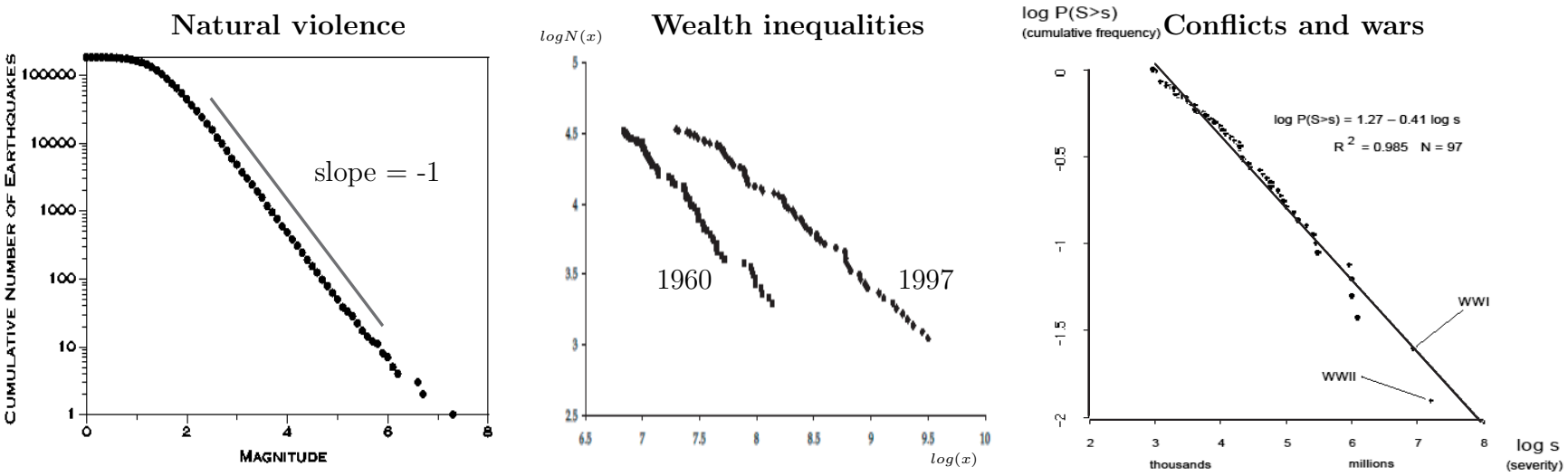
it is sad to miss the **origin** on a **devil's staircase**

it is best to find the **root** in the straight **hypotenuse**!

oh simple line of peace, i.e., $\mathbf{Y = X}$, oh equation $\mathbf{1 = 0.999...}$

The lack of power in power laws

(Puente, 2006a)



natural **complexity** organizes in **simple** log-log fits

man-made complexity also yields power-laws

could we learn from nature to achieve **peace**?

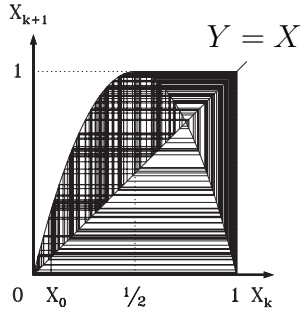
yes, avoid **criticality** and find true power in **powerlessness**

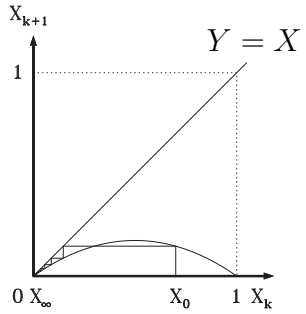
there is no **invisible hand** growing a sand pile but our own

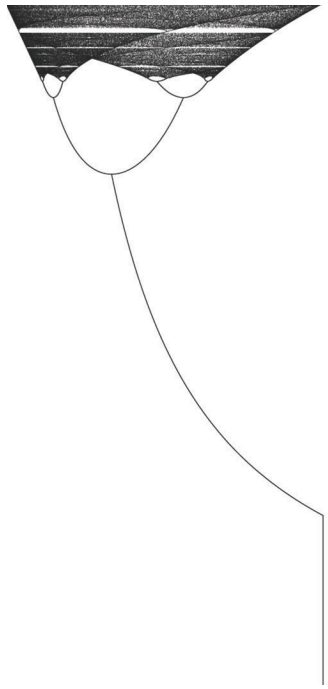
A scientific prophetic fig tree from chaos theory?

(Puente, 2006d, 2009)

$$X_{k+1} = \alpha X_k (1 - X_k)$$







a fruitless **feigenbaum** filled with **thorns** and **dust**
you may see tender branches and the sprouting of buds
only the **root**, by reaching the **origin**, is a worthy destination
hence the implied **logistics** is to remain below the **line**

¡TÓMALO SUAVE!

Tengo un amigo por aquí
líder muy sabio,
nombre de arcángel
que brilla, ay sí. (2)

Por agua nos conocemos
y el afán de ser muy buenos,
ponderamos el futuro
entre sueños y modelos.

Con razones insistimos
entre estiajes y desvelos,
y en encuentros no fortuitos
susurramos viejos truenos.

OH TAKE IT EASY!

I have a friend over here
very wise leader,
name of archangel
with brilliance, yes. (2)

We met due to water
and the urge to be very good,
we ponder the future
amongst dreams and models.

With reasons we do insist
between droughts and insomnia,
and in non fortuitous encounters
we wishper our old thunders.

Es toma y dame brillante
con esgrimas y boleros,
y entre risas consonantes
se entrelazan los sosiegos.

Convergemos, no lo dudo,
ahondamos los apegos,
y en despedida elegante
reaparecen los consejos.

Tómalo suave, eh eh,
tómalo suave,
vive despacio, tú ves,
esa es la clave,
tómalo suave, eh eh,
tómalo suave,
vive tranquilo, tú ves,
esa es la llave.

Is a brilliant give and take
mending fencing and boleros,
an in consonant laughter
our tranquility gets woven.

We converge, I have no doubt,
we deepen our closeness,
and in an elegant farewell
reappears good advice.

Oh take it easy, eh eh,
oh take it easy,
live slowly, you see,
that is the code,
oh take it easy, eh eh,
oh take it easy,
live in peace, you see,
that is the key.

¿Dime qué pasa señor?,
si se cortan las montañas
y se llenan todos los valles,
desaparecen las redes:
¿no se perfila el amor?

Ay te contesto yo así,
mira yo así no lo veo,
estás mezclando dos cosas,
mejor dejarlas solitas
para evitar confusión.

Tómalo suave, eh eh,
tómalo suave,
vive despacio, tú ves,
esa es la clave,
tómalo suave, eh eh,
tómalo suave,
vive tranquilo, tú ves,
esa es la llave.

Tell me what happens oh sir?,
if mountains are cut
and all valleys are filled,
all networks dissappear:
doesn't love shape up?

Oh I answer you like this,
look I do not see it like that,
you are mixing up two things,
better to leave them alone
to avoid any confusion.

Take it easy, eh eh,
oh take it easy,
live slowly, you see,
that is the code,
take it easy, eh eh,
oh take it easy,
live in peace, you see,
that is the key.

Ay te convido señor,
tú conoces árbol tierno
sin fruto y caos cierto,
oh escueta palabra antigua:
¿no es tiempo de reflexión?

Ay te repito yo no,
a π no lo veo en el cielo,
y para serte sincero
creo que pierdes el tiempo
arguyendo lo que no.

Tómalo suave, eh eh,
tómalo suave,
vive despacio, tú ves,
esa es la clave,
tómalo suave, eh eh,
tómalo suave,
vive tranquilo, tú ves,
esa es la llave.

Oh I invite you oh sir,
you know about a tender tree
fruitless and with certain chaos,
oh concise ancient word:
isn't it time for reflexion?

Oh I repeat I do not,
I do not see π in the sky,
and to be fully sincere
your are losing your time
arguing what is not.

Take it easy, eh eh,
oh take it easy,
live slowly, you see,
that is the code,
take it easy, eh eh,
oh take it easy,
live in peace, you see,
that is the key.

Shanti Setú, puente de paz...

Oye señor, ¿es o no es?
ay señor, el agua ayuda...

Mejor subir al cielo,
evapórate,
que precipitarte,
ay, no lo crees?

Oye señor, ¿es o no es?
ay señor, el agua ayuda...

Mejor seguir la línea,
ay de una vez,
que ir por un meandro,
óptimo no es.

Oye señor, ¿es o no es?
ay señor, el agua ayuda...

Shanti Setú, a bridge to peace...

Listen oh sir, is or is it not?
oh sir, water helps us...

Better to go up the sky,
evaporate yourself,
than to precipitate,
oh, don't you believe it?

Listen oh sir, is or is it not?
oh sir, water helps us...

Better to follow the line,
once and for all,
than to take a meander,
optimal it is not.

Listen oh sir, is or is it not?
oh sir, water helps us...

Mejor ya saturado,
de toda fe,
que fluir críticamente
sin todo poder.

Oye señor, ¿es o no es?
ay señor, el agua ayuda...

Mejor filtro inefable
y campana fiel,
que cascada demente,
bella no es.

Oye señor, ¿es o no es?
ay señor, el agua ayuda...

Mejor sin precipicio
e infierno aquel,
amor pagó el suplicio
y es quien es...

Better all saturated,
with plentiful faith,
than to flow critically
without all power.

Listen oh sir, is or is it not?
oh sir, water helps us...

Better ineffable filter
and truthful bell,
than insane cascade,
beautiful it is not.

Listen oh sir, is or is it not?
oh sir, water helps us...

Better without precipice
and hellish place,
love paid all anguish
and is who is...

Tómalo suave, eh eh,
tómalo suave,
vive despacio, tú ves,
esa es la clave,
tómalo suave, eh eh,
tómalo suave,
vive tranquilo, tú ves,
esa es la llave.

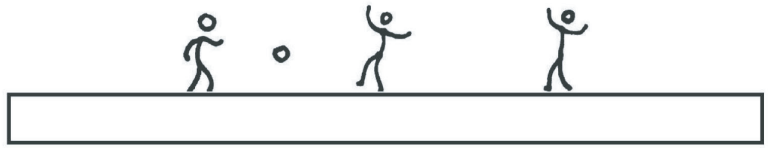
Seguiremos toma y dame,
con respeto y con sabor,
lo importante, Dios lo sabe,
es la vida y el buen humor.

¡Que viva el agua!
vamos pa'l agua... (4)

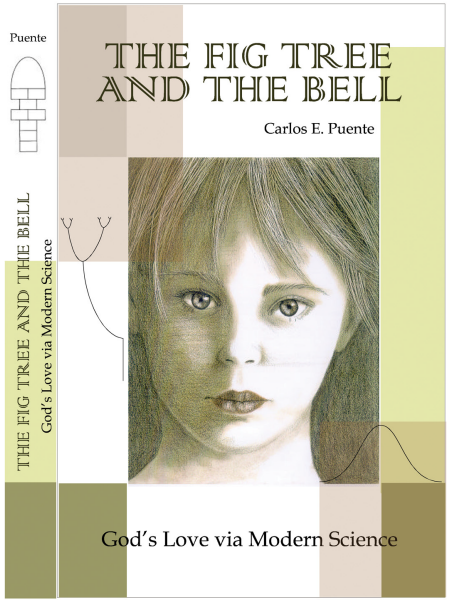
Oh take it easy, eh eh,
oh take it easy,
live slowly, you see,
that is the code,
oh take it easy, eh eh,
oh take it easy,
live in peace, you see,
that is the key.

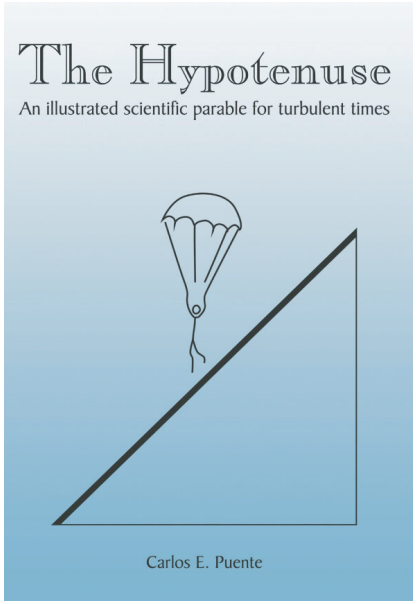
We'll continue give and take,
with respect and with good taste,
what matters, God knows it,
is life and good humor.

Long live water!
let's go to the water... (4)



More on http://puente.lawr.ucdavis.edu/





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