Let's talk about chaos

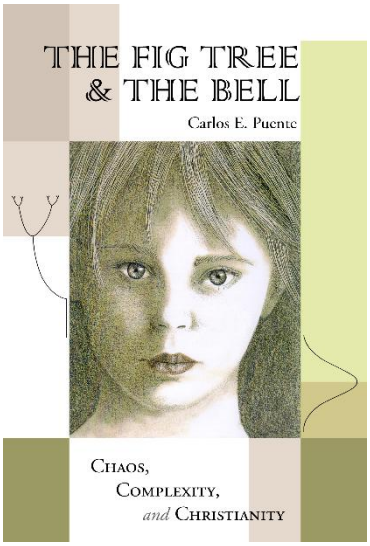
A translation of https://campanitasdefe.com/2019/02/16/hablemos-de-caos/

Summary. *This little bell explains in detail the astonishing* ***route to chaos*** *through* ***successive bifurcations*** *and outlines how such ideas, including a curious* ***fig tree from science****, are useful for describing the possible states of our lives: peaceful or not, now and in the hereafter. My a cappella rendition of an old version of the song "****Caos nunca más****" (****Chaos never more****)" can be heard* ***here****. This song, in Spanish, can also be heard and visualized in a YouTube video by the end of the text.*

The conference ***Learn an urgent lesson from a chaotic fig tree!****, in English, as I shared it at* ***Ateneo Pontificio Regina Apostolorum*** *in* ***Rome*** *in 2013, summarizes the theme of this little bell and also of the following ones:* ***here****,* ***here****,* ***here*** *and* ***here****. The YouTube video of this talk can be accessed* ***here*** *and at the end of the text.*

The blog ***Presentation*** *provides information about the purpose of these little bells and the blog* ***Organization*** *shows how the entries are grouped by categories. This entry belongs to the categories "****Calls to conversion****," "****Hell****" and* ***Chaos and its fig tree****."*

In this little bell, and in two subsequent ones, ***here*** and ***here***, is summarized what is found in the second chapter of my book ***The Fig Tree & The Bell***:



Sadly, the word **chaos** is increasingly used to describe what is happening in these modern times. Wherever one looks on our fragile planet, the implicit disorder and inherent randomness that we colloquially call "***chaos***" appears more frequently in various areas of life: there is ***chaos*** at the ***borders***, or it is said that there is; there is ***chaos*** in ***politics*** induced by deep-rooted ***corruption***; there is ***chaos*** in the ***economy*** reflected in ever-growing ***inequalities***; and there is ***chaos*** from the ***death*** of ***innocents skinned alive*** everywhere and more. Unfortunately, such ***chaos*** is so widespread that we hardly react to its presence, and only occasionally does it seem painful and repugnant to us, as when a notorious ***immoral scandal*** erupts that should not be.

There is a branch of modern knowledge that studies ***complexity*** and that can be used to understand the essence of ***disorder*** and the way we can combat it. This includes the famous ***chaos theory***, which is more than a traditional theory, as its results are fully verifiable. Knowing that this may be the most challenging little bell to date, I will attempt to explain next the ***science of chaos*** and its fascinating implications.

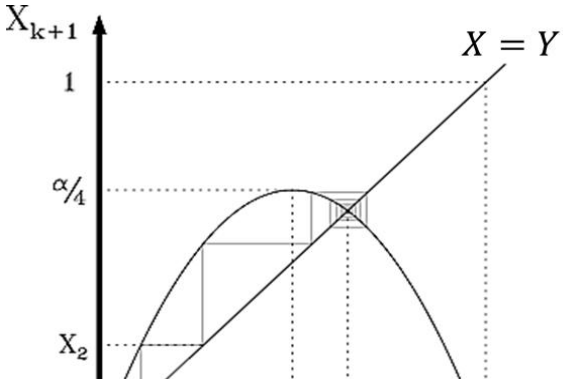
As will be seen in this and the next three blog entries, it is worth studying this topic with some attention as it leads to accurate and relevant teachings, both for ***everyday life*** and for ***eternal life***. In any case, recognizing that the matter is not trivial, I trust that the general description of the topic, along with its songs at the end, will help understand the essence of the matter.

The formula used — ***do not be discouraged, my dear reader, and keep on reading****!* — to introduce the concept of **chaos** is the so-called ***logistic map***:

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

where X is the ***size*** of a ***population*** (normalized between 0 and 1), let's say of "***rabbits***," k and $k + 1$ are successive ***generations***, and α is a ***parameter*** whose value is between 0 and 4.

The equation, ***quadratic*** when expanding its right side, describes what happens from one ***generation*** to the ***next*** and defines a ***symmetric parabola***:



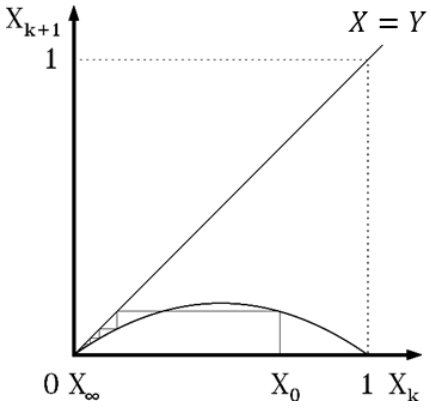
When $X_k = 0$, $X_{k+1} = 0$, of course, because ***rabbits*** do not come from nothing, and when $X_k = 1/2$, $X_{k+1} = \alpha/4$, gives the ***peak of the parabola***.

The shown graph, for a value of α equal to 2.8, exhibits the ***evolution*** of the ***rabbits*** starting the process with a small ***size*** of them X_0. As can be understood by reading the ***parabola*** successively — that is, following the ***vertical-horizontal lines*** shown towards the line ***X = Y*** at 45-degrees — the ***population*** first grows to X_1, then to X_2, and eventually ***converges***, painting a spiral that follows the clockwise direction, to the value X_∞ shown, which, as seen, corresponds to the ***non-zero intersection*** of the ***parabola*** with the ***straight line***.

The ***parabola*** well expresses a ***logistical*** organization of the ***population***, as it logically describes an increasing trend "***upwards***" when there are ***few rabbits*** and a decreasing trend "***downwards***" when there are ***many***. When the number of ***rabbits*** is at the maximum possible $X_k = 1$, the ***dynamics*** lead to a "pointed" ***parable*** — a subtle lesson using the other non-geometric meaning of the word ***parabola*** in ***Spanish*** — because it predicts the ***extinction*** of the ***rabbits*** in the next generation, $X_{k+1} = 0$, when they fight "***to death***" over scarce and insufficient resources.

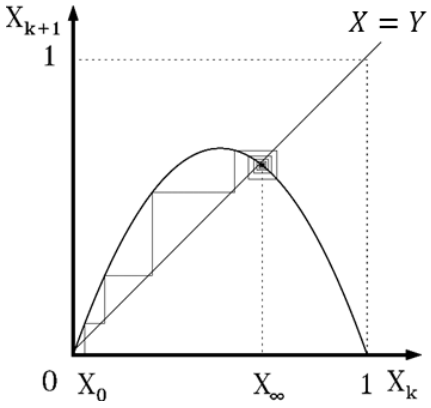
It happens that the final fate of a ***population***, X_∞, dramatically depends on the value of the ***parameter*** α in the ***logistic*** formula.

When the ***parabola*** is situated ***below*** the ***one-to-one line*** ($\alpha \leq 1$):



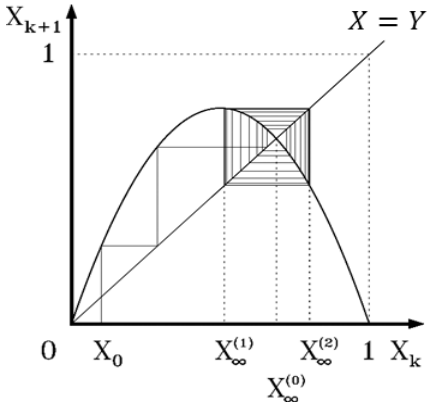
The ***vertical-horizontal lines*** obtained from an initial X_0 show how the ***population decreases*** until it fades away, $X_\infty = 0$. For these cases, there is a ***convergence***, or ***attraction*** towards ***the origin*** — the point (0,0) — and this is true regardless of where the process starts.

When $\alpha > 1$, the ***parabola crosses the threshold*** $X = Y$ and the ***population*** no longer ***converges to zero***; rather, it ***diverges*** from it, causing that ***the origin*** no longer ***attracts***, but instead ***repels***:

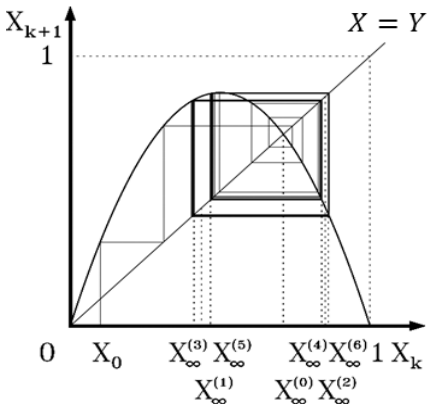


As observed, the ***slope*** of the ***parabola*** at ***the origin*** exceeds that of the ***threshold*** — meaning it is greater than ***one*** — and thus, for predominantly ***geometric*** reasons, a small value X_0 leads to values that no longer travel towards ***the origin*** as they did when the ***parabola*** was ***small*** but instead ***move away from zero*** and never return. When $1 < \alpha \leq 3$, the ***dynamics*** indeed ***converge*** to the ***non-zero intersection*** between the ***parabola*** and the ***straight line***, which, by equating the formulas, is $X_\infty = (\alpha - 1)/\alpha$.

When α increases beyond 3, the ***non-zero intersection*** undergoes the same fate as $X_\infty = 0$ did when ***crossing*** the ***threshold*** $\alpha = 1$, or when the ***parabola crossed*** the ***straight line***. The ***dynamics***, instead of ***converging*** to such a point, now ***repel***, and for $\alpha = 3.2$ (as shown), it ends up drawing, in a surprising way, a ***square*** that expresses that the ***number of rabbits oscillates*** and ultimately repeats every ***two generations***:



This repetitive behavior, also called ***periodic***, occurs again for purely ***geometric*** reasons, as the precise ***curvature*** of the ***parabola*** for such a value of α synchronize the two values shown with the line ***X = Y***. However, as happened before, such behavior ***repels*** when α is increased beyond another ***threshold***, because, for example, when α = 3.46, and in a remarkable way as if guided by a new ***geometry***, there appear now ***oscillations*** every ***four generations***:

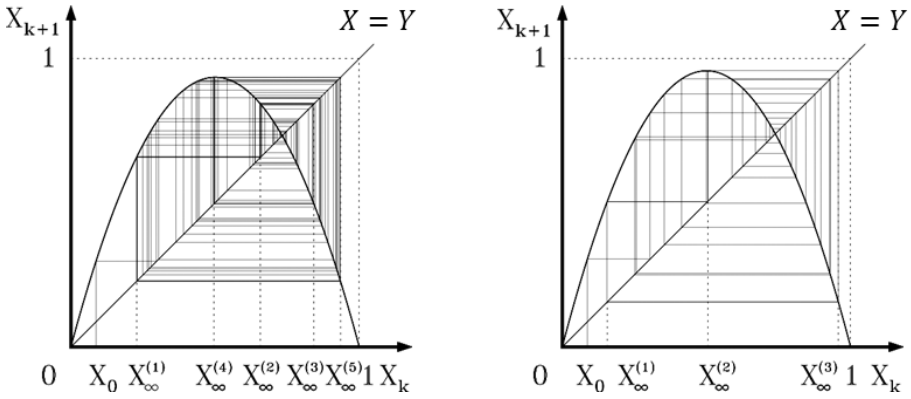


This happens as if by magic: starting the process with an X_0 close to the ***origin*** leads to ***vertical-horizontal lines*** that quickly travel towards the non-zero intersection of the ***line*** and the ***parabola***, but that point ***repels***, and the ***lines*** move towards the ***square*** from the previous example, but this also ***repels***, generating the pattern indicated by the eight dark lines that show everything repeats every ***four generations***. How ingenious these ***rabbits*** are!

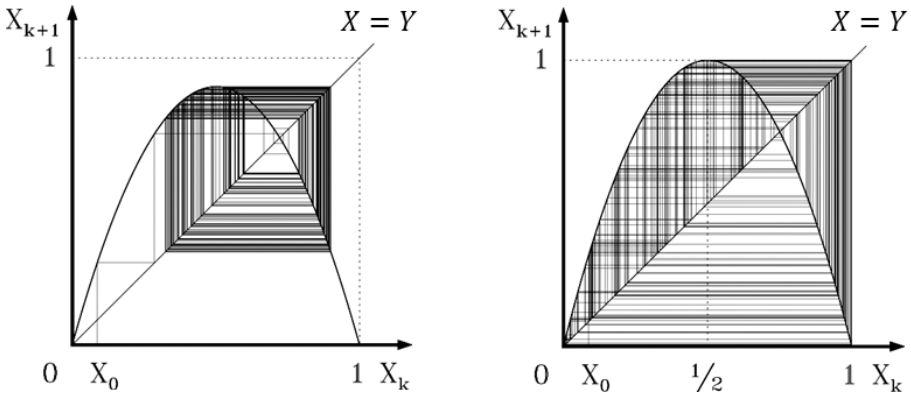
As α is increased to a value $\alpha_\infty \approx 3.5699$, a ***chain of bifurcations*** is established, that is, ***doubling*** the ***size*** of the ***population*** and ultimately encompassing ***all powers of two***. Notably, and as it was difficult to foresee analytically before the modern advent of computers, the ***logistic parabola*** defines an infinity of ***thresholds*** where the ***dynamics*** change behavior, transitioning from ***converging*** to ***diverging***, or from ***attracting*** to ***repelling***, and all of this occurs based on a ***simple equation*** by merely increasing its ***parameter*** α.

But there is more, as we have not yet reached the maximum value of α which is 4, since the ***peak of the parabola*** is $\alpha/4$. Beyond α_∞, the ***parabola*** continues to subtly forge its ***curvature***, leading to other unexpected and surprising results.

For example, sometimes the number of ***rabbits*** repeats ***periodically***, but no longer in ***powers of two***, as it occurs for values of α equal to 3.74 and 3.83 that give rise to repetitions every ***five*** and every ***three generations***:



But in other times, and more commonly, the ***population*** gives rise to ***dynamics*** that ***do not exhibit repetitive behaviors***, but rather outline ***infinite*** paths, as it happens for values of α equal to 3.6 and 4:



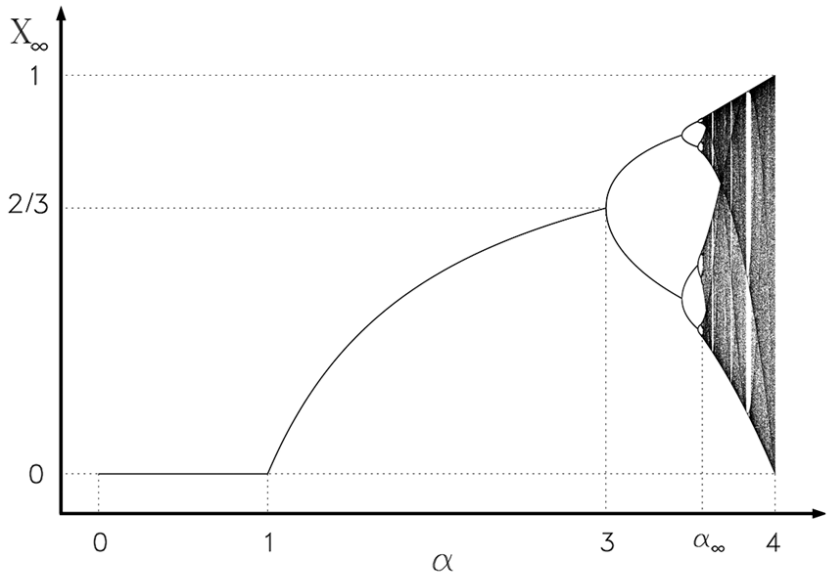
In an admirable way, when $\alpha > \alpha_\infty$ there are ***parameter*** values for which the ***rabbits*** end up ***repeating*** exactly every n ***generations***, for any natural number that ***is not a power of 2***. And, intertwined with this ***unlimited*** gamut of ***periodicities***, there are values of α for which the ***population*** becomes ***infinite*** and does not ***repeat***, but rather ***wanders forever*** in an endless dance in a set known as a ***strange attractor***. This subtle nomenclature reflects the "unusual" nature of finding a ***population*** that ***varies forever***, but this notation turns out to be not entirely accurate, for beyond α_∞ these "***strange***" sets are the most common.

The ***infinite attractors***, due to their infallible change, define the ***scientific concept*** of **chaos**: a delicate pilgrimage ***without repetition*** that does not depend on chance but rather on the

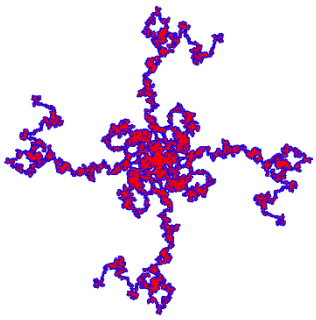
particular ***geometric*** shape of the ***parabola***, that is, its ***curvature***. Such notation turns out to be also coherent, for when such ***disorder*** settles, two ***populations*** arbitrarily close to each other, when propagated, ***diverge*** from one another rapidly. This is the famous "***butterfly effect***," the fact that a small error — tiny as the flutter of a butterfly — prevents us from knowing the exact evolution of a ***chaotic population***, as the only way to achieve this would require measuring and calculating with infinite precision.

As can be observed above for the value of α equal to 3.6 and also for α equal to 4, the ***chaotic dynamics***, while ***infinite***, ***do not encompass*** all possible ***values in an interval*** (nor two intervals as in the first case), but rather contain ***holes*** — as a cake with many layers — through which the ***attractor*** does not pass. This "***hollow***" structure occurs for any ***strange attractor***, and thus the inherent ***fragmentation*** of the process, beyond the ***infinite bifurcations***, can be qualified by saying that **chaos** occurs over a set lacking cohesion — composed of points that do not touch — which therefore has the structure of **dust**, as also found in a ***previous*** little bell, in relation to ***turbulence in the air***.

The graph showing what the ***logistic map*** produces, that is X_∞, as a function of the ***parameter*** α:

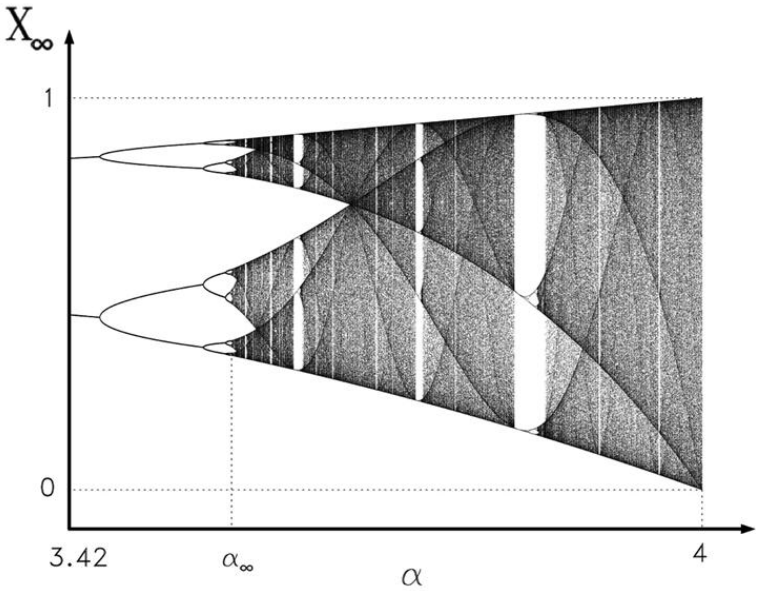


is known as the ***bifurcations diagram***, or rotated ninety degrees counterclockwise, as the ***Feigenbaum tree***, in honor of the physicist **Mitchell Feigenbaum**, who showed that there is a precise order in the transition from **order** to **chaos**, that is, in the way ***bifurcations*** occur from left to right ...



... As observed after a pause with a bow inside the ***circular Gaussian bell***, the ***tree*** has a ***straight root*** that corresponds to the ***extinction*** of the ***rabbits***, $X_\infty = 0$, and contains for α from 1 to 3 a "***tender branch***" which represents the ***convergence*** of the ***population*** to a ***single value*** at the ***non-zero intersection*** of the ***straight line X = Y*** and the ***parabola***. From the value of 3 onward, the sequence of ***bifurcations*** emerges, creating increasingly smaller ***branches*** that encompass ***all powers of two*** at $\alpha_\infty \approx 3.5699$.

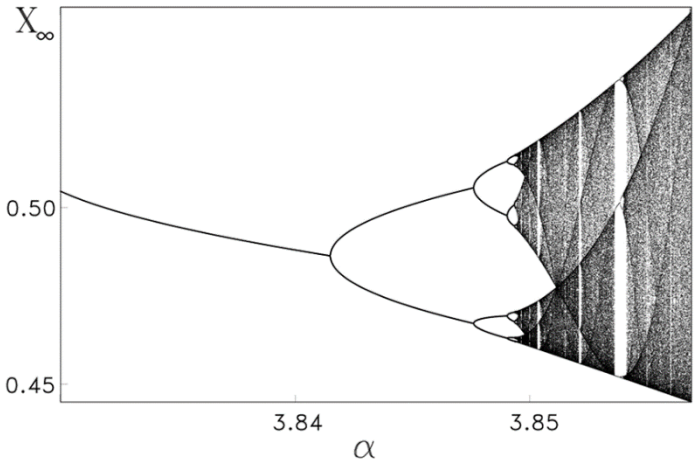
As can be appreciated much better in the magnified tail of the diagram:



the ***tree*** contains many additional ***periodic branches*** and intertwined with them, multiple ***chaotic strange attractors***, whose ***infinite*** values — drawn vertically as far as the resolution of the drawing allows — represent the ***dusty foliage*** of the ***tree***.

As observed, the ***tail of the diagram*** contains vertical ***white bands*** that correspond to all the ***periods*** that are not ***bifurcations***, and the most prominent ones are, from left to right, those related to ***repetitions*** every ***six***, ***five***, and ***three generations***. As can be appreciated, perhaps straining the eyes a bit, within these ***stripes*** there are ***protuberances***, such as in the widest ***band*** of ***period 3***, which contains ***three*** visible "***buds***."

Zooming in on the ***middle bud*** reveals something remarkable:

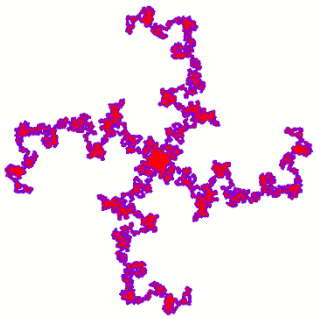


for within it lies a ***reduced copy*** of the same ***tree*** — though without the ***straight root*** — which, as seen, also ***sprouts chaotic*** and ***periodic*** behaviors, the former defined by separate points forming many ***dusts*** and the latter reflected in more ***white bands*** and more ***buds***.

Remarkably and perhaps incredibly if you can't see it to believe it, in each of the ***infinite white bands*** corresponding to ***periodic*** repetitions in the ***tail of the diagram***, there are indeed, ***universally***, ***buds***, ***reduced copies ad infinitum*** of the ***branches*** and ***dust leaves*** of the ***tree***.

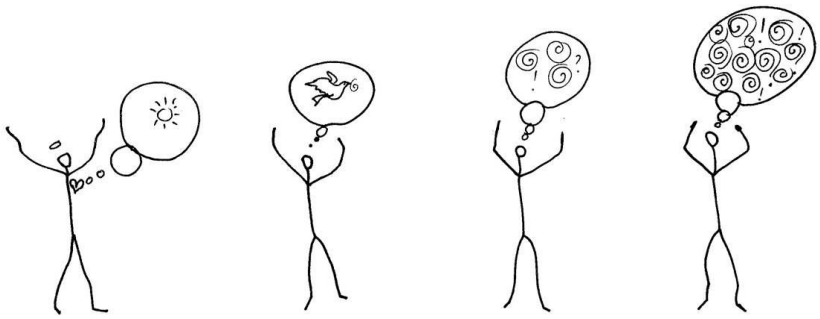
Although there are other possible paths that lead to ***infinite sets without repetition***, that is, to ***strange attractors***, the ***Feigenbaum tree*** — ***the fig tree*** in German — provides the most spectacular route towards ***disorder*** and is the most famous icon of ***chaos theory***. What an incredible story of the innocent little ***rabbits*** whose ***populations*** behave in such unexpected ways! Who would have believed that their ***dynamics*** would encompass ***repetitions*** according to ***all natural numbers*** and also occur according to a ***non-repeatable and strange disorder***!

Although this is now considered "***classic***" and even "***trivial***" in certain circles since it was discovered in the 1970s, I cannot help but marvel at the splendid ***infinite*** spectacle in the ***chaotic fig tree***. The dismemberment of the object is, without a doubt, impressive, and as it becomes ***dusty***, crossing and re-crossing ***thresholds***, its ***dynamics*** seem to be guided by a ***deceptive and divisive cross***, one therefore filled with confusion: ...



... If we ponder the truly admirable results of ***chaos theory***, the vibrant ***fragmentation*** there suggests that it is reasonable to employ such notions — the ***logistic equation*** and its ***parabola***, the chain of ***bifurcations***, the ***chaotic fig tree***, the general ***repetitions***, and ***dust*** — to think about how we, when not careful, often end up in the distressing confusion of ***chaos***. For even if healthy brains exhibit more ***chaotic*** traits than ***repetitive*** ones, the ***parameter*** α turns out to be a good indicator of the way we live, as it reflects our ***inner peace*** or lack thereof in ***distress***, and also our propensity to live in ***harmony*** or our inclination to create ***conflict***.

With due imagination, of course, and understanding that the matter relates to ***us*** and not to the ***beautiful little rabbits***, we can see that the ideas represent an appropriate and impartial framework for contemplating our behaviors, for in a precise way — even if it occurs figuratively as if it were merely a ***parable*** or ***lesson*** — we all have experienced diverse states in our lives that are well reflected in the different locations of the ***Feigenbaum tree***, as follows:



From left to right, either a ***gentle*** or ***humble*** state defined by the proverb of "***not crossing the line***" to remain in the ***essence*** of the ***origin***; another state that is ***proud*** and ***selfish***,

reflecting the ***absence of peace*** in ***fixed*** and ***stubborn*** actions that distance us from the ***truth*** of the **origin** by relying solely on our ***understanding***; a ***confused*** or ***indecisive*** state ***lacking peace*** that arises from ***repeated doubts*** in our misguided attempts that cross various ***thresholds***; or a state of great ***discontent*** or ***anguish***, often accompanied by the ***chaotic violence of disorder***, where, by crossing ***numerous thresholds***, our excessive problems condemn us to ***wander*** in a ***strange*** manner, "***biting the dust***."

In this spirit, the different states in the ***Feigenbaum tree*** can be used to visualize our essential dilemmas in choosing, never by force and always enjoying ***free will***, whether a path toward ***true peace*** or another ***lacking true unity***. This is the case because the ***logistic map*** can be used — from time to time — to represent, in the product of X and its complement $(1 - X)$, the ever-present ***stresses*** and ***tensions*** that we all experience, and also to clairvoyantly describe what happens when we choose to ***minimize*** such effects, that is, when we select values of α ***less than or equal*** to **one**, rather than the opposite.

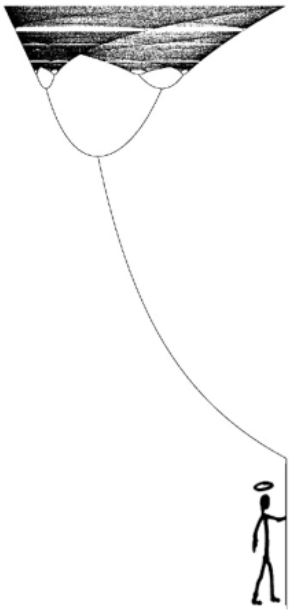
As expressed in a ***previous*** little bell related to the also divisive ***turbulence***, in the ***logistic*** chart of the ***Feigenbaum tree*** we can visualize our fundamental options toward ***order*** or ***disorder***, as recalled, for example, by our "***slopes at the origin***" being "***mild***" or "***steep***;" our choices of the ***simple*** or the ***complex***, remaining ***below*** the **one-to-one line** or ***not***; and our ***attractive*** states of ***serenity*** and ***peace*** or of ***rebellion***, ***chaos***, and ***turbulence***.

Choosing **chaos** or **not** is certainly relevant, as the discussion reiterates that there is ***one and only one*** way to achieve ***true peace***, which corresponds to ***converging*** to the ***origin***, ***remaining*** at the ***straight root*** of the ***tree*** where there is no ***division*** whatsoever. For, while it is often tragic for some to lose their ***rabbits*** — or their ***wealth*** — it is even sadder to ***climb*** the ***Feigenbaum tree***, that is, to ***ascend*** the ***fig tree***, as this distances us from the ***peaceful*** essence and rather leads us to states filled with ***fragmentation*** and ***unease***, as is eminently the case in ***chaotic states***, where ***wandering forever*** without being able to return ***home*** (to the ***origin***) represents a truly ***deplorable*** condition that we should not wish upon anyone. Does this remind you of anything?

As the ***relentless*** nature of ***chaos*** and its subtle ***butterfly effect*** infiltrate our lives when we ***climb*** the ***tree***, the ideas remind us that we must indeed choose between ***decreasing*** and ***increasing***, that is, between deciding to be ***humble*** in our actions or ***not***, as reflected in ***attenuating*** ($\alpha \leq 1$) or ***magnifying*** ($\alpha > 1$) our responses to the ***problems*** we face. As these notions point toward the symbolic ***root*** and the very ***Origin*** reached by **the hypotenuse**, now a clear ***narrow gate*** for those who "***pay attention***" by choosing a ***parabola below the line***, such a condition is associated with doing what **God** commands, which can only be

achieved ***below X = Y***, and not ***above***, tempted by the last point of the ***tender branch*** of the ***tree*** when α equals 3, that is, $X_\infty = 2/3 = 0.666\ldots$, where our true ***common enemy*** is vividly reflected, the very **devil** mirrored in the ***eddies*** of ***turbulence***.

This reflection exposes our options of ***deviations toward chaos*** or **not** and calls us to a condition of faithful ***abandonment*** or ***conversion***, that is, to the **zero** of ***holiness*** and ***obedience***:



coming down the ***tree***, instead of remaining in ***selfishness*** and ***stubbornness***, which carry ***blessings*** and ***life*** instead of ***curses*** and ***death***, as reflected in a ***biblical*** manner in the concept of ***dust***.

Truly, the ***chaotic dynamics*** are really sad, for traveling ***forever*** in the ***dust*** represents a terrifying and definitive ***exile*** from the **origin**, akin to the ***horrendous***, ***ancient*** and ***real hell*** that we will discuss a bit more in the ***next*** little bell.

To conclude, here comes a song that emerged as a response for a good friend, and also my dear professor, who once told me "he did not understand ***chaos***." Curiously, this composition came about in an airport, amidst the "***chaotic***" wait that ensued due to the further delay of an already overdue flight.

CHAOS NEVER MORE

Bridge of Peace, reviewing...

Don't tell me no

that you don't get it
oh no say no,
don't tell me no
chaos afflicts us
with ample pain.

It all begins like this
with a subtle attraction,
a foreign fruit you see
it seems pure honey,
the ego says: “oh yes!”
you cross your own level,
you bite the dust and is
oh chaos in quantity.

It's so common, oh yes,
the devil and his nuance,
destroys friendship
denying the root,
the ego says: “so what?”
brave and powerless,
you move away surely
it's chaos of anxiety.

Don't tell me no
that you don't get it
oh no say no,
don't tell me no
chaos afflicts us
with ample pain.

It's always sad indeed,
oh the fatal dynamics,
a very tiny error
grows fast not by chance,
the ego says: “oh no!”
I can do it without Him,

you act like a fool and
it's chaos oh in truth.

It's something so puerile,
unfortunate the decision,
a divisive cascade,
hey, aggravates confusion,
the ego, oh doesn't see
with neither fruit nor season,
you go up the fig tree
it's chaos with no good.

You know it’s true
oh, you understand well
oh yes, it’s true,
you know it’s true:
chaos loses
to love.

The just payment, oh yes,
oh colossal banishment,
the logistic confirms it
in the threshold liberty,
the ego, faithful at last,
learns his own mission,
you accept the good fire
and chaos goes away.

The change now for good
a radical conversion,
no more the six I tell you
zero and nine to arrive,
the ego in its feast
oh proclaims humility,
you draw near the Origin
and chaos is not there.

It all ends like this
with a gentle attitude,
the verb snatches you
doesn't let you lie no more,
the ego beautiful in peace
incarnates its brotherhood,
you walk by His hand
there's no chaos never more.

Chaos loses
to love.

Essential love
radical solution.

Chaos loses
to love.

Oh, listen with the just one
the ego finds its peace.

Chaos loses
to love.

Oh, I tell you, my friend,
the mess is infernal.

Chaos loses
to love.

In the Risen One,
there is no chaos never more.

Chaos loses
to love.

(May 2007 / January 2019 / April 2023 / November 2024)

The song in Spanish, arranged by ***Lázaro Alemán López*** and interpreted by ***Leonel Mederos Bravo***, one that I do not always fulfil, may be heard and visualized ***here***...

The video of my conference **Learn an urgent lesson from a chaotic fig tree!**, in English, which summarizes the theme of this little bell and also the one on the following entries: **here**, **here**, **here** and **here**, may be heard **here**.