# Part I

# 1: CHAOS

##### **Everything begins and ends in chaos.**

##### **Synopsis:** In the fundamental trinity of reality, that of chaos, energy, and order, chaos comes first. By definition, it exists before any *thing* exists. It is the engine of creation and annihilation and the always-present foundation of all existence. Chaos exists across a spectrum that stretches between the 0 of nothingness and the ∞ of somethingness. This is the 1st duality of creation from which all that ever was, is, or will emerge.

In the fundamental triad of reality - chaos, energy, and order - chaos comes first. It exists by definition before any objects or things exist. Chaos is the driving force behind creation and destruction and is always present as the foundation of all existence. It exists along a spectrum that ranges from the 0 of nothingness to the infinity of somethingness. This is the first duality of creation from which everything that has ever existed, exists, or will exist emerges."

##### **Keywords:** chaos, randomness, pattern, duality, creation, zero, infinity

The Oxford English Dictionary gives three definitions of the word *chaos*:

* The formless matter supposed to have existed before the creation of the Universe.
* The formless and disordered state of matter before the creation of the cosmos.
* A state of extreme confusion and disorder.

I am not sure what the difference is between the first two definitions. Regardless, we’ll skip over the apparent contradiction of “formless matter” existing before creation… for now.

Some colloquial, older definitions of chaos describe it as matter before there was any energy, but as we now know that matter itself is nothing but energy, that description no longer applies.

There is also the Ancient Greek mythological definition of the word χάος, *Khaos*, referring to the void state preceding the creation of the Universe or cosmos and personified in the Greek creation myths as the god who was “*the first created being, from which came the primeval deities Gaia, Tartarus, Erebus, and Nyx.”*

In physics, chaos is defined as “*The property of a complex system whose behavior is so unpredictable as to appear random, owing to great sensitivity to small changes in conditions*”, a. k. a. *The Butterfly Effect*, but as science writer James Gleick points out:[[1]](#footnote-23)

No one [of the chaos scientists he interviewed] could quite agree on [a definition of] the word itself, and so instead gives descriptions from a number of practitioners in the field. Those scientists that do have a definition are hardly in agreement, as Philip Holmes defined “chaotic” as “The complicated aperiodic attracting orbits of certain, usually low-dimensional dynamical systems.”

… while Chinese theoretical physicist Bai-Lin Hao describes chaos as “a kind of order without periodicity”.

Another term for *chaos* comes from cosmology, and that is the *primal void.*

Modern cosmology’s Big Bang theory is quite compatible with this idea that before there was anything, there was nothing but a primal void, a term often used by cosmologists. The primal void is a descriptive synonym for at least one state of chaos.

The primal void has also been called the *gap between heaven and Earth*, the *abyss*, *absolute-limitless nothing*, *ex nihilo*, *primordial waters*, and several other terms, all trying to convey the idea of an immeasurable nothingness, a concept that may well be impossible for the mind to grasp. This nothingness also includes (rather, excludes) the concept of time, as there can be no time in a void of nothingness, at least according to Stephen Hawking.[[2]](#footnote-24)

Everyone from scientists to mystics seems to agree on the rather obvious premise that before there was something, there was nothing, and then, presto, somethingness appeared in the nothingness. What that somethingness was is still unsettled. It could have been some form of singularity that may or may not have spontaneously appeared and expanded to create the Universe or some form of energy intense enough to warp space to the point where it became mass or even some type of multidimensional projection. In all these theories, and all beliefs and speculations, there is the understanding that before there was something, there was nothing.

## Nothingness

How “big” was this nothingness? Is there a limit to nothingness? If there is, how is that defined? If there is no limit, then is nothingness infinite? These may sound like silly questions, but they are actively being researched and debated in the worlds of science, philosophy, and mathematics[[3]](#footnote-27).

First, we must be clear about what we mean by *nothing* because conceptually, there are numerous types of nothingness (and many types of ∞ as well, possibly infinite).

According to various authorities, there are multiple levels of nothing, but a good overall understanding is provided by physicist *Sabine Hossenfelder*[[4]](#footnote-29), who describes up to 9 levels of nothing. Below, we list these 9 levels, their 3 general categories, and the 2 basics concepts of relative and absolute nothingness that we will use in this book.

What level would “I have nothing in my bank account” be categorized? Having a measurable balance of 0 puts your absolutely empty bank account in Level 6, and being a measure of the non-physical entity of credit puts it in level 7. Although being flat broke may feel like absolute nothingness, finances are a value that is derived from material things and is the transference of energy between things (people, businesses, etc.), and could even be considered a “field”, making your poverty a relative form of nothingness.

*Relative nothingness* is contextual. *Absolute nothingness* has no context because nothing exists to give it context, so there is nothing that can be said about absolute nothingness. Even calling it *absolute nothingness* is limiting, as the concept of *absolute* implies “*to the largest degree possible*”, which implies size, measure, and time, none of which exist in *absolute nothingness*, and just adding words like *super-duper-ultra-unlimited* doesn’t fix this. Perhaps the only thing that can be said about true nothingness is that there is nothing we can say about it. In this way, primal, true, or absolute nothingness is synonymous with the *Tao* as described by Lao Tzu when he said:

The Tao that can be described   
is not the eternal Tao.

The name that can be spoken is not the eternal Name.   
The nameless is the boundary of Heaven and Earth.

The named is the mother of creation.

Which is to say:

The nothingness that can be described   
is not the eternal Nothingness.

The nothing that can be spoken of is not the eternal Nothing.   
The eternal Nothingness is the boundary of all that can ever be and all that is.

Nothing is the mother of creation.

If there are (at least) 2 kinds of nothingness, does that mean there are (at least) 2 kinds of dualities? Yes. Each of the 9 levels listed exists in some type of duality (except perhaps #9) and has a duality of some sort, but with only 2 types of nothingness, we refer to only 2 types of duality; the *primal Duality*, which is the duality of the first *thing* that existed in the *primal nothingness*, and *relative duality*, which is every duality that exists because of, or within, the *Primal Duality*.

We symbolize this primal duality as 1 and 0; from 1 and 0, all other numbers appear. It might seem more sensible that the primal duality would be that of ∞ and 0, which is also true, as ∞ is a concept representing the totality or unity of all numbers and is not a number itself, while the number 1 *does* represent unity, and is even defined as “unity”. In this case, which is limited to the context of *unity*, 1=∞, or rather, the unity of 1 represents the unity of all, and the mapping the range of 0→1 to 0→∞ is common in mathematics and computer programming for exactly this reason.

All the dualities that follow the primal duality exist in the realm of *relative nothingness*. We have names for these relative dualities, such as positive and negative, yin and yang, or any difference that separates *somethingness*. Measurement of any kind is a byproduct of relative nothingness. This *relative duality* is the duality of our reality, the mundane duality that allows *things* to exist, energy to move, and has states of balance and imbalance. In this context, balance refers to the balance *within* movement, and not the balance of stillness. Dancing, electricity, nature, the cosmos, these are all examples of balance within movement.

Just as nothing must precede something, 0 precedes 1, so we can say that everything starts with 0. We will be using the concept of 0 and nothingness quite a bit, so let’s review this “simple” and common concept we use daily.

### Zero

The general concept of nothingness is represented by the number 0, but it was only recently in human history that we could even grasp the concept of nothingness, and even then, its adoption took thousands of years and was hotly debated. It is officially recognized that 0 was first recorded in Mesopotamia around 3 B.C.. Still, the ancient Indian *Bakshali manuscript* from 1500 B.C. appears to use the symbol of a dot (•) to represent 0. In either case, these were followed by 0’s appearance in Mayan Meso-America circa 4 A.D., again in Mayan Meso-America in the 5th century, Cambodia in the 7th century, and China and the Islamic countries in the 8th century. The concept of 0 didn’t reach Western Europe until the 12th century, and even then, it was not entirely accepted as a legitimate number concept for hundreds of years, which is a bit embarrassing considering that bees[[5]](#footnote-31), monkeys [[6]](#footnote-33),[[7]](#footnote-35),[[8]](#footnote-37), and crows[[9]](#footnote-39) have no problem with the concept of 0.

Similar to Dr. Elisabeth Kübler-Ross’ well-known 5 stages of grief; denial, anger, bargaining, depression, acceptance, the adoption of the number 0, according to animal physiologist Andreas Nieder, went through its own 4 stages[[10]](#footnote-42), which seems appropriate as the concept of nothing, on an existential level, it not unlike death.

* **Stage 1:** Recognition of the absence of something.
* **Stage 2:** Recognition of nothing vs. something (5th c. BC, Greece).
* **Stage 3:** Recognition of 0 preceding 1 (7th c. AD, India ).
* **Stage 4:** Ability to assign rules and properties to a symbolic representations (13th c. AD, North Africa).

*Note: these dates are best-guess estimates based on documented references.*

Curiously, humans achieved such an advanced state of intelligence yet never developed the concept of 0. It’s almost as if humans were gifted the benefits of intelligence via genetic mutation, alien intervention[[11]](#footnote-45), or psychoactive stimulation[[12]](#footnote-46), thereby skipping a critical phase of the long, hard, slow work of evolution to get there.

It is not a coincidence that the modern world and the concept of 0 arrived simultaneously, as it was 0 that allowed for the creation of things like modern math and calculus. This ability of 0 began to eclipse the philosophical objections that you can’t get something from nothing, much to the chagrin of the Christian church, which was not very happy that this handy number was being introduced by the Muslims, not to mention that if something can come from nothing, what does that say about god? [[13]](#footnote-47).

### The Complexity of Nothing

0 is challenging enough without the added confusion that comes from the clearly ridiculous yet mathematically correct answer to 00=1 that many calculators provide (including Google’s calculator. The more realistic answer is *00=undefined*). However, X0 is always 0 as long as X!=0. Although this may look like math mumbo-jumbo, it’s pretty straight forward: X0=X1-1===1. In addition to 0 representing nothing, this proof shows us how 0 also represents a state of nothing that *results from something*, as 1-1=0, or conceptually speaking, *something-something=nothing*. Hence, 0 is not only the “womb” from which all numbers emerge but also where numbers go when they disappear from context.

I wonder if this is what Lao Tzu was also referring to in the *Tao Te Ching* when he said:

Yet mystery and reality   
emerge from the same source.   
This source is called darkness.   
Darkness born from darkness.   
The beginning of all understanding.

Which is to say (in this case):

Yet the unknown and the known   
emerge from the same source.   
This source is called nothingness.   
Somethingness born from nothingness.   
The beginning of all understanding.

This single number of 0 represents the antithesis of all other numbers, just as the idea that all that ever did, does, or will exist, does so because of the zen-like oxymoronic paradox of the “existence of nothingness”. Countless conjectures and proofs have been written on 0; that it is equal to 1, or to the sum of all numbers, or to ∞, or and many other, or even all, values. This is not hyperbole, as these concepts are hotly debated in mathematics and philosophy. On its surface, the statement 0=∞ looks like a senseless statement because 0 is a number but ∞ is a concept, so they can’t ever be equal. However, 0 is both a concept *and* a number, as it has a *quantitative* value of 0 and a *qualitative* value of *nothingness*. This is similar to how the number 1 has a *quantitative* value of 1 and a *qualitative* value of *unity*. Of course, all numbers are concepts, and most common numbers have well-known qualitative, but the first pair of *nothingness* and *unity* started it all. It’s worth noting that Parmenides, Leibniz, and other giants in the history of math equate *unity* with ∞ with the argument along the lines of all that *is* collectively defines the unity of existence; hence, the concept of 1=∞, which leads to concepts like =1∴1-∞=0∴∞-1=0∴0+1=∞, etc., etc. While these concepts may not work so well quantitatively as when balancing your budget, they are fundamental qualitative concepts that have been examined by great minds, from Heraclitus to Hegel.

The truth is, or rather *a* truth is, the numbers 0 and 1 are remarkably flexible as they are two concepts that encapsulate the idea of the nothing of nothingness and the totality of somethingness; the two poles that define the arena or spectrum wherein all things exist. What happens inside this arena? In a word: *order*. There is no order in the *nothing of nothingness* for there is nothing to order, and there is no order in the totality of somethingness as there is no form, structure, sequence, etc. If 0 is the mathematical concept of nothingness, then 1 is the ultimate mathematical black hole, and in that sense, 1 *does* represent ∞. 0 and 1 (or 0 and ∞ if you prefer) are two states of chaos. Order only exists *between* these 2 states, and our understanding, discovery, and invention of order allow us to know this.

#### **Key 1:** chaos is a state lacking any order, time, or energy; total nothingness; 0.

#### **Key 2:** chaos is a state of total energy and matter; total somethingness; ∞

## Order and the chaos of 0 and ∞

It was Newton’s contemplation of that led to his invention of calculus, and while we are taught that equations with 0 or ∞ are problematic and best to stay away from, calculus can prove that ∞∞, 1∞, 00, , 0×∞, ∞-∞ all equal , and yet, even today, we are not sure what actually is. We can see evidence of this in current research, such as the research of the Chief Editor of the publication *Causation*, Ilija Barukčić, titled “*Zero Divided by Zero Equals One*”[[14]](#footnote-53), which starts with:

Objective: Accumulating evidence **indicates** that zero divided by zero equals 1

And concludes with:

Conclusion: The findings of this study **suggest** that zero divided by zero equals one.

Or, in a paper co-authored by Ilija Barukčić that appeared in *Journal of Applied Mathematics and Physics* [[15]](#footnote-55):

A solution of the philosophically, logically, mathematically and physically far reaching problem of the division of zero by zero (0/0) is still not in sight.

In addition to this ambiguity, not only can 0 = ∞, it can equal any number. That is actually a true math statement (I didn’t just make it up). In math, when an answer can be many values, it is called an *indeterminate* answer, meaning an equation, like , has no single or fixed value that can be determined (even though it looks likes the answer should be 1). The same can be said for ,0×∞, 00, ∞0, 1∞, ∞=∞, as they are all *indeterminate*. Indeterminism is the equivalent of mathematical chaos, which supports our claim that 0 and ∞ are qualitative representations of chaos. They are also the only numbers that represent a concept that has no value; 0 being the explicit lack of any value, and ∞ which is a concept that represents the opposite of 0 and yet can have many different forms. In general, and how it is used in this book, ∞ is meant as a frame for all positive numbers, as in *0 < positive\_numbers < ∞.*

While the above is a mathematical argument for why 0 and represent states of chaos, we can also use the current definitions of chaos to make the same argument. While we can say that nothingness has no order or periodicity and is therefore chaotic, *chaos* also has another definition that means precisely the opposite, similar to the *∞=0* concept. Take, for example, the study of chaos in the origins of the Universe that was undertaken by Chicago’s Northwestern University physicist Adilson Motter, who concluded that 10-36 seconds after the Big Bang happened; there was a state of *total chaos*. Do you know what was happening at 10-36 seconds after the Big Bang? Everything, and in a temperature of over 1 trillion degrees. Motter concluded from his study:[[16]](#footnote-56)

“Now we establish once and for all that [the universe] is chaotic.”

We are not claiming here that the Big Bang theory is correct, but we are asking the question; How can the concept of *chaos* describe the state of the void of total nothingness as well as the state of all matter and energy in the Universe, total somethingness?

The definition of chaos that works for both is *“the degree that order is present in any state”*. Both extreme states of total nothingness and total somethingness have no order, pattern, or periodicity, which is quite compatible with another common definition of *chaos* as synonymous with *unpredictability*. A more flexible definition of *chaos* comes from the authors of “*Introduction to Complex Systems, Sustainability, and Innovations*”,[[17]](#footnote-58), which simply states:

chaos explores the transitions between order and disorder. An order arises from the ever growing disorder of the Universe - chaos and order together.

But this is still too vague for our purposes because it is more reasonable to consider *chaos* as a spectrum from 0 to ∞. More correctly, the spectrum of *chaos* is the inverse of the spectrum of *order* (which is further defined later on), because just as there is no such *thing* as darkness, only a lack of the *thing* that is is light, chaos is the lack of order. For this reason, we initially define using a slightly inaccurate definition shown below. However, we will be refining this concept as we continue.

#### **Key 3:** chaos as a measure of pattern, order, and predictability.

Chaos is not the same as randomness. A random event is *non-deterministic*, meaning it can’t be determined when it will happen because it has no pattern, rule, or reason (that we can discover) and no known immediate cause. At least, that is how we define the word as it is used in this book. It may be the case that the concept of randomness simply exists to label unexplainable events that are actually chaotic in nature but far beyond our current abilities to understand, like a super-chaotic event. An example of this is from the website RANDOM.ORG, which generates random numbers. In order to make them more truly random, they use atmospheric noise as an input. That ambient noise is not random but is chaotic. Another example is how computer random number generators use electrical noise and heat as inputs to their number generator. Again, these are chaotic inputs.

Another way to understand the difference between randomness and chaos is in the value of π (pi). The value of π is infinite in numbers and the sequence of those numbers is quite predictable using simple math, which is how we can calculate the value of π, but there is no pattern to the numbers, so there is no way to determine the following number based on the previous numbers. This is similar to how prime numbers can only be calculated as they have no pattern. This makes the value of π chaotic because the value is deterministic yet produces a series of numbers that appear random and uniformly distributed (a.k.a. *normal* distribution). We say “appear” because there is no way to prove that π is random or *normal*, just as there is no way to prove that the infinite numerical sequence contains every possible combination of numbers that can ever exist, but evidence suggests that’s *probably* the case[[18]](#footnote-59). So, chaos has a pattern, but it is unpredictable, and **randomness has no pattern and therefore contains *every* pattern**. Here we see an instance of the concept of not only 0=∞, but that ∞ exist *within* 0.

There’s a beauty to Pi that keeps us looking at it... the digits of Pi are extremely random. They have no pattern, and in mathematics that’s really the same as saying they have every pattern.” **~Jonathan Borwein, mathematician**

Depending on who you ask, you can get a number of different definitions of “random”, but the definition we will be referring to is:

#### **Key 4:** A random event is a spontaneous event with no apparent cause.

Of course, this leaves a lot of room for speculation as to the randomness of an event, as there are undoubtedly many cases where we just can’t see the cause. What appears as random could easily be related to the *butterfly effect*, which states that small changes can have a growing and cascading effect. This idea is often exemplified in the question, “*Does the flap of a butterfly’s wings in Brazil set off a tornado in Texas?*” which was also the title of a 1972 talk[[19]](#footnote-63) given by Edward Norton Lorenz, a mathematician, meteorologist, and founder of chaos theory.

While this is a bit of an aside, it is a fascinating piece of history and an excellent example of the *butterfly effect* in so far as how it can affect society and how a candid meeting of two strangers in a ball in Prague in 1896 would be responsible for World War I and World War II.

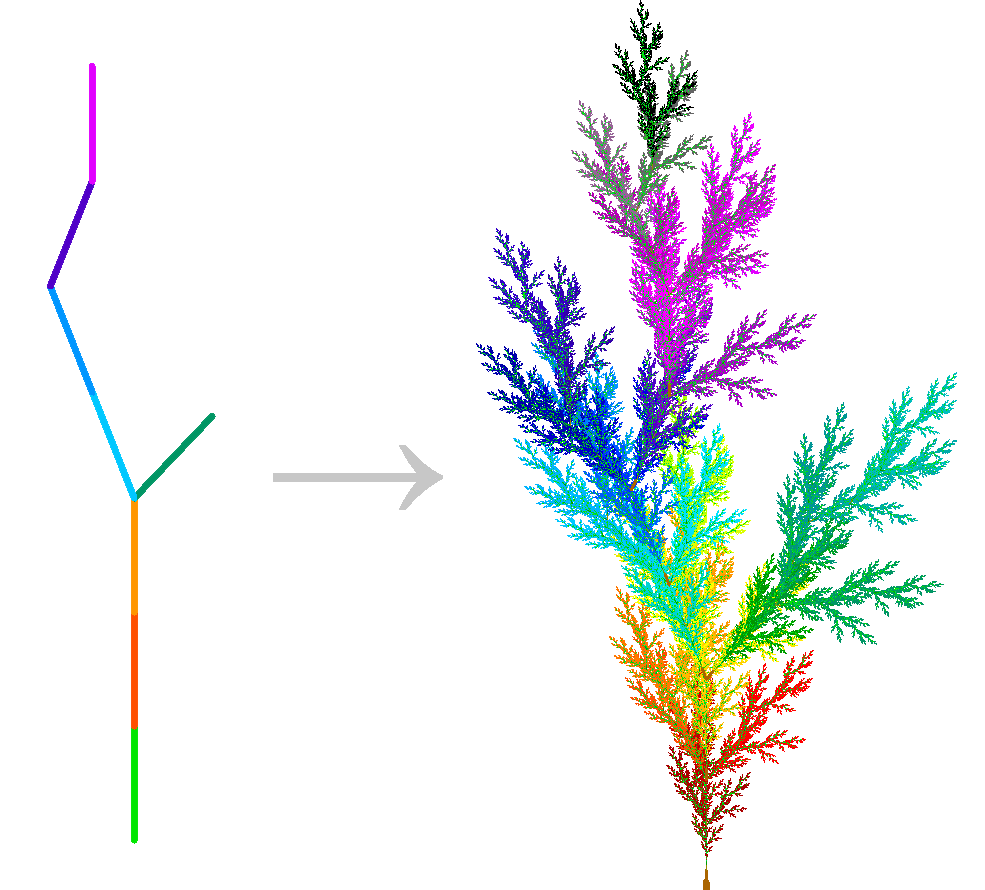
The two strangers were Arch Duke Franz Ferdinand and Sophie Chotek, a duchess and the daughter of a Bohemian Count, who met, fell in love, and got married. The problem was Sophia, being a mere duchess was not royalty, and given royalty’s strict adherence to their self-aggrandizing customs, it was forbidden that she appear next to the Archbishop in any official royal ceremonies. The Arch Duke may have loved Sophie, but he was still an obedient autocrat, and so he followed the rules. However, this meant he *was* allowed to have her by his side during non-royal ceremonies, such as when he was acting as the Inspector-General of the Austria-Hungarian Army. Taking advantage of this loophole, he decided to show off his wife to the world by taking a public trip to inspect the Bosnian army with his wife by his side. To ensure everyone saw them together, they traveled in an open car for all to see. It was during this public demonstration of his undying love that the Serbian nationalist, Gavrilo Princip, ran up to the car and shot both of them at point-blank range, killing them instantly.

Austria was outraged, demanding an apology from Serbia. Serbia, while denouncing the assassinations, refused to apologize, stating they had nothing to do with the plot. Austria responded by declaring war on Serbia, which forced treaty-bound Russia to ally with Serbia. Germany, who was treaty-bound to Austria, declared war on Russia, causing France and Great Britain to come to Russia’s aid. World War I devastated Germany, which laid the fertile ground for the rise of nationalism and Hitler, which resulted in World War II.

All of the death and destruction of these wars was a consequence of a chance meeting at a ball, plus countless other *butterfly effects*, such as Gavrilo stopping to buy a sandwich which happened to place him at the right time and place, and every other interaction that has ever taken place since the First Cause started the show. But such stories are deceptive because they take away from the inconceivably profound realization that every trivial act is also a result of everything that has happened since the beginning of time. Yes, it’s quite possible that WWI would have occurred in any case, but in this timeline of history, this is what *did* happen, just as you may not have spilled your drink if you hadn’t turned your head because you heard a weird sound, but you did because everything that has ever happened since the beginning of time was leading up to that moment. This may sound like there is no such thing as “free will,” but we won’t get into that now as it is addressed towards the end of the book.

One of the classic “truly random” events in the Universe is radioactive decay, but only the decay of a single atom. As a group, the decay is entirely predictable, which is how we calculate half-lives of radioactive material. This is the same as saying we know that there is a 1 in 366 chance of getting into a car accident on a 1,000-mile car trip, but it is impossible to predict the who, when, or where of any one particular accident. Insurance companies try to minimize the odds with reams of data on the probabilities of accidents regarding teen drivers, aggressive drivers, weather, speeding, impaired driving, driver error, distracted driving, etc., which narrows the range but still can’t predict one accident. Still, this does not make individual accidents random. Suppose Sally gets drunk because she just got fired for aggressive behavior, and she decides to drive home from the bar in a snowstorm while arguing with her husband on the cell phone and going 30 miles an hour over the speed limit, and she gets into an accident with Bob. In that case, there is nothing random about that, nor is there anything random about how Bob’s car was where it was when it got hit. Both Sally and Bob were on a path resulting from a series of chaotic events (i.e., life). Each event increased or decreased the probability of an accident. In Sally’s case, those events clearly created a high probability scenario for an accident. Bob, on the other hand, being a careful driver who was paying attention and was going slow, had a very low probability of an accident, yet he got hit anyway. We would say this was a random event (“bad luck”) for Bob but a highly predictable event for Sally. In this scenario, “random” means an unpredictable yet deterministic chaotic system (Bob’s life) that influenced another unpredictable yet deterministic chaotic system (Sally’s life). Because neither system is predictable, it is impossible to predict when or if they will interact; thus, “random” is often synonymous with “theoretically unpredictable,” as this random accident was the effect of a cause created by the intersection of 2 chaotic systems.

A more common example of this is the idea of a stock market. The price of a stock is unpredictable, but it is not truly random, as the price is determined by the individual actions of thousands of buyers and sellers, each making non-random decisions based on their financial interests. Each of these cause/effect chains is a system in and of itself, and all these systems combined form the larger system of a stock market.

Chaos is *deterministic* because it adheres to rules and even has a pattern, but the effects over time create unpredictable results. Chaos does not happen in one moment. It happens over time, and what happens next depends on what happened before, making chaos a self-similar or self-referencing process. Because it is *change* that happens over time, there are two components to consider; a *growth factor* and a *limiting factor*. For example, in the image to the right, we start with a simple pattern that never changes but can replicate itself in its children, and after 10 generations, it turns into a tree. The *growth factor* is self-generating, and the *limiting factor* is that all of the variables (length, angle, color) are permanently fixed. Popular real-world chaotic systems are things like the weather, economics, growth patterns, etc.. Still, in actuality, everything that grows, moves, or has energy moving through it, has elements of chaos in its system that are influenced by millions of variables forever changing.

Below are some diagrams to help make this concept clearer.

**Row A:** The top-left shows the changes to a simple form where a line half the length extends from its parent line at 20°. This newly extended line will then also have a line half its length extending from it, and so on. The top-right image is the same pattern, but with 90° instead of 20°. They are side-by-side to show how the natural form of plants is the same pattern as a now-common man-made grid pattern. Why is that significant? Because this grid pattern was adopted as a way to grow and expand new territory more efficiently, which is why the architects of the New World adopted it in the 1700s. Thomas Jefferson first used this pattern to “gridify” the entire country to make it easier to expand into. City planners found the same pattern far more effective than the more organically formed cities of old Europe. The major driving force behind this pattern was financial, of course, and it’s no surprise that this efficient form of development appeared and grew in parallel with the industrial revolution and the radical expansion of city populations, such as London, which grew 600% from 1775 to 1885. We see this same evolution of patterns in biology, such as grid cells, which are the cells that allow us to navigate our environment and which form a triangular grid with their impulses. It may seem like a stretch to claim that the industrial revolution, capitalism, and suburban roads are just another instance of the same patterns that determine tissue growth and the stripes of a Zebra Fish, but that is precisely the case[[20]](#footnote-72). The only difference is the context in which these patterns are being applied and the resources at hand.

**Row B:** The middle row shows the simplest of all forms, the triangle. In this case, a new line is always created at the end of the previous line but rotated left 120°. At the end of that child line, a new parent line is created but rotated in the opposite direction (whose child will also rotate right, and so on). In the left image, all variables remain the same. In the middle image, the deviation was allowed to wander 1° in either direction. In the right image, the deviation was allowed to wander in any direction. These images represent the three states of order; perfect and unchanging, transitioning, and total chaos.

This is also an example of an instance of a relative duality. While the prime duality is that of primal nothingness and primal somethingness, a relative duality is that of a relative nothingness and a relative somethingness. In this case, the relative somethingness is the lines formed by the rule, and the relative nothingness is where there are no lines. Together they create a perfect form (according to the rules); in other words, an archetype. It is perfect because the rules are perfect. When we add a tiny bit of imperfection of 1° (or 0.27%) of randomness, the form is no longer perfect but still identifiable. With 100% of randomness, it is total chaos, a perfect mess. This is an example of the path from order to one type of chaos (the path from chaos to order is addressed in the chapter on energy).

**Row C:** Because chaos is deterministic (but appears random), whatever a chaotic system does, it will do exactly the same way every time if all the variables remain the same. In our world, these variables are dynamic, so there will always be some changes to some variables. This is why all pine trees don’t look identical. The row shows five instances of the 5th generation of the same source pattern where slight variations in length and divergence were allowed. This is meant to demonstrate that while growth is a chaotic system, evolution is a chaotic system with some amount of randomness in it, for without those slight variations, nothing would ever change. Reality expands in chaos but evolves in randomness. At least, that is the premise we start from because random events can exist within the chaos of change, but the chaos of change can not exist in a random event, and the Universe is certainly a system of change.

When looking at these images, remember that these are only 2-dimensional patterns of 10 or fewer generations from their starting point, with only length and divergence changing slightly. In the 3-dimensional world we live in, the starting point from which all form descends is the beginning of existence. The variables and generations at any and every moment since the beginning of time are countless, and the change in the variables range from minuscule to dramatic. The impossibility of accounting for all the details necessary to make a prediction of a chaotic system is why it is unpredictable.

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