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How Can Chaos Theory Help Us toward the Emergence of a New Civilization?

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Abstract

The human world as a *system* has become chaotic due to rapid population growth and ever-increasing connectivity among people. This has led to a number of systemic crises such as the ecological, financial, and societal crises. Conventional wisdom and Newtonian approaches to these problems are inadequate for understanding the new chaotic world. It is imperative that we develop a new theoretical approach to better decipher today's reality. Chaos theory indicates that human civilization may either be on the brink of a huge collapse or the formation of a whole new civilization. This article aims to explore why the world became chaotic and how we can contribute to either a "clash of civilizations" or, instead, the "shock of a new civilization." The findings can contribute to understanding and action to promote the emergence of a new, more complex and more harmonious civilization.

Keywords

evolution, future, civilization, chaos, complexity, breakthrough, emergence, collapse, breakdown, butterfly effect

Introduction

Because of the steady increase in the number of people throughout human history, and the far greater increase of connections among them, the human world *system* has become chaotic. This has resulted in systemic crises in such areas as ecology, finance, and society.

Most of what we learned at school and also of our popular opinions and beliefs are based on classical Newtonian and Euclidian theories. Yet many of these classical rules and views no longer apply to a new world far removed from equilibrium in many respects. We need to update our system of thinking. Indeed, chaos theories can help us to understand a world that has become chaotic.

Most important, chaos theories show us that human civilization may be on the verge of either a huge collapse, or the emergence of a new civilization. How can we help this emergence to happen? How can we contribute to a breakthrough to a new, more complex and more harmonious civilization?

Why and How Humanity Has Become Chaotic

Why has the world become chaotic or turbulent? Essentially, for three reasons: increase in the number of people, speed, and connectivity.

How many of us were on earth 150 years ago? One billion. How many are we today? Seven billion. Within the past few decades, the global population has grown incredibly. We

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have gone from three to seven billion in just one or two generations.

Our world is also moving faster and faster. The lithosphere (minerals) evolved over billions of years. The biosphere (living creatures) evolved over millions of years. But growth in the noosphere (information) is now measured in nanoseconds! At the scale of human history, it took man three million years to go from the "hunter and gathering" era to "agriculturist and breeding" era, then thirty thousand years to enter the era of "industry and commerce," and only three hundred years to pass into the age of "creation and communication," which itself is only thirty years old. Technological, social, and economic revolutions happen today in just one or two generations. Neither human beings nor cultures have time for gradual adaptation.

During previous transitions, the "human world system" had time to change and adapt in a "near to equilibrium" way, and traditional Newtonian mechanics could be used to understand the transitions. But at the unprecedented speed of change we are seeing now, the system is put out of equilibrium; in fact, it is so far from equilibrium that classical rules and views do not apply.

So human civilization is facing an unseen increase in both the number of people and the speed of change. It is also facing an incredible increase (and again at an amazing speed) in the number of connections among these people.

On August 4, 1938, an exploratory expedition of the American Museum of Natural History, looking for new species of birds in New Guinea, changed human history. Entering the Great Valley of the Balim River, which was thought to be uninhabited, Richard Archbold and his colleagues were surprised to find a culture with a population of more than fifty thousand people. They experienced what was to be the last "first encounter." For perhaps the last time in human history, men and women who were completely ignorant of each other's existence on the planet met.

Five hundred years ago, a human being had little chance of meeting more than a thousand people in his or her lifetime. Yet by 1900, 11 cities had more than one million inhabitants. Today, 414 cities have more than one million inhabitants, and more than 50 percent of the world population is living in cities. We are living closer to each other. But not only that, at every moment, one million people are flying above our heads. More than one hundred thousand flights land and take off each day in the world and make it possible for millions of people to meet across countries.

Even more important, people also communicate more and more. We are even more connected in the virtual world than in the real one. More than three billion people have access to the Internet. And, since 2014, there are more mobile phones than people on this planet. There are actually more people who have a mobile phone than have a bank account, or access to drinking water, or toilets!

More and more agents (people) become more and more connected. And all this is happening at a speed that takes the whole system (human world) far from equilibrium, and ever closer to chaos. As David Ruelle, one of the first scientists to speak about the theories of chaos, writes, "The more oscillators there are and the more interconnection there is between them, the readier we should be to see chaos."

As we will see now, this can explain why we are experiencing more crises and on a larger and larger scale than ever before.

What Is Chaos?

Isaac Asimov, the visionary science-fiction writer, recounts in one of his short stories the narrative of a people who from generation to generation, from one civilization to the next, repeatedly ask a gigantic computer: "Will we be capable one day of beating the second law of thermodynamics?" And for generations on end, century after century, the computer systematically gives the same answer: "Data insufficient to answer question." Billions of years pass, stars and galaxies die, but the computer connected directly to the energy of Space-Time continues to calculate. At the end, the universe dies, but the computer finally comes to a conclusive answer. He now knows how to beat the second law—and that is when a new universe comes into being.

Entropy reigns, and nothing can escape the implacable hold of the second law of

thermodynamics. This is what we learned at school: with every passing second, our world, our solar system, our entire galaxy come progressively closer to their inevitable death at the end of Time. Disorder or entropy will only grow. "And to dust you shall return." But the theories of chaos teach us that this is only one facet of the story! They do not deny that all shall return to dust; instead, they also show us the emergence of incredible complexity ever since the universe began.

At the dawn of time, when we thought only the void existed, matter emerged, followed by life and then consciousness. The universe has not stopped growing in complexity nor has it ceased to evolve. Individuals and humanity as a whole have done the same. From atoms to molecules, from unicellular organisms to multicellular ones, from the reptilian brain to the brain of mammals until we arrive at the neocortex in man, the universe has not ceased to surprise us with its inexhaustible creativity—continually integrating the already existing to grow in complexity and evolve, passing from the mineral and life to a higher consciousness, and to more beauty, truth, and goodness. Evolution, self-organization, integration—that is the other facet of existence.

We are living at a unique moment in which humanity, itself the product of billions of years of evolution, suddenly has become conscious of this evolutionary process. And unless we choose to return to death and dust, the theories of chaos bring to us absolutely essential elements for understanding how we can help contribute to this growth toward increasing complexity. They show us how a system can evolve toward either greater entropy (and eventual collapse) or greater complexity (and eventual breakthrough). They also enable us, thanks to a radically new way of seeing, to observe and take part in this evolution. For the first time in human history, man has become conscious that he is not merely a spectator but also an actor in the evolution of the universe.

Let us come down from the stars then and look at one of the classic examples used in the theories of chaos to understand the evolution of turbulent or chaotic systems: water flowing out of a tap. If you open a tap very gently, you will get a regular, steady, seemingly immobile flow called a *stationary, linear*, or *laminary* flow (see Figure 1).

Figure 1. System at equilibrium represented here by a straight line.

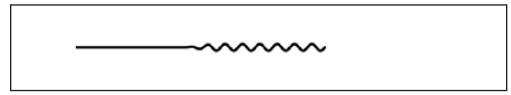

Figure 2. System oscillating.

If you keep opening the tap very, very slowly, you might notice a regular, subtle pulsation of the water jet. This is the *oscillating* or *periodic* state (see Figure 2).

If you keep opening the tap further, the pulsation becomes irregular, and eventually, opening it even more, the flow becomes a turbulent torrent. This is the turbulent or chaotic state. But do not stop there! If you keep increasing the release of water, a surprising phenomenon can occur. Swirls might appear. Order is now emerging from chaos, order from disorder!

So a system can go through different stages, each one having very different properties. It may be stable, in equilibrium, but if it does not move, it does not evolve. Then, after a certain moment, the system may start oscillating like the tap water described above or like a swing. In this condition, the system is still under some sort of *control* or *negative feedback*, such as a thermostat. If the heat exceeds a certain temperature, the heating is cut off.

In any system, at a certain threshold called the *tipping point*, the system can go out of equilibrium. The oscillations just keep increasing after that. The theories of chaos teach us that once the tipping point is crossed, the system will never be able to regain its previous equilibrium (see Figure 3). This is due to the effects of *positive feedback*. The phenomenon is self-amplified. The higher the temperature, the more that heat will be increased. There are numerous examples of positive feedback in physical, biological, and social systems. There is positive feedback when we are born: the

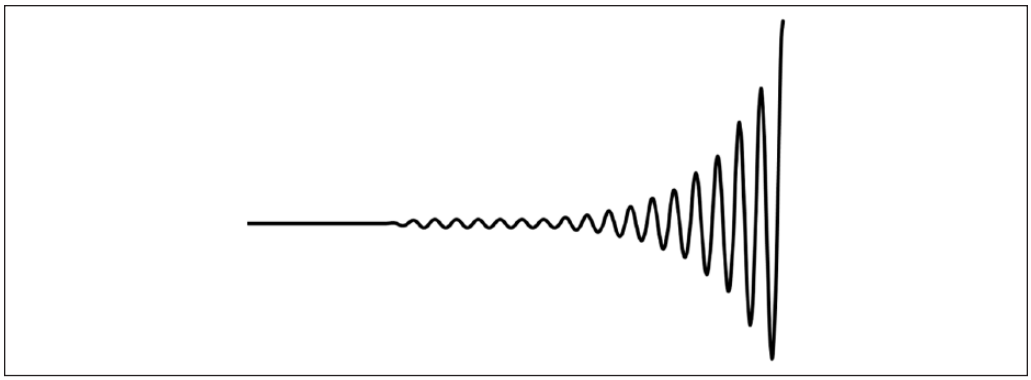

Figure 3. System going out of equilibrium after the *tipping point*.

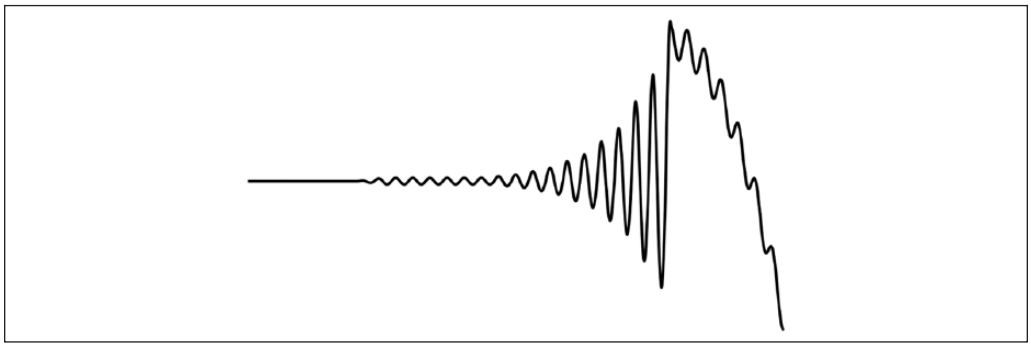

Figure 4. Breakdown after the *decision point*.

pressure of the baby's head on the uterine neck triggers uterine contractions. The contractions push the head further into the uterine neck, which in turn multiplies the contractions further. Positive feedback then leads to the expulsion of the baby from the womb.

We can see the same with the creation of social networks such as Facebook. If only few people use it, then few people want to join it. But if you have more friends who use it, then the temptation is greater to subscribe to it. The more people use it, the more other people want to use it, and so it goes. Positive feedback then is amplification, an acceleration of a process by itself on itself. Examples include demographic growth, nuclear chain reaction, capital deposited on compound interest, economic depression, panic in a crowd, and so on. In everyday language, we also talk about a vicious or a virtuous circle, based on whether we like the effects of acceleration or not. Our newly crowded and connected world is subject to many positive feedbacks.

What happens postequilibrium, after the oscillations, after coming out of control, is called the *decision point.* Here, two possibilities emerge: either the system collapses (see Figure 4). This is the working of the second law of thermodynamics: "And to dust all shall return," or there is a breakthrough (see Figure 5), and the system finds a new equilibrium at a higher level of complexity.

This is how living creatures and the universe have evolved: from atoms to molecules, from unicellular organisms to multicellular ones, from the reptilian brain to the brain of mammals, until we arrive at the neocortex in man. The system continues to integrate what existed earlier and self-organizes to grow in complexity.

Several civilizations have already collapsed in the past, and today's civilization may collapse as

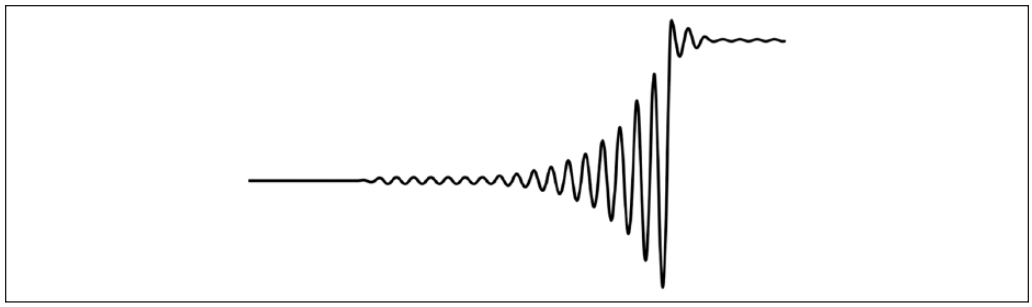

Figure 5. Breakthrough after the *decision point*.

well. The difference between previous collapses and today's would be the scale and speed of that collapse. Previous civilization collapses were more or less regional. In a connected world, the collapse would likely be global. But it also seems possible that a global emergence to a new civilization could happen in today's highly connected, chaotic world.

Most people, interestingly, find a negative connotation in the words "chaos" and "turbulent." "It's pure chaos" or "what a turbulent child" are rarely used as compliments. But chaos is merely a description of a state of things, neither good nor bad. Just as H_2O can exist as a gas (steam), liquid (water), or solid (ice), a system can exist in a state of equilibrium, whether linear, oscillating, or turbulent/chaotic. We can thus look at the turbulent or chaotic state simply as one specific phase of a system, neither good nor bad.

We are talking then about dealing with a system using the appropriate tools for the phase it is in. Several aspects of humanity and of our organizations are still linear or in a state of equilibrium. We thus use classical mechanics to understand and act upon such a system. However, as we saw in the first part, humanity has emerged from the state of equilibrium in a number of fields and has entered a turbulent and chaotic phase. Therefore, using the theories of chaos, we shall try to develop new tools that allow us to see further. We will thus be able to understand and, most important, to act upon those parts of our personal lives, of our organizations and of humanity that have entered a chaotic phase. We will be able to see and understand the different developments, the crises, and work toward the emergence of new equilibriums and more complex and harmonious organizations. We will then be able to choose to work toward this emergence or breakthrough and not merely be victims of collapse or breakdown.

What Can We Do?

The first thing we can do is to give up our linear binary vision. The second thing we can do is to learn from Nature. After all, life has survived and developed in a chaotic environment for billions of years!

We are used to seeing and describing our world as if it never changed. That is because we rely mainly on our Newtonian and linear way of thinking and seeing. We see mountains as cones or triangles and clouds as balloons. But if we can attain a better view and understanding of our world, we could then act and decide in more appropriate ways. Chaos theories can help us again, this time with *fractals*. As Michael Bamsley writes, "Fractal geometry is a new language. When you learn to speak this language, you can describe the form of a cloud as precisely as an architect can describe a house."

Understand Fractals

The term *fractal* was used for the first time by Benoit Mandelbrot. This is how he defined fractals:

> Fractals are objects, whether mathematical, created by nature or by man, that are called

> irregular, rough, porous or fragmented and which possess these properties at any scale. That is to say they have the same shape, whether seen from close or from far. (Mandelbrot 1983)

To understand the difference between classical and fractal geometry, look at the difference between the blade of a knife and the coast of Brittany. Watched under the microscope, the blade of a knife appears very irregular and full of rough edges. But if we change the scale, to the naked eye, the blade appears completely straight. On the contrary, if you look at the coast of Brittany from not too high up, you see an irregularly indented coast. But if you change the scale by increasing the altitude, you still continue to see an indented coast! Benoit Mandelbrot himself had asked the question, "How long is the Brittany coast?" Quite evidently, the answer varies considerably in accordance with the altitude from which you measure it: a few hundred kilometers when seen from a satellite and several thousand, when measured with your ruler.

This is one of the aspects that made Benoit Mandelbrot adopt the term *fractal*. Fractal as in "fractured" but also as in "fraction," as it describes objects that are of a "non-integer" dimension. Classical geometry has accustomed us to objects of an integer dimension—space or volume, for instance, or the plane, the straight line, and the point. Three values are sufficient to determine the position of something in space: latitude, longitude, and altitude. Space is a three-dimensional object. Similarly, two values are sufficient to define the position of something on a map. The plane surface is a two dimensional object. Finally, one single value enables us to define the position of something on a line: "It is at eight miles from here on the state highway." The line has just one dimension.

It is quite evident then that the Brittany coast does not exactly correspond to any of the preceding examples. Without going into details, Mandelbrot showed that we could define the Brittany coast with a non-integer number, a fraction, and this is how the term *fractal* came to be.

As Mandelbrot pointed out, in all fractal images, each portion can be seen at any scale: each part is (visibly) a copy of the whole. This phenomenon is called self-similarity. A snowflake is then a marvelous example of fractals. If you see it through a magnifying glass, you see a structure with six sections. If you see one single section, you observe that it, too, is composed of six sections. The same thing is true of a fern stalk or certain kinds of cabbage.

A snowflake, the leaves of a tree, a cloud are a few examples that can be described through this branch of fractal mathematics. So, we can confirm that contrary to the approximations of classical geometry, clouds are not spheres, mountains are not cones or triangles, and lightning does not move in a straight line. Clouds, mountains, lightning as well as trees, rivers, drying soil, and galaxies are all fractals. Nature itself is seldom linear. From our lungs to galaxies, the universe is often organized as fractals.

How can we start to use these fractal images to gain a more accurate view of our newly chaotic world, and see how this world could evolve toward a more complex, new civilization? Let us take an example.

A Shock for Civilization?

A few years ago, Samuel Huntington wrote a highly successful book, *The Clash of Civilizations*. This success redoubled post-9/11 (2001) by popularizing the presumed conflict between the Muslim and Western worlds. Huntington explains in his book that the world is divided into major distinctive civilizations, and some of them think it is their vocation to fight with each other. So he gives us a map of these civilizations, dividing the world into Chinese, Japanese, Hindu, Muslim, Western, and so on. This well-demarcated world with clearly defined boundaries is typical of a linear way of thinking and seeing. But this map has become an illusion and is but an afterimage of a world that no longer exists. Today, the other, the foreigner, can be one's neighbor or one's colleague at work. You may actually be living in a very Chinese culture in Palo Alto and in a very Western culture in Shanghai.

Everywhere in the real world, different communities are developing locally and

perhaps even more locally in the virtual world. If you understand that mountains are not cones or triangles and that fractals describe them better, then you may realize the civilizational map today looks more like a fractal. That could make a big difference in action: the other, the stranger, is not far away anymore. She or he may be living next door. War can be at our doorstep, as some events constantly remind us. But peace is also at our doorsteps (one might even say, it is within ourselves in a fractal way).

Also, seeing our institutions and organizations as fractal could help us to imagine new institutions and organizations better adapted to our new chaotic world. Using only the concept of "Nations" for units from which to invent a new international system of governance may not be enough for our new fractal world. Obviously, humans are not adequately defined or represented simply by the nation in which they were born or where they happen to reside. Even the still controversial concept of democracy may not be perfectly adapted to the emergence of a more harmonious civilization. Or, at least, democracy may not be the only appropriate governance tool to use.

What processes of collective decision making could we set in place to make democracy operational in a world that has become turbulent and chaotic? Let us take this as another example of how our new fractal vision can help us identify new processes that can respond to new needs for a harmonious and efficient functioning of our new "City"—the world.

Today, our democratic vision remains essentially binary:

- Two political parties in general (or, in some countries, the number of parties reduced to two by the final round of an election)
- The winning party in the election gets most of the power for a given period

In this linear-visioned democracy, we elect the supposedly most competent citizens so that they can govern us in an enlightened and efficient way. This implies that they are (and will remain) the most competent for the entire duration of their mandate and for each of the functions for which they were elected. This democratic system was long believed to be the best (or at least "the worst system of government, with the exception of all the others that have been tried out in history," according to Winston Churchill). It is, indeed, adapted to societies in which relatively few people have the necessary knowledge to govern (these being the more educated in a society, the elite, objectively speaking), and it functions well when the phenomena that those who govern must contend with are relatively simple and occur at a scale of time that is fairly slow.

But who can believe today that in this chaotic world any single person can ever have the capacities to grasp the existing complexity and make the right decisions on very diverse subjects that are getting ever more complex? And this for a duration of several years? Or who can still believe that if our leaders lack these abilities, it does not really matter because they can always surround themselves with good advisors or the right experts? Experts who are increasingly shut up in the ivory tower of their subject of specialization, whereas the analysis of a complex world requires, on the contrary, an increasingly broad vision. Today, information is accessible to all and fragmented as well: your next door neighbor may know more about the future of bees than your elected Member of Parliament!

There could be two lines of experiments for a functioning democracy adapted to an increasingly complex and fractal world:

- **Multilayered decision-systems** going from the local to global. It is evident that complex and universal problems such as global warming, the financial crisis, and so on can no longer be resolved at the purely local or even at the national level. It is only at the global or supranational level that they can be dealt with. Sooner or later, universal forms of governance will become indispensable. Likewise, it seems quite insane to try and resolve local problems at the national or international level.
- **Participatory democracy-type decision-making systems**. In such a

> democratic system, we could, for instance, think of creating bodies composed of well-known specialists, elected representatives, officers nominated by a competent administration, and citizens chosen randomly. We could constitute panels of concerned partners (clients, suppliers, regulators, users, elected representatives, etc.) who would make the decisions. The main idea is to give such bodies or panels the necessary time and means to acquaint themselves with the subject as well as they can, and to decide on the process of governance that would allow that body to make the best decisions. Such systems are in no way utopian. They exist and have amply proven how effective their functioning can be, from eighth and seventh century Ancient Greece, to the Iroquois confederacy in nineteenth century North America to the recent experiments in Brazil's Porto Alegre. (https://en.wikipedia.org/wiki/Participatory_democracy)

We could then evolve toward democratic systems that are more in tune with our ever more complex and fast-changing world.

How Are Nature and the Universe Doing It?

We have just seen that Nature and the Universe are showing us great examples of fractals. We have also one example of how we might apply this new perception to help a new civilization emerge. Let us go a little further.

Life has been able to adapt for millenniums to survive, grow, and evolve in environments that are naturally turbulent and chaotic. Let us examine some of the principal characteristics of each basic element of life that has made such an achievement possible: the cell.

- **A higher goal**: A cell first works for the well-being and survival of the body as a whole; it looks after its own interests only subsequently. The cell is ready to sacrifice itself and die to protect and ensure the growth of the whole. Each cell in our body, therefore, lives but a fraction of the time of our entire life. Could this be the higher goal of a new civilization?
- **Exchange**: A cell is always in contact and communication with other cells. Messenger molecules wander around the whole body to keep track of what is going on even in its remotest part. Indeed, the Internet already provides amazing tools of this nature. How could we assure that all human beings have access and take part in global communication?
- **Consciousness**: A cell is conscious of each moment. It is capable of adapting to any change of circumstances, however sudden, and will respond in an adequate manner. What information tools, what data, should we use to know and feel what is happening at every level of global human civilization?
- **Otherness**: A cell recognizes and accepts the importance of all the other types of cells. Every bodily function is important and interdependent. Cross-cultural studies have made great progress in the past decades. How can we do still more to embrace and use human diversity?
- **Efficiency**: A cell functions with the minimum use of energy. It also stocks a very small quantity of it, equal to three seconds of supply. It trusts the whole completely to provide it with what is required. There is, indeed, here a great challenge regarding how we use and produce energy as human beings and as a civilization.
- **Links**: A cell knows, beyond differences and distinctions, that it shares the same DNA as its peers. Liver cells are different from heart cells. The cells of the skin are different from those in the brain. However, they all share the same identity that transcends them. As we see with questions raised by transhumanism, how could we collectively expand the definition of what it means to be a human being?
- **Giving**: The essential activity of the cell is to give, which fosters the existence of

other cells and the soundness of the whole. There is a total commitment to giving that constitutes one half of the natural cycle; the other half is receiving. As many say, it may be time to redefine the global economic system along similar lines.

Can we be like the cells in our body but at the scale of humans as part of a new civilization? Can all humans, our organizations, and institutions be organized as a harmonious fractal image? In this way, we could naturally and instinctively find the means not only to survive but, more importantly, to live and flourish both individually and collectively. We will then be ready for the breakthrough described by the theories of chaos. We will be capable of realizing our own personal metamorphosis, and the metamorphosis of humanity toward a more complex and more harmonious system in which each person finds fulfillment in a natural and organic way.

Conclusion: An Unpredictable World Awaits Our Actions

One evening, the meteorologist Edward Lorenz forgot to switch off his computer, into which he had programmed a simulation for meteorological forecasting. His computer, on its own, calculated the weather forecasts for several days although Lorenz had forgotten to remove the last decimals from his parameters, the thousandth, ten thousandth, and the hundred thousandth. When he returned to the computer, Lorenz realized that the final weather portrait was totally different from what he would have obtained if he had removed those last decimals (which he had thought to be almost worthless, so very infinitesimal they were in the initial data). Thus was born what is called the butterfly effect.

Lorenz discovered that, in meteorological systems, one can never forecast the weather with total accuracy, for a variation of some very minor phenomenon, such as the fluttering of butterfly wings, could alter the initial conditions sufficiently to provoke enormous changes after some time. The final result will be totally unpredictable, even if we think we are using the same data as the ones used at another period when the most important conditions were almost identical. In weather forecasts, a practically infinitesimal action can provoke totally unforeseen consequences. This is what made him say, "The simple fluttering of a butterfly's wings in Japan can unleash a few weeks later a storm in New York."

Today, similarly, a few words on a smartphone could unleash a revolution in some country.

He who has understood that the world is far from equilibrium, that its workings are no longer linear and binary but chaotic and turbulent, understands that one single action, one single project, one single individual transformation may change the world (although we cannot predict if it will, nor how or when this might occur). Thus, social transformations are increasingly linked to a few individual actions rather than to mass phenomena. This is because the essential conditions for the emergence of the butterfly effect are more prevalent than ever before.

If classical mechanics taught us that the same causes produce the same effects, the theories of chaos teach us just the opposite! The same causes do *not* necessarily produce the same effects! Or, more precisely, even the slightest difference in the initial conditions can lead to a completely different result.

All these elements place the power to transform the world in our hands and within our reach, for in such a chaotic situation, the slightest modification can tip everything over. In a linear world, we need to be sufficiently large in number or sufficiently powerful to *change the world*. In a turbulent chaotic world, a simple little action by an individual can change everything.

A chaotic world is unpredictable, but never in the history of humanity has a single human being had so much power to change things, for better or for worse.

Another well-known chaotic phenomenon example of hydrodynamics is the Benard instability (also known as *dissipative structure*). In this experiment, we heat a liquid from below. When there is a sufficiently large difference of

temperature above and below, vortices appear in which billions of particles follow one another. Nonequilibrium creates long-range correlations. Ilya Prigogine loved stating that matter in equilibrium is blind, each molecule *perceiving* only the molecules immediately around it. On the contrary, nonequilibrium leads matter to *see* the whole and in this way, a new coherence emerges from chaos, a beautiful turbulence.

The analogy is easy. When humanity is close to equilibrium and linear, classical Newtonian laws apply, and we only notice those who are close to us, family, tribe, or nation. When the increase in the number of persons and the volume of interaction does not allow such a mechanistic vision to operate, when humanity has become a chaotic system, then the human beings who constitute this system may be in a position for the first time to perceive the whole of humanity. Only then can a true world consciousness and vision emerge, and potentially even a cosmic consciousness incorporating nature and the totality of living beings. The latest developments in technology and innovation in the Internet and communication already make this possible. What we need now is not only technological innovation and evolution but also social innovation and evolution.

Evolution is the fruit of a ceaseless battle between order and disorder, entropy, and the emergence of order. From this titanic struggle, chaos comes forth out of the delicate balance between the atomic forces and those at the human scale. This delicate and improbable balance has produced the evolution of life and of consciousness.

That which is at the source of chaos, the increase in number, the increase in connections and interactions, enables one to develop a cosmic and global vision. And this increase in the volume of interaction and exchange, which generates turbulence and chaos, also permits the emergence of a level of complexity, needed for living harmoniously among several billion human beings, the emergence of a new civilization.

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Suggested Reading

Asimov, Isaac. "The Last Question." In *Robot Dream*. New York: Ace Books, 1956.

Diamond, Jared. *Guns, Steel and Germs*. New York: W.W. Norton, 1999.

Diamond, Jared. *The Third Chimpanzee*. New York: Harper Perennial, 2006.

Diamond, Jared. *Collapse*. London: Penguin Books, 2011.

Gladwell, Malcom. *The Tipping Point*. New York: Little, Brown, 2001.

Gleick, James. *The Theory of Chaos*. New York: Penguin Books, 2008.

Hoverstadt, Patrick. *The Fractal Organization*. Chichester, UK: John Wiley, 2008.

Huttington, Samuel. *The Clash of Civilizations and the Remaking of World Order*. New York: Simon & Schuster, 1998.

Lazlo, Ervin. *Science and the Akashic Field*. Rochester, VT: Inner Traditions, 2007.

Mandelbrot, Benoît. *The Misbehavior of Markets*. New York: Basic Books, 2006.

McIntosh, Steve. *Integral Consciousness*. St. Paul, MN: Paragon House, 2007.

Morin, Edgar. *Homeland Earth*. Cresskill, NJ: Hampton Press, 1999.

Morin, Edgar. *On Complexity*. Cresskill, NJ: Hampton Press, 2008.

Nowak, Martin. *SuperCooperators*. Edinburgh, Scotland: Canongate Books, 2011.

Prigogine, Ilya. *From Being to Becoming*. New York: W.H. Freeman, 1981.

Prigogine, Ilya. *The End of Certainty*. New York: Free Press, 1997.

Prigogine, Ilya. *Is Future Given*? Singapore: World Scientific, 2003.

Prigogine, Ilya, and Isabelle Stengers. *Order Out of Chaos*. New York: Bantam, 1984.

Ray, Paul, and Sherry Anderson. *The Cultural Creatives: How 50 Million People Are Changing the World*. New York: Broadway Books, 2001.

Rifkin, Jeremy. *The End of Work*. Los Angeles: Tarcher, 1996.

Rifkin, Jeremy. *The Age of Access*. Los Angeles: Tarcher, 2001.

Rifkin, Jeremy. *The European Dream*. Los Angeles: Tarcher, 2005.

Rifkin, Jeremy. *The Empathic Civilization*. Los Angeles: Tarcher, 2009.

Rifkin, Jeremy. *The Third Industrial Revolution*. New York: Palgrave Macmillan, 2013.
Rifkin, Jeremy. *The Zero Marginal Cost Society*. New York: Palgrave Macmillan, 2014.
Ruelle, David. *Chance and Chaos*. PrincetonPrinceton University Press, 1993.
Taleb, Nassim. *Fooled by Randomness*. New York: Random House, 2005.
Taleb, Nassim. *The Black Swan*. New York: Random House, 2010.
Taleb, Nassim. *Antifragile*. New York: Random House, 2014.
Toffler, Alvin. *Powershift*. New York: Bantam, 1991.
Toffler, Alvin. *Future Shock*. New York: Bantam, 1984.
Toffler, Alvin. *The Third Wave*. New York: Bantam, 1984.
Warneck, H. J. *The Fractal Company*. Berlin: Springer-Verlag, 1993.
Wilber, Ken. *Integral Psychology*. Boston: Shambhala, 2000.
Wilber, Ken. *One Taste*. Boston: Shambhala, 2000.
Wilber, Ken. *A History of Everything*. Boston: Shambhala, 2001.
Wilber, Ken. *A Theory of Everything*. Boston: Shambhala, 2001.
Wilber, Ken. *Grace and Grit*. Boston: Shambhala, 2001.
Wilber, Ken. *Sex, Ecology and Spirituality*. Boston: Shambhala, 2001.
Wilber, Ken. *Integral Spirituality*. Boston: Shambhala, 2007.
Wilber, Ken. *Integral Vision*. Boston: Shambhala, 2007.

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