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# Chaos Theory from Science to Literature: Approaching Chaos in the Algerian Contemporary Novel

# نظرية الفوضى من العلم إلى الأدب: مقاربة الفوضى في الرواية الجزائرية المعاصرة

BENNACER Fouzia[1]
f.bennacer@centre-univ-mila.dz
[1]University Center Mila- Algeria

BENNACER Souad[2]
bennacer_souad@yahoo.fr
[2] University Constantine1- Algeria

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## ABSTRACT:

The present paper sheds light on the third most important scientific theory of the twentieth century, "The Chaos theory". The central concern of the study is applying the theory to contemporary Algerian literature, in a first attempt to approach the contemporary Algerian novel with a contemporary theory and a critical approach taken from it directly. The research benefited from the philosophical, intellectual and technical concepts of the theory such as: sensitivity to the initial conditions, strange attractors, geometry of repetitive variable (Fractal), complex dynamics, and Entropy. These concepts were used to study ten Algerian novels that touched the theory. At the end, a general result of the research into chaos theory and the application of its concepts to the contemporary Algerian novel are provided.

Key Words: The Chaos theory, contemporary Algerian novel, sensitivity to the initial conditions, strange attractors, geometry of repetitive variable (Fractal).

## RÉSUMÉ

يركز هذا المقال على ثالث أهم نظرية علمية في القرن العشرين ألا وهي "نظرية الفوضى". الاهتمام الأساسي للدراسة هو تطبيق النظرية على الأدب الجزائري المعاصر، في محاولة أولى لمقاربة الرواية الجزائرية المعاصرة بنظرية معاصرة ومنهج نقدي مأخوذ منها مباشرة. استفاد البحث من المفاهيم الفلسفية والفكرية والتقنية للنظرية مثل: الحساسية للظروف الأولية ، والجواذب الغريبة ، وهندسة المتغير المتكرر (الفركتال) ، والديناميكيات المعقدة ، والانتروبيا. استخدمت هذه المفاهيم في دراسة عشر روايات جزائرية تطرقت للنظرية. في الأخير ، يتم تقديم نتيجة عامة للبحث في نظرية الفوضى وتطبيق مفاهيمها على الرواية الجزائرية المعاصرة.

الكلمات المفتاحية: نظرية الفوضى ، الرواية الجزائرية المعاصرة ، الحساسية للظروف الأولية، الجواذب الغريبة ، هندسة المتغير المتكرر (الفركتال).

## 1. Introduction

Most of the important phenomena in the universe, such as biological, social, and environmental systems are open systems; they interact and exchange energy and information with their surroundings, and any attempt to understand them using deterministic, certainty, and mechanic rules is doomed to failure. This is simply due to the fact that we live in a changing reality, and a permanent process that we cannot be reassured of its status which seems to us stable. In one moment, this whole reality can be turned upside down, and create a state of absolute chaos, as it is the case of revolutions, economic collapse, environmental disasters, etc.

However, the concept of "Self-Order", the base of chaos theory, allows us to approach chaos from a different perspective. Self-order refers to trials of finding the order within chaos, then, the reconstruction of a new order out of that upside down reality; in other words, the construction of another reality that guarantees for us persistence without large losses. This discovery astonished scientists at the beginning; they were wondering how can order imbed chaos? And how can chaos give birth to a new order? But the ongoing research in various fields has continuously supported the chaos theory, and the latter has become inclusive and very helpful in perceiving the world differently.

Literature, which is an open and varied system within which creativity plays the role of the elusive system that is difficult to grasp, cannot be placed far away from such discovery. Based on its scientific background, chaos theory had its own applications in literature. These were apparent in the works of the American critic "Catherine Hayles" who is considered to be a pioneer in identifying the theory and its applications in literature, in an attempt to provide a new critical approach for a different reading. In her book "*Chaos and Order, Complex Dynamics in Literature and Science",* which was the first reference in the field, she denoted the characteristics of the literary text that belongs to this theory intellectually, literally and technically, and identified a number of new critical terms associated with the theory, in a relentless endeavor to introduce the theory critically, and facilitate its use in reading and understanding the literary texts in a different and specialized manner, and why not to establish it as an inclusive critical approach, as it is the case of the theory in its original scientific context.

Therefore, the contemporary novel entered the midst of deciphering the codes and secrets of the permanent, irregular, and non-linear movement of the world as an art that does not acknowledge the rules. This fact makes the novelist, as claimed by Goldman, one of the problematic individuals who search for the meaning through narration. The novelist, presupposed to be a thinker to a certain degree, is aware that the world is complex and hides its secrets behind its chaos, and that the journey of searching for the unknown will draw him a different path of thinking, which is the same idea that charts a distinctive and a special shape of his literary creations. Thus, philosophy, science and thought overlap with literature to constitute human creativity with its own laws inspired by the chaos of the world in which the individual lives.

The present research seeks to provide answers for the following problematic questions:

- What is chaos theory, and how did it shift from science to literature and novel? And how did it appear in the Algerian contemporary novel?
- How does the novel enter the world of chaos? How can the novel get out of it? And Can the novel deal with it?

- Can a chaotic narration make a difference and shift the novel into new aesthetic stages in writing? In other words, does chaos produce a new aesthetic system in narration?

To answer the aforementioned questions, we will address the concept of chaos theory, its most important principles and characteristics, and its relationship to literature and postmodernism to reach the representations of this theory in samples of the Algerian contemporary novel.

## 2. Introducing Chaos Theory

Chaos theory is scientifically known as 'the theory of non-linear dynamic systems', and 'Complexity Theory', however, the most commonly used terminology in the scientific, cultural and literary fields is "Chaos Theory". It has become a third scientific revolution in the twentieth-century, after the relativity theory and the quantum theory, which changed the human vision of the world, and replaced certainties that had invaded minds for centuries. Chaos Theory paved the way for the emergence of "the new science" as claimed by James Gleick in his groundbreaking book *Chaos: Making a New Science* (1988). It moved from being a mathematical theory specialized in solving complex non-linear equation to a theory that influenced all the fields of science. Thus, not only the new physics, but the natural sciences, environment and economics were among the first discoverers and developers of the theory. Besides, the theory had an apparent influence on social sciences and humanities which explore the human new vision of the world, and its impact on the construction of the contemporary individual's identity.

Since its emergence in the seventies, and the spread of its concepts in journals and scientific papers, the concepts of the theory have had another parallel spread among intellectuals, artists, and writers, allowing them to delve deeper into ideas that seemed untouchable in the past. Moreover, the published researches about the theory have changed the prevailing concept of the complex language of science which made the theory smoother and more acceptable to non-specialized groups. The matter was not limited to the researches; it reached also books written by specialists in science and its philosophy. These books have simplified the concepts and made them available to more groups, including the aforementioned James Gleick's book, and *"Order out of Chaos, Man's new dialogue with nature "* by Ilya Prigogine and Isabel Stangers, through which they made a tremendous work that had a positive response among readers of different orientations and specializations. Alvin Toffler, the presenter of the book in his English version, said that they presented us with a landmark work that stimulates discussion and thought, a book full of far-sighted visions that destroy many of our assumptions. The emergence of this work in France in 1979, launched an amazing free scientific movement among eminent intellectuals in different fields such as entomology and literary criticism. In the field of culture and literature, the critic "Natalie Catherine Hayles ", in her book: *"Chaos Bound, Orderly Disorder in Contemporary Literature and Science"*, that is published in 1990, adapted the concepts of the scientific theory and simplified its principles affirming the close link between it and the humanities and literature, which resulted in making the concepts of chaos theory and postmodernism interdependent temporally and theoretically.

Hayles, in her book "*Chaos and Order, Complex Dynamics in Literature and Science"*, and Prigogine & Stengers, in their book "*Order Out of Chaos"* explained that the first and original definition of chaos was given by the Greek philosopher and poet "Hesiod " in his text (*Theogony*), by his famous saying over time "In the beginning it was the chaos, nothing but emptiness, colossal and infinite void", he defined chaos from the mythical aspect to be the origin of the universe; it is not the opposite of the system, but rather its partner. Hesiod had also placed chaos in the philosophical and scientific contexts and dealt with it as a natural and not a

supernatural phenomenon. Consequently, the concept of chaos became central to the critical examination of the natural world of the Greeks. Heraclitus, for example, believed that the world is made up of a group of "Fluxes", and continuous and uncontrolled change, similar to the undifferentiated, turbulent, and "chaotic" state of the universe, which "Hesiod" described before the system evolution. Heraclitus assumed that the change and chaos he observed in life was an important real phenomenon that deserved scrutiny. On the other hand, Parmenides assumed that the turbulent world observed by Heraclitus was an illusion. He concluded that the "real" ideal world is eternally fixed, because he cannot accept the fact that the "ideal" reality can change, so change means the deficiency in his view. The concept of "flux", or chaotic change, is one of the most controversial issues discussed in ancient Greek philosophy. Hesiod's definition of chaos deeply influenced the early Greek philosophers, whose ideas influenced later philosophers, including Plato.

Among the most accepted definitions by the scientific community is the one presented by Kellert in his book: *In the Wake of Chaos, Unpredictable Order in Dynamical Systems,* which viewed that chaos theory is "the qualitative study of unstable aperiodic behavior in deterministic nonlinear dynamical systems" (Kellert 1994 p. 2). Likewise, Hayles (1990 p. 9) explained that

> chaos theory is a wide-ranging interdiciplinary research front that includes work in such fields as nonlinear dynamics, irreversible thermodynamics, meteorology, and epidemiology. It can be generally understood as the study of complex systems, in which the nonlinear problems that perplexed Poincaré's contemporaries are considered in their own right, rather than as inconvenient deviations from linearity.

It is evident in these explanations that chaos theory has two main focuses. The first views chaos as a precursor and partner to the system, not the other way around. However, the second focuses on the hidden arrangements found within chaotic systems. Chaos in this use differs from real randomness, because it can be shown to contain deeply coded structures called "strange attractors". Moreover, chaos theory has two sides: it attempts to resist its globalization, and to synthesize its tendencies by accepting irrationality and the unknown, while at the same time trying to overcome indeterminism by defining the order within disorder.

James Gleick suggested that the scientific approach to nonlinear complex phenomena did not fundamentally change until chaos theory developed in the next decade, that is, the seventies. "Gleick" said that in the seventies of the last century, a few American and European scientists began to concern themselves with the matter of disorder and chaos. They were mathematicians, physicists, biologists and chemists. Everyone sought to search for the threads that gather all the phenomena of chaos. However, the term chaos was not officially adopted by the scientific community until 1986 in a conference organized by the Royal Society in London, and the conference defined chaos as "arbitrary behavior that occurs in the inevitable system" (Stewart, 1990 pp. 16-17)

## 3. Chaos Theory: Principles and Characteristics

### a. Sensitivity to Initial Conditions

The meteorologist "Edward Lorenz" realized the impossibility of predicting weather accurately for long periods due to what he later called the "butterfly wing effect", whereby "relatively small elements of the weather can spoil the value of the best weather predictions"

(Stewart, 1990 p37). As errors and unexpected things multiply, their effects unite and coalesce through a series of disturbances. They transform from small local elements into a movement that includes continents and appears to the eyes of satellites.

This effect has a scientific name, which is "sensitive dependence on initial conditions," just as in the American story mentioned by "Gleick" who said that "for want of a nail the shoe was lost, for want of a shoe the horse was lost, for want of a horse the rider was lost, for want of a rider the message was lost, for want of a message the battle was lost, for want of a battle the kingdom was lost, and all for the want of a horseshoe nail" (1988, p 39). Where the sequential events always reach a critical point, after which the effects of small things are amplified. The chaos theory looks at this matter based on the non-simple equations consisting of three mathematical equations, that is, the "nonlinear" equations, which are the equations that Lorenz used to create a complex behavior to simulate the weather first, and after to simulate a number of phenomena such as the movement of liquids in a cup of coffee, the movement of the dynamo, the wheels of water, etc., until he ended to the result of using three equations with three variables to describe the movement in the system, which launched the attractor known by his name "Lorenz's Attractor".

**b. Strange Attractors**

The concept of the attractor has always been attached to many interconnected details, which are interrelated concepts that formed chaos theory and its comprehensive concept later, and we mean by them: nonlinear equations (which cannot be solved unless with efforts), turbulence (the state that the system reaches after a period of time), and space of state (a modern mathematical method that transforms numbers into transformed images based on the given information).

"Lorenz Attractor" is considered as a mathematical being with a complex structure that defies normal engineering intuition. However, it is not easy to define the attractor. Attractors can be defined as a finite set that takes in paths. An emergency attractor is, simply, a model of the path that the system's behavior draws when we express it schematically. The behavior of nonlinear systems tends to shrivel or contract within specific regions of the state space, we call this constriction as the "attractor". Actually, it expresses a set of points that all converge to paths heading towards. For example, when we feed the computer with the movement of a complex system, the probabilities of that movement appear in the form of drawings that show the extent of the consistency in the movement of the systems that were thought to be chaotic. These probabilities look like a collection of points or a complex orbit.

It is believed that each system has one or more attractors, and these attractors change the systems with time depending on the type of forces to which the system is exposed; economic, social, political, climatic, or environmental, etc. Before the strange attractor was discovered, scientists dealt with two types of attractors:

**Point (Fixed) Attractor:** It is a condition in which the system stops changing in order to stabilize in a fixed position which does not change with the passage of time.

**The Limited-Cycle (Periodic) Attractor:** This path leads the system to fall into the trap of "controlled repetition", in other words, the permanent repetition of its previous behavior patterns without any slight change. The behavior of the system is completely identical to the behavior of the machine and its discipline and lacks any innovation spirit. This situation arises as a result of the interaction of two opposing forces within the system. As an example, "work / rest duality" means that a hard day's work pushes a person to desire a rest or a deep sleep, at the same time, this sleep prepares him for a new work day, henceforth, the cycle of work and rest is repeated every day without any occurring changes, even if there is a slight change.

However, with Strange (Chaotic) Attractor, the system becomes in a state of continuous change, renewal, and sustainable development. It is a condition in which there is no chance for repetition or reproduction of a previous behavior. Therefore, the system in this situation is permanent, and the transition from a state to a new state differs every single time (Hayles 1990).

**c. Fractal Forms**

The French mathematician Benoit Mandelbrot coined the term "fractal" and "fractal geometry" from the word 'Fraction' and its literal meaning is (fractional form). It is a method of measuring characteristics that did not have a clear description, such as the degree of roughness, breakage, or irregularity in things based on some techniques of creating shapes, or from some information. Mandelbrot left his new architecture working on some irregular patterns of nature. He noticed that the degree of regularity remains constant, across varying scales. Soon, his theory affirmed once again that the world is full of organized disorder. He called his discovery "fractal geometry". Fractal geometry determines the fractional dimensions of chaotic systems that cannot be measured or represented appropriately by using standard Euclidean geometry. On one hand, Euclidean geometry is based on points, lines, circles, and triangular, quadrilateral and pentagonal shapes. On the other hand, fractal geometry is explained in logarithms. It is a set of directions to create shapes (not straight lines, circles, or triangular or quadrilateral shapes, etc.). Computers translate the directions into wonderful shapes, which are frequent, variant shapes. These shapes are subject to the principle of self-similarity, so every part, no matter how tiny it is, has the characteristics of the original part which it was emanated from. This discovery would not have happened without computers and their development. The latter can perform enormous mathematical operations, with the ability to repeat information, and clarify the difference between each model and its parallel unlike humans who have always seen things as completely identical. He had no doubt that this similarity was changeable between the models, which was what happened with "Lorenz" at the beginning. The existence of the fractal forms is not limited to computers, but these shapes appeared in several disciplines other than mathematics, and each discipline proved its importance, magnificence, high accuracy and ability to explain The behavior of systems that were previously ambiguous, or those that seem chaotic, or have no clear order or cause to happen (Mandelbrot, 1975).

## 4. Chaos Theory in Literature

The essence of the human sciences shifted from an emphasis on universalizing integrated systems towards an interest in fractured local systems and their analysis patterns. Cultural studies, between the 1960s and 1980s, posed questions about how random differences in complex systems affect the evolution and stability of the system. It has been realized that small causes can lead to very large effects. This awareness includes increased attention of random fluctuations, and thus, interest in the role that chaos plays in the development of complex systems. New critics believed that textual boundaries are random constructions, whose components depend on who were reading and why. The texts were not deterministic or predictable, instead, they were able to become unstable whenever the slightest disturbance was presented.

The American critic Catherine Hayles (1990) stated that chaos should not be visualized as non-existent or null in the texts, but as a positive force in itself, the more chaos increases in the system, the more information it produces. Hayles also discussed the importance of chaos theory to literature and culture. Chaos theory is not confined to new theories and techniques' building, but

reaches "re-seeing" the world. In other words, chaos theory establishes a new worldview that has the ability to unify the sciences and humanities.

The place that chaos theory has gained in literature has been motivated to a large degree by popular texts such as: (*Chaos: Making A New Science* by Gleick) and (*Order out of Chaos* by Prigogine & Stangers), because these texts defined chaos theory as opposing for the institution and inclusive sciences. They stated that it differs cognitively and systematically from traditional sciences, as it focuses heavily on the prevailing topics and values in human sciences. Gleick argued that chaos theory defined itself in opposition to the Newtonian traditions that characterize Western science, and that the most enthusiastic advocates of the new science go so far as to say that the sciences of the twentieth century will be remembered for only three things: relativity, quantum mechanics, and chaos theory.

Chaos theory has become the third largest revolution in the physics during this century. This argument is supported by critics and theorists known as 'postmodern appropriators of chaos theory'. Douglas L. Kiel and Euel Elliott (1996), for example, argued that the emerging model of chaos has profound repercussions on Newton's previously dominant view of a mechanical and predictable universe. Whereas the Newtonian world is based on stability and order, chaos theory recognizes that instability and turbulence do not only pervade in nature, but are fundamentals to the development of complexity in the universe. Thus, chaos theory, like relativity and quantum theory, offers another blow against any individual commitment to determinism from Newton's view of the natural world. The scientific theory, with its modern details, helps to facilitate understanding of the world, regardless of the degree of its ambiguity, and helps scholars of literature to understand the most profound, chaotic and ambiguous literary works. Hayles (1990) emphasized that the latest writing styles take into account the chaos theory and its main features, namely:

1- There is a strong focus on the beginning of the work, and this is evident in the poetry and in the short story more particularly. The author focused on the first line or the first lines of the work, which has a strong effect on the development of the work as a whole.
2- Not to be linear, it is desirable for the causes and their consequences in a literary work to be very different. This is one of the manifestations of what is known as the butterfly effect. The latter refers to the fact that the fluttering of a butterfly wings in any place of the world may cause a hurricane in a very remote direction from the location of the butterfly. The application of this in literature calls for giving a great importance to the beginning representing a slight change in it, in the form of an event or events that may not seem important at the time, but the writer makes them a spark or the beginning of events that grow and amplify with the development of the literary work
3- It should be complex and structured, which makes its dimensions unpredictable. The nonlinear dynamics assumes a difference not only in volume but also in the qualitative value of this volume between linear and nonlinear systems. Where in the chaotic or disorganized systems the units of that system have no ability to recover their components, in complex systems content cannot be repeated twice. No matter how similar the circumstances are, there are minor changes remaining.
4- Necessity of an attractor in the literary work, or what is called stability islands, where the focus changes from one of the work units to return to the point of attraction. In a non-linear dynamic, the path appears as vortices inside vortices that repeat but never resemble

identical. Moreover, the small changes between those vortices can cause massive changes that send the path of the work in new directions.

5- Existence of a kind of exchange of benefits between the components of complex texts. To state the matter differently, the outputs emanating from a bifurcation will return to the text as inputs that enhance its structure. Therefore, bifurcation is considered as a creative source that benefits not only the text itself, but also the writer of the text whose experience increases with the growth of literary work, which makes him able to create more bifurcations for the text.

Hayles (1990) also looked at the science of chaos in terms of its relevance to creativity in general, and mentioned the existence of two branches of the science of chaos:

a) The first branch views chaos as a material by which the order is formed, and to be involved within the order rather than being contrasted to it. It means that "the order is the result of chaos". This branch is concerned with philosophy rather than reaching conclusions, as many literary works have arisen from this science and its applications.

b) The second branch of the science of chaos is concerned with discovering patterns of order within chaos, and it is the one which achieves results rather than relying on philosophy.

Hayles (1990) asserted that the link between science of chaos and postmodernity is based on the second branch that celebrates the complexity and ambiguity in the literary work, and considered them as a contributor to the globalization of the creative structures, but at the same time it is considered an anti-globalization.

Polvinen (2008) tried to get access to the literary work through a completely different proposition, a proposition that is adjacent to cultural criticism and humanism than to structural and deconstructive theories and beyond. She focused her criticism on the identity of the creative work and its reality without being biased neither chronologically nor historically for any philosophical position. The term "reality" refers to the overlapping ideologies produced by the human being. Polvinen declared that the latter must be respected by the critic because they are joint human efforts, and that true realism is the one found in physical phenomena and biology. Therefore, we, as critics, must assimilate it into literary studies as shown in her research. She said that there are striking similarities between the methods through which nonlinear mathematics can explain the structure in the universe and the methods that thinkers take in literature to enable the composition in the literary text. The metaphors derived from these methods can become sources of inspiration for thinkers in either field.

Within the framework of her theorizing, Polvinen presented the strange attractors and how they can be exploited in literary works in the work of "*Tom Stoppard*" that is entitled (*Arcadia*) and "*Frameworks of Arabesque art*" by "John Barth". As well, she tackled the concept of complex systems and self-similarity in her analysis of the human mind and the surrounding world. The author believed, based on her idea of reality, that the language of science came closer to the language of literature and culture in the stage of chaos science, and this is what made literature come closer to reality, as well, it develops and produces a new understanding.

John Barth approached chaos theory more in writing and theorizing, and he is the one who found in chaos theory the ideal metaphors and structures for expressing what he had been doing for decades, instead of treating it as an inspiration for something completely new. His novels that are ranged between two short novels that carry principles of nihilism: *"The Floating Opera*"

(1956), and "*The End of the world*" (1958), and between his long novels "*Letters"* (1979), and "*Tidewater Tales*" (1987). All stem from its author's interest in the nature of stories: how they arise, how they differ from writer to writer, from reader to reader, and how does it feed after her creators? "Barth" is the one who is credited for revealing the eastern origins of chaos theory in plastic art, and that is what he explained in his books: "*Further Fridays"* and "*The Friday book"*, and in an article entitled*: Chaos Theory Postmodern Science Literary Model.* The American storyteller and critic discussed the relationship of chaos theory to postmodernism from a comprehensive perspective that includes both ancient and modern human creativity. This relationship does not include literature solely, but transcends to include other arts and aesthetics with features similar to those upon which chaos theory is based. The origins of the theory of chaos, according to him, go back to the Islamic Arabesque art, represented in the designs of oriental carpets. They are based on small decorative units of repeated lines and curves which represent the general geometric shape of the carpet. The overall shape of the carpet is usually limited by a main frame and / or several frames that surround the repeating small units and give them meaning (these shapes are similar to the fractal geometry of Benoit Mandelbrot) (Polvinen, 2008).

According to Barth's point of view, the art of oriental arabesque is reflected in its fictional literature, *Rubaiyat al-Khayyam* and The Book of *One Thousand and One Nights* are an evidence of that. There are repetitive cutting units bounded by a general frame, in which other interconnected frameworks are intertwined in a non-linear and unexpected way. Here the critic distinguishes between the nonlinearity of postmodernism and the nonlinearity of the science of chaos in literature. The former relates to the path of narration (this characteristic is not limited to postmodernity; it is one of the characteristics of modernity as well). As for the nonlinearity of the latter, it is related to the disproportion between the idea and the result and the events resulting from it. For example, a fringe event can generate a series of important major events that violate the recipient's expectation, and this is what Chaos theory calls "bifurcation" (Al-Aboudi, 2011).

In this context, Al-Aboudi cited the reason for Barth's interest, theoretically and artistically, in the theory of chaos. She asked the question: why should the writer be interested in the theory of chaos? And answered by: for two reasons. The first is to give importance, not only for his literary work form and language, but to all its components of plot, focus, development, style and description. As well as to give great importance to the external influences which contribute in the formulation of the work, such as the writer of the work and the culture that produced him. These components all become indications of the meanings that could be contained in the work.

The second reason is that the writer does not write a work that is characterized by novelty once he writes about new matters. Novelty means that the author writes according to the latest writing styles, and the latter are those that reflect the features of chaos theory, such as interest in the beginning of the work, the structure of the text, and the presence of strange attractors, etc. Barth was not the only one interested in the theory, there are many studies that support his opinion and link the theory to postmodernism, and even beyond.

## 5. Chaos Theory and Postmodernism

Hayles delt with many concepts that are common between chaos theory and postmodernism. The interpretation and the literary application of chaos theory, for her and for critics specializing in the theory, are based on two basic approaches: the studies of social and

imaginary systems conducted by the human sciences can be compared to the systems taught by science, and that the similarity aspects exist between it and postmodernism to the extent that the two can be considered parallel chronological and theoretical models (Ward, 1998). In addition, both shared literary works that reflect chaotic and postmodern concepts in that they:

1- Acknowledge a type of system as its basis, the system may be represented in the return of characters to the past, or in the inclusion of events from the past or narrations from it within the new work, that is, rewriting the past to draw the present. Or the system is represented in the presence of events in the literary work that contain a type of the order (similar to a tennis player throwing balls), but the results of its presence are chaotic.
2- Introducing foreign elements to the system to dismantle its unity and create a crack for chaos to enter (Al-Aboudi, 2011).

In her introduction of the book *"Chaos and Order: Complex Dynamics in Literature and Science*" (1991), Hayles argued for an indivisible relationship between postmodernism theory and chaos, stating that

> chaos theory is influenced by the culture within which it arose... it is one site within the culture where the premises characteristics of postmodernism are inscribed. The postmodern context catalyzed the formation of the new science by providing a cultural and technological milieu in which the component parts came together and mutually reinforced each other until they were no longer isolated events but an emergent awareness of the constructive roles that disorder, nonlinearity, and noise play in complex systems (p.5)

Hayles (1990) explained that the subject of her study is "complex interconnections" between theory, technology and culture. She also focused on "feedback loops" that link science and culture, arguing that these feedback loops indicate the close relationship between chaos theory and postmodernism. She further manifested that chaos theory and postmodernism both contribute to and resist the globalizing tendencies of modern science and modern culture:

> The science of chaos shares with other postmodernisms a deeply ingrained ambivalence toward totalizing structures. On the one hand, it celebrates the disorder that earlier scientists ignored or disdained, seeing turbulent flow not as an obstacle to scientific progress but as a great swirling river of information that rescues the world from sterile repetition. On the other hand, it also shows that when one focuses on the underlying recursive symmetries, the deep structures underlying chaos can be revealed and analytical solutions can sometimes be achieved (p. 291)

Furthermore, Hayles (1990) studied the similarities and differences between chaos theory and postmodernism to ascertain the influence of the former on the latter. She argued that deconstruction shares with Chaos theory the desire to penetrate the boundaries of classical systems through introducing it to a new type of analysis, by which information is created rather than preserved. From her perspective, the principle of indeterminacy is essential when comparing between chaos theory and deconstruction. The latter reveals the interrelation between traditional ideas of the order and oppressive ideologies in the same way that chaos theory questions the dominance of the order's discourse. The critic pointed to the fact that chaos theory and postmodernism prefer the concept of disorder over order, because both paradigms reflect

traditional priorities: Chaos is considered more fertile than order, uncertainty is privileged above predictability, and bifurcation is a truth that is denied by arbitrary definitions of closure.

The interest in postmodernism and chaos theory was not limited to "Hayles". A number of influential texts have been published in the past decades to document the parallels between chaos theory and postmodernism. In "Michael Zimmerman's" book "*Contesting Earth's Future: Radical Ecology and Postmodernity*", the critic argued that chaos theory appears to be compatible with postmodern theory's critique of modernity's search for a univocal, stable structure that organizes all phenomena" (p13). Furthermore, the critic pointed to one of the most obvious similarities between chaos theory and postmodernism; both reject linear causal models and the structures of the paradigms that precede them: Newtonian science and modernism. Besides, both acknowledge a collapse of the 'modern' categories of logic, objectivity, and rationality. Instead, an epistemology that is built on the principles of indeterminism and uncertainty has been promoted (Ward, 1998 p. 5).

In another context, "Young" identified other similarities between chaos theory and postmodernism in *"Chaos and Social Change: Postmodern Metaphysics"* (1991) in which he saw that chaos theory "decenters" determinism, certainty, coherence, and order from priority in science. Thus, chaos theory corresponds to the unbounded and uncertain parameters of postmodern culture. Moreover, "Young" clarified that chaos theory removes all the claims of perfection, finality, normality or historical necessity from its indisputable elevated position, similarly to what postmodern theory does. Hence, he perceived chaos theory to provide an elegant theoretical envelope for locating postmodern science.

## 6. The Politics of Chaos in the Contemporary Algerian Novel

The chaotic postmodern literary work is characterized by: sensitivity to elementary conditions, nonlinearity, complexity, variable repetition, tricky information, unpredictability, different focus points (i.e., strange attractors), and bifurcation (i.e., many inputs and outputs). The fictional works respect these characteristics, making the creative text an open field for study from all sides. Chaos theory in literature creates renewable systems which critics do not have to link to any time, place, or space, because the use of these characteristics develops the literary work after each discovery, and the theory is full of surprises, due to its unpredictable nature. Despite its accuracy, the theory is not certain and open. It leaves a permanent chance for doubt and possibility. Hence, the chaotic narrative systems are fictional and open to interpretations; if the reader arrives at an interpretation, it is his own and not imposed on others because the text wants it as well.

Writing takes a liberating turn for the narrators and writers in the novels of "*Sierra de Muerte*" by "Abdel Wahab Issawi", "*Nawras Basha*" by "Hadjer Kouideri", "*The blood of the deer"(Dam Elghazal*) by "Merzak Bagatash", and "*The blues of resurrection"(Hadayan nawakis Elkiama*) by "Muhammad Jaafar". Whereby writing is taken as an instrument liberated from all the various restrictions. The creation of change begins by discovering the beginning of chaos within the writer's self in order to control the act of writing and to manage it, and by exploiting the gaps and coincidences and employing incentives and obstacles. The self, then, is aware of the strategy that makes its process, and this leads to the appearance of a new and permanently changing self that is difficult to anticipate, draw an end to, or hold on to its complete secret. As a consequence,

the ends in such narratives are more like stopping the narration rather than reaching a satisfying end for the narrator.

However, the texts of the "Boukebba" *"Shadow Skin (Jild Dhil)"* and "*The Crescent Scar (Nadbat Elhilali)"* represent special dynamic systems that reject stability, certainty, and the unwavering belief in the sacred and the One, with a mixed variety of renewed strategies such as pluralism, breach, unpredictability, non-linearity, organized complexity, reflexivity, self-criticism, etc. It is possible to say that this diverse collection, despite its complex, jumbled and confusing concepts, has managed to achieve an aesthetic approach to the novel, which is new in the Algerian novel. But aesthetic is not related to strategy only, but also linked to another system that is more complex than the form, which is the system of concepts presented in their distinction and complexity. His creative process was based on the relationship between order and chaos.

According to "Waciny Laredj", in his novel "*2084: The Tale of the Last Arab*", the system of the narrative novel is aligned with the philosophy that the characters take. When dividing the characters into certain and uncertain, the novel allows for the emergence of controlled, deterministic, predictable worlds, and other changing, unstable, indeterministic, and unpredictable worlds. It is through these worlds that "Waciny" placed the gaps in the narrative system to show the gaps in the thinking of the characters, from both the philosophical and the scientific sides. The gaps message is intended and represents the strange attractors around which the narrative revolves in this novel.

The strange attractors create narrative swirls in different forms of varying accuracy, magnitude and aesthetics. They are strange because they affect without showing their influence. *"In another Novel (Fi Riwayatin Okhra)"* by the novelist "Mohammed Allawa Hadji", strange attractors are locomotive and dynamic, they take the form of a circular spiral that grows and develops with each event, which means that they are not static, but rather changing, and include new elements that offer a new and constantly unexpected dimension every time. Since the use of time was unstable and non-linear as a preliminary information to predict and anticipate events and build them at the same time, the dynamic of narration has not lost its vitality in all chapters of the novel, and the dynamic here does not refer only to time, but rather, there is a multiplicity of characters between the original and fake, or similar copies, as these characters are intertwined in a complex network, creating many question marks for the reader.

In the novel *"Sacarat Nadjma"* by "Amel Bouchareb", it is found that the more the information entropy increases, the more the characters get internally turbulent. Henceforth, time for each character that has large information entropy, automatically develops from our sense of the character's inner time without having to search for its past, present and future. The readers' vision will be clear whenever they get to understand this rule. However, if we view entropy as a measure for the degree of freedom possessed by the parts of a system, then an increase in entropy represents an increase in the need for a large amount of information, which helps the characters to put many restrictions, and gives the information seeker a greater degree of freedom than others. This overlap between stability and chaos in the narration form an inflation for the effect of dissipated structures, or simple information that seems ineffective. Thus, these small events take a significant place in the novel's system and make their end.

"Rachid Boudjedra" put in *"the chaos of things"* an applied meaning of chaos in the field of literary narration that is simple and deep at the same time. When repetition - with other things he mentioned - is the basis of narration and speech, and a principle of life chaos and its logic at the same time, it is absolutely not just a repetition. It is the variant repetition that many philosophers and scientists have tackled. The repetition that is focused on his mixed memories creates strange attractors that draw the path of the novel and control the narration, while the narrator is trying to reach the self-organization of the chaos within himself, focusing on the psychological knowledge of the self. As a consequence, the technique of transcription is produced, it was taken as a technique that violates all of his previous experiences, combining different techniques in narration, with a confusing chaotic renewal, which stems from the narrated topic. Henceforth, the more psychological fragmentation increases, the more there will be a complexity in the method of communicating this fragmentation to the recipient, and this prompts us to say that Boudjedra is still searching for a reader who understands his chaos.

## 7. Conclusion

In conclusion, we point out that chaos theory is theoretically and practically, and its use as a subject and method at the same time is considered a scientific risk, especially in the field of literature. Its application to the literary text is an exploratory procedure that requires accuracy and caution, because the first error in the analysis leads to many errors which drive the researcher to a point of stagnation, in which the text is confused, and enters a maze of misunderstanding that result in the fall of the entire process of criticism. The concepts of the theory are not limited to its diverse scientific origin between mathematics, physics, biology and meteorology. Rather, its philosophical and intellectual origin constitutes the most difficult element because the theory is a mixture of order and chaos, which are two important elements and partners that make the theory. The mix between popular concepts of chaos and its contemporary concept associated with scientific theory, made the interpretation somewhat difficult to introduce its concept to the field of the humanities, which is the same thing that mathematicians and physicists faced in the early emergence of the theory. This interesting "mixture" of chaos and order allows researchers and scientists to take a different approach in studying the processes that were thought to be completely random.

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