

## Quantum Politics New Methodological Perspective

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*(Received 15 Oct 2014 Accepted 1 Jul 2015)*

### Abstract

The unpredictability nature of politics has made it fit to marry with quantum theory which by definition stands upon this characteristic. In recent years, “chaos and quantum theories” have attracted academics and scholars as alternative research methodology across a wide range of social science discipline including politics and international relations.

Traditionally, we understand political phenomena and international relations in terms of positivist approaches based upon Newtonian worldview, which is mechanistic and reflecting “systemic determinism” governed by eternal universal laws. This is how we used to explain for instance the concept of “Balance of Power” and a host of other theories during the cold war. The post cold war period, and most particularly the unpredictability of the September 11 events, proved the methodological insufficiency and inadequacy of this approach. In recent years many authors have questioned the wisdom of continuing to rely on the Newtonian philosophy to deal with the emerging problems in world affairs and domestic issues which no longer respond to the conventional epistemological and ontological views of the past. Reliance on mere cause and effect, two dimensional “space and time,” political determinism, structure, interaction, order, sovereignty and the like are not responsive to our present methodological requisites. This paper is an attempt to explain the matter through a new methodological approach built on chaos and quantum theories.

**Keywords:** International Relations, Politics, Methodology, Quantum Theories.

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This paper is a follow-up of a previous essay by the author on Dynamic versus Static Political Inquiry which was written last January 2011. It is suggested that the two papers be read together for better understanding the subject. See: Academia [www.academia1.blogspot.com](http://www.academia1.blogspot.com)

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## **Quantum Politics**

### **New Methodological Perspective**

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**Ali Asghar Kazemi**<sup>\*</sup>

#### **Introduction**

Recent events and escalating crises at the start of the year 2011 throughout the Arab states of the Middle East and North Africa, from Tunisia and Egypt to Yemen, have truly shocked observers, researchers, and specialists who missed the symptoms of these fundamental shifts. It appears that traditional and existing theories have not been able to predict the development of unexpected changes in the region. This paper is an attempt to explain the matter through a new methodological approach built on chaos and quantum theories.

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If you are among those students of politics and international relations who are fed-up with enormous numbers of theories, methods and paradigms in these fields, try to understand this last one exposed in the present short essay. It may help you to view and discuss political phenomenon in a different and new way. Of course, the novelty of this approach may make its comprehension a little bit difficult. Therefore, I do not guarantee that you will grasp the subject swiftly and make a separate research case. It is suggested that the interested reader pay great attention when going through the text and references and to repeat the process if necessary.

### **Paradigm Shifts in Politics**

When we speak of “paradigm” we cannot skip over the name of Thomas Kuhn<sup>1</sup> who has made several important claims and contributions concerning the progress of knowledge.<sup>2</sup> The followings are the most notable that are relevant to our study in this paper:

First: science undergoes periodic "paradigm shifts" instead of progressing in a linear and continuous way; . second: these paradigm shifts open up new approaches to understanding that scientists would not have considered valid before; and third: scientists can never divorce their subjective perspective from their work; thus, our comprehension of science can never rely on full "objectivity" - we must account for subjective perspectives as well.<sup>3</sup>

Traditionally, we understand political phenomena and international relations in terms of positivist approaches based upon the Newtonian worldview, which is mechanistic and reflects “systemic determinism” governed by eternal universal laws.<sup>4</sup> This is how we used to explain, for instance, the concept of the “Balance of Power” and a host of other theories during the cold war. The post-Cold War period, and most particularly the unpredictability of the events of September 11, proved the methodological insufficiency and inadequacy of this approach.

In recent years many authors have questioned the wisdom of continuing to rely on the Newtonian philosophy to deal with emerging problems in world affairs and domestic issues that no longer respond to the conventional epistemological and ontological views of the past.

Reliance on mere cause and effect, two dimensional “space and time,” political determinism, structure, interaction, order, sovereignty and the like are not responsive to our present methodological requisites.<sup>5</sup>

Many attempts have been made to remedy this paucity in political inquiries and a number of post-positivist approaches have been devised to fill this gap.<sup>6</sup> From an ontological perspective, we find those departing from objective (mechanistic) to subjective (interpretive) approaches; and from an epistemological point of view, we depart from mere description and explanation to “understanding” of the political phenomenon in its entirety. Thus emerged, what we now refer to as post-modern approaches that include hermeneutics, language and discourse analyses as well as all other methods relating to post-behavior and post-structural concepts.<sup>7</sup>

Despite all these endeavors, we still feel that we are in an epistemic vacuum and are not sure about the explanatory and predictive capacity of our methods and approaches. This is what we refer to as an uncertainty in politics that gravely impedes our inquiries. Let us see whether quantum theory has anything to offer to remedy this malaise.

### **Quantum Theory and Uncertainty in Politics**

The unpredictable<sup>8</sup> nature of politics makes it fit to marry with quantum theory, which by definition has this characteristic. In recent years, “chaos and quantum theories” have attracted academics and scholars as an alternative research methodology across a wide range of social science disciplines, including politics and international relations.

Most of us are very bothered with the idea of uncertainty and unpredictability in politics and are not satisfied with expert explanations given about events and situations that have led to certain drastic changes in the domestic and international realms. This has guided some thinkers who worry about the future to embrace the concept of “quantum theory.” By the same token, the “Uncertainty Principle” is one of the most renowned concepts in the field of quantum theory formulated by Heisenberg.<sup>9</sup> The idea is that when we observe a phenomenon, our mere act of observation affects the condition of the observed “thing.” This idea in some ways matches the postmodern theory of politics. The underlying

common factors are what "Post-Modernism" proposes; that is, the conviction that all "truths" are subjective and relative and that there are no objective facts.

In this view, "there are no immutable natural laws to be discovered. Everything that seems lawful is at best probabilistic, and perhaps fundamentally random." In other words, anything that seems to be immutable is merely a consequence of "the limited time horizon of humans and therefore, nothing can be predicted with certainty about the events that may happen in the future. If we accept this argument and expand it to the field of social science and politics, we will eventually feel much easier in our attempts to make faulty predictions.

While the concept of quantum theory goes back to the early 20<sup>th</sup> century,<sup>10</sup> its entry and application in social sciences and especially in politics is relatively new. Many modern political scientists have claimed that they had thought of or used the concept one way or another in the course of their teaching or research.<sup>11</sup> However, not until some years ago, with the publication of an innovative book: *Quantum Politics: Applying Quantum Theory to Political Phenomenon* edited by Professor Theodore L. Becker, did the subject become widely exposed to academic debate.<sup>12</sup>

According to Becker, "quantum physics provides the means for replacing 18th century political and economic philosophies with a new paradigm more consistent with our current understanding of physical reality."<sup>13</sup> A number of political scientists have contributed to the elucidation of this subject. The main pivotal argument here is "that a Newtonian world view dominant in the past, can no longer explain political phenomena."<sup>14</sup>

The Newtonian theory is more attuned to classical and liberal democratic thinking and thereby to indirect, representative democracy. Quantum theory, on the other hand, is linked to participatory democratic thoughts, that is to say "a more direct and purer form of democracy."<sup>15</sup> The classical Newtonian worldview is rationalistic, mechanistic, and predictive - relying on cause-and-effect, and assuming an objective real world that can be objectively observed and measured by a trained, neutral observer, whereas "quantum politics is based on the unpredictable, contradictory nature of human beings."<sup>16</sup>

Most social and behavioral science theories developed since Newton say that these assumptions are not the basis for understanding actual

human behavior. Darwin and Freud, to name two intellectual giants of the 19th century, have quite different paradigms which suggest how marginal indeed are rationality, predictability, and objectivity in human decision making. But in the early 20th Century, quantum physics seemed to go even farther.

### **Quantum Politics and Post-Modernism**

In our ordinary reasoning and academic arguments we usually assume that men are rational and act accordingly to increase their gains and lower their losses in their interactions. Furthermore, it is assumed that in a democratic society, law and politics, incorporated in a legal system and the relevant political institutions, are the product of collective wisdom that encourages good behavior on the part of citizens and government responsiveness and accountability. However, this view is challenged by critics, including in most democracies. This view also relates to assumptions underlying modern political systems, such as people's voting behavior, freedom of expression, and other kinds of liberties associated with fundamental rights in society.

A critical introduction to the debate concerning the conceptual foundations of quantum mechanics and the problems it has posed for physicists and philosophers from Einstein to the present is reflected in a book by Christopher Norris: *Quantum Theory and the Flight from Realism*.<sup>17</sup> According to Norris "Quantum theory has been a major influence on postmodernism, and presents significant challenges for realists."<sup>18</sup> Clarifying these debates for the non-specialist, Norris examines the premises of orthodox quantum theory and its impact on various philosophical developments. "He subjects a wide range of opponents and supporters of realism to a high and equal level of scrutiny. Combining rigor and intellectual generosity, he draws out the merits and weaknesses from opposing arguments."<sup>19</sup>

On the one side of the quantum world view, there are some scientists who suggest that "there is no real world, or at least no one real world;"<sup>20</sup> meaning that there may be many and perhaps an infinite number of worlds. In this contention, even if an objective real world exists, one cannot say anything with certainty about it at the micro level since any

attempt to observe or explain and quantify the observed world will disturb its condition. This is one important element of uncertainty in human observation of the universe: because he is a part of it and not an independent observer.

Political scientist, Harold Lasswell,<sup>21</sup> who has studied almost everything new in political science before and after the Second World War, has also dealt with “the idea of policy sciences which is very compatible with a quantum perspective.” Pioneer positivist, Auguste Comte, who must be viewed as the father of the entire social physics perspective, also contributed to the explanation of the Positive philosophy and introduced the important relationship between theory, practice and human understanding of the world. Comte’s emphasis on quantitative mathematical basis for decision-making remains with us even today. It is a foundation of the modern notion of positivism, modern quantitative statistical analysis, and business decision-making.<sup>22</sup>

The point here is that when politicians claim something as fact or truth, they are hiding some aspects of their actions or decision from the public since there cannot be a concrete truth in the corner that one might grasp. But, in politics, you are permitted to build your own truth and sell it to the public either through convincing arguments or through concealment. Therefore, it is safe to suggest that in politics pretending to know the truth is surely a sign of weakness, rather than an admission of the existence of human fallibility and the lack of certainties in life.

Human fallibility is a fact of life and since politicians are human they too make mistakes like others. But the important point is to admit the fact and embrace the idea of uncertainty in politics and adopt the idea of Quantum Politics. There is no reason to get excited when we disagree with each other. The solution is to discuss the ideas we disagree upon and to be prepared to admit when we are wrong. This means that we must move away from the old dichotomy of 'we're right and you're wrong' attitudes “towards the kind of Open Society, discussed by Karl Popper<sup>23</sup>. We don't have to stick to the old models anymore.”

### **Quantum Politics and Chaos Theory**

Students of international relations are more or less familiar with the notion of “anarchy,” which somehow represents the condition of “chaos” in a social or political environment. This, in fact, describes the dynamic

nature of international system, composed of more than 200 independent nation-states that are the sole arbiters of their decisions and actions. Anarchy is the condition of the “state of nature” or rule of the jungle in which naked power and the instinct for survival are determinant factors. This means that chaos and anarchy are inseparable parts of the global system.

I have called that condition the “critical order” in my last book: *The End of Politics and the last Myth*.<sup>24</sup> This represents the threshold of a fragile order in a system that can break down with the slightest unrestrained stimulus and cause instability of the whole system in a chain reaction. We may explain this in term of the famous “Butterfly Effect”<sup>25</sup> in chaos theory.

From an academic point of view, chaos theory is a field of study in applied mathematics, with applications in several disciplines including physics, economics, biology, and philosophy. Chaos theory studies the behavior of dynamical systems that are highly sensitive to initial conditions; an effect which is popularly referred to as the butterfly effect. Small differences in initial conditions (such as those due to rounding errors in numerical computation) yield widely diverging outcomes for chaotic systems, rendering long-term prediction impossible in general.<sup>26</sup>

This happens even though these systems are deterministic, meaning that their future behavior is fully determined by their initial conditions, with no random elements involved. In other words, the deterministic nature of these systems does not make them predictable. This behavior is known as “deterministic chaos,” or simply chaos. Since the International System can be considered a nonlinear dynamic system, it is reasonable to take this theory into account for the study of the global order.<sup>27</sup>

The impact of Chaos theory on social science and politics relates to such concepts as class, race, gender, and ethnicity in society. This goes beyond existing paradigm, epistemology as well as the prevailing structural models and the underlying assumptions. Some scholars believe that chaos theory provide “a means of escaping structuralism's two signal flaws: it is inherently dynamic and time-sensitive and it permits a definition of social structural entities in such a way that if real, living, unique human beings vanished then the structures of society would also vanish.”<sup>28</sup>



## Chaos Theory and the “Butterfly Effect”

One of the most interesting dimensions of chaos theory that can be applied to politics and international relations is the famous “butterfly effect.” The butterfly effect “is a metaphor that encapsulates the concept of sensitive dependence on initial conditions in chaos theory; namely, a small change at one place in a complex system can have large effects elsewhere.”<sup>29</sup>

In simple term, the concept refers to the idea that “a butterfly's wings might create tiny changes in the atmosphere that may ultimately alter the path of a tornado or delay, accelerate or even prevent the occurrence of a tornado in a certain location.”<sup>30</sup> The flapping wing represents a small change in the initial condition of the system, which causes a chain of events leading to large-scale alterations of events. This impact is like “domino effect”<sup>31</sup> in that a series of events successively create similar change in the subsystems of a large global system. Recent crises in North Africa and the Middle East could be cited as vivid example of this kind.<sup>32</sup>

Chaos theory can also provide an analytic paradigm which might allow us to see how providing a set of democratic laws to a totalitarian culture does not necessarily transform it into a democratic society. This explains the reverse effect of chaos in a resistant system non-sensitive to its environment, which usually represents a closed as opposed to an open society.

We may apply chaos theory to human behavior as well. The findings of some research confirm the universality of chaotic behavior within human interactions.<sup>33</sup> These findings “challenge some of the underlying assumptions on which work motivation theories are based, and suggest that chaos theory may offer useful and relevant information on how this process is managed within organizations.”<sup>34</sup>

The study further suggests that systems with chaotic dynamics share certain important features that can be categorized as follows:

- They show “aperiodicity,” meaning that they happen at irregular intervals. In other words, they are systems whose dynamics or state of motion never pass twice along the same path;
- The dynamic behavior of the system stays within a finite range of values, after which it is self-contained;
- The dynamic is deterministic, that is, it is regulated by rules; and finally,

- The system shows sensitive dependence on initial conditions. In other words, a tiny difference at starting points, will give rise to very different evolutions of the system.<sup>35</sup>

As stated above, this last aspect is also known as the “butterfly effect” which deals with the notion of proportionality or lack of it at the initial stage and the final outcome. In other words, sometimes a small and almost imperceptible disruption in the initial condition of sub-systems is capable of generating significant changes in the behavior of a larger system.<sup>36</sup>

The concept of the butterfly effect is frequently referred to in popular culture in terms of the novelty of a minor change in circumstances causing a large change in the outcome. What the butterfly effect seems to posit, is that the prediction of the behavior of any large system, (such as the global system) is virtually impossible unless one can account for all the tiny factors, which might have a minute effect on all the sub-systems. Thus, large systems like international order remain impossible to predict because there are too many unknown factors and variables, which concurrently occur in a dynamic (non-linear) fashion, to take into account.<sup>37</sup>

## Conclusion

Political events and crises remain unpredictable and difficult to forestall. Conventional positivist and mechanistic approaches based upon a Newtonian worldview which reflects “systemic determinism” governed by eternal universal laws, are no longer responsive to our inquiries. Interpretive approaches in the post-modern period too, while confirming uncertainty in human behavior and collective state conduct, lack sufficient clarity for prescriptive actions and predictions.

Events that escalated into a full-blown revolution in Tunisia and proliferated to Egypt and other states, were merely due to a “butterfly effect” that gained momentum after an unemployed graduate Tunisian citizen set himself ablaze. Similar incidents often happen elsewhere without being exposed to public attention but, this instigated a tornado that pierced through North Africa and the Middle East with amazing impacts. The phenomenon surprised everybody, from experts to politicians to the average person.

Characteristics of non-linear and spiral-exponential equations in situations with numerous variables in spheres of politics and international relations lead us to go beyond traditional methods influenced by a post-Newtonian world view for satisfying explanations. Quantum theory might shed some light on the dynamic behavior of systems which make them difficult to predict. Quantum politics and chaos theory can better describe the fragile condition of authoritarian political institutions, governments, and states' interactions. The notion of the butterfly effect tells us that a minor change in a dynamic system can cause a large change in the outcome. However, depending on the unpredictable circumstances, the same stimulus may produce no result; or by the same token change the course or attenuate the force of a crisis. Thus we cannot generalize the rule with certainty in other similar situations.

Potentially chaotic, but deterministic systems in international relations, whose future behavior is not fully determined by their initial conditions, have a tendency to perform in a random fashion. In other words, the deterministic nature of these systems does not make them predictable. This is called "deterministic chaos." If we consider the International System as a nonlinear dynamic system, then we can reasonably argue that the global order is ruled by chaos theory.

As stated above, the impact of chaos theory relates to all aspects of politics and international relations in the global context. This makes the underlying assumptions of an existing paradigm, epistemology, as well as the prevailing structural models, out of date. Whether we can build a convenient methodological tool on the basis of this new worldview depends on our effort to fully grasp and apply the post-Newtonian perspective in our academic inquiries.

## References

1. Thomas Samuel Kuhn; July 18, 1922 – June 17, 1996 was an American physicist who wrote extensively on the history of science and developed several important notions in the sociology and philosophy of science.
2. See e.g.: Kuhn, T.S. **The Structure of Scientific Revolutions**. Chicago: University of Chicago Press, 1962. Kuhn's work has been extensively used in social science; for instance, in the post-positivist/positivist debate within International Relations
3. **The Structure of Scientific Revolutions** was originally printed as an article in the International Encyclopedia of Unified Science, published by the logical positivists of the Vienna Circle. In this book, Kuhn argued that science does not progress via a linear accumulation of new knowledge, but undergoes periodic revolutions, also called "paradigm shifts" (although he did not coin the phrase), in which the nature of scientific inquiry within a particular field is abruptly transformed. Taken from **Wikipedia, the free encyclopedia**.
4. Cf. Dimitrios E. Akrivoulis , The 'Quantum Politics' Metaphor in International Relations: Towards a Hermeneutics of Political Metaphoricity Paper presented at the **57th Political Studies Association Annual Conference** University of Bath, UK, 11-13 April 2007
5. Cf. Ibid. See also Walker, R.B.J. (1991) "State Sovereignty and the Articulation of Political Space/Time", **Millennium**, Vol. 20, No. 3, pp. 445-461. See also e.g.: DeTombe, Dorien J. & C. van Dijkum (Editors) **Analyzing Complex Societal Problems: a methodological approach**, Munich; Mering; Hampp, 1996 .
6. See e.g. my paper: Ali Asghar Kazemi, "Dynamic versus Static Political Inquiry" in The **Middle East Academic Forum**. www.aakazemi.blogspot.com January 2011.
7. Many contemporary philosophers and scholars have contributed to this development among whom the names of Heidegger, Sartre, Merleau-Ponty, Bachelard, Foucault and Riceour are most cited in academic milieu.
8. Unpredictability may be based on incomplete data or on non-linear feedback loops which is the case of chaos theory. "A process that is unpredictable is undetermined in terms of time and other variables that determine the state of a process. Cited in: DeTombe, Dorien J. & C. van Dijkum ,**Analyzing Complex Societal Problems: a methodological approach**, 1996.
9. The **Heisenberg uncertainty principle**, a quantum physics concept which is commonly (yet inaccurately) used to refer to the fact that in the Copenhagen Interpretation model of quantum mechanical behavior, observers affect what they are observing, by the mere act of observing it alone (this is actually the observer effect, and is commonly confused with the Heisenberg uncertainty principle). In quantum mechanics, the

Heisenberg uncertainty principle states by precise inequalities that certain pairs of physical properties, such as position and momentum, cannot be simultaneously known to arbitrarily high precision. That is, the more precisely one property is measured, the less precisely the other can be measured. See : <http://en.wikipedia.org/wiki/Heisenbug#Heisenbug> See also: [http://en.wikipedia.org/wiki/Uncertainty\\_principle](http://en.wikipedia.org/wiki/Uncertainty_principle)

10. Quantum theory evolved as a new branch of theoretical physics during the first few decades of the 20th century in an endeavor to understand the fundamental properties of matter. It began with the study of the interactions of matter and radiation. In contrast to Einstein's Relativity, which is about the largest things in the universe, quantum theory deals with the tiniest things we know, the particles that atoms are made of, which we call "subatomic" particles. In contrast to Relativity, quantum theory was not the work of one individual, but the collaborative effort of some of the most brilliant physicists of the 20th century, among them Niels Bohr, Erwin Schrödinger, Wolfgang Pauli, and Max Born. Two names clearly stand out: Max Planck (1858-1947) and Werner Heisenberg (1901-1976). Planck is recognized as the originator of the quantum theory, while Heisenberg formulated one of the most eminent laws of quantum theory, the Uncertainty Principle, which is occasionally also referred to as the principle of indeterminacy. See **Wikipedia** under the subject of "Quantum Theory."
11. I used the concept in my early manuscript in the last chapter of a book on **Method and Insight in Politics** in late 1980's when I was dealing with new emerging methods and approach in political science. See Ali Asghar Kazemi, **Method and Insight in Politics, (A Philosophical, Scientific and Methodological Approach)**, Tehran: Institute for Political and International Studies (IPIS), 1995. Chapter 11, p. 282.( In Persian)
12. One reviewer of the book has described it in the following manner:"I am confident that this volume will mark a turning point in political theory, political design, and eventually political practice. It definitely should be on the assigned reading list of every student of politics, and every political activist. I don't expect many current politicians to read it, although they certain should, but I do expect it to be a kind of Bible for future political generations." Reviewed by Jim Dator
13. Theodore L. Becker, ed. **Applying Quantum Theory to Political Phenomenon** New York; Westport, Connecticut; London: Praeger, 1991. 232 pages, plus 16 page preface
14. *ibid*
15. *ibid*
16. The standard explanation of what takes place at the quantum level is known as the Copenhagen Interpretation. This is because much of the pioneering

work was carried out by the Danish physicist Niels Bohr, who worked in Copenhagen. Quantum theory attempts to describe the behavior of very small objects, generally speaking the size of atoms or smaller, in much the same way as relativity describes the laws of larger everyday objects. We find it necessary to have two sets of rules because particles do not behave in the same way as larger everyday objects, such as billiard balls. We can, for example, say precisely where a billiard ball is, what it is doing, and what it is about to do. The same cannot be said for particles. They are, quite literally, a law unto themselves, and why this should be so is a source of much debate.

17. Christopher Norris, **Quantum Theory and the Flight from Realism: Philosophical Responses to Quantum Mechanics (Critical Realism)** (London: Routledge, 2000) [Paperback]. Prof. Norris is Distinguished Research Professor in Philosophy at Cardiff University. He is one of the world's leading scholars on deconstruction, and the work of Jacques Derrida. This book is a valuable source for those who are interested in the debate concerning the conceptual foundations of quantum mechanics and clarifies the problems it has raised for physicists and philosophers. In a sequence of closely argued chapters, Norris examines the premises of orthodox quantum theory, as developed most influentially by Bohr and Heisenberg, and its impact on various philosophical developments.
18. *ibid*
19. Norris, *Ibid*
20. To them, there may be many worlds or may be infinite worlds. Becker, ***ibid***
21. Harold Dwight Lasswell (February 13, 1902 — December 18, 1978) was a leading American political scientist and communications theorist. He was a member of the Chicago school of sociology and was a professor at Yale University in law. He was a President of the **American Political Science Association** (APSA) and World Academy of Art and Science (WAAS). See: [http://en.wikipedia.org/wiki/Harold\\_Lasswell](http://en.wikipedia.org/wiki/Harold_Lasswell)
22. Isidore Auguste Marie François Xavier Comte (19 January 1798 – 5 September 1857), better known as Auguste Comte. He was a French philosopher, a founder of the discipline of sociology and of the doctrine of positivism. He may be regarded as the first philosopher of science in the modern sense of the term. Strongly influenced by the Utopian socialist Henri de Saint-Simon, Comte developed the positive philosophy in an attempt to remedy the social malaise of the French revolution, calling for a new social paradigm based on the sciences. See : [http://en.wikipedia.org/wiki/Auguste\\_Comte](http://en.wikipedia.org/wiki/Auguste_Comte)
23. Sir Karl Raimund Popper, (28 July 1902 – 17 September 1994) was an Austro-British philosopher and a professor at the London School of Economics. He is regarded as one of the greatest philosophers of science of the 20th century; he also wrote extensively on social and political

philosophy. Popper is known for his attempt to repudiate the classical observationalist / inductivist account of scientific method by advancing empirical falsification instead; for his opposition to the classical justificationist account of knowledge which he replaced with critical rationalism, "the first non justificational philosophy of criticism in the history of philosophy"; and for his vigorous defense of liberal democracy and the principles of social criticism that he came to believe made a flourishing "open society" possible.

24. See: Ali Asghar Kazemi, **The End of Politics and the Last Myth: Critical Order in the Post-Political 21st Century**. Tehran: Ghoomes Publishing Co. 2001. ( In Persian)
25. See below for an explanation of the Butterfly Effect
26. See **Wikipedia**, also see: Smith, R. D. (1998) "Social Structures and Chaos Theory" in **Sociological Research Online**, vol. 3, no. 1, <[http:// www.socresonline.org.uk /3/1/11 .htm](http://www.socresonline.org.uk/3/1/11.htm) Abstract
27. Mostly from **Wikipedia** under the title of "Chaos Theory."
28. Smith, **Op.cit.**
29. See: **Wikipedia** [http://en.wikipedia.org/wiki/Butterfly\\_effect](http://en.wikipedia.org/wiki/Butterfly_effect)
30. Ibid
31. Comparing this effect to the domino effect is slightly misleading. There is dependence on the initial sensitivity, but whereas a simple linear row of dominoes would cause one event to initiate another similar one, the butterfly effect amplifies the condition upon each interaction.
32. This is for example like the crisis that happened in Tunisia at the beginning of the year 2011 and very quickly proliferated in Egypt and other countries of the Middle East and North Africa. See my trilogy articles on the subject in The Middle East Academic Forum
  1. "Crisis Proliferation in the Middle East"
  2. "Tunisia Crisis Turned into a Revolution"
  3. "Tunisia Crisis: A Call for Change in the Middle East"
33. See e.g. : José Navarro, and Carlos Arrieta, "Chaos in Human Behavior: The Case of Work Motivation. **The Spanish Journal of Psychology**, Vol. 13 No. 1
34. Ibid
35. Cf. Ibid
36. Cf. idem
37. In human behavior, one can certainly see how small changes could render behavior, or another complex system, extremely unpredictable. Small actions or experiences stored in the unconscious mind, could certainly affect a person's behavior in unexpected ways.