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Engels' philosophy of openness and nonlinear system in dialectics of Nature

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Abstract

Engels' natural dialectics thought is the model of combining philosophy with natural science and is an important part of the Marxist ideological system. There is a close connection between the dialectics of nature and contemporary systems science. The former provides ideological support, philosophical basis, and theoretical origin for the latter, and points out the direction for the development of contemporary systems science. The law of the dynamic development of material forms revealed by dialectics of nature reveals the complex objective things and the objective world, as well as the nonlinearity, complexity, and diversity of matter. The analysis and study of system complexity, openness, and nonlinearity, has important theoretical significance for the enrichment and development of materialist dialectics and provides a new perspective of research analysis and demonstration for materialist dialectics.

Keywords

Engels; Dialectics of nature; Open; Since the organization.

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Engels' thought of the Dialectics of nature is a model of the combination of philosophy and natural science and an important part of the Marxist ideological system. There is a close relationship between the thought of the Dialectics of nature and contemporary system science. The former provides the latter with ideological support, philosophical basis, and theoretical origin, and points out the direction for the development of contemporary system science. The law of the dynamic development of material form displayed by the thought of Dialectics of nature shows a variety of characteristics, such as complex objective things and an objective world, as well as material nonlinearity, complexity, and diversity. The analysis and Research on the complexity, openness, and nonlinearity of the system, have important theoretical significance for the enrichment and development of materialist dialectics and provide new research, analysis, and demonstration perspective for materialist dialectics.

Engels put the nature and the universe as a highly complex, interrelated, interaction, the complicated whole follows the rules of the development of circulation and eternal nature, and the universe's development is no longer stagnant, but always in a sublation, synergy, and the dialectical negation of the organizational development process. Engels deeply discussed the cosmology of self-movement. He said, "All the rigid things dissolve, all the fixed things dissipate, all the special things regarded as eternal existence become fleeting things, and the whole nature is proved to be moving in the eternal flow and circulation". [1] The change of nature from simple state to complex state is described by Engels as "from the smallest thing to the largest thing" [2]. This unceasing movement and change are not linear growth. Everything in the world is in constant flow, which is exactly open, dynamic, and non-linear self-organization. Advancement and the vitality of dialectics are self-evident, the scientific philosopher and ecologist Richard Evans (Richard Levins) has praised dialectics, "of holism and structuralism, the hierarchy theory and system theory were provided as an alternative model to explain the world, as out of reductionism lead us into the dead end. However, there has always been another positive and productive tradition of thought, dialectics, which is now widely recognized." [3] Thus, dialectics can bring about a new mode of explaining the world. Based on the perspective of complexity science, we study the internal consistency between the ideas of openness, material movement, and nonlinearity contained in Engels' dialectics of nature and the complex system theories and methods in the philosophy of systems science.

1. Engels' criticism and open thought of "heat death"

Yan Kangnian, an expert on the history of science and technology, said, "The theory of heat death in the universe is a philosophical principle, an academic issue that cannot be directly verified in natural science, and a major issue concerning the future of mankind and the universe. Soon after its appearance, it naturally aroused attention and heated debate in the scientific and philosophical circles. [1] After Clausius put forward the theory of heat death, Engels paid close attention to it because it involved the survival and extinction of the universe. Clausius applied the second law of thermodynamics, namely the law of entropy increase, to the universe, which was regarded as an isolated system, the energy of the universe remained unchanged, and the entropy of the universe tended to be maximum. When the universe runs out of free energy and reaches an equilibrium state of maximum entropy, it enters a dead, eternal state. Engels saw the damage that Clausius's theory of heat death could do to the basic materialist principle of the indestructibility of motion. Therefore, the theory of heat death was seriously criticized in dialectics of Nature, which exerted a profound influence on the research of science and philosophy in the following hundred years.

First, the theory of heat death violates the laws of energy transformation and the immortality of motion. Engels, whose work first described heat death from a cosmic perspective, said that in trillions of years: "The earth, a dead frozen orb like the moon, is becoming more and more

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narrow in deep darkness along the orbit around the dead of the sun, the same last fall to the sun above", "like our solar system, our island universe all other galaxies or early or late to be the fate". [2] The Earth, other planets, the solar system, the Milky Way, and even the galaxy will gradually die. Engels then asks what will happen to our universe when the dead galaxies in the universe are left alone in their orbits. He believed that to solve this problem, "modern science must adopt the principle of motion immortality from philosophy" [3], to give a thoughtful and rational answer. The core of the principle of motion immortality is Engels' emphasis that "the immortality of motion cannot only be understood quantitatively but also qualitatively". [4]

The "heat death theory" asserts that all motion in the universe will eventually be transformed into heat, and the phenomenon of "heat death" in the universe will occur when entropy reaches the maximum is directly contradictory to the principle of eternal motion. Engels about the movement of mass conservation, mass conservation principle to follow the law of conservation and transformation of energy, and "heat death theory" only admitted on the amount of material movement have immortality, do not recognize the transformation of material movement has unlimited possibilities, because of the second law of thermodynamics that nature directional other forms of energy to heat, heat cannot be converted to other forms of energy in nature. According to the second law of thermodynamics, both the energy of nature and the universe will be converted into heat, and the heat will be gradually dissipated into the universe, leading to the "heat death" of the universe, which is also the key point of Engels' criticism of "heat death". Engels believed that all kinds of motion forms of matter have both the transformation to heat energy and other forms of transformation, so we cannot just think that there is only the transformation of all matter to heat energy in the universe. All forms of motion are converted into heat energy, and the universe eventually reaches a state of "heat death" equilibrium, in fact denying the materialist principle of the indestructibility of motion.

Second, the heat death theory presents philosophers and scientists with an important question: how can the heat radiated into space be reused? Heat death is the theory that all the kinetic energy of the universe will eventually turn into heat, and the universe will eventually become heat dead due to the loss of energy. In Engels's view, the resurrection of the dead universe could not happen until this problem was solved. Engels was greatly inspired by the ideas of The Russian philosopher Leonid Lavlov in his book "On the History of Ideas". Lavlov suggested that dead planets continued to move through the sky before forming new nebulae and that the remains of dead stars became the material for the formation of new ones. Engels pointed out that "the problem can only be solved by proving how heat radiated into space can become useful again" [5], which is the same problem raised by the law of eternal motion for the "heat death theory".

According to Engels, how could the universe develop and self-organize from birth to death and from death to rebirth? "It must be possible," he said, "that the heat which has been dissipated into space must by some means (which nature will at some later time be named) be transformed into another form of motion in which it can reassemble and move. Thus, the principal difficulty which prevented the renewal of the dead sun into a hot mass of air is removed." [1] Today, the path Engels spoke of is the self-organizing development of open systems from disorder to order, known as "dissipative structures." According to Prigozhin, the increasing entropy generated inside a system describes an isolated system, whereas, for an open system, there is an exchange of energy and matter with the environment. Under the premise of infinite expansion, the evolution of the universe can be orderly. Therefore, if there is a local decrease in entropy in the universe, that is, the entropy of the system gradually decreases over time and the universe will not remain "heat dead" forever.

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Third, the closed universe applicable to heat death contradicts the open and infinite universe. He Zuoxiu, a physicist and member of the Chinese Academy of Sciences, argues that heat Ji only works in limited, isolated systems. "It is simply a generalization of an argument from the second law of thermodynamics, 'the entropy of isolated systems will continue to increase to the maximum,' to the entire universe," he explains. [2] Engels's objection to heat death did not mean that he disagreed with the law of entropy, but rather that Clausius extrapolated the second law of thermodynamics to the universe, which should be viewed as a complex system in perpetual motion, self-organizing, and open. Prominent Marxist scholars and ecologists John Bellamy Foster and Paul Beckett emphasized that "Engels' view, rooted in the astronomical theory of his day (not just the extrapolation of thermodynamics), held that the universe was in fact an open, dynamic system." [3] Engels in retort resistance in "humans don't have the ability to meet the infinite" point of view, points out that "when we say, matter and movement can neither be created nor destroyed, we said is the universe is as infinite progress there, which exists in the form of any evil, and in this way, we have to understand this process must understand everything." [4] Engels believed that the universe was infinite, and the matter and energy in the universe could neither be created nor destroyed. However, the universe was not in a static or permanent "balance" state as Newton thought, but in a constant motion and change. This change is accompanied by periodic collision, expansion and contraction, random fluctuation, attraction, and repulsion evolution.

In short, when we re-understand Engels' criticism of "heat death theory" from the perspective of system science, we can realize that Engels not only believed that the motion of matter is immortal but also believed that matter itself could create the mutual transformation of motion forms, so the universe will not have the state of "heat death". At the same time, Engels believed that the universe itself was an infinite and open existence. Therefore, matter and energy in the universe could neither be created nor destroyed, and the universe would not be in a permanent "equilibrium state". This is Engels based on the then scientific and technological development results of the simple open thought.

2. Engels' thought of material self-movement

Engels in the "dialectics of nature" in nature and expounds material self-thought embodies the self-organizing theory, he thought, that nature and the universe heavenly bodies are according to the inherent law and the interaction and interlinked, then draws the universe we observe is through the transformation of sports, this transformation is material has the characteristics of its own. Thus, The South African Marxist Ted Grant commented, "Engels approvingly quotes Hegel's words [5], which contain the profound idea that movement and energy are inherent in matter, and that matter is self-moving and self-organizing." [6]

Based on absorbing Darwin's theory about the variaty of species through natural selection, Engels assumed that the evolution of organisms from a few simple forms to increasingly diverse and complex forms to human beings is the result of the continuous development and evolution of nature. Engels in the "dialectics of nature" with particular emphasis on the life is the result of the nature of this important view, nature is through its own conditions and strength by mutation and evolution, and highlights the phenomenon of life, he said: "life is a result of all nature, this and this was not a bit conflict: Proteins, the only independent carriers of life, are produced under certain conditions given by the whole of nature, yet happen to be produced as a product of some chemical process." [1] Engels speculated that protein bodies were produced in a chemical process in nature, and the appearance of protein bodies is the basic condition for the survival of life, profoundly revealing the diversity of selection and self-organizing system from inorganic matter to organic matter in nature. Engels then elaborated on the conjecture of human origin, stating: "Human beings are also produced by

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differentiation" and "a single egg cell differentiates into the most complex organism produced by nature" [2]. We can even substitute the "differentiation" here with self-organizing emergence. Every emergence of life, human beings, and even human civilization is great progress.

Based on criticizing the mechanistic view of French materialism in the 18th century and summarizing the development achievements of physics and chemical dynamics in the 19th century, Engels scientifically discussed the principle of self-motion of matter. He pointed out that "matter and its mode of being, namely motion, cannot be created and are therefore its own ultimate cause". [3] This is a classic statement of the principle of matter's self-motion. The whole world is the material movement and development evolution, Engels laid special stress on this process is a state of development, Engels in the Ludwig Feuerbach and the end of the German classical philosophy "is put forward, the world is not static, everything is in the generation and the changing of destruction, this change is a kind of forward development. In nature dialectics, Engels has the same description: "from rotating, hot air mass (they motion may be after centuries of observation revealed itself before I can figure out the stars), after contracting and cooling, developed in the Milky Way is the most outside the ring for the boundaries of our island universe thousands of the sun and the solar system." [4] Engels agreed that the birth of cosmic bodies is a self-organizing phenomenon of self-movement (contraction and cooling) from simple to complex, he pointed out that the diversity of the universe is the result of the evolution of cosmic particles from simple to complex.

3. Engels and the thought of nonlinear interaction

Nonlinear science, which emerged in the 1960s and 1970s, is a science that studies the commonness of nonlinear problems. It deepens the intersections of different scientific fields and is of great significance to the exploration and study of complex phenomena and complex systems in the world. According to Christian Fox, an Austrian sociologist, and professor at the University of Westminster, Engels questioned the reductionism and individualism of 'metaphysical thinkers'. With its emphasis on dynamic development, self-organization theory can be seen as a restatement of dialectical philosophy." [5] "Self-organization theory is also dialectical. It often sees self-organization as emergent evolution." [6]

Materialist dialectics believes that there is universal interaction between things, and the mutual connection and interaction are the fundamental cause of the movement and change of things. "They interact with each other, and their interaction is the movement" [7]. In Engels' view, the material interaction, namely the motion change and movement transfer of matter, is not reciprocal and simple, but complex, dynamic, or nonlinear. In Dialectics of Nature, Engels proposed that the transfer of material movement is complex and diverse. He pointed out that "the transfer of movement can only happen when all the conditions are ready, and these conditions are often diverse and complex". [1] of Engels in the Ludwig Feuerbach and the end of the German classical philosophy, the book clearly sees the world as a movement, change, complex, development and non-linear, he thinks the world is not static, it is a process of aggregation, the world is as a process, there are no eternal things. Engels regarded the whole world as an interconnected, interacting, and constantly changing whole, denying that the world is an isolated, static, and linear existence, which is a philosophical description from disorder to order, from simplicity to complexity, and from part to whole.

First, is the law of mass reciprocity and fractal geometry. One of the three basic laws of materialist dialectics, the law of mutual change of quality reveals that: quantitative change is the increase or decrease of the number of things or the change of the place, which is a continuous and linear change; Qualitative change is the gradual interruption of things

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themselves, is the fundamental and nonlinear change of things, is a sudden change, leap phenomenon. Dialectics emphasizes that quantitative change is an accumulation process of qualitative change. When the quantitative change inside things reaches and breaks through the critical point, things will transform from one germplasm state to another, which is manifested as nonlinear, fundamental, and significant mutations. According to the self-organization thought, when a system has nonlinear interaction changes, all parts of the system are no longer simple linear superpositions but appear unpredictable phenomenon, and the system will appear transformation and leap in nature. Take the Koch Snowflake curve as an example, take an equilateral triangle, triseptate each side of the equilateral triangle, remove the middle part and add the equilateral triangle of equal length, then the middle part of the trisecting of each side is carried out according to this rule. Repeat this iterative process repeatedly, and a snowflake shape emerges, the Koch curve, which has a strange property different from Euclidean geometry: limited area but infinite perimeter. It can be seen from the Koch curve that the change in the side length of the equilateral triangle will lead to a qualitative change in the whole geometric shape. After countless iterations, snowflake curves completely different from the initial equilateral triangle can be produced, and the property of perimeter changes from finite quality to infinite. The study of fractal geometry and nonlinear science provides scientific facts that quantitative change causes qualitative change and changes from disorder to order.

Second, mass tautomer and bifurcation theory. Engels in the "dialectics of nature" reveals the phenomenon and the example of quality mutual change, the quality of produce in nature tautomerism made a wonderful summary, he thinks some of the fundamental constants of physics, many are the critical point of the change of the nature of the object, or a sign of key points, "on these key points, the amount of movement of increase or decrease will cause corresponding qualitative change to the state of the object, So at these points, quantity becomes quality "[2]. At the same time, Engels emphasized that the law of mass mutuality was carried out under the state of constant motion and change of objects, which precisely corresponded to the existence of self-organization only in dynamic open systems with constant motion and change. The complexity of evolution in nature is caused by the complex and varied forms of qualitative change caused by quantitative change, and the process of generating new qualities is unpredictable. The interaction within and between things is presented as a quantitative change, and the quantitative change is the change in the number of stable states of the system, that is, bifurcation. Armin Fox, a complex systems scientist at Florida Atlantic University and a student of Haken, pointed out that "when parameters exceed a certain threshold, it is this qualitative change in behavior that makes nonlinear differential equations the preferred modeling tool for describing transition phenomena observed in nature" [3]. Amin then pointed out bluntly that "such qualitative changes are also called bifurcations" [4]. We consider the simplest system condition, when there is no external control parameter input, the system parameters remain unchanged, and the system is in a stable equilibrium state; When there is no input of external control parameters and the system parameters increase continuously, the system is more and more away from the equilibrium state. When the stability threshold exceeds a certain value, the system equilibrium point bifurcates with the change of system parameters. The continuous change of system parameters will lead to instability or imbalance of the system, leading to fundamental changes in the nature of the system. In Engels' example, when the liquid approaches the freezing point, the slight rise and fall at this time will lead to the rapid instability of the system and change its integrity, causing the system to fluctuate greatly. If the temperature continues to drop, the liquid will change from liquid to solid after crossing the bifurcation point, forming a new ordered structure.

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Thirdly, the law of mass mutuality and chaos theory. With the phenomenon of mass alternation and its mutual transformation and the sensitivity of initial conditions of chaos theory, there are similarities and complementarities between the two different theories. Small differences in initial conditions in the singular attractors of chaotic systems can lead to exponential changes in the system's behavior, an example of the famous "butterfly effect": is the flapping of a butterfly's wings in Brazil can produce a terrifying hurricane in America. The law of mass tautomer holds that the quantitative change is the change of the number of things, which is not significant in the range of degree. Qualitative change is the change of the nature of things, is a fundamental change in the structure and function of the system; As the degree in a specific range and state between quantitative change and qualitative change, once the change of the quantity of things goes beyond this degree, the nature of things will have a sudden change. Therefore, we can see that when there are some insignificant changes around the range and state of degree, the whole thing will change qualitatively due to the "butterfly effect". This is a kind of non-linear relation out of proportion, a kind of irregular nonlinear movement and mutation.

To sum up, nonlinear interaction and materialist dialectics are similar in concept and phenomenon, and the whole process from quantitative change to qualitative change is nonlinear interaction. It can be said that nonlinear theory has enriched and developed materialist dialectics. In fractals, bifurcations, and chaos, we can use scientific examples to explain the law of mass mutuality, which is of great significance to explore the nonlinear law of the world and supplement the law of materialist dialectics.

Natural science is the foundation of philosophy. Engels constantly enriched and developed the dialectical materialist view of nature-based on absorbing and summarizing the achievements of natural science in the 19th century. It is because the cross-era development of natural science in this period opened one breakthrough after another in the mechanical view of nature, which laid a solid foundation for Engels to express clearly and clearly the view of self-movement of nature, and thus described a picture of self-organization evolution of nature. Therefore, contemporary complexity science and systems science and philosophy should regain classic works, absorb Engels' rich system thought and his rational comments and values explanation on "heat death theory", the concept of self-motion of matter, and materialist dialectics in Dialectics of Nature, which is the need of further development of systems science.

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