From 1973 Chinese Scientific Journal

The Universe is the Unity of Infinity and Finiteness

by Bian Sizu

Recently an important collection of scientific articles from Mao's revolutionary forces in China has come to our attention. These articles were published in ten (and possibly more) volumes of a Shanghai journal, Dialectics of Nature, *from 1973 through the end of 1975. To our knowledge, they have not been published anywhere in English, even though they speak to some of today's most pressing scientific and philosophical questions. For this reason we are asking for people to contact us to assist in translating more of these articles for publication not only in this newspaper, but in other forms as well—getting these articles into various arenas where they should be seen.*

Some of the topics covered in other articles include: "On Necessity and Contingency in Mutation", "Motion is not Eliminatable—Commentary on Black Hole Theory", "Cancer is Knowable, Cancer is Curable", "Practice Raises our Understanding of the Brain's Function", "Critique of Einstein's World Outlook", "Can Physiology Give One Intelligence?", "On the Conservation and non-Conservation of Motion—also comment on the 1st and 2nd laws of thermodynamics", "The Internal Factor and the External Factor in the Evolution of Living Things". These are just a few of the titles from the tables of contents.

Dialectics of Nature *was mainly a journal for the broad popularization of scientific knowledge and scientific outlook among the Chinese poeple. It also contained theoretical work on the most up-to-date scientific questions. Linking science with the masses and putting it at the service of the laboring people was a revolutionary principle in China. This was not only a question of spreading scientific knowledge, but an important question of the class struggle within China. There was a serious struggle to break the monopoly of the exploiting classes on the leadership and the outlook guiding science, which was being used by these class forces as capital in contending with the proletariat for overall leadership in society. There was also a question of breaking down superstition and unleashing the role of the masses as the main force in scientific experiment. Beyond combatting the idea of science as private capital, the revolutionaries also struggled within scientific circles against metaphysics and idealism and for dialectical materialism to play a guiding role, leading scientists to break new barriers and make further advances in scientific theory.*

These documents, along with other, more technical ones, need to be rescued from the bin the current leadership in China has dumped them in in their attack on the achievements of the Cultural Revolution.

This article is the second translation of articles from Dialectics of Nature *to appear in the* Revolutionary Worker. *The first one, titled "Matter is Infinitely Divisible" by Bian Sizu, appeared in the September 18, 1981 issue of the* RW *(issue No. 122). All footnotes in the article below are translator's notes. Additional translator's notes appear in brackets in the text.*

THE UNIVERSE IS THE UNITY OF INFINITY AND FINITENESS

By Bian Sizu

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ABSTRACT

Based on the development of human knowledge about the universe, this article expounds the following views: (1) In terms of space, the universe is infinite. Infinity nevertheless cannot exist by itself independent of things finite. Infinity and finiteness form a unity of opposites. The finite transforms into the infinite, and the infinite transforms into the finite.[1] None of the theories of the infinity and the finiteness of the universe that have existed in history, from Newton's classical model of the universe to modern cosmology, can lead to a correct knowledge of the dialectics of infinity and finiteness; as a consequence, they all degenerate into metaphysics and idealism. (2) In terms of time, the universe is also infinite. Matter in the universe is in incessant development. The totality of the universe has neither beginning nor end. The theory of a motionless universe is unsound. The development of human knowledge of the universe profoundly reveals that the universe is a unity of such opposites as absolute infinity and relative finiteness.

Section 1: THE OVERALL CONCEPTION OF THE "UNIVERSE".

What Is The "Universe"?

The "Universe" is the universal, eternal, material world. In terms of space, on the macro-aspect of the universe, there are tens of billions of suns outside our solar system, tens of billions of galaxies outside of our Milky Way Galaxy. It is unbounded and borderless. On the micro-aspect of the universe, there are atoms within molecules, "elementary" particles within atoms and "elementary" particles also have complex structure. It is inexhaustible and without end. In terms of time, no matter how far one traces the universe back, it still has an infinite past; no matter how far one looks forward, it still has an infinite future. It has neither beginning nor end. Whatever form of matter, whatever kind of motion, all objective being is included within the universe. There is no way to exist outside of the universe.

Is there anything outside of the universe? Nothing. The universe is everything; the universe is all-encompassing; the universe is the totality. Some western scholars have proposed that outside of this universe of ours there probably also exists an "anti-universe" composed of "anti-matter". Actually, what is being called by them "anti-matter" is nothing but a special structural form of matter. There indeed exists such a material form in the universe. This further demonstrates the infinte divisibility of matter. This is still matter, a kind of material form which hasn't been really understood by us today. Therefore, even if there exist celestial bodies composed of anti-matter, they are still a part of the universe, not at all some "anti-universe" outside of the universe.

The universe is the totality of everything, hence its fundamental characteristic is its universality and eternity. This is to say that in space, the universe extends infinitely and in time the universe develops infinitely. In our own country, as early as the Warring States Period[2] someone proposed that "The Four Directions and Up and Down is called *yu*; from Past to Present is called *zhou*."[3] "*Yu*" means infinite space. "*Zhou*" means infinite time. The universe is the unity of the infinite space and infinite time of the material world. This is a very profound concept of the universe.

The Development of Human Knowledge of the "Universe"

The universe in its essence is infinite, but the universe as it is manifested, i.e. the universe that human beings comprehend, is always finite. "Mankind therefore finds itself faced with a contradiction: On the one hand, it has to gain an exhaustive knowledge of the world system in all its interconnections, and on the other hand, this task can never be completely fulfilled because of the nature both of men and the world system". (Engels, *Anti-Dühring*, FLP, p. 46)

The history of human being's understanding of the universe is a process of inexhaustibly expanding from the finite toward the infinite. Human beings have always tried to understand the whole universe, but at any given time, man's understanding of the universe can only be finite, and can only reach a finite portion of the universe. Everytime, whenever people's understanding expanded to a certain scale and reached a certain stage, there have always been some people who stopped halfway and jumped out to paint some "world picture" of the "whole universe", and to proclaim that the knowledge of the universe had reached its limit, thereby drawing the metaphysical conclusion that the universe is finite. But, as people's knowledge further developed, one after another of such "universe pictures" have all been successively destroyed.

At the very beginning, people's vision of the "universe" was a big tent with a round sky and square ground. This was actually only the finite framework of the surface of the Earth. Later on, people's vision expanded. They gradually discovered that the Earth is not a flat surface, but rather a sphere, and the theory appeared that the Earth is at the center of the universe (geo-centrism). At this time, the "universe" was the Earth, and the Sun, Moon, and stars were nothing but ornaments around it. In the 16th century, Copernicus summed up the accumulated knowledge of the universe and proposed the solar-centric theory, thus expanding the "universe" to the whole solar system with the sun at its center. In the 18th century, aided by the optical telescope, people were able to extend their vision beyond the solar system, expand their view into the Milky Way Galaxy. The galaxy, in the words of Herschel of that time, was the "universe-structure". In modern times, due to the development of production practice [advances in the level of the productive forces] and the employment of radio telescopes, people's vision of the "universe" again broke through the limit of the galaxy and expanded into galaxy clusters, super clusters and an overall cluster consisting of billions and billions of galaxies. There are some people who think that the radius of the overall cluster might be as big as several billion, even tens of billions of light years. If this estimate is correct, then this is roughly the extent of space that we can observe today. But no matter how gigantic this overall cluster is, still it can only be some concrete expression of the universe. Though it can also be called some concrete universe, it can never be the whole universe. Earth, solar system, galaxy, galaxy cluster, overall cluster.....all are the different levels of the material world, the concrete universe known by man at a given time. It is also the universe as reflected in the natural sciences. If yesterday the universe found its limit in the solar system or the Milky Way Galaxy, and today it finds its limit in the galaxy cluster or overall cluster, then tomorrow it will necessarily find a new limit in a certain level of celestial body structures until that "limit" is in turn broken. "Dialectical Materialism insists on the temporary, relative, approximate character of all these *milestones* in the knowledge of nature gained by the progressing science of man." (Lenin, *Materialism and Empirio-Criticism*, FLP, p. 314). This concept of the universe in natural science, i.e. the knowledge of some concrete universe-structure and characteristic is relative, finite.

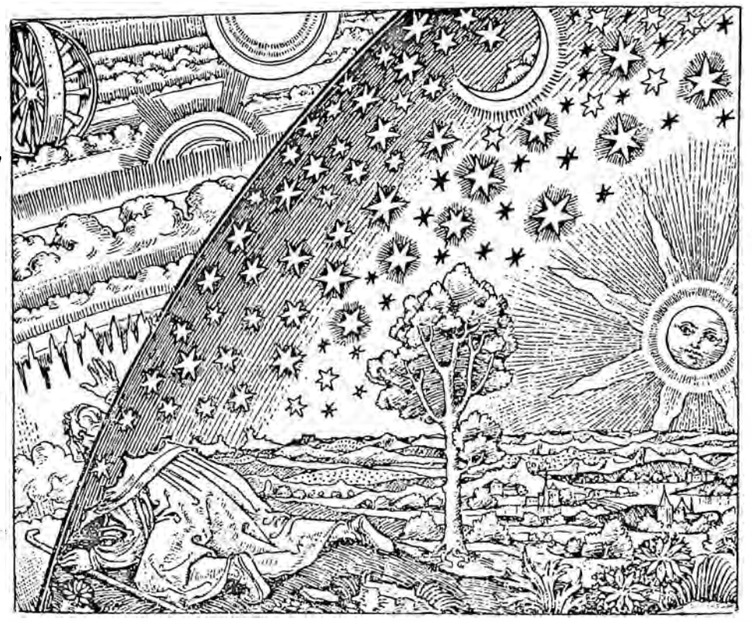
But the levels of the material world are also inexhaustible, will never come to an end. In this "Universe-world" which is higher than the ordinary macro-world, people will never reach the "end of the universe", will never exhaust the knowledge of the whole universe, just as in the micro-world, people will never be able to find the "origin of matter", never be able to exhaust the knowledge of even a tiny "elementary" particle. Therefore, in the theory of knowledge, the universe signifies the philosophical category of the universal, eternal, objective Nature, which is reflected in human consciousness through the continuous development of human being's knowledge, from small to big, increasing both deeply and comprehensively.

The concepts of the universe in natural science and in philosophy are both distinct and interrelated. The overall conception of the universe in philosophy is always some summation of natural scientific knowledge of the universe; in turn, the concept of the universe in natural science is always governed by certain philosophical world outlooks. The dialectical materialist universe [world] outlook is formed through summing up the developments and achievements of natural science as a whole. It asserts that the universe is infinite, the concrete expression of the universe is finite. The infinity of the universe is absolute, the finiteness of the universe is relative; the universe is the unity of absolute infinity and relative finiteness.

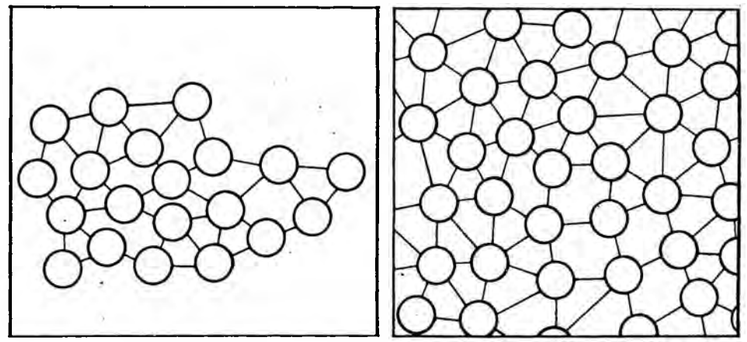
The Origin of the Two Kinds of "Universe" Outlooks

The theory of the finite universe arose out of the limitations of human knowledge. In class society, this theory often leads to theism and idealism of various stripes.

If the universe were a big tent, then what would be outside this tent? If someone stuck his head out of the tent, what would he see? As long as the universe has a boundary, then there is an "other side world" outside the universe. There, then, exists a residence for God. The reactionary ruling class can thus use such an "other side world" to argue for the existence of God, and argue that their rule is "bestowed by Heaven" and cannot be changed. Every step of advance of human knowledge of the universe is met with the desperate resistance of reaction. In the beginning, the theory that the Earth is round was viewed as a heresy. Later, solar-centric theory also suffered rabid, frenzied persecutions. In the 17th and 18th centuries when the newly rising bourgeoisie directly used the theory of an infinite universe to oppose religion, they still covered this under a cloak of theism. Even materialists such as Spinoza could only shamefacedly call God "the infinite one", using God as a code name for the infinite universe to oppose the tangible God.



The accepted view of the universe during medieval times. Based on Aristotelian cosmology, the universe was seen as finite and beyond it was God. This reactionary view is openly idealist and theistic.



These two so-called "ball and stick" cosmological models illustrate the Newtonian view of the universe, which envisions the universe as a big box without boundaries, in which all celestial bodies are distributed homogeneously in the infinite void of space. This metaphysical materialist view was an advance over the earlier views of a finite universe, but itself ends up in a trap. In this view the infinity of space is actually only seen as an abstract or fake possibility. It first assumes a boundary and then lifts it. Connected with this it views infinity in space only in the quantitative sense, that is, more and more of the same things evenly distributed throughout the universe. The first model above shows the view of Newton himself, and the second is that of Leibniz, who was part of the same basic school of thought as Newton.

The universe is infinite, but at any concrete point, people can know only finite things. The infinite exists within the framework of the finite. Therefore, people are always "seeking and establishing the infinite in the finite, the eternal in the transitory". (Engels, *Dialectics of Nature*, Progress Publishers, p. 234). In the history of philosophy, some people didn't understand dialectics and absolutely separated the infinite from the finite. While they also recognized the infiniteness of the universe, they departed from the concrete expression of the universe to look for purely abstract infinity. Conse-

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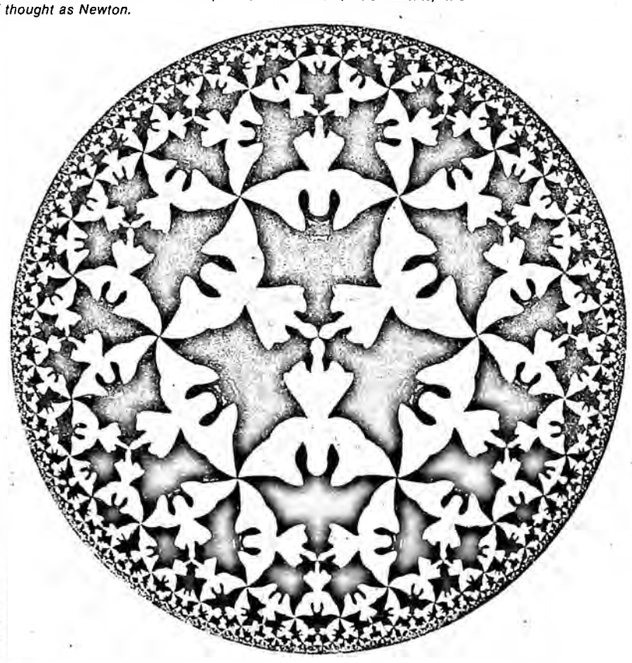

This model of the surface of a so-called 4-dimensional "pseudosphere" illustrates the Einsteinian cosmological view which envisions the universe as finite yet unbounded, as a "four-dimensinal pseudospherical continuum." This view of an unbounded but finite universe rejects the Newtonian model of the homogeneous straight-line outward universe and its abstract or fake infinity, but itself ends up in contradiction to the actual infiniteness of the universe in time and space, with a model of a finite universe. Einstein at one point even "calculated" the radius of the universe to be 3.5 billion light years. Below is the description of this "pseudosphere" from an article entitled "Will the Universe Expand Forever?", which appeared in the March 1976 issue of Scientific American.

SURFACE OF A PSEUDOSPHERE is represented in an etching, *Circle Limit IV*, by M. C. Escher. In the etching the surface is projected onto a plane. As in any map projection, the scale is not constant; on the pseudosphere itself the figures of angels and demons would all be the same size. If a single figure is regarded as a unit of measure, it is apparent that the circumference of a circle increases much faster than in proportion to the radius. Similarly, each figure defines a triangle (with the vertexes at the feet and the wing tips); from the number of triangles that meet at each vertex it can be shown that on the pseudosphere the sum of the angles of a triangle is less than 180 degrees. The pseudosphere is an infinite surface of negative curvature, analogous to space in a universe that expands forever. It has no privileged position that could be considered a center, and projection would be unchanged if it were centered on any other point.

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quently, they could not but depart from the universe in reality and jump into the spiritual world, jump into God's world or man's subjective thinking to look for infinity. Thus, in their eyes, the infinite universe has become the "absolute spirit" or has become man's subjective spirit: "The universe is my mind, and my mind is the universe." This is the universe [world] outlook of idealist apriorism.

In the sphere of natural science, some people have replaced the infinite universe by the already-known finite universe. Today, the radio telescope extends our vision 10 billion light years deep into space. But, no matter how far human vision gets extended, there is always some infinite unknown territory beyond our sight, and the theory of the finite universe can exploit the limitation of human knowledge at every stage of historical development and resurface in different forms. It can always set the conception of the universe in natural science against the universe [world] outlook in philosophy using the concrete universe known to natural science in place of the universal, eternal, objective Nature in philosophy. This is positivism and idealist empiricism that directly takes man's subjective sensations as the essence of matter. The "cosmology" founded in the 20th century was born under the influence of this trend of thought. The definition of cosmology is given as "The system of all kinds of concepts and relationships constructed by man for the purpose of making an orderly description of the world as a whole with man himself as part of this whole." (*Encyclopedia Britannica,* Vol. 6, p. 582, 1964 edition, translated from the Chinese). This is an unreachable and extravagant wish. As Engels well put it, "If at any epoch in the development of mankind such a final, definite system of the interconnections with the world...were constructed, this would mean that the realm of human knowledge had reached its limit." "Which would be an absurdity, pure nonsense." (Engels, *Anti-Dühring,* FLP, p. 46.) During the past half-century, many scholars have proposed one "universe-structure" after another, built one "universe model" after another, and while some of them have also reflected in certain respects man's knowledge of certain concrete universes, and have played or are still playing a certain role in the development of science, as far as the knowledge of the whole universe is concerned, these various "structures" and "models" all artificially "circle" the infinite universe, and artificially impose upon the whole universe the laws of some local region. In the words of their own "ancestor", the great bourgeois philosopher and scientist Bacon, they all "use their own impotence in science to slander the universe." [translated from the Chinese].

The proletariat needs to study cosmic questions too, needs to sum up people's knowledge of the universe based on the development of production practice and scientific experimentation and to serve the needs of social practice. We soberly understand that such knowledge can only be local, relative. Human knowledge of the universe is an infinite process, will never exhaust its subject nor reach its "peak." The so-called "cosmology", under the influence of the idealist and metaphysical world outlooks, can only be, fundamentally speaking, a blossom bearing no fruit on a branch of the big tree of natural science.

Section II: INFINITY OF THE UNIVERSE IN TERMS OF SPACE

The struggle between the theory of the infinite universe and the theory of the finite universe first manifests itself in the question of *yu*, i.e. the question of infinity and finiteness of space. This struggle is very complicated. Metaphysicians do not necessarily all absolutely reject infinity. On the contrary, to a certain extent they sometimes also recognize that the universe is infinite. They use the metaphysical outlook on infinity to oppose the theory that the universe is finite. Even though they have played a certain historical role, at bottom such an outlook on infinity is also wrong, and still ultimately joins the side of idealism. Therefore, the struggle between the theory of the infinite universe and the theory of the finite universe at certain times has also been expressed as the struggle between the dialectical outlook on infinity and the metaphysical outlook on infinity. In modern times, in dealing with the so-called "universe-structure" question, this struggle has concretely been expressed as the struggle between the theories of "level-type" universe-structure and "homogeneous-type" universe-structure.

The Finite Transforms Into the Infinite

The metaphysical outlook on infinity views the infinite from the possibility of the finite transforming into the infinite. It sees that the finite constitutes the infinite; the infinite contains the finite. This is correct. The metaphysical outlook on infinity indeed sees one aspect of the mutual relationship of the infinite to the finite.

The conjecture of the infinity of the universe by ancient primitive materialists had been built on just such an outlook on infinity. Some ancient Greeks argued that the universe has no boundary, because, if the universe had a boundary, anyone standing on the boundary sticking his hand-cane outside of the boundary could expand this boundary. Then one could stand on the new boundary and further expand it—on and on, without end.

In the 17th century, for the first time Newton, on the basis of natural science, painted a picture of the infinite universe. He postulated that the universe is a big box without boundary, where all the celestial bodies are distributed homogeneously in the infinite void of space. This is the homogeneous type model of universe-structure. Celestial bodies are engaged in mechanical motion governed by a "cosmic force", namely the gravitational force. The "cosmic force" can project along a straight line to an infinitely far distance and the celestial bodies can engage in straight line motion without end simply by the action of this force. Just as the infinite series of integers 1,2,3,4...can go on infinitely without end. This "picture of the universe" is essentially still the same picture as that of the Greeks, except that it substitutes the laws of mechanics for the hand-cane. Such an infinity is the concept of "potential infinity" developed in mathematics during the 17th century.

This universe-structure is materialist. It has seen the possibility of the finite expanding into the infinite and demonstrated from one aspect that the infinite character of the universe exists objectively. Therefore, such an outlook on infinity has active significance in the struggles against the theories of a finite universe, and religions. It was precisely this concept of potential infinity which brought the idea of infinite changes into mathematics and made dialectics enter mathematics.

But such an infinite universe outlook is also one-sided. It takes infinity as a simple expansion of finiteness, a simple continuation in quantity of finiteness, no discreteness, no qualitative change. As a consequence, it inevitably leads to a series of contradictions that cannot be overcome. If the universe were indeed such a big box filled with infinitely many of these stars that radiate light and exert gravitational force, then, as the "paradox" put forward in the 19th century said, any point in the universe must receive an infinitely large quantity of light, and infinitely large sum total of gravitational force. If this were so, then all the star bodies would be burnt to ashes instantly, and the whole universe would contract into one piece instantly! This is of course absurd. This metaphysical outlook on infinity bumped into a fatal difficulty.

Kant at that time had already sharply perceived this contradiction. He said that when human thought tried to "expand the links in the universe into infinity—link to stars outside the stars, the worlds outside the world, to celestial body systems outside the celestial body systems...imaginations are exhausted in such an immeasurably distant forward march, thoughts are also exhausted in such immeasurable imaginations; just like a dream, a person is walking forward forever without ever seeing how much further he must go." (Quote in Hegel: *Science of Logic*, translated from the Chinese.) Indeed, if the universe is extended homogeneously, uniformly in this way, then where is the end? The universe is infinite, not only in quantity, but also in quality. How could it be only such a simple enlargement in quantity without causing qualitative changes? How could the universe be such a big box filled with all the same kind of stars? Besides, even though this theory of infinity points out the possibility of the finite transforming into the infinite, this possibility will never be realized. It is only an abstract, fake possibility. It first assumes that the universe extends to a certain boundary, then lifts this boundary line, then assumes a new boundary, and lifts it again...and at any point you can only extend it to a finite boundary. No matter how big the universe gets extended to, still it cannot get rid of that boundary seemingly held by the Ghosts of Finiteness. The infinite series 1, 2, 3, 4....no matter how much it increases, is still finite, and infinity forever lies far ahead, conceivable but not reachable. Thus, this outlook on infinity, while to a certain extent reflecting the dialectics of finiteness transforming into infinity, is one-sided. If you make it absolute, then you are in fact absolutely separating infinity from finiteness, and infinity has become something intangible, vague, and void. Hegel called this infinity "bad infinity". As Lenin said, this "infinity qualitatively counterposed to finitude, not connected with it, separated from it,...as if the infinite stood *above* the finite, *outside* of it". (Lenin, "Conspectus of Hegel's *Science of Logic*", *CW* 38, p. 112.) This is false infinity, not real infinity.

In order to comprehensively understand the infinity of the universe in terms of space, it is not enough to just see the possibility of the finite transforming into the infinite, in the way of the homogeneous type universe-structure; it is also necessary to see the other aspect of the dialectical relationship between the infinite and the finite, i.e. the aspect of the infinite transforming into the finite.

The Infinite Transforms Into The Finite

The homogeneous-type model structure of the universe bumped into a stone wall in science. This forced some bourgeois scientists and philosophers to propose another, level-type model. Kant thought that besides this "island universe" (actually meaning the Milky Way Galaxy) where our solar system is located, in the universe there are countless other "island universes" and the "big universe" consists of all of them. Many, many such "big universes" compose even higher level bigger universes. Such steps ascend continously without end. Later, some other people clearly divided the universe-structure into the following levels: Solar system, first level; star clusters, second level; galaxies, the third level; galaxy clusters, fourth level; overall cluster, fifth level;...In the beginning of the 20th century, someone used this universe-structure to solve the paradox to which the homogeneous-type model of the universe gave rise: Since the universe ascends level by level, the quantity of light and gravitational force that one star receives from other celestial body systems would decrease level by level, approaching zero. Thus, the light lumins and gravitational force received at any point in the universe, even though the result of infinitely many other celestial bodies, is nonetheless in its sum total, convergent and finite.

This illustrates that not only can the finite transform into the infinite, the infinite can also transform into the finite. "Take a one-foot-long stick. If you chop away half of its length daily, you can go on in this way for millions of generations". This, in mathematics, is the infinite series ½, ¼, 1/8, ... This process is infinite and it illustrates that "a one-foot-long stick" contains infinitely many parts. But the sum total of ½ + ¼ + 1/8 + ... approaches 1. Thus the totality of these infinite parts constitutes a finite "one-foot-long stick". Herr Dühring had propagated what Kant had said "An infinite aggregate of actual things cannot therefore be viewed as a given whole," (quoted in *Anti-Dühring,* FLP, p. 60) but in reality, not only are the Milky Way Galaxy and the solar system infinite, but one house, one cup, etc. are also infinite, even down to one molecule, atom, or "elementary" particle—all equally manifest themselves as complicated and inexhaustible worlds. Contrary to Dühring's b.s., every given finite whole is exactly the infinite aggregate of actual things.

Hegel called this infinity that can transform into finiteness, the "real infinity". The real infinity is the reachable, graspable infinity. It envisions that the infinite can transform into the finite, that the finite contains the infinite. Therefore, it is possible for matter to compose itself as given masses, and for the universe to possess a given level-type structure. The infinite material compositions form finite "elementary" particles, atoms, molecules, macro-objects, life, planetary systems, galaxies, clusters.... Within it, every level is a different state of aggregation of matter, each is both an inexhaustible "universe" and a given finite whole. In this way, the infinite is no longer some void thing beyond the finite actual, but rather actually exists within concrete things. Engels said, "States of aggregation—nodal points where quantitative change is transformed into qualitative". (Engels, *Dialectics of Nature*, p. 285.)

The process of the finite transforming into the infinite is no longer a simple expansion in quantity, but rather there appears discreteness, qualitative changes. From such a "small universe" as an "elementary" particle to an atom, molecule... till such a "big universe" as an overall cluster, all these have been one after another turning points in the transition from the finite to the infinite.

The level-type structure of the universe based on the concepts of real infinity contains dialectics. It opposes the views that treat the universe as a block of structureless, absolutely homogeneous mess, and illustrates that matter has definite structure and is divisible.

But, within the real infinity another deviation is covered. The real infinity is infinity completed, and makes the infinite finite. This actually is only a link in the process of the finite transforming into the infinite, an approximation in the method of treatment. If you make it absolute, and view this infinity as the final infinity, then you are liquidating infinity. Hegel is like this. He really worships the real infinity, treats it as something beyond the infinite. "Beyond" the infinite, doesn't it return to the finite? Therefore, in Hegel, if the bad infinity is like a straight line without an end, then the real infinity "picture is a circle, it is a line reaching itself, closed and completely present, without starting or ending

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Reader Writes for Help on Science Book

Dear *RW*:

I am writing a book in refutation of Jeremy Rifkin's *Entropy,* and with the aim of elaborating on certain Marxist concepts in relation to science and historical materialism, etc. I would appreciate hearing from anyone who has done some thinking and study in relation to the *Cosmos* debate. I would particularly like to hear from C.M., the author of "The One-Sidedness of the 2nd Law of Thermodynamics" letter in *RW* No. 117. Please write to:

Ronald Hayley
c/o P.O. Box 5811 (Station A)
Toronto, ONT M5W 1P2
CANADA

Yours, in common struggle,
Ronald Hayley

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point". (*Science of Logic* V.1, translated from the Chinese.) Circular lines of course won't touch boundaries, but the realm of space is infinite. Thus, in order to solve the contradictions to which the bad infinity gave rise, Hegel in the end simply abandons infinity and returns to the finite. His universe is actually the circle of his "absolute spirit".

During the 20th century, because bad infinity was bumping into so many difficulties in cosmology, one natural scientist after another turned to the Hegelian real infinity, at the same time abandoning the level-type universe-structure, and returning to the homogeneous-type structure, thus closing up the infinite universe. So, with the turning of the bourgeoisie from its rising period to its declining period, their viewpoint toward the universe has also changed from the materialist yet metaphysical theory of the infinite universe to the anti-metaphysical yet idealist theory of the finite universe. Einstein's "universe model" is a typical example of this. In contrast to Newton, he abandoned bad infinity and avoided that bothersome boundary question: "If we can view the universe as a finite and closed continuum, then we don't need any boundary conditions at all". ("The observation of cosmology based on the theory of general relativity", *Principles of Relativity*, 1923, U.S. edition, p. 184, translated from the Chinese.) At the same time, he also abandoned the level-type structure of the universe, and eventually circled the universe into a so-called "4-dimensional continuum". This continuum is continuous everywhere, nowhere discrete, and therefore is a boundary-less yet closed 4-dimensional spherical space, identical to Hegel's circle. Starting from this "boundary-less, finite" universe model, Einstein even "calculated" the "radius" of the universe to be 3.5 billion light years. This is the inevitable result of pushing the real infinity to the extreme.

The scientists headed by Einstein negated the metaphysical bad infinity, and opposed the absolute separation of the infinite and the finite. This was an advance. But, they didn't understand dialectics. By pursuing the aspect of the infinite being able to transform into the finite, they ended up at the other one-sided aspect, and absolutely equated the infinite with the finite, consequently abolishing the infinite and returning to the finite. They started with opposing metaphysics, but not daring to recognize dialectics, they finally walked back into metaphysics. This is the punishment that dialectics dealt them.

Space As A Unity of the Infinite and the Finite

Engels said, "Infinity *is* a contradiction, it is full of contradictions." "The removal of the contradiction would be the end of infinity." (Engels, *Anti-Dühring*, FLP, p. 63, 64). We say that the universe is the totality of everything. Actually, this sentence itself contains various contradictions. Since it is "of everything", then is the universe itself also included in it? If not included, then it is not "of everything". If included, then there exists an even higher universe that encompasses this universe, and the universe has become an inexhaustible series of "universes".

From the viewpoint of dialectical materialism, such a contradiction is not strange at all. It precisely reflects the contradiction of infinity and finiteness. Infinity cannot exist alone, it always exists in a dialectical unity with finiteness. Even though the universe is infinite, the "universe" that people can know is always finite, and the infinite series of such universes compose the inexhaustible levels of the universe, and compose the universe. If one cuts apart this unity, artificially imposing concepts such as "closed system" applicable only to finite things, to the infinite universe, only absurd conclusions will follow.

The homogeneous-type model of the universe-structure imagines the universe as a big warehouse filled with all the same kind of goods, a unified, infinite space. This is not correct. Space is always concrete. Concrete material space is always finite. Atomic space is finite, molecular space is finite. Similarly, the spaces of a galaxy, cluster, and overall cluster are also finite. Apart from these various sizes and stripes of concrete space, there is no abstract space of some "whole universe" independent from finite things. Searching for such a unified space would certainly land you in bad infinity. The infinity in space of the universe can only be realized in countless finite concrete spaces, and cannot be separate from these. Therefore, the universe is always both finite and infinite, both with and without boundary. Every concrete universe has its boundary and limit, this is equally true from the atom to the overall cluster. Beyond the boundary of this "universe", this "universe" has reached its peak; there will be qualitative change taking place, thus it will enter into an even higher level "universe" with its own new boundaries. Therefore with regard to the universe as a whole, the universe is boundary-less, limitless, and is infinite in space. The rational factor in the level-type universe-structure is expressed here: With levels it is possible to have the diversity of material forms. Not only does this structure illustrate the infinity of the universe in quantity, but it also makes it possible to illustrate the infinity of the universe in quality.

Potential infinity and real infinity, each seeking to solve the contradiction between the infinite and the finite from two different aspects, each individually grasps a one-sided truth. Potential infinity grasps the aspect that the finite can transform into the infinite, but pushing this to its extreme, separates the infinite from the finite. Thus the infinite has become a conceivable yet unreachable void,an intangible ghost. Real infinity grasps the aspect that the infinite can transform into the finite, but pushing this to its extreme, equates the infinite with the finite. Thus, the infinite has also become finite. Finally, just like a frog in a well, looking up and insisting that the sky is only as big as the opening of the well, as a result of such an absolutization, bad infinity has then become false infinity, real infinity has become real finiteness. Both have liquidated the infinite and returned to the finite. Scientists and philosophers, if they don't recognize the materialist dialectics of Marxism, then owing to the limitations of their world outlook, will often fall into either this or that one-sidedness. No matter how far they go, still they cannot escape the domain of the theory of a finite universe. [Translator's note: Here the original text makes reference to a well known episode of the novel *Journey To The West*, in which the Monkey King, despite his unusual powers to leap 18,000 miles, cannot escape a pawn of Buddha—to illustrate the point above.]

Then, will it do to avoid the contradiction by employing the method of simply eliminating the concept of infinity? No. "Every attempt to eliminate these contradictions leads, as we have seen, to new and worse contradictions." (Engels, *Anti-Dühring*, FLP, p. 63, 64). For example, one Soviet revisionist scholar has declared "Talking about the infinite space and infinite time of the universe... is just as meaningless as the discussions caused by trying to understand the question of whether the universe is blue or yellow or whether the universe as a whole has color". This concept of infinity was "obtained from religion". (Kolemann [?], *On The Concepts of Space, Time, Matter and Motion in Cosmology*, translated from the Chinese). In so declaring, this fundamental question of whether the universe is infinite or finite, which has been heatedly debated during several thousand years of human civilization, has become a mere argument for argument's sake, a question of religious belief. He wants to eliminate the contradiction of infinity and finiteness, but ends up only completely betraying the basic positions of dialectical materialism, of Marxism. The representatives of the bourgeoisie during its rising period, Bacon, Spinoza, Newton, Kant, etc., had all, in different forms, recognized the theory of the infinite universe. The big retrogression of modern revisionism can only demonstrate that it is the doomsday offspring of the decaying, reactionary bourgeoisie.

Section III: THE INFINITY OF THE UNIVERSE IN TERMS OF TIME

The struggle between the theory of the infinite universe and the theory of the finite universe is also manifest over the question of "*zhou*", i.e. the question of infinity and finiteness of time, in the theory of the developing universe and the theory of the static universe.

The universe is infinite in space, it necessarily includes infinitely diversified forms of development and possesses the potential for infinite development. Therefore in time it is also necessarily infinite. Engels said, "The eternally repeated succession of worlds in infinite time is only the logical complement to the co-existence of innumerable worlds in infinite space". (Engels, *Dialectics of Nature*, p. 39). The dialectical materialist theory of the infinite universe firmly holds that the universe is an infinitely incessantly developing process of being both discrete and continuous.

Everything In the Universe Is Continually Developing

Everything in the universe is changing, everything is a process. All things in the universe, as tiny as an "elementary" particle, or as big as all the celestial bodies, are developing forward as processes, all experiencing the process of birth, development and death. All concrete things in the universe are finite in time. Their existence-time varies, life-expectancy varies, but no matter whether long or short, at bottom, each is a finite process.

"Elementary" particles can be called "changing without certainty [order]"! Except for electrons and protons which are relatively more stable so that today we still don't know how long they live, "elementary" particles are all short-lived. Neutrons can be counted as long-lived, but can only live approximately 17 minutes. All the various mesons and hyperons generally can live only a hundredth of a millionth of a second down to a tenth, hundredth or a thousandth of a billionth of a second. But even though so short-lived, they still experience the whole life of birth, "decay" or "decline", finally transforming into other matter, Therefore, "elementary" particles are both "without order" and "with order", both changing and stable. Without the relative stability, "elementary" particles wouldn't be "elementary" particles and they wouldn't exist.

The "life-span" of celestial bodies is amazingly long. If counted by the "year" on Earth, the "ages" of the Milky Way, Sun, and Earth are not several decades, or several centuries, but rather over several billions, or tens of billions of years. Take the Sun for example. It is estimated to have approximately a 5 billion year history. The Earth may be slightly younger, but still over 4 billion years old. But no matter how long their life-spans are, still they are like a human life, and can't escape from the process of birth, aging, sickness and death. The stars started out as giant and thin nebula, contracting and condensing into shapes by virtue of the gravitational force. Later, their temperatures rose and they experienced their youth. After a thermonuclear reaction had begun, they entered middle age. When the hydrogen in the core is all transformed into helium, some stars [for example] become red giants. They increasingly decay and enter old age. Later on, the outer shell will disappear and they will become white dwarfs, until all the energy dries up and only a pile of "bones" is left behind. They will have transformed themselves into other material forms. Therefore, even though the changes in celestial bodies are slow, even though their life-spans are long, they cannot last forever.

Lengths of time are relative. "Erlai' is 48,000 years old". This can be regarded as long-lived but compared to celestial bodies' several billions of years life-expectancy, it is only a split second. A split second should be counted as short, but compared to a π^0 meson' which is only able to lead a life a few hundredth quadrillionths of a second, it is almost like infinitely long. The length of time exists in relative terms. No matter how long, the existence time of any concrete thing is always finite. There are no forever unchanging, permanently existing things in the universe at all.

Of course, compared to a human's life, the lives of celestial bodies are after all very long. Overwhelmingly, the major portion of the development and changes of celestial bodies is not only very difficult for a person to eyewitness, but even the whole human history is rarely witness to such changes. People see that the Sun always rises in the east and sets in the west, the moon is always full in the middle of the [lunar] month and a slim crescent in the beginning of the [lunar] month. The 7 stars of the Little Dipper always circle around the North Star. Because of this limitation in knowledge, people very easily exaggerate the aspect of order in celestial bodies and draw the conclusion that the universe or the heavens is unchangeable. All reactionary classes exploit this mistaken understanding of people and promote the theory of an unchanging universe, that "Heaven won't change and the Order won't change on Earth either". Obviously, if they admit that the heavens are changing and society is developing, this would no less than announce their own class's death sentence. Therefore, the struggles between the theory that the universe is developing and the theory that the universe is unchanging have historically reflected the class struggle between the advanced forces and the reactionary forces. The spokesman for the ancient slave-owner class, Aristotle, declared that celestial bodies were perfect without any defects and eternal without any decay, which reflected the dreams of the slave-owner class to "rule generation after generation". Newton of the 17th and 28th centuries thought that the stars would forever stay in their original positions, the Earth would forever run along a given fixed orbit, which reflected the class wishes of the bourgeoisie after having seized power and its desire to maintain its own established interests.

All concrete things in the universe have their birth and death, beginning and end, always from quantitative change to qualitative change, continuously transforming into their opposites. They are all "closed systems"; in space, closed in finite domain, in time, closed in a finite period. All things produced are bound to die out. "Elementary" particles are bound to transform, humans are bound to die, the Milky Way, Sun, and Earth are bound to finally decay and be destroyed. Even something lasting as long as "Heaven and Earth", eventually will come to an end. Even the human species itself is going to change, and going to die out. But the doom of the Sun, Earth, and the human species are not some "doomsday of the universe". When the Earth dies out, there will be even higher levels of celestial bodies to replace it. By that time, people will celebrate the victory of dialectics, welcoming the birth of new stars. When the human species dies out, there will also appear even higher level species. Speaking from this point of view, human activities are creating conditions for the appearance of even higher species. If the old did not go, the new wouldn't come. The death of the old is precisely the necessary condition for the birth of the new. "In the world it is always in this way that the new replaces the old, in this way the new supercedes the old, getting rid of the old and making way for the new or weeding through the old to bring forth the new."

The finite transforms into the infinite. Precisely because all things in the universe are continuously changing and continuously developing, they constitute the endless development of the whole universe. Precisely because everything has its birth and death, beginning and end, can the universe as a whole be without birth or death, without beginning or end. All things are like thousands and millions of streams which join together and form an inexhaustible long river of the universe. As far as concrete things are concerned, their development is finite, time is finite. But infinite are the transitions from one kind of thing to another, from one form of matter to another,

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The Universe

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namely from one concrete time to another concrete time. Precisely because of the finiteness of concrete things in time, they constitute the infinity of the universe as a whole in time, and the development of the universe will never come to an end, will never reach the peak. Just as in space, in time the universe is also both finite and infinite, and the infinite is composed purely of and transformed from the finite.

The Universe As A Whole Has Neither Beginning Nor End

When we say that the universe is also developing, isn't it meant that the universe as a whole is changing and developing just like the concrete things in the universe? This question is formulated incorrectly. The development of the universe *is* expressed in the developments of all things in the universe. Isolated from the developments of concrete things, the development of the universe itself is meaningless.

During the past several decades, within bourgeois cosmology, there has developed a trend, "evolutionary cosmology", which advocates the "evolution" of the universe itself. These cosmologists think that the universe has an origin. In the West, since the '30s, there have been some people who have advocated the theory that the universe originated in a Big Bang of a "primitive atom" or a "primitive fire ball". As a result of the explosion, the debris of this primitive matter scattered in all directions and subsequently continuously expanded just like a balloon. In the mid '60s, the "3°K microwave radiation" was discovered and the "Big Bang cosmology" again asserted that this is the residual heat of radiation after the Big Bang of the primitive fire ball. Since the universe itself is "expanding", no matter how big it gets, no matter how potentially infinite its expansion at any given moment, the universe is always finite. Because we can talk about the expansion only of a finite thing, how can an infinite universe possibly expand? Where would it expand to? Therefore, the "evolution" here is a sham. any idea of the evolution of the universe as a whole already implies a finite universe. This universe has not only a beginning, but also necessarily an end, a doomsday.

Since the end of the 19th century, there have always been people trying to argue for the doomsday of the universe. Using the 2nd law of thermodynamics, they proposed the so-called "heat-death theory of the universe". That is to say, since heat can only spontaneously transfer from warmer objects to cooler objects, i.e. a closed system can only more and more approach thermodynamic equilibrium (entropy becoming bigger and bigger), sooner or later the universe will also reach a state of thermodynamic equilibrium, and will become a stagnant pool, losing all potential for any motion or change. This *is* the doomsday of the universe.

The universe as a whole cannot have an origin and doomsday, because the universe as a whole is not a concrete thing [like a table, chair, or cup], not a closed system. Concrete things have their beginnings and ends, have their own time. An "elementary" particle has the time of "elementary" particles, man has man's time, the solar system has the time of solar systems. All these times are finite. The sum total of these concrete times constitutes the time of the universe; the time of the universe exists then within these concrete times. Is there a general time independent of these concrete times? No. Time which is divorced from concrete forms, namely "time *as such*" (Engels, *Anti-Dühring*, FLP, p. 65) is only an abstraction in our thinking, just like the concept of house, table, etc. are all abstractions in our thinking. Metaphysicians always postulate one unified stream of time of the whole universe, as though there really is an inexhaustible long river of the universe, which doesn't exist within concrete material processes, but rather exists independently outside of material processes, and everything in this river appears, develops, and dies within this unique time line of the whole universe. This is completely wrong. If there indeed existed such a unique all-encompassing river of time, then it is for sure beyond the material world, and must become the absolute being over and above matter, which can only be a synonym for God. Therefore, if one imagines time by analogy as a river, then time exists in the universe not as one unique river, but rather with thousands of origins and flowing in millions of valleys in competition. The time river of the universe can only exist within all this not outside of it.

The Unity of Infinity and Finiteness In Time

Chariman Mao has taught us that all absolute things can exist only within relative things. Time is infinite, but it is also finite. The infinity of time exists within finite time, and the sum total of countless finite times express the infinity of time. This is the dialectical unity of infinity and finiteness in time.

Bourgeois scholars don't understand this, hence they fall into insoluble contradictions. Kant is a typical case. He thinks that it is both OK to say time is finite, time has a beginning, and to say that time is infinite, time has no beginning. This is self-contradictory. If you say that the world has a beginning in time, then what about before that? There must have been a nothing-can-happen "void time", i.e. time as not-time; this is beyond imagination. Conversely, if you say that time has no beginning, then "to reach *any known point in time*, it must have passed through an eternal time. Therefore, in the world, an infinite series of things must have already *flowed past* in a mutually linked continuum. The infinity of a series consists in the fact that it can never be *completed* through successive syntheses." (Quoted by Hegel in *Science of Logic* Vol. 1. Translated from the Chinese). That is to say, the universe has passed through an infinite time before it reached any given moment. But infinity is named as such, precisely because it can never be reached. Since an infinite time stream would necessarily make the universe develop to an infinitely high level, why has it only reached the contemporary finite level of development?

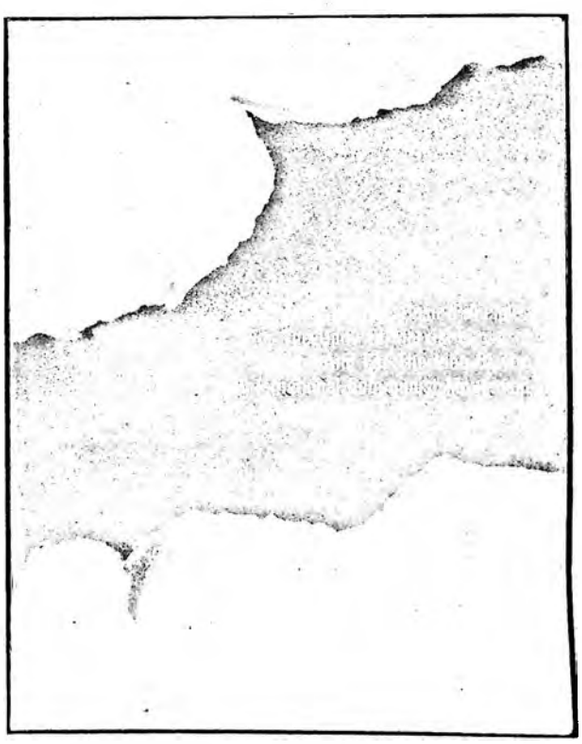
Kant's contradictions originate in his not knowing the dialectics of infinity and finiteness. The finite transforms into the infinite, the infinite also transforms into the finite. The infinite time series is precisely what makes it possible and necessary to reach the given contemporary level of development. For example, one man is 40 years old, he has experienced 40 years of finite time series and reached such a definite development level as 40 years of age. What was there before this man? He is also the result of over 1 million years development of human history, and has thus also passed through a finite time series of over 1 million years. What about before mankind? There were also several billion years of historical development of the whole of living beings, and there was also the history of development of the solar system, and of the Milky Way Galaxy... The sum total of these finite time series constitutes the infinite time series.

There is no such thing as a unified universe time at all. Is there a beginning and an end of the universe? Or in other words, does time have a beginning and an end? We say that: There is both a beginning and not a beginning; there is both an end and not an end. Time is always a concrete thing's time, it is concrete time. Such a time has a beginning and an end. One person has his beginning and end; mankind has its beginning and end; the solar system has its beginning and end; therefore, this kind of time that we have experienced, namely the time calculated according to year, month, day, and hour, has also its beginning and end. This time is linked with the existence of the solar system. What about before the time of this kind? Certainly there existed other time, which was linked to other material processed and there existed another time framework and other time characteristics of which we as yet have no knowledge. Modern theorists of the heat-death of the universe take time as the growth process of entropy (the process of approaching thermodynamics equilibrium). If this thermodynamic process also possesses its own particular time form, then, this is still only one kind of particular time. Even if a certain material system has reached the maximum of entropy, that still can only be the termination of the concrete time of that kind, and later there will still begin some new time. It definitely is not the only time stream in the universe, and it can only be one kind of time among infinitely many concrete times. One kind of time terminates, and another kind of time begins. That is to say, one "universe" is finished, and another "universe" is born. The universe is in this way going continuously from quantitative changes to qualitative changes, in transition from one kind of material form to another, forever, without end and without boundary. Therefore, time, "time *as such*", namely time in the general sense, is the universal form of existence of matter; it is eternal and infinite. But time as concrete time is always the form of existence of concrete things, it is always transient and finite.

In sum, time is like space; it is only the form of existence of matter. Matter has both unity and diversity. Matter in essence is unified, but the concrete manifestations of matter are rich, colorful, and diversified. The general can only exist within the particular and unity can only exist in diversity. These characteristics of matter are equally reflected in the forms of existence of matter—time and space. This is our conclusion. □

Footnotes

1. (Translator's Note) The Chinese words for infinity, the infinite, infinitude, infiniteness, etc. are all the same. Likewise for the finite, finitude, finite, finiteness, etc. We have used our judgment in rendering subtle distinctions in meaning into English.
2. (Translator's Note) Approximately 475—221 BC when China was divided into different states at war with one another. The time of the Confucian/Legalist struggle, a period of transition from slave society to feudal society, and time of "a Hundred Schools of Thought Contending."
3. (Translator's Note) *yu zhou* is the Chinese 2-character word for universe.
4. (Translator's Note) Erlai—A legendary Chinese elderly person.
5. pi-zero meson.



A draft document from the Revolutionary Communist Party of Chile and the Revolutionary Communist Party, USA for discussion in the international communist movement and within their respective Parties. The document was submitted to the autumn 1980 international conference of Marxist-Leninist Parties and organizations, which held that, "on the whole, the text is a positive contribution toward the elaboration of a correct general line for the international communist movement. With this perspective, the text should be circulated and discussed not only in the ranks of those organizations who have signed this communique, but throughout the ranks of the international communist movement."