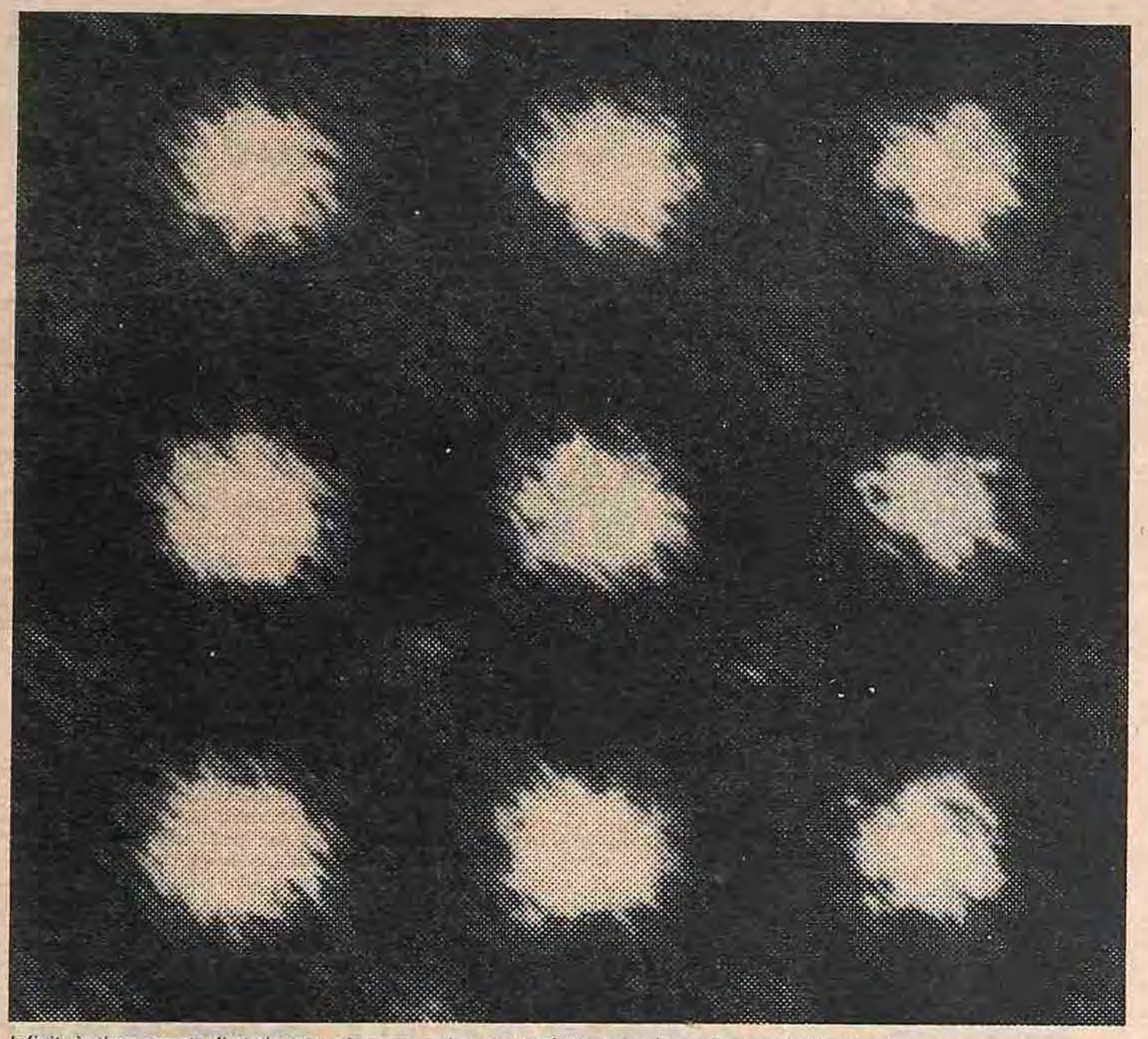
Contribution to the Discussion on the Finite and Infinite

Infinity: The Ultimate Perspective

Some time ago, we printed translations of two important articles from the Shanghai journal Dialectics of Nature. *This journal was published by Chinese revolutionaries from 1973 through the end of 1975. The two articles were authored by Bian Sizu, and titled "Matter Is Infinitely Divisible" (*RW *No. 122) and "The Universe is the Unity of Infinity and Finiteness" (*RW *No. 135). The appearance of these articles aroused great interest, sparking correspondence on these questions which can be found in* RW *issues 141 and 214. The following was submitted as a contribution to the continuing discussion.*



Infinity in the concrete: first electron microscope photograph of atoms as they exist in a solid, zirconia.

Carl Sagan states that his intention in the book *Cosmos* (and the TV series) is to deal with perspective. The ultimate question of perspective, the most "cosmic" form of this question, is that of infinity. Does matter, everything that exists (in his opening sentence Sagan defines the term cosmos as "all that is or ever was or ever will be"), have a final boundary or a beginning or an end? Or is it possible to speak of the entirety of all existing matter as if it is a concrete existing whole thing? And if only concrete, particular, individual things exist, can there be such a statement that the universe is infinite, boundless and timeless? This is the question of the relationship between the universal and the particular in terms of infinity in space and time. Thus the question of infinity is an aspect of the most fundamental question of dialectics. *On Contradiction* states that "This truth concerning general and individual character, concerning absoluteness and relativity, is the quintessence of the problem of contradiction in things: failure to understand it is tantamount to abandoning dialectics." (Mao, *Selected Works*, Vol. 1, p. 330)

Sagan comes to deal specifically with the question of infinity, of extension in space, of beginning and end, in the context of the big bang theory. He takes this theory as his starting point. He then poses two alternative modes of development, and with each mode, he disposes of God as a solution to the question of origins (although with some reluctance).

The first mode of possible development is the ever-expanding universe, beginning with the big bang. But there arises here the more difficult question of what happened before that. "In many cultures it is customary to answer that God created the universe out of nothing. But this is mere temporizing. If we wish courageously to pursue the question, we must, of course ask next where God comes from. And if we decide this to be unanswerable, why not save a step and decide that the origin of the universe is an unanswerable question? Or, if we say that God has always existed, why not save a step and conclude that the universe has always existed?" (*Cosmos*, p. 257)

The second mode of possible development is an infinitely oscillating universe, a constant process of repeated expansion and contraction, with the big bang as the end of each cycle, and the jumping off point of each new oscillation. In terms of origin, he relates that the Hindu religion is "the only one of the world's great faiths dedicated to the idea that the Cosmos itself undergoes an immense, indeed an infinite, number of deaths and rebirths." (p. 258) He finds the Hindu idea that the universe is but an endlessly recurring dream of the god, and the idea of infinite universes each with its own god dreaming the cosmic dream, a "deep and appealing notion." Still, his final summation expresses the thought that these great ideas are tempered by "perhaps" a still greater one. "It is said that men may not be the dreams of the gods, but rather that the gods are the dreams of men." (p. 258)

There is another reference to God as creator in Chapter 2, where Sagan deals with evolution and natural selection. He states that natural selection is a far more compelling explanation for the organization of life than that of a Great Designer. And he argues further that qualities of natural selection, trial and error and inability to anticipate the future, are inconsistent with an efficient Great Designer. But he seems reluctant to just leave it there, and adds parenthetically, "(although not with a Designer of a more remote and indirect temperament)." (p. 29)

In all this it seems that Sagan tends to think of the universe, the Cosmos, as some thing, as a whole with many parts. Thus the door is left open for some Thing else to exist. Bian Sizu writes, "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." (*RW* 135) (And the opportunity for a reactionary ruling class to proclaim its divine right to rule.) Sagan is resolutely against such a proclamation, and does much to debunk the notion of God upon which it rests. But there is a problem, and a comment in "Another reader's" letter (*RW* 214), written in a somewhat different context, is applicable here. "The problem arises in trying to turn infinity *into* finiteness, and thus attempting impossibly to turn a concrete expression of the Universe into *the* Universe."

The universe cannot be understood as some thing. If the universe is not understood as both finite and infinite, both with and without boundary — the universe infinite, the concrete expression of the universe finite (as Bian Sizu expresses it) — then questions remain about origins, and what is out there beyond.... The door is open for god.

This problem has special reference to the big bang theory, which Sagan relies upon, although not in an absolute sense. Using Bian Sizu, "Another reader" shows how the big bang theory, useful in some ways to the proletariat, must also be understood as a limited and one-sided scientific premise. As such, it gives a new lease on life to attempts to reconcile science with religion. This is because it can readily be used by the idealist to describe an act of creation, the creation of the universe out of nothing. And then the question, who did the creating?

So on two counts Sagan finds himself on shaky ground as he pursues the truth that there is no God, no creator. The universe is not some thing. The universe is infinite, every concrete expression of the universe is finite. The big bang theory is not the beginning of the universe. Though Sagan in some ways avoids the idealist trap, he is still vulnerable, and his reluctance to give up entirely on divinity shows this.

"Do we live in a universe that expands forever or in one in which there is an infinite set of cycles?" (*Cosmos*, p. 260) Thus Sagan poses two alternative conceptions of infinity. In fact, neither speaks to an infinite universe, and Sagan himself finds both cosmologies a little depressing. In the first, some 10 to 20 billion years ago, the universe begins somehow with the big bang, with matter continuing to disperse. The quantity of matter in the universe is not sufficient to exert enough gravitational force to cause a reverse action. Thus the universe "expands forever, the galaxies mutually receding... the stars cool and die, matter itself decays and the universe becomes a thin cold haze of elementary particles." (p. 259)

This must be criticized on two counts. Bian Sizu argues that no matter how long or how far the universe expands, it is always a finite universe that does the expanding; "how can an infinite universe possibly expand?" Likewise, it is a doomsday scenario of the universe, as Sagan himself describes it, a universe with an origin and doomsday. But in one of the key insights in the Bian Sizu article, we read, "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." So this cosmology cannot express infinity in space. No matter how long or how far the universe expands, "no matter how potentially infinite its expansion at any given moment, the universe is always finite... how can an infinite universe possibly expand."

Nor can the statement that this concrete universe has always existed express infinity in time. Infinite time does not exist as a concrete entity. There are only finite times of all material forms, all of which have a birth, development, and death. Infinite time exists within these concrete times, as their sum total. "Another reader" puts it this way, that the universe is infinite in time, "not 15 billion, or 15 billion billion years — not time of any concrete measurement at all."

This infinite regression scenario looks a lot like the Newtonian picture that Bian Sizu criticizes as being materialist, but also metaphysical, rightly expressing the finite transforming into the infinite, but not the infinite transforming into the finite. Newton proposed a universe like a big box without boundary, with matter homogeneously distributed, and moved by gravity in a constant series of motions, that is, an infinite series. The big bang/entropy scenario differs in that it is entropy that forces matter to disperse, but it likewise disperses in an infinite series, without boundary. The truth that is hit upon here is that the finite constitutes the infinite. But what is missed is the infinite *realized* in the finite, transposed into the finite. Infinity forever remains *potential* infinity. The big bang/entropy universe is a finite universe.

That this scenario is not favored by Sagan seems clear in that he spends the majority of his efforts on the second scenario, an infinitely oscillating universe, in which gravity is the dominant force. The big bang is but the end of the previous cycle, "expansion followed by contraction, universe upon universe, Cosmos without end." (p. 259) Does this cosmology express infinity?

Sagan applies to this oscillating universe

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the conception of a universe curved like a sphere, finite and unbounded, that is, a four-dimensional hypersphere. "...the universe as a four-dimensional hypersphere with no center and no edge, and nothing beyond." (p. 264) Such a universe has a closed shape, and light must be trapped within it. Thus he says it is perfectly correct to describe this universe which is closed and from which no light can escape, and beyond which there is nothing, as a black hole. Then there arises the possibility of a black hole, the universe, being also a passageway to other holes, other universes, so that there are many other universes. Being consistent with Sagan's description, one must conclude that these other possible universes all partake of the same characteristics of a curved sphere, finite and unbounded, a four-dimensional hypersphere, and all form the content of the eternally oscillating "universe."

What is described here is the universe that Bian Sizu criticizes in his remarks on Einstein, as being a "...boundary-less yet closed four-dimensional spherical space, identical to Hegel's circle." It does not express an infinite universe.

Hegel's circle had its origin in his attempt to counteract Newton's "bad infinity," an infinity that always remains potential, a straight line without end. Hegel proposed "real infinity" in which the infinite is realized in the finite. But he did so by picturing a circle, "a line reaching itself, closed and completely present, without starting or ending point" (as quoted in Bian Sizu). Hegel's conception was an advance over Newton, because it opposed the absolute separation of the infinite and the finite. But it is also a trap, because it is one-sided in the other direction; it equates the infinite with the finite. As "bad infinity," a cosmos eternally receding into space, is only potential infinity, so "real infinite," an eternally oscillating closed universe, is real finiteness.

I want to note here that I think "Another reader" errs in the *specific way* of criticizing the eternally oscillating, finite and unbounded universe that "A reader" (*RW* 141) upholds. "Another reader" calls it false infinity, and quotes Bian Sizu to this point: "The real infinity is infinity completed, and makes the infinite finite." The way I read that sentence, and the paragraph and sense of that section in Bian Sizu, is that the real infinity being referred to, is being referred to in order to criticize it, not to uphold it. This is because real infinity, like false infinity, also expresses a one-sided view...in this case, the infinite transforming into the finite. It is the position of Hegel and Einstein. I think it is in terms of Hegel's real infinity, which is real finiteness, that the eternally oscillating, finite and unbounded universe must be criticized, not in terms of false infinity (potential infinity).

The infinite universe, the sum total of all finite matter, is not some thing, is not ultimately an immensely large or infinitesimally small "apple pie," as Sagan calls it in one place. Both cosmologies that he first advances make it so. Infinity, the eternal, boundless universe, is only realized and expressed in particular, finite, and ever developing concrete forms of matter. But there is not end to such expressions. And no beginning, or limit. Thus the particular forms of matter *in motion*, as they constantly transform into new forms, are both temporary and timeless, both bounded and boundless, each finite whole is likewise the infinite aggregate of all matter. This is the contradiction, which will ever remain a contradiction, of the infinite and the finite.

Both the first and second cosmologies that have so far been described, in the main express an homogeneous, structureless universe, metaphysical matter, without differentiation or qualitative change. In this respect they are Newton's universe which, because of its materialist characteristics, was an advance in his time. And they are also Einstein's homogeneous universe. But, unlike Newton, Einstein reverted back to a homogeneous universe after Hegel's break with metaphysics and his expression of a level-type universe, matter with definite structure and divisible. Thus to posit a homogeneous universe these days represents a backward position that reflects the declining period of capitalism, as Bian Sizu expresses it.

Sagan's predilection is clearly away from these homogeneous type universes, and for a level-type universe. He fights for this understanding. When he speaks of the massive and continuous explosions, and transformation in space that far outreach anything we have dreamed possible, and the process of cosmic evolution in which he says order and disorder are equally evident, he speaks of "clusters of galaxies, galaxies, stars, planets, and, eventually, life and an intelligence able to understand a little of the elegant process responsible for its origin." (p. 247)

But when it comes to resolving some of these basic questions that Sagan raises — homogeneous, vs. level, regression vs. cycle, it is disturbing to read him making such a statement as, "When the cosmic inventory is completed, the mass of all the galaxies, quasars, black holes, intergalactic hydrogen, gravitational waves and still more exotic denizens of space is summed up, we will know what kind of universe we inhabit." (p. 262) Such a statement follows from his misconception of the universe as if it is some thing, as if it is possible to make an accurate census of the total amount of matter in the universe, or to see to its edge. But it is also inconsistent with Sagan's usual methodology in *Cosmos*. The assumption of this statement is that more facts, the simple accumulation of more data, will automatically lead to a true conclusion on the nature of the material universe. More consistently, Sagan's method is in line with Stephen Jay Gould's theme that science is a human endeavor, that theory is not just a summation of facts. Gould writes, "But creative thought in science is exactly this — not a mechanical collection of facts and induction of theories, but a complex process involving intuition, bias, and insight from other fields. Science, at its best, interposes human judgment and ingenuity upon all its proceedings. It is, after all (although we sometimes forget it), practiced by human beings." (*Ever Since Darwin*, p. 125)

In discussing the specific question of the relationship between the infinite and the finite, this statement must be taken further. That is, to the relationship between philosophy and natural science. Bian Sizu's critique of false and real infinity is a philosophical critique, relying on dialectical materialism to resolve, not (and never) totally or exhaustively, but truly to resolve the dilemma of the contradiction between the infinite and the finite. "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 beings' knowledge from small to big, increasing both deeply and comprehensively." Without dialectical and historical materialism, there can be no solution to this dilemma. But with it, we know right now that the universe is infinite, unbounded in time and space, in no sense a single whole thing. And likewise, we know that only particular things exist, and all our knowledge of infinity is dependent upon and reflects back upon particular and temporary forms that matter takes in its endless and relentless process of development — first of all known through natural science, and known philosophically as a summation of natural scientific knowledge, which itself is never simply an accumulation of data or a deduction of theory.

Sagan asks, "Will we ever come to an end in our understanding of the nature of matter, or is there an infinite regression into more and more fundamental particles? This is one of the great unsolved problems in science." (p. 220) We know the answer to this right now, though not in any sense that these answers exhaust truth or replace "the need for scientific investigation into every sphere of society," as Bob Avakian has put it, in a different context, in his questions to Gould. ("More Questions to Carl Sagan, Stephen Gould, and Isaac Asimov," *RW* 207) We know that we will never come to an end in our understanding of the nature of matter, that there is no such thing as the ultimate particle or the ultimate universe. We know this with the surety of philosophy reflecting upon, influencing, and summing up the findings of natural science, in the spiral-like development in which "science and scientific understanding are influenced by and guided — correctly or incorrectly — by philosophical class outlook and struggle," as "Another reader" expresses it. The content of our knowledge of the nature of the universe at this time forms a guideline and a foundation for further and continual deepening and enriching of our understanding of the nature of matter, as a part of the class struggle. (Another of Avakian's points in that same reflection bears repeating here. That is, that ideas become a powerful factor in changing the world only as they become weapons in the class struggle, "grasped and applied by the advanced class in society.")

Sagan continually finds himself cramped and held in by the two cosmologies described here. At the same time, at every point, he tries to break away from any theoretical formulation that limits and restricts the understanding of the cosmos. He explores themes that go up against what Engels calls universe structures or models which "artificially 'circle' the infinite universe, and artificially impose upon the whole universe the laws of some local region" (as quoted in Bian Sizu).

In this spirit Sagan concludes his chapter on infinity with a third possible cosmology, one which "stirs the blood." He speaks of it as entirely un-demonstrated and religious in origin. "There is, we are told, an infinite hierarchy of universes, so that an elementary particle, such as an electron, in our universe would, if penetrated, reveal itself to be an entire closed universe. Within it, organized into the local equivalent of galaxies and smaller structures, are an immense number of other, much tinier elementary particles, which are themselves universe at the next level, and so on forever...upwards as well. Our familiar universe of galaxies and stars, planets and people, would be a single elementary particle in the next universe up, and the first step of another infinite regress." (pp. 265-67)

First, this "infinite hierarchy of universes" is explicitly a level-type universe. Matter is discrete, and structured, although the fact of continuous qualitative change is not dealt with here. Second, the "infinite regress" is not the same as the regress in false, that is potential infinity, because here the infinite is contained and realized in the finite. The description here more approximates Bian Sizu's expression: "...the universe has become an inexhaustive series of 'universes'...every given finite whole is exactly the infinite aggregate of actual things."

Third, this cosmology is not the circled universe of real infinity, not a universe as if it is some thing. The elementary particle, which is in itself "an entire closed universe," also contains within it levels of universes, upward and downward forever. This again approximates Bian Sizu's expression: "...every level is a different state of aggregates of matter, each is both an inexhaustive 'universe' and a given finite whole."

This third cosmology does not address infinity in time. But it is not inimical to the understanding of a cosmos both bounded and unbounded in time. In fact, it lends itself to such an understanding, so that Bian Sizu's description of infinity in time can be applied to this cosmology without wrenching the meaning of either. "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."

Sagan concludes the chapter musing on what other universe levels would be like, if they would be built on different laws of physics, with unimaginably different forms of life...musing on a cosmology that objectively moves toward and in search of a dialectical and materialist understanding of the universe. The universe, in "Another reader's" words, "the totality of all that exists, the totality of all matter in space and time," that is both finite and infinite, bounded and without boundary in space and in time. □