feature | Biosphere and Noosphere

Vladimir Vernadsky and Teilhard de Chardin

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Introduction

Theories of the biosphere have become crucial for environmental sciences such as ecology, biogeochemistry, environmental ethics, and sustainability science. In many ways, theories of the noosphere are logical, though more speculative, extensions of biosphere theories. While noosphere theories have met with more suspicion, they too have been influential to many subjects such as artificial intelligence, transhumanism, and global communication technologies.[1)] The historical development of these influential theories are much like an ellipse, containing two foci that are related, though distinct. We see this metaphor played out between French paleoanthropologist and Jesuit Priest Pierre Teilhard de Chardin (1881-1955) and Russian geochemist and naturalist Vladimir Vernadsky (1863-1945), both of whom are credited with developing the biosphere/noosphere theories in their earliest systematic forms.

The term “biosphere” began as a geological term, first mentioned in *The Formation of the Alps* (1875) by Austrian geologist Eduard Seuss. There it was used to describe the living layers of the Earth.[2)] Both Vernadsky and Teilhard shared an enthusiasm for Suess' initial concept and their resultant theoretical systems used the “biosphere” to organize varying elements from philosophy, the social sciences, the earth science, and the natural sciences.[3)] One important goal shared by both researchers was to prove that life and consciousness were not spontaneous or accidental phenomena. By developing Suess' theoretical work, both researchers attempted to integrate the presence of intelligent life on Earth into an all-embracing scientific world-view: a global theory of life.

Vernadsky began using the term “biosphere” as early as 1911, and published the first systematic version of the theory, *The Biosphere*, in the 1920s.[4)] From the very beginning, Vernadsky's biosphere theory had an impact on global and holistic approaches in Russian life sciences. At approximately the same time, Teilhard de Chardin was developing a much different theoretical system, but one involving similar terms, such as “biosphere” and “noosphere,” and based on a comparable amount of empirical data.[5)] There is evidence to suggest that their work was well-known to each other, to mutual benefit. Teilhard was developing the concept of the “noosphere” when Vernadsky visited Paris in the 1920s, and was introduced to Teilhard's work byway of mathematician and philosopher Edound LeRoy.[6)] It is

also suggested that during that time, Teilhard had attended Vernadsky's lectures on geochemistry at the Sorbonne.[7)] Later, Teilhard would formulate his own systematic theory of biosphere and noosphere in *The Phenomenon of Man*, written between 1938-1940.[8)]

Ultimately, both Vernadsky and Teilhard would come to argue for the existence of fundamental and lawful processes that "direct" evolution development toward increasingly conscious and intelligent forms. Further, for the sake of such comprehensive projects, both thinkers would, in their own way, leave behind the boundaries of purely descriptive natural science and enter into more speculative theoretical territory concerning the evolutionary future of humanity. Vernadsky and Teilhard shared similar bodies of empirical data, general methodological premises and concepts, and comparable theoretical objectives. Yet, each of their resultant biosphere/noosphere theories describe fundamentally different theoretical worlds, down to the very nature of the atom. To come to understand the significant variation between the two global theories of life, we will separately outline the fundamental principles and rationality for both theories in order to make explicit their scientific/theoretical commitments and speculative dispositions. We will then briefly compare some of their more central divergences, though space restriction will limit the scope of this comparative analysis.

biosphäre, noosphäre, monismus, umwelt

Vernadsky: The Biosphere from Geology

The interconnected and lawful nature of geological processes served as the initial empirical impulse for Vernadsky's biosphere and noosphere theories. Vernadsky worked on these issues in his early research on the regularities of mineral formation in ore deposits. Also in the early years of developing the biosphere theory, Vernadsky founded a new field of scientific studies that, while distinct, was not wholly separate his earlier work on mineralogy and soil sciences. This new field called "biogeochemistry" considered the interplay between living and non-living (inert) processes, extending those early observations on the integrated and regular nature of geological processes. His biogeochemistry looked at the geological manifestations of life and considered the biochemical processes in living organisms in relation to their impact on the earth's geology within a cosmic context. Specifically, Vernadsky focused on the complex role played by living matter in the history of the earth's crust and the atmosphere.[9)] In short, Vernadsky's biogeochemistry understood living matter as the major factor in Earth's chemistry because biological life-cycles and functions control flows of atoms. These functions include 1) gas functions, which regulate the gaseous structure of the atmosphere, submarine, and subterranean environments; 2) concentration functions, which allow organisms to capture and concentrate the chemical elements of their environments; 3) oxidation-reduction functions; 4) various biochemical functions wherein feeding, breathing, multiplication and destruction of organisms redistribute and mix matter; and 5) the biogeochemical functions of the mankind.[10)] Thus, living matter forms a kind of complex geosphere (like the troposphere, the hydrosphere, the land surface)[11)] that plays an active role in Earth's own planetary geology, and thus, the study of biological phenomena can be understood geologically.[12)]

Understood this way, the Earth, as a geological sphere, is seen as being occupied by, and chemically organized by, a biological geosphere or "biosphere": a living envelope that surrounds the planet:

"The biosphere appears in biogeochemistry as a peculiar envelope of the Earth clearly distinct from the other envelopes of our planet. The biosphere consists of some concentric contiguous formations surrounding the whole Earth called geospheres. The biosphere has possessed this perfectly definite structure for billions of years. This structure is tied up with the active participation of life, is

conditioned by life to a significant degree and is primarily characterised by dynamically mobile, stable, geologically durable equilibria which, in distinction to the mechanical structures are quantitatively fluctuating within certain limits in relation to both space and time."[13)]

The structure of the biosphere is described as a dynamic equilibrium: "Not a single point of this system is fixed during the course of geological time. All points oscillate around a certain midpoint."[14)] The biosphere is more than a premise about the planet's crust. The biosphere is a self-regulating system comprising the totality of living organisms (living matter) and the various geospherical levels serving as their environment. This was determined after Vernadsky examined living matter from the biogeochemical viewpoint and arrived at the conclusion that the chemical compounds of living matter do not reflect that of their environment. Rather, life seems to determine the geochemical history of almost all the compounds of the Earth's crust in the process of making the environment favourable to itself.[15)]

biosphäre, noosphäre, organismus, umwelt

Vernadsky: From the Biosphere to the Noosphere

Studying the natural history of the chemical elements, Vernadsky arrived at the conclusion that living matter modifies its geochemical environment.[16)] The above-mentioned biochemical biogeochemical functions correspond to specific classifications of organisms, and all are necessary for the continued function of the biosphere. Given that living matter is in turn affected by their inert environments, Vernadsky came to the following three conclusions: (1) All basic biogeochemical functions can be carried out by unicellular organisms; (2) There is no species able carry out all of these functions; and (3) Over the course of geological time, different species could replace one another, but the biogeochemical functions must have still been carried out.[17)] In his later works, Vernadsky claimed that the biosphere has clearly definable evolutionary "interests" and, because of its holistic operation, the biosphere has an evolutionary *strategy*, partially independent from the needs of adaptation.[18)]

Here we must briefly consider the Dana principle, derived from the work of American geologist and zoologist J. D. Dana (1813-1895). Dana noted that in the course of geological time, a certain part of the planet's inhabitants acquired an increasingly complex central nervous system. Studying the Crustacea, he termed this process cephalization, stating that "the higher centralization of the superior grades, and the less concentrated central forces of the inferior … This centralization is literally a cephalization of the forces."[19)] "Cephalization" describes the process whereby nervous tissues tend to concentrate at one end of an animal's body, creating a head (cephalization from the Greek word *kephale*, "head"). For Vernadsky, the effects of the Dana Principle helped the biosphere to realize its evolutionary "interests" by increasing the intensity and complexity of the biogenic migration of atoms in life over time. This migration of atoms is integral to the regulation the biosphere's dynamic equilibrium.

For Vernadsky, the conclusions he reached from studying dynamic equilibrium and the Dana principle implied an even more profound conclusion: that biospheric life is an eternal phenomenon. It is important to recall again that while Vernadsky studied life in the context of geology, he also sought to describe the interruptible border between living and inert matter from the biogeochemical viewpoint, something that distinguishes him from Teilhard. This distinction played an important role in his understanding of life as being regular and non-sporadic. On what is this distinction based? Unlike Teilhard, in Vernadsky's cosmos atoms bear no properties that allow us to postulate whether life or non-life was already present on the atomic level. The Pasteur principle had earlier stated that organic molecules displayed "asymmetrical" structures. We see such asymmetry in the structure human bodies as well (i.e. left hands and right hands). Vernadsky would consider this kind of asymmetry as

asymmetry *in space*. For Vernadsky, asymmetry in spatial structure also implied asymmetry in time, meaning that organic or biological temporal processes like aging cannot run backwards.[20] Said differently, living matter manifests “duration,” a concept of asymmetric time taken from the work of philosopher Henri Bergson (1859–1941), who was very influential for both Vernadsky and Teilhard:

“[O]ur duration is not merely one instant replacing another; if it were, there would never be anything but the present—no prolonging of the past into the actual, no evolution, no concrete duration. Duration is the continuous progress of the past which gnaws into the future and which swells as it advances. And as the past grows without ceasing, so also there is no limit to its preservation”.[21]

In Vernadsky's view of biological space-time, the asymmetry and duration define “spatial-temporal energetic peculiarities” that sharply distinguish life from its inert environments.[22] Further, if a) life cannot come from non-life, and b) Vernadsky's biogeochemisty suggests life is a dynamic equilibrium, then life must have been biosphere-like from the very beginning and can exist only in the form of the biosphere: “The first occurrence of life in the biosphere could not be in form of separate organisms but only in the form of the sum total of organisms carrying out various geochemical functions. Biocoenoses necessarily had to occur from the very beginning.”[23]

These conclusions have significant impact on Vernadsky's prediction about the future of humanity and lead to the postulation of the noosphere. The noosphere is a lawful stage in the evolution of the biosphere. For instance, if life's geochemical processes are asymmetrical in space, and therefore in time, then the growth and centralization of the centralized nervous system (cephalization) within the the course of geological time is also asymmetrical, and therefore *irreversible*. Thus, humanity's own intellectual capacities are being progressively and irreversibly increased through directed evolutionary processes. Vernadsky grounded these claims in Dana's work on the cephalisation process and in the geologist Joseph LeConte's notion of a coming “psychozoic era” of the “mastery of superior intelligence.”[24] These theories and bodies of research indicated the “momentum” within evolution towards the noospheric stage.[25]

For Vernadsky, the crucial characteristic of this last stage of biospheric evolution is the dominance of scientific reason. Humanity's increasing social and scientific capacities also increase humanity's geochemical effects, and therefore increased the potential control humanity can have over the biosphere. In this way, the move from biosphere to noosphere describes a physical and cultural transformation of the planet's surface, a reconstruction of the biosphere through scientific attention. More abstractly, the noosphere can be thought of as a “thinking stratum” of a collective human consciousness that has turned its scientific attention onto its own relationship with the planet. By this logic, science becomes increasingly a form of ecological stewardship, taking the planet's “natural” biospherical processes under its control. At the same time, science is a product of the human species, and therefore also a natural planetary phenomenon, growing out of the evolutionary history of the biosphere. For these reasons, Vernadsky would not consider the noosphere as a “new sphere“ on the Earth's surface, but rather, an augmentation of the biosphere itself. All noospherical events take place in the frame of the biospheric geological stratum. There is no appeal to mysticism in this view, and Vernadsky never discussed the temporal limits or the possible end of the noosphere.[26]

biosphäre, noosphäre, evolution

Teilhard: From Physics to the Biosphere

Teilhard de Chardin began in Jesuit seminary, and was educated in scholastic philosophy before moving into geology and physics.[27] From there, he turned to the study of mammals and

palaeontology, for which he would become famous with the Piltdown Man discovery (1908-1915). These various influences converged in Teilhard's research. Beginning with the atom, Teilhard hoped to prove that complexity and consciousness were bound together as a principle of matter leading toward biospherical phenomena, and finally the noosphere. Further, Teilhard did not consider evolution as exclusively a biological or random phenomenon, but as a way of describing the progressive development of all matter, for which biological evolution was a special case.

For Teilhard, there are a number of fundamental methodological postulates. First, the universe is a "closed" system, and nothing can appear within it that did not already exist. The planet Earth is also a closed system, insofar as it is of a finite mass and shape. Second, the nature of matter is dichotomous, having processes that are distinctly external ("tangential") and internal ("radial") to those bodies: "Since the stuff of the universe has an internal face at one point in itself, its structure is necessarily bifacial; that is, in every region of time and space . . . [is] co-extensive with its outside, everything has an inside."[28)] Third, Teilhard discusses matter in terms of finite units or *corpuscles*, which exist at various levels of complexity and size. For example, the atom, the cell, and the human body can all be considered as finite and enclosed corpuscles of matter. Fourth, the dual-nature of matter corresponds to two modes of energy in the universe. External *tangential* energy is measurable by the physicist's instruments, while internal *radial* energy is a kind of psychic or spiritual energy.[29)] Teilhard mystically referred to the internal nature of matter as the "within of things" or "the heart of matter" and placed great importance on the cosmic role of its "radial" energy. Specifically, he postulated that radial energy directed the organization of matter towards further complexity and centralization.

As a general property of matter, evolution describes the development of corpuscles of matter throughout various level of complexity. Complexity, as Teilhard understands it, is a form of combination; a grouping and knitting together of smaller corpuscles within a closed-in whole of a determined radius, creating a larger corpuscle at a higher level. Indeed, for Teilhard, self-organization is a primal disposition of the universe.[30)] The variety of corpuscles is diverse, ranging from tiny rudimentary atoms to the cosmos itself. One can also understand this grouping phenomena with a helpful analogy to gravity that also describes a universal tenancy for matter to cluster.[31)] As matter becomes increasingly complex, it also demonstrate cephalization, increasing in terms of its "centricity" or *centro-compleixty*.[32)] In short, Teilhard also holds that when matter becomes more complex it also becomes increasingly centralized. Roberts (2000) notes that it was Teilhard's "aim to show that the 'still hardly coherent universe of the physicists and biologists' can be arranged from top to bottom in the light of this concept of centro-complexity."[33)] Further, Teilhard insists that the progressive cosmic history of combination and centralization, from atoms, to cells, to human bodies, can be captured mathematically as increasing "curve of corpuscularisation."[34)]

Unlike Vernadsky, Teilhard proclaimed the absence of an impassable border between living and non-living matter. Consciousness and intelligence were a result of higher centro-complexity in matter from the beginning, in the form of radial energy. However, due to the extremely low degree of complexity at the atomic level, we cannot observe such phenomena in atoms. It is therefore extremely important for Teilhard to demonstrate the similarities of living and inert substances: "Life as I shall continue to insist throughout what fallows, appears experimentally to science as a material effect of complexity."[35)] The virus is a simple form of life that serves well as an example of an observable "transitional form" between life and non-life.

After dismissing the life/non-life boarder, Teilhard is able to place biology within the context of physics, a body of knowledge from where he felt it had been previously excluded.[36)] Further, his project of synthesis formulates "biology [as] simply the physics of the very highly complex."[37)] Thus, Teilhard saw biological evolution as a continuation of pre-biological evolution, and the growth of mind

as a regular stage in this process.

Like Vernadsky, Teilhard's view of evolution was highly influenced by Bergson. Bergson's theory of evolution had a marked difference from his contemporaneous English counterparts. His *L'Évolution Créatrice* was published in 1907, and later in 1927, it would win Bergson the Nobel Prize in Literature. In this text, what is likely his most popular work, Bergson argued against the increasingly popular ideas of "Social Darwinism" within England and its spokesperson, Herbert Spencer. Spencer had famously coined the phrase "survival of the fittest" in his *Principles of Biology* (1864) to claim that natural selection favored individuals who were bigger, stronger, and faster than their counterparts. For Spencer, this was true of both biological and social evolution. Bergson claimed that this view reduced evolution to self-interest and social domination. Specifically, as Stevens-Arroyo (2011) notes: "Bergson rejected the notion that human advance derived solely from social power acting in self-interest and advocated instead a greater respect for the development of virtuous altruism in evolution."[38] Thus, in Bergson's view, evolutionary "fitness" may have less to do with self-interested individuals who become bigger, stronger, and faster, and more to do with cooperation among members of the species. This view seemed to be supported by grouping behaviours in both humans and other animals, be they in "packs" or "nation states." Stevens-Arroyo also notes that Bergson criticized Spencer's emphasis on the merits of an individual "physical" attributes by stating that "evolution was a spiritual force contained within matter . . ."[39] Teilard would take up at least two of Bergson's conclusions: 1) that evolution, especially for humans, is a collective phenomenon; and 2) that spirit and matter are not separate from each other, but somehow are entangled or related.

It is from these observations and theoretical commitments that can understand Teilhard's biosphere as the results of 1) the law of complexity-consciousness and the curve of corpuscularisation; 2) the limited, closed-system of the planet Earth; 3) a view of evolution as directed toward increased complexity, life, and finally consciousness; and 4) a Bergsonian understanding of biological evolution.

Teilhard: "From Piltdown Man to point Omega"[40]

The human being occupies a significant place in the cosmos for both Vernadsky and Teilhard. For Teilhard, the fossil records shows that after *homo sapien*, no further differentiation takes place evolutionarily. Evolutionary *convergence* appeared to be evidenced by the discovery of the infamous Piltdown Man, which he co-discovered with Charles Dawson in 1912, and Peking Man in 1921, in which he also took part.[41] These fossils were significant for Teilhard in that they applied there were human ancestors belonging to a new evolutionary line that underwent no further differentiation. Even when the Piltdown Man fossils were shown to be chemically treated and therefore a hoax, Teilhard never abandoned his theory of directed convergent evolution in humans. Increasing cerebralisation in mammals had provided *homo sapiens* with incredible intellectual capacities, and human socialization seemed to only enhanced the effects of corpuscularisation on humanity. Without the fossil evidence, it appeared that humanity was following a convergent evolutionary path, creating a new sphere on the earth more closely knit and homogeneous than the biosphere.[42] Teilhard considered human beings to be the only creatures capable of such development, and summed up his view in one line concerning self-reflection: "the animals knows; but only man knows that he knows."[43]

Teilhard also postulated that the same mechanisms operating in biological evolution and governed human history.[44] Though Roberts points out that "[t]here is ample evidence . . . to show that Teilhard blurred, if not obliterated, the distinction between the social, the spiritual and the biological."[45] Teilhard describes becoming aware of the noosphere during prolonged contact with war, in which masses of troops faced each other in the trenches in France. Within the battles of WWI, vast amounts of individuals had come together for a goal outside of their own individualities. Teilhard regarded social units such as tribes and nations to be a more sophisticated manifestation of the same grouping

mechanisms found in other animals, and in matter more generally.[46] Increasing social bonds, culture, and intellectual capacity are majors factors in the directed evolutionary culmination of noosphere because they promote internalization.

Teilhard's theory of the noosphere can be seen as the speculative conclusion of his system so far outlined. The noosphere is the postulated consequence of the law of complexity-consciousness, and represents the highest level of complexity achievable.[47] The culmination of noosphere creates the most complex, conscious, and irreversible entity possible in evolution. This entity is also most stable and permanent combination possible.[48] Conservatively considered, the noosphere is the “thinking sphere” or envelop on top of the biosphere,[49] as it was with Vernadsky. However, this would ignore the considerable thrust Teilhard places in the concept. It is true that it is with “reflection” that biosphere becomes noosphere, but more specifically, the noosphere acquires “incomparable substance and capacity” by having consciousness become exterior to the individual,[50] as in the example of the troops during war. Like Vernadsky, the appearance of scientific thought is a crucial aspect of the noosphere, but Teilhard would not remain within the bounds of Vernadsky-like conception of the noosphere as geospheric stewardship. For Teilhard, this shift to externality is the “universal consciousness of humanity,”[51] where we can make an analogy between noosphere being like a planetary brain, composed of every autonomous human brain. There is one key difference between the noosphere and a brain, however: in the human brain thought arises from a system of non-thinking fibres while noosphere is compressed of autonomous units of reflection.[52]

The *point Omega* is the aspect of Teilhard's theory that is most heavily influenced by his theological interests and education. In Teilhard's cosmology, the point Omega serves as both the final stage towards which the evolution of matter is directed (from biosphere, to noosphere, to point Omega) and as a quasi-divine point outside of evolution, directing its progress in the form of radial energy. Teilhard equates this final stage of evolution with “the noosphere’s internal turning back on itself as a unit, having simultaneously reached its utmost degree of complexity and concentration . . . the reversal of equilibrium, detaching the spirit, complete at last, from its material matrix, to rest from now on with its whole weight on God-Omega.”[53] Teilhard also equates the coming of the point Omega to the end of the world, in terms of the complete internalization of the noosphere and the detachment of spirit from matter, leading to endless life outside of the matter world, and therefore outside of space-time.[54]

synergetik und naturphilosophie, evolution, noosphäre, biosphäre, komplexität, synergetik als weltanschauung, synergetik (physik)

Conclusions

Both Vernadsky and Teilhard de Chardin used the scientific data of their time as the empirical basis for their theories. In both theories, the same basic terminology is used: the biosphere, the noosphere, cephalisation, living matter, etc. Both theories contain similar methodological principles, such as, the declared principle of phenomenology and the implicit principle of teleology. Through what Vernadsky referred to as the *Dana principle* and Teilhard called *the law of complexity-consciousness*, both researchers give complexity a central role in their theories of the biosphere and noosphere, and understand the universe and the biospheres in term of their wholeness. Both seem to agree that evolution tends towards increased complexity and centralization of that complexity, leading to increased intelligence over the course of evolutionary time. The asymmetry and irreversibility of these processes was important also for both, though Vernadsky developed his theory of space-time from biology (*ala* Bergsonian duration) and Teilhard adopted his space-time theory from physics.

Nevertheless, Vernadsky and Teilhard created theories with differing views on crucial subjects and the

concepts of the biosphere and the noosphere are vastly different in both theoretical systems. Teilhard accepts abiogenesis whereas Vernadsky dismisses it due to the self-regulating dynamic equilibrium of the biosphere, which requires substantial energetic difference between living and inert natural bodies.[55)] Further, Vernadsky claims that terrestrial intelligence is unthinkable outside of the biosphere; Teilhard brings up the idea of the “splitting of evolution”.

Vernadsky's and Teilhard's different interpretations of the biosphere and the noosphere concepts can be said to be connected with two divergent properties. First, they had different theoretical premises, in that Teilhard connected the appearance and future development of the human consciousness with the concept of dichotomous matter, while Vernadsky aimed to place humankind into the geological history pointing out the impassable border between living and inert substances. Second, the differing scientific experience of both theoreticians caused vastly contrasting approaches.

Finally, Teilhard and Vernadsky made the same principle methodological error, which allowed them to go far beyond the explanatory possibilities of the basic statements of their theories: a certain phenomenon (process) which exists on Earth is analogically extrapolated either in time or in space (or, even, in a spaceless-timeless domain) without any convincing grounds. “We have seen and admitted that evolution is an ascent towards consciousness” - an empirical generalisation. “Therefore”, according to Teilhard, evolution “should culminate forewards in some sort of supreme consciousness.” Even if one accepts that the evolutionary process is a straight line leading to human consciousness, this does not imply that the process will inevitably go further, for human consciousness may be the highest form of reason. Vernadsky also takes the same methodological liberty. He would agree with the first part of Teilhard's passage quoted above, but Vernadsky makes different predictions based on the same statement. The human mind will not result in any higher spiritual entity, but will extend to the limits of the whole biosphere taking under its control all biospheric processes. It is clear that the same methodological liberty allowed Vernadsky and Teilhard de Chardin to pose different explanations based on similar empirical generalisations.

Biosphäre, Noosphäre, Pierre Teilhard de Chardin, Vladimir Vernadskij, Komplexität, Henri Bergson, Evolution, Umwelt, Herbert Spencer, Komplexität, Struktur

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This subheading was taken from the title of Roberts excellent and comprehensive study of Teilhard; a text to which we owe much. See Roberts, N. K. (2000). From Piltdown Man to Point Omega: The Evolutionary Theory of Teilhard de Chardin. New York: PeterLang Publishing.
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The Piltdown Man discovery was of course proving to be a hoax, and Teilhard was even considered among the hoaxers, though Robert (2000) makes a strong case against this allegations. To his credit, Teilhard did not believe that the jaw and the skull belonged to the same animal. See Gould. S. J. (1983) The Piltdown Conspiracy. In Hen's Teeth and Horse's Toes (201-227). New York: W.W. Norton; and Roberts (2000), p. 19-22.
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43)

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