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METAPHYSICAL AND EPISTEMOLOGICAL PRESUPPOSITIONS IN STEPHEN HAWKING'S INTERPRETATION OF THE CREATION OF THE UNIVERSE

In philosophical discussions of the past, the problem of the creation of the universe out of nothing attracted many philosophers. Steven E. Baldner and William E. Caroll are right when they regard this problem as "a crucial nexus of faith and reason" bringing one of the most fascinating intellectual issues discussed in every epoch[1]. The growth of natural sciences resulted in new attempts at finding physical solutions to many questions that were previously discussed by philosophers. The most intriguing proposals were provided by the so called steady state theory (Bondi, Gold, Hoyle) and by Stephen Hawking's "no boundary" or "no edge"[2] quantum model of creation. The steady state theory was practically falsified in 1965, after the discovery of the background radiation, the existence of which turned out inconsistent with basic tenets of the steady state theory. The Hawking's proposal, in spite of its interpretative difficulties, inspires a version of a pop-metaphysics in which one reads that in this approach "there is no

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[1] S. E. B a l d n e r, W. E. C a r r o l, *Preface*, [in:] *Aquinas on Creation*, "Medieval Sources in Translation", 35(1997) IX.

[2] The concept of the edge, so important for Sagan's popular expositions of Hawking's ideas, can be found in: S. W. H a w k i n g, *The Edge of Space-time*, [in:] *The New Physics*, ed. P. Davies, Cambrigde: Cambridge University Press 1989, 68.

room for a Creator God. Not that God is dead: God never existed"[3]. This combination of sophisticated mathematics with naive metaphysics brings philosophical argument which Quentin Smith calls "the worst atheistic argument in the history of Western thought"[4].

After presenting in this paper the cosmological context of contemporary debates, I will try to make evident controversial metaphysical and epistemological presuppositions implicitly assumed by Hawking in his argument. When one brackets these controversial presuppositions, Hawking's physical proposal becomes neutral in its metaphysical content. Consistently it can be accepted also in Theistic interpretation of the quantum creation *ex nihilo.*

I. THE CREATION PROBLEM AND THE BEGINNING OF TIME IN RELATIVISTIC COSMOLOGY

Before the theory of big-bang inspired discussions about the possible creation of the Universe 15 billion years ago, the corresponding question of the absolute beginning of cosmic time was raised on theoretical basis in relativistic cosmology. In 1922 the Russian physicist, A. A. Friedman, provided in his paper on Einstein's Theory of General Relativity a mathematical description of the initial stage in the cosmic evolution. In this description, strange physical parameters appeared, since in the moment t_0 the Universe's volume was equal to 0 while the parameter of mater density assumed an infinite value. These physical properties corresponding to the moment t_0 seemed so strange to Friedman himself that he decided to call the initial state of the cosmic evolution "the state of creation of the world". The very expression caused many troubles to those later Soviet ideological commentators of Friedman who had to argue that the term expressed only the sense of humor of its author.

For a long time, the prevailing opinion in cosmology was that the singular state in Friedman's solution resulted from simplified assumptions concerning the distribution of matter in cosmic space. Einstein himself suggested that if the assumptions were more realistic, the singular points

[3] A paper from *Stern*; cited by William Lane Craig in: W. L. C r a i g, Q. S m i t h, *Theism, Atheism and Big Bang Cosmology*, Oxford: Clarendon Press 1995, 279.

[4] Q. S m i t h, *The Wave Function of a Godless Universe*, [in:] *Theism, Atheism* [...], 322.

would not appear in cosmological models and the problem of the creation of the world would have no scientific basis. Contrary to such a view, in the late 1960's, S. W. Hawking, R. Penrose and R. Geroch proved that the appearance of singularities in cosmological models does not depend on simplifying assumptions but results from suppositions that seem both unsophisticated and realistic.

On philosophical level the discussions about the initial singularity inspired the standpoint called sometimes "singularity mysticism". Its adherents regarded singularity as a boundary or an edge in cosmological models. Subsequently they referred to God the Creator to explain the breakdown of the laws of Nature and principles of modern physics in singularities. In those interpretative proposals, one finds a new version of the Clarkean physico-theology in which God of scientific gaps invented by Samuel Clarke in his 18th century polemics with Leibniz is replaced by God of cosmological edges. In this new approach, God the Creator appears as the God of scientific edges introduced in the well-known manner characteristic of the *Deus ex machina* when the natural sciences reach a boundary in their explanatory procedures. The problem revealed by the history of science is that after new scientific discoveries former gaps could have been bridged without referring to any supernatural Agent. This experience confirmed by the growth of scientific study of nature results in criticism of new attempts to reduce the Divine Creator to the role of a cosmic edge that determines the initial distribution of physical objects.

Neither philosophical antipathy to the God of scientific gaps nor possible theological predilection for the God of cosmological edges may substantiate any answer to the question whether the Friedmanian moment zero constitutes the absolute beginning in the physical evolution of the Universe. There are no physical or philosophical means that would make possible to prove that at this very moment our universe emerged from ontologically understood nothingness. The methodological principles of modern physics imply that any physical state S_n should be explained by reference to an earlier state S_{n-1}. For methodological reasons, the scientific series of explanations in the past of the Universe should be continued *ad infinitum* unless one proves that the moment t_0 must be introduced in cosmic history as the absolute zero, in the same manner as the absolute zero of temperature must be accepted in Kelvin's scale.

II. PHYSICAL CREATION AND QUANTUM ELECTRODYNAMICS

In the classical doctrine of creation *ex nihilo* the basic role is played by the very notion of *nihilum.* How to define physically what philosophers call nothingness or non-being? This fundamental concept was defined in such a vague manner that many authors did not distinguish between metaphysical nothingness and physical vacuum. Heinz Pagels mentions that when he questioned using the term "nothing" in Alex Vilenkin's theory and asked the author "what do you mean by nothing?" the only answer he received was: "nothing is nothing"[5]. Very often in this approach philosophically understood nothingness is identified with physical vacuum. A vacuum in quantum electrodynamics is understood as the lowest energy state of a field in which no physical particles exist. Against its identification with philosophically conceived nothingness one may argue that the vacuum possesses a rich mathematical structure that can be described by means of the formalism of quantum field theory. The absence of physical particles in the vacuum is described in this formalism by the formula $\hat{a}\ \Psi_o = 0$, where $\hat{a}$ is an annihilation operator and Ψ is the state vector. Despite the absence of particles, physical fields do not disappear, and their properties can still be characterised in the abstract language of mathematics. The state vector Ψ characterising an arrangement of n particles in states i = 1, 2, ... can be presented as the result of the action of n creation operators on the state vector of the vacuum. Designating these operators by $\hat{a}_i$, we can describe any physical state of the investigated system as a function of the state vector of the vacuum:

$$\Psi = \hat{a}_1\ \hat{a}_2,\ ...,\ \hat{a}_n\ \Psi_o$$

The indicated possibility manifests that in an evolving physical system any particular state described by the vector can be regarded as the actualization of potentialities that are contained in the physical vacuum. From philosophical point of view, this vacuum may be conceived as a unique field of potentialities of which only some possibilities are exemplified (= instantiated) in the physical processes that occur at the present stage of cosmic evolution.

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[5] H. P a g e l s, *Perfect Symmetry*, New York: Simon & Schuster 1985, 343.

New physical theories of creation contribute to a better understanding of classical distinctions between the actual and the possible on the one hand and being and nothingness on the other. Firstly, one has to notice that the "nothingness" in these theories possesses rich mathematical structure. It can be described in the language of mathematical principles. Consequently, its status seems similar to the status of philosophical logos rather than to non-being. Secondly, to avoid conceptual chaos one must grant the real existence not only to actual but also to possible objects. Such a decision requires ontological commitment in which abstract possibilities constitute the primordial ontic level and their concrete exemplifications constitute the subsequent observable reality of everyday experience. It depends on personal terminological preferences whether this primordial level shall be characterised in terms of universals, properties or states of affairs. Different terminological predilections can result in identical explanatory power if only one acknowledges the real existence of universals which at a given period are uninstantiated but can be instantiated in different circumstances.

Regardless the standpoint in classical controversy about the nature of universals, the physicists who rightly contend that four dimensional empty space cannot be regarded as metaphysical nothingness undertook more ambitious attempts to construct better physical models of the creation *ex nihilo*. In an interesting proposed by Alex Vilenkin[6] in 1983 in a paper *The Birth of Inflationary Universe*, there is no pre-existing space. The creation of space-time results from the quantum mechanical effect that can be described in terms of the so called tunnelling. Before this effect occurs, there are no physical particles, no matter, no space and time; using the language of mathematics one could compare this state with the empty set of set theory.

Can we identify the mathematical concept of the empty set with metaphysical non-being? C. J. Isham seems to answer positively this question when he describes the philosophical significance of tricky solution proposed by Hartle and Hawking. In his opinion: "The initial space from which the universe "emerged" can be defined to be that part of the boundary of the four-dimensional space which is **not** part of the (later) three-surface. But

[6] A. V i l e n k i n, *Boundary Conditions in Quantum Cosmology*, "Physical Review", D 33(1982) 3560-3569.

this is the empty set, which gives a precise mathematical definition of the concept of "nothing"![7]

Is the empty set also a counterpart of the metaphysical definition of the concept of nothingness? One has to notice that mathematically understood "emptiness" is subject to the laws of quantum cosmology as well as to basic principles of logic. These principles and laws are valid even when no physical structures exist. Their validity defines the domain of the *possible evolution of the universe.* Regardless the methodological conventions, there remains the very fact that we can mathematically describe the mechanism of emergence of the existing cosmic structures from the state of physical "nothingness" in which only abstract mathematical-logical principles may be thought of as real. A possibility to overcome these flaws in Vilenkin's model was indicated in Hawking's explanatory schemes.

Before Hawking there were many authors who tried to describe physically the physical process of creation. Some of their proposals cannot be strictly understood as a classical creation *ex nihilo.* Instead of metaphysical nothingness, a mathematical structure was explicitly adopted as a conceptual arena where physical particles emerged. Accordingly, the authors who followed E. P. Tryon[8], R. Brout, F. Englert and E. Gunzig[9] described the process of creation within the framework of pre-existing space-time. One could not have strictly spoken of the *creatio ex nihilo* in this approach since the newly created particles emerged from the curvature of space-time. However, in a radical appraisal of the role of these new theories, John Gribbin argued that the new physics of creation leaves no place for the traditional metaphysics of creation since new cosmological models ultimately explain how the Universe *created itself*, emerging from nothing at a certain moment t_0; and as a result the metaphysicians "are out of job"[10].

An opposite view was defended by C. J. Isham who contended that there are many intriguing problems related to creation and evolution of the universe that cannot be explained in the cognitive framework of modern theoretical physics. Consequently one must look for explanations that do

[7] *Creation* [...], 396, 401.

[8] E. P. T r y o n, *Is the Universe a Vacuum Fluctuation?*, "Nature", 246(1973) 396.

[9] R. B r o u t, F. E n g l e r t, E. G u n z i g, *The Creation of the Universe as a Quantum Phenomenon*, "Annals of Physics", 115(1978) 78-106.

[10] J. G r i b b i n, *In Search of the Big Bang: Quantum Physics and Cosmology*, New York: Bantam Books 1986, 392.

not belong to physical sciences[11]. Personally I share the latter opinion, and I think that its significance is important to critical appraisal of any physical theory of cosmic creation. Determining philosophical principles implicitly assumed in creation models accepted in the theory of vacuum fluctuations contributes to our better understanding of important philosophical presuppositions that are tacitly implied by these models.

The discussion on singularities in cosmology brought again classical problems that were discussed in the 18th century debate between Clarke and Leibniz. It was Hawking who in his paper of 1980 claimed that in physics we will find a complete theory in which all questions will be answered without intellectual gaps[12]. Similar declarations imply important epistemological and methodological issues which must be discussed to distinguish what in physical doctrine of creation can be regarded as scientifically justified proposals and what brings controversial and arbitrary philosophical presuppositions.

III. GOD OF GAPS AND OCKHAM RAZOR

In his quantum model of creation, Hawking provided very interesting explanatory device in which the problem of the absolute beginning of time is eliminated thanks to the introduction of imaginary temporal coordinates in the sense of complex numbers. In this approach, the methodological regress *ad infinitum* can be avoided by reference to imaginary time. The basic methodological question deals then with the principle of Ockham. We can formulate this question asking: Should one refer to any non physical factor in explaining the physically described process of creation when there are no gaps in its physical description and the very process seems to be satisfactorily interpreted within the cognitive framework of natural sciences? Do we need metaphysical and theological explanations when a particular problem is adequately explained on the level of physical research?

In traditional attempts to answer the question dealing with interaction between God and nature, God's creativity was often referred to when

[11] C. I. I s h a m, *Creation of the Universe as a Quantum Process*, [in:] *Physics, Philosophy and Theology*, ed. R. Russell [et al.], Vatican Observatory 1988, 405.

[12] S. W. H a w k i n g, *Is the End in Sight for Theoretical Physics?*, Cambridge: Cambridge University Press 1980.

scientists could not have determined any natural phenomena to explain empirically confirmed effects. Such a procedure appeared risky from the standpoint of the scientific development because many phenomena that were supposed to be explained theistically found later natural explanation. God who was introduced initially as a necessary cause became an useless hypothesis when gaps in scientific outlook were filled up. The reference to the God of the gaps who enters in world's history mainly by occasional interventions was clearly inconsistent with methodological principles of modern science adopted already by Galileo. Though he never denied the value of theological explanation, Galileo argued in the *Dialogo* that, for methodological reasons, any theological factors must be excluded from the domain of astronomical research. If, in the spirit of medieval astronomy, one refers to the role of angels to explain the motion of planets, one could always introduce the hypothesis of angels to explain any set of empirical data. As a result, in such an approach, astronomy would remain merely a branch of an applied angelology[13].

Galileo's methodological distinctions implied what we call now the principle of methodological positivism. At the beginning of modern science they seemed unacceptable to Gabriel Naude when he accused Girolamo Borro of being an atheist because the latter denied the existence of the empyrean heavens[14]. Naude's main argument can be presented in the form: "When there is no empyreum, there is no God". Contemporarily it may seem extravagant combining the theories of the empyreum with atheism. We find, however, a new version of Naude's philosophy in Stephen Hawking's model of quantum creation out of nothing[15]. Hawking's dictum "if there is no edge, there is no God, the Creator" expresses the essence of the same philosophy which we find in Clarke's gaps and in Naude's empyreum. Regardless terminological preferences, the reference to the "the edge", "the gap", or to "the empyreum" implies the breakdown of natural laws and makes psychologically easier the search for the Supernatural.

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[13] *Le Opere di Galileo Galilei*, ed. A. Favaro, Florence: G. Barbera 1890-1909, VII, 263. Cf. *Opere*, VII, 325; V, 316.

[14] Cf. G. S p i n i, *The Rationale of Galileo's Religiousness*, [in:] *Galileo Reappraised*, Berkeley: University of California Press 1966, 56.

[15] Its classical version the knowledge of which is presupposed in this paper was presented in the article by J. B. Hartle, S. Hawking *Wave Function of the Universe*, "Physical Review", D 28(1983) 2960-2975.

Hawking himself in his justification of the "no boundary" model, tries to make his reasoning more rational not by reference to the psychological but to the methodological factor. When replying that in his model there is no God but the very edge plays the role of God-like principle, he claims: "if we could show that we can explain everything in the universe on the hypothesis that there is no edge, I think that would be a much more natural and economical theory"[16]. Many authors share the same views and do not accept much more sophisticated concept of God hidden in natural laws because they worry that any attempt at theological interpretation of the laws of nature would be regarded as contrary to the basic principles of interpretive economy. Why to refer to God immanent in ordered nature when the very notion of physical order is enough to explain investigated phenomena. Their methodology seems justified on the level of physical investigations. It cannot be, however, justified on the level of philosophical explanation.

Our belief in epistemological simplicity and economy of explanation resulted in the well-known principle of Ockham's razor. This very principle, however, is methodological in nature, not the doctrinal one. It could inspire effective research procedure but it cannot provide simple answers to complicated metaphysical questions. Even on the level of physical research, this principle often played heuristically negative role. Its critics indicate many examples of the disadvantageous consequences of its application in science. It is true that in the 19th century the appeal to Ockham's razor retarded the development of extragalactic astronomy by nearly one hundred years. Dogmatic adherents of the Ockham's principle argued at that time that there are no extragalactic objects because all observed astronomical phenomena can be explained more economically by reference to the objects in our Galaxy. This search for simplicity resulted in a false cosmological model. As a result, in the contemporary philosophy of science a special "de-Ockhamization" program has been promoted in which the Ockham's principle has a relative, not an absolute value.

Can this very principle justify the absence of God in philosophical interpretation of nature? Can our reference to natural laws make useless any reference to God, the Creator? Similar questions cannot be answered on the level of scientific explanation. They require philosophical answers which

[16] R. W e b e r, *Dialogues with Scientists and Sages: The Search for Unity*, London: Routledge and Kegan Paul 1986, 214.

must not be submitted to the Ockham's razor, the razor effective only on the level of research characteristic of the natural sciences. The questions dealing with the order, necessity and lawfulness belong to the classical questions of metaphysics. Science cannot answer them for the same reasons for which it cannot provide mathematical description of human goodness. Nonetheless, we can find rational answers if we treat seriously the philosophical doctrine of God immanent in nature. Paul C. Davies adopts such a doctrine when he argues in his Templeton Lecture: "The idea of God who is just another force or agency at work in nature, moving atoms here and there in competition with physical forces, is profoundly uninspiring. To me, the true miracle of nature is to be found in the ingenious and unswerving lawfulness of the cosmos, a lawfulness that permits complex order to emerge from chaos, life to emerge from inanimate matter, and consciousness to emerge from life, without the need for the occasional supernatural prod; a lawfulness that produces beings who not only ask great questions of existence, but who, through science and other methods of enquiry, are even beginning to find answers"[17].

In this understanding of God's immanence in nature, the reference to laws of physics does not preclude philosophical search for ultimate explanations in which one discusses those questions that seemed already basic for Leibniz. Possible finding of Grand Unified Theory in physics does not imply that metaphysics will become meaningless and useless after this discovery. In classically understood metaphysics there are questions that cannot be formulated in the language of physics. The hypotetic completeness of future physical theories will be relative to a particular language in which this theory is formulated, since completeness in metalogic is always relative to a language of an adopted system. Accordingly, one should not expect that all metaphysical questions shall receive physical answers, because it is impossible to express the content of the former in scientific vocabulary of physical theories. To the terms "laws of physics" or "order of nature" various meaning can be ascribed even by scientists who use them in their comments to observed physical regularities.

Dependent on philosophical preferences, various authors in using these terms may refer to God's immanence in nature or to the divine mind underlying physical laws. They speak of the neo-Platonic Logos or the

[17] *Physics and the Mind of God*, "First Things", 55(1995) 34.

philosophers' Absolute to present the cosmic order as a different name for the immanent God. Those who committed to agnosticism, as Heinz Pagels, refer only to the cosmic code. All these expressions refer to the same reality which in the neo-Platonic tradition was called a cosmic Logos and understood as a principle of cosmic order immanent in the laws of nature. This principle should be ontologically anterior to any physical process which are only instantiation of the relationships determined by the laws in question. The existence of the Logos, conceived in this way, seems to be assumed implicitly even by these authors who develop ideas explicitly opposed to any form of theistic interpretation. For instance, Hawking in his famous proposal of the creation of the universe as a quantum object does assume implicitly that in the neighbourhood of the "no boundary state" our logical principles and the basic concept of rationality hold. If these assumptions are not accepted, one could not eliminate the possibility that before the boundary state S_i there existed different universes with laws different than our laws of Nature, different principles of mathematics, etc. Such universes could have been submitted to laws of physics unknown to our science. Their evolution could have been developed, for instance, according to the logic of our dreams while the edgeless "initial" boundary state would be just a state that happens from time to time in the discontinuous process of cosmic growth. In this approach Hawking's "no boundary" state of creation would be regarded only as a relative beginning of a new stage in cosmic evolution, not the absolute beginning.

Without auxiliary assumptions it seems methodologically impossible to prove that in a discontinuously evolving Universe this state could not have been anteceded by another physical states subject to different physical and logical laws. The pre-existence of the cosmic Logos, defining a set of basic principles of scientific rationality, seems thus necessary to prove that the state S_i can be regarded as the boundary state not preceded by any physical phenomena.

One can try to defend Hawking against the former objection by arguing that in his model we cannot meaningfully ask what was *before* the "no boundary" time because to the time described by imaginary coordinates one cannot apply the very concept of temporal precedence in its classical understanding. To assess the value of such an objection one has to answer the question whether Hawking assumes the epistemology of realism in his cosmology or is he only an istrumentalist which constructs mathematical models and avoids question of their correspondence with real processes in

the physical world. In his *Brief History of Time: From the Big Bang to the Black Holes*, several statements suggest that the author rejects scientific realism in favor of cognitive instrumentalism. For instance, he describes as "meaningless" the question whether the time of our physical experience corresponds to the real or imaginary coordinates of the space-time representation of relativity theory. He argues that scientific theories do not describe reality but are merely useful mathematical models which describe regularities that exist "only in our minds"[18]. After such a strong declaration, one is amazed to read, two pages later, that physical cosmology is so successful in "describing events" and cosmic laws that in its picture of the completely self-contained universe without boundaries there is no place either for a Creator or for theological explanations. Such arguments are mutually inconsistent. When one rejects realism in discussing the nature of time one cannot argue that objectively God does not exist. One can only claim that there is no place for God either "in our mind" or in particular model. Such a claim scarcely could be called inventive. Cosmological models with physical place for God would namely imply nothing but the well-known regressus to methodology of the pre-Galilean epoch.

The cosmic Logos mentioned above in various philosophical schools is described as the Absolute, the field of rationality, the formal field, etc. To avoid terminological debates and to shed a new light on the nature of this Logos, we can define its nature in the language of relationships determining both cosmic evolution and its scientific study. In this class of the relationships one may distinguish a proper subset of relations that are instantiated in the physical processes as well as in the actual scientific procedures. In our physical world, e.g. in the hadron epoch, no law of the evolution of galaxies was instantiated since there were no galaxies at that time. In research practice of medieval physics no normalization procedure was accepted because the quantum phenomena were unknown at that period. Consistently, we are entitled to claim that the initial Logos containing all scientific principles and physical laws is only partially instantiated in the actually existing cosmic structures and in the process of scientific growth. Its reality is disclosed in the observed physical phenomena through their conformity to the principles of theoretical physics which implies both the

[18] S. W. H a w k i n g, *A Brief History of Time: From the Big Bang to the Black Holes*, New York: Bantam 1988, 139.

effectiveness of this physics in predicting new facts and in the effectiveness of the language of mathematics in describing physical phenomena.

IV. EVOLUTION IN HAWKING'S CONCEPT OF COSMIC CREATION

In appraising the growth of Hawking's understanding of cosmic creation one has to take into consideration at least three versions of his proposals. They are contained in:

1) the paper on the wave function of the Universe[19],

2) the bestseller *A Brief History of Time*[20],

3) the late Hawking's writings bringing the most critical and most mature version of his philosophy of creation.

Certain defects of the early quantum theories of creation were avoided in an approach proposed by J. B. Hartle and S. Hawking in 1983. The important accomplishment of this new approach was that the authors did not assume any space-time framework and did not introduce traditional distinction between boundary conditions and equations of motion. In this cosmology without initial conditions, a single unique state-function is defined to determine probabilistically the entire evolution of the quantum universe. The model, dependent on particular physical assumptions, implies sets of physical data that can be empirically tested at least in principle. Its explanatory value, combined with conceptual tricks, introduces into attractive interpretative framework and provides possibility of avoiding many confused traditional questions. Substantively Hawking-Hartle proposal has two important merits in the domain of classical philosophical issues:

1. It removes the problem of the beginning of time by adroit procedure in which no initial singularity appears in the edgeless compact space-time. There is no breakdown of physical laws in the initial stage of the cosmic evolution. In this model, the past infinity is avoided because time ceases to be well defined in the early cosmic stages. However, "to ask what happened before the universe began is like asking for a point on Earth at

[19] J. B. H a r t l e, S. H a w k i n g, *Wave Function of the Universe*, "Physical Review", D 28(1983) 2960-2975.

[20] S. W. H a w k i n g, *A Brief History of Time: From the Big Bang to the Black Holes*, New York: Bantam 1988. Numbers placed in the text in parentheses refer to the pages of this edition.

91° north latitude; it just is not defined"[21]. Accordingly, the so called "beginning of time" looses its importance as a feature of cosmic history.

2. As a result of eliminating the singularity gap at the moment t_0, the model eliminated also the need for the deistically conceived Creator who was supposed to bridge the singularity gap. As Willem B. Drees commented: "The removal of a beginning would imply that the watchmaker God is not a defendable image"[22]. Both Hawking in his publications of the period 1981-1988 and Sagan in his *Introduction* to the *Brief History of Time* identified the Clarkean God of physical gaps with the God of Christian Theism. In their arguments cosmological edgelessnes implies metaphysical denial of the existence of God. Similar identifications, assessed critically already by Leibniz in his polemic with Clarke, are revoked as groundless by Hawking in 1993 in his *Black Holes and Baby Universes and Other Essays*. It turns out that not only physical models of creation evolved in Hawking's scholarly contributions but also his metaphysics and theology became more mature.

While Hawking's idea of the wave function of the universe was appreciated because of its mathematical concepts in which the question of the beginning of time is avoided, Hawking's philosophy of creation is developed mainly in the most naive of his books *A Brief History of Time*. This famous best-seller should have been called rather "A Brief History of Modern Physics", for it is only in its Chapter 9 that is deals with time. The other ten chapters deal with the development of physical ideas about the universe from Copernicus to string theories. The author's concern with philosophical and theological issues makes the books interesting even for readers who need not be told anew about the uncertainty principle or special relativity theory.

The content of the work was directed to the general reader. Since the writing of his "quite unreadable" *The Large Scale Structure of Space-time*, says Hawking, he learned a lot how to write in an understandable manner (*VI*). He does not use mathematical equations beyond the famous $E = mc^2$ because, he was told, that each equation "would halve the sales". Thus,

[21] S. H a w k i n g, *Quantum Cosmology*, [in:] *Three Hundred Years of Gravitation*, ed. S. Hawking, W. Israel, Cambridge: Cambridge University Press 1987, 651.

[22] *Beyond the Big-Bang: Quantum Cosmologies and God*, La Salle, Ill.: Open Court 1990, 71.

instead of using exponential notation in 10^{66} he says just of "1 with 66 zeros after it" (*108*).

This road to marketing leads him to oversimplify details not only in mathematics, which could be justified, but also in other matters, making the work often historically inaccurate and philosophically amateurish. Sharing cognitive optimism of the early positivism, Hawking asserts repeatedly that current physics may be "near the end of the search for the ultimate laws of nature" (*156*). In this perspective of the cognitive successes of physics, where science explains everything, the role of philosophy is to be reduced to the analysis of language (*175*). Hawking cites Wittgenstein to justify this opinion and calls him "the most famous philosopher of this century" (*175*). In fact, the late Wittgenstein, of the period of Philosophical Investigations, revised his earlier stand and declared that philosophy cannot be reduced to the analysis of language.

These side remark disclose philosophical competence of the author; they do not affect, however, the essence of his philosophy of creation. In the context of his earlier explanations dealing with the beginning of time and the special role of imaginary coordinates in describing the cosmic evolution, the important epistemological question emerges whether Hawking's cosmology underlies epistemological realism. Several statements in the book suggest that the author rejects scientific (epistemological) realism in favour of epistemological instrumentalism. For instance, he describes as "meaningless" the question whether the time of our physical experience corresponds to the real or imaginary coordinates of the space-time representation of relativity theory. He argues that scientific theories do not describe reality but are merely useful mathematical models which describe regularities that exist "only in our minds" (*139*). After such a strong declaration, one is amazed to read, two pages later, that physical cosmology is so successful in "describing events" and cosmic laws that in its picture of the completely self-contained universe without boundaries there is no place either for a Creator or for theological explanations (*140 f.*). If scientific theories describe solely the reality existing "only in our minds" then the absence of God in a given explanatory scheme indicates merely that God was absent in the mind of the author of the theories.

In his Introduction to Hawking's book Carl Sagan maintains that the absence of God in the universe is the principal topic of A Brief History. He sums it up by saying that in this universe there is "no edge in space, no beginning or end in time, and nothing for a Creator to do" (*X*), the

statement that has been quoted in many reviews. Drawing such a conclusion from the book is a bit too hasty, considering at least Hawking's remark that his idea of an edgeless universe is not a conclusion but a proposal which cannot be deduced from more fundamental principles (*136*). Certainly, one can dogmatically adhere this idea accepting it as an article of faith. There are, however, alternative cosmological proposals developed in Penrose's twistor program or in Linde's "chaotic cosmology". Criteria of selection should depend on explanatory content of particular models in the domain of quantum cosmology, not on metaphysical preferences of their authors.

The author's metaphysical and theological views demonstrated in the *Brief History of Time* seem to be as simplified as his mathematical notations. He repeats trivial cliches of the Scholastic theology when asks how heavy stones can be created by God, and does not avoid the question by whom was God himself created (*174*). To Hawking's presentation of a God of the edge, who is imagined to counteract the limitations of scientific theories, one may apply Leibniz's 18th century comments, in which he criticized Clarke for introducing the hypothesis of God to fill the gaps in physical theories. The difference between Hawking and Leibniz is that in the present intellectual climate practically no theologian defends theological views of Clarke, the views that are so strongly and extensively criticized by Hawking. Contemporary polemics with Clarke look like a new form of criticism of Ptolemy's astronomy. They could be right but not particularly inventive.

V. EPISTEMOLOGICAL PRESUPPOSITIONS IN CREATION MODELS

To assess objectively the value of Hawking version of quantum creation out of nothing one must answer the question whether the metaphysical concept of *nihilum* can be meaningfully defined in these theories. According to Adolf Gruenbaum, all quantum descriptions of the emergence of energy of the so called nothing imply creation *ex nihilo* "only in a rather Pickwickian sense"[23]. Though I not share philosophical views of Grünbaum, I do agree that in none of the models of creation proposed by Hawking we can find a counterpart of the metaphysically conceived creatio ex nihilo.

[23] A. G r u e n b a u m, *The Pseudo-problem of Creation in Physical Cosmology*, [in:] *Physical Cosmology and Philosophy*, ed. J. Leslie, New York 1990, 110.

This objection does not stem from the epistemological differences between metaphysics and quantum cosmology. Such differences would be obvious and natural. The basic problem remains, however, that in none of Hawking's models the very notion of nothing (*nihilum*) is accepted in this sense in which it was classically understood in metaphysical description of the *creatio ex nihilo*. When "nothing" denotes "something", the so called "creation", in a physical sense of this term, can denote anything. This very problem requires more exhaustive analysis in the domain of epistemology and metaphysics.

All Hawking's proposals imply important ramifications in the domain of physics, epistemology, metaphysics, and theology. Hawking himself initially did not distinguish these three cognitive levels. Consequently he claimed that his physics of creation makes useless traditional interpretations worked out in philosophy and theology. In his version of cognitive monism Hawking argued that evolving scientific theories allow us to eliminate from human knowledge both the notion of mystery and of God[24]. Accordingly after presenting his model of creation out of nothing during a Vatican conference in 1981 he was seriously disappointed that in his later speech John Paul II dared to mention God the Creator.

Hawking's belief that physical theories can eliminate the need for both metaphysics and theology was consistently extended on the domain of his existential attitudes. His first wife, Jane Wade, in one of her interviews stresses the point that her important role in everyday family situation required to make Stephen aware that he really is not God[25]. In Hawking's epistemological attitude of this period one can find simplistic tenets of the early logical positivism. The belief in one rational interpretation of the world that eliminates any sense of mystery, the belief that science can answer all ultimate questions of humankind, the conviction that physics can provide explanations that would be at the same time consistent and complete - resound outdated principles of the philosophy of science that was developed in the early 1920's. Maybe in the case of Hawking it was biology-laden philosophy of science. When his organism had to search for simplest forms of reactions to answer complicated questions of theoretical

[24] Cf. R. W e b e r, *Dialogues with Scientists and Sages: The Search for Unity*, London: Routledge and Kegan Paul 1986, 212.

[25] Cf. M. W h i t e, J. G r i b b i n, *Stephen Hawking: A Life in Science*, London: Viking Press 1992, ch. 16.

physics, in a natural way Hawking himself professed a form of cognitive monism in which he adopted simplest epistemological principles to make privileged the explanatory proposals provided by him. Being fascinated by the effectivenes of the mathematical description of the world, he argued then that comments on mystery of nature are developed mainly by those authors who do not understand mathematics[26].

In the context of his existential experience one can excuse Hawking's naive philosophy ascribed to his physical models. It is, however, much more difficult to excuse those authors who uncritically followed Hawking's naive remarks in their explanations which were supposed to provide substantive analysis of such fundamental issues as the relationship between theological and physical interpretation of nature. An example of this pseudointellectual attitude can be found in Michael White's and John Gribbin's bestseller *Stephen Hawking: A Life in Science*. When describing 1981 Hawking's meeting with John Paul II the authors inform that his quantum theory of creation was contrary to the orthodox doctrine of the Church and its author shared views inconsistent with the Church's teaching about the creation *ex nihilo*[27].

VI. THE METAPHYSICAL PRESUPPOSITIONS IN PHYSICAL CONCEPT OF CREATION

In his search for physical theory of cosmic evolution, Hawking looks for both the most fundamental laws of nature and the ultimate boundary conditions of the Universe. After assuming the famous axiom that "the boundary condition for the Universe is that it has no boundary" he regards a state S_i as the only boundary and calculates its probability on the basis of general principles of quantum theory. Many authors argue that the emergence of the Universe in the initial state S_i can be regarded as creation from nothing since "the Universe [seems] to appear from Nothing"[28] because there was no other physical state prior to S_i. The temporal notion of priority, defined

[26] Cf. his dialogue with R. Weber in: R. W e b e r, *Dialogues with Scientists and Sages: The Search for Unity*, London: Routledge and Kegan Paul 1986, 210.

[27] Ibidem, ch. 12.

[28] 1983, 2961.

in the terms of the absence of the spacetemporal edge, does not imply, however, the metaphysical notion of absolute nothingness.

Is there a notion of nothing, in its classical sense that was adopted in traditional metaphysics and theology, underlying any paper by Hawking? My answer is negative since it is easy to demonstrate that the alleged nothing of Hawking cosmological models implies the existence of physical principles and logical-mathematical structures that from metaphysical point of view can never be regarded as nothing. Only on physical level such identification may seem acceptable either because certain observation parameters assume zero values or tacitly accepted presuppositions concerning preconditions of theoretical physics are unnoticed since they seem obvious. The psychologically conditioned notion of obviousness does not justify, however, reducing to nothing principles and conditions that are far from trivial from metaphysical point of view.

What kind of physical or nonphysical entities are implicitly assumed as necessary conditions in the quantum process of the emergence of the edgeless Universe?

1. The validity of a set of the laws of Nature is assumed before the construction of the model. Were the reality orderless and chaotic in the traditional sense of the latter term there would be no reasons to apply field equations and laws of quantum cosmology to the boundary state S_i.

2. Mathematical principles dealing with probabilistic distribution are accepted in the description of the no boundary state. Mathematical definitions dealing with topological concept of compactness and the theory number concept of imaginary coordinates are necessary to describe the earlier stages of cosmic evolution. Their use implies implicit references to another set of sophisticated mathematical structures that must be assumed to make possible the construction of the model.

3. Logical principles allowing deductive reasoning in the construction of the model are far from trivial. Cosmological prehistory of the Universe could have been essentially different if the logic of dreams with Feyerabend' famous principle "anything goes" governed the early stages of cosmic evolution. Our imposing on these stages the well-known principles of classical logic imposes important restrictions on physical reality. These principles seem ontically prior to the emerging physical objects. Consequently, an enigmatic reality of a cosmic Logos seems anterior to any physical process; we may argue that these processes originate in cosmic Logos. What was too easily identified with metaphysical nothingness seems

to be a sophisticated reality of the Logos, described by Hellenic philosophers of neo-Platonic tradition. One cannot justify announcements of the creation of the Universe out of logos because mathematical-logical structures are not transformed into physical substratum. The significance of these structures for the creation process cannot be, however, ignored because they are real in a different manner than the physical objects given in everyday experience.

One could have tried to defend a reinterpreted version of Hawking-Hartle proposal by arguing that we do not need a pre-existence of any principles, whether physical or mathematical in nature, before the emergence of the Universe in the boundary state S_i. Only after this emergence, the laws of physics are as they are and principles of logic remain valid for the evolving Universe. If such were the case one could not eliminate the possibility that before the boundary state S_i there existed different universes with different than ours laws of Nature, different principles of mathematics, etc. Such universes could have been submitted to laws of physics unknown to our science. Their evolution could have been developed, for instance, according to the logic of our dreams while edgeless "initial" boundary state would be just a state that happens from time to time in the discontinuous process of cosmic growth. Unless Hawking accepted the preliminary validity of the principles mentioned in 1., 2. and 3. he could hot have proven that his model describes the earliest stage of the cosmic evolution and was not anteceded by another models subject to different physical-mathematical principles. The pre-existence of a cosmic Logos seems thus necessary to prove that the state S_i can be regarded as the boundary state not preceded by any other physical phenomena.

4. There are even methodological presuppositions implied by Hawking--Hartle model. They deal, for instance, with the so called normalisation procedure. To determine the wave function of the Universe the authors assume that there is a equal to 1 probability of having a metric at a three-dimensional spacelike surface. This procedure requires at least two methodological assumptions: 1. Analogies from quantum physics can be used on cosmological level to describe the Universe which has been ex definitione the only and unique object in its class; 2. the normalisation of the wave function of quantum objects requires that the integral of the probabilities over the whole space must yield probability equal to 1 at any moment t. In such normalisation practice, the very assumption in which the

outcome is set to 1 tacitly introduces the thesis that there exists the universe.

This very procedure implies many awkward problems[29]; certainly when the growth of theoretical physics will bring a new technic in normalisation procedures one could imagine methodology different that the one presupposed in Hawking-Hartle model. In this new methodology, however, certain assumptions still shall be required to solve the problems that are metaphysically important though in Hawking's proposals they were implicitly accepted as self-evident. Such a possibility throws a new light on the nature of the Logos mentioned above. We can define its nature in the language of relationships determining both cosmic evolution and its scientific study. In this class of the relationships one may distinguish a proper subset of relations that are instantiated in the physical processes as well as in the actual scientific procedures. In our physical world, e.g. in the hadron epoch no law of the evolution of galactics was instantiated since there were no galactics at all. In research practice of medieval physics no normalisation procedure was accepted because the reality of the microworld was unknown at that period. Consistently, we are entitled to claim that the initial Logos containing all scientific principles and physical laws is only partially instantiated in the actually existing cosmic structures and in the process of scientific growth. Its reality is disclosed in the observed physical phenomena through their conformity to the principles of theoretical physics and through the effectiveness of this physics in predicting new facts. These important characteristics of physical structures of the world make groundless declarations about the physical models of the creation of the universe out of nothing. The alleged nothing turns out to be a complex reality of ordering principles without which there would be no uniformity in nature and no scientific study of natural phenomena would be possible.

VII. PHYSICAL CREATION AND THE QUESTION OF SUFFICIENT REASON

In 1985 in his letter published in "American Scientist" Hawking acknowledged metaphysical neutrality of his earlier publications dealing with the

[29] Cf. letter by C. J. Isham to W. Drees of 16 December 1987 (D r e e s, *Beyond the Big-Bang*, 275).

creation of the universe. He wrote: "I had left the question of the existence of a Supreme Being completely open. [...] It would be perfectly consistent with all we know to say that there was a Being who was responsible for the laws of physics"[30]. It is hard to accept that his later scientific contributions disclosed inconsistencies between modern physics and Christian version of Theism. In *A Brief History of Time* one finds both popular, simplified exposition of physics and naive philosophy. Fortunately, radical evaluations contained in this best-seller were moderated in later comments formulated by Hawking himself. Hence, in his interview for BBC given to Sue Lawley in December 1992 he imposed important constraints on his earlier philosophical comments concerning his no boundary model of creation. Eliminating the naive Clarkean theology he admitted that his model of creation justifies no conclusion of the existence or non existence of God. It only illustrates that the possible creative act of God was not arbitrary in nature but depended on laws and principles known in theoretical physics[31]. He specifies neither what kind of dependence is involved here nor whether the principles in question are results of the creative act of God. His personal philosophy remains open to this question. Consequently, one should not ascribe to Hawking's model a restrictive philosophical significance that was not intended by the author himself. The accent put on rational character of the process of creation that should not be understood as a capricious violation of the laws of Nature may seem trivial because there are few authors who, following Bertrand Russell, would afford a whimsical creation independent of any deterministic interpretation. One has to remember, however, that most of the Marxist authors in their critique of the possibility of cosmic creation quoted F. Engels to argue that such an act of creation is scientifically illegitimate because it violates basic laws of Nature, including the law of energy conservation. Hawking's cosmological contributions reveal groundlessness of similar opinions.

Another important point is stressed by Hawking in the same interview of 1992. He emphasizes that physical description of the appearance of the no boundary universe does not explain why the universe does exist in any particular moment of cosmic time. In this profound remark we can find an echo of the Leibniz's question: why there exist anything rather than

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[30] S. W. H a w k i n g, *Letters to the Editor: Time and the Universe*, "American Scientist", 73(1985) 12.

[31] Id., *Black Holes and Baby Universes*, ch. 14.

nothing? Both questions are metaphysical in nature because physics itself does not raise such questions and never asks e.g. why laws of Nature exist when Nature itself could have been an uncoordinated disorder in which no regularities could have been determined. Physics presupposes the uniformity of Nature and this presupposition constitutes a *conditio sine qua non* for the existence of physics in its present form. Had the universe evolved in discontinuous manner when in the moments of discontinuity either physical laws or physical structures would disappear, there would be no science in the present meaning of this term. One could at most develop a local counterpart of science – between succeeding discontinuities. Continuity in the existence of the laws as well as of physical objects remains metaphysically non-trivial property of the Universe that attracted attention of many philosophers who discussed the question of contingency of cosmic structures[32].

It is important that Hawking himself highlights the cognitive significance of this property. His remark remains consistent with important intellectual tradition that defined the status of creation in terms of dependence of the created object on its Creator. It was Thomas Aquinas who wrote in *S. th.* I a, q. 45, art. 3 (c): "creation is none other than the relation of the creature to the creator as to the principle of its very being". This very relation remains independent of time; in the Christian intellectual tradition it was described either as *creatio continua* or *creatio passiva*. In Teilhard de Chardin's terminology it would be called "evolutive creation" – *creation evolutive*.

Hawking's final version of creation would be certainly attractive for Christian representatives of the process philosophy inspired by A. N. Whitehead's metaphysics. It uncovers the process of creation in which the traditional basic question of the absolute beginning would be either pointless or dependent on conceptual convention. In this approach a Clarkean God of edges is replaced by immanent God sustaining his creation in all moments of time. He remains also transcendent to the created world in this sense that as the Creator he remains the fount of being for all creation. Such a vision is suggestively illustrated by C. J. Isham when he writes of "the universe [...] being held in the cup of God's hand"[33].

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[32] Cf. P. D a v i e s, *The Mind of God: The Scientific Basis for a Rational World*, New York: Simon & Schuster 1992, 69.

[33] *Creation* [...], 405.

Whether to blame Isham's analogy for its anthropomorphism or to exalt its biblical resemblance remains question of personal preferences. The analysis provided above points out that there is no substantive conflict between Hawking's no boundary model of creation and the traditional Christian doctrine of creation. Personally, I share the opinion of William L. Craig that to answer all philosophical questions underlying the Hawking concept of quantum creation we need not a god of physical gaps, but "a sort of Leibnizian Sufficient Reason for the universe"[34].

It is worthy to note that in his interview of 1992 Hawking emphasizes that there are important domains of human experience that cannot be reduced to physical level. He mentions love, faith and morals as three examples of experience which cannot be explained by reference to the laws of physics. This statement reveals that in the late Hawking we find no longer epistemological monism that inspired his works at the period when he thought that theology can be replaced by physics. Such epistemological declarations can be justified only when one affords that on ontological level there exists reality irreducible to physical elements. We find no such explicit declaration in Hawking. We can, however, summarize his philosophical evolution saying that his earlier proposals were programmatically provocative, his later views are much more balanced and closer to the classical tradition in philosophy.

[34] *Theism, Atheism and Big Bang* [...], 300.

METAFIZYCZNE I EPISTEMOLOGICZNE ZAŁOŻENIA W STEPHENA HAWKINGA UJĘCIU KREACJI WSZECHŚWIATA

S t r e s z c z e n i e

Artykuł przedstawia ewolucję poglądów Stephena Hawkinga dotyczącą kreacji wszechświata z nicości. Po przedstawieniu kosmologicznego kontekstu współczesnych koncepcji kreacji autor ukazuje kontrowersyjne tezy epistemologiczne i metafizyczne przyjęte w sposób ukryty przez Hawkinga. Ich status jest całkowicie niezależny od przyjmowanych interpretacji fizykalnych. W konsekwencji można przyjąć fizykę Hawkinga, odrzucając jego epistemologię i metafizykę.

Podczas gdy na poziomie fizykalnym prace Hawkinga zawierają wiele interesujących idei, jego filozofia pozostaje arbitralna i naiwna. Można ją zastąpić znacznie bardziej krytycznym opracowaniem z zakresu filozofii, dlatego też propozycje Hawkinga dotyczące kreacji trzeba uznać za neutralne metafizycznie. W pracach późnego Hawkinga znajdujemy znacznie bardziej dojrzałe opracowania epistemologiczne. Jego słynne propozycje dotyczące stworzenia świata okazują się ostatecznie zgodne z teistyczną interpretacją kwantowej kreacji *ex nihilo*.

Streścił Autor

Słowa kluczowe: czas, epistemologia, kosmologia kwantowa, kreacja, metafizyka, nicość, osobliwość, stworzenie, wszechświat.

Key words: time, epistemology, quantum cosmology, creation, metaphysics, nothingness, peculiarity, creature, universe.