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Contents

THE HUMAN PERSON AS A BRIDGING CONCEPT

SCIENCE AND RELIGION IN CULTURE

PRIZE WINNING ESSAY

Presidential Address

During the last decades, science-and-theology has emerged as an interdisciplinary field of study in which there is an actively growing interest. An increasing number of scholars in the natural sciences as well as theology discover the fascinating nature of the topics within this field.

The *European Society for the Study of Science and Theology* (ESSSAT) is an active participant in this development. A decade after its foundation in 1990, ESSSAT is now an established and well-known organisation. Today ESSSAT has members from almost every European country as well as members from several other continents.

The *European Conferences on Science and Theology* (ECST) have become a creative meeting place, where hundreds of scholars have found the excitement of co-operation and exchange of ideas across borders, both geographical and linguistic, as well as disciplinary and confessional.

With this volume of *Studies in Science and Theology* (SSTh), ESSSAT will start a new policy for its publications. It will involve changes in several directions.

When SSTh was started in 1993, it was supposed to fulfil two different tasks. One of these was to create a publication with scholarly articles on various themes within the field of science-and-theology. The other task was to publish a yearbook directed to the members of ESSSAT. In this respect, SSTh was considered to offer selective reports from the biennial European Conferences on Science and Theology.

During the years 1993 to 1998 we have published six volumes of SSTh. They focus on the themes of past ESSSAT conferences: *Origins, Time and Complexity, The Concept of Nature in Science and Theology,* and *The Interplay Between Scientific and Theological Worldviews.* These

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Non-scientific Sources of the Big Bang Model and its Interpretations

Gregory Bugajak

Abstract: In considering relations between science and theology, the discussion of the Big Bang model plays a significant role. Amongst the sources of this model there are not only scientific achievements of recent decades taken as objective knowledge as seen in modern methodology, but also many non-scientific factors. The latter is connected with the quite obvious fact that the authors, as well as the recipients of the Model, are people who are guided in their activity - including obtaining their rational knowledge - by non-rational motives.

Those motives appear on the one hand in the very process of creation of the Model. Different scientific theories as well as non-verified hypotheses are being joined in one "picture" called The Standard Model. It seems that it is being done on the grounds of various factors that lie outside the field of science. Among them there are the different convictions of the persons constructing this view of the world. However, those convictions, commonly shared by the authors and recipients of the Model, are not based on the rational criterion of scientific knowledge. On the other hand, the Big Bang model may be interpreted in an opposite way by its recipients. The influences of religious, and other beliefs are so essential, that they may lead to extremely different conclusions though based on the same ground.

Keywords: Big Bang, creation, cosmology, world view, The Beginning

1. Epistemological Status of the Big Bang Model.

When reading popularised scientific articles dealing with the Big Bang model, one may be under the impression that the model is an exact scientific theory; that there is a well-established theory describing the evolution of the universe, its development from an initial moment until now, and that this theory is empirically confirmed. It shows, however, that the picture of the universe expanding for the last dozen or so billion years, from the state of infinite density, pressure and temperature, when space-time was contracted to a point[1] , is only the common view of various scientific theories of different epistemological status.

The basic theory for contemporary cosmology is the General Theory of Relativity. The idea of a dynamic, expanding universe appeared when GTR equations were applied to the cosmos as a whole. However, when the details of cosmic evolution are analysed, other scientific theories, especially unification ones, are taken into account. When looking at the evolution of the Universe 'going back' in time, we reach the point when unification of the fundamental forces should take place: electromagnetic and weak nuclear forces become one interaction. The theory describing this unification was expressed by S.Weinberg and A. Salam. It was also experimentally confirmed. Therefore, we speak today of one unified interaction - the so called electro-weak force.

The Weinberg-Salam theory and the GTR are sound scientific theories. They have coherent and consistent theoretical parts and they are also empirically verified. The Standard Model, however, implies moments in world history, which are difficult to describe on the grounds of known scientific theories. It supposes, that in the history of the universe there was a moment when the electro-weak force was unified with the strong nuclear force. The theory describing this united force is called the Grand Unification Theory. The problem is, that it seems we are unable to confirm this theory, since the energy

[1] Such concepts that can be found in popular as well as philosophical papers (e.g. Butryn 1996) are not only inexact, but physically meaningless. That is what I call the common view of a scientific theory.

required for such a process is far beyond the present capabilities of our laboratories. Therefore this process of unification is only a supposed one, and the theory describing it is not, strictly speaking, a theory but an hypothesis[2].

When we look at the history of the Universe in the light of the Standard Model, we reach a point (the so-called 'Planck threshold', when 'the cosmic clock' would read $t = 10^{-44}$s) where nothing can be said about events that took place before, if that 'before' has any sense at all[3]. We do not have a theory which would describe physical processes taking place under such extreme conditions (density: 10^{93} g/cm^3, temperature: 10^{33} K). It is supposed that to overcome this problem, we should apply the quantum theory of gravity. That means a theory which would somehow join two discordant theories, i.e. General Theory of Relativity and quantum mechanics. Many attempts have been made to formulate such a theory, but none of them is considered to be successful. What is more, whilst some physicists say that those attempts point in the right direction and we will have the desired theory in a few years time (e.g. Hawking 1988), others maintain that we have not made even the smallest step towards the solution as yet[4]. These latter call this situation a crisis in

[2] See comments on the subject in a paper by J.Horgan (Horgan 1994). The decay of a proton would be also an indirect confirmation of 'grand unification'. Such a process, however, has not been reported as yet. According to some physicists, a kind of GUT is required to explain the very existence of our universe since this theory supposes a process responsible for the fact that the amount of matter and antimatter in the universe is probably not balanced. This latter fact however is not undoubted. Therefore, GUT remains a hypothesis.

[3] "The universe *enters its history* (...) at the instant of time which (...) should be recognised as the hour $t = 10^{-44}$s on the cosmic clock." (Heller 1997, 54). My emphasis- GB.

[4] Non-authorised opinion of Prof. A.Staruszkiewicz (Institute of Physics, Jagiellonian University, Cracow), 3rd Cracow Methodological Conference, May 1996. Similar opinion expressed also Prof. J.Kijowski (Department of Physics, Warsaw University), Popperian Conference, Cracow, May 1995. See also Horgan 1994.

physics, which has lasted for the last few decades, ever since both great theories were formulated. What is especially important, is that the discordance mentioned above affects two theories, both vital for the Standard Model. GTR is the basic theory for the whole model, while quantum effects - as it is supposed - have great influence on the beginning phases of the universe's evolution.

There are two well known observational tests, which are considered as confirming the Standard Model. These are background radiation, and red shift in galactic spectra. Indeed, both phenomena are predicted by the Model: red shift, due to the Doppler effect, is a consequence of the receding of galaxies, while background radiation is the remains of the early stages of cosmic evolution. However, beside these explanations of the phenomena in question, there may also be others. For instance, red-shift may be caused not only by the Doppler effect (cf. Davies 1995, 152-154; Pierce & others 1994; Begley 1994). The fact, that alternatives to the 'standard' explanation of these phenomena are possible, weakens their confirming power with reference to the Big Bang model.

As indicated above, the Big Bang model lacks theoretical coherence as well as empirical verification of its certain elements. Therefore it may not be taken as an exact scientific theory. In common understanding however, this model plays the role of the precise and true description of the phenomena that have taken place in the universe since the very beginning of its evolution. Especially it seems to point to that 'beginning' as a real event in the history of the world. All this leads us to the question: on what grounds are the different scientific theories (even discordant to each other) and non-verified hypotheses being joined to make one picture called the Big Bang model?

Undoubted technical and cultural progress resulting from scientific discoveries, has given rise to a great belief in the power of science. This belief is widely shared between laymen and scientists. People expect that science should be able to answer every question vital to human beings including the question of the Beginning. This naive trust leads the average reader of popular scientific papers to acknowledge, regardless of the detailed problems which modern

cosmology becomes involved in, that science today answers completely and unhesitatingly the question of the Beginning.

The second reason for such a conviction is the need to have a coherent view of the world. Such a need is characteristic of everyone. Scientific ideas and religious beliefs about the creation seem to meet in the Big Bang model[5]. This attractive harmony between science and religion easily forgets the high price that must be paid for that desirable coherence. On the one hand, science itself is diminished because of such attempts. Ignoring the limits of the scientific method, and disregarding the fact that not every question can be posed within the framework of science, eventually leads to the impairment of the status of science as objective knowledge. What is more, the search for easy harmony between religion and science is based not on exact scientific knowledge, but, as shown above, on its common sense interpretation. In this case, the notion of 'science' is applied to a set of convictions which are not scientific in fact. On the other hand, joining religious beliefs with scientific certainties may unsettle the former. Science naturally changes. This occasional redirection, obvious and necessary in science, may be fatal for religious beliefs, which stem from Revelation and must stay constant.

The need to have synthesis and generalisations, manifested in the process of constructing a common view of the world, is familiar also to naturally critical scientists. The symptom of this need is the aspiration - characteristic not only of today - to describe all physical processes and phenomena by one theory. This aspiration has even attained a 'technical' name: The Theory of Everything (see Barrow 1991). It may be the reason for preferring such explanations of certain phenomena (red-shift and background radiation), that are in agreement with the model of the expanding universe.

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[5] Even the pope Pius XII must have been under such an impression: ".. modern science has confirmed contingency of the Universe and also the well-founded deduction to the epoch when the world came forth from the hands of the Creator." (Pius XII 1952, 41-42). Later on, however, the pope probably retreated from this view - see Coyne 1997.

2. Interpretations of the Big Bang Model

Among contemporary thinkers writing about the Big Bang model, some affirm that cosmology proves that the 'God hypothesis' is needless, whereas others maintain that the same scientific achievements support the thesis of the existence of the First Cause of the world. The dispute between A. Grünbaum and W.L. Graig as reported in *Philosophia Naturalis* in 1994 may serve as an example (Craig 1994a, 1994b; Grünbaum 1994). The main controversy concerned the notion of cause and the problem of 'coming into being'. Grünbaum argued that the notion of cause does not apply to the Big Bang, since the components of the causal relation are events, while the initial singularity[6] cannot be called an event on the grounds of GTR (Hawking & Ellis 1973, 56; Wald 1984, 213). Therefore the question of the cause of the Big Bang he calls a pseudo problem (Grünbaum 1990, 821-822). What is more, the finite age of the universe does not lead to the conclusion that the world had to come into being. The Universe could have existed always, that is *for all actual times* (Grünbaum 1994, 227). According to Grünbaum, one cannot maintain that the Universe came into being in the moment of the Big Bang if the very notion of time had no physical meaning 'before' that moment.

Craig, in turn, maintains that the achievements of contemporary cosmology force us to accept the thesis of the First Cause. According to him, the world not only came into being in a moment in the past, which is obvious because of its finite age, but seeing that it came into being, one must admit that this fact had a cause.

As we see, one can call the question of the cause of the world a pseudo problem, whereas the other maintains that the thesis of the First Cause is proved. What is important, is that both of them base their arguments on the same ground - the Big Bang model. The authors however simplify the problem. The most serious simplification is the lack of reflection upon the notion of 'coming into being'. In

[6] In certain contexts the notions of initial singularity and Big Bang are being used interchangeably (see e.g. Hawking 1988).

this case a sound definition of 'coming into being' should be previously formulated. It ought to be possible to apply this to the results of natural sciences, and - what follows - the time relation in this definition should be carefully considered or even avoided. The next simplification (by Grünbaum) is that the notion of the cause was restricted - a cause has been treated as an event. Taking a cause as an event however, is not the only definition of the causal relation (see e.g. Bunge 1959). Craig, in turn, bases his considerations on the causal principle (If *A* came into being, it implies that *A* had a cause). In this way he introduces a philosophical premise which can be accepted or rejected independently of any empirical evidence.

It shows that in considerations dealing with the cause of the world, that are based on the Standard Model, one can accept various additional assumptions. This acceptance leads to extremely different conclusions. It is obvious therefore, that not the Model itself, but these additional premises are crucial since they decisively influence final conclusions. These premises are often of a philosophical nature (for instance: the acceptance of a certain notion of cause - Grünbaum; causal principle - Craig). It seems that the reason for the acceptance of a certain philosophical option may be religious motives. Accepted philosophy, joined with scientific data, is meant to strengthen certain religious (or areligious) ideas. Reasoning which is based on such premises leads to a 'proof' of a thesis that is in fact assumed previously. Such a thesis may proclaim: "the world has always existed" or - on the contrary - "the world had a cause".

3. Conclusion

The influence of non-scientific beliefs can be seen in the process of creating the Big Bang model, as well as in its interpretations. The role of a person constructing a world view - a common as well as a scientific one - consists not only in passively receiving objective scientific data, but may also be decisive in the shaping of this view. The above considerations force us to pose the following questions:

1. Can objectivity of knowledge be defended in the face of the influence of non-scientific factors on scientific theories?
2. To what degree are common beliefs consistent within themselves -

even those based on scientific knowledge - in comparison with the consistency of scientific theories?

3. What is the status of these concepts, according to which, scientific theories could refute or strengthen religious beliefs?

4. Can non-rational motives be eliminated when constructing a world view?

5. How are philosophical premises decisive in formulating conclusions that seem to result from scientific theories?

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