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USES AND ABUSES OF COSMOLOGICAL ARGUMENTATION

1. INTRODUCTION

Cosmology is a wonderful science. It gives a global perspective of the world, or at least of what is considered to be its global perspective at a given epoch. A prize cosmology has to pay for this fascinating possibility is that it must, to the much higher degree than other sciences, base its methods of constructing theories and models on unverifiable assumptions, which enter the edifice almost on each level of cosmological extrapolation[1]. These peculiarities of the science of the Universe create an exceptional field of possibilities which various philosophical and theological doctrines could use (or abuse) on behalf of their own goals.

In the present essay, after quoting two examples of abusing cosmology to support two opposite philosophical doctrines, I shall look for a methodological criterion which would allow one to defend cosmology against dangers of this kind. It is well known, for quite a time, that cosmology as a natural science is neutral with respect to philosophical or theological views. Unfortunately, however, this does not prevent scientists, philosophers, theologians, and many other outsiders from abusing cosmological argumentation. It is usually the so-called God-of-gaps theology which prepares a snare for too hasty a thinker.

[1] See, G. F. R. Ellis, *Cosmology and Verifiability*, Quart. J. Roy. Astron. Soc. 16, 1975, 245—264; G. F. R. Ellis, *Relativistic Cosmology: Its Nature, Aims and Problems*, [in:] General Relativity and Gravitation, Invited Papers and Discussion Reports of the 10th International Conference on General Relativity and Gravitation, Padua, July 3—8, 1983, eds. B. Bertotti, F. de Felice and A. Pascolini, Reidel, Dordrecht, etc., 1984, pp. 215—288; M. Heller, *Questions to the Universe*, Pachart, Tucson, 1986, especially chapter 7.

The danger consists not only in constructing too easy „proofs" of God's existence from „weak points of our knowledge", but also in rejecting God on the ground that there are no gaps in our science in which he could safely dwell. My recipe against such maneuvers is that it is the intrinsic „problem situation" in science and not metaphysical prejudices that should guide responsible research in science, especially in those its regions which are remote from the standard experimental control.

In section 2, I shall present my two examples; in sections 3 and 4, I shall analyze God-of-gaps and no-gap-no-God theologies, respectively; short section 5 will close my analysis.

2. TWO EXAMPLES

My first example is taken from the once widely read book *God and the Astronomers* written by Robert Jastrow[2] [3] [3]. His apologetic attitude is revealed already on first pages:

> The essence of the strange developments is that the Universe had in some sense, a beginning — that it began at a certain moment in time, and under circumstances that seem to make it impossible — not just now, but *ever* — to find out what force or forces brought the world into being at the moment. Was it, as the Bible says, that *Thou, Lord, in the beginning hast laid the foundations of the earth, and the heavens are the work of thine hands?*

At the end of the book the dot is put over the i:

> It is not a matter of another year, another decade of work, another measurement, or another theory; at this moment it seems as though science will never be able to raise the curtain on the mystery of creation. For the scientist who has lived by his faith in the power of reason, the story ends like a bad dream. He has scaled the mountains of ignorance; he ist about to conquer the highest peak; as he pulls himself over the final rock, he is greeted by a band of theologians who have been sitting there for centuries[4] [5] [5].

The fact that Jastrow admits he is „an agnostic in religious matters" makes the case even stronger:

> When an astronomer writes about God, his colleagues assume he is either over the hill or going bonkers. In my case it should be understood from the start that I am an agnostic in religious matters. However, I am fascinated by some strange developments going on in astronomy — partly because of their religious implications and partly because of the peculiar reactions of my colleagues'.

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[2] Werner Books 1980 (first published by Reader's Library in 1978).
[3] Ibid., p. 12, italicized by Jastrow.
[4] Ibid., p. 125.
[5] Ibid., p. 11.

A decade had passed and cosmologists begun to explore questions „forbidden" by Jastrow. Now they try to find out exactly „what force or forces brought the world into being". Another bestselling book tells this story. I have in mind Stephen Hawking's *A Brief History of Time*[6]. The point is that the Big Bang theory, so admired by Jastrow, is a purely classical, i.e. non-quantum, theory, and by now we know that in the extreme densities of the Bang quantum gravity effects must enter into play. So far nobody has created a satisfactory quantum gravity cosmology. Hawking in his book tells us about his own search for such a theory. The model he develops presents a fascinating picture. *If one assumes that the laws of quantum physics are at work,* one can explain bringing of the superdense Universe into existence via the quantum tunneling process. An interesting feature of the model is that this process turns out to be atemporal. In such extreme conditions there is no time in any meaningful sense of this term. It gradually emerges as quantum correlations give place to higher and higher probabilities which, in turn, slowly change into fully determined temporal order of things. From the mathematical point of view there is no singularity, the history of the Universe never terminates. The only justification of the world's existence are the laws of quantum physics.

Let us quote a few passages from *A Brief History of Time* in which Hawking explores some philosophical ideas implied or suggested by his model.

When we combine quantum mechanics with general realitivity, there seems to be a new possibility that did not arise before: that space and time together might form a finite, four-dimensional space without singularities or boundaries, like the surface of the earth but with more dimensions. [...] But if the universe is completely self-contained, with no singularities or boundaries, and completely described by a unified theory, that has profound implications for the role of God as Creator[7] [8].

The following paragraph develops these implications:

Einstein once asked the question: 'How much choice did God have in constructing the universe?' If the no boundary proposal is correct, he had no freedom at all to choose the initial conditions. He would, of course, still have had the freedom to choose the laws that the universe obeyed. This, however, may not really have been all that much of a choice; there may well be only one, or a small number, of complete unified theories, such as the heterotic string theory, that are self-consistent and allow the existence of structures as complicated as human beings who can investigate the laws of the universe and ask about the nature of God*.

One should notice that the above reasoning is based on a „there-may-well-be" argument. Nevertheless philosophical vistas opened by the model are worthwhile to be rationally contemplated. Hawking is aware of the fact that any physical theory (even if it will be the fully self-consistent and unified theory) „is just a set of rules

[6] S. W. Hawking, *A Brief History of Time — From the Big Bang to Black Holes,* Bantam Books, Toronto, 1988.

[7] Ibid., p. 174.

* Ibid.

and equations", and the most important problem remains: „What is it that breathes fire into the equations and makes a universe for them do describe?"[9] In other words: „Why does the universe go to all the bother of existing? Is the unified theory so compelling that it brings about its own existence? Or does it need a creator, and, if so, does he have any other effect on the universe? And who created him?"[10] The final sentence of Hawking's book is: „If we find the answer to that, it would be the ultimate triumph of human reason — for then we would know the mind of Good"[11].

What Hawking did not openly say, was said be Carl Sagan in his introduction to Hawking's book:

> This is also a book about God [...] or perhaps about the absence of God. The word God fills these pages. Hawking embarks on a quest to answer Einstein's famous question about whether God had any choice in creating the universe. Hawking is attempting, as he explicitly states, to understand the mind of God. And this makes all the more unexpected the conclusion of the effort, at least so far: a universe with no edge in space, no beginning in time, and noting for Creator to do[12].

My two examples are, in a sense, typical. The first example comes from the period in which people were fascinated with the enormous vision of the firework beginning of the Universe. The second example illustrates the present tendencies to look for ultimate explanations in the (so far unknown) fundamental laws of physics. In the previous period religious interpretations of the Big Bang cosmology were an easy temptation, although the steady-state cosmology of that time, developed by Bondi, Gold and Hoyle, could be considered as a heroic struggle to defend the self-explanatory character of the Universe. In our days the attitude prevails to fill in all gaps in science with the most audacious hypotheses which too often seem to have philosophical motivation as their only rational basis.

3. GOD-OF-GAPS THEOLOGY

The case of Jastrow is a generic case of the God-of-gaps theology. In the Big Bang event the history of the Universe (as contemplated backward in time) breaks down creating an enormous gap in our knowledge: we do not know where the Big Bang comes from, we ignore its cause, we know nothing about the previous state of the world, we even have no idea as to whether the world did exist before that critical event. Our lack of knowledge is immense, and it seems that only the hypothesis of God would be able to fill it in.

God filling gaps of our knowledge is a hypothesis which to-morrow will almost certainly turn out to be superfluous. At the basis of the God-of-gaps theology lies

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' Ibid.

" Ibid.

" Ibid., p. 175.

[12] Ibid., p. X.

our lack of imagination to figure out that what is now a boundary of science can soon be its well explored region. It is both theological and scientific error. From the theological point of view, it reduces God to the rank of a dubious methodological principle (allowing one to be satisfied with difficulties in which actual theories are involved): and from the scientific point of view, it violates a fundamental rule never to go beyond natural phenomena.

It is only the difference in degree that separates Jastrow-like arguments from claims of physico-theology adherents in the 17th century, when, from the harmony of planetary motions in the presence of ceaseless gravitational perturbations, people inferred the existence of the omnipotent clock-maker, or from the marvelous machinery of gnat's eye they concluded the existence of the divine designer.

4. NO-GAP-NO-GOD THEOLOGY

The God-of-gaps theology is perhaps less transparent in my second example, nevertheless it doubtlessly works in it. Behind the whole argumentation the God-of-gaps conception of Creator is hidden and it steers the entire line of reasoning. Sagan clearly suggests that God should be rejected since in the Hawking's universe there is „nothing for Creator to do". One could put it shortly: no gaps, no God. For people accepting this principles God (who is to be rejected) is necessarily God of gaps: there are (or rather there will be) no gaps, therefore the „hypothesis of God" is superfluous.

This is clearly very bad theology. Is it equally bad as an approach to scientific problems? It depends. If it inspires looking for solutions of hitherto unsolved problems, it can render a good service to the progress of science. However, if its only goal is to populate science with strange hypotheses in order not to leave any gaps for „metaphysical ingredients", the road to correct solutions could be easily blocked by misleading ideas.

Hawking's scientific career guarantees that the last possibility is excluded. Many of his works are lasting contributions to science and he is a too serious researcher to allow himself to be guided by dubious ideologies. I suspect that philosophical comments in his book are *ex post* reflections rather than principles guiding his scientific research[13]. There is no doubt, however, that

[13] This view is strengthened by the fact that Hawking's monograph (written together with G. F. R. Ellis) on classical singularities ends wit the following paragraph: „The Creation of the Universe out of nothing has been argued, indecisively, from early times; see for example Kant's first Antinomy of Pure Reason and comments on it [...]. The results we have obtained support the idea that the universe began a finite time ago. However the actual point of creation, the singularity, is outside the scope of presently known laws of physics" *(The Large Scale Structure of Space-Time,* Cambridge "University Tress 1973, p. 364).

some authors introduce metaphysical ideologies into the very body of scientific work. Let us quote an example.

In a recent paper, proposing certain modification of an inflationary world model, the authors briefly summarize their results in the following way:

> The most remarkable feature of eternal inflation is that it can be eternal on both 'ends'. It does not halt, but there is no need to turn it on either. One can, out of conceptual inertia, assume that the eternally inflating universe had a pre-inflationary epoch (with an initial singularity or a quantum era) and immediately be faced with the problem that we have just encountered: how did it start? However, this is not necessary. One can just as well assume that there was no beginning (and that there will be no ultimate end) and that we live in a universe which is a minuscule part of a steady-state eternally inflating metauniverse[14].

And now the comment follows:

> This seems like a drastic proposal, but for the time being, and most likely for a very long time in the future, there does not seem to be a single observational clue — or even an idea for one — which will enable us to distinguish between a universe which began with a bang (and has undergone an inflationary phase later) and one which is a part of an ever-inflating meta-universe. The fact that there is no present observational distinction between these two options is not necessarily a virtue: it would be nice to be able to test this radical proposal. But this also means that eternal inflation without a beginning cannot be ruled out right away. At least for the time being it should be taken as seriously as the (by now more conventional) initial singularity or initial quantum era proposal. Since the assumption of no initial conditions seems to be the simplest one, Occam's razor will tell us to prefer it and to conclude that we live in a tiny part of a steady-state inflating meta-universe that has existed and will exist forever[15].

The situation is depicted very clearly: There are two possibilities, neither of them has any experimental corroboration, neither of them is privileged by any sound physical theory. There are only philosophical reasons — criterion of simplicity and Occam's razor — that suggest the correct choice. If an infinite mother-universe giving birth to infinite number of generations of child-universes without any possibility of experimental verification is what Occam's razor would leave after doing its job...

I think that the best way of doing cosmology is to stop thinking about any metaphysical preconditions or implications when one starts constructing one's cosmological model. If we discard metaphysics what should lead our research in regions such remote from the laboratory experimentation as are our present cosmological theories concerning the origin of the universe? My answer is that also in this field we should be guided by the same principle as in other branches of science. Having to do some research we are always facing a certain *problem situation.* It cannot be logically defined. It is well understood by good scientists, and it is badly understood by bad scientists. A good scientific work usually poses

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[14] D. S. Goldwirth, T. Piran, *Inflation — an Alternative to the Singular Big Bang,* General Relativity and Gravitation 23, 1991, 12.

[15] Ibid., pp. 12—13. It is worthwhile to notice that this work has received the third award from the Gravity Research Foundation in 1990.

new (and often unexpected) problems that are to be solved.

These problems are clearly *autonomous.* They are in no sense made by us; rather, they are *discovered* by us; and in this sense they exist, undiscovered, before their discovery[16].

We should notice that also experimental data (if they are available) or experimental possibilities (if they are open) enter into what Popper calls the problem situation. Outside such a situation experimental results remain sterile and only casually can lead us to valuable conclusions.

To put it short, it is a problem situation and not metaphysics or theology that creates the correct environment for scientific work. I do not say that metaphysics or theology are insignificant or meaningless; I am only claiming that they should not directly interfere with the process of creating new scientific models or theories.

As far as the questions of the origin of the Universe and of the physical laws are concerned, the problem situation is to-day formed by two major programs of theoretical physics: the program of quantization of gravity and the program of unification of all physical interactions. In such a situation some metaphysics is unavoidable, but it cannot be planned or artificially implanted into scientific theories and models; it should be implicitly arrived at and only then put into surface and critically examined.

5. ADVENTURE OF DOING SCIENCE

Gaps in our knowledge can be of the twofold nature. There might be gaps through a deficit, when we know nothing about something we would like to know about. In such a case, we are looking for a knowledge that could fill the gap. The initial singularity in classical (i.e. non-quantum cosmology) is an example of such a gap. The histories of particles and observers break down at the edge of space-time, beyond which a great hole in our knowledge extends. There might also be gaps through excess, when we do not know because the true hole in our knowledge is filled with empty hypotheses and misleading models.

In such a case, the gap is even more dangerous. It becomes a trap. One does not realize when one starts hunting one's own shadow.

Doing science is an adventure, and adventures are sometimes dangerous.

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[16] K. R. Popper, *Objective Knowledge,* Clarendon Press, Oxford 1972, pp. 160—161; italicized by Popper.