

ANTHROPIC REASONING IN CONTEMPORARY COSMOLOGY

Gabriel NAGĂȚ¹

Abstract. *Contemporary cosmology tries to explain the apparently „fine-tuning” of the universe by using an „Anthropic Principle”. According to this, we have to accept as a fact that our location in the universe is necessarily privileged to the extent of being compatible with our own existence as observers. However this idea seems to overrule the very spirit of the „Copernican revolution”, which was considered to be the turning point towards modern science. The article examines some possible logico-methodological and epistemological consequences of accepting the anthropic reasoning in today's science.*

Keywords: Cosmology, Copernican principle, Anthropic principle, Methodology.

1. Introduction

Contemporary cosmology was badly shaken up by the discovery of certain „large number coincidences”, a set of surprising relations between some natural constants and initial cosmological conditions which were taken as existing in the earliest evolution stages of the visible universe. These relations were sometimes seen as a set of „anthropic coincidences”, and this means they could pretend the status of an irrefutable empirical evidence that from its very beginning our universe is more or less „fine-tuned” for the evolution of intelligent life. While some physicists consider that this apparent fine-tuning should be taken as it is, as a simple fact lacking any special scientific significance, other physicists as well as many philosophers hold that it insistently cries out for an explanation. Discounting any sheer luck and putting aside the old purposeful design argument, the most convincing explanation of this unexpected „bio-philia” of our visible universe seems to be the „multiverse” hypothesis. According to this, „the Universe” we are usually seeing and talking about is, actually, only one singular piece of a vast ensemble containing a lot of cosmic regions or distinct „universes”, each possessing its own laws and specific conditions. Accordingly, the reason why we observe such a favourable to life universe is that we just couldn't observe an universe which would be unfavourable to life – to human life, in our specific case: „If the Universe and its laws could have been otherwise, then one explanation for why they are as they are might be that we (the observers) have selected it from a large ensemble of alternatives”. [1] So the living beings, humans or whatever form of intelligent life, are constantly suffering from the influence of an inescapable observational selection effect.

¹Ph.D., Senior Researcher, Institute of Philosophy and Psychology, Bucharest, Romania (e-mail: gabnagat@yahoo.com)

Starting from these issues some physicists advanced, consequently, the idea of an „anthropic principle” able to support the interpretation of that empirical evidence and to prepare the necessary logical and methodological foundations for an „anthropic” kind of scientific reasoning, which by and large means „drawing of scientific inferences from a consideration of Man’s Place in Nature”. [2] But know it is quite obvious that anthropic reasoning seems to disregard something considered to be a *sine qua non* condition for the birth of modern science, a fundamental methodological principle given to scientists by Copernicus and developed by his followers to the dimensions of a genuine scientific – and then cultural – revolution. As it is very well known, „the Copernican revolution” was, first of all, a rejection of the old dogma according to which man would have a very special position in the universe or, more exactly, a denial of the conviction that *man is the central figure in the universe*. So Copernicus’ arguments induced the conviction that one couldn’t find sufficient reasons to support the idea of the supposed privileged position which man would have to occupy in the universe. Similarly, three centuries later Charles Darwin will show us that the origin of man as a species has actually nothing special, that mankind is not somehow biologically privileged when compared with the other species.

I will try to examine the main ideas which open the path of the anthropic reasoning in contemporary cosmology, in order to identify some possible logico-methodological and epistemological consequences implied by this special type of scientific investigation.

2. Anthropic reasoning as a methodological strategy

As some of the leading contemporary cosmologists tell us, using the anthropic kind of reasoning in cosmology (and, more generally, in empirical science) means drawing of scientific inferences starting from a premise involving the man’s place in nature. Although the anthropic idea seems to be rooted in 19th century physics, when Ludwig Boltzmann tried to explain the direction of time, the term „anthropic principle” was used for the first time in 1974 by the astrophysicist Brandon Carter. More than thirty anthropic principles have been formulated since then, and many of them have been refined and redefined again and again, so the discussion around anthropic reasoning is quite confusing. Anyway, Carter was trying to find out some less „exotic” explanations of certain numerical relations known as „large number coincidences”. He thinks that despite a hypothesis formulated by Paul Dirac, even those remarkable numerical relations could be viewed as evidence in favour of conventional physics and cosmology (i.e., Generalized Relativity and Big Bang theory), and the same conventional theories could in principle be used to predict them prior to any direct observation. However, says Carter, these are a very special kind of predictions, insofar as they

claim to invoke an *Anthropic Principle* stating that „what we can expect to observe must be restricted by the conditions necessary for our presence as observers”. In other words, when we formulate our theories we have to take account of the objective situation that our location in the universe is necessarily a *special* one so as to be compatible with our existence as observers. Therefore, thinking in accordance with such an anthropic principle means to accept an idea quite distant from what became the Copernican orthodoxy, namely, the idea that „although our situation is not necessarily *central*, it is inevitably privileged to some extent”. [3]

Consequently, the most striking thing in invoking the anthropic principle is that it seems to enter in an unavoidable contradictory relation with the notorious Copernican revolution and its well-known change of perspective on the questionable centrality of the Earth and humanity in the middle of the visible universe. (By the way, it's not useless to emphasize that the so-called „anthropic reasoning” is not actually an idea concerning the existence of a *human* observer, but an idea prompting to the *observability* in general, regardless of the kind of intelligence which could be effectively involved in the act of observership.) Carter says very clearly that he wants to introduce the anthropic principle as „a reaction against exaggerated subservience to the ‘Copernican principle’”, whose sound and very important lesson was that „we must not assume gratuitously that we occupy a privileged *central* position in the Universe”. In a way, the gift of Copernicus for us is a „principle of mediocrity”, as Paul Davies calls it, since it states that „the portion of the universe we observe is not special or privileged, but is representative of the whole”. [1] The „subservience” mentioned here designates the strong tendency to extend that principle to a very questionable dogma claiming that our situation couldn't be privileged *in any sense*. Rejecting this dogma means accepting as a regulative and extremely important scientific idea that „although our situation is not necessarily central, it is inevitably privileged to some extent” [2]. Paradoxically, although Copernicus was the first physicist who developed the idea of a moving earth around the sun into a comprehensive system, it's not completely unfair to say that his system was actually „a last attempt to patch up an outdated machinery by reversing the arrangement of its wheels”. Consequently, despite his reputation he was rather a „canonical” thinker, „the last of the Aristotelians among the great men of science”. [4]

The promoters of anthropic reasoning claim that although Copernicus thought us that our position in the universe cannot be interpreted as special or central in *every* way, this does not necessarily mean that it cannot be privileged in *any* way. According to Carter, it is possible to formulate the anthropic principle in two different styles, obtaining either a strong form of it or a weak one. The *Strong Anthropic Principle* is the statement that „the universe (and hence the

fundamental parameters on which it depends) must be such as to admit the creation of observers within it at some stage”, while the *Weak Anthropic Principle* states just that „we must be prepared to take account of the fact that our location in the universe is *necessarily* privileged to the extent of being compatible with our existence as observers”. Carter considers that a prediction based only on the weak form of the anthropic principle could always amount to a „complete physical explanation”, while a prediction based solely on the strong version of the principle could not be completely satisfactory for a true physicist, because there is still possible to find out a more profound underlying theory capable to explain the predicted results.[3] Although the anthropic principle seems to be merely a tautology, it unveils an interesting meaning as soon as we accept that the universe and its laws could have been otherwise than we observe: „one explanation for why they are as they are might be that we (the observers) have selected it from a large ensemble of alternatives”.[1]

One of the most passionate critics of anthropic reasoning is the physicist Heinz Pagels, who argues that this type of approach to cosmology is nothing more than a futile effort to find „a middle ground between the pre-Copernican view, which saw the universe as being centered on humanity, and the post-Copernican view, which denies humanity any special cosmological status”. Consequently, the worldview behind this approach is, in some respect, a kind of anthropocentrism „as profound as that which underlay the pre-Copernican view of the universe”, and in this respect using the anthropic reasoning means „giving up on the attempt to find a truly fundamental explanation for the nature of things”.[6] Anthropic reasoning, says Pagels, is „the lazy man approach to science”, „a far-fetched explanation for those features of the universe which physicists cannot yet explain” and a gratuitous abandon of the successful program of conventional physics. Unlike the genuine principles of physics, the anthropic principle is not testable, it affords no way to determine whether it is right or wrong, so it cannot be subject to experimental falsification. But since it explained nothing and it was incapable to offer genuine scientific knowledge, anthropic reasoning should be abandoned as a promising methodological strategy.

John Barrow considers that the „enthusiastic condemnation” formulated in Pagels’ critical comments is an expression of the most common misconception regarding the anthropic principle – namely, that in some sense this principle would be „a rival cosmological or particle physics theory which one is being offered as an alternative to the standard picture”. In fact, all that is being claimed by its promoters is that the anthropic principle must be used as „a *complement* to the standard deductive theories, otherwise there is a real danger of drawing erroneous conclusions or, more commonly, providing elaborate ‘explanations’ for non-existing problems”. [1] It is true that the strong form of anthropic reasoning

departs from the very spirit of modern science, and even when the cosmologist uses it, at least in principle it would be possible to identify a more *conventional* type of scientific explanation. When „no stronger physical argument is available”, says Carter, it is „philosophically possible” to promote a prediction based on the strong form of anthropic principle to „the status of an explanation” using the idea of a „world ensemble”. [3] On the other hand, the decision to take the fine-tuning as an unquestionable fact would be epistemologically and methodologically objectionable, since it would involve accepting more complicated theories with many free parameters. But one of the most important methodological principles is that one should prefer simpler theories if they also can account for the same data. [7]

Every scientist knows very well that the process of data collection affects the inferences which he can draw from that data. But scientific data is filtered either by all sort of limitations in our instruments (they „samples only from a proper subset of the target domain”), or by the precondition that somebody be there to build those instruments and to have or assess the data yielded by using them. The biases that occur due to that precondition could be called *observational selection effects*, and Nick Bostrom suggests that, in this sense, anthropic reasoning is just the effort to „detect, diagnose, and cure such biases”. [7] According to Bostrom, we are not yet prepared to give a satisfactory account of observation selection effects, so he intends to develop „a methodology for how to reason when we suspect that our evidence is contaminated with anthropic biases”, a methodology capable to make sense of contemporary scientific reasoning – anthropic reasoning included. The fact is that anthropic reasoning provides „important separate clues to what the correct theoretical account of observation selection effects must look like”.

In Frank Tipler formulation, the weak version of the anthropic principle states that „the observed values of all physical quantities are not equally probable, but rather take on values restricted by the fact that these quantities are measured by a carbon-based intelligent life form”. [2] So the weak anthropic principle is, actually, an attempt to extrapolate the idea of observational selection to the level of the human instrument or, as John Barrow emphasizes, it is „a recognition of the constraints that are placed upon what we can expect to observe in Nature by the selection effect of our own existence as observers”. The man itself is a kind of instrument, and this is a fact to remember whenever our research data are to be interpreted. On the other hand it is important to notice that the weak anthropic principle „should not be viewed as a falsifiable theory or theorem”, but as a „methodological principle which one ignores at one's peril” or as a complement to our accepted theories. [5]

Conclusions

As Paul Davies sharply emphasizes, one could say that „all cosmological models are constructed by augmenting the results of observations by some sort of philosophical principle”. So, while many cosmological models (the „standard” models) are built using the Copernican principle, there is also possible – and, due to the limitations of the Copernican principle, it is now necessary – to build cosmological models taking the biophilic selection and the Anthropic principle as foundational ideas.

The fundamental problems at the frontiers of modern cosmology are of a unique type. Unlike the problems of laboratory physics, these are not problems which always „respect the traditional dogmas about the philosophy and practice of science”. In this sense they can be considered „extraordinary problems” and can claim for „extraordinary solutions which it will require extraordinary methods to coax from the Universe”.^[5] This seems to be the best strategy to draw a more or less clear boundary between fundamental science, metaphysics and theology. Even if the mathematical models seem so esoteric that we have no means to test them, says Barrow, „we might simply have to believe” they are adequate.

Since the origin and structure of the universe give rise to an unusual sort of scientific problems, „extraordinary problems”, modern cosmology itself is a special or extra-ordinary science. Consequently, it „would be foolish to discard certain approaches to these problems simply because they do not have analogues in more mundane scientific investigation”. After all, the objections raised by Pagels and many other critics of anthropic reasoning should be interpreted as expressing nothing but an excessive form of respect for the „traditional dogmas about the philosophy and practice of science”, about paradigms, verification, falsification and so on. But, as Barrow points up, „to believe that we will be able to test and falsify all theories is just the sort of anthropocentric view of the Universe that critics of the Anthropic Principle so roundly decry elsewhere”.^[5]

I think an analogy with the situation in the social sciences – another sort of „special sciences”, as many philosophers and social scientists are ready to admit – will be helpful for understanding the contemporary approaches of cosmological issues. As we already noticed, the promoters of anthropic reasoning tell us that the weak anthropic principle is not at all a falsifiable theory or theorem, but only a complement to our accepted theories and, most important, a methodological principle which, inasmuch as we are concerned in answering cosmological questions, „one ignores at one’s peril”. Now, let’s think about how Karl Popper tried to solve the problem of rationality assumption in social sciences and its relation to social theorizing. The solution offered by Popper is to regard the principle of rationality (*i.e.*, the principle of „acting adequately to the situation”,

or rather the „adequacy of our actions to our problem situations as we see them”) as „an integral part of every, or nearly every, testable social theory”. But, strictly speaking, the principle of rationality as we define it is false and has nothing to do with the idea that man always adopt a rational attitude. However, Popper thinks it would be „a good policy, a good methodological device, to refrain from blaming the rationality principle for the breakdown of our theory” and to make the model responsible for the failure of the theory, because the model is „far more interesting and informative, and far better testable” than the principle. Although we know it is not strictly true, the principle of rationality „is as a rule sufficiently near to the truth” and, anyway, an attempt to replace it by another one „seems to lead to complete arbitrariness in our model-building”. [8]

This type of open attitude towards the methodological requirements suggested or just imposed by the specific conditions in a research domain offers a good analogy for evaluating the present situation in cosmology. Confronted with the „extraordinary problems” of their domain, many cosmologists can not resist the strong impulse to adjust the accepted methodological rules of their community so as to cope with those problems, even in an unorthodox manner that offends both science and philosophy of science. Turning now to the consequences of such an approach for the philosophy of science, the philosopher have to find convincing answers to many legitimate questions posed by cosmologists like John Barrow: „Why should Nature be constructed upon a scale that is spanned by human intelligence? Why should what is true also be humanly falsifiable or verifiable?”, and so on. [5] The philosophical lesson given by contemporary cosmology is, I think, that philosophy of science should never ignore the benefits of such more or less periodical incentives to „naturalized” reorganizations.

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