Article

THE WEAK ANTHROPIC PRINCIPLE AND THE DESIGN ARGUMENT

by Joseph M. Życiński

Abstract. The design argument for God's existence was critically assessed when in the growth of modern science the cognitive value of teleological categories was called into question. In recent discussions dealing with anthropic principles there has appeared a new version of the design argument, in which cosmic design is described without the use of teleological terms. The weak anthropic principle (WAP), a most critical version of all these principles, describes the fine-tuning of physical parameters necessary to the genesis of carbon-based life. It defines no physical mechanisms of the observed coordination between physical parameters. If in a future unified physical theory such mechanisms are discovered, the weak anthropic principle should be replaced by the strong anthropic principle, which asserts the physical necessity of fine-tuning. Neither of the versions can be regarded as physically trivial unless one accepts strong assumptions of the existence of parallel universes. Consequently, a new version of the philosophical design argument can be developed on the basis of the weak anthropic principle.

Keywords: anthropic principle; chance; cosmic isotropy; cosmology; design argument; logos; necessity; physical laws; teleology; unified theory.

"I cannot believe that our existence in this universe is a mere quirk of fate, an accident of history, an incidental blip in the great cosmic drama. Our involvement is too intimate. . . . Through conscious beings the universe has generated self-awareness. This can be no

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trivial detail, no minor byproduct of mindless, purposeless forces. We are truly meant to be here" (Davies 1992, 232). With these words Paul Davies closes his book *The Mind of God* (1992), in which he provides a new physical basis for a critical probabilistic version of the design argument. In the past this very argument had a poor reputation among scientists because very often it combined naive teleological assumptions with amateurish physics. There are a few authors who would like to cultivate teleological categories in modern science.[1] In the process of scientific growth, causal explanations turned out to be much more effective than teleological ones. However, the contemporary search for a unified physical theory, as well as new discoveries in relativistic cosmology, place the grand questions of the traditional metaphysics in a new cognitive context. To this group of exciting problems belongs the so-called weak anthropic principle (WAP) which describes the fine-tuning of physical parameters necessary for the genesis of carbon-based life. According to Dennis Temple, this very principle provides a new basis for a revised version of the design argument because "the creator hypothesis has a good claim to be the best explanation of cosmic fine-tuning proposed so far" (Temple 1994, 135).

Of course, the creator hypothesis, for obvious methodological reasons, cannot be introduced at the level of physical explanation. However, can we accept the hypothesis of the Creator's fine-tuning design on the level of philosophical explanation? The authors who argue that the WAP provides no premises for such explanation try to trivialize its content either by showing its tautological character or by calling into question epistemological realism. A stronger attempt at trivialization referes to the future growth of physics. It asserts that research will eventually explain the parameters of the strong anthropic principle (SAP), thus obviating the initial parameter constraints described in present physical research by the WAP. Authors who are skeptical toward such an expression of cognitive optimism try to neutralize the metaphysical importance of any form of anthropic principle by assuming the existence of an ensemble of parallel worlds either in Everett's interpretation of quantum mechanics or in cosmological models proposed by such authors as Charles Misner, Andrew Linde, or Lee Smolin.

After indicating the interpretive problems faced by supporters of all these counterproposals, I shall try to defend the philosophical importance of the WAP.

THE CONTENT OF THE WEAK ANTHROPIC PRINCIPLE

In order to avoid the ideological anthropomorphisms that are often used by supporters of various versions of anthropic principles, Ernan Mc Mullin uses the expression "initial parameter constraint" (IPC) to denote the highly specific initial conditions that were needed for the emergence of carbon-based life in the universe (Mc Mullin 1994, 115). Sharing his methodological criticism, I will use the expression "weak anthropic principle" as an IPC synonym to follow the prevailing terminological practice.

The expression "anthropic principle" was used for the first time by Brandon Carter in 1973. During a Copernican conference in Cracow, he advanced the thesis that the position of the earthly observer in the universe is privileged in the sense that development of carbon-based life could not take place under arbitrary physical conditions, but required special conditions dependent on such properties of the universe as its age, its rate of expansion, and the values of particular parameters. Cosmologists have long been intrigued by the question of why life appeared so late in a universe that has been expanding for 20 billion years, and why the density of matter in the universe is so small that successive generations continually relive Pascalian anxiety in their experience of the emptiness of infinite spaces. Modern cosmology supplies a partial explanation. Even if life were to develop in only one place, a large and old universe would be required. Billions of years of cosmic evolution are necessary for the appearance of carbon-producing stars, an indispensable element for the rise of known forms of life.

The natural consequence of the expansion lasting billions of years is the observed size of the universe. If expansion were taking place much more rapidly, systems like our solar system would be unstable, and life could not have developed in its present forms. On the other hand, if expansion were taking place much more slowly, the evolution of stars would make the appearance of carbon compounds impossible, since the hydrogen would be burned up before the physical conditions required for the development of life could come into being. The rate of expansion, in turn, is dependent on the density of matter in space. Today we know that Pascal's dread has its source in the observed density of matter in the universe, which is lower by thirty orders than the density of water. Yet if the density of matter were considerably greater than 10^{-30} g/cm^3, the expanding universe would recollapse so rapidly that the conditions for the development of life would not have enough time to appear. With the density of matter much smaller than 10^{-30}, expansion would take place so rapidly and planetary systems would be so unstable that one might only speculate on the possibility of development of other types of living organisms, based, for example, on interstellar dust.

If the strong nuclear force were 5 percent weaker, there would exist only hydrogen and no helium would have formed. If it were 2 percent stronger, there would be no hydrogen in the universe because all hydrogen would be converted into helium. If the electromagnetic force were slightly stronger, there would be no planets in the universe and all stars would exist in the form of red dwarfs. If the weak force were slightly weaker, only helium could have formed. Possible discussions about whether helium-based life can exist on the surface of red dwarfs belong rather to science fiction than to science itself. In science we can study mutual relationships between particular parameters and search for deeper mechanisms generating this network of connections.

As early as the 1950s, these interdependencies had been studied by G. Whitrow, G. Idlis, and R.H. Dicke. Dicke's work built upon the work of P.A.M. Dirac, whose 1937 Large Numbers Hypothesis emphasized that the number 10^{40} appears very often as a ratio between parameters characteristic both of phenomena of the microworld and of gravitational interactions (Dirac 1937, 323). The presence of this number inspired new forms of neo-Pythagorean speculations on the role of mathematical relations in the physical structure of the world. Attempts to answer new questions led to Dirac's research program which allows for the variation in time of some parameters previously regarded as constant. New versions of this program are still being developed in physics, and to form definitive conclusions about them now would be premature.

On the other hand, the critical evaluation of A. Eddington's numerological speculations, to which Dirac—formally rather than substantively—referred in his program, seems justified. The author of *The Theory of the Expanding Universe* made an attempt in the twenties to construct a cosmological model whose structure would be determined by combinations of the following six parameters: c, the velocity of light; G, the gravitational constant; h, Planck's constant; m_e, the electron mass; m_n, the proton mass; and e, the electron charge. Some of Eddington's interdependencies were extremely artificial and resulted from the arbitrary introduction of artificial combinations of parameters. Max Born, who was known for his empiricist sympathies, in his skeptical appraisal of such numerology sarcastically observed that Eddington's interpretive liberalism would even allow the mathematization of Saint John's *Apocalypse*. Its mathematical version would inform one that the beast coming out of the sea, which had $f(2)$ horns, was given power for x months, where x equals $1 \cdot f(3) - 3 \cdot f(1)$.

In the history of modern science, such numerological speculations, important also for the WAP's content, have not always played a heuristically positive role. On the contrary, in many cases they inspired research programs which turned out to be neither theoretically nor empirically progressive. The situation became different in relativistic cosmology when parameters relating to the evolution of the early universe were studied. The simultaneous appearance of independent properties, which are a necessary condition for the existence of known forms of life, was all the more intriguing, the less probable was the appearance of the now observed properties. For example, the universe exhibits a high degree of isotropy—i.e., the amount of microwave background radiation observed from our planet is very nearly independent of the direction in which we look. This high isotropy of the universe plays an important role for conditions essential in the process of the development of life. When attempts were made toward the end of the 1960s to explain its appearance, it was hypothesized that the evolution of the universe, starting from arbitarary initial conditions, with the passage of time inexorably led to the presently observable high isotropy. Theoretical studies undertaken by C.B. Collins and S.W. Hawking have confirmed the opposite conclusion: of all conceivable initial conditions that the universe could have had, most of them lead to anisotropy; only a comparatively small number of initial conditions, out of an infinitely large number of possible conditions, lead to observed isotropy (Collins and Hawking 1973, 317–34). Therefore, the conditions that we perceive are highly improbable, whereas cosmic evolution in which anisotropy appears with the passage of time would have been quite natural. If the incredibly improbable isotropization had not taken place in this evolution, conditions would not exist in the universe for the appearance of carbon-based forms of life, and cosmology as a science would not exist. Without avoiding paradoxical statements, Collins and Hawking close their analyses with the conclusion that "in a sense, the isotropy of the Universe is a consequence of our existence" (1973, 317–34). W.L. Craig calls their opinion both substantively unfounded and intellectually irresponsible (Craig, Barrow, and Tipler 1988, 392). To avoid semantic debates we may express Hawking's and Collins's paradoxical conclusion in a less controversial formula: "If life could not arise without isotropy, then from the existence of the human observer one can conclude that the universe is isotropic."

The basic variant of the WAP is independent of any ontological commitments that are characteristic of the majority of the anthropic proposals contained in the monograph of Barrow and Tipler (1986, see note 2). The WAP merely determines the relations between various observables and concludes that the observed values of physical and cosmological parameters take on values in an interval that makes possible the emergence of life based on carbon compounds. Whether these cosmological coincidences should be regarded as an accident or as manifestations of the teleology of nature goes beyond the cognitive competence of the natural sciences. In philosophical debates on the question, however, we must tackle the question of how to explain the mysterious cosmic correlations.

IS THE WAP TRIVIAL OR SELF-EVIDENT?

One of the easiest methods of "explaining" any cognitively intriguing phenomenon is to show its trivial or self-evident character. An easy epistemological trick that enables trivialization of the WAP's significance involves calling into question scientific realism. Various versions of such interpretive practice are popular in contemporary epistemology. According to the radical constructivism developed by Bruno Latour and Steve Woolgar, the so-called physical reality is nothing but a result of scientists' consensus dependent on social compromise and laboratory "phenomenotechnics" (Latour 1986; Woolgar 1988). According to Bas van Fraassen's constructive empiricism, the scientist's claim of the real existence of physical objects has the same epistemological status as the ontological commitment of the philosopher who accepts the existence of God (van Fraassen, 1980).

In the cognitive framework of scientific antirealism one can explain neither the effectiveness of scientific theories in technology nor the nature of empirical confirmation of predictions in theoretical physics. The unexpected discovery in 1965 of the so-called background radiation provides an impressive example of the empirical adequacy of cosmological theories. The existence of 2.7° K radiation emitted 20 billion years ago was predicted on purely theoretical grounds by George Gamow in the early 1940s. The prediction was empirically confirmed by scientists who had never heard of Gamow's paper and did not know about relativistic cosmology. Within the cognitive scope of this discipline, the position of epistemological antirealism remains arbitrary and unconvincing—much more than in any other scientific discipline.

Another sort of attempt to trivialize the WAP implies the following reasoning: the world is as it is because we could not exist in a different world with cosmic parameters and physical laws different from the observed ones. The very fact of our existence thus implies the initial parameter constraints, and so there is nothing left to explain in the regularities described by the WAP. Critics of the philosophical significance of the WAP do agree that the weak version of this principle is free of such strong metaphysical assumptions as those that underlie either the participatory or the final version of the principle.[2] They claim, however, that the WAP is tautological in nature because the very fact of our existence implies the necessity of the actual existence of physical parameters that are necessary for the emergence of carbon-based life. In this approach, stronger versions of the anthropic principle could be philosophically significant, but they are physically unfounded; the WAP is physically justified but philosophically trivial.

This attempt at trivialization of the WAP confuses important distinctions between different levels of explanation. Had Sherlock Holmes argued in the same manner, he could have said: "The very fact that Dr. Watson is present here indicates that a crime was committed. If X had not murdered Y, neither I nor Dr. Watson would ever have arrived here. Thus everything is tautologically self-evident and there is no need for any additional explanation."

In Sherlock Holmes's argument, using the word *thus* in the last sentence seems to be a logical crime. The same events can be explained on various levels and the very existence of the explanation E_1 of the event E does not imply that different aspects of the same event cannot be explained by a series of complementary explanations E_2, E_3, ... E_n. Calling into question the apparent triviality of the WAP, I would like to emphasize that in the growth of science a very important role is played by the discovery of facts that, under a certain interpretation, could have been regarded as trivial. The very notion of cognitive triviality turns out to be relative to an adopted system of knowledge. A fact regarded as trivial in the system S_1 is not necessarily trivial in another system S_2. Accordingly, the commonsense trivialization of the WAP would not imply its absolute trivialization.

In context of medieval cosmology, the darkness of the night sky seemed to be natural, trivial, and unimportant for scholarly research. In the nineteenth century what was previously trivial became paradoxical when H. W. Olbers pointed out that a great number of stars evenly distributed in space should result in uniform luminosity of the night sky. After the formulation of the famous "Olbers paradox," the allegedly trivial fact became intellectually intriguing. One century later, when the expansion of the universe was discovered, one could explain the paradoxical darkness of the sky by referring to the red shift effect. Any claim of cognitive triviality, or paradoxicality, of a particular physical phenomenon thus implies a body of knowledge, adopted at least implicitly in interpreting given facts.

The shift in assessment of possible triviality depends not only on the growth of scientific knowledge but also on epistemological distinctions characteristic of different disciplines at the same stage of research. The equality $a = a$ can be regarded as trivial from the standpoint of classical logic, but the possibility of our determining similar equalities in the domain of the actual certainly possesses nontrivial ontological aspects. Every process of scientific identification implies a tautology $a = a$ which is logically trivial but at the same time important in its empirical content. The latter depends on the identity of two physical designates a and b that previously seemed distinct. Such an identification could be regarded as trivial only if in the context of scientific discovery it was originally self-evident that $a = b$. However, it cannot be called "trivial" when we successively discover that $a \cdot d = c \cdot b$, and $d = c$, so that $a = b$.

What does it mean that the WAP is both self-evident and trivial? Such an assessment is formulated in the system of knowledge in which, regardless of recent cosmological discoveries, one refers to the body of commonsense knowledge. In this frame of reference, it is obvious that if a carbon-based life emerged in the past evolution of the universe, the physical conditions for such an emergence must have existed. What *must* means, precisely, was never discussed in this commonsensical approach. If we consistently use such an approach, we could trivialize any actual fact by arguing, "If F is actual, then the fact that it must have happened is trivial." Such a notion of cognitive triviality cannot, however, be regarded as an invariant independent of the adopted system of knowledge. Growth in both philosophy and science is possible because of our discovery of the amazing content in these facts that earlier appeared trivial in a different respect.

The third way of making the WAP trivial implies an ambitious attempt to interpret the initial parameter constraint as a consequence of yet unknown physical laws that could be discovered in a future unified theory. Such an approach seems both substantively well-grounded and confirmed by the data illustrating the growth of science. It would be natural to deduce the regularities described by the WAP from a physical principle more basic than the WAP itself. Since the time of Mach we have known that science has not been a catalogue of recorded facts. Hence efforts are made to discover the hidden cosmic code that would transform the present play of observables into necessary consequences of basic physical laws. We should support seriously the possibility that the future growth of cosmology will bring on the discovery of physical determinants underlying the coincidences that are important for the WAP. After discovering hitherto unknown laws *L* governing the early stages of cosmic evolution, one could argue that the WAP is cosmologically trivial, since its content can be explained on the basis of this newly discovered law. In such an approach, what is amazing and fascinating in the body of present science would be nothing but a physically necessary consequence of the laws of nature that will be known to future science. The WAP would be greatly trivialized in this framework, since one could then argue that, on the basis of the laws *L*, the universe must have those properties that allow life to develop within it at some stage in its history. However, if such an approach succeeds, it will yield the replacement of the WAP by the SAP. What now seems factual will appear physically necessary in the new scientific framework. The question remains whether this form of physical necessity excludes metaphysical necessity or rather provides a new physical basis for its existence.

One of the well-known variants of Carter's strong anthropic principle states that the universe must have those properties which make possible the development of life in a particular stage of cosmic evolution. Depending on how *must have* is interpreted, this variant can imply essentially different philosophical interpretations. In its weakest interpretation the term *must have* can be regarded as an ex post facto reconstruction similiar to Collins's and Hawking's procedure mentioned above. Everything suggests that this is the meaning Carter originally gave to the term: since life in fact did appear, explanations of the earlier stages of cosmic evolution must posit conditions that led to the appearance of the human observer.

It is easy to show that the astonishing correspondence in the set of independent physical parameters—i.e., the correspondence ascertained by the WAP—was far from trivial for cosmologists who studied the physical conditions of the evolution of the early universe. Continual attempts at causal explanation of this correspondence still remain unsuccessful. On the other hand, the series of inflationary models originated in 1980 by Alan Guth (Guth and Steinhardt 1984, 127) eliminated some previous questions—e.g., dealing with the so-called flatness problem—and revealed that some interconnections that earlier seemed statistically improbable are physically necessary. Even in these models, however, "calculations yield reasonable predictions only if the parameters are assigned values in a narrow range" (Guth and Steinhardt 1984, 127). It remains an open question whether the situation changes and whether in future cosmological models all initial parameters must generate the present conditions for the emergence of life.

The statement declaring "The Universe must have those properties which allow life to develop" precisely expresses the content of the so-called strong anthropic principle. Owing to the presence of the enigmatic *must have* in the proposed formula, this version of the principle is regarded today as metaphysics-laden and physically unfounded. If (and only if) future growth in cosmology goes in the suggested direction, and the SAP is accepted, the WAP can really be regarded as physically trivial. Nevertheless, philosophical discussions dealing with the strong anthropic principle would then be focused on the same questions that are discussed by contemporary opponents and supporters of the WAP. In the present debates on the philosophical importance of the WAP, one often finds the methodology well-known in the arguments describing the "God of the gaps." In this approach, a hypothetical God is introduced by philosophers to explain the physically unexplained network of relationships between initial parameters. If a version of the SAP were accepted in the future, there would be no gap in our knowledge of the cosmic correlations since everything would be explained on the basis of physical laws *L*. These laws themselves would disclose a cosmic design in which the physical evolution of the universe was predetermined in such a way that the emergence of life is a physically necessary process. Nevertheless, this internal direction of 20 billion years of cosmic evolution will reveal, in a new context, the same metaphysical questions that are discussed in contemporary debates on the WAP. For this reason, many critics of the WAP try to neutralize its philosophical significance on the basis of probability calculus.

The Ensemble of Worlds and the Anthropic Principles

In order to trivialize any form of the anthropic principle, it is enough to assume that in the universe there exists a set of relatively independent physical systems with different laws of cosmic evolution, different numbers of dimensions, different values of physical constants, etc. In such an approach the meaning of the WAP, and of the SAP also, is neutralized by an appeal to the principles of the calculus of probability. In the infinite-world ensemble, all possible combinations of laws, physical constants, and initial conditions must be realized. Our "universe" also had to come into being. There is nothing mysterious about the fact that we found ourselves in a privileged system. In other systems the physical conditions were simply not appropriate for the appearance of the human observer. Accordingly, the cosmic fine-tuning we observe can be explained by assuming that our position in the universe is not typical, since we find ourselves in one of the exceptional subsets of the infinite ensemble of worlds.

A physical basis for this explanatory model may be found in various cosmological theories of multiple universes. Their detailed description is provided by Jacques Demaret and Dominique Lambert in their monograph *Le Principe Anthropique* (cf. Markov, Berezin and Frolov 1985). Some variants of this approach refer to a conception defended by J.A. Wheeler in the past: an infinite sequence of systems which evolve cyclically, leading to a change in physical conditions and laws. Other versions refer to Markov's version of semiclosed worlds (Markov, Berezin and Frolov 1985) or to the idea of the bubble universe. This concept, introduced initially in 1966 to save the steady-state theory, was later modified and developed by R. Gott (1982).[3] The most popular of all physical proposals is H. Everett's interpretation of quantum mechanics, which allows the existence of parallel worlds. Some physicists expect that this approach will lead to a new scientific paradigm, but most contemporary scientists regard the Everett-Graham-DeWitt interpretation as only a product of creative imagination, with its greatest value being its mathematical formalism.

Our intellectual creativity could generate new versions of the many-worlds theory, for instance by adopting Ellis's globally inhomogeneous cosmological models or models of baby universes proposed by K. Sato, H. Kodama, M. Sasaki, and K. Maeda (1982). In reference to this form of explanatory proposals, John Leslie seems correct when he attempts to reduce the entire problem to an alternative: "My argument has been that the fine tuning is evidence, genuine evidence, of the following fact: *that God is real, and/or there are many and varied universes*" (Leslie 1989, 198).

In various interpretations of Everett's hypothesis, one finds essentially different ontological, epistemological, and physical assumptions concerning the nature of human existence in the system of parallel worlds. Very often the proposed models seem closer to science fiction than to science. Their astonishing popularity depends on, among other things, the unclear content of statements about the real existence of so-called possible worlds. When presenting his version of the world-ensemble hypothesis in 1937, G. Steigman referred to the notion of possible worlds. This concept is the central subject of contemporary analyses in the ontology of modality. In the prevailing doctrine of modal actualism the key role is played by the opposition between the possible and the actual world. If we accept this standpoint of modal actualism, the many-worlds hypotheses would no longer be useful in explaining determinants of the regularities shown by the anthropic principles. The problem unexplained in this approach would refer to the cosmologically atypical position of the human observer. In the infinite set of physical systems there are only a few systems in which carbon-based life would have evolved, and we just happen to live in one of those systems. Probabilistically one can explain nothing more. Intellectually, however, we experience a discomfort similar to the embarrassment experienced in situations when one explains probabilistically the genesis of hi-fi technological devices by reference to statistical fluctuations. The explanation seems theoretically acceptable but intellectually unsatisfactory.

Another essential flaw of the world-ensemble hypothesis is its obvious conflict with the principle of Ockham's razor (Polkinghorne 1986, 49; 1984, 68). An interpretative procedure in which worlds are multiplied without need and without substantive grounds gives rise to understandable opposition. For this reason a special "de-Ockhamization" program has been linked with it. The program's supporters furnish many examples of the disadvantageous consequences of the application of this principle in science. It is true that in the nineteenth century the appeal to Ockham's razor retarded the development of extragalactic astronomy by nearly one hundred years. In that situation, however, empirical data were available to challenge the validity of economic interpretations based on Ockham's principle. As regards the world-ensemble hypothesis, the situation is quite different. Not only is there no empirical confirmation, but in fact there can be none, since the neighboring worlds are supposed to be causally disjoint and thus inaccessible to direct observation.

Trying to compare the degree of logical simplicity of two competing interpretations, Richard Swinburne claims that "the existence of God is much more likely on the evidence of our life-producing world than the existence of 'many worlds'." In his opinion it is simpler to postulate the existence of one Divine Designer than to suppose the "complexity and non-prearranged coincidence of infinite dimensions beyond rational belief" (Swinburne 1990, 172). It is risky to introduce any criteria of simplicity and probability calculation to appraise the status of such theses as the existence of

God or the structure of the universe. It remains true, however, that many versions of the theory of multiple universes remain unfalsifiable, contrary to the basic principles of the Popperian scientific methodology. For this reason they seem closer to metaphysical speculation than to scientific thought. Demaret and Lambert are convincing in their arguments when they disclose physical deficiencies of the multiple-universes hypothesis and claim that it has all the characteristics of the classically conceived hypothesis ad hoc (Demaret and Lambert 1994).

In radical reinterpretation of the world-ensemble hypothesis one may try to eliminate its metaphysical character. The terms *real dispositions*, *potentialities*, *capability*, *propensity*, and *the dispositional properties* of physical objects (Thompson 1988, 68) may be used to eliminate the exotic content of the "parallel worlds" and "multiple universes." In this approach, the philosophical questions raised by the SAP and the WAP remain unexplained, because we still have no answer as to why, in the large set of theoretically admissible possibilities, there was actualized only a small set of physical parameters that allow the emergence of carbon-based life. The initial question raised by the WAP returns in a new form. In answering it, one has to choose between fantasy and metaphysics. Certainly one can choose both. This is why Paul Davies stresses that "it is perfectly consistent to believe in both an ensemble of universes and a designer God" (Davies 1992, 220).

Cosmic Design and Theistic Constraints

In his comments on the infinite hierarchy of the semiclosed universes, M. A. Markov claims that this very idea remains so attractive from a mathematical point of view that one should develop it regardless of its correspondence with any physical data. A similar epistemological approach is shared by many authors who appreciate the formal beauty of a theory more than its empirical confirmation. One has to remember, nonetheless, that in the history of science a similar epistemology inspired many research programs that turned out to be theoretically useless.

Speculations about the infinite world ensemble seem similar in many respects to the old-fashioned theory of the chain of being. The supporters of this theory, after accepting the basic axiom *quidquid fieri potest fit* (whatever can happen will happen), argued that in the universe everything is actualized, except for the objects that would be internally inconsistent. On the basis of this axiom, B.L. de Fontenelle argued that all planets in our solar system, as well as other cosmic objects, are inhabited by creatures similar to human beings. To strengthen his rational arguments in his *Entretiens sur la pluralité des mondes* (Dialogues on the Plurality of Worlds), Fontenelle referred also to empirical evidence. He argued: Since in a drop of water there lives an immense number of bacteria, why should there not be an immense number of living organisms in distant cosmic systems? This rhetorical question, Why not?—*pourquois pas?*—inspired many French authors to describe in detail the creatures that constitute the great chain of being in accordance with the unsophisticated axioms of the prevailing philosophy. Many authors of the seventeenth century stressed the role of mermaids in the plurality of biological species. On the basis of empirical data provided by seamen, these authors distinguished even between female mermaids (*mulier marina*), male mermaids (*homo marinus*) and sea bishops (*episcopus marinus*). Even an author as critical as John Locke was among the philosophers who treated these fantasies seriously (Lovejoy 1973, chap. 9).

In the growth of modern science, physical-biological laws replaced unverifiable conjectures of the infinite hierarchy of being. The search for these laws turned out to be more valuable heuristically than did belief in unobservable fantastic worlds. We may expect that the same attitude will be confirmed by the growth of cosmology and that the initial parameter constraint will be deduced from as yet unknown physical laws. On the level of physical research one has to accept such a deduction as a final answer to the questions provided by anthropic principles. On the level of metaphysical investigations, one has then to recognize that the entire cosmic evolution seems directed to the rise of carbon-based life. The more than 20 billion years of cosmic evolution aim at the emergence of life as their natural consequence. This process can be regarded as an expression of cosmic design only if one regards physical laws and logical necessity as the essence of the design.

Should we recognize the existence of the Divine Designer when we acknowledge this cosmic design? My answer is negative when by the Divine Designer we understand the God of classical theism conceived as an omnipotent Person. I agree with John Leslie that to explain the nature of the cosmic design one can refer to a force or a form of energy imposing rational structures on the physical processes (Leslie 1989, 165–74). The neo-Platonic Logos or the philosophers' Absolute would be enough to explain the cosmic design disclosed by anthropic principles. In my opinion, this restriction imposed on the arguments presented refers to all forms of the design argument, not only to those based on anthropic principles. Kenneth T. Gallagher seems absolutely right when he argues that it is impossible to prove that the Cosmic Designer must be "a transcendent being which is self-subsistent, infinitely perfect and personal. It is far from perspicuously clear that the mind manifested in nature must be so conceived. The hypothesis could certainly be entertained, for example, that a pantheistic Heraclitean logos might be sufficient to fulfill the exigencies of reason striving to comprehend the spectacle of the world" (Gallagher 1994, 30).

However, I disagree with Gallagher when he claims that the design argument is not cosmological in nature because in its structure the main role is played by a priori reasoning. The evidence presented above is inconsistent with Gallagher's claim that any form of the design argument cannot be more empirical than traditional metaphysical proofs of cosmic teleology, because the thesis "that the world is the expression of mind is not so much a conclusion of our thinking as its presupposition" (Leslie 1989, 31). It is hard to agree that the parameters' correspondence described by the WAP is nothing but a presupposition of our thinking. John Leslie's claim seems much more justified when he maintains that in reference to cosmic fine-tuning and to the cosmic design it is "tempting to call the fact an observed one. Observed indirectly, but observed nonetheless" (Leslie 1989, 198).

On the one hand, the WAP significantly changes the status of the design argument and demonstrates that "it is high time we philosophers took the Design Argument seriously" (Leslie 1989, 198). On the other hand, the irremovable possibility of replacing the Divine Designer by a neoplatonic logos may dissatisfy those metaphysical perfectionists who would search for stronger conclusions. The conclusions obtained are, nonetheless, very important for philosophical controversies of our time. They demonstrate, among other things, how quickly relativistic cosmology falsified Jacques Monod's metaphysics in which physical-biological processes were supposed to be merely an interplay of chance and necessity.

NOTES

1. Their attempts are described in Barrow and Tipler 1986, chap. 3.
2. The latter versions are formulated and developed by Barrow and Tipler (1986).
3. Presentation of these proposals may be found in Gale 1990, 189–206.

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