EuJAP | Vol. 8 | No. 1 | 2012
ORIGINAL SCIENTIFIC PAPER
UDK: 1 Dummett, M.
1:53
530.1:140.8
113/119

THE ROLE OF PHILOSOPHY IN A NATURALIZED WORLD

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ABSTRACT

This paper discusses the late Michael Dummett's characterization of the estrangement between physics and philosophy. It argues against those physicists who hold that modern physics, rather than philosophy, can answer traditional metaphysical questions such as why there is something rather than nothing. The claim is that physics cannot solve metaphysical problems since metaphysical issues are in principle empirically underdetermined. The paper closes with a critical discussion of the assumption of some cosmologists that the Universe was created out of nothing: In contrast to this misleading assumption, it is proposed that the Universe has a necessary existence and that the present epoch after the Big Bang is a contingent realization of the Universe.

Keywords: : Dummett, physics, philosophy, metaphysics, underdetermination, cosmology

1. Introduction

Why are humanists and natural scientists unable to understand one another? This seems to be one of the two main questions that concern Sir Michael in his thought-provoking essay "The Place of Philosophy in the European Culture." He does not himself supply us with any definite answer, but suggests that philosophers in general do not know much about the natural sciences, and therefore do not dare to speak up against the natural scientists (and those who do are not interested in the same kind of problems as the scientists.) Moreover, because of the great success of the natural sciences scientists are often arrogant by assuming that the only knowledge we can have is the knowledge they are able to provide. The diagnosis, Dummett here offers, is, I think, to a large extent correct. Others have made similar observations before. Sir Michael's hope of reconciliation of the humanities and the natural sciences were shared by C.P. Snow who, in his famous talk at Cambridge in 1959, spoke about the two cultures, the humanities and the natural sciences, standing in stark contrast to one another. Neither humanists nor scientists were able to speak the language of the other part and therefore had no way of understanding each other's way of thinking. This problem is no less

pressing today than it was when Snow made his appeal to the educated elite.

Today, it seems that Snow's manifesto had little effect on the two cultures. Much has changed since he published his essay, but the gap between humanists, such as philosophers, and natural scientists has only grown wider. Philosophers have a share of responsibility for this development. Either they ignore their duty as philosophers by not comparing philosophical claims with scientific knowledge, or they downplay the achievement of the natural scientists by suggesting that the entire scientific enterprise is a social construction which cannot claim a higher objectivity than other disciplines.

2. Science as a Social Construction

In recent years, a number of humanistic thinkers have endorsed transforming philosophy of science into a kind of sociology of knowledge. They challenge the fundamental idea of many scientists that their discipline seeks to gain knowledge about objective facts without their own subjectivity and social constraints having any lasting influence on the result. It is, however, not unknown that constructivists' arguments often do not distinguish between whether it is things in themselves that are socially constructed or it is the idea of these things put forward by science that are so constructed. As today's version of the old idealists, some constructivists would even deny there is any difference between the thing and the idea of the thing. Their denial has far-reaching consequences. The upshot in the human sciences is that no object in itself has the character of being a text, an artwork, a historical source, a tool or equipment, until it is constructed by the interpreter as a text, an artwork, a historical source, etc. Every 'thing' depends on subjective interest, different perspectives, and interpretative stances. The same attitude applies to 'discoveries' in the natural sciences. There were no quarks until they were invented by physicists. What is true is true only in relation to a particular theory, a linguistic practice, or a constructive interpretation; nothing is true 'in reality'.

Many scientists consider this criticism of scientific truth and objectivity with great concern, because they see the relativism of social constructivism as an excuse and an opportunity of bringing alternative research policies into play for the purpose of exerting political control over science in society. For instance, granting a socially constructed reality opens up the possibility for a different, but politically more attractive view of global warming than the one supported by the majority of scientists. If there are no objective facts, we can with equal justification draw a different scientific picture of reality.

Such a view was obviously not well received by the natural sciences. The scientists struck back. They accused these hip philosophers of intellectual deceit, and philosophy as such was looked upon with deep contempt. In 1996 the American physicist Alan D. Sokal published an article, "Transgressing the Boundaries: Towards a Transformative Hermeneutics of Quantum Gravity" in the prestigious but very postmodern journal *Social Text*. In the article he described how quantum physics openly confirmed postmodernists' criticism of scientific objectivity. At the same time, he published

another paper in *Lingua Franca*, in which he stated that the *Social Text* article was all pure fabrication concocted for the purpose of satirizing the postmodernist view of science. His intention was to show that human and social scientists do not know what they are talking about when they describe the object of science as a social construction. The articles launched a passionate debate called *The Science Wars* – a debate between natural scientists and postmodern philosophers.

One party saw the natural sciences as a guarantor of truth and rationality, while the postmodern philosophers were accused of being relativistic and irrational and of worshiping any new philosophical fashion. In contrast, the other party claimed that even the natural sciences are socially constructed, that so-called scientific knowledge is just based on interpretations and social norms, and that there are no objective facts allowing the researcher to hide behind a method whenever he or she believes to investigate things-in-themselves. Snow's talk about dialogue between scientists and humanists from 1959 seemed to be completely forgotten.

Although constructivists deny the charges of idealism, they do hold that humans construct their concepts of the world in response to social interactions rather than in reaction to their interactions with an objective reality. And humans continue to use given concepts not because of the instrumental value of these concepts in understanding an objective reality but because they help us to uphold a linguistic tradition, social powers, or an established culture. This claim seems reasonable as long as we are dealing with a social reality. Very few, if any, would question that a large part of the social world is a result of social interactions over time. Even when it comes to understanding the physical world, it is true that natural scientists construct their own concepts as means to grasp the physical reality just as the social scientists and the humanists construct theirs. Also it may be true that the same fraction of reality might be grasped from different conceptual perspectives. Realism does not require that things have a particular *essence* whose description gives us the only possible true description. More than one construction of concepts may apply to the same phenomenon. But this claim does not entail that the construction of scientific concepts is unguided by our interactions with an objective reality. Nor does it entail that these concepts are still in use even if the instrumental value of them is no longer evident. On the contrary, the basic postmodernist claim that there is no independent, interpretation-free world to assist us in forming interpretations must be defended by argument and not just taken for granted.

3. Is Philosophy Dead?

In opposition to social constructivists we see scientists who consider philosophical inquiries to have fallen out of fashion. The scientists themselves can do things much better. Some physicists' recent patronizing remarks concerning philosophy show how remote philosophers and physicists are from one another. The famous physicist Stephen Hawking has started a crusade against philosophy, and he might win the public audience, not because of convincing argument, but because of his status as a

celebrity who cracks one-liners about philosophers. He opens his new book *The Grand Design,* written together with his colleague, Leonard Mlodinow*,* by raising questions about the nature of reality, about the origin of everything, and about the necessity of God. "Traditionally", say they, "these are questions for philosophy, but philosophy is dead. Philosophy has not kept up with modern developments in science, particularly physics. Scientists have become the bearers of the torch of discovery in our quest for knowledge." (Hawking and Mlodinow 2010, 5) Since books like this one, written by famous scientists for a larger audience, easily gain cultural resonance, they may contribute to the failure of understanding between scientists and philosophers, and indeed, to the broad discrediting of philosophy in the wider culture.

"Philosophy is dead", declares Hawking; in the same manner as Nietzsche announced God's death. Indeed, if Hawking received his inspiration of discrediting philosophy from information about the Science War and claims of postmodern philosophers, much of his derogatory talk might be excusable. But, apparently, he knows little about what has happened within philosophy of science and in particular philosophy of physics since the heydays of logical positivism. Nor has he understood that physics as it is practiced today involves many philosophical problems which physicists are not trained to address. I shall prove Hawking wrong later, but here I just want to illustrate Hawking's philosophical ignorance. He and Mlodinow write about the common sense view about the world: "The naïve view of reality therefore is not compatible with modern physics. To deal with such paradoxes we shall adopt an approach we call model-dependent realism. It is based on the idea that our brains interpret the input from our sensory organs by making a model of the world." (Hawking and Mlodinow 2010, 7) This is exactly what Wilfrid Sellars argued more than fifty years ago when he distinguished between models and a set of commentaries on the one hand and theories on the other and applied the concept of model to the manifest image and the scientific image.

Hawking and Mlodinow are not the only physicists with little or no regards for philosophers. The physicist and popular science writer Paul Davies shares Hawking's disrespect. Writing on time Davies says "there has probably been more nonsense written by philosophers on the subject of time, from Plato onwards, than on any other topic" (Davies 1995, 252). Hence, Aristotle, Leibniz, Kant, and McTaggart have not made more than vacuous comments on time. What an insight! No philosopher of today would deny that Newton and Einstein have made important contributions to our understanding of time, but nobody in the knowing will dismiss the significant impact of the former as well. Again, I don't know how well-informed Davies believes that he is about history of philosophy. But most modern physicists are not able to read their predecessors' work, like for instance Newton's *Principia*, so how can Davies be so sure that he has grasped the meaning of the earlier philosophical doctrines?

In addition, even in more recent time, many questions concerning the nature of time and causation, and their interrelationship, as being discussed by physicists have already been argued earlier by philosophers. For instance, in the sixties there was a long discussion among physicists whether or not super-luminal particles could exist

and what kind of paradoxes these things would generate if they actually existed. But none of those physicists seemed to be aware of the fact that philosophers had already begun an intense discussion about these problems in the fifties, and had isolated many of the same paradoxes which physicists rediscovered ten to twenty years later. One of the groundbreaking pioneers of this discussion was actually Sir Michael who initiated an ongoing debate in philosophy about backward causation (Dummett 1954, and again Dummett 1964). Much later, I myself contributed to this debate in my book *The reality of the future* (1989) in which I not only defend the conceptual possibility of backward causation but also attempt to analyze the physical conditions necessary for causal processes to go backwards in time. Also the Australian philosopher Huw Price has written extensively on backward causation (Price 1996). He and I have developed different views of what it physically takes for nature to have processes moving backwards in time. Even though both views cannot be true I think they both help us to understand the theoretical possibility of backward causation and why we see so little of it in our present universe.

If Davies had declared that no present-day philosopher can reflect intelligibly about time without knowing physics such as thermodynamics, quantum mechanics, and relativity theories, I think many philosophers of science would be quite open for such a declaration. This is also a view which Dummett endorses: "The scientific understanding of more general concepts yet, such as time, space, cause and matter itself, which are salient components of every thought, is not general currency; it was for this reason that I earlier laid such stress on the need for philosophers to know physics." (2007, 28; 2012, 22) Physics is, as Dummett stresses, a substantial part of metaphysics.

However, I take metaphysics to be a branch of philosophy even though physics is based on metaphysics. So I would prefer to put the matter slightly differently: Both physics and metaphysics contribute to the understanding of the nature of reality, both fields address the ontological issue of what exists, but physics inquires into it in one way, metaphysics in another. These two sorts of inquiry should indeed supplement each other, and if they are in conflict, it should force physicists and philosophers to get together and talk it over. This is the reason why metaphysicians should know physics (and other sciences as well), and why physicists should have a general knowledge of philosophy.

So I, for my part, want to add that the requirement of philosophers of knowing physics does not imply that physics provides all the answers which a philosopher of time believes are true. Rather it seems that some of the physicists' claims about the connections between time's arrow and various physical irreversible processes have been questioned by very competent philosophers of physics. What establishes the direction of time is not something physicists can determine by pointing to a particular physical theory because all fundamental laws are time-invariant. It depends on interpretations and arguments in support of these interpretations whether you think that boundary conditions are sufficient for grounding the direction of time. Similarly you can find different philosophical interpretations of the fact that different observers may see events, which are not causally connectable, having an inverse order in time within Minkowski

space-time. Again, one cannot just appeal to the special theory of relativity to prove that the static picture of time is true and therefore that there is no becoming and therefore that past, present, and future events exist on a par. A physicist qua physicist is not better equipped to discuss these metaphysical issues than a philosopher of physics; rather a metaphysician qua being a philosopher of physics seems to have excellent skills for giving the most profound and elaborated account of time due to the fact that such an account always goes far beyond our experience and is not testable at all.

4. The Distinction Between Science and Metaphysics

Before continuing I want to explain what I take to be the difference between the inquiries of physics and metaphysics. Physics presupposes metaphysics. Whatever scientistic opinion writers of popular science books might entertain, they cannot explain the metaphysical foundation of their own field by means of scientific methods. A particular metaphysical stance is always tacitly built into one's paradigm as Kuhn pointed out. Neither can they explain scientism as a scientific doctrine. Nor explain naturalism on which modern science and much philosophy rest. Nor any other -ism. One may criticize or defend naturalism but it will always be with arguments borrowed from philosophy. For instance, it is not enough to appeal to the cognitive success of this particular metaphysical position because how can we show by scientific inquires alone that success is an epistemic virtue to follow?

Physics deals with matter and fields in space and time. It sets up theories and models which help to infer hypotheses concerning the constituents and the structure of the world, and these hypotheses remain physical only as long as they can be tested by observation and experiments. The interaction between bold thinking and experience is the real essence of all empirical sciences. The astonishing success of the empirical sciences is due to the fact that speculative assumptions have been corrected incessantly in light of new experiences, and the natural sciences will continue to be successful only if they stick to this formula. So I shall say that a theory, or a model, is a *scientific* theory (or a *scientific* model), only if its predictions are in principle testable, only if they can be controlled by our experiences.

However, inquiries of metaphysics begin where those of science end. Metaphysics asks questions concerning the nature of the ultimate existent of reality whose answers are outside the range of science. The distinction between science and metaphysics is a separation made, not by language, but by conditions of epistemic access: between what we can and cannot empirically know. The sciences come to an end at the point at which hypotheses are empirically underdetermined. So long as science can put well-defined questions to nature, society, and human subjects and their outputs and, via sensory experience and scientific methods, is able to get well-defined answers in return, issues of what constitutes truth and falsity do not arise. But whenever the scientist is unable to elicit such answers from her material, she faces an instance of non-determination. Such situations are those where sensory experience and scientific methods are unable to determine the truth-value of alternative hypotheses. The individual hypothesis may

be empirically or intensionally adequate but not necessarily true.

There are several forms of empirical underdetermination. The crucial point is what it is that is underdetermined. One kind of underdetermination turns on ontology and we may call it:

> *Global underdetermination*: a hypothesis is globally underdetermined by the empirical data if there are two alternative worlds which ascribe differing truth-values to the hypothesis in question, but where the empirical data remain the same irrespective of which world is the actual world.

There are other forms of underdetermination in which it is the semantics that is empirically or intensionally underdetermined. One of these we might call:

> *Extensional underdetermination*: a hypothesis containing theoretical terms is rendered semantically underdetermined by the language in which the evidence is expressed if the vocabulary of this language is inadequate to fix the extension of the theoretical terms.

Finally, we have a third type of underdetermination. It turns on epistemology, or rather, on the circumstance that general hypotheses of what can be experienced by us are empirically underdetermined. This type we shall call:

> *Local underdetermination:* a hypothesis is locally underdetermined by the empirical data in a possible world if every finite set of data is inadequate to determine whether the hypothesis is true or false.

Every universal hypothesis is locally underdetermined by its data; it states more than there is a warrant for in experience, in the same way as induction *qua* method logically underdetermines its conclusion. We cannot on the basis of experience show that induction is a valid form of inference that yields true hypotheses. All inductively derived, universal claims are locally underdetermined.

The sciences yield hypotheses that may be extensionally underdetermined; metaphysics offers hypotheses that are globally underdetermined. Metaphysics pursues hypotheses which cannot be established as representative by our powers of perception and our methods. These are hypotheses about the interpretation of theories or facts where the question of the accuracy of the interpretation can never be established by reference to experimental hypotheses, sources or readings.

It happens that the sciences sometimes use divergent hypotheses to explain the same facts, hypotheses that are empirically equivalent. In such cases the truth-value of the individual hypothesis cannot be determined by empirical means since its extension is underdetermined relative to the researcher's data. We must distinguish, then, between two species of scientific hypothesis: between those that are empirically decidable and those that are not. The latter are empirically underdetermined with respect to their

respective extensions or, as we might say, are extensionally underdetermined. Atoms once belonged to our hypothetical conceptions, today they are ontological existents: the boundaries between the empirically decidable and the extensionally underdetermined have not been drawn once and for all. They are concomitant on technical and intellectual advances and on the data available to the scientist. Indubitably, there will be things-in-themselves that have so far gone undiscovered, and others still that will never come to light. To the extent to which they happen just not to be empirically accessible at present – and that irrespective of whether we speak of items in the natural world or those in the mind of another person – claims regarding them will qualify as hypotheses that lie within the purview of science. And once they have become accessible to the scientist in his practical work, such things become part of science.

But often the same theory will occasion more than one interpretation of its ontological content. It is when the scientist pursues such hypotheses in areas where they are not in principle empirically decidable that he crosses the line separating science from metaphysics. In so doing, he turns metaphysician.

These last statements also indicate where I may disagree with Dummett's view of the interpretation of physical theories. In his paper Sir Michael states: "Different interpretations of one of the same physical theory – quantum mechanics, for example – yield what are in fact different but, for the time being, empirically equivalent theories." I think we ought to make a distinction between a physical and a metaphysical interpretation of a theory. Every physical theory needs an interpretation. Physical theories themselves are different from what they are supposed to linguistically represent.[1] It is characteristic of them that they are expressed in terms of mathematics, which implies that the mathematical symbols must be assigned a physical meaning in order for these theories to be relevant for a physical description of some particular model. This form of interpretation is the proper physical reading. Another more global form of interpretation is the metaphysical construal of a theory. It attempts to understand what the basic formulas tell us about the world and whether we should be realist or antirealist with respect to the theory and entities in question.

In general, a physical interpretation operates by relating the mathematical symbols with already well-known physical terms based on representational conventions. The trained physicist therefore understands the use of the mathematical symbols in the context of a specific theory without being involved in any act of interpretation. This he does to the extent that the representational conventions are part of the physical practise and background knowledge as is the case as long as the theory is used within its standard repertoire of applications. But a new theory may introduce mathematical terms which have no counterparts in old theories. A nice example is Pauli's matrices. They stand for spin in quantum mechanics which is not identical with the classical angular momentum. Here one cannot rely on the classical convention in reaching an

1 Although I don't think that theories, like classical mechanics, general relativity, and quantum mechanics, are anything but linguistic rules

understanding of what the symbol stands for or what it means. Physicists must keep on interpreting the physical meaning until a common understanding of that expression crystallizes. Such a common understanding appears when its representational structure is determined with respect to the experimental practise and physical data.

The situation is quite different with respect to the metaphysical interpretation of a theory. All metaphysical interpretations are grossly underdetermined by data and will always be. Whereas a physical interpretation eventually becomes established as the shared understanding of a particular physical theory, a metaphysical interpretation is always debatable without further empirical findings. For instance, the standard physical interpretation of Schrödinger's wave function is that it represents a probability amplitude. This understanding of that mathematical symbol determines how it is used in the calculation of experimental results. Nevertheless, on top of the physical meaning of the wave function one may add a metaphysical interpretation by claiming that a reference to such a probability amplitude only makes sense if the symbol also stands for a real material field which somehow collapses during a measurement.

In philosophy of physics there is an ongoing metaphysical dispute about whether the standard theory of quantum mechanics should be interpreted realistically or non-realistically, and if interpreted realistically, what kind of realist ontology one might coherently extract from the mathematical formalism. The motivation for this debate is based on two insights. On the one hand, a literal mathematical interpretation identifies observables in physical reality with a mathematical model of operators. Such a model is the abstract Hilbert space. On the other hand, a literal physical reading takes the physical understanding of the theory at face value. This suggests a physical reality very different from the world of classical physics. It is a reality which consists of value-indefiniteness, superposition, entanglement, intrinsic probabilities, and measurement collapse. In both cases, it leaves us with an understanding of physical reality which is very unfamiliar. Therefore, many philosophers, regardless of their overall attitude to realism and non-realism, do not think of any of them as constituting a satisfactory metaphysical understanding.

However, Dummett seems to believe that different interpretations of the same physical theory give different but empirically equivalent theories. To me this claim seems to rest on a mistake. The metaphysical interpretation of a physical theory does not belong to the theory itself. Different metaphysical interpretations of quantum mechanics do not transform quantum mechanics into many, although empirically equivalent, theories. If these distinct interpretations were translatable into one another, you might have thought so, but the various interpretations of quantum mechanics are ontologically quite distinct. Just try to compare any version of the Copenhagen interpretation with a version of the many world interpretation and you will find it impossible to demonstrate that they are logically or semantically equivalent. I guess that Sir Michael will agree that the philosophical discussion of realism versus antirealism concerning scientific theories is perennial in the sense that no empirical discovery will be able to settle the discussion once and for all. In the end it is the realism-antirealism issue that drives various interpretations of quantum mechanics and furnishes them with different

metaphysical content.
Yet, what I have just said may not oppose what Dummett really intended. We have seen that J.S. Bell was able to establish a theorem which roughly says that no physical theory based on local hidden variables can reproduce all of the predictions of standard quantum mechanics. Later physicists have been able to show experimentally that in cases where the predictions diverge the outcome strongly supports the orthodox quantum mechanics. Is this not just an example in favour of Dummett's argument? Well, I think not. Local hidden variable theories are substantially different from the standard theory. These theories are not just other interpretations of the standard quantum mechanics alongside, say, the Copenhagen interpretation. The local hidden-variable theories were developed to meet Einstein's misgivings that quantum mechanics was not a complete theory. By this he meant that there was still a part of reality which the standard theory was unable to handle. Local hidden variable theories introduced deterministic variables which had no counterpart in quantum mechanics. The latter theory allows dynamic variables of a system in a singlet state to be entangled over huge distances; whereas the former theories require that the deterministic variable of one particle only can have an effect on the variables of the other particle in case a causal influence does not exceed the velocity of light.

The same holds for the relationship between Bohm's theory and standard quantum mechanics. Even though Bohm's theory apparently yields the same predictions as standard quantum mechanics, we are here facing two different theories, which are supposed to be empirically equivalent; these two theories are not merely different interpretations of one and the same theory. They are different theories because their mathematical structures are distinct. According to Bohm's theory, an atomic particle has a classical trajectory in real space and real time guided by a non-local quantum potential; something which is quite foreign to the standard theory.

The reason why I think it is important to make a distinction between physics and metaphysics has to do with the division of labour between physicists and philosophers of physics. Physics is basically an empirical discipline whereas philosophy isn't. It is clear, when it comes to quantum mechanics and its physical interpretation, that physicists are those people who eventually will discover that quantum mechanics, though being the most successful physical theory of today, is not a complete theory in the sense that there is a discrepancy between its predictions and experimental results. This is not something philosophers qua philosophers can decide. Even a philosopher cannot be expected to develop a new physical theory for a possible replacement of quantum mechanics because such a theory has to be in accordance with observation and experiments. But philosophers of physics can contribute to the metaphysics of quantum mechanics, point to some of the hilarious and baroque results of existing interpretations, making-up new interpretations, elaborate on determinism and indeterminism, and indicate logical flaws in the physicist's way of thinking about relation between theories, representations and interpretations. Moreover, philosophers can point to new forms of understanding which may help physicists to develop new physical ideas since they are trained to inquire into possibilities rather than actualities.

5. Physics Versus Philosophy

Now let me return to Hawking's attitude towards philosophy. Reading *The Grand Design* shows that it is just as much a book about philosophy of physics as it is a book about physics. It seems quite obvious that the authors draw heavily on discussions in modern philosophy without mentioning its central authors. The book raises questions about the nature of laws, the nature of reality, and the origin of the universe. These are all philosophical questions which modern philosophers of science have discussed over and over. So how can Hawking and his fellow author Mlodinow hold that philosophy is dead? It seems because they pretend to be ignorant about modern philosophy or because they believe that philosophical questions can be explained by science. I shall argue, however, that those questions cannot be explained satisfactorily by science, and even in terms of what Hawking and Mlodinow tell their reader, they are not doing science but philosophy. Therefore philosophers may sometimes be able to do metaphysics better than physicists.

Can philosophers say something about the universe which physicists and cosmologists cannot? Not in principle, of course. Metaphysical speculations are not reserved for philosophers. Much of what modern cosmologists do is nothing but metaphysics under the pretext of making physics. But this also means that philosophers can discuss these matters and contribute to a critical understanding of what physicists have to say. They may even actively contribute to the metaphysics of cosmos. This has to do with something which Dummett points to namely that "there are forms of philosophical enquiry that will never be absorbed by the sciences that have become extraneous to it." (Dummett 2007, 23; 2012, 17) What are these?

They could be transcendental inquiries. But one has to be careful not to overemphasize transcendental arguments since they are not as conclusive as one might think. What modern philosophy is good at is to show that specific answers to questions, which are empirically underdetermined, depend on alternative interpretations, and to find arguments in support of an inference to the best interpretation. This means that philosophers are trained to consider all metaphysical questions in a broader context where the argued answers depend not only on physical considerations or but also on general ontology, epistemology, and semantics.

What then do Hawking and Mlodinow say about laws of nature? They don't say anything which hasn't been said by philosophers over the years. They mention Hempel and Reichenbach's old example that all spheres of gold and uranium have a diameter less than 1 mile of which only the statement about uranium expresses a law. They do not credit these authors but John W. Carroll. So they grant that not all generalizations we observe can be thought of as laws of nature but claim that "most laws of nature exist as part of a larger, interconnected system of laws." This seems very much to fit into the Ramsey-Lewis account of laws. However, their expression "interconnected system of laws" is ambiguous. Do Hawking and Mlodinow think of a body of law statements or do they have in mind those structural entities that these statements are supposed to refer to? Needless to say there are many philosophical accounts of laws, and which one

of the many accounts is the most satisfactory one is not something physics can decide because these accounts are empirically underdetermined.

However, Hawking and Mlodinow continue by saying: "in modern science laws of nature are usually phrased in mathematics. They can be exact or approximate, *but they must have been observed to hold without exception* – if not universally, then at least under a stipulated set of conditions." (Hawking and Mlodinow 2010, 28, my italics) So they think that it is a necessary condition (for being physically acceptable) that laws of nature have been observed to hold. But this claim contradicts what they have said in the beginning of their book. Here they state: "We will describe how M-theory may offer answers to question of creation. According to M-theory, ours is not the only universe. Instead, M-theory predicts that a great many universes were created out of nothing. Their creation does not require the intervention of some supernatural being or god. Rather, these multiple universes *arise naturally from physical laws*. They are a prediction of science." (2010, 8, my italics) But if we grant them their criteria of physical acceptability, the physical laws they are here referring to have never been observed to hold; therefore multiple universes are not scientifically acceptable and their existence cannot be a prediction of science. Rather, as we shall see, the M-theory rests on a heavy metaphysical interpretation of quantum mechanics which has no empirical implications. In fact, what they take to be science is nothing but metaphysical speculations, even according to their own standards.

In their book Hawking and Mlodinow argue for a position they call model-dependent realism. It is neither realism nor antirealism. It is not realism since it does not assume the existence of an objective world whose properties are definite and independent of the observer who perceives them. Nor is it antirealism in the sense that it attempts to restrict science to what can be observed. Indeed, physics goes beyond what is directly observable. Realism cannot be defended, they say, because according to quantum mechanics a particle has only position or momentum when such a quantity is measured by an observer. This was exactly Niels Bohr's argument for his view of complementarity (Faye 1991). Bohr was an entity realist while at the same time a theory antirealist. In my book on Bohr I called this position objective anti-realism inspired by Dummett's work in philosophy of language.

Several philosophers of science have defended similar forms of theoretical pluralism before Hawking and Mlodinow by holding that "different theories can successfully describe the same phenomenon through disparate conceptual frameworks" (2010, 44). The most notable example is Ronald Giere (1999, 2006) who calls his view scientific perspectivism, and I have forwarded a similar view (Faye 2002); a view which I would call context-dependent realism. These different contributions all take a pragmatic stance on the scientific practise without avoiding realistic commitments. Nothing of what Hawking and Mlodinow write about theory and models and how these might represent reality comes as a surprise to philosophers of science.

However, there is a twist to their characterization of model-based realism: they hold that "if there are two models that both agree with observation ..., then one cannot

say that one is more real than another." (2010, 46). Perhaps this statement illustrates why they believe that there is no place for philosophical inquiries into which of the many empirically underdetermined models that represent reality. For instance, Bohr's interpretation of quantum mechanics states that it does not make sense to ask which way electrons take in a double-slit experiment, whereas according to the sum over histories-interpretation of Feynman's path integral "particles take every path, and they take them all *simultaneously*!" Indeed, these two models of quantum mechanics are mathematical and physical different, even though the predictions are the same. Hence one cannot say that one is more "real" than the other.

From a metaphysical point of view Bohr's interpretation is the most humble and pragmatic one, closest to everyday life experience. However, Hawking and Mlodinow prefer the most spectacular one. But what are the consequences? John Wheeler once considered a cosmic version of his delayed-choice experiment in which the path of photons from a quasar billions of light-years away is split into two by gravitational lensing. Now, if one attempts to get information about which path each single photon took, one will destroy the interference pattern, indicating that the photon only took one of the paths, but if one does not seek this information, each single photon seem to take both paths and thereby create an interference pattern. So Hawking and Mlodinow conclude: "The choice whether to take one or both paths in this case would have been made billions years ago, before the earth or perhaps even our sun was formed, and yet with our observation in the laboratory we will be affecting that choice." (2010, 83) In addition, they assert "Like a particle the universe doesn't have just a single history, but every possible history, each with its own probability; and our observations of its current state affect its past and determine the different histories of the universe, just as the observations of the particles in the double-slit experiment affect the particles' past." (*ibid.*)

Hawking and Mlodinow don't even pause to reflect on whether or not it makes sense to interpret the path integral as a sum of *actual* histories rather than mere *possible* histories, whether or not it is intelligible to claim that all these infinitely many actualized possible histories each have their own probability, and whether or not it is rational to say that quantum entanglement means that the present observation "causally" affects a past event. Here physicists might get a little help from their philosopher friends concerning truth, meaning and representation. No physicists' interpretation should indeed be accepted at face value but discussed and perhaps challenged by philosophers of physics.

6. The Metaphysics of Cosmos

One of the most fundamental questions in metaphysics is why there is something rather than nothing. The reflection behind that question is that the Universe, and everything in it, is contingent which means that it is accidental whether it exists or not. Traditionally, the question has been answered by an appeal to Leibniz's principle of sufficient reason. Nothing contingent can exist by itself; there must be a sufficient reason for its existence

which cannot be contingent, it must be something that exists by necessity. So the conclusion was that this necessary existence had to be God. But the soundness of the argument seems to have changed with modern science and the discovery of the expansion of the universe. Going back in time, physics tells us, we reach an earliest moment of the history of the Universe where the Universe came into existence. The episode is called the Big Bang, and ever since the Universe has evolved from being very condensed and very tiny to something which is far beyond our observational range.

Evolutionary ideas have been with us for a long time but it was not until the Enlightenment that these entered into the foreground of human mechanistic thinking. From geology and biology the ideas of evolution and naturalism as explanatory principles were taken to other fields of science, in particular to cosmology as the observation of the stars and galaxies began to accumulate. The detection of the red shift of star light by Vesto Slipher and the establishing of the Hubble law in 1929 gave the first hint about the evolution of the universe, and later the discovery of supernovas and stellar cycles in the 1930s supported that thought. But only after the Big Bang theory was strongly confirmed in 1960s and 70s – and the Steady State theory had fallen into oblivion – and after the rise of the standard model in the field theory of quantum mechanics, we see that the principles of evolution and naturalism are used as of what has happened in the universe since Big Bang took place 13.7 billion years ago. Here empirically based physics also stops in helping us to understand what happened before that time.

This limitation of physics gives rise to at least three metaphysical questions: 1) Did the universe come into existence by chance or was it created by a Divine Being? 2) Is the concept of a Divine Being in conflict with the concept of the evolution based on natural causes? 3) If these two concepts are in disagreement how then can we account for the fact that there is something rather than nothing? My answer to the first question is that the universe was neither created by chance nor by a Divine Being. The notion of God as a creator and supporter of the universe is indeed in conflict with naturalism, but physics cannot prove that God does not exist. However, I shall suggest to the third question that the Universe has always been here, although the present stage of the universe is around 13.7 billion years old, and that it will always be here. The Universe itself is not contingent; it does not have an origin but has a necessary existence.

I grant that I am a naturalist both in an ontological and an epistemic sense. I believe that everything that happens in nature is a result of nature's own causal powers, and that everything should and could be explained according to these powers. I even think that language, culture, and religion are parts of nature whose origin can be explained in terms of human intentions as these eventually appeared as a result of human evolution. Hence we must, by my philosophical lights, explain Big Bang as a result of nature's own forces. We need not God as an explanatory vehicle. This does not imply that naturalism as such excludes God from existing, only that such an omnipresent and omniscient Being cannot be omnipotent.

Some cosmologists, including Hawking and Mlodinow, claim that the Universe is created out of *nothing*. So instead of using God's omnipotence as their explanatory principle, they take the existence of nothing as their explanation of the universe. But

how can nothingness have explanatory power? It's like choosing between Scylla and Charybdis. Already Parmenides argued that nothing comes from nothing, *ex nihilo nihil fit*, and this metaphysical principle still holds. Hence philosophers could easily object to those physicists that this cannot be the case. Nothing explains only nothing.

In fact if you look into the physical notion of 'nothing' it is something. The term refers to the quantum vacuum field devoid of matter. So even if there was no stuff or radiation there would still be the zero-point energy according to the quantum field theory. The existence of a Big Bang would also be a violation of conservation of energy-momentum if this event really came from nothing. The claim is that the present universe arose from fluctuation of vacuum field and that zero-point energy feed the acclaimed inflation and the continuous expansion of space-time. There are cosmologists who associate Einstein's cosmological constant with this energy and thereby explain the expansion of the universe. However, an inflationary period in the past is just a possibility, a hypothesis, something we do not know yet. Perhaps there was a burst of inflation, and perhaps there wasn't one. Everything we have empirically discovered is compatible with inflation having taken place and also with it not having taken place. (See Earman and Mosterin 1999)

It is true that, in order to produce the actual universe, the conditions at the start must have been exceptional unique. The creators of the inflationary model thought that it would transform any initial conditions into a universe like this one. But we know now that that is not the case. Inflation needs its own initial conditions and most initial conditions (most potential curves of the inflaton field) would either not produce any inflation at all or produce the wrong type of inflation. So we exchange the very specific initial conditions of the classical big bang for equally specific conditions of inflation.

As the Spanish philosopher Jesus Mosterin remarks after having criticized the introduction of the cosmological constant: The cosmologists "are trying to understand the workings of the heavens by postulating fields and forms of matter and energy (the inflaton field of inflation, the cosmological constant, the new quintessence, the dark energy) not detectable on Earth, which play no role in real, standard, laboratory-testable particle physics. Unfortunately, the dream of unifying cosmology and particle physics has not yet come true." (Mosterin 2001, 175)

In contrast to inflationary model a different view is taken by Steinhardt and Turok, and by Baum and Frampton respectively. They have proposed different oscillatory cosmological models that seem to be possible, but also not implied by observations. I would say that the standard big bang model does not say anything about times earlier than (say) 10^{-30} s. Physicists lack any empirical data and their theories collapse and do not work any longer. Thus astronomical observation cannot distinguish between the various conjectures. The field is wide open to wild speculation and quite closed to disciplined testable thinking.

As a philosopher I believe for metaphysical reasons that the present stage of the universe is only one of many. The Universe is a metaphysically necessary entity. It is not contingent, as philosophers usually hold. The Universe is its own cause, sui generis, its own creative force, which at one moment manifested itself physically in a Big Bang. The present epoch with all stars and galaxies, and the stuff we cannot see, is a result of the Big Bang.

But as a metaphysical entity the Universe has under one form or another always been here and will continue to be here forever. It is merely as a physical entity, which we experience at present, that the universe is 13.7 billion years old. It is the current epoch that is contingent, but the University as such is a metaphysically necessary entity. If we philosophers can produce a compelling argument that proves such a claim, I think we could guide cosmologists in their search for the best explanation.

7. **Philosophy as Part of the Humanities**.

Philosophy is no longer a part of high culture as Dummett rightly maintains. Educated people know more about cosmology from reading popular science books (which often have been written by some brilliant physicist) than they know about analytic philosophy. Unfortunately, philosophers don't write similar books. Therefore they are not without responsibility for the disrespect which physicists as well as non-physicists might have against philosophy. One of my colleagues said to me the other day that he didn't think that there would be departments of philosophy fifty years from now. The reason behind this prophecy was the heavy specialisation that has happened in analytic philosophy after World War Two. Nobody outside philosophy can bear listening to the philosophical story anymore.

Today few analytic philosophers make contributions to more than one or two areas within philosophy whether it is epistemology, metaphysics, aesthetics, philosophy of science, philosophy of language, philosophy of mind, ethics, or political philosophy. For instance, one is not merely a philosopher of science but is either a philosopher of general methodology, physics, chemistry, biology, medicine, or the social sciences, and those disciplines can even be further subdivided. This is due to the huge amount of publications, which appears in every field each year, plus the facts that one has to know the particular scientific theories of those fields to become a philosopher of any of them. Hence, it becomes so easy to fall victim of specialization. I also believe that research policy plays a significant role in this development. Research educations in the form of writing a PhD-dissertation and the institutional demands of "publish or perish" jeopardize philosophy as a broader humanistic discipline providing insight and knowledge. Thereby analytic philosophy is put aside as a broad theoretical inquiry into the relationship between all aspect of nature and human life.

I agree with Sir Michael that something important is thereby lost from analytic philosophy. In the future much philosophy will be done within the particular discipline like physics, biology, economics, anthropology, history, and literary criticism. But the more technical and specialized every discipline becomes, the more we need philosophy to keep a critical focus on the natural sciences, the social sciences as well as the humanities. A philosopher should at the same time display special knowledge and general understanding. If philosophers keep cultivating both aspects of their competence by focusing their abilities on both analysis and synthesis, I believe that philosophy will continue to be alive and make new contributions to human understanding. It is Dummett's wish that "Philosophy may give birth to new disciplines which we cannot now imagine." This is my hope too. Nevertheless, it remains to be seen whether analytic

philosophers have guts to renew themselves and become creative and unconventional instead of staying conform to common ideas and traditions. Philosophy is the best guarantee for critical thinking. Putting well-established "truths" into their proper perspective is the only way by which we philosophers can gain respect from scientists as well as non-scientists. And writing popular philosophy books is the way to convince a broader audience that philosophy is not quite dead.

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Received: July 1, 2011
Accepted: May 28, 2012

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