The Unconscious Quantum

Metaphysics in Modern Physics and Cosmology

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Preface

Can it be that so many men, of various times and nations, outstanding minds among them, have devoted so much effort, and indeed fervor, to metaphysics, when this consists of nothing more than words strung together without sense?

Rudolph Carnap[1]

When an untitled manuscript of Aristotle was found following his treatise *Physics*, first century editors assigned it the title *Metaphysics.* Since then, this term has been associated with those studies that are believed to transcend the material world of physics, cutting to the core of a supposed ultimate reality that goes deeper than appearances.[2]

Most people take for granted that such a reality exists, that some kind of perfect world lies beyond the realm of imperfect matter. In religious terms, this world is heaven, or more generally the domain of the spirit. In Western philosophy, metaphysical reality is patterned after Plato's world of perfect "forms" from which our senses draw a distorted image of the true reality. Most mathematicians and scientists view their theorems and laws in Platonic terms, though few will admit it.

If a realm exists beyond matter, then how can we know about it? By definition, it is inaccessible to our senses, at least in any direct way. In religion, the world beyond is accessed by revelation or some other mystical channel that bypasses the senses. In ostensibly more rational discourses on metaphysics, the Platonic world is thought to be accessed by reasoning from fundamental insights that are themselves not directly amenable to the empirical testing methods of conventional science.

Since physics is concerned with the material world as it is presented to our senses and the scientific instruments that enhance the power of those senses, metaphysics is concerned with notions that transcend the senses and may not be constrained by physical law. On the assumption that mind is somehow separate from matter, metaphysics also can refer to studies of the relationship between mind and matter.

Finally, to the lay public, metaphysics is associated with psychical and occult ideas, as evidenced by the volumes that can be found on the shelves marked

"Metaphysics" in popular bookstores.

By the twentieth century, science had progressed to the point where it had become the dominant thought system, at least in Western, secular circles. Among philosophers, in the meantime, metaphysics had gradually fallen out of favor. The coffin of metaphysics seemed to be permanently sealed by the rapid developments in physics that occurred early in the century. Einstein's theory of relativity, and the quantum theory that followed on its heels, demonstrated that our most fundamental notions of space, time, and matter were intimately tied to the way in which we chose to make observations and do experiments.

Einstein showed that the observed tick rate on a clock depends on the motion of the clock relative to the observer, implying that time intervals are simply obtained by counting the clock ticks between events. Distance and mass were also found to be relative, to depend like time on the observer's frame of reference. In similar fashion, quantum mechanics demonstrated that observations at the microscopic scale could not be made without interfering, sometimes catastrophically, with the object being observed. For example, the position of an electron in an atom cannot be measured without destroying the atom. Philosophers asked: Does it even make sense to assume the existence of quantities that cannot be measured?

From the time of Galileo and Newton, science has been firmly grounded on observation and measurement. The empirical method was effectively promoted by eminent philosophers such as John Locke and David Hume. However, the new physics of the twentieth century encouraged some philosophers to go much farther. Members of a school of philosophy called **logical positivism**, centered in Vienna, came to the conclusion that the study of anything except the measurable was necessarily empty of content.

For the logical positivists, Einstein's demonstration of the relativity of time suggested the notion that perhaps all metaphysical discourses on the meaning of time were themselves meaningless. A similar conclusion was drawn for our concepts of space, matter, and energy. Physical properties now appeared to be nothing more than arbitrary human inventions.

The logical positivists did not claim that the concepts of time, space, and energy

were useless. Quite the contrary. Defined operationally by well-prescribed, repeatable measurement procedures, these quantities formed the framework upon which physics and the rest of science was constructed. Since these methods had more than proven their utility, it seemed that the instrumental definitions must be the correct ones and previous speculations about space, time, matter, and energy were based on muddled thinking that should now be tossed on the rubbish heap of outmoded ideas.

The logical positivists insisted that all our concepts rest ultimately on observation. To the extent that our speculations about ultimate reality rested on observation, they were not metaphysics but physics. To the extent that metaphysics did not rest on observation, it was meaningless. This left no room at all for metaphysics; it became a fruitless enterprise.

But humans have never hesitated from pursuing fruitless enterprises in the past, and metaphysics proved no exception. The logical positivists did not convince everyone - including themselves - that metaphysics was a waste of time, even if time was just a count of ticks on a clock. Furthermore, after developing the theory of general relativity in 1916, Einstein had discarded his original positivist position (if, indeed, he ever had one).

General relativity seemed to imply that space and time are not simply arbitrary human inventions but represent some aspect of a real, if invisible, backbone of the universe. Einstein showed that gravity could be re-interpreted in terms of an underlying, non-Euclidean curvature of spacetime. That curvature was not directly observable, but existed in abstract form within the elegant tensor equations of general relativity. Thus spacetime curvature seemed to possess a reality akin to Plato's forms, an underlying, invisible, perfect order that lay beyond the grubby data collected by scientific instruments.

Philosophers also found much to criticize in the more extreme conclusions of the logical positivists and the school soon fell out of favor, opening up metaphysics once more as a legitimate subject for philosophical discourse. More recently, an ironic twist of the tale has taken place that leads to the theme of this book.

As relativity evolved to a form compatible with the Platonic model of reality, the quantum revolution broke new metaphysical ground. Quantum mechanics was found

to produce apparent paradoxes when interpreted in terms of familiar, classical concepts. Quantum phenomena seemed to have the property that they cannot be fully described at one point in space without knowing about conditions that exist at the same instant at other points. A decision made at one place, such as orienting a particle detector in a certain direction, appears to affect what will be observed in another detector at another place. This can happen within a time interval too small for a signal to go between the two detectors without travelling faster than the speed of light, the limiting speed of objects according to Einstein.

So despite Einstein's retreat with general relativity, quantum mechanics provided continued support for a positivist, or instrumentalist, view that was taken to imply that physical properties do not have an objective reality independent of their observation. Since consciousness comes into the act of human observation at some point, many modern authors then suggested that quantum mechanics provides for the connection between the human mind and the universe that has been claimed for millennia by mystics East and West.

Quantum mechanics, as a mathematical theory, has proved to be of immense practical utility. But it has come to be recognized very slowly that this success was not to be regarded as any demonstration of the validity of the attempts that have been made to put words behind the mathematics, to provide what is called an **ontological interpretation.** Several interpretations are equally capable of yielding the same empirical results. Since none provides its own unique predictions, this can only mean that all the interpretations of quantum mechanics are equivalent - at least until someone shows us how to improve on one, or falsify the others.

If an interpretation were to be found that allows quantum effects to be described in familiar terms, it would be a preferable choice. This has happened before. In the nineteenth century, atoms were shown to underlie the thermodynamic behavior that had been established for macroscopic systems. The atomic model of matter was adopted as the fundamental underpinning of the macroscopic phenomena.

Thus it seems sensible to seek a comparable deterministic model to underlie quantum mechanics. Presumably this would be the simplest model, requiring the fewest new assumptions, and so would be accepted by the principle of parsimony. But

theoretical physics does not proceed in a vacuum; it requires experimental data, and in particular empirical anomalies, to guide the way.

After the better part of a century of experimentation with the most sensitive instruments ever built by humankind, no evidence for a sub-quantum world akin to the world of atoms has yet been found. Indeed, a sub-quantum world with the familiar properties of classical physics may even be incompatible with the data. As has been shown theoretically, and verified experimentally, any sub-quantum model will have to be capable of producing instantaneous effects over great distances, in apparent violation of Einstein's principle that nothing can move faster than light.

Although the metaphysical elements of the various interpretations of quantum mechanics imply quite different conclusions about the nature of physical reality, they have been muddled together in a new genre of popular literature I call **quantum metaphysics.** This book takes a detailed look at both quantum mechanics and quantum metaphysics in an attempt to find a parsimonious explanation for their apparent paradoxes and cosmic implications.

We will also review some of the other discoveries in modern physics and cosmology claimed to have metaphysical consequences. We will consider the *big bang* and the origin of the universe, to see if our very existence required a miraculous violation of the laws of physics. We will explore the so-called *anthropic coincidences* that seem to imply a special place for humankind in the universe.

Recent developments in *chaos theory* that have been stirred in with the quantum mixture to give yet another claimed basis for a great holistic "paradigm-shift" away from reductionist physics will also be examined. We will find that no such shift is in fact implied by chaos, but that the new sciences of complexity of which chaos is a part offer the means to understand the process of **emergence** by which highly-interacting material systems develop the properties we associate with life and mind.

Finally, we will discuss some of the arguments made by mathematician Roger Penrose that certain principles of mathematics and computer science lead us to return once again to a Platonic view of the universe. To some, "Penrose mysticism" suggests that perhaps the human mind can reach beyond sensory experience to the realm of true reality, to read the "mind of God." However, we will see that Penrose insists that he is

proposing new physics, not mysticism. This discussion will enable us again to examine the nature of human thinking and the meaning and role of consciousness in the cosmos.

Much of the literature of modern metaphysics, with important exceptions such as the books of Penrose, is written in "gee-whiz" fashion for a popular audience. That audience is duly impressed by the mysteries of the EPR paradox and Schrödinger's cat, and eager to believe the implications drawn that human consciousness holds the key to reality and their personal immortality. My task is much more difficult, if not impossible, since I am telling people things that many do not want to hear: that according to our best knowledge, the world of matter is all that exists.

Still, I feel it must be done. As science and critical thinking become increasingly watered down in our educational system, and opposing forces exploit the consequent public gullibility, the duty of every scientist is to speak out in protest. The anti-scientists who pursue a political agenda, and the pseudoscientists who pursue the dollar, need to be fought at every turn. Scientists cannot continue to ignore these issues. As I write this, major basic research projects are being cancelled or cut back, granting agencies are being told to do more applied work, and unscientific alternative medicine is creeping into health care systems. In some cases, such as "quantum healing," the public is being led to believe that science and mysticism are converging on a new "paradigm" in which matter and spirit, body and mind, are one.

I have attempted to write this book for the broadest possible audience without watering down my arguments to the gee-whiz level. I recognize that this audience is not likely to include everyone. Those who pick up this book will probably already be familiar, at least in general terms, with the popular and semi-popular literature on the new physics and metaphysics. Judging by the number of books and articles on the subject, I can safely assume that this group is still a large one.

The reader of this book does not have to be a physicist or philosopher, just someone who has an interest in the issues and is capable of following a chain of reasoning. While I present all the arguments from scratch, the going may be difficult for those hearing them for the first time. Terms that may be unfamiliar are indicated in boldface type where they are first definitively discussed, so the reader can refer back to that section as needed.

I have included some mathematical discussions for completeness. Clearly boxed off and using a *sans serif* font, these are designed for those with some background in physics who are then able to explore the subject in more precise detail. The difficulty of the material in these special sections varies from rather simple freshman-level physics to an occasional graduate-level discussion. However, the main text does not depend on the mathematical sections, and the latter can be skipped without losing the thread.

I believe this book fits into, but hardly begins to fill, a niche that is currently almost empty. I know of no other work that addresses the metaphysical claims of the new physics from a relatively detailed critical perspective. While some fine popular books written by prominent physicists can be found that are critical of various aspects of the new metaphysics, these discussions usually amount to little more than flippant dismissal. None of these books probe very deeply into the questions raised by the much larger collection of credulous volumes. Many of the latter have been written by physicists and other scientists and so require a scientist response. I hope other scientists and philosophers will join me in providing the reading public with a more balanced view of the significance of developments in twentieth century physics and cosmology.

Notes

1. Carnap 1931.

2. For a history of metaphysics as applied specifically to physics, see Trusted 1991.