

Dear Tim Maudlin:

I admire your efforts to expand the discipline of physics to include issues about the foundations of physics. In your April interview by Ashar Kahn this year, and in your book, *Quantum Theory*, you separate the problems in quantum physics from philosophical problems about realism. You want to ban Bohr's Copenhagen "interpretation" of quantum mechanics from physics, along with all talk of interpretations, as epistemological attitudes one might take about quantum mechanics. Quantum mechanics is a physical theory, and though there are problems with it, you insist that the issues are ontological. They are about the entities to which its laws correspond in the natural world where they are confirmed. I agree that the right track is turning to ontology. But I want to suggest that quantum physics will still fail to solve its problems unless it corrects a deeper epistemological attitude.

The method of physics assumes that well-confirmed mathematically formulated laws of physics are the deepest possible empirical knowledge of the natural world, and you expect the problems of quantum physics to be solved by discovering what corresponds to laws that are well confirmed by careful measurements. You see the laws as describing regularities about how entities move and interact. But you still see the goal as discovering what corresponds to the laws of quantum physics, so you seem to be suggesting that the problems of quantum physics can be solved by recognizing that its goal is basically ontological.

Though I agree that the goal of physics is basically ontological and that one obstacle to solving the problems is confusing this goal with epistemological issues about interpretations of laws in philosophy, there is a deeper foundational issue, and it is an epistemological issue in philosophy that physicists need to

address. Philosophers have long assumed that mathematics is known with certainty because it is known by a faculty of rational intuition, independently of what perception finds in the natural world. You confess to sharing that attitude when you admit that you are a Platonist about mathematics. And when physicists use mathematics as a language for describing regularities about change, they take it for granted that the truth of mathematics is known independently of perception. But it is possible that mathematics is true because it corresponds to a basic aspect of the natural world, and settling that epistemological issue could be the key to solving quantum puzzles because if mathematics is true by correspondence, knowing what it describes could constrain what corresponds to quantum laws in a way that could reveal what they describe.

Physics cannot explain mathematical truth by correspondence to the natural world because it assumes, in practice, that mathematics is known a priori. But since physicists are naturalists, there is a way for the empirical to discover how mathematics corresponds to the natural world. Naturalists assume that objects in the natural world exist independently of one another, and instead of assuming that laws of physics are the deepest possible empirical knowledge about the natural world, they could assume that the natural world is constituted by substances. That is what the pre-Socratic philosophers concluded in their search for what they called the first cause.

In the end, the pre-Socratics understood substances as self-subsistent entities with definite ways of existing in themselves that endure through time. Since substances cause what is found in the natural world by constituting it, their self-subsistence explains the existence of what is found, while their ways of existing can explain the kinds of things found. The pre-Socratics believed that substances interact, so they assumed, in effect, that their intrinsic

properties included powers by which they can act on one another. Thus, their interactions could explain regularities about change found in the natural world. Since ontology is defined as the study of existence, it is fitting to call substances ontological causes.

The pre-Socratics could not agree on the kinds of substances that constitute the natural world. But contemporary ontological naturalists are in a different position because among the things they find in the world are the mathematically formulated laws of physics. If they inferred the basic kinds of substances constituting the natural world as the best way to explain the truth of mathematics by its correspondence to the natural world, that would explain what Wigner called the “unreasonable effectiveness” of mathematics in discovering laws of physics. And they could hope to find a solution to the problems of modern physics by discovering more specific powers of those substances as the best explanation of the regularities described by laws of physics.

There are kinds of substances that can explain the “unreasonable effectiveness” of mathematics in physics. This is not recognized because substances are usually assumed to be material. But space could be a substance, and the natural world could be constituted by bits of matter coinciding and interacting with parts of space. The essential natures of space and matter could explain why mathematics corresponds to the natural world. Space has an intrinsic geometrical structure as it exists independently of matter, so it explains why Euclidean geometry corresponds to the natural world. Arithmetic can be explained by rules for counting things with a distinct existence, including units of space and time, so if matter has an intrinsic quantity (measurable by units) as it exists independently of space, all the properties of what is found in the natural world would be quantitative. That is, bits of matter coinciding with parts of space would have definite quantities, and

assuming that species of bits of matter are defined by the (spatio-temporal) geometrical structures of their correspondence with parts of space, all regularities about change generated by the interactions of space and matter would necessarily be quantitative.

If that is why mathematics is so “unreasonably effective” in discovering laws of nature, it is possible that space and matter have more specific powers that enable their interactions to generate the regularities described by laws of physics. Discovering those powers would not only confirm this ontological explanation of the truth of mathematics, but also solve the problems of modern physics. Since our ordinary way of understanding the natural world includes geometry and counting, there would be nothing puzzling about what corresponds to the laws of physics, and that is the goal.

What is more, this way of reducing physics to ontology could expose the basic cause of intractable problems in quantum physics. Though physicists can use mathematics as a language for describing regularities about change because they are all quantitative, the way that they use mathematics could hide some regularities from physics. Space acts on matter by giving bits of matter spatial relations, and its role as the container of matter is represented by the use of coordinate systems to describe how they move and interact. But if space and matter inter-act, bits of matter can also act on space in ways that affect other ways that space acts on matter, and their omission could be what causes problems in modern physics. Those roles of space in helping matter generate regularities about change cannot be described by equations that use coordinate systems to describe how bits of matter move and interact. For example, some ways that space acts on bits of matter besides giving them spatial relations could be the long-suspected hidden variable that explains the

probabilistic character of quantum laws as just an appearance. It could not, in principle, be described by a mathematically formulated law of physics.

I predict that the discovery that space is a substance that interacts with matter will solve the problems of modern physics, and I defend that prediction in some quantitative detail in the first volume of a trilogy called *Naturalistic Reason* that I am self-publishing as I send you this message. It describes interactions of space and matter, called ontological mechanisms, that generate the regularities described by laws of physics. I leave some quantitative details to be filled in, and they may need to be corrected in minor ways. But since regularities of all kinds described by laws of physics are explained by ontological mechanisms, I am confident that this way of broadening the foundations of physics ontologically will solve the problems of modern physics. Besides reducing quantum laws to ontology, the first volume describes ontological mechanisms that generate the regularities described by Einstein's special and general theories of relativity. They show how the belief in spacetime and curved spacetime is caused by the use of transformation equations to describe the undetectability of absolute motion and gravitation. They describe regularities indirectly, and in both cases, they are blind to a role that space plays in generating the regularity.

All these ontological mechanisms are ways that the same two opposite substances interact always and everywhere, and since they explain the laws of both quantum and gravitational physics, they will overcome the mathematical disparity between quantum and gravitational physics. That is why the first volume of *Naturalistic Reason* is named the *Unification of Physics*. It implies, by the way, that there is a way of measuring absolute velocity.

I should mention that Naturalistic Reason includes much more. The second volume, the Unification of Science, shows how the reduction of physics to spatio-materialism reveals a kind of efficient cause, not recognized by physics, called geometrical causes, and shows how specialized sciences use it to explain the regularities they study completely enough to discover that evolution brings beings like us into existence on suitable planets throughout the universe. The third volume, the Unification of Science and Philosophy, shows how consciousness can be part of a world constituted by matter and space, and it shows how ontological scientists will use an illusion inherent in consciousness to trace the origin of ontological science to an exchange of metaphysical arguments in Western civilization that causes a distinct stage in the evolution of life and turns science into naturalistic reason.

All these predictions are justified in enough detail to cause the scientific revolution that they predict. But they all depend on the reduction of physics to ontology, and though you also see ontology as the foundation of physics, you will be skeptical about its foundation being as deep as the discovery that space and matter are substances that interact with one another because it is hard to believe that powers of space and matter can be found that enable their interactions to explain the laws of quantum physics. But that is what the first volume describes in some quantitative detail. Since you will wonder about anyone who asks you to consider such an unlikely prediction, let me say something about myself and its origin. I have been working on this argument, pretty much on my own, for over 45 years, while teaching philosophy at American University for 30 years and since retiring from teaching over 20 years ago. As a philosopher, I have written this argument with a care that justifies expecting it to stand up under such scrutiny, and I am prepared to defend it on all fronts. My reason for writing you and a few others is to make what I have discovered

public. I am about to turn 83, and I believe that it is my duty to tell others about my discoveries because my society has given me the leisure and privilege to enjoy a life spent in such an exceedingly meaningful way.

But even those who take arguments seriously will find the prospect of reading a detailed all-inclusive explanation of the natural world in three volumes daunting. So, I am offering an easier way of learning more about it. An executive summary of the entire argument is presented in a short (150 page) book titled *Sapere Aude* that I am also self-publishing now. It has three parts, and since the first chapter of each part is about physics, you will find what you need in it. I am including a free Amazon link to an eBook version of it. (See below.) And there is more information about this argument at natReason.com, including an introduction to the trilogy, a Table of Contents for it, a bookstore, and more information about me. I would be happy to answer any questions you may have and very grateful to learn about any problems that you think may cast doubt on it. You can reach me personally at philliphscibner@yahoo.com.