

Dear Max Tegmark:

In several *Closer to Truth* interviews, you have defended the view that the world is just mathematics. That can sound preposterous. But you distinguish between mathematics as the structure described by mathematics and mathematics as the language used to describe it, and since you don't deny that mathematics can be used to describe other possible worlds, you admit that our world is just one of many possible mathematical structures. Though you insist that it is especially symmetrical and elegant, as shown by the laws that physics has discovered, your point must be that numbers describe all the properties of every possible world.

I believe that you are basically correct—and that it will be confirmed. You are intent on denying that the world is something non-mathematical whose properties are merely described by mathematics. But when you say that the world is a particular mathematical structure, you are saying that it is something more than mathematics because it exists and other possible mathematical structures do not. A particular mathematical structure is what physics discovers. Now, existence is something non-mathematical, so all you need to defend your view is a theory about the nature of existence, and it was discovered in ancient Greece.

The cause of existence is what pre-Socratic philosophers discovered in their search for what they called the *first cause*, that is, a single cause of everything found in the natural world. They concluded that the first cause is all the substances constituting the natural world, where *substances* were understood 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. Such substances are fittingly called *ontological causes*, since *ontology* is defined as the study of existence. If you are willing to admit that existence depends on being constituted by substances, then you can defend your view about mathematics and lead physicists to make a discovery that solves all the seemingly intractable problems of modern physics.

What you say about the world being a mathematical structure would be true, if it were constituted by space and matter as two opposite substances enduring through time. This goes unrecognized because substances have usually been 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. Their essential natures 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 must 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. That is how you can defend your claim that the world

is just a mathematical structure. All properties would be numbers.

Your claim about the world being just a mathematical structure is plausible because it explains what Eugene Wigner called the “unreasonable effectiveness” of mathematics in discovering laws of physics. And your alliance with the pre-Socratics could solve the problems of modern physics. Since regularities are generated by interactions of substances, scientists could infer more specific powers of space and matter that enable their interactions to generate the regularities described by laws of physics. The discovery of 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, we could understand what corresponds to the laws of physics, and that is its goal as a branch of science.

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, its role as the container of matter is represented by the use of coordinate systems to describe who 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 call the ontological mechanism that explains the laws of quantum physics the *inertial system*, and in the ontological explanation of Einstein's law of gravitation, the inertial system is just part of an all-encompassing ontological mechanism called the *gravitational system*. But to play its role, the inertial system must explain the regularity described by Einstein's special theory of relativity (by following H. A. Lorentz and using deformations of material bodies caused by their motion relative to space to explain the undetectability of absolute velocity). Since the Lorentz transformation is described mathematically by the equation that Minkowski used to construct his spacetime diagram, this shows how points in a 4-D Riemannian manifold correspond to interactions of space and matter as they endure through time. The gist of the ontological explanation Einstein's general theory of relativity is that curved spacetime corresponds to the acceleration of the inertial system (and all the matter interacting with space in it) in a Newtonian gravitational field (because points in the gravitational field are moving relative to the inertial system and suffering Lorentz deformations).

Ontological mechanisms for laws of physics of all kinds are presented in some quantitative detail in the *Unification of Physics*, the first volume of a trilogy, called *Naturalistic Reason*, that I am self-publishing as I send you this message. The ontological reduction of gravitational physics shows that the non-locality of quantum entanglement evident in Bell Inequality experiments can be explained by how space interacts with bits of matter everywhere in the universe at once. This reduction of quantum physics to ontology includes an explanation of all the particles

described in the Standard Model, and though I have not tried to understand the mathematics of string theory, I would not be surprised if this ontological mechanism corresponds in some interesting ways to equations used in string theory. In any case, this reduction of physics to ontology will overcome the most pressing problem of theoretical physics, the mathematical disparity between quantum and gravitational physics, because all the regularities described by those laws are generated by interactions of the same two substances everywhere in the universe. And by the way, it implies that there is a way of measuring absolute velocity, which may be possible in few years with a space-based LIGO.

No one, to my knowledge, has tried to explain the laws of physics in this way. But since it is an empirical confirmation of your seemingly preposterous theory, I hope you will take this ontological explanation of how the natural world is just mathematics seriously. But I should mention that it is just part of what follows from the discovery that space is a substance that interacts with matter. The second volume of *Naturalistic Reason*, 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 you will naturally doubt that anyone could have found powers of space and matter that enable their interactions to explain the laws of modern physics. That is, however, what I believe I have found, and since you will wonder about anyone who makes such an unlikely claim, 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. But I am confident that the discovery that space is a substance that interacts with matter will eventually solve the seemingly intractable problems of modern physics and cause the scientific revolution I predict, 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](http://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 [phillipscribner@yahoo.com](mailto:phillipscribner@yahoo.com).