

The actual interplay between science and religion has been shown to be much more complex, spanning the full spectrum from discord to concord depending on, among other factors, the specific theological and philosophical beliefs framing the discussion. A number of key scientific developments, like the idea of the Big Bang, are grounded in religious imagery and concepts. Moreover a number of scientists, Newton, Einstein, and Planck among them – the latter being one of the most influential physicists of the twentieth century as well as the originator of the quantum theory, which along with Einstein's theory of relativity, is a cornerstone of modern physics – were deeply spiritual in their outlook. In his 1937 lecture "Religion and Naturwissenschaft," Planck held that God (though not necessarily a personal God) is everywhere present, and "the holiness of the unintelligible Godhead is conveyed by the holiness of symbols."¹² Many of today's scientists who oppose religion dismiss this particular aspect of these scientists' character as idiosyncratic in spite of the fact that this perspective shaped their scientific outlook and inspired their science. And while contemporary myth holds that Kepler's mathematical laws governing planetary motion excludes the notion of an involved deity, neither Kepler nor Newton interpreted it as such. As noted by science writer and commentator M Wertheim:

Kepler saw the world as the material embodiment of mathematical forms present within God before the act of creation. "Why waste words?" he wrote, "Geometry existed before the Creation, is co-eternal with the mind of God . . . geometry provided God with a model for the Creation." Thus, "where matter is, there is geometry." Because he believed that the world was a reflection of God, who was a perfect being, according to Kepler it must necessarily be a perfect world, and therefore the manifestation of sublime geometric principles. "It is absolutely necessary that the work of such a perfect creator should be of the greatest beauty."¹³

And indeed, mathematics or more precisely, mathematics that contains inherent symmetries – not only physical symmetries of the kind we see in the construction of the Taj Mahal or in a snowflake, but

also more abstract forms of symmetries – appears to have within it the power to take seemingly disparate physical phenomena, distill them down to their essence and bind them all into an ever-growing fold of unity. The laws that govern the natural world at the most fundamental level are not just a haphazard collection of rules; rather, they all appear to flow from a single unifying principle, and the fundamental particles that comprise matter, ordinary or otherwise, emerge “naturally as nearly ideal embodiments of the intricate, abstract symmetry principles”¹⁴ within the mathematical forms of the theories of fundamental interactions.

This “order and harmony” in nature has been (and continues to be) a source of both enthrallment and considerable mystification among physical scientists, especially theorists. Why nature has a mathematical character to it is something that we simply do not understand. In Einstein’s words: “The most incomprehensible thing about the Universe is that it is comprehensible.”¹⁵ Yet, we accept it as an article of faith, and this faith has served us well over the years. There are countless examples in the annals of physics where the search for beauty, elegance, and symmetry within the mathematical forms of the physical laws has led to discoveries of new phenomena and new forms of matter. Still, it is an article of faith. Eugene Wigner, physicist and Nobel laureate, in writing about the “unreasonable effectiveness of mathematics in natural sciences,” concluded that

The miracle of the appropriateness of the language of mathematics for the formulation of laws of physics is a wonderful gift, which we neither understand nor deserve. We should be grateful for it and hope that it will remain valid in future research and that it will extend, for better or worse, to our pleasure, even though perhaps to our bafflement, to wide branches of learning.¹⁶

And for many physicists – myself included – this and other similar aspects of our work inherently imply that the physical Universe is not merely a human construct, nor are our theories merely ways of relating groups of measurements. Rather, there exists an inherent order and harmony underlying the physical Universe and this is seen as indicat-

ing the existence of something “real” that transcends the physical. Our physical theories represent human efforts to glimpse at this reality, always approximate and always limited but improving with every successive refinement. And it would appear that the expressive language of this reality – in so far as the physical world is concerned – is mathematics: Referring to this power of mathematics, Einstein – in a lecture at the University of Oxford – said:

I am convinced that we can discover by means of purely mathematical constructions . . . the key to understanding of natural phenomena. Experience may suggest the appropriate mathematical concepts, but they most certainly cannot be deduced from it . . . The creative principle lies in mathematics. In a sense, therefore, I hold it true that pure thought can grasp reality, as the ancients dreamed.¹⁷

It was to the process of uncovering these fundamental harmonies in nature that Einstein, when asked why he did what he did, responded “I’m not interested in this or that phenomenon, in the spectrum of this or that element. I want to know [God’s] thoughts; the rest are details.”¹⁸ Of course, I should make clear that this power of mathematics is at present most powerfully manifest on the most fundamental stratum of the physical world. As phenomena become more and more complex, the power of our current mathematics fades. However, acknowledging the present-day limitations does not in any way take away from the question of why mathematics works in the very first place. And in fact, the very aesthetic of beauty – in the form of symmetry, for example – still continues to inform research in theoretical physics today. The holy grail of modern physics is to discover the single unifying principle that contains within it, in the form of symmetries for example, the full gamut of physical phenomena that animate the Universe – multiplicity emerging out of Unity as it reflects within itself. I can’t help but be struck by the parallels in poetic symbolism of this thought with those of Muslim mystics over the ages.

