A Perspective on Wigner's "Unreasonable Effectiveness of Mathematics"

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Introduction

Many people have weighed in on the topic of Wigner's "Unreasonable Effectiveness of Mathematics in the Natural Sciences" [7], notably Hilary Putnam [5] and Richard Hamming [2]. However, none of their arguments have left the domain of academic philosophy and so were never accepted (or even heard about) by most mathematicians and physicists. What I propose instead is the invocation of a philosophical system outside of academic philosophy that I believe will shed some light on this, and other, quandaries. The system of metaphysics I will invoke is the "Metaphysics of Quality". It was introduced by Robert M. Pirsig, in nascent form, in his book *Zen and the Art of Motorcycle Maintenance* [3] and then more fully conceived, expanded upon, and applied in *Lila* [4].

Zen and the Art of Motorcycle Maintenance captured the imagination of the public when it was first published in 1974 and has become generally acknowledged as one of the most widely read philosophy books ever written. In it Pirsig tells the story of how he arrived at the concept he calls Quality, embedded in an autobiographical journey "in search of himself" on a motorcycle with his son, Chris, and interwoven with various meditations on related topics. Through his experience of teaching rhetoric at a college in Bozeman, Montana, he relates how the concept of Quality first came to him. Exploration of its consequences led to his pursuing (unsuccessfully) a Ph.D. at the University of Chicago and his eventual "nervous breakdown" and committal to a psychiatric hospital, where he was treated with electrical shock therapy.

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A Short Summary of Pirsig's Work and Ideas

Pirsig discusses his breakdown experience more fully in his second book, *Lila*, in which he explains that his exploration of Quality actually led to his arrival at a state of enlightenment, which was misinterpreted as a mental breakdown. In his first book, he equates his idea of Quality with the ancient *Tao* of eastern philosophy, the *arête* of Greek philosophy, and finally he equates Quality with the *dharma* of Hindu philosophy in his second book. Along with this, and a critique of anthropology, he fleshes out his understanding of Quality by creating a Metaphysics of Quality and using it, after expanding on insights in his first book, to solve many well-known but outstanding metaphysical quandaries.

The Metaphysics of Quality is, in some limited sense, as follows. He had in his first book realized (and made the case) that Quality is an undefinable entity that is the precursor of subjects and objects; everyone knows what it is but no one can define it. He proceeds to understand that subjects and objects are only one dual pair of defined things into which the undefined Quality event gets split as it is "realized"—that is, made real through a necessarily incomplete attempt to define it. He pursues the split into another pair, this time of complementary ways of understanding (or aspects of) the universe, which he terms "classic" and "romantic". These terms may be understood with the example of two different ways of valuing a car: a classical value might keep the car's engine perfectly tuned but not care about how it looks, whereas a romantic value might keep the car looking perfect but not worry about whether it runs well. He uses this split to explore, in some depth, the "evils" of technology.

In his second book, however, he is led to a different split into what he calls "static" and "dynamic" aspects of reality as the best split possible, the most useful. He actually terms them *static quality* (or value) and *Dynamic Quality*, and with them he builds his Metaphysics of Quality, a metaphysical framework that provides a different, and, he demonstrates, better way of understanding the world we live in. Dynamic Quality is the undefined Quality that was described in his first book, but now he introduces static patterns of quality alongside it to reflect the "realization" of that undefined Quality which makes up our world. They act like a ratchet: the Dynamic Quality is the constant stimulus to move to something "better", to ratchet *up*, but the static quality is the latch of the ratchet itself, the making tangible of the motion up into something concrete which will prevent falling *down* into something "worse". Dynamic Quality is the creative urge, whereas static quality, or patterns of static quality, is what is created in response.

In building his Metaphysics of Quality, Pirsig classifies patterns of static quality into four discrete yet interrelated levels: Inorganic, Biological, Social, and Intellectual. He describes the relationship between these levels as being analogous to the relationship of computer hardware to computer software—the software is run on the hardware, but has nothing, really, to do with it. The program that you run on your computer and write your article with has nothing to do with the computer hardware itself. Furthermore, the content of your article has nothing to do with the program you write it in. In this way the levels of static quality are related to each other: Biological is built on Inorganic, Social is built on Biological, and Intellectual is built on Social, but each level is independent of the other.

Using this idea, Pirsig makes the case that Darwinian evolution is just Dynamic Quality at work by understanding "survival of the fittest" as meaning the movement of static quality (survival) towards Dynamic Quality (fittest). Then the four levels of static quality are levels of evolution. Further, Pirsig makes the case that Quality is morality, and as such the four levels are a hierarchy of morals. "It is more moral for an idea to kill a society than for a society to kill an idea" is an expression of this concept between Social (society) and Intellectual (idea) levels of evolution. But morality, as we commonly think of it, is a static pattern of morals. The Metaphysics of Quality tells us that there is also, above all the static patterns of morals, a Dynamic Morality (Quality) that cannot be defined. There is a tension between the two, as exemplified by the example of a religion as contrasted to a saint. A religion is a static pattern of values, of morality, whereas a saint follows a higher morality, Quality, that cannot be pinned down by dogma. To summarize this, Pirsig quotes the adage: "Nothing disturbs a bishop quite so much as the presence of a saint in the parish" [4, p. 377].

With this breakdown, Pirsig immediately solves three long-standing philosophical puzzles. First, the idea of "value", which is another word for Quality, seen as being the precursor of everything, is confusing and unclear—"value" to one atom choosing to bond to another to form a stable molecule is different from the "value" an animal sees in a mate, which is different from the "values" that form a nation, which is different from the "value" that one proof of a theorem has that makes it better than another. But with the levels of evolution, values are clarified. They all refer to *static patterns* of value: a static Inorganic pattern of value in the case of the molecule, a static Biological pattern of value in the case of the animal, a static Social pattern of value in the case of the nation, and a static Intellectual pattern of value in the case of the proof. Second, he solves the classical mind-matter dilemma: what is the relationship between the patterns of mind and patterns of matter if the world is composed only of these? The solution, from the perspective of the Metaphysics of Quality, is simple. The first two of the levels of static quality, the Inorganic and Biological, constitute "matter", and the other two, Social and Intellectual, constitute "mind". Since the former two are composed of "substance" and the latter two are not, they may be called "objects" and "subjects", which are eternally separate in a subject-object metaphysics. In fact, Matter is really only thought of as being static Inorganic patterns, and Mind is really only thought of as being static Intellectual patterns. What the Metaphysics of Quality adds is a way of relating them, namely as two ends of an evolutionary continuum, connected by static Biological and Social patterns of value. Thus they are completely separate, but yet related, and the paradox vanishes. Third, Pirsig resolves the "free will versus determinism" controversy by simply noting that, within the Metaphysics of Quality, behavior is determined to the extent that it is controlled by static patterns of quality, and free to the extent that Dynamic Quality is followed.

Pirsig then goes on to apply his Metaphysics of Quality to some unexplained curiosities in the world and comes up with some remarkable clarifications as to the meaning of events in the twentieth century. He also critiques western philosophy as a whole but connects his Metaphysics of Quality with the work on pragmatism and radical empiricism of William James by adding Quality as the primal *empirical* reality from which all subjects and objects spring. Pirsig illustrates this empirical reality using the metaphor of sitting on a hot stove. First there is an awareness that something is not good, and then the intellectual awareness follows that the stove is hot and that we are getting burned. Pirsig speaks of this as the "preintellectual awareness" that we all have of Quality, the primary empirical

reality, in this case the low quality of being on a hot stove. He makes the point that this phenomenon is around us all the time and explains that there is always a small gap of time between our first awareness of anything (awareness of Quality) and our intellectual conception of it (into subjects and objects). Thus, he says, Quality may be thought of as the source of all subjects and objects.

He ends his second book by connecting Quality with the deepest roots of eastern philosophy and religion, seeing that they are one and the same thing. Finally, he explores insanity and how it relates to static intellectual and social patterns of value, as well as to mysticism, by noting that both insanity and mysticism are instances in which a person has taken leave of the static intellectual patterns of quality that compose his or her culture. The insane person, Pirsig explains, has gone into a world composed of static intellectual patterns of quality that only he or she knows about, whereas the mystic has left all static intellectual patterns behind in favor of being only with pure Dynamic Quality.

Applying the Metaphysics of Quality to Some Questions Surrounding Mathematics and Physics

Our goal here is to apply these ideas to some quandaries surrounding mathematics, in particular to get an understanding of Wigner's observation that mathematics is "unreasonably" effective in describing phenomena in the natural sciences. First, mathematics, in the language of the Metaphysics of Quality, is a static pattern of intellectual values. Mathematics is built up from definitions or axioms and their logical consequences. Definitions can be reinterpreted as "static patterns of intellectual value", and the logical consequences of these definitions are just "static intellectual patterns that value the definitions/axioms". The reason, Pirsig explains, is that implication or causality can be rephrased in terms of value by saying that *A causes B* is the same as *B values* the precondition *A*. Pirsig talks about Poincaré, who also held that even the axioms of mathematics are only definitions, but definitions guided by what he called the "subliminal self", something similar to Pirsig's "preintellectual awareness". Poincaré noted that a mathematician does not just explore any combination of the definitions he works with or create new definitions in any mechanical way; there are too many such possibilities. Rather, the subliminal self is what guides mathematicians to solutions on the basis of "mathematical beauty". About this mathematical beauty, he famously said, "This is a true aesthetic feeling which all mathematicians know… but of which the profane are so ignorant as often to be tempted to smile" [3, p. 261]. Poincaré was criticized for this view, his ideas being called "conventionalism". His critics thought that it implied that mathematics was then based on nothing but the whims of mathematicians doing "whatever they like" with nothing solid to back it up. But "whatever you like" is only dubious in a subject-object metaphysical system. If the metaphysics is changed to include Quality, then "what you like" is merely following Quality, the progenitor of reality.

But this is the link between mathematics and science that Wigner intuited, and why mathematics is so unreasonably effective at describing it. When Poincaré spoke of "our choice among all possible conventions being guided by experimental facts" [3, p. 257], he meant that mathematics (in his case the axioms of geometry) are a *model* for science and nature. And since nature is simply *inorganic* and *biological* patterns of value that follow Dynamic Quality, it is not surprising that mathematics, a static *intellectual* pattern of quality that also follows Dynamic Quality, should arrive at the same conclusions. That is the reason that mathematics that is done in isolation ends up explaining nature so well—both are patterns of static quality created by following Dynamic Quality!

The key word in Wigner's thesis is "unreasonable"; he actually hit on the solution to the problem in the title of his article. Since Dynamic Quality cannot be defined, it is by definition (so to speak) unreasonable. But that is the reason that any explanation of Wigner's observation requires an expanded metaphysics. In our tacitly assumed subject-object metaphysics, as Pirsig makes clear, anything "unreasonable" is discarded, and so the effectiveness of mathematics in describing the natural world is an insoluble quandary. Once an "unreasonable" entity, Quality is seen as the root or precursor to all subjects and objects, the quandary fades.

That mathematics follows Quality has been claimed in many different ways by many different people, especially working mathematicians. One of the best such expressions was made by the famous Princeton mathematician Goro Shimura. Discussing his famous Taniyama-Shimura conjecture, part of whose proof led to the solution of Fermat's Last Theorem, Shimura said,

> I have this philosophy of goodness. Mathematics should contain goodness…. It's a rather crude philosophy but one can always take it as a starting point…. I might say that the conjecture stemmed from that philosophy of goodness. Most mathematicians do mathematics from an aesthetic point of view and that philosophy of goodness comes from my aesthetic viewpoint. [6, p. 210]

A "crude philosophy" perhaps because he knows what the "goodness" his mathematics follows is but cannot define it, making it imprecise and certainly

unreasonable. However, with the Metaphysics of Quality, what Shimura was trying to explain may now be made more precise—the "goodness" that was his starting point is not some abstract idea, but Quality, reality itself.

The Metaphysics of Quality also explains something else long debated in mathematics: whether it is an art or a science. Art is the realization of Dynamic Quality in a given medium—that is, Art is following Dynamic Quality, and the pattern of static quality which is a "work of art" is left in its wake, in whatever medium the artist chose. In this sense, mathematics, especially pure mathematics, is an art, as it is the realization of Dynamic Quality in the medium of mathematical definitions and their logical consequences. Wigner, in fact, began his article with one of the famous quotes describing this, by Bertrand Russell:

> Mathematics, rightly viewed, possesses not only truth, but supreme beauty—a beauty cold and austere, like that of sculpture, without appeal to any part of our weaker nature, without the gorgeous trappings of painting or music, yet sublimely pure, and capable of a stern perfection such as only the greatest art can show. The true spirit of delight, the exaltation, the sense of being more than Man, which is the touchstone of the highest excellence, is to be found in mathematics as surely as in poetry. [7]

But mathematics is also a science. It is commonly classified as such, being in the science faculty of most universities. More to the point, though, it is also generally seen as similar to empirical sciences in that it involves an objective, careful, and systematic study of an area of knowledge. It is, however, different because it verifies its knowledge using a priori rather than empirical methods. But, within the Metaphysics of Quality, its methods are totally empirical. In fact, it may be argued that from this perspective, it is even *more* empirical than the other sciences. Mathematics is following empirical reality (Quality) directly, whereas other sciences are one step removed from empirical reality (Quality): they follow nature, which, in turn, follows Quality. Thus mathematics is really both an art and a science and, in fact, can act as something of a bridge between the two.

The Metaphysics of Quality also easily solves another long-standing dilemma among mathematicians regarding the nature of their subject: the "is mathematics invented or discovered?" debate. The solution to this debate is reminiscent of the Metaphysics of Quality's resolution of the "free will versus determinism" debate referred to above. Mathematics is invented insofar as it is a process of following Dynamic Quality—that is, insofar as it is "free". It is discovered insofar as it is a process of fleshing out previously unknown consequences within the static patterns of quality that are mathematics as it stands. Most Ph.D. theses and much published mathematics are more of this latter type—original work, that is, new consequences of existing static patterns, but not in the sense of following only Dynamic Quality. In fact, one might say that any new development comes as a mixture of both types of originality; it lies on a continuum between purely static quality at one end and purely Dynamic Quality at the other. The most "creative" and "original" mathematics obviously sits toward the Dynamic Quality end of the spectrum.

Finally, turning to Wigner's own natural science of physics, we apply the Metaphysics of Quality to the recent "free will theorem" of John H. Conway and Simon Kochen. This theorem "…asserts, roughly, that if indeed we humans have free will, then elementary particles already have their own small share of this valuable commodity" [1]. As was mentioned above, Pirsig showed that free will in humans is simply the ability to follow Dynamic Quality, whereas determinism is simply the degree to which our actions are molded by static patterns of value. However, within the Metaphysics of Quality, this also applies to elementary particles: Their "will" is free to the extent they follow Dynamic Quality as well, and their actions are determined by how much they follow static patterns of value. The only difference is that humans have four levels of static patterns (Inorganic, Biological, Social, and Intellectual) to be free from, whereas elementary particles have only one (Inorganic). As the four levels are built one upon another, and in fact evolved from each other, the Inorganic level is far older and thus, we may infer, far more "stable" in terms of Dynamic Quality than any of the higher levels. That is, we may think of the movement toward Dynamic Quality as a limiting process that never reaches Quality but gets closer the longer the process continues. It is in this sense that Inorganic patterns of quality are more "stable" than those of higher levels. So the free will versus determinism, Dynamic Quality versus static quality, debate is more apparent in humans than elementary particles as the higher levels of evolution are less stable. What Conway and Kochen have confirmed is that elementary particles do, in fact, have this debate. The Metaphysics of Quality gives a framework within which to understand why.

The assertion that elementary particles have free will and follow Quality very closely leads to some startling consequences. For instance, the wave-particle duality paradox, in particular the baffling results of the famous double slit experiment, may now be reconsidered. In that experiment, first conducted by Thomas Young at the beginning of the nineteenth century, a point light source

illuminated a thin plate with two adjacent parallel slits in it. The light passing through the slits was projected on a screen behind the plate, and a pattern of bright and dark bands on the screen was observed. It was precisely the interference pattern caused by the diffraction patterns of waves passing through adjacent holes in an obstruction. However, when the same experiment was carried out much later, only this time with photons being shot at the screen one at a time—the same interference pattern resulted! But the Metaphysics of Quality can offer an explanation: the photons each follow Quality in their actions, and so either individually or en masse (i.e., from a light source) will do the same thing, that is, create the same interference pattern on the screen.

Conclusion

The Metaphysics of Quality presented by Robert M. Pirsig is a powerful extension of the subject-object metaphysics that is currently assumed by our culture. With it he offers an understanding of a number of pressing philosophical quandaries, including the mind-matter paradox and the free will versus determinism debate. We used it to offer an understanding of several quandaries surrounding mathematics and physics. In particular, Wigner's "unreasonable effectiveness of mathematics in the natural sciences" was looked at, as well as the "is mathematics invented or discovered?" debate, the question of whether mathematics is an art or a science, and finally the "free will theorem" of Conway and Kochen, along with a resolution of the long-standing wave-particle duality paradox. Many other long-standing quandaries and paradoxes may also benefit from having the Metaphysics of Quality applied to them.

The goal of this article, apart from offering a new perspective on several questions on the cusp between mathematics, physics, and philosophy, is to introduce the Metaphysics of Quality into academic discourse. The hope is that this will provide an expanded arena in which mathematics, physics, and really all science is done and allow many outstanding quandaries to be better understood in all areas—illustrated here with a resolution of the wave-particle duality paradox. It is also my hope that the introduction of the Metaphysics of Quality will allow research in science to flourish in many directions previously unavailable due to metaphysical barriers—directions intuited by scientists but unrealized for lack of a comprehensive framework, as Goro Shimura's intuition above illustrates. Further, I hope that the breakdown of barriers brought by the introduction of the Metaphysics of Quality will allow a dialogue to be opened with disciplines such as art, religion, philosophy, psychology (possible connections to these are alluded to by Pirsig and in this article), and many others in the arts and humanities and beyond and with which a common framework for understanding in the Metaphysics of Quality can now be applied.

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