Jason Wilson

Article

Integration of Faith and Mathematics from the Perspectives of Truth, Beauty, and Goodness

Jason Wilson

How should the enterprise of mathematics-faith integration be classified? In his essay, "The Matter of Mathematics," Russell Howell groups contemporary mathematics-faith integration into five categories: foundational, worldview, ethical, attitudinal, and pranalogical. In this article, an alternative approach is proposed using Alister McGrath's scheme of truth, beauty, and goodness. While Howell's categories are somewhat mutually exclusive, truth, beauty, and goodness are viewed as different perspectives of the same mathematical phenomena. In addition, throughout this article, the faith-learning integration scheme of John Coe is applied to the subject matter. Coe asserts that there are conceptual, methodological, and teleological dimensions to all faith-learning integration. The complementary approaches are intended to enrich the project of mathematics-faith integration, and help apply it not only to the head but also to the heart. The perspectives and dimensions described may be viewed as providing mathematics educators with ways to go beyond the usual secularized mathematical content and connect it with the Creator and the students' relationship with him.

> *The fear of the* L*ORD* *is the beginning of knowledge;*
> *Fools despise wisdom and instruction.* (Proverbs 1:7[1])

> *Now God gave Solomon wisdom and very great discernment and breadth of mind, like the sand that is on the seashore. Solomon's wisdom surpassed the wisdom of all the sons of the east and all the wisdom of Egypt. For he was wiser than all men, than Ethan the Ezrahite, Heman, Calcol and Darda, the sons of Mahol; and his fame was known in all the surrounding nations. He also spoke 3,000 proverbs, and his songs were 1,005. He spoke of trees, from the cedar that is in Lebanon even to the hyssop that grows on the wall; he spoke also of animals and birds and creeping things and fish. Men came from all peoples to hear the wisdom of Solomon, from all the kings of the earth who had heard of his wisdom.* (1 Kings 4:29–34)

The attainment of wisdom attributed to Solomon occurred under the Old Covenant. How much more then should we be able to grasp the wisdom of God, which is Christ himself (1 Corinthians 1:24, 30), since we have the "mind of Christ" in the New Covenant (1 Corinthians 2:16)? I believe that the kind and manner of insight divinely given to Solomon is available to us today in Christ, and that it is not limited to the ethics, hymn-making, and biology of 1 Kings 4:29–34. Rather, in this article, let us consider the possibility that it is available for multi-faceted discernment in all knowledge, including the teaching and research of mathematics and the sciences.

Jason Wilson *is an associate professor of mathematics at Biola University. He loves discipling students and doing statistical research. Jason's research interests include high-dimensional genomics data, mathematics-faith integration, statistical apologetics, and baseball statistics.*

The occasion of this article is a response to the broad and thought-provoking lead essay, "The Matter of Mathematics" by Russell Howell.[2] To structure his essay, Howell employed Arthur Holmes's four categories of faith-learning integration: foundational, worldview, ethical, and attitudinal. To these he added a new category: pranalogy (= practical analogy). Within each of these five categories, Howell discussed many of the major contemporary areas of mathematics-faith integration in an attempt to provide a foundation for advancing the scholarly Christian thought in this area. This article seeks to make three contributions to this advance: (1) develop an alternative, but complementary, categorization of the entire mathematics-faith integration enterprise, (2) develop and illustrate three different dimensions of viewing the enterprise, and (3) offer a novel subcategory within Howell's pranalogy.

In a bold appeal to the theological community, theologian Alistair McGrath brilliantly calls the church to recast our natural theology.[3] He argues that the classical view of natural theology was almost exclusively focused on the cognitive-rational-ontological part of life, to the exclusion of the affective (emotions) and enactive (practical outworking). As such, he proposes an intentional re-envisioning of natural theology around the three classical themes of the *Platonic triad*: truth, beauty, and goodness, which correspond to the cognitive, affective, and enactive aspects of life, respectively. After reflecting on McGrath's work, this author has been challenged to see that his conception of mathematics-faith integration has largely been subject to the same narrow focus on the cognitive that McGrath warns against. How fitting is mathematician Howell's timely essay that guides mathematics-faith integration forward in this direction.[4]

In an independent line of inquiry, a different way of viewing faith-learning integration is provided by John Coe, Director of the Institute for Spiritual Formation at Biola University. Coe describes three dimensions of faith-learning integration in education: conceptual, methodological, and teleological.[5] The *conceptual* dimension is the harmonization of the subject matter content with the Christian worldview. In the *methodological* dimension, students bring their disciplines before the Lord in prayer and ask him to teach them in it, using such questions as "Lord, what does this truth prompt in my heart?" and "Is my attitude about this area right before You?" The *teleological* dimension asks the Lord, "How does this apply to my life?" and "What should I do as a result of this teaching?"

The conceptual dimension is the primary kind of mathematics-faith integration that has been done by Christian mathematicians. In fact, the conceptual dimension has been so strongly emphasized that Howell provocatively opens his essay with Emil Brunner's statement that "it is meaningless to speak of a *Christian Mathematics*." The quote implies not only that are there no methodological and teleological dimensions to mathematics-faith integration, but also that the conceptual dimension of mathematics is so untainted by sin that there is no distinction between what would otherwise be a secular vs. a Christian mathematics. Similar to McGrath's enlarging the faith-learning enterprise by considering the additional perspectives of beauty and goodness, Coe enlarges the faith-learning enterprise by considering the additional dimensions of methodological and teleological.

The primary thrust of this article lies in expanding the discussion of the categories for approaching the mathematics-faith integration enterprise. In addition to advancing scholarship, the expanded categories can be useful for teaching. The first contribution intended with this article is to provide an alternative way to classify mathematics-faith integration by using McGrath's categories of truth, beauty, and goodness. While not stated as such, Howell's categories appear to be intended as a somewhat mutually exclusive classification. By contrast, McGrath's categories comprise three different perspectives on the one reality of mathematics. Howell's five categories are still considered useful, and the alternative approach explored in this article should be viewed as complementary. The three perspectives form the titles of the three main sections of this article. By viewing mathematical phenomena from different perspectives, students are able to obtain a more well-rounded view of mathematics-faith integration. In particular, the beauty and goodness perspectives legitimize inquiry in fresh directions as well as providing connections with other disciplines.

The second contribution intended with this article is to provide three different dimensions of integration by applying Coe's dimensions. The rationale behind the two less-discussed dimensions, methodological and teleological, is similar to that behind Howell's invention of his fifth category of "pranalogy," a "practical application of an analogy gleaned from one's discipline or life experience."[5] That is, there is much truth in mathematics, but what ought one do with it, spiritually speaking? Exploring answers to this question has proven to be a fruitful source of motivation in the author's classroom. Methodological and teleological integration will be modeled in each of the three main sections through scripture quotations, discussion of quotations from student papers who practiced it,[6] and occasional reflection prompts. The first prompt offers the following suggestions both for personal use with this article and for future use with students: (1) pause to reflect on the section, waiting on the Lord; (2) consider the student's response in the quotation; and (3) ask The Teacher if he has anything for you at that point (1 John 2:27).

The third contribution intended with this article is the proposal of a novel biblical type of a mathematical phenomenon, which may be classified as a Howellian pranalogy. It is given in Section 2.2 Images of Divine Things. The other examples of mathematics-faith integration throughout this article are less detailed. They are crafted primarily to illustrate the mode of approaching the entire enterprise of mathematics-faith integration from the three perspectives of truth, beauty, and goodness, and the three dimensions of conceptual, methodological, and teleological.

1. Truth

> *Buy truth, and do not sell it,*
> *Get wisdom and instruction and understanding.*
> (Proverbs 23:23)

This verse highlights the well-worn path of those who think about mathematics-faith integration today. Section 1 Foundations and section 2 Worldview of Howell's article intersected this area, comprising about one-half of his material, on the topics of logic, ontology, and chance. Howell's book, *Mathematics through the Eyes of Faith,*[7] co-edited with James Bradley, provides accessible quality coverage of additional mathematics-faith integration questions on truth in chapters entitled "Infinity," "Dimension," "Chance," "Proof and Truth," and "Ontology." Since truth is the most widely covered perspective of mathematics-faith integration, this section is limited to one remark on one truth topic from Howell's article. It is included as a full section in order to provide an illustration of truth as a perspective in relationship to the beauty and goodness perspectives later.

Howell succinctly summarized Gödel's mathematical incompleteness theorems, which state that no consistent axiomatic system can demonstrate its own consistency.[8] Call this *mathematical incompleteness*. In other words, mathematical incompleteness finds consistent axiomatic systems that require information from the outside to determine whether they are true.

Consider another form of incompleteness:

> Christian theology provides an ontological foundation which confirms and consolidates otherwise fleeting, fragmentary glimpses of a greater reality, gained from the exploration of nature without an attending theoretical framework. A traditional natural theology can be thought of as drawing aside a veil briefly, partially, and tantalizingly, eliciting an awareness of potential insight, and creating a longing to be able to grasp and possess whatever is being intimated.[9]

Call this *natural theology incompleteness*. In other words, natural theology incompleteness finds internally consistent systems of natural theology that require outside information to determine whether they are true.

Could an analogy be made from mathematical incompleteness to natural theology incompleteness? It could be along these lines: *As formal mathematical systems require outside information to determine whether they are true, so differing natural theologies require outside information/revelation to determine if they are true*.

Gödel made the mathematical argument rigorous. Could theologians utilize an analogy of this sort to gain further insight into the general vs. special revelation issue by leveraging the mathematical insights?

It is generally held that many mathematical axiomatic systems are true, for example, the Zermelo-Fraenkel axioms of choice, Euclidian geometry (local scale), and the Kolmogorov's axioms of probability. However, Gödel demonstrated that they cannot be *proved* true within the system itself. The manner of escaping the mathematical incompleteness trap to arrive at the truthfulness of mathematics was discussed in Howell's section 1.2 Ontology and section 2 Worldview Issues.[10] The former was in a discussion of the competing philosophies of mathematics. The latter was in the subsection Unreasonable Effectiveness? in which the remarkable fit between the abstract world of mathematics and the real world is discussed. This provides our first contrast between Howell's five categories and McGrath's three perspectives. Here two different categories were referenced in response to one question. By contrast, the question about these concepts arises from the perspective of truth (Is a particular axiomatic system true? Does a particular mathematical concept "fit" the real world?). The concepts are further elucidated from the perspective of beauty (To what degree are the properties of competing axiomatic systems beautiful and what is their meaning? What are the implications of the unreasonable effectiveness of mathematics?). The concepts are yet further elaborated from the perspective of goodness (What is the axiomatic system good for? How can the mathematical concept be used to help humankind?).

Let us now shift to Coe's categories. Up to this point, the dimension of this section has been conceptual. The following two quotations are from student papers: the first response depicts the methodological dimension; the second, the teleological dimension.

> I have always been taught that physics, not mathematics, is the natural law that defines what we observe in nature. Though mathematics is a crucial element of physics, it was interesting to consider the field as distinct from the laws of physics … Here the author establishes a solid argument for the link between divine nature and created order. Our God has made a covenant, a binding contract, with the nature that he himself created. In so doing, God reveals his glory to us and receives the praise for the intricate work of his hands. Mathematical equations that have been developed by humankind reveal the divine nature of God to humans in natural law, thus proving that God has intricately designed them.

Methodological integration is seen in the student's gaining a vision of the "link between divine nature and created order" and seeing God's glory.

> This section is reminiscent of the *Centuries* by Thomas Traherne in describing the gift and worship that is called upon by the glories of the cosmos. A particularly relevant aspect of this participation in the plan of God is the explicitly glorious nature of "nature" itself, not for itself, but in its expression. With the informed position that nature may teach of God and that it is made by his wisdom, participation in the divine nature changes the very way we engage with and perceive life as well as encouraging us to call upon the divine, as the cosmos itself is an orchestration of God's purpose.[11]

Teleological integration is seen in that the student is prompted to make connections with readings in other courses, and then pray ("call upon the divine").

2. Beauty

> *[Wisdom] will place on your head a garland of grace;*
> *She will present you with a crown of beauty.*
> (Proverbs 4:9)

Mathematics contains numerous beautiful phenomena. This has been known by mathematicians for thousands of years, but to this day it is still largely unknown by the public at large. As history has progressed, the power of mathematics has become more widely known, and math occupies an authoritative place in curricula from kindergarten through college. Nevertheless, the power and authority of mathematics are often viewed as lifeless, being felt by people more as a bully than as a ballet dancer. The author has been embroiled in conversations similar to the following countless times:

> "What do you do?"
> "I teach mathematics."
> "Oh. [Memory of pain appears on face]
> The farthest I ever got was …"

It is culturally acceptable to put mathematics in a separate box from the rest of learning and be bad at it, or not like it. This attitude ought not to be! Would a wider public awareness of the beauty perspective of mathematics help?

The beauty of mathematics, and of scientific theories that are expressed in the language of mathematics, is well known throughout the mathematical community, as Howell describes in the subsection Aesthetics.[12] For many, it is even a guiding principle: when confronted with two possible choices, whether results, expressions, proofs, and so forth, people will invariably choose the more beautiful, if possible. Only when the more beautiful option is definitively shown to be incorrect or otherwise inferior will they move to the less beautiful. But what is beauty in mathematics? It is elegance, awe-strikingness, symmetry, power, simplicity, generality, complexity, profundity. Beauty is a nonessential characteristic of mathematics that so regularly characterizes it. But why? What is it doing there?

In 2004, James Bradley founding editor of the *Journal of Christians in the Mathematical Sciences (JACMS),* wrote in his inaugural letter fourteen questions the community needed to address. Question 10 asks,

> Mathematicians frequently state that one of their principal motivations for their work is that they find mathematics of great beauty. What is the concept of aesthetics being used here? How does it compare and contrast with aesthetic concepts in the visual arts and other fields? Christian thinkers have often emphasized the beauty of God. Is there a relationship between these concepts of beauty? If so, what is it?[13]

Trolling through *JACMS* archives reveals references to the relationship between the beauty of mathematics and God, such as mathematical beauty inspiring worship of God, but they do not provide detailed elaboration. The chapter "Beauty" in *Mathematics through the Eyes of Faith*, edited by Bradley and Howell, has perhaps the most extensive Christian discussion of the beautiful mathematical content, including quotes on the relationship by Nicholas Wolterstorff, C. S. Lewis, and Abraham Kuyper. Nevertheless, the actual relationship between mathematical beauty and God is not elaborated beyond the following most explicit quote, "… beauty derives from the beauty of God and that our sense of beauty may derive from our being made in the image of God."[14] As such, the beauty within mathematics is a reflection of the nature of God and, as such, can and should be viewed as a window through which to give the awe/worship to its proper source, which is God.[15] Howell calls for more work in this area.[16] The first subsection below offers an approach to explaining what the beauty means. The second subsection is a lengthy exposition on a theological approach to aesthetics, or interpreting the beauty of God, which may be construed as a Howellian pranalogy.

2.1 Beautiful Mathematics

> *It is the glory of God to conceal a matter;*
> *But the glory of kings is to search out a matter.*
> (Proverbs 25:2)

Given any [Euclidian] triangle ABC, is it not amazing that the median of each side intersects at a single point called the centroid? And the perpendicular bisectors of each side intersect at a single point called the circumcenter? And the altitudes of each side intersect at a single point called the orthocenter? And these three centers lie on a single line called the Euler line? And on the Euler line, the distance from the orthocenter to the centroid is always twice the distance from the centroid to the circumcenter? This is stunning because one could conceive of a triangle whose medians (or perpendicular bisectors or altitudes) did not connect at a single point. And even if the three centers were all points, it is surprising that these points would always have such a simple and elegant relationship.[17] The successive combination of so many phenomena, each amazing on its own, presents to the soul a profound sense of awe not unlike the scene of an exquisite waterfall on a magnificent mountainside amidst a gorgeous forest. Any one of these beautiful scenes would amaze, but a superlative effect emerges when they combine. Their united exponential beauty is further enhanced by the absence of the contrary, for example, if the forest were brown, or if the altitudes failed to converge at a point.

Consider another illustration. How is it that π is not merely the ratio of the circumference of a circle to its diameter, but also is the sum of the innocuous looking Leibniz infinite series

$$\pi = 4(1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \frac{1}{9} - \cdots)$$

and the area under this curve

$$\pi = \int_{-1}^{1} \frac{1}{\sqrt{1-x^2}}\,dx$$

and Vieta's irrational product

$$\frac{2}{\pi} = \frac{\sqrt{2}}{2} \cdot \frac{\sqrt{2+\sqrt{2}}}{2} \cdot \frac{\sqrt{2+\sqrt{2+\sqrt{2}}}}{2} \cdot \ldots$$

and part of the exact scaling constant needed for the famous bell-shaped curve density function

$$f(x) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

and part of Euler's fundamental equation

$$e^{i\pi} + 1 = 0$$

and many, many more diverse phenomena?[18] The extent to which π penetrates mathematics and the sciences is mind-blowing and widely known, yet without a good explanation. What does it mean? Surely it reveals an underlying connectedness and order within the universe, which begs the question of its origin.[19] From a Christian worldview, the origin is aptly understood to be God.

Or why does the Fibonacci sequence describe not only certain population growths (honeybees), but also plant taxonomy (phyllotaxis), music (number of rhythms with one- and two-beat notes), the golden ratio, the golden spiral (galactic spirals), and so on? This is not a random, but a parsimonious, multifaceted, ubiquitous pattern. It is parsimonious because such classes of phenomena are easily envisioned with different, even random, sequences. It is multifaceted and ubiquitous because the complete pattern occurs throughout diverse abstract and real-world realms. Such phenomena are very pleasant, and even fun, to discover and to behold. They again point to a profound order.

Going deeper than triangles and constants and sequences, there is another profound beauty. Why do those phenomena in the world match abstract equations? Why does mathematics "fit" the world so well? See Howell's discussion, particularly the interaction between Wigner and Hamming.[20] While Hamming's naturalistic approach has some explanatory power, it falls short and is devoid of life. The "fit" is beautiful because it resonates with the soul upon viewing it the right way. To those without understanding, it is a mystery that invites them on a quest.[21] To the Christian, it is a corollary of the doctrine of the *Imago Dei*, humankind created in the image of God.

Again, the "fit" is beautiful because it yields an ennobling power: enabling humankind not only to meet their need, but also to serve, explore, and expand through such means as science, engineering, and technology. Without the sublime correspondence between the abstract and concrete realms—if the mathematics "did not work"—none of these outcomes would be possible. Again, this belief finds theological support within the Christian worldview in the creation mandate of Genesis 1:26. It became one of the fundamental assumptions that led to the scientific revolution of the seventeenth century.[22]

The abstract realm is beautiful and mysterious. It has an allure that draws the mathematician in, spurring him or her to make even more discoveries. What can be done to make such beautiful phenomena more visible and appreciated by nonmathematicians? And again, why are these connections there? What do they mean? Many Christians would agree with general propositions such as "God put them there" and "The beauty and order reflect God's nature as in Romans 1:20."[23] These answer, why? but not, what does it mean? Theologically, an answer was discussed: this means that the world is profoundly ordered, that there is a God, that humankind is created to perceive mathematical beauty, and that the world was intentionally created with the abstract-concrete "fit" to benefit humankind.

In the preceding, we have attempted to elaborate on some of the ways in which mathematics is beautiful, and used the following words or phrases: amazing, stunning, surprising, simple, elegant, profound, sense of awe, superlative, exponential, infinite, mind-blowing, parsimonious, multifaceted, ubiquitous, pleasant, fun, ordered, resonating, inviting, mysterious, ennobling, and sublime. While they properly refer to mathematics, each may also be applied, in some sense, to God. Such beautiful phenomena, and the questions they elicit, are not only a treasure, but also a treasure map leading to the Ultimate Treasure.[24]

2.2 Images of Divine Things

> *One thing I have asked from the Lord, that I shall seek:*
> *That I may dwell in the house of the Lord all the days of my life,*
> *To behold the beauty of the Lord*
> *And to meditate in His temple*. (Psalm 27:4)

In section 5 Pranalogical Issues, Howell introduces his fifth category of pranalogy (=practical analogy). He cites the different infinities and mathematical paradoxes as fabulous examples of mathematical phenomena which are known to be true, and by analogy make theological phenomena more understandable or believable.[25] From the perspectives of truth, beauty, and goodness, pranalogies might be perceived in each one.

But what if, instead of our using the intellect to draw parallels between known earthly things to unknown spiritual things, we go in the reverse? That is, we "see" that God has placed in the world signs (types) which were intended to reveal divine things (antitypes). This is called typology. The study of the typology in the Bible is biblical typology. An example would be marriage. According to Paul, marriage was created by God to teach humankind about the mystery of Christ and the church (Ephesians 5:32). This is to be contrasted with the analogy approach the author had always held, namely, that Paul cleverly seized upon this deep and multidimensional part of the world to teach about Christ and the church. William Wainwright gives a particularly lucid discussion of this issue.[26] Of course, there is a fundamental question for analogies: at what point do they break down (because they depend upon human creativity)? For a type, however, there is a related fundamental question: is it real (because it depends on divine creation)?

Jonathan Edwards, the great Puritan preacher of the First Great Awakening, a founding father of Evangelicalism, and called the "most brilliant of all American theologians," discusses this issue.[27] Augustine believed that "God has left traces of the divine identity, character, and nature in the created order, in addition to the explicit, ostensive acts of revelation, culminating in Jesus Christ" and that "these *signa naturalia* are clearly distinct from the *signa data* of divine revelation."[28] Augustine also believed that "God has provided us with a richly textured and signed world which we may enjoy, while at the same time allowing it to denote and signify its original creator and its ultimate goal."[29] In addition to Augustine, an entire Christian tradition viewed the world typologically:

> The Syriac tradition regarded the typology found in Scripture as a particular manifestation of the nature of things. Types, symbols, and mysteries are at the core of Creation itself. The Syriac world view affirms that the world was created by the Word of God and thus is revelatory by nature. It further claims that the Incarnation is the summit of Creation, and was prepared for throughout history. Therefore, the typology found in nature and in Scripture is not just an interpretive tool, but is of the very essence of things.[30]

What follows is part of an answer to the aesthetics question, "What does [this particular beautiful mathematical phenomenon] mean?" It is the suggestion that there could be typological significance in mathematical phenomena. This may be construed as a subcategory of Howellian pranalogy from the perspective of beauty. It is from the standpoint of a Christian who holds that the Bible is the written word of God, profitable for our instruction today; this was also the position of Edwards when he wrote in defense of extrabiblical types. Consider the following two fascinating quotations from Edwards that articulate the position:

> Types are a certain sort of language, as it were, in which God is wont to speak to us. And there is, as it were a certain idiom in that language which is to be learnt the same that the idiom of any language is … Great care should be used, and we should endeavor to be well and thoroughly acquainted, or we shall never understand [or] have a right notion of the idiom of the language. If we go to interpret divine types without this, we shall be just like one that pretends to speak any language that han't thoroughly learnt it … God han't expressly explained all the types of Scriptures, but has done so much as is sufficient to teach us the language.[31]

> I expect by very ridicule and contempt to be called a man of a very fruitful brain and copious fancy, but they are welcome to it. I am not ashamed to own that I believe the whole universe, heaven and earth, air and seas, and the divine constitution and history of the holy Scriptures, be full of images of divine things, as full as a language is of words; and that the multitude of those things that I have mentioned are but a very small part of what is really intended to be signified and typified by these things: but that there is room for persons to be learning more and more of this language and seeing more of that which is declared in it to the end of the world without discovering all.[32]

Thus Edwards describes his belief that the Bible does not exhaust all true types, but that the whole world signifies or typifies divine things. The case is sketched in his notebook.[33] An example of a clear spiritual type never made explicit in the Bible is that the lampstand in the Tabernacle represents the Holy Spirit.[34] An example of a plausible nature type not explicit in the Bible is that the sun is an image of Christ.[35]

To propose a hermeneutic (set of interpretive rules) for identifying an extrabiblical type, consider again Edwards. He wrote two entire volumes analyzing the biblical data on the subject,[36] in addition to his notebook containing his abstracted thoughts.[37] The vast majority of Edwards's types were taken directly from the Bible, although he did provide a theological and philosophical basis for expanding the set of types from explicitly biblical types to include extrabiblical types, particularly from nature and history, of other spiritual realities.[38]

> First, to lay down that persons ought to be exceeding careful in interpreting of types, that they don't give way to a wild fancy; not to fix an interpretation unless warranted by some hint in the New Testament of its being the true interpretation, or a lively figure and representation contained or warranted by an analogy to other types that we interpret on sure grounds.[39]

This gives rise to

Rule #1: *Extrabiblical types are permitted if there is warrant by the New Testament or an analogy can be made to a sure biblical type.*

The following additional rule is proposed:

Rule #2: *The role of extrabiblical types should be limited to enhancing Christian experience, such as inspiring awe or worship, or explaining theology, but not to developing new theology or new biblical interpretation.*

This limits extrabiblical types to the beauty perspective, or aesthetics. To tie in the methodological and teleological dimension, it is recommended that candidate extrabiblical types be sought, studied, or pondered in an atmosphere like that practiced in the tabernacle of David, with its 24/7 praise and worship established by God, from which many of the Psalms came.[40]

In closing this section, if it is true that phenomena in nature—and history—are images or shadows of divine things, then perhaps mathematical phenomena would point not just to the orderliness and beauty of God's nature, but to something more. Howell's pranalogies of infinity and paradoxes might be construed this way. Could it be that Gödel's incompleteness theorems go beyond mere analogy and are a sign of the limitations of even our theological (conceptual) beliefs about God? And what about the geometric theorems, and π, and the Fibonacci phenomena? Could they be images/shadows of divine things as well?

Having focused on Coe's conceptual dimension of integration in beauty, as in truth, consider the following quotes to illustrate methodological integration.

> My mind was able to wrap around the idea of His beauty and glory in other forms of life. For example, I was able to envision the trees reaching towards God, the flowers blooming towards the heavens, and the fiber of our brains which allow us to embrace the reality and the existence of God. Through the prayer, God answered by showing me the impossible that was also made possible, and gave me visions of his beauty and glory all around the earth.
>
> Something that really touched me and kept me thinking was that natural law is a reflection of God's nature. The order that is in the world and is seen by scientists, and described by mathematical equations is not only because of the design of the Creator, but it is most importantly a revelation of the divine nature of the Creator. With this, God showed me that he is Almighty God, who created me and has my life in his hands. This made me think of Psalm 121 … This passage touched my heart in a way that I cannot describe.[41]

This is methodological integration: responding to the truths of God. It is fitting to end this subsection with a final quote from Edwards.

> The enjoyment of [God] … is the only happiness with which our souls can be satisfied … Fathers and mothers, husbands, wives, or children, or the company of any, or all earthly friends … are but shadows; but the enjoyment of God is the substance. These are but scattered beams, but God is the fountain. These are but drops. But God is the ocean.[42]

Having walked the paths of truth and beauty, we round the corner to traverse the third and final perspective of McGrath's platonic triad.

3. Goodness

> *He who gets wisdom loves his own soul;*
> *He who keeps understanding will find good.*
> (Proverbs 19:8)

At the turn of the twentieth century, mathematics was a unified discipline. Then, the famous G.H. Hardy encapsulated the tragic split between pure vs. applied mathematics with his aphorism, "Nothing I have ever done is of the slightest practical use."

Pure mathematicians tend to focus on the abstract and are at home discovering truth. Applied mathematicians, however, want their mathematics to solve problems in the real world—using it for good.

In the 1920s, modern statistics emerged as a separate discipline from mathematics, although at most universities today statistics is taught by mathematics departments and is widely viewed as a branch of mathematics. Statistics presents another case of using mathematics to effect good in the world. Taking a broader view, then, mathematics, particularly through its applied and statistical forms, can be an incredible force for good in the world. The application of mathematics and statistics for "the good" is part of the fulfillment of the creation mandate of Genesis 1:28. This is seen through engineers who design things for people, actuaries who create financial models to keep people insured, statisticians who analyze data to improve processes, and so on. Such good is well known to much of the Christian church.

The teleological dimension arises here. For the Christian mathematician, all work, whether applied or not, should be for the glory of God. The Christian who has this belief should experience enhanced motivation beyond his or her non-Christian counterpart (Colossians 3:17). This comports with Howell's remarks on both attitudinal and ethical issues.[43]

Another "good" would be a mathematics education that brings students into all three dimensions of integration. With this outcome, it is seen that the third and final perspective on integration is well known (engineering, education, etc.) and widely discussed even in non-Christian circles.

Having focused on Coe's conceptual dimension of integration in goodness, as done previously in truth and beauty, consider the following student quotes to illustrate teleological integration.

> God showed me that I need to trust him in the little things, and that nothing is too small that it escapes his attention. If he is truly sovereign over even the most miniscule molecular forces, how much more is he sovereign over my life! This gives me great peace knowing that whatever happens in this life, I still have the promise of living with my Creator forever. And my eternal life doesn't start when I die, but it started on the day that I surrendered my life to him. I am so thankful for what God has shown me through this paper. Before, I wasn't aware that learning about God's sovereignty over natural law could have these implications for my life.
>
> Honestly, after reading this paper, I feel a prompting to improve the quality of my time in praise toward God. I do already praise him, but after reading this I was reminded of how insignificant my praise really is. I see his invisible qualities all around me every day, even when I am not looking at anything; the laws of gravity are holding me down, as an echo of his steadfast and steady love. It is a love that never lets up, or wanes in its intensity. As a part of the praise I feel prompted to begin, I also feel prompted to be more aware of the world around me. The Lord has his invisible attributes in everything and I should want to be constantly seeking these out.[44]

Teleological integration is the application of biblical truth. Here, students were challenged to trust God more and improve their praise quality.

Conclusion

> *The fear of the* Lord *is the beginning of wisdom;*
> *And the knowledge of the Holy One is understanding.*
> (Proverbs 9:10)

All things in mathematics may be seen to find their end in Christ, as has been implied on this walk through the perspectives of truth, beauty, and goodness in mathematics. Howell framed mathematics-faith integration in terms of five different categories. To illustrate, he described ontology as a foundational issue, while chance was described as a worldview issue. Using the three perspectives, a different approach emerged. Both ontology and chance may be viewed from the perspective of truth. If so, the exposition of ontology would remain the same, while chance might shift to more of the technical details. Going further, ontology and chance could be viewed from the perspective of beauty. Are the different proposed mathematical ontologies beautiful? What properties of beauty do they possess? What do these elicit in the viewer? Lastly, ontology and chance may be viewed from the perspective of goodness. What good can be done with the different mathematical ontologies? For chance and goodness, the innumerable applications of probability and statistics have been harnessed in the service of the Lord and humankind. Using the three perspectives of the

Platonic triad to broaden mathematics-faith integration as a complementary alternative to Howell's five categories was the first contribution intended in this article.

The second contribution was to provide a paradigm for how Christian mathematicians can obtain a deeper spiritual engagement with the subject. This was conducted with Coe's three dimensions of faith-learning integration applied to mathematics. While most of the focus remained on the conceptual, scripture quotations, excerpts from student work of methodological and teleological integration, and occasional prayer remarks were provided to model these dimensions of mathematics-faith integration.

The third contribution was to suggest that some mathematical phenomena may be discovered to signify divine things as Edwardsian types. A hermeneutic for developing such types was provided, which included limiting such Edwardsian mathematics-types to the beauty perspective. All three contributions can be useful for teaching because they provide ways to go beyond the usual secularized mathematical content and connect it with the Creator and the students' relationship with him.

The introduction opened with Proverbs 1:7 and this conclusion closes with Proverbs 9:10. Both verses begin with, "*The fear of the* L*ORD* *is the beginning of* …," but 1:7 says "knowledge," while 9:10 says "wisdom." In mathematics, we need both. In the truth, beauty, and goodness sections, we quoted a Proverb connecting wisdom with each perspective. Thus, it is only through the fear of the Lord that we can obtain true knowledge and wisdom, from which truth, beauty, and goodness are only fully comprehended by the mind of Christ (1 Corinthians 2:16). To achieve this is a spiritual attainment, not of our own strength (1 Corinthians 2:6–3:1). Mathematical truth itself reflects the ordered nature of God (Romans 1:20). Goodness is an attribute of God and, as such, all good ultimately has its origin in him. Beauty is another attribute of God so that, similar to goodness, all beauty has its origin in him. Therefore, when we are enabled to see truths of mathematics such as the beauty of π embodied in the Creator's world and used for the good of humankind through the bell curve, let us increasingly endeavor to do it in the fear of the Lord. Is it not God's will that we see *through* the truth, beauty, and goodness of the mathematical phenomena to see him?[45] Let us then seek him above all and pray that his Wisdom, which is Christ (Proverbs 8:22–35; John 1:1–4) would be manifested through mathematics and our teaching as it was through ethics, hymn-making, and biology in Solomon's day (1 Kings 4:29–34). ◊

Notes

[1]All scripture are from the New American Standard Bible.
[2]Russell Howell, "The Matter of Mathematics," *Perspectives on Science and Christian Faith* 67, no. 2 (2015): 74–88.
[3]McGrath is well-poised for such a call as the Andreas Idreos Professor of Science and Religion at Oxford. Alister E. McGrath, *The Open Secret: A New Vision for Natural Theology* (Oxford: Blackwell, 2008). McGrath's book is cited approvingly in the introductory chapter of W. J. Bradley and R. W. Howell, eds., *Mathematics through the Eyes of Faith* (San Francisco, CA: HarperOne, 2011), 11.
[4]John Coe, "Intentional Spiritual Formation in the Classroom: Making Space for the Spirit in the University," *Christian Education Journal* 4NS, no. 2 (2000): 96–97.
[5]Howell, "The Matter of Mathematics," 87–88.
[6]Quotes are from my Biostatistics class, Spring 2014, responding to integration prompts after reading Jason Wilson, "The Laws of Nature in the Natural Versus Spiritual Mind," *Journal of the Association of Christians in the Mathematical Sciences* (2012–2013), http://www.acmsonline.org/journal/2012_2013/Wilson2012.htm.
[7]Bradley and Howell, eds., *Mathematics through the Eyes of Faith*.
[8]Howell, "The Matter of Mathematics," 76–78.
[9]McGrath, *Open Secret,* 248.
[10]Howell, "The Matter of Mathematics," 78–83.
[11]From students' papers in Biostatistics, Spring 2014.
[12]Howell, "The Matter of Mathematics," 82–83.
[13]James Bradley, "Letter from the Founding Editor," *Journal of the Association of Christians in the Mathematical Sciences (ACMS)* (2004), http://www.acmsonline.org/journal/letterfromeditor.htm.
[14]Matt Delong and Kristen Schemmerhorn, "Beauty," in *Mathematics through the Eyes of Faith*, Bradley and Howell, eds., 165–67.
[15]See Romans 1:20 and Wilson, "The Laws of Nature in the Natural Versus Spiritual Mind."
[16]Howell, "The Matter of Mathematics," 84.
[17]See Peter Woo's beautiful applet depicting this relation along with many others, http://woobiola.net/math/organs.htm. See also the proofs, http://woobiola.net/math/gbook/ch01d.htm and http://woobiola.net/math/gbook/ch03a.htm.
[18]See the collection at http://en.wikipedia.org/wiki/List_of_formulae_involving_%CF%80.
[19]Wilson, *Natural Law,* 1–3.
[20]Howell, "The Matter of Mathematics," 81–82.
[21]This is part of Proverbs 25:2, cited at the beginning of this section. See also the quotes in Wilson, *Natural Law,* 1–3; Howell, "The Matter of Mathematics," 81–82.
[22]Nancy R. Pearcey and Charles B. Thaxton, *The Soul of Science: Christian Faith and Natural Philosophy* (Wheaton, IL: Crossway Books, 1994).
[23]Wilson, *Natural Law,* 4–7.

[24]Proverbs 2:4–5.

[25]For a rich, spiritual look at the use of analogy to penetrate the divine, see Thomas Dubay, *The Evidential Power of Beauty* (San Francisco, CA: Ignatius Press, 1999), 294–96.

[26]William J. Wainwright, "Jonathan Edwards and the Language of God," *Journal of the American Academy of Religion* 48, no. 4 (1980): 524.

[27]George Marsden, *Jonathan Edwards: A Life* (New Haven, CT: Yale University Press, 2004), 1. Unfortunately, Edwards's ideas on the subject were not picked up by his successors because they were not published after his untimely passing in 1758. It would not be until 1948 that the first of his notebooks on typology was published in Perry Miller, *Images or Shadows of Divine Things* (New Haven, CT: Yale University Press, 1948). It would not be until 1993 that the notebook which succinctly articulated his views was published under the title *Types* in Jonathan Edwards, *Typological Writings*, vol. 11 of *The Works of Jonathan Edwards* (New Haven, CT: Yale University Press, 1993), see remark on p. 145.

[28]McGrath, *The Open Secret*, 258.

[29]Ibid.

[30]Joseph Beggiani Seely, "The Typological Approach of Syriac Sacramental Theology," *Theological Studies* 64 (2003): 543–44.

[31]Edwards, *Typological Writings*, 151.

[32]Ibid., 152.

[33]Ibid., 146–53.

[34]See Exodus 25:31–35; Hebrews 8:1–5; cf. Revelation 1:4, 4:5; Zechariah 4:2–6.

[35]Edwards, *Typological Writings*, no. 4, 52.

[36]"Images or Shadows of Divine Things" and "Types of the Messiah," in Edwards, *Typological Writings*.

[37]Ibid., 146–53.

[38]Ibid. Throughout the work, Edwards discusses Psalms 78:2; 125:1–2; John 9:7; 6:31–32; Romans 5:14; Galatians 4:21–23; 1 Corinthians 9:9–10; 10:1–4, 6, 11; 13:2; Hebrews 4:3; 5:6, 11; 7; 8:2, 4–5; 9:1–4, 5, 8–11, 22–24; 10:1; 11:19; 13:11–13; 2 Corinthians 3:13–14; and Colossians 2:16–17. This list includes all Bible references in *Types*, except those in his argument from the permutation of names, p. 150. Nevertheless, Edwards's catalog was primarily biblical types (on his view), though he did include some extra-biblical, including the numbers 76, 95, 142, 146, 156, 196, and 147.

[39]Edwards, *Typological Writings*, 148.

[40]See 1 Chronicles 16:37–42; 23:5; 25:7; 28:13, 19, 21.

[41]Biostatisics students, Spring 2014.

[42]Jonathan Edwards, *Sermons and Discourses, 1730–1733*, vol. 17 of *The Works of Jonathan Edwards* (New Haven, CT: Yale University Press, 1993), 394.

[43]Howell, "The Matter of Mathematics," 83–85.

[44]Biostatistics students, Spring 2014.

[45]Wilson, *Natural Law*, 7ff.

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