Bibliography of Christianity and Mathematics

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Abstract: This invited address provides historiographic background for the second edition of *Bibliography of Christianity and Mathematics.* The second edition builds on the first edition written jointly with Calvin Jongsma, on the historiographic work of Ivor Grattan-Guiness, and on the computer skills of Gregory Ross.

1. Introduction to the Second Edition

Every thesis should have the same outline: "I have a great new idea. Here's why it's new. Here's why it's great."[1] Every thesis begins with a literature search to make sure that the work has not already been done. Thus the point of the first edition of this *Bibliography* was to do the literature search necessary to allow you to start on some great new ideas relating Christian faith and love of mathematics. Indeed, the Association of Christians in the Mathematical Sciences (ACMS) was only six years old when the first edition appeared. The ACMS is now almost three decades old.

The *Bibliography of Christianity and Mathematics: 1910-1983* helped scholars contribute to the dialogue. Therefore, we offer this second edition, in which we add materials gathered in the past 22 years, going back to the Middle Ages and forward to 2005. We offer it in two forms: printed, and electronically on compact disk.

2. Methodological Introduction

Our motive in preparing this *Bibliography* is to allow you to synthesize your own view of the relationship of mathematics and Christianity. We have begun to do that ourselves (see our own entries in the *Bibliography*), and we invite your collaboration on our project. What limits have we set for ourselves in gathering the material of the *Bibliography*? What methodological principles have guided our selection of the material?

One should not list every reference to theism by a mathematician, nor every reference to mathematics by a Christian. These may provide interesting quotations to spice up or round out a lecture, but they do not further the interdisciplinary enterprise. Mathematicians as great as August-Louis Cauchy claim that humanity should immediately accept divine revelation.[2] But that does not itself tie together mathematics and Christianity.

The first edition of the *Bibliography* covered only 1910-1983. In the past century, the mathematical enterprise has diverged so widely from what was once Natural Philosophy that few mathematicians reflect on their work beyond its internal consistency or its practical applications. mathematics today has been characterized as fallible. Reuben Hersh claims that there are four myths about mathematics today: its unity, its objectivity, its universality, and its certainty.[3] Amidst this post-modern fragmentation, attempts to relate mathematics to Christianity in terms of truth and universality stand out as strangely modern.

One of the problems of tracing the connection prior to 1910 is that a Judeo-Christian theism becomes the air that Western mathematicians breathed. Only in this century has there been a breach that has needed mending between mathematics and Christianity. That makes studying the relationship between Christianity and mathematics in prior centuries a challenge.

Crowe in his historiography of mathematics says that the metaphysics of a mathematician might not be evident in a surface way in his writings; it might not even be evident to the mathematician himself! It can be "uncovered by historical research"; it can become "apparent in mathematical controversy."[4] Einstein, for example, is surely not writing from a Christian perspective, yet recently two theologians have marshaled his support in defense of a Christian world view.[5] In his controversy with Ernst Mach, Einstein defends a view of the knowability of Nature, a view which draws on the Christian roots of such men as Robert Boyle (1627–1691) and Johannes Kepler (1571–1630). We include Boyle and Kepler. We exclude Einstein, while commending an outstanding intellectual biography of Einstein by Max Jammer.[6]

Although Galileo (1564–1642) disagreed with Francis Bacon (1561–1626), both were arguing from a Christian perspective. Galileo, Kant, and Einstein are defenders of an *a priori* view of mathematics, thinking God's thoughts after Him. In contrast, Francis Bacon argues that mathematics is *a posteriori*. But the issues are clouded. Bacon does not seem to be far enough away from Medieval rationalism to consider the possibility of a truly contingent universe, and so his view is a necessary *a posteriori* view. Kant, further from the Middle Ages, defends mathematics as the *a priori*, but a synthetic *a priori*. We include Galileo. We find too little mathematics in Bacon, too little Christianity in Kant. We exclude them.

This confusion in which a Christian world view is shared by opponents on both sides of historical controversies leads to a second problem. One is tempted to reinterpreted pre-Christian ideas with Christian hindsight. We have tried as much as possible to make this a bibliography of works which themselves explicitly relate mathematics and Christianity, rather than of works which we believe to be helpful in the philosophical aspect of that enterprise. Thus we do not see the Trinity in Aristotle's writings, as one Protestant Scholastic did.[7] We have no intention of baptizing Aristotle and Plato, even though Christ is the Light that lights every man that comes into the world. But nor do we dismiss a relationship between mathematics and God just because it appears in Chinese or Classical Greek thought as well as in Christian thought.

Augustine's (354–430) Platonism (427–347 BC) influences both mathematics and Theology. For example, Georg Cantor (1845–1918) credits Augustine for his conception of infinity. Thomas Aquinas (1225–1274) perpetuates Aristotle's (384–322 BC) rational approach to Theology. Aquinas's *Summa Theologica* has been called the Spiritual Euclid for its style having been patterned after the deductive logic of Euclid. Thus the foundations of both Christian theology and mathematics between the start of the Christian era and the early 1800s live in this air that everyone breathed. A third thread, documented in Granville Henry's *Logos* [Henry, 1976], is the influence of non-Euclidean geometry on the enterprise of Process Theology, through Alfred North Whitehead. But again the confluence of ideas makes cause and effect hard to sort out here. The oft-repeated observation that ideas are "in the air"—available simultaneously to thinkers in various disciplines—makes even sorting out how Gauss and Saccheri and Lobachevski came upon non-Euclidean geometry a dissertation-sized project, especially if one hopes to address the question of whether it was a cause or an effect of the loss of absolutes which characterized the 19th C. Lipman Bers points out that this shift must have occurred somewhere between 1776 and 1863 because the Declaration of Independence says, "We hold these truths to be self-evident that all men are created equal." But Abraham Lincoln's Gettysburg Address says, "We are dedicated to the proposition that all men are created equal." Culture shifted from axioms as self-evident truths to axioms as propositions to which we are dedicated.[8]

In the second printed edition, we have been more selective than previously. If you are interested in ephemeral or second-rate references, the electronic version can be searched with a selectivity threshold lowered.

We have included references which claim that there is no connection between mathematics and Christianity, since such a discussion relates to the study of the connection. Secondary sources have been omitted if they merely point to a primary source, unless the primary source is not readily accessible. Secondary sources have been included if they include some measure of analysis on their own.

3. Presuppositions

Two new presuppositions have resulted in changes in this edition.

First, we are **more discriminating.** When we didn't think that we'd have much material, we included everything that we could find without evaluating its quality very much. For example, student coursework and numerology were included. Abstracts were carefully written in value-neutral language. Our motives were good. We wanted to encourage students to contribute to the dialogue, so we put their names in print. We wanted to show the passion with which some people approach integration, even though passionate numerology is still usually both bad science and bad theology.

In this edition, we have the luxury of having enough material to be discriminating in the best sense of the word, and enough experience to provide more subjective abstracts. We have included a "quality" scale in the electronic edition that allows you to select only entries that are of high quality.

Second, we are **less narrowly analytic.** The selection of sources has been informed by the new book, *Scholarship and Christian Faith: Enlarging the Conversation* (NY: Oxford University Press, 2004). There Douglas Jacobsen and Rhonda Hustedt Jacobsen broadens the range of activities that qualify as Christian scholarship. Prior to this book, several academic disciplines had a hard time demonstrating that they were doing Christian scholarship because their academic product was a musical performance or a minority-run business in the inner city. The Christian scholarship had to be tacked on by way of a reflective component. Their work was already synthetic, but to match the "faith-discipline integration" model, they had to tear it apart with analytic tools and then put it back together again. All "integration" was philosophical, or perhaps pedagogical. The Jacobsens in turn were influenced by at least three strands of thought: Ernest Boyer's broad vision of Christian scholarship, Howard Gardner's broad description of multiple intelligences, and a broadening to multiple Christian traditions in contrast with the decidedly Calvinistic flavor of Christian scholarship in earlier decades. Thus in addition to the usual accustomed fare, you are more likely to find in this edition works of art or practical projects. The Greeks would call both *techne,* a word that represents both "technique" and "technology," and this edition celebrates that reconnection.

4. Christian scholarship as a recent activity, historically

There are relatively few items available prior to the 20th C. on the relationship between Christianity and mathematics where you might have expected many. For example, we have the complete list of abstracts of all of the Vatican's manuscript collection on mathematics. Not a one attempts to integrate mathematics and Christianity.

What accounts for how few items there are?

First, there are few items because a fish may not be aware of the water in which it swims. Prior to the Renaissance, there was no attempt to integrate, because there was no sense of separation. The world was of a piece. Christians did mathematics to the glory of God. Christians didn't think to document their motives and their presuppositions. Connections between faith and the mathematical sciences are not always available, even when teased out by speculative biographers.[9]

Second, there are few items because we come to an integration project with categories for which we are looking. There might be excellent examples that escape our gaze because of the lenses through which we look.

This second reason explains why the tomb of Galileo appears on the back cover of this second edition. As a contributor to mathematics with ideas about infinity, and as a committed Christian with a gift for writing that has often been compared with that of Dante for its beauty, Galileo would—one might hope—have written a clear and compelling statement connecting his faith and his science. He did no such thing. A. C. Crombie explains why. Hear Winifred Wisan.[10]

> As A.C. Crombie has pointed out, Galileo has long been a philosophical symbol. In the 19th century for example we was diversely regarded as a Kantian rationalist, an empiricist anticipator of Mill, a founder of the 'positive philosophy,' and a Machian phenomenologist. In the early 20th century, he naturally became the father of the hypothetico-deductive-experimental method. ... Crombie link[s] Galileo to Aristotelian sources. On the other hand, Koyré ... insist[s] upon Galileo's Platonism.

To phrase it in another way, Galileo was a complex person just as we all are. We are under no obligation to fit neatly into anyone's categories to classify us. Neither is Galileo. It is too tempting to oversimplify Galileo's contribution to the dialogue between faith and the academy. When theories are lined up against persons, no matter how accurate the theory, the fit is ambiguous at best. As historian of science John Hedley Brooke cautions, it is all too easy to read harmony back into history where there was none.[11]

Similarly, Georg Cantor's principle biographer Joseph Dauben calls him a formalist,[12] but a more careful reading of Cantor reveals nominalist, Platonist, and psychologistic accounts of his "actual infinities."[13] True, Cantor's psychologism was a later development, but we must allow changes over a person's lifetime as well as complexities at any given time.

As a further example, it would be easy to oversimplify Newton's contribution to this dialogue as well. What view of mathematics would you ascribe to Isaac Newton? David Sepkoski argues, "Labels such as 'nominalist' and 'realist' break down . . . when trying to describe Newton's approach."[14] What view of Christianity would you ascribe to Newton? Given that he subscribed to the Arian heresy, one might wonder whether he had a Christianity to integrate. We often use the word "Newtonian" to describe the growing mathematization of various disciplines that followed the time of Newton, but Newton himself was not a Newtonian.[15] Newton continued to be influenced by astrology, alchemy, and numerology (gematria), as was common in the Hermetic tradition.[16] The historical transition from a mystical view to a rationalistic view was gradual. Equally gradually is the transition from modernism to postmodernism.

As a final example, Christian interpretations of Leibniz's philosophy of monads oversimplify. Should we look further back than Leibniz for Christian and mathematical connections? Alonzo Church begins his bibliography of symbolic logic inaugurating the *Journal of Symbolic Logic*

with Leibniz because Church believes that any logic prior to Leibniz would not properly be of the symbolic sort.[17] Yet Ramon Lull (see the *Bibliography*) provides a much earlier case study of integration of Christian faith and mathematical logic, if only to defend the faith against Islam.

Third, there are few items because Christians borrowed Platonic and Aristotelian ideas wholesale. One should not automatically assume that if a learned doctor of the church such as Aquinas is quoted on the subject of mathematics, there is a Christian component. Since Aristotle distinguished "natural philosophy" (physica) from mathematics and logic, this leaves mathematics aside in many discussions of theology. Either the mathematics in many discussions of theology is implicit, or the connection is two steps away. For example, N. L. Rabinovitch writes the book *Probability and statistical inference in ancient and medieval Jewish literature*[18]. The probability is qualitative instead of quantitative and the Jewish connection is not specifically Christian. Nonetheless, the book is a useful resource for background and comparison. Fortunately, the present *Bibliography* allows full-text searching, so even materials alluded to but not themselves entries can be searched, including materials referenced in this Introduction.

We cannot avoid reading back into the past themes that interest mathematicians and computer scientists today. For example, because Leibniz wrote philosophy and created mathematical theorems, and because he is famous today, one should look harder for integrative themes in Leibniz's work than in the work of some other mathematicians. Neither famous mathematicians nor famous theologians are necessarily included. Not every mention of infinity by a theologian is a relationship with mathematics. Not every Bible quotation by a mathematician is a relationship with the Christian faith. We tried to respect the intent of the authors. A complete list of mathematicians considered is provided with the *Bibliography.* Not all appear in the *Bibliography.*

Even obscure philosophers receive some mention if their works have been used in contemporary discussions of the mathematical sciences. For example, the abovementioned Ramon Lull, a 13th-century philosopher from Majorca, has recently been rediscovered by historians of computer science as having provided earlier insights into computational logic than had been thought before.

5. Acknowledgments

ACMS members have provided 28 years of Christian fellowship, encouraging a passion for relating faith and scholarship. The ACMS Board provided a scholarship for student help in 1991. Messiah College provided sabbaticals in 1983, 1991, and 2004 which were partly spent in preparing these bibliographies. Emily provided encouragement and many blessings.

Endnotes

1. So says linguist Joseph E. Grimes.

2. "Sept leçons sur la physique générale 1833,'" cited in "Mathematical physics in France, 1800-1840,'" by Ivor Grattan-Guinness, p. 177 of *Mathematical Perspectives,* ed. by Joseph W. Dauben. NY: Academic Press, 1981.

3.Philip J. Davis and Reuben Hersh. *The Mathematical Experience.* Boston: Birkhäuser, 1981. Davis quotes Hersh on p. 1 of *Humanistic Mathematics Newsletter #5,* May 1990 to this effect.

4.Crowe, Michael J. "Ten `laws' concerning patterns of change in the history of mathematics." *Historia Mathematica 2,* 1975: 161-166. Law 5, p. 163.

5.In 1986, Iain Paul's *Science and theology in Einstein's perspective.* In 1987, Ralph G. Mitchell's *Einstein and Christ: a new approach to the defense of the Christian religion.* Both books are published by Scottish Academic Press, and are volumes 3 and 5 of the series, Theology and Science at the Frontiers of Knowledge, sponsored by the Center of Theological Inquiry in Princeton.

6. *Einstein and Religion: Physics and Theology.* Princeton University Press, 1999. See especially Chapter 3, which forms the third third of the book.

7. Johann Hasler claimed that Aristotle's intellect, intelligence, and understanding were the Trinity; and that Aristotle's determinism begins the doctrine of justification by grace alone. See Christopher J. Burchill, "Aristotle and the Trinity: the case of Johann Hasler in Strasbourg 1574-1575." *Archiv für Reformationsgeschichte 79,* 1988: 282-309. Among 16th C. "Protestant logicians," "Aristotelian logic was considered as an indispensable tool for formulating theological arguments." See Irena Backus, "The teaching of logic in two Protestant academies at the end of the 16th century," *ibid. 80,* 1989: 240-251.

8. Beers is credited for this thought by Edwin E. Moise on pp. 382-383 of Moise's *Elementary Geometry from an Advanced Standpoint* (Addison-Wesley, 1963).

9. Ivor Grattan-Guinness has a very helpful paper discussing this issue, abstracted in our Bibliography: "Christianity and mathematics: Kinds of link, and the rare occurrences after 1750." (*Physis: Rivista Internazionale di Soria della Scienza, Nuova serie, xxxvii,* 2, 2000.)

10. Wisan, Winifred L. Review of *Galileo's intellectual revolution: Middle period, 1610-1632,* by William R. Shea (NY: Science History Publications, 1972). *Historia Mathematica 3,* 1976, pp. 103-109.

11. *Science and Religion: Some Historical Perspective.* Cambridge U. Press, 1991: 42–51.

12.Dauben, Joseph Warren. *Georg Cantor; his mathematics and philosophy of the infinite.* Cambridge, MA. Harvard University Press, 1979.

13. See Gene B. Chase, "How has Christian theology furthered mathematics?" in *Facets of Faith and Science; Volume II The Role of Beliefs in Mathematics and the Natural Sciences; an Augustinian Perspective.* Ed. Jitse M. van der Meer. Lanham, MD: University Press of America. 1997.

14. In "Nominalism and constructivism in seventeenth-century mathematical philosophy," *Historia Mathematica, 32,* 2005: 33–59. Page 52.

15. Kline, Morris. *Mathematics in Western Culture.* NY: Oxford University Press, 1953.

16. So much so that Michael White calls Newton "the last sorcerer." See p. 109 of his *Isaac Newton: The last sorcerer.* Reading, MA: Perseus Books, 1997.

17. *J. of Symbolic Logic, 1,* 1936: 121-218.

18. Toronto: Uinversity of Toronto Press, 1973.