Mathematics and Theology: A Conversation

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Isn't mathematics the most abstract, the most unworldly discipline? Bertrand Russell, writing about the hypothesis-to-conclusion logical nature of mathematics noted, "If our hypothesis is about anything and not about some one or more particular things, then our deductions constitute mathematics; thus, mathematics may be defined as the subject in which we never know what we are talking about, nor whether what we are saying is true." [1., p. 4] If we believe Russell, then what can mathematics have to do with theology? In what way could we hope to serve the Catholic nature of our university with such a "closed" discipline?

The structure of mathematics is, on the one hand, rather simple. There are axioms (postulates or basic assumptions) with which we begin. Some terms are defined and some are left undefined but obtain some kind of internal or relative meaning in that they appear in the axioms. On such a starting point a vast mathematics can be built. Theorems can be proved using the "laws" of logic. Actually, logic itself is mathematical in its structure. Perhaps another way to say this is that mathematics is a particular branch of formal logic. Looked at this way, we can see mathematics in the manner Russell describes, but we should note that what mathematics has is more a validity rather than what is usually called "truth."

So what do we make of all this? Isn't it possible to teach mathematics as this logical construct and never refer to things of the "real world?" Of course we could do that, but it would, for most people, make a very boring course. (I know some of you reading this have a very snappy comeback to that last line.) In our introductory courses we don't teach mathematics in such a sterile manner. After all, our students do not come to us in beginning courses in order to appreciate the pure logic of the subject. They come because they need it for their major, because they need it for the general requirement or just because they like the subject. It is in these courses where we reach out to students in general, and this is certainly one place where we can demonstrate the connections between mathematics and the real world. That is, after all, why it is required in the first place — because it does have these connections.

Naturally, we cannot cover all or even a large part of the ways in which mathematics is used, but the students do see some of the most powerful applications of particular parts of mathematics. For example, in calculus we trace ways in which it is used to develop an approach to understanding in physics or economics. In other courses we look at counting, probability and statistics and how they are used to bring sense to data obtained in psychology or political science. We can and do make much of such examples of the power of mathematics, and this power is possible precisely because of the abstract nature of mathematics. In the form of a mathematical model, we can use mathematics in worldly and practical manner. Given this outline for our courses, does this allow us to claim that we are about something so pure and direct that we have nothing significant as a department to add to the Catholic identity of our university? I hope not.

I need to be quite careful here. We have a definite responsibility to teach both the theories and applications of mathematics, and I am not attempting to set a prescription for what else we should be doing. I do want to investigate some of the things we might do to address this question of our role in shaping our special institutional identity. I do believe that in order for a teacher to be really effective, she or he must really "own" the teaching. We cannot simply try to emulate the model of some "great" teacher and expect it to work for us. We work best with our own style, our own approach. On the other hand, we always need to be open to trying something new that may help change us and the effectiveness we can have professionally. We need the confidence of knowing that we are doing something valuable and that we are doing it well (or at least fairly well). We also need the humility of thinking that we could always learn more and become better. It is in this spirit that I offer a few thoughts below.

One of the things that can bring a special character to our teaching is the manner in which we make broad connections between our subject and other disciplines. This should be done not just because we want to make a particular point about a mathematical topic but also because we want to show the beauty and insight that comes from the blending of thinking, which ought to go on in any sophisticated study. These interdisciplinary "episodes" need not take that much class time, but they can truly enrich the class. A student here and there will have a new insight and perhaps begin a new personal study because of something introduced in this way. Students will find more value in their general education because it shows the ways in which disciplines interweave and cross-fertilize. For purposes of our discussion here, rather than look in general at interdisciplinary work, I want to focus on mathematics and theology (with some philosophy thrown in for good measure).

To consider connections between mathematics and theology, I will concentrate on two main themes: the ways in which mathematics can inform a real and significant study of theological issues and the ways in which theological considerations can have some effect on mathematics or its uses.

First, how can mathematics find application in theological matters? The history of philosophy and theology is full of examples of not simply the consideration of mathematical reasoning but its application to arguments in other areas (theology in particular for our purposes here). St. Augustine wrote at length of mathematical reasoning, mathematical truth and "the platonic number-theme which goes back to Pythagoreanism." [2, p. 922] His arguments about the existence of God and eternal truths in God must be considered at the same time one considers his arguments about mathematical truths as examples of absolute truths. [2, pp. 74-77]

St. Anselm began his proof of God's existence from the concept of God as that than which no greater can be conceived. This is the beginning of a fairly recent work by Mortimer Adler in which he employs mathematical reasoning to complete arguments about the nature of God. [3] It is unfortunate that he didn't seek better advice about his particular use of mathematics (regarding ordered sets), but his oversight is yet another example for a close conversation among the disciplines.

Indeed, the structure of mathematical argumentation runs through theological reasoning and, in particular, the proofs of the existence of God in the works of St. Thomas Aquinas, Descartes, Pascal, Leibniz, Spinoza, Berkeley, Hume and Kant. For example, in the Ethics, "… it is quite in the spirit of traditional logical argumentation that Spinoza gives this mathematical cloak to his metaphysical speculations … ." [4, p. 89]

Perhaps it would be instructive to take a more extended look at one fairly recent theological work that relies heavily on mathematical reasoning. Hans Kung's book, Does God Exist?, begins with the statement, "It is not surprising that mathematicians in particular have always had a special interest in an unconditional, absolute certainty in the realm of life and knowledge." [5, p. 3] The book then goes on to consider Descartes and the first section, "The ideal of mathematical certainty." [5, p. 3] Kung states, "With Descartes, European consciousness in a critical development reached an epochal turning point … the medieval way of reasoning from the certainty of God to the certainty of the self is replaced by the modern approach: from certainty of the self to certainty of God." [5, p. 15] Kung's approach demands a real understanding of mathematical structure to appreciate the considerations throughout at least the first quarter of his substantial text. There is thoughtful reference to the non-primacy of certain axiom systems, to the debate about logical methods and to the uncertainty in contemporary mathematics that would be of real interest to students studying higher mathematics as well as those to whom the book is directed. [5, p. 33] There is also a good consideration of the work on scientific revolutions by Thomas Kuhn. [5, p. 106]

These few examples serve only to illustrate the fact that today, as in the past, if we are to consider reason as a tool to help us approach truth, we must consider the ways in which mathematics uses reason. Theology is obviously one place where this combined examination of reason is meaningful and which should not be the object of discussion only among theologians.

Now we raise perhaps a harder question: how can theological matters come into our mathematical world? If mathematics is the abstract structure that Russell describes, how can there be room for considerations of theological questions?

Certainly one question that some mathematicians ask concerns the origins of mathematics itself. For one case, let's look briefly at the history of geometry. Until the 19th century, we had one geometry (now we refer to that subject as Euclidean geometry). Euclid saw that a very impressive collection of geometrical "insights" could be derived from a single and fairly simple set of axioms. These axioms were regarded as "self-evident truths" or as eternal truths. Many have argued that they come from the structure of the universe or from God. They were the foundation of the geometry for over 2,000 years, and supposedly gave us insight into the very nature of God's design. But people came up with the axioms, and people noticed over the years that these axioms were not complete and perhaps not independent; nevertheless, we did not give up on our one geometry. Then, beginning in the last century, people discovered that there were alternate geometries possible; that a different and contradictory list of axioms gave a geometry which had all the logical validity as did Euclid's. As time went on, people discovered that some of these non-Euclidean geometries were more appropriate than was Euclid's for answering certain questions about our universe. While these discoveries presented substantial philosophical questions about the nature of our disciplines, it also called into question the assumptions about the source and nature of the kind of mathematical insight necessary to establish a mathematics in the first place. "The discovery that non-Euclidean geometry was not a God-given attribute of the world caused all manner of similar prejudices and beliefs to be questioned … ." [6, p. 12] If geometry is not God-given, then it is people created, and how do we think about human creativity? It seems that theology must play a role in an attempt to answer this question.

While this and related stories are told in many places, perhaps it would suffice here to consider our issues as they are outlined in a recent book, which is the source of the quote just above. This is John Barrow's Pi in the Sky. Barrow begins his book by stating, "… that at the root of the success of twentieth century science there lies a deeply 'religious' belief — a belief in an unseen and perfect transcendental world that controls us in an unexplained way … ." [6, p. 1] He traces a history of mathematical thought and inquiry beginning with the Pythagoreans, one of the "quasi-religious communities" of ancient times. Logic itself comes into question and Barrow discusses our "faith" in the two-valued logic we use. [6, p. 16] There is a whole chapter that addresses (among other things) the question of the source of mathematics — is it discovered or invented? [6, Ch. 4] That discussion alone would make for a very interdisciplinary conversation. He covers many other interesting topics (intuitionism, constructivism, the nature of infinity, computability, incompleteness, etc.), but perhaps the examples above make the point.

So far we have examples of how questions in and about mathematics can connect with issues from theology. We should not lose sight of the fact that we need to look also at the applications of mathematics. The faculty should model and advocate for a proper and ethical approach to such work. There are many places, especially with the use of statistics, where the informed mathematician can and should guard against the improper, mistaken, misleading or biased use of mathematics.

Now what do we make of all these interconnections? How does knowledge of the issues mentioned above affect our curriculum and our role in the special nature of our university? I would hope that an ideal liberal arts university faculty would raise all sorts of interdisciplinary questions in their courses. In a Catholic university, I would hope faculty would be especially sensitive to those interdisciplinary questions that connect their field with theology. Naturally, this would not happen all the time or even in each class, but it should not be absent from the curriculum. By raising such issues, students can see that disciplines are interrelated, that there is real coherence to their overall program of studies and especially that questions of faith and belief are not just relegated to certain departments.

We cannot expect that faculty come to us ready to augment classes with such considerations. We all clearly face substantial work in establishing a base of knowledge about things theological so that we may make the kinds of connections described above. In this pursuit is a call for real interdisciplinary efforts by faculty. It is not a project that can be accomplished in one workshop or seminar. The examples above are just a few selections from what is a starting base for one person. I need to know so much more, and in general we need ongoing conversations among all our colleagues, but perhaps we should concentrate, from time to time, on working together with those in theology so that we may understand their work and how it may relate to our fields. I have every confidence that they would welcome this collaboration. But isn't this interdisciplinary work exactly the kind of thing that one would expect from a university whose undergraduate program so values liberal education, and isn't this exactly what we would expect from a Catholic university?

Notes

1. Newman, James R. The World of Mathematics, Volume I. New York: Simon and Schuster, 1956.

2. Copleston, Frederick. The History of Philosophy, Volume II, Mediaeval Philosophy, Part I, Augustine to Bonaventure. New York: Image Books, 1962.

3. Adler, Mortimer J. How to think about God: a guide for the 20th-century pagan. New York: Macmillan, 1980.

4. Jaspers, Karl. (Edited by Hanna Arendt, Translated by Ralph Manheim), Spinoza. New York: Harcourt Brace Jovanovich, Harvest Edition, 1974.

5. Kung, Hans. (translated by Edward Quinn), Does God Exist? An Answer for Today. New York: Doubleday, 1980.

6. Barrow, John D. Pi in the Sky, Counting, Thinking and Being. Oxford: Clarendon, 1992.