Ten Mathematicians Who Recognized God's Hand in their Work

The fear of the LORD is the beginning of wisdom, and knowledge of the Holy One is understanding.
Prov. 9:10

Scottish philosopher David Hume (1711-1776) once observed that

"Whoever is moved by *faith* to assent to [the Christian religion], is conscious of a continued miracle in his own person, which subverts all the principles of his understanding, and gives him a determination to believe what is most contrary to custom and experience."

Evidently Hume's cynical pronouncement did not apply to Euler, Cauchy, Cantor, and other profound thinkers who believed God had commissioned and equipped them to glorify Him in their pursuit of truth through mathematics – And based on their extraordinary achievements the principles of their *understanding* do not appear to have been *subverted* too badly!

Leading mathematicians of past generations commonly affirmed that God created and sovereignly rules the universe and that He providentially sustains and nurtures His creatures. Despite Hume's assertion, history teaches us that faith often informed rational inquiry and vice versa. In many cases Christian commitment stimulated intellectual activity; sometimes mathematical understanding led to spiritual insight. In this paper, ten of history's most influential mathematicians express the role faith in God and religious conviction played in their work *in their own words*. The author does not wish to summarize or paraphrase the eloquent and moving statements of these gifted and godly practitioners of the art of mathematics.

The essay for each mathematician includes an overview of his/her accomplishments, a brief description of his/her faith and convictions, and one or more quotations. We proceed in chronological order.

1) Nicholas of Cusa (1401 – 1464)

Nicholas of Cusa (also Nikolaus Cusanus), a cardinal of the Roman Catholic Church in the Holy Roman Empire (Germany), was one of the greatest scholars and theologians of the fifteenth century. A true Renaissance man, Nicholas made significant contributions to law, philosophy, art, science, mathematics, astronomy, medicine, and theology, and served as an administrator, diplomat, scientist, and jurist as well as a cleric. Mathematically and scientifically, Nicholas was a catalyst for later discoveries in a number of key areas: calendar reform, calculus and set theory, and heliocentricity and the noncircular orbits of planets.

Nicholas's writings reveal him to be an orthodox Christian immersed in praise to God for His transcendence and for His providential care, and to Jesus Christ His Son for His mediatorial and redemptive work. According to Nicholas, God *transcends all understanding* and is *eternal and immutable* (Selected Spiritual Writings, pp. 28, 109), and that *nothing will happen except according to God's providence* (Selected Spiritual Writings, p. 118). He sees in Christ the union of human and divine natures:

> In you, O Jesus, since you are human son, human filiation is most profoundly united to divine filiation, so that you are deservedly called son of God and human son (Selected Spiritual Writings, p. 274).

For the sins of humanity this sinless Jesus must suffer and die, and be raised from the dead on the third day (Selected Spiritual Writings, pp. 184, 188); God then saves the sinner through *faith* [in Christ] *above all reason* (Selected Spiritual Writings, p. 197).

Nicholas's mathematical thought greatly impacted his understanding of God, as the following quote demonstrates.

> All our wisest and most divine doctors concur that visible things are truly images of invisible things and that from creatures the Creator can be seen in a recognizable way as if in a mirror or in an enigma. But the fact that spiritual things, unattainable by us in themselves, may be symbolically investigated rests on what we have already stated. For the way to the uncertain is possible only by means of what is presupposed. But all sensible things are in a continual instability because of the material possibility abounding in them. However, where such things are considered, we perceive that those things, such as mathematicals, which are more abstract than sensible, are very fixed and very certain to us, although they do not entirely lack material associations, without which no image of them could be formed, and they are not completely subject to fluctuating possibility. Proceeding in this way of the ancients, we agree with them in saying that since our only approach to divine things is through symbols, we can appropriately use mathematical signs because of their incorruptible certitude. (*Nicholas of Cusa: Selected Spiritual Writings*, pp. 100-101)

Nicholas of Cusa: Selected Spiritual Writings, translated and introduced by H. Lawrence Bond, preface by Morimichi Watanabe (New York: Paulist Press, 1997)

2) Johannes Kepler (1571 – 1630)

One of the truly great early modern scientists was the German astronomer and mathematician Johannes Kepler. His laws of planetary motion were foundational to Newton's law of universal gravitation and revolutionized the field of astronomy; his method of *smallest divisions* paved the way for the discovery of infinitesimal calculus (Caspar, pp. 146, 383); his genius for geometry led to his groundbreaking work in optics; and his enthusiastic support of Copernicanism led to its eventual acceptance by the scientific community and the world. In addition, Kenneth Howell claims *it was Kepler who first searched systematically for physical causes of celestial phenomena and whose mathematical application achieved a degree of accuracy previously unknown.* (Howell, p. 109)

Kepler regarded himself as a lifelong Lutheran, but he was unable to subscribe to his church's official confession. He took exception to the beliefs that Christ's body was omnipresent and that His body and blood were present with and permeated the bread and wine during the Lord's Supper, a viewpoint called consubstantiation. He favored the Calvinist position that Christ was spiritually but not bodily present with the elements during the sacrament (Hubner,

"Kepler's Praise of the Creator," pp. 369-382). As a result of holding this conviction he would suffer ongoing persecution from his church.

Kepler unapologetically expressed his praise of the Creator and His wonders as revealed in His two books, Scripture and Nature, particularly the heavens, in several of his scientific works and in his personal letters. The following quote illustrates his belief that mathematical reasoning illuminates our understanding of God:

> For He Himself has let man take part in the knowledge of these things and thus not in a small measure has set up His image in man. Since He recognized as very good this image which He made, He will so much more readily recognize our efforts with the light of this image also to push into the light of knowledge the utilization of the numbers, weights, and sizes which He marked out at creation. For these secrets are not of the kind whose research should be forbidden; rather they are set before our eyes like a mirror so that by examining them we observe to some extent the goodness and wisdom of the Creator. (*Harmonies* as cited in Caspar, p. 381)

Kepler reveals in the statement below that his ultimate desire was to glorify God in his work:

> I had the intention of becoming a theologian. For a long time I was restless: But now see how God is, by my endeavors, also glorified in astronomy. (Baumgardt, p. 31)

Baumgardt, Carola, *Johannes Kepler: Life and Letters* (New York: Philosophical Library, Inc., 1951)

Caspar, Max, *Kepler,* translated and edited by C. Doris Hellman (London and New York: Abelard-Schuman Limited, 1959)

Howell, Kenneth J., *God's Two Books: Copernican Cosmology and Biblical Interpretation in Early Modern Science* (Notre Dame, IN: University of Notre Dame Press, 2002)

Hubner, Jurgen, "Kepler's Praise of the Creator," *Vistas in Astronomy, 0018: 1 (1975), pp. 369-382.*

3) Blaise Pascal (1623 – 1662)

One of the most profound thinkers of the 17th century was the French mathematician, physicist, philosopher, and theologian Blaise Pascal. He (along with Pierre de Fermat) is credited with developing modern probability theory; he devised Pascal's triangle as an efficient means of obtaining the binomial coefficients; in exploring the geometry of cycloids Pascal employed methodology that anticipated Newton and Leibniz in their development of calculus; he made important discoveries regarding fluids (e.g., Pascal's Law), pressures, and vacuums; and he invented the hydraulic press, the syringe, and a primitive calculating machine. Transformed by a dramatic religious experience in 1654, Pascal devoted the rest of his life to studying and writing theology and philosophy, producing such influential works as *The Provincial Letters* and *Pensees* (Thoughts). (http://www.answers.com/topic/blaise-pascal).

To Pascal Christianity was both rational and spiritual. He observed that

> The Christian religion has as many signs of certainty and of evidence as the things which are received in this world as the most indubitable (Cailliet, p. 326).

Yet reason alone was insufficient for a true understanding of God:

> It is the heart which perceives God and not the reason. That is what faith is: God perceived by the heart, not by the reason (Pensees, 424 – Rogalsky)

He belonged to a sect of Roman Catholicism known as Jansenism, which emphasized man's depravity, God's sovereignty in salvation and sanctification, and the importance of pious living. One must understand the truths of the Gospel, i.e., Christi's divinity and humanity, His death on behalf of sinners, His resurrection, and His offer of salvation to all who believe upon Him. But understanding must be accompanied by heartfelt belief, which is possible only by God's initiative. And this faith must be characterized by action – a life of prayer, self-sacrifice, and service to the poor and needy (Rogalsky).

Though Pascal would vehemently deny that mathematical reasoning produces faith, he contends by his celebrated *Wager* that having faith is reasonable:

> Belief is a wise wager. Granted that faith cannot be proved, what harm will come to you if you gamble on its truth and it proves false? If you gain, you gain all; if you lose, you lose nothing. Wager, then, without hesitation, that He exists (Pensees, 233).

http://www.answers.com/topic/blaise-pascal

Cailliet, Emile, *Pascal: Genius in the Light of Scripture* (Philadelphia: The Westminster Press, 1945)

Rogalsky, Tim http://www.acmsonline.org/journal/2006/Rogalsky.htm

4) Gottfried Wilhelm Leibniz (1646 – 1716)

The German mathematician and philosopher Gottfried Wilhelm Leibniz substantively enhanced so many fields of knowledge that he has been dubbed *the last universal genius*. Along with Sir Isaac Newton, he is responsible for developing the infinitesimal calculus, and it is his notation that has survived to the present day. The binary system, invaluable to modern computer science, owes its origins to Leibniz. The fields of physics, biology, medicine, linguistics, law, politics, and theology have also greatly benefited from his expertise. His contributions to philosophy are considerable – he was one of the seventeenth century's leading proponents of rationalism, and his works laid the foundation for important branches of modern philosophy. Optimism, the view that God created the best of all possible universes, and monadology, the belief that elementary and indivisible entities (monads) comprise the spiritual realm, are attributed to Leibniz (http://plato.stanford.edu/entries/leibniz/).

Leibniz emphasized God's supremacy in the universe, especially as the only perfectly rational Being. God is all-wise, all-powerful, and benevolent; He employed *divine mathematics* to maximize goodness in creating and sustaining the best of all possible worlds: *All in all that method of creating a world is chosen which involves more reality or perfection, and God acts like the greatest geometer, who prefers the best construction of problems* (Rutherford, p. 26). He endowed man, whom He created in His image, with sufficient reason to apprehend Him and His works. Though no substitute for faith, reason must serve as a foundation to faith, lest it be superstition (Koetsier and Bergmans, pp. 487-496).

The following quotes demonstrate that Leibniz's mathematics informed his understanding of God and vice versa:

> The sovereign wisdom, the source of all things, acts as a perfect geometrician, observing a harmony to which nothing can be added. True physics should in fact be derived from the source of the divine perfections. It is God who is the ultimate reason of things, and the knowledge of God is no less the beginning of science than his essence and his will are the beginning of beings. It sanctifies philosophy to make its streams arise from the fount of God's attributes. Far from excluding final causes and the consideration of a being who acts with wisdom, it is from these that everything must be derived in physics. (*Coudert and Popkin*, p. 157)

> God is all order; he always keeps truth of proportions, he makes universal harmony; all beauty is an effusion of his rays. It follows manifestly that true piety and even true felicity consist in the love of God, but a love so enlightened that its fervor is attended by insight. (*Leibniz*, p. 51)

> Since therefore it is by the nature of things that God exists, that he is all-powerful, and that he has perfect knowledge of all things, it is also by the nature of things that matter, the triangle, man and certain actions of man, etc., have such and such properties essentially. God saw from all eternity and in all necessity the essential relations of numbers, and the identity of the subject and predicate in the propositions that contain the essence of each thing. (*Leibniz*, p. 242)

Mathematics and the Divine: A Historical Study, edited by T. Koetsier and L. Bergmans (Amsterdam: Elsevier, 2005)

Leibniz, Mysticism, and Religion, edited by Allison P. Coudert, Richard H. Popkin, and Gordon M. Weiner (Dordrecht: Kluwer Academic Publishers, 1998)

Leibniz, G. W., *Theodicy: Essays on the Goodness of God and Freedom of Man and the Origin of Evil* (London: Routledge & Kegan Paul LTD, 1951)

http://plato.stanford.edu/entries/leibniz/

Rutherford, Donald, *Leibniz and the Rational Order of Nature* (Cambridge: Cambridge University Press, 1995)

5) Colin Maclaurin (1698-1746)

The greatest Scottish mathematician of the eighteenth century, Colin Maclaurin defended and developed Newton's *method of fluxions* (calculus) and made important discoveries in algebra, geometry, actuarial science, and mechanics, particularly the gravitational attraction of ellipsoids. His *Treatise of Fluxions* brought organization and rigor to Newton's calculus, especially regarding the fundamental theorem of calculus, integration theory, optimization, and summation of infinite series. He (along with Leonhard Euler) discovered *the Euler-Maclaurin formula*, an important relationship between integrals and sums, and *the Integral Test* for convergence of a series. Though not the first to approximate functions by power series, he worked so extensively in this area that the Taylor series centered at zero bears his name. His pioneering work in actuarial science benefited the widows and orphans of Scottish professors and pastors. (http://www-groups.dcs.st-and.ac.uk/~history/Biographies/Maclaurin.html)
In *Treatise of Fluxions* (1742) Maclaurin introduced Europe to *the Integral Test* for the convergence of infinite series.

A Presbyterian raised in a clergyman's home, Maclaurin believed God to be *the Author and Governor of the universe*, *the first and supreme Cause*, and *the Lord and Disposer of all things*. (Maclaurin, pp. 3, 382, Bi-Centenary, p. 7) The perfection and multiplicity of design and the fulfillment of messianic prophecies provided him with compelling evidence of the existence and attributes of God:

> The plain argument for the existence of the Deity, obvious to all and carrying irresistible conviction with it, is from the evident contrivance and fitness of all things for one another, which we meet with throughout all parts of the universe… The admirable and beautiful structure of things for final causes, exalt our idea of the Contriver: the unity of design shows him to be One. The great motions in the system, performed with the same facility as the least, suggest his Almighty Power, which gave motion to the earth and the celestial bodies, with equal ease as to the minutest particles. The subtility of the motions and actions in the internal parts of bodies, shows that his influence penetrates the inmost recesses of things, and that He is equally active and present everywhere. The simplicity of the laws that prevail in the world, the excellent disposition of things, in order to obtain the best ends, and the beauty which adorns the works of nature, far superior to anything in art, suggest his consummate wisdom. The usefulness of the whole scheme, so well contrived for the intelligent beings that enjoy it, with the internal disposition and moral structure of those beings themselves, show his unbounded goodness. (Maclaurin, p. 381)

He viewed the prophecies of Daniel 9 (seventy weeks representing 490 years) to be *one of the best proofs of Christianity*. (Mills, p. 19)

To Maclaurin nature is God's handiwork and studying His works (via science and mathematics) is tantamount to studying Him:

> But natural philosophy is subservient to purposes of a higher kind, and is chiefly to be valued as it lays a foundation for natural religion and moral philosophy; by leading us, in a satisfactory manner, to the knowledge of the Author and Governor of the universe. To study nature is to search into his workmanship; every new discovery opens to us a part of his scheme. And while we still meet, in our enquiries, with hints of greater things yet undiscovered, the mind is kept in a pleasing

expectation of making a further progress; acquiring at the same time higher conceptions of that great Being, whose works are so various and hard to be comprehended. (Maclaurin, p. 3)

Bi-Centenary of the Death of Colin Maclaurin (1698-1746), Mathematician and Philosopher, Professor of Mathematics in Marischal College, Aberdeen (1717-1725) (Aberdeen: The University Press, 1951)

http://www-groups.dcs.st-and.ac.uk/~history/Biographies/Maclaurin.html

Maclaurin, Colin, *An Account of Sir Isaac Newton's Philosophical Discoveries (1748)* (New York and London: Johnson Reprint Corporation, 1968)

The Collected Letters of Colin Maclaurin, edited by Stella Mills (Cheshire, England: Shiva Publishing Limited, 1982)

6) Johann Bernoulli (1667-1748)

Johann Bernoulli, along with his older brother Jacob, disclosed to the world the utility of the infinitesimal calculus by bringing it to bear upon a variety of problems in the sciences and applied mathematics. His ability to integrate functions by antidifferentiating them enabled him to be the first to solve certain differential equations and sum infinite series. An optimization problem he proposed in 1696 (that he and others eventually solved) founded the branch of mathematics known as the calculus of variations. He also made valuable contributions to the science of mechanics, particularly, hydrodynamics (http://www-history.mcs.st-andrews.ac.uk/Biographies/Bernoulli_Johann.html).

Following in the footsteps of previous generations of Bernoullis, Johann was an orthodox Calvinist. His grandparents had been Huguenots (members of the Protestant Reformed church of France) and had migrated from Antwerp, Belgium, to Basel, Switzerland, to avoid persecution by Roman Catholics. Later on in life, in response to an unjust accusation of religious heresy, he passionately defended his faith: *All my life I have professed my Reformed Christian belief*, *which I still do*. (Sierksma, pp. 27-28)

It is clear that Bernoulli's pursuit of mathematics appreciably informed his understanding of God and His attributes, and his desire to glorify Him:

> Nowhere is God's power and wisdom more evident than in the study of his works, and none is better equipped for this study than the philosopher and mathematician, who tries to fathom both the nature and character of God's works. They are much to be ridiculed who scoff at philosophy and mathematics pretending the latter are of no advantage in matters of the greatest importance. (Sierksma, pp. 28-29)

> God the almighty grant that all this turns only to the glory of his name. (Bernoulli, p. 93)

Bernoulli, Johann, *Dissertations on the Mechanics of Effervescence and Fermentation and on the Mechanics of the Movement of the Muscles* (Philadelphia: American Philosophical Society, 1997)

http://www-history.mcs.st-andrews.ac.uk/Biographies/Bernoulli_Johann.html

Sierksma, Gerard, "Johann Bernoulli (1667-1748): His Ten Turbulent Years in Groningen", *The Mathematical Intelligencer,* 14(4) 1992

7) Leonhard Euler (1707-1783)

The breadth and depth and impact of Leonhard Euler's works establish him as one of the truly great mathematicians of all time—mathematics historian Morris Kline ranks him at the highest level with Archimedes, Newton, and Gauss (Kline, p. 401). His output was colossal – he was *far and away the most prolific writer in the history of (mathematics)* (Eves, p. 433). Euler's genius brought new and powerful results to nearly every branch of mathematics—analysis (calculus, differential equations, calculus of variations), algebra, classical and analytic number theory, complex variables, Euclidean and differential geometry, topology, graph theory, and combinatorics. Especially noteworthy has been his enrichment of analysis: *There are few great ideas pursued by succeeding analysts which were not suggested by Euler, or of which he did not share the honor of invention* (Cajori, p. 247).

Other fields have benefited from the Swiss mathematician's superlative industry and insights, most notably physics but also engineering, navigation, and business. The discoveries and advances he made in several branches of physics, including mechanics, astronomy, electricity and magnetism, light and color, hydraulics, optics, acoustics, and elasticity, were considerable—Clifford Truesdell regarded him as *the dominating theoretical physicist of the eighteenth century* (Truesdell, *Essays*, p. 106).

Euler proclaimed the God of the Bible to be *omnipotent*, designating Him *the Almighty* and *the Divine Omnipotence* (*Letters*, pp. 5, 353); *omniscient*, speaking of *the infinite wisdom of the Creator* and His *Most consummate wisdom* (*Letters*, pp. 395, 401); and *omnipresent*, declaring that *His power extends to the whole universe and to all the bodies which it contains… God is everywhere present* (*Letters*, p. 409). Euler declared that *the world is the work of his infinite might and wisdom* (*Defense*, II) and that *everything has been created in the highest perfection* (*Letters*, p. 390).

Euler's scientific expertise deepened his reverence for God as Creator, Sustainer, and Ruler of the universe. He asserted that *the immensity (of space and the heavenly bodies) is the work of the Almighty, who governs the greatest bodies and the smallest* (*Letters*, p. 5). In stark contrast to the deists, he argued that the universe is *no mere machine* but is

> … infinitely more worthy of the almighty Creator, who formed it. The government of this universe will, likewise, ever inspire us with the most sublime idea of the sovereign wisdom and goodness of God. (*Letters*, p. 382)

Euler was particularly intrigued with vision and the structure of the eye:

> … the eye alone being a masterpiece that far transcends the human understanding, what an exalted idea must we form of Him who has bestowed this wonderful gift, and that in the highest perfection, not on man only, but on the brute creation, nay, on the vilest of insects! (*Letters*, p. 198)

> …though we are very far short of a perfect knowledge of the subject, the little we do know of it is more than sufficient to convince us of the power and wisdom of the Creator. … We discover in the structure of the eye perfections which the most exalted genius could never have imagined (*Letters*, p. 187).

As a Calvinist, Euler insisted that God sovereignly foreordains all events without violating man's free will; that man is fallen in nature and is utterly incapable of saving himself; and that God is the architect of man's salvation in Christ:

> It is therefore a settled truth that Christ is risen from the dead: since this is such a marvel, which could only be performed by God alone, it makes it impossible to cast any doubt on the divine sending of Christ into this world. Consequently, the doctrine of Christ and of his apostles is divine and since it is directed toward our true happiness, we can therefore believe with the strongest confidence all the promises which have been made in the gospel regarding this life as well as the one to come, and view the Christian religion as a divine work aiming at our spirituality. But it is not necessary to elaborate further on all this, since each one who is convinced only once of the resurrection of Christ cannot doubt any further the divinity of Holy Scripture. (*Defense*, XXXVI)

Euler further argued that

> The holy life of the apostles, and of the other primitive Christians, appears to me an irresistible proof of the truth of the Christian religion. (Letters, p. 507)

Cajori, Florian, *A History of Mathematics*, (New York: MacMillan and Co., 1894)

Euler, Leonhard, *Letters of Euler to a German Princess, Vol. I*, (Bristol, England: Thoemmes Press, 1997)

Euler, Leonhard, "Defense of the Divine Revelation against the Objections of the Freethinkers," *Leonhardi Euleri Opera Omnia*, Ser. 3, Vol. 12, (Zurich, Switzerland: Orell-Fussli, 1960), translation by Rev. Charles L. Winkler, April 2006

Eves, Howard, *An Introduction to the History of Mathematics, 6th ed.*, (Forth Worth: Saunders College Publishing, 1990)

Kline, Morris, *Mathematical Thought from Ancient to Modern Times*, (New York: Oxford University Press, 1972)

Truesdell, Clifford, *Essays in the History of Mechanics*, (Berlin Heidelberg: Springer-Verlag, 1968)

8) Maria Agnesi (1718 – 1799)

Though chiefly remembered today for a curve that bears her name, Italian mathematician, philosopher, and linguist Maria Agnesi initially achieved fame for authoring *Analytical Institutions*, the first comprehensive calculus textbook. Praised for its organization and clarity, this work synthesized results from a number of mathematicians, notably Newton and Leibniz. Born into a wealthy Milanese family, Maria was a child prodigy who learned seven languages by the age of 13. Being the eldest of 21 children (her father was married three times), she was expected to teach her younger siblings – the mathematics textbook mentioned above was originally intended for their instruction. In a commentary she wrote on l'Hôpital's calculus text, she discussed the curve which is now named *the witch of Maria Agnesi*, the word *witch* resulting from a mistranslation of an Italian word meaning *to turn* as in *to turn a sail* (http://womenshistory.about.com/od/sciencemath1/a/maria_agnesi.htm).

Agnesi's life was characterized by religious zeal, submission to authority, and self sacrifice. An orthodox Catholic, she earnestly sought to emulate Christ in His piety and sufferings, and to deny the flesh and earthly pleasures (Mazzotti article, p. 673). In obedience to her father, she mastered abstract topics in philosophy and the sciences and regularly conversed in them with his erudite houseguests. Upon his death she abandoned these activities in favor of caring for the underprivileged women of Milan. She devoted the rest of her life and means to serving the poor, the infirm, the orphans, and the elderly, eventually dying in poverty (Mazzotti book, pp. 145-147, http://womenshistory.about.com/od/sciencemath1/a/maria_agnesi.htm).

Maria's scholarly endeavors were intended solely to glorify God, and clearly they enriched her understanding of Him and His attributes.

> Man always acts to achieve goals; the goal of the Christian is the glory of God. I hope my studies have brought glory to God, as they were useful to others, and derived from obedience, because that was my father's will. Now I have found better ways and means to serve God, and to be useful to others. (Mazzoti, p. 145)
>
> Holiness does not consist in doing great and admirable works, but in doing every thing, however small, with sublime intentions; intentions of love, and abundance of sanctifying grace. (Cupillari, p. 217)
>
> In truth, the principle on which you [Bertucci] founded your doctrine, that is the law of uniformity that God proposed as his way to operate, is an extremely just principle, and this uniformity in God's way to operate can be seen more and more as one makes progress in the knowledge of natural things. And one should not be afraid that this uniformity stands in opposition to the variety of things, which form the beauty of the universe, and instead the variety is more beautiful and admirable in the midst of this uniformity. (Cupillari, p. 192)

Cupillari, Antonella, *Biography of Maria Gaetana Agnesi, an Eighteenth-century Woman Mathematician* (Lewiston, NY: Edwin Mellen Press, 2007)

Mazzotti, Massimo, "Maria Gaetana Agnesi: Mathematics and the Making of the Catholic Enlightenment," *Isis: Journal of the History of Science Society*, 92(4) Dec. 2001

Mazzotti, Massimo, *The World of Maria Gaetana Agnesi, Mathematician of God* (Baltimore: Johns Hopkins University Press, 2007)

http://womenshistory.about.com/od/sciencemath1/a/maria_agnesi.htm

9) Augustin-Louis Cauchy (1789 – 1857)

One of the most prolific writers in the history of mathematics (second only to Leonhard Euler in the sheer volume of his works), the French mathematician Augustin-Louis Cauchy made major contributions to complex function theory, analysis, algebra, number theory, and mathematical physics. One of the pioneers of complex analysis, he developed *Cauchy's integral theorem*, *Cauchy's integral formula*, the concept of *residues*, *the residue theorem*, and *the Cauchy-Riemann equations.* By introducing rigorous standards in calculus regarding limits, continuity, and tests for convergence of series, he was one of the founders of modern analysis. As an algebraist, he initiated the study of permutation groups, and as a number theorist, he proved Fermat's *polygonal number theorem*. In physics, he made important discoveries in the wave theory of light and the mathematical theory of elasticity, and his *argument principle* has benefited control theory in engineering. He also generalized the theory of determinants (http://www.answers.com/topic/augustin-louis-cauchy).

An orthodox Roman Catholic, Cauchy passionately defended and practiced the Christian faith throughout his lifetime. In a pamphlet he published he declared:

> I am a Christian, that is, I believe in the Divinity of Jesus Christ, with Tycho Brahe, Copernicus, Descartes, Newton, Fermal, Leibnitz, Pascal, Grimaldi, Euler, Grudin, Boscowich, Gerdil; with all the great astronomers, physicians, geometricians of past ages… My convictions are not the 'result of inherited prejudices', but of profound examination… It gave me great pleasure to find all the nobility and generosity of the Christian faith in my illustrious friends. (http://www.catholictradititon.org/Easter/easter42.htm)

Closely aligned with the Jesuits, he strictly observed their practice of charitable deeds and service to the poor. He and other members of the *Institut Catholique*, established to promote Catholic higher education in France, regularly prayed that God would bless their pursuit of truth and that He would be glorified in their work (Belhoste, pp. viii, 180).

Cauchy believed that his faith inspired his mathematical/scientific achievements, and conversely, that his work enhanced his spiritual illumination:

> The Christian religion is so highly favorable to the advancement of the sciences and to the development of the most noble faculties of our intelligence. (Belhoste, p. 216)

> The great crime of the last century was that of wanting to raise nature itself up against its very Author, of desiring to set creatures in a state of permanent revolt against the Creator and even to arm the sciences against God Himself, the sciences whose only real aim must be the search for truth… In many instances the science of numbers and analytical methods can help us to discover the truth or, at the very least, how to recognize it (Belhoste, pp. 218-219).

http://www.answers.com/topic/augustin-louis-cauchy

Belhoste, Bruno, *Augustin-Louis Cauchy: A Biography* (New York: Springer-Verlag, 1991)

http://www.catholictradititon.org/Easter/easter42.htm

10) Georg Cantor (1845 – 1918)

Brilliant in his ability to abstract, German mathematician Georg Cantor revolutionized mathematics by developing modern set theory. Formerly primitive and limited in its utility, set theory now provides a generalized framework in which components of a subject are unified and clarified, and in which powerful problem-solving machinery can be brought to bear. This transformation was a result of Cantor's investigations of well-ordered sets, one-to-one correspondences, countable and uncountable sets, transfinite numbers (representing *degrees* of infinity), cardinal and ordinal numbers and their arithmetic, and the *continuum hypothesis*. Results of fundamental importance he was able to prove include *Cantor's theorem* (the cardinality of the power set of a set is greater than that of the set); the countability of the rational numbers (using his famous diagonal argument) and the algebraic numbers; the uncountability of the real numbers and the transcendental numbers; and the existence of *Cantor's set*, which is uncountable but has measure zero (http://www-history.mcs.st-and.ac.uk/Biographies/Cantor.html).

As an orthodox Lutheran, Cantor viewed God as all wise, all powerful, infinite, and perfect in all His ways. He believed God had blessed him with profound insights concerning infinity and had commissioned him as a prophet to proclaim this message to others. Asserting the existence of the actual infinite brought him fierce opposition from both mathematicians and theologians, the latter group decrying his apparent violation of God's position as the unique and supreme infinity of the universe (Dauben, *Georg Cantor: His Mathematics and Philosophy of the Infinite*, pp. 120-124, 143-145, 229, 238-239). Cantor pointed out that God's status as the Absolute Infinity enhanced rather than diminished His infinitude and *the extent of His nature and dominion*, and showed more effectively His perfections (Drozdek, pp. 45-46).

The following quotes express Cantor's fervent hope that his work would glorify God and edify His church:

> It would please me best if my work would be of benefit to the Christian philosophers dearest to my heart, to the *philosophia perennis'* [lasting philosophy]. (T. Koetsier and L. Bergmans, p. 534)

> Every extension of our insight into the origin of the creatively-possible therefore must lead to an extension of our knowledge of God. (T. Koetsier and L. Bergmans, p. 535)

> I am so in favor of the actual infinite that instead of admitting that Nature abhors it, as is commonly said, I hold that Nature makes frequent use of it everywhere, in order to show more effectively the perfections of its Author. (Dauben, *Georg Cantor: His Mathematics and Philosophy of the Infinite,* p. 124)

From me, Christian philosophy will be offered for the first time the true theory of the infinite. (Dauben, "Georg Cantor and Pope Leo XIII: Mathematics, Theology, and the Infinite", p. 107)

Dauben, Joseph Warren, "Georg Cantor and Pope Leo XIII: Mathematics, Theology, and the Infinite", *Journal of the History of Ideas,* 38(1) Jan. – Mar. 1977, pp. 85-108

Dauben, Joseph Warren, *Georg Cantor: His Mathematics and Philosophy of the Infinite* (Princeton, NJ: Princeton University Press, 1990)

Drozdek, Adam, "Number and Infinity: Thomas and Cantor", *International Philosophical Quarterly*, XXXIX (1) Mar. 1999

http://www-history.mcs.st-and.ac.uk/Biographies/Cantor.html

Mathematics and the Divine: A Historical Study, edited by T. Koetsier and L. Bergmans (Amsterdam: Elsevier, 2005)

Conclusion

Despite the contemporary view that God and religious faith play no part in serious intellectual inquiry, history has repeatedly demonstrated that quite the opposite is true. As the quotes in this paper illustrate, many leading mathematicians proclaimed the greatness of God and His works, and readily acknowledged their utter dependence upon Him for initiative and insight. Rather than substantiating David Hume's claim, discovery and advancement in mathematics and the sciences produced in the subjects of this paper a greater appreciation for an all-wise, all-powerful, and benevolent Creator, who has enlightened the human mind and spirit so that He may more fully be known and worshiped. May today's Christian mathematicians and laypersons alike not follow the world's lead in applauding man's accomplishments apart from God, but instead learn from our illustrious forebears that He alone enables our endeavors to succeed and He alone is worthy of praise.

Unless the LORD builds the house, they labor in vain who build it. (Ps. 127:1)