Ten Mathematicians Who Recognized God's Hand in Their Work (Part 2)

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Abstract

Leading mathematicians of the past commonly affirmed that God created and sovereignly rules the universe and that He providentially sustains and nurtures His creatures. History teaches us that faith often informs rational inquiry and vice versa. In many cases Christian commitment stimulated intellectual activity; sometimes mathematical understanding led to spiritual insight.

In my former paper, ten of history's most influential mathematicians expressed the role that faith in God and religious conviction played in their work in their own words. This paper explores the same for mathematicians numbered eleven through twenty.

1 Introduction

> *"For since the creation of the world His invisible attributes are clearly seen, being understood by the things that are made, even His eternal power and Godhead, so that they are without excuse." (Rom. 1:20)*

Enlightenment philosopher Denis Diderot (1713 – 1784) once observed that "Mankind have banned the Divinity from their presence; they have relegated him to a sanctuary; the walls of the temple restrict his view; he does not exist outside of it." Evidently his lesson was lost on Euler, the Bernoullis, Gauss, Riemann, and other notable mathematicians who believed God was actively working *outside the box* in commissioning and equipping them to glorify Him in their pursuit of truth through mathematics. Isaac Newton once declared, "All my discoveries have been made in answer to prayer."

My earlier paper [1] featured (in chronological order) the following mathematicians who clearly articulated their assurance of God's unmistakable presence in their lives and work:

1) Nicholas of Cusa (1401 – 1464)

2) Johannes Kepler (1571 – 1630)

3) Blaise Pascal (1623 – 1662)

4) Gottfried Wilhelm Leibniz (1646 – 1716)

5) Johann Bernoulli (1667 – 1748)

6) Colin Maclaurin (1698 – 1746)

7) Leonhard Euler (1707 – 1783)

8) Maria Agnesi (1718 – 1799)

9) Augustin-Louis Cauchy (1789 – 1857)

10) Georg Cantor (1845 – 1918)

This paper highlights ten more mathematicians who endeavored to do the same as those listed above. The essay for each mathematician includes an overview of his accomplishments, a brief description of his faith, and one or more quotations. We again proceed in chronological order.

2 Mathematicians Eleven through Twenty

11) Nicolaus Copernicus (1473 – 1543)

A native of the German-speaking territory of Prussia in the Kingdom of Poland, Nicolaus Copernicus launched one of the greatest revolutions in the history of science with the publication of his treatise *On the Revolutions of the Heavenly Spheres* in 1543. Eminent as a mathematician, physician, jurist, governor, military leader, classical scholar, Catholic cleric, economist, translator, and artist, Copernicus pursued astronomy only as an avocation [2]. Yet his heliocentric model of the universe, which opposed Ptolemy's time-honored geocentric view and was unacceptable to most scientists and churchmen of his era, was championed by Kepler and Galileo in the next century and was ultimately brought to widespread acceptance by Newton [29].

Near the beginning of Book One of *On the Revolutions*, Copernicus extols the virtues of astronomy as the pinnacle of the liberal arts in that it elevates the mind to the contemplation of the orderliness and goodness of the universe and its *Divine Architect*, as is captured in the following quotes.

> *"For who would not, while constantly studying the universe so clearly arranged in the most beautiful order and directed by divine wisdom – who would not, through the constant contemplation of this, I might almost say through intercourse with it, be induced to do everything good and to admire the Architect who created all this, in whom there is the highest bliss and in whom all good reaches its summit? The inspired psalmist would not sing that he is enraptured by God's creation and that he rejoices in the work of His hands, if he, like all men, were not moved by the sight of this Creation to the contemplation of the Supreme Good [25]."*
>
> *"So vast, without any question, is this divine handiwork of the Almighty Creator [19]."*
>
> *"For my part I believe that gravity is nothing but a certain natural desire, which the divine providence of the Creator of all things has implanted in parts, to gather as a unity and a whole by combining in the form of a globe [9]."*
>
> *"But we should rather follow the wisdom of nature, which, as it takes very great care not to have produced anything superfluous or useless, often prefers to endow one thing with many effects. And though all these things are difficult, almost inconceivable, and quite contrary to the opinion of the multitude, nevertheless in what follows we will with God's help make them clearer than day – at least for those who are not ignorant of the art of mathematics [8]."*

Regarding an exact determination of the trajectories of the planets, Copernicus observes:

> *"This more divine than human science, which inquires into the highest things, is not lacking in difficulties... In the case of the other planets (besides earth) I shall try – with the help of God, without Whom we can do nothing – to make a more detailed inquiry concerning them. [9]."*

12) Tycho Brahe (1546 – 1601)

Tycho Brahe, a Danish astronomer, mathematician, and alchemist, is credited with compiling the world's most accurate and comprehensive astronomical data prior to the discovery of the telescope. He made nightly observations of the stars and planets from Uraniborg, the celebrated observatory he built on the island of Hven off the coast of Denmark. After a disagreement with Denmark's king in 1597, Tycho became imperial mathematician and astronomer for Rudolph II, the Holy Roman Emperor, in Prague, Bohemia. Here he was assisted in his work by Johannes Kepler until the former's death in 1601. Kepler later used Tycho's observations to formulate his laws of planetary motion and in 1627 had them published as the Rudolphine Tables [5].

Tycho lost most of his nose as a result of a duel with a fellow Dane in 1566, and wore a realistic replacement made of brass for the rest of his life. Reputedly, the dispute was over the relative mathematical skills of the combatants! Also, Tycho kept a pet moose at his home near Hven that met an untimely end when it fell down stairs after it drank too much beer [14]!

The publishing of Tycho's geoheliocentric view in 1588 stimulated a lively discussion between him and a pair of German mathematician/astronomers, namely Cristoph Rothmann and Caspar Peucer. Rothmann, a supporter of Copernican heliocentrism, maintained that the Bible should not be taken literally in passages relating to science, as it was not written for that purpose but for matters relating to salvation. Below is a portion of Tycho's response.

> *"Much less do the things you affirmed deserve a place because you excuse those things that Holy Scripture asserts to the contrary. The reverence and authority due to the sacred writings is and ought to be greater than that of dragging them into common discussion. For although they adjusted themselves to the common method of understanding in physics and some other matters, yet let it be far from us to think of them as speaking in such a common manner that we do not believe them to be speaking the truth. Thus Moses, even if he does not refer to the deep things of astronomy when treating the creation of the world in the first chapter of Genesis, because he is writing for the common people, nevertheless he does introduce that which our astronomers can concede [24]."*

Peucer favored Ptolemaic geocentrism and held to an even more literal view of Scripture than did Tycho. In a letter to Peucer Tycho wrote:

> *"Nevertheless, the substantial absurdity of the earth's ordinary and continual revolution presented quite an obstacle to me, to say nothing of its being contrary to the unquestionable authority of the Sacred Scriptures [24]."*

Tycho's views of God as Creator and Ruler of the universe and the authority of the Holy Scripture are expressed in the following passages.

> *"So the heavenly bodies necessarily teach their meaning by the power placed in them by God and so one can infer that there are causes which signify. Nor does this in any way detract from divine omnipotence or liberty which are tied to secondary causes. Although God is a perfect and free agent, unrestrained by any natural law, yet he did not want to pervert the order of nature that he set up. And although God could have done everything without intermediaries, yet he was pleased by his inscrutable wisdom that all these things that normally happen in the world come from Him through means [4]."* *"For this reason I judge that, after the true and appropriate knowledge of God, revealed in the Word which he has given us, nothing is more suitable to the nature of man, and more agreeable to the purpose for which he has been created and placed on Earth, the centre of the universe, than that, while beholding as from a central place the things which shine forth in the whole structure of the world, but especially in that heavenly and brilliant court of so many everlasting stars, he should agreeably spend his life in this pleasant and studious contemplation, and that, while acknowledging God as Creator in these his wise and varied works, he should worship him with due veneration and praise [4]."*

Inscribed at the entrance to Tycho's observatory in Hven were the following words:

> *"Consecrated to the all-good, great God and Posterity. Tycho Brahe, Son of Otto, who realized that Astronomy, the oldest and most distinguished of all sciences, had indeed been studied for a long time and to a great extent, but still had not obtained sufficient firmness or had been purified of errors, in order to reform it and raise it to perfection, invented and with incredible labour, industry, and expenditure constructed various exact instruments suitable for all kinds of observations of the celestial bodies, and placed them partly in the neighbouring castle of Uraniborg, which was built for the same purpose, partly in these subterranean rooms for a more constant and useful application, and recommending, hallowing, and consecrating this very rare and costly treasure to you, you glorious Posterity, who will live for ever and ever, he who has both begun and finished everything on this island, after erecting this monument, beseeches and adjures you that in honour of the eternal God, creator of the wonderful clockwork of the heavens, and for the propagation of the divine science and for the celebrity of the fatherland, you will constantly preserve it and not let it decay with old age or any other injury or be removed to any other place or in any way be molested, if for no other reason, at any rate out of reverence to the creator's eye, which watches over the universe. Greetings to you who read this and act accordingly. Farewell [37]!"*

13) John Napier (1550-1617)

A Scottish mathematician, physicist, astrologer, and theologian, John Napier is credited with the discovery of logarithms, which revolutionized mathematical calculations and facilitated advances in many of the sciences, particularly astronomy. He also brought the decimal point into widespread use in mathematics and created a computational device known as Napier's Bones, which greatly simplified such operations as multiplication, division, and extraction of roots [13].

A student of the Bible, Napier wrote a treatise on the book of Revelation entitled *A Plaine Discovery of*

the Whole Revelation of St. John, important in Scotland as the first biblical commentary authored by a Scot and highly regarded in France, Germany, and the Netherlands as well [45]. In *A Plaine Discovery* he consistently demonstrates his desire to glorify God and to edify His church and readily acknowledges man's impotence apart from God. Below are some excerpts from this treatise.

> *"And, surely, this that I have, how small soever it be, till God enlarge me more, I offer it gladly unto the glory of God, and education of his true Church. To God, therefore, the disposer of this and all other godly works and meditations, who liveth and reigneth eternally in Trinity and Unity, be glory, praise, laud and thanks for ever and ever. Amen [28]."*

> *"In vain are all earthly convictions, unless we be heirs together and of one body, and fellow partakers of the promises of God in Christ, by the Evangel [7]."*

> *"There be three equal persons of the Deity; Father, Son, and Holy Ghost. So be there here of this Jerusalem three equal dimensions of longitude, latitude, and altitude. None of the three persons of the Deity is separable from the other; so none of these three dimensions of a city, or of any solid body, can be separable one from another, for then should it become a superfice and no solid body. The three persons of the Deity and their functions cannot be confounded; so are not these three dimensions confounded, for the length is not the breadth, nor the breadth the height [27]."*

Napier wrote the following as a dedication of his work to King James:

> *"For shall any Prince be able to be one of the destroyers of that great seat, and a purger of the world from Antichristianisme, who purgeth not his own country? Shall he purge his whole country, who purgeth not his own house? Or shall he purge his house, who is not purged himself by private meditations with his God? I say, therefore, as God hath mercifully begun the first degree of that great work in your inward mind by purging the same from all apparent spot of Antichristianisme, as that fruitful meditation upon the 7, 8, 9, and 10 verses of the 20 Chapter of the Revelation, which your highness hath both godly and learnedly set forth, doth bear plain testimony to your Majesty's high praise and honour, so also we beseech your Majesty (having consideration of the treasonable practices in these present days, attempted both against God's truth, your authority, and the common wealth of this country) to proceed to the other degrees of that reformation, even orderly from your Majesty's own persons to your highness' family, and from your family to your court; till at last, your Majesty's whole country stand reformed in the fear of God, ready waiting for that great day, in the which it shall please God to call your Majesty or yours after you, among other reformed princes, to that great and universal reformation... [7]."*

14) Galileo Galilei (1564-1642)

Hailed as one of the founders of modern science, Galileo Galilei was an Italian mathematician, physicist, astronomer, philosopher, and musician. Improvements he made to the telescope revolutionized observational astronomy and his support of Copernicus' heliocentric view of the universe helped to promote

its eventual acceptance by the scientific community. The telescope enabled him to explore the moon's surface, discover several moons of Jupiter, confirm the phases of Venus, and observe sunspots. His work in experimental physics included numerous innovative applications of mathematics [39].

Well documented is Galileo's persecution by the scientific community and ultimately the Roman Catholic Church for his outspoken support of Copernicanism, then considered to be both unscientific and unbiblical. Admittedly, Galileo had a hand in drawing the Church's ire. The Roman Inquisition tried and convicted him of heresy for his 1632 work *Dialogue Concerning the Two Chief World Systems*, in which he caricaturized the Pope as foolish for holding to a geocentric position [23]. He was forced to recant and was confined to house arrest for the last ten years of his life [39].

Galileo's awe of the Creator and the esteem in which he held His Word and Works are clearly demonstrated in the following passages of *Dialogue*.

> *"Let us, then, exercise these activities permitted to us and ordained by God, that we may recognize and thereby so much more admire His greatness, however much less fit we may find ourselves to penetrate the profound depths of His infinite wisdom [16]."*
>
> *"Many times have I given reign to my fancies about these things, and my conclusion is that it is indeed possible to discover some things that do not and cannot exist on the moon, but none which I believe can be and are there, except very generally; that is, things occupying it, acting and moving in it, perhaps in a very different way from ours, seeing and admiring the grandeur and beauty of the universe and of its Maker and Director and continually singing encomiums in His praise, I mean, in a word, doing what is so frequently decreed in the Holy Scriptures; namely, a perpetual occupation of all creatures in praising God [16]."*

Galileo demonstrates in his correspondence with his eldest daughter Maria Celeste his zeal to credit God for the astronomical discoveries he made by telescope and his acknowledgement of God's sovereign wisdom in human suffering.

> *"I render infinite thanks to God for being so kind as to make me alone the first observer of marvels kept hidden in obscurity for all previous centuries [31]."*
>
> *"Whatever the course of our lives, we should receive [sufferings] as the highest gift from the hand of God, in which equally reposed the power to do nothing whatever for us. Indeed, we should accept misfortune not only in thanks, but in infinite gratitude to Providence, which by such means detaches us from an excessive love of Earthly things and elevates our minds to the celestial and divine [31]."*

Galileo observes that although the study of the heavenly bodies cannot bring complete knowledge, it does better equip us to honor God as Creator and to learn lessons imparted by Him in general.

> *"Finally, lifting us to the final purpose of our efforts, namely, the love of the Divine Architect, [efforts toward learning some of the properties of sunspots] can sustain our hope of learning all other truths from Him, source of light and truth [17]."*

Galileo responds to what he considers to be a misapplication of Scripture to support claims of a stationary earth in a letter to friend and fellow mathematician Benedetta Castelli.

"The Holy Scriptures can never lie or err, and its declarations are absolutely and inviolably true. I should have added only that, though Scripture cannot err, nevertheless some of its interpreters and expositors can sometimes err in various ways [17]."

In an effort to persuade Christiana of Lorraine, the Grand Duchess of Tuscany, that Copernicanism does not violate the teachings of Scripture or of the Church, Galileo writes:

"To prohibit the entire science would be no different than to reject hundreds of statements from the Holy Writ, which teach us how the glory and the greatness of the supreme God are marvelously seen in all of His works and by divine grace are read in the open book of the heavens [17]."

15) Rene Descartes (1596-1650)

Rene Descartes, a French philosopher, mathematician, physicist, and writer, has been hailed as the father of modern philosophy and of analytic geometry. His philosophical works, notably *Discourse on the Method, Meditations on First Philosophy, Principles of Philosophy, Passions of the Soul*, and *Rules for the Direction of the Mind*, have greatly influenced Western philosophical thought and *Meditations* continues to be used in modern university philosophy programs. In mathematics, he devised the Cartesian coordinate system and developed analytic geometry, which provided a framework in which Newton and Leibniz would formulate the infinitesimal calculus. As a physicist, he made valuable contributions to mechanics and optics [38].

In his correspondence with French polymath Le Pere Mersenne, Descartes expresses his views of God as the omnipotent and omniscient source of all truth (including mathematics) and man as His limited and dependent subject.

"As for the eternal truths, I repeat that they are true or possible only because God knows them as true or possible; and he doesn't have this knowledge in a way that implies that they are true independently of him... In God, willing and knowing are a single thing in such a way that by the very fact of willing something he knows it and it is only for this reason that such a thing is true. So we mustn't say that even if God didn't exist these truths would be true; for the existence of God is the first and the most eternal of all truths that exist and the only one from which proceeds all others. What makes it easy for this to be misunderstood is that most people don't regard God as a being who is infinite and beyond our grasp, the sole author on whom everything depends; they get no further than the syllables of his name... Those whose thoughts go no higher than that can easily become atheists; and because they perfectly grasp mathematical truths and don't perfectly grasp the truth of God's existence, it's no wonder they don't think the former depend on the latter. But they should rather take the opposite view that because God is a cause whose power goes beyond the limits of human understanding and the necessity of these other truths doesn't put them out of our reach, these truths are less than, and subject to, the incomprehensible power of God [11]."

In Part I of his *Principles*, Descartes affirms God's infinitude and omnipotence in an effort to reconcile His sovereignty with man's free will.

> *"... that we shall have not the slightest trouble in ridding ourselves of the difficulty (which one may have in harmonizing the freedom of our will with the order of the eternal providence of God) if we observe that our thought is finite, and that the knowledge and the Omnipotence of God, whereby he has not only known from all eternity all that which is or which can be, but also has willed it, is infinite. We have therefore quite enough intelligence to recognize clearly and distinctly that this knowledge and this power are in God [26]."*
>
> *"That there is freedom of our will and that we are able to assent or not assent is so evident that it should be counted among the first and most common notions that are innate in us. At the same time, God is all-powerful, and everything is preordained by Him. [12]."*
>
> *"Although the light of reason, however clear and evident it is, may seem to suggest something different to us, we should put our faith exclusively in divine authority rather than in our own judgment [12]."*

Meditations, a systematic exposition of Descartes' philosophical thought, explores the nature of truth and of material things, the distinction between mind and body, and the existence of God. *Meditation V*, entitled *Of the essence of material things, and, again, of God, that He exists*, includes Descartes' assertion that God's truth is foundational to all other truth.

> *"And thus I very clearly see that the certitude and truth of all science depends on the knowledge alone of the true God, insomuch that, before I knew him, I could have no perfect knowledge of any other thing. And now that I know him, I possess the means of acquiring a perfect knowledge respecting innumerable matters, as well relative to God himself and other intellectual objects as to corporeal nature, in so far as it is the object of pure mathematics [which do not consider whether it exists or not] [10]."*

16) Jacob Bernoulli (1654 – 1705)

The eldest of eight prominent mathematicians belonging to the Swiss family Bernoulli, Jacob Bernoulli made outstanding contributions to the development of probability theory and Leibniz's infinitesimal calculus. In his treatise *The Art of Conjecture*, he systematized earlier work in probability theory and included his own pioneering work in permutations and combinations, the form of the binomial distribution, Bernoulli trials, Bernoulli numbers, and the law of large numbers. In collaboration with his younger brother Johann, whom he had tutored in mathematics, he demonstrated the usefulness of calculus by applying it to a number of areas of mathematics, including transcendental curves and isoperimetric inequalities. He also made important contributions to the subjects of geometry, mechanics, algebra, differential equations, infinite series, the calculus of variations, and catenary curves [34], [35].

The Bernoulli brothers' relationship devolved into one of jealousy and bitter rivalry, a sad footnote to the account of such otherwise illustrious men. Brotherly love was replaced by boasting, verbal assaults, priority disputes, accusations of plagiarism, and estrangement [36]. Nevertheless, each had an unwavering faith in God as Creator and Sovereign Ruler of the universe.

In *The Art of Conjecture*, Bernoulli uses a theological argument to help explain an important aspect of his law of large numbers. G. W. Leibniz had argued for an observable distinction between deterministic and probabalistic events and Bernoulli responds that from God's perspective all events are predetermined. He writes:

"They object first that the ratio of tokens is different from the ratio of diseases or changes in the air: the former have a determinate number, the latter an indeterminate and varying one. I reply to this that both are posited to be equally uncertain and indeterminate with respect our knowledge. On the other hand, that either is indeterminate in itself and with respect its nature can no more be conceived by us than it can be conceived that the same thing at the same time is both created and not created by the Author of nature; for whatever God has done, God has, by that very deed, also determined at the same time [3]."

Elsewhere in his great work Bernoulli, while observing that man's knowledge of the certainty of events is incomplete and subjective, elaborates upon God's complete and objective knowledge of and control over all such events:

"In themselves and objectively, all things under the sun, which are, were, or will be, always have the highest certainty. This is evident concerning past and present things, since, by the very fact that they are or were, these things cannot not exist or not have existed. Nor should there be any doubt about future things, which in like manner, even if not by the necessity of some inevitable fate, [all] nevertheless by divine foreknowledge and predetermination, cannot not be in the future. Unless, indeed, whatever will be will occur with certainty, it is not apparent how the praise of the highest Creator's omniscience and omnipotence can prevail [3]."

17) Carl Friedrich Gauss (1777 – 1855)

Generally included in the trio of greatest mathematicians of all time (along with Archimedes and Newton), German mathematician and physicist Carl Friedrich Gauss made major contributions to number theory, algebra, analysis, statistics, geometry, geodesy, astronomy, magnetism, and optics. His treatise *Disquisitiones Arithmeticae* (Number Research), which combined results of other mathematicians with new discoveries of his own, ushered in modern number theory. Statistics has benefited greatly from his derivations of the method of least squares and the normal distribution, and algebra has from his proof of its fundamental theorem and his method of Gaussian elimination. His work in non-Euclidean geometry predates that of Bolyai and Lobachevski, but priority of discovery goes to the latter pair because he didn't publish in the field. His Theory of Celestial Movement revolutionized computation in astronomy, and his collaboration with scientist Wilhelm Weber produced important results in electricity and magnetism [41], [40].

In defending the science of astronomy in his inaugural lecture on the subject at the University of Gottingen in 1808, Gauss recognizes God as the all-wise Creator of the magnificent structure of the cosmos.

"This sublime enjoyment which this study of astronomy guarantees, the peculiar satisfaction which occupation with serious sciences gives, and which cannot be described but only felt if one has the taste for it, the beneficial withdrawal from the frequently unpleasant material world by means of quiet contemplation arousing no passion, finally the magnitude and sublimity of the objects themselves – which extend our cosmic view, and so much that what we consider great and important in the hostile activity on our planet, appears petty, and why would we not confess finding again the vestiges of an Eternal Wisdom in the wonderful arrangement of the cosmic structure, the peaceful quiet which our nearsightedness

probably often believes lost to view in that hostile activity: According to my opinion these are worthy answers to the question, of what use is the study of astronomy [18]?"

In his delightful collection of stories and anecdotes, *Mathematical Circles Squared*, Howard Eves relates Gauss' acknowledgment of God as his source of inspiration to complete a difficult mathematical proof.

"Finally, two days ago, I succeeded not on account of my hard efforts, but by the grace of the Lord. Like a sudden flash of lightning, the riddle was solved. I am unable to say what was the conducting thread that connected what I previously knew with what made my success possible [15]."

In expressing his appreciation for philosophy as well as science, Gauss ranks the question of man's relation to God as one of highest importance.

"There are problems to whose solution I would attach an infinitely greater importance than to those of mathematics, for example touching ethics, or our relation to God, or concerning our destiny and our future; but their solution lies wholly beyond us and completely outside the province of science [33]."

Living with his eldest daughter after being widowed, Gauss conveys his hope that neither of them would have to live without the other:

"The best and greatest that God could grant us would be this one favor, that we two on the same day might die together [6]."

18) William Rowan Hamilton (1805 – 1865)

Irish mathematician and physicist Sir William Rowan Hamilton made fundamental discoveries in mechanics, optics, algebra, and graph theory. His reformulation of Newtonian mechanics was foundational to the development of quantum mechanics and Einstein's theory of relativity a century later. His theory of optics gave new insights for the wave theory of light and conical refraction in biaxal crystals [22]. And Hamiltonian paths and circuits are central to the graph theory applications of business efficiency, optimal routing, and the traveling salesman problem [53].

The quaternions, for which Hamilton is (perhaps) most well known, generalized complex numbers to higher dimensions and yielded fruitful applications in algebra, computer graphics, control theory, signal processing, and orbital mechanics. The rules for quaternion multiplication dawned upon him as he and his wife were crossing the Broom Bridge in Dublin, Ireland, and in his excitement, he proceeded to carve these rules in the bridge with his pocket knife [42]!

Robert P. Graves' voluminous biography of Hamilton sheds much light on his Christian faith and his desire to glorify God in his life and work. In a speech given to honor the foreign attendees of a *British Association for the Advancement of Science* meeting at Liverpool in 1854, Hamilton acknowledges the accomplishment of French physicist Leon Focault, architect of the Focault pendulum, before looking heavenward to the source of all such intellectual triumphs.

"Essentially and throughout submissive to the laws which the great Creator of all things has been pleased to impress upon matter, I admired anew the activity of the French intellect; but I looked up with even greater reverence than before to the Supreme Giver of all intellectual and of all higher treasures [21]."

Admitting in correspondence with a friend his struggles with discouragement, Hamilton maintains that his faith, though wavering in intensity, has remained intact throughout his trials.

"My struggles and alternations in the spiritual life have not been (as that former expression of mine may for a moment have led you to fear) between belief and doubt; but between warmth and coldness. My intellect has never ceased to embrace Christianity with satisfactory and complete conviction [20]."

Upon learning that his fiance Helen Maria Bayly is suffering melancholy he encourages her to trust in God's attentive care.

"Our God indeed chasteneth those whom he loveth, but not because he grudges them prosperity. Let us commit ourselves to His hands without fear that He will visit us with affliction for its own sake, or because we are happy now [20]."

In a letter to his friend and correspondent the *Marquess of Northampton* he reflects upon hearing of learned men who had rejected Christianity.

"I could not resist the impulse to repeat that (declaration) of Him to whom was given the Spirit without measure: 'I thank thee, O Father, Lord of Heaven and Earth, that thou hast hid these things from the wise and prudent, and has revealed them unto babes [20]!' "

In the same letter letter to the *Marquess* he demonstrates his understanding of Christ's sacrifice on his behalf and the eternal life that is thereby attained.

"We (he and Mrs. Hamilton) went together to the Church of Castleknock, a place known to the readers of (Jonathan) Swift; and there enjoyed what I fear Swift never knew, as it ought to be and may be known, the pleasure of joining, with thankful hearts and minds, in the commemoration of that Last Supper upon Earth of Him who gave for us His body and His blood, and who has appointed to us a way whereby we may feed on them forever [20]."

19) George Stokes (1819 – 1903)

One of the most influential scientists of the nineteenth century, Irish mathematician and physicist Sir George Gabriel Stokes made major contributions to fluid dynamics, mathematical physics, and optics, and provided invaluable leadership to scientists at Cambridge University and the Royal Society of London for half a century. His work in fluid dynamics, e.g., motion, viscosity, Stokes' Law, the Navier-Stokes Equation, etc., enhanced the foundations and applicability of that science. The field of optics

greatly benefited from his discoveries in wave theory and aberration of light, polarization, fluorescence, and spectroscopy, and mathematical physics did, in general, from the rigorous methods he employed. As Lucasian professor of mathematics at Cambridge and both president and secretary of the Royal Society, he found ample opportunity to encourage and mentor fellow scientists (most notably Lord Kelvin and James Clerk Maxwell) and to suggest possible areas of investigation [51], [52].

The design argument was for Stokes, an evangelical Protestant, overwhelming evidence of the existence of an omnipotent and benevolent God, and exploration of His Creation was a means of drawing closer to Him. That Scripture was divinely inspired and therefore authoritative was also a deeply held conviction of his. The following excerpts illustrate these views.

> *"Trials of some kind or other are almost sure to come, and death we know must come at last. But even death itself is only an incident in the bright course if we live as God grant we may. We must bear and forbear, love, comfort, and forgive, until by God's mercy we reach, as I trust we may, that City, into which must enter nothing that defileth, where there shall be no more death, neither sorrow nor crying, neither shall there be any more pain, for the former things are passed away; where, while faith shall have no more exercise, and human knowledge shall have vanished away, love shall abide forever [30]."*
>
> *"God be with you. Pray to Him to guide you aright, and if you see it to be right to go on, may He be with us in our journey through life, keeping us united in the ties of the deepest mutual affection and in the ways of His commandments, until it pleases Him to call one of us away; and at last when this transitory state of our probation is over may we dwell for ever before Him [30]."*

Stokes responds as follows to an inquiry from Mr. Arthur H. Tabrum, an official of the London Post Office, regarding the relationship between science and theology.

> *"As to the statement that recent scientific research has shown the Bible and religion to be untrue,' the answer I should give is simply that the statement is altogether untrue. I know of NO sound conclusions of science that are opposed to the Christian religion [30]."*

In another letter to Mr. Tabrum in which he points out the limitations of science in explaining the origins of life, Stokes argues for the existence of a Creator.

> *"I quite think that the existence of life is one of the strongest arguments for the existence of a Living Being who is the Author of life. I quite think with you that the great gaps which we find in the series of animated things, both plants and animals, weaken the theory that man came in an unbroken chain from some lowly form of life [30]."*

In the second of his three lectures on *light* delivered at Aberdeen University in the 1880s, Stokes reflects upon God's attentive care for man despite the vastness of the universe.

> *"In face of the views that thus open out to us, the feeling of the littleness of man comes upon us with almost overwhelming force, so much has modern research emphasized those*

words uttered of old, 'What is man that thou art mindful of him?' But when from the contemplation of such immeasurable distances we turn to an individual living being, when for example we consider the structure of our own bodies, and the wonderful adaptation of the various organs to their purpose, we see that the vastness of the universe has not caused the Creator to be unmindful of the least of his creatures. It is rather on the vastness of the scale and yet unity of plan of the universe that this year's course has led us to ponder [32]."

"Our inability to explain by mere natural causes the vast variety of forms of life, and their changes in geological time; difficulties of the Darwinian theory if regarded as a solution of the problem; evidences of design afforded by an examination of the structure of living things; marvelous adaptation of the eye to its uses; self-existence, beyond which we cannot go, not attributable to the visible universe; the evidence of design leads to the contemplation of a designing mind, of whom self-existence has been affirmed; further evidence derived from the study of the mind; inadequacy of the human mind to take in together the ideas of personality and exemption from limitation of time and space; the character of God revealed to us through the Son [32]."

Stokes also expressed in this lecture his view that the overwhelming evidence of design points unmistakeably to an omniscient and self-existence Creator.

"When I say we contemplate all this, it seems difficult to understand how we can fail to be impressed with the evidence of Design thus imparted to us. But that we want nothing more to account for the existence of structures so exquisite, so admirably adapted to their functions, is to my mind incredible. I cannot help regarding them as evidences of design operating in some far more direct manner, I know not what; but design is altogether unmeaning without a designing mind. The study then of the phenomena of nature leads us to the contemplation of a Being from whom proceeded the orderly arrangement of natural things that we behold. Thus we are led to place in a Being this attribute of self-existence which we failed to find in the races of living creatures, or even in the majestic march of the planetary bodies. And in the present connection it is noteworthy that it is precisely this attribute of self-existence that God himself chose for his own designation, when Moses was commissioned to go to his countrymen the Israelites and announce their coming deliverance from Egyptian bondage, and enquired by what name he was to call Him who sent him, the reply is, 'Thus shalt thou say unto the children of Israel, 'I AM hath sent me unto you [32].' ' "

Stokes further observes in his lecture that the reality of Jesus Christ as God's Son is evidence of a personal Creator God who loves and cares for His children.

"Are we then left to lose ourselves in an ocean of immensity, and driven to the conclusion that God is unknowable? Nay, as Christians we believe that the character of God has been revealed to us as it never had been before through that Diving Being who took our nature upon him and dwelt among us full of grace and truth. The greatness of the universe displays to us something of the greatness of its Author; but when we study the character of the Son, who is the image of the invisible God, we learn as never had been learnt before the lesson that God is love [32]."

20) Bernhard Riemann (1826 – 1866)

German mathematician Georg Friedrich Bernard Riemann's genius for abstraction profoundly impacted the fields of geometry, complex and real analysis, analytic number theory, and mathematical physics. He developed Riemannian (elliptic) geometry, a type of non-Euclidean geometry which served as the framework for Einstein's general theory of relativity and is foundational to algebraic and differential topology [48]; Riemann surfaces, configurations of the complex plane in which holomorphic functions, in particular multiple-valued functions, can be represented; the Riemann integral, which brought a new standard of rigor to integral calculus [49]; and the Riemann-zeta function, centrally important to analytic number theory. The Riemann hypothesis, which concerns roots of the aforementioned function, remains one of the most famous unsolved problems in all of mathematics [47]. His notion of hyperspace paved the way for James Clerk Maxwell's unified field theory for electricity and magnetism [43].

The son of a Lutheran minister, Riemann adopted his father's faith in God at an early age and it shaped the rest of his life. The following statements made by fellow mathematician and friend Richard Dedekind in his brief biography of Riemann provide a glimpse of the latter's faith and character.

> *The son of a Lutheran pastor, Riemann was sustained by a deep religious faith – not faith of the proud or proselytizing kind, but one which saw the main duty of the devout life as: "Daily self-checking before the face of God (Tgliche Selbstprfung vor dem Angesichte Gottes) [46]."*
>
> *Through all his troubles, he maintained a steadfast faith and conducted daily spiritual examination. As he was succumbing to tuberculosis, the Lord's prayer comprised the last words on his lips. His tombstone bears the inscription of Romans 8:28, "All things work together for good to them that love God [44]."*
>
> *"The gentle mind which had been implanted in him by his father's house remained with him all his life and he served his God faithfully as his father had, but in a different way [50]."*

3 Conclusion

Many of history's greatest mathematicians and scientists deny the Enlightenment/contemporary view that their respective disciplines have no need of religion or of God. As the quotes in this paper illustrate, many unashamedly proclaimed the greatness of God and his works and recognized that his enabling power is essential to discovery and advancement in mathematics and the sciences. Rather than substantiating Diderot's claim, they testified to an omnipresent, all-wise, and benevolent Creator who delights in enlightening the human mind and spirit in scholarship and in understanding of the universe around them. May today's God-fearing 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)*

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