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A Brief Look at Mathematics and Theology

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> *"Such a really remarkable discovery. I wanted your opinion on it. You know the formula m over naught equals infinity, m being any positive number? [m/0 = ∞]. Well, why not reduce the equation to a simpler form by multiplying both sides by naught? In which case you have m equals infinity times naught [m = ∞ x 0]. That is to say, a positive number is the product of zero and infinity. Doesn't that demonstrate the creation of the Universe by an infinite power out of nothing? Doesn't it?"*

Aldous Huxley, *Point Counter Point,* (1928), Chapter XI.

I

Introduction

We are living in a mathematical age. Our lives, from the personal to the communal, from the communal to the international, from the biological and physical to the economic and even to the ethical, are increasingly mathematicized. Despite this, the average person has little necessity to deal with the mathematics on a conscious level. Mathematics permeates our world, often in "chipified" form. According to some theologies, God also permeates our world; God is its origin, its ultimate power, and its ultimate reason. Therefore it is appropriate to inquire what, if anything, is the perceived relationship between mathematics and God; how, over the millennia, this perception has changed; and what are its consequences.

I begin with two stories. Recently, I spread the word quite among my mathematical friends that I had been invited to lecture on mathematics and theology. I wanted to get a reaction, perhaps even a suggestion or two.

One, a research mathematician, the chairman of his department, who, in his personal life would be considered very devout in a traditional religious sense, told me that "God could never get tenure in our department."

Another friend, well versed in the history of mathematics, told me that "The relation between God and mathematics simply doesn't interest me."

I think that these two reactions sum up fairly well the attitude of today's professional mathematicians. Though both God and mathematics are everywhere, mathematicians tend towards agnosticism; or, if religion plays a role in their personal lives, it is kept in a separate compartment and seems not to be a source of professional inspiration

There is hardly a book that deals in depth with the 4000 year history of the relationship between mathematics and theology. There are numerous articles and books that deal with particular chapters of the story. Ivor Grattan-Guinness has written on mathematics and ancient religions. Joan Richards has treated the influence of non-euclidean geometry in Victorian England. Joseph Davis and others have treated the attempts at the reconciliation of science and religion by Jewish scholars of the seventeenth century. But most historians of mathematics in the past two centuries, under the influence of the Enlightenment and of positivistic philosophies -- have avoided the topic like the plague.

This suppression has been an act of "intellectual cleansing" in the service of presenting mathematics as a pure logical creation, "undefiled" by contact with human emotions or religious feelings. It parallels the many acts of iconoclastic destruction that have overtaken civilization at various times and places and is still taking place. Why has it occurred? Numerous reasons have been suggested. Is it the Enlightenment and positivistic philosophies?

But things are now changing. The separation of mathematics and theology is now not nearly so rigid as it has been since, e.g., Laplace's day. There is now a substantial reversion in physics , biology, mathematics, etc to the older position. The material published runs from what is very thoughtful and sincere to what might be called "crazy." (And what is the test for what is and what is not "crazy"?).

Why? Is it part of the general perception that rationalism has its limitations? The current generation finds positivistic philosophies lacking in social and emotional warmth and in transcendental values. It is now trying to reclaim those values with

syntheses of God, the Bible, Apocalyptic visions, the Nicene Creed, Zero, Infinity, Gödel's Theorem, Quantum Theory, the Omega Point, the God Particle, Chaos, Higher Dimensions, Multiple Universes, Neo-Pythagoreanism, Theories of Everything, etc. etc. I find that most of this is bizarre. When it comes to specific statements, such as "God is a mathematician", I find the discussions both pro and con unconvincing , but I would not say, as an older generation of positivists might have said, that the statement is meaningless.

The extent of the historic relationship between mathematics and theology should not be underestimated. There is much that can be and has been said. Practically every major theme of mathematics, its concepts, its methodology, its philosophy, have been linked in some way to theological concepts. Individual mathematical features such as number, geometry, pattern, computation, axiomatization, logic, deduction, proof, existence, uniqueness, non-contradiction, zero, infinity, randomness, chaos, entropy, fractals, self-reference, catastrophe theory, description, modeling, prediction, have been wide open for theological questions and answers.

As simple examples: is God constantly geometrizing? Does God have the power to make 2 + 2 other than 4? Does God predict or simply know?

The links between mathematics and theology are part of the history of mathematics and part of the mathematical civilization into which we were born. They are part of applied mathematics. In recent years, these links have been extended to embrace theological relations to cognition, personhood, feminism, ethnicity.

The contributions of mathematics to theological thought have been substantial. The young John Henry Newman (1801-1890. Later: Cardinal) asserted that the statements of mathematics were more firm than those of dogmatic theology. Hermann Cohen, philosopher (1842 - 1918) thought that mathematics was the basis on which theology must be built. In many recent discussions, as we shall see, mathematics takes objective priority over theology just as it did to Cardinal Newman. On the other hand, one should remind oneself of the ascending hierarchical order in the days of the Scholastics (e.g., St.Thomas Aquinas, 1225-1274): mathematics, philosophy, metaphysics, with theology at the apex.

In the other direction, the contributions of theology and religious practice to mathematics were also substantial – at least until around the 14th Century. As examples church and astronomical (secular) calendars are mathematical arrangements and needed reconciliation. The Jewish philosopher and theologian

Moses Maimonides (1135 - 1204) wrote a book entitled *On the Computation of the New Moon*. Among Moslems, the determination of the qibla (the bearing from any spot towards Mecca) was important and fostered the development of spherical trigonometry. These various demands led to improved techniques and theories. Kim Plofker has only recently discussed the historical attempts to reconcile sacred and secular Indian cosmologies.

Astrology which very often had links to theology and religious practice, demanded exact planetary positions,and astrology stimulated and supported mathematics for long periods of time and led to intellectual controversy. Astrology carries with it an implication of rigid determinism and this came early into conflict with the doctrine of free will. The conflict was reconciled by asserting that though the stars at the time of one's nativity control one's fate, God has the final say, so that prayer, repentance, sacrifice, etc., undertaken as a free will impulse, can alter the astrological predictions. This is the message of *Christian Astrology*, two books with the same title written centuries apart by Pierre Dailly (1350-1420) and by William Lilly (c. 1647).

With the discrediting of astrology as a predictive technique (even as it remains a technique for individuals to shape their daily behavior), such contributions have certainly been much less publicized or emphasized in recent mathematical history than, e.g., technological or military demands

On a much wider stage and at a deeper level, claims have been made and descriptions have been given of the manner in which Christian theology entered into the development of Western science. Here is the contemporary view of Freeman Dyson:

> *"Western science grew out of Christian theology. It is probably not an accident that modern science grew explosively in Christian Europe and left the rest of the world behind. A thousand years of theological disputes nurtured the habit of analytical thinking that could be applied to the analysis of natural phenomena. On the other hand, the close historical relations between theology and science have caused conflicts between science and Christianity that do not exist between science and other religions.... The common root of modern science and Christian theology was Greek philosophy."*

The same claim might be asserted for mathematics, though perhaps with somewhat less strength.

A few western opinions over the ages, arranged more or less chronologically, should give us the flavor, if not the details, of the relationship between mathematics and theology. (See e.g., David King for Islamic writings, and David Pingree and Kim Plofker for Indian.)

However, while citing and quoting is a relatively easy matter, it is not easy to enter into the frame of mind of the authors quoted and of the civilizations of which they were part; how the particular way they expressed themselves mathematically entered into the whole. Thus Plofker has written:

> *"It is difficult to draw a clear and consistent picture of the opinons of authors who reject some assumptions of sacred cosmology while espousing others... To many scholars eager to validate the scientific achievements of medieval Indians according to modern criteria, the very notion of their deferring to scriptural authority [the Puranas] at all is something of an embarassment."*

To appreciate this, it helps to remember that the secularization and the disenchantment (i.e., disbelief in ritual magic) of the world is a relatively recent event which occurred in the late seventeenth century. For an older discussion of this point, see W.E.H.Lecky.

To quote contemporary historian of mathematics Ivor Grattan-Guinness:

> *"Two deep and general points about ancient cultures are often underrated: that people saw themselves as part of nature, and mathematics was central to life. These views stand in contrast to modern ones, in which nature is usually regarded as an external area for problem-solving, and mathematicians are often treated as mysterious outcasts, removed from polite intellectual life."*

And David Berlinski, (contemporary, philosopher, and science writer) writes

> *"As the twenty-first century commences, we are largely unable to recapture the intensity of conviction that for all of western history has been associated with theological belief."*

I now shall present numerous clips, mostly of older authors, organized according to certain mathematical topics.

Number

Perhaps the earliest mathematics/theology relationship is "number mysticism", the attribution of secret or mystic meanings of individual numbers and of their influence on human lives. This is often called numerology and its practice was widespread in very ancient times. Odd numbers are male. Even numbers are female. In Babylonia the numbers from 1 to 60 were associated with a variety of gods, and these characteristics are just for starters. Since alphabetic letters were used as numbers, the passage from numbers to ideas and vice versa was rich in possibilities.

"All is number," said Pythagoras (c. 550 BC), around whom a considerable religious cult formed and whose cultic practices seemed to involve mathematics in a substantial way. The historian of mathematics, Carl B. Boyer, wrote

"Never before or since has mathematics played so large a role in life and religion as it did among the Pythagoreans."

The words "or since" may be easily challenged without in the least denying the importance of mathematics for the Pythagorean Brotherhood.

Some mathematical mysticism occurs in Plato's Timaeus. There, Plato (c. 390 BC) takes the dodecahedron as a symbol for the whole Universe and says that: "God used it for the whole." For Plato, the world has a soul and God speaks through mathematics.

Ideas of number mysticism spread from Pagan to Christian thought. The Revelations of John (c. end of 1st Century) is full of numbers and of number mysticism. For example:

"Here is the secret meaning of the seven stars which you saw in my right hand and of the seven lamps of gold: the seven stars are the angels of the seven churches, and the seven lamps are the seven churches." (Rev. 1:20).

And then, there is the famous, oft quoted passage in Revelations 13:18:

" ... anyone who has intelligence may work out the number of the Beast. The number represents a man's name and the numerical value of its letters is six hundred and sixty six."

Innumerable computations of the Second Coming, or of the Days of the Messiah have been carried out. The idea that the end of the world can be computed is very old.

The Apocalypse, foretold in Revelations, and said to precede the Second Coming, has been and still is a favorite subject for mathematical speculation and prediction. The predictions are usually made along arithmetic lines and make use of some method of giving numbers to the historic years. For the details of a computation of the date of the Apocalypse carried out by John Napier (1550 - 1617), the creator of logarithms and one of the leading mathematicians of his day, the reader is referred to the splendid book of Katharine Firth.

Religious authorities have often proscribed such computations. But such computations have never disappeared and the desire to calculate the end of days is present in contemporary end-of-the world-cosmologies based on current astrophysical knowledge as well as in tragic episodes of religious fundamentalism.

Iamblichus (c. 250 - 330), a Neo-Platonist, in his *Theologoumena tes Arithmetikes* (The Theology of Arithmetic) explains the divine aspect of each of the numbers from one up to ten.

St. Augustine (354-430) asserted that the world was created in six days because six is a perfect number (i.e., a number equal to the sum of its divisors). Augustine also said: Numbers are the link between humans and God. They are innate in our brains.

In the 12th Century, the Neoplatonist Thierry of Chartres opined: "The creation of number was the creation of things."

The colorful mathematician and physician Geronimo Cardano (1501 - 1576) cast a horoscope for Jesus and earned thereby the wrath of the hierarchy.

The humanistic Shakespeare, whose works display little religious sentiment, has a line: "There is divinity in odd numbers." Was he perhaps picking up on the Trinity and the mystic number 3 ?

Blaise Pascal (1623 –1662), an early figure in the development of probability theory, "proves" the existence of God by means of a wager:

"God is or He is not. Let us weigh the gain and the loss in selecting `God is.' If you win, you win all. If you lose, you lose nothing. Therefore bet unhesitatingly that He is." – Pensées.

"Pascal's Wager" has generated a vast literature of its own.

Sir Isaac Newton, convert to (heretic) Arianism, alchemist, theologian, (1642-1727), the "last of the magicians" according to John Maynard Keynes, is so preeminent in mathematics and physics that the amount of material on his "non-scientific" writings – for long considered by historians of science to be an aberration -- is now substantial. See, e.g., James E. Force and Richard Popkin and also B.J.T Dobbs. Briefly, Newton attempted to combine mathematics and astronomical science so as to prepare a revised chronology of world history and thereby to understand the divine message. For example, we find in Newton's *The Chronology of Ancient Kingdoms Amended:*

"Hesiod tells us that sixty says after the winter solstice, the star Arcturus rose just at sunset: and thence it follows that Hesiod flourished about an hundred years after the death of Solomon, or in the Generation or Age next after the Trojan War, as Hesiod himself declares."

"Newton saw his scientific work as evidence of God's handiwork. He turned to religious studies later in life and considered it an integral part of his thinking. Indeed, just as today's cosmologists are trying to find a `Theory of Everything' , Newton looked for a unification of the sacred texts with his mathematico-physical theories." --Katz & Popkin.

In mathematician and clergyman John Craig's "Mathematical Principles of Christian Theology" (1699), Craig calculated, based on an observed decline in belief and a passage in St. Luke, that the second coming would occur before the year 3150. To a contemporary mathematician, Craig's reasoning is not unlike an argument from exponential decay.

Expressions of number mysticism ebb and flow. They seem never to disappear entirely. Today, number mysticism is widespread. There are said to be lucky and unlucky numbers – an ancient idea. These selections, intended for personal use, are widely available in books and newspapers."Your number for the day is 859." "In the year 1000 or 1666 or 2000 something good or something bad will happen." The

question of whether these kinds of assertions are "deeply believed" is often irrelevant given the extent to which its practice results in human actions.

Recently there were various to-dos about the new "Millennium", (including a billion-pound exhibition in London) as though the year 2000 inherited mystic properties from its digital structure. In the "Y2K flap", digital programming was indeed important, but the excessive publicity and mild hysteria were hallmarks of a virulent attack of number mysticism.

The spirit of Pythagoras seems to have influenced the thought of a number of distinguished 20th Century physicists. Arthur Eddington (1882-1944) and P.A.M. Dirac (1902-1984), for example, have searched for simple whole number (i.e., integer) relationships between the fundamental physical constants expressed non-dimensionally. Then, seemingly denying simplicity, Dirac wrote:"God is a mathematician of a very high order. He used some very advanced mathematics in constructing the Universe. "

The number of amazing patterns that can be constructed via simple arithmetic operations is endless, and to each pattern can be attributed mystic potency or divine origin. Ivor Grattan-Guinness, who is also a musician and musicologist, in a section on "the power of number" in his History of the Mathematical Sciences, gives instances involving Kepler, Newton, Freemasonry, and Bach, Mozart, and Beethoven. About W.A. Mozart (1756-91), he says in part:

> *"Mozart's opera The Magic Flute, written in 1791, to defend Masonic ideals against political attack, is crammed with numerology and some gematria. [Gematria = the identification of letters with numbers and used to arrive at insights]."*

But number, though operating within a theological context, is not always conceived within a mystic theology though we may now think otherwise. Thus Leibniz (1646-1716):

"Cum Deus calculat et cogitationem exercet, fit mundus."

(When God thinks things through and calculates, the world is made.)

Today, we may omit "Deus" from this precept: via calculation we create everything from huge arches in St. Louis (which has a great spiritual quality), to

designer drugs or to the human genome map project. To some people, these numerical computations provide the latest answer to the Biblical question

"What is man that thou are mindful of him; the son of man that thou shouldst visit him?" (Ps. 8,4)

without answering in the least what the long-range effects of such computations will be.

Thus, numbers. All of the instances cited, together with those that follow in later sections, may be deemed "applied mathematics", for they apply mathematics to human concerns and not to mathematics itself. Such an expanded meaning would be in strong disagreement with the current usage of "applied mathematics." .

Geometry ; Space

We find in the Old Testament, Proverbs 8:27: "He girded the ocean with the horizon." The Hebrew word for gird is "chug." A mathematical compass is a "mechugah." Same root. God compasses the world.

The image of God as the one who wields the compass was common. The Renaissance artists liked it and drew it over and over. In Amos Funkenstein's splendid *Theology and the Scientific Imagination,* you will find that on his cover there is a mediaeval picture showing Christ measuring the world with a compass. The compass motif lasted well into the 18th century when William Blake (1757-1827, mystic artist and poet) produced a famous engraving that combined these elements. Was this merely artistic metaphor, or was it stronger?

The world, therefore, was constructed geometrically. The classic statement is "God always geometrizes."

On a much more abstract level, Moses Maimonides (1135-1204, philosopher, theologian, and physician) denied the infinity of space. In this regard, he sided with Aristotle. On the other hand, Hasdai Crescas, poet and philosopher, (1340 - 1410) allowed it.

In Art: Dürer (1471 - 1528), Michaelangelo (1475 - 1564), Leonardo da Vinci (1452-1519), and numerous other artists of the period, men who were well versed in

the mathematics of the day, looked for the divine formula that would give the proportions of the human body. The human body was God's creation and perfection must be found there. This perfection was thought to be expressible through mathematical proportions.

Hermetic geometry (i.e., geometrical arrangements that were thought to embody occult or religious forces) abounded. Churches were constructed in the form of the cross. Secular architecture was not free of it: the Castel del Monte erected for Frederick II Hohenstaufen (1194 -1250), by Cistercian monks, displays an intricate geometrical arrangement, a fusion of European and Arabic sensibilities, based on the octagon and whose plan has been said to symbolize the unity of the secular and the sacred.

In the *Monas Hieroglyphica* (heiros, Greek: sacred, supernatural) of John Dee (1564), mathematician, the first translator of Euclid into English, a man who was both a rationalist, an alchemist, and a crystal-ball gazer, delineates certain assemblages of figures that have potency deriving from a mixture of their geometrical/astral/theological aspects.

Consider next the spiral. Much has been written about its symbolism: in mathematics, in astronomy, in botany, in shells, and animal life, in art, architecture, decoration, in Jungian psychology, in mysticism, in religion. To the famous Swiss mathematician Johann Bernoulli (1667 - 1748) who created the mathematically omnipresent Spiral of Bernoulli, its self-reproducing properties suggested it as a symbol of the Resurrection, and he had its figure carved on his gravestone in Basle. Today, the double helix carries both a biological meaning as well as an intimation of human destiny.

In my childhood, the circle persisted as a potent magic figure in the playtime doggerel "Make a magic circle and sign it with a dot." The interested reader will find thousands of allusions to the phrase "magic circle" on the Web. Magic ellipses or rectangles are less frequent.

The Buddhist mandalas which are objects of spiritual contemplation,
embody highly stylized geometrical arrangements. The amulets and talismans that are worn on the body, placed on walls, displayed in cars; the ankhs, the crosses, the hexagrams, the outlined fish, the horseshoes, the triangular abracadabra arrangements and magical squares, the sigils (= magical signs or images) of which whole dictionaries were compiled in the 17th century, the hex signs placed on house exteriors, all point to geometry in the service of religious or quasi-religious practice

There is a multitude of geometrical figures signs employed in kabbalistic practices, each associated with stars, planets, metals, stones, spirits, demons, and whose mode of production and use is specified rigorously. Wallis Budge, student of Near Eastern antiquities wrote:

> *"According to Cornelius Agrippa* [physician and magician, 1486 – 1535]*, it is necessary to be careful when using a magical square as an amulet, that it is drawn when the sun or moon or the planet is exhibiting a benevolent aspect, for otherwise the amulet will bring misfortune and calamity upon the wearer instead of prosperity and happiness."*

Let semanticists and semioticists explain the relationship between our geometrical symbols and our psyches for it lies deeper than simple designation (e.g., crescent = Islam). The geometrical swastika, which over the millennia and cultures has carried different interpretations, is now held in abhorrence by most Americans. The memory of World War II is certainly at work here, but the geometry can go "abstract" and its meaning become detached from an original historic context.

Why has Salvador Dali (1904 – 1989) in his large painting *Corpus Hypercubus* in the Metropolitan Museum in New York, placed a crucifixion against a representation of a four dimensional cube? Art historian Martin Kemp has commented:

> *"Dali's painting does stand effectively for an age-old striving in art, theology, mathematics, and cosmology for access to those dimensions that lie beyond the visual and tactile scope of the finite spaces of up-and-down, left and right, and in-and-out that imprison our common sense perceptions of the physical world we inhabit. The scientists' success in colonizing the extra dimensions is defined mathematically.."*

Pattern, Harmony, Order, Beauty

In yet a different direction: mathematics is an expression or a reflection of the pattern and of the harmonious interaction of various aspects of the world. This is an old view already expressed by Pythagoras. Ear-pleasing musical combinations, called harmonies, are correlated with simple ratios of string lengths.

One of the theological views of Middle Ages is that all phenomena are interrelated and operate according to an overall plan. What plan? A mathematical plan. God is a mathematician and has designed the world according to a mathematical plan that achieves harmony. As already noted, renaissance artists looked for the ideal mathematical proportions in the human body. Man's search for the relevant mathematical laws that control the Universe is therefore an act of piety.

Kepler (1571-1630), famous for his astronomy and mathematics, wrote:

"I undertake to prove that God, in creating the Universe and regulating the order of the cosmos, had in view the five regular bodies of geometry known since the days of Pythagoras and Plato, and that he has fixed according to those dimensions, the number of heavens, their proportions and the relations of their movements." -- The Mystery of the Cosmos, 1596.

Kepler (expressing platonic views)

"Geometry existed before the creation. It is co-eternal with the mind of God. It is God himself. Where there is matter there is geometry. ... It is absolutely necessary that the work of such a creator be of the greatest beauty...."

Some have pointed out that for Kepler, the human mind was a simulacrum of the divine mind, both being essentially geometrical. Man, as mathematician was the true human reflection of God, and through the mathematical study of the world we can truly participate in the divine.

Maupertuis (1698-1759, French scientist), whose *Principle of Least Action* is of importance in today's theoretical mechanics, wrote that God has ordained the motions of the Universe in the most perfect way, (most energy efficient, we would probably say today.)

Colin MacLaurin, (Scottish mathematician, 1698 – 1746), known to all students of calculus for the infinite series that goes by his name, wrote in the introduction to one of his books that he undertook his labors to understand and bring forth the glory of God's creations.

Chance, Probability

Diametrically opposed to order and harmony, there is the link between God and randomness or chaos which, to some extent, can be brought to heel by theories of probability. Such theories appear late on the mathematical scene.

It was thought (and is still thought by some) that God speaks through chance, e.g., through casting lots, through dice. Lots permeate the *Old* and *New Testaments* (e.g., *I Sam. 14:41; Acts 1:26*). The casting of lots to predict the future or to arrive at plan of action was a common practice.

A vestige of this practice can be seen when we flip a coin to determine an action. We may cast lots (i.e., proceed by randomization) in the interests of democratic "fairness." Lots are said to eliminate subjective judgements. It is true also that while lotteries --- which are a process of mathematical randomization --- may have multiplied enormously in the past two decades, we rarely give them -- among the "educated" public at least -- the interpretation that God has had a finger in the subsequent redistribution of wealth. But Lady Luck is often invoked and she may act as a surrogate to the Divine.

Proof

The Scholastics designed "proofs" of the existence of God that were mathematical in spirit. But where, really, is there proof positive in the world? In physics? None. In law? None. In religion, there is experience, revelation, faith, testimony, authority, interpretation, and reinterpretation, intuition, passion, and paranormal or trans-rational illuminations. But proof? The "proofs" proposed within theology appear to have little theological status and carry little emotional fervor.

In mathematics, on the other hand, there is said to reside proof positive. This being the case, mathematics has been cited as implying the possibility of indubitable knowledge in other fields, including the theological. This view of mathematics, widely accepted in the past, and still an article of faith among most mathematicians, has been challenged in recent years.

Hermeticism, Occult, Kabbalah, Astrology, Magic

It would be a total misrepresentation of the history of the relationship between mathematics and theology, if mention of these widespread doctrines and practices were omitted from this brief survey. The historical study of these doctrines, pursued now by a small but devoted corps of scholars, would be given short shrift by today's historians of "normative " science and simply dismissed by them as irrelevant,

irrational, foolish, primitive, misguided, superstitious, pre-scientific; in short, material that is best forgotten. Plofker pointed out that

>*"probably the most famous negative remark on the subject is that of Thomas Macaulay [1800-1859] to the effect that Indian astral science `would move laughter in girls at an English boarding school'."*

The connection between mathematics, theology, and mysticism, is present in the doctrines of Rosicrucianism and Freemasonry. Frances Yates who wrote extensively on these topics claims that these chapters of human thought constitute a link between the Renaissance and the Enlightenment.

The amount of material available on these topics is vast, and we may acquire from it an idea of the way that some of its doctrines and metaphysics, particularly in astrology, fostered the future development of the mathematical sciences.

Counter Opinions

In the Ancient World and later we may also discern counter opinions that assert a disconnect between mathematics and theology.

Euclid's *Elements (*c. 300 BC), one of the sacred texts of mathematicians and a paradigm of mathematical exposition and methodology, does not mention God. God is not a part of Euclid's scheme. (But in Euclid's personal life, for all we know, he may have sacrificed to the gods as everyone else in the ancient world did.)

Claudius Ptolemy (great mathematician and astronomer, 2nd century): wrote in the beginning of his *Almagest:* that "Observational astronomy is more credible than (Greek) theology."

Mohammed ibn Zakariya al-Razdi (865 - 925) wrote

>*"Books on medicine, geometry, astronomy, and logic are more useful than the Bible and the Qu'ran. The authors of these books have found the facts and the truths by their own intelligence, without the help of prophets."*

Galileo (1564 - 1642) said that God reveals himself as much in Nature's actions as he does in Scripture. The story of Galileo's controversy with the Church (observation vs. theological revelation) is too well known to be repeated here.

Baruch Spinoza (1632 - 1677): To speak of God's existence in the world was simply a way of describing the action of mathematical description and principles. No transcendence is asserted in Spinoza.

Mixed Opinions

And then there are "mixed opinions." To Nicholas of Cusa (1401 - 1464), cardinal of the church and mathematician, number was the image of God's mind. To Nicholas, the way to knowledge of the world was through number and measurement. Amos Funkenstein has pointed out that

> *"Nicholas refused to attribute even to natural motions a perfect geometrical shape.... Mathematics is an artificially constructed language; mathematical entities are* entia rationis*, generated by us. As the ultimate conceptual abstraction, mathematics is our best tool for understanding nature.. Both the success and failure of the mathematical conceptualization are an image of God's ideas--- of the world he created by `weight and measure'. The descent from the paradoxical mathematics of the infinite to the domain of finite magnitudes that are distinct and particularized because they obey the principle of non-contradiction is analogous to God's contraction into the creation."*

Pico della Mirandola (1463 - 1494) and Marsilio Ficino (1433 - 1499) introduced Kabbalah to the Christian world. Its numerological features ("gematria"), are based on the dual use of letters of the alphabet both as letters and as numbers (e.g., V = 5 in Roman numerals). The Council of Trent (1563) took a hard line against all this "mathemagic" and other forms of magic.

Despite such expressions of disapproval, we know that Tommaso Campanella actually practiced Ficinian magic (whose source can be located in the *Corpus Hermeticum* of the anonymous Hermes Trismegistus) at Rome in 1628 for Pope Urban VIII. The Pope was afraid of eclipses which his enemies (particularly his Spanish enemies) prophesied would cause his death. Campanella performed magic rituals in his presence to ward off the evil.

The Rise of Modern Science and Enlightenment Philosophy

With Galileo, Descartes, and Newton (who has been called the last of the magicians or the last of the mediaevalists) begins the gradual separation of science (and particularly mathematics) from theology

By the time we reach Pierre-Simon Laplace (1749 - 1827, who was also called the "Newton of France") the separation is ready to go public. The story (or legend) of Laplace and Napoleon is well known:

Napoleon: "I don't find God in your book on astronomy."
Laplace: "Sire, I have no need for that hypothesis."

This separation is characteristic of the subsequent history of mathematics up to the present day. It accounts for the story related earlier of the mathematician who told me that "God would never get tenure in my department." Though the turnabout was striking, the separation has never been totally complete.

In the 16th and 17th centuries -- and one can cite the names of Galileo, Descartes, Spinoza, Leibniz, Newton, Hobbes, and Vico among many others, a kind of secular theology developed, i.e., a theology independent of historical theological dogmatics and of institutionalized religious structures. Secular or cosmic theology gave a nod to the emerging science.

The link between theology and ethics is well appreciated: Spinoza sought to create an ethics *more geometrico* (in the geometrical manner), deriving inspiration from the deductive format of Euclid's *Elements.* Leibniz thought that an ethics and a practice of law based on mathematical calculations might be developed.

Stephen Toulmin points out the religious background to Leibniz' thought. In the aftermath of the absolutely devastating Thirty Years War between Catholics and Protestants, he dreamed of a language or symbolism, the *characteristica universalis,* accepted universally, which would create a common basis for a peace inducing dialogue.

Descartes attempted an analytic demonstration of God, but found the cosmos chaotic in nature. Nonetheless, he attempted to give structure to the chaos with his theory of vortices.

The story (or legend) of the great Swiss mathematician Leonhard Euler (1701 - 1763) satirizing the "mathematical-like proofs" of the existence of God before the Court of Frederick the Great of Prussia is repeated in every history book of mathematics. But in reality, Euler was reasonably devout. In his published *Letters to the Princess Friederike Charlotte*, (simple lectures on mathematical physics and astronomy; no formulas) Euler points out over and over again the wisdom and the beauty with which God has created the Universe.

Moving closer to our times, Karl Pearson (1857 - 1936, one of the founders of the subject of bio-statistics) wrote

"It is impossible to understand a man's work unless you understand something of his environment. And his environment means the state of affairs, social and political, of his own age. You might think it possible to write a history of the 19th Century and not touch theology or politics. I gravely doubt whether you could come down to its actual foundations without thinking of Clifford, and du Bois Reymond and (Thomas) Huxley from the standpoint of theology and politics. What more removed from those fields than the subject of differential equations? Yet, you would not grasp the work of de Saint Venant or Boussinesq unless you realized that they viewed singular solutions as the great solution of the problem of Free Will; and I hold a letter of Clerk Maxwell in which he states that their work on singular solutions is epoch making on this very account."

Einstein: The existence of physical laws is evidence of a "cosmic theology."

But many of us know the story of how Niels Bohr became impatient with Einstein's theological pronouncements and was led to rebuke him with:

"*Albert, don't tell the dear Lord what he should be doing.*"

Hermann Weyl (1885 - 1955, famous mathematician, Göttingen, Princeton): in the first essay in his *The Open World*, God = order = mathematics. Weyl rejects a historical God for ethical reasons. How could God put up with so much suffering?

Paul Dirac (as quoted before)

"One could perhaps describe the situation by saying that God is a mathematician of a very high order, and he used very advanced mathematics in constructing the Universe."

So we are back, essentially, to the Pythagorean "All is Number."

Why Has the Subject of Mathematics and Theology Been Neglected?

In view of the sentiments just cited, why, then, has there been no recent, extensive, recent, and scholarly book on mathematics and theology? The confluence of a number of factors can serve as an explanation:

* The gods are not mentioned in Euclid, and Euclid is the methodological and expository role model of most mathematicians.

* Secularization of western society in the wake of the "triumph" of science and technology.

* The opinion that there is really nothing worth saying on the topic. What has been said is nonsense and has impeded progress. We are now ashamed of it and so it's best forgotten or brushed under the rug.

* While mathematical ideas have permeated theological notions, the reverse is less true, so that at best, the relationship has been largely a one way street. As one skeptical mathematician said to me, "Show me how the precepts of dogmatic theology have entered into the formation of theorems."   ccc

As regards the "hard core" mathematics that I, personally, been able to produce, I have never found theological ideas to be consciously stimulating in any way. I think it is best to maintain a separation of mathematics and theology but I realize that the mathematical community is sufficiently diverse so that it is not absolutely possible to do so.

* The harmonious order and simplicity, declared in antiquity, trumpeted through the ages, ridiculed by Voltaire, and on which such 20th century mathematicians as Hermann Weyl based their mild secular or cosmic theism, is, after all, neither so harmonious nor so simple. Order and simplicity remain as research

goals, as aesthetic ideals, (cf. a Theory of Everything), but have remained elusive, and the theories evolved are certainly not simple even to most mathematical physicists.

* The miraculous is an every day occurrence in our technological world and requires no supernatural or trans-rational explanations.

* A gradual decline in the Platonic view of mathematics as preexisting independent of humans. The Platonic view requires a deistic back up of a Platonic God. The title of Brian Rotman's 1993 book says it all: *Ad Infinitum: The Ghost in Turing's Machine: Taking God out of Mathematics and Putting the Body Back in.*

* In the view of some thinkers, God must be located within a whole communal practice and experience: in ritual, in belief, in dogma, in rules, in tradition, in ethics, in imagination, in art, in song, in sacred texts, in the lives of inspired individuals. By and large, these have not been recent concerns of physicists and mathematicians. They have usually distanced their science from human concerns.

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These Irish Protestants, often living in London but regretting Ireland, stemming from families with strong clerical and professional colorations, whose occult preoccupations surely mirror a sense of displacement, a loss of social and psychological integration, and an escapism motivated by the threat of a takeover by the Catholic middle classes,...." --- Donaghue.

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II

A Brief Look at Mathematics and Theology

Some 20th Century Opinions

Philip J. Davis

Until the Enlightenment, all mathematics and sciences were conceived and developed against a strong background of religious thought and practice. Afterwards, this background weakened, never disappearing entirely, and was replaced in the minds of the occasional mathematician by a secular theology, which could, for all "practical" purposes, be ignored as regards the historiography of mathematics.

Now, two hundred and fifty years later, religious thought seems to be returning in a stronger measure to the minds of physicists and in a lesser measure to the minds of mathematicians. This thought takes on a variety of forms: theological terminology imported (metaphorically perhaps) into discussions of theoretical physics, e.g., the god-particle (Lederman), the physics of immortality (Tipler); traditional religious dogmatics updated and interpreted in the light of current physical theories and experiments; reassertions of faith as one component that underlies mathematical creativity; feminist agendas; sci-fi apocalyptisms; trans-rational personal experiences; computer Kabbalah; occultisms of many varieties; New Age doctrines. These are a few of the forms; and it should be pointed out that in addition, all the connections between mathematics and theology mentioned in Part I have been updated and revitalized.

What reasons can be assigned for this turn around? From whence comes the attempt of the remarriage of science, mathematics, and theology after such a long divorce or separation? One hears that God is once again good for sales, and that clever literary agents and publishers, with their noses to the winds of profit, sensing this, urge pliant authors to "theologize" their mathematical essays.

Cynicism aside, is it that for the most part, scientists have pushed forward with their work without consideration of the ethical consequences (until it is too late)?

"The sole end, the sovereign good, the supreme value in the ethic of knowledge – let us acknowledge it – is not the happiness of man, much less his comfort and security – it is objective knowledge itself."

--- Jacques Monod (Molecular Biologist), Collège de France, 1967.

Monod goes on to say that as a consequence, the pure pursuit of science contains an ethic that teaches us "the evil of violence and of temporal domination." This view may be argued vigorously.

Is it simply the realization that the deep questions asked by the human psyche are not answerable by so-called "rational" discourse and by the sorts of investigations that characterize science? The belief in a platonic mathematics has often been a substitute religion for people who have abandoned or even rejected traditional religions. Where can certainty be found in a chaotic universe that often seems meaningless? Mathematics has often been claimed to be the sole source of absolute certainty.

Historian of science Stephen Toulmin suggests that it is time that the notion of rationality (identified as mathematization) and the mad, neurotic quest for certainty be abandoned. When rationality is abandoned and when faith is weak or discarded, what moves in to fill the vacuum? Historian of science, Stephen Toulmin suggests that rationality be replaced by "reasonableness" and that certainty give way to living with uncertainty.

But more radical, unreasonable solutions have been surfacing. Pyrrhonism (extreme skepticism) is one of them. Another is mysticism of Christian, Buddhist or other varieties. Perhaps a significant and recent return to mysticism by a physicist was the publication of Fritjof Capra's popular *Tao of Physics*. This book pointed out certain similarities between theories of elementary particles and statements occurring

in eastern mysticism. Nobelist in Physics Wolfgang Pauli, a Jungian, asserted that if these alternate vacuum fillers appear inadequate then

> *"There remains only one choice: to expose themselves fully to these ... opposites and to their conflict. This is how a scientist can find an inner path to salvation."* (Quoted in Paul Feyerabend's article in Hilgevoord's collection *Physics and Our View of the World*.)

Scholars who have studied the rise of occultisms, kabbalisms, diabolisms, messianisms, apocalyptisms, sometimes point to social displacements at their root. As examples, the strong messianic movement among 17th Century Jews has been correlated with their displacement in the Mediterranean mercantile trade by the English and the Dutch. The Salem witchhunt has been seen as a response to the displacement of an older agrarian establishment by a new mercantile class. The strong occult tendencies in late 19th-early 20th Century Irish Protestant writers (such as W.B.Yeats, Sheridan Le Fanu, Bram Stoker, etc.) have been correlated with the power displacement of the Irish Protestants by the Irish Catholics.

The new spiritualities we are experiencing -- and they come in many varieties -- may also be correlated with displacements, not necessarily social. The past century, in some ways characterized by the triumph of science and technology, has also been a century of ideals lost — paradises lost or abandoned. Established religions have waned even as they have engaged in internecine warfare brought on by what Freud has termed "the narcissism of small differences." Marxism has been found politically and economically bankrupt. The balance between the good and the bad that has accompanied the triumph of science/technology is seen as now tipping towards the bad. Once providing light to our lives, the light provided by science and technology may now be flickering.

David Berlinksi has written:

> *"No one believes any longer that physics or anything like physics is apt to provide contemplative human beings with a theoretical arc sustaining enough to provide a coherent system of thought and feeling."*

The dream that the idealisms just mentioned would produce ideal societies and happy, contented individuals has in some cases become an absolute nightmare. The downside of science/technology has become clearer. Even as medical science has extended our lifespans, there is a price that must be paid and we are only now beginning to realize what its dimensions are. The ultimate social displacement of

humans by the machine, or humans wiped out entirely by their own cleverness or by diabolical schemes, have been staring us in the face since the bombing of Hiroshima on August 6, 1945. The WTC events of Sept 11, 2001 have reemphasized that the forward march of technology takes place under a Faustian contract.

New ideals, new utopias, have emerged or are emerging: feminism, green movements, born-again "isms" of all varieties, the dream of a race-irrelevant society, the dogma of the free market, the thought that genetic engineering combined with medication to produce "mid-course corrections", can produce beautiful, perfectly adjusted individuals, the thought that the computer -- that most mathematical of machines -- can free up our lives from its daily dross and leave us to spend our time in pure creativity (whatever that means). All these are part of a background against which theology has sought a dialog with science and science and (to a lesser extent) mathematics has sought new spiritualities.

There are numerous institutes and centers founded in the 20th Century that have attempted to bring together scientists and theologians for dialogue. Many conferences have been held and their publications should be consulted. Thus, the *Conference of Science, Philosophy and Religion in the Relation to the Democratic Way of Life* dates from 1939. The more recent *Center for Theology and the Natural Sciences* in Berkeley, according to its founder Robert John Russell, physicist and theologian, calls for a creative interaction, a synthesis of science and religion that uses the similarities that have shown up between the two. The two are

"*not at the poles of objectivity and subjectivity... Religion...needs the rigors of science to rid it of superstition, for religion inevitably makes truth claims which must be weighed against the grueling tribunal of evidence.... Science needs religion to expose its pretensions to absolute authority and unique an unequivocal truth.*"

Great syntheses have occurred in the past, e.g., the 13th Century Aquinian blend of aristotelianism and dogmatic Christianity. A significant marriage between science/mathematics and theology has not in my opinion yet occurred. Though a myriad of new religions are born each year (see Lester) none appears to be a syncretism of science and theology. One may well wonder whether a genuine such synthesis would mean the end of science and of religion as it has been up to now experienced.

The amount of recent material on science and theology both commercially available and on the Web is absolutely staggering. One authority has estimated it at several hundred published books a year. In scanning this material lightly, I find is

that theologians are still suffering from the shock of Galileo and that mathematicians are still locked into a belief in the absolute objectivity and indubitability of what they have produced. It should be pointed out that in most statements about science, mathematics occurs only implicitly; much theoretical science is now completely immersed in or identified with applied mathematics.

I will comment on but a few of those statements; ones that have caught my particular attention.

Kurt Gödel

The name of Kurt Gödel (1906 - 1978), a singular genius and a man of extraordinary mathematical insight, is known to the general reading public if only through Douglas Hofstadter's prize winning, *Gödel, Escher, Bach.* His works on the limits of logic have inspired awe, respect, endless development and speculation among mathematicians, and indeed among all theoretical scientists. His "Incompleteness Theorem" around which most of the development and speculation revolves, states that given a consistent formalization of arithmetic, there are arithmetic truths that are not provable within the system. This has been interpreted as a limitation on rationality and it shattered the views of previous logicians.

Recent biographies of Gödel -- particularly that of Hoa Wang who had long conversations with him -- reveal that Gödel was greatly concerned with theological matters. Indeed Wang implies that it would be very difficult to separate Gödel's scientific impetus and accomplishments from his religious concerns.

Gödel believed that God is the central monad, the last word interpreted in the Leibnitzian sense. He speculated on an afterlife:

> *" I am convinced of the afterlife, independent of theology. If the world is rationally constructed, there must be an afterlife."*

Gödel gave an "ontological proof" of the existence of God. (Wittgenstein remarked that those who wanted to provide an intellectual basis for belief furnished proofs of existence of God. But their actual belief was not based on the proof.)

Gödel*: "Einstein's religion is more abstract, like Spinoza and Indian philosophy. Spinoza's god is less than a person is; mine is more than a person*

is; because God can play the role of a person. There may be spirits which have no body but can communicate with us and can influence the world."

In sum, I would say that while Gödel's mathematical accomplishments were remarkable, his theological beliefs and statements were rather unoriginal. What, perhaps, is remarkable is that Gödel was educated and worked at the University of Vienna within the shadow of a group of logical positivists (the *Wienerkreis*) comprised largely of agnostics, atheists, or secular theists. If it means anything, Gödel, in his later years, was a far-gone paranoid schizophrenic. It would appear that his theological views acted as compensation for and existed in severe tension with his logical discoveries.

John Polkinghorne: Analogies from Physics

There are books that attempt an integration of theology and science/mathematics along traditional religious lines. One such is John Polkinghorne's prestigious Gifford Lectures*; The Faith of a Physicist* and his earlier *One World: The Interaction of Science and Theology.*

Polkinghorne left a brilliant career as a theoretical physicist at Cambridge University to take orders in the Anglican Church. Polkinghorne explains how he was able to make a commitment to dogmatic Anglican theology coming, as he did, from the current scientific practice and its metaphysics. He uses a variety of argumentative devices to make his case: analogy, metaphor, non-contradiction, apodictic statements, etc. For example: the dual nature of Christ as god/man is displayed as parallel to the wave/particle complementarity of quantum physics.

In his Gifford Lectures, Polkinghornes's faith is threaded through the assertions of the fourth century *Nicene Creed* in a remarkable tour de force. The various items of the creed are separated and argued into, not argued away from.

Polkinghorne also sets out a number of principles as part of his contemporary, personal credo; namely, the world is elusive, intelligible, problematic, surprising, containing chance, necessity and futility. It is big, tightly knit, and both complete and incomplete.

Polkinghorne's theology is both abstract Platonism and very personal: my God, my beliefs, and I. His intellectual scheme does not constitute a religion in the fullest

sense of ritual, church, a community of believers, psychological support or the consequences of institutionalization

Sarah Voss: "Mathaphors"

Far from Polkinghorne is Sarah Voss' *What Number is God?* A Unitarian Minister with some scientific training, Voss uses mathematical expressions metaphorically to clarify religious concepts.

> *"For me, mathematics is a tool to use in promoting spiritual inquiry and growth. It's useful, beautiful, and just a bit gimmicky. With `holy mathaphors' I believe we have a chance at genuine dialogue. We know what it means when we say `God is a woman' or `God is Christ'* [P.J.D: do we really?]; *maybe we like what it means and maybe we don't. We may even be passionate about it. But who knows what it means to say `God is a definite integral of calculus'? Well, I do. And maybe I can convey that idea well enough that you'll agree with me when I offer the metaphor as a way of thinking about God that is particularly relevant to modern-day society."*

Mary B. Hesse: The Inadequacy of Scientific Models of God.

Mary B. Hesse who was professor of philosophy of science at Cambridge University, discusses various models of God and their plusses and minuses. Note the word "models." I believe this derives from the scientific neologism "mathematical models" and which implies an impermanence of a theoretical conception. She exhibits models from nature, cosmological models, evolutionary models and finds them inadequate. (See her article *The Sources of Models for God* in Hilgevoord.)

> *"The attempt to build models of God from the structure of natural laws is misguided"*

> *"Mathematical structure, even if convergent in true laws, is not strong enough to serve as a surrogate model for God."*

As regards evolutionary models, to eliminate time (so as to produce a time-invariant deity), one must

"fill the gap with some metaphysical or teleological such as that God is an agent who directs the Universe along just one of the possible paths allowed by evolutionary science... On this view, God has to be reckoned the designer of undesirable features such as the capacity of the world for evil and disaster whether natural or created by humans. ... A model of a good God has to presuppose a moral structure of the Universe which can certainly not be derived from the scientific facts alone."

Margaret Wertheim: A Feminist Explanation of Current Scientific Religiosity.

I turn next to Margaret Wertheim's *Pythagoras' Trousers: God, Physics and the Gender Wars,* a book that locates current scientific religiosity in male macho-ism.

Margaret Wertheim is an Australian science writer who holds bachelor's degrees in both in physics and in mathematics. She writes books, magazine articles, and has done prize-winning radio and television work relating to the mathematical education of women. Some of what she has written is easily refutable; some is problematic; but all has engaged my attention.

Why did Wertheim get out of science? Wertheim tells us that after a point she couldn't stand the heat in the mathematical and physics kitchen and changed into writing and the media.

"One of the reasons more women do not go into physics is that they find the present culture of this science and its almost antihuman focus, deeply alienating. ... After six years of studying physics and math at University, I realized that much as I loved the science itself, I could not continue to operate within such an intellectual environment." (p. 15)

There will be found in *Pythagoras' Trousers,* often intertwined, polemical material on male dominance and misogyny ,profiles of a number of distinguished women scientists , a plea for more women in science, the relationship between science and theology over the past 2500 years. This material has been well chewed-over in previous literature.

What is present in *Pythagoras' Trousers* and has been less discussed in older literature are the displacement of religious revelation and salvation by scientific revelation and salvation and the "dubious phenomenon" of the reemergence of God on current pages of physics popularizations. (Less the case with mathematics.) Both trends are interpreted along feminist lines.

God has returned to the stage from the wings, and science, Wertheim says, is now an overtly religious enterprise. This is due to the exclusion of women from the field and she relates it, perhaps metaphorically, to the exclusion of women from the religious priesthood. The priestly and god-seeking atmosphere now surrounding contemporary physics is inhibiting the entry of women into the field!

> *"Mathematical Man's problem is neither his math nor his maleness per se, but rather the pseudoreligious ideals and self-image with which he so easily becomes obsessed." "How should we respond to the powerful religious undercurrents in physics today? We should reject them."*

"The time has come," she concludes, "for a mathematical based science envisioned and practiced equally by both sexes."

The bottom line of Wertheim is that if more women were in mathematics and science (particularly in physics), then they would create

> *"an environment in which one could pursue the quest for mathematical relationships in the world around us, but within a more human ethos." ... "The issue is not that physics is done by men, but rather the kind of men who have tended to dominate it."*

One may truly wonder whether with a larger participation by women in science and mathematics the theological impulse would recede? Would it point to a unique feminine perception and sensibility to the world? This is an issue on which feminists themselves have not been able to agree.

The "Big Question" Books

I turn lastly to a category into which numerous major publications fall: the "Big Question Books." Here are some of the "Big Questions": Why is there something and not nothing? What is time? What is reality? Are time and space finite or infinite? Are mind and matter distinct? Is psychology really biology? What is consciousness? Is the human brain a computer? Is the Universe? What are the beginning and the end of the Universe? Is there design to the Universe? Can theology be deduced from (or refuted by) science? Can morality? Can immortality be inferred?

What does it all mean? All of these questions edge towards an engagement with the theological. Theological statements are among the Big Answers.

The "Big Questions" are often answered by "The Big Scientific Principles." What are some of the current Big Principles? Gödel's incompleteness theorem. The 2nd law of thermodynamics, the principles of evolution, Einsteinian relativity, the principles of indeterminacy. The Church-Turing hypothesis (that all that is computable can be done on a Turing machine.)

Our finest scientists have written some of these books and some of them have made the best seller lists. This is surprising since the public hates the details of science as scientists experience them on a day-to-day basis. On the other hand, it loves answers to the Big Questions much more than work-a-day scientists do. And the public is willing to pay to pay for the answers, especially when answers come spiced with apocalyptisms.

All the Big Questions will presumably be answered when scientists succeed in arriving at a "Theory of Everything". The speculations surrounding a presumptive Theory of Everything are certainly engaging: what form will it take, mathematical or other; what will be its explanatory limits; will it be unique; does it spell the "end of science"; does it mean, as Stephen Hawking has written, that if we had such a theory, "it would be the ultimate triumph of human reason – for then we would know the mind of God."

In Margaret Wertheim's view, Steven Hawking is quasi-religious. His god is a Pythagorean god stripped of all psychological and ethical qualities; "a god whose sole function is to bring into material manifestation a Universe based entirely on mathematical laws." He limits the options that God has. Ultimately, Hawking = God.

Wertheim claims that the search for a Theory of Everything is an aspect of monotheism. The physical development of the cosmos that came after the big bang was symmetry breaking and that was a parallel to the Expulsion from the Garden.

If a Theory of Everything can be regarded as a "master narrative", then scientists' tendencies to create such narratives is in opposition to the general contemporary intellectual tendencies:

> *"The 20th century has been the age of the aftermath: post-modern equals post-war, post-holocaust, post-colonial, post-gender, post-history, and most important for the cultural critic's enterprise, post-`master narrative'."* ---

Dagmar Barnouw, quoted by Toulmin

Human Consequences of Philosophies of Mathematics

Philosophies of mathematics, maintained consciously or unconsciously, affect research, education and applications. They spill over into attitudes of the general public and can ultimately embody them.

Consider a heterodox (i.e., non-establishment) application of mathematics. Post- rational religious groups and their mathematically inclined members do mathematical exercises with the Hebrew Bible text, e.g., skipping every 2nd, 3rd, ... letter. In this way they claim to discover future events embodied in the text. There are historic precedents for this kind of activity, but is this serious in today's world or is it merely hoaxing with mathematics? Eyebrows have been raised in scientific circles ; such investigations embarrass and enrage the mainstream and have been dubbed an abuse and a desecration of mathematics.

Yet, there is another way of looking at the matter: from a pragmatic or utilitarian point of view. Ask: what do the beliefs and activities of mathematics of whatever sort, pure or applied, or of theoretical physics, do to people, or what do they do for people? Topics such as astrology, numerology, kabbalah, hermetic magic, alchemy, have mathematical components, often trivial, often deep, and they satisfy certain needs. These are topics in which the ancestry of mathematics and science must be located. What actions do people take as a result? They are multifold.

Despite today's repugnance and rejection of them by establishment scientists, they must NOT be written off as non-applications. They have had social consequences, even as theories of exterior ballistics or a proposed construction of a super-collider have had consequences. We should not separate out for consideration an officially approved subset of science/technology and brush the rest under the rug. We should make value judgements – scientific, ethical, moral, utilitarian, aesthetic -- on all sorts of mathematical material. The world of "established" applied mathematics, in addition to its triumphs, is itself strewn with failed or inadequate or socially deleterious models of all kinds.

A PERSONAL CREDO

All the post-enlightenment histories of mathematics that I've read have deleted most of the thoughts of very substantial mathematicians on the relationship between mathematics and theology. This suppression has been an act of "intellectual cleansing" in the service of presenting mathematics as pure logical creation, "undefiled" by contact with human emotions or religious feelings.

I realize that historically the separation of mathematics and theology is now not nearly so rigid as it has been since, e.g., Laplace's day. There is now a substantial reversion to the older position; in mathematics, physics biology, etc. The material published runs from what is very thoughtful and sincere to what might be called "crazy." (And what is the test for what is and what is not "crazy"?)

I believe that in my generation, the belief in a platonic mathematics has often been a substitute religion for people who have abandoned or even rejected traditional religions. Where can certainty be found in a chaotic universe that often seems meaningless? Mathematics has often been claimed to be the sole source of absolute certainty.

The current generation finds positivistic philosophies lacking in social and emotional warmth and in transcendental values. It is now trying to reclaim those values with syntheses of God, the Bible, Apocalyptic visions, the Nicene Creed, Zero, Infinity, Gödel's Theorem, Quantum Theory, the Omega Point, the God Particle, Chaos, Higher Dimensions, Multiple Universes, Neo-Pythagoreanism, Theories of Everything, etc. etc. I find that most of this is bizarre. When it comes to specific statements, such as "God is a mathematician", I find the discussions both pro and con unconvincing.

As regards the "hard core" mathematics that I, personally, been able to produce, I have never found theological ideas to be consciously stimulating in any way. I think it is best to maintain a separation of mathematics and theology but I realize that the mathematical community is sufficiently diverse so that this separation will never occur.

of one address at the *Ősterreichisches Symposion zur Geschichte der Mathematik*, Neuhofen an der Ybbs, Spring, 1999.

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" The lights of science couldn't hold a candle
to Mary risen, gorgeous as a jungle bird!"

Clipped from a poem written on the occasion in 1950, when the Pope defined the dogma of Mary's Bodily Assumption.

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