Catholic Scientists Throughout the Ages

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The notion that the Church has traditionally been hostile to, or even suspicious of scientific innovation and discovery is a common misconception. In this regard, one need only look at one great scientific institution that the Church supports, and a brief tour of some of the great scientists from history who were devout Catholics and whose work was never censured by the Church in any way. Indeed, some of these individuals were even cardinals, bishops, priests and religious women, and a few have even been beatified and/or canonized as saints.

1. The Pontifical Academy of the Sciences

In 1603, the *Academy of the Lynx-Eyed* (*Accademia dei Lincei*) was founded in Rome under the patronage of Pope Clement VIII. The purpose of the Academy was to develop "a method of research based upon observation, experiment, and the inductive method"– in other words, a truly *scientific* method. Its unusual name was coined by *Federico Cesi*, the Roman prince who started the Academy, and referred to his desire that the scientists who worked there have eyes as sharp as wildcats in order to penetrate the secrets of nature, on both the tiniest and the largest levels.[1] It predates all other existing scientific societies, including the English Royal Society and the French Academy of the Sciences.[2] In 1611, Galileo was inducted and quickly became its greatest member and president. The Academy published at least two of his works before it closed with the death of Cesi in 1630.

It was refounded in 1847 by Blessed Pius IX, under the name *Pontifical Academy of New Lincei*. In 1937 it received its present name from Pope Pius XI – the *Pontifical Academy of Sciences* ("pontifical" refers to the pope, who is also known as the Roman *Pontiff*). Its goal is "the promotion of the progress of the mathematical, physical, and natural sciences, and the study of related… questions and issues."[3] Since 1908, it has had forty-five Nobel Prize winners among its members.

As should be expected on the basis of the Church's teaching regarding the legitimate autonomy of the sciences, the Pontifical Academy of the Sciences enjoys autonomy as a scientific organization.[4] It includes scientists without regard to their membership in the Catholic Church, recognizing that all human beings are capable of reason, and therefore, of good science. As of 2017, members included the renowned physicist Stephen Hawking, a self-proclaimed atheist, and Francis Collins, the geneticist who led the team that mapped the entire human genome, an evangelical Christian.

Through supporting and maintaining this internationally esteemed Academy, the Church offers a clear example of her love and respect for the sciences. It is clear from its

[1] Marcelo Sorondo, *The Pontifical Academy of Sciences: A Historical Profile*, The Pontifical Academy of Sciences Extra Series 16 (Vatican City: 2003), 8.
[2] Ibid., 8.
[3] Ibid. 1-2. Cf. Pontifical Academy of Sciences, *Statutes* of 1976, art. 2, §1.
[4] Ibid., 18.

existence that the Church shares the biblical perspective on science as something God desires of his human creatures. As we shall see in the next section, it is a call to which many Catholics have responded through the centuries, some of whom have changed science and the world forever through their discoveries. Let us turn to these great Catholics now.

2. Catholic Scientists throughout the Ages[5]

If our tour of the evidence of Sacred Tradition were only to show us openness to scientific insights on the part of the Church, but no or just very few actual scientists within the Church, it would be rather empty. Perhaps there is no better way to see the witness of Sacred Tradition regarding science than to observe how many great scientists the Church has had within her ranks throughout history. Stretching back to ancient times and forward to the present day, Catholic men and women have understood God's call to include investigating the natural world, and have made major contributions to science; some of them have even been *game-changers*, i.e. scientists who founded whole branches of science or whose original discoveries advanced understanding for all ages to come. The following is a very incomplete chronological list of Catholic scientists, with special attention given to the game-changers in Church history.

John Philoponus (Catholic Layman: Astronomy, Physics 490-c. 570) was a theologian and natural philosopher in Alexandria, Egypt. One major contribution lay in his passionate denunciation of the widespread pagan belief that the stars were unchanging, divine entities. He saw that they were changeable and different from each other in numerous ways. Against the scholarly opinions of his day he correctly theorized that the Sun was made of the same fire that we see in earthly fires, that the space above the Earth might be a vacuum, and that light actually moves.[6] He also realized, contrary to the thought of Aristotle, that the weight of an object does not affect the time it takes for it to fall—in other words, heavier objects fall at the same rate as lighter ones.[7] These were all revolutionary ideas for his time, and a thousand years later he was still being recognized for his genius. In fact, the principle of impetus, proposed by Jean Buridan as mentioned above, was first proposed by Philoponus.[8]

Game-Changer: Sylvester II (Pope: Mathematics, Astronomy, c. 946-1003) also known as Gerbert of Aurillac, introduced Arabic numerals, the abacus (an ancient computing device) and other scientific methods and devices into the Western world. During three years in a Spanish monastery he studied the writings of Muslim scholars in the monastic library and discovered numerous innovations unknown in Europe. At that time people were still using Roman numerals for calculation. Gerbert realized that Arabic numerals, with their inclusion of the number zero, were much easier to use in math than the cumbersome, long Roman numerals. In astronomy he reintroduced the *armillary sphere*, a model of objects in space centered on the Earth (depicted as a globe) and showing their movements in relation to the Earth. In fact, he constructed one with

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[5] (*Author's note: This section was partially created by Stephen M. Barr and Dermott Mullan. It was originally an account of priest-scientists from the Middle Ages to the 20th century, but has been expanded.)*
[6] David Bentley Hart, *Atheist Delusions* (New Haven, CT: Yale University Press, 2009), 69.
[7] James Hannam, *The Genesis of Science* (Washington, D.C.; Regnery Publishing, 2011), 172.
[8] Ibid., 179.

precision and amazing accuracy for its day. He even invented and built a hydraulic-powered musical organ.

Game-Changer: St. Hildegard of Bingen (Nun, Abbess, Naturalist: Botany, Zoology, Medicine, 1098-1179) was a German Benedictine mystic, abbess, playwright, composer and philosopher of nature who wrote texts on botany and medicine, a genius who even constructed an alternative alphabet and language. Her book entitled *Physica* is an encyclopedia of information on plants, trees, animals, stones, metals, and elements. She also composed a book on diseases and their causes, although in this regard her insights were limited by a lack of information about microscopic organisms that no one possessed at the time. Hildegard may have been the first woman to produce such works, and so is considered one of, if not the, first female scientist in Western civilization. She was declared a doctor of the Church in 2012 by Pope Benedict XVI, who also officially added her to the list of the Church's saints due to her eminent holiness.

Robert Grosseteste (Bishop: Physics, 1168-1253) used both mathematical analysis and experimentation in the study of the behavior of light (the branch of science called *optics*). These were vitally important steps in the development of truly empirical science. Grosseteste formulated a geometric law for the refraction of light that was qualitatively correct, and used it to explain (correctly) how lenses magnify images.

Game-Changer: St. Albert the Great, a.k.a. *Albertus Magnus* (Dominican Priest, Bishop: Biology, 1200-1280) is famous for being the teacher of St. Thomas Aquinas. He emphasized in his writings the importance of an experimental approach to science. And he practiced what he preached, by doing a great amount of original observational work in botany and zoology, especially in the classification of plants, flowers, and fruits; in animal reproduction and embryology; and in the study of insects. For example, he was the first to distinguish between thorns and prickles on the basis of their formation and structure, to note the influence of light and heat on the growth of trees, to establish that sap is tasteless at the root of a plant but becomes flavored as it ascends, and to discover that ants lose their sense of direction when their antennae are removed. The *Dictionary of Scientific Biography* calls his work *On Vegetables and Plants* "a masterpiece for its independence of treatment, its accuracy and range of detailed description, its freedom from myth, and its innovation in systematic classification."[9]

Thomas Bradwardine (Priest, Archbishop: Physics 1290-1349) analyzed Aristotle's ideas on motion and showed that they were mathematically inconsistent. He then attempted to develop a mathematical law that related the force acting on a body, the body's resistance to force, and the resulting velocity of the body. Even though Bradwardine's law was not correct, it was the first attempt to formulate a mathematical law of motion. And it illustrates both the creativity of medieval scientists and their willingness to criticize the mistakes of the science that they inherited from the ancient world.

[9] "Albertus Magnus, Saint," in *Complete Dictionary of Scientific Biography,* Vol. 1 (Detroit, MI: Charles Scribner's Sons, 2008), 101.

Game-Changer: Nicholas Oresme (Priest, Bishop: Physics, Astronomy, 1329-1392) was the most brilliant scientist of the Middle Ages. Oresme was not only very original, but also remarkably broad in his interests and accomplishments. He made contributions to musicology, psychology, physics, and mathematics, and is considered the greatest economist of the Middle Ages.

In mathematics, Oresme discovered the rules for combining "exponents," and even discussed fractional exponents and irrational exponents. He developed the use of simple graphs to plot physical quantities, thus anticipating by three centuries some of the ideas of Cartesian "analytic geometry." He used such graphical methods to prove the "Merton theorem," which gives the distance traversed by a uniformly accelerating body. Oresme proposed that the speed of a falling body is proportional to the time it has fallen, which is correct and is equivalent to the famous "law of falling bodies," which Galileo discovered almost three hundred years later. Oresme argued that the apparent motion of the stars could be explained by the Earth's rotation on its axis, and the analysis by which he refuted common physical objections to this was superior in some ways to those later given by Copernicus and Galileo, because he understood how to decompose motion into horizontal and vertical components.

Interestingly, Oresme and his teacher Jean Buridan were the first in Church history to propose that the Sun, not the Earth, might be at the center of the universe (no one had a concept of a solar system distinct from the universe until after the Scientific Revolution). Although they incorrectly concluded that the Earth was at the center (*geocentrism*), they showed that no physical arguments existed that could refute the position that the Sun was at the center (*heliocentrism*), paving the way for Copernicus, who used an analogy he discovered in Buridan's writings to make his argument for the Earth's motion around the Sun.[10]

Historians of science rightly admire the boldness of Copernicus and Galileo in suggesting that the Earth was in motion and that the Sun rather than the Earth was at the center of the universe, and rightly disapprove of those who attempted to repress this idea. Yet it is not often mentioned that Copernicus got the idea from a priest (Buridan) and a bishop (Oresme) who investigated it over a century before he did.

Nicholas of Cusa (Priest, Bishop, Cardinal: Cosmology, 1401-1464) was an important figure in medieval philosophy. In fact he was really more of a theologian and philosopher than a scientist. For theological and philosophical reasons, Cusa suggested that the universe is infinitely large and has no center and that all bodies in the universe, including both the Earth and the Sun, are in motion in infinite space. He also theorized favorably about the existence of intelligent life on other planets, which he thought was probable due to God's perfect wisdom and creativity.

Game-Changer: Nicholas Copernicus (Layman, Founder of Modern Cosmology, 1473-1543), the great Polish astronomer who speculated that the Sun, not the Earth, was the center of the universe. It was his great book *De Revolutionibus orbium coelestium* ("On the Revolutions of the Heavenly Spheres") that sparked the Scientific Revolution. Contrary to widespread opinion, Copernicus received no resistance in his lifetime from

[10] James Hannam, "Medieval Christianity and the Rise of Modern Science, Part 2," October 31, 2012, *BioLogos*, https://biologos.org/blogs/archive/medieval-christianity-and-the-rise-of-modern-science-part-2.

Church officials, and *De Revolutionibus* was read and taught in universities and was never banned by the Church, although it was suspended in 1616 and then revised in 1620 by Church censors to make his heliocentrism appear hypothetical, for reasons we shall explore when we consider Galileo.

Christoph Clavius (Jesuit Priest, Mathematics, Astronomy, 1538-1612) made his great contribution by combining astronomical observation and mathematical genius to give us the calendar we use today. Our calendar is called the *Gregorian calendar* after Pope Gregory XIII, who promulgated it in 1582 after appointing Clavius to revise the calendar. Clavius' ability to produce the calendar was fueled by his incredible abilities in math. He was "the first to use a decimal point, some twenty years before it became common; the first to use parentheses to collect terms; and the first to use the plus and minus signs + and - in Italy." Through these he made computation much more efficient for astronomers, paving the way for many future discoveries.[11]

Clavius would be only the first of many Jesuits to make contributions to science. The Jesuit Order was founded in 1540, and within a few decades its members were already in the forefront of scientific research. They were among the leaders in astronomy in the 1600s and for quite a while after that. In fact, at the time of the American Revolution, 30 out of the world's 130 astronomical observatories were operated by the Jesuit order.

José de Acosta (Jesuit Priest, Naturalist: Geography, Botany, Zoology, 1539-1600) entered the Jesuits at age 15 and later became a missionary to South America, serving for fourteen years in Peru and then three years in Mexico. While there he began compiling what would become the *Historia natural y moral de las Indias*, a work which catalogued the constellations, elements, metals, plants and animals of that part of the New World, as well as accounts of Incan and Aztec cultures and languages. Acosta theorized that the native peoples he encountered in South America had migrated from Asia via a land bridge or narrow strait located to the north, a hypothesis about human migration that is now widely accepted and has recently been boosted through genetic analysis of the remains of an Alaskan infant who died over 11,000 years ago.[12]

Christoph Scheiner (Jesuit Priest, Astronomy, 1573-1650) was one of five people who discovered sunspots independently of each other, and practically at the same time. (The others were Thomas Herriot, Johannes and David Fabricius, and Galileo.) To be more precise, these men were the first to discover them *with telescopes*. It was Galileo who first figured out what sunspots were, but it was Scheiner who made the most sustained and systematic observations of them, published in his massive treatise, *Rosa Ursina*, in 1640. Scheiner tracked sunspots as they moved across the face of the Sun, and showed

[11] C. Sigismondi, "Christopher Clavius astronomer and mathematician," *Il Nuovo Cimento*, https://arxiv.org/pdf/1203.0476v1.pdf.

[12] Price, Michael. "Ancient Americans arrived in a single wave, Alaskan infant's genome suggests." *Science | AAAS*. January 03, 2018, http://www.sciencemag.org/news/2018/01/ancient-americans-arrived-single-wave-alaskan-infants-genome-suggests?utm_campaign=news_daily_2018-01-03&et_rid=197047915&et_cid=1769935.

from this data that the Sun was rotating on an axis that is tilted with respect to the Earth's orbit.

Benedetto Castelli (Benedictine Priest: Founder of Hydraulics, 1578-1643) was a student of none other than Galileo himself. Castelli defended Galileo and Copernicanism throughout Galileo's troubles. At a critical moment in these troubles, when Galileo decided to defend himself publicly against some of his accusers, he chose to do so by means of an open letter addressed to Castelli.

At Galileo's recommendation, Castelli was made professor of mathematics at the University of Pisa in 1613. There he began to study water in motion. In 1628, he published his magnum opus, *On the Measurement of Water Currents*, which is considered the beginning of modern hydraulics.

Niccolo Zucchi (Jesuit Priest, Astronomy, 1586-1670) made no great discovery. However, he was the first person to build a *reflecting telescope* (i.e. telescopes which use mirrors to gather light, rather than lenses). Today the reflecting telescope is still the most advanced non-electric apparatus for observing planets and other bodies in space. Zucchi constructed his telescope in 1616, or perhaps even earlier—more than 50 years before Isaac Newton, who is often credited with building the first reflecting telescope. Zucchi used his telescope to make accurate observations of spots on Mars's surface in 1640, and his data contributed to the discovery in 1666 that Mars rotates on its axis.

Game-Changer: Marin Mersenne (Minimite Priest: Founder of Acoustics and Architect of the European Scientific Community, 1588-1648) was a French priest of the Minimite Order. In our day, scientists and mathematicians learn about new developments in their fields and share their discoveries with other researchers in several ways: through professional journals, international conferences, and, more recently, by the internet. However, in the 1600s when the scientific revolution began, there were no professional journals; there were no international conferences; and, of course, there was no internet. What they did have, at least in France, was Marin Mersenne.

Mersenne carried on volumes of correspondence with the leading scientists of his day. They would inform him by letters of their new results and he would disseminate the information by letters to other scientists. His convent in Paris became a meeting place of scientists. In 1653, Mersenne organized the *Academia Parisiensis* (i.e. the Paris Academy), one of the earliest scientific organizations in Europe. He was thus one of the "architects of the European scientific community," according to the *Dictionary of Scientific Biography*.

Today, Mersenne's name is most well-known in the mathematical world, because of so-called "Mersenne prime numbers." But Mersenne's really significant contributions to science lay elsewhere, in particular in the sciences of optics and acoustics.
In optics, Mersenne contributed to the theory and design of reflecting telescopes. Although he never manufactured one, he improved the basic design.

Mersenne made even greater contributions to the study of sound and vibrations. One of the basic facts taught in college physics courses is how the frequency of vibration of a string is related to its length, its mass-per-unit-length, and its tension. These relationships were first discovered by Mersenne. He also measured the speed of sound

and showed that it was independent of frequency and loudness. For these and other discoveries Mersenne has been called the "father of acoustics."

Giambattista Riccioli (Jesuit Priest, Astronomy, 1598-1671) has the distinction of being the first person to observe a binary star. We now know that most stars are not single stars like the Sun, but orbit around other stars in binary systems. Riccioli also perfected the pendulum as an instrument to measure time precisely, which was important for later scientific research. With his fellow Jesuit, Francesco Grimaldi, he mapped the surface of the moon. A copy of their map stands at the entrance to the lunar exhibit at the Smithsonian Museum in Washington, D.C. Thirty five of the moon's craters are named after Jesuit astronomers, including several of the largest craters. For example, a crater 250 miles in diameter is named after Grimaldi.

Francesco Grimaldi (Jesuit Priest, Astronomy, 1618-1663), who helped Riccioli map the surface of the moon, made his greatest discovery in physics, not astronomy. It is one of the truly great discoveries in the history of science. He discovered (and named) the very important phenomenon of the "diffraction of light." Grimaldi studied the shadows cast on a screen by objects of various shapes illuminated by a thin beam of Sunlight that he allowed to enter a darkened room through a small aperture in the wall. He discovered that within the shadow region on the screen there were faint fringes of light, and in the illuminated region there were faint fringes of shadow. Grimaldi not only discovered these "diffraction fringes," he made very careful observations of their number, intensity, and coloration. Grimaldi's pioneering work was known by later investigators, including Hooke and Newton. However, it was not until almost two centuries later that the significance of the diffraction effect was understood: it shows that light is a wave. In the twentieth century it was discovered that all matter is made up of waves, and consequently the phenomenon of diffraction is important in many branches of physics—entire chapters are devoted to it in college and graduate-level physics textbooks. If you have ever wondered why CDs and DVDs have those bands of bright color, it is a diffraction effect. So when you see those colors, think of Fr. Grimaldi.

Game-Changer: Blessed Nicholas Steno (Priest, Bishop: Founder of Stratigraphy and Fossil Study, 1638-1686), also known as Niels Stensen, was a remarkable figure in many ways. He made fundamental contributions to four branches of science: anatomy, paleontology, geology, and crystallography. While still in his twenties he was already recognized as one of the leading anatomists in Europe. His anatomical studies greatly increased knowledge of the glandular-lymphatic system. Various parts of the body are named after him, including Stensen's duct, Stensen's gland, Stensen's vein, and Stensen's foramina. He also did important work on heart and muscle structure, brain anatomy, and embryology. He was a Dane by birth, but eventually ended up in Florence, where he worked in a research institute that included some of Galileo's pupils. In 1666, while he was dissecting the head of a Great White shark that had been caught near Livorno, he noticed that the teeth of the shark bore a strong resemblance to the so-called tongue-stones that were common on the island of Malta. He realized that the tongue-stones were actually ancient shark teeth. This mystified him, because these teeth (as well as seashells) were very often found high up on cliffs and mountaintops. Unraveling this

mystery led him to develop, after much further investigation, a detailed theory of the origin of fossils and of sedimentary rock that was very controversial at that time, but was essentially correct. He is thus regarded as the founder of the study of fossils and of the branch of geology called "stratigraphy." Steno's theory of how geological strata were laid down allowed people to begin to understand the history of the Earth and of life.

The study of geology led Steno to the study of crystals, where he discovered the basic fact, known as *Steno's (aka Stensen's) Law*, that in all crystals of the same mineral the angles are the same.

Steno was raised as a Lutheran, but after a deep study of theology and early Church history, he converted to Catholicism. He left scientific research to become a priest, and was soon elevated to the rank of bishop. In his last public lecture as a scientist, he offered to history one of the greatest descriptions of the relationship between nature, our grasp of truth, and the absolute mystery of God:

Beautiful is what we see.
More beautiful is what we comprehend.
Most beautiful is what we do not comprehend.

As bishop, he was known as an ardent advocate for the poor, for whom he sold all of his belongings, even his bishop's ring. He practiced rigorous asceticism, constantly praying and fasting. On October 23, 1988, he was beatified by Pope John Paul II.

Game-Changer: Laura Bassi (Laywoman: Physics, 1711-1778) was only the second woman in history to receive a European university degree, and the very first woman ever to receive a chair at a European university, the University of Bologna. She spent her early career studying gravity, performing experiments based on the work of Sir Isaac Newton. In her later career she focused her experiments on electricity, but managed to perform experiments in virtually every other area of physics known in her day.[13] While obviously opening doors for future women scientists, Bassi also raised eight children and maintained a close friendship with Pope Benedict XIV, who included her as the only woman in the *Benedettini*, an elite group of 25 scholars that he created.

Lazzaro Spallanzani (Priest: Biology, 1729-1799) is regarded as one of the top biologists of the eighteenth century. He investigated digestion, the dynamics of blood circulation, regeneration of limbs in lower animals, fertilization, respiration in plants and animals, and the senses of bats. He disproved the idea of *spontaneous generation*, the ancient belief that some complex organisms, such as worms and flies, are generated from non-living matter vs. biological reproduction. When Louis Pasteur sought to do the same thing a hundred years later, he based his own experiments on those of Spallanzani.

Rene-Just Haüy (Priest: Founder of Crystallography, 1743-1822) is regarded as the founder of the science of crystallography.

[13] Ulrich Lehner, *The Catholic Enlightenment: The Forgotten History of a Global Movement* (Oxford: Oxford University Press, 2016), 78.

Giuseppe Piazzi (Priest: Astronomy, 1746-1826) was the director of the Palermo Observatory**.** On January 1, 1801 (the first day of the nineteenth century), he discovered the first known (and also the largest) asteroid, which he named *Ceres*. To honor him, a crater on the moon was named Piazzi in 1935 by the International Astronomical Union.

Game-Changer: Pietro Angelo Secchi (Priest: Astronomer, 1818-1878) continued the great tradition of Jesuit astronomy into the nineteenth century. He is one of the founders of modern astrophysics. He pioneered the study and classification of stars using *spectroscopy*, or color classification. Before his contribution it was thought that, besides their position in the sky, we would never be able to discover the "stuff" of stars, i.e. their material composition. Secchi challenged this by attaching a prism to his telescope, allowing him to classify the stars by the colors they emitted, colors which revealed their chemical constituents. His classification of stars was the standard one for two decades, until a somewhat improved one was developed at Harvard University in the early twentieth century. Perhaps nothing so dramatizes the positive relation of faith and science as the fact that Secchi did much of his research using a telescope that was set up on the roof of *San Ignazio*, one of the most beautiful churches in the city of Rome, right above the sanctuary where he and his fellow Jesuits daily celebrated Mass.

Game-Changer: Gregor Mendel (Augustinian Priest: Founder of Genetics, 1822-1884) is universally honored as the founder of the science of genetics, the first ever to discover the basic principles of *heredity,* the passing on of characteristics (traits) genetically from one generation to another.[14] Mendel was the son of a peasant who entered the monastery in Brno in what is now the Czech Republic at the age of 21. He was sent to study at the University of Vienna, where he excelled in physics, mathematics, chemistry, and plant physiology. He took his learning into the classroom but also into the garden, where he spent most of his time from 1854 onward conducting a careful, private research program on heredity. He focused on pea plants because he could easily control their propagation. In 1865 he delivered his results in lectures that were largely ignored by the scientific community, both at the time and in a later publication. Mendel had created an entirely new way of studying heredity that would not be appreciated in his lifetime. He is reported to have said, "Though I have had to live through many bitter moments in my life, I must admit with gratitude that the beautiful and good prevailed. My scientific work brought me much satisfaction, and I am sure it will soon be recognized by the whole world."[15] Around the year 1900 his work would be discovered and become foundational to the new science of genetics, and in the 1930's would revolutionize evolutionary biology as well.

Henri Breuil (Priest: Paleoanthropology, 1877-1961) was for decades one of the leading paleoanthropologists in the world. In particular, he was considered the foremost authority on cave paintings and prehistoric art. In a humorous take on his religion, he is often called "the pope of prehistory."

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[14] Vítězslav Orel, Staffan Müller-Wille and Robert Olby, "Mendel, Johann Gregor," in *Complete Dictionary of Scientific Biography,* Vol. 23, 97.
[15] Ibid.

Julius Nieuwland (Holy Cross Priest: Inventor, 1878-1936) was a professor of chemistry at the University of Notre Dame. His work led to the development of "neoprene," the first synthetic rubber.

Game Changer: Georges Lemaître (Priest: Founder of the "Big Bang" Theory and of Modern Cosmology, 1894-1966), a Belgian priest, was one of the two originators of the *Big Bang Theory*, now accepted as the correct account of the beginnings of the universe. One might say that the Big Bang theory was too revolutionary for Einstein, even though it was based on Einstein's own theory of gravity, the Theory of General Relativity. Einstein published his theory in 1916. In 1922, a Russian mathematician Alexander Friedmann and, independently a few years later, Fr. Lemaître found solutions of Einstein's theory that described a universe in which space itself is expanding. Einstein and others at first resisted the idea, but in 1929, the astronomers Edwin Hubble and Milton Humason confirmed that the universe is indeed expanding, and physicists began to accept Lemaître's idea. Lemaître also served as the Director of the Pontifical Academy of the Sciences. His great discovery will be discussed in more detail in Chapter Seven.

Hilary Ross (Daughter of Charity: Biochemistry, 1894-1982) was not a trained scientist nor was she a cradle Catholic. Raised an Episcopalian in California, she frequently attended a Catholic Mass with a friend and converted at the age of 19. She entered the Daughters of Charity two years later and undertook their mission of nursing. Struck with facial paralysis after a botched surgery, she could no longer be a nurse, and so she became a pharmacist and was sent to Carville, Louisiana to serve in that capacity at the leprosarium located there. It was there that she took up biochemistry and began publishing papers on the biochemistry of leprosy (aka *Hansen's Disease*), especially the changes it makes to human tissue. There was no laboratory when she first arrived, so she established one, and continued her study for 37 years. In 1958 she received the Damien-Dutton Award for her significant contributions towards the conquest of leprosy.[16]

Game-Changer: Miriam Michael Stimson (Dominican Sister: Biochemistry, Genetics, 1913-2002) was a chemist who taught at Siena Heights University in Adrian, Michigan where she also ran a laboratory that she put together in a converted bathroom. She researched cancer there for over 30 years, and in the process began to unravel the mystery of DNA. Using the method of ultraviolet analysis of DNA that she pioneered, James Watson and Francis Crick would discover its double helix structure; after they did, she developed another method of analysis using infrared light to prove that Watson and Crick were right. Because of her groundbreaking work she became only the second woman in history (Marie Curie was the first) to be invited to lecture at the Sorbonne in Paris, which she did in 1953.[17]

3. Conclusion

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[16] "Sister Hilary Ross," International Leprosy Association – History of Leprosy, http://leprosyhistory.org/database/person41; "Inventive, Even to the Point of Infinity: Sister Hilary Ross," Maria Climbs a Mountain, August 8, 2012, http://www.mariasmountain.net/2012/08/inventive-even-to-infinity-story-of.html.

[17] Sam Kean, *The Violinist's Thumb and Other Tales of Love, War and Genius as Written by Our Genetic Code* (New York: Back Bay Books, 2012), 95-102; cf. Jun Tsuji, *The Soul of DNA* (Ocala, FL: Llumina Press, 2004).

Through our tour of history we see that important Catholic scientists have existed since the First Millennium of the Christian era. They had significant firsts to their credit, and some were “founding fathers” of entire branches of science: acoustics, hydraulics, stratigraphy, fossil study, crystallography, genetics, and Big Bang cosmology. With them there is no doubt that a commitment to science is in the very spiritual DNA of the Church, part of her very life and consciousness that we call Sacred Tradition.