Faith and Science:
A resource book for the Archdiocese of Louisville

with foreword by
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by the Archdiocese of Louisville Faith and Science Dialogue Group

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www.vaticanobservatory.org
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www.archlou.org/faith-and-science

Heavenly Father, we gather in your presence seeking your guidance and your wisdom.

As we embark on the noble pursuit of knowledge, grant us the grace to recognize the harmony that exists between scientific inquiry and our faith in you.

Help us to understand that both paths seek the ultimate truth which is found in you alone.

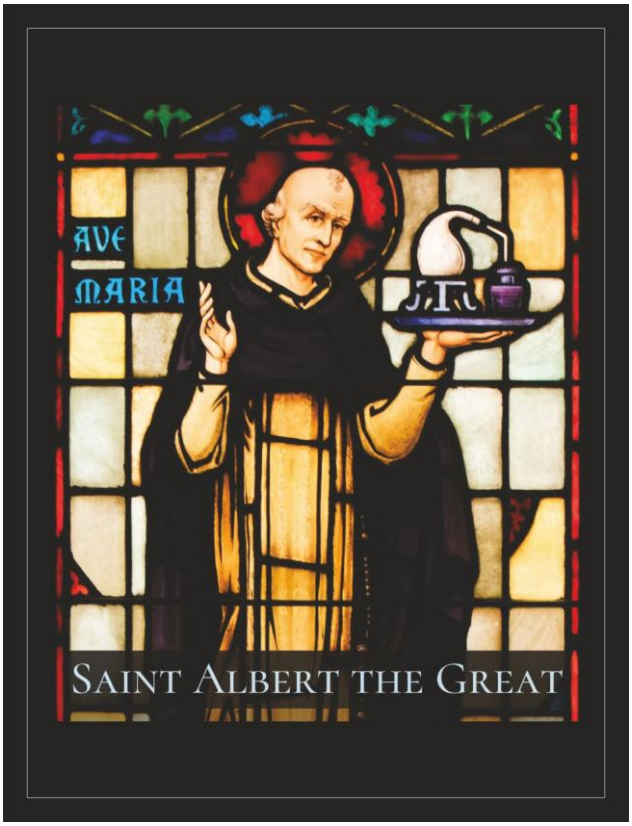
We ask that you illuminate our minds and hearts, helping us to see the awe-inspiring beauty of your creation in every scientific endeavor.

Opening prayer by Archbishop Shelton J. Fabre at the University of Notre Dame McGrath Institute/Society of Catholic Scientists St. Albert Initiative on Science and the Catholic Faith, Bellarmine University, Louisville, March 6, 2025.

O Lord our God,
Creator and sustainer of all things, as You inspired St. Albert the Great to study the creatures you made and begin to explain them to others, so, with the help of his inspiration, example and prayers, may all scientists be filled with your grace as they search through the wonders of creation, and grow in love of You. May they use their skills to appreciate and help our fellow humans and all creatures as we also follow the promptings of the Holy Spirit in our lives.

We ask this through Christ our Lord. Amen.

Saint Albert the Great, pray for us.



Prayer for the intercession of St. Albert the Great, patron saint of scientists, composed by Fr. Patrick J. Dolan of the Archdiocese of Louisville, PhD (Chemistry). Image credit: Dominican Friars, province of St. Albert the Great.

TABLE OF CONTENTS

Foreword: Scientific Discovery and the Presence of God

Br. Guy Consolmagno, S.J.
Director, Vatican Observatory
Vatican City State and Tucson, Arizona
May 30, 2025

Why do we do science? Why does anyone do science?

Often we confuse science with technology. It's easy to see the benefits of improving technology; it helps people, and it makes money for the one selling the gizmos. But there is no such simple rationale for just studying the universe for its own sake.

The ancient Romans could build aqueducts that survive today, two thousand years later, but they had no interest in understanding why stones were strong, or why water flows downhill. They saw nature as the activity of nature gods; who needs to study meteorology, or electricity, if you're satisfied with thinking that rain and lightning bolts come from the whim of the god Jupiter?

Indeed, modern science—the study of the physical universe in and of itself, with no need for some immediate payoff—has been fostered only in certain cultures, and by certain religions. In particular, the Abrahamic religions (Judaism, Christianity, Islam) understand that the physical universe is the creation of God. Thus, the study of creation is a way of getting to know the Creator. "Since the beginning of time, God has revealed himself in the things He has made," St. Paul reminds us in his Letter to the Romans.

But Christianity takes things one step further. By realizing that "God so loved the world that He sent His only Son" to be a part of that world (John 3:16), we recognize that this universe is not just the passive creation of some bored deity; it is a place that God finds so important that He became Incarnate within it.

We humans have been given the physical ability to manipulate the universe and the intellect to reflect on what we learn through those manipulations. We don't do it to make us rich or powerful, but to make us ever more aware of how marvelous our Creator really is.

And we are encouraged and rewarded for our efforts merely, and importantly, by the joy we experience when we understand more about who we are and where we live—whether we live in Rome or in Bardstown,

Kentucky. The joy of scientific discovery is the same joy that we experience in prayer. It is the hallmark of the presence of God.

Faith and Science: Perspectives from History and from the Archdiocese of Louisville

Science is central to modern life. It is science that gives us today's medicine, transportation, agriculture, communication, clothing, weaponry, pollution and so on. Science gives us the good and the bad of it all.

Science also has an impact on people's beliefs. Surveys of Catholic Christians who have left the faith, including young people, show that many cite "science", or perceived conflict between Christianity and science (or between religion in general and science), as a significant factor in their leaving. The personal experiences of the members of the Archdiocese of Louisville Faith and Science Dialogue Group, in speaking with students, parishioners, family members, friends, and acquaintances show likewise. The connection between science and religious disaffiliation seems to extend beyond the Catholic world, to non-Catholic Christians, Jews, and Muslims.

This booklet probes the story of the Catholic Church and science with reflections and commentary from those within the Archdiocese of Louisville. It is designed for priests, educators, and parents (including those who home school) who might encounter questions about the Church and science. It is intended to be accessible to anyone interested in this story.

This booklet is intended to be informative, not authoritative. Its contents are not "official" positions or teachings of the Church or the Archdiocese. Rather, its contents primarily reflect the expertise of the members of the Faith and Science Dialogue Group that created it.

The story of the Church and science goes back a long way. It is still unfolding today. It is not the story most Catholics are familiar with. But it is a story Catholics should know, exactly because science is so central to modern life.

Advancing our Understanding: Revelation and Science

Homily for the 2022 Archdiocese of Louisville Gold Mass for Science
Monday, November 7
Louisville, Kentucky
Most Reverend Shelton J. Fabre
Archbishop of Louisville
Wisdom 13:1-9; Luke 9:28–36 (used in all Gold Masses, 2021-2024)

From the many cares and concerns of our lives, we gather here today. Today in life, time is a precious commodity, and to give some of our time to come to such a celebration as this usually means that we are aware that something significant is the focus. Our presence here states that we recognize the important reasons for being present here today. In my own thought and prayer in preparation for this reflection, I believe that the reasons that we gather here today can be divided into three.

The first reason that we gather here tonight is because the annual Gold Mass is an opportunity that is provided each year for those who are involved in the realm of scientific study, research, and other realms of the field of science to gather and to implore the guidance of the Holy Spirit of God in their individual and collective actions and deliberations that will take place throughout this year. The gifts of the Holy Spirit, for which we pray, are seven in number, and they are: *Wisdom*, *Understanding*, *Knowledge*, *Courage*, *Counsel*, *Piety* and *Fear of* or *Respect for God*. With an awareness of these seven gifts and because of our prayer tonight it is our sincere desire that these gifts again be abundantly poured out by God upon all who are involved in the many aspects of the realm of science.

Another reason we gather here is because this celebration of prayer links us to those who in the past and present have enriched humanity through scientific research and discovery and have also been people of great faith, some of them priests and religious in the Church. On their part, and in Church teaching, there was and is an awareness that faith and science are not in opposition to one another. In fact, faith and science need one another. St. Pope John Paul II stated the following in a letter dated 1 June 1988 to the Rev. George Coyne, S.J., Director of the Vatican Observatory:

Science can purify religion from error and superstition; religion can purify science from idolatry and false absolutes.... Only a dynamic relationship between theology and science can reveal those limits which support the integrity of either discipline, so that theology does not profess a pseudo-science and science does not become an unconscious theology. Our knowledge of each other can lead us to be more authentically ourselves. No one can read the history of the past century and not realize that crisis is upon us both. The uses of science have on more than one occasion proved massively destructive, and the reflections on religion have too often been sterile. We need each other to be what we must be, what we are called to be.

Luke 9:28–36
Jesus took Peter, John, and James and went up the mountain to pray. While he was praying his face changed in appearance and his clothing became dazzling white. And behold, two men were conversing with him, Moses and Elijah, who appeared in glory and spoke of his exodus that he was going to accomplish in Jerusalem. Peter and his companions had been overcome by sleep, but becoming fully awake, they saw his glory and the two men standing with him. As they were about to part from him, Peter said to Jesus, "Master, it is good that we are here; let us make three tents, one for you, one for Moses, and one for Elijah." But he did not know what he was saying. While he was still speaking, a cloud came and cast a shadow over them, and they became frightened when they entered the cloud. Then from the cloud came a voice that said, "This is my chosen Son; listen to him." After the voice had spoken, Jesus was found alone. They fell silent and did not at that time tell anyone what they had seen.

Now I do not mean to simplify the complexities of the relationship between faith and science, but I do think the Pope gives us good insight into how faith and science are called to be in overall relation to one another. Further, I want to state that I believe that a case could be made that faith and science progress along similar lines. For example, in our gospel today, we hear the story of the Transfiguration of Jesus Christ. This was an experience on the part of those apostles that Jesus took with him up the high mountain to experience him in his glory as Messiah and Lord. Jesus had always been Messiah and Lord, and he granted to them a glimpse of his glory. However, though Peter, James and John witnessed the transfiguration, this does not mean that they immediately fully understood the significance of what they had seen and experienced. St. Luke gives the impression that they were silenced by it, as they shared it with no one. After the crucifixion, death, resurrection

and ascension of Jesus, the apostles who witnessed the transfiguration came to a deeper understanding of what they had seen and experienced.

In like manner to the apostles, with time, discernment and prayer, the Church continues today to come to a fuller understanding not only of the Transfiguration but of all revelation, or all that has been revealed or manifested through the full example, message and mission of Jesus Christ. In theological circles, we say that though direct revelation closed with the death of the last apostle, revelation from God nonetheless continues today. Through a deeper understanding of revelation, the Church comes to a greater understanding of how Jesus invites us to be his disciples today. This ongoing revelation serves to benefit our dogma and doctrine as we continue to strive to advance the Kingdom of God and for the common good of all. With time, reflection, discussion, prayer, and Church teaching, revelation advances our understanding of how God is active in our lives today.

In a similar manner, scientists witness and discover interesting things all the time. However, simple discovery does not necessarily mean that the significance of such discoveries are completely understood at the time of discovery. Some discoveries take time for their full effect to lead to a fuller understanding, which can then lead to inventions, which advance the common good by placing what is learned in discovery at the service of humanity. Just as some revelations of God take time to fully understand and comprehend for the benefit of faith and the common good, so some scientific discoveries take time to lead to inventions that advance the common good. In this way, we can say that faith and science progress in similar manners.

Our first reading today from the Book of Wisdom reminds us that humanity has always been involved in the natural sciences but counts as foolish those who did so without allowing such knowledge to lead them to the living God, the origin and source of all things. The Transfiguration story reveals, as someone communicated to me, Jesus as the "wholeness of the universe", which was the desire and search of the ancients. In God, all things, which include science and all of us, should encounter the wholeness of the universe, of life and of love. Those who do not encounter God in science are missing something foundational and significant, something that science itself reveals, as our first reading makes clear. According to our first reading, the failure to connect with God through science is unpardonable.

Wisdom 13:1-9
Foolish by nature were all who were in ignorance of God, and who from the good things seen did not succeed in knowing the one who is, and from studying the works did not discern the artisan; Instead either fire, or wind, or the swift air, or the circuit of the stars, or the mighty water, or the luminaries of heaven, the governors of the world, they considered gods. Now if out of joy in their beauty they thought them gods, let them know how far more excellent is the LORD than these; for the original source of beauty fashioned them. Or if they were struck by their might and energy, let them realize from these things how much more powerful is the one who made them. For from the greatness and the beauty of created things their original author, by analogy, is seen. But yet, for these the blame is less; For they have gone astray perhaps, though they seek God and wish to find him. For they search busily among his works, but are distracted by what they see, because the things seen are fair. But again, not even these are pardonable. For if they so far succeeded in knowledge that they could speculate about the world, how did they not more quickly find its LORD?

The reading concludes with an interesting question regarding those involved in science who do not find or acknowledge God by stating, "For if they so far succeeded in knowledge that they could speculate about the world, how did they not more quickly find its LORD?" Therefore, another reason for being here tonight is to gather to remember and to celebrate all those scientists in the past and present who encountered the living God as revealed through science. I again thank you, who are involved in the realm of science, for your presence here tonight as people of faith.

Thus, one reason for being here tonight is to pray for the wisdom and guidance of the Holy Spirit. Another reason for being here is to celebrate the faith of past and present scientists who advance the common good. The final reason that I propose for our presence and our prayer here tonight is perhaps the most important. Our presence and prayer here tonight is an expression of our utter and complete dependence on God. In this celebration, we express and acknowledge our dependence upon God and his gifts, a dependence that has always been a part of the reality of human existence since God first created us in love. In countless ways down through history, and in many cases based on science, mankind has attempted to subvert in various blatant and subtle ways our total dependence on God, or even to call into question the very existence of God. Countless have been the ways that humanity has at different points in history and even today attempted to remove the living God from our existence. Such efforts have always led to disastrous results, and some have recognized this.

In his 1984 Post Synodal Apostolic Exhortation *Reconciliation and Penance*, Pope John Paul II stated, "...man can build a world without God, but this world will end by turning against him [R&P #18]". I am certain that all of us here know the importance and the benefits of continuing to engage in scientific research, experimentation and advancement. But in line with the thought of St. Pope John Paul Il, if we attempt to do this without God, in the end it will turn against us. Therefore, our third and ultimate reason for being here today is, in essence, to keep our engagement in science focused on recognizing its need for faith.

So let us pray for an outpouring of God's gifts of the spirit upon all who are here today. Let us remember those in the past and present who have provided good example in finding the Lord and how he desires to assist us through science. In this manner, let us entrust our efforts to the living God, so that scientific research and experimentation may always be that which it was created to be, something of benefit to all, rather than something that turns against us because we have forgotten our dependence on the living God in all things. Amen.

Hope in the Lord: The Compatibility of Faith and Science

Homily for the first (2021) Archdiocese of Louisville Gold Mass for Science
Most Reverend Joseph E. Kurtz
Archbishop of Louisville
(version published in *The Record*, November 24, 2021)

For the last four years, I have hosted a dialogue group with scientists, theologians, teachers of science and theology, priests who have a background in science, and professors who know a heck of a lot more about science than I do. We have gathered to understand the rich compatibility between the work of science and the work of faith, a dialogue that has been going on for centuries.

The Gold Mass we celebrate tonight has been a rather recent gathering in the United States. Its purposes are to promote a healthy compatibility between faith and scientific progress and to hold up the great dignity of the profession, and may I say, the vocation of being a faith-filled scientist.

We use the expression *noble profession* to talk about those who are faith-filled and who are scientists or aspire to be scientists. We need prayer. We need the ability to honor those who are scientists in our community, and so this is a wonderful day for you and me to join in prayer. Whether you are an aspiring scientist, like me, or an expert, I would like to reflect on what I would call the four marks of someone who brings together faith and science.

The first mark emerges strongly from Sacred Scripture tonight. This is the *sense of wonder and awe* that usually comes about with a stirring of curiosity. It is the gift of being able to fathom God's great creation, and the more specific we get in that process, the more engaged we become. The first reading from the Book of Wisdom speaks about that gift of God's creation and the Gospel passage about the Transfiguration of Jesus, the mystical experience that Jesus shared with his apostles.

Remember when Jesus said that if you want to be a person of faith, you should become like a little child? Well maybe if you want to become a great scientist, you should become like a little child. A little child has that enormous capacity of awe. Give a little child a leaf that is changing colors right now, and that will occupy a good two hours. That gift of wonder and awe is the first mark of someone who has a healthy sense of the compatibility of faith and science.

The second mark is a *deep desire to search for the truth*. This is what spurs scientists on to make great progress, to do great studies, to make great sacrifices in their lives. It also is what inspires good theologians to study about the things of God, the things of faith.

The search for truth has a double element of first, critical thinking, of being able to ask questions and continuing to ask questions when you do not initially understand. It also has the capacity to ask the moral question, which is a question of faith, conscience and ethics. This question is:

> *Because I can do something, should I do it?*
> *Because I can make weapons of great mass destruction, should I do that?*
> *Because I can do things that will profit me but hurt the environment, should I do that?*
> *Because I can tamper with the genetics of a human person and manipulate humans as if I were a god, should I do that?*

Faith needs science to pursue a search for truth, but science needs faith in order to ask what I should do in my search for truth.

The third mark of a compatible and healthy understanding of faith and science is the *search for meaning*. Does my life matter? What is the meaning of my being created and of living on earth for a period of time? When I was in seminary and before I began studying psychology, I became a fan of Viktor Frankl, who was a psychotherapist. Frankl survived a concentration camp during World War II and after he was released began asking what made him live and others give up. His book, *Man's Search for Meaning*, and his therapy—logotherapy—focus on seeking meaning in our lives. A scientist can uncover many things, but the ultimate questions are the questions that need to be completed by persons of faith.

The final and fourth mark of a compatibility between faith and science is the *gift to be humble*. Perhaps one of the oldest definitions in Latin of theology was "fides quaerens intellectum" or "faith seeking understanding." I believe, but I seek to understand my belief. Doesn't that sound like a scientific inquiry? It takes some humility to say that my belief needs to be completed. There is a journey for me to understand fully what I have been given in the gift of faith. Scientists also may look at theories they held thirty years ago and say, "Well, I think that was mostly correct, but I have learned

something new." The work of science and faith requires humility. We recognize that we do not have all the answers, and science and faith need each other.

Dear friends, whether you came to today's Mass as a scientist, as a student or as someone who always goes to new events, God wants us to be a part of that gift of making science and faith compatible in our hearts and in our culture. Without our efforts to be an agent of that compatibility, our culture will continue to see faith and science as two different worlds that never speak to one another. We pray that through our efforts, God's grace will bring faith and science together in our lives and in our culture.

What truly is Real?

Homily for the 2023 Archdiocese of Louisville Gold Mass for Science
Monday, November 27
Louisville, Kentucky
Father Pat Dolan
Archdiocese of Louisville
(Fr. Dolan spoke extemporaneously; the following is taken from the report by Ruby Thomas on the 2023 Gold Mass, published in *The Record*, November 30, 2023.)

Father Patrick Dolan, who concelebrated the Mass with Archbishop Shelton J. Fabre.... told the congregation that the Gospel reading detailing the transfiguration "speaks beautifully" to the fact that—like the apostles Peter, James and John—people are always looking for what is real as God reveals it.

Science and faith intersect in the Eucharist when people try to determine what "truly is real," Father Dolan said.

Throughout the centuries people have questioned whether "there is anything more than just the bread and wine there" at Communion, he noted. Even notable theologians struggled with this question, he said.

Father Dolan listed "four wonderful reasons for us to believe that there is something significantly more than just the bread and wine, that there really is the Body and Blood of Jesus Christ."

First, he said, are Jesus' words. His words are "effective" and "powerful"; they could forgive sins and heal the sick, he said.

Second, he pointed to "the effect" of the Eucharist throughout the centuries. "When the Eucharist was present, things flourished spiritually," he said.

Third are the hundreds of miracles attributed to the Eucharist, said Father Dolan. These miracles were not meant to deceive, he said, but to allow people to see more of Jesus, as the apostles did during the transfiguration.

Fourth, Father Dolan said, is what St. Thomas Aquinas called "our spiritual eye," which is something within that allows one to sense the real presence of Christ in the Eucharist.

"There's something real and we have every good reason to believe in the reality of the Body and Blood of Jesus," he said. "You can't measure it with

a machine … but you can detect it with the human soul made in the image and likeness of God that resonates with that."

Father Dolan went on to share with the congregation that science is to be taken seriously when it comes to the Eucharist.

In 1949, he said, a question came up about the "reality of physical things and the reality of spiritual things. How do they come together in the most sacred Eucharist?"

The question went something like this, he said: If the church claimed that bread and wine are changed into flesh and blood, where does the change take place—in the protons, neutrons, electrons, or in something smaller?

As this was debated, some theologians claimed such questions should not even be asked, he said. Others claimed "We have every right to look at where and try and figure it out so we can behave appropriately," Father Dolan said.

That debate went on until the beginning of the Second Vatican Council, he said. Some of the arguments were lost in all the changes brought about by the council, but the conclusions remained, he said: Science should be taken seriously and it could help determine "how to do things correctly in our ceremony."

For example, science helps the church determine what qualifies as Communion bread.

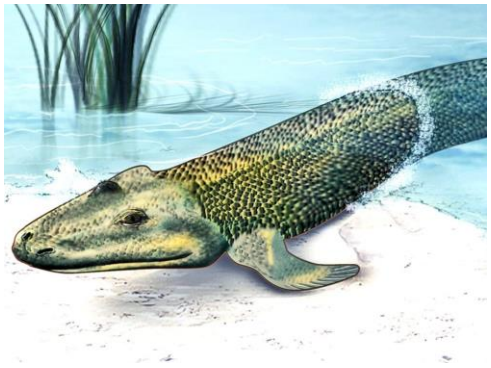
Speaking to the congregation, he concluded, "May you truly be able to use all the tools of human investigation … and may God's grace grow in you as you investigate your world around you and like our first reading says, may you quickly find its Lord."

The Imago Piscium: Christ's Inner Fish

Homily for the 2024 Archdiocese of Louisville Gold Mass for Science
Monday, November 18
Louisville, Kentucky
Deacon Ned Berghausen
Archdiocese of Louisville
(version published at **www.VaticanObservatory.org**, February 1, 2025)

How many of you listening to this homily have heard of "Tiktaalik?" I'll say the word again: Tiktaalik. Tiktaalik is the name of an animal that lived 375 million years ago. It was a fishlike aquatic creature that was among the first to evolve the ability to crawl out onto dry land.

Tiktaalik's fossils were found by paleontologists Ted Daeschler and Neil Shubin twenty years ago in the arctic on Ellesmere Island, in Nunavut, northern Canada. Tiktaalik is called a "transitional fossil," which embodies a transition from one major evolutionary stage to another. A second example of this is Archaeopteryx, which embodies the transition of dinosaurs to birds. Tiktaalik is sometimes referred to as "a fish with wrists" having fish-like qualities, but limbs that could support its weight as it crawled onto land, as an early ancestor of the amphibians.



Tiktaalik. Image credit: Wikimedia Commons.

I learned about this fossil from my wife who is a paleontologist and who used Neil Shubin's book, *Your Inner Fish*, in class with her students at Bellarmine University in Louisville. Shubin explains how, as a member of the lineage that made that transition to land, Tiktaalik is an ancestor of the human species, indeed of all land-based vertebrates. If we look at the morphology of our bodies, we can discover vestiges of an inner fish—the structures of an inner Tiktaalik that we evolved from. These clues are visible in the morphology of our inner ears, and the arrangement of the nerves in our head, among other things.

Depending on your knowledge of this topic, you may be surprised to hear me preaching about evolution from the pulpit. But Catholics have seen

no conflict with evolution since at least 1950 with Pope Pius XII's encyclical *Humani Generis.*

Of course, as Catholics we believe that our bodies are the image of God—the *Imago Dei.* The material of our bodies has received its shape in some way through an evolutionary process that unfolded over the last 3.5 billion years. Yet, the shape and design of our humanity also reflects a divine imprint. We creatures, we *Homo sapiens*, uniquely reflect our creator.

When we picture Christ standing on Mount Tabor, bathed in the uncreated light of his transfiguration, we perceive his divinity in dazzling white. And yet, Jesus by becoming incarnate and dwelling among us as a human being, became a descendant not just of Abraham and Adam, but also a son of the created world. In order to get a fuller picture of the person of Christ, and by extension ourselves, we need to extend his and our own genealogy—our family tree—to include our aquatic ancestors, and everything that came before that. We human beings are created in the image of an inner fish as well as the image of God. The *Imago Piscium* and the *Imago Dei*.

My wife [a scientist] typically reads, proofs, and edits my homilies before I give them. In this way, my preaching represents a dialogue between theology and science, happening while editing an early version of a homily. She wrote a long comment on the evolutionary tree that we are part of, writing,

> *To me this is the most amazing thing. To discover this deep time family tree is an incredible revelation from science about our origins. We gained some sense of this in the mid-nineteenth century with Darwin and his contemporaries, but this story is still being uncovered, with more fossil discoveries and sequencing of genomes. To discover that humanity (including Jesus) has this ancient past, as a part of our created world, is an even more incredible reminder of being created out of the earth itself. It gives us a new understanding of who we are in our physical forms. That Jesus himself is God incarnate, but also creation incarnate.*

St. Athanasius famously wrote in his work *On the Incarnation*, "the Son of God became human so that we might become God." Sometimes this last phrase is translated to "so that we might become 'divinized'", to become *like* God. By becoming human, human beings became sharers in God's divine nature. To a scientist, that may sound excessively anthropocentric. The Psalmist agreed, writing in Psalm 8:

> *When I see your heavens, the work of your hands,*
> *the moon and stars that you set in place—*
> *What is man that you are mindful of him,*
> *and a son of man that you care for him?*
> *Yet you have made him little less than a god,*
> *crowned him with glory and honor.*

Anthropocentric, but somehow, despite the vastness of the tree of life, it is true. It is a beautiful, poetic truth that the transfiguration illuminates for us. Yet, the process of incarnation also went the other way. God, in becoming human, also joined into the great history of evolutionary life.

Jesus's human body reflected and embodied the 3.5-billion-year journey of life from single-celled organisms to Homo sapiens. His body was a walking time capsule of the ages and organisms that came before, one that even held mementos of the ancient star that formed the carbon atoms in his cells and the Big Bang that formed the hydrogen atoms in them. His body manifested creation itself: the conditions of chemistry, biochemistry, physics, atmospheric science, geology, biology, oceanography and every scientific field that describes our created universe.

Science allows us, in the words of the thirteenth chapter of the Book of Wisdom, to discern the artist by studying His works, "for the original source of beauty fashioned them", and we can discover the author through "the greatness and the beauty of created things."

I pray that this Gold Mass can deepen our appreciation for the knowledge that comes from both Reason and Revelation—two sources of wisdom that are not in conflict. As we read in the Collect for St. Albert the Great, patron saint of scientists, on his feast day which we celebrated last Friday, November 15:

O God, who made the Bishop Saint Albert great
by his joining of human wisdom to divine faith,
grant, we pray, that we may so adhere to the truths he taught,
that through progress in learning
we may come to a deeper knowledge and love of you.
Through Christ, our Lord, Amen.

Origins, Evolution, and Big Questions

Some of the biggest, most common questions related to Faith and Science are the ones about Origins and Evolution—both of human beings and of the universe (i.e. the “Big Bang”).

For this book, Holly McGuire, Director of the Office of Continuing Education for Priests and Lay Ecclesial Ministers of the Archdiocese of Louisville, and a member of the Faith and Science Dialogue Group, surveyed a dozen priests in 2025 about the Big Questions they encounter from people regarding Faith and Science. The survey results pointed to the Origins and Evolution questions as being the biggest ones (other big questions included perceived historical conflicts between Church and Science, and questions about perceived conflicts between science and our Catholic faith in matters of modern medicine and the nature and beginning of human life).

Those survey results generally agree with the personal experiences of the members of the Faith and Science Dialogue Group. Over the years that the Dialogue Group has been meeting, many discussions have revolved around the questions people have regarding Origins and Evolution.

What follows is a two-part treatment of Origins and Evolution.

Origins and Evolution Part 1: The Big Questions of Faith and Science

Faith and Science Dialogue Group meetings also serve as the meetings for the Louisville Chapter of the Society of Catholic Scientists (SCS). On the SCS website there is a list of common Faith and Science questions. These are also consistent with the 2025 survey:

Q1: (A) Does the Catholic Church accept Evolution? (B) Did the Catholic Church ever condemn Evolution in the past?

Q2: Doesn't Evolution show that a "Creator" is not needed?

Q3: Don't physics theories of how the universe began show that a "Creator" is not needed?

Q4: Doesn't the Book of Genesis contradict the Big Bang and Evolution?

Q5: If humans evolved from other animals, how can we be special, have "spiritual souls" or be made "in the image of God"?

Q6: How do "Adam and Eve" fit in with evolution and the science of human origins?

Q7: Aren't miracles contrary to the laws of nature and therefore impossible?

Q8: Science is based on evidence; what is the evidence for God?

Q9: Isn't the idea of "faith" contrary to reason, evidence, and freedom of thought, which form the basis of science?

Q10: Hasn't the Catholic Church historically been opposed to science (e.g. Galileo)?

Q11: Can a scientist be a Catholic believer?

Q12: How are humans any different from thinking machines (AI) or intelligent animals?

Q13: Doesn't science show that free will is an illusion?

Q14: Aren't human beings and human minds completely explained by physics and chemistry?

Q15: Would the existence of intelligent Extraterrestrials be consistent with Catholic belief?

Q16: Doesn't the vast size of the universe show that humanity doesn't matter in the cosmic scheme?

For those interested, detailed answers to these questions are available at **https://catholicscientists.org/common-questions/**. They were prepared by the Board of the SCS in consultation with the Theological Advisory Committee of SCS (which consists of theologians who are professors at Catholic seminaries).

The answers are not short and not simple. If you need something different, contact the Faith and Science Dialogue Group through the Archdiocese of Louisville Office of Faith Formation. We can help with questions like these.

- **https://www.archlou.org/faith-formation/**
- (502) 636-0296
- ff@archlou.org

However, what might be as helpful as "answers" is a look at how Origins and Evolution have been discussed within our Archdiocese over the past century. This is covered in Part 2.

Origins and Evolution Part 2: The Archdiocese of Louisville and the Big Questions

How have Origins and Evolution have been discussed within our Archdiocese over the past century? The answer to this question might be as helpful to the Big Questions as any lengthy effort to answer those questions directly.

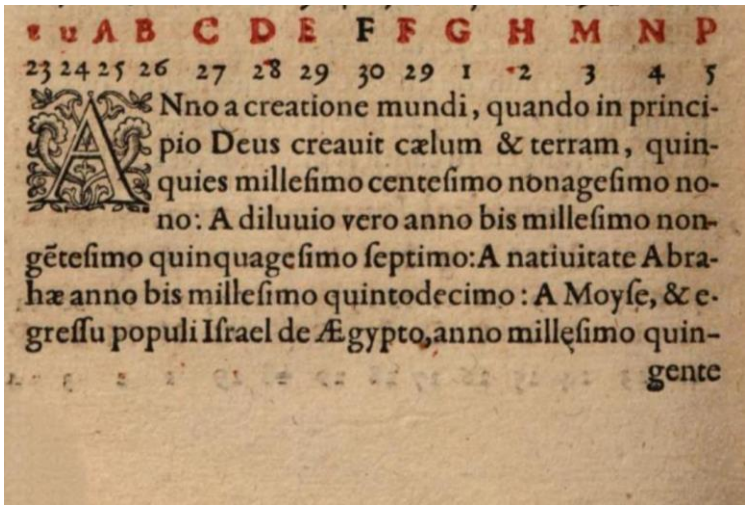
Consider something that is often heard at Christmas Eve Midnight Masses throughout the Church, namely the proclamation of "The Nativity of our Lord Jesus Christ from the Roman Martyrology":

> *When ages beyond number had run their course from the creation of the world, when God in the beginning created heaven and earth, and formed man in his own likeness;*
> *when century upon century had passed since the Almighty set his bow in the clouds after the Great Flood, as a sign of covenant and peace;*
> *in the twenty-first century since Abraham, our father in faith, came out of Ur of the Chaldees;*
> *in the thirteenth century since the People of Israel were led by Moses in the Exodus from Egypt;*
> *around the thousandth year since David was anointed King;*
> *in the sixty-fifth week of the prophecy of Daniel;*
> *in the one hundred and ninety-fourth Olympiad;*
> *in the year seven hundred and fifty-two since the foundation of the City of Rome;*
> *in the forty-second year of the reign of Caesar Octavian Augustus,*
> *the whole world being at peace,*
> *JESUS CHRIST, eternal God and Son of the eternal Father, desiring to consecrate the world by his most loving presence, was conceived by the Holy Spirit,*
> *and when nine months had passed since his conception,*
> *was born of the Virgin Mary in Bethlehem of Judah,*
> *and was made man:*
> *The Nativity of Our Lord Jesus Christ according to the flesh.*

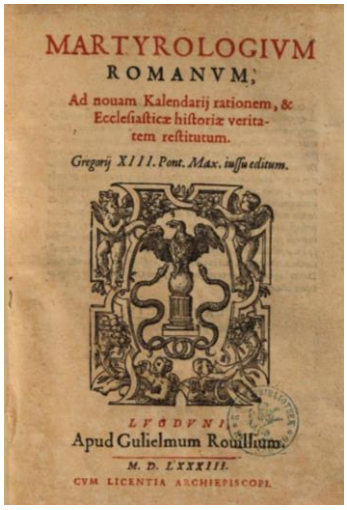
The Church's stance toward Origins and Evolution is reflected in the proclamation. It is a striking example of the Catholic Church accommodating the findings of science (something it has been doing since the early Church, as discussed in §14.1 of this book). Consider the proclamation as it was in the early twentieth century:

> *In the year from the creation of the world, when in the beginning God created heaven and earth, five thousand, one hundred and ninety-nine;*
> *from the flood, two thousand, nine hundred and fifty-seven;*
> *from the birth of Abraham, two thousand and fifteen;*
> *from Moses and the coming of the Israelites out of Egypt, one thousand, five hundred and ten;*
> *from the anointing of King David, one thousand and thirty-two;*
> *in the sixty-fifth week, according to the prophecy of Daniel;*
> *in the one hundred and ninety-fourth Olympiad;*
> *in the year seven hundred and fifty-two, from the founding of the city of Rome;*
> *in the forty-second year of the empire of Octavian Augustus,*
> *when the whole world was at peace, in the sixth age of the world,*
> *Jesus Christ, eternal God, and Son of the eternal Father,*
> *desirous to sanctify the world by His most merciful coming,*
> *having been conceived of the Holy Ghost,*
> *and nine months having elapsed since His conception,*
> *is born in Bethlehem of Juda,*
> *having become man of the Virgin Mary.*
> *The Nativity of our Lord Jesus Christ, according to the flesh.*

This is an English translation of the Latin text that had been in place since the Roman Martyrology was published under Pope Gregory XIII in 1583. The years given here are actually in conflict with the chronology of the Vulgate Bible, as Fr. Prosper Guéranger noted in the late nineteenth century in his influential multi-volume book, *The Liturgical Year*: "[O]n this one day alone, and on this single occasion, does the Church adopt the Septuagint Chronology, according to which the Birth of our Saviour took



ANno a creatione mundi, quando in principio Deus creauit cælum & terram, quinquies milleſimo centeſimo nonageſimo nono: A diluuio vero anno bis milleſimo nongẽteſimo quinquageſimo ſeptimo: A natiuitate Abrahæ anno bis milleſimo quintodecimo: A Moyſe, & egreſſu populi Iſrael de Ægypto, anno milleſimo quingente



MARTYROLOGIVM
ROMANVM,
Ad nouam Kalendarij rationem, & Eccleſiaſticæ hiſtoriæ veritatem reſtitutum.
Gregorij XIII. Pont. Max. iuſſu editum.

LVGDVNI,
Apud Gulielmum Rouillium.
M. D. LXXXIII.
CVM LICENTIA ARCHIEPISCOPI.

Above left is the text from the 1583 *Martyrologium Romanum* (title page at right) stating that Jesus was born in the "quinquies millesimo centesimo nonagesimo nono" year after the creation of the universe—that is, "the five thousand, one hundred and ninety-nineth".

place five thousand years after the creation; whereas the Vulgate version, and the Hebrew text, place only four thousand between the two events."

Therefore, there is a conflict between the proclamation and a literal reading of the Biblical text that is regularly used by the Church—and there always has been, for as long as there has been a Catholic Church in Kentucky. Apparently, stating an unambiguous age for Creation has never been the Church's interest.

Therefore, it might not be so surprising to see an openness to Evolution here in the Archdiocese of Louisville a century ago. In August of 1925, in the midst of the famous "Scopes Monkey Trial" over the teaching in Tennessee of *biological* evolution, Benedict Elder, the Editor of *The Record*, wrote about Catholics and Evolution in two editorials. This was before the idea of an evolving *universe* had even been proposed. Elder did not insist on adhering to a literal reading of the Bible regarding biological origins.

In an August 6 editorial, he noted that, "Within limits, a Catholic may teach evolution as a theory, but not as a fact, because it is not proved." He urged that this was fitting, and not limited to Catholics. He noted "the Board of Education of the state of California... allows the school instructors of that state to teach evolution as a theory but forbids them to teach it as a fact."

The language of “proof” that he uses to describe evolution is not quite what a modern scientist might say. We might instead say that “a Catholic may teach the theory of evolution while also recognizing that evidence may be uncovered on the topic.” What is important to note here, however, is that a Catholic education, even in 1925, permitted the teaching of evolution as a scientific concept in school.

The next week (August 13), Elder wrote further regarding “the facts of evolution” (by which he meant the actual physical evidence, such as artifacts on display in museums):

> *The facts [of science] need no religious test, we know, but the “explanation” is man-made, and needs every test, and should be able to meet every test, that man knows by reason or experience. Science is not the only field where facts are found, and any “explanation” of the facts of science that ignores the facts in other fields, cannot be a true explanation. There are facts of religion as solid and unimpeachable as any fact of science and, therefore, an explanation of the facts of science does need some religious test, as well as every other test of human reason and experience, in order to determine that it is the true explanation....*

There were good reasons in 1925 to want to subject certain interpretations of Evolution to tests by religion, human reason, and experience. Ideas that devalued human beings, like eugenics (see §14.7), were being connected with the theory then. Elder continued,

> *There is no conflict between science and religion, none between the truth of the Bible and the facts of evolution. Where there seems to be conflict it is somebody's interpretation of the Bible clashing with one of those “explanations” of the facts of science.... Science in all its branches is taught in our Catholic Universities. According to standard educational tests these universities rank A-1. They never have any difficulty with regard to the facts of science and the truth of the Bible.*

Almost a century later, *The Record* published another discussion of Evolution, by Kate Bulinski, then an Associate Professor of Geosciences at Bellarmine University and a member of the Archdiocesan Faith and Science

Dialogue group ("Teaching Our Faith" section, May 16, 2019). The theory was now supported by more evidence, had been thoroughly disconnected from ideas like eugenics, and to Bulinski, a Catholic scientist, it evoked awe of God:

> *The science of evolution and how it relates to human origins reveals an incredible picture of our own history on this planet. Despite the fact that the teachings of the Catholic Church are compatible with evolution, I have encountered many Catholics who are unsure how to reconcile evolutionary science and their faith.*
>
> *Much of this confusion is a product of literalist readings of Scripture... as well as the way that evolution has been portrayed (often incorrectly) in mass media. This perceived conflict between faith and science is unfortunate as it may introduce obstacles towards the pursuit of scientific and religious truths. Persons of faith may avoid pursuing careers in the sciences, or science-minded people may see the pursuit of a faith life as incompatible with scientific observations and experimentation.*
>
> *As a Catholic scientist, I recognize that science and faith are not mutually exclusive, but rather complementary. Science and faith present ways of exploring our world that enhance each other. We can use science to ask testable questions about evolutionary origins and processes and grow in our faith by exploring existential theological questions about our purpose and the nature of the human soul. Learning about our relationship to the natural world is another way to know God. The questions posed and explored through the lenses of science and faith can complement each other by probing mysteries and generating a deeper understanding than what either methodology might be able to reveal alone.*
>
> *The theory of evolution provides an elegant explanation for the progression of life on our planet. Nearly 160 years of biological research has unfolded since the genetic experimentation of Fr. Gregor Mendel and the publication of Charles Darwin's "On the Origin of Species." Over roughly the same time frame, paleontologists*

uncovered patterns and processes of evolution within the fossil record that add to our understanding of biological relationships over hundreds of millions of years. Taken together, humanity has gained a rich understanding of the beautiful complexity of life on the earth. So why is it that many are so uncomfortable with the notion that human beings are also a product of evolution? How does evolutionary biology interface with the Catholic teaching that humans are created in the image of God?

Knowing that the structures and functions of our own biology are the product of a tree of life that extends back millions of years is a humbling and sometimes jarring realization. Some may balk at the idea that we are a part of the animal kingdom, connected much more intimately to our evolutionary ancestors than we would like to admit. For me, I find that learning about the processes of evolution that gave rise to our species is an awe-inspiring way to know and love God....

Science and faith, when taken together, are powerful ways to learn about the natural world. For me, one without the other only provides part of the story of our place and purpose on the earth. These complementary ways of knowing give us a glimpse of where humanity fits into God's plan for us and for all of creation. My hope is that more people find ways to incorporate both into their search for truth in this world.

Note the reference to Fr. Gregor Mendel. Shortly after Elder's 1925 editorials, Fr. George Lemaître, a Belgian physicist, developed what we now call the "Big Bang" theory, implying an evolving universe. His theory contradicted what scientists had long believed—not that the universe was created thousands of years ago, but rather that the universe was eternal, with no beginning at all. Thus, not only does the Church not reject the science of origins that is so often at the center of the Big Questions people have, but Catholic scientists have played important parts in that science.

The Role of Science in Catechesis

Published August 17, 2023 in *The Record* of the Archdiocese of Louisville under the "Science in the Bluegrass" column.

Dr. Kate Bulinski, paleontologist and Professor, Bellarmine University.

This summer [2023], I had the privilege to attend the Society of Catholic Scientists annual conference. As a Catholic paleontologist, it was very exciting to be able to spend time in fellowship with other scientists of faith.

I learned about topics as wide-ranging as recognizing *caritas* in the fossil record of early hominids and the nature of dark matter and the structure of the universe. I also attended a lecture entitled "Does Artificial Intelligence Need the Gospel?"

When Catholic scientists attend a conference like this, it allows us to ask and explore questions that aren't usually encountered within a secular scientific context. Questions of ethics and morality and truth as they relate to God are not typically included in professional scientific circles. They are explored at an SCS conference.

This is important because our church needs Catholic scientists as role models for demonstrating the compatibility of faith and science. According to the 2018 Georgetown University/St. Mary's Press study, "Going, Going, Gone: The Dynamics of Disaffiliation in Young Catholics," more than a third of young adults and teens who disaffiliated from the Catholic faith, who abandoned Catholicism (and often religion altogether), cited a conflict with scientific beliefs as a somewhat or very important factor for why they left Catholicism.

According to that study, the median age for leaving the church was 13. Middle school. A time when young Catholics are discerning Confirmation and coming of age. They raise big questions, like how to reconcile scientific knowledge with the biblical stories of creation in Genesis that were likely their entry point to Scripture.

Those 13-year-olds who are in Catholic school or enrolled in CCD might be able to seek answers with help from their teachers or members of the clergy. If they are lucky, their teachers, deacons or priests have a clear understanding of the compatibility of faith and science within the Catholic faith.

However, after doing some faith and science outreach in the Archdiocese of Louisville, I've also discovered that our educators and clergy do not always have a clear understanding of Church teaching about the compatibility of faith and science.

The topics end up being completely separated in our classrooms, with science teachers teaching science, religion teachers teaching religion, with no intersection, dialogue, or integration.

There is an opportunity for approaching this problem that holds a lot of promise. Last year, through the archdiocese's Office of Faith Formation, Deacon Ned Berghausen and I began offering professional development workshops for K-12 teachers and parish catechists on the topic of faith and science.

Participants received training in what this relationship looks like, according to Catholic teaching, what church history and Scripture tell us about faith and science, and how to best implement this topic in the classroom.

After two years of running these workshops, it is abundantly clear that faith formation in this topic is essential. Anyone educating our young people in the Church needs to know that faith and science do not need to be kept in separate religion and science classes but that they actually can enhance one another in a way that provides clarity to our children.

As far as I can tell, not many dioceses are taking these steps, but there are other places to find this kind of educational professional development, most prominently the Science and Religion Initiative through the McGrath Institute for Church Life at the University of Notre Dame.

If you are a teacher or catechist and interested in learning more about faith and science and the Church, be sure to check out [the summer] offerings from the Office of Faith Formation. You will hopefully learn some new ways to engage our young people using science and faith.

Be a Rebel, be a Catholic Scientist

Published February 18, 2025 in *The Record* of the Archdiocese of Louisville under the "Science in the Bluegrass" column.

Pat Burton, Science Chair and STEM Coordinator, Mercy Academy.

When I joined the faculty at Mercy Academy in 2009, I was invigorated by the prospect of teaching biology at a Catholic high school. But more than a few times over the years I've been surprised by individuals—Catholics and non-Catholics alike—who have asked me a silly question:

"Do they really let you teach all that biology stuff in a Catholic school?"

In some instances, I could tell that the person was joking. Other times I wasn't so sure. And that's concerning.

The Venerable Catherine McAuley, foundress of the Sisters of Mercy, is quoted as saying, "No work of charity can be more productive of good to society than the careful instruction of women." As I've pointed out to my students before in class, we should take note that Mother McAuley does not include "except for science" in her beautiful statement.

So why do people continue to bring this up? Scientists have indeed developed ideas that seem to contradict the teachings of the Catholic Church. This dates all the way back to the second-century astronomer Ptolemy showing that, contrary to appearances and Genesis 1, the moon is smaller than the stars.

Of course, Charles Darwin's theory of evolution by natural selection is one of the favorites that people like to bring up. And it can be hard to deny that, at least on the surface, Darwin's ideas are in opposition to the Genesis stories of God's Creation. But there's more to it than that.

In his 1950 encyclical "Humani Generis," Pope Pius XII was the first to officially suggest that evolution and Catholic teachings could be compatible, a sentiment that has been echoed by St. John Paul II, Pope Benedict XVI and Pope Francis in the years since.

We can even look to the teachings of St. Thomas Aquinas, who wrote that "it is a greater perfection for a thing to be good in itself and also the cause of goodness in others, than only to be good in itself." Put simply, it makes more sense for God to have created us not as stagnant beings, but as creatures with the capacity to cause change ourselves.

Yet this seems to surprise people, and the misconception that there is inherent “beef” (as my students would say) between Catholics and scientists persists in our modern society, where we often seem to seek conflict over harmony.

This, in my opinion, is why teaching the full scope of science in our Catholic schools is as essential as it’s ever been. If our students are able to master scientific methodology, I believe their capacity to also deepen their faith will only grow.

The true purpose of science is to ask questions, look analytically at the world around us, and gain knowledge that can be used to solve problems that all of us face. I would argue that this is also a formula for building a stronger connection to God, as well.

Looking at Church teachings with a critical eye, being rebellious and asking difficult questions in pursuit of God’s truth, and seeking ways to serve those around us—this is what our faith is all about. And it is my job as a Catholic school educator to ensure that the next generation of critical thinkers is prepared to continue down this path that other Catholic scientists paved before me.

Just this past summer, Pope Francis reaffirmed the Church’s support of scientific research, and encouraged scientists to “harmonize” faith and science to best serve humankind.

In other words: Go ahead, be a rebel. Let’s show them it’s totally cool to be a Catholic scientist.

God Speaks to Us through Matter

Published February 13, 2024 in *The Record* of the Archdiocese of Louisville under the "Science in the Bluegrass" column.
Dr. Anna Christianson, Associate Professor of Chemistry, Bellarmine University.

As a graduate student, I heard a fascinating lecture by Nobel-prize-winning chemist Roald Hoffmann on his "side project," a chemical/historical exploration of indigo dye. Indigo is the chemical responsible for the color of blue jeans—mostly made synthetically today, but naturally found in certain plants (indigo and woad) and certain Mediterranean snails.

From these snails, ancient Mediterranean peoples derived the famous Tyrian purple dye, the "royal purple" that only Roman emperors were allowed to wear. The dye's exact color could vary from dark red to purple to blue—and this blue was (quite literally) intertwined with the ritual traditions of ancient Judaism.

Hoffmann, a Polish Jew who escaped the Nazis as a child, described the significance of this blue dye, known as *tekhelet*, in his own Jewish heritage. References to *tekhelet* abound in the Hebrew Bible, particularly in descriptions of worship in the tabernacle or Temple, where the Lord commands that "blue and purple and scarlet stuff" be used for priestly robes and coverings for the sacred objects.

In the Book of Numbers (15:39-40), the Lord further commands:

> *They shall make for themselves fringes on the corners of their garments … and they shall place upon the fringes a cord of* tekhelet. *So, when you see the fringes, you shall remember all of the commandments of the Lord and do them.*

These fringes, called *tzitzit*, are worn by Jewish men as a perpetual reminder of their covenant with the Lord. The blue color symbolized the glory of God, evoking the expanse of the sky and the waters of his creation.

Hoffmann explained that later rabbinic traditions specified that *tekhelet* could only be considered authentic if produced from snails, not from plants—no cheap substitution would do for this sacred reminder. However, around the 6th or 7th century AD, the technology for creating *tekhelet* from

snails was lost. Blue dye was still produced from plants or, later, through synthetic chemistry, but true *tekhelet* was nonexistent. In many Jewish communities, *tzitzit* were made pure white from then on—the absence of the blue becoming yet another symbol of loss for the Jewish people, and of longing for the coming of the Messiah who would restore the kingdom, the temple and the covenant.

Hoffmann then described his research to reconstruct the ancient chemical process for creating *tekhelet* dye from snails. First, the snails would be harvested—10,000 of them to produce just one gram of dye! This gives an idea of just how precious this color was, valued by ancient peoples higher than its weight in gold.

To make the dye colorfast, the extract would go through a laborious process of boiling, fermentation and treatment with other (nasty) substances. In the second-to-last step of this process, the dye would lose its color, turning a sickly yellow. Only upon dipping cloth in the mixture and exposing it to air and sunlight would the indigo color reappear. As Hoffmann put it, believing that this dye would give you back the beautiful color you had worked so hard for was as much an act of faith as of chemistry.

I remember so distinctly Roald Hoffmann's lecture about indigo, not only for the fascinating history and chemistry, but also for the deeply personal meaning the project clearly had for him.

Matter matters, as we chemists are fond of saying. The material, the substance, the "stuff" of our lives is infused not just with scientific, but spiritual meaning. God speaks to us through matter, through color, through craft, through beauty, through sacrament.

For us as Catholics, this should come as no surprise. For us, whose God has become flesh, matter has been made even more sacred. Our Messiah has indeed come to touch and to heal us—by "even the fringe of his garment".

God Leads Us through the Unexpected

Published August 16, 2024 in *The Record* of the Archdiocese of Louisville under the "Science in the Bluegrass" column.
Fr. Patrick J. Dolan, Archdiocese of Louisville.

A little over 100 years ago, a very senior chemist, who was retiring after an honorable career of service, left a series of "fragments of chemistry" for whomever would pick up the gauntlet of examining that unexplained data.

Over half a century later, another senior chemist gave that data to a young seminarian (who had deep Bluegrass connections) to figure out why weird color changes, unexpected explosions, etc., were occurring in that reaction.

Trusting in God (and being a bit foolhardy) that seminarian accepted the task. He examined why a stable white powder hexachloro-ethane (C_2Cl_6) when added to a very strong base, a grey slurry of potassium amide (KNH_2) in liquid ammonia, suddenly turned bright yellow and pulled all the elements off the molecule sending them in different directions.

Elemental nitrogen bubbled away, elemental carbon precipitated out (almost violently dropping to the bottom of the flask), and potassium chloride (a salt) was left.

It seemed like the hand of God was indeed pulling the atoms off of the molecule and sorting them out. However, the flask with the residue always exploded when anyone tried to clean it—almost as if God didn't want people to find out what was happening.

Not believing in a God who would be that malicious, the seminarian employed other techniques to separate the residuals very clearly, using a vacuum line that isolates such materials from ordinary air and moisture.

It turns out that God was showing us something unexpected. The chlorine atoms were being pulled off as positive rather than the normal negative ions—which finally explained everything, including the explosions. Many of the intermediate partial products were very explosive, such as dichloro-acetylene (C_2Cl_2) and hydrazine (N_2H_4).

God's love for us remains with us always, even when He sometimes presents (or leads us through) dangerous areas to find new and unexpected discoveries (human as well as chemical).

Perhaps this may help explain what “lead us not into temptation” might convey in the Lord’s Prayer. The common way theologians have examined that plea is as a parallel to “deliver us from evil,” just as many phrases in sacred Scripture are doublets (the same thing said in two different but parallel ways to enhance the meaning).

But is it not also possible to view that plea much like a challenge to overcome one’s fears in dangerous situations, trust more deeply in God and find ways of getting through a difficult temptation by understanding it and “pushing through it” rather than falling into it?

Indeed, sometimes we cannot avoid temptations; but God can lead us “through” them rather than “into” them.

For example, there are times when we have to work with someone we are tempted to disrespect, or we have to be in a place that would entice us toward gluttony, drunkenness or lust, and we have tried, but are not able, to avoid those circumstances. Could not asking God to “lead us not into temptation,” but help us get through them, get done those necessary tasks in those dangerous circumstances, and still be “delivered from evil” just might be a deeper nuance for what that ending of the Lord’s Prayer actually means?

As we sometimes find ourselves in very awkward and perhaps tempting situations, might this century-old conundrum from chemistry help us grow in our trust in and love for the God who created all things (even unexpected explosions in the laboratory), and who loves us more than we can ever imagine? Blessings to you as you do science in the Bluegrass.

The Journey of a Catholic Astronomer

Published June 19, 2025 in *The Record* of the Archdiocese of Louisville under the "Science in the Bluegrass" column.

Dr. Gerard Williger, Professor of Physics and Astronomy, University of Louisville.

When I was little, I always asked, "Why?". I never grew out of that, which led me to become a scientist—a professional astronomer. That has involved more travel, and more Catholic connections, than I ever expected. Along the way, I have realized that the Big Questions in astronomy are often similar to the Big Questions in faith, like "Where did we come from?" or "How did we get here?"

Walsh Jesuit High School near Akron, Ohio led me to dive deeply into the Big Questions. I then went to Ohio State, doing science and math while becoming a Eucharistic Minister in the Newman Center. I met more student scientists with faith, and was happy that at least some people didn't think I was an atheist. I also had my first research experience, studying SS-433, an interesting black hole the mass of a big star.

In Cambridge, England, I pursued a doctorate in astronomy while learning about the very checkered and bloody past of Catholicism in England. Catholics are only about 10% of the population there, but they are devout and stick together. I met Catholic scientists, and had the pleasure of serving the Novus Ordo Mass, which gave me an appreciation of my father's serving the Tridentine Mass in his native Budapest. My research included writing computer programs to simulate the evolution of gas clouds in intergalactic space as seen in the foreground of quasars, which are bright "lighthouse galaxies".

After Cambridge, I moved to La Serena in Chile, a beach town 50 miles west of the big international astronomical observatory at Cerro Tololo. I did not complain to go to a Catholic country. I just needed to learn Spanish. I found a friend in a seminarian who spoke no English—perfect! The Archbishop there spoke English, and sometimes slipped astronomy references into his homilies. I appreciated having Catholic holidays off and seeing religious processions, but learned that Chileans who practice their faith are very devout but are only 10-15% of the population. I was happy to

This artist's concept depicts a distant galaxy with an active quasar at its center. A region about the size of the solar system, powered by a supermassive black hole, pours out 100 to 1,000 times as much light as an entire galaxy containing a hundred billion stars, generating a glow that outshines its host galaxy and everything in it. Radiation pressure from the vicinity of the black hole pushes material away from the galaxy's center. The "quasar winds" propel hundreds of solar masses of material outward into the galaxy disk each year. This affects the entire galaxy as the material snowplows into surrounding gas and dust. Image Credit: NASA, ESA and J. Olmsted (STScI).

get my hands on some of the biggest telescopes at the time, and learned how to use them to observe quasars.

The next place was Heidelberg, Germany. That was great. I have relatives in the country and the cuisine is "home-cooking" for me. I attended the university chaplaincy there, dedicated to Edith Stein just before she was canonized, and met more friends for life. I did more research on quasars, frequently travelling to use German time on telescopes in Spain and Chile (as Germany itself is cloudy).

Then it was on to NASA in Maryland, where I frequented the University of Maryland Catholic Student Center and also went to Hungarian and German-language Masses in Washington. I worked with the Hubble Space Telescope team on its imaging spectrograph. I continued to study quasars, and also started studying young stars because there were young star experts there. Young stars led me to Johns Hopkins in Baltimore and an ultraviolet research satellite for studying them.

Lastly I came to the University of Louisville! Here I (accidentally) started the Archdiocesan Faith and Science Dialogue Group, by inviting Archbishop Kurtz to one of the lectures connected with the 2017 solar eclipse. He answered! That answer has led to this Archdiocese becoming a faith and science hub, as I could see at this year's Society of Catholic Scientists "St. Albert Initiative", where over 400 students came to Bellarmine University for a day of discussing faith and science.

I love getting to know the Church in various countries and meeting the faithful, who teach me new ways to appreciate and connect with the Lord while chasing those Big Questions.

A Desperate Plea to Fellow Priests and to Catholic School Teachers

Fr. Patrick J. Dolan, Archdiocese of Louisville
Doctorate in Theology (Angelicum, Rome)
Doctorate in Chemistry (Indiana University, Bloomington)
Chaplain, Brigadier General, U.S. Army (retired)

False conflict. "Divide and Conquer" has been a tool used by enemies throughout the centuries, including enemies of the Church. In the United States in the late nineteenth century, Dr. J. W. Draper, one of the founders of the American Chemical Society, with the subsequent cooperation of Dr. A. D. White, one of the founders of Cornell University, spread a completely false claim that there is a conflict between people of faith and those working in science. That deliberate distortion was used to drive a wedge between the scientific and engineering community and the Catholic church.

Though recognized historical experts at the time disputed this deliberate attack on the ongoing Catholic support for science throughout the ages, and still do today, some media outlets then, and especially many social media

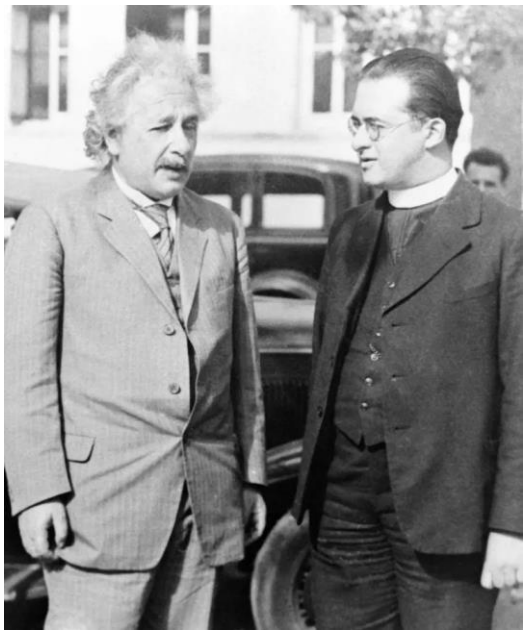
While Draper and White were promoting their idea of inherent conflict between religion and science, one of the pioneering astrophysicists of the nineteenth century, Fr. Angelo Secchi, S.J. was breaking new scientific ground from his observatory atop the church of St. Ignatius in Vatican territory in Rome; then, when the Vatican lost its territory to the modern Italian state, Pope Leo XIII founded the Vatican's own astronomical observatory, whose telescope domes were placed on the walls of the Vatican itself. They are visible in this 1924 image of the Vatican (arrows). Image credit: Vatican Observatory.

posts now, have perpetuated that non-existent divide. This error, this fake conflict, has caused considerable anguish among young students of every denomination who both believe in God and want to study science.

Trapped in this error. Today, there are very few scientists who advocate against belief in God, though there is a tiny, obnoxiously vocal minority that does so and gets press coverage. Indeed, the idea of "intelligent design" (rather than pure chance) has long been supported by scientists as the best accounting for all the wonderful order in the universe. This is not a new perspective in science.

From the time of Aristotle, who searched for the "uncaused cause" of everything, down through the ancient philosopher-scientists like Euclid and Archimedes and others throughout the ages, the reasonability of the design of the universe and all its parts has encouraged scientists to search for its source. And they made great use of what they found while searching for that Source of all that is.

In Christian times, Alcuin (735-804) encouraged mathematics at the court of Charlemagne. Abelard (1079-1142), who has been called the Descartes of the Middle ages, and Hildegard of Bingen (1098-1179), a worker with natural history and herbal medicines (as well as music and art, etc.), both lived at the time of the transition from Catholic Cathedral Schools to the first universities. Albert the Great (1200-1280) wrote the Libelus of Alchemy (the first chemistry book). Roger Bacon (1219-1292) advocated for experimentation and was the founder of the science of optics. Nicholas Steno (1638-1686), was the founder of geology. Gregor Mendel (1822-1884) was the founder of genetics. Georges Lemaître (1894-1966) was the developer of the Big Bang theory and a friend of Albert Einstein. All these Christian-era groundbreakers in science were also



Albert Einstein and Fr. Georges Lemaître.

Catholic clergy or religious: nuns, deacons, priests and bishops. They, as well as the many Catholic lay faithful who worked in science and engineering, saw no conflict between their pursuit of science and their deep faith—so why should we?

Over the centuries, the One who made that intricate design of all aspects of the universe has been, and still is, revealing it ever more deeply to scientists the deeper they study material reality. His fingerprints are all over creation. Scientists, then and now, notice the effects of God's handiwork, the things He has done outside Himself, and have routinely come to believe in His existence as a necessary part of what their scientific investigations have revealed. Indeed, people of faith appreciated this effort as far back as the book of Wisdom (13:1-9; see §3) in the centuries before Christ, which calls to task those who fail to recognize God's handiwork when studying creation. So why, today, do so many priests and other people of faith accept the lie that there is a conflict between faith in God and working in science?

Cooperative pathways. Though science can only describe what we know of God from the "outside" by examining the works of His hands, those works do so describe Him as the source of power, design, beauty, and even love; for He designed humans to instinctively care for others as they depend on one another to survive and propagate. Into this ancient world, made by God as essentially good (Genesis 1) and thus *knowable* so that scientists might look for the author of these good aspects of material reality, Christ came "in the fullness of time" to build on that longing to know the ultimate reality. He revealed to us the "inside" of God. His teaching has cooperated with scientific understanding throughout the ages to take us deeper into God's love.

Such belief does not contradict the findings of science or its longing for clearer explanations. Indeed, scientific investigation, specifically, the requirement that scientifically investigated and verified miracles be used as evidence for canonizations, shows that cooperation. So does scientific investigation of the ongoing miracles or "signs" of Christ's divinity, such as the Shroud of Turin, the Tilma image of Our Lady of Guadalupe, or the healings at Lourdes, which has given us evidence to support belief that these "signs" are real. If science thus helps provide "evidence" that there is a

spiritual reality, why do so many clergy and schoolteachers feel they have to be enemies of, or at least distant from, that helpful science?

Overcoming our fear of science. Perhaps that fear of science stems from trouble understanding it, or fear of the tests on it many endured in high school or college, or simply an uneasiness with something that seems "too complicated" to understand well—therefore many choose to believe the lie that there is some kind of conflict. Such concerns didn't stop clergy in the Middle Ages from trusting their engineers to build the cathedrals. Their construction took generations and cost a lot of money, but the clergy trusted the builders and didn't feel that they themselves had to master the needed calculations involved. They trusted the scientifically necessary flying buttresses and even made poetic descriptions of them.

With Catholic text books on science for our grade schools easily available (and with teachers' manuals that illuminate the wonder of God's creation), can we not use our common understanding of things (including using measuring devices like we do when we bake cookies or brownies, which is chemistry at home) to look just a bit deeper at God's handiwork without being intimidated? If we trust our doctors to use the best modern medical science, can we not trust our Catholic scientists and engineers, such as the ones whose contributions are found in this booklet, to do their parallel research equally well, and let them examine all the wondrous new findings of science for us?

Trusting one another. Common sense can ground our understanding and trust of science. We know that the sun will rise in the east. We know that salt will reduce the freezing point of water, allowing us to melt ice on our sidewalks and roads in winter. We know that when we pour water at baptism, it will flow by gravity down onto the child's head. We know that the material components of the sacraments are real, with specific characteristics (wine has to be pure grape, bread has to be wheat, oil is from olives not oil wells, etc.) which are important to their being conveyors of spiritual grace. Can we not trust our Catholic scientists (who are far from all-knowing and who trust clergy about many spiritual and social things) to certify these material things, just as we trust our Catholic doctors and nurses

to work together with clergy to make our world better through healing arts? As scientists expand our vision of the universe, or of the tiniest part of human anatomy, can we not let them help deepen the awe we feel for its Creator?

Removing obstacles. Sadly, many clergy and spiritual writers unwittingly impose obstacles to that scientific deepening of awe. Here are four all-too-common ones:

- Some folks insist that scientists cannot look for certainty, claiming that the Heisenberg Uncertainty Principle (at the sub-atomic level) prevents all other disciplines dealing with larger things from knowing anything. This is absurd, for every cleaner knows what a broom or mop is and how to use it, despite the fact that it is made up of sub-atomic particles. Astronomers told us with certainty when and where the solar eclipses of 2017 and 2024 would pass over our archdiocese, even though the sun and moon are made up of sub-atomic particles. Moreover, there are many other areas even at the subatomic level of that Heisenberg Uncertainty Principle and smaller, that scientists know with considerable accuracy, such as the four unique forces (Weak Nuclear, Strong Nuclear, Gravitational, and Electromagnetic) that make up all physical reality and thus allow us to live.

- Others say that we should not ask *how* about sacraments or anything "spiritual", for science only looks at *how* and religion asks *why.* Yet this too undermines human research, for every *how* leads to another *how* and eventually to a common *why*. This search can lead us closer to the uncaused cause and tell us something more about the "outside" of God that enhances our understanding of the "inside" of God revealed by Christ. Moreover, just because science looks for intermediate physical causes (rather than divine ones), that does not make science atheistic, for these all eventually lead toward Aristotle's uncaused cause.

- Others tell us to not even seek answers, for "almost all accepted theories have subsequently been replaced by others." Yet seeking the depths and details of "intelligent design" again lets us see with greater clarity the wonders of the created universe, distinguishing false theories from more correct ones. Even incorrect understandings of nature have helped move folks toward more correct understandings, and have been useful in the process. Not knowing exactly how gunpowder works did not stop its being very useful in defending one's nation.

- Finally, some people caution against any scientific research, lest it undermine the Bible. Yet, those who advocate such a position do not understand that the Bible is truly written by God, but beautifully put forth in the only ways humans could understand it at the time it was written—much the same way we would describe something to a four-year-old in terms less complex than we would explain that same phenomenon to a college student. Both explanations may be equally true, but proportioned to the understanding of the recipient. Trying to describe the creation of the world using relativity theory and gas laws would have been lost on the Israelites wandering in the Sinai desert.

A way forward. As scientific research has shown us the common origin of all human life (through L-amino acids) and hence the dignity of all humans as individuals intricately made by the loving hands of God, and just as the Big Bang theory has shown us that the universe had a unique beginning, can we in the Church (clergy and religious and lay alike) not allow scientists to show us, ever more deeply, the intricacies and more of the wonder of all the gifts God has created for us on this earth, and help us thank and praise Him more profoundly? If we allow science to help deepen our faith, and we use our belief in God (which gives meaning and purpose to all activity, even scientific research) to encourage and sustain scientists, we will be defeating the anti-Catholic enemies who tried to weaken our church by propagating that false animosity between faith and science over 150 years ago.

The Church and Science: A History in Seven Parts

History must be an important part of any resource book for Catholic priests, educators, and parents regarding faith and science. There is a popular perception that the Catholic Church has been historically opposed to science, and either still is opposed or has only recently come around to accepting science. The story of Galileo and Pope Urban VIII and the question of the motion of the earth is usually cited as an example of this; a presumed Catholic opposition to the Theory of Evolution is another example.

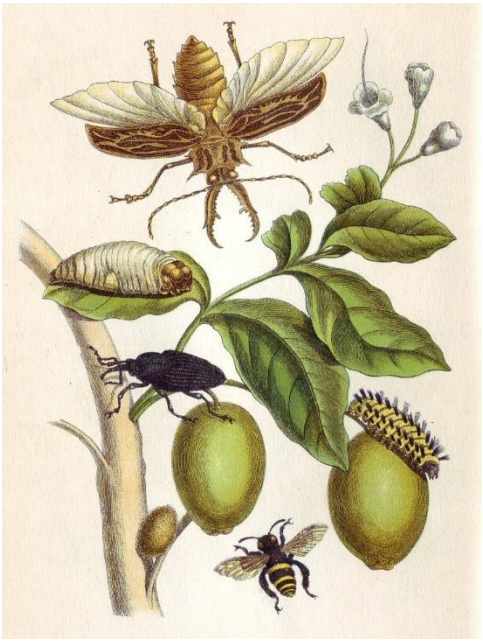
However, that popular perception is merely a perception. Both Galileo and Evolution are complex stories, but neither happened because the Catholic Church is "opposed to science". This seven-part discussion of Church, science, and history provides a more in-depth look at these stories. It is taken from the "Series on Church and Science" by Christopher M. Graney of the Vatican Observatory and Vatican Observatory Foundation (and of the Archdiocese of Louisville Faith and Science Dialogue Group), published by *Aleteia* between November 12, 2024 and February 17, 2025 at **https://aleteia.org/tag/church-and-science**. It has been lightly edited, mainly to remove references to links, and to include some additional figure captions.

This series is based on the paper "The Vatican and the Fallibility of Science," presented by Graney at the "Unity & Disunity in Science" conference at the University of Notre Dame, April 4-6, 2024. The paper, which is available through ArXiv (https://arxiv.org/abs/2403.05516), contains details and references for the interested reader.

The paper, and the *Aleteia* series, expands on ideas developed by Graney and Vatican Observatory Director Br. Guy Consolmagno, S.J. in their 2023 book *When Science Goes Wrong: The Desire and Search for Truth* (Paulist Press).

The Church and Science Part 1: St. Augustine and the Two Great Lights

The story of the Catholic Church and science is usually not one of conflict. The history of science is full of deeply religious scientists who see their work more or less as described in the Catechism of the Catholic Church (CCC 159): "the humble and persevering investigator of the secrets of nature ... being led, as it were, by the hand of God … for it is God, the conserver of all things, who made them what they are." Nevertheless, the points of conflict between science and religion have become famous. Stories of conflict draw our attention. For that reason, this Church and Science history series will focus on the conflict stories.



Maria Sibylla Merian is an example of a scientist whose attitude was that of an investigator of the works of the hand of God. Part of one of Merian's hymns of praise:

> ***Lord, of everything Creator,***
> ***all the wonders Thou has wrought,***
> ***in Thy wisdom, I will sing them,***
> ***works that beggar human thought…***

Merian's work is particularly spectacular, as seen in this illustration from her 1705 *Metamorphosis Insectorum Surinamensium*. However, many other scientists across history, from the physicist Isaac Newton to the pioneering microscopist Anthony van Leeuwenhoek, described their work in broadly similar terms. The astronomer Johannes Kepler, like Merian, included hymns of praise to God in his works. Image credit: Wikimedia Commons.

So, when did the Church first find itself faced with a faith-science conflict? The answer to that question is, *a long time ago!* Conflict sprang up between the results of science and the words of Scripture even before the Council of Nicaea in 325 A.D.—even before the Church had formulated essential doctrines on the Trinity and the person of Jesus.

Genesis 1:16 describes the creation of the sun, moon, and stars: "God made the two great lights, the greater one to govern the day, and the lesser one to govern the night, and the stars." What does "great" mean here? If we are thinking of the sky as a simple dome, with these lights on its surface, then "greatness" is merely a matter of

sight. The sun, moon, and stars should all be the same distance from Earth; therefore, their relative physical sizes should be simply what appears to the eye. The sun and moon should indeed be "greater" than the stars, in terms of actual physical bulk as well as in terms of appearance and power of illumination.

However, careful study of the sky reveals it not to be lights on a dome. The astronomer Ptolemy, of Alexandria in Egypt, worked around 150 A.D. His life overlapped with the lives of people such as St. Polycarp and St. Irenaeus. Ptolemy discussed in his book *Almagest* how the appearance of the stars does not depend on the place on Earth from which they are observed. That means that the size of the Earth is as nothing—it is like a point, he said—compared to the distance to the stars. The stars of Taurus the Bull, for example, look no different when observed from Alexandria than when observed from places much further north or south. That is not true for the moon, meaning that Earth is not merely a point compared to the distance to the moon. The moon must be much closer than the stars.

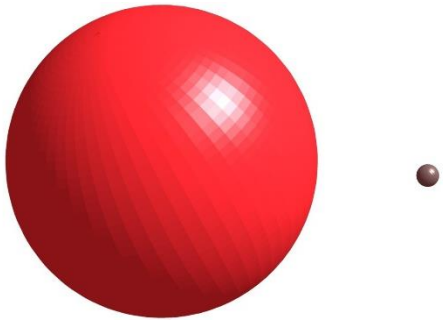
Ptolemy's science was persuasive. Anyone who travelled and had good eyesight could confirm what he said. Thus, despite the contradiction

The moon passing through the stars of Taurus (including the prominent star Aldebaran) in September of 139 A.D., as seen from (left to right), Alexandria in Egypt, central Africa, and northern Europe. The moon's position is slightly different as seen at the same moment in time from each place, showing that the size of the Earth matters in regard to our view of the moon. The appearance of the stars, however, is unchanged in all three, showing that the size of the Earth is as nothing as regards the stars. This simulation, made with the *Stellarium* computer app, shows the stars as having similar apparent sizes (compared to the moon) to what the astronomer Ptolemy measured, or to what anyone with keen eyes (20/20 vision) and experience would see them to be.

between the words of Genesis and the calculations of Ptolemy, St. Severinus Boethius, for example, would cite Ptolemy by name in his *On the Consolation of Philosophy* of 523 A.D. and write,

> *You have learned from astronomy, that this globe of earth is but as a point, in respect to the vast extent of the heavens; that is, the immensity of the celestial sphere is such that ours, when compared with it, is as nothing, and vanishes.*

Ptolemy measured the apparent sizes of stars. Observers everywhere, and over centuries, agreed with his measurements. The vast distance to the stars meant that they actually had to be very large in order to appear even as small as they do. Ptolemy determined the most prominent stars (like Aldebaran in Taurus) to be more than four times the diameter of Earth, while the moon was less than one third of Earth's diameter. A prominent star was therefore far "greater" than the moon.



The size of a star (left) compared to the moon (right) as determined by Ptolemy. Today we know that stars are even larger than this, compared to the moon.

Indeed, every visible star in the night sky would be greater than the moon. Anyone with good eyesight who cared to look could at least approximately confirm Ptolemy's measurements. The stars might *appear* small, but the moon *was* small. The moon was arguably not a "great light"—contrary to Genesis.

How did the Church handle this conflict between Scripture and science?

St. Augustine discussed the matter in his *On the Literal Interpretation of Genesis*. He noted that "many of the stars, however, so they [astronomers] boldly assert, are equal to the sun, or even greater, but they seem small because they have been set further away." After elaborating further on what might be said about the celestial lights, St. Augustine concluded:

> *Let them at least grant this to our eyes, after all, that it is obvious that they [sun and moon] shine more brightly than the rest upon the earth,*

> *and that it is only the light of the sun that makes the day bright, and that even with so many stars appearing, the night is never as light when there is no moon, as when it is being illuminated by its presence.*

Centuries later St. Thomas Aquinas addressed the "great lights" question in his *Summa Theologica*, Question LXX ("Of the Work of Adornment, as regards the Fourth Day—In Three Articles"). He considered various objections to the Genesis account of the creation of the celestial lights, including,

> Obj. 5. *Further, as astronomers say, there are many stars larger than the moon. Therefore the sun and the moon alone are not correctly described as the* two great lights.

His answer to this:

> Reply Obj. 5. *As Chrysostom says, the two lights are called great, not so much with regard to their dimensions as to their influence and power. For though the stars be of greater bulk than the moon, yet the influence of the moon is more perceptible to the senses in this lower world. Moreover, as far as the senses are concerned, its apparent size is greater.*

This idea that Genesis speaks to how the stars appear to our eyes, and not to the actual physical sizes of stars, was not only the interpretation of Catholic thinkers. John Calvin made the same general point, but at greater length. He praised the findings of astronomers and claimed that Genesis was written in terms of what we see with our eyes, because "The Holy Spirit had no intention to teach astronomy"; "the Spirit of God here opens a common school for all... adapt[ing] his discourse to common usage" and thus Genesis "does not call us up into heaven... [but] only proposes things which lie open before our eyes".

These three men lived in very different times. St. Augustine lived from 354 to 430 A.D. St. Thomas lived from 1225 to 1274. Calvin lived from 1509 to 1564. All accepted the science that said that the stars are larger than

the moon in terms of actual size. All interpreted Genesis as referring to what our eyes perceive.

Others also treated the question of star sizes and Genesis (St. Thomas mentions St. John Chrysostom). Some of these, including St. Robert Bellarmine, were discussing it at the time when Copernicus's hypothesis that the Earth circles around the sun was being debated. Across the centuries, the Church handled this religion-science conflict by accepting the results of science, while noting that Genesis was speaking in terms of how we see the sky. The Church has been accepting persuasive science and figuring out how to interpret faith in light of that persuasive science for almost 2000 years.

The Church and Science Part 2: A Church of Imperfect People and Processes

The Church has been accepting persuasive science and figuring out how to interpret faith in light of that persuasive science for almost 2000 years, since at least the question of the "two great lights" of Genesis 1. But some of the Church's best minds, St. Augustine and St. Thomas Aquinas, weighed in on that particular question. There is not always an Augustine or Aquinas around. And, things have changed since Augustine, and even since Aquinas.

When there is a conflict between science and the Catholic faith, and there is no Augustine or Aquinas around, what does the Church do? Or, more specifically, what does the Vatican do? How are decisions made and actions taken when the subject is something like science?

There have been few instances where there was significant conflict between science and religion, of the sort where the Vatican got involved. The Church is not really going to have much opinion on most scientific developments. The debates of scientists about the existence of what we now call oxygen, or about bird migration, are unlikely to generate broad conflicts with religion.

One instance where broad conflict did arise and the Vatican got formally involved is the theory of evolution. There is a lot of documentation about the processes the Vatican used during that conflict. That was only about 150 years ago—just yesterday in Church history! The Vatican kept plenty of records that have survived to today. In the late twentieth century, the Vatican opened the archives containing those records so that scholars could study them. Therefore, there is plenty of information available about what went on when the Vatican was confronting the question of evolution.

Scholars have pored over that information and written about what they found. There were six faith-and-science cases involving evolution that reached the Vatican in the later decades of the nineteenth century. All were related to Catholics writing about the theory of evolution.

There were two Vatican groups that could address these sorts of cases. One was the Holy Office (later the Congregation for the Doctrine of the Faith, now the Dicastery for the Doctrine of the Faith). The other was the Congregation of the Index (merged into the Holy Office by Pope Benedict

XV in 1917). The Holy Office had a broad role regarding matters of faith and morals. The Congregation of the Index, which published the *Index of Prohibited Books* for more than three centuries, was much less important in function and rank. Its decisions were less important. Its mission was much more concrete and modest. Nevertheless, when there was Vatican action in the six evolution cases, it was the Congregation of the Index that acted, not the Holy Office.

It turns out that the Congregation of the Index operated like many academic or parish committees—which is to say, imperfectly! The Congregation did not have any set program for reviewing books in general to catch ones the Church might find problematic. There was no plan of action. The Congregation only looked at a book when someone submitted a formal complaint to them about the book.

When that happened, the secretary of the Congregation was required to examine the book and to name book reviewers, called "consultors", who also examined it. Someone in the group would write a report. There would be a meeting of the consultors. Then there would be a meeting of the full Congregation of the member cardinals. They would produce a judgement on the book, to be submitted for the pope's approval. If a book was found to need censure, a decree was published, adding the book to the *Index*. But only that decree of condemnation was made public. The reasons why a book was condemned were not specified.

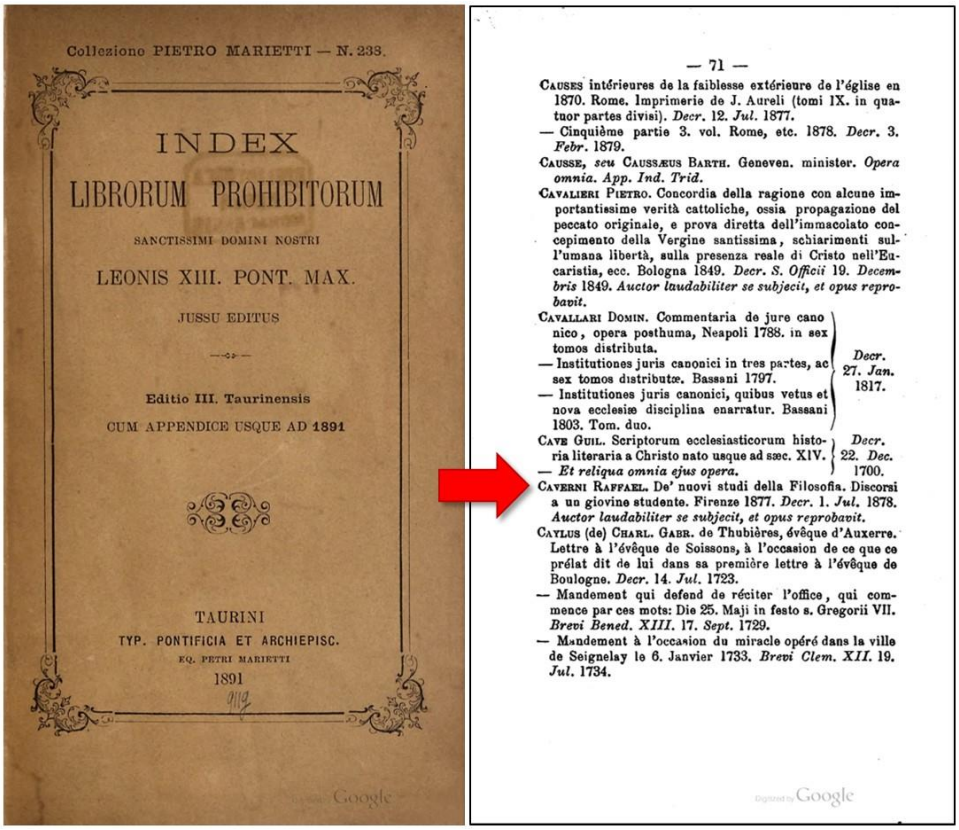
That is how things worked in principle. In reality, new editions of the *Index* were not issued with any regularity. The consultors and cardinals who were members of the Congregation did not attend meetings regularly, either. The Congregation consisted of twenty to thirty cardinals during the evolution discussions, but records show that usually only five or ten cardinals showed up at a meeting! Members of the Congregation had other priorities.

Then there were the reports. There might be multiple reports from different consultors, with the views of the consultors not agreeing with each other at all. In the case of Fr. Dalmace Leroy and his 1891 book *The Evolution of Organic Species*, Congregation consultors wrote six different reports over time! The consultors were not in agreement about Leroy's book. They were not in agreement about evolution.

Consultors themselves recognized the weakness of the process. One of the consultors who reviewed Fr. Leroy's book suggested that the cardinals not prohibit it, but rather just warn Fr. Leroy through his superiors to issue a retraction of the book on his own. Why not prohibit the book? In part because the consultor thought Fr. Leroy had good intentions and was a bright and upright priest. But in part it was because the consultor thought that Fr. Leroy should not be subject to having his book condemned when other writers had similar books in circulation that would not be condemned—not because those books were better somehow than Fr. Leroy's, but simply because no one had complained about them to the Vatican.

Even the overall Congregation might hold back on their opinions. They did not always put a solid effort into their evaluation of evolution (as evidenced by the attendance at meetings), relying on their own efforts rather than consulting a wide group of experts. So sometimes they worried that their decisions were not above criticism from the top minds in theology. Given the haphazard nature of the Congregation's workings, it is not surprising that in five of those six evolution cases mentioned above, the Congregation took no official action, opting to either privately communicate with authors or to take no action at all. The only book to be publicly condemned as a result of its treatment of evolution was the 1877 book, *New Studies of Philosophy: Lectures to a Young Student* by Fr. Raffaello Caverni, who had served as professor of physics and mathematics in the seminary of Firenzuola. But since the reason for a book's being listed on the *Index* was never given (in keeping with the normal practice of the Congregation), and there was no mention of evolution in the book's title, no one who was not directly involved in the book review process would have ever known what the problem was. People knew Fr. Caverni's book had been prohibited, but not why. Caverni had some criticisms of the ecclesiastical world in his book—for all anyone in the public knew, maybe that was why it was put on the *Index*. Unsurprisingly, the case of Fr. Caverni is usually overlooked in discussions of the Vatican and evolution.

The Vatican, like the Church as a whole, is made up of people—imperfect people. Imperfect people make for imperfect processes, imperfect



An 1891 edition of the *Index of Prohibited Books*, which features the *New Studies of Philosophy* of Fr. Raffaello Caverni (arrowed). The note commends the author for agreeing and rejecting the book himself. Image credit: Google Books.

actions, and imperfect results. That is important to keep in mind in exploring the story of the Catholic Church and science.

Of course, we might ask—if the Church's processes are so imperfect, why would it ever get involved in a science question in the first place, if there was no heavy hitter like Augustine on hand? Isn't science the best way we have of knowing things?

The Church and Science Part 3: Science Goes Wrong

Why would the Vatican ever decide to meddle in a scientific question? We've just seen in the previous Part the imperfection of the Church's processes for evaluating science. Isn't science, by contrast, one of the best ways we have for knowing things? It is self-correcting, always bringing us a truer picture of the universe. Science makes the modern world. Science *works*.

Besides, as we saw in the first Part, the ancient matter of Genesis and the "two great lights" is a template for addressing faith-science conflict: the Bible speaks to common understanding, to how the average person might see things; it does not give us a scientific description of the universe. That has been known since St. Augustine's time.

So why wouldn't the Vatican just mind its own business?

The answer to this question gets complicated—and offensive.

Scholars have looked at what was taking place in the later nineteenth century when the evolution question was being discussed within the Church in general, and the Vatican in particular. They have found that various learned people within the Church were emphasizing the importance of the descent of all people from Adam, and the unity of humankind: a provincial council; a bishop; Jesuit critics of evolution; and a Pontifical Biblical Commission.

For example, in 1898 Bishop John Cuthbert Hedley of Newport, Wales wrote a review of four works by of Fr. John Zahm, CSC, a priest and scientist from the University of Notre Dame in the United States who wrote on evolution. In this review, Bishop Cuthbert stated that "there are some matters so clearly revealed as to be out of the field of question or investigation." A bishop was arguing that science had no business studying some things!

What sort of things? "The unity of the human race," was one such thing, the bishop wrote, "as Dr. Zahm himself admits." This unity, Bishop Hedley thought, was one of several subjects, "in which it would be not only a mistake, but also an offence against religious faith, not to start with a firm hold of what is taught by the Church."

As another example, a 1909 Pontifical Biblical Commission did not reject evolution itself, but was concerned about Genesis in terms of the origins of the human race. The commission was concerned about humanity's "monogenistic" origin, such that humanity comprised a single, united family.

The Bible is clearly "monogenistic". All human beings are descendants of the same parents, Adam and Eve. We are thus all of one family.

A competing idea, however, was that different "types" of people had of separate origins. Under this idea there were, supposedly, actually different species of human (-like) creatures, with these different species commonly being called "races". This idea is "polygenism"—multiple origins for the multiple human "types" or "races", with most "races" not being of the line of Adam and Eve.

Polygenism was an ancient idea. It had been bolstered in European minds by voyages of discovery that revealed distant, peopled lands. Polygenism was also considered to be very much heretical.

Giordano Bruno is famous for having been burned at the stake in 1600 as an unrepentant heretic. He advocated many ideas that his contemporaries found offensive. Because he also advocated for the idea of an infinite universe of other suns, all of which were circled by inhabited worlds like Earth, he is sometimes considered a martyr for science. It is a matter of debate among scholars how much his ideas about the universe played in his burning versus, for example, his denial of Christ's divinity. But one Bruno idea that would offend many today was his polygenism. He argued in 1591 that the different "races" could not all have a common origin:

> *For of many colors*
> *Are the species of men, and the black race*
> *Of the Ethiopians, and the yellow offspring of America...*
> *Cannot be traced to the same descent, nor are they sprung*
> *From the generative force of a single progenitor.*

Bruno noted that "it is said in the prophets... that all races of men are to be traced to one first father", but added that "no one of sound judgement can refer the Ethiopian race to that protoplast."

Bruno's singling out "Ethiopians" was typical. It seems it was usually the "black race" that "sound judgement" supposedly indicated was most removed from "true" humans.

Some argued that sound judgement, and indeed science, stood against polygenism. In 1680 Morgan Godwyn published a book called *The Negro's & Indians Advocate, Suing for their Admission into the Church*. In it, he noted that different species do not beget fertile offspring. A horse and an ass, for example, can beget offspring, namely a mule, but that offspring is sterile. Godwyn wrote that, if different races were different species like horses and asses, then the people of mixed race, "must, *like the Mules*... be for ever Barren", unable to procreate. But, Godwyn said, the contrary is seen daily. "Mixed race" people certainly have children. Thus, humans are of one family, whatever "race" they may be. That was just a fact of science. (Godwyn also noted that Catholic missionaries recognized the unity of humankind, and would even portray Jesus as black in their efforts to evangelize all people.)

Polygenists claimed science anyway. For example, J. H. Van Evrie (M.D.) in his 1861 book *Negroes and Negro "Slavery"* claimed that "the inference... that whites and negroes were of the same species, because the mulatto, unlike the mule, did reproduce itself, is simply absurd." Van Evrie argued that people of mixed race were absolutely sterile—the sterility simply showed up over several generations. This was common knowledge among those who dealt in the slave trade, he said.

Van Evrie was not alone in his ideas. The 1850 meeting of the American Association for the Advancement of Science featured discussion of how the "types" of human beings were fixed, because "hybrids" were sterile in the long term, and thus died out. The science of polygenism was central to the whole business of racial slavery and oppression. As Van Evrie himself noted,

> *If the Negro had descended from the same parentage, or, except in color merely, was the same being as ourselves.... then it would be [a Christian's] first and most imperative duty... to set an example to others, to labor night and day to elevate this (in that case) wronged and outraged race—indeed, to suffer every personal inconvenience,*

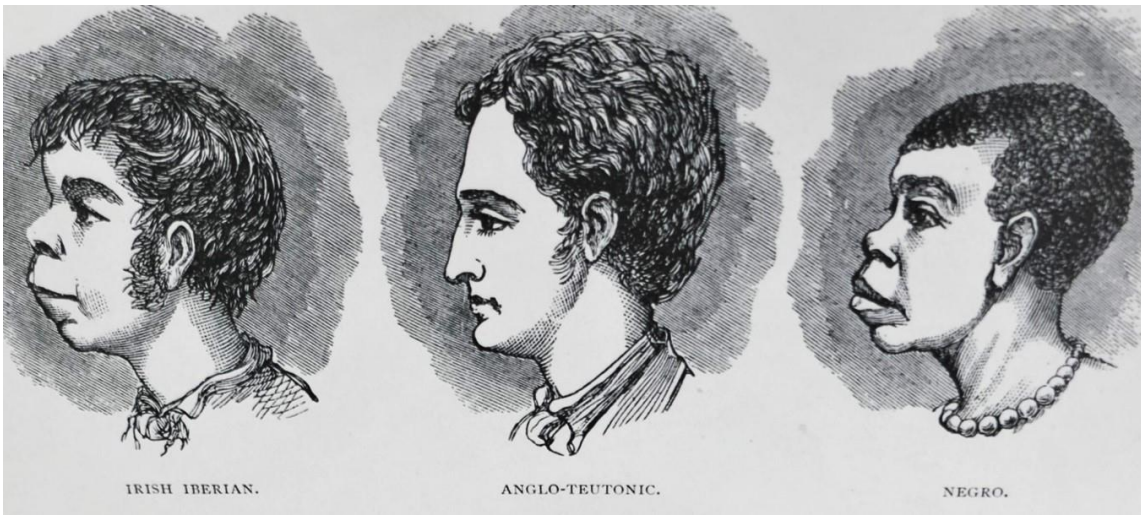
> *even martyrdom itself in the performance of a duty so obvious and necessary.*

This sentiment was not limited to Americans tied up with the question of slavery. Others argued that traditional religious ideas about the unity of and nature of human beings should yield to scientific evidence that showed that there were different species of human (-like) beings. Georges Pouchet of the Muséum national d'Histoire naturelle in Paris complained of how, despite the battles "fought and won" by science against religion in astronomy (about Earth's motion) and geology (about Earth's age), "man is a sacred, and, therefore, a forbidden subject." We can study rocks, but not humankind, he groused. Religion treats facts with derision, he said. You can talk about bears and elephants however you want, "but an Esquimaux and a European, a Negro and a Persian, were to be invariably treated as of one species." "The true man" was "the large-brained and small-mouthed Caucasian". Others urged that religious ideas

> *should succumb to the clear demonstrations of inductive science, and racial facts be championed to their appropriate place, as among the most important and reliable data upon which history, more especially that of the earlier ages, can be based.*

Of course, today ugly ideas such as these are not part of science. Modern science is essentially monogenistic; it says that all people are of the same family, and that "racial" variations are quite minor, compared to the variations between individuals, and compared to variations found within other species. The "scientific racism" ideas promoted by Van Evrie and Pouchet have been so thoroughly rejected that today you hear them called "pseudo" science, even though they were science in the nineteenth century.

Today it is considered (to paraphrase Bishop Hedley) not only mistaken, but offensive, not to start any scientific investigation with a firm hold of the idea that all human beings, regardless of their "race", are of the same family, and fundamentally equal. Any scientist today who proposed a new polygenistic theory for the origin of human beings, asserting that certain



The frontispiece from H. S. Constable's 1899 book *Ireland, from One or Two Neglected Points of View*. Constable's caption for this image borrows from evolutionary ideas, discussing how the "Irish Iberians" had roots in Africa and were descendants of a "low type" with a protrusive jaw, "who, in consequence of isolation from the rest of the world, had never been out-competed in the healthy struggle of life, and thus made way, according to the laws of nature, for superior races." Note the portrayal of mouth sizes. Image credit: Wikimedia Commons.

types of people are not truly of the human family, would be roundly condemned.

Today we simply reject the idea that science can tell us that the man or woman standing next to us is not fully human. Those who do not reject it are ranked among the least pleasant kinds of crackpots. Some matters are considered to be so clear (again paraphrasing Bishop Hedley) as to be out of the field of question or investigation.

Therefore, because evolution and polygenism and the idea that certain people were not fully human were all linked together in the nineteenth century, even those today who care little for the Catholic Church might understand why the Vatican would decide to meddle in the evolution question. Even people today who have little interest in discussions of original sin and salvation history might understand why the unity of humankind must be sacrosanct. The example of "scientific racism" urges that science be subject to confrontation and criticism from outside of science. The fact that science is *eventually* self-correcting, *eventually* brings us a truer picture of the universe, and *eventually* works is not good enough when science can go so far wrong, in such a consequential manner.

The Church and Science Part 4: Evolution

We have seen that the Church has been dealing with the question of how scientific discovery impacts faith going all the way back to the time of St. Augustine in the Roman Empire. The question then was Genesis and the astronomer Ptolemy and the "two great lights". We have seen the imperfections of the Vatican's processes for handling such questions. We have also seen, through the question of polygenism and "scientific racism", that science can go so far wrong in such consequential matters that even those who might not support religion might nevertheless agree that some sort of interference from outside of science is warranted. So let's look at a famous case where all of this came together—the Vatican's discussion of evolution at the end of the nineteenth century.

As we saw in Part 2, scholars have identified six cases of the Vatican confronting the evolution question in the late nineteenth century. All six arose from Catholics writing on evolution. In all these cases, the Congregation of the Index handled things. It never took any recognizable public action against evolution—the closest thing being the condemnation of the 1877 book, *New Studies of Philosophy: Lectures to a Young Student*, by Fr. Raffaello Caverni. It was condemned, but since the only decision made public was the prohibition of the book, and the book's title does not mention evolution, there was no way to know why it was condemned. In the other five cases, the Congregation took no public action of any sort, although one scholar has argued that the Vatican's private censuring of various authors effectively amounted to at least a temporary condemnation of evolution.

In the late nineteenth century, evolution was easier to attack on scientific grounds than it is today. Scholars note that the late nineteenth century saw an "eclipse of Darwinism"—scientists at that time did not agree on a mechanism for evolution; Charles Darwin himself retreated a bit on the idea that natural selection was the sole mechanism of evolution; some in the world of British biology were sounding the death knell of Darwinism. Certainly, Darwin's ideas were not so easily confirmed as Ptolemy's ideas about the sizes of stars (Part 1).

And here is something to keep in mind: Ptolemy was right that stars are much farther away and much larger than the moon; but he was wrong about

how large and how far. Stars are much larger, and much farther away, than he calculated. Ptolemy did not understand the nature of light like we do today. That threw off his results. Science goes wrong often. Ptolemy's star size science was not so far off base as the scientific racism we encountered in the last Part, and certainly not so consequential, but it had real problems.

Scholars have found one Catholic critic after another in the late nineteenth century harping on the real problems they perceived in the theory of evolution, its *scientific* weaknesses. Most of these critics emphasized in some way that we do not abandon the obvious, natural sense of biblical words, unless necessary (like with the "two great lights"), and that there was no such necessity in the case of evolution because of the scientific problems in that theory.

Francesco Salis-Seewis, for example, was one of a group of Jesuits who wrote against evolution in the Roman Jesuit publication *La Civiltà Cattolica*. He argued in the 1890s that evolution must first pass scientific muster. "Only then," he said, "will it merit to face Revelation." Until then, it is pointless "to introduce this failure of science in the sacristy." Salvatore Brandi, another *La Civiltà Cattolica* Jesuit, noted:

> *The first impediment to accepting evolution for educated Catholics comes not from the fear of contradicting the Bible, but from the scientific insufficiency of that system, that is, the absolute lack of evidence that confirms it.*

A scientific idea must be solid before it can be used in interpreting Scripture, Brandi said. "It is certainly required", he wrote, "that the words of eternal Truth not be interpreted and warped on the basis of gratuitous hypotheses, to make [those words] say today in obedience to one theory, what will be said tomorrow in obedience to another."

In other words, the fact that science could influence scriptural interpretation was obvious, thanks to the "two great lights" of Genesis 1. But the science had to be solidly demonstrated. If a theory had weaknesses scientifically, why bother to consider it theologically? After all, the interpretation of Scripture could not be allowed to simply flutter in the

changing winds of passing scientific ideas, following one fallible scientific idea today, another tomorrow.

One perceived scientific weakness of evolution was the matter of infertility of hybrids discussed in Part 3. Different species were known to beget offspring; a horse and an ass can beget a mule. But that offspring is sterile. This is not considered relevant to evolution today, but in the late nineteenth century even writers who were enthusiastic about evolution considered it a problem.

Another scientific problem, one that the Jesuits of *La Civiltà Cattolica* found particularly significant, was the problem of the origin of life. Salis-Seewis wrote, "The first postulate with which evolutionism opens its series of imaginative theories is that of the spontaneous generation of the very first organisms." He then went on to point out that the idea of the spontaneous generation of life from inanimate matter, though very ancient, had been repudiated by modern science. Indeed, he said, science had repeatedly pronounced judgement on "this first and fundamental supposition" of evolution, and "primordial spontaneous generation has been declared devoid of any foundation and contrary to the constant induction of facts and to one of the best-established laws of Nature." Salis-Seewis was correct—while there were still a few advocates for some sort of spontaneous generation even in the late nineteenth century, by the end of that century the idea had been rejected by science. Today the origin of life remains a puzzle, scientifically speaking.

Many Catholic theologians in the late nineteenth century viewed support for evolution as a sort of atheistic ideology based on a scientific theory that lacked any serious foundation. Without such a foundation it was easy to dismiss evolution from a theological point of view. But with time, the changing winds of passing scientific ideas calmed. Science that once seemed all too obviously fallible began to have the kind of persuasive power possessed by Ptolemy's work. And importantly, that science of evolution ceased to be something associated with polygenism that undermined the idea of the unity of the human family.

We see, in the Vatican's confrontation of evolution in the late nineteenth century, an effort to wrestle with science that was unsettled and consequential. Evolution was consequential, seen at that time as

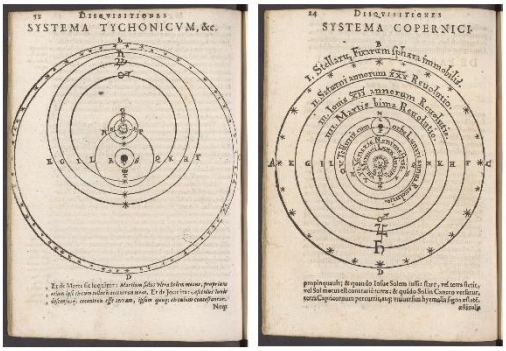
undermining the unity of humanity and placing some people outside of salvation history. Evolution was unsettled, with Darwinism in "eclipse" and many thinkers having serious scientific questions about it (at least one of which remains unanswered today).

The Vatican's process for wrestling with the idea of evolution was, in essence, a committee of men who lacked the time, expertise and commitment really necessary to address the matter at hand. As imperfect as this process was, it is difficult to envision better processes, or to envision no processes. Many people today view evolution as emblematic of "conflict between science and religion", but if today a scientific idea arose that was promising yet unverified, and that had "race"-based implications for who was fully human and who was not, what would happen? Panels and committees would be formed; reports would be issued; harsh words would be said—outside of religion. There would be consequences to individuals much like what the Vatican could dish out in the late nineteenth century. The process would be imperfect. Modern processes for dealing with consequential scientific ideas, whether they involve the development of weapons or the response to deadly diseases, have been imperfect—like the Vatican's discussion of evolution at the end of the nineteenth century.

But what about back when the Vatican dished out consequences worse than just having a book put on a "prohibited" list? What about Galileo?

The Church and Science Part 5: Science and Galileo

What about the case of Galileo? In the previous Part, we saw how much concern there was within the Church regarding the scientific problems with the theory of evolution. We also saw concern regarding any revision of religious thought for the sake of theories that might not withstand the test of time.



The models of the universe of Tycho Brahe (left) and Nicolaus Copernicus (right), as illustrated in the 1614 book *Mathematical Disquisitions* by Fr. Christoph Scheiner, S.J. and his student Johann Georg Locher. Copernicus had the Earth and the planets circling the sun, while Brahe had the sun circling an unmoving Earth with the planets circling the sun. Relative motions within the planetary system were identical in both (Venus circled the sun in both, for example); both were compatible with Galileo's discoveries. Under Copernicus, however, the stars had to be very far away—and, it seemed at the time, extremely large—contrary to what is shown in the right-hand diagram. Image credit: ETH-Bibliothek Zürich.

Was that what was happening in the Galileo case?

There is less information available about the Galileo case than the evolution case, but it seems likely that the answer to this question is "yes".

You will find it said in many places that Galileo proved Nicolaus Copernicus's "heliocentrism", the idea that the Earth circles the sun. That is not true. Heliocentrism was hard to prove. Earth's motion around the sun was not so easily verified as Ptolemy's claim that the stars were larger than the moon, contrary to the "two great lights" of Genesis (see Part 1).

Those who opposed Galileo focused on a problem involving the sizes of stars in a Copernican universe—in essence, on a variant of the "great lights" question. Ptolemy discussed how the appearance of the stars is independent of the place on *Earth* from which they are observed, with the result that stars must be far larger than the *Earth* (and the moon). That logic, when applied to a moving Earth, where the appearance of the stars becomes independent of the place on *Earth's orbit* from which they are observed, results in stars being far larger than *Earth's orbit*. If Copernicus was right, stars would all utterly dwarf the sun.

This was first pointed out around the turn of the seventeenth century by the astronomer Tycho Brahe. He also produced a new Earth-centered model

for the universe that, some years later, turned out to be fully compatible with the new telescopic discoveries of Galileo. Some Copernicans, including Johannes Kepler, simply accepted the enormous stars implied by heliocentrism. Brahe, however, said that they were absurd. Brahe's model generally retained Ptolemy's stellar distances and sizes. It did not suffer from the star size problem.

In the first half of the seventeenth century, following the advent of the telescope, Jesuit astronomers such as Frs. Christoph Scheiner, Giovanni Battista Riccioli, and André Tacquet developed Brahe's star size argument further. Scheiner and Tacquet produced brief, elegant versions of the argument (the discussion above of how Earth's orbit in heliocentrism becomes the basis of observation as opposed to the Earth itself, is from Tacquet). Riccioli, by contrast, published large tables containing precise telescopic stellar measurements and the results of calculations made from those measurements, along with pages of discussion—and reached similar conclusions about heliocentrism and star sizes.

What this all meant was that Brahe's star size argument, and his model, seemed to grow stronger over time. Science seemed to be backing the idea that Earth *did not* move. In 1674 Robert Hooke, the scientist who clashed with Isaac Newton and who did early work with microscopes, called the star size argument "a grand objection alleged by divers of the great *Anti-copernicans* with great vehemency and insulting; amongst which we may reckon *Ricciolus* and *Tacquet*… hoping to make it [the Copernican universe] seem so improbable, as to be rejected by all parties."

However, by 1674 astronomers including Hooke himself had begun to publish data suggesting problems with measurements of the apparent sizes of stars. These problems indicated that such measurements wildly inflated star sizes, even when done carefully and telescopically. Nevertheless, the sizes of stars remained a difficulty for heliocentrism well into the eighteenth century.

The star size argument was known to some of those involved with the Vatican's actions against heliocentrism, both in 1616 when the subject of heliocentrism was first treated by the Congregation of the Index, and in 1632-33, following publication of Galileo's *Dialogue Concerning the Two Chief Worlds Systems: Ptolemaic and Copernican*. Msgr. Francesco Ingoli,

who Galileo believed to have been influential in the rejection of heliocentrism by the Congregation of the Index in 1616, cited the star size argument against Copernicus in his writings. So did Fr. Melchior Inchofer, S.J. who was selected for a three-person Special Commission formed by Pope Urban VIII to investigate the publication of the *Dialogue*.

Jesuit scientists in the seventeenth century determined that, if Earth rotated like Copernicus said, objects on Earth's surface would move at different speeds (faster toward the equator, slower toward the poles) and this should cause observable effects in objects moving through the air. The diagram at left from Fr. C. F. M. Dechales, S.J. shows a cannonball missing its target owing to this effect. The Jesuits argued that no effects were observed and that was evidence for the immobile Earth of Tycho Brahe. They were right about the effect, but wrong about how obvious it would be. The effect, known today as the "Coriolis Effect", is the cause of the rotation in weather patterns, including hurricanes (right). Image credit: Vatican Observatory Library (left) and NOAA (right).

Star sizes were not the only scientific problem with heliocentrism. There was nothing to explain how the Earth, a sphere of rock and water of obviously vast weight, could be carried around the sun. Isaac Newton's physics, which would explain it, lay decades in the future. By contrast, an explanation for how the sun and stars might be carried around the Earth dated all the way back to Aristotle. He simply supposed that celestial bodies were made of an ethereal substance that moved naturally. Also, heliocentrism called for a rotating Earth. Such rotation should induce deflections in the observed trajectories of projectiles and falling bodies—deflections that were not observed, as Riccioli and other Jesuits took pains to emphasize. There was, as Salvatore Brandi would later say about evolution (see Part 4), an absolute lack of scientific evidence to confirm heliocentrism.

A full picture of the role that scientific objections played in the Vatican's actions against heliocentrism and Galileo is not yet available. More study is needed to better understand the extent to which scientific arguments such as Brahe's, bolstered by the work of astronomers such as Scheiner, motivated those actions. The parallels between the heliocentrism and evolution cases suggest, however, that what went on in the Galileo case in the early seventeenth century was similar to what went on in the evolution case in the late nineteenth century—when scientific questions, combined with the idea

that the natural sense of biblical words should not be abandoned unless necessary, were significant considerations for the Church authorities who were trying to evaluate a complex scientific question. Why would anyone consider reinterpreting Scripture for what seemed at the time to be a weak theory?

Indeed, what would be the implications of reinterpreting Scripture for a weak theory?

The Church and Science Part 6: Galileo and Scripture

When we talk about the Church and science and the Vatican's actions in the Galileo case, we might ask, "Why would the Vatican care?" We have seen how imperfect its committee-driven processes can be. Yet in March of 1616, the Congregation of the Index declared heliocentrism false and contrary to Scripture, and temporarily prohibited Nicolaus Copernicus's 1543 book *On the Revolutions of Celestial Spheres*. Why do that? With evolution, important ideas like the unity of humankind were involved. What was important about the motion of the Earth? Parallels between the evolution and heliocentrism cases may help to answer these questions.

The reason the Congregation of the Index gave for its declaration, re-iterated in the sentence pronounced against Galileo in 1633, was that the "false" doctrine of heliocentrism needed to be prevented from advancing further "to the prejudice of Catholic truth". Heliocentrism was declared "altogether contrary to Holy Scripture", a "pernicious" doctrine containing "various propositions against the authority and true meaning of Holy Scripture". The idea was to "completely eliminate" heliocentrism, and to "remedy the disorder and the harm which derived from it and which was growing to the detriment of the Holy Faith."

Scripture does speak of the Earth as unmoving—1 Chronicles 16:30, for example: "the world will surely stand fast, never to be moved." Yet the long-standing matter of Genesis 1 and the "two great lights", which we encountered in Part 1, was a template for addressing heliocentrism. Thanks to the science of Ptolemy, the Bible had long been taken as speaking to appearances regarding the apparent *sizes* of celestial bodies. That logic could certainly be applied to the science of Copernicus and the apparent *motions* of celestial bodies.

It was not. Why not? Why did the Vatican decide that a moving Earth was pernicious, but stars greater than the moon were not?

We saw in the evolution case how much concern there was in the Church regarding the descent of all people from Adam, and the unity of humankind. Even people today who care little for the Catholic Church might understand why the Vatican decided to turn loose its imperfect, committee-driven processes on the evolution question. Even people today who have little

interest in discussions of original sin and salvation history will understand why the unity of humankind must be sacrosanct.

Well, what was the parallel in the case of heliocentrism? What was sacrosanct then? It seems that what was sacrosanct was reinterpreting Scripture only when *necessary*.

We have seen from the "two great lights" case (Part 1) that Augustine, Aquinas and Calvin all accepted the need to reinterpret Scripture in the light of scientific evidence. Of these three, only Calvin (1509-1564) lived to see the advent of heliocentrism. In the case of the two great lights, he gave a spirited defense of astronomy, even as it contradicted a plain reading of Genesis 1. "Astronomers investigate with great labor whatever the sagacity of the human mind can comprehend," he said. "Astronomy is not only pleasant, but also very useful to be known: it cannot be denied that this art unfolds the admirable wisdom of God." Yet despite his admiration for astronomy, Calvin firmly rejected heliocentrism:

> *We will see some who are so deranged... that they will say that the sun does not move, and that it is the earth which shifts and turns. When we see such minds we must indeed confess that the devil posses them.... So it is with all who argue out of pure malice, and who happily make a show of their imprudence. When they are told: "That is hot," they will reply: "No, it is plainly cold."*

Calvin's logic regarding the two great lights could certainly be applied to heliocentrism. It seems, therefore, that he simply found heliocentrism unpersuasive, lacking evidence. To him, it was a baseless hypothesis, hatched up merely for the sake of being contrary. To reinterpret Scripture to accommodate it would be religiously deranged, or devilish.

Echoes of this can be found in the seventeenth century among those who interacted with Galileo. When Galileo queried Cardinal Carlo Conti about heliocentrism and scripture in 1612, Conti replied that an orbiting Earth was not consistent with Scripture; therefore, heliocentrism could only be reconciled with Scripture by invoking the idea that the Bible was speaking according to common usage of language. But, Conti warned, "*that* mode of interpretation is not to be admitted unless absolutely necessary."

Likewise, Cardinal Robert Bellarmine wrote a few years after Conti:

> *If there were a true demonstration that... the earth circles the sun, then one would have to proceed with great care in explaining the Scriptures that appear contrary, and say rather that we do not understand them than that what is demonstrated is false. But I will not believe that there is such a demonstration, until it is shown me.... and in case of doubt one must not abandon the Holy Scripture as interpreted by the Holy Fathers.*

Bellarmine had applied this logic to his own ideas. When he was a young professor he had argued against the prevailing view of astronomers of his time. They said that celestial bodies like the stars were carried along by complex but ethereal celestial machinery. Various scriptural verses, Bellarmine said, suggested that, no, they moved autonomously, with no machinery to hold them. But, said the young Bellarmine,

> *If then one ascertained with evidence that the motions of the heavenly bodies are not autonomous… one would have to consider a way of interpreting the Scriptures which would put them in agreement with the ascertained truth: for it is certain that the true meaning of Scripture cannot be in contrast with any other truth.*

That is, the interpretation of Scripture must be adapted to science when necessary.

A third example in addition to Conti and Bellarmine is Riccioli. He argued in 1651 that,

> *If the liberty taken by the Copernicans to interpret scriptural texts and to elude ecclesiastic decrees is tolerated, then one would have to fear that it would not be limited to astronomy and natural philosophy and that it could extend to the most holy dogmas; thus, except in cases of manifest necessity, it is important to maintain the rule of interpreting all sacred texts in their literal sense.*

Riccioli then proceeded to argue at length that science showed that there was no manifest necessity. Heliocentrism was false and inconsistent with what was known from physics, astronomy, and mathematics, he said—as seen from, for example, his tables of stellar measurements, calculations, etc. that were discussed in the previous Part.

Riccioli did not specify what most holy dogmas he had in mind, but of course the dogma of the unity of humankind comes to mind at this point. "Are we to tolerate the followers of Bruno regarding heliocentrism?" we can imagine Riccioli saying; "If so, what will we do when they start pushing Bruno's ideas about Ethiopians not being true people? [see Part 3]"

Heliocentrism was unsettled science in Galileo's time. There were powerful scientific arguments against it. Heliocentrism certainly seems less consequential to our modern eyes than evolution and the sorts of unity-of-humanity questions associated with it in the nineteenth century. What was considered consequential at Galileo's time was not, it seems, whether scriptural interpretation could be accommodated to heliocentrism, but whether it should be, absent manifest necessity. Scriptural interpretation had long been accommodated to science when necessary, as seen in the "two great lights" case. But to let scriptural interpretation flutter in the changing winds of unsettled and obviously fallible science would put at risk things far more consequential than Earth's fixity.

That seems to be a likely reason for why the Vatican would care about Galileo and heliocentrism.

The Church and Science Part 7: Historical Questions

We have taken a deep dive into the story of the Catholic Church and Science, revealing an ongoing struggle to figure out science. Solid scientific ideas have prompted re-evaluations of interpretations of Scripture. The imperfect process of evaluating and accommodating scientific discovery is almost as old as the Church itself.

Questions lurk in the background, however. One of these is certainly, *"What about how the Church treated Galileo?"* We have seen how imperfect the Church's processes for dealing with scientific questions can be. We have also seen how science can go wrong in ways so consequential that some sorts of processes for dealing with such questions will be necessary. Because they will involve people, they will be imperfect.

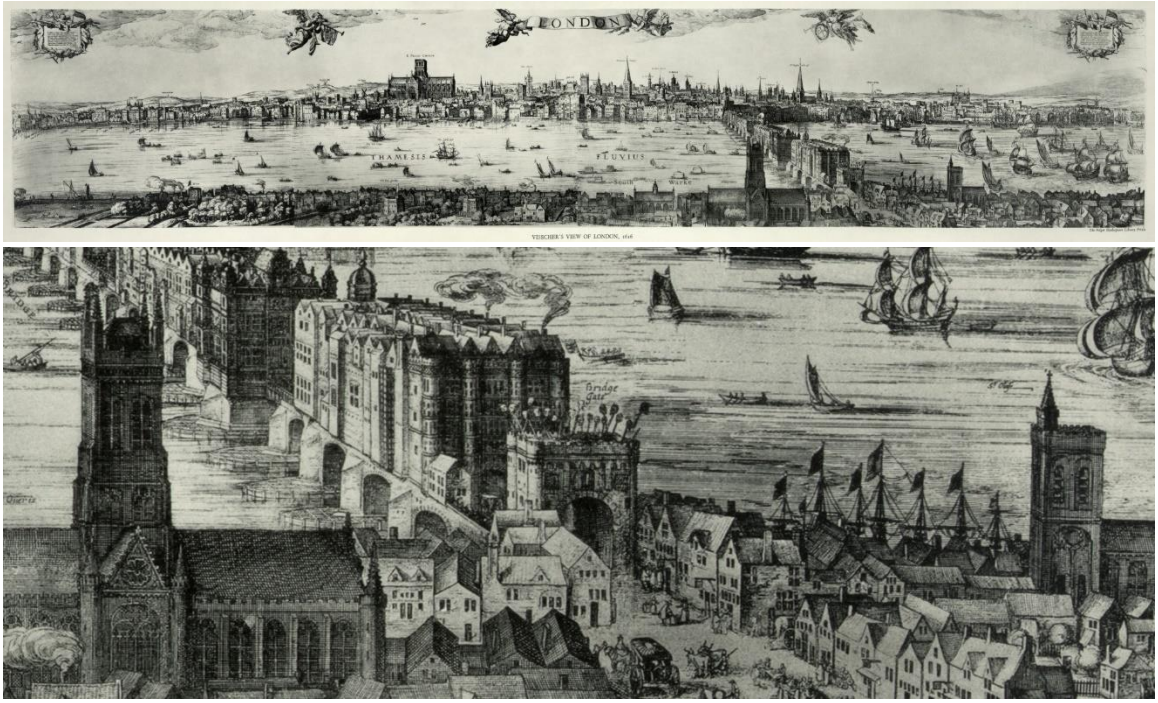
But the processes brought against Galileo were more than just imperfect. The Catholic writers whose work on evolution was the subject of complaints to the Vatican in the late nineteenth century were perhaps unofficially asked to retract their work. Retractions—of, for example, articles in scientific journals—are not uncommon even today. But Galileo was sentenced to prison and then house arrest; he died under house arrest. What of that?

Galileo had the misfortune to run afoul of a powerful man, Pope Urban VIII. At one time, Urban had addressed Galileo "as a brother" and had written poetry praising Galileo's telescopic discoveries. Before the publication of Galileo's *Dialogue*, Urban's powerful nephew had said that Galileo had "no better friend" than Urban, and Urban had granted Galileo an audience. After the *Dialogue's* publication, Urban would explode into anger at Galileo's name.

Urban could deal coldly with things that angered him. Once, he had the birds in the papal garden killed when their noise became a bother. He silenced Galileo, too.

Nothing excuses Urban. Nevertheless, recall that the early seventeenth century of his papacy was a different time than the late nineteenth century when the Vatican was considering the evolution question. Consider the African-American astronomer, Benjamin Banneker, who argued in a letter to Thomas Jefferson that people of African descent were indeed true human beings. The story goes that Banneker had been taught to read and write by

his Welsh grandmother. She had fled to the New World to escape a possible death sentence, for petty theft. Consider Claes Visscher's panorama of London in 1616. Visible atop London Bridge are heads, impaled on poles, of executed people.



Those grisly heads were there to be seen by even the youngest children crossing the bridge with their parents. Consider that in this same time, people from Africa were first being brought to what is now the USA to be slaves. A pope abusing his power and unleashing his wrath on a former friend is a reprehensible abuse—one more in a century full of them.

Another question might be, *"Doesn't the Church always lose in these confrontations with science?"* After all, despite the abuse brought to bear against Galileo, the Vatican failed to "completely eliminate" heliocentrism (to borrow the Vatican's language of Galileo's time). Indeed, heliocentrism prevailed. The Earth circles the sun. Scripture has been reinterpreted to accommodate, just like it was with Genesis and the "two great lights".

No, the Church does not always lose.

Consider the situation with evolution. Yes, in many ways, evolution has prevailed much like heliocentrism did. A striking example of the Catholic

Church reinterpreting Scripture to accommodate an evolutionary view of *the universe* is the proclamation of "The Nativity of Jesus Christ from the Roman Martyrology", often recited during the celebration of the Liturgy of the Hours on December 24 and before Midnight Mass at Christmas (see §7.2). Traditionally, this text stated that Christ was born in "the year from the creation of the world, when in the beginning God created heaven and earth, five thousand one hundred and ninety-nine". Today, the text states that Christ was born "when ages beyond number had run their course from the creation of the world".

But the evolution that has prevailed is a monogenistic evolution. No reputable scientists today proclaim that there are different species of human (-like) creatures like the scientific racists did in the nineteenth century. The "most holy dogma" of the unity of humankind has prevailed, while the work of those scientists is now called "pseudo" science.

But the unity of humankind did not prevail because of some Vatican decree intended to protect it and to "completely eliminate" polygenism and scientific racism. We might wish that a decree could have squelched those ideas and remedied "the disorder and the harm" (to again borrow the Vatican's language) that derived from them. They and their offspring, eugenics, thrived for decades, to the detriment of many, especially those with the least power. Those with the least power needed the Vatican. They were abused by science gone wrong. Yet scholars who have studied the evolution case suggest that the Vatican's actions were constrained by the shadow of the Galileo case.

The history of the Vatican's efforts to confront evolution reflects the need for a process, a committee, a Congregation, even if imperfect, for confronting fallible science. The history of the Vatican's efforts to confront heliocentrism reflects the need for vigilance in ensuring that process is not abused. Both histories need an understanding of the Church's much older confrontation with the matter of the "two great lights" of Genesis 1.

And that brings us to a third question: *"Hasn't the Vatican apologized for all this already?"* That is unclear. In 1979, the new Pope John Paul II told the Pontifical Academy of Sciences that he hoped that "theologians, scholars, and historians, animated by a spirit of sincere collaboration, will study the *Galileo case* more deeply and, in frank recognition of wrongs from

whatever side they come, dispel the mistrust that still opposes, in many minds, a fruitful concord between science and faith." In 1992 he again spoke to the Academy, after a Vatican commission had studied the Galileo case. That speech is often interpreted as a sort of apology to Galileo.

It was not quite that, but the pope did describe the Galileo case as a "tragic mutual incomprehension". He also said that "the new science, with its methods and the freedom of research which they implied, obliged theologians to examine their own criteria of scriptural interpretation. Most of them did not know how to do so."

"Paradoxically," the pope continued, "Galileo, a sincere believer, showed himself to be more perceptive in this regard than the theologians who opposed him." The pope mentioned Galileo's famous letter to Christine de Lorraine (mother of the Grand Duke of Tuscany and occasionally de facto ruler of Tuscany herself). The letter, the pope said, is "like a short treatise on biblical hermeneutics."

The pope did not mention the case of the "two great lights" of Genesis. According to Fr. George V. Coyne, S.J., Director of the Vatican Observatory at the time and a member of the Galileo commission, the commission lacked any historian of science. It seems that the "two great lights" case, widely known in Galileo's time, escaped the notice of the commission and the pope. Theologians of that time who knew the "two great lights" surely *did* know how "to examine their own criteria of scriptural interpretation."

Even the letter to Christine de Lorraine is a tricky business. Galileo in that letter insisted that astronomers must not be asked to "protect themselves against their own observations and demonstrations", to "do the impossible". He went on to urge that knowledgeable people "should see more clearly that it is not within the power of the practitioners of demonstrative sciences to change opinion at will." Likewise, "no creature has the power of making [the arguments of Copernicus] true or false, contrary to what they happen to be by nature and de facto. So it seems more advisable to first become sure about the necessary and immutable truth of the matter, over which no one has control."

It all sounds very good, but Christine de Lorraine was not doubting Galileo's observations—things that anyone with a good telescope could replicate. She was doubting his interpretation of those observations.

Moreover, the scientific racist Van Evrie (see Part 3) used language similar to Galileo's letter: "We cannot believe that which we know to be untrue, and to affect such belief however good the motive may seem, must necessarily debauch and demoralize the whole moral structure.... The fact of distinct races or rather the existence of species of Caucasian, Mongols, Negroes, etc., are physical facts, subject to the senses, and it is beyond the control of the will to refuse assent to their actual presence…. [We must] bow to that fixed and immutable standard of truth which the Eternal has planted in the very heart of things." Galileo's language could be applied even when science was going very wrong.

Imperfection has been central to our story of the Catholic Church and science, so it should not be a surprise to find that even John Paul II's Galileo commission, the process he put in motion to evaluate the processes of evaluating science, should be imperfect. Thus, the story is still unfolding today as we consider overlooked parts of the story that go way back, like the "two great lights". The Catechism of the Catholic Church states that *true* science "can never conflict with faith, because the things of the world and the things of faith derive from the same God [CCC 159]." With both scientists and Churchmen being imperfect, it is that *"true"* part that is so difficult. Around this matter of science so much of the Church-and-science story has seemed to unfold, and no doubt will continue to unfold.

WHO IS THE FAITH AND SCIENCE DIALOGE GROUP?

The Archdiocesan Faith and Science Dialogue Group consists of scientists, educators, and people in ministry, all from within the Archdiocese of Louisville, who meet regularly to discuss questions of Faith and Science, who plan Faith and Science activities within the Archdiocese, and who serve as a resource to others in the Archdiocese regarding matters of Faith and Science. The Dialogue Group was established by Archbishop Joseph Kurtz and several local scientists following the 2017 solar eclipse, in recognition of the significant role that questions of Faith and Science play in the Catholic community, especially among younger Catholics. It is housed under the Office of Faith Formation.*

Past activities include:

- regular dialogue sessions (approximately quarterly)
- planning of the Archdiocesan Gold Mass (for Science)
- professional development for teachers
- educational programs for young people through the Office of Hispanic ministry
- "Science in the Bluegrass" column in *The Record*
- restoration of Msgr. Bouchet Telescope in the Archdiocesan History Center

The Dialogue Group logo reflects our motivation to faithfully explore our world as the New Testament refers to Christ as "the bright morning star" (Rev. 22:16), our salvation, and new life. For the faithful, Christ shared in our human experience and is the source for our Christian journey. We can see glimpses of the Divine in the world around us. Christ invites us to know

*From "Archdiocesan Faith and Science Dialogue Group", https://www.archlou.org/faith-and-science/.

what the world means through scientific exploration as lived out by such Catholic scientists as Albertus Magnus (Saint Albert the Great), Nicolaus Copernicus, Galileo Galilei, Blaise Pascal, Blessed Bishop Nicholas Steno, the Sisters of the Holy Child Mary (Rome), Father Georges Lemaître, and Sister Mary Kenneth Keller. In the Morning Star, we placed an atom to represent the committee's joint scientific approach with faith, and the atom is symbolically recognized in society, forming the basic building blocks of all matter in the universe. Science discovers how the universe works. Through the lens of faith, there are no limits to our exploration, as there is always more to know and understand about God's creation.*

Members of the Sisters of the Holy Child Mary, making measurements from glass photographic plates as part of the Vatican's participation in the "Carte du Ciel" international photographic sky-mapping project.

*Both the logo itself and this paragraph discussing it were created by Holly McGuire.

The Discussion Group consists of (as of August 1, 2025):

- Dcn. Ned Berghausen, St. Xavier High School, St. Agnes Church
- Seth Blakeslee, Science, Trinity High School
- Dr. Kate Bulinski, Professor of Geosciences and Fellow for Catholic Identity, Bellarmine University
- Patrick Burton, STEM Coordinator, Mercy Academy
- Dr. Anna M. Christianson, Associate Professor of Chemistry, Bellarmine University
- Fr. Patrick Dolan, STD, PhD (Chemistry), Archdiocese of Louisville
- Prof. Christopher M. Graney, Vatican Observatory and Vatican Observatory Foundation
- Fr. John Baptist Hoang, O.P., Chaplain, University of Louisville Catholic Campus Ministry
- Christine Kelly, Curriculum, Instruction, & Assessment Specialist, Office of Catholic Schools, Archdiocese of Louisville
- Holly McGuire, MTS, Director, Office of Continuing Education for Priests and Lay Ecclesial Ministers, Archdiocese of Louisville
- Kari Sims, Science, DeSales High School
- Art Turner, Director of Faith Formation, Archdiocese of Louisville
- Judith Waggoner, Science, Trinity High School
- Dr. Gerard Williger, Professor of Physics and Astronomy, University of Louisville
- Laurel Wyatt, Office of Faith Formation, Archdiocese of Louisville

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Discussion Group members “emeritus” and deceased (†). Positions listed are those held while serving on the Group:

- Dr. Mary Beth Bowling, Superintendent, Office of Catholic Schools, Archdiocese of Louisville

- Dr. Timothy Dowling, Professor of Atmospheric Science, University of Louisville
- Fr. William Lee Fichteman, PhD (Chemistry), Archdiocese of Louisville †
- Louisville Archbishop Joseph Kurtz
- Dr. Eric Mathis (working with the Franciscans at Mt. St. Francis)