

The Faith of a Scientist

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I speak to you today as a religious Brother in the Jesuit order; I have taken vows of poverty, chastity, and obedience to live in a community of priests and brothers doing the work the Church asks us to do. But I am also a scientist, an astronomer, a planetary geologist who specializes in the study of meteorites. I've got advanced degrees from MIT and Arizona; a few years ago I was elected the chair of the American Astronomical Society's Division for Planetary Scientists, the largest organization of planetary scientists in the world, and I have also served in a number of positions with the International Astronomical Union. I was even part of that group who demoted Pluto from planet status!

I tell you these things about myself, not to brag – or at least, not only to brag – but also to show that by my very existence you have living proof in front of you that it is possible to be, at the same time, both a fanatic and a nerd. I am a fanatic about my science; I love it, it is what I do. (And I am something of a nerd about my Church.)

We all learned in school that the world is round. But, day to day, each of us lives in a much narrower universe. Our own day to day horizon is at the edge of a flat expanse, marked by a few buildings or trees, with ourselves at the center of it all. It seems that the most important locations in our personal universe are where we sleep and eat, where we work, or where we entertain ourselves. We mostly live our lives without ever experiencing that we're walking on the surface of a sphere... much less,

that this globe which seems so big to us is but an insignificant speck orbiting an average star in an average galaxy, one of billions of such stars and billions of such galaxies.

And, indeed, you might ask: do we need to know that? The writer of the opening chapter in Genesis described the universe as a disk covered by a dome; he knew nothing of modern astrophysics. But he knew God, and he lived a good and holy life. Isn't that enough for us?

I would argue, it is not. To be self-satisfied with our ignorance is to limit both ourselves and our relationship to God. Consider the Book of Job. When Job, in his crisis, complains to God about the injustices he has endured, God responds in a fascinating way. Starting in Chapter 38, God asks Job if he knows all the wonders of the universe; wonders that Job had never thought about before. "Do you know the way to the dwelling of light? Do you know the laws of the sky?"

God asks this not to "show off" His greatness, nor even just to put Job's problems in perspective. Rather, there is implied an invitation: come with Him, to discover the way to the dwelling of light! Join with the morning stars who, we are told, sang in chorus while all the sons of God shouted for joy at the foundation of the Earth!

For those of us who are called to be scientists, the exploration of God's creation is a response to an invitation to spend time with the Creator. We get to play with Him, so to speak, uncovering the delightful puzzles He sets for us and marveling at the way the laws of the universe fit together with a logic that is both harmonious and elegant. In this way we learn to see a side of God's personality. Even if we are not professional scientists, we can still be fascinated by the workings of the universe that the professionals can share with us, and take part in the game at least as spectators.

In any event, it is clear that the one attitude we can never take toward science is fear, as if it were a threat to God. Speaking about science, Pope John Paul II put it most bluntly: "Truth does not contradict truth." Science does not replace God. Rather, it reveals that God is more amazing than we could ever have realized.

The writer of Genesis insisted that God made everything; everything that could be seen: the flat Earth, the dome above it, even the "waters above and below the dome." If today we recognize that the universe includes all the stars and galaxies, extending for 13.8 billion light years (and that's only the part we can see), how much bigger we must recognize God to be!

Speaking of domes... this incredible Church of St. Ignatius is a perfect place to speak about the faith of a scientist. It turns out that there are a number of very important figures in the history of science and faith who are associated with this church.

The building itself was designed in the 1600s by Father Orazio Grassi, a Jesuit priest who was not only an architect but also a mathematician and quite a good astronomer. In 1618 three comets visible to the naked eye blazed across the skies and he arranged with other Jesuit colleagues in Europe to observe them and their positions simultaneously, using telescopes. Now, Galileo had only just introduced the telescope to the world of astronomy less than ten years earlier; and no one had ever seen a comet through a telescope before. Certainly Galileo had not.

The results of Grassi's observations were published in a small booklet in 1619. He showed that the comet appeared in exactly the same position relative to stars, whether observed in Rome or the north of Europe. This proved that comets were quite far away; they really did orbit in space, beyond the orbit of the Moon. Since their

motions were very odd compared to the planets, coming closer to the Sun and Earth and then moving much farther away, this posed great challenges to everybody's theories for how the planets moved, Ptolemy or Brahe or Copernicus.

Galileo himself refused to believe the evidence. He couldn't see how comet orbits like the ones Grassi inferred could be possible in the Sun-centered Copernicus system – remember, he didn't understand Kepler's idea of elliptical orbits – and so he concluded that comets must merely be optical illusions in the Earth's atmosphere, like rainbows or Sun dogs.

Instead of accepting Grassi's evidence, Galileo made fun of Grassi and the way he had written up his results. Grassi wrote in the florid style of the times, tying his observations to the ideas of the ancient Greeks and Babylonians. Galileo wrote a book against Grassi, called *The Assayer*, where he insisted that one must rely only on the evidence of observation and experiment, not on the authority of the ancients or any other authority figure. Today this book by Galileo is considered the foundation of the scientific method, and rightly so. Of course, in it, Galileo asserted his point of view only on the basis of his own authority; and he refused to accept the observations that Grassi and his companions had made when it came to comets!

That was a shame. Among other things, it turned the Jesuits against Galileo. Before then, they had been among his strongest supporters. Father Clavius, the Jesuit priest who took part in Pope Gregory's reform of the Calendar in 1582 and taught mathematics at the Roman College just one street over from here, had written letters of recommendation for Galileo when he was first looking for a job, and late in his life he even looked through Galileo's telescope at Jupiter and its moons.

And when Galileo was first called in to be questioned about his theories, it was under the care of the Jesuit Cardinal Robert Bellarmine, the greatest theologian of his time. After Bellarmine interviewed Galileo he gave him a document certifying that Galileo was no heretic. Bellarmine wasn't convinced of Galileo's science, however. The heliocentric system was a radical change, it would be like overthrowing Einstein today, and Bellarmine felt Galileo hadn't proved his point. (And in fact, Galileo hadn't proved his point. It would take another fifty years before Newton's theories showed how Kepler's version of the Copernican system actually worked, and centuries before the motions of the Earth were finally directly observed.)

But Bellarmine did say something very interesting about Galileo and his ideas. About the time of his interview with Galileo, Bellarmine wrote: "If there were a true demonstration that the Sun was in the center of the universe and the earth in the third sphere, and that the Sun did not travel around the earth but the earth circled the Sun, then it would be necessary to proceed with great caution in explaining the passages of Scripture which seemed contrary, and we would rather have to say that we did not understand them than to say that something was false which has been demonstrated. But I do not believe that there is any such demonstration; none has been shown to me." Here we see Bellarmine's openness to new ideas, and his realization that his understanding of Scripture might not be the last word. And we also see the sort of scientific skepticism that we honor among scientists. Clever ideas aren't enough: show me the evidence! The fact that, in the long run, Galileo was proved right and Bellarmine wrong was no fault of either, given the state of the evidence at the time.

Father Bellarmine is buried right over there, beneath that altar on the right hand side of the church.

There's another notable astronomer associated with this church. You may have noticed the very odd dome here. In fact, as by now you must have realized, it's a fake. It's not a real dome. They ran out of money; instead of building a dome, they put in a flat roof and then a few years later a Jesuit brother, Andrea Pozzo, painted the ceiling and the dome in this marvelous forced perspective so that it looks just like a real dome... from certain points of view, anyway.

Well, the fact that there are these massive pillars designed to hold the weight of a dome, but no dome itself, led Father Angelo Secchi in the 1850's to construct four telescopes, one on each pillar, on the roof of this church. One of the telescopes marked the time each day when the Sun crossed the meridian; this was used to signal a cannon that would be fired so that everyone in town knew it was noontime. But the biggest telescope was used for some of the most important astronomical observations of the 19th century. Father Secchi observed the planets, especially Jupiter and Mars, and he was the first person to describe them not as dots of light in the sky but as actual places, with clouds and weather and surface features. He used the term "canali" to describe some of the features on Mars; later other astronomers misinterpreted this word to imply that there were actual canals on Mars, and Martians who had built them. Secchi also did pioneering work on observing the Sun. Today there's a NASA spacecraft observing the Sun that gives Secchi the ultimate honor of using his name as an acronym for the Sun Earth Connection Coronal and Heliospheric Investigation package.

But the most remarkable work that Secchi did from the roof of this very church was to put a prism in the light path of his telescope and turn every dot of starlight into a rainbow of colors. He saw how different stars had different spectra, and he classified more than five thousand stars this way. And he knew how to interpret those spectra in terms of the elements present in those stars; for example, he discovered that some rare stars were rich in the element Carbon. Suddenly, astronomy was no longer measuring the mere position of the stars and planets; it became the study of what those stars and planets were made of, and how they got to be the way they are today. Father Secchi, from the roof of this church, became the father of astrophysics.

This confluence of church thinkers and scientific thinkers in this place is quite remarkable. Now, you may well ask, why was a priest like Father Secchi doing astronomy? For that matter, why was the Church concerned in any way with what a scientist like Galileo was writing?

In Galileo's day, science was still well embedded in the field of what was called Natural Philosophy. And the Church, who also invented and ran the medieval Universities, was in the position of what we sometimes call "the Academy", the received wisdom against which new ideas are tested. It had a responsibility to teach the truth as it knew it, and to protect against crazy ideas. That was especially important in those days, when crazy ideas would lead to wars. We tend to forget that the Galileo trial took place at the height of the Thirty Years War.

It's no different today. (Except for the wars.) To get a scientific paper published you need to pass it by a series of anonymous referees, experts in the field who will judge if the paper is free from major errors and worth publishing. I have been a referee

many times; and I have been refereed myself, many times. On more than one occasion the referees have stopped me from publishing a paper I'd submitted; and thank heavens. They have found many errors that I had missed. I am thankful to these referees. They've saved me from making a fool of myself in public.

We need referees because we aren't always right. We make mistakes. We also need referees to remind us that science, like philosophy, like religion, is not something we do alone. We do it as a part of a community.

Science is not a big book of facts; it is a conversation with other scientists. To have a conversation, you need a common language so that when I say "porphyritic type two olivine chondrules in a carbonaceous chondrite fall" the other meteorite scientists know exactly what sort of material I am talking about. That's one of the important reasons we study at universities – not to learn the facts, which anyone could do just from reading books, but to learn the language by living and working in the world of science where that language is spoken and alive, where we can grasp all the subtle shadings of meaning that no book can teach us.

And having a conversation means that to do science you have to do the sort of work that other people are interested in. You can't have a conversation if no one is listening. That also means you have to take the time to be around and to listen to the others, as well.

You know, we get a lot of letters at the Observatory from people who are working alone in their attics and who think they have discovered some new secret of the universe that the rest of us have missed. It's very sad. They are so eager to make a big breakthrough and become famous, or at least eager to be part of the wonderful fun of

playing in God's Creation. But of course, most everything they write to us is nonsense. And even if, buried in all the nonsense, there really were some great insight, it would be completely useless if it is not part of the conversation.

You can tell from their letters that they aren't part of the conversation. They try to use the same words that scientists use, but they use them in ways that don't really mean what we mean, how we learned to use them in all those years we spent at University learning how to converse in the language of science.

It is exactly the same thing that happens to people who think they can find God without organized religion. They use ideas and words that they read someplace – probably in books produced by the very religions they are rejecting – without really knowing what they mean. They think they have grand insights into the nature of God and the Universe. But they are not in conversation with the rest of us... and by "us" I don't mean just with those of us around today, but with those of us who have lived in the past, who make up our traditions and history. They don't have referees to warn them when they're making mistakes. They wind up wallowing in a dream world devised by their own egos, rather than confronting the glorious but challenging and always slightly incomprehensible reality that true religion, and true science, tries to deal with.

But here's the trickiest part: sometimes they actually do get it right. Kepler was such a person. He had a very strange idea of religion; he thought that the physical universe should exactly mirror the nature of God. Since the Sun was the brightest thing in the sky, he assumed that it must represent the place of God the Father. The light coming off the Sun, he said, was the Holy Spirit. The realm of Earth on which it fell, was the same as the Second Person of the Trinity. Now, this is really odd theology. It wasn't

made any better by the fact that Kepler wrote in a really tortured form of Latin that many people had a hard time understanding. When he sent his books to Galileo, Galileo tossed them aside and never bothered to read them; he never even bothered to send Kepler a nice note thanking him for the books. Frankly, in Galileo's place I would have done the same thing.

But here's the odd part. Because Kepler insisted that the Sun was like God, he also insisted that it must be the exact center of the universe. And he had read Copernicus deeply enough to realize that in the Copernican system, with perfectly circular orbits, the Sun actually had to move in a tiny circle around the center in order to make the positions of it and the other planets match the observations. This little eccentric circle, which most people hadn't noticed (I suspect they only looked at the pictures in Copernicus's book, and never actually read the math), this little circle was horrifying to Kepler. God the Father wouldn't make such a goofy little dance around nothing. So instead Kepler devised a system where the planets moved in ellipses, with the Sun fixed at a focus of the ellipse. It was only fifty years later that Edmund Halley, the comet guy, pointed out Kepler's work to Isaac Newton. Newton showed that his new theory of gravity actually predicted such elliptical orbits. And modern physics finally was born.

Now, notice that Kepler's theological idea was crazy. But it led to a scientific idea that was brilliant. How odd.

Meanwhile, Newton's successful physics led to its own odd development in the realm of science and religion. By being able to predict the positions and orbits of the planets with great accuracy, at least as accurate as people could observe back then, his

physics gained great credibility. As the famous poem of Alexander Pope put it, "Nature and Nature's laws lay hid in night: God said, "Let Newton be!" and all was light." And so people began to think that they could use the certainties of Newton's physics as a basis of religion.

For example, there were many subtle points of planetary motions that Newton's physics couldn't exactly explain, at least not at first; surely these gaps were the places that proved God was necessary? Of course we know what happens with this way of thinking. First, you reduce God to the sort of Watchmaker of the Deists, someone who merely winds up the Universe and lets it run, adjusting it as necessary from time to time. Then, you realize that all the gaps, all the adjustments you thought showed you that needed God, actually can be filled in without resorting to God. Your reason for believing in God gets squeezed out as the gaps get closed. Pretty soon you're an atheist who believes in a completely mechanical universe. And then, of course, modern physics comes along and shows that all of Newton's assertions about the universe were terrible oversimplifications. Quantum physics gives a whole new set of gaps to lure us into thinking once again that we have science proving a need for God.

Notice how in Galileo, Kepler, and Newton we find three different ways that people have tried to fit together faith and modern science.

Newton and his followers thought you could use science to prove the existence of God. Of course, the God they came up with was no longer the God of love, the God of scripture; and it eventually led to no God at all.

Kepler did the opposite; he thought that he could use his theology, his idea of God, as a basis for explaining how the universe ought to work. We honor Kepler today

only because he was lucky enough to have come up with a description of orbits that worked, even though the philosophy it was based on it was total nonsense.

Galileo himself spoke of two separate ways to reach God, what he called “two books”: the book of scripture and the book of nature. (I remind you that Galileo, even after his terrible and unfair trial, remained a devout Catholic; his two daughters were both nuns.) But a lot of people have taken his “two books” idea as if they were separate ways to view the universe, without any overlap. You do science during the week, they say, and you leave religion to Sundays.

None of those ways work.

Father Michael Buckley, an old teacher of mine, is the Jesuit theologian whom I am borrowing from here. He writes about this in a book called *Denying and Disclosing God*. And in the last chapter of his book, he points out that all of these attempts at connecting science and faith fail because they miss out on the essential fact of why we believe.

We are all scientists now, living in this scientific age; we all look for evidence for everything. And our theories are the way we organize what we believe in order to explain that evidence. What is the evidence on which we base our faith? It is not the orbits of the planets, or the position of the Sun or the Moon. It is not the authority of ancient sages, either saints or scientists. Instead, Buckley quotes a twentieth century philosopher, Raïssa Maritain, who came to Christianity by encountering, in history and in her life, the lives of saints. The essential data point for her was what she called “the fact of sanctity.” Holiness exists. Any theory of the universe that fails to take into account that existence, is incomplete.

This can lead us to a deeper connection between faith and science. It is clear, I hope, that you cannot substitute one for the other; science does not replace faith, nor does faith replace science. And yet they do not deal with totally separate realms, as if they never overlap.

Because in fact science and religion do overlap most surely in one important place: in the human being who chooses to do the science, in the human being who comes to know the Creator through the things that have been Created.

Not every culture has produced scientists; not every religion supports science. And by support I don't just mean finding someone to pay your salary, though of course that's important; it is also the support of your family and friends, so your mom doesn't keep asking you why you're wasting your time doing science instead of making real money writing computer games.

There are in fact three very important religious assumptions you have to make before you can do science.

The first assumption is that you must take on faith the proposition that the universe really exists. What we see is not mere illusion. We are not butterflies dreaming that we are scientists. There are some religious traditions and some philosophies who insist otherwise; solipsism, for instance, suggests that everything you experience is merely a projection of your own imagination. At least, that's what they claim, though I find it hard to imagine how you actually live this way from day to day. The humorous Irish writer George Bernard Shaw relates the story of confronting a woman who told him, "I am a solipsist, and so are most of my friends!" (Think about it.)

The second assumption that you must make about the universe before you do any science on it is to accept on faith that there actually are scientific laws to be discovered, that effects have causes, that things don't just happen on a whim or at random. It seems obvious to us that scientific laws exist, because we have learned some of them and we can see how they work; but what gave the first scientists the confidence to think that there actually were such laws to be found?

If you were a believer in the ancient Roman gods, as so many people were whose temples are now ruins surrounding us here in Rome, then when lightning struck you could blame Jupiter, god of lightning; when your crops grew well you could thank Ceres, goddess of crops. No need to look any further for why these things happened. When Christians came along they were persecuted for being atheists, and rightly so – they rejected all these nature gods in favor of one, supernatural, God. But if there are no nature gods, then you are free to speculate why natural events actually do occur.

There is a third and most subtle religious believe you must have before you can be a scientist, however... a belief that a lot of people today don't have. You must believe that science is worthy of spending your life doing. I don't mean making nice technological toys, like vaccines and iPods. Those are lovely, but that's a different level from doing the frankly useless work of trying to understand black holes or Martian weather. Pure science like astronomy won't make you rich, and it won't make you powerful – it's rather telling that you find astrologers and other fortune tellers in the poorer parts of town. It doesn't necessarily attract girls (at least it didn't for me!). So why would anyone spend their life doing astronomy?

Worse yet, if you believe that the physical universe is fundamentally evil, a trap and a snare to pull you down from the more noble spiritual things of life, then your religion will actively try to stop you from wallowing in this dirty, dangerous physical morass. I remember once talking to a student from a such a religion who wanted to become a geologist, but he was afraid – he asked me, “what will I tell my mom?”

But Christianity, like Judaism and Islam, believes in a universe that was deliberately created by a Creator God, who made things in an orderly way, step by step, and at each step of the way stopped to see that It Was Good.

Even more, as Christians we believe that God so loved the world that He gave His Only Son for its redemption. As Saint Athanasius put it 1700 years ago in his book *On the Incarnation*, we are “cleansed and quickened” by the Incarnation of God into Nature that we celebrate during this Christmas season. And as he further states, the fact that the Word of God entered our world because He provided the works of creation as a means by which the Creator might be known. In that, Athanasius is only echoing St. Paul’s Letter to the Romans where in Chapter One he reminds us that from the beginning of time God has revealed Himself to us in the things that He has made.

We study creation to come closer to the Creator. And how do we know when we have come close to God? One sign is a sense of joy; a joy that I know I have felt when I encountered some wonderful insight into how the universe works. I don’t mean just my own discoveries – those are few and far between – but other peoples’ discoveries as well, which fill me with delight and a feeling of “rightness” in seeing how the pieces fit together, which is unmistakable once it has been experienced.

Learning to recognize those moments of rightness, those moments of God's presence, is another connection between science and faith. Science gives us experience with learning how to recognize the truth, and this experience can be invaluable when we search for truth in other endeavors. Notice that I am not talking about the truths themselves, but the way that science tries to find these truths.

First, it is important to remember that science describes, it does not prove. And those descriptions are constantly open to improvement.

Say you walk into a room, flip the switch on the wall, and the light comes on. For you, that's "proof" enough that the switch controls the light. But in point of fact, it could just be a coincidence – someone else could have hit the real switch at exactly the same time. The more often your switch seems to work, the higher the confidence you have that you've really found the right switch; but you can never be 100% sure that it isn't just a remarkable string of coincidences. (Or that someone isn't just playing a joke on you.)

Scientists report their findings with statistics to show just how confident they are that their theories are really describing what they think they see. But that confidence, while it can be very high, is never perfect. Even if you're 99.9% sure you got it right, you can expect one time out of a thousand you'll have been fooled. Yet you never know ahead of time which case will be the exception. And with thousands and thousands of such theories and experiments, inevitably those exceptions will pop up. They are rare; but they happen. The history of science is littered with theories that were logical, well supported by experiment, but nonetheless wrong.

But notice what that means about the attitude that a good scientist has to have. First of all, you have to admit you don't know everything; otherwise, you wouldn't be

motivated to learn anything new. Secondly, you have to be humble enough to admit that, at any point along the way to new knowledge, you could go wrong. That's why you constantly test your ideas with experiments, and then test your experiments with better theories; why you work with others, rather than just work alone.

And that's why science books keep getting updated. While scientists rightly revere Galileo or Newton, nobody actually tries to learn astronomy or physics by reading their original books. As we make new discoveries, our understanding changes ("Pluto is not a planet!"). We find better ways of describing the things we've been looking at for centuries. By contrast, books of literature or philosophy – Plato, or Shakespeare, or the Bible – are timeless. Those books are not science books.

A religious believer can learn something from this humility. No matter how close to God we think we are, we must recognize that like his Creation, God too will always be more than we can ever completely know.

Science is always inadequate, always only partly true, always full of terrible oversimplifications. But we learn to recognize the pattern that truth makes; we develop a taste, an instinct, that helps us guess which theory of all the possible theories is the best one to pursue at this point, which possible experiment the next experiment I ought to try.

It may sound funny to talk about guesses and instincts when dealing with the rational world of science, but the truth is that science is a wonderful blend of the rational with the instinctual. That is why science is not done by robots; it is done by human beings. Indeed, doing science is one of the things that makes us human.

I recall when I was a young postdoctoral fellow at MIT, before I joined the Jesuits, I would lie in bed late at night pondering the meaninglessness of my life. Why

was I worried about the rings of Saturn when there were people starving in the world? Eventually I realized that I had no answer to that question. My life of a scientist was meaningless... or so I thought.

So I quit my job as a scientist and joined the US Peace Corps. I said I would go anywhere they sent me, do anything they asked me to do, as part of this big volunteer group working with the poor in the third world. They sent me to Africa, and told me I would be teaching high school science in a school up-country. But my assignment kept changing... a better high school, a government high school, a national high school... after three months I was assigned to the University of Nairobi, teaching postgraduate students; teaching astronomy.

There was a logic to it. To develop their nation, Kenya needed schools and teachers. The students I was teaching would go on to teach at the state Teacher's College to teach the teachers to teach the students, to raise the technical level of the nation.

But I would also go up-country, where the rest of my fellow volunteers were working, taking my small telescope with me, and in every village everyone would line up at night to see the rings of Saturn and the craters on the Moon. They were fascinated; exactly the same way as my friends and family back in America were fascinated to look at these things. And then finally it struck me. Being in awe of the sky, looking at the galaxies in Andromeda, wondering about what it all is and how we fit into it; these are things that human beings do. I had a very clever cat in those days, but she never wanted to look through my telescope. Astronomy is something that makes us different from a cat, from well-fed cows.

And to deny someone the chance to indulge in those very human wonderings and longings, just because they were poor or hungry or born in the wrong time or the wrong continent, is to deny them their humanity. To give them the opportunity to ponder these things, is to feed their soul. And this is terribly important. The Africans taught me why we do astronomy, even in a world where people are hungry. One does not hunger for bread alone.

Both astronomy and religion remind us that there are bigger questions than “what’s for dinner?” They force us out of our day to day concerns and see everything with a different perspective.

Sitting in this church, we are strongly reminded of perspective... how it can fool us, or how it can make us see things in a new way that we might not have realized before. I hope you have a chance to walk around this church, look up at the ceiling, and see the “dome” from each of the wings of the building; see how different it looks. You have to be in just the right place to get the full effect of the artist’s perspective; and then you have to look at it from a different place, to appreciate how he did it.

Do we learn truth from science or from religion? Which one gives us the truth? Like looking at that dome, you really only get the full truth when you have more than one point of view.

But, you might say, one point of view gives me an illusion, a lie! There is no dome, it is just fooling me into thinking that there’s a dome. And that’s true. If you only have one point of view you might well be fooled by what you see, and interpret what you see as something different from what it really is.

But, here's an odd thing about illusion. Granted, that is not a real dome. But real domes do exist. And if you had never seen a real dome, if you did not know what real domes was, if there were in fact no real domes, then this illusion wouldn't work at all. You wouldn't know what it is you were supposed to be seeing. You wouldn't be reminded here of domes you have seen in the past. Your mind wouldn't be able to be led to the vision that the the artist, Pozzo, painted; the vision that the architect, poor Father Grassi, had designed but which, for technical reasons, he couldn't complete. The illusion only works because of the reality that the illusion is attempting to invoke.

All our scientific descriptions of nature are, ultimately, illusions. They are incomplete. They are sketches; they are idealizations of the real thing; they are not "literally true." After all, even an equation in physics is a metaphor for the activity it describes; and a good mathematical physicist can read those metaphors like a poem. They are not themselves the truth. But they point us to the truth.

And likewise all our descriptions of God can only be poetry; no mere words can describe that which is beyond description. But like that painting on the ceiling, a good piece of art – and science is ultimately a masterful piece of human art – a good piece of art can lead our imaginations beyond our mortal bounds into realms that we can only now glimpse from afar.

I am a scientist and I am a Jesuit brother. But you can't split me in two and say this part is the man of science, that part is the man of faith, any more than you could split Grassi into the mathematician or the astronomer or the architect, any more than you can split the painting above us into what it looks like from one point of view versus

what it looks like from over there, to say that it is a dome or it is some strange abstract shape. Both are the one and same painting on the ceiling.

It is the one same universe that we live in, scientist and believer, and the one same truth we search for. If we are both observer and believer, we are blessed in being able to look at that truth from more than one direction and thus learn things that one direction alone could never tell us.

And we are all called to be scientists in that way. We may not all learn the language of science, the poetry of the mathematics, or participate daily in the conversation. But you don't have to be a musician to listen to music. You don't have to be a saint yourself to experience the holiness of others. You don't have to be an artist to appreciate painting. I can't paint perspective like Brother Pozzo but I can let his talent pull me up into his vision of an infinity over my head.

We have been given the gift of intelligence to at least look through the telescope and be amazed by the beauty of nebulae and rings. We all have been given the ability to know other people and experience God's presence within them. It just requires us to open our eyes and see.

That is the faith of a scientist.