

The Origin and Goal of the Scientific Vocation

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Thank you for the invitation to speak on this important topic of the scientific vocation. I would like to begin by briefly recounting my own journey from scientist to theologian. For me, science always held the key to reality and truth. To know how things work is, in some way, to know the real. I majored in science, initially because I wanted to study medicine. In 1979 I received an MS in Biology from Seton Hall University, after finishing a BS in Biology from DeSales University. While I did well in my studies, I was not as fanatic about getting into medical school as were many of my classmates; hence when I was not accepted, I felt relieved that I could pursue an interest in the growing field of Neuroscience. I received a teaching assistantship at UMDNJ-GSBS and went down the road to study in the Department of Pharmacology. I loved my classes at the Medical School but fell in love particularly with study of the nervous system. The brain was the most fascinating organ I had encountered and the intricate complexities of its multiple layers provided endless fields of exploration. My specific expertise was Neurophysiology and I worked collaboratively with Neuropathologists and Neurologists to examine the etiological basis of proximal axonal swellings in motoneuron disease. My doctoral dissertation was on motoneuron dysfunction induced by a synthetic chemical that mimicked the pathology of Lou Gherig's disease (ALS). Related interests were in the pathology of Alzheimer's disease and peripheral neuropathy, which I pursued in postdoctoral studies at Rutgers University. Although I did not think of my professional life in Neuroscience as a "vocation" I did feel privileged to work in this area. I recall feeling as if I had inside knowledge to the secrets of nature. The world of science was just that—a different universe of

thought that brought with it a sense of otherness; a life sequestered from the norms of the world, to which I would return at the end of the day.

I must admit that I found the life of a scientist “fun” and, at times, thrilling. The lab was like a large sandbox of creativity and imagination. I was awed by the precision and interconnectivity of neuronal networks. The first time I entered into the world of a motoneuron through an electron microscope, I discovered an amazing mini-universe of interweaving dendrites, cell bodies and glial cells, thinking that this exquisite complexity of nature could only be of God. My first recording of a single motoneuron was so exciting that I ran down the hallway to find someone to share my discovery—unfortunately no one was around. Science was not merely something I did each day, like brushing my teeth; it was an adventure. Every experiment held the potential for new discovery.

For me, entering the sandbox of research meant leaving behind the humdrum noise of daily life and entering into mysterious labyrinth of nature. I think very few scientists would describe their work as a “job,” in the same that mowing the lawn is a “job.” Study of the physical world whether biology, chemistry or physics is a transcending experience of the mind. There is an irresistible lure of nature that is intellectually seductive. With the use of sophisticated technology and the analytical tools of mathematics, the mind sifts through myriad pieces of data, trying to make sense of the fragmented pieces, creating a story out of them that is coherent with a larger whole. Much of scientific research can be routine and, at times, frustrating but when a pattern appears in the data the results can be breathtaking.

Shortly after receiving my doctorate in Pharmacology, I was offered a postdoctoral position in the Departments of Neurology and Neuropathology at Johns Hopkins Medical School; however, I left the world of academic research science to enter a monastery of disalced

(shoeless) Carmelite Nuns. People have often asked why I made such a dramatic leap from science into the cloister. My research colleagues thought it was sheer madness and wondered, did she burn out or was she jilted in love? What I had a hard time conveying to my scientist friends was my religious faith and attraction to religious life. In the lab, religion came up in conversation only sparingly and then only as a piquant topic of personal interest. But God was the first love of my life and I felt that to be truly free as a person, I had to follow this deeper call. While I lasted only four years in the monastery (four *long* years of labor and prayer I might add!), I eventually entered a community of German Franciscan Sisters. Because the Sisters placed a high priority on education, the community thought it would be helpful if I studied theology or spirituality. I chose theology as a more rigorous discipline and was sent to Fordham University for my studies. I began my theology studies with tongue-in-cheek, not knowing how long I would last. I was a hard core scientist and felt that science alone could arrive at truth. I was, of course, mistaken.

A Brief History of Science

At Fordham, I concentrated in historical theology and did my doctoral work on the medieval Franciscan theologian, Bonaventure, a contemporary of Thomas Aquinas. It was through my theological studies that I began to understand science in the much broader framework of creation. The history of science has its roots in western Christianity. The Middle Ages, in particular, set the stage for modern science. The great theologians such as Bonaventure and Thomas, like all medieval university students, were required to study physics, astronomy and geometry, in addition to Scripture and Patristics. In other words, the framework for studying theology in the Middle Ages was cosmology. Understanding creation was integral to

understanding God; to know God was to know the cosmos created by God. Creation was considered as a book and mirror reflecting the divine Maker. The hierarchical order of God, angels, cosmos and humanity followed the Neoplatonic idea of procession and return of creatures. Just as everything flows out from God, everything returns to God. Science was considered within the wider context of theology (considered to be the “queen of sciences”) because knowledge of the created world (*scientia*) was the first step to knowing God.

My studies in medieval theology helped me understand the integral relationship between science and religion and their separation in the Enlightenment. There are several important developments which influenced the rise of science in the Middle Ages. First, the *Sentences* of Peter Lombard introduced discussion of the world picture into academic theology. While up to the Middle Ages theology was based on Scripture and experience (monastic theology), an analytical method of was introduced to objectify theology. The method of disputed questions (*Questiones disputatae*) began with the hypothesis, “whether or not” and became the basis of scholastic theology. In turn, the rise of scholasticism set the foundation for what would become known as the scientific method. Second, the translation of Aristotle’s works into Latin by Boethius (6th cent) enabled scholars to apply Aristotelian logic to theological problems. The introduction of Aristotle’s writings into the university curriculum coupled with the Arabic commentaries on these writings also contributed to the foundation of science in the Middle Ages. Third, the translation of Plato's *Timaeus* into Latin and other classics such as the works of Augustine helped forge the rise of science. The *Timaeus* became the central text for natural philosophy because it reconciled Platonic cosmogeny with the account of creation in Genesis. In short, the cosmic order coupled with Aristotle’s philosophy enabled scholars at the various

universities of Oxford, Paris and Bologna to debate cosmological questions. The task of the theologian was to read the book of creation clearly so that knowledge of God may be deepened.

There are a number of fascinating schools of thought in Middle Ages, such as the school Chartres and the Victorines, but two theologian-scientists who were influenced by the philosophy of Aristotle stand out in particular. The first is Robert Grosseteste, a lector in theology at the University of Oxford. Grosseteste was one of the first Scholastics to fully understand Aristotle's vision of the dual path of scientific reasoning: generalizing from particular observations into a universal law, and then back again from universal laws to prediction of particulars. While this path became important to modern science, he also subordinated the sciences to mathematics which he considered the highest of all sciences and the basis for all others. His research focused on light which he believed to be the "first form" of all things, the source of all generation and motion. Light could be reduced to lines and points and thus be fully explained by mathematics, rendering mathematics the highest order of the sciences.

Grosseteste would have rejoiced over modern physics since his own description of light intuited what became known in the twentieth century as the Big Bang theory. In his *De Luce* he begins with God's creation of a single point of light from which, through expansion and extension, the entire physical order came into existence. To initiate the process of creation from that single point of primordial light, Grosseteste used the image of an expanding sphere of light that diffuses in every direction instantaneously so long as no opaque matter stands in the way. He believed that the mathematical nature of the universe followed most directly from its being made of light. The expansion of light replicating itself infinitely in all directions was the basis of the created world.¹

Grosseteste's scientific program was continued by a younger Englishman, Roger Bacon (ca. 1216-1292). Not much is known of Bacon except that he studied at Oxford and Paris and taught in the faculty of arts at Paris where he lectured on Aristotle's books on natural philosophy. He joined the Franciscan Order and spent his life in study and writing. Bacon distinguished "natural scientific argument" from moral and religious mystical intuition. His aim was to provide a *method for science*, one analogous to the use of logic to test validity in arguments. This new method consisted of a combination of mathematics and detailed experiential descriptions of discrete phenomena in nature. He was a forerunner of critical realism, distinguishing real universals from mental universals. For Bacon, real universals are found only in and with individual things: matter and form constitute things and are the causes of individuation. He was certain that scientific knowledge would someday give humans mastery over nature and envisioned the technical world of the future including submarines, automobiles, airplanes and other inventions that have become part of daily life.² However, scientific knowledge was in the service of theology, the purpose of which was to help prepare for the second coming of Christ. What distinguished Grosseteste and Bacon's study of the natural order was the notion of "vocation." Study of the natural world allowed them to discern a deeper purpose in nature; the call to study nature was a means of glorifying God. In a way they saw themselves as diviners of the mystery—the book of creation could only be clearly read by one who prayed because the study of creation was itself a mystical path to God.

The Rise of Modern Science

The notion of creation as endowed with divine meaning was lost with the rise of the Enlightenment and scientific materialism. The flourishing of the human in the Renaissance and

the rise of the Enlightenment gave the human mastery over nature. Freed from the constraints of religious authority, the human person could use one's intellect to create a new world. As the Marquis de La Place replied to the emperor Napoleon's question on the place of God in his system, "I have no need for such a hypothesis." Mechanisms within nature and the development of mathematics could explain phenomena once attributed to God. The new cosmology wrought by heliocentrism had set the eternal celestial realm in opposition to the terrestrial scene of change and decay, challenging the immutability of God and dissolving the hierarchy of being. The Jesuit trained mathematician/philosopher Rene Descartes tried to reconcile the picture of a mechanical world with belief in God by rescuing God from the clutches of a changing world. He did so by searching for true and certain knowledge not in the cosmos but in the human person as thinking self; basic certainty was no longer centered on God but on self. The transcendent One became identified with the immanent subject. Whereas in the Middle Ages the power to unify the many came from the one God who created heaven and earth, in the enlightenment the power to unify the many was sought in the individual. What was lost in all this shuffle was the separation of science from theology and thus the human person from the larger cosmos.

As the new science story emerged between the seventeenth and twentieth centuries, the human person was not part of the story, that is, the human person had no defined role in the new science of cosmic life. Once center of the cosmos, the human person was now subsumed into a sea of data on a spinning planet. As theology separated from science, creation was stripped of its sacred character. Modern science ushered in a new cosmology, while theology remained tied to the medieval cosmos. The marriage of Greek metaphysics to Christianity gave rise to a system of God, humanity and creation that was too neat and orderly to be disrupted. Christian doctrine was inscribed within the framework of a perfect, immutable, hierarchical and anthropocentric

order. While the vaults of heaven became artifacts and celestial mechanics became more sophisticated, the God of the Middle Ages remained unchanged. The widening gap between theology and cosmology confined theology to abstract, speculative ideas on fixed principles. John Haught has shown that a religion built on stability and immutability was not prepared for a cosmic order based on change. Thus it is no surprise that Darwin's theory of evolution in the 19th century was seen as a "dangerous idea" because it seemed to dispense with the need for God. Contrary to the aspirations of scientific materialism logical positivism, however, the new science, built on the twin pillars of evolution and quantum physics, corresponds in the postmodern age to a new sense of mystery and hence spirituality. Instead of dispensing with religion, modern science has aided the rebirth of religion.

Putting Spirit Back into Science

The modern dialogue between religion and science began over forty years ago when Ian Barbour published his book *Issues in Science and Religion* (1966) which laid out four distinct ways of relating science and religion:

conflict – science and religion contradict and are incompatible with each other;

independence – science and religion are separate realms of inquiry;

dialogue – both science and religion have things to say to each other about phenomena in which their interests overlap

integration which aims to unify science and religion into a single discourse.

Although scientific materialism still abounds, we see increasingly the inability of science alone to address the deepest questions of humankind. Thus we are impelled to ask: Can the insights of science be harmonized or find compatibility with religious faith? How can science and religion form a unified vision of our world? Far from being inimical to science, we can now see how religion complements science. The cosmos and the laws which govern it do not form a self-explanatory system; they point beyond science and call for a deeper foundation that can address questions of ultimate meaning and value. Religion speaks to us of the intelligibility of the universe, of its fruitfulness for life and of the ethical and aesthetic perceptions we experience in it. Religion can articulate what science cannot grasp: the aim and purpose of an evolutionary universe, a cosmic order which anticipates a future fulfillment. A world without religion finds it hard to explain how “something of lasting significance is glimpsed in the beauty of the natural world and the beauty of the fruits of human creativity,” as John Polkinghorne writes.

On the other hand, modern science challenges us to widen our beliefs, not to become rigidly fixed in them. It inspires us to awaken to something more awesome and deep at the heart of created reality. Science needs religion because theism makes more sense of the world and of human experience than science alone but religion also needs science to prevent it from falling into superstition and worship of false absolutes. Science cannot prove the existence of God and religion cannot prove the existence of quarks, but scientific discoveries can ignite “questions of the more” to which science and religion mutually contribute.

Blessed John Paul II recognized the need for mutuality between science and religion. Openness to the modern sciences, John Paul said, can help the Church remain on the path of truth and not wander off into error and superstition. On the occasion of Einstein’s centenary birth, the Pope commended Einstein’s contribution to the progress of science and encouraged

theologians to consider his insights for a deeper understanding of truth: “Filled with admiration for the genius of the great scientist, in whom is revealed the imprint of the creative spirit, without intervening in any way with a judgment on the doctrines concerning the great systems of the universe, which is not in her power to make, the Church nevertheless recommends these doctrines for consideration by theologians in order to discover the harmony that exist between scientific truth and revealed truth.” With the amazing discoveries today in big bang cosmology, evolution and quantum physics we must ask, how big a God do we believe in? Both science and religion point to the fundamental incompleteness of created reality and a basic openness to a level of completion which does not now exist. The questions that linger in the human heart today, questions of lasting values, moral decisions and life’s direction are questions that cannot be answered by science alone. Yet the scientist has a valuable role to play in creating meaning for the larger whole of life. Without keen attention to nature’s connections and the means to articulate these connections through scientific research, we cannot really make sense of evolution or its direction. Without science, theology is sterile.

The Vocation of the Scientist: Pierre Teilhard de Chardin

Having looked briefly at the rise of science in its relation to Christianity, we return to the word “vocation” with new insight and enthusiasm. The word “vocation” comes from the Latin *vocare* meaning “call” or an occupation into which one is “drawn.” What is the “call of the scientist?” Into *what* is the scientist drawn? It is easy to use the word “vocation” for religious life because one is drawn by God into God. But can we say the same for the scientist? Is one drawn by God to God through the study of nature? The separation of science and religion has made it difficult to see this larger context of the scientific vocation, but if we can disarm

ourselves of Enlightenment biases we can see that the role of the scientist is something of a priestly nature. One is set apart to offer the fruits of the intellect for the glory of God; to carefully discern the ground of worship. As one is drawn into a particular area of scientific study, the experience of matter itself becomes a means of prayer.

Here I think of the Jesuit scientist Pierre Teilhard de Chardin, a paleontologist whose greatest spiritual insights came while working in the area of human origins. In his scientific study of human origins, Teilhard discovered how truly earthy the human person is; we not only come from the earth but we remain in the earth, as the earth remains in us. He wrote: “I realized that my own poor trifling existence was one with the immensity of all that is and all that is still in process of becoming.”³ Teilhard’s experience of the sacred depths of nature allowed him to see continuity between the physical universe and his own life. He claimed that “beneath the ordinariness of our most familiar experiences, we realize, with religious horror, that what is emerging in us is the great cosmos.”⁴ His impassioned love of the earth did not fit with the Christianity of his day which was an other-worldly ideal. While Catholics prayed to be released from a “valley of tears,” Teilhard spoke of his love for the world and for “holy matter.” Thomas King wrote: “In his direct experience of the cosmos, Teilhard believed he found an ‘Absolute’ that drew him and yet remained hidden. . . .He decided to surrender and allow himself to be rocked like a child in the arms of the great mother—the earth.”⁵ Teilhard was attracted to matter and disappeared in matter as if swept up by a power of immense energy that could not be transcended. He sought to join the work of his life to the material world and actively continue its creative work. Teilhard emphasized that this awesome physical world is holy matter—or as the mystic Angela of Foligno exclaimed, “pregnant with God.” The vocation of the scientist is like that of a midwife, bringing to birth new forms or patterns of life hidden in nature.

As priest and scientist, Teilhard worked to bring together evolution and Christianity. Following Julian Huxley he wrote that the human person “is nothing else than evolution become conscious of itself.” In this long unfolding story of the universe, we humans are the last two words—*homo sapiens*; we know that we know. Teilhard assigned a particular role to humankind in the course of evolution because the human is self-conscious earth and must continue development of cosmic life as the unfolding life of God. We do not go to God directly, he claimed. We go to God through and with the earth which gives one the energy needed to rise to God. We are to create ourselves through the course of evolution by increasing human unity and building a common world.

The vocation of the scientist is integral to Teilhard’s “mysticism of action.” Through investigation and the desire for knowledge, the mind unifies the fragments of data presented to it. To think is to unify, to make wholes where there are scattered fragments. Knowledge is a creative act, open to the future. The mind creates by perceiving the phenomena of reality and in so doing continues the fundamental work of creation. Each time the mind comprehends something it unites the world in a way that is new. Evolution advances through the dynamism of faith and reason. To discover and know is to actually forward creation as a universe and to help complete it; this active engagement through knowledge deepens the spirit. The process of knowledge, therefore, is oriented toward the future, to see what is not yet seen. To think the world is not merely to register it but to confer upon it a form of unity it would otherwise (i.e. without being thought) be without. For Teilhard, the work of science is fundamental to faith itself because every act of knowledge which brings about greater unity is a new appearance of God, a new disclosure of divine mystery. Hence knowledge, even scientific knowledge, is in the service of love.

Closing Reflections

As I reflect on my own experience as a scientist *and* theologian, I would offer several suggestions to those actively involved in scientific research and education today. The first is that the study of science must take place within the context of a larger whole. What is the larger context of your scientific studies? How do you balance the intensity of scientific research within the larger whole of religious belief, social justice, passion for life, family, friends and community? Many times, scientists shrink into their specializations and lose sight of the larger picture of humanity and the world. Perhaps they can learn some lessons from Ignatian spirituality which focuses on “discernment of spirits,” seeing where God is in the picture. Where is the place of God in your life and work? What do you hope for in your scientific studies? Who are you in dialogue with and how wide are your relationships? Again as I reflect on my time as a scientist, I recall some good colleagues whose lives were fragmented. They were so deeply immersed in their specializations that the rest of their lives became compartmentalized as well. Years ago at UMDNJ I worked next door to a researcher who was a leading expert on a calcium channel involved in Multiple Sclerosis. He spent many years working on the protein structure of this channel. But outside the lab he was socially awkward with little time for anyone. He was shocked when his wife divorced him after many years of marriage. He did not see anything larger than the protein of the calcium channel because the channel came to define his world.

The scientist is first a human person and as person is called to be a relational being. Robots can be mechanical experts but humans must be whole-makers and meaning-makers and thus must be open to the wider circle of relatedness. In this respect, the pursuit of science must be reflexive of becoming more integrated within oneself and in the larger context of culture and society. One cannot flee from the world into the laboratory; rather scientific research impels one

more deeply into the world. Science shapes culture and in turn society. The vocation of the scientist is not simply to science but to humankind in its public, political and religious realms, as well as to earthly and cosmic life. The scientist has the responsibility of seeking true reality and to communicate authenticity of reality. The scientific vocation is a call to participate in evolving reality and to help reality become more unified in its many dimensions.

Reflecting on my own experience as a scientist, I would describe the choice for science as a call and gift, not simply to use one's intellect but to become more authentically human through the study of nature. I believe the response to the call must be one of gratitude. The thankful scientist can be the prayerful scientist when the work of the scientist is not to control nature but to mediate mystery. Doing science is in a way like doing theology, using the mind to seek deeper truth and to help unify nature for the fullness of life. The scientist is asked to think and reflect on life's unfolding, to engage the mystery of nature—not simply to figure it out—as if nature is a problem but to explore nature's capacity for more life and more being. It is the search for the more which leads to greater wholeness of life.

I do think science needs religion (or spirituality) as a dialogue partner to prevent it from falling into self-sufficiency and materialism. At the same time, science can help religion from falling into idolatry and false absolutes. Even Albert Einstein saw the vocation of the scientist as an awesome and holy one. He wrote:

A knowledge of the existence of something we cannot penetrate, of the manifestation of the profoundest reason and most radiant beauty, which are only accessible to our reason in their most elementary forms – it is this knowledge and this emotion that constitute the

truly religious attitude: and in this, and in this alone, I am a deeply religious man.

The vocation of the scientist is best seen, in my view, in the context of religion; not religion in a narrow or institutional sense but a deep drive to connect to a larger whole or an ultimate ground. It is participation in the wholeness of life by opening up new windows to nature's mysteries, making connections beyond what is visible to the naked eye. The passion of the scientist is belief in the world as rational and knowable, the belief that truth is worth pursuing. The work of the scientist is faith, not in the strictly religious sense, but a commitment to something beyond oneself that affirms an ultimate in one's life. The scientist seeks to know everything about something, an openness that knows no bounds. The tension, however, is the lure to become overpowered by specialization, which can thwart the expanse of inquiry. The scientist can fall prey to the trap of misplaced concreteness, mistaking insight for certainty, thus losing the spirit of unrestricted wonder and creativity.

While science can explain aspects of reality, religion provides meaning and purpose to reality's direction. Einstein once quipped, "science without religion is lame and religion without science is blind." The vocation of the scientist is oriented toward the fullness of life and must be a constant discernment of life. What is worth knowing? What is worth pursuing? What is worth hoping for? Science that grows in openness to the real and knowledge of the real helps unify creation, rendering God more visible in the details of nature. That is why the goal of the science should never be limited to results or data, for science peers into the heart of the divine mystery with each new discovery. The scientist may, unwittingly, be the first to see the face of God.

NOTES

¹Daniel Horan, “Light and Love: Robert Grosseteste and Duns Scotus on the How and Why of Creation,” *Cord* 57.3 (2007): 246 – 47.

²Richard E. Rubenstein, *Aristotle’s Children: How Christians, Muslims, and Jews Rediscovered Ancient Wisdom and Illuminated the Middle Ages* (New York: Harcourt Books, 2003), 188 – 89.

³Pierre Teilhard de Chardin, *Writings in Time of War*, trans. Rene Hague (New York: Harper & Row 1968), 25.

⁴Teilhard de Chardin, *Writings in Time of War*, 27.

⁵Thomas King, SJ, “Teilhard and the Environment,” *Ecotheology* 10.1 (2005): 91.