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relative space; rather, it is the ultimate dimension of reality out of which space, time, energy, matter, and mind all emerge . . . This luminous space is the ground from which all possible worlds appear, and it is the ultimate nature of every observer's mind" (Wallace 2007).

Wallace continues, "Much as physicists describe the current universe as 'frozen' with respect to the perfect symmetry of the melted vacuum, so do Buddhists characterize our current minds as frozen with respect to the perfect symmetry of primordial consciousness" (Wallace 2007). He quotes from the present Dalai Lama and the nineteenth-century Great Perfection teacher Dudjom Lingpa to show that even the same analogy of water and ice is used. In this case, symmetry-breaking occurs when phenomena and the mind are taken to have their own separate realities. The mind then reacts to phenomena with desire or aversion or indifference, leading to a chain reaction of karmic action and result, but since even the dualistic, grasping mind is ultimately of the nature of primordial consciousness, the Great Perfection holds that there is a way out. "The way to return to the perfect symmetry of primordial consciousness is to realize how all phenomena fundamentally emerge from and are of the nature of absolute space" (p. 112). As is always the case in Buddhism, this cannot be a purely conceptual understanding. Such understanding must be followed by meditative contemplation in order to produce a nonconceptual, transformative realization.

Cross-References

- ▶ Buddhism in the West
- ▶ Classical and Quantum Realism
- ▶ Consciousness (Buddhist)
- ▶ Cosmology
- ▶ Dependent Arising
- ▶ Modernity in Buddhism and in Islam
- ▶ Physics
- ▶ Quantum Theory
- ▶ Reality in Buddhism
- ▶ Science in Buddhism

References

Ames, W. L. (2003). Buddhism and science: Breaking new ground. In B. Alan Wallace (Ed.), *Emptiness and quantum theory* (pp. 285–302). New York: Columbia University Press.

Lama, D. (2005). *The universe in a single atom: The convergence of science and spirituality*. New York: Morgan Road Books.

Mansfield, V. (2008). *Tibetan Buddhism and modern physics: Toward a union of love and knowledge*. West Conshohocken: Templeton Foundation Press.

Mind and Life Institute. http://www.mindandlife.org/

Mingyur Rinpoche, Y., & Swanson, E. (2007). *The joy of living: Unlocking the secret and science of happiness*. New York: Harmony Books.

Ricard, M., & Xuan Thuan, T. (2001). *The quantum and the lotus: A journey to the frontiers where science and Buddhism meet*. New York: Crown Publishers.

Wallace, B. A. (1980). *Choosing reality: A contemplative view of physics and the mind*. Boston: New Science Library. Reprinted as *Choosing reality: A Buddhist view of physics and the mind*, Ithaca/New York: Snow Lion Publications, 1996.

Wallace, B. A. (2007). *Hidden dimensions: The unification of physics and consciousness*. New York: Columbia University Press.

Zajonc, A., & Houshmand, Z. (Eds.) (2004). Space, time, and the quantum. *The new physics and cosmology: Dialogues with the Dalai Lama*. New York: Oxford University Press.

Physics in Catholicism

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Related Terms

Catholic church; Physical knowledge

The Nature of Catholicism

What could uniquely characterize the Catholic vision? One certainly needs to point out at first the harmony of reason and faith and the capacity to put the communion of all before anything that could lead to focusing on one's difference. This vision has something apophatic about it, since it

is easier to see what the Reformation has rejected from Catholic beliefs on particular points than it is to see what surplus there is in the unhampered essence of Catholicism.

During the modernist crisis, at the onset of the twentieth century, Maurice Blondel partly succeeded in the articulation of such an interpretation by speaking of a tradition that can be implicit but that is also self-consciously facing denials. Marian dogmas such as Immaculate Conception (defined 1854) and the Assumption (defined 1950) show that there is place for an implicit to be disclosed.

Catholicism is a tradition that values the human element in the human-divine union and as such recognizes the need for a visible presence, institutional or through the testimonies of the lives of the faithful, despite all the risks that could be encountered in the process of the unfolding of God's plan of salvation. This means that, while there have been important mystical figures in this tradition, the emphasis has not been on a non-mediated access to God. Christ is the mediator, but the Church also is since she is "Jesus Christ diffused and communicated" (Bossuet). There is therefore a role of tradition in illuminating Scripture, which entails that our situation is *made* meaningful by the Word of God but that it also *gives* it meaning. The Ecumenical Council Vatican II (1962–1965) reasserted the position originally defined at Trent (Session 5, 1546) concerning the Church's role in the interpretation of Scripture but made clear that the Church is to place Christ above both the written word and tradition, however important, since both flow from a unique divine wellspring (*Dei Verbum* §9).

The Question of the Development of Science

When the subject of science and Catholicism is treated historically, some of the following accusations are often raised against the Catholic Church. It dominated the dark and barbarous Middle Ages, whereas Protestantism freed the Western mind from bondage since, by securing religion in a heavenly realm, it permitted its faithful to fully engage in the development of science and technology. One will also hear that the modern world was built around the Protestant work ethic.

Catholicism always maintained that there was a troubled state in the religious relationship between man and God which is located in the *will* but that human *nature* had kept, in a profound sense, its integrity. There is a rational optimism which is part of Catholic convictions, although the ways in which this "faith in the world" has come to play are quite complex. It is remarkable that some religious orders, such as the Jesuits, have had in many cases a tendency to keep looking for a universe directly symbolic, almost hieroglyphic, even if it might have entailed at times an incapacity to give sufficient autonomy to the natural course of things (Ashworth in Lindberg and Numbers 1986:156; Hellyer 2005:221; Principe in Numbers 2009:104–105).

Historians have shown the untenable nature of the exclusively conflictual scheme "science versus religion" even if popularizers of science sometimes still have recourse to it (Cantor 2003). Religion is not an obscurantist force while science would be an expression of freedom; those categories are too wide and are "reifications" (Denton 2005). The problem has to be broken into a look at particular Christian confessions. Each one of those has had its historians who have been vehicles of apologetics. Fr. F. Russo for instance, while complaining about this situation, made himself guilty of it nonetheless in posing as a Catholic Hooykaas (Russo 1963:319). He highlighted the fact that if one reads the Dutch historian of science, the impression one gets at times is that it is Protestantism *as it differs* from Catholicism that has served as a force to promote modern science. To this, he objected that if indeed the former has produced several examples of observation and experimentation, modern science has built itself *against experience* more than it would have looked to confirm it passively (as Koyré, and also Bachelard, argued quite correctly) (Russo 1963:308).

If one looks at the question from the angle of the faith confessed by a practitioner of physics, inquiries have shown that the personal worldview instilled by one's denominational creed was not the most important factor and also that, perhaps contrary to some commonly held assumption, the Catholic faith is fairly permissive in that department if some fundamental dogmatic theses, few in number, are recognized.

Historical Outlook at Some Transitional Moments

For the Greeks, the universe was undergoing cycles of progress and decay, and if they promoted some technology, they were responsible for very little experimental science (otherwise one would incur the wrath of the gods). As J. Abelé recalled, the slaves were associated with the physical basis of geometry, measurements, and as such with the corresponding idea that those never carried with them the perfection of disembodied archetypes, which was an impediment to science's development (Abelé 1961:54). In metaphysical terms, it has been necessary to go through a de-spontaneization of nature as a condition for a confidence in the human capacity to understand her workings. The idealization that has been necessary to launch the modern scientific revolution could have happened easily a thousand years earlier as Whitehead saw. There is still discussion on the motivations for this delay, but certainly, one cannot avoid thinking about the panpsychism that is implicit in the idea of nature as a productive force. The main idea that had an influence on minds, in the physics that came to be diffused and systematized by Aristotle, and which had to be overcome, was that of a motion necessary obtained through application of force by a mover. There was also the attribution of a divine nature to the heavenly bodies and the idea of the perfection of circular motion.

Experimental methodology started at Oxford in the thirteenth century. It took until the seventeenth century for some of Aristotle's ideas in physics to be repudiated. What was physics like at that point? Was it tied to something the Church had to protect and preserve? For Aristotle, no overarching scientific method and demonstrations were possible since one was not to mix entities from different genera. He refused all that is the basis of calculus-oriented physics: the idea of a rate of change was dismissed as confusion while the rise of the concept of fields of smooth, continuous quantities is what unlocked classical physics (Funkenstein 1986:305–306). The changes that took place and configured progressively the modern conception of the laws of nature implied a shift from contemplative knowledge to the capacity to *do* things, a form of "ergetic" knowledge (Funkenstein 1986:296–297).

Galileo and the Consequences of a Thought Revolution

The Catholic Church decree of 1633 against Galileo has been the object of much attention. Although the matter is a complex one, there was more to it than contradicting the prevalent understanding of the reading of Scripture. As Russo observed, Catholics and Protestants would be in the same boat regarding the interaction of astronomy to Scripture, the Protestants having put historically more restrictions on allegorical interpretation of Scripture. It is now clear with hindsight that Galileo had inconclusive arguments, lacked proper means of observation, and refused to declare his vindication of Copernicanism only a theory, stating that knowledge would be true when obtained through observations and necessary demonstrations (Galilei 1957:182–184). In fact, Copernicus' system gave to circular motion an exclusive place; it contained eccentrics and epicycles although he freed himself of their need to account for planetary retrogressions.

Along with the Eucharistic dogma, entailing for Catholics a special presence of Christ to his Church, A. Kojève has argued that the dogma of the Incarnation of the λόγος is the most important conceptual shift that has permitted modern science to appear: the world is no longer unworthy of the presence and descent of God in it (Kojève 1984). To study it directly means learning

something about God's wisdom (Principe in Numbers 2009:105).

The systematization of the great principles of the new physics of Newton carried with it the need for the integration of all phenomena, electrical, magnetic, and chemical. Not only successes will be obtained: if matter attracts matter, how to account for its structural stability? The applicability of Newton's ideas was impressive. For instance, one can think of the Coulomb potential which governs the interaction between electrically charged particles as a particular application of the inverse square law which one could verify all the way from the macroscopic level of pith balls to the minutest components of matter. The overthrow of ancient physics implied the destruction of special qualities that would have accounted for properties inherent in bodies; it replaced essences that bodies, animate and inanimate, were supposed to be striving toward by focusing on systems that operate according to general laws and deploy their effects from initial conditions. If the clock is the metaphor of this era, we must remember that it presupposes for its function mechanisms rightly calibrated and organized, as well as hands that are set correctly, making the clock analogy *mathematical* rather than mechanical. There was a tendency in Newton of retrieving a natural theology by seeing in the order and the stability of the solar system, which it cannot itself account for on its own, a sign of divine intervention.

The next step that is worth noting is the nebular hypothesis and the formation of the solar system which P. S. de Laplace claimed he could account for by positing that the perturbations in the orbits of planets, considered by Newton to be cumulative, were periodic and would self-correct. Laplace conjoined a parable involving an omniscient demon with the idea of an intrinsic conditional probability, later to be replaced by two extrinsic and converse conditional probabilities. His first idea was that chance as epistemic limitation rendered it possible by its progressive eradication to detach the worldly regularities from the decrees of the divine. One could often hear that he eliminated the God hypothesis, but as studies of R. Hahn and others have shown, it is not atheism that one ought to find in Laplace but rather a determination of the fact that a first cause will never be accessible to the scientist's outlook, something more obscure to be kept for the work of theologians.

Thus, there was a passage from a system where we draw theological conclusions directly from the disposition of things to another form of thought where a certain metaphysical determinism, hypothetically applied to reality, makes superfluous the invocations of a divinity *in the natural sciences*. If one can sometimes notice that a God such as conceived by the deists has a tendency to disappear since he becomes useless in serving as a tool for physical explanation (Polkinghorne 2001:53), deism is far from removing its metaphysical necessity, since the world as mechanical and as a machine smacks of a clever engineer.

If we summarize and ask what conditioned the development of classical physics, we can think of:

- The abandonment of an attempt to find general intentionally defined concepts and the adoption of universally workable magnitudes.
- An idealization from local motion to in-principle accessible ranges of experience.
- Temporal sequences coming to replace substantial forms.
- Induction from experiments (promoted in different ways by both Descartes and Newton).

When Dogma Meets Science

It was already pointed out that the Catholic Church did not impose a natural philosophy on her faithful. She did show concern however for the dogmatic consequences of some metaphysical positions. One cannot say that Christian churches, upon hearing of the word "atomism," uttered condemnation. As a matter of fact, an ontology of particles of a Democritean kind was adopted by P. Gassendi, a devout Catholic priest, without being worried. Some Protestant theologians (N. Taurellus, C. Vorstius) did the same in an attempt to defend the Calvinist belief in the Eucharistic presence which entailed the rejection

of that part of the Lutheran account that had kept modified Aristotelian natural philosophy categories (Leijenhorst and Lüthy 2002:395–397). If one shifts the ground and thinks of the tradition of the *plenum*, that of Descartes, Huygens, and Leibniz (the most metaphysically ambitious who sought to reconcile continuity and discreetness), one will find that atomistic elements *with the overarching metaphysical determinism he adduced to them* could be said to have caused some problems to Descartes and later his disciples such as Fr. Méland. To have relegated everything real to primary qualities, while in the Eucharistic dogma only secondary qualities are said to subsist (Hellyer 2005:105–111; Leijenhorst and Lüthy 2002:396) meant that, defining matter as extension, secondary qualities were by the same token defined out of existence.

There remained a difficulty in assessing what was the thesis in ontology that brought trouble to those who like Galileo defended Copernican astronomy, especially when we consider that Copernicus, himself a canon, was asked by Pope Leo X to study discrepancies in the calendar and did it without anything being brought up against him. In view of the awkwardness of a papal commission gathering experts and working intensely for a month to condemn something they helped promote, it has been suggested that the main bone of contention for Galileo might have been not his defense of Copernicanism, of which alone he would have been accused to *protect* him, but rather his adoption of an atomistic conception in natural philosophy (Redondi 1987:165, 247–249).

The Council of Trent (1545–1563) seems to have favored peripatetic categories in some of its definitions regarding the Eucharist, but "substance" in those, in particular that of transubstantiation (session 13, Chap. IV, 1551), is not to be understood as having the technical sense it had in Aristotle's philosophy (Hellyer 2005:108). One can either say that there are different Aristotelianisms and that the meaning of such a natural stance shifted (Leijenhorst and Lüthy 2002:378), or like E. Schillebeeckx that the dogmatic Eucharistic definition never had that technical philosophical sense, as indeed many of the Trent Fathers would have avoided it if they could have (Schillebeeckx 1966:331). If "substance" meant what one encounters in peripatetic physics, this would signify that Christ's body is still submitted to properties known in human experience, and as such, theologians would hardly have been in a position to blame Galileo or Descartes.

W. Ashworth asserted that nothing in the realm of ontology is refused to a Catholic because he would confess that faith (Ashworth in Lindberg and Numbers 1986:147) and thus was led to look at institutional impediments as more significant concerning hindrance to the development of science. This sociological criterion might imply that Catholics are closer to creatures of mere obedience, but the case of Pascal, which he himself analyzes, testifies otherwise (Ashworth in Lindberg and Numbers 1986:143). Worldviews carry metaphysical implications, such that one cannot believe in metempsychosis and be Christian, as the case of Giordano Bruno would illustrate, irrespective of any judgment on the means by which he was silenced.

If one can say, judging from examples of historical practice of physics by Catholics, that "... the term 'Catholic Science' ... has no meaning whatsoever" (Ashworth in Lindberg and Numbers 1986:147) and if J. Polkinghorne in a similar fashion can dismiss the very idea of a "Christian physics" (Polkinghorne 2001:40), it is important to keep in mind that our usual understanding of the cohabitation, in one's mind, of one's religious conviction, and one's worldview is often oversimplified. The last statement especially only makes sense after centuries of efforts to find the delimitation of respective provinces of inquiry. In this sense, it might be tempting to judge as simplistic whomever would look for a conception of space and of bodies' extension that allows to preserve the meaning of the dogma, particularly the Eucharistic one – sometimes fighting Aristotelianism and sometimes adapting it – but one must not forget that a universe with a beginning in time was deemed repugnant by cosmologists such as A. Einstein, A. Eddington, and F. Hoyle for reasons that have everything to do with metaphysical preferences. As S. Barr argues (Barr 2006:43), this would imply

a metaphysics and might hint at a form of religious commitment with which some of them wanted to have nothing to do. A "Eucharistic physics" is no more an impediment to science than this interference of a religiously-based pagan metaphysics (Hellyer 2005:105–113). G. Lemaître, a Catholic priest who proposed a model of cosmic expansion that went beyond the limitations inherent in the models of Einstein and De Sitter, later to be termed by himself the "hypothesis of the primeval atom," ironically fought against Einstein in the name of truth as harmony with rationally and empirically established facts, while the most famous physicist of the twentieth century was found clinging to theological presuppositions hampering the reconciliation with experimental evidence.

Contemporary Physics and the Worldview of Catholicism

Short of capturing the essence of contemporary physics in a few words, one can identify three clusters of significant work: (1) cosmology, models of the universe and astrophysics; (2) microphysics and quantum theory, and (3) computational chaos and the studies in complexity and self-organization.

Physical Research on the Very Large

The first cluster includes theories of the infinitely large, with general relativity and astrophysics, all the way to string theory and supersymmetry. Einstein understood that the laws of nature must be expressed so that they look the same to all observers, no matter where they are and how they move. Newton's laws of motion would have retained their form only for special observers moving in a simple way, without acceleration or rotation. There happened an important redefinition of purely intellectual evidence around the criticism of absolute simultaneity.

We can summarize the *first* constellation of work in physics by highlighting the following features:

- A modification of the Galilean principle of relativity, affecting the correct idea of an indifference to uniform motion, that had maintained a relationship to elapsed time from one referential to another which could not be salvaged in the context of electromagnetism.
- Inversion of the order of priorities of the physics of the day, since instead of studying properties of matter and aether accounting for those of space and time (contraction of rods and rulers), Galilean relativity was abandoned with the introduction of new transformation formulae.
- Since special relativity forbids traveling faster than the speed of light and Newtonian gravitation was considered to act everywhere instantaneously, a contradiction had to be solved: the result was general relativity, wherein gravity is associated to the curvature in the fabric of space-time itself, described using Riemannian geometry.
- Relativity receives early on a mathematical formulation characterizing it by the action of groups of transformation (the Poincaré group) and becomes the geometry of space-time that underlies all the current work on fundamental particles.

In the years of its early popular dissemination, after World War I, accusations where voiced against relativity, and some, like Cardinal W. O'Connell of Boston, saw in it a contribution to the erosion of the moral sense and an atheism camouflaged as pantheism (Holton Fall 2003:30–31). What was happening in reality had eluded the prelate: here was the challenge put in front of the Catholic Church to state to what extent the God she proclaims is an "outsider" to this creation. The difficulty is formidable indeed since, as previously stated, Catholics have always striven to maintain a harmony of nature and grace, alongside that of reason and faith.

There was with the implications in ontology of general relativity an installation of a rational transparency at the heart of reality which recaptures for man an important and seemingly forever lost place, altering the "principle of Copernicus." The human thinker through his mind is reinstalled at the heart of things, far from being chased from them (Gingerich in Harper 2005:60;

Danielson in Numbers 2009:50–58). Contrary to the Cardinal's fear, it is not a relativization of morality and personal philosophy that was fostered but an absolutism of the knowledge claimed from who has played with God's wisdom in creation (Prov 8), in other words a revival of the claim of Galileo almost three centuries earlier: the God of redemption cannot in his holy books require us to dismiss what is disclosed by the (Pythagoreo-) Christian book of a nature written in mathematical language. As argued by D. Dubarle, with Einstein, we reconnect in a better way with the original Galilean insight into inertial reference frames and we get rid of the encumbering uniform space and time of Newton. Even more beautifully, we find the vindication of a Keplerian epistemology centered on the descriptions of different observers with covariance of the *maßbestimmung* (Dubarle 1971:21).

The universe models invented around Einstein's general relativity are manners of reinserting the local in the global, and one must understand the implications of field equations that define a model of a universe for all the different situations represented. This dialogue between mass-energy and space-time is profoundly intriguing. The to and fro motion between local and global implicit in the Kaluza-Klein geometry insights that opened the road to adding additional dimensions into the existing understanding of space-time – leading to explorations in topology that were to develop into Calabi-Yau manifolds with many more unobservable dimensions – certainly has theological significance. The attempt at generalizing that was done amounted to the adoption of a geometry dictating its properties to the universe. This idea of a perfect rational transparency and predictability as it survives in relativity is that of the lifting of the veil which hides the mystery of things: they become accessible to the scientist achieving salvation through knowledge. The price paid is that the idea of creation and that of miracles become supremely abhorrent. Yet for this to happen, geometry first had to be made commensurable to its object. One would rightly see in this an intimation of the union of two natures signified at the heart of cosmological reality.

R. Feynman asserted numerous times that we do not know what the concept of energy really entails and that it is incomprehensible that there can be so many different ways to measure it. We say that electrical or mechanical work, then heat, are different forms of energy, with a total amount that remains constant. Different forms of energy are measured in different units, and one could draw an analogy with different forms of money measured in so many currencies. When we exchange them, they undergo a conversion *rate*, and this can be considered to have been fixed. The possibility does not always exist to convert them one into the other, since there are exchange restrictions. That restriction in physics is the second law of thermodynamics. If one disregards its effects, one is led to an "it from bit" universe that is a gigantic canvas of information which we could term for short Wheeler's universe. In such a case, there does not subsist any nonformal substratum, with a consequent evanescence of substance. This troubled Einstein himself toward the end of his life, with space-time understood as a structural quality of the field, and is sometimes referred to as the "hole problem," which attempted to show that no generally covariant field equation can be satisfactory. If one were to ask: "how can we keep matter in the picture?," it would be found that the same Catholic faith (in the wider sense including Orthodox Christians and many Anglicans) which at times seemed tilted toward some emphasis on an other-worldly spirituality is in fact the more "materialistic" of the world religions, as emphasized by W. Temple and Derwyn Owen. Not only does she affirm God making himself a part of his creation and abiding by her laws, but she insists on the sacramental continued presence of God to this same world and, far from teaching its disappearance or illusory character, awaits in hope a transfiguration of this our earthly body.

Physical Research on the Very Small

The *second* great constellation in physics is that of the infinitely small, where we have come to realize that energy exchanges which constitute the substratum of the world are done in

consequence of a distribution which does not obey the continuist logic that allowed to imagine metaphysical determinism as prevailing everywhere. In the new picture, even the most established principles such as that of the conservation of energy are *approximately* true, holding on average. It is not that science has grounded, or proven, freedom as we sometimes hear but that it has brought an end to a lasting obstacle to its being physically significant.

If we try to summarize important elements of this reconfiguration of physical knowledge, we find that:

- A distinction had to be made between measurements carried in the microworld and macroworld, since we are too heavy to pretend we could observe subatomic elements without disturbing them; although some magnitudes (e.g., mass and spin) might be obtained with arbitrarily high precision, conjugate magnitudes cannot be simultaneously obtained.
- There is the problem of weak objectivity: we always knew in classical science that our measurements were idealizations, but we thought that we could disregard that which is left out of the initial conditions.
- New rules of probability that are nonlinear.
- Incomprehensible effects in the material universe that can suddenly be explained through quantum tunneling, since there is a nonzero probability that through an interplay of the energy/amplitude relationship, particles behaving as waves will be found to exist outside potential obstacles.
- We realize with hindsight that the universe of classical physics had no inherent stability; the building-up of the internal structure of atoms could have been done in any haphazard way, which means that, had it really predicted the structure of the universe, we should have witnessed a chaos (little did Newton realize that his unease in front of the stability of planetary motions in the solar system in fact applied to the constitution of matter as picturable in his own system of physics).

Physical Research on Chaos and Complexity

The *third* constellation is conceptually related to the second just reviewed, and we can summarize it as follows:

- Unrestricted determinism was found to be unattainable from a calculation viewpoint, following a study of the properties of gases and by drawing the implications of inherent limitations to our retrieving information from the microworld.
- H. Poincaré working on the 3-body problem demonstrated that, for a question to be formulated with classical equations, a multiplicity of possible trajectories would be generated, that were affected by extremely small changes in the setting of initial conditions.
- With more advanced computational techniques, the meteorologist E. Lorenz formulated a more general theory of deterministic chaos.

As Dubarle also noted, the conditions which are required for the grand cosmological models of our first category to work (T-symmetry, equivalence of energy balance) are part of the initial Galilean idealization, but in our universe, which is hospitable to life, they are rarely if ever met. A freedom and an interplay of chances seem to lead to stabilization of structures (Dubarle 1971:25–26).

Fr. P. Teilhard de Chardin (1881–1955) anticipated relativistic physics early on in thinking of matter as a manifestation of energy. The mass-energy convertibility has an operational sense and it was known even before relativity. In Teilhard, it had acquired a religious and a metaphysical sense. How can we capture this difference? Einstein's vision seems to entail pantheism, it affirms our immortality but as impersonal energy distributions in a universal manifold along some fourth dimension (think of his letter of March 1955 to Michele Besso's widow, where he claims that ultimately the difference between past, present, and future is a persistent illusion), whereas for Teilhard, stretcher-bearer during World War I, a vindication of our going down and a resurrection of the flesh was awaited with the rising of dead soldiers. The blood of their sacrifice was the cement of the walls of the New

Jerusalem. It is precisely in the Eucharistic mystery that he found this conviction. The Spinozistic universe which smiles at us and is only hospitable in not ruling out the possibility of our presence shows a supreme indifference to the singularity manifested in our selves and to what we call personhood.

What Catholicism has to say about this is not forthcoming in the guise of one or many categorical statements; however, it helps us see in hindsight that a universe which transformed man into a being made up of aether or celestial matter, regaining a body as a sort of elementary minerality, amounted to an evacuation of human reality. It was to be judged with reference to some Empyrean heaven which never would have seen beings existing in their individuality but only as a species eternally less than some absolute postulated to be perfect according to a geometric archetype of circular motion. It is not that the quantum theory lays ground for an ontology that would replace the one which is behind general relativity, as is commonly assumed; in fact, relativity is needed to assess some elements that make the internal cogency of quantum mechanics. It is more that, as M. Heller says (Harper 2005:228), Einstein tried to save his view of a universe which is all there is, and when we realize that both relativity and the quantum theory are derivable from Noether's theorem, we come to see that the question is not to have established the reign of stochasticity but rather, as Cantor first indicated with his meditation on transfinite fractals, that the principle of plenitude, liberality, and generosity (*not* a human natural inclination) lay under the fabric of this world. The universe is not only discrete but, as M. El Naschie has argued, it is transfinitely discrete. The notion of transfinite discreteness is homomorphic to fuzzy topology, foliation, and fractal geometry (El Naschie 2005; Nottale 2007).

There is thus an interesting convergence between the rediscovery of the role of time in science – as factor of irreversibility – and this manner for man to imagine that human individual destiny, that of the human nervous system, of the encounters that have brought humanity about must subsist with humanity itself, anticipating a resurrection that would mean infinitely more than some angelization. The very idea of a history of salvation where we can cooperate to what happens to us requires a universe which has a certain openness to the unpredictable.

Awaiting a "Grand Narrative" and the Final Vision of Harmony

Physics and an Unfolding Revelation

The intimations of God in the harmony of the laws and their immanence in the universe, related to our first cluster, are not at odds with the Catholic vision. Some elements speak in favor of this ideal, for example, the fact that God in the Catholic tradition is said to be more dissimilar than similar to us and as such beyond person as we know it (Lateran Council IV, Chap. 2). For Einstein, religion could powerfully influence science, suggesting harmony, flight into the eternal and the perfect, but science could not influence religion, since it describes what is, as much as possible without prior biases, and is value neutral (Einstein 1950:21–24). The Catholic vision achieves a balance between the insertion in the whole that is not encountered in many forms of religious particularism, and the legitimate claims of an individual-centered vision of perfection in some atemporal present. The thrust of all this is to get closer to the idea of a continued revelation mediated through our effort to better formulate the operation of nature's laws and their openness to mutual interactions making possible the coming of improbable and unanticipated states of affairs.

In a Catholic conception of time and of the role of the Spirit informing the Church as the soul of the body she is, information is all given in the enacting of the events of salvation: the event infinitely intelligible for us has taken place, but the development of this information will need the history of the universe and the action of the Holy Spirit to deploy itself. This presence, in its balance with the work of the Son, is a trait characterizing Catholicism, a continuation and a valorization of the in-between, the time of history, and that of the Church acquiring a celestial value.

The universe revealed to us through deterministic chaos, our third constellation, is one where all is interrelated and where we can insert not only contingently inconsequential actions but make do with a sort of hypothetical necessity, understanding that this necessity might be discovered and oriented by gestures that are minute, in the manner of the interventions of the divine in a world of which it would respect all the laws.

The common representation of quantum spontaneity at the heart of atomic disintegrations, a factor of chance in all fundamental interactions, can be pictured as some historical march destabilizing our self-image which turns out looking more like the efflorescence of a decorative effect. Yet this can also reveal a transposition introducing itself in the universe in being patient without dismantling anything, as would a lure.

The Conversation with Process Thinking

Attempts have been made to articulate D. Bohm's vision, which had Einstein's approval, to a Catholic theology valuing the hiddenness of the divine in a cosmic process of enfolding and unfolding (Schindler 1986). If it is customary to see physicists draw connections between oriental Hinduistic or Buddhist teachings and contemporary quantum physics (such as G. Zukav or F. Capra), something to which Bohm himself was driven at times, preceded by Schrödinger, one must say that there is no rigorous basis to establish them. There would be as many reasons to draw connections between Bohm's "holomovement" and the Augustinian and Anselmian tradition, present in Catholicism, which looks at the universe as a gigantic system of signs; this vision suffered an eclipse with the rise of nominalism and the enclosing of the allusory character of the sign within the mind of the signifier but impressive, and as yet unexplored, means of revitalizing it can be found in the semiotics of C. S. Peirce (Auletta in Harper 2005:185–186).

What is likely to complement this search is a renewed account of process (Schmitz in Schindler 1986:119). The organicist philosophy of A. N. Whitehead in this regard has been and will remain a source of inspiration but might very well be found wanting in the end, since firstly it does not respect a necessary apophatism in the knowledge of God (Hill in Schindler 1986:88), and secondly, one might consider that it surreptitiously inserts *our* form of psyche in nature (Shimony and Malin August 2006:272–273). A Catholic outlook on the question would militate for the value of all creatures, since their model is in the λόγος and, welcoming insights of natural theology along with the majority of her theologians that has so interpreted Paul's teachings on the way of the mind to God from the world (*Romans* 1:19–21), recall that there is more to God's relation to this created universe than fulfilling the aspirations of human beings.

A Creation-Centered Spirituality

As already shown, there existed all along another attitude of mind in the Church, which finds the exclusion of the divine from the world distressing and thus seeks to see it present not so much in gaps of scientific explanations (something almost universally reprobated) but rather in an attraction of all things toward their final goal and "solidity" to be achieved only in Christ, who is the archetype through which they were made. It has expressed itself in the search for a creation-centered, cosmic spirituality. It is not unremarkable that chaos theory, through strange attractors, has rediscovered something of this exploration and stabilization around regimes of spontaneous order. The Church asserts the reality of the world, its value in the plan of God when it will pour in the bosom of eternity all of its fruits and time, as suggested by J. Moltmann, "will roll up like a scroll." The Catholic faith is not a vehicle of other-worldly spiritualization but asserts our common destiny with the cosmos through the belief in the resurrection. If it is remarkable that the Church has never condemned a theorem of mathematics and by the same token respected the autonomy of the science of physics since as we saw conceptions of natural order have only been questioned when they clashed with the absolutely central dogmas by which she lives, the transhumanist attitude which makes us a mind by analogy to a computer and a disembodiable software is not in her spirit

(Gagnon 2012). Refraining from any condemnation of mathematics, the Church also never condemned the theory of the evolution of organic forms on earth, only restricting its acceptability for her faithful to forms that have not degenerated in a materialistic philosophy of the self-sufficiency of the process.

Along with fractal ontology and the principle of an order that is coming from order all the way down (Barr 2006:78–9), the Church with her doctrine of the hypostatic union and the conceiving of all intelligible forms in the λόγος through the Spirit can help the science of physics live up to the challenge of reconciling conflicting understandings of cosmic order. If one were to object to this last statement that very often order is, in the words of S. Kauffman, "for free" (Belouzov-Zhabotinski reactions, self-regulatory networks), one would have to account for its usability. The real problem is not just the generation of patterns and redundancy but the "fire in the equations," the breath not so much of life but of a self-referring intimation of personhood wherever the trace of God's creative action is said to extend, which is unbounded like the universe and also limitless.

Cross-References

- ▶ Astronomy
- ▶ Astrophysics
- ▶ Christian Cosmology
- ▶ Cosmology
- ▶ Mathematics and Religion
- ▶ Natural Theology
- ▶ Physics in Christianity
- ▶ Physics in Protestantism
- ▶ Process Theology
- ▶ Quantum Theory
- ▶ Relativity
- ▶ Worldview

References

Abelé, J. (1961). *Christianity and science* (trans: Trevett, R. F.). New York: Hawthorn Books.

Ashworth, W. B. (1986). Catholicism and early modern science. In D. Lindberg & R. Numbers (Eds.), *God and nature* (pp. 136–166). Berkeley: University of California Press.

Barr, S. M. (2006). *Modern physics and ancient faith*. Notre Dame: University of Notre Dame Press.

Cantor, G. (2003). Religion and science. In J. L. Heilbron (Ed.), *The Oxford companion to the history of modern science*. Oxford: Oxford University Press.

Denton, P. (2005). Religion and science. In S. Restivo (Ed.), *Science, technology, and society*. Oxford: Oxford University Press.

Dubarle, D. (1971). Science and the unified vision of the universe: Einstein's Ideas and Teilhard de Chardin's contribution. In *Science and synthesis* (*UNESCO International Colloquium*) (pp. 17–28, trans: Crook, B.). New York: Springer.

Einstein, A. (1950). *Out of my later years*. New York: Philosophical Library.

El Naschie, M. (2005). Einstein's dream and fractal geometry. *Chaos, Solitons & Fractals, 24*, 1–5.

Funkenstein, A. (1986). *Theology and the scientific imagination from the middle ages to the seventeenth century*. Princeton: Princeton University Press.

Gagnon, P. (2012). The problem of transhumanism in the light of philosophy and theology. In A. G. Padgett & J. B. Stump (Eds.), *The Blackwell companion to science and Christianity*. (pp. 393-405). Malden/Oxford: Wiley/Blackwell.

Galilei, G. (1957). *Discoveries and opinions of Galileo* (trans: Drake, S.). Garden City: Anchor Books.

Harper, C. (Ed.). (2005). *Spiritual information: 100 perspectives on science and religion*. West Conshohocken: Templeton Foundation Press.

Hellyer, M. (2005). *Catholic physics: Jesuit natural philosophy in early modern Germany*. Notre Dame: University of Notre Dame Press.

Holton, G. (2003). Einstein's paradise. *Daedalus, 132*(4), 26–34.

Kojève, A. (1984). The Christian origin of modern science (trans: Lachterman, D.). *St. John's Review*, *35*(1), 22–26.

Leijenhorst, C., & Lüthy, C. (2002). The erosion of Aristotelianism: Confessional physics in early modern Germany and the Dutch republic. In *The dynamics of Aristotelian philosophy from antiquity to the seventeenth century* (pp. 375–411). Leiden/Boston: Brill.

Nottale, L. (2007). Scale relativity: A fractal matrix for organization in nature. *Electronic Journal of Theoretical Physics*, *4*, 16-III, 187–274.

Numbers, R. (Ed.). (2009). *Galileo goes to jail and other myths about science and religion*. Cambridge: Harvard University Press.

Polkinghorne, J. (2001). Christian faith in the academy: The role of physics. In R. Sullivan (Ed.), *Higher learning and catholic traditions* (pp. 39–59). Notre Dame: University of Notre Dame Press.

Redondi, P. (1987). *Galileo heretic* (trans: Rosenthal, R.). Princeton: Princeton University Press.

Russo, F. (1963). Catholicism, protestantism, and the development of science in the 16th and 17th centuries. In *The evolution of science: readings from the history of mankind* (pp. 291–320, trans: Woodward, D.). New York: New American Library.
Schillebeeckx, E. (1966). Transubstantiation, transfinalization, transfiguration. *Worship, 40*(6), 324–338.
Schindler, D. (Ed.). (1986). *Beyond mechanism: The Universe in recent physics and Catholic thought*. Lanham: University Press of America.
Shimony, A., & Malin, S. (2006). Dialogue Abner Shimony-Shimon Malin. *Quantum Information Processing, 5*(4), 261–276.

Physics in Christianity

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The discussion on "Physics and Christianity" represents a subtopic of a wider issue on "Science and Christianity" (or Science and Religion). Its aim is not to bring into a simple, naïve correlation the content of contemporary physical practices and theories with the written, verbal, and practical teachings of the Christian Church (its theology) in order to establish a hierarchy in scientific and religious views of the world. The aim is to enquire in the essence and meaning of such a discussion. Indeed, the enquiry into the relationship between physics and Christian theology is counterintuitive: If one adopts a position that physics deals with nature, understood as the visible of this world, accessible to sensible, empirical verification and based in rationality related to the notion of objectivity (i.e., to a conviction that physics has access to reality as it is in itself, independently of the conditions of observability and subjectivity of the enquiring physicist), this runs against the sense of theology whose claims about the world and humanity have deep foundation in a different type of experience of personal communion with the Divine, experience which not only exceeds the capacity of the senses, but also makes reason (including scientific thinking) inadequate and incomplete in apprehension of this experience. Understood in this way, a comparison of physics and Christian theology does not have sense since it attempts to relate two types of human experience by means of a mental procedure. To succeed in this attempt would imply to transcend both physics and theology and adopt a sort of generic (let us say philosophical position) which would incorporate both of them. However, this hypothetical position can only be an abstract suggestion with no means of justification, because it is problematic to imagine an experience which would exceed both, experience of the world through science and experience of God as well as of the world through communion. This is the reason why the topic of physics and Christianity must be approached in the conditions of its concreteness in the human condition incarnate in material events and history of the spirit. In this case, the problem of physics and Christianity is seen as an existential issue of overcoming different experiences and attitudes to the world in being of one and the same human person. More precisely, the dialogue between physics and theology appears as an encounter of two *traditions* of the human spirit, the traditions which in their apparent fragmentation follow some common *teleology*, which the dialogue attempts to articulate.

Tradition in Theology and Physical Sciences

Elements of History

Tradition in theology means the integrity of religious experience within the Church, its intrinsic catholicity, which is affirmed through the interaction of ecclesial community with the Spirit of God. For theology, tradition is not only constant reassertion of religious events commemorated liturgically or through reciting Scriptures and texts of the Fathers of the Church. It is the constant invocation of the presence of God in the Church and in the world which carries an ontology of forming and sustaining the reality of the Church and its theology (Nesteruk 2008).

Science also follows a tradition which dates back to the inception of Classical philosophy.