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SPECIAL SECTION

Prologue: Science and religion

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Science without religion is lame, religion without science is blind.

Albert Einstein [E2, p. 26].

The thoughtfulness of the editor of *Current Science* in bringing out this issue, commemorating the centenaries of two great scientists, one a religiously inclined but non-synagogue Jew and the other a Roman Catholic priest, offers a chance to stress the friendship between good religion and good science. Amid the welter of hostility toward science shown by some prominent but uncritical clerics, and the aminosity towards religion voiced by some uncritical scientists stands the truth that the greatest discoveries of post-Renaissance science have come from discoverers of deep religious conviction.

The first great accomplishment of post-Renaissance science, the dethronement of the earth from the center of the universe, began with the priest Copernicus. He saw no conflict between his Christianity and a Pythagorean heliocentric conception of the cosmos. His great disciple Johannes Kepler, a Lutheran, clearly saw God as the architect of the heavens and of the harmony that governs it. Next, listen to Copernicus' second great disciple, Galileo Galilei:

> Methinks that in the discussion of natural problems, we ought not to begin at the authority of places of scripture, but at sensible experiments and necessary demonstrations. For, from the Divine Word, the sacred scripture and nature did both alike proceed . . . Nor does God less admirably discover himself to us in Nature's actions, than in the Scripture's sacred dictions. [B, p. 83]

These great pioneers paved the way for the *Principia* of Isaac Newton, another religious scientist (of whom more later). The *Principia*, dethroned both earth and sun, and forever demarcated anthropocentrism as an erroneous conceit.

We should emphasize that the first sentence in the Galileo quotation articulates an attitude towards scripture to which subscribed the Church Fathers Tertullian and St. Augustine, the Jewish theologians, Philo of Alexandria and Moses ben Maimon (Maimonides) of Cairo, and the Islamic doctors Ibn Sinna (Avicenna) of Bokhara, and Ibn Rashud (Averroes) of Cardova. Were this attitude to govern ecclesiastical judgments on science, the ground for conflict between scripture and good science would disappear. The suppression of knowledge and the persecution of scientists by ecclesiastic authorities stem usually from the failure of the churches to comply with this sensible attitude.

Nor should we forget Galileo's famous statement on mathematics in *Il Saggatore* (1623). It is the infinite and the ideal in mathematics that gives the mind an effective vehicle with which to interpret empirical reality. While the need for such ideality was completely clear to Spinoza (1632–1677), witness his words:

> It is in the nature of reason to perceive things under a certain form of eternity (*sub quadam aeternitatis specie*). [S, p. 117, Part II, Prop. 44, Cor. 2].

the modern secularist finds it offensive to grant so momentous a place to the invisible and the ideal in the life of man. Suppressed in our idolatry-infested educational system are these important messages of Galileo and Spinoza, and their religious antecedents.

Another major accomplishment of post-Renaissance science was the establishment of atomism as a fundamental aspect of cosmic structure. The firm affirmation by the priest, Pierre Gassendi, that Christian scripture does not rule out an atomistic cosmos, weighed heavily with the physico-theologians of the Royal Society,

Newton, Boyle and Hooke, who in the spirit of Galileo looked upon Nature as a second scripture. Their atomistic view is well expressed by Newton in the following famous passage in his *Opticks*:

> It seems probable to me that God in the beginning formed matter in solid, massy, hard, impenetrable particles, of such sizes and figures, and with such other properties, in such proportions to space, as most conduced to the end for which He formed them; and that these primitive particles, being solids, are incomparably harder than any porous bodies, compounded of them, even so very hard as never to wear or break in pieces: no ordinary power being able to divide what God Himself made one in the first creation. [N, p. 400]

The atomistic conception scored a great hit when the Quaker John Dalton (1766–1844) made it the foundation of the theory of the chemical elements and of chemical reactions. The Quakers are a Christian sect, that expresses its allegiance to the Lord by pursuing truth, charity and simplicity on the one hand, and by eschewing ceremonial on the other. As Dalton's biographer tells us, their love of knowledge led them to science:

> This sect's strong emphasis on education and interest in natural philosophy, displayed by so many of its members, is the key to understanding the favorable context in which Dalton grew and matured as a scientist. [T, p. 537]

Among its members, besides Dalton, was the great cosmologist and early mentor of Lemaître, Sir Arthur Eddington.

It is necessary to interrupt our narrative on atomism, and turn first to a third major discovery of post-Renaissance science, to wit, the electromagnetic field. Here the main pioneer, the experimental genius, Michael Faraday, hailed from the fundamentalist Christian sect, the Sandemanians. Did his ardent religious beliefs jibe with his scientific work? Listen to his biographer:

> Faraday drew more than strength from his religion. It gave him both a sense of the necessary unity of the universe derived from the unity and benevolence of its Creator and a profound sense of the fallibility of man. . . The origins of field theory are to be found in Faraday's detailed experimental researches on electricity, but *the speculations and imaginings which led him to his experiments and the courage which permitted him to publish physical heresies owe something to his unquestioning belief in the unity and interconnections of all phenomena.* This belief, in turn, derived from his faith in God as both creator and sustainer of the universe. The fallibility of man was clearly described in the Book of Job, and this was the book in Faraday's Bible which he had marked the most with marginal emphases. . . He considered himself to be merely an instrument by which truth was revealed [W, p. 527] (emphasis added).

The theoretical genius, who put Faraday's field conception on a secure footing, was James Clerk Maxwell, author of the equations of the electromagnetic radiation, which are hailed as among the greatest intellectual creations of man. Born of religious parents, he himself

> maintained a strong Christian faith, with a strain of mysticism which has affinities with the religious tradition of the Galloway region, where he grew up. [E3, p 38].

At Trinity College, Cambridge, he joined the Christian socialist movement and helped in founding the Cambridge workingmen's college. He continued to teach evening classes for artisans in Aberdeen and London. His books *The Theory of Heat* (1860) and *Matter and Motion* (1877) grew from these lectures.

Einstein has described his own general relativity theory as putting 'a sort of finishing touch to the mighty intellectual edifice of Maxwell and Lorentz' [E1, p. 69]. His position on religion is clear from our opening quotation and his firmer affirmation:

> I believe in Spinoza's God who reveals himself in the harmony of what exists, not in a God who has anything to do with the fate and affairs of man.

The field concept is far from exhausted, but to date its great advancement has come almost entirely from devout and dedicated scientists, among them Abdus Salam.

To return to atomism, its development beyond the Dalton atom came from electrochemistry. Here the pioneers, Faraday and his mentor Humphrey Davy (another if less intense religionist), were both guided by the non-materialist idea of the Jesuit R. J. Boskovik (1711–1787) that an atom is the (non-material) center 0 of a fluctuating force, repulsive or attractive, depending on the distance from 0. Faraday's experiments on electrolysis strongly suggested the existence of subatomic electric charges, later confirmed by the discovery of the electron. The next great advance of atomism, its entry into the field of radiation, was the work of Planck and Einstein, again both religionists.

These successes of atomism were but a prelude to a deeper and more unified conception of nature in which neither particle nor wave can be given priority, each being just a facet of a more subtle reality. Here again the pioneering step came from Louis de Broglie (1892–1987), a devout Roman Catholic. He suggested the representation of the atom as a wave in a plenum. He argued that just as light manifests both particle and wave properties, so matter itself can manifest wave-like properties. This conception, beautifully worked out by E. Schrödinger (1887–1961), another idealist and religionist, ushered in the new quantum theory (1925), which lends itself to a beautiful articulation in the language of Hilbert spaces.

We now turn to a most important revelation of post-Renaissance science, viz. the prevalence of evolution at all levels of the cosmos. The initial cosmology of Newtonian science was basically biblical: God had initially set the natural world in motion according to certain laws; the changes in the world are, like day and night and the seasons, periodic or near periodic; the world as a whole does not evolve. The first questioning of this cosmogony came in 1755 with Immanuel Kant's *History and Theory of the Heavens*, a tentative outline of the evolution of the planets. Laplace's more definitive *Exposition du system du monde* came 40 years later. Here again a decidedly idealistic and religious philosopher took the pioneering step. Evolution next entered the arena of geology. This development got a bad start from the dogmatic attempts of the Theological Faculty of the Sorbonne to save the tottering Mosaic account of the creation and deluge given in the Old Testament. Georges Buffon was forced to recant, and James Hutton and Sir Charles Lyell faced religious opposition.

More conducive was the milieu in which evolution entered the field of biology. Among the early naturalists were the Anglican natural theologians Ray, Brice and Willoughby. However, they regarded man as governed by laws differing sharply from those that rule the rest of Nature. In the struggle to free biology of such anthropocentrism, religiously-minded scientists did participate, though not as overwhelmingly as in the fields discussed earlier. The early evolutionists Lamark (1744–1829) and Erasmus Darwin (1731–1802) were deists, who viewed Nature as a self-regulating mechanism and saw in evolution the vehicle for such self-regulation. But amid the growing social unrest, careful scientists, who felt that divine causation was not involved and that man too fell in the arena of natural evolution, had to face opposition.

Initially Charles Darwin (1809–1882) and A. R. Wallace (1823–1913) too were deists. But neither could explain how Nature is able to utilize the variations in an animal or plant species to bring about evolution, until they had stumbled (in 1838, 1858, respectively) on the 1798 *Essay on Population* by the Rev. T. R. Malthus. Malthus had found that the reproductive potential of mankind far exceeded the growth of the food resources needed to feed it, and that it was lethal factors such as famine, disease and war that kept equilibrium. Wallace and Darwin saw at once that the same applied to non-human populations: only those variations within the species that are better able to create fertile offspring survive, the rest die. This Malthusian input ushered in the Wallace–Darwin theory of *Natural Selection*, but the schemes' inherent cruelty shook Darwin's faith in a benevolent creator, and he became an agnostic. But no creator, howsoever benevolent or omnipotent, can create a round square! Until a thermodynamic system, which allows the joys of life without pain or death, is demonstrated, doubts cast on the benevolence of the creator are premature.

Darwin and his colleagues were unaware of the 1865 paper of the Augustinian monk Gregor Mendel, which 35 years later was seen to be the foundation of the modern science of *genetics*. Genetics provides the key to what brings about the variations in species on which natural selection acts. Its proper synthesis with evolution, worked out during the 1930s and 1940s, has shown that organisms have to contend with an *inner environment* as well as an outer one. Thus the struggle for survival is as much a struggle for *self-improvement* as it is for dominance over other organisms. As we learn from the Jesuit Teilhard de Chardin, there is nothing irreligious about such an evolutionary conception.

To turn away from the earth to the stars, we need only say that apart from Canon Lemaître, several great cosmologists, Einstein, Sir James Jeans, Sir Arthur Eddington and E. A. Milne, were religiously inclined.

A careful scan of the fields of anthropology, history, economics and contests will show again that the pioneering efforts have come from dedicated religionists. For instance, in the fields of history and anthropology, it was the devout Roman Catholic philosopher Giambattista Vico (1668–1744) who set the stage, and put forth the genetic view of history, long before Hegel and Karl Marx. By strong contrast, under the anti-religious regime of the Soviet Union, every bold venture, be it relativity, quantum theory, genetics or cybernetics, was met with initial official suspicion, and had to be rehabilitated, often in a dilute form, by a reluctant and agonizing reappraisal, in the course of which some great scientists were made to suffer. The materialists conceive of mind as 'matter that thinks'. But the pioneers in the field of the embedability of intellectuality in-the-metal, the early computer builders, were Blaise Pascal and Gottfried Wilhelm Leibniz, in the philosophies of whom God is supreme.

The lesson is clear. Secularism, which easily slips into idolatry, far from liberating the imagination, cramps it. The inspiration that sets the imagination free comes from the faith that the cosmos manifests great intelligence.

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