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## Science and Technology in Light of Religion

HOLMES ROLSTON III, COLORADO STATE UNIVERSITY

Physics and biology are the two principal natural sciences affecting contemporary religious thought. Both have developed at microscopic and megascale levels, unknown when the Christian or other world faiths were founded. Astronomy opens up vast space and time; atomic physics reveals strange elemental particles. Evolutionary biology finds deep time on Earth, molecular biology reveals the building blocks and coding for life. Geology first raised the question of vast time scales. Technical sciences, such as medical science and computer science, raise both theoretical and ethical issues, often because they make possible novel, sometimes quite unprecedented, human actions; examples include questions about therapeutic genetics made possible by sequencing human DNA, or about cloning. Theologians also interact with the social sciences—psychology, anthropology, economics, history—although they are not addressed directly here.

Science as we know it today arose in the Christian West, with both Greek and Hebrew roots. Historians often find that such science required the monotheist worldview for its origins, providing the belief that the world is ordered and rational, knowable by observation, and that humans have the power and destiny, as Kepler said, to "think God's thoughts after him."

Scientists often insist that the **scientific method**, especially since the European Enlightenment (the last four centuries), is based on reason and observation; they seek theory corroborated by evidence. Currently they often contrast this with "faith," or belief in things not seen and not proved. They advocate repeatability or testability, although many of the phenomena scientists investigate (such as the big bang or origin of life) are historical and not directly repeatable or testable. Further, scientists often "believe" in what their theories suggest should be there—for example, spending

decades looking for the neutrino, a massless, chargeless minute particle, or entelechy, a vital life force supposed to be in living things (biology) and absent in physics and chemistry.

Scientists also increasingly realize that theory, models, data, and description are more entwined than once supposed. When moving beyond immediate, native-range observation, scientists see mostly what their constructed theories and instruments enable them to see. This, together with discoveries in physics and shifting scientific theories over time, has softened the hard objectivity earlier advocated in science in favor of more historical and culture-bound accounts. Western science is but one way to look at the world; it features laws, natural causes, empirical facts.

But the world we inhabit is complex and multileveled; any scientific account is partial and abstracts from the real world, somewhat as a map only partially depicts the whole landscape. One also needs accounts of meaning, significance, and guidance for life to make one's way around in the real world. Critics of science, especially postmodernists, press these claims about the social construction of science further than many scientists wish, and theologians debate whether to welcome these developments (Rolston 2006).

Science and religion may relate in four ways, according to an analysis made popular by Ian Barbour (1990). There may be conflict, independence, dialogue, or integration. Scientific materialism and biblical literalism will be in direct conflict. But perhaps science works with causes, religion with meanings. The two are as independent as law and poetry. Or perhaps, though each has its own integrity, they overlap and complement each other in ongoing dialogue. Perhaps a comprehensive science even points toward God, launching a theology with which it can integrate, as in the tradition of natural theology (Van Huyssteen 2003).

The relations between physics and theology are surprisingly cordial at present; the relations between biology and theology are more difficult. Astrophysics and nuclear physics, combining quantum mechanics and relativity theory, are describing a universe fine-tuned for life, while evolutionary and molecular biology seem to be discovering that the history of life is a random walk with much struggle and chance, driven by selfish genes.

Physics has made dramatic discoveries at astronomical and submicroscopic ranges, remote from ordinary, native-range experience. Physics has discovered that the universe (this universe at least) originated thirteen billion years ago in a big bang and has since been expanding. From the primal burst of energy elementary particles formed, and afterward hydrogen, the simplest element, which serves as fuel for the stars. In the stellar furnaces all the heavier atoms were forged. Some stars subsequently exploded (supernovae). The heavier elements were collected to form, in our case, the solar system and planet Earth. Startling interrelationships are required for these creative processes to work.

These results have been summarized as the **anthropic principle**, which argues that the universe has been fine-tuned from the beginning and in its fundamental construction for the subsequent construction of stars, planets, life, and mind (Barr

2003). There are nontheological, naturalistic ways of interpreting these discoveries, but a plausible interpretation is divine design. Theologians and philosophers have often been wary of design arguments, remembering **William Paley**, his fine-tuned watch, and the many telling criticisms of such arguments. Nevertheless the physical world has again begun to resemble a fine-tuned watch, and now many quantitative calculations support the argument.

Biology stands in stark contrast to the above — at least at first glance. Molecular biology, discovering DNA, has decoded the "secret of life" (once ascribed to the Spirit of God). Evolutionary history has located the secret of life in natural selection operating over incremental variations across enormous time spans, with the fittest selected to survive (see **evolutionary biology**). Speciation begins with the simple and results in the complex, from microbes to persons. As with physics, the two levels have been theoretically interrelated. The genetic level supplies variations, through the coding of life in DNA. Organisms cope at their native-range levels, inhabiting ecosystems, and across deep evolutionary time species are selected as they track changing environments, transforming one into another.

The process is prolific but no longer fine-tuned. To the contrary, evolutionary history can seem tinkering and make-shift at the same time that, within structural constraints and mutations available, it optimizes adapted fit. Natural selection is thought to be blind, both in the genetic variations bubbling up without regard to the needs of the organism, some few of which by chance are beneficial, and also in the evolutionary selective forces, which select for survival without active agency or direction. Evolutionary theorists insist that nothing in natural selection theory guarantees progress; many doubt that the theory predicts the long-term historical innovations that have occurred, such as a centered nucleus, multiple-celled life, capacities to acquire information, enlarging brains, and the emergence of humans.

Theological reaction to the biological sciences is mixed. Fundamentalist theology denies much of (or all of) evolution and sometimes seeks to prevent its teaching in public schools. Others construct an evolutionary theism, emphasizing the continuing vital creative processes over time, the ascent of life from the simple to the complex, the increase of information, the effective and efficient results of genetic creativity and natural selection, producing a quasi-design, the production of more out of less over long millennia (see **creationism**). Increasing knowledge of the sophistication of molecular structures has led some to look for **intelligent design** there (see also **William Paley**). Many geneticists are now speaking of genetic programs as sophisticated problem-solving processes (see **genomics/genetics**). Some suppose divine intervention at quantum levels (see **quantum theory**). The watchmaker-design approach to the concept of a Creator, if appropriate in physics, may not be the model for biology, where more autonomy and self-creativity is combined with the divine will for life, a divine parenting entwined with spontaneous creative process (Rolston 1999).

Science is both pure and applied, and the application of science has brought an explosion of **technology**. This is true in two main areas: medicine and industry, the latter including industrialized, high-tech agriculture. Communication and transporta-

tion are also spectacularly advanced. Consider the transformations on Earth in the last century resulting from automobiles and airplanes, electricity and electronics. Although long in coming, a threshold was crossed with the coming of the steam engine. Prior to that the work of the world was done by muscle and blood, with some windpower and waterpower. But with the switch to motors and gears and the escalating technology thereafter, humans gained vast powers for the transformation of their world. The result has been a population explosion by one species, *Homo sapiens*, unprecedented in Earth history. Combined with the technological explosion of powers, this has brought escalating consumption, as well as increasing differential in the distribution of these resources. With world capitalism, as it has developed in recent times, the rich get richer and the poor poorer.

Science here is both pivotal and puzzling. Hard science has a soft underbelly: conscience. Phrased less metaphorically, science can answer *is* questions, but not *ought* questions. Science has made us increasingly competent in knowledge and power, but it has also left us decreasingly confident about right and wrong. Indeed, there is no scientific guidance for life. With due admiration for its successes, science leaves the ultimate value questions still urgent and unresolved. If one requires proof of that, one need only read the newspaper: the Iraqi war, the 9/11 terrorist attacks, Enron, protests at G-8 summits, health care for the poor, corruption in government, deforestation, global warming — the list goes on and on.

Scientists may object that these are not issues in science, though they may deal with its application in economics, technology, and public policy. They are, however, issues arising from the powers launched by science and technology. What do scientists who launch these powers care about? What do those to whom their science becomes available care about? Science is a magnificent enterprise, but many, including theologians and scientists themselves, probe the logic of science and worry about its zest for mastery, fearful lest this become a lust for mastery. Science is the quest for knowledge, and knowledge is power.

Even pure science is driven by a desire to understand, and that, ipso facto, is a desire to conquer. The fundamental posture of science is analysis, the discovery of laws and generalizations, theory with implications, prediction, testability, repeatability. One wants better probes, better techniques, higher-resolution detectors, more computing power. Such attitudes always invite control, but more than that, this very approach to nature is driven by the desire to control. The underlying premise of all scientific logic is mastery, and with that insight the claims to detachment, objectivity, and independence take on a different color.

Fueling technology, science brings escalating know-how without know-whether. More than any people before, as a result of our technological prowess through science and industry we have the capacity to do good and evil, to make war or to feed others, to act in justice and in love, or in self-interested aggrandizement. Allegedly objective science is inevitably bent, sooner or later, into the service of technology, and such scientific knowledge coupled with technological power is neither detached nor objective. Thus relativity theory is used to make nuclear weapons; the human genome,

mapped, invites first medical therapy and later genetic engineering. Such utility is not simply an outcome of science, it is part of its worldview.

Science is the product of the powerful urge to dominate nature, and those who have it are ready enough to colonize elsewhere and harvest whatever resources they can wherever they can, to build machines of industry and of war, to dominate other peoples and races. There are three problems: overpopulation, overconsumption, and underdistribution.

When moving from pure to applied science, scientists seem to care; the benefits of science in the service of humans are preached incessantly. While often such caring and benefits are present, it is also certain that science without critical caring for others, by scientists or those who exploit their science, is what has produced the present triple crisis. And caring for others — loving one's neighbor — is the central claim in religious ethics. Science is not theology. Theology cannot suggest the content of any science, but theologians can notice the forms into which such content is being poured. One can do science without advertent explicitly to theology, but one cannot live by science alone.

Indeed, science cannot teach us what we most need to know — that about which we most should care. Science could be as much part of the problem as part of the solution. Science can, and often does, serve noble interests. Science can, and often does, become self-serving, a means of perpetuating injustice, violating human rights, making war, degrading the environment. Science is used for Western domination over nature and over other nations. As a result of the powers of science-based technology, humans are altering the natural history of the planet, threatening alike the future of life, the fauna and the flora, and human life (Gottlieb 2006). The values associated with the pursuit of science, as well as those that govern the uses to which science is put, are not generated out of the sciences. Nothing in science ensures against philosophical confusions, against rationalizing, against mistaking evil for good, against loving the wrong gods.

Despite the evident progress in the sciences in today's world the value questions remain as acute and painful as ever. There lie crises ahead, not for the lack of science but for the lack of wisdom, a wisdom that only religion in the broad sense can supply — worldviews that orient us philosophically and that can redeem our human nature from its perennial failings. The need for justice, for love, for caring will remain undiminished, and science will need conscience in the next century more than ever before.

What on Earth are we doing? What on Earth can we do? What on Earth ought we to be doing? There is no figuring this out without both science and religion; there is no doing it right without integration of the two.

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