The Turbulent Universe

an excerpt from the forthcoming book

By Paul Kurtz, Editor-in-chief

The Emergence of Science and Reason

A radical change in understanding nature occurred when humans recognized that supernatural explanations could not account for natural phenomena. The earliest pre-Socratic philosophers in ancient Greece sought to explain events by reference to natural causes. They appealed to reason and observation to interpret nature, not faith or revelation, miracles or theology, uncorroborated by objective evidence. Modern science did not develop until the Renaissance. The ancients used reason and common sense (for example, Aristotle observed a lunar eclipse and reasoned that Earth must be a sphere because it cast a round shadow).

Scientific inquirers in the modern world have continued to raise intriguing questions about the nature of the universe. They ask whether it all fits together; and if so, how. And they continue to probe the implications of the scientific outlook for our understanding of the human condition. The Copernican Revolution of the 15th century placed the sun, rather than the Earth, at the center of the solar system. And the Darwinian theory of evolution in the 19th century replaced former doctrines of creation and intelligent design. The difference between present-day cosmologies and those of the historical past is that they are based on the methods of science, and this includes both mathematical coherence in the formulation of theories and the experimental confirmation of their adequacy.

Modern physics and astronomy began by stepping outside religious authority. The medieval church at first opposed the new science, imposing theological constraints on inquiry. In the 16th and 17th centuries the natural philosophers (as they were called), including Copernicus, Galileo, Newton, and Kepler, rejected occult causes and developed the laws of mechanics based on careful observations and mathematical precision. These scientific cosmologists depicted the universe as a fixed system governed by universal laws. The model was similar to a clock or machine, in which every cog and wheel is interconnected to every other. Within the whole, the picture was mechanistic and deterministic.

There was great confidence in the power of mathematical rationality coupled with experimental observation to unravel our understanding of the universe. If we knew the exact positions and velocities of the material objects within the universe, we could predict with precision the state of all material events in the future, declared French astronomer and mathematician Pierre Simon LaPlace at the end of the 18th century. What is the place of God in the materialistic scheme of things? asked Napoleon Bonaparte. "Sire, I have no need of that hypothesis," LaPlace was reputed to have replied. The poet Alexander Pope extolled Newton as such:

> Nature and nature’s laws laid hid in night.
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> God said, let Newton be!

And all was light.

By the 19th century it was widely believed that Newtonian physics would permit the scientist to understand the total state of mass and energy throughout the universe. It was also believed during the Enlightenment that the natural sciences could be extended beyond physics to chemistry, biology, psychology, and the social sciences. At the beginning of the Industrial Revolution Marquis de Condorcet confidentially prophesied that this knowledge would contribute to the progressive improvement of mankind, including free public education, equal rights for women and racial minorities, a constitutional republic, a liberal economy, and democracy. He died in prison, sacrificed by the passions unleashed during the French Revolution.

The revolutionary findings of Charles Darwin, developed on his voyage on the Beagle to the Galápagos, gave a rude jolt to the belief of theologians that all species designed by a divine intelligence were fixed and eternal. Instead, the principles of natural selection were presented as an explanation of how species evolved, including the descent of man. Evolution had been suggested by Empedocles in the ancient Hellenic world, though it was rejected by Aristotle. For the first time, science took history seriously by attempting to explain how things change throughout time.

In the 18th and 19th centuries the social sciences began to develop daring new ideas. Voyages to unexplored continents led to the comparative studies of anthropology and sociology. Authors, such as Machiavelli in The Prince, offered astute and often ruthless prescriptions of how to seize and hold power. This led to the development of a realistic study of politics and the eventual emergence of political science in the 18th century. Adam Smith's influential book The Wealth of Nations had sparked political economy which led to the new science of economics, to which David Ricardo, John Stuart Mill, and others contributed. The founding of psychological laboratories by William James at Harvard and Wilhelm Wundt

at Leipzig raised expectations that we could understand psychological experience objectively by studying behavior. Psychologists have emphasized the need for testable experimental studies. Today many scientists and philosophers believe that neuroscience will be able to chart the microgeography of the brain and thus understand consciousness in objective neurological terms.

In the 20th century the theory of relativity introduced by Einstein altered classical conceptions of absolute space and time, and quantum mechanics transformed classical physics by postulating the uncertainty principle of Heisenberg. The dramatic findings in atomic and subatomic theory in the 20th century have altered our conceptions of how nature operates. Is chance a real factor in nature? Is the universe open to contingency, indeterminacy, diversity—no longer a unified or fixed system, but full of process and change? Astronomy in the 20th century has extended our conceptions of the universe and its dimensions. For contemporary astronomers the universe is expanding rapidly. The Big Bang theory was postulated to explain this. By spectroscopic analysis of light from the stars and galaxies, a shift toward the red indicates that its speed is increasing.

The Generic Traits of Nature

I argue that the best approach to understanding the world of nature is to turn to the sciences, which attempt to explain how and why nature operates the way it does. The division of labor between scientific disciplines, however, has intensified, and new specialties have appeared at a breathtaking pace. As a consequence it is difficult to find a unitary theory that will explain everything. Rather, a feasible goal is to develop a set of general categories from the various sciences which, at the very least, describe the broad contours of nature.

Any attempt to understand the generic traits of nature is in itself not a simple task, given the proliferation of separate disciplines; yet we need to attempt this on an interdisciplinary scale. To understand nature we need to draw upon our observations of data by means of meticulous descriptions and measurements. We then need to develop hypotheses and theories to explain why what is observed is happening. Scientists historically describe and classify things and their properties, and they catalogue different kinds of things. But their passionate interest is to formulate causal explanations of why the phenomena under observation behave the way they do. They seek to develop theories and endeavor to test them experimentally. To be accepted within the body of knowledge such theories need to be replicated and corroborated by a community of inquirers committed to the methods of science. The justification of a theory must be open to inspection and peer review. Often the knowledge obtained is piecemeal, and it may be limited to the highly specialized context under inquiry. There are constant efforts to extrapolate what we learn and to apply this knowledge to other domains if possible. Of course, the conceptual development of theories depends upon mathematics, which serves as an essential tool of inquiry. Thus, the theories of mechanics have had a wide range of applications in field after field, and this has contributed greatly to the growth of physics and astronomy.

We also draw on generic presuppositions that may not be formulated in law-like fashion or tested experimentally, yet may serve as powerful analogies for a wide range of subject matter. These generic principles serve as guidelines for inquiry in other fields. A good illustration is the atomic theory, which is a comprehensive interpretation of all things encountered in the world of nature. Leucippus and Democritus postulated an atomic theory among the pre-Socratics of ancient Greece, but this was purely speculative and had no experimental basis; nor was it interpreted mathematically. It was not until the dawn of Newtonian science in the 17th century that it was applied to physics and confirmed experimentally using the powerful tool of calculus.

The impressive progress in the 20th century in developing the atomic theory fascinated generations, and Nobel Prizes were awarded for these remarkable discoveries in physics. Philosophers have attempted to interpret the implications of the general atomic theory to our conception of nature. The dawn of the atomic age by midcentury provoked a widespread public debate about nuclear contamination from nuclear weapons and nuclear power plants. Every breakthrough in subatomic physics intrigued the public. What did this portend for our understanding of nature? Would an application of the basic laws of physics and chemistry—mass and energy on the atomic and subatomic level—suffice for us to understand all phenomena? This was the thesis of physicalist reductionists. Or does one have to introduce principles on more complex levels to understand life, psychology, and sociology? Do we need higher order concepts and theories to explain organic matter, biological processes in the biosphere, human psychology, and social institutions?

The great breakthroughs in astronomy are of incalculable significance today. What may be called the "Hubblean Revolution," after Edwin P. Hubble, the American astronomer, clearly demonstrated in the 1920s that our own galaxy was not the only one in the universe, and that the cloudy blotches seen on photographs taken from telescopes were not part of our Milky Way but were themselves massive galaxies which had first been labeled as "nebulae." These star systems were separated from us by astounding distances. Moreover they were traveling away from us at enormous velocities and the more distant the galaxy, the more rapid its velocity. These conjectures were based on the ingenious spectroscopic analysis of the light waves received by our telescopes. The distant galaxies were traveling enormous distances. As contemporary astronomy advanced it postulated new worlds, the birth and death of stars, the collision of galaxies, dark matter, worm holes and black holes, supernovae, dwarfs, quasars, pulsars, and the discovery of new planets in other solar systems. All of this boggles human imagination and has deflated the special status of the human species in the universe and the historic conceit that humankind was at the center of things and had a privileged place in the universe. Indeed, God was fashioned in the image of man. Alas, we have discovered that we are only one species among innumerable others on a minor planet in a modest solar system on the edge of one galaxy of the billions that exist.

What does this mean to our conceptions of the universe and the place of the human species within it? Formerly we focused on our own solar system and galaxy, but the revamped Hubble and Kepler telescopes opened up our universe to dimensions heretofore only surmised, not observed, at cosmic leaps beyond ours. As our knowledge expands the human species seems to shrink in proportion, even though the advance of our scientific and philosophical comprehension of the vast scope of things is truly awe inspiring.

No doubt these telescopes, and new instruments yet to be developed, will catapult the powers of human observation to other worlds and other possible dimensions. These powers were expanded still further by the advent of the Space Age. The launching of satellites into outer space enables our vision to go beyond the distortions of our own atmosphere, not only by sending telescopes into clearer space but by shooting spaceships to the moon and satellites to Mars, Venus, Mercury, Jupiter, Saturn, and other planets, and even leaving our solar system and transmitting data back. This is truly impressive; yet, the more we discover, the more we shrink in significance. The immensity of the universe and the extensive time scales reduce what happens on our planet, which is of lesser importance in the nature of things.

The fact that humans are able to fathom so much about the universe by drawing on science is impressive, at least in comparison with other species on our planet. Thus we need to question the classical and modern premise of philosophy, theology, and science that the universe is an elegant system of fixed laws and perfect order. This concept has its origin in Plato’s conception of ideas, and that of Aristotle and Aquinas of a fixed order of species; and it was also a postulate of Newtonian science.

The area of scientific inquiry that has forced a radical reconceptualization of the traditional view of the universe is the Darwinian revolution. This has placed the biosphere at the center of human interest of so much of present-day science. There is fascination with Darwin’s hypothesis of natural selection, the process by which new species emerge and others become extinct. Modern theories of evolution recognize the vital role genetic mutations play in providing new capacities that are favorable for survival, and may be transmitted to offspring by means of differential reproduction. In this way there is a change of species and the evolution of new ones. Chance and adaptation thus play vital roles in the biosphere as a multiplicity of new species continues to evolve. The extraordinary diversity of the biosphere reveals so much about nature. A dramatic example of this is the fossils discovered in the Burgess Shale in Canada, most of them from the Cambrian period of 500 million years ago. It indicates the great diversity of life forms that evolved with intricate anatomical features, but which are now extinct. Thousands of specimens have been assembled, most without any resemblance to current organisms. It also demonstrates that no species is eternal—not even our own—because millions of species have become extinct. There have been several species of humans and all, including the Neanderthals, are now extinct, except for Homo sapiens. Is the great illusion of human immortality now shattered once and for all? What does this portend for the human quest for eternity? Is there any consolation for humankind, bereft of salvation?

Well, yes, in a dramatic sense, for although we live in an ordered yet indeterminate universe, we have a creative role to play in our lives. Adaptation, discovery, and innovation imply a creative aspect to the evolutionary process of the human species. We have discovered that the universe manifest both order and disorder, diversity and contingency, and especially uncertainty and ambiguity. All of this is amplified in the human domain, which implies an open and free arena for behavior. We live in a restless and unfinished universe, and human affairs manifests all of these characteristics. What are the ethical implications of living in an open universe in which the end purposes are not predetermined, and in which everything we do has consequences? We have some power of choice, however modest, in the lebenswelt that is our own, and in our impingement on the environment in which we interact.

The Role of Philosophy and Neo-Humanism

The above reflections are drawn from what the natural biological and social sciences tell us about nature and life. What role, if any, does philosophy have in this inquiry?

In The Turbulent Universe, my reflections are based on what we have discovered about the physical universe, the biosphere, and the human sphere—upon the scientific accounts of nature that are now available. This is drawn from interdisciplinary scientific fields; they rely upon the methods of science for establishing their truth claims. It is a synoptic view of the universe, a cosmic outlook at this stage in the development of human knowledge. It is, if you will, a conceptual landscape of some of the main features of what we know about nature; and it includes the human species and human civilizations in the schema.

In a more technical sense I am attempting to develop a set of basic categories, the generic traits or generalizations of our knowledge about nature. I am seeking to describe the conceptual framework and its basic presuppositions. The biologist E. O. Wilson characterizes this as consilience, which means the statement of some of the main interdisciplinary principles at work, the results of our knowledge of nature.

A search for descriptive generalizations seeks to find common traits or characteristics across fields: not scientific laws, only analogical similarities, such as the atomic theory or the germ theory of illness. So the view that nature evinces evidence of chance events and that what will endure is a product of interacting lines of causality seems corroborated by the sciences today. In response to Einstein’s famous statement that "God does not play dice with the universe," I state that He or She does indeed, and that the universe is like a game of craps in the sense that we never know which numbers are going to come up. In his quote Einstein was referring to randomness inherent in quantum mechanics, a problem that he wrestled with all of his life without solving it. My qualification is that there is insufficient evidence that God had a hand in the universe or even that God exists. But if we interpret Einstein's statement metaphorically, my answer is that God does indeed play dice with the universe in the sense that what will happen is indeterminate, dependent on competing contingencies and probabilities at any one moment in time. It all depends on initial conditions that are present.

Accordingly, we may ask, "What are the generic traits of the universe? Can we fathom its meaning and structure, or is it beyond human comprehension?" My answer is yes and no. Yes, we can expand our understanding of the universe, but there are no easy answers. Can we develop a unified theory in which everything is reduced to a limited number of basic laws, rooted in their physical-chemical sources? An ambitious goal, but whether it can ever be attained either way is difficult to ascertain a priori. We appear to live in a pluralistic, multifaceted universe or multiverse, where an interdisciplinary approach is closer to actual empirical data. Hence a less ambitious yet perhaps more achievable goal as a halfway house is more realistic in describing and accounting for generic properties and characteristics discoverable in the multidisciplinary sciences. Here we find both regularity and chaos. The universe is amenable to elegant, comprehensive mathematical interpretations on the basis of which we often make surprisingly precise predictions; yet at the same time it can best be interpreted by historical reconstructions and by reference to individuation, uniqueness, chance, and novelty so that what occurs is not fixed but is contingent on a converging series of causal events. All of this suggests that we live in a turbulent, open-ended universe, where whatever will be is not predetermined or necessary, but is dependent on processes and events that appear to be contingent. We ask, what is the place of human beings in this orderly yet random universe?

The modern age of science ultimately spelled "the twilight of the gods." Does it also portend the dawn of a new age in which humans are finally on their own, dependent on their own creative intelligence and courage for sustenance and survival? Or will this lead to new depths of pessimism and nihilism?

Is the "new atheism," so-called, an abortive resurgence of a crude and rude denunciation and immolation of the gods, or can it help to usher in the flowering of the human spirit in all of its grandeur? Will the new secularism, which is rapidly growing in Europe, Asia, and America, lead to a new Humanism?

There are at least three possible scenarios:

First, the new atheism may eventually penetrate social awareness—and belief in God declines. God is sentenced to death and a stake driven through his heart.

Second, this may lead to an age of despair and hopelessness, receptive to new mythological theologies of escape.

Or third, a powerful new secularism may prevail in a world where humans concentrate on the things of this world rather than the next. A new Humanism may be ushered in, in which humans are at last liberated from the constraints of ancient fears and cowardice and a new flowering of the highest human potentialities and aspirations is made possible.

Interestingly, Marx proclaimed a new atheism for the 19th century. It focused on secularism, the things of this world, and building a more just society. Yet it enshrined the ideology of communism which became tyrannical and dogmatic, and in which the ethics of freedom was abandoned.

Today we need a new approach, which uncompromisingly affirms neo-Humanism. This emphasizes individual freedom, human rights, a new morality, the empathetic imperative, and the realization of human dignity, lives of joyful creativity and exuberance for all persons on the planet. The Institute for Science and Human Values (ISHV), which we have recently founded, is committed to investigating these pressing issues from an ethical perspective on a truly global scale. The need has never been greater.

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