A Casual Essay

No Beginning and No Ending

THE PERSPECTIVE OF AN IMPRESSIONIST

Wontack Hong

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I Wish I Had a Chance to Think about All These When I Was a Freshman

PREFACE

This is a casual essay written by a profoundly ignorant impressionist trying to form, in his own way, a primitive picture of reality by piecing together the immediate sense impressions obtained from his accidental readings and observations.

This is not a book for experts in the fields on which the writer touches. It has been written primarily for his own self-education, but published for those who, just like him, having been immersed in mundane work, never had the time to think about these matters until late in life. The writer hopes to induce others to become fellow tardy travelers on the path of reflection. Not only misery but also joy loves company.

The writer has plundered words from the Masters, sacred verses and hymns translated into English by great scholars that he came across and found most appealing to him. The selection is representative of his taste, and it may well motivate readers to search for selections that satisfy their taste.

One may get nowhere, but the very process of seeking to comprehend or to wander leisurely toward the realities of life itself seems to be surprisingly rewarding.

Author

Professor Mary Schriber of Northern Illinois University thinks that
the following verse from a poem by T. S. Eliot
would be perfect for the preface to my casual essay.

“We shall not cease from exploration
And the end of all our exploring
Will be to arrive where we started
And know the place for the first time.”

Thomas Stearns Eliot, *Little Gidding* (1942)

CONTENT

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Pilgrim's Progress

"The disciples asked Jesus: Tell us about our end.
What will it be?
Jesus replied: Have you found the Beginning
so that you now seek the end?
The place of the Beginning will be the place of the end.
Blessed is anyone who will stand up in the Beginning
and thereby know the end and never die."

The Gospel of Thomas
Surfaced in the archaeological discovery of the Nag Hammadi Library in 1945.

"If there was a beginning,
then there was a time before that beginning."

So says Zhuang-zi (369-286 BC?),
a Daoist sage who lived some two centuries after Lao-zi.

"Approach it and there is no beginning;
follow it and there is no end."

From the Verse 14 of Lao-zi's *Dao De Jing* (*written in 6th century BC*).

繩繩 Perhaps time is more like a circle, not a line. 繩繩

1

The Big Bang Cosmology

By listening to the whisper of the radiation that permeates the universe, scientists have figured out that the universe started with the Big Bang "about 13.7 billion years" ago, though much may have gone on beforehand. The Big Bang cosmology gives a sort of beginning and a history.

At the moment of the Big Bang, the whole of the universe erupted from a very hot, condensed singularity--the microscopic primordial material that could, through their gravitational interactions, draw matter together that was more than enough to form clusters of galaxies. The Big Bang explosion created all matter and energy, plus space and time themselves.

Until some 380,000 years after the Big Bang, there existed only a uniform primordial "soup of free-floating protons and electrons," the ionized gas (a gas in which atoms have been stripped of electrons) called plasma, able to interact with the photons of light, exchanging energy and momentum. Plasma is the fourth state of matter (after solid, liquid, and gas). The matter was uniformly distributed with almost a constant density of particles. They infer from chaos theory that the Big Bang was followed by self-organizing processes.

Particles sped away on the expanding seas of space-time. As the universe was expanding, it was also cooling, and it became cold enough for electrons and protons to combine, forming atoms of hydrogen and helium. New atoms became decoupled from the photons which drastically reduced the pressure that had kept

gravity at bay. With gravity free to work on all the newly formed hydrogen and helium atoms, the universe could evolve into galaxies and intergalactic gas.

First stars were born somewhere between 200 million years and one billion years after the Big Bang. Stars are nuclear fusion reactors that gravitationally compress gas to such high densities that light atomic nuclei smash together to form heavier elements, releasing enormous amounts of energy that make the stars shine. The core of the sun is a plasma denser than lead and so hot (15 million degrees C) that pairs of hydrogen atoms fuse together to form helium atoms, releasing a huge amount of energy. This nuclear reaction, called fusion, is what happens in a hydrogen bomb. The universe was filled with gas but became shining with the starlight, ending the dark era. Chemistry was all about the bonds between atoms in particles.

There was dark matter which interacted with our kind of matter, atoms and molecules, only through the force of gravity.

The pressure and temperature at the core of a giant star are much higher than those of our sun, and hence it can manufacture heavier elements up to silicon and iron from hydrogen and helium. When this giant star finally runs out of fuel and has no more fuel to support itself, gravity takes over and collapses it, creating the phenomenon called as a supernova. So much energy is generated in a supernova explosion that, for a few weeks, it shines with the energy of 100 billion stars, or an entire galaxy (as was the "new star" reported at the birth of Jesus), being blasted (just outside the core) deep into interstellar space, sprinkling the void with all the elements of the periodic table up to uranium, the atoms that eventually formed our bodies. We are stardust.

The core region a supernova may be crushed into a black hole. Giant stars have short lives, fertilizing interstellar space with new chemicals, and triggering the gravitational collapse of a cloud of such matter to give birth of second- or third-generation stars

like our sun. All the planets of our solar system were made from Sun's debris and constructed within its gravitational field.

The Sun and the planets formed simultaneously some 4.5 billion years ago. From the chance operation of self-organizing processes emerged self-replicating organic molecules.

The self-replicating molecules, in their interactions and resulting mergers, produced more complex self-replicating entities. They grouped themselves into cells, apparently giving up their life as free and independent replicators in the sea. There could have been a single universal progenitor of all surviving organisms, probably resembling a sort of bacterium. Bacteria, lacking a nucleus for storing genetic material, are regarded as the single-celled biological origin of the earth. The oldest bacterial fossils (from Warrawoona in Western Australia) are dated at about 3.5 billion years ago, and hence the origin of all surviving life forms on this planet must have been earlier than that.

Until 2.7 billion years ago, bacteria that could generate energy by fermentation without the aid of oxygen ruled the Earth. The ancestor of the eukaryotic cell (a sort of bacterium, an archaeon, to be exact, that lacks a nucleus) that could generate energy by using oxygen, appeared about 2.7 billion years ago, coinciding with a small rise in oxygen to about 1 percent of present atmospheric level. A giant leap across genetic space was then achieved, not by small mutations, but by the union of two very different genomes. A prototype eukaryote was able to internalize energy conversion by co-opting a bacterium called mitochondria, and discovered the secrets of larger size and morphological complexity. The prokaryote without a nucleus became a full-fledged eukaryote with a nucleus about 2.2 billion years ago, coinciding with a much larger rise in oxygen to about 5-18 percent of the present atmospheric level. The earliest known fossils of eukaryotic cells date from about 2.1 billion years ago.

Peter Mitchell discovered the way that life generates its energy, presented the implications of his ideas for the origin of life, and won the Nobel Prize for chemistry in 1978. He was a reclusive genius, who set up his own laboratory in an old country house in Cornwall, which he had renovated himself, following his own designs. At one time, his research was funded in part by the proceeds from a herd of dairy cows, and he even won a prize for the quality of his cream. He expounded his theories in two little grey books, published privately and circulated among a few interested professionals.

Bacteria evolved an amazing biochemical versatility, but never discovered the secrets of larger size. Bacteria still remain tiny single-celled bacteria, but eukaryotes containing mitochondria evolved into an enormous size and amazing complexity ever since.
See Nick Lane (2005: 24-6, 69, 105), and (2002: 18, 36, 43-5, 57, 71).

From the union of two bacterial cells emerged in due coarse algae, fungi, plants, and animals. First multi-cellular algae appeared about 1.85 billion years ago. Fossils of the earliest multi-cellular equivocally worm-like animals, large enough to be visible to the naked eye, were found, dating back about 600 million years. Their ancestors must have emerged between 700 and 1,000 million years ago. The oxygen level rose to the present atmospheric level between 600 and 550 million years ago, and there followed the Cambrian explosion of about 540 million years ago. The oldest fossil record of life on land goes back only about 425 million years.

According to the mechanistic view of life, complex design emerges as evolution does its work, preserving some organisms and discarding others. The adaptive complexity of living organisms is the result of feedback interactions between organisms and environments in the form of survival and reproduction. Entirely new species can therefore be formed over time by natural selection. No godly master designer is needed to explain the complexities of life. Homo sapiens is one of the many products of biological evolution. Choosing egocentric standards of comparison, humans tend to be self-congratulatory, fancying themselves to be the most

wonderful product of evolution.

The universe as presented by modern science seems to operate according to strict laws that may eventually be discovered by scientists. Some day, scientists may find out that the fundamental constants of the universe are not independent of one another. They say that, if God created the universe, He evidently left it to run entirely according to its own logic and rules.

Not only living organisms but the physical universe may also be subject to a sort of natural selection. Why? Because those inorganic physical entities that do not follow the principle of constrained optimization to reach a steady state would not remain in the observable universe.

The ultimate fate of every species, including homo sapiens, is extinction. It is a real challenge for humans to confront the fact that all living organisms as individuals are destined to die. It is not easy for humans to find meaning and purpose of life in face of the transience of ourselves as individuals. Humans have been seeking for a way to accept mortality and feel positive about such life as they have.

In human history there seem to have been two types of religious traditions. Through believing or awakening, one may be able to realize heaven or nirvana on earth and die expecting to enjoy a blissful eternal life beyond. The teleological tradition has sought redemption by believing in the existence of an almighty God, and finding positive meaning in the specifically defined nature of the Creator. In this tradition, the reconciliation of religious concepts with new scientific concepts becomes a real challenge. On the other hand, the inanimate tradition has sought, without assuming design, intension or purpose in nature, salvation in the awakening to the divine dispensations of Nature. At least in the purest versions of the inanimate tradition, there seems to be no fundamental conflict with modern science. On the contrary, advances in modern science seem to facilitate the understanding of the divine dispensations of Nature.

Regardless of the progress in science, however, human knowledge is bound to have limits, and hence some questions must always remain mysteries. Regardless of innate inquisitive craving, humans may never know where they came from. They will only keep guessing, and guessing. Though humans tend to be enraptured in the progress of modern science, in terms of wisdom or awakening, a modern-day sage with the benefit of all those Nobel laureate scientists may well be no better than a sage with the ideas of, say, Aristotle only.

The African art shows that an artist working with a laser beam cutter does not necessarily have any more esthetic sense than the one working with a hammer and a chisel.

"Cosmology used to be considered a pseudoscience and the preserve of physicists who might have done useful work in their earlier years, but who had gone mystic in their dotage. … However, in recent years, the range and quality of cosmological observation has improved enormously … Cosmology cannot predict anything about the universe unless it makes some assumption about the initial conditions. … Yet many people believe that science should be concerned only with the local laws which govern how the universe evolves in time. They would feel that the boundary conditions for the universe that determine how the universe began were a question for metaphysics or religion, rather than science." Hawking and Penrose (1996: 75)

2

Physical Principles

Isaac Newton (1643-1727) invented calculus, explained how gravity works and discovered the laws of motion in 1665-6. Newton's law of gravitation states that any particle of matter in the universe attracts any other with a force varying directly as the product of the masses (m) and inversely as the square of the distance between them. That is, the magnitude of attractive force $F = G(m_1m_2)/R^2$ where G is the gravitational constant.

James Clerk Maxwell (1831-79) realized that not the bodies but the behavior of the field between them is essential and crafted a comprehensive account of electromagnetism in 1873. Maxwell's four equations describe the interrelation of electric and magnetic fields. In terms of the vector operators of divergence and curl,

Div D = ϱ	where ϱ is charge density; D is field quantity;
Div B = 0	where B is the magnetic field;
Curl E = -dB/dt	where E is the electric field;
Curl H = dD/dt + J	where J is current density.

Maxwell showed that light consists of oscillating electric and magnetic fields.

Modern scientists often present their argument at a much lower (or shallower) level, requiring "a technical understanding of the mathematics and physics," although they are well aware of the fact that if "the argument is conducted at a higher (or deeper) level," it "will interest a broader audience." See Hawking and Penrose (1996: viii).

Albert Einstein (1879-1955) established the general theory of relativity and pioneered quantum mechanics in 1905-19, though his discoveries contradict one another. In 1905, Einstein had presented his special theory of relativity which states that $E=mc^2$, where E is the total energy and c the speed of light (300,000 km per second). Energy and mass are convertible by two factors of the speed of light. The speed of light is an invariant, and stays constant under various transformations. It is constant, no matter what speed the observer is traveling at. Nothing can travel faster than light. Time is not invariant.

Without mass, the universe would be a sea of particles zipping around at the speed of light that is the natural condition of any massless object. Some bosons (the particles that convey the forces which hold things together) have no mass. Photons transmit the electromagnetic force and are massless. W-bosons, which carry a short-range force in the atomic nucleus, are massive.

In nuclear-fusion reactions that transform hydrogen to helium, 0.7 percent of the original rest energy of the hydrogen is released from the body and converted to other forms of energy, and the mass of the body is accordingly reduced. Einstein's general relativity is a theory of gravity compatible with special relativity. Space and time are interwoven and relative. Accelerated motion and gravity are equivalent. When a mass moves, the force acting on other masses was understood to adjust instantaneously to the new location of the displaced mass. Special relativity theory, however, states that all physical signals travel no faster than the speed of light. The background for all events was no longer the one-dimensional time and the three-dimensional space continuum, but the four-dimensional time-space continuum.

"Once one learns the complex mathematical language required to express his ideas, Einstein's theories are the simplest and most obvious of any in physics."
The Economist, January 1st 2005, p. 61.

The general theory of relativity and quantum mechanics cannot be true everywhere. In classical physics, if we know the

external forces acting on a material particle that has definite positions and velocities at any instant, we can predict its future path. Physics had been deterministic. Consequence followed with no room for uncertainty. In quantum mechanics, we have a crowd of individual particles, such as electrons or photons, behaving in an unpredictable way. Discontinuity replaces continuity. Chance plays a fundamental role in the interactions of elementary particles. Uncertainty is at the core of quantum mechanics.

Physicists smash beams of particles together in accelerators to discover phenomena unseen in the mild conditions prevailing on the surface of Earth. They have found that quantum interactions are "non-local" and occur instantaneously over arbitrarily long distances. If one particle is spinning in one direction, its partner must spin in the opposite. The first particle, however, does not have a definite direction until it is measured, so the second particle cannot know how to point until a measurement is performed on the first particle, by which time the second particle may be millions of kilometers away. Quantum mechanics is unable to explain how particles communicate. Einstein termed this "spooky action-at-a-distance." Perhaps the communication between particles is conducted in the time dimension.

The fate of a particle does not depend on its age. It is not possible to formulate a law governing the behavior of an individual in a crowd. Quantum physics gave up the description of the possible motion of elementary particles in space and time. It aims to formulate laws governing crowds, i.e., the laws governing the changes in time of the probabilities and relating to congregations of individuals. Only statistical laws governing large aggregations of particles can be formulated. Physicists can foretell only the probability that an individual particle will behave in some particular manner. They are indifferent to the fate of the individual particles. They seek only to determine the average values typifying the whole aggregation. Scientists may tell the same kind of story for an individual human being: there is nothing deterministic in the fate of a person; there are only the probabilities for his lot.

The matter we are made of consists mainly of protons and neutrons that are stuck together to form atomic nuclei. They are combinations of smaller particles called quarks, and are about 2,000 times heavier than electrons. Every atom came to possess an equal number of electrons and protons and thus be electrically neutral. All matter exhibits both particle-like and wavelike properties.

Matter, energy, electric charge or light has a granular structure, and is composed of elementary particles. Photons are the elementary particles of energy of which light is composed. Electrons are the elementary particles of which electric charge is composed. Light is an electromagnetic wave, consisting of oscillating electric and magnetic fields. Light or an electron is actually both a particle and a wave simultaneously. The density ratio of neutrons-protons to photons stays constant over time, even as the universe expands and becomes more diluted.

Nuclear forces keep quarks glued together inside protons and neutrons, and also keep the latter tightly crammed together inside atomic nuclei, surrounded by electrons. "Quark" is a whimsical name taken by the theoretical physicist Murray Gell-Mann from "Three quarks for Muster Mark," a line in James Joyce's *Finnegan's Wake*. This passage is part of a scurrilous 13-line poem directed against King Mark, the cuckolded husband in the Tristan legend.

One of the fundamental constants of our universe is the magnitude of strong force, the force that binds the components of an atomic nucleus, i.e., the nuclear force that has to be overcome when one splits the atom. The magnitude is measured as E, the proportion of the mass of a hydrogen nucleus that is converted to energy when hydrogen fuses to form helium, and amounts to 0.007 (reminiscent of Snelling's *Double O Seven, James Bond, A Report* published in August of 1964 when Fleming died). All the chemical elements in the universe are made ultimately from the simplest and lightest element, hydrogen, by nuclear fusion in the intensely hot

interiors of stars. If the strong force were too small, the universe would contain only hydrogen, and no interesting chemistry could result. If it were too large, all the hydrogen would have fused to make heavier elements, and there would be no water and no life.

Relatively small stars, such as our sun, can make only light elements such as helium. Only big stars develop high temperatures needed to forge the heavier elements. These big stars may then explode as supernovas, scattering their materials in dust clouds that eventually condense to form new stars and planets, rich in heavier elements that make chemistry and life possible.

The cycles of big bang, expansion, contraction and crunch (say, in black holes) with new laws and constants may have been going on for ever. The anthropic principle explains that we have to be in one of those universes whose fundamental constants of physics happen to be those that were capable of producing Goldilocks zones for planets with liquid water—not too hot and not too cold. See Dawkins (2006: 135-143).

Anthropic principle is the assertion that any life existing in a universe will impose conditions that significantly restrict the physical properties of that universe, i.e., the existence of life restricts the universe's type.

Unlike the case of electromagnetic and gravitational fields, quantum physics characterizes the statistical behavior of large aggregations and not the actual transition of an individual particle. The laws cannot be verified by measurement of one individual, but only by a series of repeated measurements. It is impossible to say why just some particular individual atoms are doomed in radioactive disintegration, though we can foretell approximately how many atoms will disintegrate during the next half-hour.

They say that: "If you think you understand quantum mechanics, you really have not understood it."

Einstein believed that quantum mechanics was describing some sort of statistical average of an underlying phenomenon that was deterministic.

Three U.S. physicists won the 2004 Nobel Prize for explaining how quarks, which make up the protons and neutrons in the nuclei of atoms, stick together. Protons and neutrons consist of three quarks each, and there are six different types of quarks, such as "up" and "down" quarks. They discovered the phenomenon of asymptotic freedom whereby quarks behave as free particles when they are close together, but become more strongly attracted to each other as the distance between them increases, preventing them escaping the proton or neutron. When they are pulled apart, they snap back together as if held by a sort of rubber band.

The interaction between the particles, such as quarks, become arbitrarily weak at ever shorter distances, i.e., distances that asymptotically converges to zero. When they are close together, as in a nucleus, they are almost free to move around. It implies that in high-energy scattering the quarks move within nucleons, such as the neutron and proton, essentially as free, non-interacting particles. This is the opposite of what happens for the force between two electrically charged particles, which grows stronger as the particles become closer to each other. Their discovery makes it possible to understand the behavior of matter under extreme conditions such as occurred in the earliest moments of the Big Bang. Their work led to the theory of chromo-dynamics that explains how quarks behave. It was an important contribution to the emergence of a Standard Model of particle physics based on quantum field theory. And it has brought physics one step closer to a unified theory.

The Standard Model of particle physics describes all physics connected with the electromagnetic force (which acts between charged particles), the weak force (which is important for the sun's energy production) and the strong force (which acts between quarks). It also describes the fundamental particles that make up all matter. It is a quantum field theory, and consistent with both quantum mechanics and special relativity.

In a particle accelerator, protons travel at 99.999999% of

the speed of light, eventually crashing head-on inside one of detectors and generating a shower of high-energy debris. The detectors are designed to reconstruct the motion and identity of each particle in this debris, for it is from such pieces that the fabric of reality is woven. They have yet to discover a particle that is needed to give mass to those particles which have it. Photons, the particles of light, are massless. They have yet to generate evidence for those theories that would explain, say, the vanishing energy.

Although the Standard Model has had great success in explaining all the known particles and their interactions, it is not a complete theory of fundamental interactions, primarily because it does not describe the gravitational interaction. Furthermore, the model contains 19 free parameters, such as particle masses, which must be determined experimentally (plus another 10 for neutrino masses). These parameters cannot be independently calculated.

The Standard Model provides no mechanism to generate cosmic inflation that is believed to have occurred at the beginning of the universe, a consequence of its omission of gravity.

The amount of visible matter in the universe, a mere 4% of it, is far smaller than is needed to account for the apparent effects of gravity. Galaxies behave as though they are much heavier than they look. The visible matter that galaxies contain (stars, gas and so on) does not have enough gravity to hold them together. There must be a new class of matter that has a gravitational field, but cannot interact with light or other forms of electromagnetic radiation, and is therefore invisible, i.e., dark matter. It is perceived only through its gravitational pull on the more familiar normal matter. The dark matter holds galaxies together, bends light, slows down the expansion of universe, and drives the formation of intergalactic structure. The spinning galaxies would fly apart without it. It is holding the universe together. The visible stars and gas is just the center of a larger structure which is surrounded by an extended halo of dark matter. Visible matter has accumulated in areas rich in dark matter. Galaxies (and, by extension, the universe)

should contain a lot of invisible dark matter (that is not composed of the same particles, i.e., protons, neutrons and electrons, as the visible matter), that is estimated to amount 22% of the universe.

The gravity of dark matter not only holds galaxies together, but it also controls its distribution in space. Galaxies form where dark matter accumulates at high densities, pulling visible matter with it. Scientists draw a two-dimensional map of dark matter by employing one of the predictions of Einstein's general theory of relativity: that the path of a beam of light (which is straight line in empty space) is bent by the gravity of a massive object. The third dimension (i.e., the distance from Earth) is obtained by examining the wavelength of light: the farther away a galaxy is, the redder it is.

Positive dark energy (i.e., the energy of the vacuum) is the greatest experimental discovery regarding the basic laws of physics. Dark energy is perceived by the opposite effect of pushing ordinary matter and the universe apart. The measurements comparing the expected luminosity of ancient supernovas with what is actually seen suggest something is pushing things apart faster than just the well-known expansion of everything that is the aftermath of the Big Bang, which must be a form of energy. The 74% of the universe is referred to as dark energy.

The so-called dark matter and dark energy have defied attempts at explanation. Scientists still do not know what they are, though understand what they do. One may say that the observable universe of atoms and molecules is merely froth floating on a sea of dimly perceived (or dimly known) unknown called dark matter and dark energy.

Astronomers are not happy to see the particle physicists running wild on their territory, tossing out astonishing ideas such as that the gamma-ray bursts, the brightest explosions in the universe, are caused by the sudden conversion of vast quantities of normal matter into dark matter by dark energy, analogous to water giving up its latent heat when it turns to ice.

3

General Theory of Relativity and Quantum Mechanics

For more than two centuries, people believed that Newton's theory of gravity could accurately explain and predict all physical phenomena. It was, however, proved on November 6, 1919 that Newton's prediction was not correct. Of course the differences, if any, between the predictions based on Einstein's general theory of relativity (*a theory of gravity* compatible with special relativity) and those based on Newton's theory are so slight that they are generally beyond human capacity to detect experimentally. Anyway, Einstein's theory of relativity was his moment of glory. It was, however, soon discovered that general relativity as formulated for the macro-universe and quantum mechanics as formulated for the micro-universe cannot both be correct.

Is the universe "divided" so as to require
one set of laws when things are large
and another set of laws when things are small?

The Planck scale, named after Max Planck, the founder of quantum theory, is where gravity and the quantum meet. At this scale, space and time are grainy, rather than continuous, and we cannot know the precise location and velocity of anything. The smooth structure of space-time breaks down into some or other structure: strings, spin-foam, lattice … who knows. It was the dream of Einstein to reconcile quantum theory with relativity, a grainy theory of quantum gravity.

Some physicists believe that the String Theory has the potential to provide a single explanatory framework for the workings of the universe uniting gravity with all other fundamental interactions. Even by partially solving the approximations to the unknown exact mathematical equations of the theory, they claim that they have already achieved the harmonious union of general relativity and quantum mechanics (solving the black hole puzzle of crushing an enormous mass to a minuscule size), and furthermore answered the questions about nature's most fundamental constituents called particles and (gravitational, electromagnetic and strong or weak nuclear) forces. Einstein's dream of a unified field theory may indeed come true.

The fundamental principle of String Theory is that everything at its most microscopic level consists of combinations of vibrating strands. The particle properties we observe are simply a reflection of the various ways in which a string can oscillate, and simple replacement of point-like particles with strings resolves the incompatibility between quantum mechanics and general relativity. M-theory, which encompasses String Theory, has eleven dimensions (ten spaces and one time). By the way, "M" suggests mysterious or mysterious membrane. String theory has been promising for more than 30 years.

The "nano" derives from the Greek noun for dwarf. A nanometer is a billionth of a meter, roughly the length of ten hydrogen atoms. The atomic world is smaller than the wavelength of visible light, and hence humans cannot see its features. We can trace the landscape of nano-scale atoms and molecules only by using the scanning tunneling microscope (STM) that employs a quantum-mechanical effect. An atomic-force microscope (AFM) works by running the tip of a probe over the surface of molecules, picking up the bumps and groves, and translating them into a picture. An AFM can alter the surface it is scanning at the molecular level, in effect writing on that surface.

Nanotechnology covers objects measuring from 0.1 to 100

nanometers. The size of the bond between two carbon atoms or the length of one hydrogen atom is about a tenth of a nanometer. At nano scales, the properties of a material are governed by quantum rules and change in unexpected ways. Nanotechnology makes use of the strange properties found in these very small worlds. In objects larger than 50 nanometers, however, the laws of classical physics become increasingly dominant.

Traditional macroscopic engineering is largely based on the effect of gravity on solid objects like concrete, steel, rubber or synthetic fibers. A modern-day engineer may soon find himself manufacturing molecule-sized products using nano-scale plant equipment that operates under the electromagnetic and (strong or weak) nuclear forces; he surely will have numerous problems communicating with those guys graduated from the steel-and-concrete engineering school.

In our cells, atoms are composed of molecules. In the nanotechnology chemical factories manufacturing 6 billion molecular bases of DNA in each of our cells, engineering is based on the effect of thermal motion on the atomic interactions within and between molecules that are endowed with kinetic energy proportional to the temperature, while most of the end-products, namely physical organs, are designed to be used in our macroscopic world. The genes possess the knowledge to design and manufacture such perfect machines as hands and fingers that operate of necessity under gravitational force subject to general relativity.

In our cells, there is apparently no conflict between the engineering based on microscopic quantum mechanics and the engineering based on macroscopic general relativity. Alas, only humans have failed to figure out the one grand physical principle that was applied to the engineering activities of the real world by the simplest bacteria more than 3 billion years ago.

Many physicists believe that the physical laws explaining the microscopic world of molecules, atoms, protons, neutrons,

electrons and quarks will also be able to explain the properties of the macroscopic world of, say, a tornado. Some physicists believe that the String/M Theory offers a powerful conceptual paradigm that may be able to provide the ultimate explanation of the universe both at its most microscopic level and macroscopic level, and to provide the firmest foundation to understand everything in the world, i.e., the "Theory of Everything." Even the feeling of love, joy, or boredom may be explained by chemical reactions between molecules and atoms, or by reactions between some of the smaller particles which are only vibrating strings. The world may indeed be reduced to a matter of particles or fields and their interactions.

Neurologists say that, by scanning (with the MRI machine) the brain of a person who claims to be in love, they can tell whether it is lust, unstable romantic love, or the long-term affectionate attachment required of an attentive parent. They say that the brain areas activated by various emotional states are all different. No heart, just the brain! Chemists say that tender affection or passionate love is a neural mechanism that is activated by the release of chemicals into the brain that trigger feelings of pleasure and romance for long-term couples, or provoke hyperactivity, recklessness and exhilaration for spellbound lovers. Passionate love shuts off activity in the reasoning part of the brain, and turns down the brain's judgment and fear centers. Lovers stop differentiating you from me. Some scientists say that a person madly in love has a chemical profile in his or her brain similar to that of people who suffer from obsessive-compulsive disorder. Partners get addicted to each other through the mediation of chemical odor. They say that every romantic love would fade, within four years at the most, because either the neurons become desensitized or the supply of chemicals fizzles out. To chemists, love is nothing but a special sort of chemistry, and humans are not born with any specific type of soul mate. Now physicists are joining the crowd to say that love may be explained by reactions between some of the smaller particles which are merely vibrating strings. Life is just a matter of physics and chemistry!

"Life, we now know, is nothing but a vast array of coordinated chemical reactions. The 'secret' to that coordination is the breathtakingly complex set of instructions inscribed, again, chemically, in our DNA." Watson (2003: 396)

Two U.S. scientists were awarded the 2004 Nobel Physiology (Medicine) Prize for their work on the biology of the sense of smell. They found that some 1,000 different genes (about 3% of our genes) are devoted to encoding olfactory receptors, i.e., to coding for proteins which act as "odorant receptors." Each olfactory receptor cell expresses only one single odorant receptor gene, giving rise to an equivalent number of olfactory receptor types.

Each receptor is unique, and when activated by an odorant, triggers the cell to send an electrical signal to the brain. All these protein receptors are located on the olfactory receptor cells, which occupy a small area in the upper part of the nasal epithelium and detect the inhaled odorant molecules. The olfactory receptor cell sends its nerve processes to the olfactory bulb, where there are some 2,000 well-defined micro-regions, glomeruli. This is the first relay station in the brain to process the odor information. There are about twice as many glomeruli as the types of olfactory receptor cells.

Each protein receptor is highly specialized, but can be sensitive to more than one smelly chemical, in different amounts. Any given chemical activates several proteins at once. Most odors are composed of multiple odorant molecules with high vapor pressures (called *volatile*), and each odorant molecule activates several odorant receptors, leading to a combined odorant pattern, which allows us to recognize and form memories of approximately 10,000 different odors.

Neurons directly connect the brain to the outside world. Smells warn us if food has gone bad and trigger distinct memories

years later. Our emotional associations are usually colored by the context in which we first encountered the smell. The sense of smell enables observing and interpreting our environments. Their discovery helps us solve the puzzle of how individuals perceive their external environment and translate the sensations around them into knowledge essential to the survival of most species.

The basic principles for the olfactory system appear to apply also to other sensory systems. Pheromones (i.e., chemicals that influence the behavior of others of the same species) are molecules that are localized to a different part of the nasal epithelium, and influence different social behaviors. The taste buds of the tongue, on the other hand, are associated with the sense of taste. "What we perceive as a fragrant perfume is actually a sophisticated tool used by plants to entice pollinators, discourage microbes and fend off predators." Eran Pichersky, "Plant Scents," *American Scientists*, Volume 92, November December 2004, pp. 514-521.

Human eyes see the world through a narrow slit in the electro-magnetic spectrum. Visible light is a chink of brightness in the vast dark spectrum, from radio waves at the long end to gamma rays at the short end. The perceptions that we call colors are tools used by our brains to label important distinctions in the outside world. Perceived hues have no intrinsic connection with lights of particular wavelengths. They are internal labels that are available to the brain, when it constructs its model of external reality, to make distinctions that are especially salient to the survival of the animal concerned. Bats may use perceived hues such as red and blue as internal labels for some useful aspect of echoes, and see color with their ears. Dawkins (2006: 362-73)

What is perceived is not a simple mapping of the images that fall on the retina (a light-sensitive membrane in the back of the eye that receive an image from the lens and send it to the brain through the optic nerves). The universe looks colored because it is useful for our brains that it should, so the retina has cells that are particularly sensitive to three different wavelengths of light, and the brain deconstructs and reforms the signals from optic nerves to

create the optical illusion called color. A conscious visual experience is a fabrication of the image-reconstruction process. Likewise the modeling functions of the rest of the five sensory organs (of seeing, hearing, tasting, smelling and feeling).

Beautiful photographs of the universe obtained through the Hubble space telescope are not what human eyes would actually see. The raw data have been translated, or fiddled with, by a team of experts (from monochrome) into visually appealing scenes of greater depth perception by making subjective choices about contrast, color and composition. The resulting images resemble romantic landscape paintings.

What astronomer Fred Hoyle dismissively called Big Bang is still regarded by many scientists as folktale. They contend that modern cosmological theory rests on a very small number of independent observations, and has at best very flimsy observational support. Scientists have indeed discovered that the spectra of distant galaxies were dramatically redshifted, hinting that the universe was expanding. Red shift implies a change in the spectrum of a star toward longer wavelengths, or toward the red end of the spectrum, caused by its motion away from the Earth. Scientists have also discovered the cosmic background radiation, a microwave whisper emitted by the gas of the universe when it was hot and young (300,000 years old)--the remnants of the Big Bang--which is accounted by the redshifts (expansion). In order to explain the existence of visible structures such as galaxies and clusters, however, theoreticians have to create a heroic notion such as the invisible dark matter which supposedly overwhelms, by a hundred to one, the stuff of the universe we can directly detect and keeps the galaxies together. In order to explain the recent acceleration of cosmic expansion (indicated by the supernova observations), which contradicts the expectation of slowing down of expansion by gravitation, scientists further have to create the unknown dark energy. (Michael J. Disney, in *American Scientist*, September-October, 2007, pp. 383-5)

The following is a nice summary of the biggest of big

pictures (by Craig J. Hogan in *American Scientist*, March-April 2007, pp. 185-6).

Cosmology is built out of physics. Modern scientific cosmology, a quantifiable account of our universe that unifies the physics of the very large with the physics of the very small and survives experimental tests, began with Einstein's general theory of relativity. The addition of quantum physics extended those ideas to include the behavior of the early universe when most energy was in the form of radiation. This Big Bang theory was confirmed with the discovery in the 1960s of vestiges of this radiation, still shining from all directions in the sky, and with corroboration of the predicted primordial abundances of elements. Observational cosmology has revealed the evolution of complexity from a simple initial state: the Big Bang was a simple, smooth system extremely close to local, microscopic thermodynamic equilibrium. Around 1980, the importation of ideas of symmetry breaking from quantum field theory led to the concept of cosmic inflation, a process that both kick-started the Big Bang's expansion and introduced small quantum fluctuations, which eventually became galaxies. The synthesis is on its way to being confirmed by observations of the cosmic microwave background that faithfully record those fluctuations. The ongoing fusion of quantum field theory with string theory, a quantum version of general relativity, promises to remake and extend cosmology once again, into the metacosmology of the multiverse. Seemingly crazy ideas—a universe arising from nothing, lots of big universes fitting into one small one, properties of physics itself varying from one universe to another—emerge naturally out of well-controlled mathematical arguments, and may survive experimental scrutiny. Much of physics in any particular universe does not derive from any mathematical principle but by random selection. A few places form universes that become big and hospitable, allowing stable atomic nuclei, galaxies, stars, planets, molecules, biochemistry and life to arise. Of course, it is just another physical hypothesis, like the other cosmologies that came before. The many worlds may exist in some kind of mathematical space we do now know. We still do not know how to define probabilities of universe, much less calculate them.

4

Darwin's Theory of Evolution

Charles Darwin (1809-82) embarked on his voyage on the *Beagle* in 1831 to survey the wildlife of the west coast of South America and some Pacific islands. He returned to England in 1836 with a vast collection of basic data. After groping about the idea that some individuals in a species were well adapted to the places they occupied in the economy of nature (i.e., ecological niches) and flourished, while others were less adapted and perished, he finally was inspired (on September 28, 1838) by *An Essay on the Principle of Population as it affects the Future Improvement of Society* (1798), by the Reverend Thomas Robert Malthus, and began writing a definitive account of evolution, culminating in the epoch-making publication of -- *On the Origin of Species by Means of Natural Selection* (1859).

Malthus had contended that geometric population increases outstrip arithmetic increases in food supply, which lead to a crunch unless one invokes some sort of restraint.

There is not yet a definitive theory
of the evolution of the universe,
but at least Darwin's theory of organic evolution
and its operating principle, natural selection,
offer a definitive view of the
incredible diversity of life on earth.

According to Darwin, species are mutable, and complex organs and instincts have been perfected by the slow accumulation of innumerable slight, successive, favorable variations, each good for the individual possessor.

The struggle for existence and reproduction, caused by the high geometrical ratio of increase of all organic beings, constitutes the most powerful means of natural selection leading to the preservation of each profitable deviation in structure or instinct and, consequently, the preservation of favored individuals or species.

Disuse brought about by changed conditions of life tends to reduce an organ, making the inhabitants of different areas widely different from each other, though having initially inherited much in common. New and improved varieties of the same species, even in want of absolute perfection, will inevitably supplant and exterminate the older, less improved and intermediate varieties.

All the individuals of the same species, and all the species of the same genus, or even higher group, have descended from common progenitors, from a few forms subsequently modified. At an embryonic age, the species closely resembled each other. Nature is niggardly in innovation, though prodigal in variety.

Darwin (1996: 391, 395)

Over time, Darwin's theory of evolutionary biology has been very much strengthened, becoming a functioning scientific discipline thanks to progress made in modern bio-chemistry and molecular genetics. Present-day pharmacists and epidemiologists no longer work on the basis of "intelligent design theory" or any other form of "creation theory."

In Smolin's model (1997), daughter universes are born in black holes produced by a parent universe, and they inherit its laws and constants but possibly with some small random change –- "mutation." The daughter universes, in turn, pass on their laws and constants to their daughters, possibly with some mutation. "So universes that have what it takes to make stars are favored in this cosmic Darwinism."

Dawkins (2004: 3)

Human nature being what it is,
we cannot avoid struggling to find
a balance between religion and science,
and to find purpose and meaning for life
in the apparently meaningless universe
presented by science.

Darwin tried to make his theory compatible with God:

"all the organic beings which ever lived on this earth
have descended from some one primordial form
[the grand ancestor of all life],
into which life was first *breathed* by the Creator."
Darwin (1996: 391)

According to Darwin,
God had created a self-replicating primordial molecule
and also installed
the operating principle of natural selection
to enable self-development.
Mutation and the God-given principle of natural selection
have resulted in such wondrous complexity
in the design of organisms.

Darwin made room for a deistic interpretation
of the complexities of functional adaptations in nature
as the product of a sort of purposeful designing.

Darwin seems to have infused a deistic interpretation
into evolutionary theory
in order to calm the fears of his wife
that her husband's theory eliminated God.

I wonder whether one can do any better than
what Charles Darwin did for his wife,
though I am not so sure whether Emma Wedgwood
really felt comfortable with Darwin's interpretation
of design in evolution.

5

Homo Sapiens

The dinosaur (meaning *terrible lizard* in Greek) was the dominant land animal during most of the Mesozoic Era (225 million - 65 million years ago). It became extinct at the close of the Mesozoic Era. The Jurassic was the middle period of this Era.

The ant appeared about 100 million years ago, and yet it still survives and even prospers through ingenuous adaptations to ever changing environment.

An Ice Man was preserved more than 5,000 years, and some insects were embalmed in amber for 100 million years, but stone fossils can be preserved for hundreds of millions of years. A fossil means the original material substituted or infiltrated by a mineral. Fossils are used to date rocks.

From the tail-less sub-Saharan African apes, the orangutan is estimated to have split some 14 million years ago (and still lives in Southeast Asia), the gorilla some 7 million years ago, and the chimpanzee some 5 million years ago (both living only in Africa). Thus was completed the split between the hominid and African ape lines.

Earth had become extremely colder and drier about 6.5 million years ago, and the hominid that ventured into dry grassland had taken the first step toward becoming human, while the apes that stayed in the forests hardly changed.

The backward convergence of all apes, including humans,

will lead to their shared ancestor, possibly some kind of monkeys, who lived about 18 million years ago. The more recent their split from a common ancestor, the greater the genetic similarity of the two living species. More than 98.8 percent of present-day human DNA is identical to that of African Chimpanzees, and 60 percent with chickens. Some cynics call humans "naked apes" or "the third chimpanzee."

There appeared all sorts of archaic prototype hominid who could make tools out of sticks between 4.5 and 2 million years ago. Homo erectus, with the ability to walk upright and make tools out of stone, emerged some 2 million years ago. The most recent Ice Age began about 2.5 million years ago and ended about 10,000 years ago. Homo erectus was the first hominid to disperse out of Africa more than 1.8 million years ago, reaching Australia 60,000 years ago, across miles of open ocean. Homo erectus is characterized by a larger brain than his forebears, a stone tool culture and the use of fire. By 600,000 years ago, however, every hominid had a big brain. These archaic human populations (including the Neandertal cousins whose skeletal remains were discovered in Germany's Neander Valley in 1856) became extinct between 30,000 and 200,000 years ago.

Homo sapiens emerged in Africa roughly 200,000 years ago. The Neandertals, in the popular imagination wearing fur and wielding clubs, had lived side by side with Homo sapiens across Europe for 8,000 years but vanished from the earth about 35,000 years ago, despite having been better adapted to a harsh climate. There was no interbreeding. The FOXP2 gene, which provided Homo sapiens an evolutionary edge with greater speech/language abilities, appeared less than 200,000 years ago, and was not present in Neandertals.

Homo sapiens started to speak languages coherently, exchanging extensive information with one another. This new species of modern humans, who developed advanced, spoken language, began to disperse out of Africa (across the strait of Bab

el Mandeb at the southern end of the Red Sea and possibly also across the Suez Isthmus) some time between 60,000 and 85,000 years ago (or about 66,000 years ago, if one pretends to be more precise), completely replacing archaic human populations. The amount of variation in Y chromosomes today suggests that about 2,000 men and an equal number of women (all together, 4,000 men and women) had ventured out of Africa at that time, becoming the "founder" population of the New Worlds. Some of these brave souls had moved into Australia (following the warm South Asian coastal route) 50,000 years ago, into the Middle East 45,000 years ago scattering into southern Europe, into parts of northern Europe from central Asia 35,000 years ago, and into the Americas from central Asia (across the present-day Bering Strait, then a land strip called Beringia) 15,000 years ago. There must have been more than one wave of exodus and migration. The speed of human migrations over central Asia and into northern Europe was influenced, perhaps, by the speed of ice withdrawal.

The Cro-Magnon Man around 40,000 years ago manifests the flowering of consciousness in Homo sapiens, and the cultural Great Leap Forward. The gene called microcephalin, which affects brain size, appeared about 37,000 years ago, coinciding with symbolic thinking and representational art in the form of figurines and jewelry. Man-made artifacts changed from crudely shaped stone tools and weapons to paintings, musical instruments, carvings, figurines, grave goods and ornaments.

All modern humans share a common origin. A single population with highly advanced language abilities and an enlarged brain emerged in Africa and began to spread out into every continent. Language and memory, not to mention the later invention of writing, facilitated the exchange and accumulation of information.

The estimated speed of human migrations suggests a rather leisurely movement at snails' pace, traveling on average much less than one kilometer per year or three meters a day. The hunter

gatherers wandered continuously. It must have been almost a random wandering in all readily accessible directions in the course of the normal daily activities of hunting and gathering. At such a snail's pace, humans could fully adjust to minute changes in temperature without too much difficulty. Most likely, they rather enjoyed the challenge of the geographic irregularities of high mountains and deep rivers, and, in a leisurely fashion, kept moving without particularly caring about the direction in which they moved.

If two people have very similar mitochondrial DNA, then they share a fairly recent common female ancestor. People who are more distantly related will have significantly different mtDNA sequences due to the accumulation of mutations that introduce new genetic forms. Assuming "constant" rates of mutation, we can count the number of mutations that separate two species or populations. The genetic distance between two populations is approximately proportional to the time of separation of those populations. This information has enabled scientists to trace the African Eve and calculate the timing of her appearance.

Mitochondria are the descendants of bacteria that had merged with one of their unicellular ancestors some two billion years ago, and now constitute parts of a cell that convert energy stored in sugar into a form that the rest of the cell can use. Most of a cell's genes are in its nucleus, but mitochondria retain a few genes of their own. Being outside the nucleus, mitochondria in humans are inherited only from the mother. Any changes in mitochondria are caused by mutation, and not by sex. Fossil evidence suggests that Homo sapiens is at least 200,000 years old. By analyzing the mutational differences that had accumulated since human mitochondria shared a common ancestor, and using an estimated (supposedly "constant") average rate of mutation, scientists discovered that all humans converge to one African Eve who lived some 150,000 years ago.

The Y-chromosome is like a last name that can also be used to trace ancestries. Using the male Y-chromosome in the cell

nucleus that passes only from father to son, scientists also discovered that the African Adam was born 60,000-90,000 years ago (or 89,000 years ago, if one pretends to be more precise). The other males ended up with no offspring at all. Male gene lines die out, say, by conquest, faster than female ones. A conqueror wins extra wives. One man in every 12 of those who live within the area that was once the Mongol empire can trace their Y-chromosomes to Chinggis Khan.

African Adam was born about 89,000 years ago, and married a girl in direct descent from African Eve who was born about 150,000 years ago. About 4,000 men and women who were all in direct descent from Adam bravely went out of Africa about 66,000 years ago to make our modern world of 4 billion human population.

The world's climate was temporarily colder and drier on several occasions after the end of the most recent Ice Age. The first of these (known as the Younger Dryas) occurred abruptly about 10,700 years ago (c.8,700 BCE). The global climate change modified the fauna and flora, adversely affecting the food supply to hunter-gatherers. This created an urgent need for Homo sapiens to find new ways to feed themselves, and induced them soon to invent agriculture, relying on rain to water their crops. Around 8,200 years ago (c.6,200 BCE), the rainfall abruptly fell below the level needed to sustain primitive farming techniques, and this sudden climate change induced farmers to adopt irrigation, planting wheat, barley or millet near rivers and digging canals. Another period of cooling and drying occurred about 4,200 years ago (c.2,200 BCE), and it caused a widespread adoption of pastoral nomadism across West Asia.

Writing emerged first as a form of accounting for resources stockpiled by the early states or as a form of religious activities. Writing provided a powerful means of storing and controlling consolidated information with the precision of spoken language, in the hands of a few elite groups who could command the skill.

The Egyptians began to use hieroglyphic writing circa 3000 BCE. The people in the Indus valley began writing c.2500 BCE, and in China at least c.1200 BCE. The Phoenicians began to use the alphabetic system some time prior to c.1000 BCE, borrowing signs for consonants from Egyptian hieroglyphics. Letters for vowels were not used until the time of the classical Greeks.

Circa 3000 BCE, the Sumerians near modern Baghdad began to write pictographically on clay. Circa 2500 BCE, they began to use a purely phonetic system of syllabic writing to express the most complicated historical and literary compositions. The Sumerian word for *arrow* was pronounced *ti*. Since the word for *life*, an abstract notion, was also pronounced *ti*, the symbol for an arrow could also be used to mean *life*. The system of symbols was simplified to less than 1000 elements by 2000 BCE. Several thousand tablets and fragments inscribed with Sumerian literary works are dated to c.1500 BCE.

Historical Time seems to have begun approximately 5,000 years ago. The event coincided with the appearance of the gene called ASPM, which also affects brain size, about 5,800 years ago. That was just before Homo sapiens established the first cities in the Middle East.

6

DNA-RNA

The earth was formed about 4.5 billion years ago, and meteorite bombardment ended some 3.8 to 4 billion years ago. About 4 billion years ago, a choking carbon dioxide atmosphere blanketed the Earth, and giant meteorites pelted the planet. And yet, in ocean floor deep enough to be protected from ultraviolet radiation, chemistry changed from inorganic to organic, and there appeared globules of self-replicating molecules. Some scientists suggest that the first replicators that made copies of themselves might have been inorganic crystals from which evolved organic molecules.

The first signs of life, the sedimentary rocks of western Greenland, date back to 3.85 years ago. With some sort of primitive genetic control, division of labor and specialization among organic molecules pulled natural selection and Darwinian evolution over time into colonies of self-replicating molecules, primitive microbes in the proto-cell, bacteria lacking a nucleus, and eukaryotes like algae—cells with a nucleus containing a dense mass of DNA.

Natural selection must have favored organic molecules that cooperated with others, forming colonies of molecules first and then communes of complex molecules with central coordination by the genes. There eventually emerged a colony of genes called cell that became a working unit for the chemical factories of the genes. The single-celled organisms, such as bacteria or algae without a nucleus evolved into our own ancestors, the eukaryotes with a nucleus.

All eukaryotes share the same genetic ancestry, and have (or once had) mitochondria. The bacteria's mechanism of energy conversion precluded them from ever evolving beyond single-celled bacteria. On the other hand, mitochondrial merger gave the eukaryotes unlimited possibilities to grow in size and evolution into higher forms of life. But our terminal decline into old age and death came as a package deal with the unique mitochondrial mechanism of energy conversion. See Lane (2005: 69).

A human, like any other living thing on earth, begins life as a single cell, a fertilized egg, which replicates into the 100 trillion cells of an adult. The single cell, the fertilized egg, inherits only the ideas of ancestral design in one master copy of the DNA blueprint from father and mother, together with a single integrated chemical factory from mother as dowry, and starts to manufacture, by cell division, all the necessary physical organs from scratch. The efforts of all these cells converge on reproducing sperms or eggs, and the fertilized eggs of the next generation.

Nano-scale manipulators build "self-assembling" proteins (using a particular 20 amino acids) and other molecules, atom by atom according to defined instructions, using nano-scale tools and machines such as rotating bearings, pumps, computers, and motors to generate energy. The nanotechnology of building molecular machinery, on a scale of billionths of a meter (nanometers), was discovered in the warm salty aqueous environment by the simplest bacteria more than three billion years ago. As a consequence of the evolution of life from a single primordial cell, all earthly living things came to be made of the same basic molecular building blocks that happened to be chosen by the earliest bacteria, and hence all modern-day cells show uniformity at the molecular level.

Humans have 23 pairs of chromosomes per cell. In each pair, one is of paternal and the other of maternal origin. DNA is the main constituent of each chromosome. DNA is about two meters long that measures on the atomic scale in width (called a double-stranded helix), cocooned in protein, consisting of a linear

sequence of small molecules called nucleotides (or called chemical bases or letters), numbering over 100 million per chromosome, and about 3.1 billion pairs per cell, packed tightly in some chromosomal territories, forming sheer walls and intergenic fissures. About 6.2 billion chemical letters spell the genetic blueprint of humans. Even the smallest DNA molecules of viruses have more than several thousand nucleotides. A chromosome is a set of instructions, in the form of genes, that are used in creating an organism.

Protein molecules, such as the hemoglobin of our blood, are chains of smaller molecules called amino acids, each containing a few dozen atoms. Proteins constitute much of the physical fabric of the body and also exert control over the chemical processes in the cell.

A gene is encoded in a short segment of DNA. A chromosome may contain more than a thousand genes. The total number of human genes amounts to about 23,000, and that of a mustard plant about 27,000. All DNA, whether found in bacteria, viruses, plants, or animals is the same basic molecule.

DNA is a double helix formed of the base pairs of adenine (A) and thymine (T), and of cytosine (C) and guanine (G). Each nucleotide is chosen from only four different kinds of nucleotides, written in the four-letter nucleotides alphabet, A, T, C, and G. A gene may look like a random sequence of thousands of nucleotides, such as TAACATGCCAT…. Genes are written in three-letter words. The DNA system of a four-letter alphabet and three-letter words implies that there are 64 different words. There are also three-letter words indicating full stop, the punctuation mark placed at the end of sentences. The 64 words are mapped onto 21 meanings – the 20 amino acids and one punctuation mark, the STOP symbol that marks the end of a gene. Some words are synonymous with others. A sequence of nucleotides (i.e., words or codons) yields a genetic message. The 64-word DNA (or RNA) dictionary is universal in every living species, and it is unchanging, with a few exceptions in certain bacteria (that employ genetic codes

slightly different from the standard one without any evidence of adaptive advantage for those creatures).

With the mediation of the messenger RNA, the protein-making apparatus of a cell can translate the message of a gene into a composition of proteins. (RNA substitutes another molecule, uracil for thymine, but the two are very similar.) The 20 amino acids are strung into sequences, each sequence making a particular protein molecule. "A sentence" of words specifying "one protein molecule" is an identifiable unit often called "a gene." Protein, in turn, can interact directly with DNA to regulate a gene's activity. The sequence of nucleotides is mapped directly into the amino acid sequence of proteins. Proteins form the enzymes that catalyze biochemical reactions, and also provide the body's major structural components. Genes control cells by controlling the structure and shape of proteins and, at the end, going through a complicated chain of influences, control various biological functions.

DNA is essentially code for proteins, and chemically inert. Chemistry is about the bonds between atoms in molecules. The messenger RNA translates the DNA code into the sequence of amino acids in a protein. RNA rounds up the amino-acid units out of which proteins are constructed in the cell's chemical factories. Proteins are the active ingredients that make life possible. DNA comes as a double-stranded helix, but RNA molecules usually have a single strand.

For some 3.5 billion years, "the standard two base pairs" have been replicated by DNA polymerases, the enzymes that copy DNA. Transmission error in the replication of cells is called mutation, often rather harmful. Such cryptic variations can be a replacement of a nucleotide by another of the four, or the addition or deletion of nucleotides that alter the function of a specific gene. The order of nucleotides may also change. With a change in the sequence, a gene's new message is broadcast to the cell's protein-making apparatus, the structure of protein is changed, and with it the protein's function is changed. Mutation can happen during any cell division, although it is rare. The mutation rate per generation is

estimated to be on the order of 1 in every 10 million base pairs that are copied, implying approximately 300 typos creeping into the copy of 3.1 billion pairs of DNA letters in each generation. Genetic mutations accumulate at random as we grow older, and it takes a particular combination of mutations to cause cancer. Since every gene, except the male sex gene Y, is written in duplicate, the gene always has a second chance of a correct version.

The standard genetic code translates from the language of nucleotide bases in DNA or RNA into the language of amino acid in a protein molecule. Why this particular code? The standard genetic code, that rules all life on Earth with a few minor variations, seems to have evolved to maximize error tolerance. It does not seem to be a "frozen accident." The synonymous words (codons) are not just scattered across the table; they clump together so that a point mutation (in one of these words) has a better-than-average chance of producing a new word that still translates into the same amino acid. When a change to a single nucleotide does not yield the same amino acid, it nonetheless has a good chance of producing one with similar properties. The standard genetic code appears very close to a global optimum for error minimization in transmitting genetic information. It seems to minimize the incidence and the consequences of errors, so that meaning can be recovered even from garbled messages.

The code seems to have been subject to evolution only in a former age of miracles. The assignment of codons to amino acids might have been subject to reshuffling and refinement in the earliest era of evolution, but at a certain point in time any further change became impossible because the code was embedded so deeply in the core machinery of life. A mutation altering the codon table, the DNA dictionary, would also alter the structure of every protein molecule that would be lethal. See Brian Hayes, "Ode to the Code," *American Scientist*, Volume 92, November-December 2004, pp.494-498.

The genetic code itself is virtually identical in all species. The DNA information in all living creatures, encoded in the pattern of their arrangement in the nucleus of every cell, has been

handed down from remote ancestors. Humans and bacteria have some DNA sequences which are so similar that whole paragraphs are word-for-word identical. Large sections of their DNA still resemble each other. Humans and bacteria have some genes that have hardly changed at all since their common ancestor. Cow insulin, for example, can be given to human diabetics. Yeast (fungous) lineage and human lineage split about 1 billion years ago, and yet the set of proteins that existed in their common ancestor has changed minimally.

The genome is the entire set of genetic instructions contained in the nucleus of every cell. There are a lot of meaningless words and sentences in a genome, just like an old hard disk in a PC. Some scientists claim that at least 90 percent of the human genome is "junk DNA" that has no clear function. Perhaps such a claim is simply revealing the extent of our ignorance.

Genome sizes vary from species to species. Locusts have about 9.3 billion pairs of nucleotides per cell, onions about 18.0 billion (base) pairs, Amoebae about 670.0 billion (base) pairs, while humans have only 3.1 billion (nucleotide) pairs. Natural selection operates to minimize the genome size in order to minimize the energy and time to replicate DNA and also to minimize the room for error in cell division.

The problem faced by a paleo-genetics scientist is that DNA (extracted from the remains of, say, a dinosaur contained in a bloodsucking insect embalmed in amber) undergoes extensive fragmentation and chemical alteration in a few years after an organism is dead. It is, therefore, only by comparing many disjoined fragments of the same DNA segment that one can possibly reconstruct the complete structure of a single short segment. Fossilization does not preserve DNA.

DNA, the carrier of genetic information, is replicated at cell division. A daughter cell receives a complete copy of the chromosomes of the mother cell, and contains DNA with a

sequence of molecules (called nucleotides) identical to that of the parent. Every cell of a human body contains an exactly identical copy of DNA. Cells talk to each other. Some cells speak with neurotransmitters or hormones. There exist many other forms of communication, the conversational media.

Through a special kind of cell division, a sperm or an egg is produced. Every human male sperm or female egg has 23 chromosomes each, containing about 3.1 billion nucleotides in a (sperm or egg) gamete. Reduction in the number of chromosomes exactly to half for every pair takes place by random assortment of breaking, mixing and shuffling paternal and maternal genes (called crossing-over or recombination). Any one chromosome in a sperm or egg would be a patchwork (a mosaic) of maternal genes and paternal genes. Every sperm or egg is therefore unique. The average over several millions of sperm or several hundreds of eggs usually results in an even representation, a fair lottery. Most mutations happen during the process of breaking, mixing, and shuffling.

The union of a sperm and an egg generates a new cell which again has exactly 23 pairs of chromosomes. In each pair, one is of paternal and the other of maternal origin. The freshly fertilized egg of a human and that of a chimpanzee are indistinguishable. It is possible for a specific gene to live, in the form of copies, for a hundred million years and be actually immortal.

All the cells of every individual have one gene of paternal and one of maternal origin for each type of gene. The paternal gene for eye color may be blue while the maternal gene may be brown. Then either one of the two genes dominates the other or the two genes make some kind of compromise, such as a bluish-brown eye. The genotype represents the genes that an organism inherits, and the phenotype represents the traits that an organism shows.

Most of our cells contain hundreds or thousands of mitochondria that generate energy for growth and maintenance of cells. Only the egg passes on mitochondria to the next generation, along with their tiny but critical genomes. Hundreds or thousands of copies of mtDNA are therefore transmitted to the progeny by the mother. By contrast, there are only two copies per gene in the nucleus of a new cell (the freshly fertilized egg) generated by the union of a sperm and an egg: one from the mother, the other from the father.

Mutation results in a new gene that is slightly different from the old gene; the different types (like the brown eye and the blue eye) are called *alleles* of that (eye color) gene. Due to mutation, we can recognize many different forms, the genetic markers called *alleles*, for each gene. A specific mutation rarely reoccurs in another individual, and hence there is only one individual in a given population carrying a new mutant allele. It is not transmitted to descendants (to have evolutionary consequences) unless it appears in sperm or egg cells (gametes). Acquired characteristics such as knowledge and wisdom are not inherited.

In clonal reproduction, an organism produces an exact replica of itself. Bacteria have clonal reproduction, but maintain genetic integrity through (asexual) lateral gene transfer. Unlike bacteria that lack a nucleus, eukaryotic cells with nuclei have sexual reproduction that is good at eliminating copying errors and preventing a mutational meltdown. The advantage of sex lies in the recombination of DNA from distinct sources that may help to eliminate damaged genes and foster variety, keeping one step ahead of inventive parasites, or rapid changes in environmental conditions.
See Lane (2005: 153).

If a gene is damaged, it will affect the protein's function, unless it can be masked by a second, undamaged healthy copy of the gene in question. Too many or too small a number of specific cells may then be produced. A number of diseases are caused by the damaged biochemical control mechanisms that switch the genes on and off. Cancer, for example, arises because of changes at the

DNA level.

With two copies of each chromosome, cells have an insurance policy against the effects of mutation (including the effects of so-called *imprinting*—one of a pair of chromosomes somehow being silenced). If a gene on one chromosome has an error, there is another copy available. For most genes, one good copy is all we need.

A new allele can become more and more frequent in succeeding generations. The proportion of a particular allele (i.e., gene frequencies) caused by a specific mutation in a gene varies from population to population on earth, and the greatest variation occurs at large distances. The study of frequencies of the different forms of a gene focuses on the behavior of a very short segment of DNA. The structure of a long DNA sequence is more likely to be split by crossing-over or altered by mutations. We see a lot of breaking and reshuffling for any two genes that are far apart on a single chromosome. Hence a gene is defined as a little bit of chromosome which travels intact through a generation without being merged with other genes.

Genetic distance between two individuals is obtained simply by counting the number of mutations that make an individual different from another. Genetic distance between populations is the difference between percentage frequencies of the form of a gene. Since people tend to find spouses from a short distance away, genetic distance between two populations tends to increase with geographic distance. For most genes, however, the frequency differences between populations are very slight and their contribution to the global genetic distance between populations is close to zero. The variation of any gene marker between two individuals randomly selected from the world's population is less than twice larger than the variation between two random individuals within one population.

Close species with recent common ancestors have fewer

discrepancies in molecular sequences than distant species. The age of the common ancestor tends to be proportional to the number of molecular discrepancies. The molecular clock based on reliably dated fossils and the "average" rate of genetic drift (obtained from the changes in a large number of different genes) in a wide variety of species can estimate the time since the divergence of present-day species from a common ancestor. That is, if we know how many typos a typist makes per minute, we can calculate how long it took the typist to finish typing a document by simply counting the number of typos. Since the DNA of living chimpanzees and humans differ by about 35 million chemical letters, scientists guess that the two lineages split about 5 million years ago.

Some genes have a high mutation rate and consequently have a higher number of alleles. For instance, due to the great geographic variation in infectious diseases, the immunoglobulin genes (which produce antibodies) tend to show greater variation. Hybridization of a single gene implies that an individual receives "different forms" of a gene from his father and mother, as in our example of eye color. The "hybrid vigor" generally increases resistance to disease. If a mutated gene for a disease is recessive, the individual will not have the disease if one of the two copies is normal. Two first cousins, for example, could have both received a copy of a rare recessive gene from the same grandparent. If both are carriers, possessing one normal copy, then there is a one-in-four chance that their union will produce a child with two copies of the rare recessive gene, and thus have the disease. We can understand why inbreeding should be avoided.

Some scientist asked the women to rate the smell of sweaty T-shirts previously worn by a variety of men. It was found that women preferred the scent of a T-shirt worn by a man whose genotype was most different from hers, possibly indicating that women are programmed to try to maximize the strength of the immune system of her offspring, the hybrid vigor.

Bacteria, viruses, and parasites keep waging the

evolutionary war game by mutating constantly to evade human defenses. Somehow these creatures make numerous mistakes in copying their own genetic information, resulting in wide range of different mutants. Ironically, they become more drug resistant and more difficult antagonists to track down because of their very inefficiency and shoddy copying practices.

Viruses depend on other living organisms and cannot exist without them. They remain inert until they infect a cell, and then replicate themselves using the energy and cellular machinery of the infected cell. A parasite may well benefit from killing its host and moving on to another, but can gain nothing from killing its supplier when it has no means of finding another host.

Chance can cause important fluctuations in the frequencies of types of genes found in different villages of small populations (called founders' effect). The effect of chance in evolution is called "random genetic drift." "Survival of the fittest" becomes "survival of the luckiest."

An individual with a favorable genetic type is more likely to have advantages in the struggle for existence and to survive until sexual maturity and reproduce more children, and hence prevail in the end. The advantageous genetic variant tends to be passed on to the next generation. Through natural selection, every member of the species eventually ends up with that beneficial characteristic.

DNA reproduces by making copies of itself. By pure accident, a copying error makes an individual better adapted to its environment, and hence makes it more likely to survive into adulthood and reproduce, so it can pass its genes on to later generations. As generations pass, genes that are good at building bodies to survive and reproduce become more frequent in the gene pool. New variations are added to the gene pool by random mistakes that occasionally turn out by chance to be good.

From the gene's eye view, successful genes are those which

have such beneficial effects, enabling those very same genes to have a greater representation in future generations. Genetic adaptations of a particular allele, called the "fixation" of a new mutant, occur through genetic change (called mutation) and natural selection, which differ in different environments.

The spread to the population of an advantageous gene (that appeared by a mutation in a single individual) is estimated to take anywhere between 1,000 years to 100,000 years. American Indians have almost 100 percent O blood type frequency thanks to its resistance to syphilis. Over time, those with the blood types A or B became dead Indians. They could leave no descendants. The most conspicuous human differences of genetic origin are height and color of hair, skin and eyes, attributable to genetic responses to different climates. The bodily manifestation of a gene is called a *phenotype*. Such differences are not fatal, and hence there is no world-wide fixation. Scientists have found that among the 55 genes which had localized evolution, six control skin pigment and hair development, four help immune system combat disease-causing organisms, six regulate metabolism in response to different diets, nine have various odd jobs, and the remaining 30 locally selected genes have functions yet unknown.

A gene called PDYN affects the brain's chemistry (neurochemicals) that underlie perception, behavior and memory. PDNY began accumulating mutations 7 million years ago, soon after the lineages of hominid and gorillas split. A hormone called oxytocin promotes trust and cooperation. Changes (in hominid) in the gene that affects oxytocin increased its production and also strengthened brain's response to it, settling hominid into a system based on enduring bonds between men and women about 1.7 million years ago.

A gene called HAR1 (that affects the geometry and layout of neutrons) is present in animals from chickens to chimpanzees to humans. It had changed in only two of its 118 chemical letters from 310 million years ago (when the lineages of chickens and

chimpanzees split) to 5 million years ago (when the lineages of hominid and chimpanzees split), but 18 letters changed ever since. Such a high rate of change in HAR1 during the last 5 million years suggests that hominid went through difficult times in unfamiliar hostile environments after their split from the chimpanzees. From the viewpoint of HAR1, the period between 310-5 million years ago was peaceful, and genetically nothing much happened. Earth, however, became extremely colder and drier 6.5 million years ago, providing a turning point in evolution. The apes that stayed in the forests hardly changed. On the other hand, for hominid that ventured into dry grassland in the East African savanna, only those with genetic advantages could survive the natural selection. They were more often prey than predators. They came to have a brain bigger than a chimpanzee's, make stone tools, and use fire. All sorts of hominid had appeared, but there occurred as much as 18 "fixations," and those human branches with less than 18 changes in chemical letters of HAR1 died out. Only Homo sapiens survived.

Fossil cannot tell when Homo sapiens lost their body hair and replaced it with clothing. Body lice that live in clothing evolved in less than 114,000 years ago from head lice that live in the hair on the head. Perhaps that's when Homo sapiens lost their body hair.

Genes are capable of self-development through mutations and natural selection. Natural selection in the form of survival (mortality) and fertility (reproduction) is the automatic process, though clumsy, of sorting out and favoring useful mutations while eliminating deleterious ones. It thus makes possible the functional improvement and accumulation of useful mechanisms in living organisms.

The competition for survival occurs not only among individuals within a species, but also between members of different species. The end result is not only the selection of some individuals as against some other individuals in given populations but also the selection of some species over other species.

Darwin believed that natural selection works solely by and for the good of each being, and hence all genes, by maintaining variations most useful to an organic being; preserving, accumulating and inheriting the good, and beautifully adapting each form to the most complex relations of life, will tend to bring about progress towards perfection.

Humans are now capable of not only cutting, pasting, and copying genes for molecular cloning, but also editing and rewriting the information in DNA to build custom proteins, engineering bacteria to produce hormones, adding genes for disease resistance to plants, inserting useful genes into human cells, and culturing cells into artificial tissues. We can read directly the DNA letter sequences or indirectly the amino acid sequences of protein into which DNA information is translated.

Migrations (called gene flows) keep reducing differences of genetic origin among populations. Natural selection works on mortality and fertility. If the progress in medical science reduces pre-productive mortality to zero, and if everybody gets married and has two children, then we might expect that there would be no further natural selection and biological evolution. In fact, however, evolution will not be stopped. Sexual selection produces offspring with better genetic traits. When it comes to sex, they say that males tend to be keener for it, females choosier about it.

Every cell of our body is stamped with an identical set of DNA unique to each individual; a human bar code. The difference in gene frequencies among the people of a specific region or nation is usually very small and, since mutation is rather rare, the difference among kinfolk or between the parent and child is extremely small.

The Human genome consists of 3.1 billion pairs of letters strung in a sequence over 23 pairs of chromosomes. Human genomes are largely identical, but there are about 10 million points in the sequence (0.00164%) where our individual codes can vary.

These tiny discrepancies (known as polymorphisms) can be important markers of, say, disease risk. Genetic variations linked to disease are sprinkled across 0.01 percent of the 23,000 human genes. So far, the gene-disease claims have a lousy track record. More often than not, the variants (i.e., spelling of A, T, C and G that are different from the norm) do not increase risk of disease as claimed. In terms of statistical probability, there may be extra risk due to a genetic variation, but nothing is definite and hence we do not have to be genetic fatalists. After all, the fact that identical twins (who have identical genomes) are identical for disease only 60 per cent of the time on average shows that a person's destiny is not completely written in his or her particular DNA sequence.

In 2005, the president of Harvard University stirred up a firestorm by suggesting that differences in intrinsic aptitude, rather than extrinsic social discrimination, may be the reason the university has fewer females in the sciences and engineering than males.

A person's sex is determined by two bundles of genes called X and Y chromosomes. Women have two Xs, while men have one X and a Y. A woman inherits two X chromosomes, one from each parent, while a man inherits an X from his mother and a Y from his father. The Y has only about one hundred genes, while the X has over 1,000 genes. These sex chromosomes originated between 230 million and 300 million years ago, evolving from the same non-sex chromosomes in some ancestral species.

Because women have their sex genes written in duplicate, they always have a second chance for a correct version. This means they are less prone to sex-linked genetic defects. Such defects explain why the birth rates between boys (49%) and girls (51%) are not equal, and males have a higher incidence of mental retardation.

In each individual female cell, one of the two X chromosomes is randomly activated. Scientists have thought that the extra X chromosome in females shuts down, while the other

works alone. It has been found, however, that about 200 genes that are expected to be switched off (so that they do not produce protein) actually escape inactivation and remain active. This means that in female cells about 20% of activated genes exist in higher concentrations. Another 10% are sometimes inactivated, and sometimes not. So some women might have a single dose of these genes while others will have a double dose. The pattern in which these 10% of genes activate is different in every woman, and the pattern of expression of these genes is unique. Expression heterogeneity implies that women can be genetically more complex and variable than men. Since somewhere between 200 to 300 genes can be uniquely expressed in women, women differ widely from one another. Men, by contrast, have only one active X chromosome plus a few genes on the puny Y chromosome.

Genetic variations have a huge impact on the brain. When navigating a maze, men tend to think spatially, while women look for landmarks. Brain scans of men and women engaged in rhyming words show that they use different brain circuits to perform the same task. Women also have 15 to 20 percent more ordinary neurons than men. And their long neurons (that help the brain distribute its processing tasks) are concentrated at the juncture between the brain's left and right hemispheres, and help women use both sides of their brain for language related tasks.

The genetic difference between men and women amounts to about 1 percent. Considering that the genetic makeup of chimpanzees and humans differs by only 1.2 percent, the difference is significant. Men and women differ genetically almost as much as humans differ from chimpanzees. One may say that there are two human genomes, one for men and one for women.

Newsweek, March 28, 2005, pp. 40-1, and *The Economist*, March 19th, 2005, pp. 76-7.

Many evolutionary psychologists have contended that a man hates to expend his scarce resources on genetically unrelated children, and hence natural selection has shaped the male brain to respond to sexual infidelity with intense jealousy. A woman, knowing that she is the mother of her children, faces no such risk.

A woman tends to believe that men can have sex without being in love. Therefore, she faces the threat that a philandering mate may divert his resources to another woman and her children and is likely to be having sex with her. For this reason, women have developed an innate psychological module that is sensitive to emotional infidelity which, they believe, is worse than physical, sexual infidelity. This theory, however, seems to be supported only by self-reports of college students and not by surveys of unfaithful adults. There is as yet no evidence for the hypothesis that men and women have innately different responses to the two forms of infidelity. Christine R. Harris, "The Evolution of Jealousy," *American Scientist*, Vol. 92, No. 1, 2004, 62-71.

When psychologists say "most people" they usually mean "most of the two dozen sophomores who filled out a questionnaire for beer money."

They say that "women feel sexiest when ovulating. A fertile woman emits a signal that she is physiologically ripe to conceive. Men are, supposedly, genetically programmed to detect the signal—since being drawn to a fertile woman is something evolution and natural selection would favor. [Men] are more amorous when women are ovulating [to] survive the brutal winnowing process of natural selection. It was probably a mistake to let scientists anywhere near the topics of love and lust. Just as analyzing a joke kills it, so analyzing why we fall in love with those we do was bound to end badly. Consider the idea that aging professors attract their nubile young female students because young women are genetically programmed to fall for high-status, well-off men, [while] aging men are supposedly wired to be attracted to fertile young things. Not your fault; blame the genes that program men to spread their seed widely. Men's taste in women is also supposed to reflect evolutionary selection. [But] Rubenesque woman is nothing like the [21st century] ideal. Genes do not evolve fast enough to account for that change in male tastes. Let's celebrate all the ways our hearts and minds, not our mindless DNA, guide us in the ways of love." Sharon Begley, *Newsweek*, February 18, 2008, p. 50. [Rearranged]

Genes can be deactivated by tagging either the genes themselves or the histone proteins around which genes are coiled with chemical suppressors. When a cell is divided, the pattern of suppressors --the epigenome-- is often replicated. Epigenetics is crucial for aging, cancer, and mental health. While genetic mutations are hard to correct, epigenetic changes can be reversed easily by adding or removing the chemical tags involved.

The moral senses such as compassion, shame and guilt are expressed in a small number of species, and are most conspicuous in human. The area of the brain called ventromedial prefrontal

cortex (VMPC) that regulates moral judgment is much bigger in humans than in other mammal species. We can only guess why it evolved the way it did. Moral judgment is not a single, rational process without conflicts, as often assumed by the moral philosophers. Neuroscientists and evolutionary psychologists believe that minds are composed of all sorts of modules evolved for given purposes. The moral-decision module either overrides or is overridden by the calculating-utilitarian module, making a person sometimes an angel, sometimes a devil and more often simply confused.

RNA could have been the first genetic molecule capable of self-replication, performing the function of both DNA and protein. RNA is simpler than DNA, and can be put together in a test tube, bringing us to believe that RNA may once have formed spontaneously in space. Plenty of organic molecules, including some of the building blocks of RNA, have been found on comets. The sun is a source of energy. RNA can replicate itself (with input of energy), and can also code for proteins directly, providing a link between template and function. RNA folds into complex shapes and catalyzes chemical reactions like enzymes.

See Lane (2005: 94-5).

Many scientists have believed that the origin of life could have been a primordial RNA world, in which natural selection acted upon self-replicating RNA molecules until they were "displaced" by the combination of DNA and proteins, demoting themselves to the mundane task of fetching and carrying. New discoveries, however, suggest that RNA is now the cell's operating system as well as the author of many other activities. All sorts of animals, be they worms, flies or people, have only around 20,000 protein-encoding genes. The RNA operating system of the cells, however, gets bigger with each advance in complexity of organism. The RNA is running each cell and also linking up with other cells. In a human, the number of different microRNAs may be as high as 37,000. About 8% of the microRNAs that are expressed in the human brain are unique to it, and different from those of chimpanzee.

Some types of regulatory RNA even edit other kinds of RNA. RNAs are active both inside and outside of the cell's nucleus. RNA has the power to turn off an entire chromosome, and control the production level of many proteins simultaneously. RNA seems to regulate the activity of more than a third of protein-encoding genes, the managing operation of cells, the highest level commands, and quite likely also the process of evolution (of life's complexity) itself. Some RNA molecules help to direct subtle chemical modifications to DNA. Such modifications make it harder for a cell's code-reading machinery to get at the affected region of the genome. The RNA drugs stops the production of disease-related protein at source, whereas most medicines try to mop up a continuous leak.

In response to an external shock, such as the environmental stimulus, RNA can change the effective composition of the DNA itself in a way similar to an actual mutation, and sometimes even stimulate the real mutations, rewriting the DNA hard-drive. It may imply that we would not be able to get off the hook simply by saying that "my DNA made me do it!" The recutionist explanations for human behavior became so popular, but one's fault may still lie in one's acquired character and nurtured moral compass, and hence one may not be able to blame always the DNA having programmed the unconscious drive of human behavior as…whatever.

RNA sometimes carries genetic information down the generations independently of DNA, by hitching a lift in the sex cells, which might make the inheritance of characteristics acquired during an individual's life time possible, optimizing the RNA software. It sounds like the discredited pre-Darwin idea of Jean Baptiste Lamarck that the experiences and traits acquired during a lifetime are passed on to the next generation. An environmentally induced changes, even as a random process subject to natural selection, can sometimes turn out to be beneficial for genetic survival.

7

The Gene is the Basic Unit of Selfishness.

Many biologists and economists regard life as a game. Assessing the behavior of others, both humans and non-humans choose a game, deploying different strategies for their own self-interest. A player may co-operate with his opponents in order to maximize group benefits, or he may free-ride, or he may reciprocate (giving tit for tat, or quid pro quo). Biologists speak about evolutionarily stable strategies. Economists speak about utility-maximizing behaviors of "rational" humans that may or may not be evolutionarily stable strategies.

Adam Smith contended that things work best when everyone is following his or her self-interest. He believed that an "Invisible Hand" stood behind individual selfish actions, maximizing benefits for the group. Darwin's writings were also embedded in the (natural) theological assumption of (deist) God. To believe in the optimality of the game theoretic solutions among selfish individual participants, however, one may have to believe in the existence of a Divine Designer.

Adaptation may be always for the benefit of the individual, rather than the group or species. From the perspective of an individual, most of its actions may make sense, but from the perspective of a group, many of its actions may not make any sense at all. More often, it is possible to make quantifiable predictions on the basis of the individual selection hypothesis and confirm predicted actions, but such actions may not make any sense from a group perspective.

Humans have a tendency to see events as caused by intention, leading us to believe in gods with superhuman powers. Dawkins believes that natural selection always favors the individual's benefit over the group's benefit, and there is nothing inherently progressive about evolution. The division of labor and cooperation among molecules, genes, or individuals is simply the game played among myopic and selfish participants. Due to the lack of perfect knowledge, even the game theoretic solution among far-sighted and wise participants does not necessarily lead to an optimal result for the group. There is no proof that the course of life's history is progressive.

Replication requires an input of energy. The first law of thermodynamics is that energy can be converted from one form into another, but never created or destroyed. Steam engines show that heat and mechanical work are interchangeable. The bonds of molecules like glucose contain potential energy that can be converted into the biological energy which may be immediately channeled into work or conserved in a different form (called ATP) ready for work. The combustion of glucose in respiration is an electrochemical reaction called oxidation. Oxygen (O) gains two electrons (together with two protons H^+ to balance the charges) from glucose, and is then reduced to water (H_2O). Oxidation (implying that a molecule such as iron is losing electrons) and the simultaneous reduction (implying that another molecule such as oxygen is gaining electrons) is called redox reaction. The energy released by redox reactions generates ATP. Electrons and protons are stripped from food, and react with oxygen to provide biological energy.

Only bacteria (that lack a nucleus) existed between 3.8 and 2.7 billion years ago, and then a few primitive eukaryotic organisms (complex cells that harbor a nucleus) appeared 2.7 billion years ago. Eukaryotic cells with mitochondria appeared about 2.2 billion years ago. The eukaryotic cells began to merge and cooperate, and then about 600 million years ago there appeared the full-fledged multi-cellular organism.

All eukaryotes are related, and they share exactly the same genetic ancestry. They either have, or once had, mitochondria—a parasitic bacterium with amazing energy conversion capacity. The eukaryotic cell maintains a predatory life style and provides parasites with a supply of food. Parasites benefit from keeping their host alive. A bacterium (called archaeon that lacks a nucleus) appreciated the energy-conversion capacity of parasitic mitochondria, and co-opted its useful capacity, evolving into modern-day eukaryotes with nuclei. Mitochondria transferred 95-99.9 percent of their genes to the nuclei, retaining a few genes necessary for their newly defined function. Large size and morphological complexity became possible once energy conversion had been internalized in mitochondria. There are economies of scale that lower the cost of living --in the form of the quantity of food and oxygen needed to sustain every cell. The energy efficiency of larger size lowers the necessary metabolic rate --defined as the consumption of oxygen and nutrients. Powered with mitochondria, eukaryotic cells are able to escape the small world of bacteria.

See Lane (2005: 22-5, 28, 40, 45-6, 72-3, 105, 137, 153-4, 157) and (2002: 36).

Bacteria remained single-celled, and showed no tendency to become more complex, although their biochemistry is far more sophisticated than anything eukaryotes can muster.

The multicellular individual is made up of cells that collaborate. Every cell within the individual organism shares identical genes derived from a single parent cell, the fertilized egg. Cells cooperate with others to pass on the identical genes they share to the next generation. There is, however, the question of the level at which natural selection operates. Neither the individuals, nor the cells, not even the chromosomes are passed on from one generation to the next; only the genes persist. An individual may be regarded as a colony of "genes" that are collaborating to serve their own selfish end of being copied in ever greater numbers. "Genes are competing directly with their alleles for survival, since their alleles in the gene pool are rivals for their slot on the chromosomes of future generations. The gene is the basic unit of selfishness."

Dawkins (1976: 39)

Some microbiologists, however, regard the whole tapestry of evolution as woven by the collaborations of single-celled bacteria, and hence regard the cell as the basic unit of selfish evolution, at least in bacteria. Bacteria replicate clonally, and the individual cell persists from one generation to the next. In clonal replication, all the genes are passed on together, so there is no distinction between the fate of the genes and the fate of the cell. When bacteria need extra genes, they can get them through lateral gene transfers. When they find some genes that are not needed, they thrust out them in order to speed up the replication process. Bacteria behave in terms of the costs and benefits to the cells themselves, not the genes. See Lane (2005: 191-9).

A multicellular colony—a colony of cells—offers an advantage (of division of labor and specialization) over the free-lance or free-living individual cells. We can still observe primitive colonies of cells in water that are capable of reproducing sexually or asexually by fragmentation. About 600 million years ago, the primitive colony of fiercely independent and selfish cells (in the name of mitochondrial bacteria or eukaryotic archaea), that never completely renounced the possibility of a return to free living, at last agreed on a genuine merger, compromising all sorts of vested interests of different cells under the stark environmental realities the cells found themselves in, subject to a common method of reproduction: multicellular individuals as a whole can replicate only by sex. Except genes, neither the multicellular individuals nor any of the individual cells, not even individual chromosomes, should persist from one generation to the next. A war of parasites must be prevented, the damaged cells must be eliminated, and the urge for free life and independent sex must be policed by apoptosis -- programmed cell death. Every cell within an individual organism became genetically identical, the possible source of reproductive inequity in a multicellular colonial life was eliminated, and therefore a cell has to accept the death penalty if it steps out of line and jeopardizes the survival of the multicellular organism. For better or for worse, they made a true commitment to the multicellular way of life. One may point out the reckless replicating behavior of a

cancer cell or may charge that mitochondria have preserved the lion's share of vested interests (by passing on their core genes to the next generation intact), but after all, nothing on earth can be perfect. "Ironically, the long battles between individual cells that ultimately gave rise to the multicellular individual may in the end have crowned a different victor, who slipped in through the back door: the gene." Lane (2005: 226).

Either the "selfish gene" or the "selfish cell" may be the ultimate unit of selection, or perhaps there exists a third entity (the ultimate ruler of life) that owns and operates the chemical factory called cell, complete with the information center called nucleus, and yet has somehow escaped our notice. Who then is the ultimate ruler of life? Can it be chemically inert?

They say evolution is not ruled by the chance of contingency but the necessity of convergence. Some people think that the evolution of humanity is an inevitable outcome of universal laws, the precise weightings of the fundamental constants of physics. If this is so, then the insights into the innermost workings of nature are the window into the mind of God.

There may be no designer, and life may be a pitiless process without any ultimate meaning. Evolution of multicellular organisms may be the blind working of natural processes, going nowhere. The laws of physics and the fundamental constants of the universe happened to allow physics to mature, via stars into chemistry and via planets into biology. But the "anthropic" notion that these must have been deliberately premeditated from the start, calculated to bring humanity eventually into existence, regresses to explaining the existence of the equally fine-tuned Premeditator. Stars brought atoms heavier than lithium into existence, but stars cannot be said to exist to make us. Dawkins (2004: 2)

8

The Flower That Once Is Blown For Ever Dies

"Into this Universe, and Why not knowing,
Nor Whence, like Water willy-nilly flowing:
And out of it, as Wind along the Waste,
I know not Whither, willy-nilly blowing."

This is Quatrain 32 of Edward FitzGerald's *Rubáiyát of Omar Khayyám* (the second version published in 1868). It has remained in my mind ever since I learned it, together with a dozen other quatrains, from an English professor in my freshman year.

"Oh threats of Hell and Hopes of Paradise!
One thing at least is certain – This Life flies:
The Flower that once is blown for ever dies."

This is Quatrain 66 of the *Rubáiyát*. Somehow, my mind refuses to remember the third line that reads: "One thing is certain and the rest is lies." A psychoanalyst could perhaps help me to understand why. My subconscious somehow seems to believe that the deletion of that line improves the poem.

The fact that the *Rubáiyát* is also one of those masterpieces almost totally neglected by its contemporaries may console the innumerable frustrated authors (of whatever) in despair.

9

An Encounter with an Alien (?)

I have recently been engaged in internet chatting with someone who claims that he resides in a planet called Atma that is one billion light-years away from the Earth. I guess people confined to lunatic asylums have access to PCs these days. Anyway, what he tells about the history of Atma sounds interesting, and quite thought-provoking. The following is a sketch of what he is saying.

About 20,000 years ago, there was a savage nuclear holocaust that almost extinguished the people on Atma planet, annihilating 99.9 percent of them. It was sheer luck that those 0.1 percent who survived could rebuild the planet in the aftermath of such wholesale destruction. In order to eliminate any possibility of repeating such a tragedy, they undertook a thorough genetic reengineering of people's brains, coupled with a very systematic indoctrination of every person on the planet. In due course, everybody on Atma came into possession of personal traits and instincts that are more peaceful than those of a lamb on earth. Everybody also being equipped with the faculty of utmost rational thinking and profound wisdom, the people of Atma no longer felt the need for weapons of any kind, and at last decided to extinguish the entire existing weapons system. It turned out to have been a grave mistake.

About 10,000 years ago, the planet Atma was attacked by savage souls from another planet who were rather primitive but well armed with what seems to have been an antiquated and yet quite deadly weapons system. Once again, by sheer luck, some staff

members working in an archeological museum managed to resurrect the museum's display of weapons, and proceeded to annihilate the invaders. However, by the time they could demolish the home base of the invaders, less than one percent of the Atma people had survived the savage onslaught. Again, in order to prevent a repetition of such a tragedy, they established the defense department and put the entire universe under a close surveillance. Certain potential sources of invasion were annihilated by preemptive strikes.

The Earth was spotted about a thousand years ago, but it was a rather harmless existence and hence was put in the custody of the anthropology department to which my internet correspondent belongs. With the human navigation system based on three-dimensional physics, the humans will never be able to reach Atma. Even with the Atma navigation system based on multi-dimensional physics, it takes one full year to reach the Earth. The human mind will never be able to understand multi-dimensional physics. (By the way, adding the time dimension to the three spatial dimensions does not make a truly multi-dimensional physics.) The anthropology department of Atma has for some time been engaged in the task of reconstructing the pre-nuclear-holocaust culture on Atma, and the observation of Earth has provided them with a lot of valuable insights. Some faculty members of the department were, however, strongly against the idea of communicating with someone on Earth, because such a rather personal pastime might cause some detour from the natural trends on Earth, reducing the reference value of Earth's own experience. But, in the end they allowed my correspondent to experiment with an obscure creature like me. The members of the research committee were persuaded by him that revealing information about Atma to the editor of New York Times or Washington Post might have some serious consequences, but no one would believe the story if told by a humble creature like me. Surely they would consider me to be just one of those UFO or Star Wars freaks.

On Earth, a human clone is now created by extracting the

DNA from, say, skin cells, fusing the DNA to the egg of a female host using an electric-current, and then implanting it into the host's womb. According to my correspondent, the art of genetic repairing and maintenance in Atma has reached such a height as to enable everybody to live a thousand years, and then biologically reproduce itself inheriting all essential memory and traits, though many small details are nonetheless lost in the process of genetic reproduction. The people of Atma are already enjoying a quasi-permanent life, but their scientists are predicting that within 10,000 years from now, the art of genetic reproduction will be perfected and then everyone on Atma will be able to enjoy a truly eternal life with a fresh and permanently young body. He says that he has recently obtained on line an e-book on the mythology of Greek Gods. He finds them rather amusing stories.

I have told my correspondent that, at least on the level of genes, homo sapiens may be said to have been enjoying a quasi-permanent life also. But apparently he does not seem to have been very much impressed by our system of reproduction via sperm and eggs. Perhaps he is trying to say that life on Atma is not based on a DNA system identical of ours, or perhaps he is emphasizing the fact that the people of Atma are, as individuals, achieving immortality, not just in spirit but in the flesh.

One thing at least seems to be certain. Whatever the degree of his insanity, the self-styled alien whom I have been chatting with is surely a learned person. Who knows, the lunatics in his asylum may include many celebrities in the class of Plato, Charles Darwin, Isaac Newton, Miguel de Cervantes, Albert Einstein, George Lukas and Steven Spielberg.

10

The Ultimate Fate of Homo Sapiens: Extinction

Around the time when the most recent Ice Age ended, about 10,000 years ago, there began the agricultural revolution, in the fertile crescent between the Tigris and the Euphrates, that brought the new stone age, the Neolithic, and eventually changed the entire nature of human life by way of a more elaborate division of labor and specialization. Agriculture supported larger populations than the hunter-gatherer mode of life with a huge surplus value, but ironically introduced slavery, and quite often enhanced the misery of human life *à la* Karl Marx.

Homo sapiens sapiens looks like the apparent ruler of the earth now, but it is still engaged in the evolutionary arms race against micro-organisms. Observing the alarming spread of resistance among pathogens that cause disease, some scientists believe that micro-organisms now constitute the only real threat to human existence.

Homo sapiens, with its creative modern human mind,
has shown a love of beauty, compassion, and gentleness,
and also a sense of justice. And yet,
even after such a long process of evolution,
there seems to be a capacity for savage violence
still remaining in some part of human brain
that can never be contained,
so that human society is unable to be free from
the cruelty that comes from
extreme selfishness and self-righteousness.

Let us have a look at

the most conspicuous landmarks of human evolution
that may reveal the speed of
evolution in the human mind.

The Historic Age of homo sapiens began about 5,000 years ago.
But slavery was maintained
in Britain until 1833,
in France until 1848,
in the United States of America until 1865,
and in Korea until 1894.

British wives secured the right to own property
only by 1870.

Women acquired the right to vote in national elections
only by 1918 in Britain,
by 1920 in the United States of America,
by 1945 in France,
and as late as in 1971 in Switzerland.

Thanks to technological breakthroughs,
an NGO with only a handful of fanatic followers
will be able to command WMD
on a global scale in the near future.
Alexander the Great or Osama bin Laden
will then look like a hero or villain in a bucolic fairy tale.

I wonder if the human mind
can evolve fast enough to cope with
the rapid spread of dirt cheap WMD among fanatics.

Some 99.9 percent of all species
that have ever lived on earth are now extinct.
The better adapted a species is
to a specific environmental niche,
the more likely it is to die out

if that niche changes or ceases to exist.

One may believe that natural selection brings about perfect adaptation. One may further believe that a master designer designed evolution so as to take humans upward and onward: every life on earth may be extinguished someday, but at least the ultimate fate of homo sapiens may not be extinction. Pessimists, however, say that there is no reason to believe that the course of life's history is progressive. Just look at what happened at the Abu Ghraib Prison in 2004! Many people thought that humans would never again have an Auschwitz.

I wonder whether human civilization
will soon become extinct by self-destruction, or
whether homo sapiens sapiens will be able to survive,
or at least avoid a premature extinction,
by mastering the art of peaceful coexistence
among billions of savage souls,
before it is too late.

11

Human Mind and Human Destiny

Herr Doctor Professor Faust:
"I have pursued, alas, philosophy, 354
Jurisprudence, and medicine,
And help me God, theology,
With fervent zeal through thick and thin.
And here, poor fool, I stand once more,
No wiser than I was before."359

Mephistopheles: "I'll give you
what no man has seen before."1674
"Through eighty years to stay forever young!" 2361
Faust: "Spell out just what the bargain turns upon."1654
Mephistopheles: "You are to give me equal worth."1659

Faust: "She is so dutiful and pure, 2611
Yet not without a pert allure,
Her rosy lip, her cheek aglow, 2613
Her glance's timid downward dart, 2615
But how she was so short with me— 2167
That was consummate ecstasy!"2618

Mephistopheles: "You'll have your Gretchen
before long."3027
Margarete: "I stand and gape in shy distress, 3213
And all I find to say is Yes.
I'm such a poor young goose, and he –
The Lord knows what he sees in me."3216

Verse numbers in Faust (translated by Arndt in 1976) are given after each line.

Faust seduces and then abandons Gretchen who represents Christian virtues, though susceptible to material temptation and sexual desire. She advances from innocence to despair, to madness and then to destruction, reflecting the injustice of eighteenth-century society and reminding us of *Tess of the D'Urbervilles* (1891) by Thomas Hardy (1840-1928) or the story of Kachusha in *Resurrection* (1899) by Leo Tolstoy (1828-1910).

Johann Wolfgang von Goethe (1749-1832) finished writing the *Tragedy of Margarete* ca. 1772-75, when he was in his early twenties. While he was writing this tragic story, he also wrote *The Sorrows of Young Werther* (1773-4), a story of unattainable, perfect love.

Goethe kept Faust at his side during the rest of his life, writing the second part and revising the early version, completed on January 29, 1832, 52 days before he died (on March 22, 1832). The Second Part represents a tragedy of a very different sort, focusing on the nature of the human mind and human destiny in general.

Faust's mythical quest for the ideal of feminine beauty, incarnate in Helen of Troy (taken from Sparta), represents a journey inward to the realm of unconscious yearning. Faust, as representative of all men, withdraws to a timeless Arcadia with Helen, fulfilling the human aspiration for love and happiness. I am not so sure whether Mephistopheles actually represents the devil or simply a magic wand. Anyway, the idyll ends abruptly, Helen vanishes, and Faust must return to reality.

Helena: "Love, to lavish human blessing, 9699
Links a noble pair-to-be;
Godly joy to be expressing,
He creates a peerless Three."

Faust: "I am yours and you are mine; 9704
See us interwoven tightly
As we must by love divine."

Helena to Faust: "An ancient truth,
alas, is proved once more through me: 9939
That beauty and good fortune are but fleetly joined.
Severed is now the bond of life like that of love,
Lamenting both, I grievingly pronounce farewell!
And one last time I fling myself into your arms."

Faust returns to the tyrannical real world of deceptive politics, inhuman warfare and perverse techno-industrial endeavors that deviates from the theme of either love or even erotic desire. Faust expands the horizon of his being from private to public life, trying to change not only his own life but that of everyone else as well. As an organizer and developer attempting to create a utopia, taking advantage of the magic wand and the technological ideal of Industrial Revolution, Faust looks successful in acquiring the power, land and feudal rights.

Despite his formulation of a socio-religious humanistic faith, the demonic powers provide the means and measures for socio-economic development, and control the world. Faust suddenly becomes a blind and dying old man. He strives to finish the grand reclamation project to harness the sea for human purposes to the very end. The world Faust leaves behind at his death is in the hands of Mephistopheles and his demonic forces.

Faust's quest for a utopia with lofty intentions can end up in an evil empire. Idealism and aspiration represent dangerous subjectivity, self-righteousness, and alienation from reality. Questing for a down-to-earth utopia and social engineering, a Faust in real world can become a Napoleon at best and a Hitler or Stalin at worst.

By having Mephistopheles, Faust becomes free to commit an anti-Christian seduction, un-Christian union with the Greek Goddess Helena, and construction of an un-Christian earthly utopia. By emancipating himself from the narrowly defined Christian straight jacket, he obtains "what no man has seen before." At the end, he does not have anything more to see on this world, becomes a blind, and joins Gretchen, angels floating in the higher atmosphere, bearing Faust's immortal essence.

Angels: "Whoever strives in ceaseless toil,
Him we may grant redemption."[11937]

Jesus said: "I will give you that which eyes have not seen,
ears have not heard,
hands did not touch, and
minds have not conceived."

The Gospel of Thomas

The entire story of Faust is a phantasmagoria. Though the whole sequence is constructed and directed by the devil, it is a rather harmless daydream or fantasy that might help one to comprehend the real meaning of life, possibly even leading one to the ultimate enlightenment.

If *Faust* is a fantasy, it is definitely a masculine fantasy. A feminine fantasy would look more like *Jane Eyre* (1847) by Charlotte Brontë (1816-1855) or *Pride and Prejudice* (1797) by Jane Austen (1775-1817).

Katha Upanishad

Death. Take horses and gold and cattle and elephants;
choose sons and grandsons that shall live a hundred years.
Have vast expanses of land, and live as many years as you desire.
Ask for any wishes in the world of mortals,
however hard to obtain.
To attend you I will give you fair maidens…
But ask me not, Nachiketas, the secrets of death.

Nachiketas. All these pleasures pass away.
And indeed how short is all life!
When a mortal here on earth has felt his own immortality,
Could he wish for a long life of pleasures,
for the lust of deceitful beauty?
Grant me the gift that unveils the mystery.

Death. There is the path of joy, and there is the path of pleasure.
Both attract the soul. Who follows the first comes to good;
who follows pleasure reaches not the End.
Abiding in the midst of ignorance,
thinking themselves wise and learned,
fools go aimlessly hither and thither,
like blind led by blind.

When a man has understood and,
finding the essence, reaches the Inmost,
then he finds joy in the Source of joy.

Mascaró (1965: 57-60)

Beyond the senses are their objects,
And beyond the objects is the mind.
Beyond the mind is pure reason,
and beyond reason is the Spirit in man.
Beyond the Spirit in man is the Spirit of the universe,
and beyond is the Spirit Supreme.
He is the End of the path.

Awake, arise! Strive for the Highest!
Sages say the path is narrow and difficult to tread,
narrow as the edge of a razor.

The Atman, the Self, the Spirit of vision,
is eternal, and without beginning or end.
When consciousness of the Atman manifests itself,
man becomes free from the jaws of death.

Do not seek the eternal in things that pass away.
Who sees the many and not the ONE,
wanders on from death to death.
Who sees variety and not the unity,
wanders on from death to death.

Mascaró (1965: 61-63)

Stephen Hawking and Jim Hartle proposed the boundary condition of the universe that it has no boundary. They believe that the no-boundary proposal can explain why the universe is still so close to the critical rate of expansion, i.e., so close to the dividing line between collapsing again and expanding indefinitely. Because general relativity would break down at a singularity, anything could come out of the big bang. So why is the universe so homogeneous and isotropic on a large scale, yet has local irregularities such as galaxies and stars? In order to be as close as we are now, the rate of expansion early on had to be chosen fantastically accurately. If the rate of expansion one second after the big bang had been less by one part in 10^{10} the universe should have collapsed after a few million years. If it had been greater by one part in 10^{10}, the universe would have been essentially empty after a few million years. The quantum general relativity, together with no-boundary proposal, predicts a universe like the one we observe, though this introduces an extra level of unpredictability. Gravity introduces a new level of unpredictability into physics over and above the uncertainty usually associated with quantum theory. Information is lost in black holes, and there can't be a unitary evolution. God still has a few tricks up his sleeve. Hawking and Penrose (1996: 59, 79, 89, 90, 92, 103)

12

The Kingdom of Heaven Is Inside You and It Is Outside You

"The father's kingdom
(Kingdom of God, Kingdom of Heaven)
is spread out upon the earth,
and people do not see it."
"The kingdom is inside you and it is outside you."

"When you understand yourselves
you will be understood.
And you will realize that
you are Sons of the living Father."

"They do not see that they have
come into the world empty and they will
go out of the world empty."

The Gospel of Thomas

Davis (2002: xxxv)

Thomas advocates the point of view that Gnostic (Knowledge) Christians also held: Knowledge of the divine and knowledge of oneself are inseparable.

The Sermon on the Mount

"How blest are those who know their need of god;
the kingdom of heaven is theirs.
How blest are the sorrowful;
they shall find consolation.

How blest are those of a gentle spirit;
they shall have the earth for their possession.
How blest are those who hunger and thirst
to see right prevail;
they shall be satisfied.

How blest are those who show mercy;
mercy shall be shown to them.
How blest are those whose hearts are pure;
they shall see God.

How blest are the peacemakers;
God shall call them his sons.
How blest are those who have suffered persecution
for the cause of right;
the kingdom of heaven is theirs."

Gospel of Matthew

Jesus was the messiah (Christ in English, Kristos in Greek and Mashiah in Hebrew) long awaited in the Jewish tradition. A small, fringe sect of Judaism became the dominant religion of the Roman Empire within three hundred years, and eventually became the world's most populous religion.

Michael Ruse summarizes Christianity in the following fashion:

Christianity is a religion
that has as its central belief
the existence of Jesus Christ,
the son of God
(in some sense, God Himself).

It supposes that God is
creator of heaven and earth, from nothing,
and we humans have a special place in the creation.

We are made in the image of God,
not physically but at least in some sense
intellectually and morally.

We have fallen into sin,
from which we cannot escape unaided,
and that is why God--in His great love for us--came to earth
to free us from the bonds of sin.

God was, in the person of Jesus Christ,
prepared to suffer on the Cross.
We are expected to love and worship God,
and we have the promise that death is not the end,
but--thanks to God's great sacrifice—
for some or all of us
the beginning of an eternity that we will spend with God.

With the influence of Greek philosophy,
the idea of God was articulated beyond the Biblical notion, and
God is seen to be a being who is all loving,
all powerful, and all knowing. He is our Father.

From the time of
Saint Augustine (around 400 AD) and before,
it has been clearly understood that

if science contradicts a literal reading of the Bible,
then the believer must be prepared
to read and interpret the Bible
metaphorically or allegorically.

The essence of the Christian faith is
in our relationship to God,
not the details of Genesis.

The deists deny the Trinity (that Jesus was the son of God), and assert that God had set things in motion (say, in the form of random mutation and natural selection) and now no longer interferes with the creation.

Ruse has asked four questions and given four answers.
Does the fact of evolution make Christianity impossible? No!
Does the fact of evolution make Christianity unnecessary? No!
Does Darwinism make Christianity impossible? No!
Does Darwinism make Christianity unnecessary? Yes!

In the absence of alternatives, the appeal to a Creator/Designer, Ruse believes, is obligatory. In the words of Sherlock Holmes to Dr. Watson: "When you have eliminated the impossible, the answer must be that which remains, however improbable."

According to Ruse, "The whole subject is too profound for the human intellect. A dog might as well speculate on the mind of Newton. Richard Dawkins may want to argue that, because of the vile adaptations produced in the struggle for existence, the problems of evil and pain have come to the fore, and that there can be no being who is all loving and all powerful. Evil comes as part of a package deal. Things are not so simple. I was an atheist, but my non-belief has softened into agnosticism. Let each man try to understand the nature of God, and believe what he can." (Excerpt from the *Special Lecture* by Michael Ruse, October 29-November 3, 2004, Seoul, Korea.)

Ruse somehow categorically precludes the approaches of Hinduism, Daoism or Buddhism from his list of possible alternatives.

Presenting "a family of proto-theories" on the evolution of various features of religion, Dennett (2006: xiii) confesses that his focus on Christianity first, and Islam and Judaism next, is unintended but unavoidable: "I simply do not know enough about other religions to write with any confidence about them."

One may perhaps take the Bible in its entirety as a parable, instead of singling out God, as Ruse does, as a metaphor. The true spirit of Christianity may not contradict the spirit of Buddhism, Daoism or Hinduism in their purest form, and at the same time it may be fully consistent with modern science. The essence of what is told by Jesus, Buddha, Lao-zi, or Hindu sages, if presented in the scientific language of the 21st century, may all be identical.

13

The Divine Dispensations of God or of Nature?

Some scientists ask whether we need the
"God hypothesis."

Many people have been seeking for redemption by believing in the existence of an almighty God. Almost an equal number of people, on the other hand, have sought salvation in the discovery of positive meaning in the divine dispensations of Nature. There seems to be no fundamental conflict between modern science and this type of religious tradition in its purest versions, but very few people seem to have been able to find purpose and meaning in an apparently meaningless universe, and consequently watered-down versions of the latter tradition have emerged, versions that do not easily square with modern science.

The Gospel of Buddhism or that of Daoism,
in its pure form,
requires a minimum number of fairly weak assumptions, while the
gospel of Christianity or that of Islam
requires a heavy dose of fairly strong assumptions.
Empirically speaking, however,
Christianity, Islam or the more popular versions of Buddhism
could save a lot more poor souls.
Buddhism or Daoism in its pure form
is beyond the comprehension of ordinary people
and can be a solace for only a few.
A trade-off, I dare say.

People rejoice in nature and feel awed by the wonderful evolutionary process of the world. Human behavior is largely intentional, and hence humans have a tendency to see events in the natural world as caused by intention. Western civilization has been heavily informed by "teleological" thinking. Scientifically, evolution may not need a godly master designer. But the existence of God, as a substitute for a blind working of natural processes, has great appeal to humans, both emotionally and theologically. For many people, the presence of God is aesthetically and spiritually elating, and helps them see a beauty that humble them and causes them to rejoice. Why can't we behold the universe as the glory of God and proof of God's existence?

We may need more compelling logic and proof for the "inevitability" of God, but do we need any more logic or proof for the "necessity" of God in human lives and in human psychology?

Evolutionary psychologists contend that, not only are our bodies a product of natural selection, but our minds are also a by-product of human cognitive evolution for genetic survival. Religious belief is not simply a result of cultural indoctrination, but a phenomenological product of mind. Human minds came to have a genetic predisposition toward religious belief in either God or Divine Nature because it is evolutionarily advantageous, and hence our brains have evolved so that religion comes naturally. On the one hand, religious belief gives an individual the purpose and meaning of life, a source of intrinsic happiness. On the other hand, religious belief refrains an individual from cheating tactics even when the chance of detection is extremely low, freeing him or her from the fear of possible retaliation and social marginalization (labeled as a poor cooperator or reproductive partner), and also making him or her a person of high integrity to enjoy the evolutionary advantage of enduring trust and respect in a society, a source of extrinsic happiness.

Dennett (2006: 316) quotes a much more simpleminded Darwinian perception of religious belief from *Time* magazine's

cover article: "Humans who developed a spiritual sense thrived and bequeathed that trait to their offspring. Those who didn't risked dying out in chaos and killing." Dennett (ibid: 317) comments: "The hypothesis that there is a (genetically) heritable 'spiritual sense' that boosts human genetic fitness is one of the less likely and less interesting of the evolutionary possibilities." According to Dennett (ibid: 309), "religion evolved, but it doesn't have to be good for us in order to evolve. (Tobacco isn't good for us, but it survives just fine.)"

One might believe that humans are the product of a godly Designer's intention and will in time achieve godliness. Unfortunately for any natural theology (in which faith and belief are illuminated and made real by nature), science can never give an affirmation of such a belief. But neither is there anything in nature that disproves God. Philosophers and religious leaders can never provide empirical proof for the authentic encounter with God, and hence they must display the same strategies as believers do, forever expounding their ideas in terms of metaphors and parables.

Theist believes in a personal God that is defined as "a God to whom one may pray in the expectation of receiving an answer." Deist believes in "an impersonal God who created the universe but does not intervene in daily events." An evolutionist is reckoned as religious if he calls himself deist.

Looking at a butterfly experiencing an overwhelming sensation of beauty does not prove there is a God but, for those who accept God, its beauty can make one's faith fuller and more rewarding. Many scientists seem to worry that, if we resort to accepting the idea of intelligent design in evolution, it may close the search for scientific exploration of the remaining mysteries. Hence scientists are willing to accept the concept of intentional design only as a metaphor. So we have "Divine Nature" for those who prefer a purely naturalistic approach and "Deist God" for those who prefer the design metaphor of evolution. An evolutionary biologist can now be a Christian on the basis of new

religious concepts of post-traditional theology. Believers may indeed hold whatever faith they choose.

You may call it either God or Divine Nature.
I think it is a matter of taste.

Any scientist, or any intellectual, may become a religious person (and "save" his or her soul) once he or she recognizes the simple fact that all the religious leaders have preached in terms of "metaphors and parables," and also the fact that the role of religion is to give the "meaning and purpose of life," and never to give definitive answers to physics or biological questions.

The Biblical literalism, for instance, may be the approach of lazy bones who hate to use the "God-given brain." If one takes the Bible as a collection of "metaphors and parables," however, then one has to figure out their true meanings and the hidden messages ---an enormous intellectual toil, and yet, perhaps most rewarding. With no inputs, there might be no outputs.

14

Mother Teresa's Letter

"For me, the silence and the emptiness are so great,
that I look and do not see—listen and do not hear."
"Such deep longing for God
—and…repulsed—empty—no faith—no love—no zeal. "
"So many unanswered questions live within me
[that I am] afraid to uncover them—because of the blasphemy
—If there be God—please forgive me
—When I try to raise my thoughts to Heaven
—there is such convicting emptiness that those very thoughts
return like sharp knives and hurt my very soul.
Did I make a mistake in surrendering blindly
to the Call of the Sacred Heart?"

These scrawled, desperate documents came to light as part of the investigation into her suitability for sainthood, conducted by the Canadian priest Brian Kolodiejchuk. The *Newsweek* columnist comments: "this is all rather unsurprising, and it is the inevitable result of a dogma that asks people to believe impossible things and then makes them feel abject and guilty when their innate reason rebels. …The case of Mother Teresa, who could not force herself into accepting the facile cure-all of "faith," is that of a fairly simple woman struggling to be honest with herself. … '*Come Be My Light*,' the subtitle of this book is what Mother Teresa claims, not that she said to Jesus, but that *He* said to *her*. …The endless hard toil, the bitter austerity, the ostentatious religious orthodoxy were only part of an effort to still the misery within—the endless drive to abolish misgiving through overwork. …She suffered from more self-hatred

the more she was over-praised. …Toward the end of her days, …one is glad to learn …that she found a sort of peace."

(*Newsweek*, September 10, 2007, pp. 49-50)

15

Using Reason in the Interpretation of Biblical Texts

GENESIS

"In the beginning of creation,
when God made heaven and earth,
the earth was without form and void,
with darkness over the face of the abyss.

God said, 'Let there be light,'
and there was light.
God said, 'Let the waters under the heaven
be gathered into one place,
so that dry land may appear,' and so it was.
God called the dry land earth,
and the gathering of the waters he called seas.
God said, 'Let the waters teem with
countless living creatures.'
'Let the earth bring forth living creatures,
according to their kind.'

God formed a man from the dust of the ground and
breathed into his nostrils *the breath of life*.
Thus the man became a living creature.

So God created man in his own image;
male and female he created them.
God blessed them and said to them,
'Be fruitful and increase, fill the earth and subdue it.' "

In 325, the Council of Nicaea stated that the Son (Jesus) is of the same substance as the Father (the Supreme Being). By the end of the 4th century, under the leadership of the Cappadocian Fathers, the doctrine of the Trinity took the form of asserting that God is one essence in substance but three in "person," Father, Son, and Holy Spirit (i.e., the presumed presence and power of God).

Unitarians stress the free use of reason in religion, and believe that God is One (a Unity), denying the divinity of Christ and the doctrine of the Trinity which has no biblical basis. The Unitarian heritage of stressing the complete humanity of Jesus, the omnipotence of God, and the rational faculty of man is traced to the early church of 2nd-4th century.

British and American Unitarianism grew out of Calvinist Puritanism. Calvin's doctrine of providence, coupled with a scientific view of the universe, led to an increased emphasis on reason, moderation, morality, human aspiration and scientific truth.

Universalism believes in the salvation of all souls, stressing the tolerance of diversity, the inherent dignity of man, use of reason in the interpretation of biblical texts, modification of belief in light of discoveries of science, and rejection of the miraculous elements of traditional Christianity and the doctrine of the Trinity. The heritage of Universalism is also traced to the early church of the third century. According to the doctrine of universal salvation, it is impossible that a loving God would elect only a portion of mankind to salvation and doom the rest to eternal punishment in the afterlife. Universalism rejects the teaching of Calvinism that the majority of humanity is destined for the fiery depths of an eternal hell. God is a beneficent being who would save all of His children. Universalists have been exploring the universal elements of religion and seeking closer relationships with the non-Christian religions.

Universalists feel a close kinship with Unitarians. The Universalist Church of America and the American Unitarian Association merged in 1961. The new statement of Principles and

Purposes of the Unitarian Universalist Association includes:

"We, the member congregations of the Unitarian Universalist
Association, covenant to affirm and promote
direct experience of that transcending mystery and wonder,
affirmed in all cultures,
which moves us to renewal of the spirit and an openness to the
forces that create and uphold life;
wisdom from the world's religions
which inspire us in our ethical and spiritual life.

Grateful for the religious pluralism
which enriches and ennobles our faith,
we are inspired to deepen our understanding
and expand our vision."

Many Unitarian Universalists are Christians and some claim other commitments and traditions. They do not have any explicit creed, either theological or social, to guide them.

Unitarian Universalist minister David Rankin, minister of the Fountain Street Church in Grand Rapids, Michigan, lists ten beliefs they hold in common.

1. The freedom of religious expression. All individuals should be encouraged to develop a personal theology, and to openly present their religious opinions without fear of censure or reprisal.
2. Tolerance of religious ideas. The religions of every age and culture have something to teach those who listen.
3. The authority of reason and conscience. The ultimate arbiter in religion is not a church, a document, or an official, but the personal choice and decision of the individual.
4. The search for truth. With an open mind and heart, there is no end to the fruitful and exciting revelations that the human spirit can find.
5. The unity of experience. There is no fundamental conflict between faith and knowledge; religion and the world; the sacred and the secular.
6. The worth and dignity of each human being. All people on earth have an equal claim to life, liberty, and justice; no idea, ideal, or philosophy is superior to a single human life.
7. The ethical application of religion. Inner grace and faith finds completion in social and community involvement.
8. The force of love. The governing principle in human relationships is the principle of love, which seeks to help and heal, never to hurt and destroy.
9. The necessity of the democratic process. Records are open to scrutiny, elections are open to members, and ideas are open to criticism, so that people might govern themselves.
10. The importance of religious community. Peers confirm and validate experience, and provide a critical platform, as well as a network of mutual support.

Buehrens and Church (1989: xxii-xxiii)

16

There is No God but God

During the sixth century, there emerged profound differences on the divinity of Christ and his incarnation. The main issue was whether Christ was wholly human and wholly divine at one and the same time as proclaimed by the Council of Chalcedon in 451, or he just had a single divine nature, his humanity on earth only appearing to be like ours.

Islam's central affirmation is "There is no god but God." It rejects a personal God. Jesus is not God, but an apostle of God, the Messiah. Over the Jewish and Christian centuries, God's message became ambiguous. God, the Compassionate, the Merciful, therefore resolved to disclose his will clearly for humankind once again through Muhammad (c.570-632), the Prophet (the Messenger) of God.

The Qur'an is the living Word of God, guidance for the entire range of human life. Believers shall enter the garden of Eden: "Blessed is the reward of Paradise."

Paradise comes from an ancient Persian word meaning "enclosed place." In (the Indo-European) Avestan language, *pairidaēza* was a compound formed from *pairi* "around" and *diz* "make, form."

Each soul will be held accountable for its actions on earth. The Koran presents life as a brief but immensely precious opportunity, offering a once-and-for-all choice. Depending on how well it has observed God's command, and how it fares in its Reckoning, the soul will repair to either the heavens or hell.

"Whoever gets to himself a sin,
gets it solely on his own responsibility.
Whoever goes astray,
he himself bears the whole responsibility of wandering."

The Koran emphasizes deeds, and teaches Muslims to walk the path that is straightforward. The Five Pillars of Islam spell out, in definite laws, the principles that regulate the personal life of Muslims in their dealings with God.

"Guide us in the straight path,
The path of those on whom
Thou hast poured forth Thy grace."

"Islam" means "peace" that comes when one's life is surrendered to God. Those who adhere to Islam are called Muslims.

Philip Novak (1994: 282) urges anyone trying to get a feel for Islam to hear the Qur'an recited in the untranslatable lyrical beauty of its Arabic original.

Muslims are admonished to be constant in prayer to keep their lives in perspective. The extensive social teachings of the Koran also call for a very specific kind of social order.

Islam does not address the theoretical question of inequality in income and wealth, but addresses the practical issue of what should be done about this disparity: Those who have much should help lift the burden of those who are less fortunate. The Koran calls for a flat 2.5 percent tax per annum on both income and wealth, a tax to be used for charity. See Smith (1991: 239-247)

"There shall be no compulsion in religion."

Insha'llah: "If Allah wills it."

The Great Arab Conquests (632-750)

At the time of the death of the Prophet Muhammad (c.570-632), Islam was confined to Arabic-speaking tribesmen in Arabia and the desert margins of Syria and Iraq. Within a century of the Prophet's death, all those Roman-Byzantine-Christian lands of Egypt, Middle East and North Africa, as well as Persia, Uzbekistan, Turkmenistan, southern Pakistan (Sind), Spain, and Portugal came to be ruled by the Arabic-speaking Muslim elite, and the local population began to convert to Islam and speak Arabic. Sicily, Crete and northern India were later added to their list of conquest.

The Bedouin nomads had traditionally lived off raiding neighboring tribes. Islam, however, prohibits Muslims, as one big family (*umma*), to attack each other. Once the tribes of Arabia (including the settled Yemen farmers) were brought under the control of Medina, the leadership, many of them with urban and commercial backgrounds, had no choice but to direct the frenetic military energies of the Bedouin against the Byzantine and Sasanian empires. It was a matter of conquest or collapse.

Caliphs, the rulers of the early Islamic states and the titular head of the Muslim community, had the more formal title of Commander of the Faithful. After 998, Caliphs often conferred on Muslim rulers the title of "Sultan" (implying the moral or spiritual authority according to Qur'an, but later came to denote political or government power).

The secret weapon of the early Muslim soldiers was their motivation. Those killed in the Holy War (*Jihād*) would go straight to paradise as martyrs (*shuhadā*), and those not killed would enjoy the fruits of their victory, enhancing the tribal pride as well--a perfect fail-safe system. The soldiers of the early Muslim armies, led by hereditary-and-elective tribal chieftains (*sharīf*), normally provided their own food and weapons, often acquiring them on the road and in battles. They began to use stirrups in the 680s.

The opponents were offered the options of either embracing Islam, or to maintain their religion by paying the poll tax.

The Berbers (*barbari*, foreigners) had inhabited from the borders of the Nile valley to Morrocco, and had to learn Latin or Greek during the Roman period, or Arabic after the Muslim conquest. Large numbers of Berbers had joined the Muslim armies, and the Arab commander at the outpost of Tangier was looking in the direction of the Rock of Gibraltar and the hills behind, that were clearly visible from the African coast, for booty to reward the Berbers for their allegiance to Islam faith. The Visigoths had conquered the Iberian Peninsula in the fifth century, and established one of the most successful Germanic kingdoms with their capital at Toledo. It was when the throne was usurped by a noble in 710 that the 7,000 Berber soldiers led by a few Arab officers came across the straits. They killed the new Visigothic king at the battle fought near Medina Sidonia on July 19, 711, and captured Toledo. A fresh 18,000-men Arab army crossed the straits in the following year, and almost the whole of the Iberian Peninsula was brought under Muslim rule by 716. The defeat of the Muslims in the battle against the Franks at Poitiers in 732, and the great Berber rebellion in 741, that could be crushed by a massive Arab army from Syria, seem to have prevented further Arab assault on France.

Spain and Portugal (*al-Andalus*) are the only places where the spread of Islam has been reversed--eight hundred years later. Ferdinand the Catholic (1452-1516), who had established the Spanish Inquisition in 1478 and later supported Columbus' voyages across the Atlantic, could conquer the Moorish Kingdom of Granada by 1492 that ended the Muslim occupation of the Iberian Peninsula.

"The Alhambra is an ancient fortress or castellated palace of the Moorish kings of Granada, where they held dominion over this their boasted terrestrial paradise and made their last stand for

empire in Spain. The palace occupies but a portion of the fortress, the walls of which, studded with towers, stretch irregularly round the whole crest of a lofty hill that overlooks the city and forms a spur of the Sierra Nevada or Snowy Mountain.

Its beautiful halls became desolate and some of them fell to ruin, the gardens were destroyed and the fountains ceased to play.

[W]e entered…into the interior of the Moorish palace. The transition was almost magical; it seems as if we were at once transported into other times and another realm, and were treading the scenes of Arabian story.

It is impossible to contemplate this once favorite abode of Oriental manners without feeling the early associations of Arabian romance, and almost expecting to see the white arm of some mysterious princess beckoning from the balcony or some dark eye sparkling through the lattice. The abode of beauty is here, as if it had been inhabited but yesterday.

The Moorish sultans enjoyed the pure breezes from the mountain and the prospect of the surrounding paradise; the secluded little patio or garden of Lindaraxa, with its alabaster fountain, its thickets of roses and myrtles, of citrons and oranges; the cool halls and grottoes of the baths, where the glare and heat of day are tempered into a soft mysterious light and a pervading freshness.

Everything invites to that indolent repose, the bliss of southern climes, and while the half-shut eye looks out from shaded balconies upon the glittering landscape, the ear is lulled by the rustling of groves and the murmur of running streams."

Washington Irving (1783-1859), *Tales of the Alhambra* (Madrid: Mostoles, 1978), pp. 33-44.

The first and last battle between the Arab army (dispatched from Samarqand) and the Tang army (led by Ko Sun-ji) was fought at Talas in July 751. The Arabs won the battle, and obtained the Chinese paper-making technology in the course of the campaign from the captured artisans that could replace parchment and papyrus with paper in the Arab world. It was the last time that Arab forces ever reached so far east.

17

Akbar the Great

1556-1605

Sultan-Ahmad Mirza, a grandson of Amir Timur (1336-1405), married a daughter of Yunus Khan (r.1429-62), who was in direct descent from Chaghatai (d.1242), the second son of Chinggis Khan (r.1206-27); and their grandson was Babur (1483-1530), that implied beaver. Babur was born prince of Fergana in Transoxiana, and was appointed governor of Andizhan at the age of eleven.

Akbar the Great (b.1542) was the son of Humayun (r.1530-56) and a grandson of Babur (r.1526-30), the founder of the Mughal (i.e., Mongol) dynasty. Akbar came to rule, as the result of his incessant conquest activities, the whole of northern India minus Assam and a part of the Deccan. He was succeeded by Jahangir (r.1605-27), Shah Jahan (r.1628-58) who constructed the Taj Mahal, and then Aurangzeb the Great (r.1658-1707) under whose reign the territory of Mughal empire expanded to its zenith but his religious intolerance caused the irreversible decline and fall of the empire, to see Queen Victoria proclaiming empress of India in 1877.

The Mughal emperors constantly legitimized their power by stressing their Mongol-Turkish lineage from Chinggis Khan and Timur the Conqueror. In India, Mughal dynasty always called itself Gurkani, after Timur's title Gurkân, the Persianized form of the Mongolian *kürägän*, "son-in-law," a title he assumed after his marriage to a Genghisid princess.

Akbar loved religious enquiry, investigation and criticism, and hence ordered in 1575 the erection the Religious Assembly Hall at the back of the famous Jami mosque not far from the imperial palaces. The building was divided into four halls to accommodate "separately" the learned leaders of various religious beliefs such as Muslims, Hindus, Christians, Jews, Zoroastrians, and Jains. The emperor occupied the central position, from which he could step into any direction and preside impartially over the discussions on theological problems.

In the heat of the controversy, the contending religious leaders, who were utterly devoid of tolerance, often forgot the presence of the emperor and indulged in disorderly behavior, sometimes even resorting to the force to lend weight to their theological argument. The emperor could not but become very angry at their inflammable language and the wild scene they produce. It was closed down a year or two after September 1579 when Akbar assumed the position of the chief *Mujtahid* (the chief interpreter and arbiter of the Muslim law) on the suggestion of the Muslim *Ulema* themselves.

Akbar made a comparative study of various faiths in a scientific manner, and came to the conclusion that there was truth in every religion, and that Islam did not possess a monopoly of truth and virtue. He was skeptical about the claim of the gospel, the scripture of either the Bible or the Quran, to be divine, and the Christian belief in the Trinity and the Incarnation. He preferred the Hindu belief that various religions were different paths leading to the same goal.

The wise emperor knew that it was not humanly possible to attain the ultimate truth, and hence he just continued his quest till the end of his life, though he remained illiterate all his life. Religious-cultural toleration and one common citizenship in his empire was the essence of Akbar's policy.

A. Y. Srivastava, *Akbar the Great*, Agra: Shiva Lal Agarwala, 1962, pp. 171, 173, 175, 238-9, and 254-5.

18

The Modern Genesis

In the beginning of creation,
when God made the universe,
there was only a dense flux of energy/matter;
smaller than an atom,
with darkness,
temperature many trillions of degrees.
There was neither time
nor space.

Matter is a sort of congealed energy, and both were then interchangeable.

It was about 13 billion years ago,
God said, "Let there be a Big Bang,"
and energy/matter exploded out of the emptiness.
So space came, and time came,
the first second.

Space underwent an enormous cosmic inflation
about a trillionth of a second after the beginning of time.

For a fraction of a second after the Big Bang,
the universe expanded faster than the speed of light.
Gravity was already working as a fundamental force.

Within the first second, quarks appeared,
and from these were constructed protons and neutrons,
the basic particles of the material universe .

As the universe cooled down,
Individual protons and neutrons began to stick together
to form atomic nuclei.

Quarks in atomic nuclei were held together
by a strong nuclear force.
At this point, energy and matter began to assume
distinct forms,
still interacting strongly with each other.

God said, "Let there be light,"
and there appeared photons of light that
carry an electromagnetic force.
Collisions of nuclei with high-energy photons
blasted apart these nuclei,
but gradually the photons lost energy through
the cooling that comes from the
expansion of the universe.

The energy of the light fell sufficiently to enable
positive protons to capture negative electrons and
electrons combined with atomic nuclei,
orbiting the nucleus to create stable, electrically neutral atoms.

Electromagnetic force controlled the relations
between the particles of matter -- electrons and protons.
There also appeared a weak nuclear force.

The matter became electrically neutral.
Matter and energy ceased to interact constantly,
and became separate realms.
Energy and light could now flow freely
through the universe.

God saw that the light was good,
and he separated energy from matter.
As the universe became electrically neutral,

cosmic background radiation was released,
and the photons of light could flow freely
through the universe.

At first, protons, neutrons, and electrons
were mostly organized into
hydrogen atoms and helium atoms.

The first stars appeared in regions where
hydrogen and helium were more concentrated.

The universe has been expanding too fast for gravity
to gather everything into a single lump.
But gravity was one of the major sources of
order and pattern in universe.

Inside giant stars,
new chemical elements were formed.
Supernova explosions fertilized interstellar space
with new chemicals, and triggered the gravitational collapse of a
cloud of matter to give birth of new stars including our sun.

Our solar system appeared about 4.5 billion years ago,
containing many new elements in addition
to hydrogen and helium.
The planets of our solar system were made from Sun's debris and
constructed within its gravitational field.

Scientists have figured out that the universe now contains
about 1.2 x 10^{79} atoms. Even a virus contains up to 10 billion atoms.

Over a billion years, the earth began to cool.
Water rained down on its surface to create the first seas.

God said, "Let the waters under heaven be gathered into one place,
so that dry land may appear";
and so it was.

God called the dry land earth,
and the gathering of the waters he called seas.
and God saw that it was good.

Then God said, about 3.85 billion years ago,
"Let the earth produce fresh growth."
So it was; complex chemical reactions,
taking place around deep-sea volcanoes,
had created simple forms of life on earth.

Powered by sunlight,
living organisms spread through the seas
and eventually over the land.

Some chemicals like crystals can create copies of themselves, suggesting the possibility of a chemical evolution. Organic chemicals can be formed from inorganic chemicals. By simulating the lightning of the early atmosphere, organic molecules such as amino acids (that can form proteins) and nucleotides (that can form nucleic acids), the fundamental building blocks of life, can be synthesized from inorganic chemicals in the laboratory. Living organisms are constructed mostly from compounds of carbon and hydrogen.

Through a chemical form of natural selection,
simple organic chemicals, containing a few molecules,
were joined together into simple organic molecules
with mechanisms of replication.

The first molecules, like some modern-day bacteria,
were reproducing themselves
and providing the instructions for reproduction.
The early form of molecules was floating in water
inside a protective container, a proto-cell.

God said, "Let the earth bring forth living creatures,
according to their kind."

Simple organic molecules evolved into the simplest type of
single-celled organisms
without nuclei such as bacteria.

For more than 3 billion years, life consisted only of
single-celled organisms in water
that became more and more diverse,
evolving through natural selection.

Then there appeared the complex cells
which have nuclei containing DNA.
They started to merge together into large colonies
to form the first multi-celled creatures
with sexual reproduction.

From about 600 million years ago,
there began to appear many-celled organisms in water,
each made up of billions of individual cells.

God said, "Let there be an ozone layer
above the atmosphere."
So God shielded the surface of earth from
the ultraviolet rays of the Sun,
and made it easier for life to evolve on land.

.

God said, "Let the waters teem
with countless living creatures,
let there be on the earth plants bearing seed,
fruit-trees bearing fruit each with seed,
and all living creatures that move and swarm,
and let birds fly above the earth."
So it was; and God saw that it was good.

So he blessed them and said,
"Be fruitful and increase,
fill the waters of the seas;
and let all living creatures increase on the land."

Even the early forms of life took advantage of
the merger and the division of labor.
Modern forms of life maintain a division of labor

between nucleotides which store genome software for replication
and the proteins that construct individual hardware
by chemical activity.

"Then God formed a man from the dust of the ground
and breathed into his nostrils the breath of life.
Male and Female he created them."
The first proto-type, hominines, evolved from apes
about 7 million years ago.
The second proto-type, homo erectus, appeared
about 2 million years ago.

Then God said, "Let us make man in our image."

About 200,000 years ago, homo sapiens,
with language to share information
and accumulate knowledge, appeared.

God blessed them and said to them:
"Be fruitful and increase,
fill the earth and subdue it,
rule over every living thing that moves upon the earth."

So homo sapiens began moving out of Africa
about 85,000 years ago.

God saw all that he had made,
and it was very good.

Thus the universe was completed
with all its mighty throng.

This is the story of the making of universe and earth
when they were created.

19

DAO Gives Birth to All Beings

25. "There was something formless and perfect
before the universe was born.
It is serene. Empty. Solitary. Unchanging.
Infinite. Eternally present.
It is the mother of the universe.
For lack of a better name, I call it the *Dao*.
It flows through all things, inside and outside,
and returns to the origin of all things.

有物混成 先天之生 寂兮寥兮
獨立而不改 周行而不殆 可而謂天下母

14. It returns to the realm of nothing.
Form that includes all forms,
image without an image,
subtle beyond all conception.
Approach it and there is no beginning;
follow it and there is no end.

復歸於無物 是謂無狀之狀 無物之象
是謂恍惚 迎之不見其首 隨之不見其後

51. Every being in the universe is an expression of the *Dao*.
It springs into existence, unconscious, perfect, free,
takes on a physical body,
lets circumstances complete it.
That is why every being spontaneously honors the *Dao*.

32. The *Dao* can't be perceived.
Smaller than an electron,
it contains uncountable galaxies.

51. The *Dao* gives birth to all beings.
Every being in the universe is an expression of the *Dao*.
34. All things are born from it, yet it doesn't create them.
It pours itself into its work, yet it makes no claim.
It nourishes infinite worlds.

4. The *Dao* is like a well: used but never used up.
It is like the eternal void: filled with infinite possibilities.
6. Empty yet inexhaustible, it gives birth to infinite worlds.

52. In the beginning was the *Dao*.
All things issue from it; all things return to it.
51. *Dao* takes all beings back to itself.
34. Since all things vanish into it
and it alone endures, it can be called great.

7. The *Dao* is infinite, eternal.
Why is it eternal?
It was never born;
thus it can never die.
Why is it infinite?
It has no desires for itself;
thus it is present for all beings.

21. Since before time and space were, the *Dao* is.
It is beyond *is* and *is not*.
How do I know this is true?
I look inside myself and see.

16. Each separate being in the universe
returns to the common source.
Returning to the source is serenity.
If you don't realize the source,

you stumble in confusion and sorrow.

When you realize where you come from,
you naturally become tolerant, disinterested, amused,
kindhearted as a grandmother, dignified as a king.
You can deal with whatever life brings you,
and when death comes, you are ready.

50. The Master knows that he is going to die,
no illusions in his mind,
no resistances in his body.
Therefore he is ready for death
as a man is ready for sleep after a good day's work.

Consciousness is a unitary process, not a thing. It is a dynamic accomplishment of the distributed activities of populations of neurons in many different areas of the brain. All your past experience is engaged in forming your integrated awareness of this single moment. Consciousness emerges from the operation of the brain. When you fall into a deep dreamless sleep, you lose consciousness, and you regain it when you wake up. After death, there is no return of the functions of the brain and body. You don't wake up. You do not regain consciousness. It is just like having a deep dreamless sleep, and never waking up.

Gerald M. Edelman, *Wider than the Sky*, Yale University Press, 2004, pp. 4-8.

According to the neurologic perception of consciousness, we experience life and death everyday. You go to sleep at night, and you lose consciousness. You wake up in the morning and you regain consciousness. One day you don't wake up, and you don't regain consciousness. Then they say you are dead.

39. The Master views the part with compassion,
because he understands the whole.
His constant practice is humility.

39. In harmony with the *Dao*,
all creatures flourish together,
content with the way they are,
endlessly repeating themselves, endlessly renewed.

34. Since it is merged with all things
and hidden in their hearts, it can be called humble.
4. It is hidden but always present.
6. It is always present within you.
You can use it any way you want.

4. I don't know who gave birth to it.
It is older than God."

象帝之先

25. The *Dao* is great.
The universe is great.
Earth is great.
Man is great.
These are the four great powers.

Man follows the earth.
Earth follows the universe.
The universe follows the *Dao*.
The *Dao* follows only itself.

Lao-zi's *Dao De Jing* (The Book of the Way and Its Power) is arranged in eighty-one brief chapters. The original chapter number in Mitchell's translation is given before each line. See Mitchell (1988)

20

The Creation Hymn of RIG VEDA

"Then even nothingness was not,
nor existence.
There was no air then,
nor the heavens beyond it.
What covered it?
Where was it?
In whose keeping?

Then there were neither death nor immortality.
At first there was only darkness wrapped in darkness.

The One breathed windlessly and self-sustaining.
There was that One then,
and there was no other.

That One which came to be,
enclosed in nothing,
arose at last,
born of the power of heat.

In the beginning desire descended on it—
That was the primal seed, born of the mind."

But, after all, who knows, and who can say
whence it all came, and how creation happened?
The gods themselves are later than creation,
So who knows truly whence it has arisen?

Whence all creation had its origin,
He, whether he fashioned it or whether he did not,
He, who surveys it all from highest heaven,
He knows – or maybe even he does not know."

The creation hymn I cite above is one of the selections by Philip Novak from *Rig-Veda*. I purchased Philip Novak's *The World's Wisdom: Sacred Texts of the World's Religions* in 1994 (invoiced on September 1, to be precise) from the now-extinct Book of the Month Club. It had been lying on my bookshelf ever since then until the morning of September 2, 2003 when I at last opened it and read it. I hope others do not delay the reading of Novak's selections for 9 years, as I did. I never expected to find such beauty in an English translation of the Chinese original. More often than not, I get a better feel for, say, Daoism and Buddhism from Novak's selections than from other non-English ones. Those who know Vedic Sanskrit might find Novak's presentation of Hinduism to be equally satisfying. The above is a selection of what I have found to be most beautiful and profound (see Novak, 1994, pp. 6-7).

The Aryan, meaning *Noble Ones* in Sanskrit (ārya), had settled in northern India and Iran in prehistoric times. They entered the Indus Valley some four thousand years ago. From their language, the Indo-European languages are descended, and from their religion descended Hinduism. The Vedas or *Sacred Knowledge* constitute the Aryan scriptural bedrock, and are chanted by Hindu priests. The *Rig-Veda* is the most fundamental one among the early Vedas, and is focused on well-being *in this life*.

"The Rig Veda is … a very worldly sacred book. Nowhere can we find the tiniest suspicion of a wish to renounce the material world in favor of some spiritual quest…. The gods are invoked to give the worshipper the things he wants – health, wealth, long life, and progeny. … these meditations stem from a life-affirming, joyous celebration of human existence." O'flaherty (1981: 299)

21

Sitting at the Feet of a Master

The core Hindu doctrines about human destiny *beyond this life*, namely, the cycle of reincarnations driven by *karma* and the liberation from this bondage by means of yogic discipline, were to be reflected in the more recent Vedic hymns, called the *Upanishads*, the sacred wisdom.

"The spirit of the *Upanishads* is the Spirit of the Universe. Brahman, God himself, is their underlying spirit. Brahma is the manifestation of Brahman as creator. Brahman is also the spirit of man, the Self in every one and in all, Atman. God must not be sought as something far away, separate from us, but rather as the very inmost of us, as the higher Self in us. In rising to the best in us we rise to the Self in us, to Brahman, to God himself."

Quotes are from Mascaró (1965: 11-12). Following are the excerpts from Vetasvatara Upanishads translated by Mascaró.

Vetasvatara Upanishad

He is the God of forms infinite
in whose glory all things are,
smaller than the smallest atom,
and yet the Creator of all,
everliving in the mystery of his creation.

He rules over the sources of creation.
From him comes the universe and unto him it returns.

There is nature, never-born,
who with her three elements creates all things in nature.
He is Brahma, the creator of all,
and the Lord of creation.
Greater than all is Brahman, the Spirit before the beginning,
the Spirit Supreme everlasting, the Infinite.
He is beyond beginning and end, and in his glory all things are.

Concealed in the heart of all beings lies
the Atman, the Spirit, the Self;
smaller than the smallest atom, greater than the greatest spaces.

When one knows God
who is hidden in the heart of all things,
and in whose glory all things are,
he is free from all bondage.

This is the God whose work is all the worlds,
the supreme Soul who dwells for ever in the hearts of men.
Those who know him through their hearts and their minds
become immortal.

He is beyond time and space,
and yet he is the God of forms infinite
who dwells in our inmost thoughts,
and who is seen by those who love him.
He is an incorporeal Spirit,
but he can be seen by a heart which is pure.

Far beyond the range of vision,
he cannot be seen by mortal eyes;
but he can be known by the heart and the mind,
and those who know him attain immortality.

Being and non-being come from him
and he is the Creator of all.
He is God, the God of love, and when a man knows him

then he leaves behind his bodies of transmigration.

The soul is born and unfolds in a body,
with dreams and desires and the food of life.
An then it is reborn in new bodies,
in accordance with its former works.
The quality of the soul determines its future body.

The soul can be thought as the part of a point of a hair
which divided by a hundred were divided by a hundred again;
and yet in this living soul there is the seed of Infinity.

When a man is bound by the three powers of nature,
he works for a selfish reward and in time he has his reward.
His soul then becomes the many forms of the three powers,
strays along the three paths,
and wanders on through life and death.

Ignorance passes away and knowledge is immortal;
but Brahman is in Eternity above ignorance and knowledge.
The soul of man is bound by pleasure and pain;
but when she sees God she is free from all fetters.

There is the **soul** of man with wisdom and unwisdom,
there is **nature**, and there is **God**.
When a man knows the three he knows Brahman.

There is a Spirit hidden in the mystery of
the *Upanishads* and the *Vedas*.
Of what use is the *Rig Veda* to one who does not know the Spirit
from whom the *Rig Veda* comes, and in whom all things abide?
For only those who have found him have found peace.

May God, who in the mystery of his vision and power
transforms his white radiance into his many-colored creation,
from whom all things come and into who they all return,
grant us the grace of pure vision.

The reading of the Upanishads

"has been the consolation of my life, and will be of my death."
Sie ist der Trost meines Lebens gewesen und wird der meines Sterbens sein.

Arthur Schopenhauer (1788-1860)

"The entire world is being driven insane
by this single phrase:
My religion alone is true.

Divine Nature can be realized and
fully actualized in daily life
by sincerely following any number of revealed paths.

All the integral transmissions of sacred wisdom
and contemplative practice
that survive the test of time are true –
true in the sense that they function authentically and
bear the sweet fruit of sanctity.

Do not allow the slightest trace of malice
to enter your mind toward any manifestation of God
or toward any practitioner who attempts
to live in harmony with that Divine Manifestation.
Kali, Krishna, Buddha, Christ, Allah –
these are all full expressions of the same indivisible
Consciousness and Bliss.

These are revelatory initiatives of Divine Reality,
not manmade notions.
Blessed is the soul who has known that all is one."

So says Ramakrishna (1836-1886), another great Hindu sage. See Novak (1994: 42-43).

22

See All Beings in Your Self and Your Self in All Beings

The human being, the *Upanishads* says, is trapped in a ceaseless round of death and rebirth (*samsara*) due to the consequences of actions (*karma*) performed in ignorance. One can be liberated from this imprisoning ignorance through one's realization of his or her inner spiritual nature, the higher Universal Self, Atman.

Concealed in the heart of all beings is the Atman, the Spirit, the hidden Self, the God within; smaller than the smallest atom, greater than the vast universe. When all desires that cling to the heart are surrendered and when all the ties that bind the heart are unloosened, then a mortal becomes immortal, the law of *karma* works no more, and even in this world he is one with Brahman, the Spirit Supreme of the universe, the divine ground of all life.

Mind is the source of bondage and also the source of liberation. You have to see all beings in your own Self and your Self in all beings. [*Isa Upanishad*] One who knows Brahman becomes Brahman. Brahman is all and Atman is Brahman. All beings have come from Brahman, unto whom they all return.

See Novak (1994: 9-24).

BHAGAVAD GITA

The *Bhagavad Gita* (The Song of the Blessed One) is the most important Hindu scripture, containing the essence of the Vedas and the *Upanishads*. The Gita forms a portion of the epic poem, the *Mahabharata*, which took shape in the centuries between 400 BC and 400 AD.

2.13 Just as, in this body,
the Self passes through childhood, youth, and old age,
so after death it passes to another body.

2.18 These bodies come to an end;
but that vast embodied Self is ageless, fathomless, eternal.

14.20 Going beyond the three *gunas*
(*illumination, desire, and darkness*)
that arise from the body,
free from the sorrows of birth, old age, and death,
he attains the Immortal.

15.16 All beings are transient as bodies,
but eternal within the Self.
4.38 You will find this wisdom within yourself.

4.35 You see all beings in yourself,
and yourself in God.

5.18 Wise men regard all beings as equal.
5.19 To them all beings are the same.

The original verse number in Mitchell's (2000) translation is given before each line.

23

Everyone Is Already and Always Enlightened

"Having myself crossed the ocean of suffering,
I must help others to cross it.
Freed myself, I must set others free,"
and thus, after hesitating,
the Buddha (*Awakened One*) decides to teach.

"To refrain from evil; to achieve the good;
to purify one's own mind;
this is the teaching of all Awakened Ones."

Human beings are obstructed by ignorance
and ensnared by craving.
They act out of greed, hatred and delusion.
Attainment of Wisdom (Nirvana),
the profound insight into the nature of reality,
removes the craving and aversion
and frees one from the round of rebirth
(*samsara*, suffering).

From enlightenment flows automatically the
four divine conditions of the mind:
compassion, loving-kindness, sympathetic joy,
and equanimity.

The Buddha was a rebel against the corrupted form of Hinduism of his time, and rejected the Hindu reliance on the authority of Brahmins (priestly caste), ritual, mystery, speculation about unanswerable questions, and a personal God.

The Arahant (*Noble Person*) is one who has traversed
the Buddhist path to its end.
The conceit of "I am" is rooted out.

Mahayana (Greater Vehicle) affirms
the core doctrines of Buddha,
but emphasizes the idea of 'emptiness,"
the bodhisattva ideal,
and devotional Buddhism.

To those of inferior understanding,
the Buddha taught that we are lost in *samsara* and that
we must struggle to win nirvana.

To the enlightened, who see that
both *samsara* and nirvana collapse into
the ultimate reality of emptiness,
we are already Buddha-nature.

There is ultimately no problem (suffering)
and no solution (nirvana, death without rebirth),
because everyone is already and always enlightened.

一切衆生 本來常住 入於涅槃
一切法 從本已來 自涅槃故

大乘起信論

The really Real can be known only by intuitive realization,
never by discursive conceptualizing.

The *Bodhisattva* (Wisdom-Being) is a person who, out of compassion, renounces the entry into nirvana in order to be reborn repeatedly to lend a helping hand to those who call upon him, undertaking the infinite work of saving all sentient beings. Buddha implies not only Siddhartha Gotama but also a grace-bestowing cosmic principle, a divine being who responds to the prayers and

devotions of the faithful.

The commingling of Mahayana Buddhism and Daoism in China produced Chan (Zen) that emphasizes actualizing our inalienable Buddha-nature through sitting meditation, directly pointing to mind and not depending on words and letters (i.e., outside the scriptures). Some Zen sects favor the gradual approach to awakening, and others favor the sudden approach.

The above are the contents that most appealed to me as I read through pages 57 and 97 of Novak (1994).

The diameter of the nucleus at the center of an atom is much smaller than the diameter of the atom itself (nucleus plus electronic cloud), by factor of about 23,000 (uranium) to about 145,000 (hydrogen), reminiscent of the Buddhist statement that the matter is empty, and empty is the matter.

色卽是空 空卽是色
受想行識 亦復如是

摩訶般若波羅蜜多心經

24

Poverty, Hell and Heaven

"Who is poor?
He who is not contented.

What is hell?
To live in slavery to others.

How is heaven attained?
By becoming free from cravings."

These are from the *Garland of Questions and Answers* of Shankara (686-718), one of the greatest sages of the Hindu tradition.

See Novak (1994: 40-41).

My mind turns to human nature as it is and feels uncomfortable with Shankara's statements. Suppose that some people, following his teaching, "destroy craving through the realization of their true self," while some infidels nurture craving and force the faithful to live as their slaves.

How do we treat the "craving" for heaven?

25

Non-Attached Action

The self-training for the vision of the unity of Atman and Brahman is called Yoga. The Central teaching of the *Bhagavad Gita* is Karma yoga: the great teaching on "non-attached action."

3.5 No one, not even for an instant,
can exist without acting;
all beings are compelled, however unwilling,
by the three strands of Nature called *gunas*
(*illumination, desire, and darkness*).

3.4 Not by avoiding actions
does a man gain freedom from action,
and not by renunciation alone,
can he reach the goal.

3.9 If you want to be truly free,
perform all actions as worship.
3.7 With no attachment to results,
he engages in the yoga of action.

12.11 Act always without attachment,
surrendering your action's fruits,
12.14 free of the "I" and "mine."
12.12 Best of all is surrender, which soon brings peace.

3.19 Without concern for results,
perform the necessary action;
surrendering all attachments,
accomplish life's highest good.

2.47 Act for the action's sake.
And do not be attached to inaction.

14.25 Unattached to action---
that man has gone beyond the three *gunas*.

4.24 All those who see God in every action
4.14 will not be bound by their actions.
5.10 Offering his action to God, he is free of all action.

13.29 He who sees that all actions are performed
by Nature alone
and thus that the self is not the doer—that man sees truly.

The original verse number in Mitchell's (2000) translation is given before each line.

The purpose of each human life is to realize the Eternal Self within and thus to know the joy of union with God, the Divine Ground of Being (Brahman). Such knowledge may of course be attained in retreat from the world, but we should know the fact that such knowledge can, or rather should, be attained in the midst of the world through non-attached action.

Freedom of activity is never achieved by abstaining from action. Nobody can become perfect by merely ceasing to act. In fact, nobody can ever rest from activity even for a moment. The world is imprisoned in its own activity.

According to traditional wisdom, action (*karma*) only begets more of the same, leading to the further bondage of rebirth. One may, however, be free from further bondage and its consequences in the very midst of action. The spiritual problem is not action itself. It is how one acts, the quality of mind with which one acts. If one identifies with one's actions, desiring certain results, one is bound to that action-pattern and doomed to bondage. They who work selfishly for results will only be miserable. However, if one acts earnestly but without attachment to results, performing every action as an offering to God, knowing that God alone is the only Actor, one proceeds on the path to liberation.

You have the right to work, but for the work's sake only. Desire for the fruits of work must never be your motive in working. Never give way to laziness, either. If you perform every action with your heart fixed on the Supreme Lord, free from all attachments to results, you will reach enlightenment. You have to be even-tempered in success and failure. When your intellect has cleared itself of its delusions, you will become indifferent to the results of all action.

In the calm of self-surrender you can free yourself from the bondage of virtue and vice during this very life. To unite the heart with Brahman and then to act: that is the secret of non-attached work. Then you pass to that state which is beyond all evil. A man reaches the ultimate Truth by working without anxiety about results.

See Novak (1994: 24-33).

Their Path Is Much More Arduous

He is unknown to the learned and known to the simple.
Kena Unpanishad, Mascaró (1965: 52)

He cannot be taught by one who has not reached him. The way to him is through a Teacher who has seen him. This sacred knowledge is not attained by reasoning. Katha Upanishad, Mascaró (1965: 58)

Upanishad means sitting at the feet of a Master.

Bhagavad Gita

12.1 One man loves you with pure devotion;
another man loves the Unmanifest.
Which of these two understands yoga more deeply?

The blessed Lord said:
12.2 Those who love and revere me with
unwavering faith, always centering
their minds on me –
they are the most perfect in yoga.
12.7 I come to them all, and quickly rescue them all
from the ocean of death and birth.

12.3 But those who revere the Imperishable,
the Unsayable, the Unmanifest,
the All-Present, the Inconceivable,
the Exalted, the Unchanging, the Eternal,

12.4 mastering their senses,
acting at all times with equanimity,
rejoicing in the welfare of all beings –
they too will reach me at last.

12.5 But their path is much more arduous

because, for embodied beings,
the Unmanifest is obscure,
and difficult to attain.
13.24 By meditation, some men can see the Self in the self;
others, by the yoga of knowledge;
others, by selfless action.
13.25 Still others, not seeing,
only hear about it and worship;
they too cross beyond death,
trusting in what they have heard.

13.30 When he sees that the myriad beings
emanate from the One
and have their source in the One,
that man gains absolute freedom.

14.24 He who is content with whatever happens
13.25 has gone beyond the three *gunas*.

14.22 Whatever quality arises –
light, activity, delusion –
he neither dislikes its presence
nor desires it when it is not there.

14.5 The three *gunas*, born of Nature,
bind to the mortal body the deathless embodied Self.
13.31 The supreme Self, although it inhabits bodies,
is beginningless, deathless, and unconfined.

15.16 All beings are transient as bodies,
but eternal within the Self.

The original verse number in Mitchell's (2000) translation is given before each line.

When the five senses and the mind are still, and reason itself rests in silence, then begins the Path supreme. This calm steadiness of the sense is called Yoga. Then one should become watchful, because Yoga comes and goes. Katha Upanishad, Mascaró (1965: 13, 65-66)

26

Just Do Your Work, Then Step Back and Let Go

2. The Master acts without doing anything.
Things arise and he lets them come;
things disappear and he lets them go.
He has but doesn't possess,
acts but doesn't expect.
When his work is done, he forgets it.
That is why it lasts forever.

9. Care about people's approval and
you will be their prisoner.
Do your work, then step back.

10. Can you deal with the most vital matters
by letting events take their course?

Can you step back from your own mind
and thus understand all things?
Acting with no expectations:
this is the supreme virtue.

24. If you want to accord with the *Dao*,
just do your job, then let go.
He who clings to his work
will create nothing that endures.

48. True mastery can be gained
by letting things go their own way.
12. The Master allows things to come and go.

15. Do you have the patience to wait
till your mud settles and the water is clear?
Can you remain unmoving
till the right action arises by itself?
The Master doesn't seek fulfillment.
19. Just stay at the center of the circle
and let all things take their course.

48. In the pursuit of knowledge,
every day something is added.
In the practice of the *Dao*,
every day something is dropped.
Less and less do you need to force things,
until finally you arrive at non-action.
When nothing is done, nothing is left undone.

The Master acts without doing anything because he has wholeheartedly vanished into the deed. Non-action is the purest and most effective form of action. It happens by itself, effortlessly, without any interference of the conscious will.

See Mitchell (1988: viii).

Novak (1994: 170, 174) quotes Lao-zi's another book (*Hua Hu Jing*):

"How can the divine Oneness be seen?
In beautiful forms, breathtaking wonders,
awesome inspiring miracles?
The *Dao* is not obliged to present itself in this way.
The highest truth cannot be put into words.
Therefore the greatest teacher has nothing to say.
He simply gives himself in service, and never worries."

We now return to *Deo De Jing*.

其出彌遠 其知彌少

47. The more you know, the less you understand.
23. Open yourself to the *Dao*,
then trust your natural responses;
and everything will fall into place.

27. A good artist lets his intuition
lead him wherever it wants.
A good scientist has freed himself of concepts
and keeps his mind open to what is.
67. Simple in actions and in thoughts,
you return to the source of being.

23. Express yourself completely, then keep quiet.
Be like the forces of nature.

30. Because he believes in himself,
he doesn't try to convince others.
Because he is content with himself,
he doesn't need other's approval.
Because he accepts himself,
the whole world accepts him.

8. In dwelling, live close to the ground.
In thinking, keep to the simple.
In work, do what you enjoy.

When you are content to be simply yourself
and don't compare or compete,
everybody will respect you.

41. The greatest art seems unsophisticated.
The greatest love seems indifferent.
The greatest wisdom seems childish.

33. If you realize that you have enough,
you are truly rich.
44. Be content with what you have
rejoice in the way things are.
When you realize there is nothing lacking
the whole world belongs to you."

38. When the *Dao* is lost, there is goodness.
When goodness is lost, there is morality.
When morality is lost, there is ritual.
Ritual is the husk of true faith, the beginning of chaos.

29. Do you want to improve the world?
I don't think it can be done.
The world is sacred.
It can't be improved.
If you tamper with it, you'll ruin it.
If you treat it like an object, you'll lose it.

42. The Master is one with the whole universe.

Confucius (551-479 BC) says:

It is good, if a person knows his work;
It is better, if a person likes his work;
But it is best, if a person enjoys his work.

A good education system is one that helps every person to acquire full knowledge of the work he or she chooses to earn a living from, as the work of a lifetime. A better system is one that helps everyone to find the work that he or she likes. The best education system, however, is the one that helps every person to find the work that he or she will truly enjoy. A person who enjoys his or her work might have a better chance to win a Nobel Prize; but such thing becomes rather irrelevant to the person's life. The person enjoys life without any feeling of TGI Friday, and will simply feel grateful for the work itself.

Confucius never pretended
to know anything about the life beyond.
He just tried to make this world
a less miserable place as much as possible.

It is said that, in the old days, a Chinese scholar was a Confucian when in government office and a *Daoist* when out of it.

Neo-Confucianism

Neo-Confucianism refers to the Learning of the Way (or "of the Mind and Heart") as synthesized by Zhu-xi (1130-1200) of the Southern Song. Zhu-xi, while in his teens preparing himself for the civil service examination, was attracted to Chan (Zen) Buddhism. His career combined periods of official service with

longer periods of teaching and writing.

Zhu-xi's philosophical reflection addressed the worldly (real, solid, practical, substantial) problems of relating the "Self" of Chan Buddhism to real society and the universe. In order to meet the challenge of the Buddhist doctrine of awakening to the truth of impermanence, emptiness, nothingness, and moral relativism, Zhu-xi attempted to formulate a systematic cosmology, placing at the center of it the "human" that, following Mencius, is fundamentally good, moral and rational.

Zhu-xi viewed human nature as being integrated with a cosmic infrastructure of principle (*li* 理) and material force (*qi* 氣), along with the morally responsible and socially responsive Self. Assured that human life had meaning and value, he presented a lofty ideal of the sage who preserves a serenity of mind while acting on a social conscience in a troubled world. He aspired to a spiritual ideal of self-sacrificing sagehood, not only for kings or scholar-officials, but also for everyone, incorporating both the universality of the Buddha-nature and the compassionate Bodhisattva.

The human mind is in essence one with the mind of the universe, capable of entering into all things and understanding their principles. Zhu-xi believed that humans can overcome the limitations of psycho-physical endowment through the study of principles, and can achieve self-cultivation and moral discipline to bring one's conduct into conformity with the principles that should govern it. By developing to the fullest the virtue of humaneness (*Ren* 仁), one overcomes all selfishness and partiality, enters into all things in such a way as to identify oneself fully with the universe, and thus unites oneself with the mind of the universe, which is love and creativity itself. *Ren* is the essence of being human, one's "humanity," and is also the cosmic principle that produces and embraces all things.

Zhu-xi believed that learning for one's self and one's own

self-development and self-fulfillment could be practiced in daily life through normal intellectual and moral faculties on the basis of natural human sentiments, reinforcing the traditional Confucian spirit of intellectual inquiry. In contrast to Buddhism, there is in Zhu-xi a definite positivism that affirms the reality, order and intelligibility of things, and the validity of objective study and science.

In Korea and Japan, Zhu-xi's writings became accepted as the most complete and authoritative exposition of Confucian teaching.

See WM. Theodore de Bary and Irene Bloom, *Sources of Chinese Tradition: from Earliest Times to 1600*, New York: Columbia University Press, 1999, pp. 667-719.

According to Yi I (李珥 1356-84), the formless *principle* is perfectly good, but it requires material force (on the level of form) in order to function, and this is where good and evil diverge. The feeling (psychological endowment) that directly follows from our normative nature in its original goodness is the perfectly pure *Dao* Mind (without the self-centeredness of selfish human desires), and the feeling that is disrupted by our physical constitution is Human Mind. He emphasized the inseparability of principle from material force, and of *Dao* Mind from Human Mind. One should develop the *Dao* Mind to its fullest extent and let it moderate the Human Mind, making the proclivities that attend our physical constitution each follow its proper norm. When the issuance of the Human Mind is not controlled by the *Dao* Mind, it may devolve into evil.

According to Yi Hwang (李滉 1501-70), understanding the universe and what is proper in the conduct of affairs is also a matter of understanding oneself. Delineating the relationship between nature (the purely good Four Beginnings) and feelings in the life of the mind-and-heart (the sometimes good and sometimes evil Seven Feelings), he pointed out the ultimate unity of man and the universe and also the path of self-cultivation that leads to the ultimate perfection of sagehood.

27

The Only Way to Learn

The most pleasant and lingering memories
from my trip to Angkor Wat are the following.

I rode in a motor-bike-pulled-rickshaw
over the unpaved roads under the patch shade-cover,
fully taking the gentle warm breeze all over my body.
I felt as if I could ride on and on.

At the end of the day's tour,
I sat down on a pile of stones watching over the ruins,
pleasantly exhausted.
I felt as if I could sit there forever.

I bravely climbed to the top of Ankor Wat,
and absent-mindedly looked down at the panorama
spread to the distant horizon.
I felt I could keep on looking down there.

I was whispering to myself:
"Will I be here again in my lifetime? No, I don't think so."

I think personal experience is everything.
You mean reading is a waste of time?
No, but reading is safe. It does not hurt you.
Why do you want to get hurt?
That's when you learn.

I remember such an exchange as this between Anthony Hopkins (acting C. S. Lewis) and Debra Winger in the movie *Shadowlands.*

They say history repeats itself because people do not learn the first time. I wonder whether people learn the second time or the third time either. How do they ever learn?

You read books, and you find that you are not alone.
A student rejoins in *Shadowlands.*

28

Tranquility, Equanimity and Dementia

Suppose that you want to see only the agreeable and attractive side of your friend. It might be possible for you to enjoy the pleasant feeling of togetherness even when encountering your friend almost every day. Regardless of the personalities involved, however, the optimum frequency of contact may be just once a week or once a month. More often than not, once a year might be just enough if you want to see only the agreeable and attractive side. Some friend might be good only once every ten or even a hundred years, with the maximum limit of ten seconds for the encounter. Perhaps that is why they say "for better or for worse" to a couple at the wedding.

When it comes to the wisdom of life, every senior citizen is an expert. But a retired professor often pretends to be a bit more expert than others. He or she has all the answers, but nobody wants to hear them.

Through the repetition of trial and error
in a constrained maximization process,
one may eventually come to
obtain a more realistic understanding of constraints,
and impose a more realistic utility function.
They say that this is the process of obtaining wisdom
and becoming a wise person.

You simply come to have
a better understanding of "reality,"
and there follows "resignation."

You come to have "more realistic" hopes,
and a "more realistic concept" of happiness
that are much more feasible for realization on earth.
A Buddhist might say that this is precisely
the emancipation from worldly attachments.

When hopes and the concept of happiness
become so realistic,
then one can realize them on this world anytime
with almost no effort,
and become very happy.
A person with a tendency to exaggerate may call it blissful.

It might look "pathetic" to some,
but then this is a matter of opinion.
What happens if that pathetic-looking guy insists that
He himself is a Buddha or a sort of Messiah?

One of Buddha's important teachings is to attain right mindfulness through sustained practice of meditation in order to realize Nirvana. They say that one has to dwell in sustained awareness of the Body, Sensation, Mind, and Mind-Objects.

Attaining tranquility and equanimity, if not nirvana itself, may not sound very difficult. As I get older, however, I find that attaining equanimity, never mention nirvana, is anything but a simple or easy matter. I find myself frequently losing my temper and equanimity over such trivial things that 24 hours later I cannot even remember what it was all about.

These days, I try to measure the time lapsed since my loss of temper until I regain equanimity. To my pleasant surprise, I find that the time required to restore tranquility becomes shorter and shorter, usually taking a couple of hours, and sometimes even less than 30 minutes. I wonder, however, whether it is due to right mindfulness or progressive dementia.

29

Accepting Mortality and Feeling Positive about Life

Human genes do not want to cast their destiny with the individual bodies of parents. They want to escape, long before their demise, to the bodies of "fresh and young" children in pursuit of a permanent life, preferably with some significant genetic superiority over their parents. The outlet into the future is to exit parents' bodies, taking the form of sperms or eggs. A permanent life for genes (replicators) requires an unbroken succession of individual organisms (vehicles) to propagate them. The genes not only want parents' survival until reproduction, but also their longevity in order to secure the protection of doting parents and grandparents, the all-purpose rearguards and the vehicles of genes' own long-term survival. Children induce a squabbling couple to make peace by providing a common source of joy. If the unwitting vehicles, unaware of the situation, desire to live beyond their useful life for genetic propagation, social security and life insurance have to step in to finance their nursing home expenses and prevent them from becoming a liability.

The coded information of DNA is copied to a new molecule
before the old molecule is destroyed.
Mortal are the individual bodies, called vehicles.
Immortal are the replicators, called genes.
To those enlightened who can see the nature of genes,
we are already living a permanent life.
It is only to those of inferior understanding that
we are destined to live an ephemeral life.
The sages have been talking about eternal life

long before they ever heard of
James D. Watson and Francis Crick.

There is no death or birth but,
(if you want to put it in modern scientific terms)
only a permanent flow of genes
from one generation to the next,
striving for perfection.

The world now looks as if populated mainly by sexual species, but in fact the majority of organisms now, as ever, are prokaryotes and simple asexual eukaryotes.

Greenflies and elm trees maintain non-sexual reproduction. A clear separation of growth and reproduction, however, must have had definite merits over the simple shedding of a cell without sex and letting it grow into a new adult through cell replication. During the lifetime of an individual human being, there can occur some beneficial mutations amongst the harmful ones which are more frequent. Marriage, however, provides for an individual the opportunity to achieve a sort of "quantum" leap in genetic improvement. Finding a spouse with attractive genetic traits is a highly rewarding enterprise. Darwin wrote *The Descent of Man and Selection in Relation to Sex* (1871) to introduce the notion of sexual selection as complementary to natural selection, suggesting the evolutionary exertion of sexual expression over all living things. Sexual selection is a secondary mechanism which involves a struggle less for food and survival and more for mates and reproductive success.

Human genes have apparently been enjoying a quasi-permanent life, with ample opportunity for self-improvement through the matrimonial system based on fair-share genetic partnership and merger, although a divorce lawyer may eagerly attest that marriage is an extremely perilous adventure. It was Frank

Knight, a famous early twentieth century economist, who expounded the idea of "Risk, Uncertainty, and Profit."

Most parents genuinely enjoy giving to children without expecting any kind of reciprocation. If parental love is blind and unconditional, conjugal love is bound to be conditional. Many children also love their parents, although the genes might think it a waste. They say that Grace Kelly could not pull herself out of grief for almost two years when her father died. Young ones get married, full of the innocent expectation of youth, and then plunge into a conjugal purgatory. As the years roll by, most couples arrive at the conjugal maturity of peaceful coexistence, sooner or later. They have already fulfilled their task of genetic reproduction without knowing it. Anything else they can enjoy may be a bonus.

It is impossible for parents and children to possess identical memory, emotion, knowledge and wisdom. Mendelian inheritance predicts that the similarity between parent and offspring is on average modest, and that hereditary monarchies last only a short time. A great king seldom produces a great heir apparent. More often than not, there is no love lost between parents and children. Imagine King Lear and no Cordelia. Hence we may well believe that parents are parents, and children are children, even though there is only a small genetic difference between them. One may also add the insurmountable gulf between husband and wife. Your children are only half you, and your grandchildren only a quarter you. So they say that a lonely soul vanishes in less than a hundred years.

"Each one of us is a center of life, a unique event in the universe, and whatever our external relations to people and things may be, the absolute fact remains that we have to live our inner life alone even as we have to die our own death: no one can live our own inner life for us; and no one can go through our own death."

Mascarò (1965: 15)

When you go through a series of false alarms,
blood tests, and biopsies,
and occasionally undergo an operation,
you come to feel as if you are here on this earth on a furlough
from the Nether Land with an approximate return date.
Anyone who served in the army and had a leave
(*à la* "All Quiet on the Western Front" or
"A Time to Live and a Time to Die" of Erich Maria Remarque)
knows the feeling:
you tend to appreciate every minute,
every passing scene, and every passerby
(including those called spouse, offspring,
relatives, and friends),
being grateful for the fact that your furlough is not over yet.
Those who know this are old ones,
and those who don't are young ones;
and they don't communicate with each other.

One might well find a meaning and purpose in life by considering the biological evolution from bacteria up to humans. It is, however, a real challenge for humans to come to terms with the transience of ourselves as individuals and as a species. It is not easy for humans to confront the fact that all living organisms as individuals are destined to die. The ultimate fate of every species, including homo sapiens, is extinction. Humans, however, have been seeking for a way to accept mortality and feel positive about such fleeting and painful life as they have. Life gives joy together with sorrow, and pain together with happiness as if a package deal. So they say l'chaim, to life, with a little wine.

There is a negative prescription for every criminal action. A 60 year old person cannot be held responsible for something he did when he was 10 years old. The 60-year old you and the 10-year old you share the same body, a body that simply grew old, but by 60 you are a very different person from your 10-year-old self. The old person cannot remember or understand what he or she did

when he or she was only 10. There is a death of the old self and birth of a new self every year, every day, and every second. The old self and the new self cannot possess the identical memory, emotion, knowledge and wisdom. An old person may not want to be young and foolish again. A person at the age of 10, 20, 30, 40, 50 and 60 may be regarded as either the same person or as an entirely different person.

Genetically speaking, the parents, children, grandchildren, great-grand-children, and so on, may likewise be considered either the same person or all different persons. The genetic differences are all a matter of degree. Whether a person believes in eternal life or not may depend, therefore, on how significant the person perceives the "small genetic differences" to be.

If a Gandhi identifies himself with all Indian people, he lives as long as the Indian people exist on earth. If a Buddha identifies himself with all the sentient, he lives as long as there exists any living thing on earth. If one can feel oneness with a rock on Mars shown on the TV screen, that person lives as long as the universe exists. Such a person can readily come to terms with the fact that the ultimate fate of every species on earth, including homo sapiens, is extinction.

One might argue that it is easier for a Gandhi to love, say, the entire Indian people in the abstract than to love a Mrs. Gandhi in concrete.

The Buddhists cannot stand the idea of killing an animal or even an insect, and hence preach a vegetable diet. A person who enjoys gardening with affection, however, might sometimes feel guilty of murder when he or she has to pluck up a plant. Eating the plant itself might sometimes give the feeling of practicing cannibalism. One does not have to be a lunatic to whisper to a flower or a plant. It might be the first step in identifying oneself with all living things on earth.

As the Hindu sages say, if you see all beings in your own self and your self in all beings, you are one with the Eternal Self. Your self becomes all beings; you see this great Unity; and your life becomes immortal. Your body goes to ashes; you leave the transient; and you find joy in the Eternal. There seems to be absolutely no conflict at all between this type of belief and the modern sciences of molecular biology and particle physics. Quite on the contrary, the knowledge of DNA in all living organisms and the knowledge of quantum mechanics in all atomic nuclei would be conducive to seeing your self in all beings, and all beings in your own self.

"He who knows the rising of life and how it comes to the body, how it abides there in its fivefold division, and knows its relation to the inner Spirit, enjoys eternal life."

Prasna Upanishad, Mascarò (1965: 15)

How would a person's religious beliefs influence his or her attitude to terminal illness? One may well expect that the religious person would accept death as God's will and, while not hurrying towards it, would not seek to prolong their lives using painful and degrading medical procedures. Atheists, by contrast, would have nothing to look forward to after death, so one may expect them to cling to life. In fact, it is the other way round--at least according to an empirical observation published in the *Journal of the American Medical Association*. Believe it or not, the author claims that the religious people seem to be curiously reluctant to meet their maker. When it comes to meeting their creator, it is claimed that many religious people do not seem to have the attitude of "Amen," but "Not yet, Lord." See Economist (March 21. 2009, p.76).

30

Model, Theory, Metaphor and Parable

Scientists try to guess the real world by setting up a simplified version of it, called "model." The model illuminates reality and makes the world understandable. Some people say that thinking is modeling.

A model is "a system of things and relations" satisfying a set of axioms (propositions), so that the axioms can be interpreted as true statements about the system. An axiom is a proposition which is assumed without proof for the sake of studying the consequences that follow from it. A hypothesis is a set of propositions set forth as an explanation for the occurrence of some specified group of phenomena, either asserted merely as a provisional conjecture to guide investigation (working hypothesis) or accepted as highly probable in the light of established facts.

A model is designed to mirror the essential characteristics of the particular phenomenon under study. Theories are scientific guesses founded on "established general ideas." One cannot, however, always draw a clear line of demarcation between a model founded on traces (empirical data) and a "logical truth" called theory.

The great American scientist and philosopher Charles Sanders Peirce (1839-1914) coined the term "abduction" to refer to reasoning that involves the generation and evaluation of an explanatory hypothesis called model. Abduction is forming and accepting on probation a model that explains the occurrence of some specified group of phenomena satisfying a set of

propositions (a hypothesis). Logicians have concentrated on deductive (or mathematical) logic and on inductive logic based on formal calculus, such as probability theory. Scientists, however, have recognized the importance of abduction in the discovery and evaluation of scientific theories, and realized that abduction is a key tool in finding a plausible explanation and making a prediction, though one may end up with a false conclusion. Abduction may be regarded as a sort of induction in a broad sense, i.e., a sort of guessing, provisional conjecture, or plausible inference, and hence a prerequisite to commence the process of inference itself by providing a starting point to guide investigation.

According to Albert Einstein and Leopold Infeld (1966: 30-1):

> It is really our whole system of guesses which is to be either proved or disproved by experiment. No one of the assumptions can be isolated for separate testing. In the case of planets moving around the sun it is found that the **system of mechanics** works splendidly. Nevertheless we can well imagine that **another system**, based on different assumptions, might work just as well.
>
> **Physical concepts are free creations of the human mind**, and are not, however it may seem, uniquely determined by the external world. In **our endeavor to understand reality** we are somewhat like a man trying to understand the mechanism of a closed watch. He sees the face and the moving hands, even hears its ticking, but he has no way of opening the case. If he is ingenious he may form some picture of a mechanism which could be responsible for all the things he observes, but he never be quite sure his picture is the only one which could **explain** his **observations**. He will never be able to compare his picture with the **real mechanism** and he cannot even imagine the possibility or the meaning of such a comparison. But he certainly believes that, as his knowledge increases, his picture of reality will become simpler and simpler and will explain a wider and wider range of his **sensuous impressions**. He may also believe in the existence of the ideal limit of knowledge and that it is approached by the human mind. He may call this ideal limit the objective truth.

Scientists and historians build models on the basis of the known traces of occurrences (i.e., empirical or historical facts) in order to make scientific guesses about "actual occurrences" that are beyond the experience of scientists themselves. Their objectives are to give plausible explanations for human activities or natural processes, to make predictions, and to obtain a more profound understanding of phenomena that otherwise would have to remain anomalous and unexplained.

Scientists try to find a way through the maze of observed facts and understand the world of our sense impressions. The purpose of a model or a theory is to explain a phenomenon and make events understandable. There are no eternal models or theories. Some of the facts predicted by a model or a theory are, sooner or later, always disproved by experiment. A conflict between reality and our attempts at understanding forces scientists to create new ideas. The thoughts and ideas later take the mathematical form of a quantitative model or theory, to make possible a comparison with empirical experiment. Verbal modeling can not properly handle the complex nonlinear and feedback interactions. As each layer of reality becomes more transparent, what is revealed is more complexity than could have been imagined. Hence we need mathematical modeling. Incomplete hypothesis underlying a model, however, leads to modeling failures.

According to Hawking (1996: 60), gravity introduces a new level of unpredictability into physics over and above the uncertainty usually associated with quantum theory: "It means an end to the hope of scientific determinism, that we could predict the future with certainty. It seems God still has a few tricks up his sleeve."

Social scientists aim to formulate the laws governing crowds, i.e., the laws governing the changes in time of the probabilities and relating to congregations of individuals. Only statistical laws governing large aggregations of individuals can be formulated. Scientists can foretell only the probability that an

individual will behave in some particular manner. It is not possible to formulate a law governing the behavior of an individual human in society. Social scientists do not attempt to describe the possible behavior of an individual in space and time. They are indifferent to the fate of the individual human being. Only novelists tell the behavior and fate of the individual human being. Medical doctors cannot foretell precisely when a person will die. The mortality of an individual does not depend solely on, say, his or her age. There is nothing deterministic in the fate of a person, only the probabilities for his or her lot. Scientists only seek to determine the average values typifying the whole aggregation. Fate is the outcome of probabilities.

A powerful model or theory does not only possess predictive and explanatory power for the existing source materials, but it also aids the search and discovery of further relevant traces, revealing equally predictive and explanatory powers for newly discovered data that played no part in its own prior formulation.

Metaphor is the application of a word or phrase to an object or concept which it does not literally denote, in order to suggest comparison with another object or concept, as in "Life is a journey." A metaphor such as "progress or evolution" is to take an idea from one domain, that of culture, and apply to another domain, that of organisms, to imply the development of species. Metaphor is a heuristic device for seeing similarities in otherwise dissimilar things, and short-hand for literal language.

Parable is a fable, a short allegorical story, designed to convey a meaning (some truth, religious principle, or moral lesson) indirectly by the use of comparison, analogy or the like. Modeling and theorizing by scientists frequently assume the character of metaphor or parable, until their ideas are empirically tested and verified.

The sheer ignorance of ordinary mortals necessitates that a sage use a metaphor or a parable in order to teach them, but it

seems that, as often as not, it distracts ignorant people, drawing them even further away from the essence of what they might learn. The way a sage applies a phrase to a concept inevitably affects how mortals perceive the concept. When a sage conveys a religious principle by the use of a parable, the simple story often impedes mortals to understand the essence underlying the complex and multifaceted reality. Mortals often take a metaphor or a parable literally, or get carried away by superficial similarities unrelated with the essence. A single metaphor such as "God" often gives way to the perception of an arbitrary monolithic concept. Unintentionally, a metaphor or a parable may rather obscure the cause and mechanism of reality, confound misconception, and deepen the riddles. Economists say that there is no free lunch. After all, there is seldom a medicine without side effect. Quite a few people, however, believe that nowhere is the seriousness of this side effect more obvious than in religion. Unfortunately, in their approach to religion, because of its very nature, sages can never shift away from metaphor and parable.

Economists have a rather humble objective of predicting and explaining the material aspects of human life with the operating principle of constrained maximization, i.e., the maximization of "utility" subject to given (real and imagined) constraints. Economists are heavily indebted to physicists for a more clear formulation of their operating principle. "Utility" is something you want to maximize; don't ask me what. Depending on how you define utility, the principle of constrained maximization may encompass the whole of physical and metaphysical life on earth and, who knows, even the entire workings of the universe. Darwin's idea was apparently inspired by Malthus' theory of population, and explains the process of evolution with the operating principle of natural selection, a sort of constrained maximization.

After spending some time exploring the universe of abstract models, a physicist (or a mathematician) may begin to notice that his model could be given a variety of interpretations, say,

in some social (or physical) context. He may then stray into neighborhoods, becoming a social scientist (or a physicist), writing papers without making any references to the physics (or mathematics) literature.

"When physicists turned their attention to genes and proteins, did they come as a plundering horde, descending on the defenseless villages of innocent biologists? Or were they refugees from the war-blasted landscape of physics, grateful for a new home in a more peaceful realm, and eager to earn their keep by helping with the chores? Or was it an alliance, a marriage of equals but opposites, demonstrating the benefits of hybrid vigor? … For one thing, some disciplines just have more to export, whereas others tend to run a trade deficit."

Brian Hayes, "Undisciplined Science," *American Scientist*, Vol. 92, No. 4, 306-310.

Physicists are still groping to find the operating principle that can bring together and explain all such disparate phenomena as gravitational, electromagnetic, and subatomic (strong or weak) nuclear forces. They are still searching for the one grand master equation that can clearly resolve the microscopic universe of stochastic quantum dynamics and the analog macroscopic universe of general relativity, and that also can explain the evolution of universe. By the way, economists are also still groping for the unified theorem to explain both micro- and macro-economics. Economists, just like physicists, have specialized either in micro-economics or macro-economics, but seldom both.

The rather chaotic-looking microscopic universe of stochastic (digital) quantum mechanics somehow presents a rather elegant (analog) macroscopic universe. On the other hand, the micro-economic world of rather well-behaving individual actors somehow produces a rather chaotic and ugly, more often far from optimal, macro-economic world. One may have to blame this chaos and ugliness on the non-optimality of game theoretic solutions (inherent in political economy) that generate all kinds of undesirable macro-economic phenomena.

The dictum of Communist Manifesto, "from everybody according to his ability and to everybody according to his need," sounds bewitching but reveals profound ignorance about human nature. Marx-Lenin idealists were pursuing a sort of unconstrained maximization that can, just like a daydream, never be realized on earth.

Cheaters take advantage of suckers whose efforts they appropriate as their own. The temptation to cheat appears to be a universal fact of life. Evolution proceeds by natural selection. Darwinism holds that differential performance allows the fittest individuals to produce more offspring (i.e., the fittest genetic variants are favored to contribute their genes to the next generation), which steers the population to become better adapted to its environment over time. In the struggle to survive and reproduce that drives evolution, selfish individuals may be favored over cooperators because they are more energy efficient. The benefits of cheating, however, wane as more individuals in the population opt to cheat. As the selfish individuals increase in relative frequency, their fitness will decline because there are fewer cooperators (suckers) present. When a cheater meets another cheater, nothing is gained, and both may well perish.

Game theory predicts which behavior (strategy) will spread through a population. Evolutionary game theory comes into play when an individual's reproductive success, or fitness, is dependent on strategy. In a game involving cooperators and cheaters, known as the prisoner's dilemma, it always pays the individual to cheat because cheating offers the only possibility of obtaining the best payoff. A potential, but uncertain, reward can drive individuals to behave in a way that is collectively irrational: both lose. The free-rider strategy will replace the producer strategy. In the prisoner's dilemma, evolutionary game theory suggests that cheaters can successfully displace cooperators and take over the population, but at the cost of lowering the fitness of the population, and thereby possibly leading to its extinction. As an evolutionary strategy, cheating can persist only if there occurs the evolution of

behavioral interactions that results in a mixed evolutionary stable strategy involving the producer.

Viruses are parasites that rely on the genetic machinery of a host organism to make copies of themselves. When a virus enters a cell (of, say, a bacteria), it hijacks the host's metabolism, instructing it to make the bits and pieces needed to assemble other viral particles. When more than one virus infects a cell, the metabolic products are freely accessible to any of the co-infecting viruses. The common resource pool allows the viruses to use each other's protein products. One virus can, however, selfishly usurp resources (that are essential to survival and reproduction of viruses) from another virus. A hyper-parasite (parasite on parasite) virus is entirely dependent on a sucker virus to provide key proteins, and interferes with the reproductive success of the sucker virus by using its products. If the replication advantage of the hyper-parasite virus drives the helper virus to extinction, both viruses will die. They can easily wind up with evolutionary dead ends because of the reliance of hyper-parasite viruses on the resources that the producer virus extracts from the host. If the hyper-parasite virus takes over, the fitness of the virus population falls to zero because the hyper-parasite cannot reproduce on its own. In this case, the strategy of the hyper-parasite virus can only persist through a mixed evolutionary stable strategy involving a producer virus. Evolutionary game theorists call this the chicken game. When a population evolves to contain only individuals with a single (say, chicken) strategy, it is defined as an evolutionary stable strategy.
See Paul E. Turner, Cheating Viruses and Game Theory, *American Scientist*, Vol. 93, September-October 2005, pp. 428-35.

They say that an individual is an organism composed of genetically identical cells, which are specialized to perform diverse tasks and collaborate for the good of the organism as a whole. When the independent cells began to merge and cooperate, there must have been conflicts of selfish interests. Such conflicts spurred the evolution of a molecular police force, which curbs the selfish interests of cells in the form of apoptosis (programmed cell death) enforced by mitochondria. When a cell opts out of the body's

centralized control and proliferates like a bacterium, it can cause cancer and kill the individual. See Lane (2005: 200).

From the perspective of an individual, most of its actions may make sense, but from the perspective of group, many individual actions may not make any sense at all. More often, it is possible to make quantifiable predictions on the basis of the individual constrained maximization hypothesis and confirm the predicted actions, but such actions may not make any sense from group's perspective.

One cannot be sure whether the living creatures equipped only with the capability of conditional reflex would fare worse in genetic survival on earth than those equipped with the capability of decision-making through "rational" deliberation. Decision-making subject to ignorance, myopic selfishness, and imperfect information may be much worse than carefully pre-programmed (tit for tat type) conditional reflex.

The organic world, say, the biological world, seems to differ from the inorganic world, say, the physical world, by the presence of game theoretic phenomena whose solutions are mostly far from optimal.

"The evolution of beauty is abetted by the principle that Darwin called sexual selection. The gorgeous colors of a male bird of paradise certainly don't help it to survive as an individual. They do help the survival of genes that make them attractive to females."
Richard Dawkins, Newsweek, Special Edition, December 2005-February 2006, p. 84.

A complex interplay of conflicting functional needs subject to gravitational, electromagnetic and (strong or weak) nuclear forces has driven the evolutionary selection process to yield surprisingly aesthetic results. Physicists, who have yet to come up with a definitive theory, have talked over a long period of time about the "Elegant Universe." Evolution favors a lower ratio of surface to volume, stabilized internal structure, and perfect symmetry, unfolding the magnificent panorama of aesthetic beauty

in the eye of the beholder all over the world. As far as beauty is concerned, natural selection seems to have more than offset the non-optimality of game theoretic solutions of living things.

They say searching for the "truth" belongs to the domain of
religious leaders and philosophers.
Was it Keats or Shelley who said:
"Beauty is Truth, and Truth Beauty"?
Was it Kant who said something similar to this?

Science is … a creation of the human mind, with its freely invented ideas and concepts. Physical theories try to form a picture of reality and to establish its connection with the wide world of sense impressions. Thus the only justification for our mental structures is whether and in what way our theories form such a link. With the help of physical theories we try to find our way through the maze of our sense impressions. We want the observed facts to follow logically from our concept of reality. Without the belief that it is possible to grasp the reality with our theoretical constructions, without the belief in the inner harmony of our world, there could be no science. This belief is and always will remain the fundamental motive for all scientific creation. Throughout all our efforts, in every dramatic struggle between old and new views, we recognize the eternal longing for understanding, the ever-firm belief in the harmony of our world, continually strengthened by the increasing obstacles to comprehension.

Einstein and Infeld (1938, 1966: 294, 296)

31

Science, Philosophy and Art

Human Perception of Reality

Scientists try to understand the universe and our world with modeling and empirical verifications. Scientists approach the reality --try to explain the reality and make prediction-- with the premise of empirical verification of his story, called model or theory.

A rationalist is a philosopher who believes that humans can gain knowledge by the use of reason alone, without any references to the external world. Rationalism has a long history in philosophy (Greek *philo+sophia*/love of wisdom), and Plato (c.427-347 BCE) was a rationalist. Descartes (1596-1650), the father of modern philosophy, is regarded as the first modern rationalist. Descartes believed that, without any reference to the reality, humans can find a basic truth. This belief enabled him to build up a philosophical system based on human thought alone.

Philosophers seem to believe that, if humans can be free from such a (mental) constraint or obligation of scientific verification, human logos may be able to perceive the reality, at least some reality, much more accurately. So they approach the reality through logos (the so-called rational human thinking), without ever worrying about empirical verification of their story. They never intend to verify their story in laboratory or by observation. They only have to check the logical consistency of their story. The logicians and mathematicians have already been doing that. But the one big difference is that, while the logicians or mathematicians are just pursuing logical truth, without ever worrying about whether

their model or theory is consistent with the reality, the philosophers are addressing to the reality, with no intention of empirically testing their hypothesis. A philosopher never proves that his story is consistent with the reality; he just believes in his logos. Mathematicians, on the other hand, are just happy to be in the idealized Platonic world of mathematical forms.

The even bigger difference between a logician or mathematician and a philosopher is that while the former specifies his axioms (assumptions) in precise mathematical terms in deducing a logical truth (such as 1 + 1 = 2), the latter has to specify his axioms in human (either spoken or written) language, and deduce the (presumably) logical truth with the linguistic means. Now here comes Jacques Derrida (1930-2004). Philosophers try to understand the universe and our world with logos, according to Derrida, in the linguistic strait jacket. Human language is, by nature, ambiguous and unstable. Language, say, a word, is essentially a symbol of some reality, and it is not the reality itself. A symbol (i.e., a word) cannot be identical to the reality that the word is supposedly representing. What a philosopher gets might be essentially a pseudo-logical truth, so long as he is depending on such ambiguous and unstable human language.

Derrida contends that the philosophers have been able to impose their various systems of thought only by ignoring, or suppressing, the disruptive effects of language. Deconstruction works to undo the idea. According to Derrida, the ruling illusion of Western metaphysics is that reason can somehow dispense with language and achieve knowledge ideally unaffected by such mere linguistic foibles. Norris (1982: 18-9)

The very meaning and mission of deconstruction is to show that things – texts, institutions, traditions, societies, belief, and practices of whatever size and sort you need – do not have definable meanings and determinable missions. Every time you try to stabilize the meaning of a thing, to fix it in its missionary position, the thing itself, if there is anything at all to it, slips away.
Caputo (1997: 31)

> Human language is the historically contingent product of social practices of particular local communities, with no assured relation to an independent ahistorical reality. Because human experience is linguistically prestructured, yet the various structures of language possess no demonstrable connection with an independent reality, the human mind can never claim access to any reality other than that determined by its local form of life. Language is a 'cage' (Wittgenstein). Tarnas (1991: 399)

Gilles Deleuze (1925-95) now confronts the very peculiar function of human brain itself (à la evolutionary psychologists), instead of the mere linguistic tool employed in human thinking. According to Deleuze, "thinking is a violent confrontation with reality, an involuntary rupture of established categories." Deleuze rejects the "assumption that thinking has a natural ability to recognize truth," and believes that a thought, just like theology, is always "presupposes axioms which do not have an intrinsic rationality," and hence is "determined by problems rather than solving them." "Reason is always a region carved out of the irrational. Underneath all reason lies delirium, and drift." The history of philosophy must say what a philosopher had taken for granted and did not say explicitly but nonetheless was present in which he did say. We should not expect a philosopher to find a single correct interpretation of reality, but simply try to find how he grappled with the problematic nature of reality. Philosophers introduce new concepts, and explain reality, but they do not tell us the problems to which those concepts were a response. According to Deleuze, philosophy is not a pursuit of truth, but a practical or artistic production of concepts, the metaphysical constructions that define a range of thinking, such as Plato's ideas, Descartes's cognito, or Kant's doctrine of the faculties.

Art is also a creation of the human mind, with its freely invented ideas and concepts, but is not a science. A sculptor or any artist also tries to form a (very primitive, scientists would say) picture of reality and to establish its connection with the wide

world of sense of impressions, but is not a scientist. An artist tries to be faithful to his or her intuition, and is never obliged to prove the plausibility of their ideas and perceptions scientifically in laboratory or by observation. An artist, unlike a philosopher, is not so fanatic about logos and internal consistency either.

Cultural memory in the folds of the brain, built by the evolutionary genome, creates what they call mind, heart, spirit, and soul. Impressionists explored the human mind and the human brain's perception of the outside world.

An artist may not have that high regards for human brain and human capability of logical reasoning. Life appeared on earth some 3 billion years ago. Almost 99.9% of living things that appeared on earth are now extinct. Ant has survived 100 million years. Homo sapiens, however, have a history of paltry 0.2 million years and, if we have a look at the way Homo sapiens behave, they would likely be extinct long before one million years. We often find people doing really shallow pseudo-logical thinking on the basis of some preposterous presumptions and sheer prejudice. They say that, when a person makes a trivial decision, he or she may well depend on the so-called "logical" thinking; but when a person is making a serious decision, it would be much safer to depend on gut feeling rather than a superficially logical reasoning.

An artist believes that intuitive approach may enable people to perceive the realities, at least for some aspects, much better than the logos-centric or scientific approach. The artists are not fanatic about logos. They never intend to do any sorts of empirical verification of their perception of reality either. They just believe in their intuition—the instinctively felt emotions or the deepest instinct, distinct from the rational or logical reasoning. Being free from the self-imposed burden of logos and empirical verification, they believe that an artist can perceive the reality, at least some reality, much more accurately than scientists or philosophers, whose stories are, anyway, often beyond the artists' comprehension. Artists believe that the intuition of free human

mind can penetrate the maze of reality much more accurately. They can never prove whether their perception is more realistic than those of scientists or philosophers, but they can evoke the sympathy of the viewers. That might be more than enough.

Artists try to create an artwork on the basis of their own intuitive perception and own concept of reality, and hope that the artwork would help not only the artists themselves but also the ordinary viewers to find their way through the maze of their sense of impressions. An artist "believes" that the reality is not very different from what he or she intuitively perceives.

Without the belief that it is possible to grasp some essential reality with our intuitions, and without the belief that there exists an exclusive domain of art that cannot be solved by science or philosophy, there could be no art or artist. This belief is and always will remain the fundamental motive for all artistic creation. Throughout the efforts of all kinds of artists, in every struggle between old and new views, artists are guided by their eternal longing for understanding, and the ever-firm belief in the power of intuitive perception of reality, beyond the conceited logos of human brain and outside the scientists' laboratories, never weakened by the progress of science and technology which are anyway often beyond their comprehension.

Human beings perceive the reality by using their physical, emotional and intellectual organs. On the basis of their experiences, perceptions, and expectations, humans have tried to understand the reality, and make all kinds of discoveries that could improve their living environment. The remarkable discoveries have been the result of the socio-cultural-scientific application of human perception of reality. The capability of perception seems to provide infinite possibilities for human being.

And yet, the universe is not what is perceived by sense impressions. One may just have a look at a popular science magazine. They say that matter of the sort that can be explained by

our kind of physics is a mere 4% of the total. The rest of the universe is made of dark matter and dark energy whose nature is yet unknown.

Natural scientists try to understand the universe with modeling-cum-empirical verifications. Social scientists try to understand our world with modeling and non-laboratory observations. Philosophers try to understand the universe and our world with logos in the linguistic strait jacket. Artists try to understand the reality with personal intuitive perception. The boundary for intuitive perception is almost limitless. Artists are privileged to enjoy the freedom that can not be enjoyed by scientists or philosophers. Artists may therefore perceive something that can not be perceived by the scientists or philosophers. Artists can perceive the reality on a dimension that is beyond the reach of scientists or philosophers. Here lies the unique function of art and artists.

An artist may believe that our present view of the universe and our present scientific theories are myths. Human minds and thinking shape our perception of the universe. The new paradigm of the future might view a universe where consciousness is the primary reality, from which physical reality is derived. Zen Buddhists believe that we can get awakening by the "direct pointing to mind" and with "no dependence on words and letters." The Buddhist idea of emptiness may imply that the really Real can be known only by intuitive realization, never by discursive conceptualizing.

Father Joseph Fessio, the provost of Ave Maria University in Florida, observes that Catholics accept three different ways of learning about reality: scientific investigation, human logos to discern divine reason in the universe (i.e., the natural philosophy), and the "direct revelations from God." Christian theologians believe that mystical communion with God is radically different from reasoning or speculation by the human brain.

Deleuze, especially after 1981, sharply distinguishes art, philosophy, and science as three distinct disciplines, each analyzing reality in different ways. While philosophy creates concepts, the arts create new qualitative combinations of sensation and feeling (the *Percepts* and *Affects*), and the sciences create quantitative theories based on fixed points of references such as the speed of light or absolute zero (the *Functives*). None of these disciplines enjoy primacy over the others: they are different ways of organizing the metaphysical flux, "separate melodic lines in constant interplay with one another." Philosophy, science, and art are equally creative and practical. Hence, instead of asking traditional questions of identity such as "Is it true?" or "What is it?", the inquiries should be functional and practical: "What does it do?" and "How does it work?"

32

Random Associations

Mathematical truths (theorems) established by logical reasoning on the basis of the pre-established validity of other mathematical assertions or axioms (whose validity is taken self-evident) exist only in the idealized Platonic world of mathematical forms, distinct from the actual physical world. The existence of some mathematical truth that is established by a human brain, such as the Mandelbrot set, is beyond the scope of human mind, for no one can fully comprehend its endless variety and unlimited complications. Human minds are often imprecise, unreliable and inconsistent. The Platonic mathematical world is a fiction produced by human minds. Euclidian geometry is a specific mathematical structure with specific axioms that provides an excellent "approximation" of a particular aspect of reality—the laws governing the geometry of rigid objects as they are moved around in 3-dimensional space. Einstein's general relativity provides geometries for the physical universe—in the four dimensions of space-time—that are different from the geometry of Euclid and are more accurate. The so-called self-evident axioms are not actually true. See Penrose (2004: 7-23).

Physicists work by modeling that more often lacks mathematical rigor, and what they can understand (such as quantum field theory) is generally much greater than what can be mathematically proved. There is often a long period between the first insight of a new physical theory and the final mathematical form. Much of the interest that mathematicians have in physics arises not from its rigor but rather from the observation of new results obtained by physicists that are difficult to put on a (currently

available) mathematical foundation. It serves as a source of inspiration to discover some mathematical notions fundamentally different from those that we know now.

A scientific model with strict internal consistency has to be a mathematical model. The physical universe seems to be governed by (stochastic or non-stochastic) mathematical principles, including some future mathematical notions fundamentally different from those that we know now or those that human reason and insight can possibly imagine. But no one has yet proved that there can never exist some physical universe that is not governed by mathematical principles.

It was a group of modern musical composers at the turn of the 20th century who attempted to break out the boundary of tonality (from Latin *tonus*, and Greek *tonos*), i.e., the musical system of melodic and harmonic relations imposed between the tones of a scale.

Cosmos (from Greek *kosmos*) means the orderly, harmonious, and systematic universe. Cosmos must be a subset of the universe (from Latin *universum* or *universus*) that implies the whole body of things and phenomena **observed** or **postulated**. Reality (from Medieval Latin *realitat* or *realis*) is something that exists independently of **ideas concerning it**. The sequence of creating such words must have been related with the progress in conceptualization by the Western people.

Some believes that there can not be physically independent mind because mentality has its roots in physicality. But we are still very far from understanding the actual nature of mental processes.

The universe is not what is perceived by sense impressions. Scientists suggest that matter of the sort that can be explained by our kind of physics is a mere 4% of the total. Some 22% of the universe is made of dark matter that has no electric charge and does not feel the strong and weak forces that bind atomic nuclei

together, but can be detected by its gravitational effects on ordinary, visible matter. Scientists have some ideas about what it might be, but are not able to find any particles, the main constituent of dark matter, with such property. The remaining 74% of the universe is made of dark energy whose effects can be seen but whose nature is unknown.

Science is about understanding nature or reality and the reasons for things. One thing at least is certain. We are sure that our ignorance exceeds our knowledge.

For all the questions science can answer, it inevitably creates more. Humans surely have made great progress, but no one can deny that we have a long way to go. The style and scale of mystery change, but not its nature.

A would-be scientist should be happy to know that there are plenty of things for which we still do not yet have any scientifically satisfactory explanations.

We still do not know, and perhaps we may never know, why the origin and structure of the universe are as they are. We may use a symbol X to designate something we do not know, and then say that nature is the way it is because X caused it to be that way.

One may now metaphorically substitute God for X. Then nature is the way it is because God designed it to be that way—as in the idea of "Intelligent Design." The only argument offered by the Creationists to support Intelligent Design is the claim that some complex biological feature is statistically improbable to have evolved by natural selection. Allowing an unevolved supernatural designer to have sprung into existence *ab initio* is, according to Richard Dawkins, not only bad science, but it is bad logic and even bad theology. Science, of course, cannot disprove intelligent design. Science, furthermore, cannot say anything about values, morals, ethics or religion.

Religion might be defined as the Search for a Way to find the meaning and purpose of life, full of pains at that, of a transient and ephemeral individual human being --- a sort of constrained maximization. Modern science would surely help us to acquire a more precise understanding of the constraints (i.e., the realities) we are faced with, and hence help us to avoid making preposterous and irrelevant presumptions. Science has nothing to say about the Way itself, but by helping us to acquire a more precise understanding of the constraints, would help us to take a more realistic approach to finding the Way.

A religious leader may believe that he has found the best Way, and wish the ignorant mass to share His belief. To spread His message and teach the fools, He more often than not has to resort to parables. It is impossible to say which Way is the best Way to achieve Heaven or Nirvana on earth and beyond. Science has nothing to say about such parables. It is a matter of belief for each individual.

Quite a few Christians seem to admit that the idea of intelligent design ---some features of the universe can be explained only by the direct intervention of a Creator--- is apparently a religious theory, not the only answer to the gaps in the theories of evolution and Big Bang cosmology. They know that if the Christian churches keep teaching things about the physical universe which are manifestly false, then everything else the churches teach would be discredited too. Some Christian scientists strongly believe that physics and metaphysics can and should be separated. And yet, they don't believe that man evolved purely as the result of a natural process of adaptation to changing conditions. They believe that the way life has developed is indicative of a divine reason which could not be discerned by scientific or philosophical methods alone. They see God's hand in "convergence" that resulted in similar processes and structures to be present in physical universe and in organisms that have evolved separately. They believe that natural selection does not say all that needs to be said for the diversity and

complexity of life in all its forms. They don't believe that Big Bang cosmology says everything about how the universe came to be.

Neither the evolutionists nor the creationists, however, seem be focusing on the very nature and role of religion. The raison d'être of religion may be in essence to give the meaning and purpose of life for humans, not simply to give some plausible explanations for evolution and physical universe. Their debate over creation and evolution seem to have missed the point.

Horizon (from Greek *horizont*, *horizein*, *horos*, or *kyklos*, and Latin *horizontem*) means the limit or range (extent of the operation; from Old French *renge*) of experience, outlook (mental view or perspective, i.e., a particular evaluation of a situation or facts from one person's point of view), knowledge (from Greek *gnostikos*), or perception (mental image or awareness derived from sensory processes; from Latin *perceptio*) at the position of a given observer. The limit, range, or orbit (range of one's activities; from Latin *orbita*--wheel track, course) of wisdom (from Greek *philos*, and Latin *sapiens*--to be wise) does not seem to be included in the concept of horizon. One may not say "boundless knowledge," but may say "boundless (from Late Latin *butina*, Old French *bonde*) wisdom."

RELATIVITY OF COGNITIVE TIME

One may perceive the *Life* axiomatically: "No one lives forever; sooner or later one dies." This axiom, unlike many others adopted by all sorts of scientists, can never turn out to be false. Then one may ask what kind of life one would like to live. A young person who is 99% sure that he or she will live until 60 or 70 years of age, at the minimum, may well pursue a time-phased life pattern: learn, save, and invest while young in order to practice what one has learned, and to spend what one has saved, invested and earned, later. An old person over the hill and down the road who cannot be so sure about "exactly" how long he or she would stay alive on earth may well try to pursue a "time-independent or time-indifferent" life pattern, say, in the words of growth economists, a "golden-rule balanced steady-state" life pattern, or in the words of Christian, ever ready to meet the Creator without any regret.

As people get older, they seem to become a little bit wiser (say, a little bit less stupid) and be able to minimize the "waste of time" they had indulged in when they were young and foolish. One may not be able to lengthen his or her "God-given" life span, but the old man/woman can at least minimize the "unnecessary" waste of time by, belatedly, being able to see all sorts of futilities that clutter one's mind. They say that "Youth is the best time of life," but perhaps "the post-retirement age with (a little bit of) wisdom may be the best time of one's life."

And yet, we hear the ordinary mortals lamenting a *fleeting* (*transient, ephemeral*) *life*, while the sages have been talking about *eternal life*.

What is the eternity? We may now turn to the cognitive world of human being.

The perception of time, as a mental process, is relative, rather than absolute. The cognition of time, as a mental state, depends upon the nature of the human mind (that is to say, the "relativity of cognitive time" just as the "relativity of values," and

the "relativity of knowledge.") All cognition must be defined relative to a frame of reference. Anything that is past (the bygones) may seem (appear to one's own senses) to be a flash. One may say that any length of time period **that has already passed** may be reckoned as "momentary;" for instance, the 13.7 billion years since the big bang, the 4.7 billion years since the appearance of our sun and planets, the 2 million years since the appearance of homo erectus, the 200,000 years since the appearance of homo sapiens, the 10,000 years since the human agricultural revolution, some 5,000 years of documented human history, some 70-100 years of your or my life, some 5 years since the retirement, those two weeks since the Christmas, and so on. On the other hand, one sometimes feels an eternity while waiting for something approaching in time (forthcoming). There is the saying that "*A second/minute seems like three years* (*a lifetime or an eternity* 一刻如三秋)." That is, you may feel "three autumns" for just "one second" under some situation. You may feel eternity and bored to death in one summer afternoon when there is nobody around and you don't have any idea about what to do with yourself. You know the old man's grumble--most likely flicking the TV remote control--: "Yes, a year seems to be fleeting, but these damn 24 hours seem an eternity." **Any forthcoming time span** (about to come forth), say, a second, a day, a week, a year, 10 years, 20 years ... from this very moment can be felt either as momentary or eternal--depending on one's mental status or mental framework. Depending on how a person lives his or her life, a week can pass as a flash, or at a glacial pace. Many active people with hectic life style say that "time flies like an arrow," lamenting the ephemeral life, while some prematurely retired people in countryside claim that life proceeds at a snail's pace or glacial pace and even claim to have experienced the sensation of life standing still. A dayfly, symbolizing the short-lived lifespan, may well feel an eternity, while a turtle, symbolizing the longevity, may feel an ephemeral existence. After all, in cosmological time frame, any time span short of one million years can be regarded momentary --- definitely there is no "significant" difference between a 1,000-year life of some turtle and the life of a dayfly. I bet quite a few dayflies could have felt the

sensation of "an eternal life."

One may invoke the Theory of Relativity. According to the Einstein's Theory of Relativity, although the velocity of light is independent of the motion of its source and has the same value when measured by observers moving with constant velocity with respect to each other, time is dependent on the relative motion of an observer measuring the time.

Anxiety and confusion of ordinary mortals on "*Our* (*Short*) *Span on Earth"* may have resulted from simultaneously holding the contradictory and incompatible perceptions of the "time in the physical universe" and the "time in the cognitive world."

A friend of mine wrote me: "I'm sorry that you, as well, have had operations since we last communicated, but happy to learn that you've recovered. As we say here, 'Getting old isn't for sissies.' Our bodies let us down. When my mother was about 80 years old, she used to tell me she wished we could be old together so we could talk about what it's like. Now I'm old enough to know what she meant. You are so productive in retirement! I haven't been at all like I expected I would be once retired. I thought I'd continue to do research and writing, and maybe even teach a little. But once I got out of the saddle, so to speak, I never got back on the horse again. I'm not sure why, and I'm not sure what to think of myself. In a way it seems a shame because in a sense I was at the height of my powers when I retired and perhaps should have continued to use in some formal way what I had learned over the years. On the other hand, the fact that I've stayed off the horse must mean that I didn't want to get back on but wanted greener or other pastures to which my old horse wouldn't take me. Unfortunately, I don't think I've found those pastures yet--but I'd better get going before I find myself in the big pasture in the sky. :-) Best wishes to you." 2011.10.28.

"When I read your email this morning, I thought of this poem [by Lisel Mueller], ***Monet refuses the operation***, and thought you might like it. I think it is a wonderful poem. It's about how we come to see the world as we age, and it insists that the world as we see it in our later years is, after all, more beautiful and accurate than the world of youth." 2011.10.28.

[Re: " 'Our bodies let us down.' Yes, but I prefer the *Present* to any time point in my *Past*; because I do not want to be 'young-and-foolish' again. I seem to understand, in my own way, why Lisel Mueller cries: 'Now you want to restore my youthful errors!' " 2011.10.29.]

"I agree completely; I would never want to be young again, with all it's foolishness, and go through what we go through in our youth. I

wish, though, that I could have the energy of youth with the wisdom of age. … I have come to believe that poetry is among the best, if not THE best, of tools through which to gain insights into life and the world, and to make choate our ordinarily inchoate feelings. I also think of it as a form of prayer.

> 'It is difficult to get the news from poems yet men die miserably every day for lack of what is found there.' -- William Carlos Williams, from ***Asphodel, that Greeny Flower***.

And here is what **your tri-polar history** involves: [a quote from ***The Sleepwalkers*** by Arthur Koestler] 'Every creative act involves . . . A new innocence of perception, liberated from the cataract of beliefs.' Best wishes. Sent from my iPad." 2011.10.29

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Yes, But Who Is She?

"Antea," by Francesco Mazzola Parmigianino (1503-40), is a luxuriously dressed, radiant young beauty who looks straight at the viewer with a magnetically arresting gaze. It has been claimed in turn that she was his mistress, a famous Roman courtesan, a garden-variety prostitute, an aristocrat, a noble bride, the painter's sister, or a man. Anyway, Parmigianino "created a woman with whom the viewer could fall in love." The Economist, January 26th 2008, p. 83.

"La Toilette," painted circa 1892 by Mary Cassatt (1844-1926), exhibits the intimate bonds between mothers and children, the principal motif of her mature period. Here Cassatt, who had never married, created the purity of mother and daughter from whom the viewer could feel the flow of Mitochondrial DNA without ever asking *Who They Are.*

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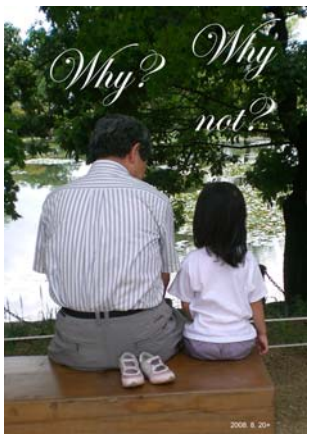

The author with his granddaughter sometime around August 20, 2008.

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WONTACK HONG, Professor Emeritus, Seoul National University (SNU), was born in Seoul in 1940. He received his undergraduate education in economics at SNU. His graduate studies were conducted in the United States at Columbia University where he received his M.A. in 1964 and Ph.D in 1966.

He has previously held the positions of Assistant Professor of Economics at the University of Wisconsin (1966-71), Senior Fellow at the Korea Development Institute (1971-7), and Visiting Fellow at the Institute of Development Studies, the University of Sussex, UK (1979). He began teaching at SNU in 1977 and served as Director of the Center for Area Studies (1990-1) and Director of the Institute for International and Area Studies (1997-8) there. He founded the *International Economic Journal* (Routledge, UK) in 1987 and served as its managing editor until 2005. He retired from SNU in 2005.

He had worked exclusively on international economics (trade and growth) from 1958-80, and on both international economics and East Asian history from 1981-2005 (causing a deterioration in his publication performance in economics). He has been working exclusively on East Asian history since his retirement.

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The giant elliptical galaxy M87 lies at the heart of the Virgo cluster, 41 million light years away. Many times the mass of the Milky Way, it appears yellow because it is made up of old stars and contains little gas and dust which lend other galaxies their red and blue colors. At the heart of M87 lies the supermassive black hole. The 5,000 light years long turquoise plasma jet emerges from a band of matter made of stars, gas and dust which is being pulled into the black hole.