

# Hanna Newcombe

## How Things Come Together

### Volume 3

Volume 3 articles are listed by category below. Most categories overlap with those used in [Volume 1](#) and [Volume 2](#), although in some cases names might be changed or categories combined.

#### Time and Space

[FROM HERE TO ETERNITY \(by Tim Folger: excerpts\)](#)  
[APPROACHING A BLACK HOLE](#)

#### Matter and Energy

[TOWARD A THEORY OF EVERYTHING](#)  
[SUPERORDINATE ESSENCES](#)  
[ASYMMETRY AND SUPERSYMMETRY](#)  
[SIX OR NINE NUMBERS OF THE UNIVERSE.](#)  
[QUANTUM THEORY IMPLICATIONS.](#)  
[SIZE SPECTRUM OF CELESTIAL BODIES](#)  
[QUANTUM PROPERTIES](#)  
[THE QUINTESSENTIAL UNIVERSE.](#)  
[IT'S TURTLES ALL THE WAY DOWN?](#)

#### Information, Meaning, Knowledge

[NINE AXIOMS](#)

#### Mind

[A UNIVERSE OF CONSCIOUSNESS.](#)  
[CHALMERS-CRICK SYNTHESIS.](#)  
[LONG-TERM POTENTIATION.](#)  
[EXPANDING BEYOND OUR SENSE-DERIVED EXPERIENCE.](#)  
[EVOLUTION OF SEX DIFFERENCES \(by Doreen Kimura\)](#)  
[A NEW DEFINITION OF LUCID DREAMING?](#)  
[HOW WE KNOW THE WORLD.](#)  
[ANIMAL MINDS.](#)  
[LEFT AND RIGHT MISUNDERSTOOD.](#)  
[DREAMING THE WORLD INTO EXISTENCE.](#)  
[NOT BY GENES ALONE.](#)  
[DENNETT'S LADDER.](#)

#### Spirit

[ARGUMENTS FOR THE EXISTENCE OF GOD.](#)  
[MEDITATION ON CAETANI'S TREE OF GOD.](#)  
[GNOSTICISM.](#)  
[SECOND THOUGHTS ON GNOSTICISM.](#)  
[INTER-FAITH CORRELATIONS.](#)  
[GOD OF THE UNIVERSES.](#)

[INTER-SECTS.](#)  
[THE RED SNAKE.](#)  
[WHO WAS JESUS?](#)  
[FROM "VARIETIES OF RELIGIOUS EXPERIENCE" \(William James\)](#)  
[SPARKS OF DIVINE ESSENCE.](#)  
[SEE THE WORLD FROM BOTH SIDES NOW.](#)  
[MULTIPLE PATHS TO TRUTH.](#)  
[OM-GAIA MEDITATION.](#)  
[HEAVEN AND HELL.](#)  
[TRUTH AND BEAUTY.](#)  
[THE MODE SWITCH.](#)

## **Life**

[DEFINITIONS OF LIFE.](#)  
[PREBIOTIC EVOLUTION.](#)  
[YUCK AND YUM.](#)  
[NANO-CHEMISTRY IS CELL BIOLOGY](#)  
[FROM ERRORS TO STABILITY: IS THAT PROGRESS?](#)  
[GENE SWAPPING AND KINSHIP STRUCTURES](#)  
[THE STORY OF THE GENES.](#)  
[IS LIFE IMMORTAL?](#)  
[UPROOTING THE TREE OF LIFE.](#)  
[ARE WE ALONE?](#)  
[CONTRASTS.](#)  
[GAIA'S RITE OF EXTINCTION.](#)

## **Society and Politics**

[ETHNOS TO ETHOS.](#)  
[CRITERIA FOR HUMANITARIAN INTERVENTION.](#)  
[EVOLUTION OF THE WAR SYSTEM](#)  
[BIOTECHNOLOGY: PROS AND CONS.](#)  
[GENOCIDES.](#)  
[DEFINITIONS OF PEACE.](#)  
[MILITARY SPENDING AND POVERTY.](#)  
[REVIEW OF "THE NEXT STEP" BY PROF. JAMES A. YUNKER.](#)  
[NONVIOLENT REVOLUTION.](#)

## **Passages**

[COSMIC EVOLUTION.](#)  
[UNIFICATIONS AND GENERALIZATIONS.](#)  
[FROM OUSIS TO MATTER.](#)  
[THE BIFURCATION TEST.](#)  
[NECESSITY IS THE MOTHER OF INVENTION.](#)  
[THE SAME OR IDENTICAL?](#)

## **Conclusions**

[IS THE WORLD STRUCTURE DISCRETE OR CONTINUOUS?](#)  
[3 or 4? 6 or 7? 10 or 26?](#)  
[SELF-ORGANIZATION OF HUMAN SOCIETY.](#)

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## FROM HERE TO ETERNITY (by Tim Folger: excerpts)

In Barbour's universe, every moment of every individual's life— birth, death, and everything in between— exists forever. "Each instant we live," Barbour says, "is, in essence, eternal." That means each and every one of us is immortal. Like the perpetually unmoving lovers in Keats's "Ode on a Grecian Urn," we are "for ever panting, and for ever young." We are also for ever aged and decrepit, on our deathbeds, in the dentist's chair, at Thanksgivings with our in-laws, and reading these words.

Barbour's central argument is that a mistaken belief in the reality of time prevents physicists from achieving their ultimate goal: the unification of the submicroscopic atomic world of quantum mechanics with the vast cosmic one of general relativity. The problem arises because each theory provides a radically different conception of time, and physicists simply don't know how to reconcile the two views. Until they do, they will never have one seamless theory of the universe comprising the very smallest objects to the very largest. And certain middling-sized objects— human beings— will never understand the true nature of time and existence.

What makes the two versions of time so different? Time in the quantum realm has no remarkable properties at all. In theories of quantum mechanics, time is essentially taken for granted; it simply regularly ticks away in the background, just as it does in our own lives. Like a clock at a sporting event, it provides an invisible framework in which events unfold. That's not the case in Einstein's general theory of relativity.

To describe the universe on the largest scale, Einstein had to weave time and space together into the very fabric of the universe. As a result, in general relativity, there is no invisible framework, no clock ticking outside the universe against which to measure events. How could there be? Time and space joined together have weird consequences: Space and time curve around stars and other massive bodies and make light bend away from straight-line paths. Near black holes, time seems to slow down or even come to a full stop.

Barbour is not alone in recognizing that the pictures of time in general relativity and quantum mechanics are fundamentally incompatible. Theoretical physicists around the world, spurred by Nobel dreams, sweat over the problem. But Barbour has taken perhaps the most unorthodox approach by proposing that the way to solve the conundrum is to leave time out of the equations that describe the universe entirely. He has been obsessed with this solution for more than 10 years, since he learned of a vexing mathematical tour de force by a young American physicist named Bryce DeWitt.

DeWitt, with the help of the eminent American physicist John Wheeler, developed an equation in 1967 that apparently melded quantum mechanics with general relativity. He did this by taking the principles from quantum mechanics that describe the interactions of atoms and molecules and applying them to the entire universe, a mind-bending feat not unlike trying to make a jockey's suit fit Michael Jordan.

Specifically, DeWitt hijacked the Schrödinger equation, named for the great Austrian physicist who created it. In its original form, the equation reveals how the arrangement of electrons determines the geometrical shapes of atoms and molecules. As modified by DeWitt, the equation describes different possible shapes for the entire universe and the position of everything in it. The key difference between Schrödinger's quantum and DeWitt's cosmic version of the equation— besides the scale of the things involved— is that atoms, over time, can interact with other atoms and change their energies. But the universe has nothing to interact with except itself and has only a fixed total energy. Because the energy of the universe doesn't change with time, the easiest of the many ways to solve what has become known as the Wheeler-DeWitt equation is to eliminate time.

Every Now is a complete, self-contained, timeless, unchanging universe. We mistakenly perceive the Nows as fleeting, when in fact each one persists forever. Because the word universe seems too small to encompass all possible Nows, Barbour coined a new word for it: Platonía. The name honors the ancient Greek philosopher who argued that reality is composed of eternal and changeless forms, even though the physical world we perceive through our senses appears to be in constant flux.

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## APPROACHING A BLACK HOLE

Time slows down for observers moving at great speeds, according to the theory of special relativity. When we, as observers in our frame of reference with respect to motion, see something or someone falling into a black hole, we perceive that they are accelerating, until at the black hole's horizon they reach the speed of light. However, someone who is falling in feels it quite differently. When they reach the horizon, they perceive themselves as sitting still forever at the horizon. Time has, for them, virtually disappeared.

How do we know that we are not in that state already? We feel quite comfortable in our frame of reference, while "actually" (whatever that means), we are already in the grip of an unavoidable catastrophe.

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# TOWARD A THEORY OF EVERYTHING

Three of the fundamental forces were theoretically unified in a theory called GUT (Grand Unification Theory). In nature, this unification would happen only at a very high temperature; only the electromagnetic-weak unification has so far been experimentally observed, in collisions with an energy of about 100 to 1,000 GeV (giga-electron-volts). A further unification of the electro-weak force with the strong force has been supported theoretically; but a final unification with gravity is an unsolved problem even theoretically. Even Einstein could not solve it, although he worked on it for many years.

According to an article in *Scientific American*, August 2000 (by Nima Arkani-Hamed et al, pp. 62-69), gravity and GUT cannot be reconciled by present methods, because gravity operates in a 4th spatial dimension in addition to our usual 3. The writers speculate that our 3-dimensional universe may be “plastered” on the wall of a 1 mm diameter curled-up cylinder of the 4th dimension. This 1 mm cylinder diameter is called “large”, since curled-up extra dimensions usually have a diameter of the order of  $10^{-35}$  millimeters, which is the Planck dimension. What we observe in our universe is similar to what was suggested people would see on the walls of Plato’s cave — not a faithful representation of the real world; only a projection to a lower dimension.

Large-scale paradoxes, such as extra dimensions of space, combine with the small-scale paradoxes of string theory of sub-atomic particles; the latter also assumes many dimensions, sometimes 26, sometimes 10 or 11. String theory and cosmology combine to give us these alien and almost incomprehensible views of the universe at extreme size scales. Our brain evolved for survivability, to which extra space dimensions are of no value. Quantum theory has several other examples of such “meta-evolutionary” concepts: non-locality, entanglement, complementarity, superposition, collapse of the wave packet. While our senses and imaginations cannot picture these realities, our symbolic capability can reason about them mathematically. We have some reach toward ultimate reality, even though it escapes our experiential grasp.

Another speculation in the article is that gravity, which of course normally increases when distances get smaller (since it varies inversely with the square of the distance between massive objects) actually increases much faster at distances such as prevail in atomic nuclei and between quarks. Conventional theory would have gravity increase to infinity at Planck distances ( $10^{-35}$  m), where it would meet the absolute impenetrability of all fermions (the Pauli exclusion principle). An infinite force would meet an immovable obstacle. However, it is postulated here that gravity increases much faster at small enough dimensions, so that it actually reaches a maximum at only  $10^{-19}$  m, where it is counteracted by the strong nuclear force between protons, neutrons and quarks.

What does this mean for negative gravity (“quintessence” or the cosmological constant), postulated elsewhere, in an article on the accelerated expansion of space? I see three possibilities: 1. The “strong plus” of gravity at ultra-small dimensions may flip to a “strong minus” at infinity (change of attraction to repulsion), like paramagnetic temperature does. 2. Real particles (or only fermions) have positive gravity (attraction), while virtual particles (those that flicker in and out of existence because they have only borrowed energy from the vacuum field) have negative gravity (repulsion). 3. It is “fermion pressure” (generated by the Pauli exclusion principle) that creates the repulsion, which is even stronger at ultra-small distances (above I called it “absolute”) than strong gravity.

I prefer the third alternative. Fermion pressure would be even greater than strong gravity or the strong nuclear force at ultra-small distances. As virtual particles are continually created (and destroyed) in inter-galactic space, their fermionic repulsion would constitute the quintessence that makes space expand exponentially with time, as intergalactic space itself expands.

Incidentally: if virtual particles continually arise in open space, would they include whole protons? Could extra matter be constantly created in space, in the form of hydrogen, as Fred Hoyle once proposed? (It would mean the conversion of virtual to real protons.) The Big Bang theory replaced Hoyle’s continuous creation theory, but maybe they will eventually be found complementary.

Note that “repelling” means “creating space”. Early “inflation”, soon after the Big Bang, was probably caused by the quintessence force — the fermionic pressure that caused the Big Bang in the first place, after the supersymmetric transformation, which I have postulated in the essay “Eons of the Universe”. In that sense, “attraction” leads to the Big Crunch. Love = Crush? Maybe...

Is the Universe “infinite in all directions”? (Title of book by Freeman Dyson.) Only in 4 dimensions, 3 of space and 1 of time. The other dimensions, tightly (more or less) rolled up into cylinders, are infinite in another sense: you could keep

going around and around forever, like going around the Earth either East or West, without ever coming to the end (Finis Terrae).

Now in the film "The Truman Show", Truman, who lived in a virtual world to provide entertainment for the television audience (without knowing it), finally touched the canvas at the limit of his Finis Terrae, his constructed world, after barely surviving an (artificial) storm at sea. Then he stepped into the real world from the virtual, and decided to stay real. But just how real is our real world? Is some TV audience (in the 4th dimension?), watching us struggle, for the thrills?

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## **SUPERORDINATE ESSENCES**

A recent article in CANADIAN GEOGRAPHIC describes the Aurora Borealis as an intrusion of cosmic plasma into the terrestrial essences which are largely limited to solid, liquid, and gas (rock, water, and air), with the occasional occurrence of fire. Yet 90% of the visible matter in the cosmos is composed of plasma. Our Earth is an island of exception.

We are not only “three-dimensional”, but also largely tri-phasic. Yet the Fourth Phase (or Element) pervades the material universe. We are either a backwater or a miracle.

However, the Universe in its appearance is also an exception, or at least an illusion to our senses. For its far overwhelming (70%) Dark Energy, Quintessence, dominates all the rest. The universe as a whole is penta-phasic.

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## ASYMMETRY AND SUPERSYMMETRY

Two books expound these seemingly opposed aspects of our universe: "Lucifer's Legacy" by Frank Close, and "Supersymmetry" by Gordon Kane. But they are not really contradicting each other. In fact, "Lucifer's Legacy", which is mainly about asymmetry, has a closing chapter on supersymmetry.

Close explains the consequences of parity non-conservation at the sub-atomic level in its linkage to the matter/antimatter asymmetry and the chirality (handedness) of many biological molecules. Mirror images are strangely interrelated, while we usually think of them as separate.

It is circularly polarized sunlight which selectively destroys one of the enantiomers, e.g. d-amino acids and 1-sugars. And the light is polarized in one circular dimension because parity (charge and mirror-inversion) is not conserved in the operation of the weak force which produces neutrinos in the Sun.

The universe began in symmetric fashion, but very early (tiny fractions of a second) the symmetry broke. This led to the other asymmetries mentioned above, and also, eventually, to differences between left and right brain in human, and the position of some internal organs (heart and stomach on the left, liver and appendix on the right). The lengths of our limbs are not equal, and even the two sides of our faces differ.

Kane's book explains that each sub-atomic particle of the so-called "standard model" may have a supersymmetric partner; i.e. each fermion has a boson partner, and each boson has a fermion partner. The superpartners of the standard-model particles have not been observed, and we do not even know their masses. But the search is on, in the big collider machines, for the "LSP", the lightest superpartner, whichever it turns out to be. The search also concerns the Higgs boson, the boson of the field that imparts mass to the particles.

So really, asymmetry and supersymmetry have very little in common, except that both concepts are at the leading edge of modern particle/physics, and explain many of the mysteries of the early and present universe.

See also "The Secrets of Stardust" by J. Mayo Greenberg in Scientific American, December 2000, pp. 70-75. Dust particles in intragalactic space in the Milky Way spin in one preferred direction, because of magnetic fields in the dust cloud. The dust particles contain organic compounds adhering to the silicate cores of the particles, or are dissolved in the ice covering. The organic compounds include amino acids and polycyclic aromatic hydrocarbons. The preferred spin direction of the dust particles polarized starlight in a preferred circular direction. This in turn polarized the amino acids. The particles may have seeded life on Earth.

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## SIX OR NINE NUMBERS OF THE UNIVERSE.

It is interesting to compare two books: Martin Rees' "Just Six Numbers" and Michael Rowan Robinson's "Nine Numbers of the Universe". I will do this in tabular form.

Nine Numbers	Six Numbers
Anisotropy of microwave background	Ripples in microwave Background (Q)
Hubble Constant H	-
Age of the Universe	-
Temperature of Microwave Background	-
Density of Cold Dark Matter	Total Matter in Universe
Density of Hot Dark Matter	
Cosmological Constant	Cosmological Constant
Rate of Star Formation	-
-	Ratio of gravity to electro-magnetic force
-	Mass deficit H to He
-	Dimensionality (3)

Comments: There is some overlap in the numbers which each author considers important. This is because of the different aim: Robinson aims at a complete description of the universe; hence he picks numbers which are not derived from each other — the independent constants. Reese emphasizes only numbers which are "finely tuned" to make life possible. But his six are also mutually independent.

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## QUANTUM THEORY IMPLICATIONS.

The Copenhagen model elaborated by Niels Bohr postulates the principle of complementarity between the particle and wave aspects of electrons, photons etc. It recommends pursuing the mathematical features of the quantum theory, which works very well in experiments, and not debating questions of the underlying reality, which seemed so paradoxical and counter-intuitive. Heisenberg joined in with his principle of indeterminacy, according to which it was impossible in principle to measure accurately both the position and the momentum (or velocity) of a wave-particle object. The wave packet, according to this view, represents only probabilities, not certainties. Thus the theory is fundamentally nondeterministic. This was unsatisfactory to Einstein, among others, who engaged in a long debate with Bohr, declaring that "God does not play dice with the Universe".

At first, I considered the following alternatives: -Betchov's soliton, a non-linear component of the wave function, essentially a standing wave.

- De Broglie's "guiding wave", which tells the electron or photon where the slits are in the two-slit experiment, or if there is one or two slits.
- Bohm's elaboration of the quantum potential.

Then I realized that these alternatives were essentially the same. The quantum potential, which is the phase of the wave, indicates where the particle "really" is. The quantum potential is the same as the soliton, a high peak moving very rapidly across the wave packet, back and forth (like the resonance of chemical bonds in a benzene ring, only still faster). Since the probability of finding the particle is equal to the wave amplitude squared, the particle is very probably where the soliton is. In a measurement, the wave packet collapses because there is no more probability, we have found the particle. We could not predict where it would be, but it had to be SOMEWHERE along the wave packet, as the soliton vibrated rapidly across it. That probability was greatest at the middle of the wave packet, where the amplitude is greatest.

This restores determinism to the theory, although it does not affect the 'experimental findings or the mathematics. It is simply an alternative interpretation. However, it does not eliminate the "weirdness" of quantum theory, it only displaces it to other aspects.

The Bohr and Bohm alternatives, as I briefly call them, are interpretations of the results of the two-slit experiment, which led to the wave-particle duality, the principle of indeterminacy, and the collapse of the wave packet when a measurement is made. We now have to pay attention to another quantum paradox, the EPR (Einstein-Podolsky-Rosen) experiment and the Bell theorem, according to which two particles flying apart from their point of creation remain non-locally entangled: they maintain the same spin (or other properties) even when only one of them is switched and they are too far apart to communicate at speeds less than the speed of light.

Here again I see some alternative explanations:

- Non-locality
- Time travel: the particles return backward in time to their point of joint origin.
- Connection by origin, like identical twins sometimes unknowingly doing the same thing at the same time, though far apart and not in contact.
- Superluminal speeds are possible, perhaps through tunnelling or a wormhole.

Again, I consider the first three alternatives as different versions of the same mechanism, violating in various ways our intuitive notions of space or time. The fourth alternative would be inconsistent with the special theory of relativity. Yet tunnelling is a real phenomenon on which some technical devices are based, and wormholes may be possible at subatomic size levels, with which we are dealing here.

The book "The Non-Local Universe" by Robert Nadeau and Menas Kafatos (Oxford university Press, 1999) also considers philosophical implications of the new physics, both for epistemology and for metaphysics. The book is co-authored by a physicist and a philosopher, but I must admit that I understand the philosopher even less than the physicist, in spite of the inherent difficulty of quantum theory concepts.

What I glean from the philosopher is again only my own interpretation. It is as follows: Phenomenology reflects the real world, although it is not identical with it; it translates sense data into perceived objects, but there is still a one-to-one correspondence, like the shadows on Plato's cave. However, once we get to a more abstract symbolic level, e.g.

expressing what we sense into linguistic form, we get more distant from reality. We can move entirely within the symbolic sphere (as described e.g. by Terence Deacon in “The Symbolic Species”) and IMAGINE (falsely) that we are getting a one-to-one correspondence between our theories and physical reality.

But then (and this is my addition), if we then test our theories experimentally, as in science, we can get back to one-to-one correspondence to reality, if the experiments confirm the theories. Science is actually a reality check, to keep us from wandering too far in our imagination. Anything not tested is mere imagination, though it may by chance be true, especially if the theory is “elegant” or “beautiful”; but that may prove to be a false clue.

Some post-modernist philosophers claim that we live in “a prison house of language”, in which language can only validate itself — it is self-referential. To me this sounds too extreme.

The authors conclude that metaphysically the universe is a seamless whole, more than the sum of its parts, because it is non-local. Everything is connected by quantum entanglement because of past multiple interactions. However, I have concluded from other readings that quantum entanglements can be broken and often are, just as chemical bonds are broken. Therefore I don't see that the leap from the EPR experiment to the assumption that “the universe is more like an organism than like a machine” is warranted. However, it MAY be true, because it is elegant and beautiful to think so.

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## SIZE SPECTRUM OF CELESTIAL BODIES

Scientific American, April 2000, had an article on “Brown Dwarfs”, also known as “failed stars”. These accumulations of matter from dust and gas clouds are not massive enough or hot enough to sustain nuclear fusion (hydrogen to helium) in their cores, and so do not shine brightly like stars, but emit only weak light from the energy liberated by their gravitational contraction, as well as some from deuterium fusion. .

Yet they are bigger than the solar planet Jupiter, our biggest, which also generates some internal heat. A minimum-size brown dwarf has a mass of about 13 Jupiters, while a minimum-size star would have a mass of about 75 Jupiters. Our Sun is 1000 times bigger than Jupiter.

There now seems to be a continuous series of sizes in celestial objects, from an asteroid (which may have an irregular shape like a big rock, not even be spherical), to a satellite like our Moon, to a small stony planet like Earth or Mars, to a big gaseous planet like Jupiter, to a small brown dwarf like Gliese 229B, to a larger brown dwarf like Teide 1, to a red dwarf star like Gliese 229A, to a yellow star like the Sun, to a big blue star which lasts only a few million years, because of its fast production of energy.

As the picture accompanying the article shows, these objects differ in mass, radius, surface temperature, age, the presence or absence of nuclear reactions, presence or absence of lithium (only brown dwarfs have it, not stars), and whether they mix from surface to centre by convection or have a layered structure like Jupiter and smaller planets.

### “Planets versus Brown Dwarfs”:

Is there a fundamental difference between the largest planets and the smallest brown dwarfs? The classical view is that planets form in a different way than brown dwarfs or stars do. Gas-giant planets are thought to build up from planetesimals — small rocky or icy bodies-amid a disk of gas and dust surrounding a star. Within a few million years these solid cores attract huge envelopes of gas. This model is based on our own solar system and predicts that all planets should be found in circular orbits around stars and that gas giant planets should travel in relatively distant orbits.

These expectations have been shattered by the discovery of the first extrasolar giant planets. Most of these bodies have been found in close orbits, and most travel in eccentric ovals rather than in circles. Some theorists have even predicted the existence of lone planets, thrown out of their stellar systems by orbital interactions with sibling planets. This makes it very hard for observers to distinguish planets from brown dwarfs on the basis of how or where they formed or what their current location and motion is. We can find brown dwarfs by themselves or as orbital companions to stars or even other brown dwarfs. The same may be true for giant planets.

An alternative view is gaining adherents: to distinguish between planets and brown dwarfs based on whether the object has ever managed to produce any nuclear fusion reactions. In this view, the dividing line is set at about 13 Jupiter-masses. Above that mass, deuterium fusion occurs in the object. The fact that brown dwarfs seem to be less common than planets—at least as companions to more massive stars—suggests that the two types of objects may form by different mechanisms. A mass-based distinction, however, is much easier to observe. -G.B.

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# QUANTUM PROPERTIES

The four properties we are considering are: entanglement, decoherence, superposition, and the uncertainty principle.

Entanglement occurs when two newly created particles must always have the same spin (and all other quantum numbers), and when the spin of one is changed, the other also changes, although they are too far apart to communicate by signals even at the speed of light. It is as if the two particles were connected by an eternal string. (No pun intended. )

Decoherence is the opposite of entanglement. The connection (“string”) between two entangled particles is broken by interaction with the environment. This is why ordinarily entanglement is not observed in the everyday world, where other dense interconnections exist.

Superposition is the existence of two different quantum states for the same particle. It occurs by the addition of the two wave equations, as if by Fourier synthesis. Thus, while entanglement is a single state for two particles, superposition means two states for a single particle.

The Heisenberg uncertainty principle says that we cannot know the position and the momentum of a wave-particle at the same time, in the same experiment. Perhaps it is evident that a wave does not have position and a particle does not have frequency (by analogy with “the dolphin click”, an essay in this collection).

Scientific American (April 2000) has an article on teleportation, in this case of a photon, in which the concepts of these properties is used. It shows that the teleportation (transfer in space) is theoretically possible for a photon (and other elementary particles perhaps), though it has not yet been done in the laboratory. But it also argues that it is not even theoretically possible for a large complex physical object, such as a person. (Star Trek’s “Beam me down, scottie” will remain science fiction.)

It seems to me that this is because elementary particles are “fungible” (indistinguishable from one another) \*, while large objects and persons are not. It is fundamentally impossible to preserve all the complex interrelationships in these larger bodies during spatial transfer. The information content exceeds all practical limits.

\* See my essay [From Fungibility to Personality](#) in this collection.

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# THE QUINTESSENTIAL UNIVERSE.

This is a summary of my (imperfect) understanding of the essay of the same title by Jeremiah P. Ostriker and Paul J. Steinhardt in *Scientific American*, January 2001, pp. 4755.

Dark Energy, which accounts for 70% of the total mass in the Universe, and which causes the recently observed acceleration in the expansion of the Universe, comes in two varieties (both assumptions):

1. Vacuum energy (Einstein's cosmological constant), which is static and constant, just so much per unit of space, but of course a growing total as space expands.
2. Quintessence, which varies slowly, up or down, and is a dynamic quantum field. A further elaboration specifies the "tracker field", which for a stretch of cosmic history tracks the decreasing energy density in the Universe.

Both types originate from the quick generation and annihilation of virtual particles in "empty" space.

There are 3 numbers (not either 6 or 9 as in two recent books) that characterize the Universe, illustrated in a "cosmic triangle": relative density of dark energy, relative density of dark matter, and the curvature of space-time. It appears that the curvature is  $\Omega = 1$ , i.e. space is flat, not either hyperbolic or spherical.

H2. Recipe for the Universe.

Dark energy	70%
Exotic dark matter	26%
Ordinary dark matter	3.5%
Visible matter	0.5%
Radiation	0.005%

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100.005%

Exotic dark matter, according to other authors, is called "hot dark matter" (mainly neutrinos) or WIMPS (weakly interacting (nearly) massless particles).

Ordinary dark matter is also called "cold dark matter", mainly brown dwarfs or Jupiter-sized planets, or MACHOS (massive astra-like cold halo objects, found in the halos of galaxies. ')

Visible matter consists of stars, galaxies, quasars, planets, and luminous interstellar clouds. "Visible" means not only by visible light, but also by ultraviolet, X-rays, infrared, or microwave; in fact the whole electromagnetic spectrum.

As I said before, quantum fields in "empty" space generate pairs of virtual particles. These fluctuations contribute positive (repulsive) energy (explosion) if the virtual particles are fermions (since fermions obey the Pauli exclusion principle and so cannot occupy the same (quantum) space at the same time, by Fermi-Dirac statistics), but contribute negative (attractive) energy (implosion) (ordinary gravity) if the virtual particles are bosons. Fermions (e.g. electrons and quarks) have halfintegral spins, while bosons (e.g. photons and gluons) have whole-integer spins. Fermions are particles of matter while bosons carry the forces between fermions.

There is not an exact cancellation of the positive and negative energy, i.e. antigravity (dark energy) and gravity. However, super symmetry (a theory that postulates that each particle has a superpartner of the different type of spin) would very nearly balance them, to 120 decimal places; but supersymmetry comes into play only at very high temperatures, which may have been present at the Big Bang origin of the Universe. This near-balancing seems like another example of fine tuning, which made galaxies, stars, planets, and life possible in our Universe. This could be justified by the anthropic principle (if it were not so, we would not be here to wonder about it, and perhaps in other universes we are not there), but another scenario is possible, as explained below.

An early event due to the overbalancing of antigravity over gravity could be the stipulated early "inflation" (super-rapid expansion or explosion) of the Universe, which occurred at 10 to the minus 35 seconds after the Big Bang. When inflation ended, quintessence (now the preferred version of the dark energy) achieved balance with gravity and expansion of the

Universe slowed down considerably. After that, the decrease in the dark energy density tracked the decrease in the density of (ordinary) energy, until the Universe was about 30,000 or 300,000 years old, when matter and energy decoupled and the Universe became transparent to radiation. This tracking (hence “tracker field”) actually continued until almost the present age, when the Universe was 5 billion years old. (It is now 15 billion years old, which is not much later than 5 billion on a logarithmic scale.) So since 5 billion years ago, when the density of total matter began to exceed the density of energy, the tracking by quintessence density of energy density stopped and changed sign again, to initiate the present trends of accelerated expansion of the Universe, which may continue at an exponential rate forever, unless quintessence changes its sign again.

If accelerated expansion continues forever at an exponential rate, galaxies and stars will move beyond the distance where communication (even at the speed of light) is possible, and there may be only isolated islands of life that don't (can't) know about each other (so what's new?), or: no life at all if everything gets too cold. If quintessence changes sign again, the Universe may contract back to its present size (or beyond?), and the age of galaxies, stars and life may reappear; but they will never know that a preexisting age of stars and life was ever here. Or are we already that second (or even nth) generation?

This is a pulsating model of the Universe, not necessarily through a previously postulated alternation of Big Bang and Big Crunch, and not necessarily my previous model in “Ages of the Universe” involving a “supersymmetry transformation” from a supercold Bose-Einstein condensate to a super-hot Big Bang unstable fermion ball. Either version of the pulsating Universe would not predict a dead end of life and humanity; but the version proposed here would do so only if quintessence is the correct model of the dark energy. If dark energy is a static invariable “vacuum energy”, the pulsation could not occur, and the dead end would be final.

A pulsating Universe was long ago postulated, without benefit of modern cosmology or quantum physics, by ancient Vedic philosophy.

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## IT'S TURTLES ALL THE WAY DOWN?

A woman of the native religion explained that the world rests on the back of a giant turtle. A doubter asked "And what does the turtle rest on?" "On a bigger turtle", said the woman. "And what does the bigger turtle sit on?" was the persistent question. The woman, seeing the infinite regress, replied defiantly "It's turtles all the way down".

That is exactly what it is NOT. Under ordinary substances are molecules, under molecules are atoms, under atoms are nuclei, under nuclei are protons and neutrons, under these are quarks, under them are strings. The underlying entities differ radically from the ones above. The laws change from ordinary mechanics to quantum mechanics to whatever obtains at Planck dimensions. Beyond common organisms is the planet Earth with its rocks, seas and air, beyond that is the solar system, beyond that the Milky Way galaxy, then the local supercluster, finally the whole universe, and maybe beyond. Again, the entities and laws change, from Newton to Einstein to Hawking.

Similarly, we encounter phase transitions when we go to high temperatures (solids to liquids to gases to nucleielectron plasma to proton-neutron plasma to quark-gluon plasma) or to extremely low temperatures (to solids with various transitions or superfluids and finally to BoseEinstein condensate). Even numbers go beyond infinity to many different kinds of infinity.

Black holes out-do neutron stars which out-do white dwarfs which follow stars on the main sequence which are bigger than brown dwarfs which are bigger than giant gas planets like Jupiter which are bigger and different than rocky planets which differ from asteroids which differ from comets which differ from meteorites.

It's definitely NOT turtles all the way down. It's a many-splendoured thing, like Love.

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## THE MAP IS NOT THE TERRITORY.

No living creature could survive in its environment without some kind of a map. We use mainly a visual map, dogs a scent map, bats an auditory map. We also use our other senses to give us partial maps. And the brain coordinates the various sense maps and makes rational decisions on how to navigate and make a living. We all get a sense of beauty from our sensual maps, and derive our joy of living from them.

We say we love "Nature". Yet all we know are Nature's maps. Like Plato's sage, we see (hear, smell, touch, taste) only the two-dimensional shadow on the cave wall. A shadow of what? Of the Real Thing that casts the shadow, the thing-in-itself in multiple dimensions of which we receive our navigational maps.

Only when we dig very deep in the physical sciences do we get an inkling of what lies beyond our cave. When we zoom in on the very small, do we get an inkling of the quantum world, and beyond that the micro-string world. No wonder that we find it very weird — we can have no experience of it through any of our sense maps. Only mathematical maps (models) can help us to navigate. Only when we zoom out to the very large (in space and time), do we get an inkling of cosmology, of beginnings and distant futures of the universe. This too is weird, in different ways. We don't even know how to put together the very small and the very large, though there are hints that they are quite intimately connected.

Is cosmology and the quantum world the Thing-in-Itself? Probably not, only the first layer in the boundary between our maps and the territory. Bohm spoke about the quantum world being enfolded in the deeper reality, and unfolded back out of it. Mystics perceive a reality which they cannot even describe in words. As in Cantor's mathematics of infinite sets, there are always infinities beyond infinities ad infinitum. There are dimensions beyond dimensions (maybe only up to 26). There is Beauty beyond beauty, Truth beyond truth.

THAT, my friend, is the Territory. Meanwhile, let us enjoy our maps, and a little bit beyond.

What is lacking to make this a religion, is love. We are immersed in divine love, but like fish in the ocean, we discuss the existence of the Ocean.

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## LAKOFF VERSUS PENROSE.

Two mega-theories can be distinguished. In his two books (“Philosophy in the Flesh” and “Where Mathematics Comes From”), George Lakoff claims that both mathematics and language are cognitive products of the mind, and hence of the brain and the body. These abstract concepts (numbers, words, structures for combining and extending them) are formed by metaphors based on experiences from daily life, related ultimately to survival, and hence the evolution of body and mind. There are innate (genetic) propensities for forming such metaphors (and hence concepts) based on and brought out by experience.

Roger Penrose, on the other hand, believes that mathematics and abstract thought exist independently in the external world, in what he calls “the Platonic sphere”.

(Both Lakoff and Keith Devlin [in “The Math Gene”] call this “the romantic view” of mathematics, which we can choose to believe or not to believe, just as the belief in God.) Penrose presents his Platonic sphere in a diagram of two spheres on pages 3-4 in his book “The Large, the Small and the Human mind”, in which he pictures the physical influencing the Platonic, and the Platonic, in turn, influencing the physical. In other words, abstract ideas do come from the brain via the physical body, but the ideas in the brain reflect, or represent in some way, the structures of the external world. (How else could we survive in the external world unless we knew “the truth”?) In Penrose’s three-sphere scheme (presented on page 96), the mental sphere has links both to the physical sphere and the Platonic sphere, while the physical and the Platonic are also linked, in that mathematics has large applications in the physical world.

If this is a “romantic view” of where mathematics and language structure come from, I am ready to believe it, without a proof necessarily, except for the inference bracketed in the preceding paragraph. It is a question of faith, like belief in God, which I also share. To that extent, Lakoff and Devlin are also right.

I also have another question. cognitive science, as used by Lakoff, is based on scientific (i.e. objective) observations of the very mind which the experimenter and the theorist uses in his/her studies. Is there not a circular argument in this somehow?

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## COLOUR VISION AND THE FOUR-COLOUR MAP PROBLEM.

From article by Dale Purves, Beau Lotto, and Thomas Polger, *Journal of Cognitive Neuro-science*, Vol. 12, No.2, March 2000, pp. 233-237.

The authors argue that the fact that the human eye can detect four primary colours, red, green, blue, and yellow, is somehow related to the fact that at least four colours are required to colour a map so that no two colours are adjacent to each other. [But I thought that the eye has 3 cone colour receptors in the retina.]

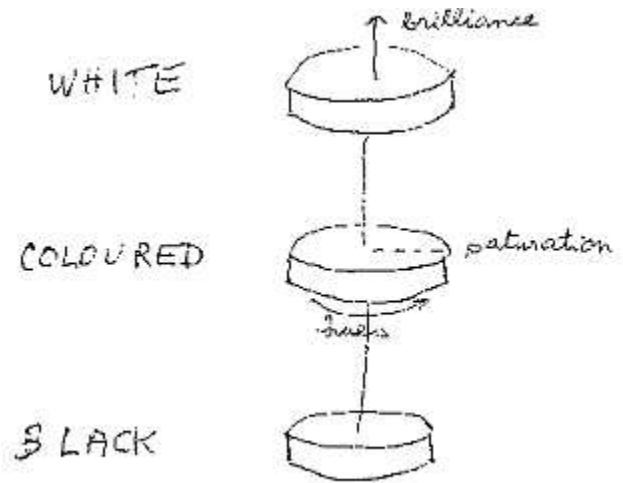
In any case, their diagram shows 3 colour wheels, above one another. The uppermost one is all white, the lowest one is all black, and the middle one shows hues (colours) of increasing saturation toward the circumference, while the middle is gray. Brilliance increases in the upward direction.

The uppermost wheel could represent Heaven or Nirvana; not only a White Hole, but a White Whole — all of the Divine Essence. The lowest wheel is a Black Hole or a Black Whole of bottomless despair.

We are in the middle wheel, the coloured one. Even at the centre, we see only gray; this is why the Godhead is incomprehensible to us. We lack the brilliance to see the White Hole, unless we are lifted up to Eternity, or achieve Enlightenment.

However, we DO have the rainbow, which Eternity lacks.

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## NON-COMMUTATIVE DICE MOVES.

Addition and multiplication are commutative operations, since  $A+B=B+A$  and  $A.B=B.A$ . Subtraction and division are not commutative, neither is raising to a power. Another interesting case of non-commutative operations is turning a die left (L), right (R), down towards you (D), or up away from you (U). A few experiments with a die convinced me of the following.

There are 16 moves if we permute the 4 simple operations in pairs: LL, RR, DD, UU, LR, RL, DU, UD, LD, DL, RD, DR, LU, UL, RU, and UR. The first 4 of these give you the opposite face of the die. The next 4 give you the starting face. The last 8, which combine the 2 dimensions, are the interesting ones. They are not commutative, i.e. the result depends on the order in which you perform the operations.

We obtain:  $RD=D$ , but  $DR=R$

$LD=D$ , but  $DL=L$   $RU=U$ , but  $UR=R$

$LU=U$ , but  $UL=L$ .

The rule seems to be that the result conforms to the last (second) letter, i.e. is equivalent to that single move. In practice, this gets much more interesting if instead of a die we have an airplane that can yaw up and down, turn left and right, and rollover either way. In some combinations, it will be pointing straight down to the ground — not a healthy condition. I am waiting to get hold of a model airplane to try it. I don't have enough spatial imagination to do it in the abstract.

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## **SENSUAL MAPS.**

The world we SEE with our EYES is only a MAP of reality. It is barely 3-dimensional; for me without binocular vision only 2-dimensional. Bats and dolphins form acoustic maps with their different echo-location senses; not optical maps which we enjoy. Dogs live by olfactory maps. Which sense maps are closer to reality? None of them, probably.

They only provide us with means to survive in an unknown and unknowable world.

Taste maps help us savour and enjoy the flavours and texture of the food that nourishes us. Touch maps? They enable us to savour and enjoy the map of the body of our beloved.

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## VERY LARGE GRAPHS.

According to Brian Hayes' article ("Graph Theory in Practice, Part II", American Scientist, March-April 2000), very large graphs (networks of points/vertices and links/edges) come in three varieties: very ordered ones like rings (in which every vertex is linked to 2 neighbours and 2 next-to-neighbours), semi-ordered ones (in which some of the links in rings are opened up to join randomly across the ring), and disordered ones (with very dense random links across the ring, but not quite completely connected).

The second type, the randomly but sparsely connected ones across the ring, are good models for "small-world graphs", such as the graph of world acquaintanceships (Milgram's "small world"), the World Wide Web (now 800 million pages, and still adding daily), the Hollywood graph (225,000 actors, and when do 2 of them appear in the same movie), the electric power grid, and telephone connections.

These small world graphs (the Watts-Strogatz model) have some properties in common:

(1) they tend to be sparse (only about  $n$  edges, where  $n$  is the number of vertices, not  $n(n-1)/2$ , as would be the case in a "clique", a completely connected graph);

(2) they tend to be clustered;

(3) they tend to have a small diameter (shortest edge between the most distant vertices, about  $\log n$ ).

Erdos and Renyi worked on these graphs. They predict real-world small world graphs fairly well. So small world graphs are not quite regular (ordered) and not quite random.

There is a parameter,  $b$ , such that if  $b > 3.4785$ , almost every graph is disconnected; if  $1 < b < 3.4785$ , almost every graph has a giant component (Kauffman's "island of order in a sea of disorder"). This adds another significant irrational number to a collection I made in an earlier essay ("Irrationality"). The parameter  $b$  is the rate at which  $\log n$  decreases as the degree increases. Degree is the exponent in the power law which describes how the number of edges varies with  $n$ , the number of vertices.

It seems to me that the intermediate nature of small-world graphs occurring in the real world has a connection to Stuart Kauffman's idea of models of life.

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## MILLION-DOLLAR MINESWEEPER (from Scientific American).

Ian Stewart explains how a computer game can make you rich

Who wants to be a millionaire? Clay Mathematics Institute, a nonprofit educational foundation in Cambridge, Mass., is offering million dollar prizes for the solutions to seven infamous unsolved problems. One is the notorious P vs. NP question. Although it is a fiendishly difficult puzzle, a clever amateur may be able to solve it with the help of Minesweeper, the popular game that runs on most personal computers.

Richard Kaye of the University of Birmingham in England pointed out the connection between the game and the P vs. NP question in a recent article entitled "Minesweeper Is NP-Complete" (*Mathematical Intelligencer*, Vol. 22, No.2, Spring 2000). First, let's review how Minesweeper is played. The computer starts the game by showing you a grid of blank squares, some of which conceal explosive mines. Your task is to figure out where the mines are without detonating any of them. In your first move, you choose to uncover any square in the grid. If there's a mine underneath it, you're out of luck: the mine is detonated and you lose the game. If there's no mine, however, the computer writes a number in that square, telling you how many mines there are in the eight adjacent squares.

You then use this information to determine the next square you should uncover, and again you either detonate a mine or reveal the number of mines in the adjacent squares. When you have deduced the presence of a mine in a square, you mark it with a little flag. A typical game position after a few moves is shown in the left illustration below. You win the game by locating all the mines in the grid.

Now we turn to the P vs. NP puzzle. Recall that an algorithm is a step-by-step procedure that can be run on a computer to solve a problem. A central question in the mathematics of computation is, How efficiently can an algorithm solve a given problem? In other words, how does the running time—the number of computations needed to produce the answer—depend on the initial data? The main distinction is between problems that are of type P, which stands for polynomial time, and those that are not. A problem is of type P if it can be solved using an algorithm whose running time grows no faster than some fixed power of the number of symbols needed to specify the initial data. If the solution can't be found this way, the problem is non-P. Type P problems can be handled efficiently by computer, whereas non-P problems cannot be solved in a practical manner, because any algorithm used to tackle them will take a ridiculously long time to yield an answer.

You can prove that a problem is of type P by finding an algorithm that solves it in polynomial time. For example, sorting a list of numbers into ascending or descending order is a type P problem, which is why commercial database programs can efficiently sort even very large sequences of numbers. In contrast, the Traveling Salesman Problem—finding the shortest route whereby a salesman can visit every city on some itinerary—is widely believed to be non-P, although this has not been proved. Finding the prime factors of a given integer is also thought to be non-P, but this hasn't been proved either.

Why is it so hard to prove that a problem is non-P? Because you can't do it by analyzing any particular algorithm. You have to contemplate all possible algorithms and show that none of them can solve the problem in polynomial time. This is a mind-boggling task. The best that has been done is to prove that a broad class of candidate non-P problems are all on the same footing: if anyone of them can be solved in polynomial time, then they all can. These problems are said to have a nondeterministic polynomial running time and are therefore called type NP.

NP is not the same as non-P. A problem is NP if you can check whether a proposed solution is correct in polynomial time. This is—or at least seems to be—a much less stringent condition than being able to actually find the solution in polynomial time. My favorite example is a jigsaw puzzle. Solving the puzzle can be very hard, but if someone claims to have solved it, it usually takes no more than a few seconds to check whether the solution is right. Just look at each puzzle piece and make sure that it fits with its neighbors. The time required to do this is roughly proportional to the number of pieces, so the check runs in polynomial time. But you can't construct a jigsaw puzzle in polynomial time. If you attempt to solve the problem by trying all potential solutions and checking each one in turn, the running time will be enormous, because the number of potential solutions grows much faster than any fixed power of the number of pieces.

It turns out that a lot of NP problems have equivalent running times. Specifically, an NP problem is said to be NP-complete if the existence of a polynomial-time solution for that problem implies that all NP problems have a polynomial-time solution. Thus, if you can solve one NP-complete problem in polynomial time, you've solved all NP problems in polynomial time. The P vs. NP question asks whether types P and NP are the same, despite all

appearances to the contrary. The expected answer is no. But if any NP-complete problem turns out to have a polynomial-time solution, then NP must equal P.

Many problems are known to be NP complete. One of the simplest is called the SAT Problem, which involves Boolean circuits. Such circuits are built from logic gates with names like AND, OR and NOT. The inputs to these circuits are either T (true) or F (false). Each gate combines the inputs in a specified way and yields the result of that combination as its output. For instance, a NOT gate turns  $\sim T$  input into an F output, and vice versa. The SAT Problem asks whether there exist choices of inputs that produce the output T for a given Boolean circuit. The problem is child's play for a simple circuit but becomes quite difficult when the circuit contains large numbers of gates and inputs.

The link to the computer game comes when we introduce the Minesweeper Consistency Problem. The challenge here is not to find the mines but to determine whether a given Minesweeper position is logically consistent. If, for example, during the course of play you encountered the position shown in the illustration at the bottom right of the 'opposite page, you would immediately know that the programmer had made a mistake. No allocation of mines could be consistent with the numbers in the squares.

In his article, Kaye proves that the SAT Problem for any given Boolean circuit can be transformed into a Minesweeper Consistency Problem for some game position. What is more, he shows that the procedure for converting Boolean circuits into Minesweeper positions runs in polynomial time. In this conversion, the inputs and outputs of the circuit become the pattern of mines in the grid: a square with a mine stands for T, and a square without a mine stands for F. The wire that connects the circuit's gates is represented by the Minesweeper position shown in the top illustration above. In this Minesweeper wire, the squares marked  $y$  have the opposite values of the squares marked  $x$  - if the  $x$  squares contains mines (T), the  $y$  squares don't (F), and vice versa. Notice that the numbers shown in the other squares are correct whether  $x$  is T or F. The effect of the wire is to "propagate" either signal (T or F) along its length.

The same procedure can also depict the logic gates themselves. The Minesweeper position in the bottom illustration shows a NOT gate. The block of numbers in the middle of the figure forces an interchange of the positions of  $x$  and  $y$ :  $x$  follows  $y$  in the input wire but precedes  $y$  in the output wire. The values of the squares are reversed whether  $x$  is T or F, which is exactly what a NOT gate does in a Boolean circuit.

Minesweeper electronics gets much more complicated, of course. You need to be able to bend and split the wires as well. Kaye manages to solve all these problems in his article. The upshot is that if you could solve the Minesweeper Consistency Problem for a given game position in polynomial time, you would have solved the SAT Problem for the equivalent circuit in polynomial time. In other words, Minesweeper is NP-complete. So if someone finds a polynomial-time solution to the Minesweeper Consistency Problem, then all NP problems have polynomial-time solutions, and hence P equals NP.

Alternatively, if someone can prove that no such solution exists for the Minesweeper problem, then P does not equal NP. Either way, the question would finally be answered.

Before you get your hopes up, though, remember that the Minesweeper Consistency Problem is a tough nut to crack. Determining whether a game position is logically consistent becomes very difficult when you're considering a gigantic grid, and most mathematicians and computer Scientists believe that there's no general solution that runs in polynomial time. Moreover, the Clay Institute, has imposed strict rules for the contest: before it will accept a solution as valid, it must be published by a major journal and be "generally accepted" by the mathematical community within two years of publication.

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# THE ROLE OF COMPLEXITY.

(Based on book "Signs of Life" by Ricard Sole and Brian Goodwin.)

Unlike Chaisson in "Cosmic Evolution" (see previous essay), this book approaches the explanation of life from the viewpoint of complexity theory, rather than thermodynamics and evolution. Of course, these explanations converge, when you think about it.

Complexity theory involves such concepts as non-linearity, chaos, strange attractors, and fractal structures; but also symmetry-breaking, criticality, self-organization, and pattern-formation; as well, most prominently, emergence and innovation. All this, structures far from thermodynamic equilibrium can do, which provides a link with Chaisson's book.

Where do complex structures stand with respect to order and disorder? The book illustrates clearly that they are intermediate, and at the boundary of a phase transition between order and disorder, as Stuart Kauffman had also indicated. Fancifully, I have called it "the Mayonnaise transition", changing from an emulsion of oil in water to one of water in oil. Order and disorder, like oil and water, do not mix, but can form two different kinds of emulsion, depending on which is the continuum and which is the droplets, or islands in the sea.

These are not New-Age metaphysical concepts; Sole and Goodwin describe them in terms of specific, rather difficult mathematical models. However, they describe wide and divergent fields of nature and society. Some of his examples are listed below.

Genetic networks of the interaction between proteins and nucleic acids, the spontaneous aggregation of slime mold (*Dicty*) from the unicellular to the multicellular state, embryo development (the precise sequence of turning on genes at the right time), the heart beat which must have a slight irregularity in order to avoid the danger of fibrillation, brain dynamics which also has to be slightly irregular to prevent an epileptic attack (too much order), ant societies which can be best understood from the ant-hill perspective rather than that of the individual ants, the organization of army ant raids without any intent of individual ants, ecosystem self-regulation without the intent of any single species, and the behaviour of markets without intention of individual buyers and sellers.

All these examples show that some explanations of phenomena, especially those with a certain degree of complexity, require a view of the whole and not only of the parts. Reductionism fails in these cases and holism is called for. The reason why the whole is greater (sometimes MUCH greater) than the sum of the parts is because of the abundant and frequent interaction between the parts (genes, neurons, ants, species, market speculators, etc.) This crucial role of frequent interactions was also mentioned by Ilya Prigogine in "The End of Certainty".

The book also contains insightful discussions of the origin and evolution of life. This includes the Cambrian "explosion" of animal species, the major extinctions, the balance of "normal" extinctions and speciations, host-parasite relations in certain diseases, food webs and key species, and the stabilizing role of hypercycles (cycles of cycles) .

The book is as rich and complex as complexity theory itself; but I love the SIMPLE title "Signs of Life", and the pictures of Foraminifera shells on the cover.

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## **TRANSCRIPTION AND TRANSLATION.**

In genetic science, transcription means the process of going from DNA to messenger RNA. It involves unwinding part of the DNA double helix through the action of enzymes and forming the new single-strand RNA on it as a template, i.e. matching the complementary bases. This preserves the information contained on the template.

The subsequent process of translation means forming the corresponding protein from the messenger RNA by passing the RNA “ribbon” through the ribosome, which reads the code according to which each triple-base codon signifies a particular amino acid to be added to the growing protein chain. This process bears an uncanny similarity to the Turing universal computer machine, with its ribbon bearing symbols to be operated on.

In linguistic science, transcription means for example going from Cyrillic script to the Latin alphabet. Translation then means going from Russian to (say) English, French, or German.

In transcription, different symbols (bases or letters) are changed to others with the same meaning. In translation, the change involves more than letter (base) substitution, namely whole words, phrases, or sentences (base sequences). Translation is a dialogue of cultures, with all the cultural and historical differences represented as accurately as possible. RNA and protein are also different “cultures”, each from a separate epoch of the origination of life on Earth.

Trans-trans is the crossing of a bridge in two steps from one entity to another, maintaining as far as possible the link of information and meaning.

Language is a living thing. Nothing could be clearer.

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# NINE AXIOMS

The nine axioms of algebra are:

1. Associativity (distributive law)
2. Identity element for addition (e.g. zero)
3. Identity element for multiplication (e.g. 1)
4. Additive inverses (i.e. negatives)
5. Multiplicative inverses (i.e. reciprocals)
6. Commutative law for addition
7. Commutative law for multiplication
8. Total ordering
9. (Least) upper bounds for sets.

Axioms 1 to 5 define groups. If we add 6 and 7, we define fields. If we also add 8, we define an algebra. If we also add 9, we get completely ordered fields.

Regarding numbers: 1 to 9 defines real numbers, 1 to 8 defines rational numbers, 6 and 7 transform groups to Abelian groups, 5 introduces rational numbers (fractions), 4 introduces negative integers, 2 introduces zero.

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# A UNIVERSE OF CONSCIOUSNESS.

(Based on book of that name by Gerald M. Edelman and Giulio Tononi, Basic Books, 2000, 274 pp.)

According to the book, consciousness is a process, not a thing. [A verb, not a noun.] It does not depend on a single brain area or on a static cluster of neurons. There is no “cartesian theatre” (Dennet) or “pearl of the mind” or a “Homunculus” who “reads” the sensual input and issues orders to the muscles. Yet Dennet (“Consciousness Explained”) finally postulates a central von Neuman linear computer (like a central processing unit, CPU) where everything . \_ comes together (and the “demons” compete for access), and Edelman and Tononi postulate a “dynamic core” in the functional cluster of neurons in the thalamocortical brain region. “These concepts seem to approximate a Cartesian theatre. I suppose that the difference is that it is dynamic, ever changing, not static and permanent.

The mind-body problem has been dealt with by many philosophers. Our subjective experience and the objective outside world seem to be realities apart. Descartes spoke about “Res Cogitans” and “Res Extensa”, connected only by the intervention of God, who synchronizes them. This was strict dualism. He also assumed that animals have no minds or souls; they are automatons. Some think-that. the “hard problem” of how the mind links to the brain will never be solved, even when we know all the details of the operation of brain systems. Schopenhauer called the “hard problem” “the World Knot”, a term adopted by Edelman and Tononi.

Subjective experience (phenomenology) and the external world are perceived very differently. We can examine brain neurological events and interactions from the outside, as is done in science, and we have progressed considerably along this road, as this book shows. In this way, an observer (scientist) examines someone else’s brain. But we also have an everyday experience of our own mental events, which in a fundamental way are the only things we really know directly, without any intervening processes of induction or deduction, even at a primitive level. The recognition of objects as permanently continuing structures comes early in an infant’s life, but it is only an inductive conclusion that can never be proved. Before this happens, the infant perceives the continued existenc~ of its own mind, the sense of “I”.

We could explain the difference as an internal and an external view of the same reality, the two sides of a coin. Perhaps, if we could be a “mind” inside an electron or a photon, we would see the quantum world very differently, maybe without paradoxes. Two sides of a strip of paper (not a coin) can be melded into one by constructing a Moebius strip. I don’t know what would be the equivalent for combining the interior and exterior view of the mind/brain system. Alexander the Great is reported to have “solved” the Gordian knot problem by cutting it apart with his sword — a solution inadmissible in topology (but typical of a warrior, to whom the sword is the solution of last resort). The World Knot cannot be legitimately cut apart. The sword, we are reminded, is not the solution to any problem.

According to Edelman and Tononi, the fundamental properties of consciousness are integration (non-decomposability) and differentiation (informativeness or complexity).

(Integration and differentiation are my own favorite metaphors for world structures of subsidiarity from local to global levels of government, derived~~~he embryonic development of organisms. The terms also invoke a resonance from the two mathematical operations so named.) The same two fundamental properties, the authors argue, must be (and are) reflected in the neural substrate that supports consciousness.

The brain is a product of evolution in more than one sense. The organ as a whole developed by natural selection because it gave the individual better survivability and opportunity to reproduce. But secondly, during fetal development, neurons compete with each other to make the right connections to other neurons; those that get lost in the maze are programmed to die. (This is similar to what happens to immune cells as they get “educated” in the thymus or the bone marrow not to “recognize” (i.e. react to) self, the cells of its own body.) And thirdly, by means of experience, mainly after birth, in childhood and adulthood, there is a selection with regard to the strengthening of some synapses and not others (Hebbian junctions: “cells that fire together wire together” is the rule). This is called memory and is involved in learning.

This is why even identical twins are not identical. Genetically they are, but they experience different events in fetal and subsequent development. Thus the phases are: evolution (of whole species), development (of the fetus), and experience (lifetime learning). It is evident, therefore, that the genes do not entirely determine who we are and how we feel, think and behave.

So memory is non-representational; it is recorded as patterns of variously strengthened synaptic connections, not as repeated sensory experiences, pictures, music, or fragrances. (Though the latter can often trigger memories.) Human

memories can be false, elaborated by the left-brain integrator which tries to fill in missing information. The higher the organism, the better it is able to tell lies. That is the faculty of imagination, the basis of creativity — like creative book-keeping.

Primary consciousness is non-verbal and non-symbolic. All (at least higher) animals have it. It is pure phenomenology. Yet animals can make choices (primary will), have feelings, and can reason at a simple level. A critical new brain connectivity appeared in the transition from reptiles to birds and mammals. (This is why we talk roughly about the reptilian and the mammalian brain, layers still existing in the human brain below the cortex.) The innovation concerned re-entrant connections between the thalamus and the cortex. In higher animals, we talk about the thalamo-cortical re-entrant system, which is the basis of primary consciousness. Also, specific thalamic nuclei were formed. The sense of self and signals from the world merge by the reentry mechanism to create primary consciousness. Then in humans the speech and symbolizing centres were added to the loop to create higher-order consciousness.

The dynamic core is a group of neurons within the thalamo-cortical system, constantly being added to and subtracted from at the edges. I have recently seen a lighted advertising display which reminded me of this: the central lights were always on, but the lights at the margins flickered on and off, seemingly chaotically. The dynamic core is the seat of the integration of all the inputs, yet maintaining their complex differentiation.

Consciousness is not the property of some neurons (as Penrose tried to imagine), nor of specific brain areas, nor even of neuron clusters scattered through different brain areas, but arises from the semi-organized semi-chaotic dynamic core. Typically, at the edge of chaos.

Edelman and Tononi then proceed to define “integration” and “differentiation” quantitatively by using concepts from information theory, such as entropy. units (such as neurons) that are interconnected achieve lesser entropy than independent units would. Thus the measure of integration is the entropy decrease due to connectivity. (Incidentally, there is an optimum level of connectivity, between none or very low (like “white music”) and complete or almost complete (like “brown music”) to a “Goldilocks” optimum (like “I/f music”). Cf. essay on “Very Large Graphs” in this volume.)

The concept of “functional clustering” is then introduced. This shows that functional integration can be brought about in less than a second. This provides a solution to the so-called “binding problem”. To quote from the book: “The activity of a group of neurons can contribute directly to conscious experience if it is part of a functional cluster, characterized by strong mutual interactions among a set of neuronal groups over a period of hundreds of milliseconds.”

There are three definitions of “information”, increasingly restricted:

- (a) the measure of order in a system far from equilibrium;
- (b) arising only with the origin of life;
- © arising only in conscious observers.

These are, respectively, physical, biological, and psychological definitions. I would call them (a) “mere” information; (b) inherent meaning; and © explicit meaning. The latter two cover the whole spectrum of “minds” according to Jantsch: metabolic (enzyme), genetic (gene), epigenetic (homeobox), hormonal (messenger signalling), immune (“recognition”), neural (neuron), and human-symbolic (meme, phoneme).

Some attention is then given to colour discrimination, central in a discussion of qualia in general. Along 3 axes (red-green, blue-yellow, and light-dark), 3 neuronal systems can fire at rates between 0 (completely inhibited) and 100 Hertz (maximum, tending toward epilepsy or deep sleep spikes, both extinguishing consciousness), preferably at about 10 Hertz (another instance of the Goldilocks effect). The mix produces a particular colour perception.

These colour perceptions are joined with perceptions of shape and motion to form overall visual experience. There are similar clusters for sound, touch, proprioception, thought, etc., the total converging in primary consciousness. But some bodily properties, such as blood pressure and heart rate, are not normally perceived, although biofeedback methods can make them accessible, and even modifiable at will.

The dynamics of the core and related neural systems can be represented metaphorically as a tangle of connected springs under tension. (A diagram is provided.) Learned unconscious routines (such as riding a bicycle) are represented by other springs not in the central cluster, but connected to it at a few points. If unconscious routines, memories, intentions, and expectations join together to form an alternative functional centre (a splinter core or a new nucleus of a self), we may have an explanation of the multiple personality disorder. Obsessions and compulsions can be fixed, rigid

unconscious routines that can only with difficulty be consciously resisted, as if certain ports in and out of consciousness were pathologically permanently open.

Finally, language and the higher consciousness liberate the imagination and open thought to the vast domains of metaphoric and symbolic existence.

The authors conclude that metaphysics (what really is) and epistemology (what we can know) should be grounded in biology, specifically in neuroscience. But I wonder if we are not locked into a circular argument, since what we know of neuroscience comes from our, possibly non-representational, perceptions. We study the brain as an “object out there”, and who are we as a subject or observer?

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## CHALMERS-CRICK SYNTHESIS.

(Reconciling the Mysterians and the Reductionists in Conceptions about consciousness.)

In reporting on the Consciousness Conference at the University of Arizona (“Wow, it’s just like Woodstock”, one attender exclaimed), John Horgens (“Can Science Explain Consciousness”, article in “The Scientific Book on the Brain”, pp. 297-309) distinguishes two types of scientists: the “mysterians” who say that consciousness can never be explained from physical principles or neuron circuits in the brain, and the reductionists, who hope to explain consciousness precisely in that way. David Chalmers represents the mysterians: he says that it is easy to explain some neural correlates of consciousness, but the “hard problem” (how this gives rise to subjective experience) remains unsolved. Francis Crick represents the reductionists, along with his colleague Christof Koch. Chalmers and Koch met and argued at this conference, without resolving their differences. However, I would like to try. (Both Chalmers and Crick have articles in this book in the same section as Horgens.)

Chalmers claims that the new field of consciousness research, also called psychophysics (I have used that term too in a previous essay, claiming that it represents the fifth branching off from standard Newtonian physics (in addition to relativity theory, quantum theory, thermodynamics, and complexity theory) needs a new basic concept, as standard physics once did in its beginning. To my delight, he thinks that the new bridging concept between physics and consciousness is information, which happens to be the “third essence” in my “three (or four) essences” theory.

Information, Chalmers claims, comes in two varieties: physical (as described by Claude Shannon in his information theory as the opposite of entropy, a concept in thermodynamics), and mental, represented in the brain by sense data transcribed into neuronal firing patterns. What the two types of information have in common, in my opinion, is the presence of structure, a map of interactions. Structure does not depend on the substrate, i.e. the nodes or entities being interconnected or linked: e.g. a painter can work in oil paints or water colours or other media to represent a structure, a sculptor can use marble or bronze or whatever.

Therefore, it seems to me, physical structure in the outside world (its information content) can be directly translated into the same structure in the medium of neuronal circuits. Thus we gain an accurate knowledge of objects in the external world; not of their matter or energy, which are “things in themselves” beyond our grasp, but of the informational structure. The shadows on the walls of Plato’s cave are written in the language of information.

However, the mind adds MEANING to this “mere information”: e.g. “this object is good to eat, that one is poisonous”, “this animal threatens me, that one is harmless, the third is my own offspring, the fourth is a friend, the fifth I can kill and eat”. This kind of meaning plus the incoming information is essential for survival, for the satisfaction of needs, for seeking pleasure, and for avoiding pain.

Now Crick too, on p. 313 in the book, says that the brain carries out complex computations to interpret an ambiguous visual signal. This implies, according to Crick, “that the brain forms a symbolic representation of the visual world, with a mapping (in the mathematical sense) of certain aspects of that world into elements in the brain.” It seems to me that this is in agreement with what Chalmers is saying.

Crick also states, as William James originally said, that conscious action requires not only awareness and interpretation of sense information, but also attention (focusing the searchlight in the “room of the mind” on the information), and short-term memory (classified as either iconic memory lasting only a fraction of a second, or working memory which lasts for a few seconds, or longer if rehearsed). Also, the hippocampal system can slowly pass episodic memories into long-term memories. Note, as described in another essay (“Long-Term Potentiation”), that memories of all kinds are represented in the brain by a pattern (structure) of more or less strengthened or weakened Hebbian junctions between neurons.

Earlier I mentioned that introspection might be a method for exploring psychophysics. I no longer think so, because conscious introspection does not penetrate into the deep unconscious, where most mental events (by far) happen. Perhaps in the meditation state introspection can reach farther, but that is by no means established.

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## LONG-TERM POTENTIATION.

The neural basis of memory and learning is the Hebbian junction, the fact that a junction between two neurons, the pre-synaptic and the post-synaptic, can be strengthened (or diminished) when they fire together. This is long-term potentiation, aptly summed up in the dictum “cells that fire together wire together”.

According to an article in “The Scientific American Book on the Brain”, pp. 146-7 (by Eric R. Kandell and Robert D. Hawkins), the molecular basis of this process has been worked out. It depends on a typical cascade process: serotonin released by the pre-synaptic neuron binds to a receptor calcium-led NMDA (N-methyl-D-aspartate) on the post-synaptic neuron. The receptor activates an enzyme called adenylyl cyclase, which converts ATP (adenosyl triphosphate, an energy transfer molecule in cell metabolism) to cyclic AMP (which functions as a “second messenger”, serotonin being the first messenger). Cyclic AMP (adenosyl monophosphate) then phosphorylates a protein kinase, which phosphorylates potassium channel proteins, which prolongs the neuron’s action potential and thereby allows calcium channels to be activated for longer periods, permitting more calcium ions to enter the pre-synaptic terminal. This then causes additional serotonin to be sent to the post-synaptic neuron.

According to an article by Joe Z. Tsien “Building a Brainier Mouse” (Scientific American, April 2000, pp. 62-68), the NMDA receptor consists of four protein subunits that form a pore which controls the entry of calcium ions into the neuron. These pores require two signals to open, calcium ions and the neurotransmitter serotonin (or in another version glutamate). This forms a “coincidence detector” that associates two brain events.

I am not sure if the two articles describe the same mechanism or two different ones, or if the latter, how they fit together. However, according to Kandell and Hawkins, they describe the molecular mechanism of short-term memory, lasting hours or days. For long-term memory, lasting months or years, the cascade (or a similar one) turns on a gene which produces a calcium-dependent adenylyl cyclase, making the record of the neuronal association more permanent.

Recording memories in the brain is nothing like taping or photographing direct sense-data. The complexity of the mechanisms leaves me gasping, and I may have got it wrong. Our brain knows far more inwardly how to operate than we can fully understand observing it from the outside. The brain is smarter than we are, or at least than I am.

In any case, the basic fact is that neurons that make each other fire form a (semi)-permanent connection, which makes future coincidence in firing more likely. It is like smoothing the path between them, for more efficient passing on of the impulse.

This reminds me of Rupert Sheldrake’s theory of morphological fields (formative causation), the observation that, once a thing has been done, with great difficulty, it is much easier to do it again, even if the second experimenter is far away and knows nothing about the first experimenter’s achievement. (Cf. “entanglement” of two subatomic particles, which change their spins in unison, even if so far removed from each other that they cannot communicate even at the speed of light). This is why the same discovery or invention is so often made almost simultaneously, by two or more people. For example, in chemistry, there are some compounds which are very difficult to crystallize; but once someone has done it, many others can repeat it.

It is somewhat like the story of the “Hundredth Monkey” phenomenon, according to which the habit of monkeys washing their fruit eventually jumped from one island to another, out of sight of the original monkeys, once enough monkeys learned it from each other. It is as if there was a groove in space-time that increasingly facilitated the operation but what could this morphological field possibly consist of?

Could learning of a new process by a bunch of individuals (monkeys or people) or society as a whole be compared to the learning process in an individual’s brain? The mechanism would have to be totally different. But some kind of “wiring together” would have to be involved. For example, can we learn from history, or would we only learn to repeat past mistakes?

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## EXPANDING BEYOND OUR SENSE-DERIVED EXPERIENCE.

Our knowledge of the world is expanding into radically unknown worlds. We began with what we perceive with our five senses, mainly sight and hearing. This is every child's preNewtonian world, beyond the Piaget stage of "formal operations". (I am following the scheme outlined in my essay [The Unfinished Road Into Knowledge](#).) Beyond that, even Newton's theories (laws of motion and gravitation) are somewhat counter-intuitive, beyond "common sense" (e.g. a force causes acceleration, not motion itself).

However, beyond Newton, our notions and theories are forced to become ever more "weird". special relativity theory shows that two observers moving with respect to each other cannot establish the simultaneity of events, because both space and time change to a different frame of reference — only the velocity of light is the same for all; space and time fuse into four-dimensional space-time; and matter and energy are interconvertible, with only their sum conserved.

General relativity theory goes beyond this, to identify accelerated motion with gravity and in turn with curvature of space-time. Where is our common sense now? Yet predictions of the theory prove to be true, thus confirming its reality.

Quantum theory shows additional conundrums: superposition of quantum states, the uncertainty principle, entanglement, wave-particle complementarity. Our sense experience knows nothing about this micro-world which underlies our everyday experience. But again, experiments confirm it.

So much is already in the previously quoted essay. But the cosmology of near-Big Bang states, theory of Black Holes, superstring and M-brane theories, have now gone far beyond this. Talk about 11 or 26 space dimensions leave us baffled. This is a micro-micro world and a macro-macro world totally beyond our conception, let alone perception. "The world is not only stranger than we think, it's stranger than we CAN think." (Quote by Wheeler, I believe.)

Backing up a bit (back to the previous essay), there is thermodynamics and its micro-version, statistical dynamics. There is nothing counter-intuitive about the arrow of time and the unidirectionality of entropy; we are all familiar with these notions in our everyday experience. However, when we get into entropy decreases in complexity theory and the theories of life, things get almost miraculous, even if we can get "order for free" and feel "at home in the Universe", as Stuart Kauffman says. This is not counter-intuitive, not a paradox, but it feels like a miracle. We are alive, after all, but it is fantastic that we manage it. Or that the Universe managed it.

And then, of course, there are mental phenomena, which we do know from experience, but still don't know how they are generated by the brain — what is that mysterious link?

We don't know how consciousness is generated, or what sleep is, although we do it every night. And some supermental phenomena, if they really exist, need to be studied. And spirituality, meditation, different states of consciousness, do exist, but again the links to ordinary consciousness are largely unknown. When mystics communicate with God, do they really? I have no reason to doubt, but it is beyond my experience.

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## **EVOLUTION OF SEX DIFFERENCES (by Doreen Kimura)**

To understand human intellectual functions, including how groups may differ in such functions, we need to look beyond the demands of modern life. We did not undergo natural selection for reading or for operating computers. It seems clear that the sex differences in cognitive patterns arose because they proved evolutionarily advantageous. And their adaptive significance probably rests in the distant past. The organization of the human brain was determined over many generations by natural selection. As studies of fossil skulls have shown, our brains are essentially like those of our ancestors of 50,000 or more years ago.

For the thousands of years during which our brain characteristics evolved, humans lived in relatively small groups of hunter-gatherers. The division of labor between the sexes in such a society probably was quite marked, as it is in existing hunter-gatherer societies. Men were responsible for hunting large game, which often required long-distance travel. They were also responsible for defending the group against predators and enemies and for the shaping and use of weapons. Women most probably gathered food near the camp, tended the home, prepared food and clothing, and cared for children.

Such specializations would put different selection pressures on men and women.

Men would require long-distance route-finding ability so they could recognize a geographic array from varying orientations. They would also need targeting skills. Women would require short-range navigation, perhaps using landmarks, fine-motor capabilities carried on within a circumscribed space, and perceptual discrimination sensitive to small changes in the environment or in children's appearance or behavior.

The finding of consistent and, in some cases, quite substantial sex differences suggests that men and women may have different occupational interests and capabilities, independent of societal influences. I would not expect, for example, that men and women would necessarily be equally represented in activities or professions that emphasize spatial or math skills, such as engineering or physics. But I might expect more women in medical diagnostic fields where perceptual skills are important. So that even though anyone individual might have the capacity to be in a "nontypical" field, the sex proportions as a whole may vary.

Doreen Kimura, September 1992

From "The Scientific American Book of the Brain" — end of article on "Sex Differentiation in the Brain"

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## A NEW DEFINITION OF LUCID DREAMING?

In last night's dream, I was in the company of several men I know from the peace movement, including Arnold Simoni, who died recently. They told me that a new group had been formed, because of the extreme danger stemming from the Kosovo war, to take over the world in order to save it. It was a high-level conspiracy; this was only one cell of it. They wanted me to join. I agreed (just as I had recently in waking life to a Y2K plea from Philip Isely). I was led through a busy hotel lobby to a back room, in which there was a hidden door which one of the men opened with a secret whispered word. We entered a spacious suite of several office rooms, well-equipped, including some machines I had never seen before. We sat down at the boardroom table, where they began to explain to me the plans. I noticed beside my seat (and beside no one else's) a flower corsage. I thought: "Is that because I am a new member, or because I am the only woman here?"

First item on the agenda was the name of the new organization. The chairman proposed "The World Communist Party", and everyone nodded their silent agreement — except me. With some fear and trepidation I spoke up. "I don't agree with that name. The Communists were undemocratic." They protested, saying that they would be democratic. I was not convinced. I said I thought this was a movement to save the world from war, not to overthrow capitalism. They were unreceptive to my arguments.

At this point I became aware that I had the power to steer events in the story, quite unlike in the real world. Yet I did not identify the story as occurring in a dream. It was more like what a novel-writer feels like when his/her fictional characters acquire a life of their own, and yet the writer can still to some extent steer them.

I chose a story end not in my own interest, conventionally speaking, and yet reflecting the despair that I feel about this war.

In the dream, which from this point on I would call lucid, I said that I refuse to join the movement. They all looked grim. Then I asked about the corsage. I said that I did not want to be identified as a woman; only as a fighter for human survival. The chairman, and Arnold, said that is not what the corsage is about. They explained that the pin of it is connected to a needle that would inject cyanide into my veins if I refused to join. I could not be allowed to leave their secret suite to tell the world about the conspiracy. Do I still refuse to join? Realizing they would never trust me anyway after this, I steadfastly refused to join, as long as they killed me painlessly. Yes, they said, it is instantaneous. They pinned it on, and after a brief convulsion, I blacked out.. — Immediately I woke up.

I want to argue that the main characteristic of lucid dreams is not knowing that you are dreaming, but knowing that you have the power to steer events, just like the writer of a novel. Why did I deliberately steer it to my death?

Because I am afraid of the widening and escalation of this war, which I would like not to witness.

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## HOW WE KNOW THE WORLD.

You can see with your tongue if your eyes are gone, \*  
For you see with your brain, not your senses.  
It matters not where the signals come from,  
Whether it's taste buds or lenses.  
The objects out there, when seen, heard, or tasted  
get known to your brain by patterns of feel.  
For no matter what some philosophers say,  
the objects out there are REAL.

\* This has been done by physicians for some blind patients.

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## **ANIMAL MINDS.**

It is not valid to assume that the animal mind is only sensation and emotion (phenomenology), and that the human brain has added cognition and computation (reason). ("Will" exists in both, as "the sensorimotor.")

Just as animals have different senses which we lack (bats, dolphins, electric eels, migrating birds and butterflies, even dogs with their sense of smell), so some of them may have cognitive and perhaps other abilities that we know nothing about, and never will, just as they don't know about our language facility. We and they live in different worlds.

Evolution is not a linear development, but a bud opening into a flower; however, it is also a bush being trimmed.

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## LEFT AND RIGHT MISUNDERSTOOD.

This is not about politics (primarily), but about the brain.

According to New Age thinkers, the left brain hemisphere thinking is linear, logical, rational, while right hemisphere thinking is artistic, holistic, and imaginative. After reading the chapter in "The Scientific American Book of the Brain", I have to disagree, especially about the "imaginative" part.

It is the Left Brain Integrator which is the organ of imagination, even sometimes confabulation. It seeks patterns avidly and in their absence, it invents them. It thinks in symbols (as in language, which it alone possesses), and is thus uniquely human. It can tell lies, and even get to believe them as false memories. The right brain, in contrast, is always truthful. But the left is also the seat of leaps of faith, as in hypothesis-formation (adduction) and metaphors. Without this, neither science nor poetry would be possible.

The right hemisphere is the brain that humans share with other primates, perhaps all mammals and birds. It is more truly the mammalian brain than the limbic system, to which this role is usually assigned. It is probably wrong to assume that mammals and birds have no cortex; yet the human cortex (on the left) differs profoundly.

The right brain is smart about perceiving shapes, colours, and motion, like the visual system. It is like people with an M-type EEG, who think in pictures. That is what beasts in the wild primarily need, to catch prey and avoid being prey. The P-type people tend to be poets, scientists, mathematicians, and musicians, using the left brain more than the right. The M-type people tend to be artists, sculptors, painters, and architects. And then there are the well-balanced people, who can do both moderately well, though not at genius level.

Symbolic thought entered the world with humans (as far as we know). Human brains are not only bigger, but are differently structured. Size alone is relatively unimportant.

One difference between men and women is also some difference in brain structure, though with considerable overlap. Men's brains are more lateralized than women's brains; i.e. the difference between the left and right hemispheres is more pronounced, sharper than in women's brains. Women tend to be more half-and-half in each hemisphere. So women, of course, can think symbolically, but in a more integrated way, though not as extremely.

As the diagrams at the end of this article show, this can be compared with the genetic composition of the sexes. The genes in the X chromosome are fully backed up by alleles in women, while men lack the alleles for most of the genes on their one and only X chromosome. So if one of the single alleles is defective, it is nevertheless expressed, while in women the other allele would be functional. (E.g. men can have colour-blindness and sickle-cell anemia, while women are far less likely to suffer from this.)

Thus women's brains can combine science and art more effectively, not be over-specialized, though perhaps not be top performers in either. (This is obviously an over-generalization.)

And in politics, to give this some attention, Left and Right each have part of the truth: society and individual, justice and freedom, change and stability. Perhaps we should all be Radical Middle.

In addition, it seems that the left prefrontal lobe creates an up-beat, optimistic mood, while the right prefrontal lobe generates a sad, melancholy mood. The whole prefrontal lobe interprets and elaborates emotional signals welling up from the amygdala. Certain hormones can suppress or accentuate happy or sad moods.

L	R
L	R

	L		R
R		L	
	L		R
R		L	

Y	X
	X

X	X
X	X

Men

Women

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## DREAMING THE WORLD INTO EXISTENCE.

Jorge Luis Borges, an author from Argentina, has a story in his collection entitled "Labyrinths" (New Directions Publishing, 1962), about a man who dreamed so intensely about a boy that the boy became a real person; and later the dreamer found that he himself had earlier been dreamed into existence by a third man. The story is called "The Circular Ruins", and shows that there could be whole generations of dream-engendered human beings. (However, I tend to think that this is males' substitute for women giving birth to actual flesh-and-blood people.)

Borges has another story in the same collection called "Tlon, Uqbar, Orbis Tertius", which describes a whole planet in which everyone believes in philosophical idealism, i.e. that thought (including dreams) is the only reality, and that matter and all objects are creations of mind. In such a world, I presume, dreaming persons into existence would be quite common, although Borges does not connect the two stories.

Australian aborigines had their own ancient "dreamtime" when the world was created, and they talk about "singing the world into existence" by their magic chants. The book "A Crack in the Cosmic Egg" talks about the dreamer REALLY flying like a bird, the bird being observable by others. The young bride in "Soul of Willow" placed her soul in a tree during the night, and actually died when the tree was cut down. A Maya saying is "In the beginning, a dream was dreaming us." And there are many stories of two people agreeing to meet in each other's dreams in a specific time at a stated time, and actually doing so.

For the aborigines, the dreamtime coincides with present time, since time is just as unreal as matter. The Hopi in southeastern USA have no word in their language for past, present, or future. The past as recorded is "manifest", but the present and future are still "manifesting". It is a whole different world of thinking, in which "words make the world".

And in theology, did not "THE WORD (LOGOS)" create the world? We human beings have REALLY been created through thoughts and dreams and words, since we ARE thoughts in God's mind. And since we were created in His image, why should we not be able to dream other humans into existence? This would create the "generations" of vertical dream descent. . .

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## NOT BY GENES ALONE.

This is drawn from the book "Alas, Poor Darwin", containing essays edited by Hilary Rose (sociologist of science) and Steven Rose (neurobiologist). The essays are directed against the claims of evolutionary psychology (EP) that human behaviour is directed exclusively by genes which have evolved by natural selection since Upper Paleolithic times. (There has not been enough genetic change since then, since the time interval between then and now is too short.)

The authors of individual essays come from several disciplines, and so the critique comes from many perspectives.

Steven Rose's introduction explains the main theories of EP and traces the history of this new science. It also briefly summarizes the individual chapters. My summary of these chapters will be even more succinct, in a way, but add some of my own perspectives. I will stress the points which seem important to me.

Sociologist Dorothy Nelkin points out that EP adherents consider genes not only selfish (ruling our bodies as mere vehicles for their own reproduction), but also sacred, in a profoundly religious sense. They are the centre of the living universe about which we talk only with bated breath of awe. The genome is a kind of a modern version of the Holy Writ. So is EP a science or a religious cult?

Architect Charles Jencks directs his attention against E.O. Wilson's claim (in W's book "Consilience") that even art production is under the control of the evolved genes. Jencks shows very interesting diagrams, plotting the influence of genes versus human freedom. Different behaviours come from different mixes of the two. A sneeze has a bigger genetic component and less free will, in sex the components are about equal, but in art production freedom predominates. Jencks' main point is that genes have more explanatory power in some behaviours than in others, and that we should not overemphasize just one factor.

Molecular biologist Gabriel Dover argues mainly against Richard Dawkins' idea of the selfish gene. Dover claims that Dawkins grossly overemphasizes what a gene is and what it does. Genes cannot act as independent units, they need protein enzymes to duplicate and to produce RNA and then protein. The DNA-RNA-protein system is wholly integrated and interdependent; the parts cannot be separated. How the system arose in the first place is another question.

Philosopher Mary Midgley argues against another suggestion of Dawkins, namely that in cultural evolution there is another unit, called meme, which is analogous to the gene in biological evolution. In the first place, cultural evolution is Lamarckian, not Darwinian (we teach our children our culture), and hence much faster (by a factor of one million). Therefore, natural selection cannot operate in the cultural sphere; it could never catch up to the speed of change.

Evolutionary paleontologist Stephen J. Gould attacks primarily philosopher Daniel Dennett's ideas on evolution. Gould defends his own idea of punctuated equilibrium in evolution, and points out the importance (which Dennett neglects) of some alternative evolution mechanisms which are non-Mendelian and therefore not under the sway of natural selection: whole sequences or domains can jump from one chromosome to another, homeotic genes which produce big changes (cf. book "Sudden Origins" by Jeffrey Schwartz) can give rise not only to adaptive body parts, but also "spandrels" which are neutral at first, but may prove pre-adapted if the environment changes in certain directions, etc. We should think pluralistically about complex systems.

Sociologist of science Hilary Rose argues against the attack by evolutionary psychologists, especially John Tooby and Leda Cosmides, who try to demolish the "standard social science model". She explains that this is a straw man, not what sociologists really believe. However, psychologists should take into account sociological findings, not reject them out of hand.

Cultural theorist Barbara Herrnstein-Smith argues against Steven Pinker's book "How the Mind Works". Pinker talks about the modular mind, and H-S considers the mind to be an organized whole.

Child psychologist Annette Karmiloff-Smith also directs her criticism against Steven Pinker's suggestion that a child's mind is like a Swiss army knife, with different tools adapted to different tasks, and that this brain structure is genetically predetermined. K-S argues for a more mixed model, with some brain structures innate and others learned. She also stresses post-natal (and I guess pre-natal) brain development, which is not wholly genetically determined. She cites a lot of experimental and observational evidence.

Ethologist Patrick Bateson criticizes Konrad Lorenz's ideas on the importance of animal instinct, and the transfer of these ideas to human behaviour. These ideas not only lead to politically unacceptable ideas about fixed race characteristics

(Lorenz was once a member of the Nazi party but later disavowed it), but also lack empirical confirmation.

Feminist biologist Anne Fausto-Sterling argues against the ideas of David Buss and Robert Wright on animal and human mating patterns. Among both humans and animals, females are not always coy and males are not always aggressive. Females, however, do usually prefer resource-rich males. But since among humans much depends on social circumstances, the Paleolithic past, whatever it was and we don't know details, has little relevance for the present.

Sociologists Tom Shakespeare and Mark Erickson want to combine biological and sociological mechanisms to obtain more complete and credible "both/and" answers to human behaviour. They focus less on criticism of EP than on a constructive synthesis. They apply their views to the case of the disabled and gays and Lesbians. Both cases have both a biological and a sociological aspect, and we need both for proper understanding.

Sociologist Ted Benton shows that the two originators of the theory of evolution by natural selection, Charles Darwin and Alfred Russell Wallace, while agreeing on biology, disagreed on the social implication of evolutionary theory. Darwin still clung to the race and gender prejudices of Victorian times, Wallace argued for social equality of women and racial minorities. Analyzing Gareth Runciman's book "The Social Animal", Benton argues for the autonomy of the social sphere. Society comes from the many shared needs of human beings, and their ability to cooperate INTENTIONALLY. While there is no intentionality in biological evolution (that was Darwin's main contribution), social and cultural evolution is BASED on intentionality. Humans are not "blind watchmakers".

social anthropologist Tim Ingold also attempts to transcend reductionism and "either/or" answers. He first outlines and then rejects the "complementarity thesis" of evolutionary biology, cognitive science, and anthropological culture theory, which together constitute evolutionary psychology: thinking in terms of units, such as genes, brain modules, and memes. He proposes instead his own triad: developmental biology, ecological psychology, and practice development in culture. In my view, it is a trilogy of genes, fetal and neonatal brain development, and selective strengthening of synapses (potentiation) by later learning.

Neurobiologist Steven Rose writes the concluding essay by way of an overall conclusion. In his criticism of EP, he points out the fallacy of two of its assumptions: the confusion between enabling and causal mechanisms, and the stress on distal over proximate causes. Some other points: 1. Naked replicators are empty abstractions. 2. Genes are not the only level of selection; there are also organisms, groups, species, and ecosystems. 3. Natural selection is not the only mode of evolutionary change (as Darwin himself admitted). 4. Not all phenotypic characters are adaptive. 5. Minds deal not only with information like computers, but with meaning as mediated by emotions. 6. Living organisms are not reducible to their genes, but follow a lifeline trajectory, simultaneously product and process, being and becoming.

To these counterarguments to EP, I would like to add the argument from the widespread practice of adopting children, both among humans and a variety of animals. This is described by Evan Eisenberg in "The Adoption Paradox" in Discover Magazine, January 2001, pp. 80-89.

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## **DENNETT'S LADDER.**

According to Kauffman, Dennett distinguishes four types of creatures along the evolutionary ladder: 1. Darwinian creatures; using mutation and recombination of genes and subject to natural selection; 2. Pavlovian creatures, capable of stimulus-response learning by conditional reflex; 3. Popperian creatures, which can form mental models and hypotheses like primitive scientists; and 4. Gregorian creatures, humans who make tools, use language, and who initiated cultural and technical evolution, a million times faster than biological evolution.

In terms of the kinds of "minds" that Jantsch recognizes, Darwinian creatures have metabolic, genetic, and epigenetic mind (and maybe hormonal mind); while the higher three add neural mind. And according to Terrence Deacon ("The Symbolic Species"), Pavlovian creatures use iconic and indexical thinking, Gregorian creatures use symbolic thinking, and I am not sure about Popperian creatures. The analogies I am trying to make are a bit uncertain and overlapping.

One could also make analogies with Piaget's schemas in cognitive development of children, but these might be even hazier. A mid-term fetus is a Darwinian creature, a small child learns by Pavlovian responses to hone its sensorimotor skills, the stage of concrete operation is reached by Popperian thinking, and the stage of formal operations by Gregorian (symbolic) thinking.

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## ARGUMENTS FOR THE EXISTENCE OF GOD.

I have basically four arguments, none of them watertight (uncontrovertible).

1. The experiences I have had, as described in my essay [The Fifth Yoga](#), of coincidences that feel like messages from God, or answers to my questions.
2. The fine-tuning of nature's laws that permit us to exist, which are usually explained by scientists by means of the anthropic principle (if fine-tuning did not exist, we would not be here to think about it), is more simply explained by the God hypothesis. It is certainly simpler than the other alternative, "multiple worlds". Adhering to Occam's Razor is preferable to inventing epicycles, as the pre-Copernicans did. Why are scientists so dogmatically opposed to the God hypothesis? It is not irrational. This is essentially the old argument from design.
3. The "super-unified field", a merger of mind and matter, could exist. It would unify the "Theory of Everything" (TOE) if we ever merge all four forces of nature (achieve quantum gravity), with mental and spiritual phenomena.
4. My theory of the Great Wrap-around, wherein we create God at Teilhard's "omega point" while God creates us at the "alpha point". The image is of the Uroborus, the snake who eats its own tail.

While points 3 and 4 are only speculative, points 1 and 2 are on firmer ground. I do not accept Biblical revelation, or the so-called ontological proof (if God is a perfect being, existence must be one of His traits).

However, while I think that God exists, I know almost nothing about His nature. Only that He sends me messages, which shows that He cares. I would like to think (but who am I?) that He represents more the principle of Love than the principle of Power.

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## MEDITATION ON CAETANI'S TREE OF GOD.

This is a picture on page 35 in Sveva Caetani's book "Re-capitulation", depicting the Kabbalah Emanations as an upside-down tree.

There is a striking continuity of light at the bottom of the upside-down tree, the Tree Beneath the Root. (God the Ground of Life.) En Sof is not even shown; He is too bright. El Kether's light, especially that of En Sof's hair, extends up through Da'at (the miracle of resurrection) all the way to Tiferet, the Flower of our Amazement. Its T stands for Truth or Top quark (the heaviest matter particle), but it also sYmbolizes Beauty (Bottom quark, the second heaviest). El Kether's light also extends sideways to Hokhmah and Binah (Wisdom and Intelligence), the first Divine pair. All these precede the Breaking of the Vessels, i.e. the Big Bang of Creation, before the original sYmmetries were broken. Truth, Wisdom, and Intelligence, as well as Beauty, are beyond this; they are Aeons of primary structure.

A blue-shifted light emanates from the above-ground structures of Life, especially human life (Shekhinah), made in the image of God, and seeking to approach Him (hence blue-shifted); but it is nowhere as bright as that of El Kether, who himself is just a pale reflection of En Sof (actually only of His single hair.)

The Flash of Wisdom is in the Scroll (Hokhmah's sign) i.e. wisdom is in the Book (Bible or Q'uran). Binah's sign, the Comb, also contains a Flash; she "combs" information to extract meaningful knowledge that can be applied. So all the pre-Break aeons (as Gnostics would call them) contain a Flash in their signs.

Binah is the Gnostics' Sophia, another name for Wisdom. But "Sophie made a choice": she wanted to create the World, or cause its creation, even though, after the sYmmetry break or the Fall, it would be an imperfect one. She gave birth to Gevurah, who is the Gnostics' Demiurge, who created this dark fallen world. (notice the absence of light in this region.) Gevurah's Justice relies on the Axe (his sign), red with blood. He is like Yahweh of the Hebrews, the Lord of Hosts.

But Hesed, Binah's brighter daughter Mercy (also called Mary), intercedes with Gevurah to save sinners from the just consequences of their sins. Mercy mollifies and moderates. Stern Justice. She is the original Goddess of Love, or Venus. She provides a shelter (her sign) for the (justly) peror prosecuted. If Gevurah represents the Old Testament, Hesed stands in for the New Testament, the forgiveness of sins. Kyrie Eleison — God have Mercy.

Venus' successor is her daughter-in-law Psyche, as in the Greek myth. Venus' son and Psyche's husband is Eros or Amor, the God of Love. Psyche is Nezah, the successor of Hesed, in a similar way. She also is Love, proving Love's Long-Lasting Endurance ("Love endures much", wrote St. Paul in his letter to a Christian community). The whole female line in the Kabbalah succession is Love in different forms, from Binah/Sophia to Hesed/Mercy/Venus to Nezah/Psyche. Love is a non-conserved entity, unlike matter or energy, and therefore, paradoxically, it lasts.

This is also true about Life, so fragile and yet so tough, getting through the bottlenecks of 6 or 7 Great Extinctions on Earth. So Nezah is also Gaia, the Goddess of Earth, the Mother of Life, Mother Nature.

Meanwhile, on the male side, Gevurah begat Hod, who symbolizes Majesty or Honour, and whose sign is the Dancer (like Shiva) or the Warrior (like Yahweh). Together, Nezah and Hod (Gaia and Shiva), (sustainability and balance between creation and destruction, i.e. long-lasting homeostasis) produced the Foundation or Fruitfulness, called Yesod, the origin of Life on Earth.

Yesod is Chi (Qi) or Kundalini, the Life Force, called serpent power; "serpent" not as the reptile of reptilian brain, not the tempter of Eve in Eden (though the name "Eve" means "Life"), but serpent as the Uroborus, the snake that eat its own tail, representing the cycles of life as well as the Great Wrap-around.) Yesod is also called "The Root", and can be identified with the lowest Chakhra, located in the tail-bone.

From this Root grows Malkhut, or Kingdom, meaning the Five Kingdoms of Life on Earth: bacteria, protists, fungi, plants, and animals. The symbol here is the World Plant, rightly so because green plants' photosynthesis is the basis of all plant and animal life, though some bacteria rely on other processes. This is associated with the second Chakhra, located in the groin, and symbolizing sexual reproduction. Again, the bacteria do not share this. The third Chakhra, in the Solar Plexus, also belongs here, representing other basic mechanism of Life.

Finally, the Chakhras of the Heart (compassion), of the Throat (speech and prophecy), of the Brow (reason) and of the Halo (spirituality) are attributes of humanity. Shekhinah, the Light of Human Reason, is blue-shifted toward God. She represents the Holy spirit, the only Person of the Holy Trinity with whom we can directly identify. She follows us into exile,

to Babylon or to sinful-ness, ever helpful, like Love herself.

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## GNOSTICISM.

The Gnostic religion features a Divine (pre-human) Fall, like the vessel-breaking in Kabbala, like symmetry breaking in the early Big Bang, in contrast to the Judeo-Christian human Fall in Eden. Yet they all start with a primeval Golden Age before the Fall into Kali Yuga. In Greek mythology too, the reign of Saturn preceded the reign of Jupiter. (I do not apologize for the mixing of religious traditions. It is deliberate, to foster super-ecumenism and reconcile religion and science.)

Another relevant metaphor: The broken mirror carried by angels who dropped it; a splinter got into little Kay's eye, making him follow the Snow Queen into the frozen desert, away from Gerda, and unable to spell "Eternity" with ice blocks, until Gerda came, made him cry, and washed the glass fragment from his eye. (This also features Redemption from the Fall.)

The book by Stuart Holroyd "The Elements of Gnosticism" cites other relevant stories: Goethe's story about Faust, who is alternately exalted in seeking knowledge (gnosis) and sinking to grossly immoral conduct (seduction and murder), but is finally saved from surrendering his soul to Mephistopheles through the entreaties of the very girl he had seduced and who had suffered as a result, Gretchen. (Is it a coincidence that Gerda and Gretchen are similar names?)

Holroyd also cites the story of captain Ahab in Hermann Melville's *Moby Dick*. Ahab pursued the white whale, which personified for him the basic evil of the world, until Ahab himself and his boat were destroyed.

While the gnostic philosophy also resonates with certain aspects of Carl Jung's depth psychology, as well as Kierkegaard's and Sartre's existentialism, yet I think that Gnosticism is fundamentally wrong in its most important view: I would hold that this universe, this earth, this flesh is not evil, it is wonderful, the very abode of God Immanent. If God Immanent, the Goddess of Nature and of Life, the Eternal Tao, is the Demiurge, I will still worship Him/Her. Sophia made no mistake in producing the Demiurge; she was Wisdom Herself. I should call myself an anti-gnostic (not agnostic).

A passage from Holroyd's book (pp. 12-13), citing Carl Jung's "Seven Sermons to the Dead", shows why: "The created world is the differentiated world, as distinct from the world of sameness of the Pleroma. Man discriminates qualities in the Pleroma which are really projections from his own being. Differentiations between light and dark, energy and matter, time and space, good and evil, the beautiful and the ugly, and so forth, are cancelled out in the Pleroma, but in human beings they are active."

This makes it clear that the Pleroma, the Divine realm of the Godhead and the Aeons, is equivalent to the equilibrium state, from which life and the living world deliberately deviate. I much prefer the multicolored rainbow to the White Hole of pure but immovable Being.

Yet I feel in touch with the Collective Unconscious and its numinous heroes and demons.

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## SECOND THOUGHTS ON GNOSTICISM.

In a previous essay on Gnosticism, it was proposed that the Godhead is like equilibrium, immovable and anti-life. On that basis I claimed to be an anti-gnostic.

However, possibly the Godhead or Nirvana is not equilibrium. It may not be Alpha, but Omega — the final point, not the starting point. It may be a White Hole, not a Black Hole. It may be the superconscious, not the unconscious.

Now in the Great Wrap-around Supercycle, which I postulated elsewhere, Alpha and Omega meet at plus or minus infinity. Also, a White Hole (Bose-Einstein condensate) is supersymetrically transformed into a Black Hole (the Big Bang) at the end of one universe and the beginning of the next universe. And the super-conscious lies just behind one door from the conscious mind, the other door leading to the unconscious workings of the body. Who knows if a secret passage behind the scenes connects the two?

Still, between the White and the Black lies the whole ~ rainbow of colours” the matter, energy, information, and meaning of the living universe. Spanning from Alpha to Omega lies the creation of Sophia and the Demiurge. I will go for that still. I am still an anti-gnostic. Maybe that is why I have such trouble trying to meditate.

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## INTER-FAITH CORRELATIONS.

This has been attempted before, in the essays “Super-Ecumenical Synthesis” and “Kabbalistic Evolution”, and especially in the meditation poem “Vessel-breaking as Symmetry-breaking”. But now I have read about Gnosticism and I can weave it into the comparisons, as well as make some other changes.

First, a parallel between the Parzufs of the Kabbala and the string theory of fundamental particles of physics. According to the former, there are 11 Parzufs (or 10 by some counts), and, according to the latter, there are 11 dimensions (or 10 by some counts) in the string-created universe. We know only the lowest 4 dimensions (3 of space and 1 of time). These might correspond to Nezah, Yesod, Malkuth, and Shekinah; in other words the long-term sustainability of life, the root of life, the kingdoms of life on earth, and our own humanity. We have no direct access to the higher divinities, who live in higher dimensions — as is said about the angels.

Nezah is equivalent to Sophia in Gnostic theology. She is said to have given birth to the Demiurge (equivalent here to Yesod the Root) without the intervention of her husband Hod, who represents Majesty. So presumably the element of ~l majesty is missing from the creation effected by the Demi-urge, but life does have the long-term sustainability of Nezah. Life does have some unsavory (non-majestic) aspects, e.g. in its physical secretions, excretions, and eliminations, but it has long-term continuity (so far, at least) through reproduction, in spite of death. (While life may lack Majesty, it does have Beauty (Tiferet) from the higher realm of Parzufs, or Aeons in Gnostic terms. Gnostics would call this the Soul.) It seems to me that, in Hindu philosophy, Shiva and Vishnu represent the Nezah-Yesod (Sophia-Demiurge) pair.

“The Dance of Shiva” pictorial allegory shows the balance of creation and destruction that is the essence of life’s sustainability, and in a story Shiva is shown to be superior to Vishnu, who created the visible world, as the Demiurge did. Brahma would presumably be the agent (or part) of Brahman, as El Kether is of En Sof.

There are 7 Chakras along the axis of the spine, not 10 or 11 (see diagram on page 260 of “How Things Come Together”) (HTCT); presumably the highest 3 have not yet been attained or even visualized. But the lowest Chakra is the Root (Muladhara), sometimes identified with Kundalini (the life force), and Yesod. The Demiurge is also the Root. And there are only 8 body levels in esoteric doctrines. (See diagram on page 202 of HTCT). The extra dimensions, so tightly curled up, apparently come into view only one by one. Or, critics might say, these doctrines really do not fit together very well. Perhaps I am trying to force them into a bed of Procrustes.

Correspondences between Kabbala and the Chacras are represented fairly well on page 126 of HTCT. But the other comparisons on that page are less convincing.

In Greek/Roman mythology, the Gods under Zeus defeated and replaced the Titans under Saturn, as depicted by my story about the war of the Planets. This is a good parallel of the Demiurge taking the place of the True High God of the Gnostics. The Zeus/Jupiter gods behave in a rather degraded human-like manner, e.g. pursuing nymphs, feeling jealousy, and fomenting the Trojan war. This is also true of the Germanic Gods, as depicted in the Niebelungen Ring myths. At the end of Wagner’s opera evenings, we are almost glad when these gods go down into extinction (Gotterdammerung) .

In Egyptian religion, Isis gives virgin birth to Osiris, like Sophia does to the Demiurge; marries him, and resurrects him after he is killed. The latter events do not correspond to anything in Gnostic myths. In Babylonian religion, the Mother Goddess Tiamat was killed by her son Marduk, who then created the world out of her blood. Marduk may well be identified with the Demiurge and Tiamat with Sophia.

In the Greek story of Demeter (Dei Mater) and Persephone, the offspring of Sophia-like Demeter, this time a daughter, Persephone spends half her time in the underworld with Hades and the other half with her mother in the world. Persephone is truly “demi” (half) good and demi-bad, equally serving the forces of good and evil, of life and death. She is a good image of the Demiurge, whom I don’t consider wholly evil.

Nezah/Sophia is the rebellious grand-daughter (in a way) of Binah, the divine active intelligence; Binah is already showing more activism than her husband and forebears. If rebellion means change, and life can only exist because it is balanced at the peak by the constant changes of metabolism (“Stoffwechsel”), then rebellion is the true origin of life.

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## GOD OF THE UNIVERSES.

Martin Reese's book "Just Six Numbers" argues that the Universe is finely tuned in (1) the ratio of the electromagnetic force to the gravitational force; (2) the mass deficit from hydrogen to helium due to the strong nuclear force; (3) the total mass in the universe; (4) the size of the antigravity force; (5) the amplitude of the ripples in the initial universe; and (6) the number of space dimensions (3). From these seemingly arbitrary values it follows that galaxies, stars and planets can exist, as well as life. If these numbers differed just a little from their actual values, this would not be so.

His explanation is that many universes exist, and we live in the only one in which we CAN exist. (This is one version of the anthropic principle.) He dismisses the idea of an intelligent Creator as unscientific. Yet, as I argue in the essay "The God Hypothesis", the creator theory is just as credible (in fact simpler by Occam's razor) as the theory of multiple universes, which is quite phantastic, and can also not be proved scientifically. Scientists are simply prejudiced against the idea of God, after centuries of ideological struggle with organized religion.

Actually, I would like to accept both theories, of multiple universes and of a Creator God. In one of my earliest essays, "Simulations", I argued that this world is God's simulation, and that He possibly runs multiple simulations of many worlds at the same time. This is doubly removed from scientific provability, but unproved theorems can nevertheless be true, as Goedel showed for mathematics. This could be one of the grandest unprovable theorems.

En Sof is indeed great beyond our comprehension, since we are only one of His simulants, i.e. one of His thoughts. In Fred Hoyle's science fiction story, "The Black Cloud", even the putative superhuman extraterrestrial being was stymied by this greatest of all mysteries.

However, how does this fit in with my assumption (equally wild) of the existence of "The Great Wrap-around" (or supercycle), in which we humans create God who in turn creates us? (This is possible because time does not "flow" in Eternity.) This view is not only anthropocentric, but also geocentric, galaxy-centred, and our-universe-centred. How can it be generalized for the multi-universe view?

I would suggest that in God's other universes there exist entities of a nature totally unknown and unimaginable to us, which also create God. Life as we know it cannot exist there, but these totally different beings might, each also wholly different from each other, may exist. Perhaps they are angels, ruled by Archangels or Aeons or different versions of El Kether. En Sof has many hairs on His head.

We can only deal with these verities by metaphors, and so I do not apologize for postulating the angelic hordes, who are always thought to live in different dimensions.

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## INTER-SECTS.

This essay is about some linkages between religions and between sects or “heresies” within religions. Thus the title is a pun, hinting at interconnections.

This started with reading about the Cathars (Albigenses) in the “Holy Blood — Holy Grail” book. They were a sect of “heretics”, put down in a bloody purge in Southern France (Languedoc) in the 6th or 7th century. They had no set dogma (unlike Catholics, but like Quakers and Unitarian), practised meditation (like Gnostics and Quakers), considered Jesus relatively unimportant and probably wholly human (like Unitarians and Arians), were dualistic, i.e. making good and evil, God and the Devil, light and dark equally powerful (like Zoroastrians, Manicheans and Gnostics), believed that the world was created by an evil spirit, Rex Mundi (like the Gnostic demiurge), believed in the equality of women (like Quakers, Bahais, and Druids; the latter had priestesses), and studied the Kabbalah (like Jewish mystics).

I share most of these beliefs; I am not sure about dualism, but I vibrate to “Rosemary’s Baby” and especially “The Son of Rosemary”, in which the Devil speaks of playing a game of Superchess with God, and the Devil wins in a gruesome way. (I don’t believe in the author’s ending that it was all a dream.)

Somehow I feel that if the sects named above all got together across history and geography (time and space), they would almost have the whole truth. But they also need Hinduism, Buddhism, and Taoism, as well in Amerindian native beliefs and even Wicca.

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## THE RED SNAKE.

The book "Holy Blood — Holy Grail" by Michael Baigent, Richard Leigh and Henry Lincoln, talks about the blood-line of Jesus, through his wife Mary Magdalene who escaped to Marseilles, France with their children after Jesus' crucifixion. The story is highly speculative and offended many Christians, especially the Vatican. It does not shock me, and I don't much care if it really happened like that.

The blood-line is sometimes called "the Red Snake", extending through history. The author discusses it mainly as a claim to the inheritance of the throne as a king, since Jesus' ancestry goes back to King David (unless he was fathered directly by God). So Jesus could rightfully claim to be King of the Jews, and his descendants were for a time kings in France, the Merovingian kings, later displaced by Charles Martel and Charlemagne from another royal line. Jesus' line is said to continue to this day.

But so what? We don't have kings, hereditary monarchies, any more. The people in the Middle Ages and early modern era were greatly concerned about claims to the throne through blood-lines, sometimes only through the male line (which makes it much simpler). Even today, patriarchally oriented men are eager to have sons who would "carry on the family name". (Cf. Henry VIII getting rid of his first two wives because they did not produce a son.) However, this type of inheritance, because of a claim to something like the throne or a name, is something much less "holy" or significant than the real incredible miracle of biological reproduction.

I tend to think of a blood line biologically as a set of inherited genes. But then a long line of ancestors and descendants dilutes the genetic inheritance very rapidly, in species like ours which reproduce sexually. Even a grandchild shares only 1/8th of its genes with a grandparent. In my perception, there is no "line", only a tangled network, especially if we do not ignore descent along the female line, which we should not ignore. In any case, Jesus' genius and significance was in his message, not in his genes.

The author distinguishes the two concerns, the people and institutions concerned with spreading and perpetuating the message, like the Roman Catholic Church and before it the Church fathers, and the people, like Jesus' family, concerned with inheritance and the blood-line, with its claims to fame, power and glory. (It means preserving memes rather than genes.) Intermarriages were made with other royal families for political and dynastic reasons. Powerful organizations, like the priory of Zion and the Knights Templar, Freemasons and Rosicrucians, backed the claims of Jesus' family, while keeping it as a secret in order to avoid the Inquisition.

I don't think that Jesus would have been too concerned about such political machinations, though the author thinks otherwise. I think that Jesus would concentrate on the message. In this, strangely enough, I agree with the Vatican, though not its Inquisition.

There is no Red Snake, only a common gene pool. It's more like a lake rather than like a river. We are all related.

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## WHO WAS JESUS?

This is another comment on “Holy Blood — Holy Grail” by Michael Baigent et al. As my previous essay “The Red Snake” indicates, I don’t agree with the authors’ presentation of Jesus, while I have no quarrel with their basic conclusion that Jesus fathered children and that his blood line still continues.

According to the “Holy Blood” book, Jesus was a man with an ambition to establish that he was a descendent of King David and therefore had a legitimate claim to be King of the Jews, as emerging from the questioning by Pontius Pilate at his trial. But we know that he was tempted by the Devil in the desert to aspire to worldly power, and refused to go in that direction. A minor point: if he was the son of God conceived immaculately by Mary, he was not the son of Joseph, even though Joseph was a descendent of King David.

Quite a different image of Jesus emerges from the book by Jim Douglass, “The Nonviolent Coming of God”, which pictures Jesus as opposing the Zealots’ movement to mount a violent revolution against Roman rule, warning that it would be a disaster, as indeed happened in 70 A.D. when Jerusalem was sacked, the Temple was destroyed and Jews were dispersed into the diaspora. He proposed instead a nonviolent opposition to Roman rule; his triumphal entry into Jerusalem was a typical and inspired nonviolent protest. He was crucified for doing so, but his message survived, long beyond the time when Rome itself was sacked and the Empire fell at the end of the 5th century A.D. Unfortunately, says Douglass, we have not learned the lesson, even though we pretend to worship the man who preached it.

Jesus was one of the great prophets, alongside Buddha and Muhammad and Lao Tse, who preceded the coming transformation of humanity into its successor species, intrinsically ethical and incapable of violent behaviour. In this sense he was the Son of Man, though not the Son of God. He was one of the holy pilgrims approaching the White Hole of God from different directions, as depicted in a painting by Sveva Caetani in her book.

The white hole is in his future, not in his past. But then, time is irrelevant in Eternity, so we may call him the *Son* of God after all.

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## FROM "VARIETIES OF RELIGIOUS EXPERIENCE" (William James)

I insert a lengthy quote from page 301 of the paperback version: "...with that I became unconscious again, and my last dream immediately preceded my real coming to. It only lasted a few seconds, and was most vivid and real to me, though it may not be clear in words. A great Being or Power was travelling through the sky, his foot was on a kind of lightning as a wheel on a rail; it was his pathway. The lightning was made entirely of the spirits of innumerable people close to one another, and I was one of them. He moved in a straight line, and each part of the streak or flash came into its short conscious existence only that he might travel. I seemed to be directly under the foot of God, and I thought he was grinding his own life up out of my pain. Then I saw that what he had been trying with all his might to do was to change his course, to bend the line of lightning to which he was tied, in the direction in which he wanted to go. I felt my flexibility and helplessness, and knew that he would succeed. He bended me, turning his corner by means of my hurt, hurting me more than I had ever been hurt in my life, and at the acutest point of this, as he passed, I saw, I understood for a moment things that I have now forgotten, things that no one could remember while retaining sanity. The angle was an obtuse angle, and I remember thinking as I woke that had he made it a right or acute angle, I should have both suffered and seen still more, and I should probably have died." This was the dream of a woman taking ether for a minor operation.

This dream stresses God's power rather than His love, as in the Book of Job. Perhaps He has to assert His power as opposed to the Devil's power. (He has to rise to the challenge of the wager with Satan.) He won in Job, but lost in "The Son of Rosemary". Maybe the powers are almost equal, and frequent replays of "mega-chess" are necessary. Yet each round takes place at the cost of human suffering. This is why there is evil in the world. There is no love here, by either God or Satan. Humans are the pawns on the chessboard of the principalities and superpowers. But if this is true, there is no difference between Good and Evil, between God and the Devil. without love — why choose one or the other?

But there are, other aspects in this passage. The pain brings supernatural knowledge to humans who serve as the pawns of the Superpowers. Perhaps the knowledge, though fleeting, is worth more than love, more than happiness, and must be paid for by pain. (I remember a story of the prisoner tortured to death by lying on a bed of nails that gradually penetrated his body; he was seen to have a face of ecstasy just before he died. Each nail communicated more knowledge. )

Pain is often the apex of pleasure, as the aurora precedes a migraine headache. Pleasure can be as intense as pain, as in sexual orgasm. Pleasure and pain impulses travel along the same neural pathways, or are close neighbours. "Let this cup pass from me"? But perhaps not. Drink from the cup of agony and ecstasy, down to the dregs. "My cup overfloweth." For this cup is the Holy Grail, full of blood and wine, red as the sunset at the end of life.

I want to KNOW, like Faust, at the cost of my soul.

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## **SPARKS OF DIVINE ESSENCE.**

The Godhead is unchanging, complete, a diamond Being, as postulated by the philosophers; in fact the only rock-hard reality. Yet occasionally sparks come from this Eternal ousis, like virtual particles emerging from the vacuum, and even more rarely become real/permanent particles, as physical particles did in the early universe. The Emanations of the Parzufs in Kabbala doctrine, or the Aeons of Gnostic teaching, are such permanent sparks (steady-burning candles), as are the angels and archangels of the Christians. The lower Parzufs or Aeons (after the Divine Fall) created the world of living things, including humans, who are again only virtual particles, flickering in and out of existence like sparks from the Eternal Fire.

We are virtual particles, doomed (or privileged) soon to merge back into the Vacuum/Plenum. Enfolded into the hidden order, as in Bohm's theory. As virtual particles, we would have no individuality or identity as eternal souls, and so could not be re-incarnated; but as personalities, something we may have earned through a good life, we may have lost this fungibility and acquired souls. How this plays out is a mystery.

Perhaps God is not finished with us yet.

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## SEE THE WORLD FROM BOTH SIDES NOW.

Robert Keith Wallace's book "The Physiology of Consciousness" (Maharishi International University Press, Fairfield, Iowa, 1993) describes in some detail the nature of the higher consciousness gained in transcendental meditation, and how it links up with the basic structure of the universe, modern science, human health, world peace, and ancient Vedic philosophy.

It explains the world in a different way from the usual — not as matter giving rise to consciousness as an emergent quality of the brain, but as matter being the "precipitated expression of ..the [unified] transcendental field of pure consciousness". In other words, Mind came before Matter, not the other way around.

Yet this should not be a big surprise to me, since I have repeatedly written about the Great Wrap-Around. The greater truth is that both views can be correct. We create God — and the unified field can be equated with God — and in turn, God creates us. The unified field is Brahman in Vedic philosophy, our Self is Atman, and it is stated that "Atman is Brahman". But we can directly perceive this only when we attain a higher state of consciousness. My own grasp is still only intellectual, and so I AM surprised.

It is still a mystery to me just HOW Mind incarnates into Matter. Would it be something like Bohm's unfoldment and enfoldment? Emergence of Mind and Creation of Matter as two aspects? In this case, Mind and Matter would be co-eval, equally eternal like the Persons of the Trinity. In fact, Wallace uses the term "uncreat.ed", also used for Jesus in Christian theology ("begotten, not created").

I am also intrigued by the Higgs field being called the densest manifestation of matter. Of course, all material particles derived their mass from it, but then why can't we see it or sense it or even (as yet) find it? Is it too condensed for us to see?

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## MULTIPLE PATHS TO TRUTH.

In her painting “The Fellowship of the Timeless”, Sveva Caetani (poet as well as artist) depicts 12 pilgrims — Holy Men (Lohans) who approach from different directions the centre of a luminous circular Mandala, on their way to the White Hole (Whole?) of Divine Reality. In this journey from Transience to Timelessness, the Perennial Philosophers “converge from all directions of the compass toward the central plunge”, drawn by a spiritual gravitation. They move with slow but not hesitant deliberateness to their goal, like “travellers from rooms they have left behind”. (Some of this language is borrowed from Caetani.)

Besides being a good image for the global interfaith movement, it also correlates with images from other situations and contexts. The four yogas of Hinduism are one such example. It is possible to attain the knowledge that “Atman is Brahman” by several routes, climbing to the summit of the mountain either by Jnana Yoga (the route of logical reasoning), or by Karma Yoga (the route of practical good deeds), or by Bhakti Yoga (the path of spiritual devotion), or by Raja Yoga (mysticism and spiritual exercises). (These are well outlined in “The Religions of Man” by Huston Smith.)

Another image is the Arthurian search for the Holy Grail, a supreme Christian vision. There are several versions of this story, but they all involve the notion that only a totally pure person can attain the vision. The morally impure Sir Lancelot could not get it, but his pure son by an innocent maiden, Sir Galahad, finally did. But he did so only by “reaching through the Worlds” from Glastonbury to Avalon, and the touch of it killed him. Just as the person who touched the Ark of the Covenant in the Old Testament.

The final image I can think of comes from an unlikely source: mathematics. In his recent book, “Where Mathematics Comes From”, George Lakoff closes the book with a “case study” of why  $e^{pi} + 1 = 0$ . This magical-sounding equation seems mysterious (what does it even mean?), but he shows in several chapters that it represents a pinnacle at which several branches of mathematics come together: algebra, calculus, geometry, analytical geometry, trigonometry, and complex numbers. Moreover, the result can be obtained by at least two kinds of approaches.

One approach starts with differential calculus and the Taylor or McLaurin infinite series. By writing out the series for  $e^x$ ,  $\cos x$  and  $\sin x$ , we see immediately that

$$e^{pi} + 1 = 0$$

from which  $e^{pi} + 1 = 0$  follows. But this still looks mysterious. It is the way the text books do it, but it does not give us insight, i.e. true understanding.

The second approach, which Lakoff uses, goes into detail of the cognitive “metaphors” used in four kinds of planes: the Euclidean plane which gives us the unit circle, and hence  $p$ ; the Cartesian plane, in which we can plot two ordered numbers as a point in the plane; the trigonometric plane, which links recursiveness (waves) to periodicity (circle); and the complex plane, which explains  $i$  and uses Cartesian plane notations to express complex numbers.

These four planes, plus the idea that exponentials map sums into products and  $e^x$  is the only function that is its own derivative (first, second, third, etc.), converge to the result ,

$$e^{pi} + 1 = 0$$

This makes us realize that insight is different from, and superior to, a formal proof. But it requires considerable “jnana” to follow the argument.

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## OM-GAIA MEDITATION.

To help my meditations, I decided to adopt a mantra.

The one I chose was “Om-Gaia”, thus honoring both God and Goddess, the Universe and the Earth, Eastern and Western religions, and male and female principles. It was reasonably short and kind of melodious, vibrant with numinous meaning.

It goes from En-Sof the incomprehensible to Neza the long-term sustainable, the root of fruitfulness and the five kingdoms of life on Earth.

Neza comes after the symmetry-breaking, the mythical breaking of the vessels in Kabbala. Hence life chooses only d-sugars and l-amino acids in its physical construction. She places the heart on the left, the liver on the right, and makes the two brain hemispheres different.

Neza is like the Gnostic Sophia — lower among the Emanations, but mother of the material world, with all its imperfections, but still wondrously harmonious.

I cannot approach Om. I can only worship His female emanations, as the Catholics worship the Virgin Mary. The fruit of her womb was also wondrous.

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## HEAVEN AND HELL.

Christians now believe in Heaven, but not in Hell, unlike in the Middle Ages or even a century ago. Yet the situation is almost the reverse of this modern belief.

The pictures in National Geographic show lava lakes in volcano craters that provide a window on the interior of the Earth, which is remarkably like the popular image of Hell. The magazine itself makes that comparison. And C.S. Lewis said so in "Perelandra".

But where is Heaven? Outer space may become the next battlefield, if the U.S. gets its way. (Cf. the paper by the US Space Command on plans for space domination.) Hell is both beneath our feet in the present and above our heads in the near future.

Perhaps Heaven is right here on our beautiful Earth, as Helen Brink once said. As long as it lasts.

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# TRUTH AND BEAUTY.

(About the quarks)

God is Truth and Beauty, Top and Bottom,  
Up and Down (i.e. Highest and Deepest),  
Strange Charm.

Charm is Karma and Charisma,  
Fate and Grace,  
Justice and Mercy.

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## THE MODE SWITCH.

Does my myth-science-oriented writing affect my everyday view of the world? No and yes. In the practical mode, I am just an ordinary person, going through the daily moves in my environment and my society.

But in special moments, when I am alone, walking on a trail through the woods, or contemplating a city view while drinking tea, like just now — I turn to this different view — you could call it spiritual. It's like flicking a switch. I can almost feel the neurons and transmitters in my brain rearranging their patterns.

Everything is different, luminous with meaning, numinous in its sacredness. Then I may write a poem or an essay, pray or meditate.

My meditation is not an emptiness, as it is for some; it is a seeking of hidden connections. If the Universe is unified in the emergent-nascent God, the connections are there, to be discovered.

My mind can't reach the end, it's too limited. But the distant light beckons like a light-house in stormy seas, like the Promised Land of Fullfilment that is not mine to reach. My intuition or inner sense may get a little closer, but it too falls short, it is not up to the task.

As the old song about clouds goes:

I've seen God from both sides now,  
from near and far,  
from here to star,  
but it's God's illusions I recall,  
I really don't know God at all.

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## DEFINITIONS OF LIFE.

These definitions come from various pages of Stuart Kauffman's book "Investigations", a highly tentative outline of what he calls "a general biology", i. e. one not dependent on Earthly materials or conditions — a biology that could apply anywhere in the Universe.

Page 32: "Life is based on collectively autocatalytic sets of molecules, not on template reproduction per se." This means that a purely protein-based world could have preceded even an RNA world, although RNA can be both an enzyme and a template. Moreover, it means that on extraterrestrial planets, some other complex macromolecules could take the place of proteins, RNA and DNA, if they can form complex collectively autocatalytic networks.

Page 35: "Life is an expected, emergent property of complex chemical reaction networks. Under rather general conditions, as the diversity of molecular species in a reaction system increases, a phase transition is crossed beyond which the formation of collectively autocatalytic sets of molecules suddenly becomes almost inevitable. If so, we are birthed of molecular diversity, children of second generation stars." [Second generation stars produced CHNOPS, the elements of life.] This is like "the Virgin birth of us all".

Again, on page 46: "Life is an expected emergent property of complex chemical reaction networks."

Page 72: "Autonomous agents may constitute a proper definition of life itself". Supplementing that, on page 8 is a definition of an autonomous agent: "A molecular autonomous agent is a self-reproducing molecular system able to carry out one or more thermodynamic work cycles." It can do so by coupling exothermal reactions (stemming ultimately from sunlight) with endothermal reactions which build up complex molecules of its body from simple molecules (food). [Proteins from amino acid, complex carbohydrates from glucose, fats from fatty acids, nucleic acids from mononucleotides.] There is a further discussion of thermodynamic work cycles, based on the Carnot cycle. still further, "work cycles cannot occur at equilibrium". It follows that "an autonomous agent must be displaced from thermodynamic equilibrium."

Page 48: "This non-equilibrium flow into a persistent adjacent possible may be the proper arrow of time, rather than the more familiar appeal to the second law of thermodynamics in closed thermodynamic systems." In other words, life tends to proliferate and spread. Later in the book, he postulates "a fourth law of thermodynamics", which states that a biosphere will tend to expand "as fast as possible", i.e. without disrupting itself. One gets a picture of a spreading contagion. But I don't see how the second and the fourth law can be reconciled. After all, while life decreases its own internal entropy, it thereby increases the entropy of the environment even faster than would otherwise be the case. I would think that life is a spatially and temporally limited system, a transitory and local fluctuation. But Kauffman would disagree with my view.

Page 86. "Maxwell's demon is almost an autonomous agent." This is a fictitious creature who can sort fast from slow molecules of a gas and thereby negate the second law of thermodynamics. But the demon cannot perform a work cycle because the gas system is at equilibrium. (Pages 81-82.) On page 83 it is stated that "work is the constrained release of energy, but it often takes work to construct the constraints."

Kauffman states in many places that the evolution of a biosphere cannot be predetermined; it is contingent on a changing environment, which is being changed by the evolution of the biosphere itself. (This is co-evolution.) This is an indeterminacy quite different both from the Heisenberg uncertainty principle and the evolution of chaos. On page 152 he states: "The biosphere is profoundly contingent upon history." And "History enters when the space of the possible that might have been explored is larger, or vastly larger, than what has actually occurred."

Kauffman's exploration of the origin and nature of life rings true to me. I am even prepared to accept that the transition to life, with its vastly increased complexity, is actually easy and frequently occurring, not rare in the Universe. Probably, we are not alone; even though our fellow creatures may be only lowly bacteria. However, when Kauffman diverges into creativity of the Universe itself, in its creation of complexity, I get lost — partly through not understanding his theories, partly because of my perceived lack of credibility of what I do understand. The Universe itself is not alive; life forms only green islands in a vast blackness. Why should that not be enough?

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# PREBIOTIC EVOLUTION.

A “Universal” step may now be seen as preceding the usual “Terrestrial” steps normally outlined. Below is a rough sketch of the complete account.

According to a recent article in Scientific American, (December 2000), “star dust” in intra-galactic space in our Milky Way galaxy contains various carbon compounds (including several amino acids and some polycyclic aromatic hydrocarbons, PAH) adhering to silicate grains with iron cores; the carbon compounds are sometimes dissolved in adhering water ice.

These dust particles sometimes aggregate to form comets (“dirty snowballs”, which nevertheless may contain iron and silicate cores). According to other ideas, comets may have collided with Earth (when comets were more numerous), and their water ice made the oceans on Earth. Along with the comets’ water, the organic compounds may have entered the newly created oceans.

The amino acids (and perhaps other organic compounds) were optically active enantiomers, i.e. they exhibited asymmetry (chirality). The cause of this was the circularly polarized sunlight (in general, starlight in other galactic planetary systems); itself arising from the non-conservation of CP parity (charge and mirror reflection) of the solar neutrinos arising from the asymmetry of the weak nuclear force which gives rise to the neutrinos.

The next steps on Earth would be as usual: energy input from lightning or volcanism or ultraviolet radiation tended to polymerize the amino acids to proteins, which could mutually catalyze each other to produce a primitive form of metabolism in the “protein world”.

Then energy-storing molecules such as ATP (adenosine triphosphate) would polymerize to form information-storing molecules, i.e. nucleic acids — at first RNA — giving rise to the RNA world. This is usually considered to be the first stage of life, because accurate reproduction would become possible, in addition to metabolism. RNA can act as an enzyme, promoting metabolism, as well as a template, promoting reproduction. However, it appears that even proteins can reproduce themselves without the help of nuclear acids, as in the case of prions, which cause mad cow disease and its human counterpart, Creutzfeldt-Jakob disease.

The unstable RNA was then replaced in part of its function by the more stable DNA, making possible even more accurate reproduction. However, RNA continued to play important roles in protein production, as messenger RNA and carrier RNA.

So what do have as the steps to life?

1. Star dust to comets.
2. Comets to Earth oceans, with amino acids in it.
3. Polymerization of amino acids to proteins.
4. Mutual catalysis of protein proto-enzymes.
5. Coacervates (Oparin) form cell membranes.
6. Polymerization of ATP to RNA.
7. Production of DNA from RNA.
8. Prokaryotes (bacteria), first simple cells.
9. Invention of photosynthesis by blue-greens.
- 10 Formation of Eukaryotes.
- 11 Invention of sex.

Step 4 produces the protein world, imperfectly reproduced, and therefore good at producing novelty fast, but bad at hanging on to it. Mutation rate is high, but reproductive fidelity is low. Step 5 isolates the proto-life unit from the environment, and thus preserves it from re-dispersing into the medium. Steps 6 and 7 stabilize reproductive fidelity and drop innovation rate. In steps 6, 7 and 8, DNA genes are still actively swapped among individual cells, so that species are ill-defined, even among bacteria, although the networking is somewhat decreased in bacteria.

Step 10 Eukaryotes eventually invent sexual reproduction (step 11), which stabilizes species while introducing genetic variation within species. However, some Eukaryotes (fungi, mosses, ferns, higher plants) also reproduce asexually, through spores, budding, cuttings, etc. But animals never do.

I have omitted the invention of photosynthesis from the point scheme, because it deals with a different subject. Also, the chirality issues is not dealt with.

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## YUCK AND YUM.

This is really an addition to the previous essay, "Definitions of Life". It is a further comment on Stuart Kauffman's book "Investigations".

In discussing the semantics of autonomous agents (primitive life forms), Kauffman comments that they already distinguish "yuck and yum", i. e. poisons and food, or later, predators and prey. (Those that didn't, didn't survive.) Which reminds me of the most prominent dimension of Osgood's semantic differential, "good and bad". It is most prominent even for humans, when he interviewed people from many cultures. It is a transcultural universal. It now seems it is a trans-species universal for all life on Earth, maybe for life in the Universe, if any. Good and Evil are "Principalities and Powers", in a theological sense.

This distinction is certainly basic for survival under natural selection, by Darwin's laws. However, it leaves me wondering about the other two prominent (though less prominent) dimensions of the semantic differential: strong vs. weak, and active vs. passive (or fast vs. slow in some cultures). These too seem to be linked to survival. As Osgood remarked, "bad" things come in two varieties, the lion and the virus (both active, but one strong and one weak), and also a train approaching on the tracks (strong and active) and an immovable obstacle, like a wall or a river, as you are driving unaware of it (strong and passive). Any autonomous agent, primitive or advanced, had better look out for all of these varieties of evil.

Similar distinctions hold for "good" things. A strong good is "cool clear water" when you are thirsty in the desert; a weak good is a snack when you are just bored. An active good is your lover, a passive good is a nice hot bath. I could make all these less material and more spiritual, but I am trying to make it applicable to all kinds of life forms.

An autonomous agent of any size or degree of evolutionary advancement also seems to have a primitive free will, as already implied in the word "autonomous", and in Kauffman's favorite example of a bacterium swimming up a glucose gradient. It is chemical, of course, but it resembles purpose and intention. Why not give them credit for it? It satisfies Occam's razor (preference for simple explanation) better than the Darwinian circumlocutions, which remind me of Ptolemaian epicycles.

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# NANO-CHEMISTRY IS CELL BIOLOGY

(From R. Dean Astumian, "Making Molecules Into Motors", Scientific American, July 2001, pp. 57-64.)

Or, it could be put in reverse: cell biology is nanochemistry. The mechanisms described here throw additional light on the basis and origin of life as well.

Brownian motion is a basic factor of any structure small enough to be buffeted about by collisions with small molecules. Contrary to what one might think, this "chaos" does not hinder the formation of structure or the function of these small structures (e.g. nano-motors that turn), but actually helps it along. The large scale metaphor for this is a car at the bottom of a hill being pushed uphill by hail in a hailstorm if a ratchet brake (that hinders downward but not upward motion) exists and the driver randomly releases and applies the brake. The hailstones correspond to the molecules in Brownian (random) motion; because of the ratchet, motion in one direction is favored

However, we have not created a Maxwell demon, violating the Second Law of Thermodynamics. The driver pushing the brake supplies the energy; the wonder is that, even when he does so randomly, the car still tends to move upward over time. So life, in working such mechanisms on the nano-scale, still needs free-energy gradients, as previously supposed. The mechanisms would not work in the equilibrium state, but only at states far from equilibrium.

Cellular structures that work in this way include ion pumps in cell membranes, transport of proteins in the cell along the microtubule tracts, and muscle contraction (an alternative theory to the usual one). An extension of this mechanism to an even smaller quantum level may have further applications.

Biological system ideas are now inspiring research into artificial nano structures. The chemistry of molecules can be exploited to manufacture artificial nano-motors. Are we heading for artificial life? And then what?

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## FROM ERRORS TO STABILITY: IS THAT PROGRESS?

In the RNA world of early life, or even in the preceding protein-only world, reproduction was not accurate, but only approximate. It had a relatively large error rate in copying sequences of nucleotides or amino acids (a few percent), and so was prone to “error catastrophe”, an accumulation of errors such that viability was destroyed: meaning decayed to nonsense. However, the virtue of this system was that it could easily explore the vast space of sequence possibilities, which are super-astronomical in number, and thus have great flexibility, but minimum stability.

This rapid mutation rate was somewhat moderated by the formation of hypercycles, in which already mutually catalytic cycles became tied together into larger cycles of cycles (called hypercycles). These are like the “attractor valleys” of Stuart Kauffman, which can correct errors in copying occurring in some constituent cycles, unless they are overwhelming (catastrophic).

For RNA (retro-) viruses, a large rate of mutation is still favourable, because it facilitates their evasion of the host’s immune system. If, like HIV, they then attack the host’s immune system directly, they are rapidly fatal to the host. This, however, ceases to be favourable to the virus, unless it achieved transmission to another host (by infection) before the death of the first host.

In any case, the change of the genetic template from RNA to the more stable DNA (error rate 1 in 100 million) decreased the error rate and increased stability. While in the RNA world we could hardly speak of a stable species (HIV has innumerable varieties), in the DNA world we are closer to being able to do so. However, even bacteria, who are DNA-operated prokaryotes, gene swapping between species often occurs, making the dividing lines between species fuzzy. We have genetic networks, rather than family trees.

Eukaryotes have a still greater degree of stability, especially with the invention of sexual reproduction, which even the lowly yeast cell achieved, among others. This was further specialized in multicellular organisms — the transition to this state passing through intermediates like slime molds and sponges. In plants there is also the transition in the adult stage from the 1N to the 2N (haploid to diploid) condition, from fungi to mosses to ferns to seed plants.

All these are steps from variability to stability. Species became stable and persistent. However, along with flexibility which variation facilitates, other properties were lost; rapid adaptability to a changing environment, rapid evolutionary change in general, and, in particular, the ability to regenerate a lost limb, or even a head (in worms). A sponge can reassemble itself even when passed through a sieve. So which way lies progress? It depends on how quickly the environment is changing, or apt to change in the future.

It is the old question also relevant to human society: is it better to be conservative, i.e. conserving previously attained values which had proved themselves to be useful in the past, or to be radical, rapidly seeking new alternatives to established ossified structures, i.e. exploring new option space? It depends on how fast society and technology is changing, and apt to change — which, however, in turn depends on the mix of conservative/radical attitudes in the society. A hypercycle?

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## GENE SWAPPING AND KINSHIP STRUCTURES

Gene swapping in early life forms (bacteria) created networks rather than genetic trees. The “tree of life” pattern was created only later, when Eukaryotes established the pattern of sexual reproduction. Then the concept of a species became meaningful, as groups became genetically isolated.

The Amerindian social system of overlapping tribe and clan structures is also a network, though of a different kind. Clans are internally linear by matrilinear descent, but extra-clan marriages crosslink clans among residence-based tribes. Thus every tribe contains people from all clans, but clans maintain cooperative relationships across tribes.

A person's identity is double: it consists of blood links in clans (actually through mitochondrial DNA, though this was not known) and mate-links (or what I like to call “love-links”) in tribes. This dilutes the concept of a “nation”, just as bacterial genetic networks dilute the concept of a “species”. I would argue that this is beneficial, as cross-linking always is, in breaking up strict “we versus they” conflict boundaries.

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# THE STORY OF THE GENES.

In his book entitled “Genome”, Matt Ridley takes us on a ride through the human genome, recently sequenced, one chromosome after another from the largest to the smallest, from 1 to 23, including the X or Y that distinguishes men and women. For each chromosome, he picks a different gene or feature and tells a story about it. Some of the stories are outlined below.

The chapter called “Life” describes the probable origin of life, from the “RNA world” on. No particular human gene is evoked here. The next chapter entitled “Species” compares chimps and humans, so close and yet so different. The third chapter-called “History” describes the discovery of DNA structure by Watson and Crick, a feat that happened not so long ago; yet since then, we have cracked the genetic code and mastered ways of bio-engineering genes.

Chapter 4, “Fate”, is the first to pick out a gene for comment. It is the gene for Huntington’s disease. (That is the wrong phrase: the normal gene causes no disease, only the mutated gene does. But the short-hand phrase is so often used in describing genetic diseases.) The ethical question is: since it is now possible to predict if you will have the disease later in life, do you want to know? About half the people at risk take the test, in order to know whether to avoid having children; the other half choose not to be tested; they want to stay happy themselves without that precaution.

Chapter 5 (and gene 5) refers to asthma, a disease partly genetic and partly environmental — so which gets the blame? In any case, its frequency is increasing, so maybe we should decrease pollution.

Chapter 6 (“Intelligence”) discusses the vexing question of IQ testing, and what it really measures. IQ measures are about 70% genetic, but no single “IQ gene” has been isolated.

Chapter 7 (“Instinct”) concentrates on human language, which, according to Noam Chomsky, is hardwired in the human brain (animals lack language), but not controlled by a single gene.

Chapter 8 (“Conflict”) discusses the antagonism between imprinted (maternal or paternal) genes (a new discovery) and the interplay between X and Y chromosomes. Battle of the sexes on the nano scale.

Chapter 9 is largely about human blood groups and the intricate relationships between them. The various blood proteins involved are strictly under genetic control.

Chapter 10 (“stress”) is about cortisol and other hormones, and the difference between sudden fear (which is useful) and prolonged anxiety (which is harmful).

Chapter 11 (“Personality”) discusses different psycho logical types and the neurotransmitters that mediate them.

Chapter 12 (“Self-assembly”) tells about fetal development, and how genes are turned on and off in a sequence strictly regulated by homeo-box genes.

Chapter 13 (“Pre-history”) deals with correlations between language families, racial groups, and the history of the geographic spread of human groups from Africa to all regions of the world.

Chapter 14 (“Immortality”) is about aging and cancer, and the influence of telomerase and oxygen free radicals.

Chapter 15 (“Sex”) deals with sexual abnormalities at birth, due sometimes to the failure of the testosterone signal in early fetal development, and with trans-sexual transformation.

Chapter 16 (“Memory”) tells about the Baldwin effect, which causes the transfer of parental experience to the child in a quasi-Lamarckian way — but really strictly genetic and Darwinian.

Chapter 17 (“Death”) discusses the role of cell apoptosis in cancer cells and in some normal development proesses, such as early embryonic neuron connections and immune cell “education” not to “recognize” self.

Chapter 18 (“Cures”) is about future possibilities of genetic medicine, particularly in the case of SCrD (an inherited immune deficit.)

Chapter 19 (“Prevention”) talks about possibilities of preventing Alzheimer’s disease, which is partly genetic, especially in the early-onset variety.

Chapter 20 is “about Mad Cow Disease and its human version, Creutz-Jacob disease. Surprisingly, it is caused by a mutation in prions, purely protein particles without any DNA or RNA, smaller than a virus. prions act by changing their configuration and cause other normal prions changing configuration too. Who says that proteins cannot act as reproduction templates?

That is the end of chromosome-inspired chapters; but two more chapters follow: Chapter 21 (“Politics”) discusses eugenics, pro and con. Chapter 22 attacks the problems of free will versus determinism.

On the whole, Ridley leans toward “Nature” rather than “Nurture”, while stressing interactions, and even finding a niche for free will.

Later addition: The place of some genes on chromosomes. This is only a very small sampling, since there are some 100,000 genes, or at least 38,000 according to a later estimate.

#### Chromosome

1

2 — HOX // \_\_\_\_CREB (memory)

3

4 — Huntington’s disease // \_\_\_\_alcohol tolerance

5 — Asthma

6 — Dyslexia // \_\_\_\_IQ

7 — Cystic fibrosis // \_\_\_\_HOX // \_\_\_\_language

8 — Maternalpaternal imprinting

9 — Blood groups // \_\_\_\_HOX

10 — stress (anxiety), cortisol

11 — Risk-taking // \_\_\_\_personality types // \_\_\_\_sicklecell anemia

12 — HOX // \_\_\_\_fetal development

13 — Breast cancer

14 — Aging // \_\_\_\_cancer

15 — Eye colour // \_\_\_\_hair colour // \_\_\_\_Tay-Sachs disease // sex abnormality at birth

16 — Thalassemia // \_\_\_\_CREB (memory)

17 — Breast cancer // \_\_\_\_apoptosis // \_\_\_\_athletic talent// HOX

18 — SCID

19 — Alzheimer’s disease

20 — Creutzfeldt-Jakob disease

21

22

XY — Homosexuality, colour blindness

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## IS LIFE IMMORTAL?

Is life immortal? Far from it (far from equilibrium to be sure). Multicellular individuals (plants and animals) die. (Bacteria not necessarily, barring accidents.) Whole species become extinct (99% of them have done so.)

Life on Earth has made it through 6 great extinctions already. But the death of the Sun and its expansion into a Red Giant will kill it, if not some earlier accident like an asteroid collision. ‘

Life is vulnerable, though quite robust and tough. In any case, in the eternal order, there is always a “life line” for Life.

## “UP-ROOTING THE TREE OF LIFE.”:

Why did we ever think that there was a common ancestor of all living things on Earth? Why did we entertain even such exaggerated myths that there was a single original cell? We told stories such as the following: we shed millions of dead skin cells every day, each of which is a straight-line descendant of the first cell that ever lived. This claim has been proved to be absurd by a recent article by W. Ford Doolittle in *Scientific American*, February 2000, pp. 90-95.

We knew that bacteria freely swap genes, rather than following the strictly vertical-descent lines of sexual reproduction. But it took detailed DNA-comparison studies to show definitely that in the bacterial superkingdom there are complex genetic networks, not vertical trees of genetic descent. Species are ill-defined in this realm. The interacting units form a community rather than a species. Kinship links are horizontal as well as vertical, with diagonal crosslinks as well. -That is the substructure, the bottom “mush”, under the proper Eukaryotic “trees of life”. Sex was a belated invention of the Protists and Fungi, carrying on then to Plants and Animals. The tree is supported by a crosslinked net of roots.

Lateral gene transfer is like lateral thinking. Why did living forms give it up for mere sex? It could have been even more productive of novelty.

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## UPROOTING THE TREE OF LIFE.

Why did we ever think that there was a common ancestor of all living things on Earth? Why did we entertain even such exaggerated myths that there was a single original cell? We told stories such as the following: we shed millions of dead skin cells every day, each of which is a straight-line descendant of the first cell that ever lived. This claim has been proved to be absurd by a recent article by W. Ford Doolittle in *Scientific American*, February 2000, pp. 90-95.

We knew that bacteria freely swap genes, rather than following the strictly vertical-descent lines of sexual reproduction. But it took detailed DNA-comparison studies to show definitely that in the bacterial superkingdom there are complex genetic networks, not vertical trees of genetic descent. Species are ill-defined in this realm; kinship links are horizontal as well as vertical, with diagonal crosslinks as well. That is the substructure, the bottom "mush", under the proper Eukaryotic "trees of life". Sex was a belated invention of the Protists and Fungi, carrying on then to Plants and Animals. The tree is supported by a crosslinked net of roots.

Lateral gene transfer is like lateral thinking. Why did living forms give it up for mere sex? It could have been even more productive of novelty.

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## ARE WE ALONE?

Are we humans alone in the universe? Opinion seems to be changing right now from “no” to “yes”. Of course, it is still a “maybe”.

Maybe life can self-organize under many environmental conditions that we would consider adverse. Recall the thermophilic anoxic Archeobacteria that probably started life on Earth, and still persist in the deep ocean and in hotspots. There are others able to survive extreme cold in the Polar regions. They could well be (or were in the past) on Mars or Jupiter’s moon Europa or Saturn’s moon Titan.

Here on Earth, the real breakthrough was the invention of photosynthesis, which covered the Earth with mats of blue-green bacteria. And then the symbiosis of several primitive cells to give us Eukaryotes, soon able to use the newly created oxygen for much more efficient energy production (respiration as the reverse of photosynthesis), and the rise of multicellular plants and animals. Could this have happened on Mars, Europa, or Titan? Quite unlikely.

On Earth, higher energy production made possible warmblooded birds and mammals, probably necessary for brain development. Eventually in humans, biological evolution led to cultural evolution, which is a million times faster. Only then could a technological civilization arise. Is this possible on Mars, Europa, or Titan? Extremely improbable, as it also depends on the previous step, also improbable.

So we need to add several steps to the Drake equation, and try to evaluate each. We may well be alone. Especially, in addition, because if any technological civilization really managed to arise, it would have quickly self-destructed, as we are about to do. It is like trying to build the Tower of Babel. God will not allow it, or we might destroy the whole universe.

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## CONTRASTS.

Life is bitter-sweet like dark chocolate.  
Sometimes I feel the nausea of addiction,  
sometimes I soar in sublime ecstasy.  
I get dizzy looking at the heights,  
I cannot fathom the deep canyons.

But spring is all around me  
singing with birds, defending  
their territories in grim struggles,  
yet — oh! — singing so sweetly to my ears.

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## **GAIJA'S RITE OF EXTINCTION.**

You were strictly tested — Mene Tekel Ufarsan —  
as you long contested in your assigned span.

You've freely partaken in the game of life,  
tasted joys and sorrows, peacefulness and strife.

Now at last, I'm finding you have failed the test,  
Mene Tekel Ufarsan, no more are you blest.

Your million years are ended, the future is foregone,  
you won't be defended, Mene Tekel Ufarsan.

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## ETHNOS TO ETHOS.

The first step from pure egoism to an enlarged identity is concern for family (both blood ties and love ties), then to clan (the extended family), to tribe, and to nation. This last step gives us ethnic identity. Two of the Ten Commandments tell us not to kill or steal from fellow citizens of our nation. That is the law, both in the Old Testament and in modern society. But it does not prohibit killing or looting in wars with other tribes or nations. The Old Testament God often urges genocides during the wars of conquest of Canaan (Palestine).

An obvious next step would be to identify with humanity as a whole, and finally with life on Earth as a whole. The prohibition of killing and heartless exploiting would then extend to these new realms. These steps have not yet been taken, except by an enlightened few. What would such a transition entail?

It would be a step from Ethnos to Ethos, from a limited community of belonging, to a sense of universal belonging; from conventional morality to principled morality; from Kohlberg's Stage 5 to his Stage 6. It would mean a full recognition of the common human essence (the theory of mind) and thence, beyond that, of full respect for life as a universal value.

In the Ethnos mode, we identify with individuals who share certain characteristics with us; it is a system of extended egoism, of extended or inclusive fitness in terms of sociobiology. That theory claims that we so act as to preserve the survival of our (selfish) genes. In ethnic theory, we assume a common (racial) kinship with our fellow state citizens. But there is a snag: most modern states are multi-ethnic. So do we identify with our fellow citizens regardless of racial kinship (so-called civic nationalism), or with our presumed kinship group (ethnic nationalism)? This has been the basic problem in modern ethnic wars, either for secession or (more modestly) autonomy.

There is another snag in the ethnic kinship assumption: a great deal of genetic mixing has occurred throughout history across previously homogeneous ethnic groups. No one has traced the family trees in detail (that would be a gargantuan task), but there is enough evidence to show that considerable mixing has occurred. Whenever there is intercultural contact, whether friendly through trade or hostile through war, genetic mixing has occurred. (Some wit has quipped "soldiers drop their genes, or jeans", however you spell it.) So the kinship link between ethnic co-members is a very thin link of commonality.

What about other links? Language, territory, cultural customs, common history? Let us examine them one by one.

Everyone of the 200 or more languages across the world has several dialects. These vary continuously from each region to adjacent ones. Initially the variations are slight, but when one considers the extremes of the spread, speakers of the dialects may have trouble understanding each other; then we are tempted to say that these extremes speak different languages. For example, among Slavic languages, there is a continuous variation from Czech to Slovak to Polish to Ukrainian to Russian. As a Czech by birth, I can sometimes understand Polish, but have great trouble with Russian, even apart from the different alphabet. So again, we have mixing and variation in language, as in kinship. (An example of mixing is French words in English introduced since the Norman conquest, and now English words in French, both in Quebec and in France.)

Territory? Political (state) borders have changed through history by wars and conquests, secessions and state mergers. Alsace-Lorraine has gone from being part of France to being part of Germany and back again. Poland was divided into three parts between Prussia, Austria, and Russia in the 19th century, reunited in 1918, then moved Westward like a "nation on wheels" in 1945, when the USSR annexed the Eastern part and gave Poland part of East Germany instead. And the U.S. bought Alaska from Russia and a large territory from Mexico. Again, we detect no stability here, only constant change.

Cultural customs, like language, seem to change in continuous manner from one locality to another, regardless of borders. E.g. Vietnamese and Thai music and musical instruments have great resemblance to each other, while Russian and Ukrainian customs (e.g. holiday feasts) have both similarities and differences. And for claims of common history, examine our section on territorial changes (shifting borders) in a previous paragraph.

If we want to go from Ethnos (of dubious definition) to Ethos (human commonality), what similarities can we quote? Obviously we are all members of the same biological species, *Homo sapiens*. According to almost all religious traditions, we are all children of the same God, and therefore brothers and sisters. We share 99.99% of our genes. Someone has figured out that each one of us is at least the 50th cousin of every other human individual. We all speak a language with a similar grammar and syntax, only the vocabulary is different. We can all do basic arithmetic unless mentally impaired.

As far as we know, we all have similar mental content, feelings, reasoning and will. As Shakespeare has Shylock say in "Merchant of Venice", "When we are cut, to we not bleed?"

Homo sapiens and several other early-enlightened religious and secular advanced thinkers. It is our only hope for any future at all. This is my version of the theory of His Second coming. It will mean, not the End of Time, but the Beginning of Time.

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## **CRITERIA FOR HUMANITARIAN INTERVENTION.**

These can be summed up under the headings of the French Revolution slogans.

- Liberty. Protect the human rights of victims against gross violations.
- Equality. Treat all states equally, from small to large, from weak to strong, from friends to foes.
- Solidarity. (Less sexist term than fraternity). Loss of life should be considered both for the intervenors and the targets.

These were all violated in the Kosovo case. Victims suffered more after the NATO bombing started. There was no intervention, e.g., in Chechnya. NATO suffered no losses, Serbians and Kosovars many.

It could be argued that "equality" is impossible, because nuclear states like Russia cannot be targetted for fear of triggering nuclear war. Perhaps this problem can be solved in the future.

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# EVOLUTION OF THE WAR SYSTEM

According to data in the book by Francis Beer, "Peace Against War", the following trends can be observed over historical time: wars have been getting

- more severe (i.e. more battle deaths)
- shorter in duration
- more extensive (more countries involved)
- about equally frequent in war starts.

The greater severity and shorter duration can be explained by the invention of more deadly weapons. The greater extension is probably due to the existence of more countries that are in contact. The unchanged frequency of war starts says something about the human propensity to escalate conflicts into wars.

We can diagram the changes as indicated below. In the past, wars were longer but milder, as shown by the humps, and peace periods between wars were shorter. The tendency now is toward sharper but narrower peaks of war, with longer periods of peace in between. (This is a rather idealized picture, since the real occurrences of war are much less regular.)

What of the future? The trends bifurcate: either the peaks become so high in severity that wars will annihilate civilization or even humanity altogether, or they become so narrow that wars will disappear and there will be perpetual peace. (The alternative between nuclear annihilation and perpetual peace is often put that way qualitatively, but the numerical trends tend to confirm it.)

Which will happen sooner: the heightening or the narrowing of the peaks? One could attempt a quantitative assessment, but the data are probably not good enough to be able to predict. And perhaps human decisions will intervene, one way or the other.

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## BIOTECHNOLOGY: PROS AND CONS.

In a way, human-created biotechnology (transplanting genes across species) is a return to gene swapping among bacteria. However, in Eukaryotes, which are much more complex than bacteria, it may not be appropriate. David Suzuki in his recent radio lectures "From Naked Ape to Superspecies" compared it to putting Elvis Presley into a Beethoven sYmphony, or "improving" a poem by inserting new words at random. This is because genes operate in a context, like words in poems, or musical styles in symphonies.

Suzuki (who is a geneticist and an ecological advocate) also cited other arguments against biotechnology:

1. In transplants of animal organs into humans, the animal cells do not remain confined to the transplanted organs, but spread throughout the body, creating a mosaic of cells from different species. This may be acceptable if the human patient is in desperate straits, but it is not "natural" .
2. Viruses may jump across species along with the genes possibly creating epidemics of new diseases.
3. New human-created species may escape to the environment, and may replace local natural species, as has happened with "exotic" flora and fauna in many places, like Hawaii and Australia. But the new ones may be more destructive.
4. Mad cow disease was a surprise: it was thought that feeding sheep brains to cows would be all right, since proteins are broken down by the cow's digestive system all the way down to amino-acids, which are re-constituted into cow proteins. But apparently prion proteins behave differently. The disease spread from sheep to cows across a species barrier. It can also cross to humans (C.J.disease) if humans eat contaminated beef.
5. A nasty surprise was averted when a new substance beneficial to plant growth was found, by a graduate student who deserves a supreme kind of medal, tested it in living soil rather than sterile soil. The new substance kills the mycorrhizal fungi essential to plant growth in nature. All the plants died in the experiment, as they would have if the substance had been approved for use in the field. It could have spread from field to field, thus depriving animals and humans of food. This graduate student saved the world. How many other nasty surprises are lurking in "unnatural" experiments? Don't we know the difference between "in vitro" and "in vivo"?

scientists working in the food industry argue that biotechnology is no different than the ancient process of improving species by selective breeding. Suzuki argues that it is in fact very different. Industrial scientists also see it as the only way that we will be able to feed a burgeoning human population. But, says Suzuki, not if an escaped new life form invades the environment. Surprise!

We should follow the precautionary principle: nothing new should be introduced until it has been conclusively proved to be safe. This is the opposite of the legal principle of presuming a person to be innocent until proved guilty "beyond reasonable doubt". New creations of science should be presumed to be guilty until proved to be innocent.

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## **GENOCIDES.**

In Africa, the AIDS epidemic will wipe out almost a whole generation. One thinks of the original inhabitants of the Americas being almost wiped out by measles and syphilis. Are these events accidental? Or is it biological warfare against peoples considered "undesirable" by whites?

Did H. sapiens eradicate Neanderthals by similar means? Or just why did they disappear?

It is a conspiracy theory, but somehow feasible. It would not be reported by historians, because it is so horrendous, and historians are mainly white people. But that it might be occurring in our day and age is certainly well hidden. Yet one report long ago speculated that the AIDS virus was artificially produced in a U.S. biological warfare lab. Africans are probably a nuisance to Americans, since we can't use them as slaves anymore. Is this why we did not help in Rwanda?

I hope this is just one of my nightmares.

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## DEFINITIONS OF PEACE.

This is a listing of various typologies of peace, some of them derived from the book "Stable Peace Among Nations", edited by Arie M. Kacowicz et al, mainly from the preface by Alexander L. George.

- Johan Galtung: Negative and positive peace.
- Kenneth Boulding: Unstable and stable peace.
- Alexander George: Precarious, conditional, and stable peace.
- Shimon Shamir: Adversarial, restricted, rapprochement, and cooperative peace.
- Common International Relations: detente and entente.
- Karl Deutsch: Defence alliance, security community.
- Hanna Newcombe: Pax, Eirene, Shalom, Shanti.
- Linda Groff and Paul Smoker: Negative, positive, integrative, environmental, feminist, holistic peace. Explanation: absence of war, also presence of justice and harmony, within as well as between nations, also peace with nature, also peace within family, inner as well as outer peace. (There are 7 not 6, but I can't find the paper.)

Some terms or stages in the various typologies overlap, as follows:

- (1) Negative, unstable, precarious, adversarial, Pax.
- (2) Conditional, restricted, rapprochement, detente.
- (3) Stable, cooperative, entente, security community, Eirene.
- (4) Positive, Shalom, integrative.
- (5) Shanti, holistic.

These could be characterized in terms of a temperature scale, with a strange inversion from hot to cold.

- (1) Hot, in terms of dangerous.
- (2) Cold, as in Cold war (but thawing) .
- (3) Lukewarm or tepid.
- (4) and (5) Warm, as in friendship.

The strange inversion is based on our psychological aversion to both extremely hot and extremely cold conditions. We prefer, as always, Goldilock's middle way of "just right" for our survival.

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## **MILITARY SPENDING AND POVERTY.**

This is the summary of an article by Errol A. Henderson in the Journal of Politics, 60(2), May 1998, pp. 503-520. It uses the data for the u.S. from 1959 to 1992.

The main conclusions are as follows:

1. Increased peacetime military spending is positively correlated with poverty.
2. Increased wartime military spending is negatively correlated with poverty (i.e. we get richer when MS is up).

The explanation is the increase in military personnel in wartime, which absorbs labour, and the decrease in social programs if military spending goes up in peacetime.

The following are the alternatives for anti-poverty policy:

- A. Increase social welfare spending. (Henderson finds this unacceptable in the present conservative political climate.)
- B. Mobilize for war. (This is untenable as a social policy — I would hope.)
- C. Convert defence industries to peacetime production in a way that is sensitive to poverty (i.e. maintains employment).

Apparently we should opt for C. according to Henderson, but I find A. acceptable as well.

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## REVIEW OF "THE NEXT STEP" BY PROF. JAMES A. YUNKER.

The proposed book, of which I have read the prospectus, is a valuable addition to the voluminous literature on world government of which I am aware. It tries to separate itself as a new and distinct proposal that would have a wider range of acceptance, and this may be true to some extent.

However, Yunker underestimates the flexibility of other World Federalists. I have been a member in Canada since 1948, and I am still active. In my experience, most World Federalists have been, and are, minimalists, not maximalists, and certainly not overly dogmatic. In fact, the main core now are working mainly on U.N. reform and functional proposals of immediate significance, for which they are sometimes criticized by the dogmatic maximalist minority.

It is also not true that World Federalists of the minimalist type have been unsuccessful since the boom of the early 1950s. As a small example, one of the six proposals of the Campaign for U.N. Reform, the creation of an International Criminal Court, is gradually reaching completion. The World Federalist Movement's New York office is highly respected by U.N. agencies and NGOs in New York. For example, William Pace has helped Cora Weiss organize the highly successful Hague Appeal for Peace in May 1999, which some

10,000 people attended, and which was addressed by 5 Nobel Peace Prize winners and a few heads of state. Unfortunately media coverage was poor for such a large event, and so academics who read only mainstream publications and academic books may be unaware of it.

Coming now to the core proposals in Yunker's book. I would think that the idea of each nation retaining the right to secede would be acceptable to most World Federalists certainly to me. I am a Canadian born in Czechoslovakia, and my land of birth has experienced "a velvet divorce" between Slovakia and the Czech Republic, and Canada would negotiate a separation of Quebec if a referendum showed a reasonably large "yes" vote (more than 50% + 1) as an answer to a clear question. In my mind, a state is not a holy thing or a living organism, but only an administrative facility, and so secession would not be a big deal. This is contrary to the historical U.S. experience in last century's civil War. In fact, economist and peace researcher Kenneth Boulding said that North and South should have separated, and the U.S. would then not be such an overwhelming superpower.

However, I have to register a strong opposition to the second core proposal in Yunker's book, namely that nations belonging to the world government should retain their armaments, even nuclear weapons. I belong to several disarmament movements, including the international one for the abolition of nuclear weapons. I also believe that even small arms and light weapons are causing an immense amount of damage, mostly to civilians, in the 35 wars raging around the world. I have an alternative proposal: let not only the nations, but also the world government, be totally disarmed (retaining only police-type weapons). Then the danger of global dictatorship, which Yunker so fears, would also become less likely, by another route. Instead of all being armed to the teeth, all levels would be deprived of "the last resort" and be forced to negotiate velvet divorces and other issues.

I was at first worried about the name "Federal Union of Democratic Nations"; it seemed to imply that only democratic nations would be admitted, which would greatly limit the very desirable universality of the world government. Such proposals, of course, do exist, and I have always resisted them. However, I was reassured as I read on, that non-democracies would in fact be admitted, in the hope that they would become democratic more quickly through the association. Of course, the world government itself has to be democratic (which the present U.N. is not), and perhaps the word "democratic" in the name refers to this requirement. I do think that the author should make this clear much earlier in the book, in order to clarify this point from the start.

About the fears of a massive redistribution of wealth by a strong world government in which poor nations have a majority: It reminds me of the fears of the aristocracy in England that if the poor were allowed to vote in an expanded democracy, their wealth would be confiscated. We should note that this did not happen, perhaps because the poor were not aware of their power to do so, or perhaps propaganda from the top persuaded them that they too could become rich individually. In any case, I am glad that the WEEP program is part of Yunker's proposal, and the redistribution would eventually take place, though more slowly and gradually.

I have always been in favour of what I call "planned gradualism", i.e. instituting reforms in such a way that they would, gradually but eventually, automatically without further reform being required, lead to the desired result. Many years ago I have made calculations for a gradual redistribution between rich and poor nations, which I called "the GAIN Plan" (Guaranteed Annual Income Plan for Nations). Planned gradualism, is also used in weighted voting plans which start by

assigning voting weights both on the basis of population and wealth, but which automatically come to be based on population alone when wealth has been equalized. Yunker's plan has this feature, as mine has as well.

With regard to the rich (nations or individuals) opposing redistribution, it would be good to point out to them (as Yunker does without explaining it) that an amount of money transferred would be a small percentage of the larger, wealth of the rich, but a large percentage of benefit to the poor. A numerical example would help. It is almost a win-win game. It should also be made clear that economic growth cannot continue forever, since resources would run out. And poor countries can never be brought to the level of the rich. Exponential growth (so many % per year) is impossible for anything in the universe, including the world economy.

Speaking of attitude change, we might also explain to the rich that happiness does not depend on wealth only, but it comes mainly from a productive life, close family relationships, friendships, enjoyment of the arts and music, and a meaningful spiritual and mental life. Most of this can be had in a life of voluntary simplicity. Gandhi said that happiness depends on the fraction of wants satisfied over wants perceived, and that this can be attained not only by increasing the numerator of that fraction, but also by decreasing the denominator.

Turning now to the voting proposals. Yunker's scheme of counting votes both on a population basis and on the basis of contributions to the world government is good. It is similar to the "Binding Triad" proposal of Richard Hudson for the U.N. General Assembly (his third way of counting is by flags, i.e. one nation one vote). It also resembles my proposal for weighted voting, where each nation's vote would depend on two factors, population and GNP (or U.N. contributions). This would achieve the same end as Yunker's scheme, i.e. a GRADUAL transfer of power from the rich to everybody, in conformance with democratic principles. But I agree that the transfer should be gradual to prevent sudden jolts, as well as acceptability, and both Yunker's and my scheme achieves this.

One additional thought about levels in a federation:

Most World Federalists at this time think in terms of "subsidiarity", which is like about 6 levels of federal structures: neighbourhood, town or city, province or canton, nation, continent, world. The principle is that problems should be solved at a level at which there are no significant external effects beyond that level. (Of course, there would be arguments about details of the division of responsibility, but only peaceful and solvable arguments.) This is quite a decentralized structure, and yet it gives appropriate powers, now, missing, to the world level. It is important (I agree with Yunker) that individuals should vote directly for each level. I picture this as a "wedding cake model".

One minor point: Yunker's proposed structures are modelled too much on the American model. The three divisions of power (legislative, executive, judicial) and a direct popular vote for the president are not features of the British or European continental systems. I am especially uncomfortable about electing judges; this would impair their impartiality, distancing from politics, which is desirable. An alternative for electing the head of state, of course, is that he or she should be the head of the winning party or coalition in the legislature. To have a President and Congress from different parties is an undesirable feature of the u.s. system.

I agree entirely with Yunker that any social experiment should be reversible, to be changed or abandoned if we don't like the results. I would like to add that, no matter how much we like our own proposals, we should always keep in mind that we might be wrong. This is a useful antidote to dogmatism. I used to be a chemist, and I know that if we try to speed up a reaction by raising the temperature too much, we might end up with a charred mess, or even a disastrous fire.

And a minor criticism: Yunker uses the concept of "homogenization" of cultures, languages, and religions as ultimately desirable. I would want to preserve diversity, which is ecologically sound not only in nature but in society as well. When a language or a culture dies, as is now occurring with native peoples, it is a tragedy. Extinction is forever. Surely we can have multiple loyalties, in the subsidiarity scheme, without impairing our overall loyalty to humanity as a whole. "Ex pluribus unum."

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## NONVIOLENT REVOLUTION.

For successful nonviolent revolution (deposing a tyrant, as in the Philippines, Poland, India, South Africa, East Germany, Hungary, Czechoslovakia, Iran, Serbia, (we really have many examples now), the following are needed:

- Large numbers of demonstrators.
  - Trust that colleagues will not betray you.
  - Communications (the cartoon "What can one man/woman do.")
  - Imaginative planning (cf. Gandhi's Salt Satyagraha, Prague 1968).
  - Persuading bystanders (general population).
  - Persuading police and army.
  - Capturing media, or using moving/hidden radios.
  - Acting "as if" change has already been achieved.
  - Refraining from violence, of course.
  - Guarding against interlopers, spoilers, looters.
  - Persisting for a long time, i.e. patience.
  - Maintaining contact with opponents.
  - Transparency — no secrets.
-

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An obvious next step would be to identify with humanity as a whole, and finally with life on Earth as a whole. The prohibition of killing and heartless exploiting would then extend to these new realms. These steps have not yet been taken, except by an enlightened few. What would such a transition entail?

It would be a step from Ethnos to Ethos, from a limited community of belonging, to a sense of universal belonging; from conventional morality to principled morality; from Kohlberg's Stage 5 to his Stage 6. It would mean a full recognition of the common human essence (the theory of mind) and thence, beyond that, of full respect for life as a universal value.

In practical application, it would mean tempering our sense of justice by the practice of mercy and reconciliation, advancing from rectitude to forgiveness. That is, adding the Mother principle of Hesed to the Father principle of Gevurah in the perceived nature of God. In political practice, it would mean using Truth and Reconciliation procedures (cf. South Africa) instead of international criminal courts (Yugoslavia) in the aftermath of violent conflicts. (See speech of Archbishop Desmond Tutu at the University of Toronto early in 2000 when receiving an honorary degree.)

Ivan Illich (interview on CBC radio program "Ideas") maintains that this is the transition in values that Jesus preached. All that followed in the history of the Christian churches has been a betrayal of that message, according to Illich. Thus Jesus brought not only nonviolence, but also the recognition of human unity, the overcoming of narrow nationalism, as exemplified in the parable of the Good Samaritan. (Read "Good Palestinian", says Illich.)

Now Norman Alcock predicts a mass conversion of at least the critical mass of humanity (maybe 30%, not 100%) to the stage of Ethos, advancing from Ethnos. At the critical mass (a concept already used by Alcock in his early booklet "The Bridge of Reason") we get what I call "the mayonnaise conversion", from an emulsion of a few dispersed advanced thinkers immersed in a sea of ethnic believers, to the opposite of an emulsion of old thinking in a sea of new thinking, like from oil droplets in water to water droplets in oil. This is predicted to happen in the new century, the new millennium, averting the catastrophes predicted by the hidden and now uncovered Bible Code.

Jesus came too soon. Humanity was not ready 2000 years ago. Much blood has been shed, much suffering inflicted. Perhaps we will now finally catch up to Jesus, who was Son of Man (the successor species, in cultural evolution, to Homo sapiens) and several other early-enlightened religious and secular advanced thinkers. It is our only hope for any future at all. This is my version of the theory of His Second Coming. It will mean, not the End of Time, but the Beginning of Time.

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# COSMIC EVOLUTION.

(Based on book of that name by Eric J. Chaisson.)

The basic claim of the book is that evolution is the main feature of everything in the Universe, from galaxies to genes, and the free energy (negentropy) gradients needed for this are derived ultimately from the expansion of the Universe. Although the author does not accept accelerated expansion, as recently discussed, he claims that steady or decelerated expansion would be sufficient to supply these gradients. New ones are opened up by the expansion as old ones are closed by the drift to entropy. So the arrow of time is ultimately due to the expansion of the Universe, essentially a continuation of the Big Bang in slow motion.

Only steady-state structures far from thermodynamic equilibrium (prigoginian dissipative structures) can make use of free energy gradients, by being open to a through flow of matter and energy. However, not only living cells and organisms are such open steady-state (homeostatic) structures, but galaxies, stars, and planets are as well.

He classifies the temporal steps in cosmic evolution in diagrams with extensive discussion. Roughly, these time sequences in the evolution of the Universe are outlined below. The first division is the Radiation Era, up to about 300,000 years after the Big Bang, when radiation predominated over matter, and the two were closely entangled; only at the end, the transition to the Matter Era, did they separate and the Universe suddenly became transparent. From then on, in the Matter Era, matter came to predominate over energy (fermions over bosons?). This was the time when first galaxies, then stars, and finally planets formed. This was then followed by the Life Era on some planets, e.g. on Earth, when cells and multicellular organisms flourished. Of course, we are still in that era.

Further divisions in the three eras are indicated. The Radiation Era (the earliest) is shown below, along with the corresponding times and temperatures.

	chaos	< 10 <sup>-24</sup> sec	> 10 <sup>20</sup> °K
Radiation Era	hadron	< 10 <sup>-3</sup> sec	10 <sup>15</sup> °K
	lepton	< 10 <sup>2</sup> sec	10 <sup>10</sup> °K
	nucleus	< 10 <sup>4</sup> yrs	10 <sup>7</sup> °K

The Matter Era can be similarly divided.

	atom	< 10 <sup>6</sup> yrs	10 <sup>4</sup> °K
Matter Era	galaxy	< 10 <sup>9</sup> yrs	10 <sup>2</sup> °K
	stellar	< 10 <sup>10</sup> yrs	3 °K

He does not indicate such a division in the Life Era.

For stars in the Matter Era, he gives the following scale, with the numbers being the free energy density flow in ergs per second per gram:

Red dwarf (10<sup>3</sup>), protostar, Sun (10<sup>4</sup>), red giant (10<sup>5</sup>), presupernova (10<sup>6</sup>).

Similarly for satellites and planets, we have

Moon (0.5), Mercury/Mars (?), Earth/Venus (10), Jupiter (30), hydrothermal vent on Earth (a possible source of life) (?), climasphere on Earth (less than the previous).

For the Life Era, we have the following epochs:

Chemical	(prebiotic) when macromolecules form.
Biological	plants (grass 10 <sup>4</sup> , pine 10 <sup>6</sup> , sugarcane 10 <sup>7</sup> ; animals (reptiles 10 <sup>8</sup> , mammals 10 <sup>10</sup> , birds 10 <sup>11</sup> ).
Cultural	hunt/gather 10 <sup>6</sup> , agriculture 10 <sup>8</sup> , industry 10 <sup>9</sup> .

Technology examples in aircraft engines.

Note the step-up in animals' free energy flows from the cold-blooded to the warm-blooded; also a step-up from plants to animals.

This illustrates a very impressive story. What will happen to the Universe in the far-distant future, especially if it is expanding at an ever-accelerated rate? Will further eras open up, beyond Life? This is a very different picture from the heat death of the Universe predicted in the 19th century when entropy was first defined.

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## UNIFICATIONS AND GENERALIZATIONS.

John C. Taylor's book "Hidden unity in Nature's Laws" (Cambridge University Press, 2001, 490 pp.) follows the history of scientific discovery since Galileo's time to the present. We can find at least 15 unifications or generalizations in this history, as outlined below.

1. From the Earth to the Sun and the planets, in Newton's law of gravitation. "As above, so below."
2. From circular to elliptical orbits of the planets. Johannes Kepler.
3. From necessity to probability: Carnot and Kelvin in thermodynamics.
4. Electricity and magnetism unified. Faraday and Maxwell.
5. Electromagnetism and light unified, as well as other types of radiation. Clerk Maxwell.
6. Space and time into spacetime. Einstein's special theory of relativity.
7. Matter and energy. Albert Einstein.
8. Particles and waves. Planck, Bohr, Heisenberg, and Schrodinger.
9. Gravity and geometry (geodesics). Einstein's general relativity.
10. Parity non-conservation in the weak force and chirality in living cells.
11. Particles and anti-particles (opposite charges.)
12. Fermions and bosons (supersymmetry).
13. Electromagnetism and weak force.
14. Grand Unification Theory (GUT). Strong force as well.
15. Theory of Everything (TOE). Gravitation as well. Not yet achieved.

I might add molecules to macromolecules to cells (pre-evolution).

I hesitate to add unity of mind and matter, of which we know very little. Perhaps through information and meaning?

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## FROM OUSIS TO MATTER.

Ousis is the usual name for the Divine Essence, about which we know nothing. In the book about transcendental consciousness and Vedic doctrine, it is assumed that Mind preexisted Matter, and that Mind (the Unified Field or God) originated Matter in the act of creation, which I would call the Alpha Point of the Great Wrap-around.

Let us see how that might play out in terms of modern physics. I picture ousis creating Matter by causing a local thickening of the Higgs field, which thus gives mass to fundamental particles, transforming them from virtual particles into real ones.

Virtual particles are constantly flicking in and out of existence by borrowing energy from the vacuum field; they cannot become real unless they pay back the energy loan to the vacuum field within nano- or femto-seconds. (It's a short-term loan.) The virtual particles in the vacuum field constitute the "quintessence" which, on the cosmic scale, accelerate the expansion of the Universe, as recently discovered. (I think this is because of the fermion pressure; according to the Pauli exclusion principle, fermions cannot occupy the same space at the same time — I assume even if they are only virtual fermions.)

I don't know how the Higgs field relates to quintessence, but God (Ousis) somehow makes them interact, and the real fermions thus created coagulate into matter as we know it, as presumably happened in the very early Universe after the Big Bang. First quarks into protons and neutrons, these then into nuclei, then nuclei and electrons into atoms, atoms into molecules, to macromolecules, to cells — and away we go.

The idea came to me while watching the little lake behind Bannister Park at Sauble Beach. Maybe it was imparted to me by the mosquitoes swarming around me from the swamp. Small creatures may know more than big ones. I paid for the idea by offering blood meals — offering matter for mind.

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## THE BIFURCATION TEST.

There are many examples of both cooperation and competition in living nature: Dicty (slime mould) cells clump together and produce a fruiting body during times of food scarcity, while walrus on the beach compete for the scarce fish. An alga and a fungus cooperate in lichen, as does another alga and a polyp in coral reefs; but predators in the jungle compete for prey. Each mode of behaviour may help survival, depending on the circumstances.

What will humans do when resource scarcity hits us? Our history also shows examples of cooperation (e.g. within nations) and competition (often between nations). Competition would further deplete resources, and even faster. Walrus on the beach can always hope for more fish in a future season, but in our much deeper depletion, such hopes may be vain, unless some unprecedented new technological invention intervenes.

Cooperation may be our better choice. It is as yet uncertain if we can do it on a global scale. We have no innate signal for clumping together, as Dicty has in CAMP (cyclic adenosine monophosphate). We stand again at the fork of two roads. Can we take "the road less travelled by" to make "all the difference"?

All past evolution is built on a series of bifurcations, as Prigogine has shown. They were always choices between breakdown or breakthrough, danger and opportunity, as in every crisis. Can we pass the bifurcation test this time, or fail, thus making room for our successors?

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## **NECESSITY IS THE MOTHER OF INVENTION.**

I would guess that evolution would be helped along if organisms initiated greater variations when conditions became adverse; this would be just a general search for alternatives, not “knowing” or “deliberately aiming” at inventing something helpful or beneficial. No purpose or teleology is implied here.

Many organisms normally use asexual reproduction (fission or budding) when environmental conditions are favourable; yeast is an example. But they switch to sexual reproduction under adverse conditions, since sexual reproduction produces more genetic variety. with greater variety, natural selection has a chance to favour the more successful variations and eliminate the less successful ones. We can observe this directly in real time when bacteria adapt to our use of antibiotics and become resistant to them.

We would then have alternating periods of quiet growth in good times (a plateau) and periods of rapid change (crises) when organisms are challenged by something like climate change or hostile attack. In other words, a run and rise scheme, like a staircase. A punctuated evolution.

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## THE SAME OR IDENTICAL?

Teleporting a person, as in Star Trek (see letter to the editor in Scientific American, August 2000) might produce an identical person, but not the same person. The original would die and a "Doppelganger" would be created. That is the letter writer's argument. "Beam me down, Scottie" would be Captain Kirk's last words, and his double would conduct the action on the exotic planet.

Identical twins are identical genetically, but they are not the same person. Fetal development and later experience make them different. Their neurons and their immune systems evolve (are selected) differently during development. Later, the synaptic patterns in their brains be different, producing differences in their memories and their learning.

But the hypothetical teleportation case is different: presumably, in science fiction, there are no developmental differences in Captain Kirk and his double. I recall the poem "Doppelganger", in which a man walking along with his wife sees his double watching in the bushes, and by the end of the story he is hiding in the bushes while his double is walking off with his wife.

The above is the note I wanted to make, but forgot 3 times (1) before I found pen and paper. Did Someone not want me to know this? Why? Because, I suddenly realized, I myself am not the same from moment to moment. The continuity of the self is an illusion. I constantly die and my doppelganger takes my place. Is this the deepest secret of all? "I think, therefore I am" is not valid! The Doppelgangers think separately, like identical twins.

So not only in teleportation, but in reality, I am annihilated in every moment (how long? 200 microseconds?), to come back identical, but not the same. Or does form (morphology) bring about sameness (continuity), though of course the material base changes? I don't know how we can ever test this.

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# IS THE WORLD STRUCTURE DISCRETE OR CONTINUOUS?

We can conceive of both kinds of structure; for example, we can count discontinuously (1, 2, 3,...) and measure continuously (never, or hardly ever, an exact counting number of centimeters or inches, or neat rational fractions thereof). But is the external world basically continuous or discrete?

Maybe it depends on which feature of the external world we are considering. Matter seems discontinuous down to molecules and atoms, as found by the early 18th century chemists with their laws of combination corresponding to small whole numbers. Never mind that prior to Lavoisier et al., solid and liquid matter (condensed phases) seemed quite continuous in naive perception. Sure, Democritus the Roman postulated atoms, but he really had no evidence, and the common folk of his time probably never heard of him.

So now we know about atoms (originally meaning “things that cannot be cut or further divided”), but of course we have smashed them (partly to our sorrow) to smaller particles. We have come to know that atoms consist of protons, neutrons, and electrons, and even that the first two consist of quarks and gluons. Did that give us pause? For various reasons, some that have to do with large scale cosmogenesis and some with the tiny-scale quantum world, we now postulate various versions of superstrings and M-branes, much tinier, by several orders of magnitude, than quarks and electrons. Will this process of subdividing ever stop? Who knows?

Light, and electromagnetic radiation in general, was first characterized as waves, in that same 18th century dawn of modern science. Later (in the early 19th century), Albert Einstein found that light comes in tiny packets called photons or quanta. Soon after, electrons too were found to have complementary waves, making us wonder if matter and energy, electrons and photons, fermions and bosons, were really interconvertible, in some “supersymmetric” sense. So was radiation (and matter) continuous like waves or discontinuous like particles? The answer “both” given by Niels Bohr is not really satisfying.

What about numbers? That’s where we began. The counting numbers are discrete, so are negative numbers and zero (integers), so are rational numbers (the above plus fractions).

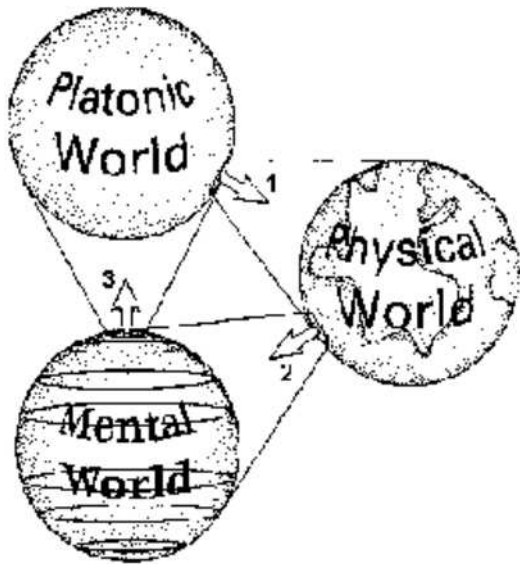
The problems come in with irrational numbers, like the square root of 2 or pi. Do the very numerous irrational numbers between the fractions “touch” each other, and so make the number line continuous? No, because the “last” (though infinitely distant) numeral of an irrational number is an ordinary natural number.

George Lakoff and Rafael Nunez deal with this question in their book “Where Mathematics Comes From”. (Basic Books, 2000.) There are apparently two kinds of mathematics. The intuitive perceptions of geometry (point with no dimensions, line without width, surface without depth) belong to the continuous perception, but modern “discrete mathematics” tries to transform it to the discontinuous realm by defining certain axioms. According to the latter, which defines numbers as “sets”, real numbers are all there is on the real number line, but the line is a set of discrete points. According to the continuous mathematics, there is an infinite number of infinitesimal numbers between every pair of adjacent irrationals, which makes the number line continuous. Again, which version of mathematics corresponds to the external world? The answer “both” again is not satisfying.

There are also certain fractal curves that are said to “fill space”. Again, that is true according to one kind of mathematics, not the other.

What about space and time? In naive perception, again, they seem continuous, a framework for objects and events. However, when we get to extremely tiny dimensions, the so-called Planck dimensions (10 to the minus 45 for time and 10 to the minus 30 for length), space-time tears apart into a sort of a foam, physicists tell us.

And there is truth. In ordinary logic, a statement or proposition is either true or false, a simple binary choice. Yet along come statements like the Cretan liar, or simply “This sentence is false”, which, if true, are false, and if false, they are true. The structure is somewhat like that of an electric buzzer, which keeps on alternating rapidly between closing and opening the circuit. We have to admit that some statements can be half-true and half-false, like the Cretan liar paradox which figures so strongly in Goedel’s proof of either the incompleteness or the contradiction in the structure of mathematics. The logical structure which includes the Cretan liar paradox (Bertrand Russell would exclude it) is called “fuzzy logic”. (There might be other fractional “truths” besides one-half.) So is logic in the external world (in Penrose’s “Platonic sphere”) clear or fundamentally fuzzy? If we make logic (or truth) continuous, the Platonic sphere must be fuzzy.



Or is there no such thing as the Platonic sphere, and are numbers and logic and space and time and matter and energy only fictions in the mind-brain, as Lakoff argues? Kant too spoke of space and time as only mental categories. But the mental structures that the mind weaves in its metaphors must to some degree correspond to structures in the environment, or we and our ancestors would not have survived in that environment. It is another type of an anthropic principle.

So in the end, I am led to argue for a Fuzzy Platonic sphere, and continuity, though with many provisos.

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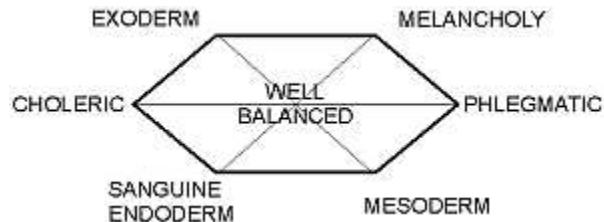
### 3 or 4? 6 or 7? 10 or 26?

	HOT	COLD
	air	water
MOIST	blood	phlegm
	<i>sanguine</i>	<i>phlegmatic</i>
	fire	earth
DRY	yellow bile	black bile
	<i>choleric</i>	<i>melancholy</i>

The ancients had 4 elements: air, water, earth, and fire. These can be put in a 2x2 table, labelled by the (non-Osgoodian) adjectives hot-cold and dry-moist, as shown in the first diagram. There were also 4 humours (fluids) in the human body and in the foods that were eaten: blood, phlegm, yellow bile, and black bile. These corresponded to 4 personality characteristics (in the same order): sanguine (generally happy), phlegmatic (lazy and indifferent), choleric (easily angered), and melancholy (sad and depressed). The moods and characters were supposed to arise when the corresponding body fluid was present in excessive amounts.

Later, the alchemist Paracelsus introduced a system based on 3 elements: mercury (which meant gases or aqueous fluids), sulphur (which meant fats and oils), and salt (which meant solids). This pretty well defines the phase composition of foods and of organic matter in general. There is also a system of 3 in defining early embryonic levels: exoderm (which forms the skin and nervous system), mesoderm (muscles), and endoderm (internal organs). The corresponding characters are: exodermic persons are quiet and intellectual, mesodermic persons are physically skilled and athletic, and endodermic persons are pleasure-loving and sensual.

Freud had 3 levels of personality: the id (the pleasure drive), the ego (the will and reason), and the super-ego (conscience derived from parental discipline).



How do the 3-based systems and the 4-based systems fit together? You cannot, of course, square a triangle any more easily than you can square a circle. But maybe a sanguine person is an id-oriented endomorph. But that's as far as it goes. We could perhaps construct a heptagon where all 3s and 4s would fit together in a cycle, or maybe a hexagon if the two points mentioned above coincide. An attempt is made in the second diagram.

The 6 or 12 problem arises when we try to match chakras (7), esoteric bodies (8), Tarot Major Arcana symbols (21), astrological zodiac signs (12), Erikson development stages (8), the 7 heavens, Psyche's tasks (4), days of the week and of creation (7), periodic table of the elements (8 in short rows, 18 in long rows), fundamental physical forces (4), Kabbalah Parzufs (10 to 13), the number of archangels (10), "minds" according to Jantsch (6 or 9), Kohlberg stages of moral reasoning (6), age ranges of the human life cycle (12 cycles of 7 years each), and other schemes of qualitative classification. We may try some of this in a huge diagram, but it would not quite fit. A series of smaller diagrams fit better. Some of them were done in the essay "Passages".

As for space dimensions postulated in string theory, the latest attempt to understand both the basic structure of matter and the nature of cosmology, I have read of 10, 11, or 26 dimensions, most of them tightly curled up. They may correlate with Kabbalah Parzufs or "Ages of the Universe" (another essay).

We humans like small whole positive numbers, which we can apprehend as having some sort of "numerical personality" which large numbers lack, especially very large numbers.

(Cf. essay on "Number in Itself".) Fractions and irrationals lack this too, except for the mysterious pi, e, golden mean, and a few others. (Cf. essay on "Irrationality".) Imaginaries and complex numbers are among the paradoxes of our mind set. But small whole positive numbers are used in the law of chemical combination, in musical scales, in letters of the alphabet, in the bases in DNA genes (only 41), all of which can produce prodigious combinatorial explosions in the form of chemical compounds, melodies (harmonies, chords), words (sentences, paragraphs, essays, books, libraries), and millions of species of life on Earth. It all unfolds as our wondrous world of experience.

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## SELF-ORGANIZATION OF HUMAN SOCIETY.

The whole Universe evolves, so does life on Earth, and so does human society. What is the aim of evolution, if there is one? It could be only aimless change, chance fluctuations like Brownian motion, but it does not seem to be. It has been evolution toward complexity.

Evolution toward complexity is impossible in a closed system, because of the law of entropy. Change should be toward disorder, down the slope of free energy hills. But the Universe is an open system, because of its continuing expansion since the Big Bang — even an accelerated expansion, as discovered recently.

Expansion continues to create free energy differences, which can be exploited by self-organizing anti-entropic systems, tending toward greater and greater complexity. Even a car without power can move uphill, if it contains a ratchet that cancels out downwards movement, and a randomly fluctuating regime is applied. The fluctuations alone can slowly propel it upwards. This can serve as a model of evolution, with natural selection acting as the ratchet that tends to prevent downward movement.

Life, of course, is an anti-entropic system, increasing order inside organisms while exporting entropy to the environment, thus preserving the validity of the entropy law. Most of the Universe is hostile to life. Only a narrow spherical shell around the centre of our Galaxy (and probably other galaxies as well) can sustain life. Too close to the centre there is too much radiation from the massive black hole and too many collisions of particles, asteroids and comets. Too far from the centre there are not enough elements beyond hydrogen and helium, such heavier elements being necessary for life. Our Sun is within this life-friendly belt.

Similarly, there is only a narrow shell around the Sun in our solar system that can keep water in the liquid state, and thus support life. Too close to the Sun a planet is too hot, like Mercury and Venus. Too far away from the Sun, a planet is too cold, like the outer gaseous planets; Mars may be in an ambiguous position. The Earth is situated in this life-friendly shell. According to the Goldilocks principle, we are not too hot nor too cold, but “just right”. We are not in a region too frenzied or too impoverished in the Galaxy. We occupy prime real estate, rare in the Universe. Is it Providence or the anthropic principle? If we tried to be anywhere else, we could not succeed, and could not therefore think about it.

We also occupy a privileged position in time, the fourth dimension. The very early universe contained no galaxies, stars or planets, and no elements beyond the original hydrogen, helium, and a little lithium. The late Universe, to come after us, may contain only black holes, neutron stars, white dwarfs and other star remnants and debris, quickly moving away from each other in a vast dark void of degraded energy. Life will not be there, or any scientists to observe and discuss it.

Evolution of life on Earth did occur, but this is nevertheless a contingency, not a necessity; though not quite chance either. There is a chemical tendency to form simple molecules like sugars and amino acids, and plenty of free energy to polymerize them to macromolecules like proteins and nucleic acids, especially because some of the latter can act as enzymes to greatly accelerate the reactions, while others act as templates to preserve information (which is the opposite of entropy) and to facilitate accurate reproduction. However, actual events might have gone otherwise. As Stephen Gould asserted, rewinding the tape of evolution (both pre-biotic and subsequent) and starting again, would most probably produce different results: either no stable life at all, or vastly different species.

Socio-cultural evolution in human societies (taking a huge leap forward) is about a million times faster than biological evolution, because we can deliberately direct it to suit our purposes and intentions, and because we can transmit innovations across generations to our descendents. In other words, social evolution is Lamarckian, no longer Darwinian.

Perhaps it is too fast; there is not enough time for consolidation, for “sober second thought”. We are becoming capable of controlling genetic evolution itself, perhaps to our detriment; we need to slow down and think. Even throughout human history and pre-history, there has been a marked acceleration of change (to agricultural to industrial to technological evolution), not all of it always beneficial, sometimes harmful to the environment, our “prime real estate”. (Even agriculture has drawbacks compared to hunting and gathering culture, although it allowed a great expansion of human population, again possibly too great.)

We now question the fragility of some of our new technology, for example interconnected computer systems. What would happen if the Internet should crash? This could happen through hostile or terrorist action (maybe through an electromagnetic pulse from a nuclear explosion), or through the playful activity of hackers, or simply through information overload. Too much of our economy now depends on the Internet — quite suddenly, in evolutionary terms. Could we

start again from scratch? Probably (we have not yet lost all our “primitive” skills, like manual calculation and recordkeeping) but it would be a huge setback. In the future, when we may be “dumbed down” ‘enough to have lost the original skills, it could be much worse. We should always keep up those skills as a fall-back position.

Also, social-cultural evolution lags behind technological evolution, and our moral-ethical evolution is even more retarded. If human society is to spontaneously selforganize as life on earth once did, and as general chemical systems can sometimes do, these lags must be repaired. This may involve slowing down the technology so that we can catch up. A sober thought: perhaps any advanced technological civilizations that may have once existed elsewhere in the Universe have already self-destructed, which is why we have not been able to contact any.

If we should be able to avoid self-destruction and achieve self-organization of human society on Earth, what would the ideal new world order look like? Ahead of that achievement, we can only speculate. We need human unity, which does not yet exist in our fractured world. We need unity with nature, to safeguard our environment. But along with unity, we need diversity, not homogenization; diversity of species, of cultures, of languages, of genetic make-up.

As the human embryo grows, its cells differentiate to perform many local functions; but the whole developing organism remains integrated through constant exchange of information and mutual cooperation. This is a good model for a future peaceful, just and cooperative worldwide human society. We are at the embryo stage; may we bring it to full term, and not abort it.

The classical political model which preserves both unity and diversity is a federation, or more specifically subsidiarity. (A federation usually has two levels of government; subsidiarity can have more than two.) We need to pay attention to both local and global levels of organization and problem-solving, and several levels in between. The optimum number of levels from person to planet would be about 8: individual, neighbourhood, town, local region, province, nation, continent, world. Problems should be solved at the lowest level possible, to be more democratic, but such that there are few outside effects. (Since in a system everything is connected to everything, the determination of “few external effects” will always be difficult, but compromises can be made, as our experience in Canada has shown.) Each unit in a subsidiarity order can self-organize according to its own culture, but the levels must also create and maintain overall integration and cooperation.

Evolution proceeds through crisis stages, when fluctuations accumulate and make the structure unstable; it can then flip either to a more stable (usually more complex) configuration or collapse — go to breakthrough or breakdown.

We do live in a crisis, in “interesting times”, according to an old Chinese curse. But the Chinese symbol for crisis also reminds us that a crisis is both a danger and an opportunity.

May we find the ratchet that will prevent us from sliding down into breakdown. We may yet succeed in climbing the peak of fitness in our rugged and changing landscape.