**The Second Law of Thermodynamics and the Origin of Life**

1Q2Q3Q says, "Fires burn out, suns die out, organisms grow old and die, cars wear out and are junked. The second law of thermodynamics expresses that things tend to go from order to disorder as time progresses. Yet, the evolutionist states that this law must be violated billions of times just to form a simple Amoeba."

Pseudoscientific creationists often claim that if evolution occurred, it would somehow contradict the laws of thermodynamics. This is an easy misunderstanding of science for fundamentalists who have no understanding of the methodology and epistemological basis of a truly difficult science such as evolutionary biology, nor any desire acquire such an understanding.

In reality, the driving force causing natural systems to evolve increasing complexity through time is the second law of thermodynamics - as exemplified in the tendency of energy to flow from sources of high potential to sinks of low potential. Stars such as the Sun provide sources of high potential energy such as short wavelengths of sunlight. Deep space provides the sink for long wavelengths of infrared. Living systems that provide a pathway able to transform and degrade the high potential forms of energy into low are powered and forced to evolve by this flux of energy from source to sink. This was well understood more than 30 years ago when I was still teaching biology and evolution.

The thermodynamics of the non-equilibrium processes driven by the systems channeling the energy from the source to the sink were ably described in 1968 in the book Energy Flow in Biology: Biological Organization as a Problem in Thermal Physics. Harold J. Morowitz, Department of Molecular Biophysics, Yale University, published by Academic Press. Search Google for a number of references to the work ["Energy Flow in Biology" Morowitz]. I will quote a few of the relevant passages:

...[The general thesis of this book] is to discuss and present evidence ... that the flow of energy through a system acts to organize that system.

...Life then appears in some way to oppose the otherwise universal drive to disorder. What is the significance of this? Does it mean that living organisms do or may violate the second law of thermodynamics?

The resolution of this apparent divergence between a biological and a physical theory is the realization that the second law of thermodynamics applies to systems that are approaching equilibrium, whereas the surface of the earth, the matrix of biological evolution, belongs to a different class of physical systems. Equilibrium systems require either isolation (adiabatic systems) or contact with a single fixed reservoir (isothermal systems). Most real physical systems are of another sort: they are in contact with more than one reservoir, some of which may be regarded as sources and some of which may be regarded as sinks. The description of these systems requires the consideration of the flow of either matter and/or energy from the sources through the systems of interests to the sinks.

...Consider ... a CHNO system at equilibrium in contact with a thermal reservoir. At equilibrium, CO2, N2, and H2O dominate the system and the order measure is zero. Next, begin to irradiate the system with a constant source of monochromatic photons. A series of photochemical reactions begins leading to a large group of intermediate compounds. These intermediates must
of necessity have a higher Helmholtz free energy than the ground state so that $L$ rises. Some of these intermediates will have very short half-lives and will rapidly decay, while others will persist for longer periods, leading to a building up concentrations of the more persistent ones. These species can enter into further photochemical processes, going into even higher free energy intermediates. The more stable the intermediates [the longer they will last]. The selection for stability plus the constant pumping by energy flow will lead to the largest possible stored energy and the largest degree of order.

If this principal is general it means that the steady state is that energy flow state which maintains the system maximally far from equilibrium. Nonequilibrium states become conceptually very different from equilibrium states. If the biosphere is that system which maximizes $L$ for the terrestrial surface, it becomes a necessary state of the system rather than an accidental one.

In other words, Morowitz’s entire argument is that the driving forces of thermodynamics actually force the surface of the world to evolve chemical complexity.

Based on my quick Google search, I see that several creationist have attempted to twist Morowitz’s calculations of the extreme improbability of macromolecules such as nucleic acids and proteins existing in an equilibrium environment as an argument that they could not have evolved in the first place. This, of course, goes totally against the whole thrust of Morowitz’s argument.

Not only does the flow of energy through the system force the evolution of increased order in the molecules, but there are a number of other natural processes which have local equilibria that actually the condensation of simple organic molecules into larger organic molecules by the removal of water molecules (dehydration reactions). Some early books on chemical evolution leading up to the origin of life (self-sustaining, self-reproducing homeostatic chemical systems) from my library include:


These books present a wide variety of scenarios where condensation reactions able to form macromolecules could have occurred and have modelled many of them in laboratory experiments. True, although some of the experimentally condensed macromolecules show catalytic properties, no one has actually created a self-sustaining self-reproducing organism in a laboratory flask from raw chemicals in an experiment running for only a few days. However, given the entire volume of the Earth’s oceans and shorelines to work with over geological time, the laws of physics and chemistry are all that are required to account for the origin of the first living organisms able to reproduce themselves.
Once life exists, the actions of natural selection are all that is required to account for the evolution of complex organisms up to and including ourselves – who have the capacity to study and understands or origins.

**Metaphysical questions**

As a physics major who eventually completed his degree in evolutionary biology from one of the world’s premier universities in this discipline, and who is currently working in the defense industry as a knowledge management expert, I see nothing in what we have learned about the evolution of the Universe from the first instant following its origin that requires anything to explain what has happened other than the playing out of the gradual decay of the energy of the origin according to the ordinary laws of physics and chemistry.

True, our understanding of how the Universe works is still far from complete (e.g., the nature of dark matter and time itself), but there is nothing in this ignorance that suggests that we cannot understand these things through scientific methodology or that we must create a god in order for it to be explained.

Nor do I require the existence of a personal god, to justify a reverence for life and to be an ethical being.

I certainly cannot see the need to create and worship a god able to interfere in peoples’ daily lives to explain how 19 people could dedicate years of planning to end the lives of thousands of other completely innocent people (husbands, fathers, wives, mothers, children all going about their ordinary daily businesses; and even rescue service people risking their own lives to save others; and even priests of the supposed god administering last rites to those already killed). If god exists, it must be the devil incarnate to allow such atrocities - along with all of the crusades, inquisitions, holy wars, pogroms, holocausts, ethnic cleansings and other religiously motivated or justified mass murders that have taken place in the name of Y'W'H (Jehova, the Trinity, Allah, the Lord, etc.). I don't believe in devils either. Human credulity, insanity and drive to obtain power are all that is required to explain our history - not an interfering god.

For me, the only place left where a god may reasonably be considered to exist is beyond the realm of physics; outside the Universe physics knows or before the Universe began.