


Ista es la versión **G o o g l e** guardada en el cachi de la http://www.mountainman.com.au/chaos_02.htm obtenida el 20 May 2007 22:53:07 GMT.


La cachi de **G o o g l e** es la instantanea de la pagina que tomamos cuando exploramos la Web en forma automatica. Es posible que la pagina haya cambiado desde entonces. Haga clic aquim para ver la [pagina actual](#) sin resaltar. Esta pagina guardada en el cachi puede hacer referencia a imagenes que ya no estan disponibles. Haga clic aquim para obtener znicamente el [texto guardado en el cachi](#).

Para vincularse a esta pagina o para marcarla, utilice el siguiente url: http://www.google.com/search?q=cache:N2akj4V4ESkJ:www.mountainman.com.au/chaos_02.htm+%22Order+out+of+Chaos%22&hl=es&ct=clnk&cd=9&gl=es

Google no tiene relacisn con los autores de esta pagina ni es responsable de su contenido.

Se han resaltado estos tirminos de bzsqueda: **order out of chaos**






**Selected Book Reviews
and [Resources](#) on**

NonLinear Systems

Order Out of Chaos

by
Ilya Prigogine & Isabelle Stengers (1984)

Web Publication by [Mountain Man Graphics, Australia](#)



Introduction

[Ilya Prigogine](#) and Isabelle Stengers present a wide ranging and well documented discourse on the gradual emergence of philosophical and scientific thought in regard to conceptions of order and chaos.

In the exposition of one of the main thematic threads of their subject matter, the authors itemise three types of conceptually different systems, only two of which were academically studied and (generally) understood by the progressive expansion of scientific research and theory in relation to the study of natural phenomena exhibited around us - in our terrestrial environment upon this earth, and in the local cosmic environment within which the terrestrial is embedded.

Systems which are in equilibrium or systems which are close to equilibrium are the first two phenomena presented, during which it is noted that such systems are - almost exclusively - the subject matter of the traditional and classical sciences. Such systems are relatively stable, exhibiting known and predictable characteristics which may be represented in parameter driven mathematical models.

However Prigogine chose to attempt investigation of a third and largely ignored class of systems - those which were **far from equilibrium**. His research earned him the Nobel Prize in 1977, for his work on the thermodynamics of nonequilibrium systems, and his contribution towards the understanding of natural processes and their descriptions has earned him the respect of many scientists and academics in many fields. The authors have subtitled their publication *Man's New Discourse with Nature*, and progressively introduce and discuss the conceptual differences between the traditional mechanistic interpretation of the so-called *laws of cause and effect* and the inability of this paradigm alone to provide explanation for that class of phenomenal systems in which equilibrium conditions are not maintained.

The following selected passages **below** represent quotations from the authors which - when reading the book - I collected for my own archive of research material. If it becomes useful and a resource to other students of life, then the small time spent in preparing it for the net will have been well spent.

All the best,

Pete Brown
Mountain Man Graphics,
Newport Beach, Australia
Southern Winter of 1997

E-Mail: prfbrown@magna.com.au

Far from Equilibrium Systems

Far from equilibrium, the system may still evolve to some steady state, but in general this state can no longer be characterised in terms of some suitably chosen potential (such as entropy production for near equilibrium states.)

Whenever we define potential, we are defining a *stable world* in which the systems follow an evolution that leads them to a static situation that is established once and for all.

When the thermodynamic forces acting on a system become such that the linear region is exceeded, however, the stability of the stationary state, or its independence from fluctuations, can no longer be taken for granted. Stability is no longer the consequence of the general laws of physics. We must examine the way a stationary state reacts to the different types of fluctuations produced by the system or its environment. In some cases, the analysis leads to the conclusion that a state is "unstable" - in such a state, certain fluctuations, instead of regressing, may be amplified and invade the entire system, compelling it to evolve toward a new regime that may be qualitatively quite different from the stationary states corresponding to minimum entropy production.

The Nature of Turbulence

*"Sometimes", wrote Lucretius, "at uncertain times and places, the eternal, universal fall of the atoms is disturbed by a very slight deviation - the **clinamen**. The resulting vortex gives rise to the world, to all natural things.*

The clinamen, this spontaneous, unpredictable deviation, has often been criticised as one of the main weaknesses of Lucretian physics, as being something introduced adhoc. In fact, the contrary is true - the clinamen attempts to explain events such as laminar flow ceasing to be stable and spontaneously turning into turbulent flow. Today hydrodynamic experts test the stability of fluid flow by introducing a perturbation that expresses the effect of molecular disorder added to the average flow. We are not so far from the clinamen of Lucretius!

For a long time turbulence was identified with disorder or noise. Today we know that this is not the case. Indeed, while turbulent motion appears as irregular or chaotic on the macroscopic scale, it is, on the contrary, highly organised in the microscopic scale. The multiple space and time scales involved in turbulence correspond to the coherent behaviour of millions and millions of molecules. Viewed in this way, the transition from laminar flow to turbulence is a process of self-organisation. Part of the energy of the system, which in laminar flow was in the thermal motion of the molecules, is being transferred to macroscopic organised motion.

[Page 141]

Dissipative Structures

The *Benard* cell

The "Benard instability" is another striking example of the instability of a stationary state giving rise to the phenomena of spontaneous self-organisation. The instability is due to a vertical temperature gradient set up in a horizontal liquid layer. The Benard instability is a spectacular phenomenon. The convection motion produced actually consists of the complex spatial organisation of the system. Millions of molecules move coherently, forming hexagonal convection cells of characteristic size.

Dissipative Structures

In far from equilibrium conditions, the concept of probability that underlies Boltzmann's order principle is no longer valid in that the structures we observe do not correspond to a maximum number of complexions. Neither can they be related to a minimum of the free energy $F = E - TS$. The tendency towards levelling out and forgetting initial conditions is no longer a general property. In this context, the age-old problem of the origin of life appears in a different perspective. It is certainly true that life is incompatible with Boltzmann's order principle but not with the kind of behaviour that can occur in far-from-equilibrium conditions.

Classical thermodynamics leads to the concept of "equilibrium structures" such as crystals.

Benard cells are structures too, but of a quite different nature. That is why we have introduced the notion of "dissipative structures", to emphasise the close association, at first paradoxical, in such situations between structure and order on the one side, and dissipation or waste on the other. Heat transfer was considered a source of waste in classical thermodynamics. In the Benard cell it becomes a source of order.

The interaction of a system with the outside world, its embedding in nonequilibrium conditions, may become in this way the starting point for the formation of new dynamic states of matter - dissipative structures. Dissipative structures actually correspond to a form of supramolecular organisation.

Page 143

Encounter with Molecular Biology

In far from equilibrium conditions various types of self-organisation processes may occur. These may lead to the appearance of chemical oscillations [such as *chemical clocks*] or to spatial structures. We have seen that the basic condition for the appearance of such phenomena is the existence of catalytic effects.

Although the effects of nonlinear reactions (the presence of the reaction product) have a feedback action on their "cause" and are comparatively rare in the inorganic world, molecular biology has discovered that they are virtually the rule as far as living systems are concerned. Autocatalysis (the presence of X accelerates its own synthesis), autoinhibition (the presence of X blocks a catalysis needed to synthesise it), and crosscatalysis (two products belonging to two different reaction chains activate each other's synthesis) provide the classical regulation mechanism guaranteeing the coherence of the metabolic function.

[...]

Biological systems have a past. Their constitutive molecules are the result of an evolution; they have been selected to take part in the autocatalytic mechanisms to generate very specific forms of organisation processes.

Page 153

Nonequilibrium systems and gravitation

Nonequilibrium magnifies the effect of gravitation. In the Benard cell, having a thickness of only a few millimeters, while the effect of gravitation on such a thin layer would be negligible at equilibrium, because of nonequilibrium, the macroscopic gravitational effects become visible.

Gravitation obviously will modify the diffusion flow in a reaction diffusion equation. Detailed calculations show that this can be quite dramatic near a bifurcation point of an unperturbed system. In particular, we can conclude that very small gravitational fields can lead to pattern selection.

From Euclid to Aristotle

One of the most interesting aspects of dissipative structures is their coherence. The system behaves as a whole, as if it were the site of long-range forces. In spite of the fact that interactions among molecules do not exceed a range of some 10⁻⁸ cm, the system is structured as though each molecule were "informed" about the overall state of the system.

It has often been said - and we have already repeated it - that modern science was born when Aristotelian space, for which one source of inspiration was the organization and solidarity of biological functions, was replaced by the homogeneous and isotropic space of Euclid. However, the theory of dissipative structures moves us closer to Aristotle's conception. Whether we are dealing with a chemical clock, concentration waves, or the inhomogeneous distribution of chemical products, instability has the effect of breaking symmetry, both temporal and spatial. In a limit cycle, no two instants are equivalent; the chemical reaction acquires a phase similar to that characterizing a light wave, for example. Again, when a favored direction results from an instability, space ceases to be isotropic. We move from Euclidian to Aristotelian space!

It is tempting to speculate that the breaking of space and time symmetry plays an important part in the fascinating phenomena of morphogenesis. These phenomena have often led to the conviction that some internal purpose must be involved, a plan realized by the embryo when its growth is complete. At the beginning of this century, German embryologist Hans Driesch believed that some immaterial "*entelechy*" was responsible for the embryo's development. He had discovered that the embryo at an early stage was capable of withstanding the severest perturbations and, in spite of them, of developing into a normal, functional organism. On the other hand, when we observe embryological development on film, we "see" jumps corresponding to radical reorganizations followed by periods of more "pacific" quantitative growth. There are, fortunately, few mistakes. The jumps are performed in a reproducible fashion. We might speculate that the basic mechanism of evolution is based on the play between bifurcations as mechanisms of exploration and the selection of chemical interactions stabilising a particular trajectory.

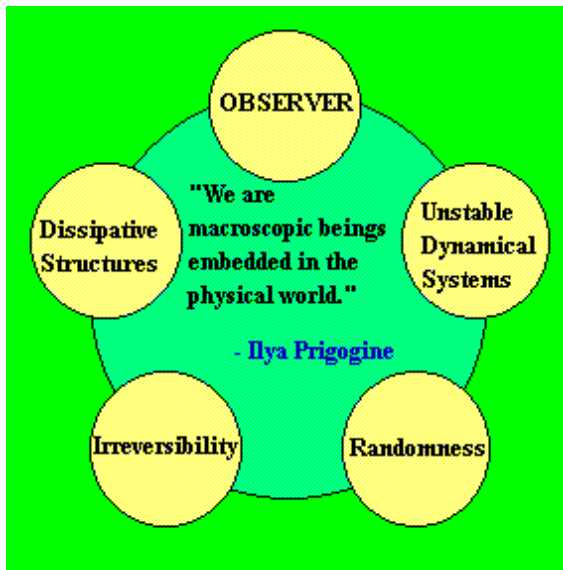
ReEnchantment of Nature

Conclusion: From Earth to Heaven - The Reenchantment of nature

Demonstrations of impossibility, whether in relativity, quantum mechanics, or thermodynamics, have shown that nature cannot be described "*from the outside*", as if by a spectator. Description is a dialogue, communication, and this communication is subject to

constraints that demonstrate that we are macroscopic beings embedded in the physical world.

We may summarise the situation as we see it today in the following diagram:



The Dynamic Process of Communication:

- Observer
- Unstable dynamical systems
- Randomness
- Irreversibility
- Dissipative Structures
- Observer

Editor's Note: *The above diagram was depicted in a straightforward text and line flowchart in the original book, with the flow (as one would read the book) going clockwise. In the above representation I have emphasised the cycle by using the circle.*

Pages 299 - 300

[Index](#) | [Next Article](#) | [E-Mail](#)

Other Resource Links

- [The Ilya Prigogine Center](#): Studies in Statistical Mechanics and Complex Systems, Texas
- [The Time Conference Report](#): Physics and Time - Bohm, Prigogine, and Process Philosophy, Claremont 1984
- [Professor Ilya Prigogine](#): Short Biography, Books, Scientific and general papers - Uni of Texas

Related Usenet Post ...

Those readers who have subscribed to usenet (news groups) will be aware that it is often a great source of information. At the time this review was being prepared for publication, the following post appeared on one of the usenet groups and, in view of the fact that it deals with the work of **Ilya Prigogine**, I thought to append it to the review:

Ryan Aebig requests some information:

- > Could anyone tell me in layman terms what he discovered? Apparently he's
- > come up with a way to combine statistical and Newtonian physics, so that
- > irreversible systems now can be reversed (ie friction and time's arrow)

In sci.astro, agraps@netcom.com (Amara Graps) responds as follows:

Prigogine won the Nobel Prize in 1977 for his work in the thermodynamics of nonequilibrium systems.

Prigogine is primarily a chemist. He was well established in his field 20 years ago, so what he's done since then, is branch out into related areas. As I understand it, his main discovery has been the discovery of "*chemical clocks*." These are chemical reactions that oscillate in a very regular and precise way. Prigogine predicted that they should exist from a theoretical chemistry standpoint several decades ago. In the late 1950's, one of his research group came back from a visit with a colleague in Russia, announcing that they had a chemical reaction that did just what Prigogine predicted. The reaction is now known as the Belousov-Zhabotinskii reaction and it is the oxidation of citric acid by potassium bromate catalyzed by the ceric-cerous ion couple.

To Prigogine, irreversibility is a fundamental property of physics. Prigogine proposes that entropy production is part of an operator (operators map functions onto functions), and time is an operator. And that the time that we are all familiar with from classical mechanics is just an ensemble average of this operator with a state vector. I.e. "ordinary" time is an average over his new time operator. And that "age" is DEpendent of the distribution.

So what does that mean about operators..? Let's say that we wish to know the time evolution of a system. In both quantum mechanics and classical mechanics, the Hamiltonian operator determines how the system will evolve in time. The evolution that we are all familiar with is a reversible and deterministic evolution (We can say that the reversible change of a wave function that represents the quantum system corresponds to a reversible motion along a trajectory that represents the classical system.) The wave function or trajectory represents the maximum knowledge of the system.

Prigogine has incorporated reversible and irreversible parts into a new microscopic equation/description. The equation contains an operator analogous to the Hamiltonian, that is a new "time evolution operator" that now can drive the system to both equilibrium or nonequilibrium states. Entropy is produced by the even part of the new time evolution operator and he has defined an operator for that.

An example that Prigogine gives looks at the conventional and his unconventional determination of energy levels in a quantum system. In the conventional quantum mechanics, both the energy levels and the time evolution of them are determined by the same quantity: the Hamiltonian operator. Prigogine's method allows him to use two different operators: the time operator for time evolution and another operator (a "superoperator" that can act on other operators) to determine the energy levels. So in this way, instead of having the "particle" and the "interaction" (conventional view), we have the physical process that contains electrons, photons, etc. that drive the total system. This process is "real" and cannot be "transformed" away by any change of representation.

Or another way to look at it: the classical order says particles come first and the Second Law of Thermodynamics comes later, while Prigogine says that we must **first** introduce the Second Law before being able to define the entities.

Another one of Prigogine's main themes is that nonlinear interactions frequently lead to order (which he calls "dissipative structures") through fluctuations. A dissipative structure is order visible on a macroscale which can exchange energy with the outside world. In particular, if the system is in a far-from-equilibrium-state this can happen.

In fact, in Prigogine's view, we can now recognize ourselves as a kind of evolved form of dissipative structure, and we can justify, in an objective way, the distinction between the future and the past. How? The time symmetry is broken in the following way: the existence of irreversible processes on the microscopic level through kinetic equations violates the symmetry of the canonical equations. And dissipative structures may, in turn, break the symmetries of space-time.

I don't know if I managed to put this in layman's terms. His theory is very mathematical. But I think this is cool stuff.

You can find out more about Prigogine's ideas in the books: *Order Out of Chaos* (few or no equations) and *From Being to Becoming* (very technical, but the same subject matter).

Amara

E-Mail: agraps@netcom.com

WWW: <http://www.amara.com/>

[Index](#) | [Next Article](#) | [E-Mail](#)

Out of. Chaos. Elite Sponsored Terrorism and the New World Order. Paul Joseph Watson.Â This is not intelligence of mind - it is system of mind. Systems of mind are like physical machines; they are limited in potential by the intelligence that built them. Likewise, the systems of mind that masquerade as "intelligence"™ only function to the standard of fuel that is fed into them in the first place. Systems of mind can be changed at any time by the controller of the system (the government). They can say $2 + 2 = 5$ and the vast majority of people will not question it. This proves to us that such systems of mind are not "intelligence"™ because true intelligence is infinite, whole and un