

Obituary

Prof. Ilya Prigogine (1917–2003)



It is known that nature has a tendency to go toward disorder. This is in good agreement with the second law of thermodynamics, which is one of the most universal laws of physics. As Sir Arthur Eddington said:

The law that entropy always increases—the second law of thermodynamics—holds I think, the supreme position among the laws of Nature. If someone points out to you that your pet theory of the universe is in disagreement with Maxwell's equations—then so much worse for Maxwell equations. If it is found to be contradicted by observation—well these experimentalists do bungle things sometimes. But if your theory is found to be against the second law of Thermodynamics, I can

give you no hope; there is nothing for it but to collapse in deepest humiliation.

The second law suggests the spontaneous increase of disorder, as represented by so-called entropy. Ludwig Boltzmann (1844–1906), the Austrian physicist who established statistical mechanics and was the first scientist to propose the universality of entropy, stated that the challenge of life is instead the production of negentropy (negative entropy), which is a measure of order. However, it was still unclear just how natural order could emerge in the midst of increasing chaos. Our common experiences are indicative of the fact that even changes in inanimate systems are accompanied by order and organization.

This problem was solved by Professor Prigogine through the discovery of self-organization of non-equilibrium systems. He can be considered as the third key person (after Ludwig Boltzmann and Lars Onsager) of thermodynamics of irreversible processes (or non-equilibrium thermodynamics), which is the thermodynamics of life, as all processes involving living organisms are irreversible. From his works, we begin to understand the constructive role played by irreversible processes in the physical world. In other words, he showed that unidirectional time phenomena over a wide range are accompanied by self-organization.

Interestingly, not only do living organisms organize themselves, but also inanimate systems involve self-organization. As Professor Prigogine stated: "Matter is more integrated than we usually believe....The gap between life and non-life is smaller than we think.... Chemical communication between molecules over long distances and long periods of time, also [exists] in non-living systems." He expanded on this idea of long distance communication in the following way:

You have a coherent system, you have communication over a long distance because it is coherent; to act all together needs communication over a large distance and over a long time, because you see dissociations for seconds or minutes and you know that. So, matter has a way of communicating over long distances over a long time. And often I say: matter in equilibrium is blind, and it communicates over short distances over a short time. Matter out of equilibrium begins to see.

In Prigogine's opinion, society can begin to investigate cultural and social change in dialogue with science. His work on the theory of car traffic confirmed the supposition that even human behavior, with all its complexity, is eventually susceptible to mathematical formulation

Where have we got to? I am convinced that we are approaching a bifurcation point that is connected to progress in information technology and everything associated with it, such as multimedia, robotics and artificial intelligence. This is the "networked society" with its dreams of a global village. But what will be the result of this bifurcation, along which branch of it are we going to find ourselves? What will be the effect of globaliza-

tion? The word "globalization" covers a variety of very different situations. It is possible that the Roman emperors were already dreaming of "globalization"—of a single culture that would dominate the world. The preservation of cultural pluralism and respect for others is going to demand the entire attention of future generations. But there are also other dangers on the horizon. Around 12,000 species of ant are known today. Their colonies range from between several hundred to many millions of individuals. It is interesting to note that the behaviour of ants depends on the size of the colony. In a small colony, the ant will behave as an individualist, looking for food and then bringing this back to the nest. When the colony is large, however, the situation changes, and co-ordination of activities becomes essential. Collective structures then appear spontaneously as a result of auto-catalytic reactions between ants bringing about chemically mediated exchanges of information. It is no coincidence that in large ant or termite colonies individual insects become blind. Population growth shifts the initiative from the individual to the collective.

Professor Prigogine was awarded the Nobel Prize in Chemistry in 1977 for his contributions to non-equilibrium thermodynamics, particularly dissipative structures. The theory of dissipative structures was proposed as a universal law, and indeed, the main theme of Prigogine's scientific work has been a better understanding of such structures, including the role of time, in domains spanning the physical sciences and biology.

Ilya Prigogine was born in Moscow, Russia on January 25, 1917. He emigrated with his family from Russia to the West in the early 1920s. After living in Germany, they settled in Belgium. He attended secondary school and university in Brussels and acquired Belgian citizenship in 1949. He obtained both undergraduate and graduate degrees at the Free University of Brussels. In 1941, when he earned his first doctoral degree, he found the orientation of his future works studying thermodynamics, focusing on the special significance of time.

Professor Prigogine died on May 28, 2003 in Brussels. He will be missed as a great scientist of our time. Everybody who personally knew him would agree with me that he was also a great man. He was a

member of 30 national and professional organizations and received numerous national awards and prizes. He also received 53 honorary degrees from universities in different countries. He was an author on 20 books and nearly 1000 research articles.

A funeral ceremony was held in Brussels on June 6, 2003. A fund to establish a fellowship in Professor Ilya Prigogine's memory has been set up; for further information regarding contributions, contact Nathalie Jockmans (njockman@ulb.ac.be).

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