

LIFE, THERMODYNAMICS, CREATIVITY, AND POLLUTION

by John W. Mehl

Today's environmental crisis is viewed by many as a manifestation and proof of man's alienation from the natural world. Knowledge, the groping for a rational approach to the rest of nature, and increasing power over his environment are viewed as the cause of man's alienation. However, this sense of alienation certainly antedates any substantial development of technology. It is so generally a part of mythology and religion that it must have its origins in something much deeper than the particular manifestations of present-day society. Man's sense of alienation may more likely have its roots in the conflict between a continuously evolving, rational basis of behavior and an instinctive or emotional basis of behavior. We have great difficulty coping with genetically programmed behavioral responses and with responses conditioned by earlier social structures in the face of the capacity for and fact of rapid social evolution.¹ These problems, or the environmental degradation associated with the development of highly technological societies, are not, however, the result of any suppression of our biological heritage, but are the consequence of that heritage.

For some years now, it has been clear that a distinguishing sign of life, on our planet at least, is that of a system which is directed toward preserving and increasing information.² The living organism is devoted to a struggle against the Second Law of Thermodynamics, at least as far as its own domain is concerned. Generally speaking, it takes less highly ordered atoms and molecules and increases their order, casting them in new patterns to yield both a decrease in entropy and an increase in free energy *within* the system.

An inorganic molecule contains the information which specifies the way in which crystallization will take place under the proper conditions. Living systems make use of this same kind of information, particularly as it may be incorporated into more complex molecules. A virus contains information at this level which determines the way in which it will crystallize; and the macromolecular subunits of a virus contain information which specifies their mode of assembly. However, the virus contains information of another order, which can be ex-

John W. Mehl is deputy division director, Biological and Medical Sciences, National Science Foundation.

ZYGON

pressed in an appropriate *living* system. As a part of a living system, it can utilize energy from its environment to protect the information which it contains and to reproduce that information.

THE BASIC DRIVE OF LIVING SYSTEMS

Living systems, in short, process energy and material from the environment to maintain or increase both their internal energy and information. In the simplest case, this represents growth and reproduction. However, the basic drive toward accumulation of information, whatever the mechanism, is evident in the evolution of more complex organisms from simple ones. Energy and matter from the environment are used to produce increasingly complicated structures within the living system. As evolution has continued, biological systems have appeared which not only arrange their internal structures but also arrange or order matter external to the systems. These activities often have an obvious utilitarian value to the organism, but I believe that they can also be viewed as the basic drive of living systems to rearrange their environment.⁸

With this view of an essential character of life, man represents the most highly developed capability. He has learned not only to use the physical capacity of his own system to rearrange his environment, but has created machines to bring more energy than he himself can process to bear on this task. Although these activities are usually directed to purposes which he views as useful, the basic nature of the biological urge also explains why man sometimes seems compelled to do things simply because they can be done. I would suggest, then, that man's propensity for environmental degradation does not stem primarily from any social or ethical structure, or from the dehumanizing effects of technology, but rather from his biological nature.

Stopping here would leave one with the rather dismal view that evolution to this point has been self-defeating. However, man has also evolved an ability to create and manipulate information of a more abstract kind. He has learned to create sound patterns, visual patterns, or simply to imagine the rearrangement and ordering of things. Processing and creating information of this kind are done with a minimum expenditure of energy and can be a source of great satisfaction for many people. This capacity has also made it possible for man to examine his own behavior and its consequences. He must come to understand that he need not be bound by the biological drive to remake the world in *all* its aspects, that there are alternative ways in which to express his creative urge, and that he must fully incorporate this understanding into his social ethic.

NOTES

1. Ralph Wendell Burhoe, "Values via Science," *Zygon* 4 (1969): 65-99.
2. Erwin Schrödinger, *What Is Life?* (New York: Doubleday & Co., 1956).
3. The argument presented does not require that the negentropic aspect be the only important characteristic of living systems or that it be entirely unique to living systems. The cybernetic aspects are obviously important, particularly when extended to the ability to run simulation models mentally or by machine. Likewise, the similarities between living systems and other systems of interacting flows far from equilibrium which have been discussed by Dr. Katchalsky are important in developing a view of the unity of natural systems, but do not negate the fact of the increase of information as an essential characteristic of biological systems. The importance of apparently random events (mutation, gene duplication, translocations, etc.), which has been emphasized by Dr. Potter, also needs to be taken into account. Indeed, there is an interesting parallel between the need to discard those random events which are not neutral (most genetic alterations are deleterious) and the need to discard most of the "eureka experiences," which, though exciting creative events for the individual, usually prove to be ultimately deleterious or "wrong."