

DISCUSSION REMARKS

by

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on

Robert U. Ayres's

SELF-ORGANIZATION AND TECHNOLOGICAL CHANGE IN THE ECONOMIC SYSTEM

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Discussion Paper on Professor Ayres' Paper on
Self-Organization and Technological Change in the Economic System ✓

These remarks on Professor Ayres' paper will be more appreciative than critical. I believe his paper represents an unusually successful effort to nourish the social sciences with insights and models drawn from the physical sciences. In this particular case it seems that the physical sciences are repaying a debt to the social sciences, for economic considerations contributed significantly to the thermodynamics and information theory invoked by Professor Ayres.

Professor Ayres borrows from thermodynamics the concept of dissipative structure developed in recent years by Prigogine and his associates. The dissipative structures treated by Prigogine are typically chemical systems that exhibit stable, coherent, self-organizing behavior, but are far from thermodynamic equilibrium. Such systems are open systems which require a continuous inflow of free energy from the environment for their maintenance. Various investigators have suggested that biological organisms, eco-systems, and human social systems can also be regarded as dissipative structures. Professor Ayres makes a persuasive case for this extrapolation and specifically models the economic system and the techno-system lodged within it as dissipative structures. The insights that he derives from the model are, to me at least, arresting and indicative of great fertility in the model. What follows is an all-too-feeble effort by a non-economist to exploit the model further.

Professor Ayres uses the model to make telling criticisms of those social critics, such as Ellul, Mumford, and Roszak, who view the techno-system as an alien autonomous force hostile to human values. Ayres points out that the economic system drives and sustains the techno-system. In turn, the economic system functions within the larger social system which is nested in the

ecological-biological system. Ultimately the forces driving the techno-system spring from the nature of man. Global and wholesale indictments of the techno-system would seem to amount to an indictment of man himself.

The model clearly implies that the techno-system is a benevolent agency in human affairs. The fact that technological knowledge produced by the techno-system can reduce the need for material and energy resources means that pure technological information functioning as a substitute for resources can enrich us all. Increasing technological knowledge tends to maximize our efficiency in the use of resources. Thus, advances in the state of technology deserve from the advocates of environmentalist and ecological causes general applause rather than the usual censure.

Application of the Ayres model to the American techno-economic system immediately raises questions about the performance of the system. As Professor Ayres points out, growth in technological knowledge is not free. It requires an investment of human and material resources in education and research. But, American society has shown great reluctance to finance this investment in recent years. Our educational system deteriorates, our technological leadership slips away, and the federal government largely ignores the problems or hands them over to the states or private agencies to solve. We are painfully slow in learning that our most important resource, an ever renewable resource, is the knowledge, talent, discipline, and imagination of our people. The Japanese and others not lulled into complacency by an abundance of natural resources have learned the lesson more quickly.

Until recently the American system has seemed to thrive on adversarial relationships. Adversarial features are prominent in and among our legal, economic, and political relationships and in our national ideology. We extol the virtues and advantages of individualism, competition, consumption and

freedom and punish or neglect their counterparts: community, cooperation, production, and duty. We grow too many lawyers and salesmen and not enough engineers. While we protect and coddle ourselves as consumers we neglect the maintenance and improvement of the material and institutional infrastructures that support our activities as producers. An illustrative example: during the recent breakup of the Bell System the probable devastation that would be wreaked on our premier industrial research organization, Bell Laboratories, seems to have been a matter of great indifference to the public, the judiciary, and the government.

The Ayres model suggests that a great deal of our legal and economic activity, however serviceable to individuals, produces few goods and services for the system as a whole and ends up adding mostly waste, noise, and disorder to the system. Surely our present massive use of lawsuits is an inefficient way to secure an equitable distribution or redistribution of wealth. This is not to mention the more glaring case of crime. However valuable the disorder-producing mechanisms in our society may once have been in destroying old outmoded structures to make way for new ones, these mechanisms now seem less benign. It is small wonder that nations with stronger social traditions of cooperation, discipline, duty, and obligation now find it relatively easy to best us in achieving a more productive economic order. To survive, grow, and "improve", such dissipative structures as the techno-economic system need mechanisms that add and store order (negentropy, information, knowledge) not entropy-producing mechanisms that destroy order.

On the other hand, the Ayres model also accounts for the more positive role in the economy that we commonly attribute to competition and other adversarial relationships. The free market triggers the release of social, and even biological, energy into the economic system from individual members of the society.

Even though this released energy entering the economic system is chaotic like heat, its intensity (temperature) can be high. Such high temperature heat can, in part, be converted into useful (ordered) output. Large inputs of chaotic energy can serve such dissipative structures as the economic system better than low inputs of ordered energy. Presumably, large inputs of ordered energy would serve even better. Some societies, such as the Japanese, seem more successful than we in mustering such ordered energy. On the other hand, the totalitarian regimes that insist on putting only ordered social energy into their economies through controlled central planning seem unable to muster enough of this energy from their people to make their economies prosper. It is significant that the Chinese regime is busily introducing more free market mechanisms, presumably to release the talents and energies of their people, to stimulate their economy.

The Ayres model elicits a concluding question. To what extent can we expect the techno-economic system to exhibit maturation? Will the system saturate, level off? Will the cost of scientific-technological research increase faster than the output? Already particle accelerators rival aircraft carriers in cost. If the techno-economic system truly resembles those other putative dissipative structures, biological organisms and eco-systems, growth should not continue forever. Animals stop growing, populations stabilize, niches fill up. Perhaps the British, representing the world's oldest techno-economy, are leading the way in some maturation process, as their social energy drains into other pursuits and concerns and their economy and technical establishment go into decline. Perhaps, the very success of the techno-economy feeds back to "corrupt" the undergirding social system and reduce the support it gives the techno-economy. In spite of present appearances the future of the global techno-economy may well lie with the younger more vigorous players of the game: China, and the Third World.