

**Maruyama M.** The second cybernetics: deviation-amplifying mutual causal processes. *Amer. Sci.* 51:164-79, 1963.  
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Some causal loops amplify change, while other loops counteract change. Heterogeneity increases, structures develop, and the amount of information grows in biological, social, and some physical processes. Similar initial conditions may lead to dissimilar results, making inferential procedure in traditional hypothesis-making invalid. [The *SCI*<sup>®</sup> and *SSCI*<sup>®</sup> indicate that this paper has been cited in over 230 publications.]

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The principle of interactions among heterogeneous elements is implicit in the traditional Japanese garden design and floral art. Moreover, the notions of change amplification and pattern development are inherent in Japanese cosmology. In my postgraduate years in Sweden I was puzzled by the fact that these notions were not natural to Europeans who were educated in the Aristotelian and Cartesian logic systems. I began writing mathematical papers on change-amplifying interactions for seminars in Sweden in 1957. In 1959 I wrote "Morphogenesis and morphostasis,"<sup>1</sup> which was published in an Italian journal, *Methodos*, in 1960. It dealt mathematically with the process of development of structure and increase of information. In 1962 Norbert Wiener's writing on change counteracting was still the prevailing paradigm. I felt somewhat fed up and wrote "The second cybernetics" by simplifying my earlier "Morphogenesis and mor-

phostasis" paper, deleting the mathematical technicalities. The manuscript was rejected by 10 American journals, but finally *American Scientist* accepted it.

The readers understood the quantitative side of it immediately. However, its *qualitative* side, (i.e., the notion that heterogeneity is indispensable, desirable, and increasing) went almost unnoticed. Consequently, I had to write "Heterogenistics"<sup>2</sup> and "Heterogenistics and morphogenetics"<sup>3</sup> to emphasize the role of heterogeneity. When I wrote "The second cybernetics," what I meant was "a different kind of cybernetics" compared to what Wiener had formulated. I meant nothing numerical in the term "the second." However, in subsequent years several authors wrote articles that they called "the third cybernetics," "the fourth cybernetics," and so on. Their sequential pattern of thinking differed from my nonserial conceptualization of cybernetics.

In my student years in Sweden I noticed that the difficulty among Europeans in comprehending *simultaneous* interactions as well as the role of heterogeneity was due to epistemological rather than intellectual limitations. Therefore, I developed theories on epistemological limitations such as "Communication-epistemology,"<sup>4,6</sup> "Mindscapes and science theories,"<sup>7</sup> and several others. I see eminent scholars trapped in epistemological prisons. Prigogine is striving to find "the prime mover" in Big Bang, Catastrophe Theory, dissipation, fluctuation, bifurcation points, and so on, despite the fact that, for interactive thinking, the notion of the prime mover is a straw man.<sup>7</sup> The inventor of photoklystron, John Freeman, as well as some eminent physicists such as Henry Kolm of the Massachusetts Institute of Technology and G.K. O'Neill of Princeton, excluded electromagnetic mutual induction in their initial design of klystron arrays to send solar energy, and it was only after my suggestion that they decided to make use of mutual induction.<sup>7</sup> Many economists are still trapped in equilibristic or cyclicistic theories.<sup>8</sup>

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2. ----- Heterogenistics. *Acta Biotheor.* 26:120-36, 1977.
3. ----- Heterogenistics and morphogenetics. *Theor. Soc.* 5:75-96, 1978.
4. ----- Communicational epistemology. Part 1. *Brit. J. Phil. Sci.* 11:319-27, 1961.
5. ----- Communicational epistemology. Part 2. *Brit. J. Phil. Sci.* 12:52-62, 1961.
6. ----- Communicational epistemology. Part 3. *Brit. J. Phil. Sci.* 12:117-31, 1961.
7. ----- Mindscapes and science theories. *Curr. Anthropol.* 21:589-99, 1980.
8. ----- Morphogenetic economics. *Technol. Forecast. Soc. Change* 29:205-13, 1986.