

# Development of systems thinking

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This diagram had been developed over a number of year in an attempt to represent the development of systems thinking and complexity and some of areas in which these developments contribute to ethical discourse.

There are isolated reactions to the 17th century mechanistic view of the world propounded by Descartes and Newton, most notably among the philosophers of the romantic movement.

The turn of the 18th century sees the first steps towards ecology and complexity being taken by Humboldt and Gauss respectively. In the 19th century Haeckel, Bernard, Poincaré, and Sussess make significant contributions to subjects which will be developed in the 20th century.

Poincaré, in particular brings back the visual representation of mathematics after centuries of concentration on algebra and arithmetic at about the same time as Florence Nightingale is developing the graphical representation of statistics. Both in their own ways contribute to the development of visual representations of complexity.

The foundations of systems thinking in the West are laid largely by the organicists who first define many common systems terms — system, emergence, hierarchy and open system. The baton is then taken up by the cyberneticists who develop the concepts of feedback, redundancy and network as well as establishing the mathematical basis for information theory and the development of systems analysis in information technology.

The biologist, Ludwig von Bertalanffy, tries to unite all the many disciplines, from the life sciences, mathematics and engineering, who are now using systems ideas but the attempt fails, in part because many members of these disciplines are still wedded to a mechanistic view of the world which progressive biologists have abandoned.

However, unbeknown to the West, Alexander Bogdanov has already formulated a theory of systems or 'complexes' which prefigures the work of late 20th century mathematicians and chemists while Gaston Julia has drawn the first fractals without knowing it.

By 1980 the fruits of Gauss's work on complex numbers and Poincaré's work on topology have led to the development of a whole new field of dynamical equations which enable Mandelbrot, Prigogine, Thom, Lorenz, Ueda, Haken and Eigen to describe the behaviour of systems which had not been understood, and in some case not recognised, fifty years earlier.

Stephen Smale had already shown how dynamical equations can be applied to ecological systems and the stage is therefore set for further advances in the study of 'systems' or 'complexes' using the insights born of the new concepts of nonlinear mathematics and far from equilibrium behaviour in a permanently unstable world where random behaviour is an integral part of the survival of many systems.

It is intended to develop the diagram to draw out further some of the associations which are obscured by the current layout, to add further information about the development of systems thinking in engineering and management and to extend its coverage to deep ecology and ecofeminism.

