



From Science I to Science II: Major Changes in the Science Landscapes

Karl H. Müller

WISDOM (Vienna)

July 2, 2010

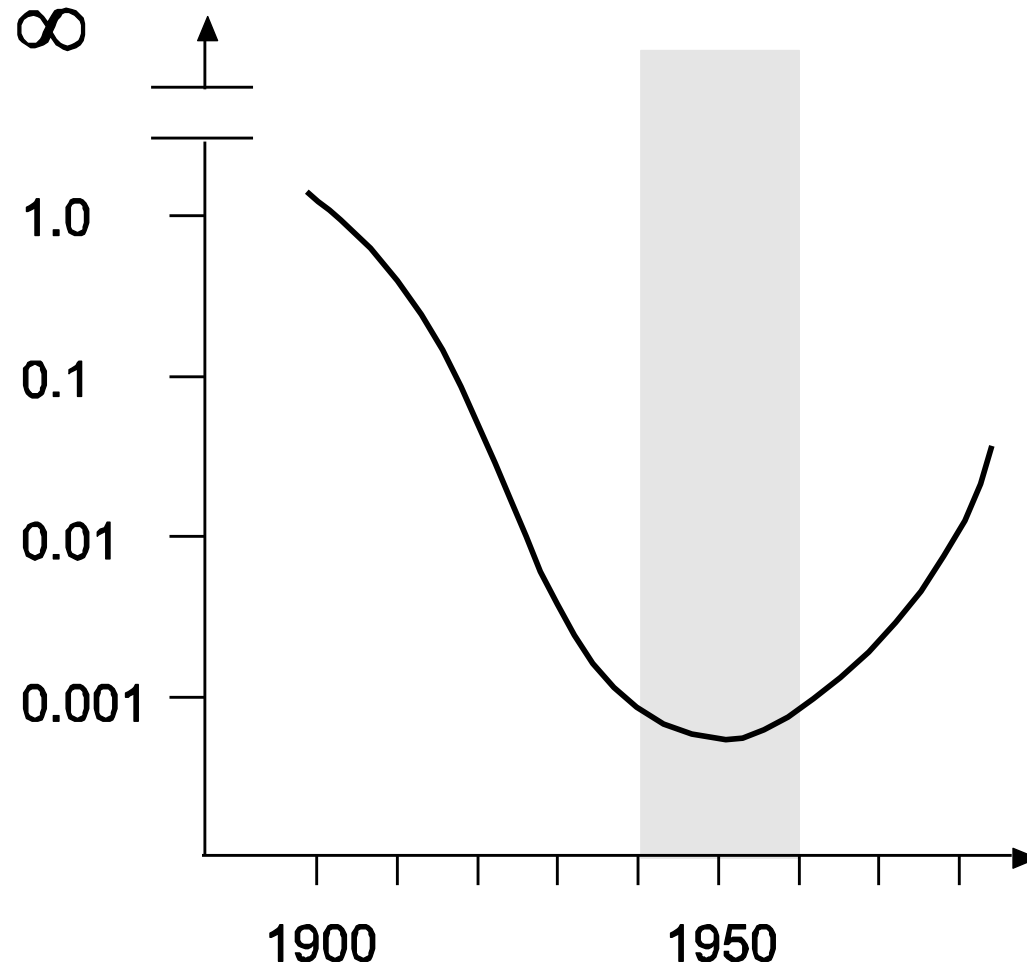
Orlando, Fl.

From Science I to Science II: An Overview

- **A Cyclical Model for Knowledge Expansion 1600 - 2000**
- **Major Shifts between Science I and Science II**
- **Two Clusters of Changes**
 - **Observer-Inclusion**
 - **New Types of Research Designs**



Rescher's Knowledge Cycles 1600 - 2000



Towards New Foundations of Scientific Landscapes 1900 - 1950

- **Opening up Two Black Boxes:**
 - Atoms
 - Cells and Cellular Reproduction
- **New Inter- and Transdisciplinary Foundations**
 - Information Theory
 - Systems Theory
 - Cybernetics
 - Artificial Intelligence/Cognitive Sciences




Relations between Science I and Science II

- The change from Science I to Science II should not be seen as a substitution process
- Rather, this change should be viewed as an exchange of center/periphery relations. The keyword should be hegemony.
 - The core principles of Science I move into the periphery of Science II
 - The peripheral, marginal or even forbidden domains within Science I become central for Science II




On Hegemonic Relations

Different Types of Hegemony in the Course of Scientific Evolution


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- **Regional Hegemonies:** The Dominance of Specific Regions in the Long-Term Evolution of Science
England 1630 – 1730, France 1730 – 1830, Germany 1830 – 1930s, USA 1945 onward
(Hollingsworth, J.R., K.H. Müller, E.J. Hollingsworth (2008), “The End of the Science Superpowers”, in: *Nature* 454, 412 – 413)
 - Hegemonies with Respect to **Operating Principles** and **Designs**

Changes between Science I and Science II




Dimensions	Science I	Science II
Leading Fields of Science	Classical Physics	Evolutionary Biology and the Sciences of Complexity
Theoretical Goals	General, Universal Laws	Pattern Formation/Recognition
Metaphors	Clocks	Clouds

Changes between Science I and Science II (Continued)




Dimensions	Science I	Science II
Cognitive Organization	Axiomatic, Reductionistic	Recombinative, Nested
Generative Mechanisms	Trivial Mechanisms	Non.Trivial Mechanisms
Forecasting Capacities	High	Low

Changes between Science I and Science II (Continued)




Dimensions	Science I	Science II
Epistemology	Observer Excluded	Observer Included
Self-Reference	Excluded	Included
Research Designs I	Exclusive	Inclusive

Changes between Science I and Science II (Continued)




Dimensions	Science I	Science II
Research Designs II	Single Step	Recursive, Closed
Relations	Causal	Generative
Cognitive Goals	Deductions. Inductions	Eigenforms

Changes between Science I and Science II (Continued)



Dimensions	Science I	Science II
Degree of Complexity	Low	High
Perspectives on Change	Linear, Equilibrium	Non-Linear Far from Equilibrium
Distributions	Mild	Wild

Changes between Science I and Science II (Continued)



Dimensions	Science I	Science II
Potential for Inter-Disciplinarity	Low	High
Common Metaphors, and Mechanisms	Low	High
Cognitive Distances for Social Sciences	High	Low/Medium
ICT-Support	Low	High

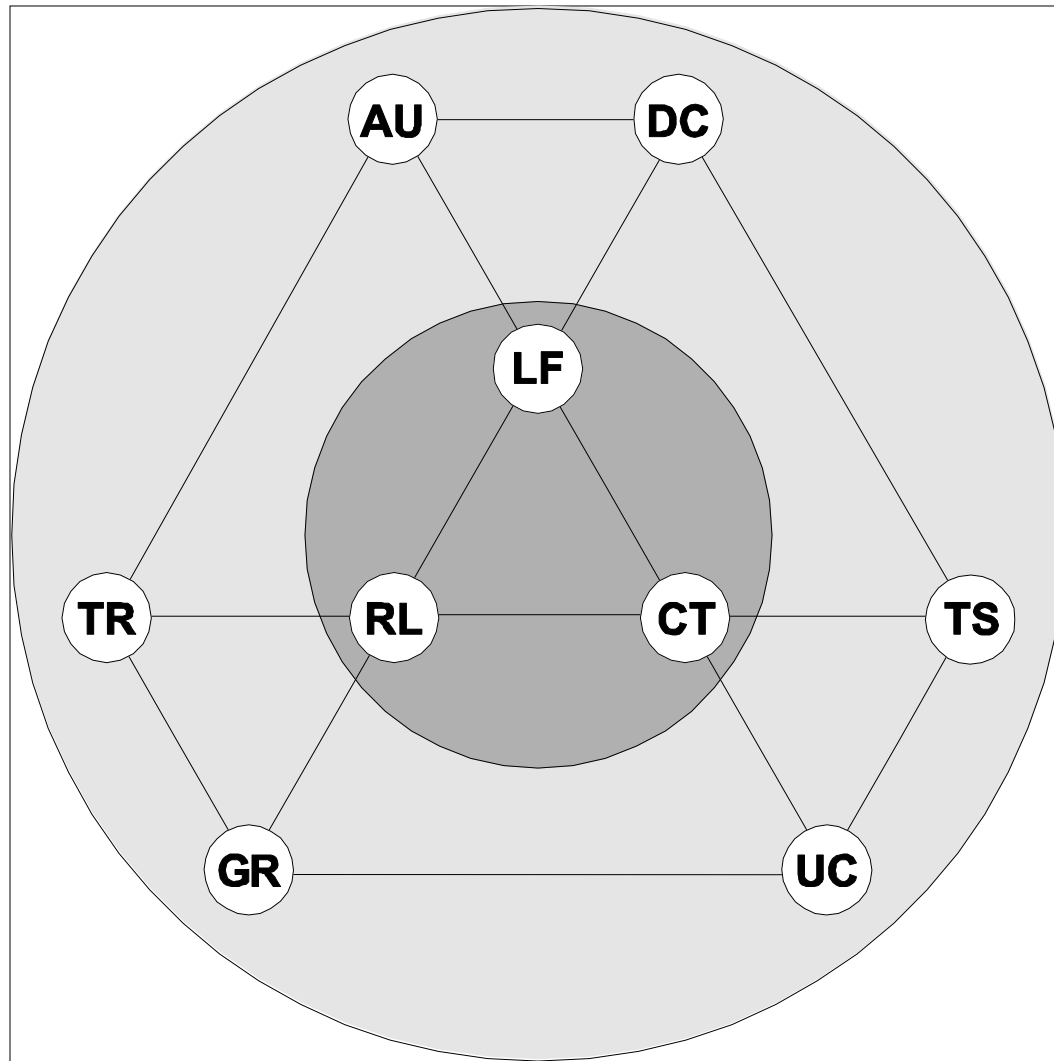
Heinz von Foerster and Second-Order Cybernetics

Second-order cybernetics (SOC) has been propagated as a new form of science of living systems by living systems for living systems

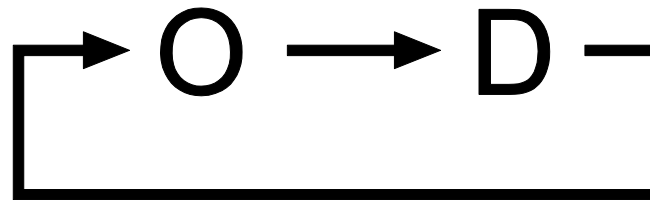
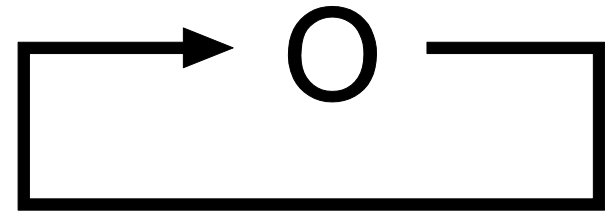
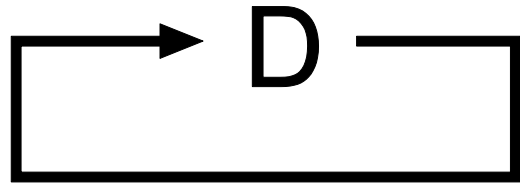
SOC was developed in several articles by Heinz von Foerster during the 1970s and 1980s, albeit in a very rudimentary manner. (But including highly interesting research ideas)



The Organization of Second-Order Cybernetics



Science II: Three Main Roads towards Self-ish Designs



Re-Entry of a Domain into Itself: $D \rightarrow D$

D stands for a variety of different domains:

- Modernization II (Self-reflective, U. Beck (1986ff.))
- Societal Problem ((= Former Scientific Problem Solution)
- Others (Self-Reflexivity, Lefebvre)
- Theoretical Concepts (Explanation, understanding, etc.)
- Theories (Evolutionary theory of evolutionary theories, etc.)
- Scientific disciplines (sociology of sociology, cybernetics of cybernetics, history of history, etc.)
- Scientific Outcomes (Tests, Meta-Analysis)
- Second-order Science (Philosophy of Science, etc.)



Re-Entry of an Observer into Her/His Operations: Ob \rightarrow Ob

A re-entry of the observer can be accomplished in a variety of ways:

- Statement \rightarrow Ob (Statement) (Contextualization)
- Object \rightarrow Ob (Object)
- Self-Mappings
- Self-Modeling
- Self-Inclusion



Re-Entry of an Observer into Her/His Observational Domain: $O(D) \rightarrow O(D)$

The Most Difficult Form of Self-ishness

- Self-Describing Descriptions
- Self-Writing Theories (e.g., DNA)
- Self-Designing Designs



Science II: Towards More Robust Knowledge

Creating More Robust Knowledge in the Phase of Societal Complexification by

- Using the New Models, Mechanisms, Models and Metaphors of Complexity Science
- Bringing the Researchers Back in
- Organizing Reserach More and More in a Transdisciplinary Manner
- Non-Trivializing the Domains of Living Systems
- Shifting to Recursive Research Designs



Relevant Literature

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Müller, A. K.H. Müller (2007)(eds.), *An Unfinished Revolution? Heinz von Foerster and the Biological Computer Laboratory.* Vienne:edition echoraum

Müller K.H. (2009 – 2011), *The New Science of Cybernetics. The Evolution of Living Research Designs*, 3 vol. Vienna: edition echoraum

Hollingsworth, J.R., K.H. Müller (2008), „Transforming Socio-Economics with a New Epistemology“, in: *Socio-Economic Review* 3 (6), 395 – 426

Comments by Robert Boyer, Renate Mayntz, Helga Nowotny, Didier Sornette et al.



Contact Details

Karl H. Müller

WISDOM

Liechtensteinstraße 22a/2/17

A-1090 Vienna

Austria

Tel: ++43 1 319 41 311 / ++43 1 664 4191 961

www.wisdom.at

mueller@wisdom.at



Socio-Economic Distances across Europe

