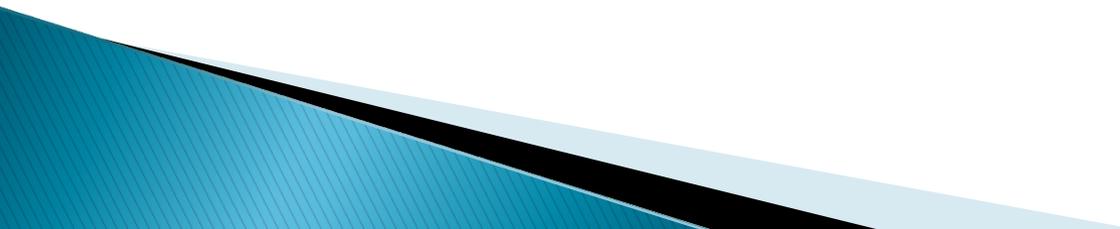


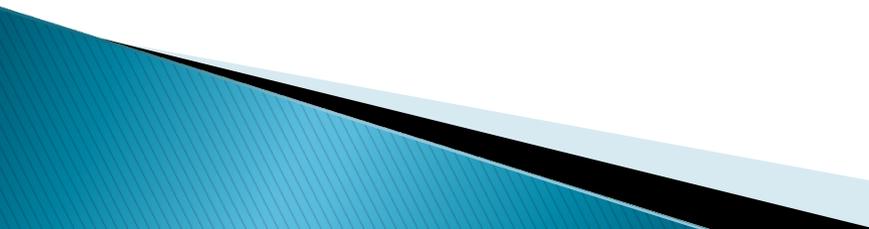
A Reflexive View of a Transdisciplinary Field: The Case of Cybernetics

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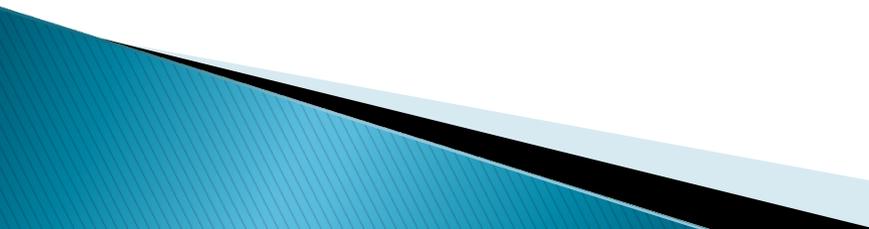
Overview

- ▶ I shall use reflexivity theory in describing the evolution of cybernetics
 - ▶ I shall make a distinction between two types of science – science one and science two
 - ▶ I shall compare the history of cybernetics with other fields in systems science (e.g., artificial intelligence, cognitive science, and complex systems) and with the social sciences
 - ▶ The benefits of and obstacles to transdisciplinary fields will be described and a proposal presented
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Definitions

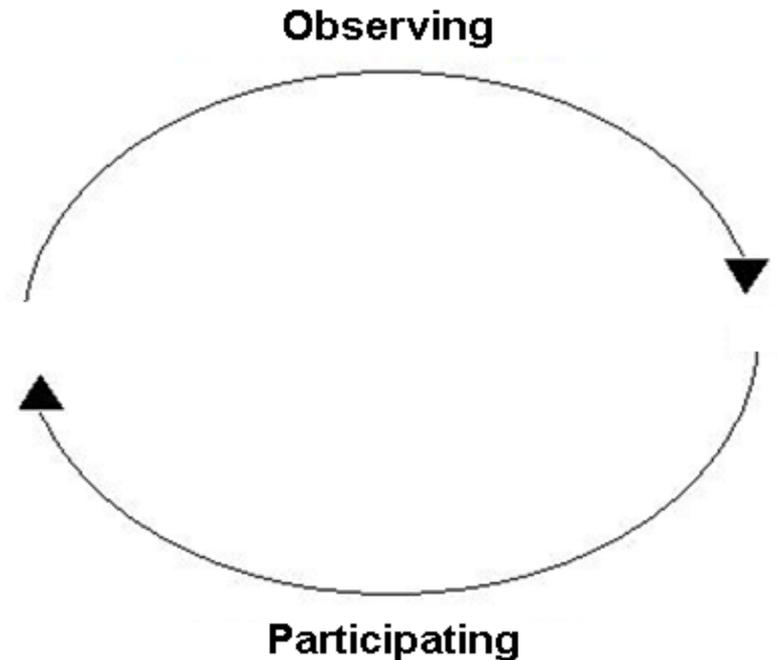
- ▶ “reflection” – the return of light or sound waves from a surface; the action of bending or folding back; an idea or opinion made as a result of meditation
 - ▶ “reflexive” -- a relation that exists between an entity and itself
 - ▶ “self-reference” – such statements lead to paradox, a form of inconsistency
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Four reflexive theories

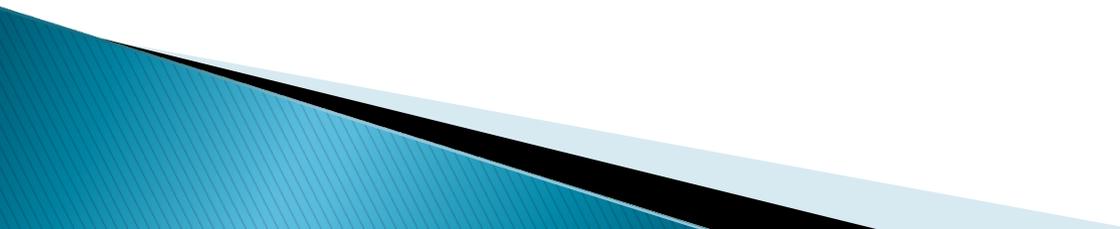
- Heinz von Foerster: Include the observer in the domain of science (1974)
 - Vladimir Lefebvre: Reflect on the ethical system one is using (1982)
 - Donald Schon: Management as reflective practice (1983)
 - George Soros: Individuals are actors as well as observers of economic and political systems (1987)
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Reflexive Practice

- ▶ This paper is an example of reflective practice
- ▶ The paper illustrates the observing function
- ▶ It is a report on the participating function



Science one and science two

- A distinction has been made between science one and science two
 - Science one is classical science, where the observer is excluded from the domain of observation
 - Science two is an expanded view of science in which the observer is included in the domain of observation
 - Science two is a reflexive view of science
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The purpose

- Promoting second order cybernetics, beginning in 1974, among scientists in various fields
 - Advancing cybernetics itself from engineering cybernetics to biological cybernetics to social cybernetics to an emphasis on the philosophy of science
 - Expanding what we think of as science by adding attention to the observer
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The environment

- ▶ Cybernetics is one of the system sciences
 - ▶ Recent cybernetics is closely related to social science
 - ▶ Just as physics provides a theory of matter and energy for the engineering disciplines, cybernetics can be seen as providing a theory of information-processing and decision-making for the social and design sciences
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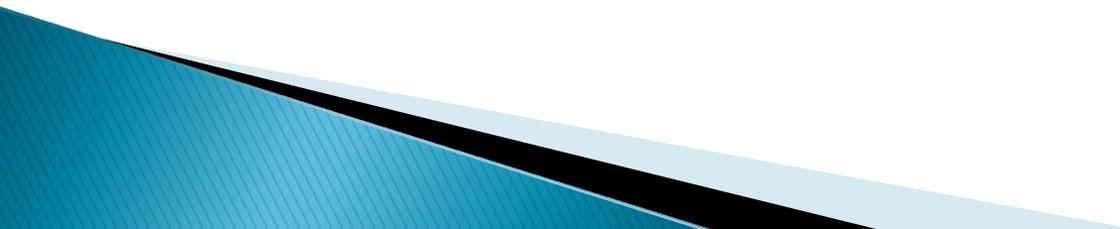
Eight dimensions on which science has expanded since World War II

1. From a concern with entities to a concern with relationships
 2. From environment free to environment full descriptions
 3. From determinism to indeterminism
 4. From linear causality to circular causality
 5. From reduction to holism
 6. From programming to self-organization
 7. From not-knowing subjects to knowing subjects
 8. From realism to constructivism in epistemology
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Unity and diversity in systems science

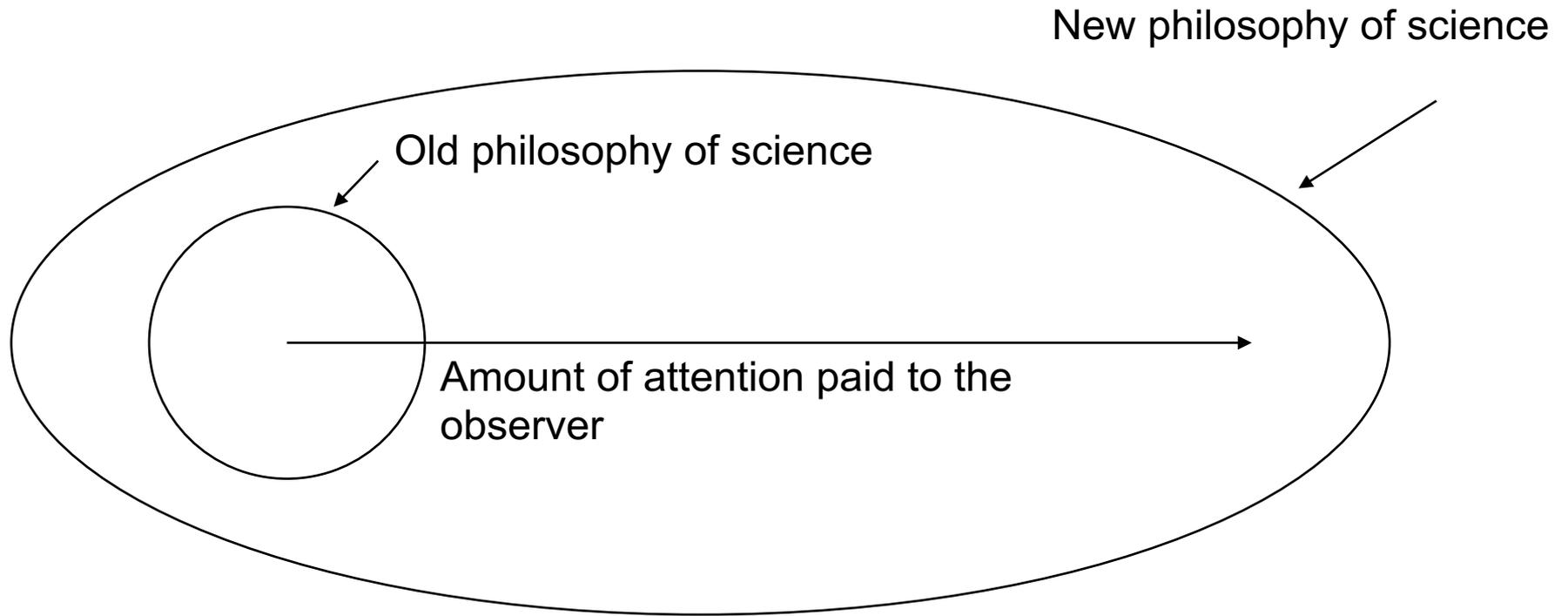
- Different fields within the systems sciences (e.g., artificial intelligence, cognitive science, system dynamics, operations research, and cybernetics) have emphasized different combinations of these eight dimensions
 - These dimensions both unite and divide
 - All systems science fields share an interest in one or more dimension
 - There are disagreements on which dimension is most important
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Informal and formal approaches

- ▶ Each dimension indicates new possibilities
 - ▶ An informal approach to the dimensions is based on the idea, “To illuminate is to obscure.” Focusing attention on one method neglects or ignores other methods
 - ▶ A formal approach to the dimensions involves the correspondence principle
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The Correspondence Principle

- ▶ Proposed by Niels Bohr when developing the quantum theory
 - ▶ Any new theory should reduce to the old theory to which it corresponds for those cases in which the old theory is known to hold
 - ▶ A new dimension is required
- 



An Application of the Correspondence Principle

Types of Scientific Fields

Dimension	Complex Systems	Cybernetics
Relationships	Yes	Yes
Environment	Yes	Yes
Indeterminism	Yes	Yes
Causality	Cellular automata	Circular causality
Holism	Yes	Yes
Self Organization	Yes	Yes
Reflexivity	No	Yes
Observation	Realism	Constructivism

Complex systems

- Primarily a method of computer simulation – cellular automata, “the game of life”
 - An extension of the theoretical work on self-organizing systems done around 1960
 - There are two processes – the creation of new variety and selection of appropriate variety
 - The first is usually done within an organism or organization; the second is done by the environment
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Self-organization

- A very general concept – competition among corporations or species, conjectures and refutations in philosophy
 - Earlier versions by Adam Smith, Charles Darwin, Karl Popper, B.F. Skinner, Donald Campbell
 - Explains emergence of new entities
 - Stephen Wolfram’s “new kind of science”
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Second order cybernetics or reflexivity

- ▶ Describes circular causal processes
 - ▶ Includes the observer in the domain of observation
 - ▶ Involves shifting levels of analysis – both observation and participation
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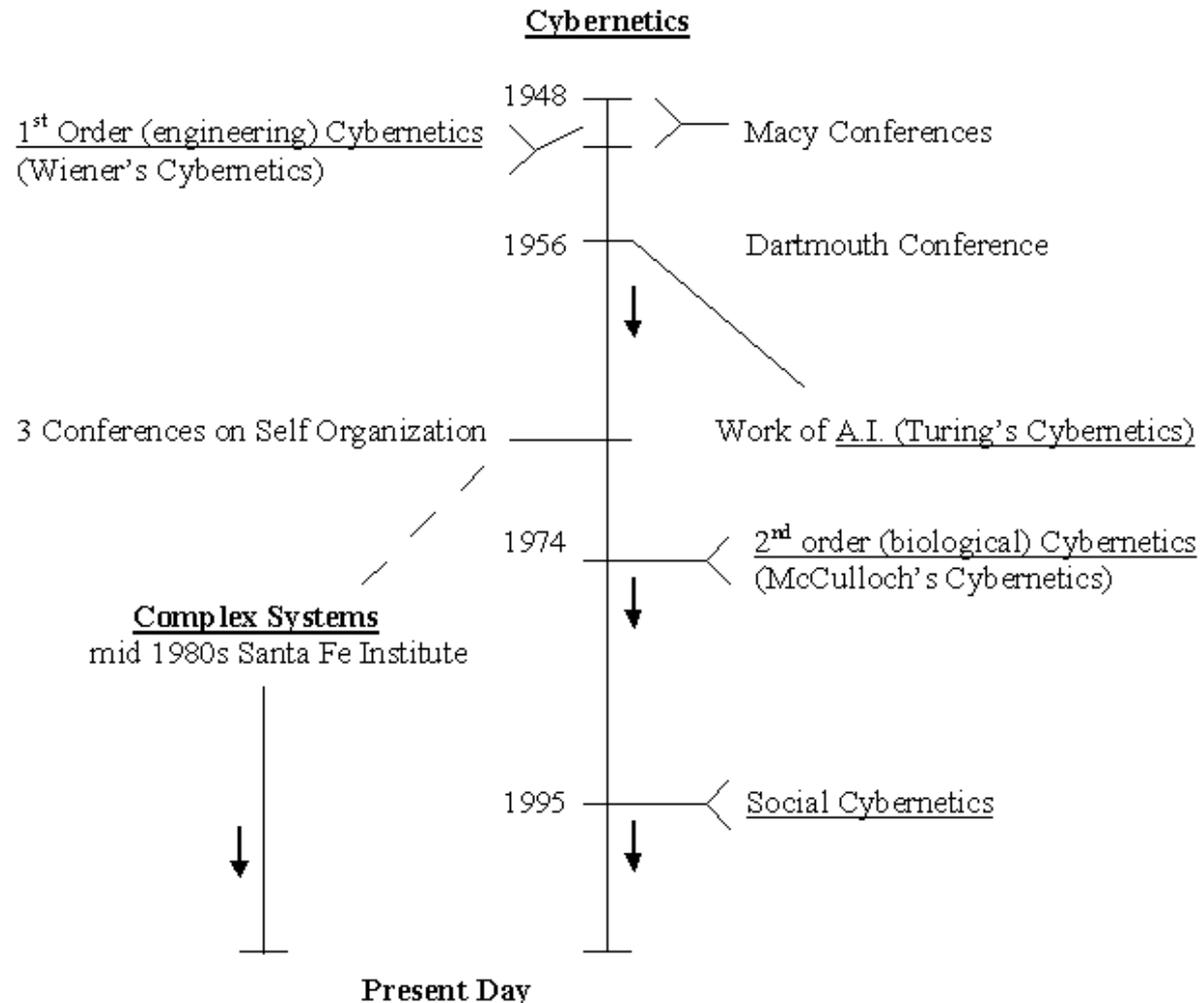
Stages in the development of cybernetics

- ▶ Engineering cybernetics
 - ▶ Biological cybernetics
 - ▶ Social cybernetics
 - ▶ Philosophy of science
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Cybernetics

	Engineering Cybernetics	Biological Cybernetics	Social Cybernetics
Key distinction	Reality vs. scientific theories	Realism vs. constructivism	Biology of cognition vs. observer as a social participant
What must be explained	How the world works	How an individual constructs a “reality”	How people create, maintain and change social systems through language and ideas

A history of cybernetics



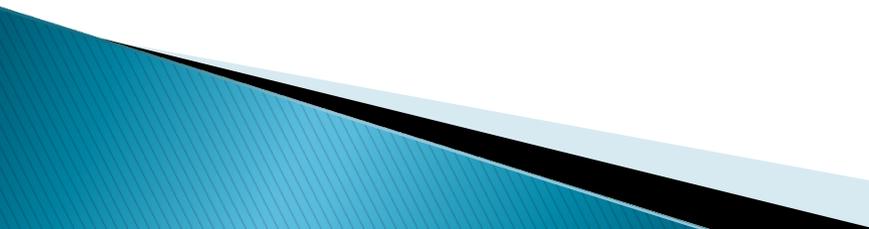
Achievements of second order cybernetics

- Cybernetics has led to changes in family therapy and psychotherapy in general
 - We now have a better understanding of the biological foundations of knowledge
 - A transdisciplinary foundation for cognitive science has been created, though ideas from cybernetics are not yet widely used
 - “Social cybernetics” is being developed, which provides a common foundation for the social and design sciences
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Current areas of application

- ▶ Returning to a closed loop, holistic approach to the global environment
 - ▶ Taking a constructivist approach to education
 - ▶ Developing reflexivity theory as an alternative to equilibrium theory in economics as a way to understand the financial crisis
 - ▶ Expanding the philosophy of science to more effectively encompass the social sciences
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Social science and the philosophy of science

- Social scientists have struggled to construct knowledge in accord with the philosophy of science
 - Economists have followed Popper's Doctrine of the Unity of Method and have constructed deductive theories based on unrealistic assumptions
 - Many social scientists have chosen to disregard the philosophy of science
 - An alternative is to expand the conception of science
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Should knowledge in the field of management be constructed in the form of theories or methods?

Theories

Methods

Is there a difference between the natural sciences and the social sciences?

Yes

No

Should we reject the philosophy of science?

Popper's doctrine of the unity of method

Yes

No

What should take its place?
How should knowledge be constructed?

Expand the philosophy of science to include knowing subjects

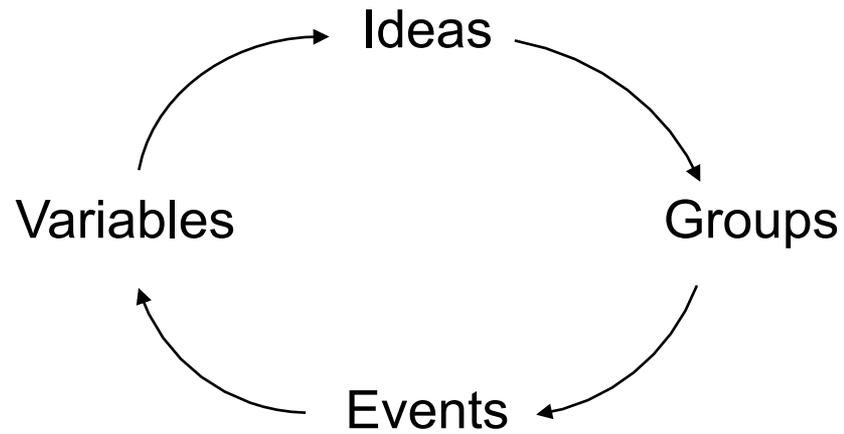
Should methods be for the use of individuals or groups?

Individuals

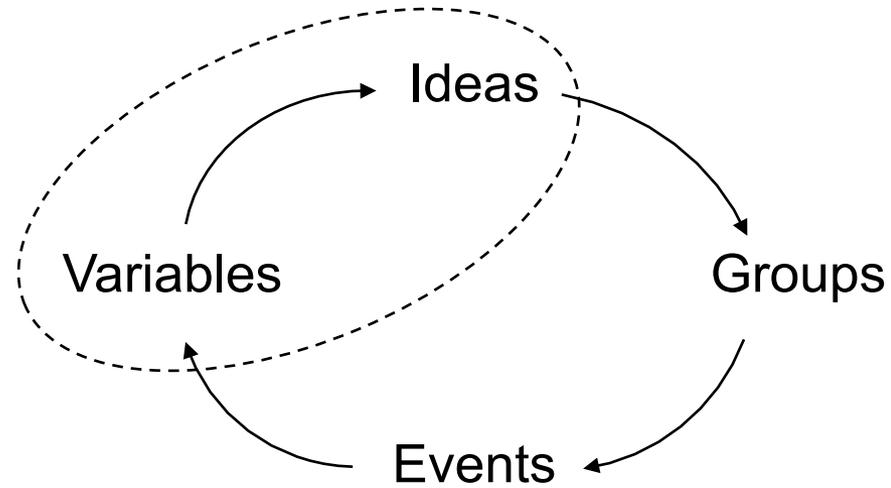
Groups

“Think like this”

“Act like this”



A model of social change using four methods for describing systems

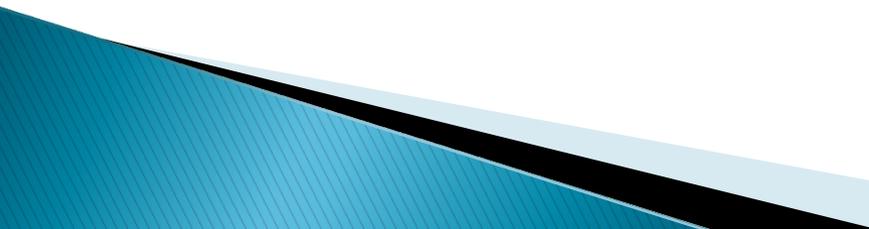


A reflexive theory operates at two levels

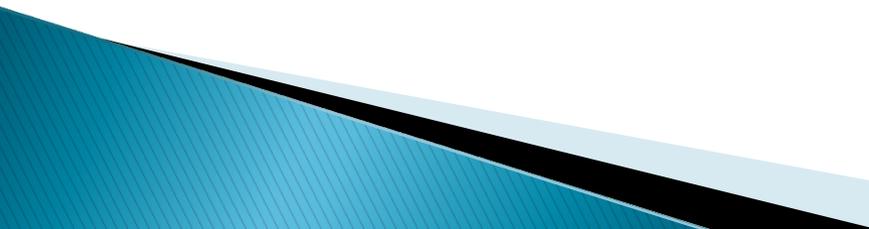
What has been learned

- History and culture affect the acceptance of scientific ideas -- ideas that generate considerable interest in one society may be of little interest in another
 - Changing the philosophy of science is much more difficult than adding an idea to a single field
 - The informal fallacies can serve as a guide to how much resistance an idea may encounter
 - Challenging existing fields diminishes funding opportunities (e.g., cognitive science)
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Institutional obstacles

- In universities promotion is enhanced by narrow specialization
 - Preserving and passing on “the literature” leads to a focus on the past rather than the future
 - A lack of degree granting programs means ideas are not passed on to the next generation
 - Accrediting agencies tend to destroy transdisciplinary research centers
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Some consequences of lack of interest in cybernetics

- ▶ Transdisciplinary ideas tend to be reinvented, sometimes in less elegant form, at about 20 year intervals
 - ▶ There is a lack of continuity in the development of ideas
 - ▶ A lack of transdisciplinary programs on campuses means communication among disciplines is less effective than it could be
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Suggestions for Promoting Cybernetics

1. Encourage transdisciplinary research on university campuses
 2. Establish cybernetics as an introductory course/field to other disciplines on university campuses
 3. The “Wandwaver Solution”
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The “Wandwaver Solution”

- John Warfield on three “colleges” in a university
 - The Heritage College offers what has been learned in the past – sciences, humanities, languages
 - The Professional College provides the disciplines of current practice – business, law, engineering, medicine
 - The Horizons College is concerned with the future and design. The core curriculum is systems science

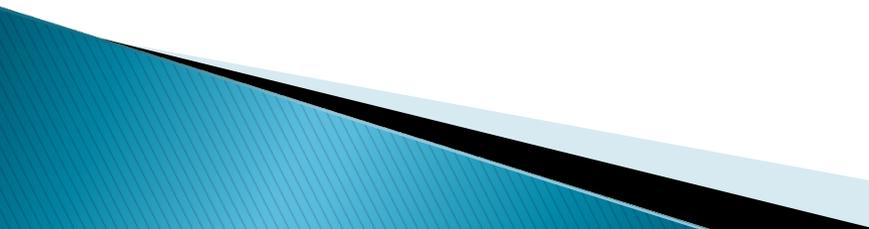
Restructuring a university

- A solution to the problem that accrediting agencies disassemble multi-disciplinary programs
 - Similar to an Institute for Advanced Study, but there is also a curriculum and degrees
 - Faculty members from the other two colleges spend some time in the Horizons College
 - The Horizons College binds together and connects the various parts of the university by designing solutions to current problems
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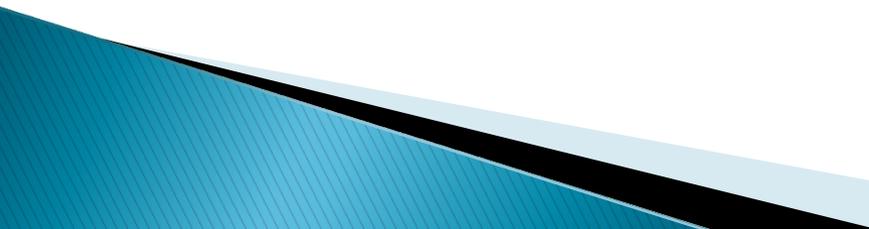
Results of this endeavor

- ▶ Some successes have been achieved in introducing new ideas to existing fields
 - ▶ The field of cybernetics itself has evolved
 - ▶ Some obstacles to change in universities have been identified
 - ▶ A better understanding of the nature of current science is one result
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Science one vs. science two

- ▶ Observing
 - ▶ Describing
 - ▶ Testing knowledge
 - ▶ Extrapolating/
forecasting
 - ▶ Reproducing
experiments
 - ▶ Accuracy/ precision
 - ▶ Participating
 - ▶ Prescribing
 - ▶ Solving problems
 - ▶ Creating/ designing
 - ▶ Achieving
agreement or
acceptance
 - ▶ Usefulness
- 

Concluding thoughts

- ▶ Reflective practice has revealed the obstacles that stand in the way of transdisciplinary research in general and cybernetics in particular
 - ▶ Potential solutions to these problems were proposed
 - ▶ More work is needed to connect cybernetics to other fields, e.g., philosophy of science, cognitive science, psychology, economics, management, political science, environmental studies
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