



A rack of test tubes containing liquids of various colors (red, orange, yellow, green) under a black light, with the word "EXPERIMENT" overlaid in white text. The test tubes are arranged in a row, and the liquids inside them are glowing with different colors. The background is dark, and the overall scene is illuminated by the black light, creating a dramatic and scientific atmosphere. The word "EXPERIMENT" is centered over the middle of the rack of test tubes.

**EXPERIMENT**



**ANTICIPATORY SYSTEMS**



**TURBULENCE**



**COEVOLUTION**

# ANTICIPATORY SYSTEMS



- Robert Rosen
- Simple Systems vs. Complex Systems
- The Modelling Relation
- Anticipatory Systems
- Example



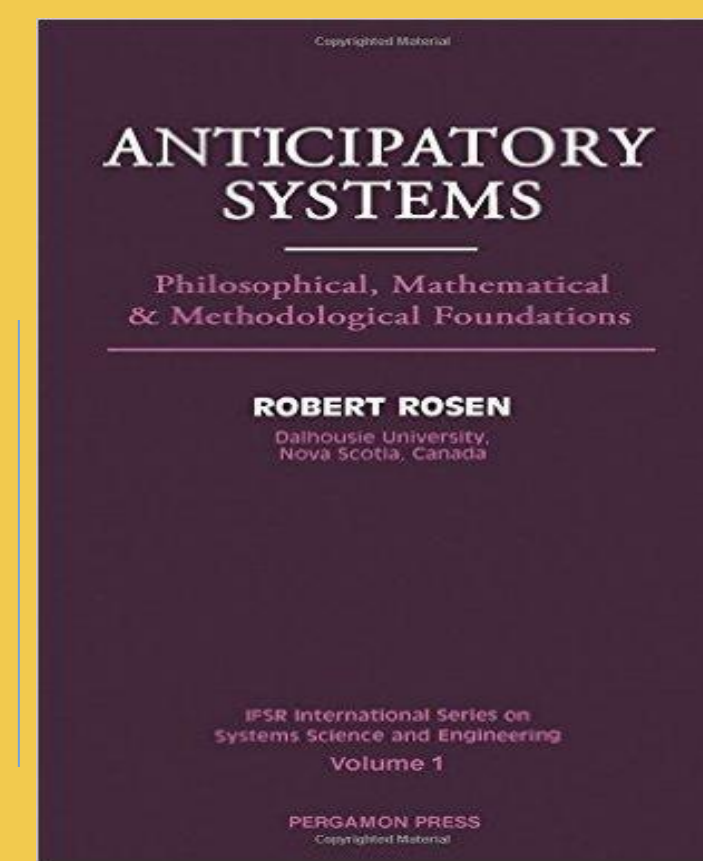


## Robert Rosen

The casual basic of life is a matter of *relational causality* rather than physical, material causality.

Organizational impact for influencing causality

= *complexity*



Robert Rosen (1934-1998)

Theoretical biologist





## *Simple vs. Complex*

### **SIMPLE SYSTEM**

**minimal organizational impact**

**completely described everything as a finite set of formalisms**

**“the sum of their parts”**

### **COMPLEX SYSTEM**

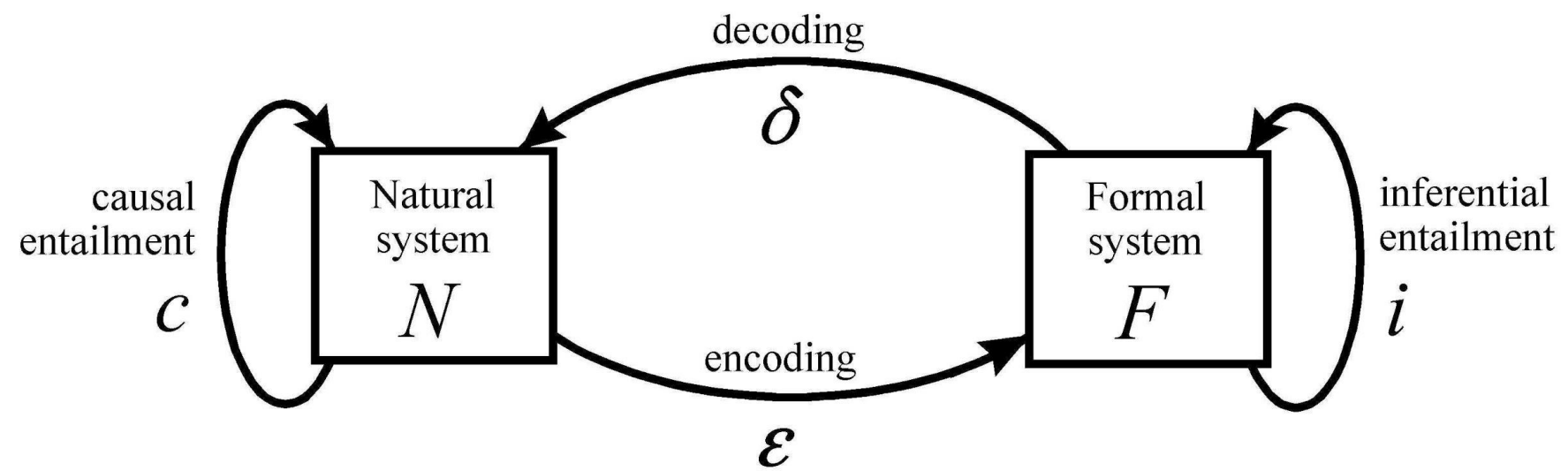
**system potential from organizational impact**

**no way to completely formalize all aspects of the system**

**“more than the sum of their parts”**



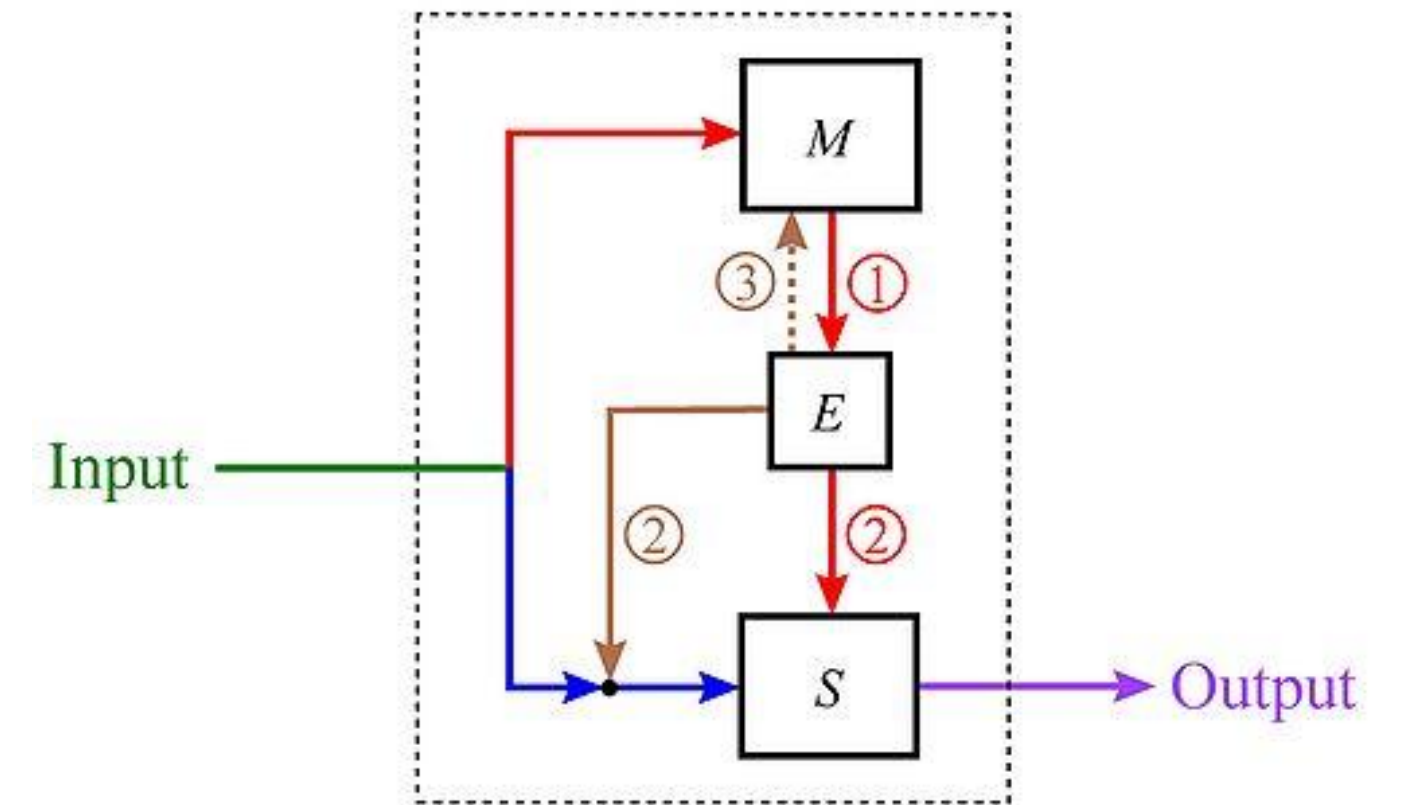
# The modeling relation





## Anticipatory System

An anticipatory system is a natural system that contains **an internal predictive model** of itself and of its environment, which allows it to **change state** at an instant in accord with the model's predictions pertaining to a **later instant**.







# *Anticipatory System*



past-> present-> future

*'real time' and 'faster than real time'*

**A form of information transfer**

**encode and decode information**

**self, species, environment**

**bad models**

**bad effectors**

**side effects**



## *Example*

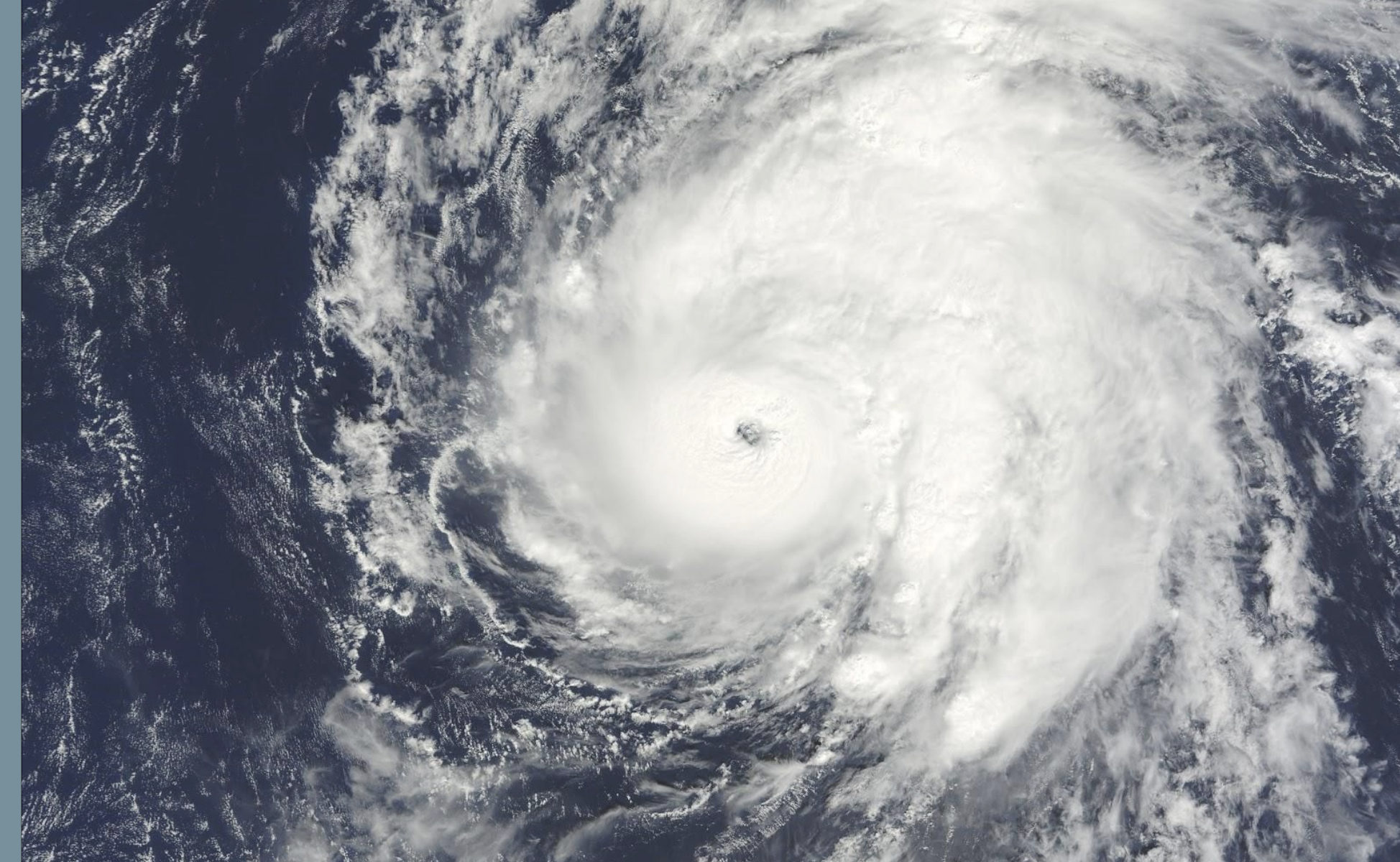
**Anticipatory systems allow organisms to make change before the changes are necessary.**



# TURBULENCE



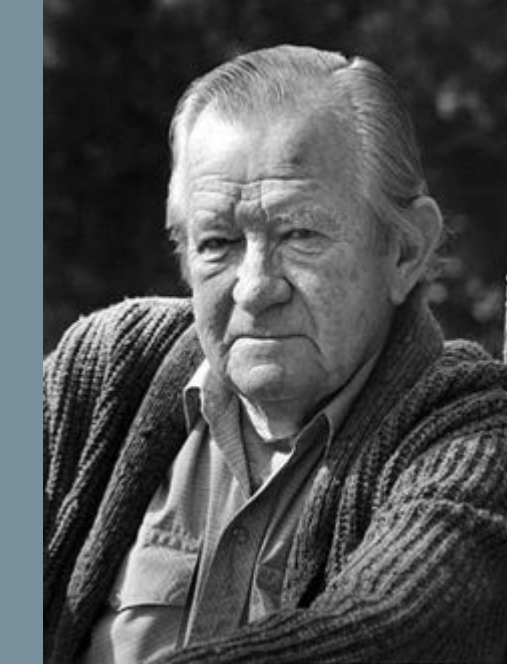
- Four Different Environments
- Negotiated Order
- Network Form Organisations
- Are we all good?



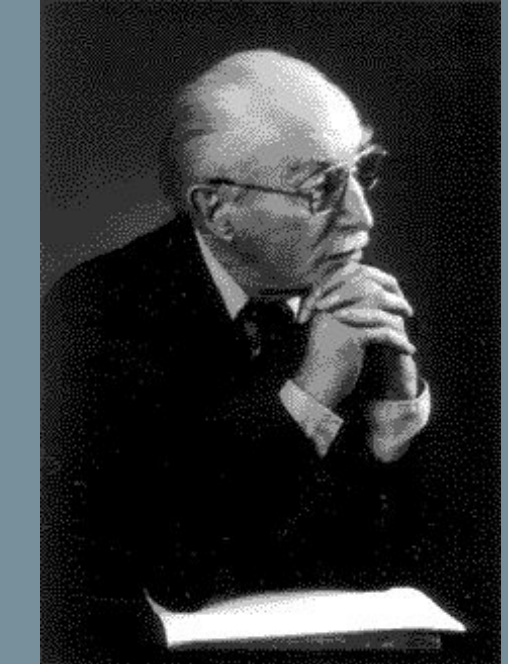


# Four different Environments

Type	Structure	Relationships ("lawful connections")	Response
Random, placid	Resources etc. are randomly distributed in the field.	$L_{11}$	Tactics
Random, clustered	Resources etc. are clustered around the field	$L_{11} + L_{12}$	Stategy
Disturbed, reactive	Similar Systems (Organizations) in competition	$L_{11} + L_{12} + L_{21}$	Operations
Turbulent	The environment becomes highly uncertain and unpredictable (move)	$L_{11} + L_{12} + L_{21} + L_{22}$	Collaboration



**Frederick "Fred" Edmund Emery**  
\*27 August 1925, †10 April 1997  
Australian Psychologist

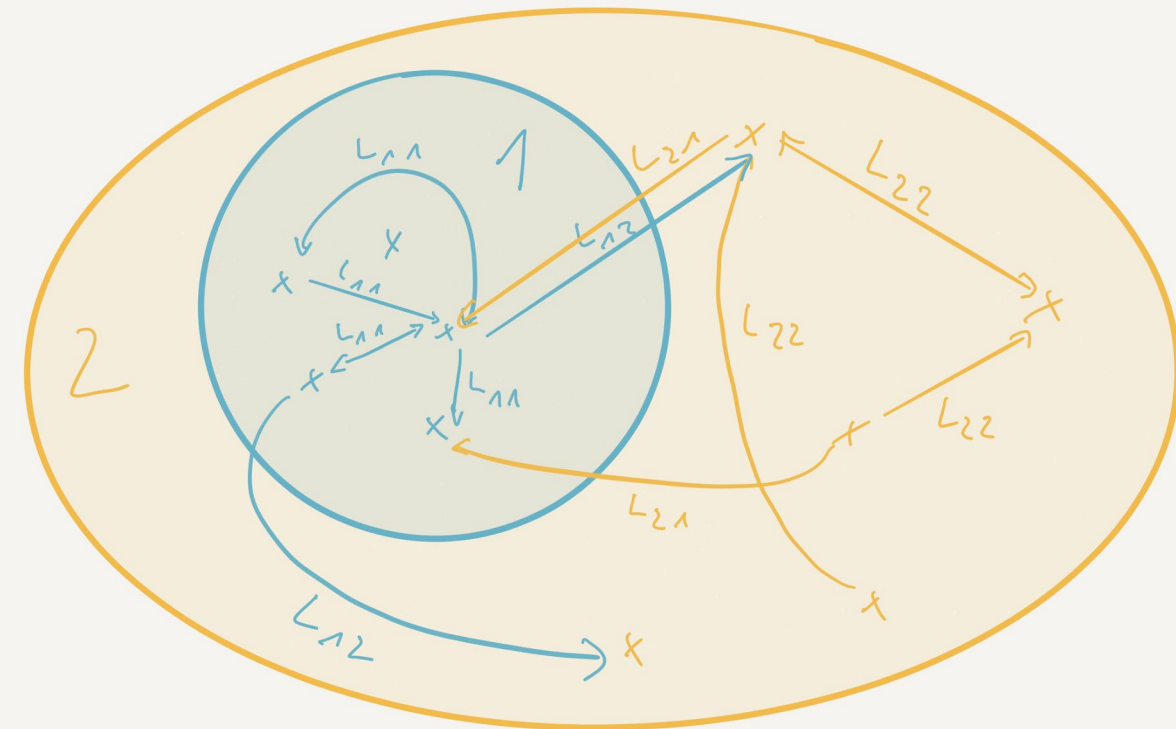


**Eric Lansdown Trist**  
\*11 September 1909, †4 June 1993  
British Psychologist

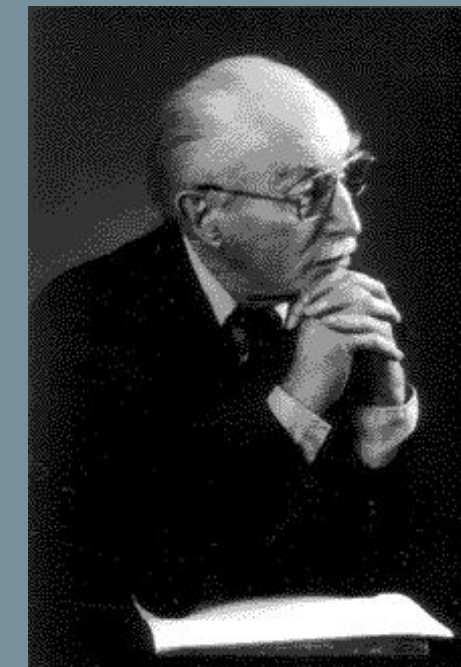


## Four different Environments

1 = Organisation  
2 = Environment  
L = "potentially lawful connections"



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\*27 August 1925, †10 April 1997  
Australian Psychologist



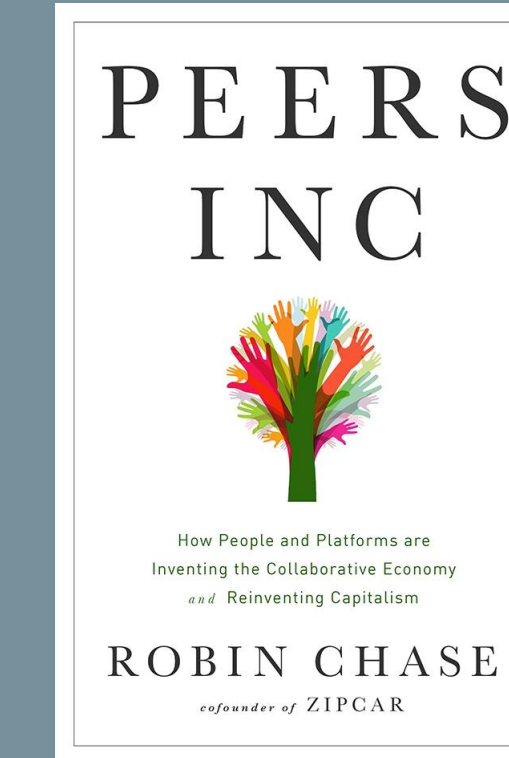
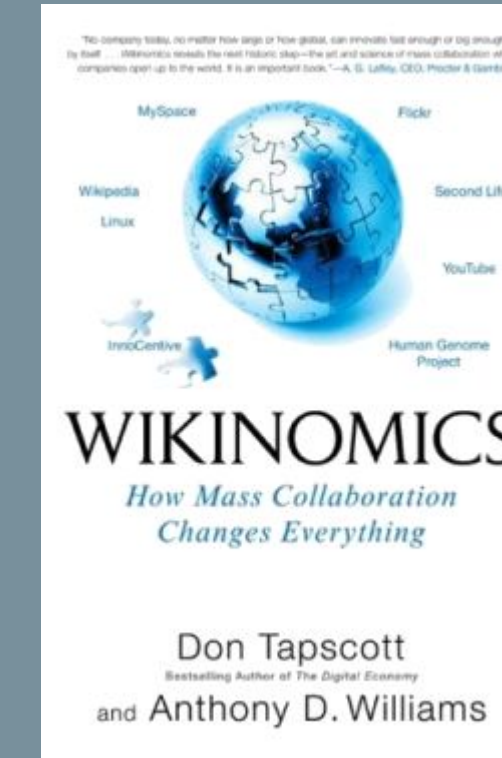
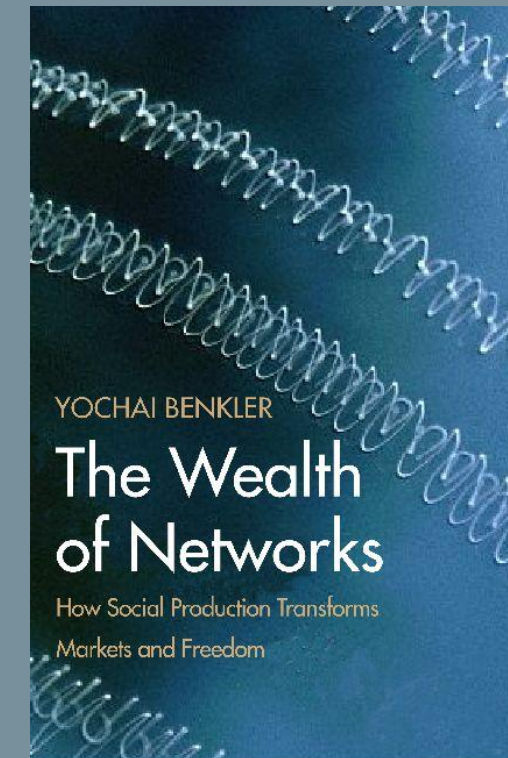
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# Network Form Organisations / Negotiated Order

negotiated order vs. legal order

Benkler: “Commons-based peer-production” in market  
and non-market environments. (2006)



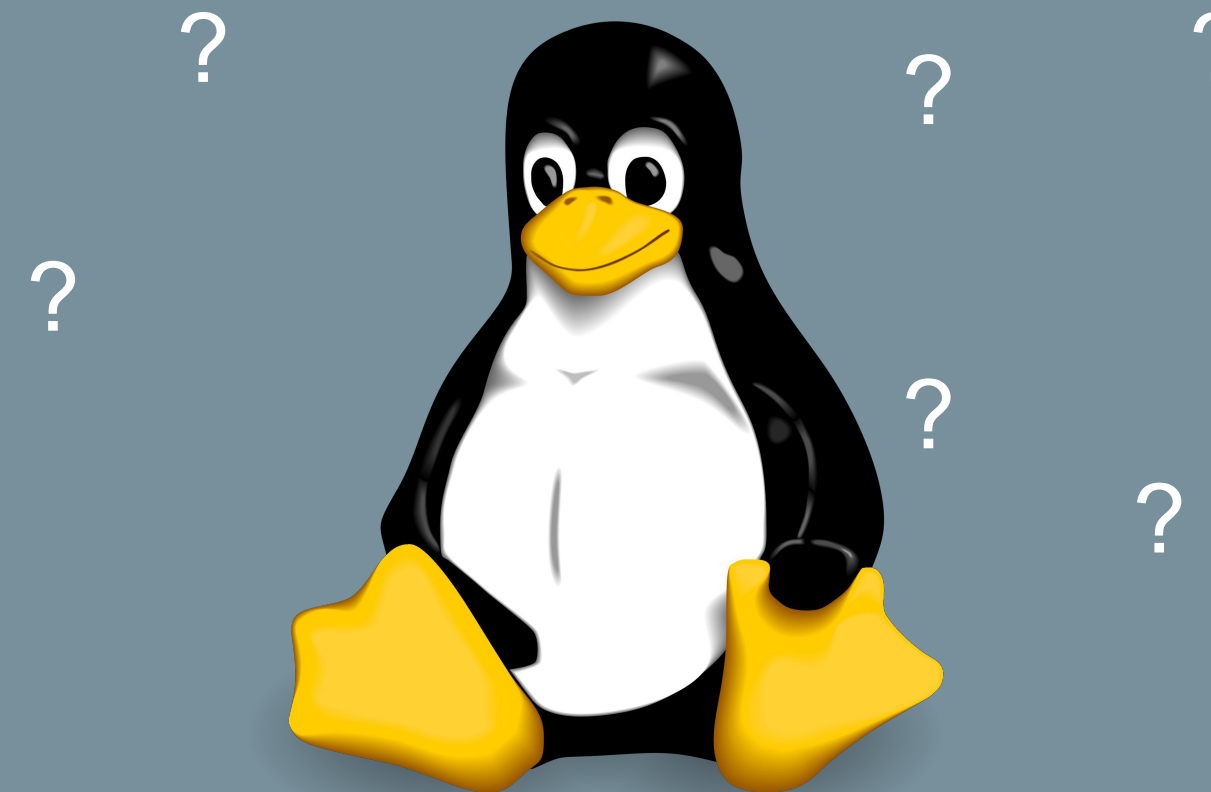


*Are we all good?*

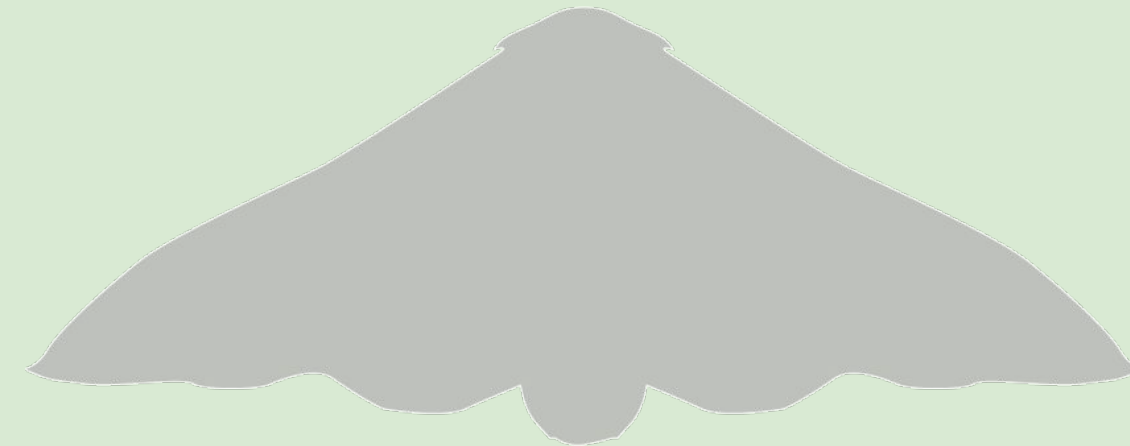
**Mark Granovetter: “social embeddedness”**

*“...the extent to which economic action is linked to or depends on action or institutions that are non-economic in content, goals or processes.” (2005:35)*

**Case: IBM Liquid**



# COEVOLUTION



- What is coevolution?
- Richard B. Norgaard and coevolutionary ecological economics
- A common coevolutionary framework
- Discussion







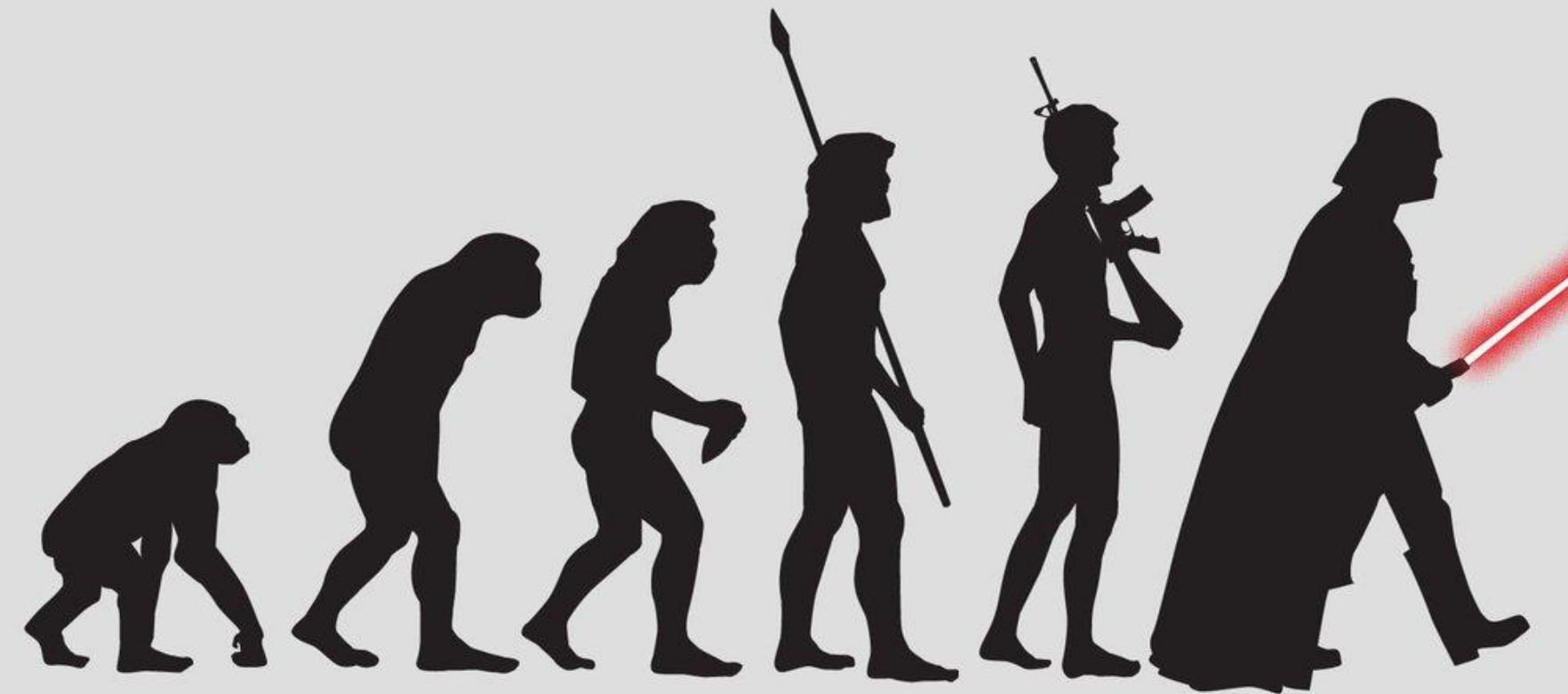
## *Coevolution*





# What is coevolution?

	Type of interaction	Species		General nature of interaction
		1	2	
	1. Neutralism	0	0	Neither population affects the other
“Negative interactions”, types 2 through 4	2. Competition: direct interference type	-	-	Direct inhibition when common resources are in short supply
	3. Competition: resource use type	-	-	Indirect inhibition when common resources are in short supply
	4. Amensalism	-	0	Population 1 inhibited, 2 not affected
Both “positive interactions” and “negative interactions”, types 5 and 6	5. Parasitism	+	-	Population 1, the parasite generally smaller than 2, the host
	6. Predation (including herbivory)	+	-	Population 1, the predator, generally larger than the host
“Positive interactions” types 7 through 9	7. Commensalism	+	0	Population 1, the commensal, benefits, while 2, the host, is not affected
	8. Protocooperation	+	+	Interaction favorable to both but not obligatory
	9. Mutualism	+	+	Interaction favorable to both and obligatory





## *Coevolutionary ecological economics*

### *Coevolutionary mechanisms*

***Biological coevolution:*** between two or more species

***Social coevolution:*** between two or more social systems

***Gene-culture coevolution:*** between cultural evolution and biological evolution of the human species

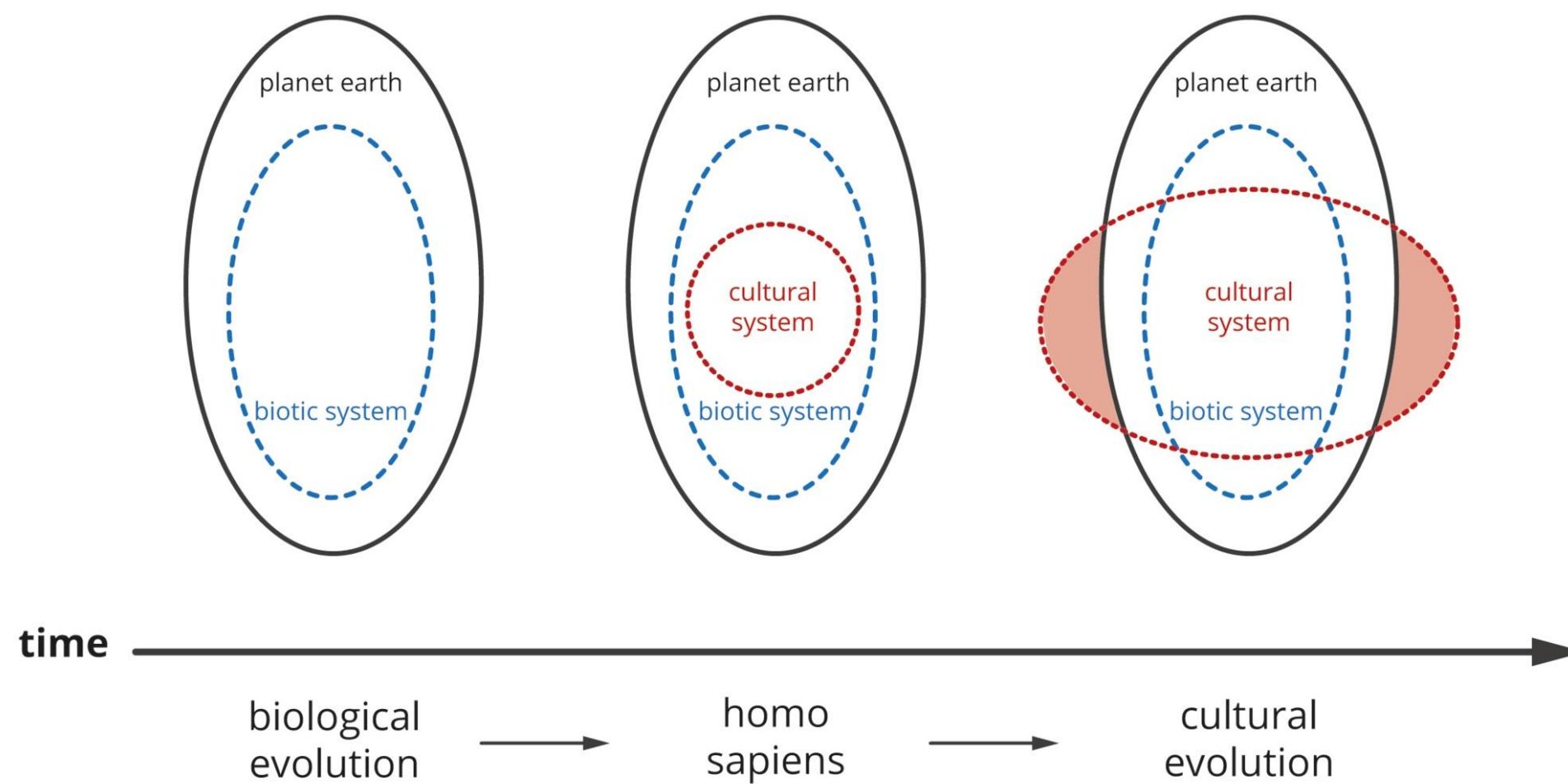
***Bio-social coevolution:*** between social evolution and non-human biological evolution

***Socio-ecological coevolution:*** social system affecting the biophysical environments, and vice versa





# *Nature vs. culture* *- Coevolutionary theory*





## *DISCUSSION*

*How do you see coevolution in your personal life and surroundings?*

*How would you connect coevolution to the exercise?*

*How would you connect coevolution, turbulence and anticipatory systems with each other?*



## *Systems Dancing*



***“It don’t mean a thing,  
if it ain’t got that Swing!”  
Duke Ellington, 1931***

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