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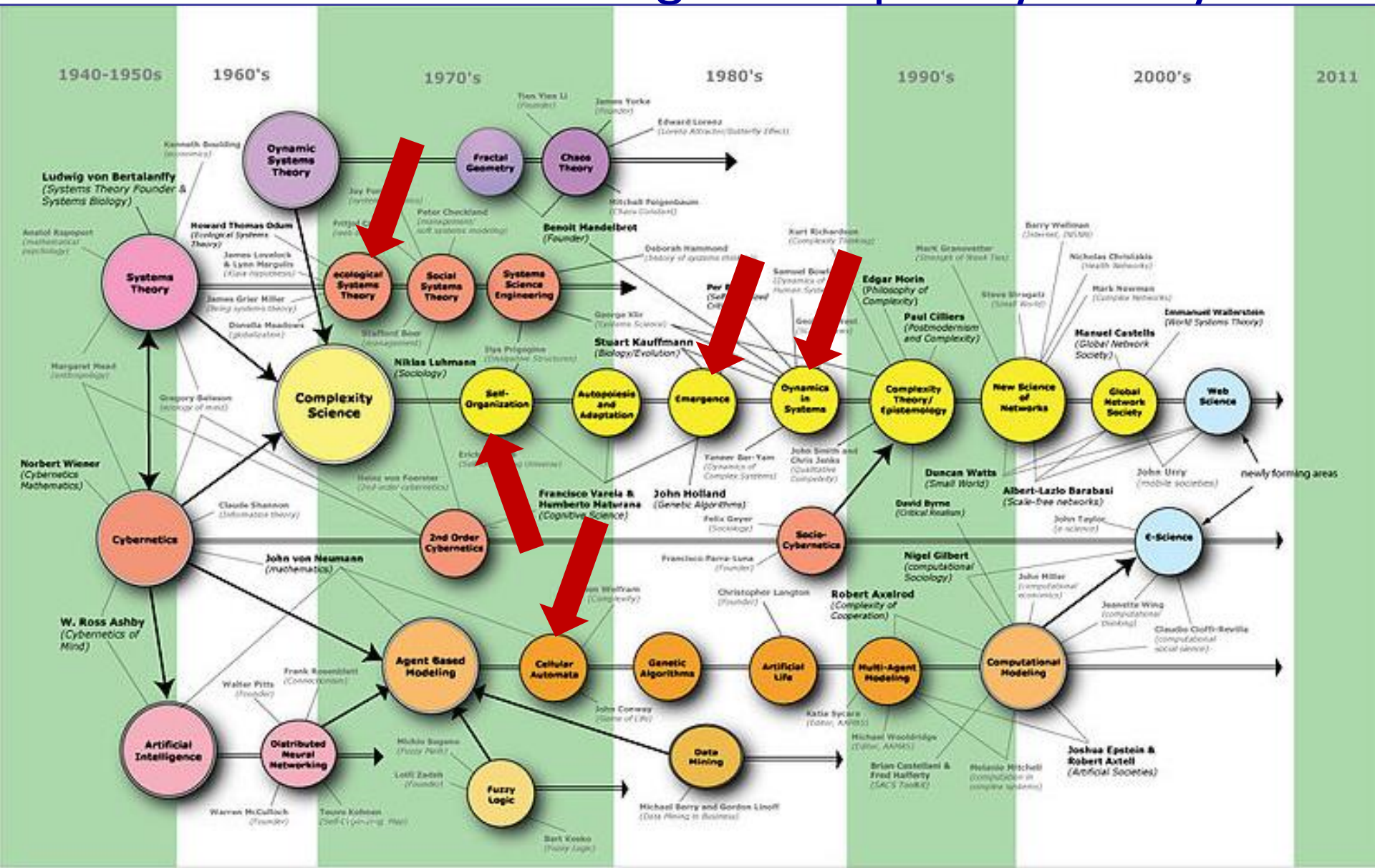
Castellani's map – history of ideas according to complexity theory



SCiO Potted History of Systems 1

Lewes: Emergence 1875

"The emergent is unlike its components insofar as these are incommensurable, and it cannot be reduced to their sum or their difference."

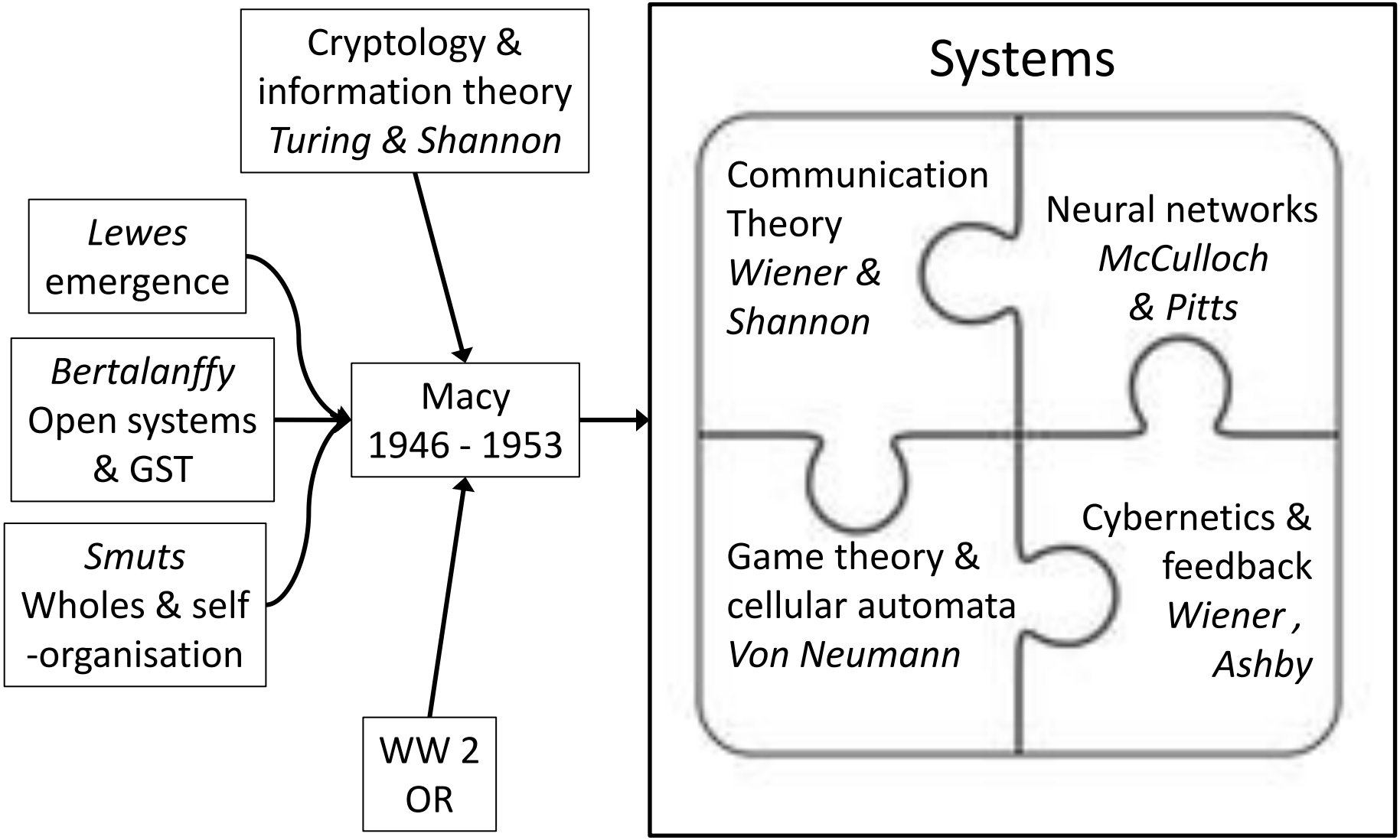
Smuts: Holism 1890 – 1926

'the tendency in nature to form wholes, that are greater than the sum of its parts, through creative evolution'

'One of the two most important ideas for the next millennium' - Einstein

Bertalanffy: Open systems 1934
General Systems Theory

Potted History of Systems 2



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McCulloch on Macy

"Even then, working in our shirt sleeves for days on end, at every meeting …. we were unable to behave in a familiar friendly or even civil manner.

The first five meetings were intolerable. Some participants left in tears never to return.

Margaret Mead records that in the heat of battle she broke a tooth and did not even notice it until after the meeting."

There has never been an agreed definition of systems thinking

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Areas of application of ST

- Ecology
- Climate change
- Learning theory
- Neurophysiology
- Psychology
- Therapy
- Medicine
- Music
- Art
- Communication theory
- Biology
- Sociology
- Conflict analysis
- Negotiation
- Network theory
- Logistics
- IT
- Finance
- Economics
- Organisation & social systems

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Core concepts in ST

- Emergence
- Self-organisation
- Relationships vs entities
- Wholes vs parts
- Autonomy & cohesion
- Complexity / variety
- Feedback (+ve & -ve)
- Causal loops vs linear causality
- Non-linear dynamics
- Homeostasis
- Stability, instability & chaos
- Unknowability

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Core concepts in ST

- System Dynamics
- Soft Systems methodology
- Socio-tech
- VSM

All incorporate some core ST principles and practices

…. Part of the furniture

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Self organisation in ST

"Systems thinking sees that systems have some kind of 'control system' that provides guidance and shapes the system, whereas complexity recognises the possibility of self-organisation."

- **Smuts**: *"The tendency in nature to form wholes that are greater than the sum of the parts through creative evolution."*
- **Ashby's** Self Organising Principle: "*Complex systems organise themselves*"
- **Beer:** *"the output of a complex probabilistic system (such as a society) is a function of a self regulating, self organizing organization …in which regulatory power is not vested in a 'controller' but in the structure of that organization itself.*
- Socio-technical systems is the study of how social groups self-organise
- Autopoiesis
- VSM as autopoietic & self-organising systems

Uncertainty & predictability in ST

"Systems thinking assumes that systems propose rational processes and predictable results, albeit through complicated means, whereas complexity recognises that solutions are arrived at via dynamic processes that are not likely to result in a final conclusion."

- **Meadows**: '*self-organizing, nonlinear feedback systems are inherently unpredictable. They are not controllable.'*
- **Ashby's** 1st Circular Causality Principle: '*Given positive feedback, radically different end states are possible from the same initial conditions'*
- Darkness Principle: *'No system can be known completely'*
- **Beer**: '*It is terribly important to appreciate that some things remain obscure to the bitter end.'*
- *'Instead of trying to specify it in full detail, you specify it only somewhat. You then ride on the dynamics of the system in the direction you want to go.'*

Holism & reductionism in ST

"Systems thinking suggests that elements in a system can be understood as isolated elements and symbols, whereas complexity forces us to see the interdependence of the nature/meaning of individual elements and the context in which they are embedded."

- **Smuts: '***A whole, which is more than the sum of its parts, has something internal, some inwardness of structure and function...some internality of nature that constitutes that 'more"*
- **Ashby**: *'the characteristic structural and behavioural patterns in a complex system are primarily a result of the interactions amongst the system parts.'*
- **Beer**: *'Relation is the stuff of system'*
- **Ackoff** : *'Never improve any portion of the system unless is also improves the whole.'*

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Learning & change in ST

"Systems thinking assumes that systems change their structures in accordance with rule-based learning, whereas complexity recognises that change is perpetual, so learning is a constant factor."

- **Iberal**: '*System stability is possible only if the system's relaxation time is shorter than the mean time between disturbances.'*
- **Beer**: '*If we cannot adapt, we cannot evolve. Then the instability threatens to be like the wave's instability – catastrophic'*
- 4th Principle of organization: '*The operation of the first three principles must be cyclically maintained through time without hiatus or lags.'*
- Real time information
- Viability – the ability of a system to maintain identity despite changes in its environment that could not have been anticipated

SCiO Calculated equilibrium in ST

"Systems thinking assumes that systems have dominant rules that can be used to calculate potential equilibrium, whereas complexity emphasises that systems tend to defy calculated equilibrium."

Canon: *'A system survives only so long as all essential variables are maintained within their physiological limits.'*

Ashby: **'***The upper limit on the amount of regulation achievable is given by the variety of the regulatory system divided by the variety of the regulated system'*

Varela: *what is the meaning of "wholeness?" This relates to two key processes. One is the process of recognizing the stable properties of wholes, by interacting with them. The other is the recognition that the stability we see arises from the self-referential, mutual, reciprocal interactions that constitute the system. Thus, the three notions I mentioned are distinction, stability and closure, and are really one and the same.*

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What's Different?

Complexity theory

- Broad application
- Stability & chaos, but emphasis on how chaos happens
- Few tools (agent based modelling), concepts & metaphors

Systems Thinking

- Broad application: biology & climate to IT, but lots on social systems
- Stability & chaos, but emphasis on how stability is achieved
- Many modelling approaches, concepts & laws
- Focus on
  - how to "think systemically"
  - the observer & cognition
  - participative techniques

Emotional biases

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In groups….

Do you think there is a significant distinction between ‘complexity thinking’ and ‘systems thinking’, and if so can you define it (in a sentence)?