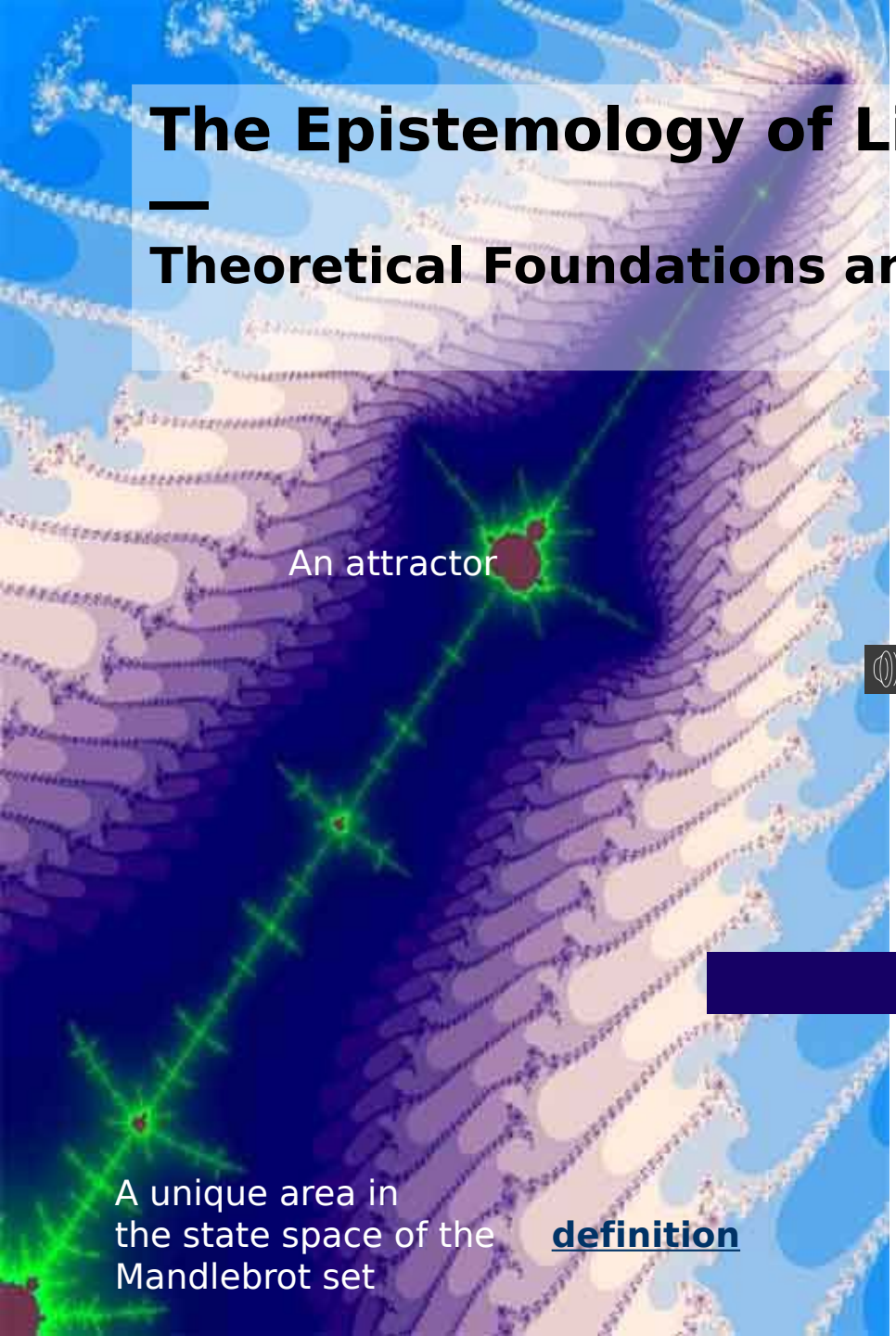
The Epistemology of Living Organizations
—
Theoretical Foundations and Practical Applications



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Presentation for Philosophy Forum, 6 October 2013

Access my research papers from Google Citations

Notes

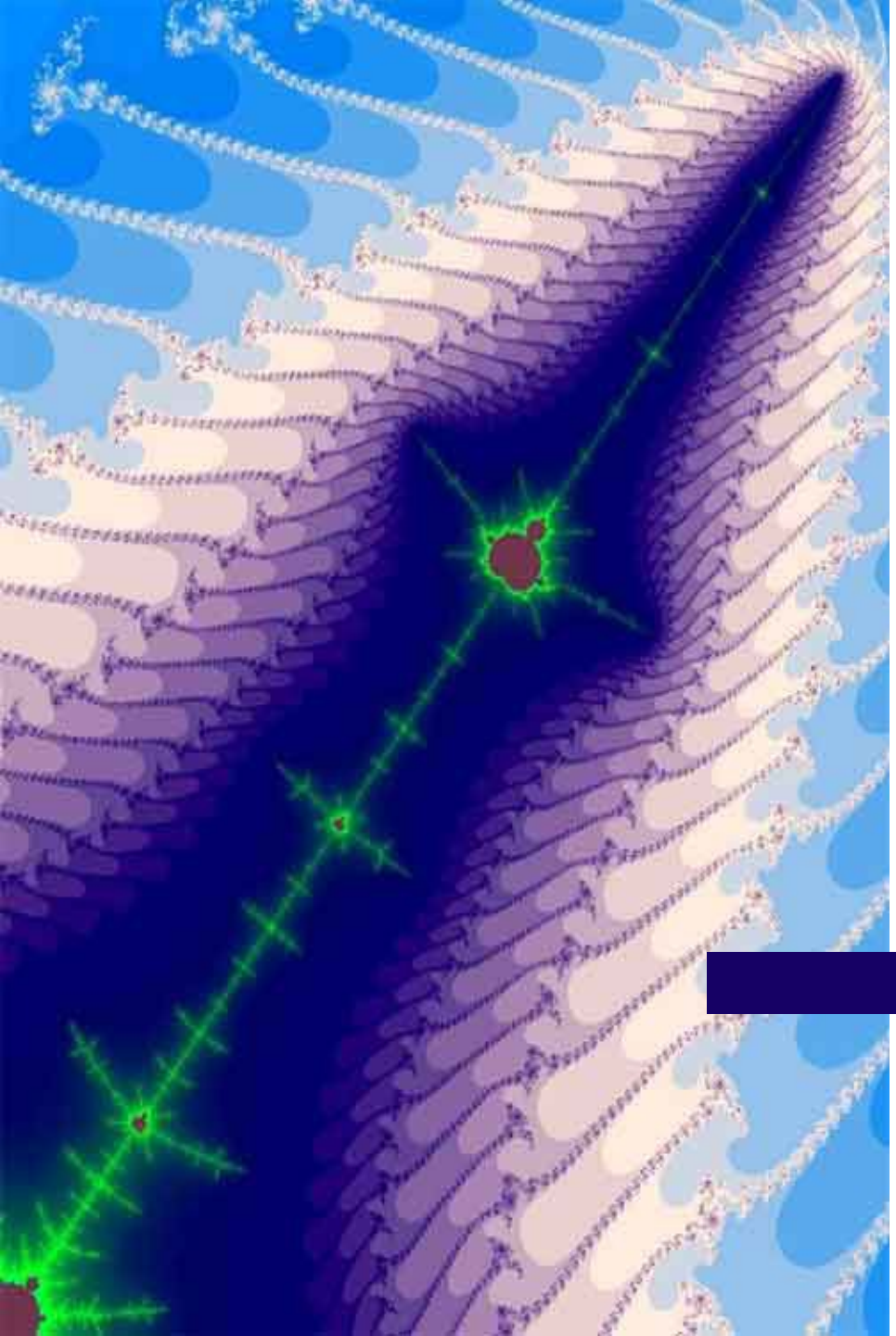
- This presentation is based largely on material drawn from a hypertext book I am writing: Application Holy Wars or a New Reformation - A Fugue on the Theory of Knowledge. A preview, some topical extracts, and a working draft can be found by clicking here. Comments would be welcome on william-hall@bigpond.com .
- Slides in this presentation are hot-linked to source documents. Click underlined words, etc. to access the linked

My Background

- Early life: physics / natural history / cytogenetics / evolutionary biology (PhD Harvard, 1973)
  - Defining life as a physical phenomenon
  - Understanding how it evolves
- 1981-1989: Computer literacy journalism, technical writing, commercial software development, banking
- 1990-2007: Documentation and knowledge management systems analyst/designer for Tenix Defence/$ 7 BN ANZAC Ship Project
  - Tenix grew to be Australia's largest defence engineering prime contractor and then failed.
  - How did Tenix succeed and why did it fail?
- 2001-now: Researcher trying to understand what organizational knowledge is and why organizations have such major problems managing and applying it

Understanding the relationships between knowledge and life

- Answering questions from my corporate career
  - Organizations as complex adaptive systems
  - James Martin's Cybercorp (1996)
  - < 2001: trying to combine my understanding of biology and corporate experience
- Karl Popper's evolutionary epistemology
- What is life - autopoiesis
- Human biology
  - Adaptation
  - Genetic vs cultural heredity (knowledge transfer)
  - Origins of culture and social organization
- Theoretical foundations of organizational knowledge
- Putting theory into practice
- This talk only scratches surface - see my publications



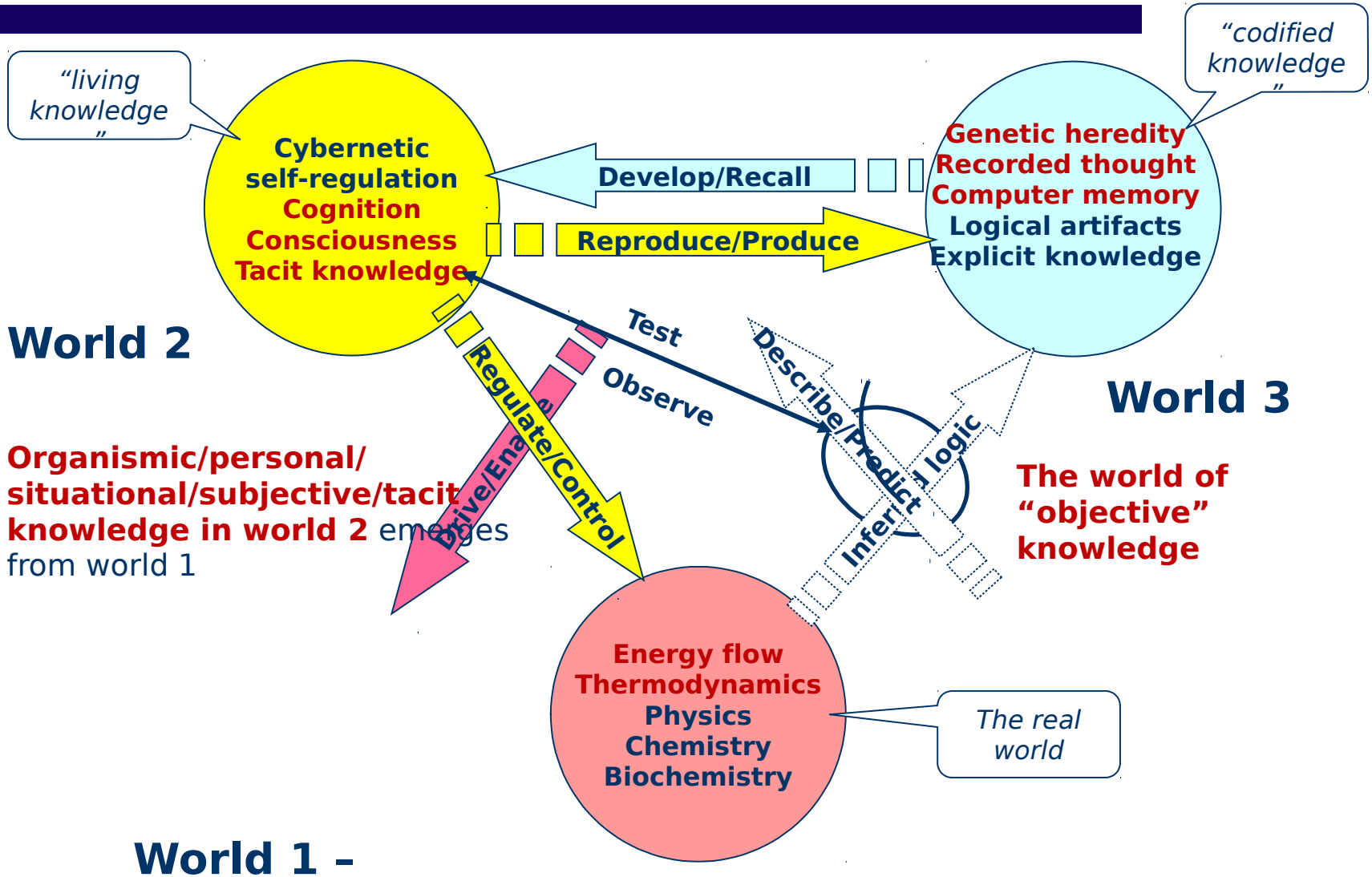
Evolutionary Epistemology

(Karl Popper)

In his later work, Popper applied evolutionary biology to his theory of knowledge

- Popper, K.R. 1972. Objective Knowledge – an Evolutionary Approach. Oxford University Press / Routledge.
- Popper, K.R. 1994. Knowledge and the Body-Mind Problem – in Defence of Interaction. Routledge.
- Hall, W.P. 2003. Managing maintenance knowledge in the context of large engineering projects - Theory and case study. Journal of Information and Knowledge

Popper's first great idea: "three worlds" ontology



Karl Popper's second great idea from Objective Knowledge:
Knowledge = solutions to problems

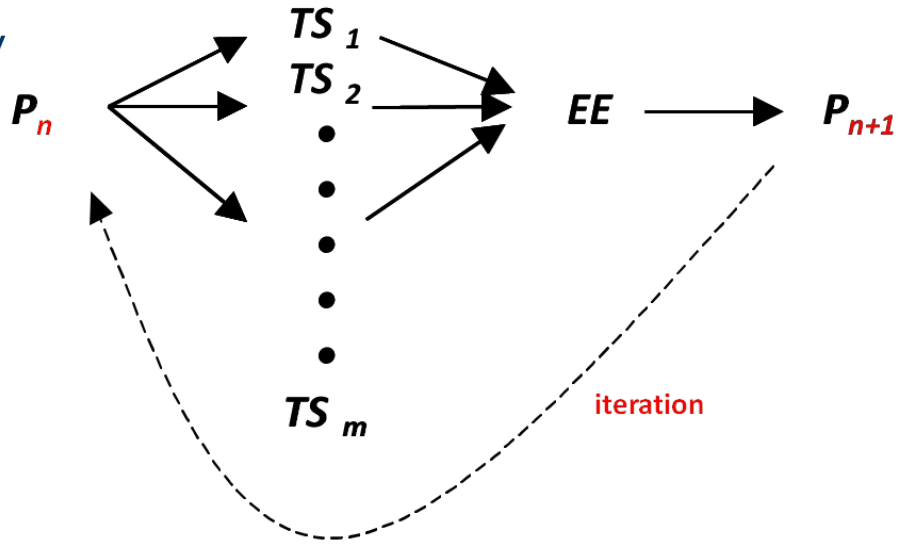
Pn a real-world problem faced by a living entity

TS a tentative solution/theory. Tentative solutions are varied through serial/parallel iteration

EE a test or process of error elimination

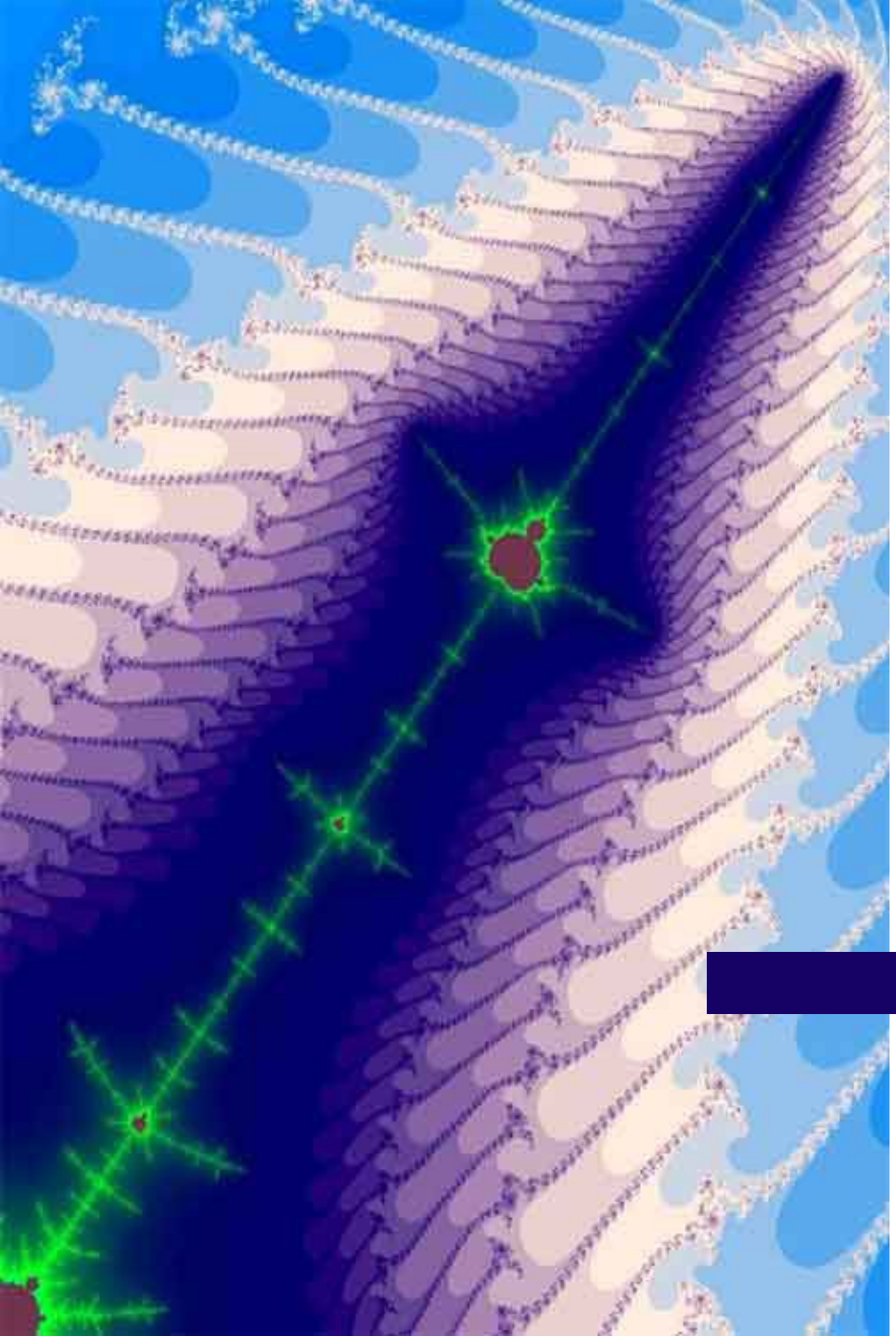
Pn+1 changed problem as faced by an entity incorporating a surviving solution

The whole process is iterated



Karl Popper, Objective Knowledge – An Evolutionary Approach (1972), pp. 241-244

- All knowledge claims are constructed, cannot be proven to be true
- **TS**s may be embodied as "structure" in the "knowing" entity, or
- **TS**s may be expressed in words as hypotheses, subject to objective criticism; or as genetic codes in DNA, subject to natural selection
- **Objective expression and *criticism* lets our theories die in our stead**
- Through cyclic iteration, sources of errors are found and eliminated
- Solutions/theories become more reliable as they survive repetitive testing
- Surviving TSs are the source of all knowledge!



Autopoiesis (theory of life)

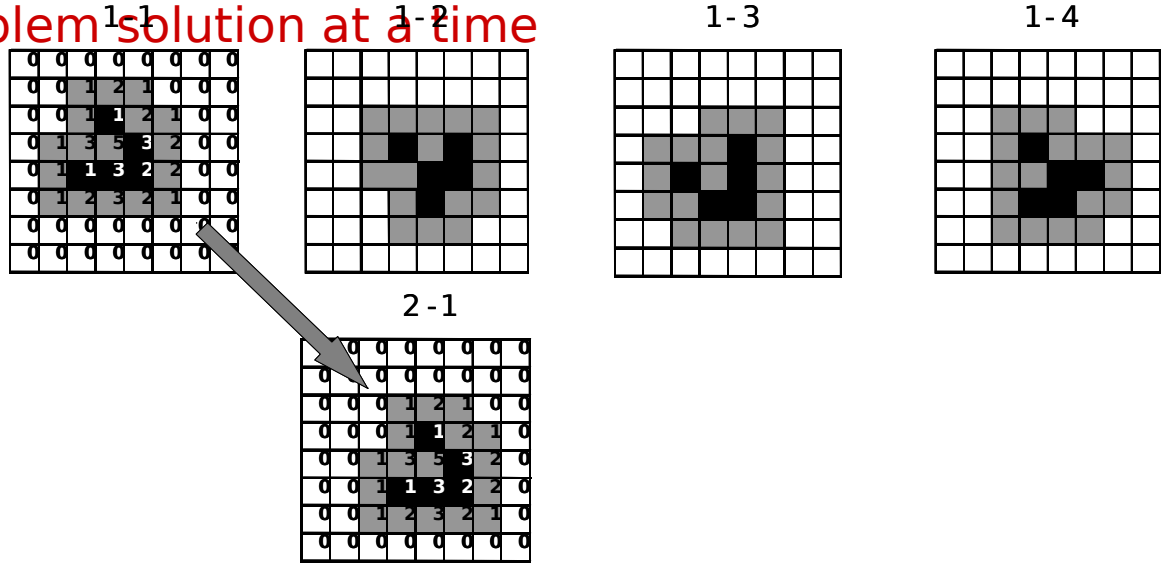
Knowledge and life are inseparable.

One cannot be understood without understanding the other.

- Maturana, H.R., Varela, F.J. 1980. Autopoiesis and Cognition – the Realization of the Living. Kluwer.
- Nelson, R.R., Winter, S.G. 1982. An Evolutionary Theory of Economic Change, Harvard Uinv. Press.
- Kauffman, S.A. 1993. The Origins of Order – Self-organization and Selection in Evolution. Oxford Univ. Press
- Hall, W.P. 2005. Biological nature of knowledge in the learning organizat

What makes a system living?

- Autopoiesis
  - Self-regulating, self-sustaining, self-(re)producing dynamic entity
  - Fundamentally cyclical, continuation depends on the causal **structure** of the state in the previous instant to produce autopoiesis in the next instant (ref Popper; Maturana & Varela)
  - Selective survival builds knowledge into the system one problem-solution at a time

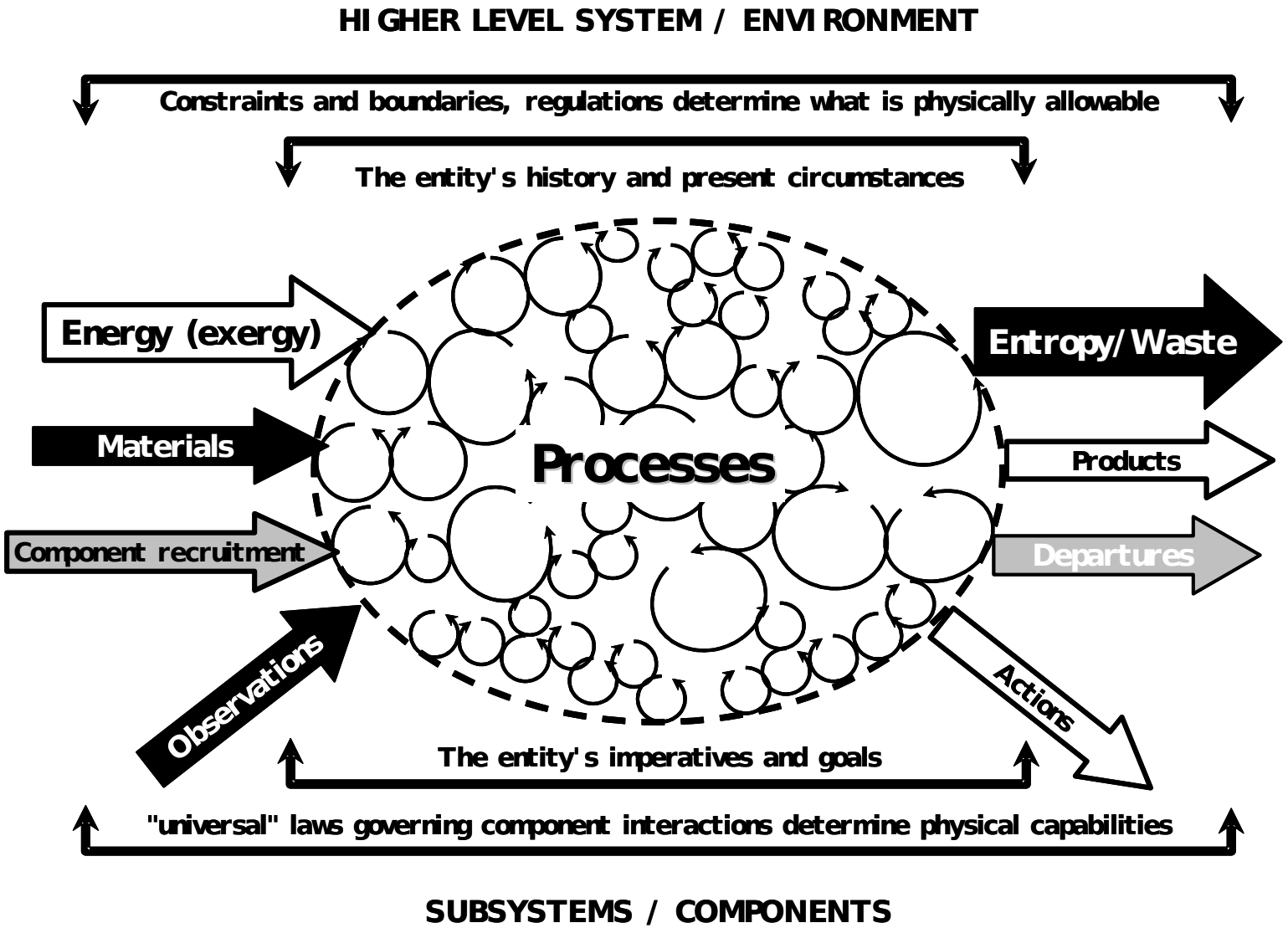


Self producing structures in a cellular automaton (Conway's Game of Life)

Varela et al. (1974)

- Six necessary and sufficient criteria for recognizing an autopoietic system
  - Bounded
    - System components identifiably demarcated from environment
    - E.g., organizational badges, logos, reception desks, gates, etc.
  - Complex
    - separate and functionally different subsystems exist within boundary)
  - Mechanistic
    - System dynamics driven by self-sustainably regulated economic cash flows or dissipative “metabolic” processes
  - Self-defining
    - System demarcation intrinsically produced
    - E.g., employment policies, procedures, etc.
  - Self-producing
    - System intrinsically produces own components
    - E.g., recruitment & training programs
  - Autonomous
    - self-produced components are necessary and sufficient to produce the system.
- Autopoiesis is a good definition for life

Structure of autopoietic system



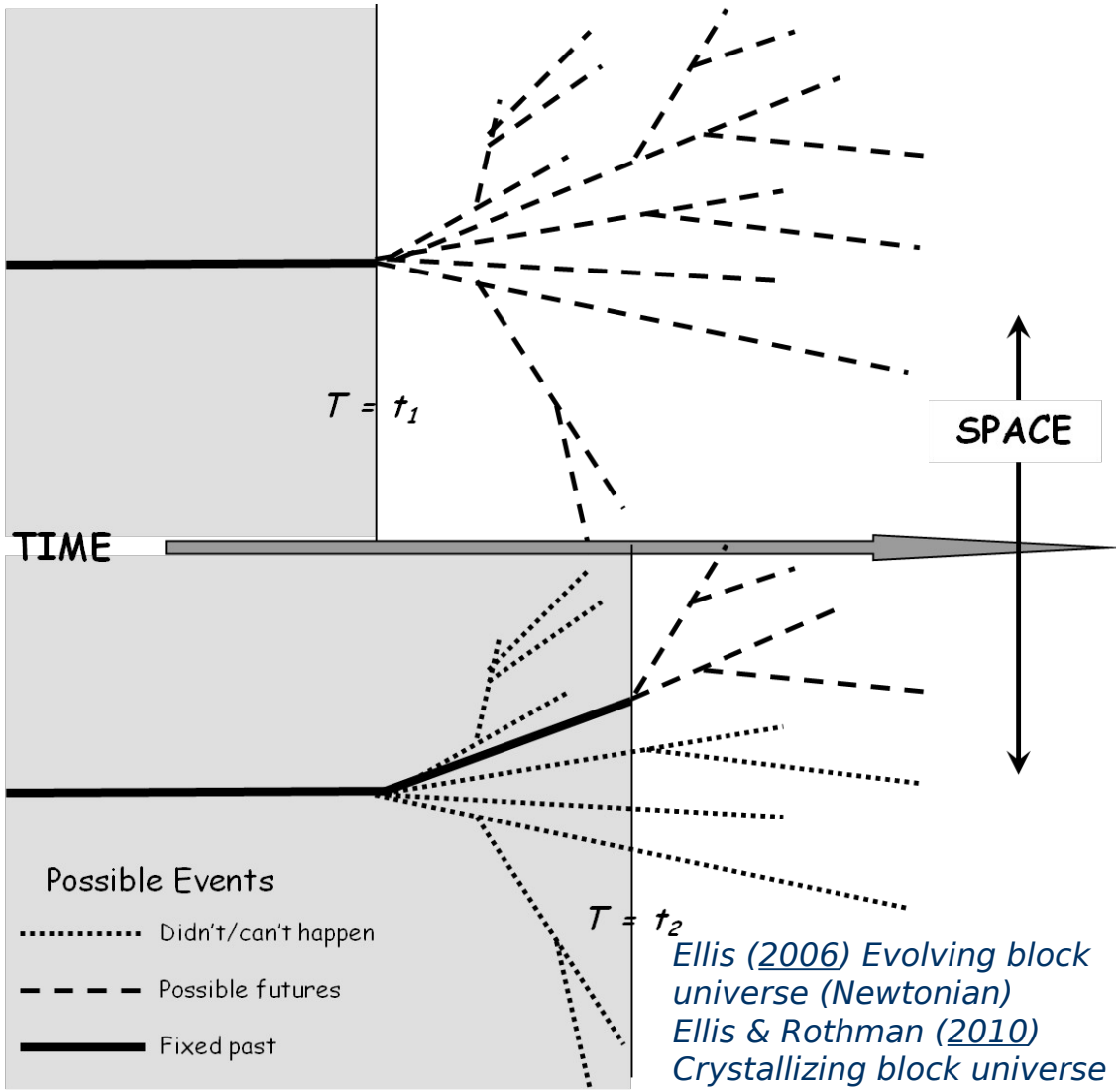
Spontaneous co-emergence of autopoiesis and knowledge

- (Stuart Kauffman) The dynamic vectors of the present instant result from causal events in past instants as reflected in the adjacent possibles of the immediately prior instant
  - Historical connections (heritage) determine the vectors in state space of the present instant.
- Chaos: divergent paths lead to incoherent structures that dis-integrate and lose the historical thread of successful autopoiesis
- Attractor basins: convergent paths may become coherently autopoietic, such that the ensemble structure of a convergent state in one instant generates an ensemble structure that remains convergent in the next instant.
- **Any convergent ensemble that remains after dis-integration of divergent outcomes retains "structural" knowledge that solved a problem of survival**

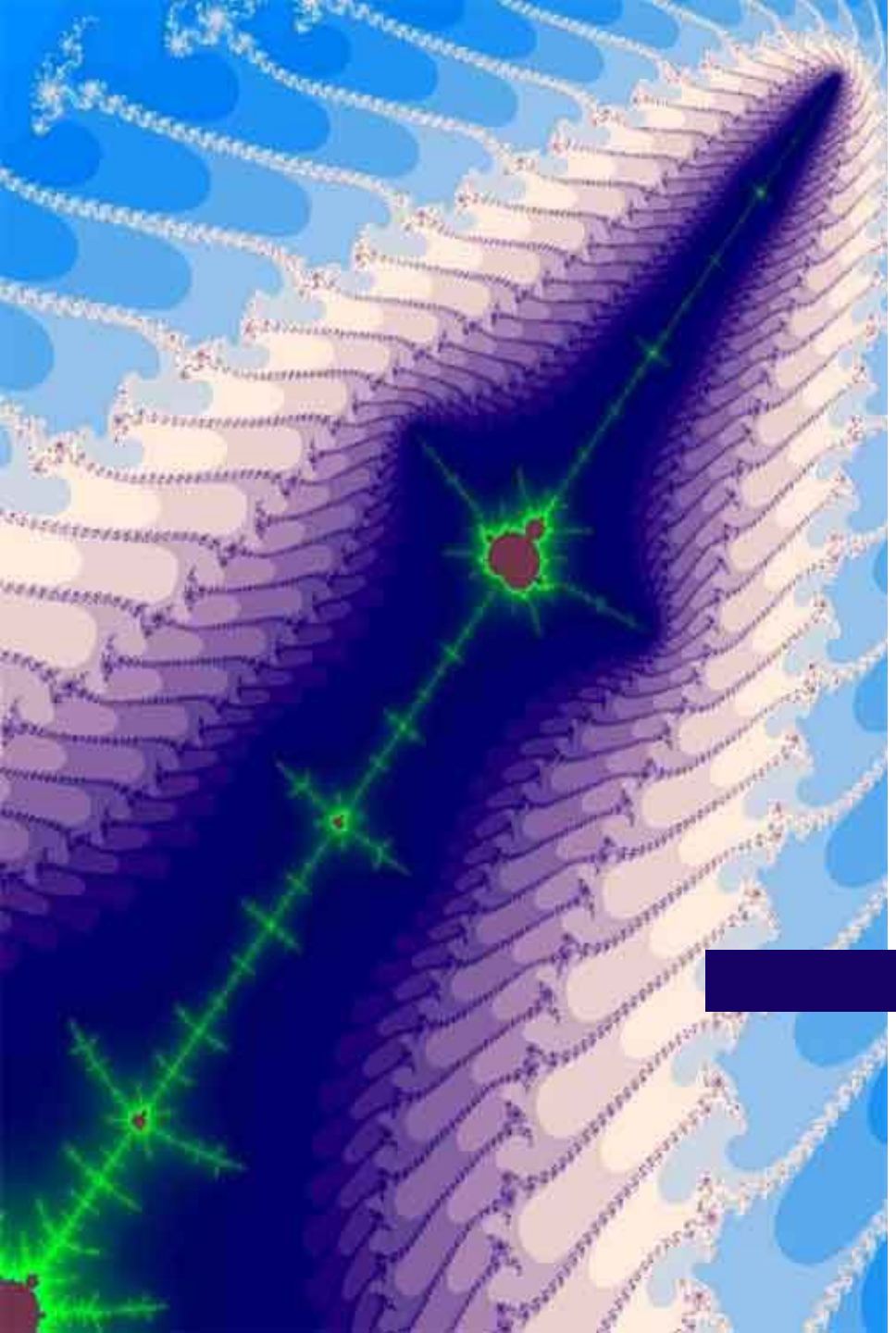
Kauffman, S. 1993. The Origins of Order. Oxford Univ Press, London.
Hall, W.P., Else, S., Martin, S., Philp, W. 2011. Time-based frameworks for valuing knowledge and maintaining strategic knowledge. Kororoit Institute Working Papers No. 1: 1-28.
Hall, W.P. 2011. Physical basis for the emergence of autopoiesis, cognition and knowledge. Kororoit Institute Working Papers No. 2: 1-63

Organization, knowledge, and life begin with historical constraints

- Past is fixed
- Present is determined in the instant of becoming
- Future is undetermined
- Solid line – what happened
- Stuart Kauffman – adjacent possible
  - *t1* Dashed lines represent all of the possible future states that can be reached in the next instant from the present instant
  - *t2* One state was realized at *t1* , Dotted lines lead to states that could have happened at *t1* but didn't/can't happen. Dashed lines represent states that can still be reached from the state at *t2*
- Future possibilities are continually and progres-sively constrained by realization of the present



Ellis (2006) Evolving block universe (Newtonian)
Ellis & Rothman (2010) Crystallizing block universe (quantum mechanical)

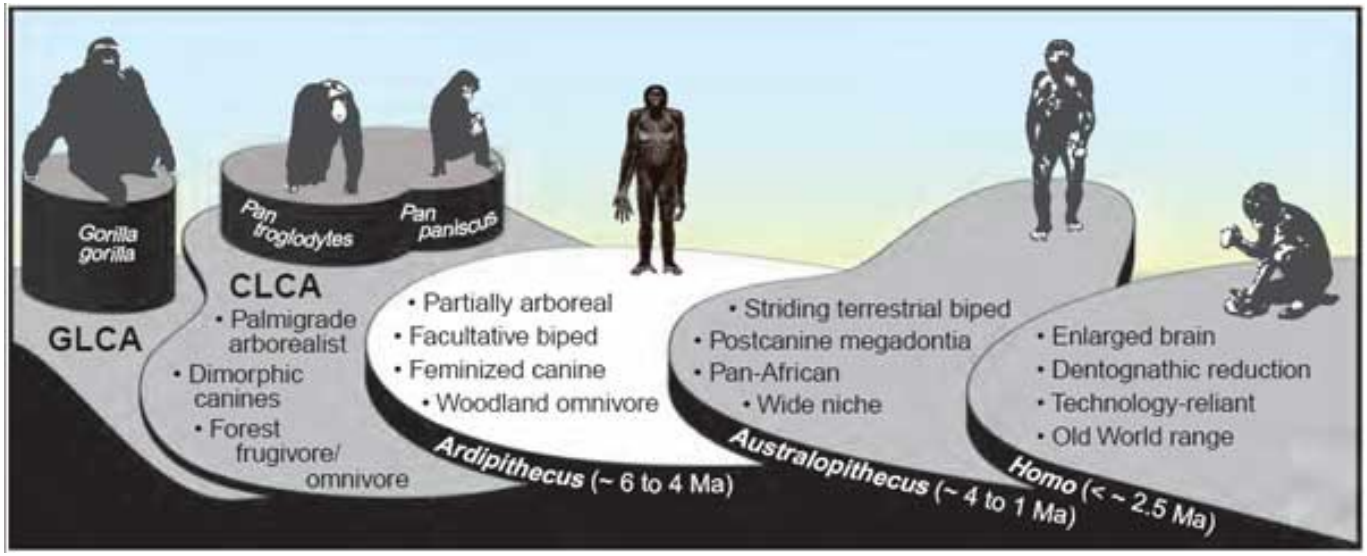


Human origins & cognitive evolution

Humans are bipedal apes who became top predators on the African savannah

Hall, W.P. 2013. Evolutionary origins of *Homo sapiens.* Extract from Application Holy Wars or a New Reformation: A fugue on the theory of knowledge [in preparation] - http://tinyurl.com/kqrcxsf

Our family tree



White et al's (2009) depiction of the adaptive plateaus achieved by the different species grade shifts in the Pliocene radiation of hominins as our ancestors became more adapted to more open and arid environments. CLCA = chimpanzee-human last common ancestor.

- CLCA was a forest ape using simple natural and biodegradable tools to increase dietary range probably a lot like today's chimps and bonobos
- Changing climates broke up forest into grassy woodlands. *Ardipithecus* adapted by developing bipedal locomotion and use of tools for self-protection and to harvest wider dietary range.
- *Australopithecus* became a successful savannah dweller
- *Homo* became top carnivore in Africa and Eurasia

We are tool-using apes

- Our close primate cousins, orangutans, gorillas, chimpanzees and bonobos live in organized social groups that make and use tools
  - Orangutans
    

    but are effective tool users and te

    Attenborough: Amazing DIY Orangutans - BBC Earth - http://tinyurl.com/avl8yby
  - C
    

    t to raid a fish trap for a meal

    Charlotte Uhlenbroek - 'Chimpanzees' sophisticated use of tools - BBC wildlife – http://tinyurl.com/lj8ejt2

    groups with a lot of

Pleiocene climate change forced some apes onto a savanna – a tough neighbourhood to survive in!

- Grave risk of predation by big cats & other carnivores on savanna

From Tattersall (2010)
Masters of the Planet, p. 49

- **Gangs of chimps can cooperate to deter cats**

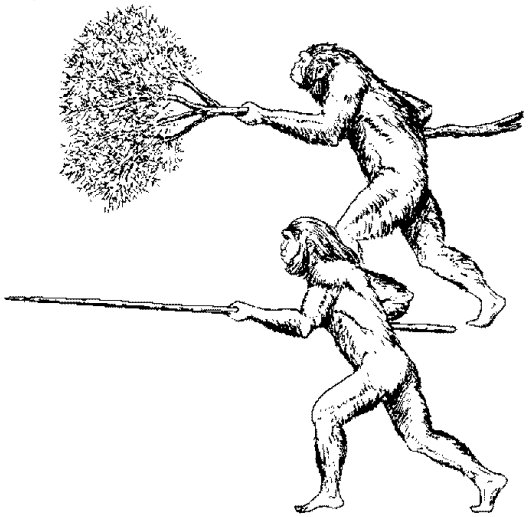
see Kortlandt 1980. How might early hominids have defended themselves against large predators and food competitors? Journal of Human Evolution 9, 79-112 – http://tinyurl.com/l5z5vu2

- Anthropoid apes aren't the only primate tool users

Development & sharing of cultural knowledge opened the savanna

- A tiny technological improvement was all that was needed for defence and stealing cats' dinners

Guthrie (2007) Haak en steek – the tool that allowed hominins to colonize the African savanna and to flourish there. (in) Roebroeks, W. (ed). Guts and Brains, pp 133-164 [download book]



- Easy step from waving a thorn branch to throwing a spear for hunting
- Evolutionary epistemology accounts for the rest

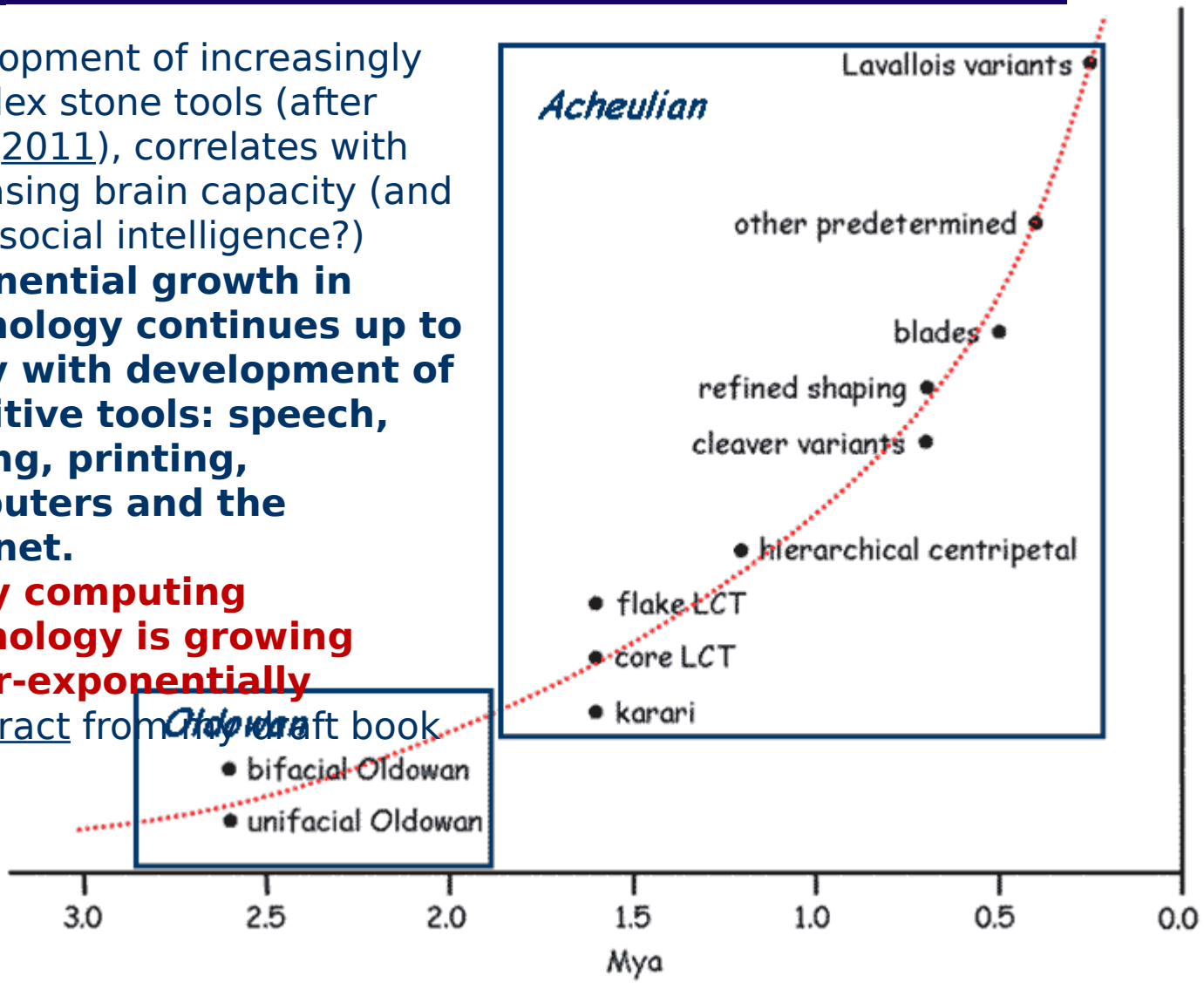
Genetic vs cultural heredity (mechanisms for knowledge transfer)

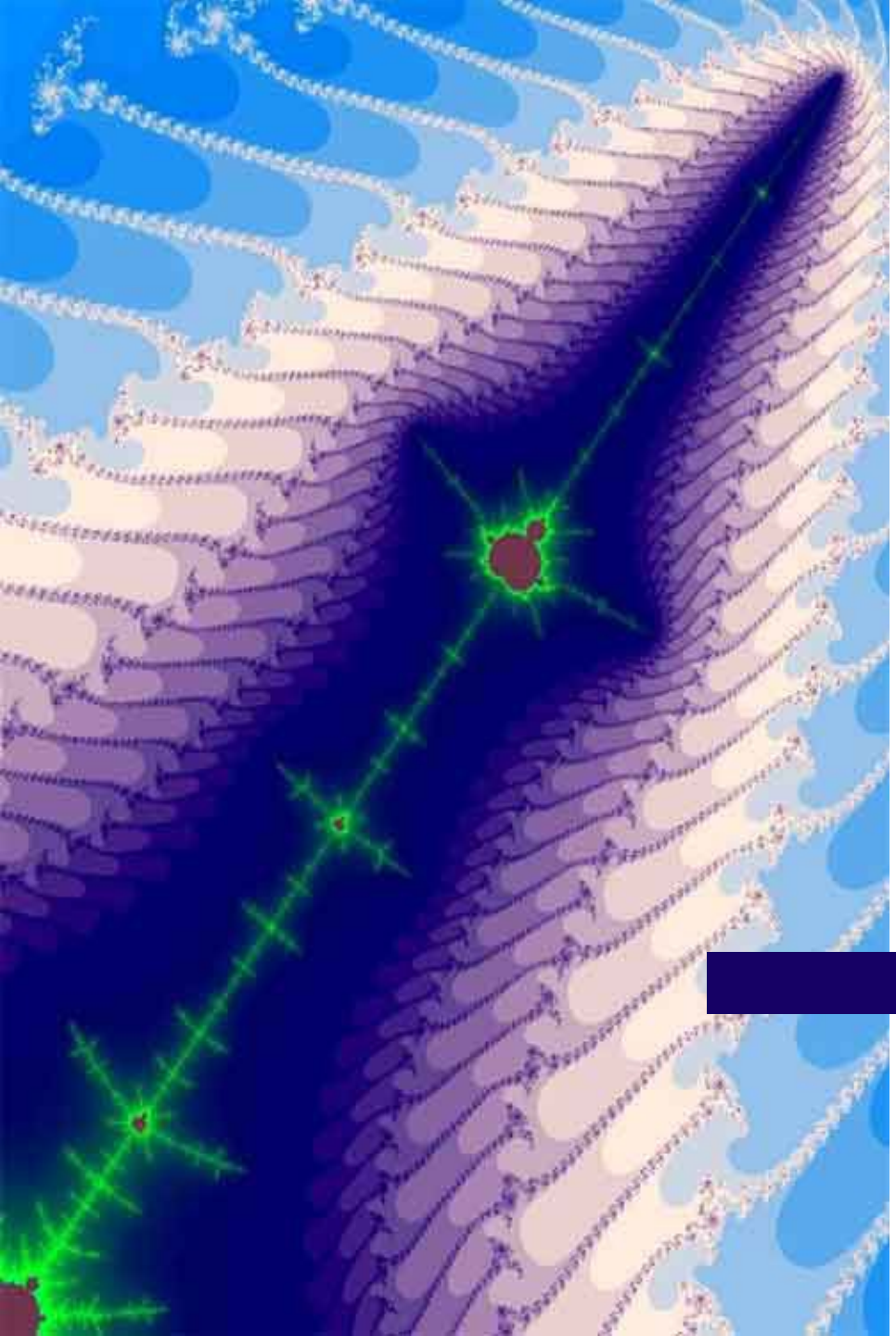
- Shared heritage defines the species/group
- Adaptation = change through time
- Natural selection eliminates entities with maladaptive genes/knowledge
  - Genetic heritage from one gen. to next is slow to change)
  - Cultural heritage can lead to more rapid change
    - More plastic but may not durable unless reinforced
    - Can be shared laterally
    - Capacity for language is very recent
    - Linguistically expressed language can be criticized & peer reviewed
    - **Tacit vs explicit sharing & transfer**
- Self-selection / criticism to eliminate errors
  - Memory of and learning from history
  - Speech, writing

Increasing tool complexity in archaeological record

- Development of increasingly complex stone tools (after Stout 2011), correlates with increasing brain capacity (and more social intelligence?)
- **Exponential growth in technology continues up to today with development of cognitive tools: speech, writing, printing, computers and the internet.**
- **Today computing technology is growing hyper-exponentially**

See extract from my draft book



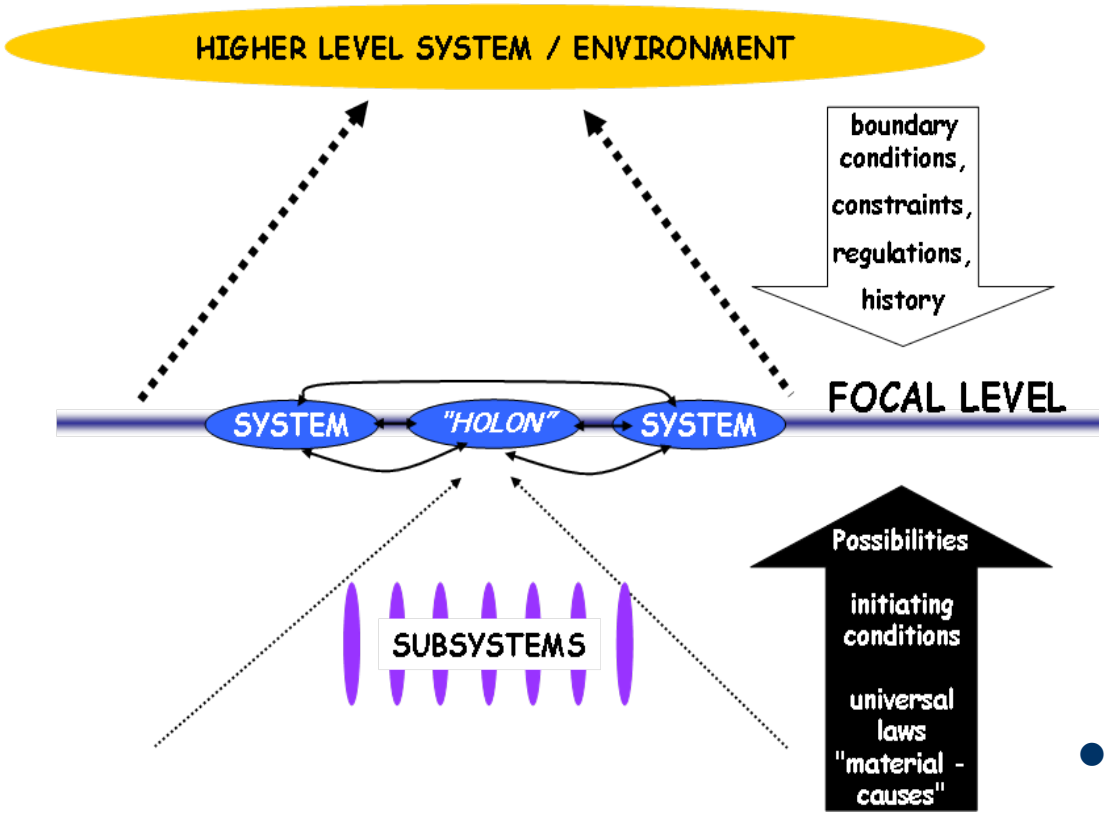


Knowledge sharing and foundations of organizational knowledge

Understanding organizational knowledge and how to manage it flows naturally from the biological point of view

- Hall, W.P., Dalmaris, P., Nousala, S. 2005. A biological theory of knowledge and applications to real world organizations. Knowledge Management in Asia Pacific, Wellington, N.Z. 28-29 November 2005
- Vines, R., Hall, W.P. 2011. Exploring the foundations of organizational knowledge. Kororoit Institute Working Papers No. 3: 1-39

Scalability and the complex organizational hierarchy

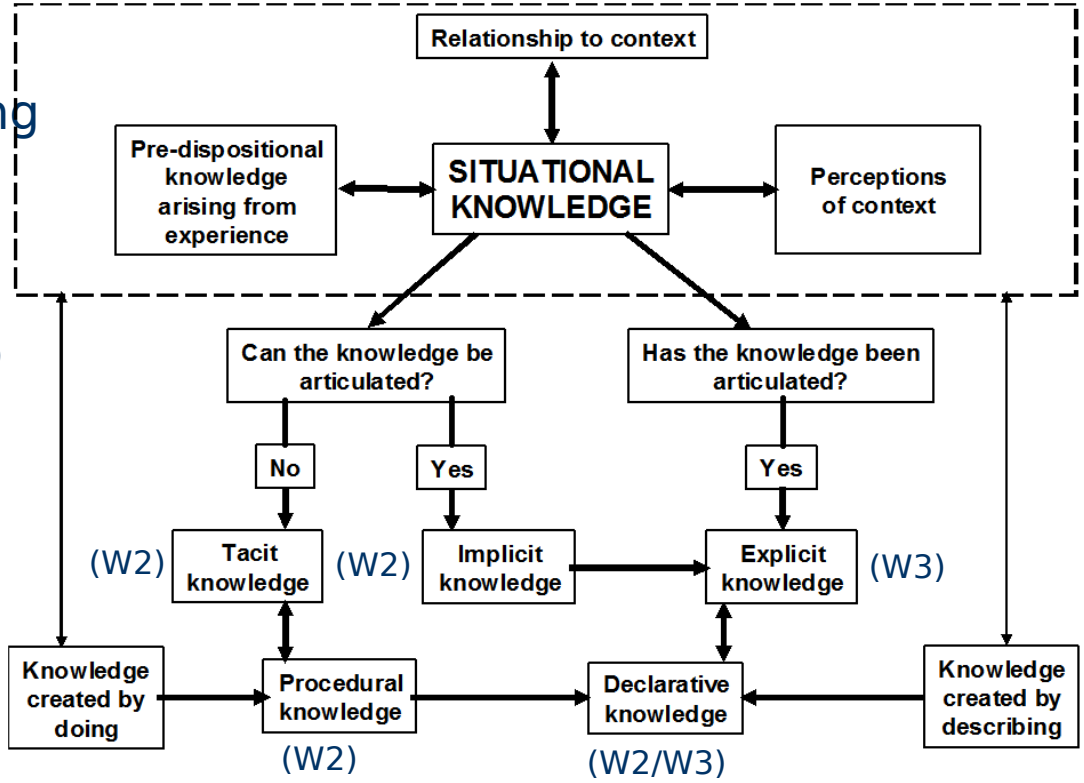


- Knowledge-based autopoietic systems may emerge at several different hierarchical levels of organizational structure
  - Nation
  - State
  - Council
  - Community group
  - Person
  - Body cell
- For effective action, flows of knowledge, decision and action must pass through several hierarchical levels

Hall, W.P. 2006
Emergence and growth of knowledge and diversity in hierarchically complex living systems
. Workshop "Selection, Self-Organization and Diversity CSIRO Centre for Complex Systems Science and ARC Complex Open Systems Network, Katoomba, NSW, Australia 17-18 May 2006

Personal (i.e., human) knowledge

- Sense making
  - W2 process constructing tacit understanding in context
  - We only know what we know when we need to know it



Nickols, F. 2000.
The knowledge in knowledge management (KM). in J.W. Cortada and J.A. Woods, eds. The Knowledge Management Yearbook 2001-2002. Butterworth-Heinemann

Creating and building knowledge is cyclical

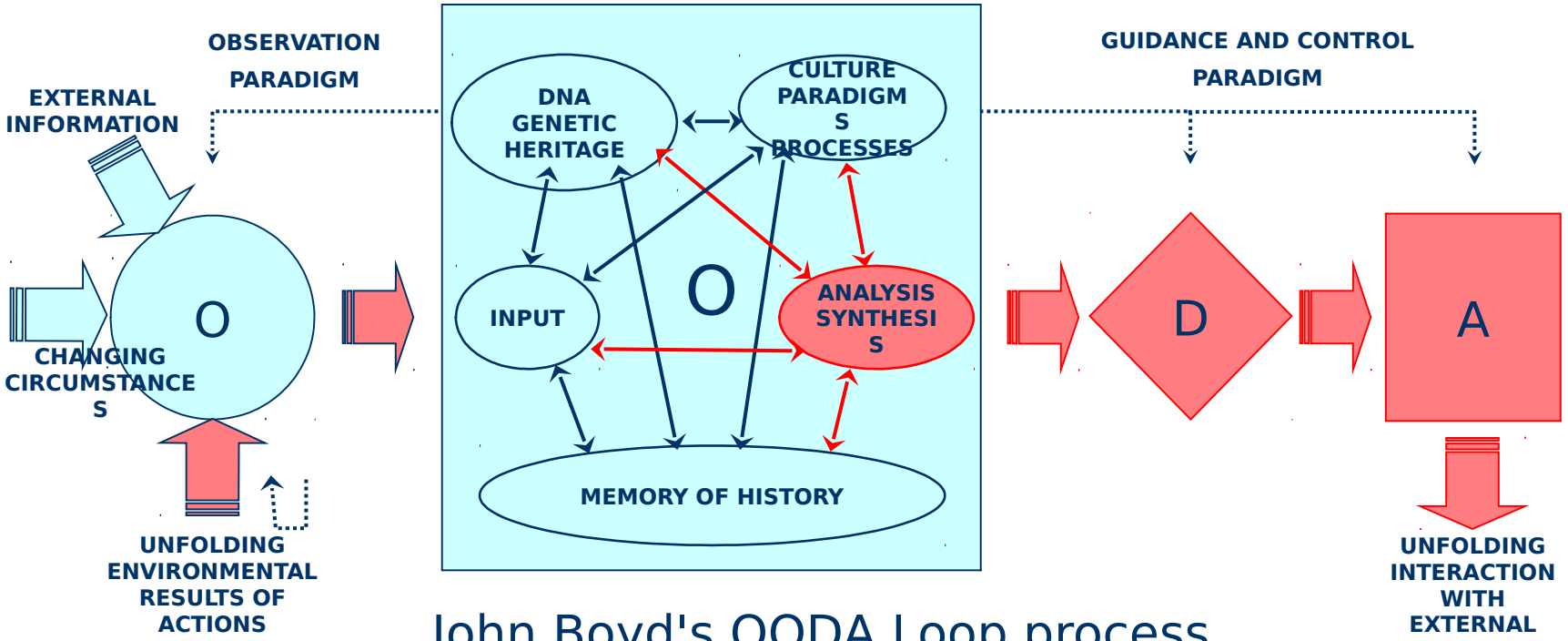
- Knowledge is solutions to problems of living
  - Iterated cycles of creation and destruction (Boyd, Osinga)
    - Creation = assembly of sense data and information to suggest claims about the world
    - Destruction = testing and criticizing claims against the world to eliminate those claims that don't work
  - Popper: solutions are those claims which prove to work (at least most of the time)
    - Knowledge is mentally constructed
    - Cannot logically prove that any claimed solution is actually true
    - All claims must be considered to be tentative (i.e., potentially fallible)
    - Follow tested claims until they are replaced by something that works better
- Knowledge building cycles are endlessly iterated and may exist at several hierarchical levels of organization

Personal vs organizational knowledge

- Important difference
  - individual knowledge (in any form) is known only by a person
  - organizational knowledge is available and physically or socially accessible to those who may apply it for organizational needs
  - Even where explicit knowledge exists, individual knowledge may be required to access it within a useful response time.
- People know:
  - what knowledge the organization needs,
  - who may know the answer,
  - where in the organization explicit knowledge may be found,
  - why the knowledge is important or why it was created,
  - when the knowledge might be needed, and
  - how to apply the knowledge
- This human knowledge is critical to the organization
- Snowden, D. 2002. Complex acts of knowing: paradox and descriptive self-awareness . J. Knowledge Management 6:100-111
  - *Personal knowledge is volunteered; it cannot be conscripted.*
  - *People always know more than can be told, and will tell more than can be written down*

Cyclic construction of tactical/strategic knowledge

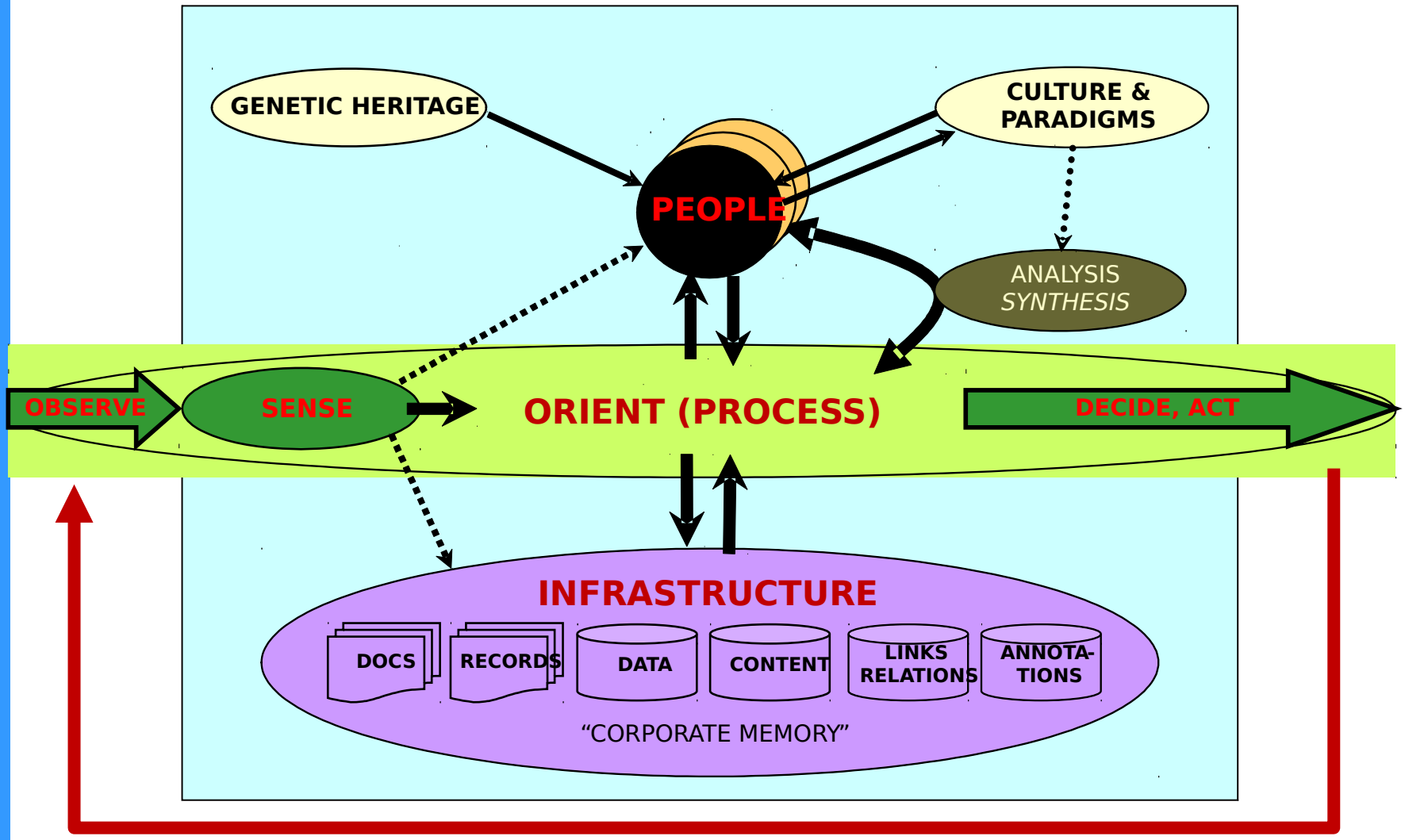
OBSERVE (Results of Test) **ORIENT** **DECIDE** (Hypothesis) **ACT** (Test)



John Boyd's OODA Loop process

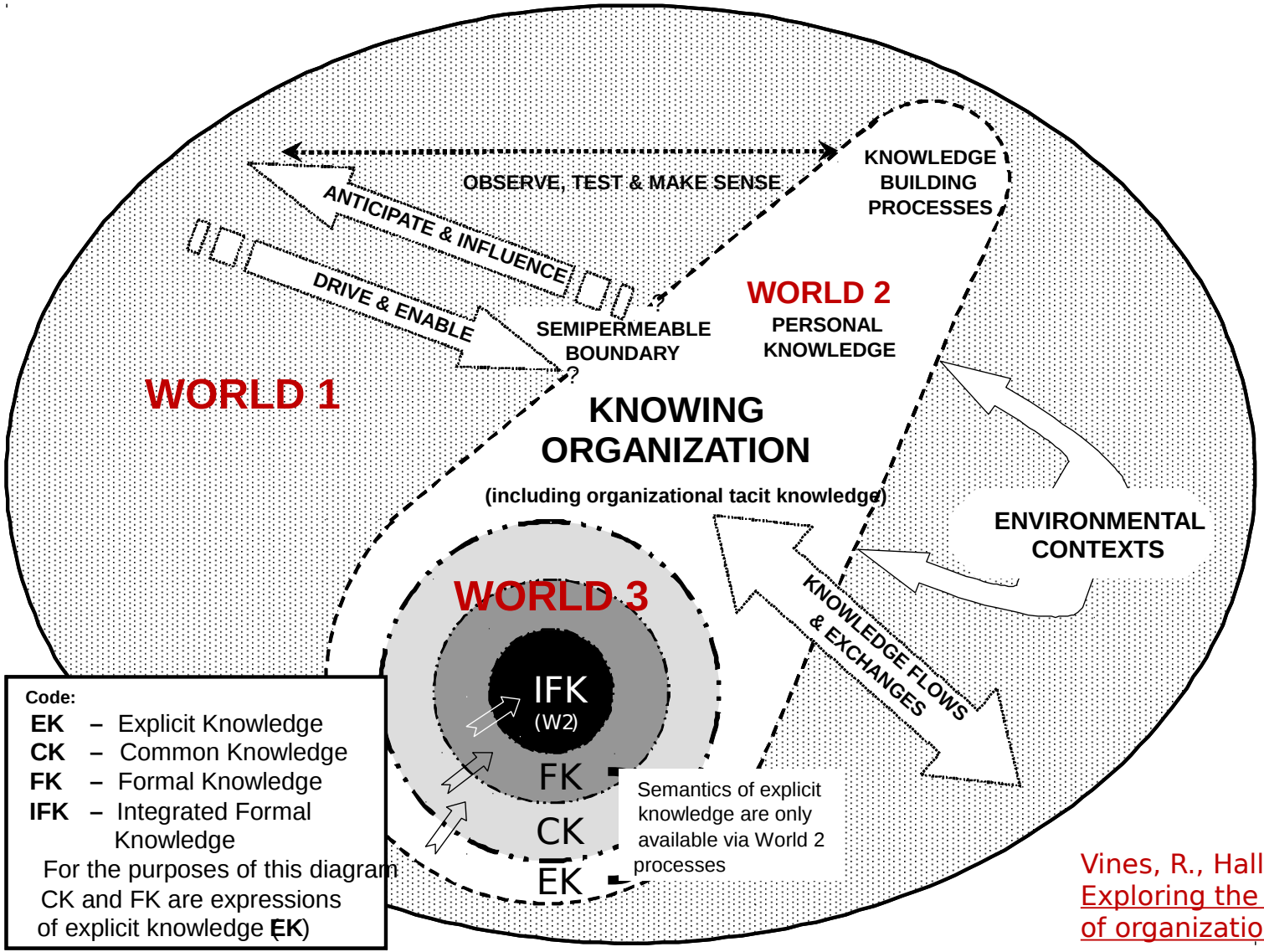
Achieving strategic power depends critically on learning more, better and faster, and reducing decision cycle times compared to competitors. See http://en.wikipedia.org/wiki/OODA_loop.

OODA system of systems in the knowledge-based organization



Boyd 1996 see Osinga, F.P.B. (2005) Science, Strategy and War: the strategic theory of John Boyd. Eburon Academic Publishers, Delft, Netherlands [also Routledge, Taylor and Francis Group (2007)] - http://tinyurl.com/26eqduv

Building and processing knowledge in the organization / community



Vines, R., Hall, W.P. 2011. Exploring the foundations of organizational knowledg