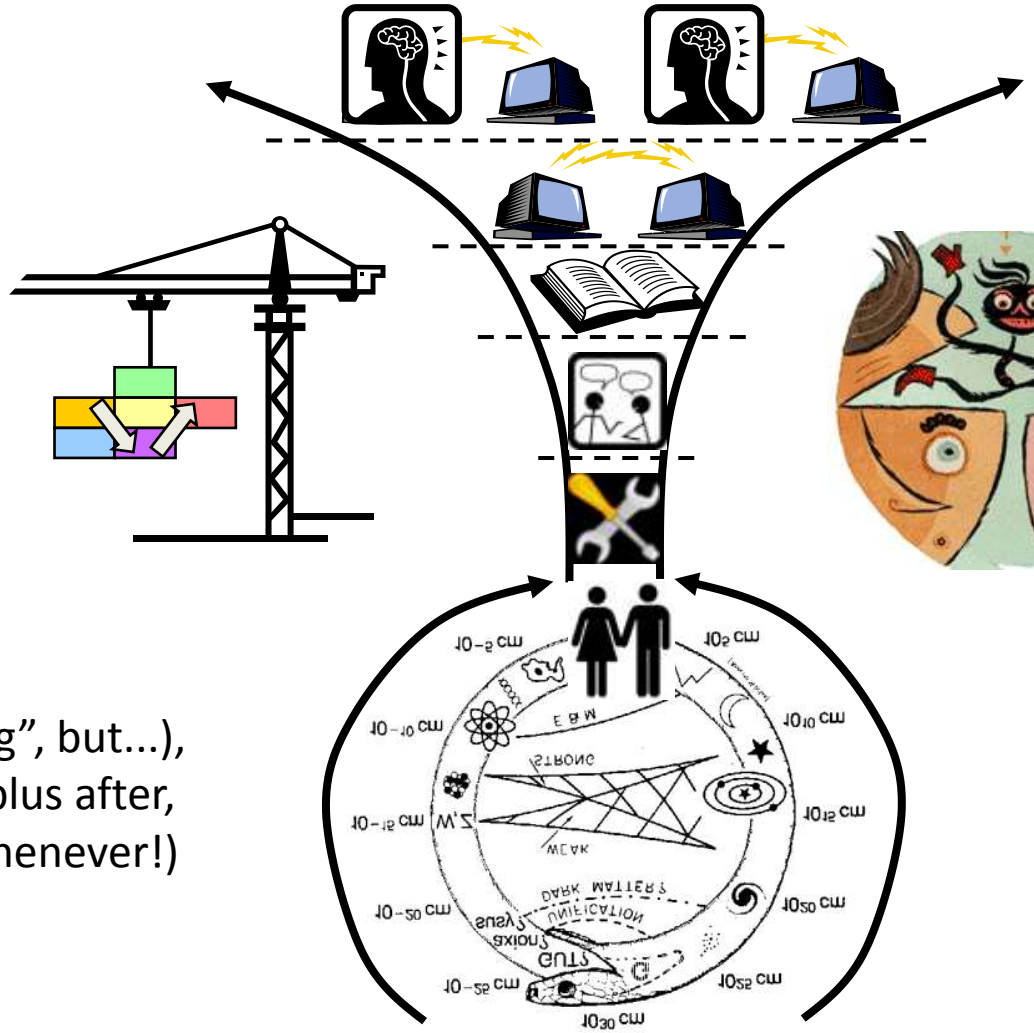
Memes and Fitness Landscapes down at the Schools-yard:

Analogies of testing context with scientific evolution

v1.0

Association for Software Testing
CAST 2011
"Context-Driven Testing"
August 8 to 10, 2011
Lynnwood Convention Center - Seattle, WA, USA
Emerging Topics track



Slides 15 minutes
(not "lightning", but...),
discussion 5 minutes (plus after, whenever!)

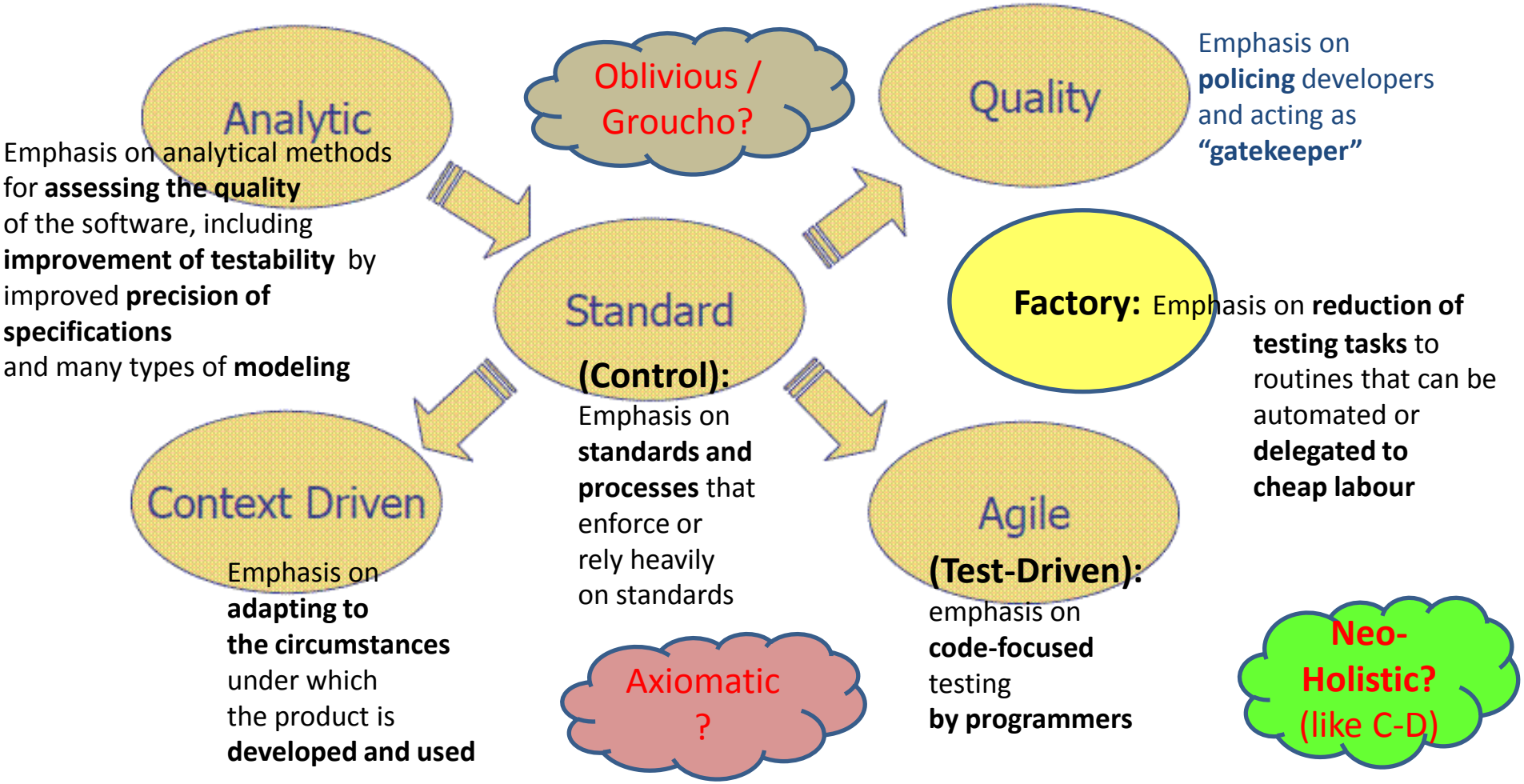
Neil Thompson

Thompson information Systems Consulting Ltd

Four, five, six... schools of software testing?

CAST 2011
"Context-Driven Testing"
August 8 to 10, 2011
Lynnwood Convention Center - Seattle, WA, USA
Emerging Topics track

(Updated version) March 2007



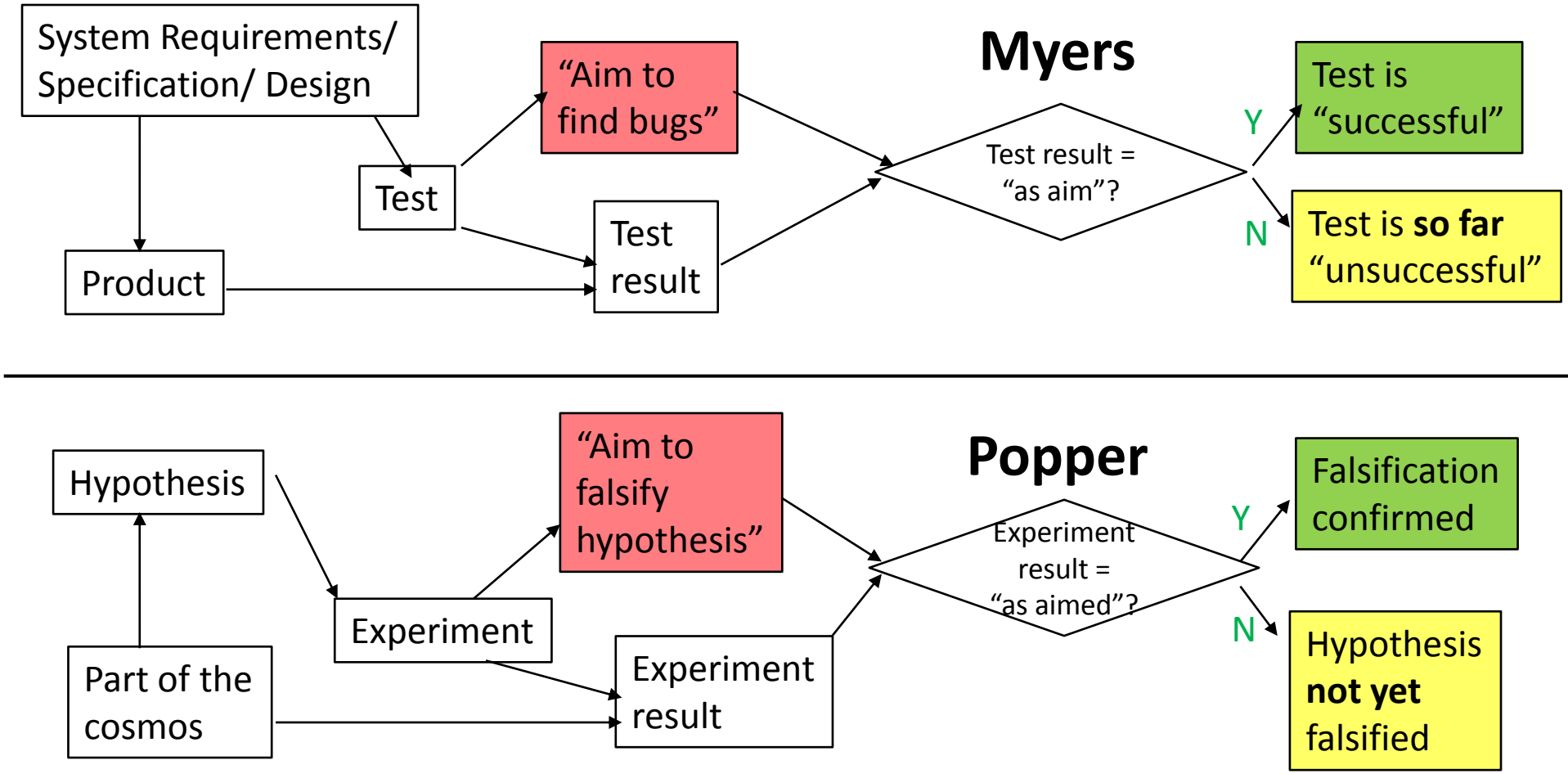
Annotations by Neil Thompson after the Bret Pettichord ppt (blue text), the list in Cem Kaner's blog December 2006 (black text) , and other sources! (red text)

Why I want to talk about this

- To understand better why and how different people work and communicate in different ways (eg balance of personal and situational factors)
- To try to broker more interactive and detailed debate (with less emotional confrontation?) between people exhibiting the characteristics of different Schools
- To help pave the way for the evolution of testing into the future, eg using power tools such as Grounded Theory with statistical analysis, Artificial Intelligence concepts such as Bayesian belief networks and genetic algorithms; testing AI itself!

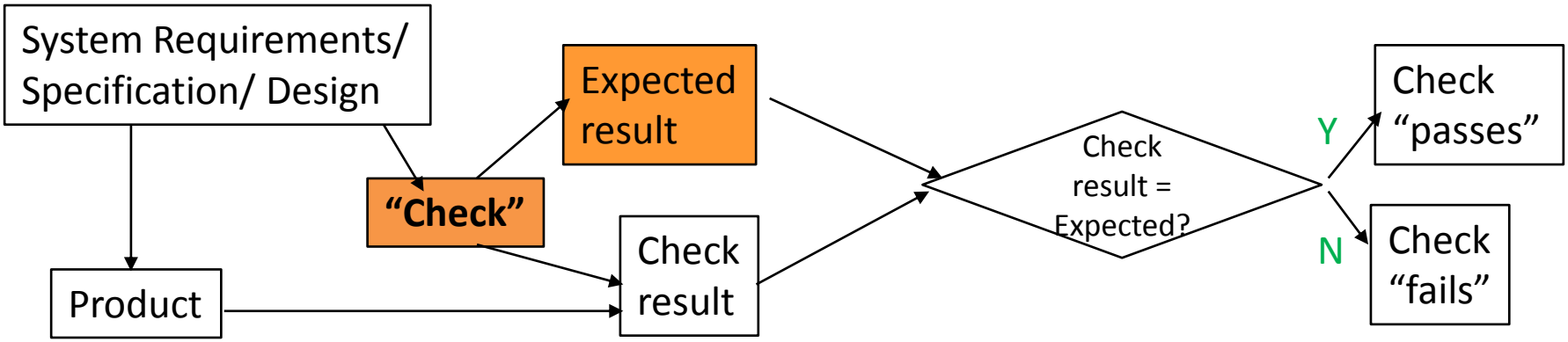
Precursor talk to this: "The Science of Software Testing"

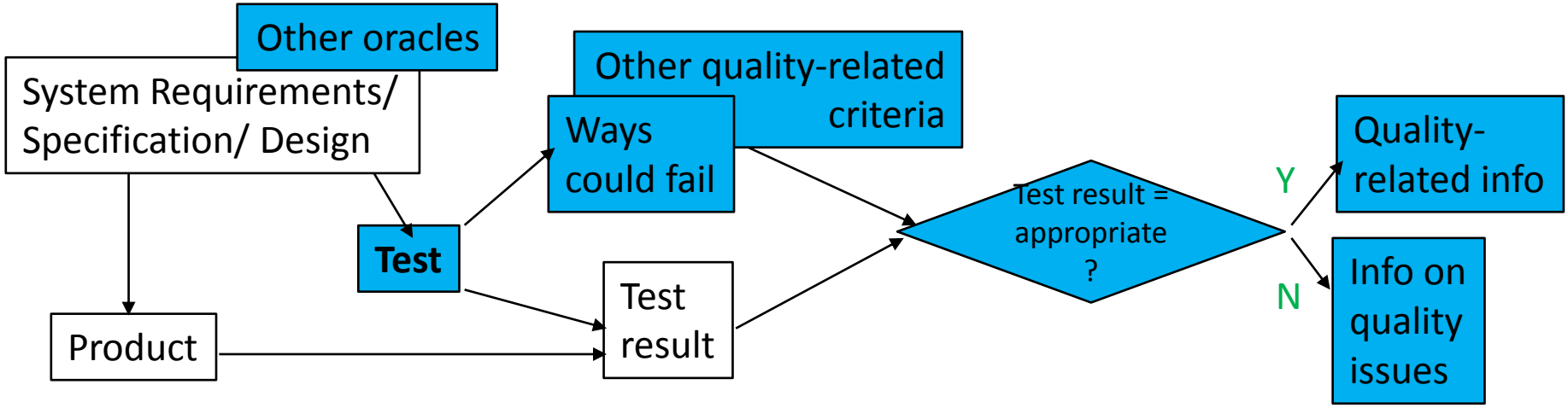
Association for Software Testing
CAST 2011
"Context-Driven Testing"
August 8 to 10, 2011
Lynnwood Convention Center - Seattle, WA, USA
Emerging Topics track



Note: this is starting with some "traditional" views of testing & science

This comparison informs the hot topic: testing versus “just” “checking”

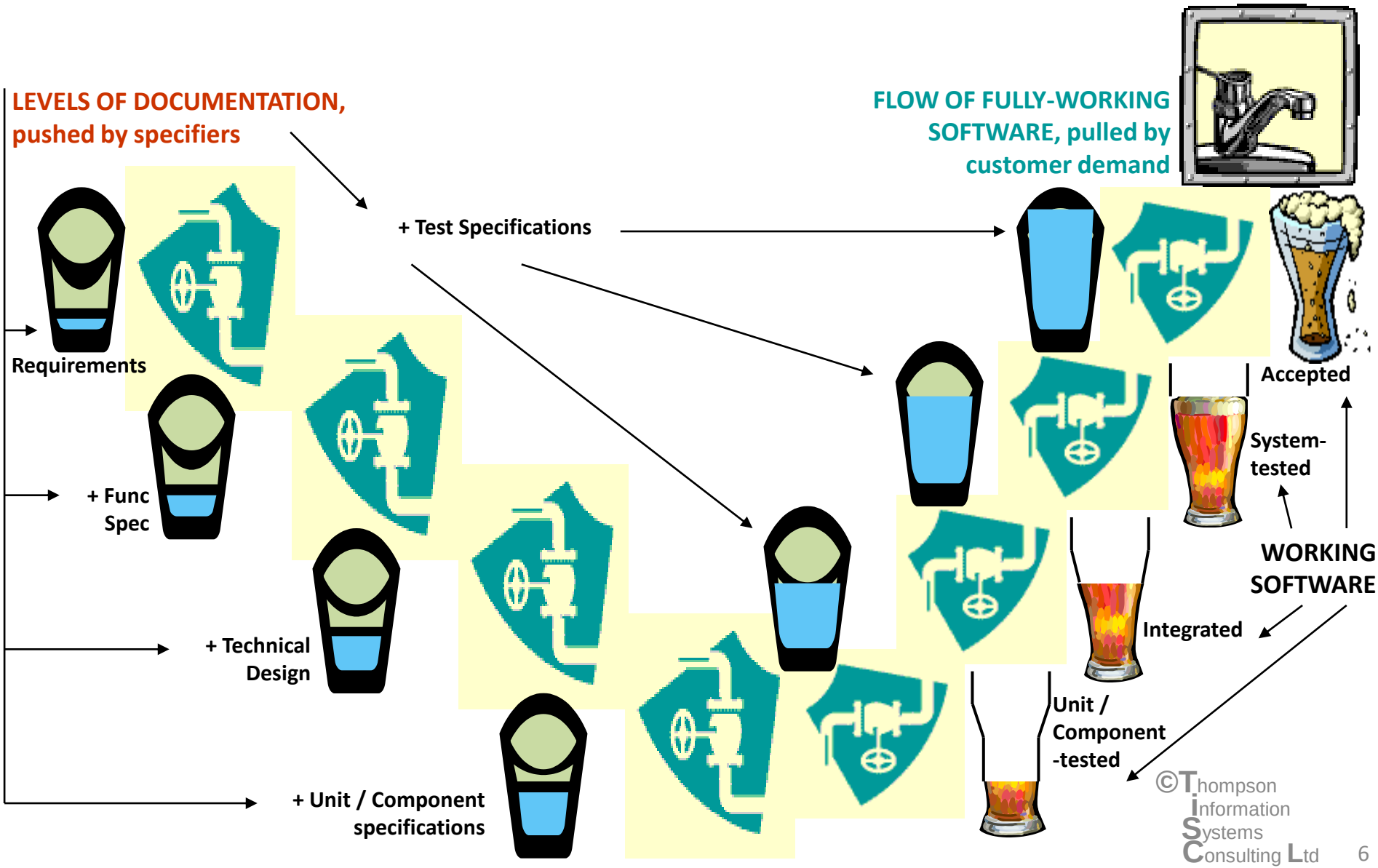




Sources: Michael Bolton blog and various Context-Driven material

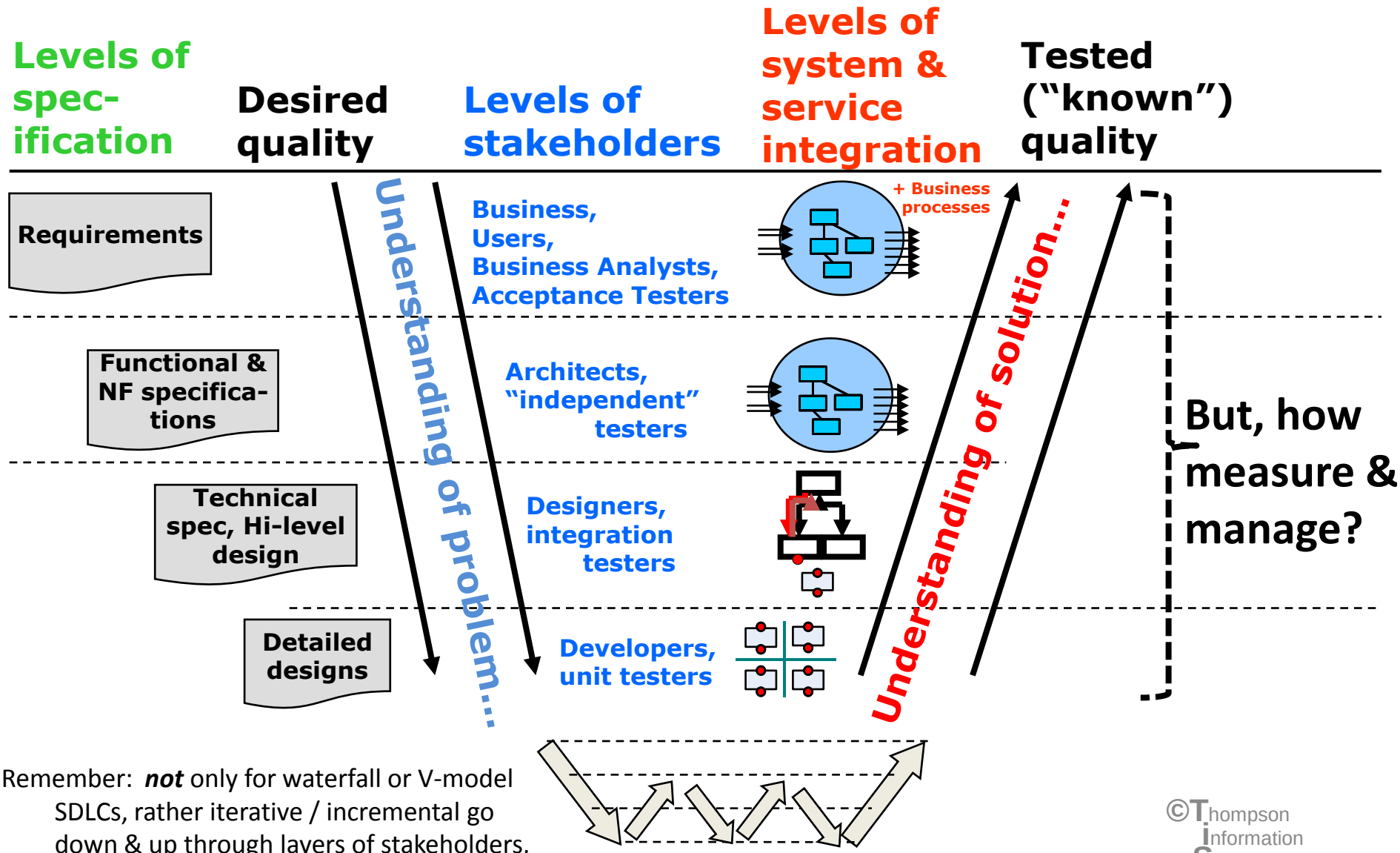
A complementary view: Testing as facilitating value flow through SDLC

Association for Software Testing
CAST 2011
"Context-Driven Testing"
August 8 to 10, 2011
Lynnwood Convention Center - Seattle, WA, USA
Emerging Topics track



Value Flow in SDLC as layers with four characteristics

Association for Software Testing ast
CAST 2011
"Context-Driven Testing"
August 8 to 10, 2011
Lynnwood Convention Center - Seattle, WA, USA
Emerging Topics track

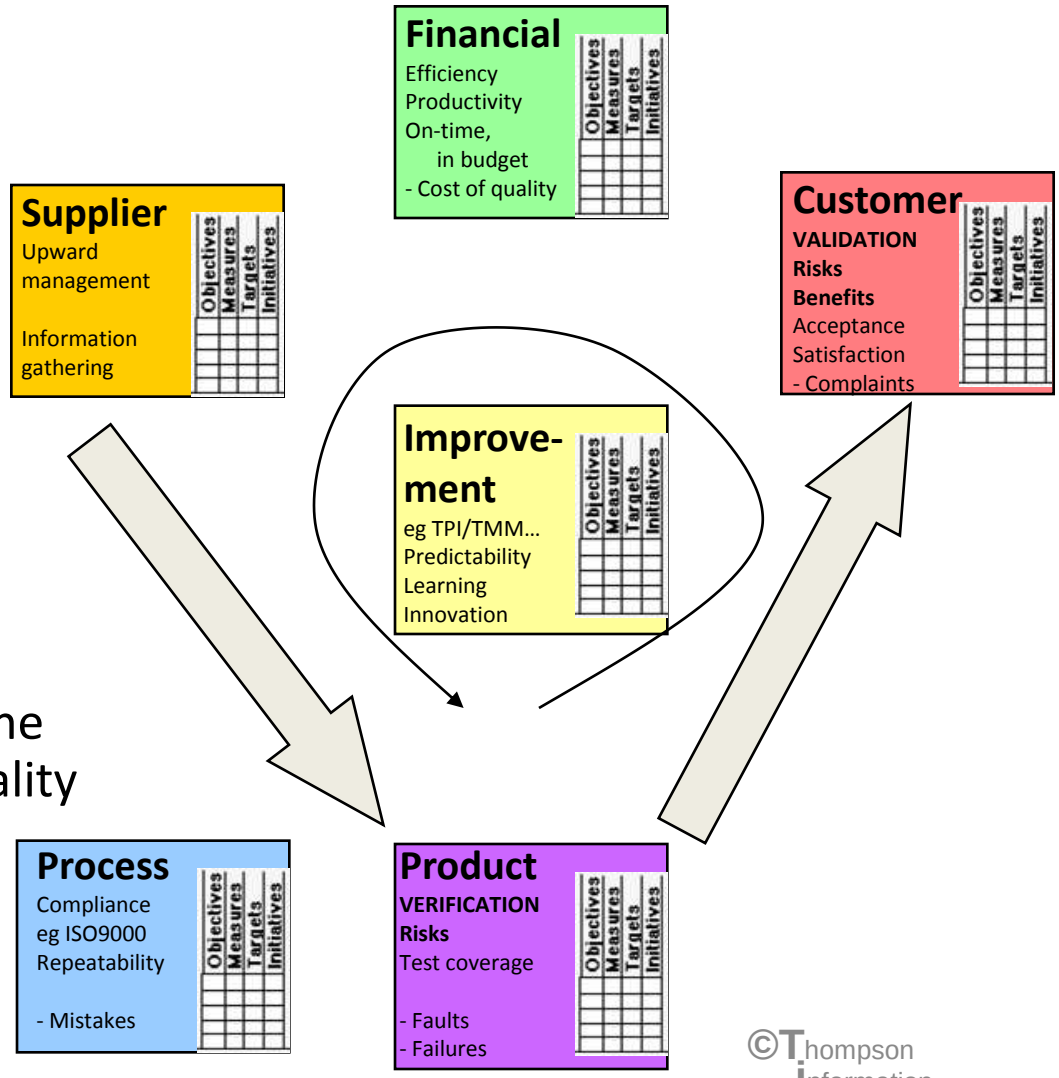


Remember: ***not*** only for waterfall or V-model SDLCs, rather iterative / incremental go down & up through layers of stakeholders, specifications & integrations

Managing Value Flow through SDLC using VF ScoreCards

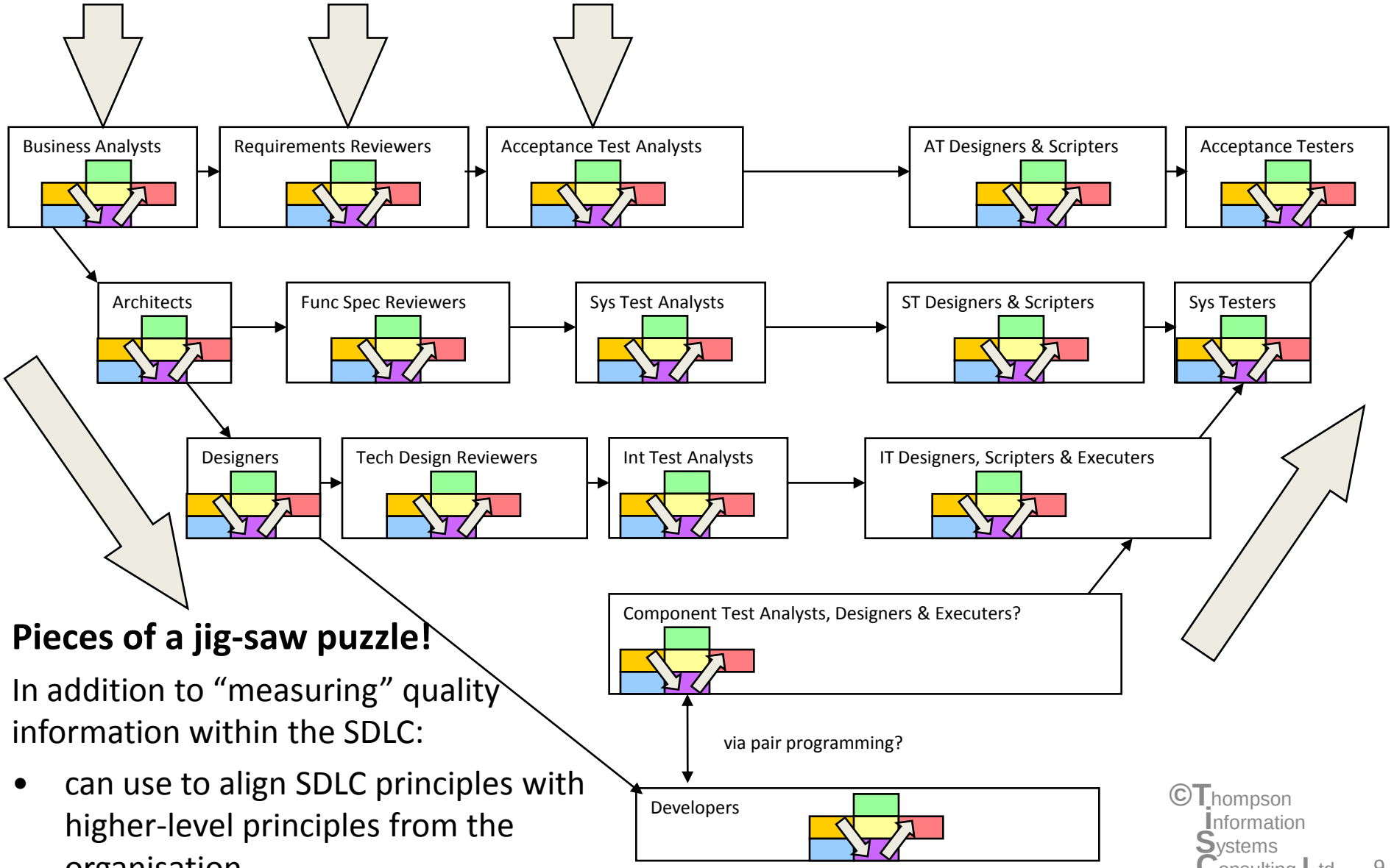
Association for Software Testing
CAST 2011
"Context-Driven Testing"
August 8 to 10, 2011
Lynnwood Convention Center - Seattle, WA, USA
Emerging Topics track

- Based on Kaplan & Norton Balanced Business Scorecard and other "quality" concepts
- Value chain ≈ Supply chain:
  - in the IS SDLC, each participant should try to 'manage their supplier'
  - for example, development supplies testing (in trad lifecycles, at least!)
  - we add supplier viewpoint to the other 5, giving a 6th view of quality
- So, each step in the value chain can manage its inputs, outputs and other stakeholders



Value Flow ScoreCards can be cascaded (...but don't necessarily need all of these!)

Association for Software Testing ast
CAST 2011
"Context-Driven Testing"
August 8 to 10, 2011
Lynnwood Convention Center - Seattle, WA, USA
Emerging Topics track



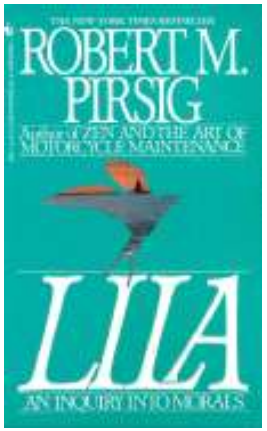
Pieces of a jig-saw puzzle!

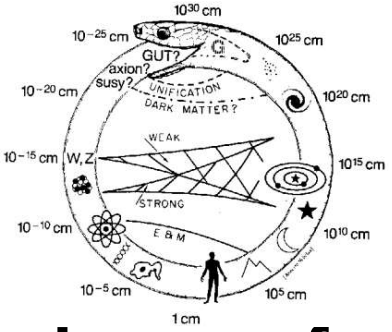
In addition to "measuring" quality information within the SDLC:

- can use to align SDLC principles with higher-level principles from the organisation

Using "Metaphysics" & Science as analogies to inform Value Flow

Association for Software Testing
CAST 2011
"Context-Driven Testing"
August 8 to 10, 2011
Lynnwood Convention Center - Seattle, WA, USA
Emerging Topics track





Layers of quality

Levels of stakeholders

Levels of system & service integration

Layers of science

Static values:

- Intellectual
- Social
- Biological
- Inorganic

Dynamic values?

Business, Users, Business Analysts, Acceptance Testers

+ Business processes

Architects, "independent" testers

Designers, integration testers

Developers, unit testers

Scale.....

(Philosophy)

Social sciences

Biology (& systems thinking)

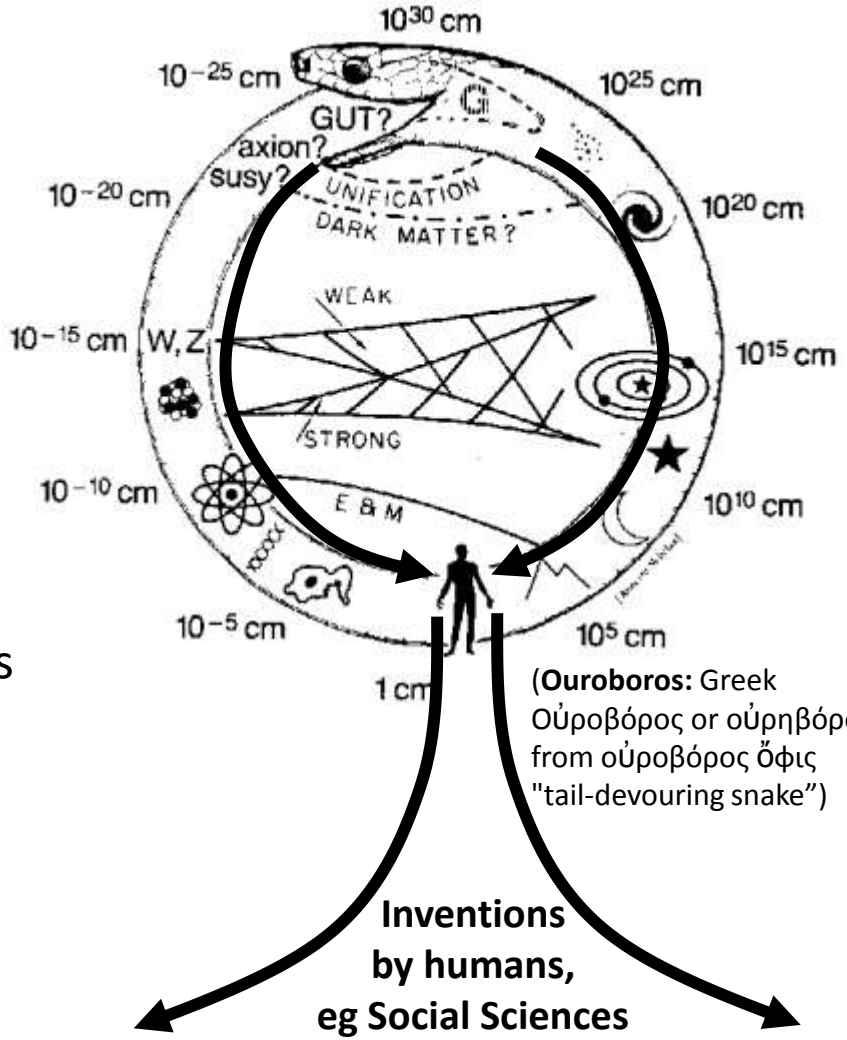
Chemistry: Organic

Chemistry: Inorganic

Physics

What was that about layers of Science?

- There is a cascade (and approx symmetry!):
  - Biology depends on Organic Chemistry
  - Organic chemistry depends on the special properties of Carbon
  - Chemical elements in the upper part of the periodic table come from supernovae
  - Elements in the lower part of the periodic table come from ordinary stars
  - Elements are formed from protons, neutrons, electrons (Physics)
  - ... quarks... string theory?? etc
- It just so happens that humans are about equidistant in scale from the smallest things we can measure to the largest
- Then... humans have evolved to use tools, build societies, read, invent computers...
- So, it is possible to think of pan-scientific evolution as a flow of value
- Now, back to software lifecycles...



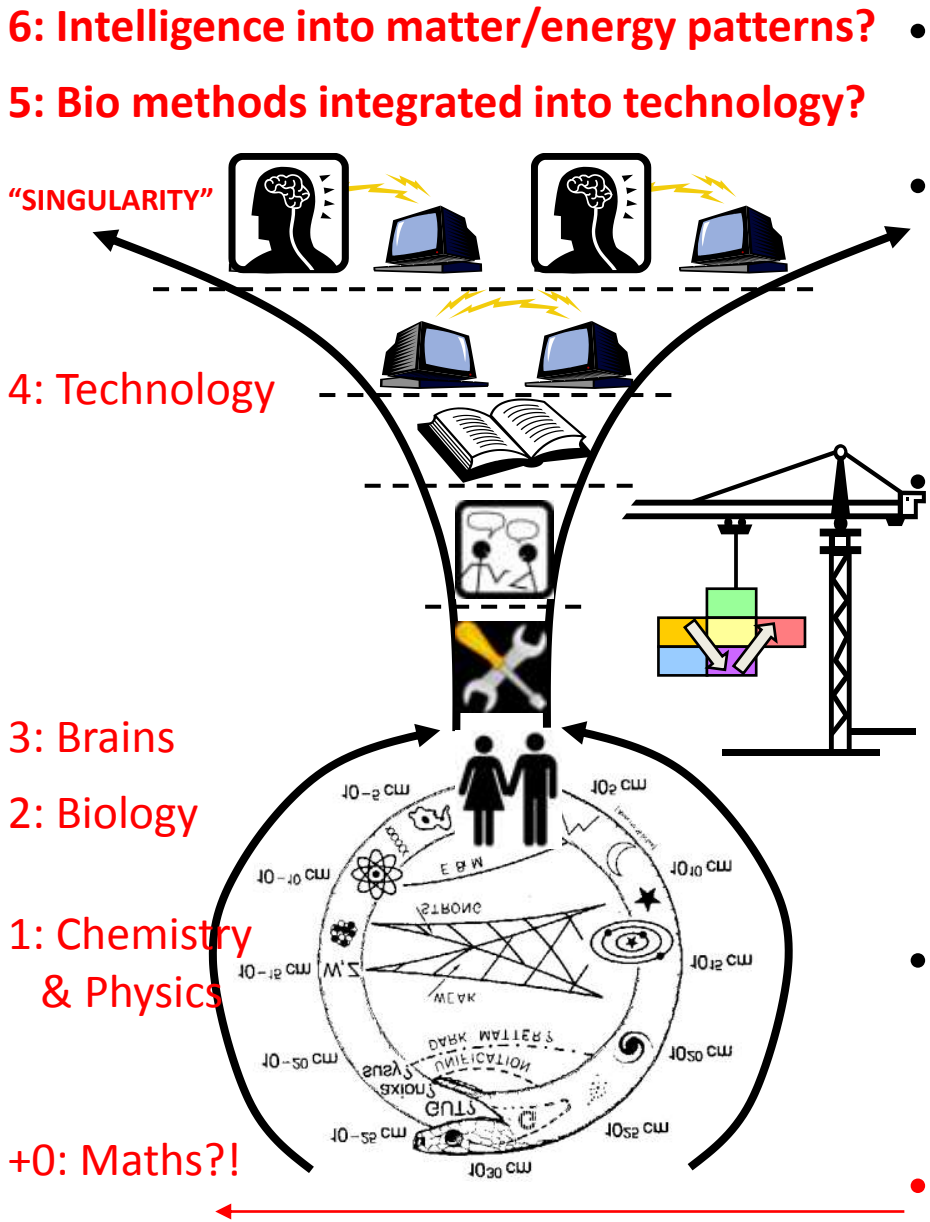
(**Ouroboros:** Greek Οὐροβόρος or οὐρηβόρος, from οὐροβόρος ὄφις "tail-devouring snake")

Sources: Daniel Dennett "Darwin's Dangerous Idea"
"cosmic Ouroboros" (Sheldon Glashow, Primack & Abrams, Rees etc)

Image from http://www.aaas.org/spp/dser/03_Areas/cosmos/perspectives/Essay_Primack_SNAKE.GIF

Invert that picture: Testing is really at the top, and should diverge fast!

Association for Software Testing
CAST 2011
"Context-Driven Testing"
August 8 to 10, 2011
Lynnwood Convention Center - Seattle, WA, USA
Emerging Topics track



- Each level of progress generates possibilities, which are tested
- Then, each level is a platform which, when established, is easily built upon by "cranes" (without having to worry about the details below)

After the science levels...

- humans made tools, talked and co-operated
- printing gave us another level
- now, software is following exponential growth

- So, software testing should surf the wave of evolution (not flounder in the shallows behind it)
- Kurzweil epochs

Evolution: first, traditional Darwinian (ie biological)

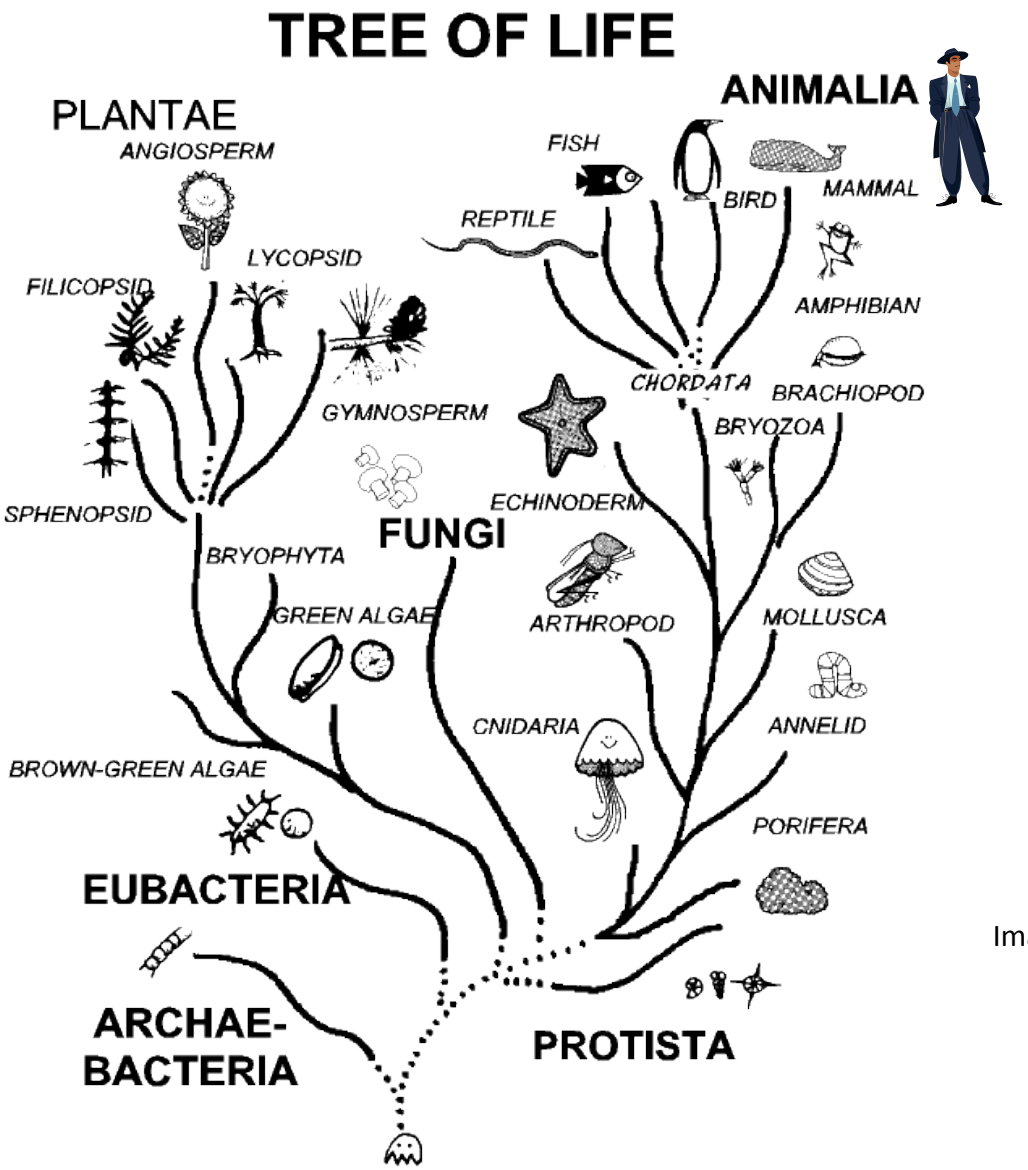
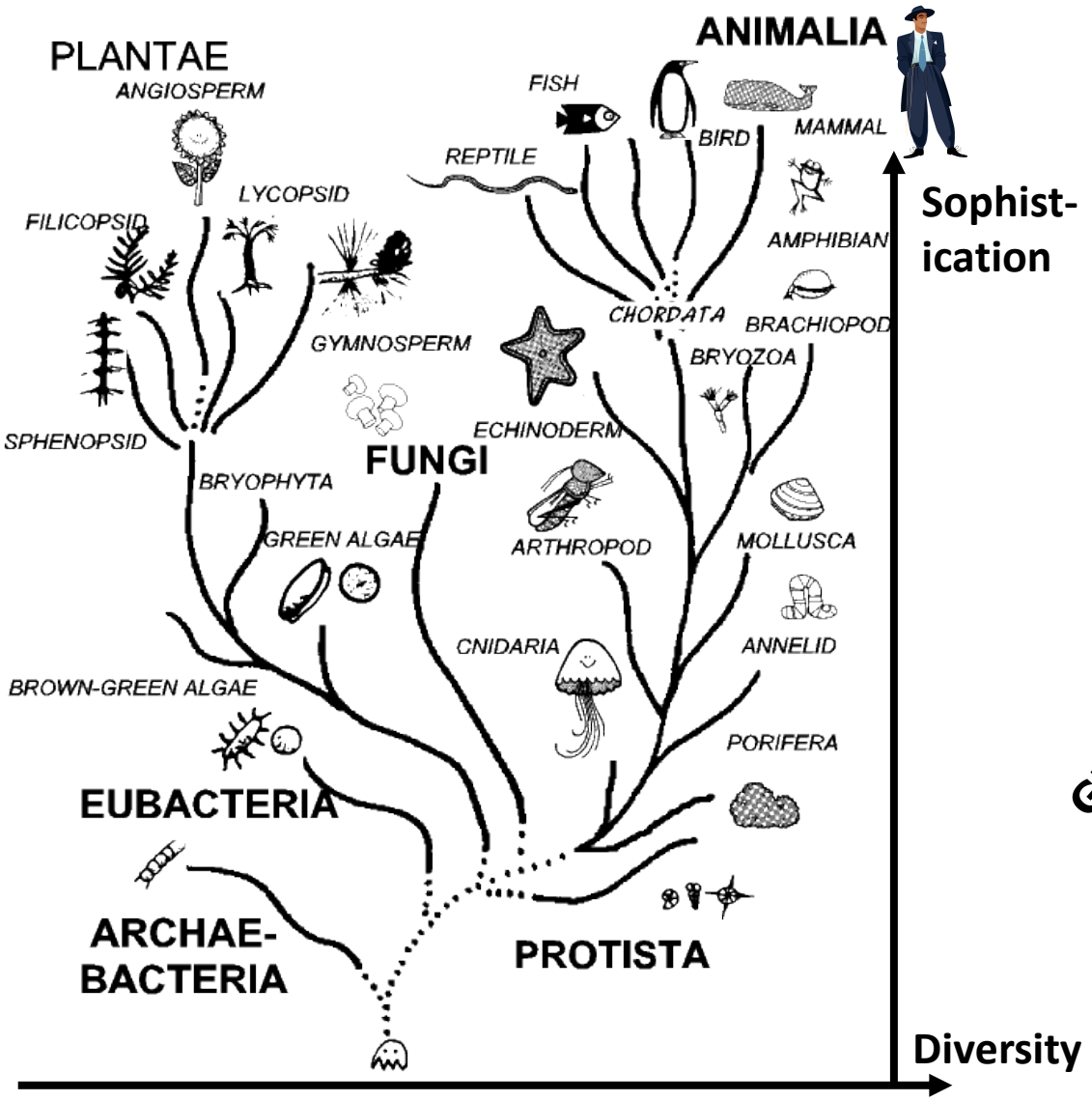


Image from www.qwickstep.com

Biological reproduction & evolution are controlled by Genes



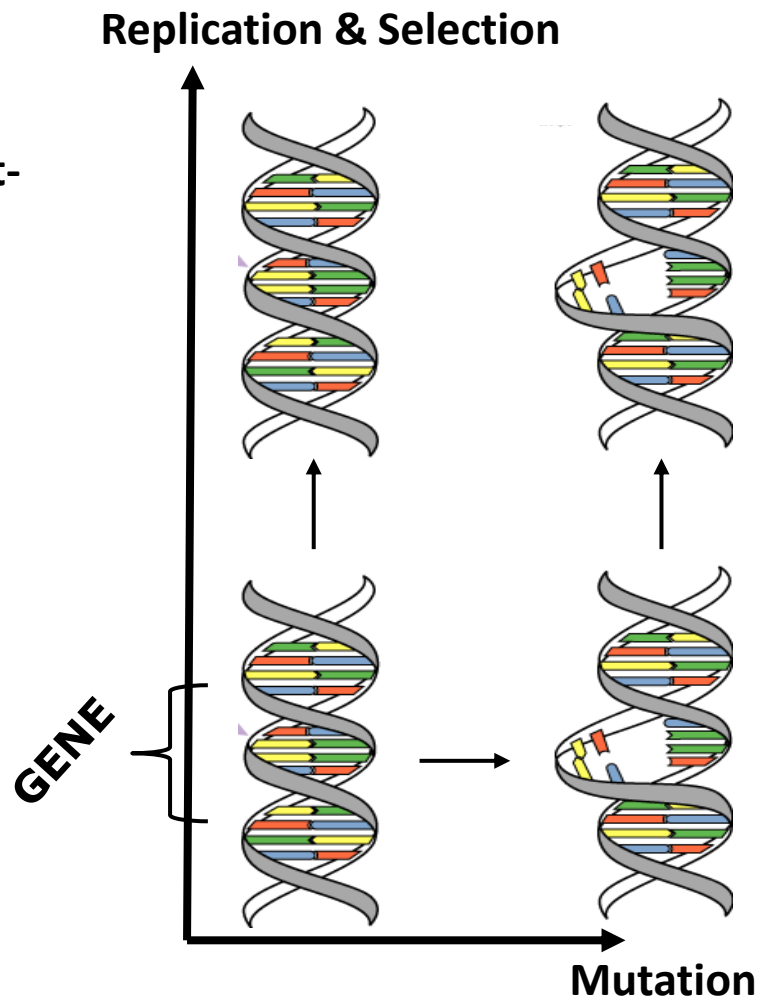
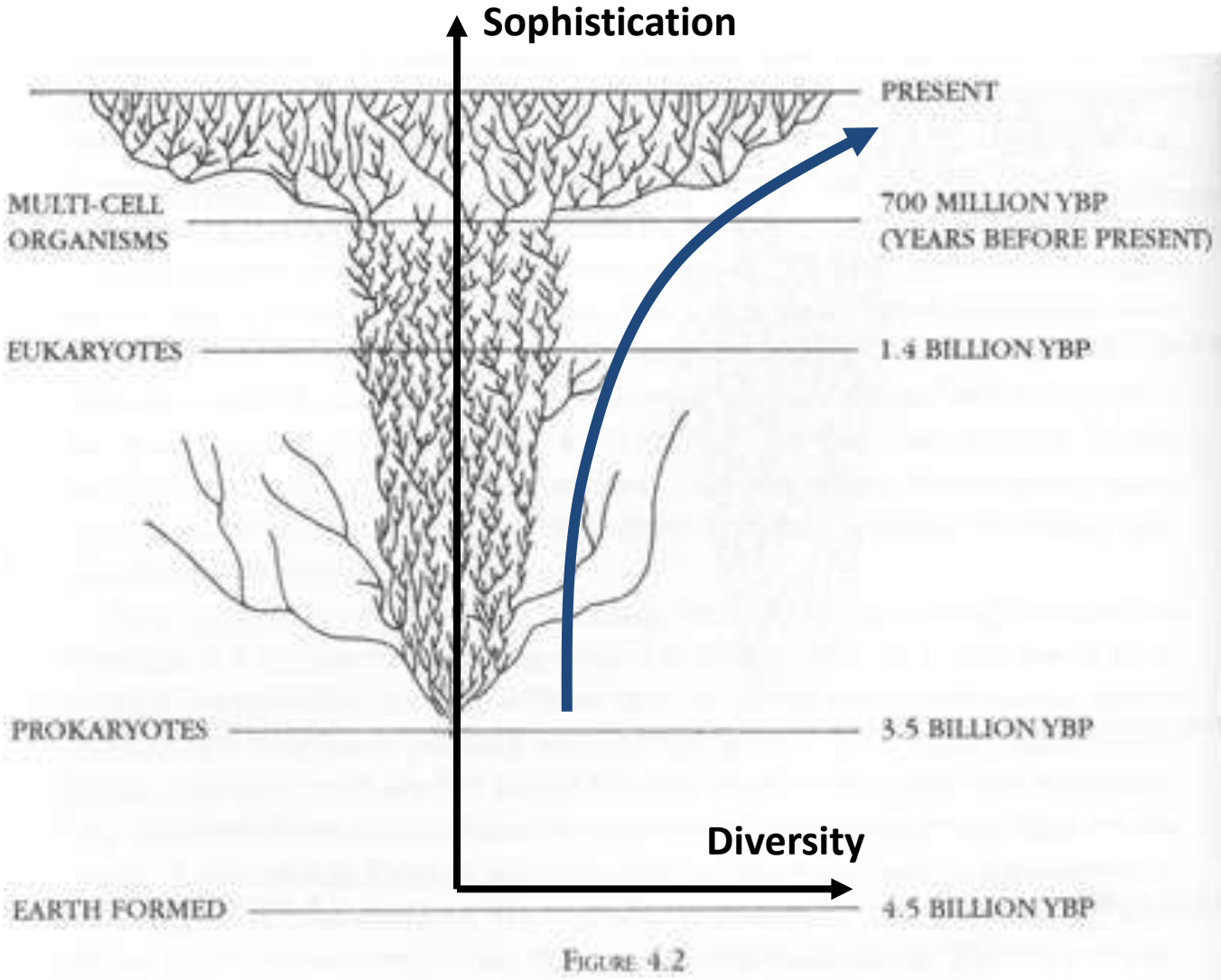
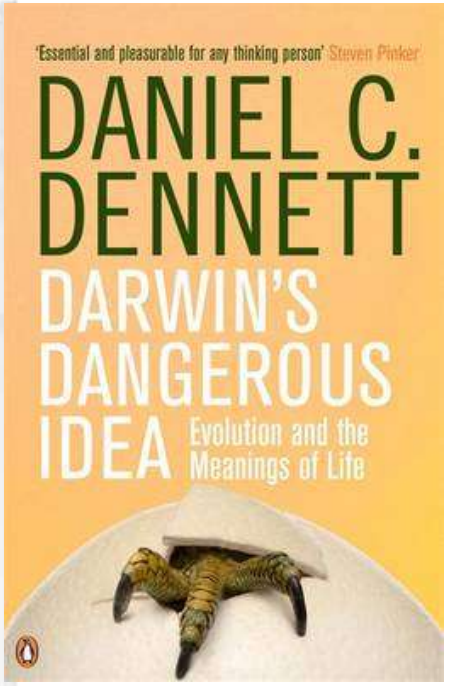


Image from www.qwickstep.com

Image from .schools.wikipedia.org

Biological Evolution as Sophistication plotted against Diversity

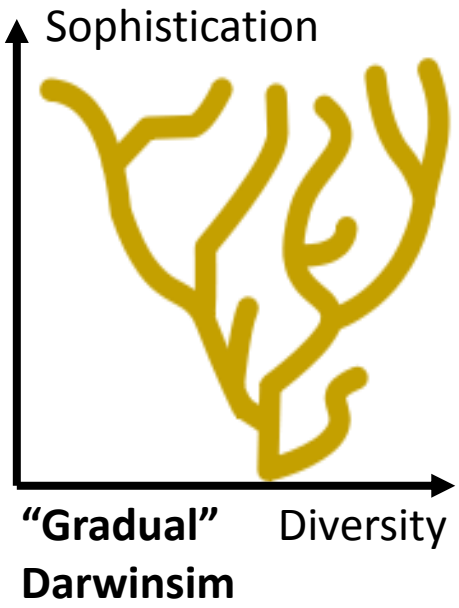




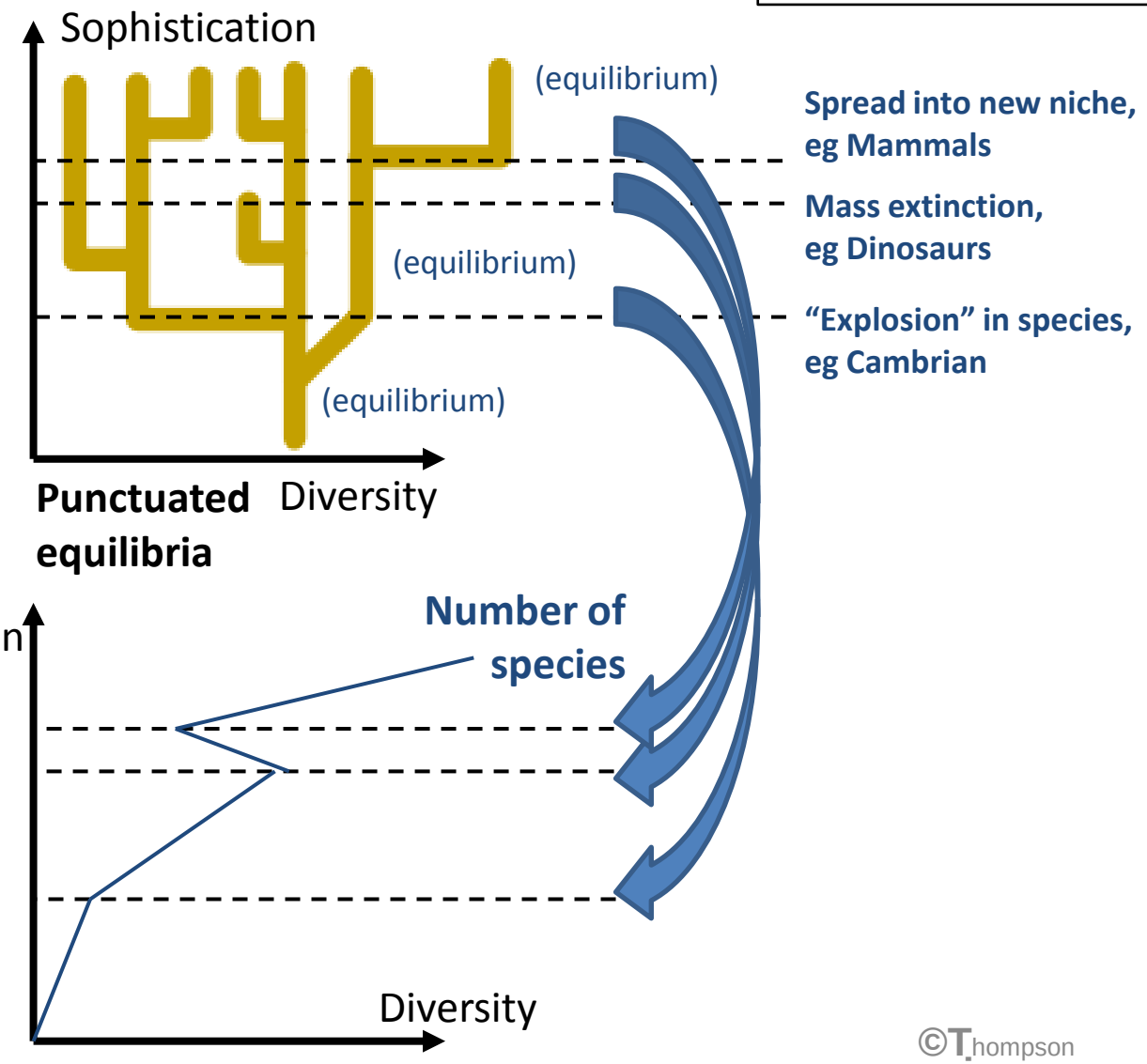
Source: Daniel Dennett "Darwin's Dangerous Idea"

But evolution is not smooth?

Association for Software Testing
CAST 2011
"Context-Driven Testing"
August 8 to 10, 2011
Lynnwood Convention Center - Seattle, WA, USA
Emerging Topics track



"Gradual" Darwinsim

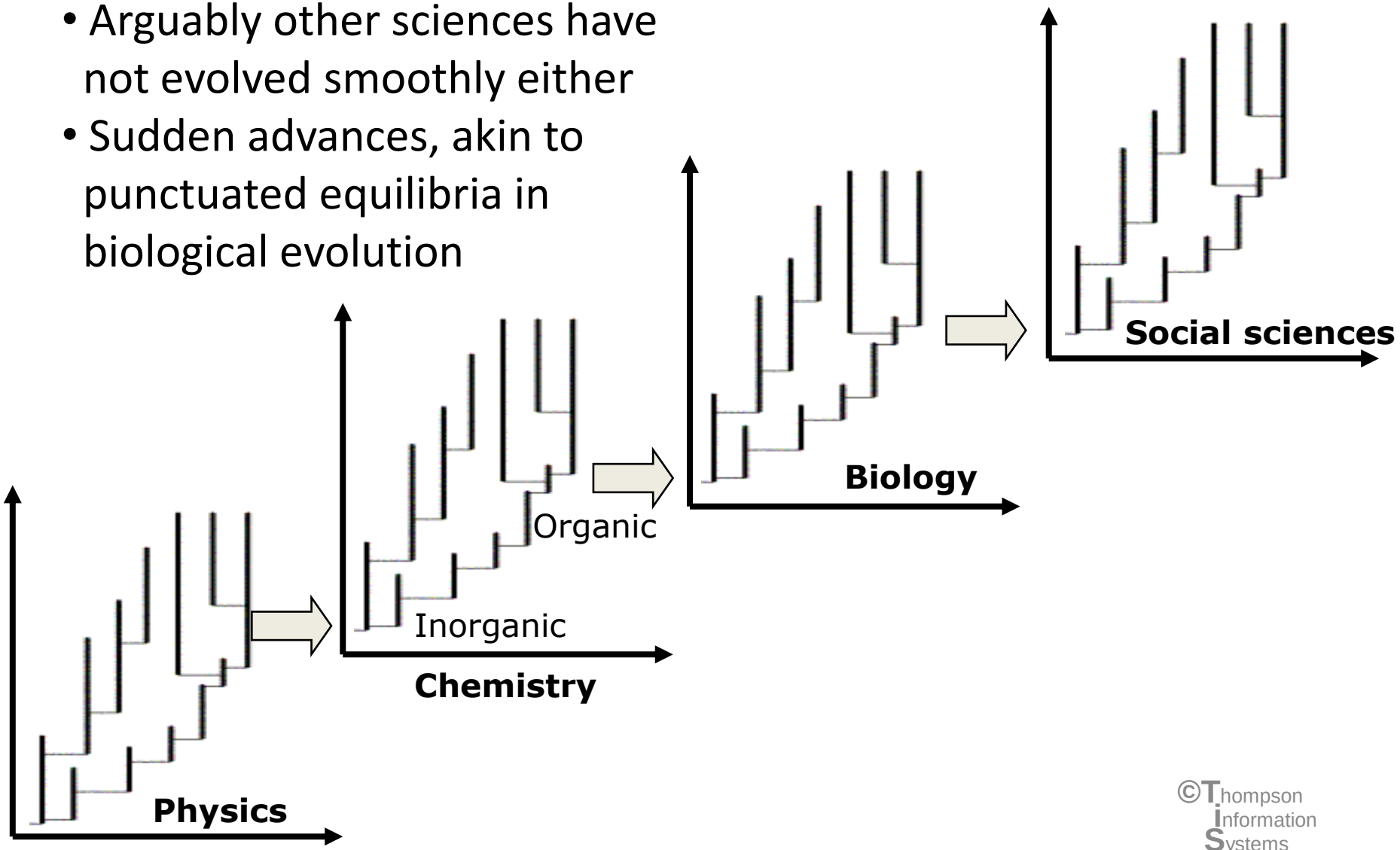


Punctuated equilibria

"Punctuated equilibra" idea originated by Niles Eldredge & Stephen Jay Gould
Images from www.wikipedia.org

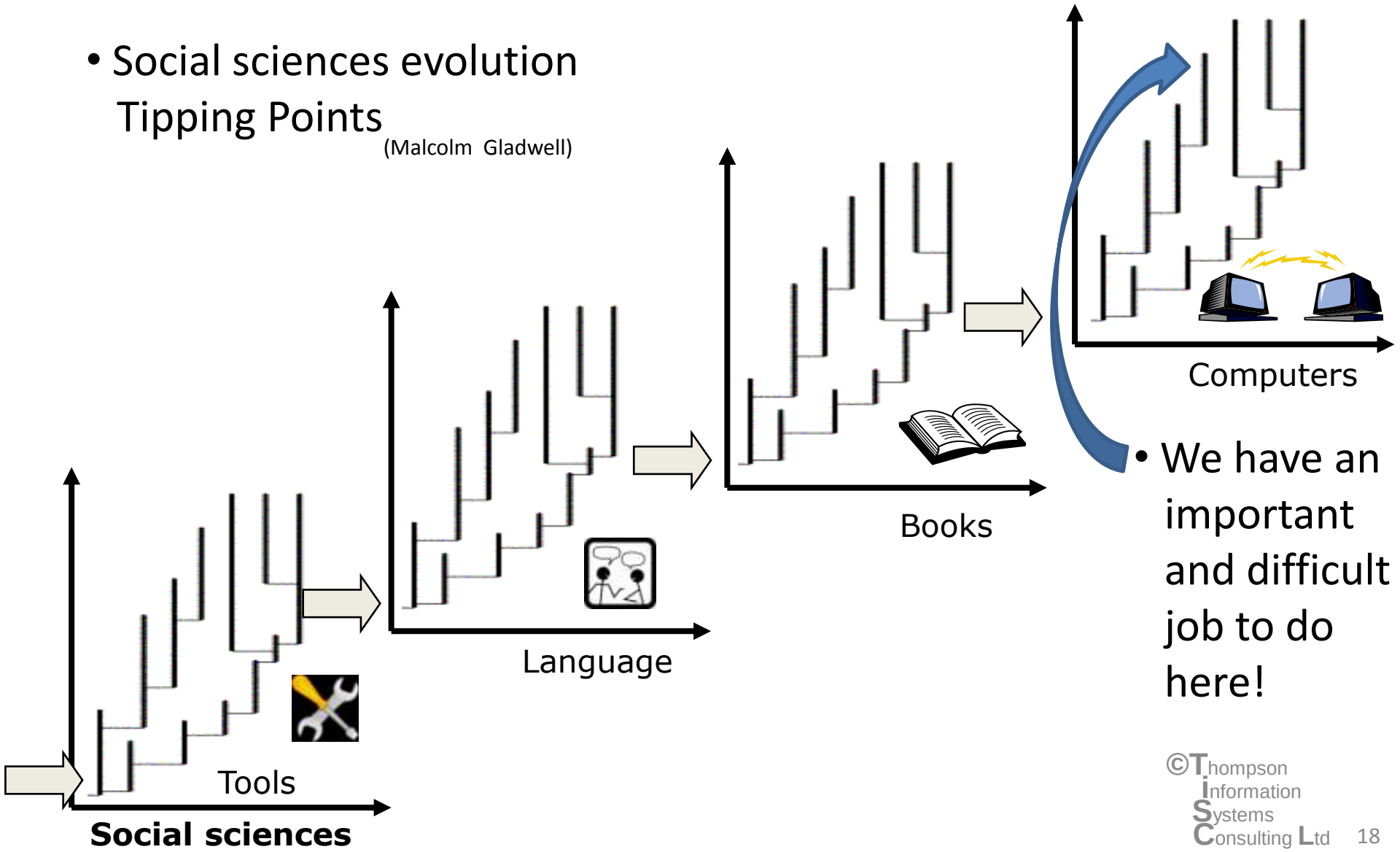
So... Evolution of Science overall

- Arguably other sciences have not evolved smoothly either
- Sudden advances, akin to punctuated equilibria in biological evolution



OK, what's this got to do with software testing?

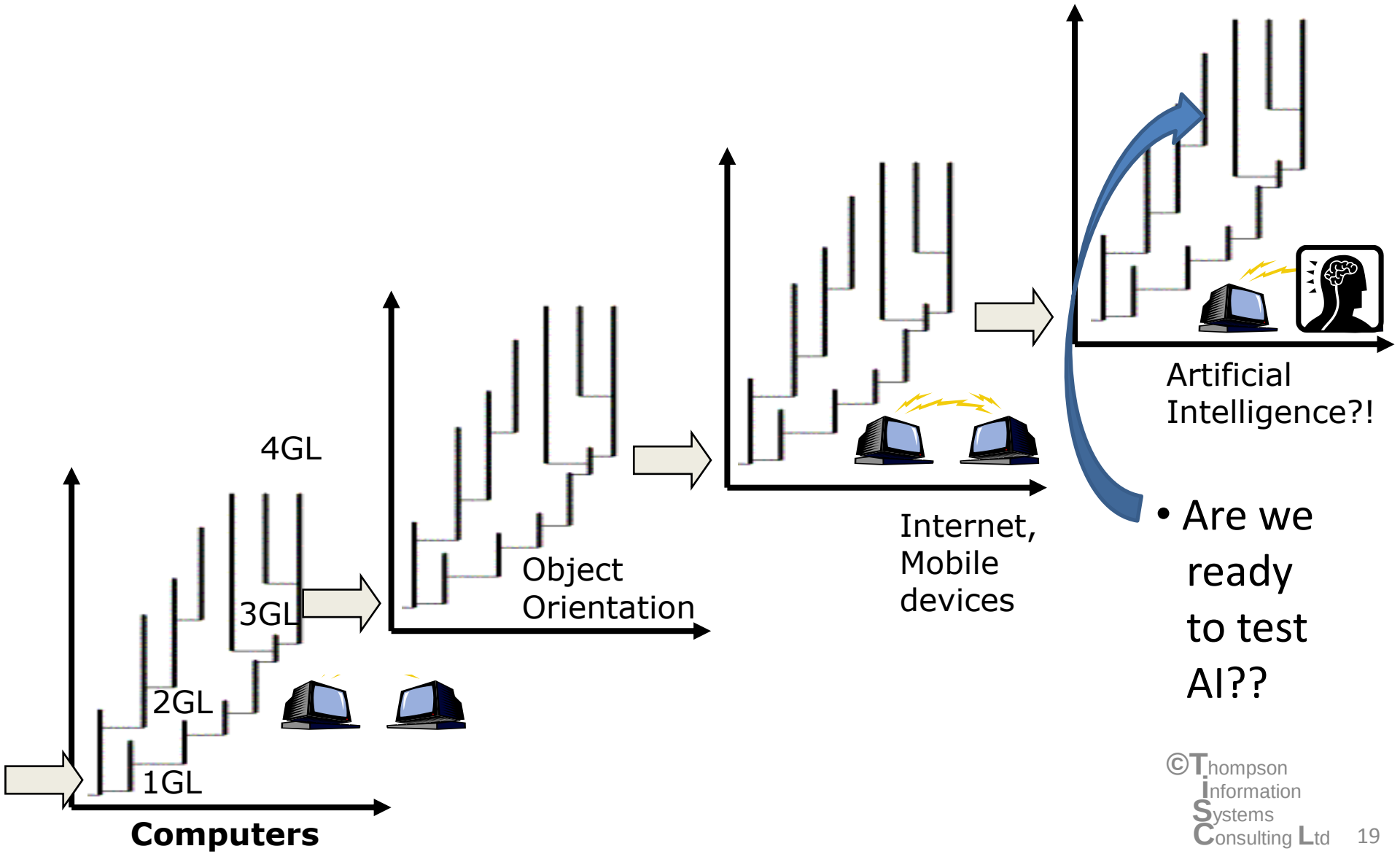
- Social sciences evolution
  Tipping Points (Malcolm Gladwell)



- We have an important and difficult job to do here!

...and computers are evolving, in both sophistication and diversity, faster than software testing?

Association for Software Testing
CAST 2011
"Context-Driven Testing"
August 8 to 10, 2011
Lynnwood Convention Center - Seattle, WA, USA
Emerging Topics track



How software testing has evolved so far?

CAST 2011
"Context-Driven Testing"
August 8 to 10, 2011
Lynnwood Convention Center - Seattle, WA, USA
Emerging Topics track

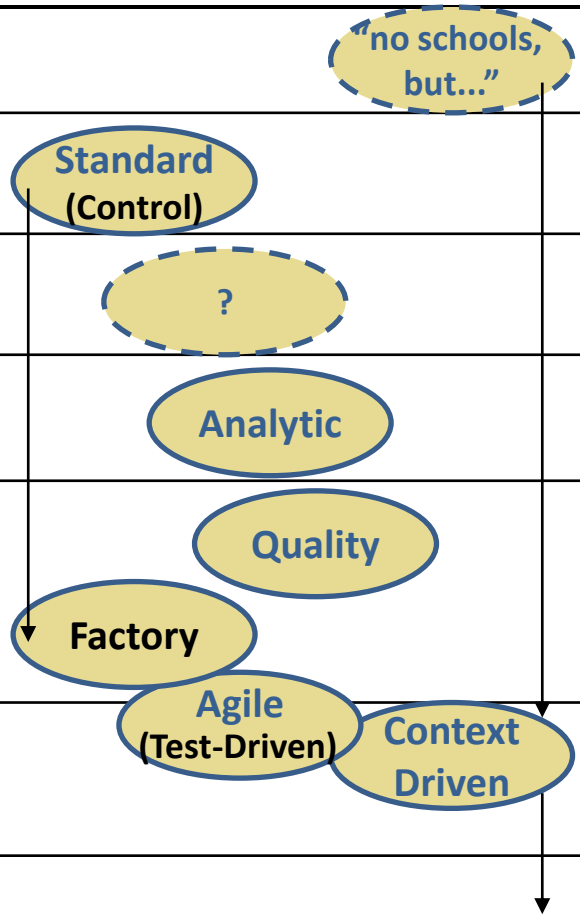
PERIOD		EXEMPLAR	OBJECTIVES	SCOPE	APPROACH
Pre-1957	DEBUGGING (**Psychology**)	Weinberg (1961 & 71)	Test **+ Debug**	Programs	Think, Iterate
	DEMONSTRATION (**Method**)	Hetzel (1972)	Show meets **requirements**	Programs	**Verify, +maybe Prove, Validate, "Certify"**
1976	DESTRUCTION (**Art**)	Myers (1976 & 79)	Find **bugs**	Programs, **Sys, Acceptance**	**+ Walkthroughs, Reviews & Inspections**
1983	EVALUATION	?	**Measure quality**		
1984	PREVENTION (**Craft?**)	Beizer (1984)	Find bugs, show meets requirements, **+prevent bugs**	**+ Integration**	
2000	SCHOOL(S)	Kaner et al (1988 & 99)	Find bugs, in service of improving quality, for **customer needs**		Realistic, pragmatic, normal
2011	Science?		Experiment & Evolve?	Neo-Holistic?	

Overall periods developed after Gelperin & Hetzel, "The Growth of Software Testing", 1988 CACM 31 (6) as quoted on Wikipedia

Can we retrofit the Schools to this history?

Association for Software Testing ast
CAST 2011
"Context-Driven Testing"
August 8 to 10, 2011
Lynnwood Convention Center - Seattle, WA, USA
Emerging Topics track

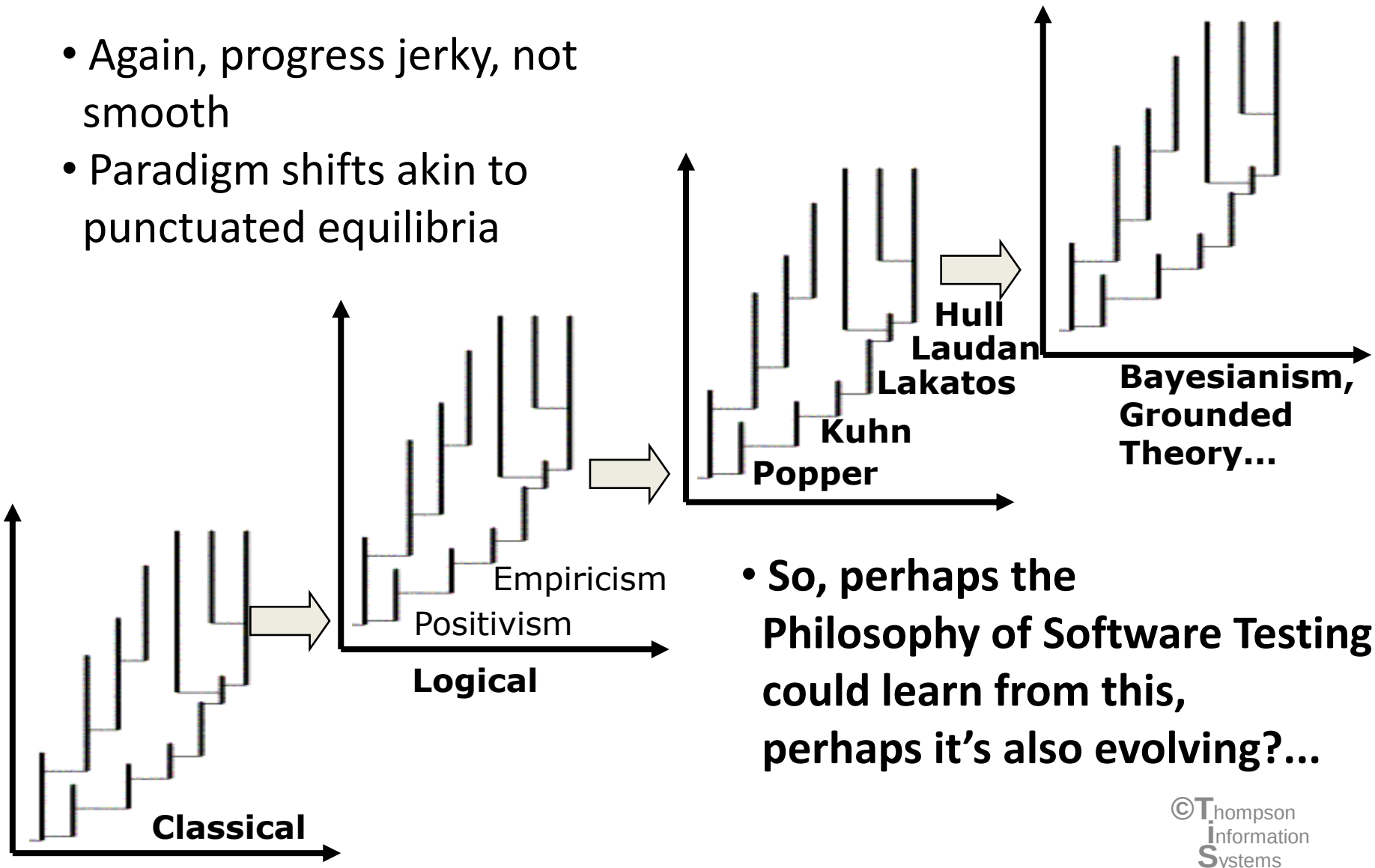
PERIOD		EXEMPLAR	OBJECTIVES	SCOPE	"SCHOOL"?
Pre-	DEBUGGING (**Psychology**)	Weinberg (1961 & 71)	Test **+ Debug**	Programs	
1957	DEMONSTRATION (**Method**)	Hetzel (1972)	Show meets **requirements**	Programs	
1976	DESTRUCTION (**Art**)	Myers (1976 & 79)	Find **bugs**	Programs, **Sys**, **Acc**	
1983	EVALUATION	?	**Measure quality**		
1984	PREVENTION (**Craft?**)	Beizer (1984)	Find bugs, show meets requirements, **+prevent bugs**	**+ Int**	
2000	SCHOOL(S)	Kaner et al (1988 & 99)	Find bugs, in service of improving quality, for **customer needs**		
2011	Science?		Experiment & Evolve?	Neo-Holistic?	



The Philosophy of Science is also evolving!

Association for Software Testing
CAST 2011
"Context-Driven Testing"
August 8 to 10, 2011
Lynnwood Convention Center - Seattle, WA, USA
Emerging Topics track

- Again, progress jerky, not smooth
- Paradigm shifts akin to punctuated equilibria



- **So, perhaps the Philosophy of Software Testing could learn from this, perhaps it's also evolving?...**

Memes as an extension of the Genes concept

Association for Software Testing ast
CAST 2011
"Context-Driven Testing"
August 8 to 10, 2011
Lynnwood Convention Center - Seattle, WA, USA
Emerging Topics track

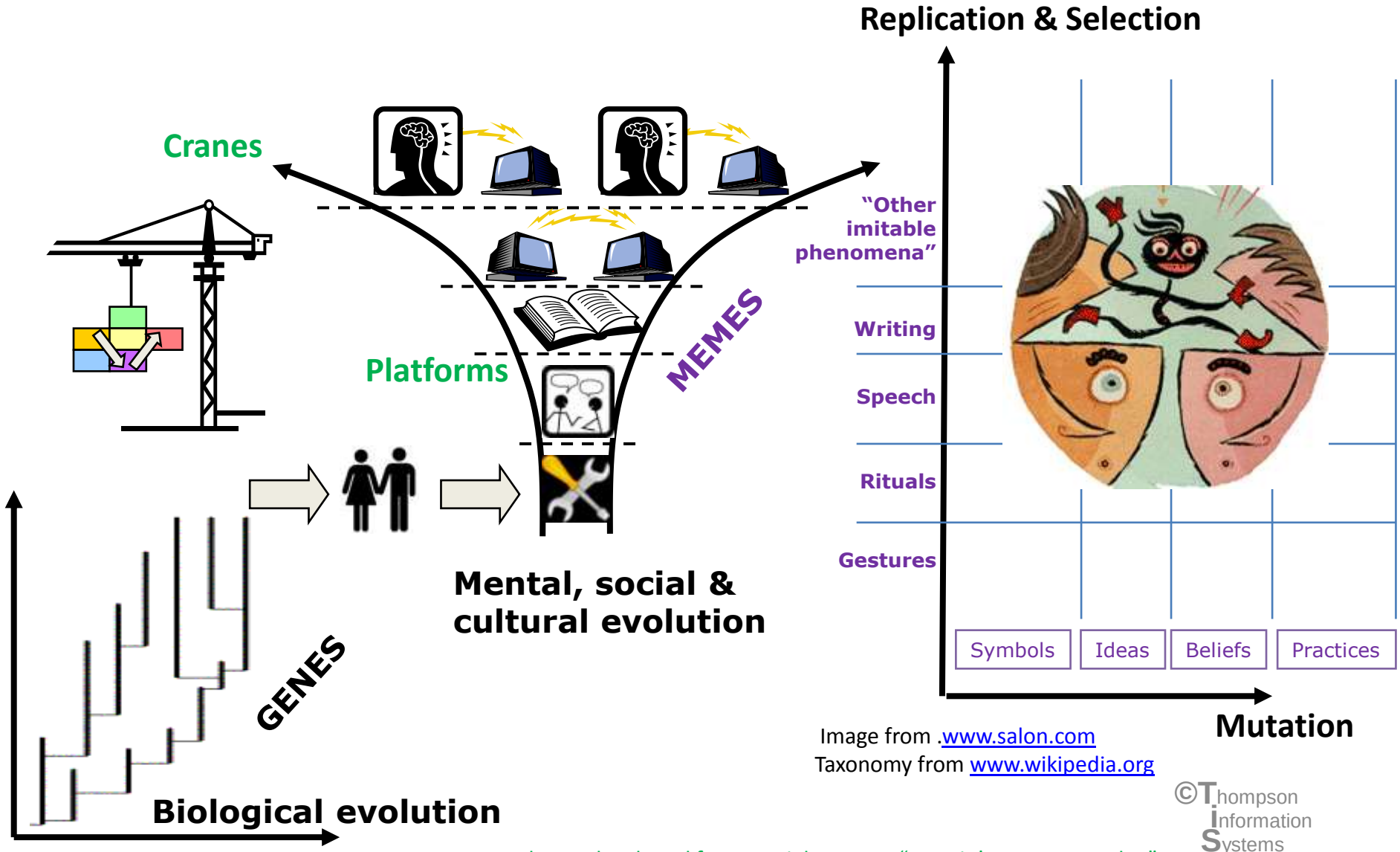
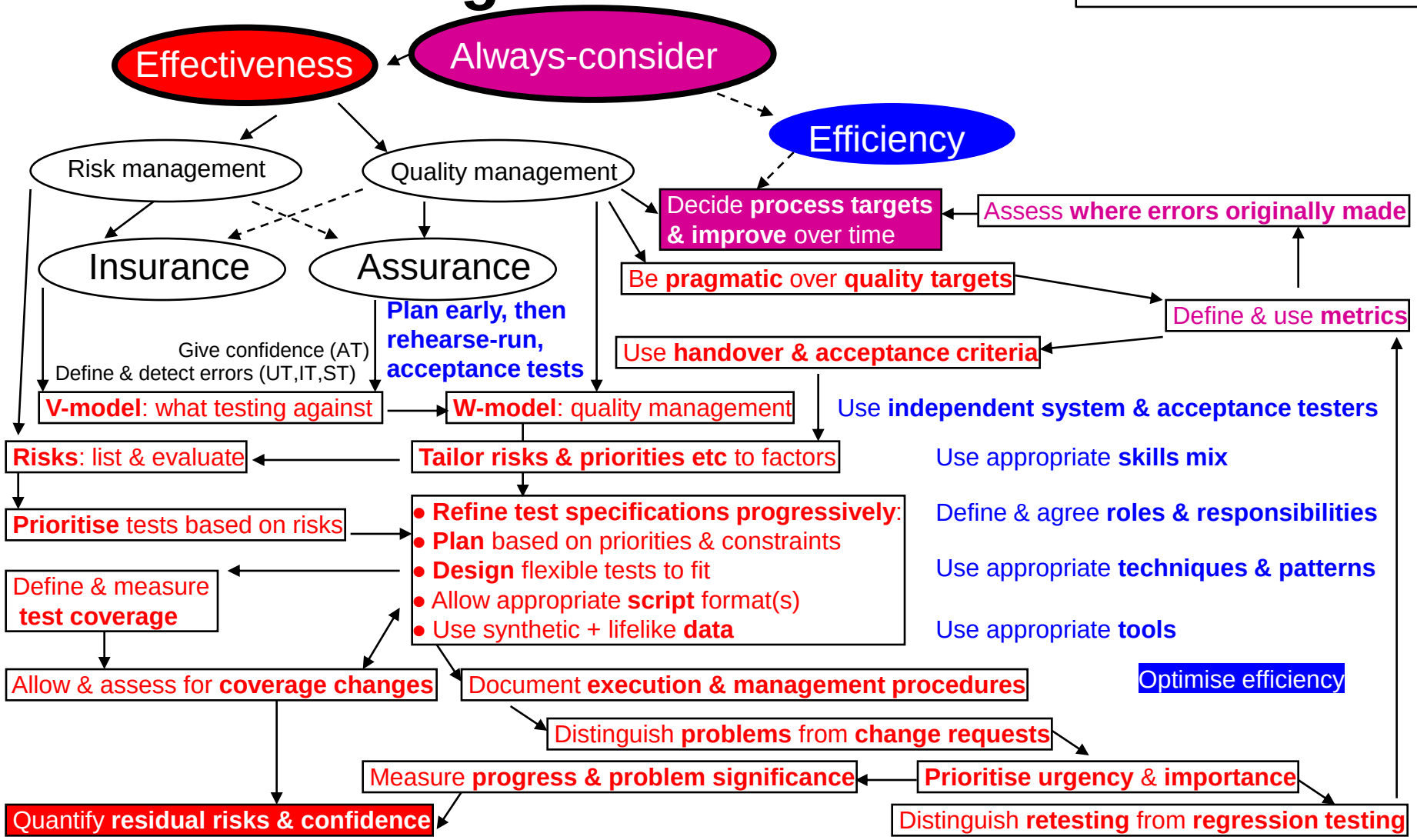


Image from .www.salon.com
Taxonomy from www.wikipedia.org

Theme developed from Daniel Dennett "Darwin's Dangerous Idea"

Some candidates for Memes in software testing

Association for Software Testing
CAST 2011
"Context-Driven Testing"
August 8 to 10, 2011
Lynnwood Convention Center - Seattle, WA, USA
Emerging Topics track

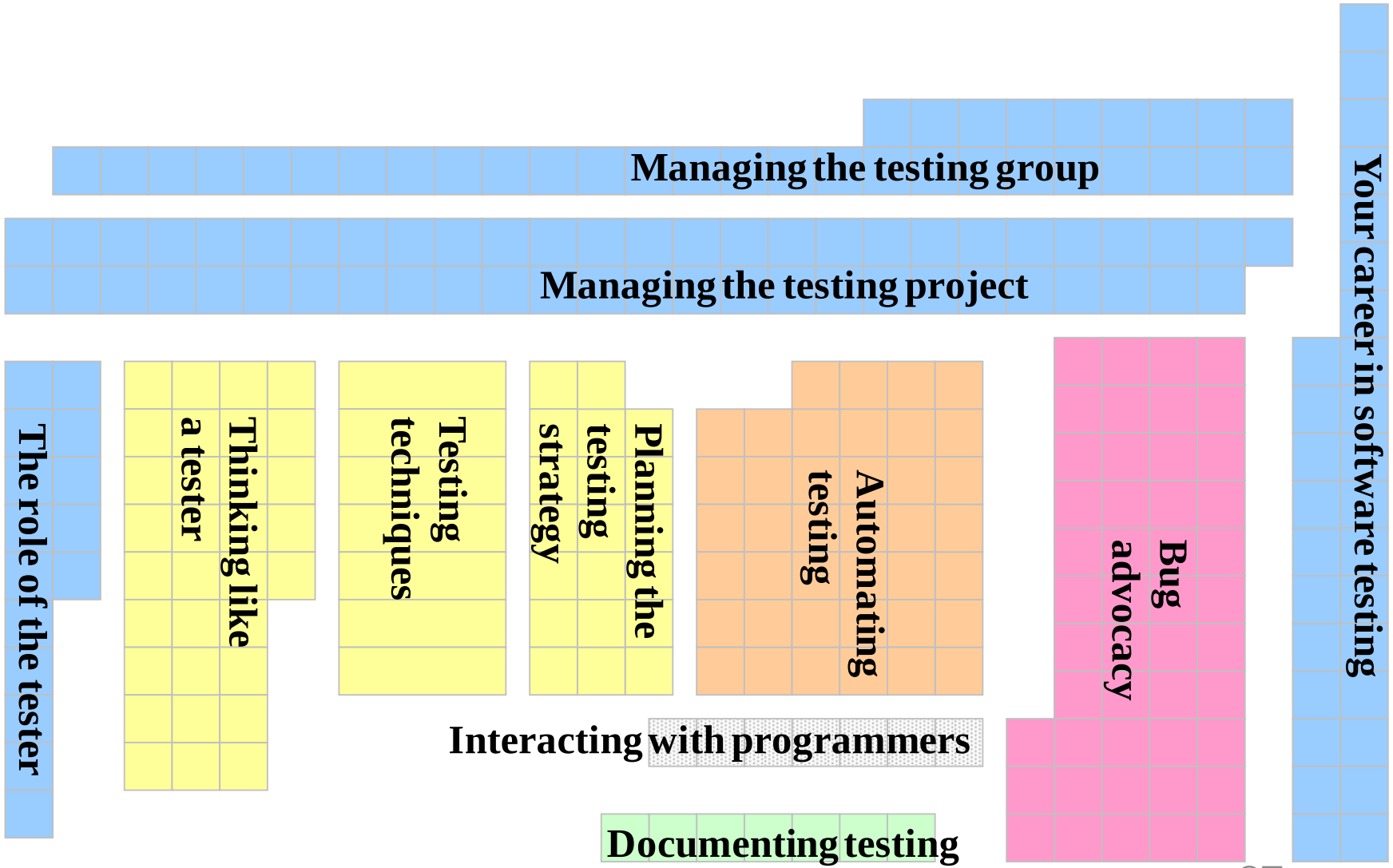


Source: Neil Thompson STAREast 2003

(not "best practices" but reference points for variation?)

An example of a different software testing "memeplex"

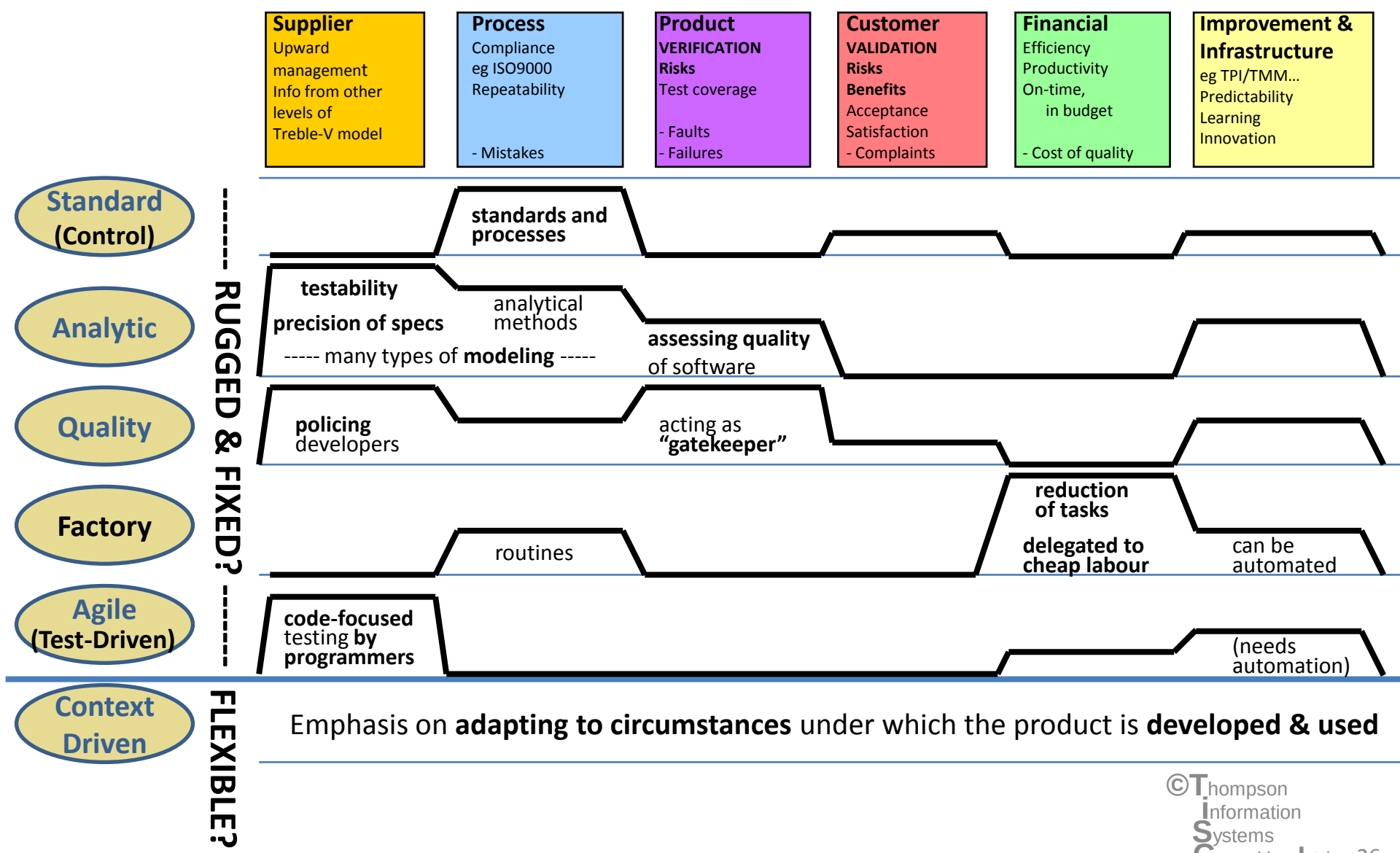
Association for Software Testing
CAST 2011
"Context-Driven Testing"
August 8 to 10, 2011
Lynnwood Convention Center - Seattle, WA, USA
Emerging Topics track



Source: Neil Thompson BCS SIGiST 2002 review of Lessons Learned in Software Testing (Kaner, Bach & Pettichord)

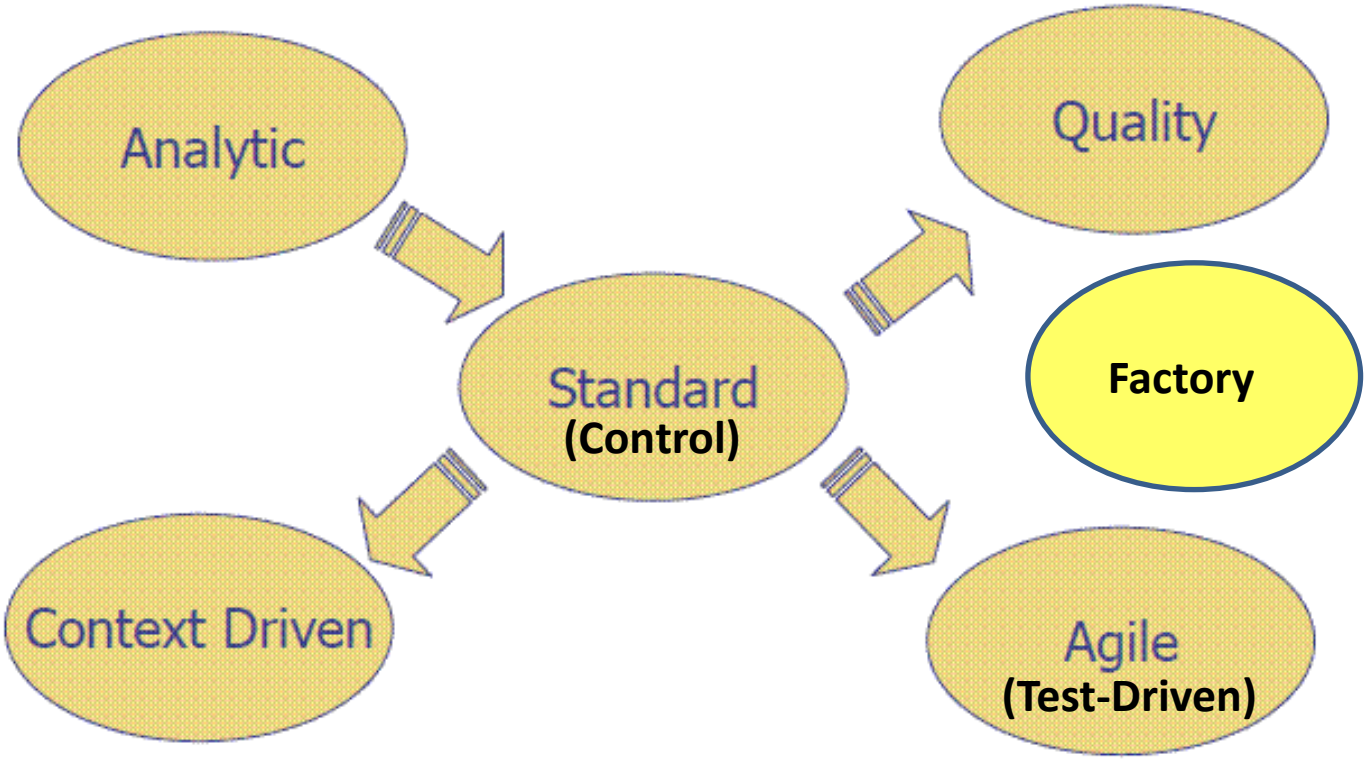
Memeplexes and Fitness Landscapes: fixed / flexible?

Association for Software Testing ast
CAST 2011
"Context-Driven Testing"
August 8 to 10, 2011
Lynnwood Convention Center - Seattle, WA, USA
Emerging Topics track

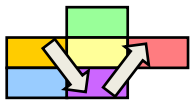


Are these separate species which cannot interbreed?

Association for Software Testing
CAST 2011
"Context-Driven Testing"
August 8 to 10, 2011
Lynnwood Convention Center - Seattle, WA, USA
Emerging Topics track

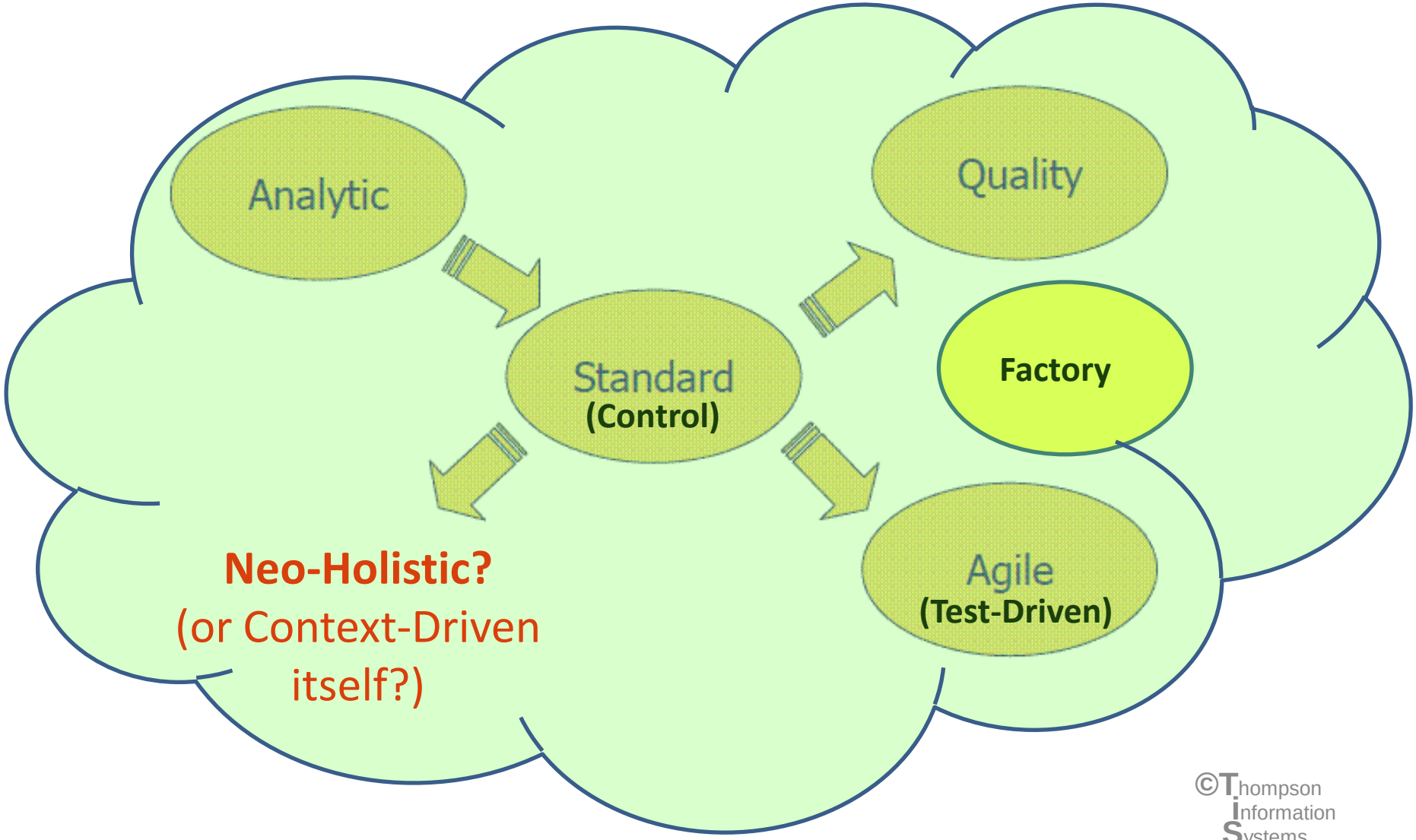


- ... or is each part of an ecosystem with its suppliers and customers?



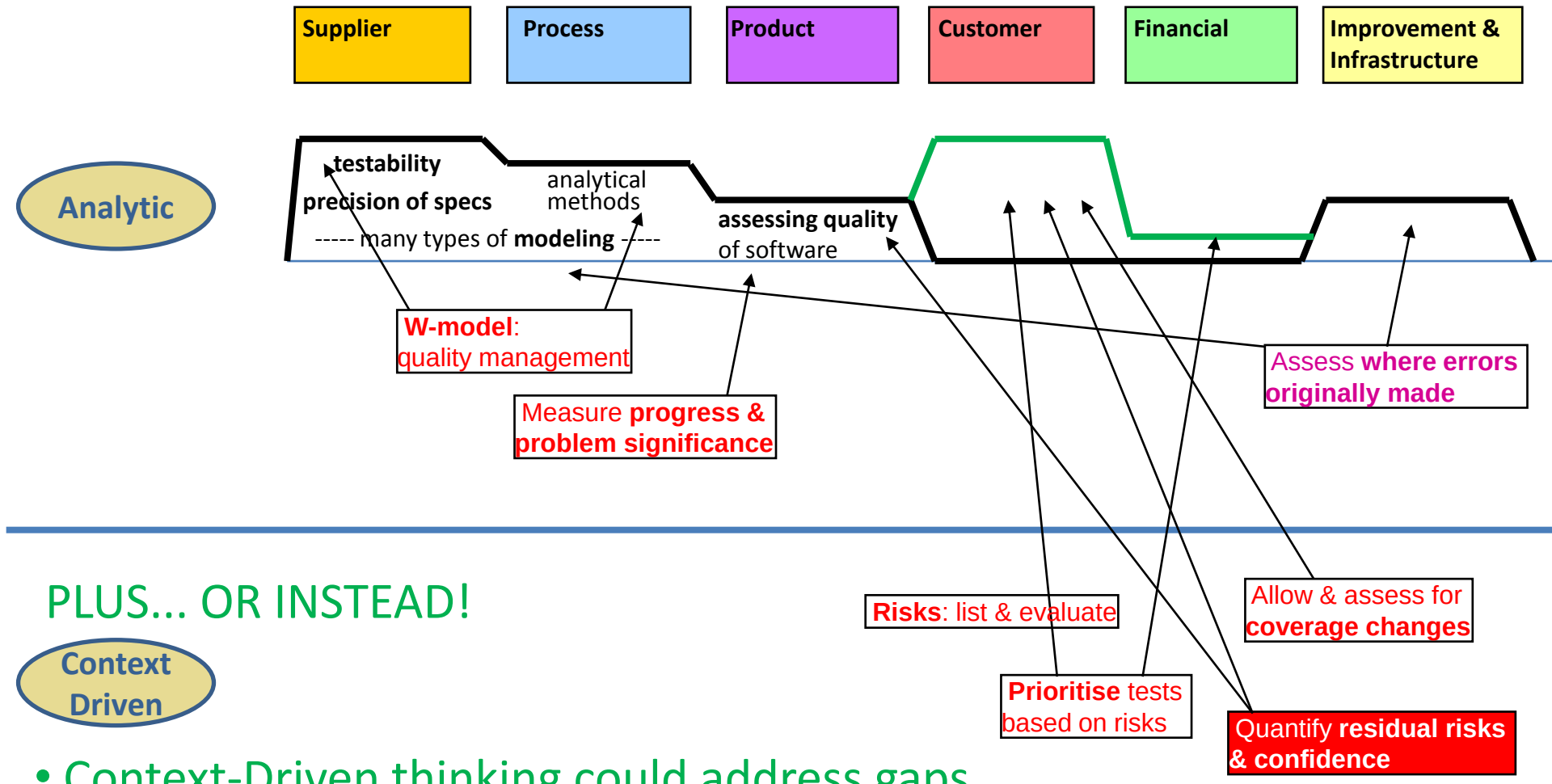
Shouldn't (or doesn't) Context-Driven subsume practices of other schools *when context is appropriate*?

Association for Software Testing
CAST 2011
"Context-Driven Testing"
August 8 to 10, 2011
Lynnwood Convention Center - Seattle, WA, USA
Emerging Topics track



Examples of how memeplexes can help ascend peaks of fitness landscapes

Association for Software Testing
CAST 2011
"Context-Driven Testing"
August 8 to 10, 2011
Lynnwood Convention Center - Seattle, WA, USA
Emerging Topics track



- Context-Driven thinking could address gaps and rebalance the scorecard; or...
- It might prefer its own scorecard

A Tester's Taxonomy for Meme generation &transmission

Association for Software Testing ast
CAST 2011
"Context-Driven Testing"
August 8 to 10, 2011
Lynnwood Convention Center - Seattle, WA, USA
Emerging Topics track

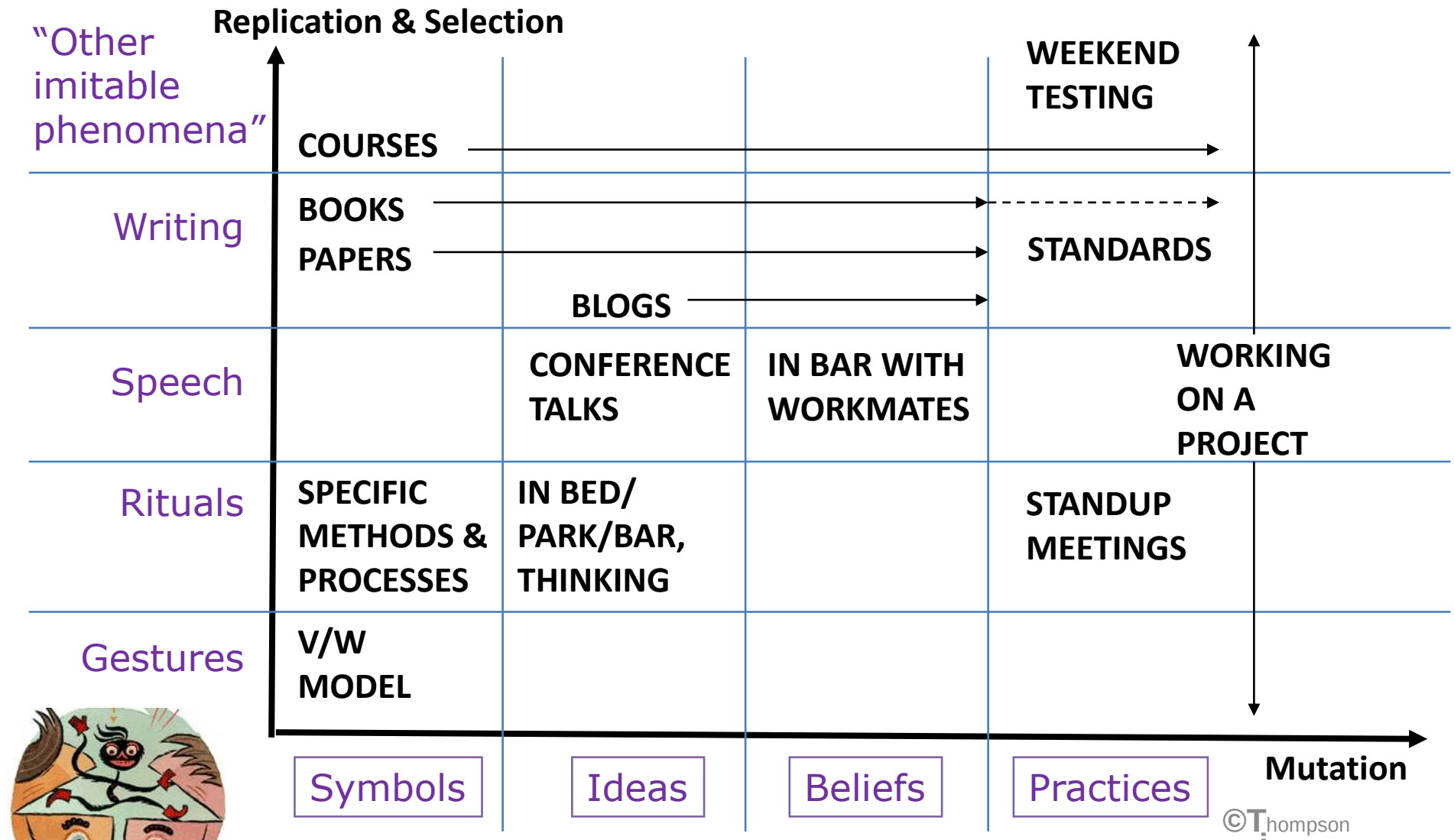
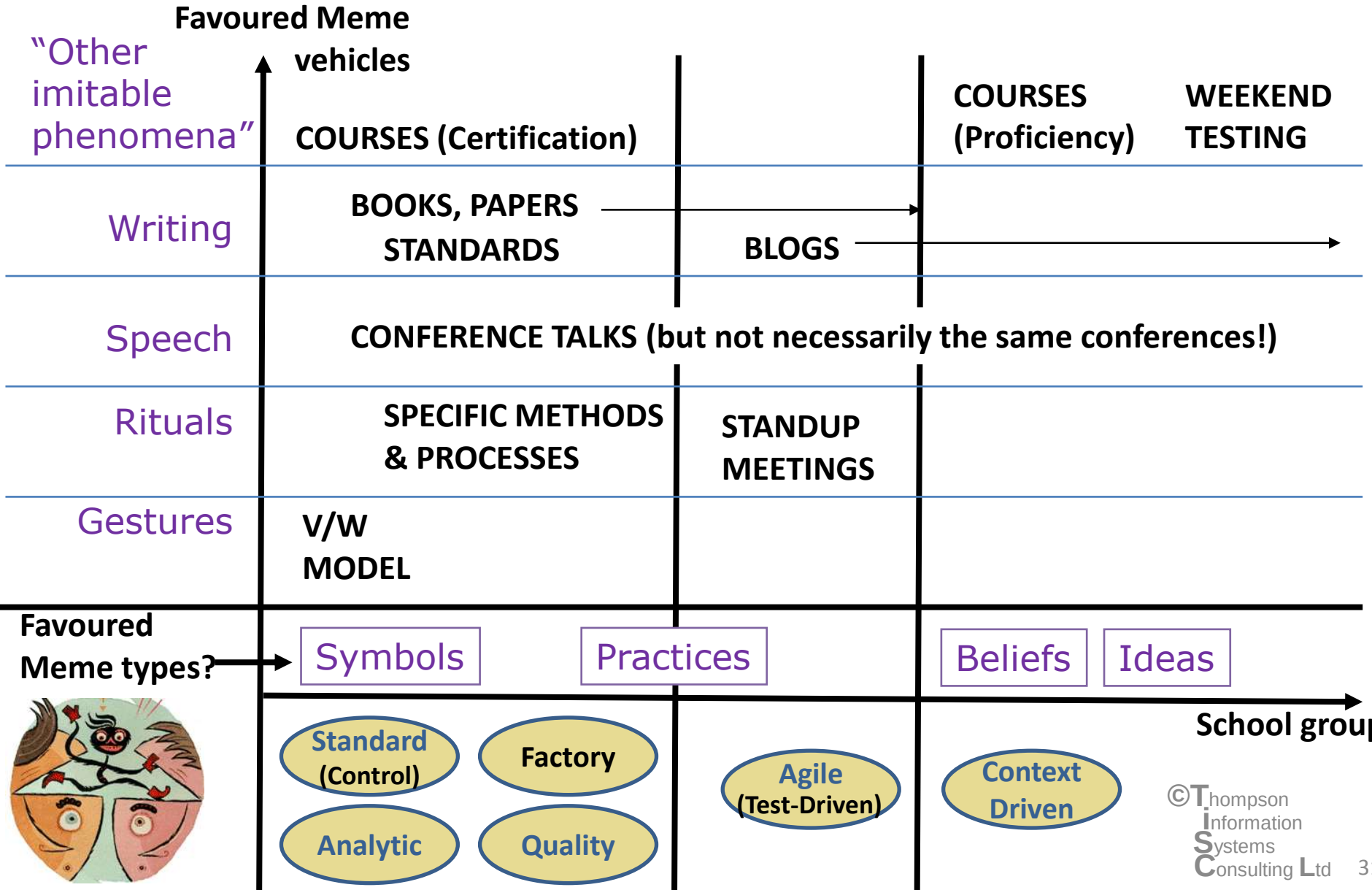


Image from .www.salon.com
Taxonomy from www.wikipedia.org

Speculation on meme variations in software testing

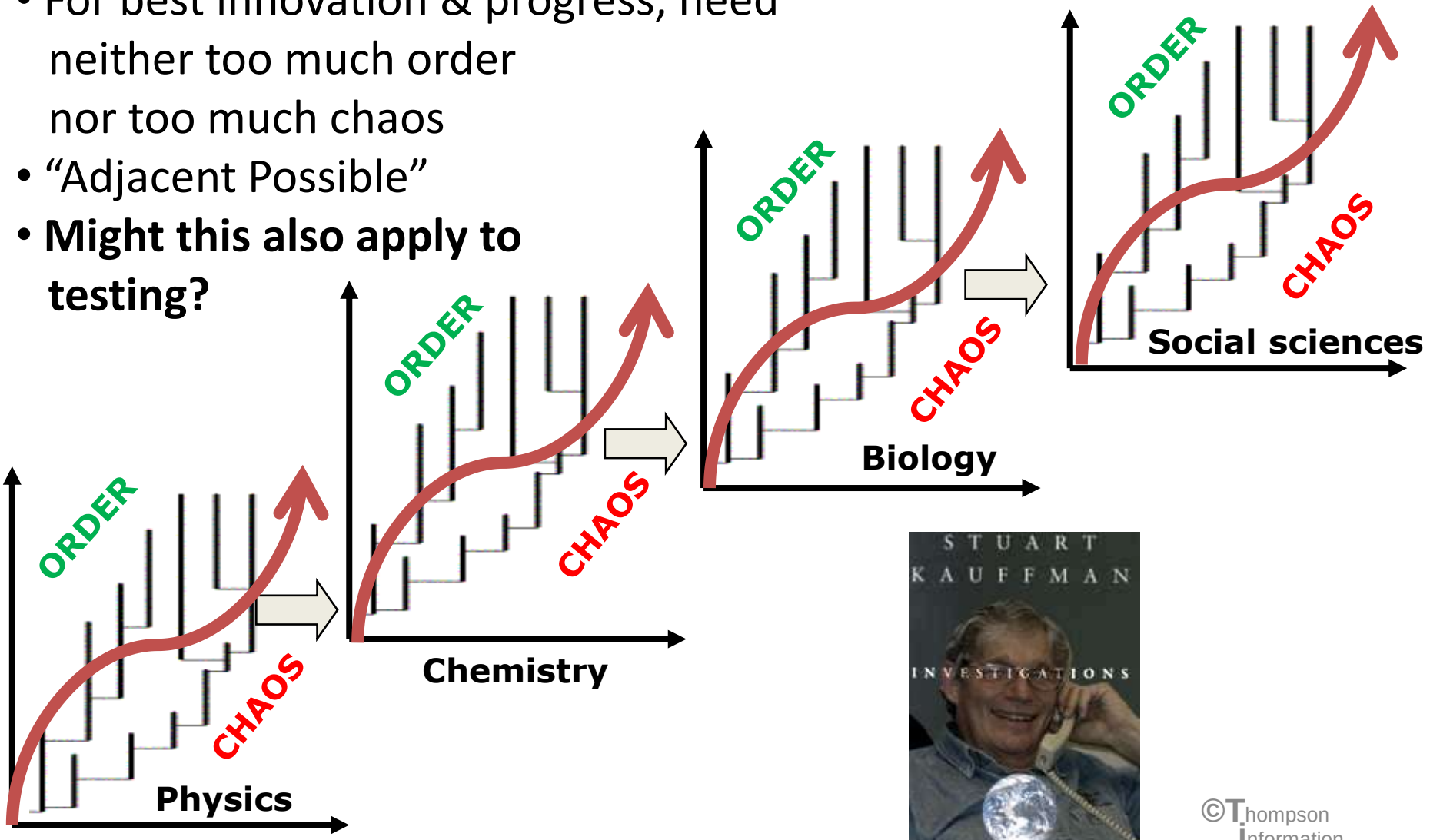
Association for Software Testing
CAST 2011
"Context-Driven Testing"
August 8 to 10, 2011
Lynnwood Convention Center - Seattle, WA, USA
Emerging Topics track



Not only Evolution, but Emergence: progress along order-chaos edge

CAST 2011
"Context-Driven Testing"
August 8 to 10, 2011
Lynnwood Convention Center - Seattle, WA, USA
Emerging Topics track

- For best innovation & progress, need neither too much order nor too much chaos
- "Adjacent Possible"
- **Might this also apply to testing?**



Extrapolation from various sources, esp. Stuart Kauffmann, "The Origins of Order", "Investigations"

So...
What's the message, here?

CAST 2011
"Context-Driven Testing"
August 8 to 10, 2011
Lynnwood Convention Center - Seattle, WA, USA
Emerging Topics track

- Regarding schools of software testing – I believe they are a very useful concept but:
  - please see analogies with species, fitness landscapes & ecosystems
  - don't just preach to testers, educate the customers!
  - are schools really fixed around beliefs, or are they more flexible?
- When you think & communicate, try using the memes framework to better understand what you are building on, where you are innovating, and what you want to achieve, with what audience:
  - could "old school" people please blog and tweet more?
  - could Context-Driven people write more books please?
  - let's share our experiences on projects
- Software testing is evolving, should continue to evolve:
  - future jumps could be quite big ("platforms & cranes")
  - may be sudden paradigm shifts (cf punctuated equilibria, Per Bak's sandpiles)
  - most fruitful path is on the chaos-order boundary?

Next steps already considering

Association for Software Testing
CAST 2011
"Context-Driven Testing"
August 8 to 10, 2011
Lynnwood Convention Center - Seattle, WA, USA
Emerging Topics track

- Analyse more specific examples of memes in congenial & hostile environments – the "Extended Phemotype"!
- More analogies of testing with history & philosophy of science – both for individual strategies and for improvement
- Practical uses of Bayesianism to focus testing – already are some? What can we actually use? What's coming?
- Is there correlation between personality (eg Myers-Briggs, Belbin) and "membership" of schools of software testing?
  - Myers-Briggs fixed, Belbin can vary with situation & mood??
- Is the Cynefin construct of any use here? (pronounced "kanavin"?)
  - quadrants of systems/situations (simple, complicated, complex & chaotic) may be suitable for different school-type behaviour – or, different responses of Context-Driven
  - suggests steps to approach, which vary in usage & sequence: Sense, Categorise, Analyse, Probe, Respond, Just-act

Questions to think about / discuss

- Are (some?) people "stuck" in a school because of:
  - their personalities,
  - upbringing,
  - education/inculcation,
  - deeply-held beliefs?...
  - the company they keep, or
  - the jobs they tend to get recruited for?
  - what their boss wanted yesterday?
- Are the schools themselves evolving – if so, how? Eg...
  - Context-Driven, from origins to book(s) to blogs to this conference?
  - Factory school in response to "maturing" of outsourcing / offshoring market?
  - current Agile movements?
- Do some memes replicate in spite of not really helping their hosts?

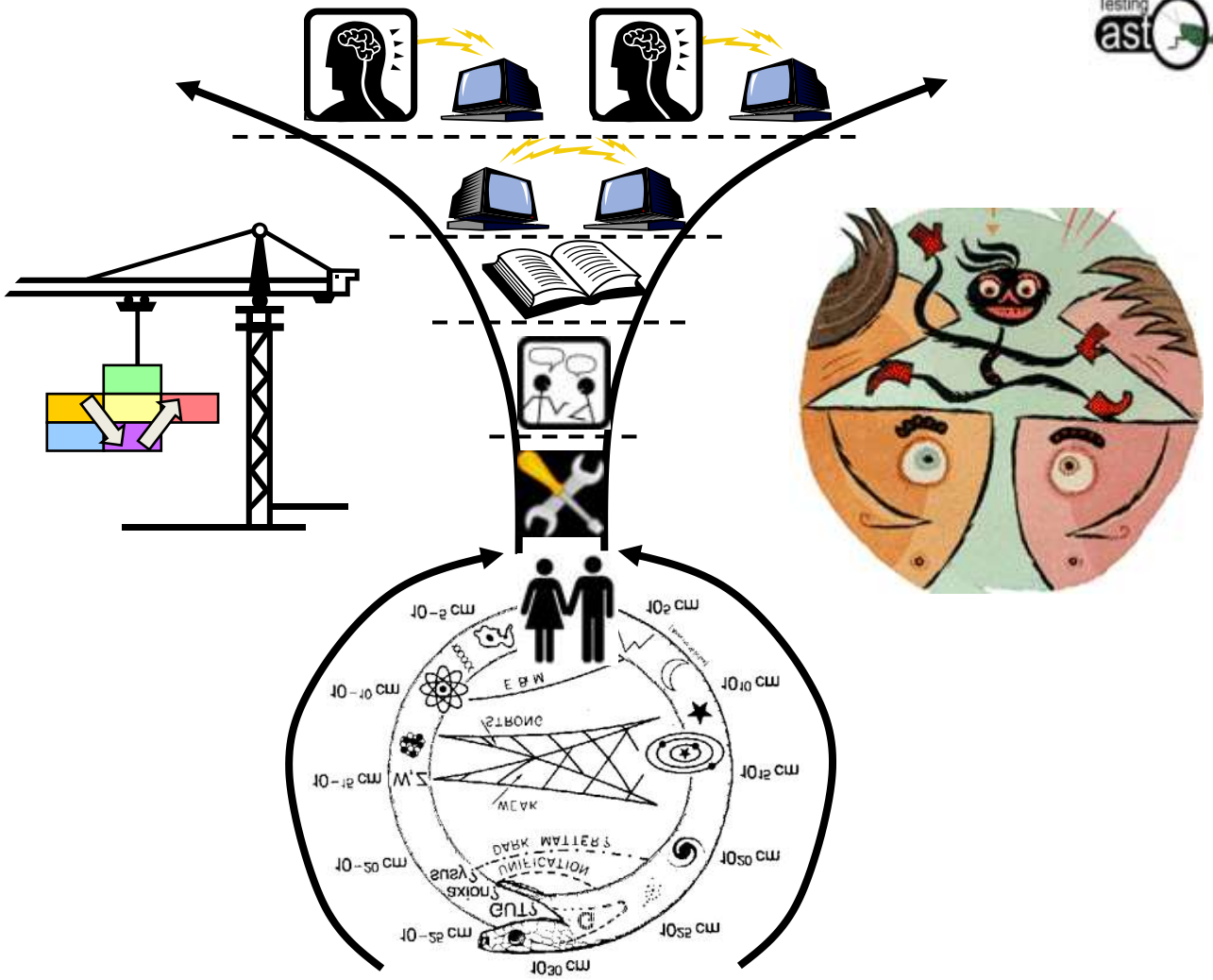
Questions to think about / discuss (continued)

Association for Software Testing
CAST 2011
"Context-Driven Testing"
August 8 to 10, 2011
Lynnwood Convention Center - Seattle, WA, USA
Emerging Topics track

- **Shouldn't Context-Driven, "by definition", embrace practices of all the other schools *where appropriate* (or are other schools bad even in their own context? Are cultural / ethical divisions insoluble?)**
- Analogies between testing schools and schisms in science, eg string theory v the others, frequentists v Bayesians
- How should individuals in software testing evolve?
- How should software testing be preparing for the future, eg testing Artificial Intelligence:
  - what happened to Genetic Algorithms?
  - what can we do with Grounded Theory?
  - and (as above) Bayesian?
- What other big innovations could be coming? (see Steven Johnson)
- Any memes about to die out?
- Do we want to go beyond testing only software?

Main references & Acknowledgements

- Bret Pettichord: “Four Schools” presentation
- Dave Gelperin & Bill Hetzel paper, The Growth of Software Testing
- testingreferences.com: testingtimeline
- Stuart Reid paper, Lines of Innovation in Software Testing
- Cem Kaner: blog, and “Software Testing as a Social Science” presentations
- James Bach & Michael Bolton blogs, plus Kaner Bach & Pettichord “Lessons Learned...” book
- Mike Smith: originating motivation & ideas, then co-development, of Value Flow ScoreCards – plus key input from Isabel Evans
- Robert Pirsig books: Zen & the art of Motorcycle Maintenance + Lila
- Sheldon Glashow: cosmic Ouroboros
- Charles Darwin books
- Richard Dawkins: various books, esp. Extended Phenotype & Climbing Mount Improbable
- Daniel Dennett: various books, esp. Darwin’s Dangerous Idea
- Susan Blackmore, Robert Aunger, Kate Distin etc: various books on Memes
- Matt Heusser, blog post 31 Jul 2009, esp. comments by Laurent Bossavit & James Christie
- Peter Godfrey-Smith book: Theory and Reality (Philosophy of Science)
- Stuart Kauffman: various books, eg Investigations
- Ray Kurzweil book, The Singularity is Near
- Jurgen Appelo book & website, Management 3.0
- Sharon Bertsch McGrayne book: The Theory That Would Not Die (Bayes)
- Dave Snowden, Cynefin



- Thanks for listening!
- Questions & discussion?