Dynamics of Pluralism: Interweaving Styles, Paradigms, and Models

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Outline

1. Introduction. Scientific Cultures: Pluralism, practice, and realism
2. Philosophical Analysis: Categories
    1. Culture L-1: Styles
    2. Culture L-2: Paradigms
    3. Culture L-3: Models
    4. Dynamics of Interweaving
3. Case Study: A Brief History of Systematics
4. Conclusion. Summary, Relevance, and the Future

1. INTRODUCTION
SCIENTIFIC CULTURES:
PLURALISM, PRACTICE, AND REALISM

Pluralism of Scientific Cultures

Crombie's & Hacking's *styles of scientific research*

Kuhn's *paradigms*

Suppes', van Fraassen's, & Cartwright's *models*

Laudan's *research traditions*

Lakatos' *research programmes*

Holton's *themata*

Foucault's *epistemes*

Practice in Scientific Cultures

agents

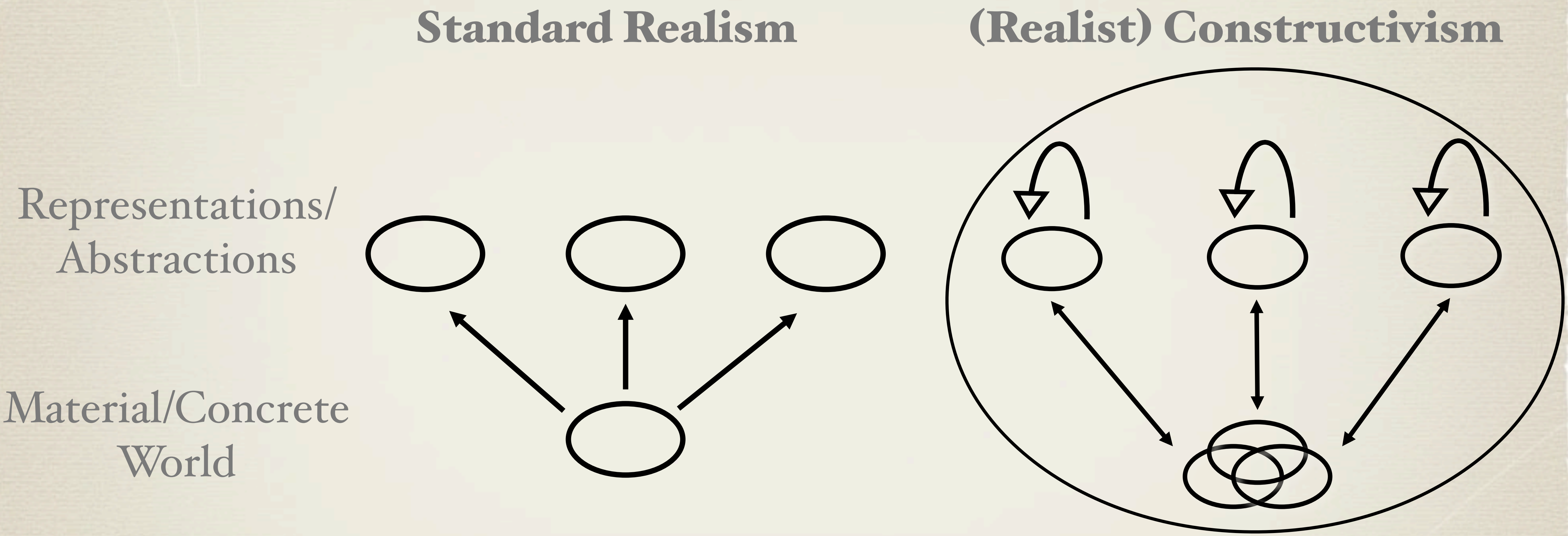
intentions and purposes

methods

ideals and assumptions

socio-political background (diachronic and synchronic)

Realism in Scientific Cultures



2. PHILOSOPHICAL ANALYSIS: CATEGORIES

Three Categories

Crombie's & Hacking's *styles of scientific research*

Kuhn's *paradigms*

Suppes', van Fraassen's, & Cartwright's *models*

Laudan's *research traditions*

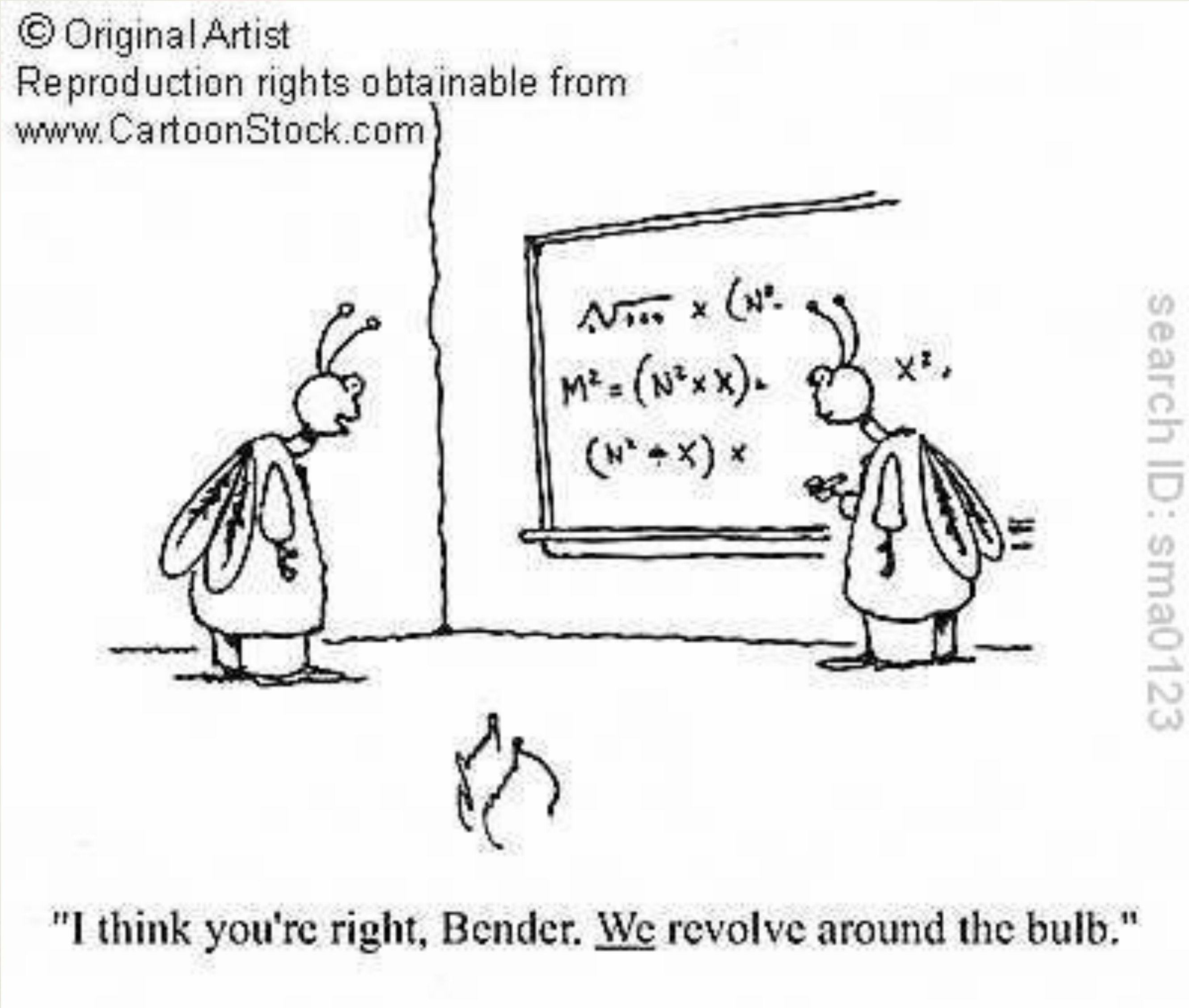
Lakatos' *research programmes*

Holton's *themata*

Foucault's *epistemes*

2.1. CULTURE L-1: STYLES

Styles of Scientific Research (SSR) Cartoon



THE **GALILEAN** STYLE

Crombie's Styles

1. The *method of postulation* exemplified by the Greek mathematical sciences (84)
2. The *experimental argument*, both to control postulation and to explore by observation and measurement (84)
3. *Hypothetical modelling* was developed likewise as an argument in which theoretical analysis preceded material action (84)
4. *Taxonomy* emerged first in Greek thought as a logical method of ordering variety in any subject-matter by comparison and differentiation (84)
5. The *probabilistic* and *statistical* analysis of expectation and choice (85)
6. The *method of historical derivation*, or the analysis and synthesis of genetic development (85)

"[each] introduced new objects of scientific inquiry and explanation, new types of evidence, and new criteria determining what counted as the solution of a problem." (Crombie 1994, vol. 1, p. 83)

SSR

	STYLES
Components and Characteristics	• objects and methods • introduction of laws and sentences • truth co-construction • crystallization • self-vindication • plurality • agents and history • general practice
1. Creators/ Defenders **2. Opponents**	1. Crombie, Hacking 2. Methodological Universalists (e.g., Popper); Historical Relativists (e.g., Kusch)
1. Standard Examples **2. Examples from Systematics**	1. Axiomatic, Experimental, Probabilistic, Hypothetical-Analogical, Taxonomic, Genealogical 2. Mathematical Modeling, Mechanism, Taxonomy, History

Galileo Galilei
(1564-1642)

2.2. CULTURE L-2: PARADIGMS

Paradigm Cartoon

Representation & Practice: Paradigms as maps & map-makers

[scientific theory] provides a map whose details are elucidated by mature scientific research. ... Through the theories they embody, paradigms prove to be constitutive of the research activity. They are also, however, constitutive of science in other respects ...paradigms provide scientists not only with a map but also with some of the directions essential for map-making. In learning a paradigm the scientist acquires theory, methods, and standards together, usually in an inextricable mixture.

(Kuhn 1962, p. 109)

Thomas Kuhn
(1922-1996)

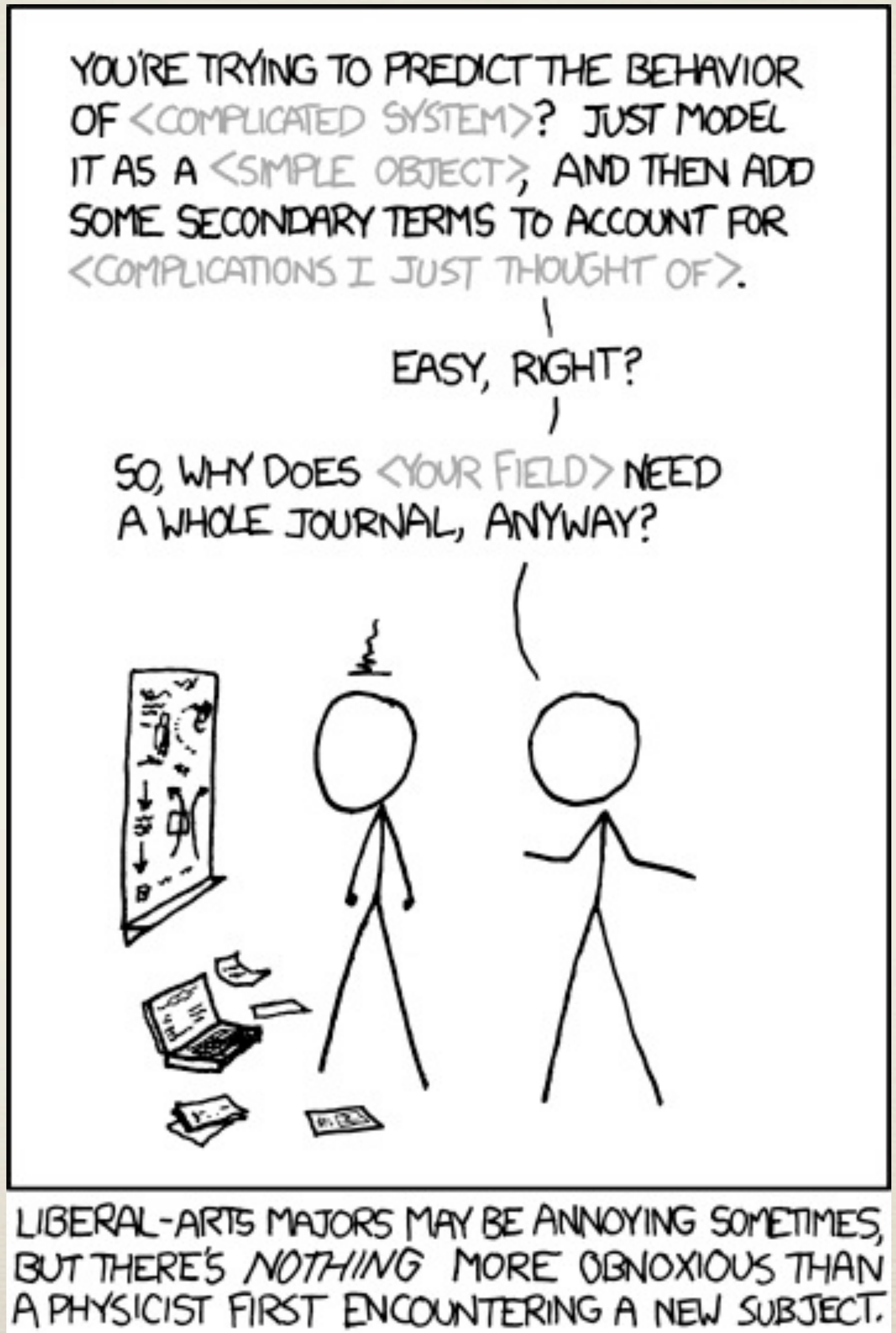
Paradigms

	PARADIGMS
Components and Characteristics	• symbolic generalizations, ontological assumptions, values, exemplars • theories and experiments • research questions • (partly reified) objects and processes • plurality • agents and history • specific practice • (some) reference & representation relations
1. Creators/ Defenders **2. Opponents**	1. Kuhn 2. Syntactic View; Methodological Universalists; Historical Relativists
1. Standard Examples **2. Examples from Systematics**	1. Copernican, Newtonian, Darwinian 2. Linnaean, Phylogenetic-Darwinian, Mathematical-Cavalli-Sforza-Edwardian

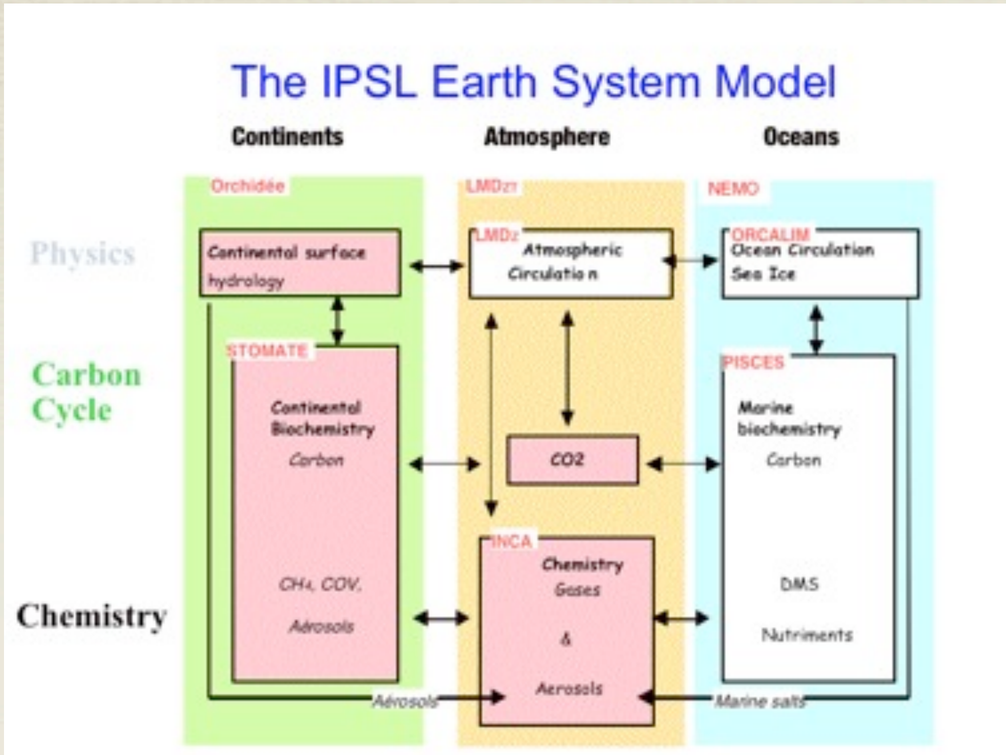
Isaac Newton (1642-1727)

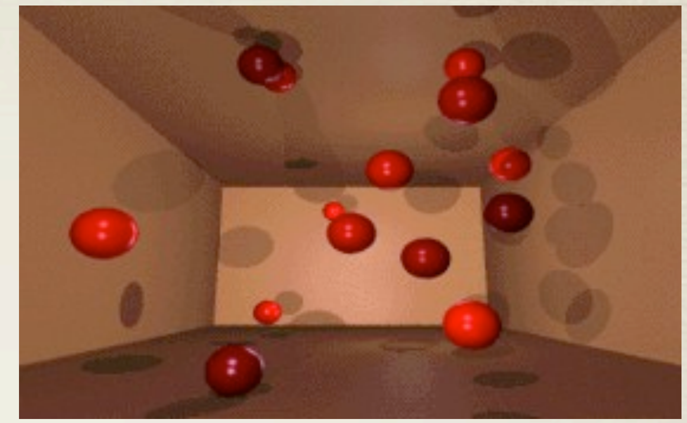
2.3. CULTURE L-3: MODELS

Model Cartoon

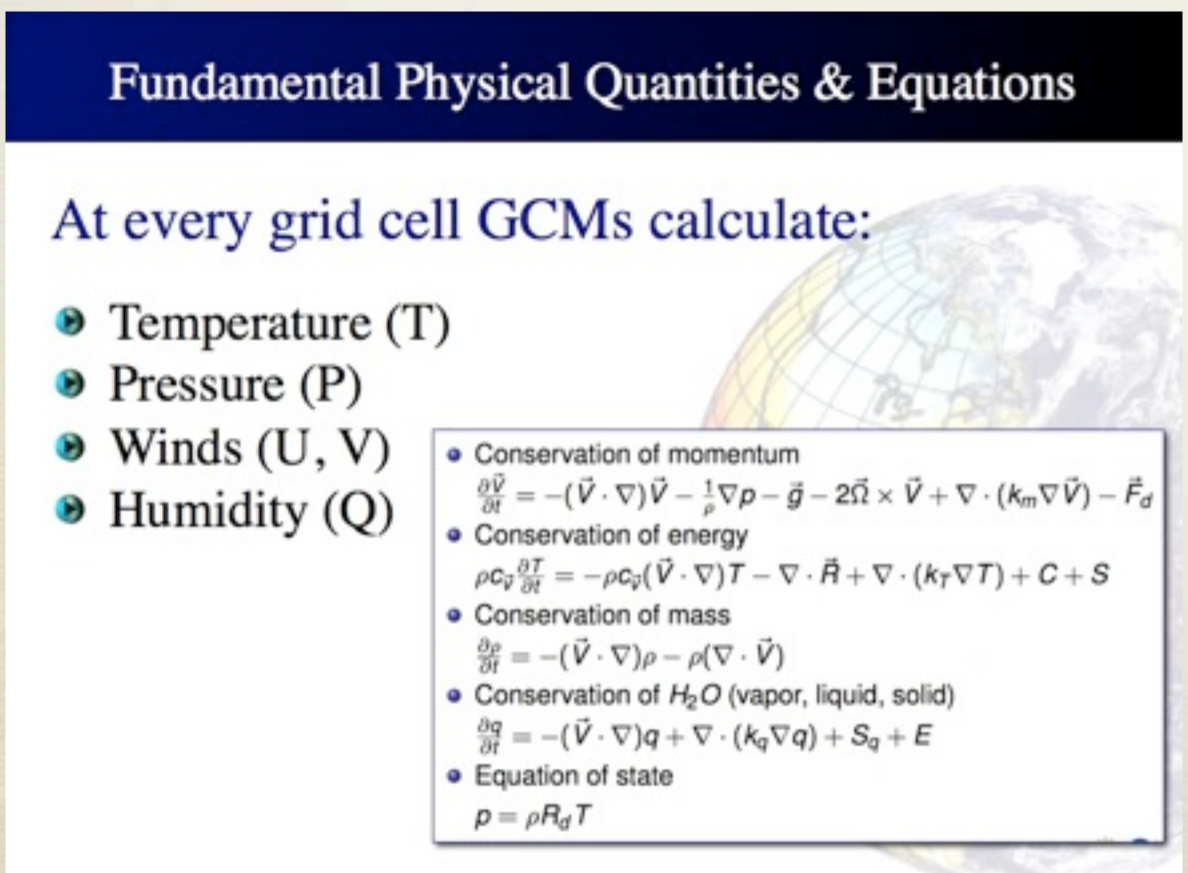


Model Examples





$PV = nRT$



http://serc.carleton.edu/eet/envisioningclimatechange/part_2.html

Pragmatic Turn of Modeling

The models serve a variety of purposes, and individual models are to be judged according to how well they serve the purpose at hand.

...

We should not be misled into thinking that the most realistic model will serve all purposes best.

(Cartwright 1983, p. 152)

Nancy Cartwright

[The] structural relationship to the phenomenon is of course not what makes [a model] a representation, but what makes it accurate; it is its role in *use* that bestows the representational role.

(van Fraassen 2008, p. 309)

Bas van Fraassen

Models

	MODELS
Components **and** **Characteristics**	• modeling methodology • model structure and expression • data models embedded in theoretical models • plurality • agents and history • highly specific practice • reference and representation relations
1. Creators/ Defenders **2. Opponents**	1. Suppes, van Fraassen, & Cartwright 2. Syntactic View
1. Standard Examples **2. Examples from Systematics**	1. London Equations, DNA scale model, Hardy-Weinberg Theorem 2. Great Chain of Being, Tree of Life, Network

James Watson & Francis Crick, 1953

Rosalind Franklin (1920-1958)

Heinz & Fritz London, 1953

Styles, Paradigms, and Models

	STYLES	PARADIGMS	MODELS
Components and Characteristics	• objects and methods • introduction of laws and sentences • truth co-construction • crystallization • self-vindication • plurality • agents and history • general practice	• symbolic generalizations, ontological assumptions, values, exemplars • theories and experiments • research questions • (partly reified) objects and processes • plurality • agents and history • specific practice • reference and representation relations?	• modeling methodology • model structure and language • data models embedded in theoretical models • plurality • agents and history • highly specific practice • reference and representation relations
1. Creators/ Defenders **2. Opponents**	1. Crombie, Hacking 2. Methodological Universalists (e.g., Popper); Historical Relativists (e.g., Kusch)	1. Kuhn 2. Syntactic View; Methodological Universalists; Historical Relativists	1. Suppes, van Fraassen, & Cartwright 2. Syntactic View
1. Standard Examples **2. Examples from Systematics**	1. Axiomatic, Experimental, Probabilistic, Hypothetical-Analogical, Taxonomic, Genealogical 2. Mathematical Modeling, Mechanism, Taxonomy, History	1. Copernican, Newtonian, Darwinian 2. Linnaean, Phylogenetic-Darwinian, Mathematical-Cavalli-Sforza-Edwardian	1. London Equations, DNA scale model, Hardy-Weinberg Theorem 2. Great Chain of Being, Tree of Life, Network

2.4. DYNAMICS OF INTERWEAVING

Three Relations of Hierarchical Nesting

1. *Realization* relation ("realized-in")

instantiate, implement, abstract-concrete

2. *Guidance* relation ("guided-by")

constrain, practice-mediated, whole-part

3. *Inheritance* relation ("inherit-from")

analogy: classes in object-oriented programming

Paradigms and SSRs

Ian Hacking

A style of reasoning is very different [from a paradigm]. It tends to be slower in evolution, and vastly more widespread. Within that style of reasoning I call statistical inference, there are many different paradigms associated with names such as Neyman, Fisher, or Bayes. A style of reasoning need not be committed to any positive items of knowledge. A paradigm surely assumes certain propositions as taken for granted: they are part of the achievement that sets the model for future work. They are stated in the paradigmatic textbooks. A style of reasoning makes it possible to reason towards certain kinds of propositions, but does not of itself determine their truth value. Even the Euclidean geometrical style does not fix which propositions are going to come out as theorems.

(Hacking 1985, p. 149)

3. CASE STUDY
A BRIEF HISTORY OF SYSTEMATICS

Styles, Paradigms, and Models: A brief history of systematics

	STYLES	PARADIGMS	MODELS
1. Standard Examples **2. Examples from Systematics**	1. (i) Axiomatic, (ii) Experimental, (iii) Probabilistic, (iv) Hypothetical-Analogical, (v) Taxonomic, (vi) Genealogical 2. (i) Mathematical Modeling, (ii) Mechanism, (iii) Taxonomy, (iv) History	1. (i) Copernican, (ii) Newtonian, (iii) Darwinian 2. (i) Linnaean, (ii) Phylogenetic-Darwinian, (iii) Mathematical-Cavalli-Sforza-Edwardian	1. (i) London Equations, (ii) DNA scale model, (iii) Hardy-Weinberg Theorem 2. (i) Great Chain of Being, (ii) **Tree of Life**, (iii) Network

Paradigms in Systematics


CAROL

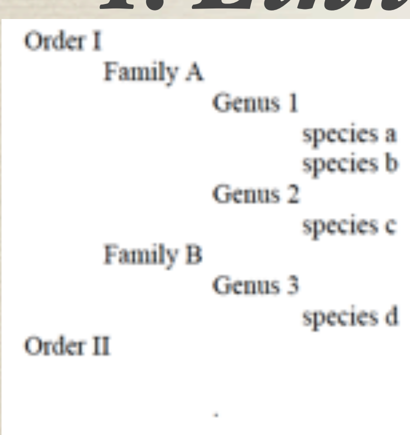
I. QUADRUPEDIA.

Corpus hirsutum. Pedes quatuor. Feminæ viviparæ, lactiferæ.

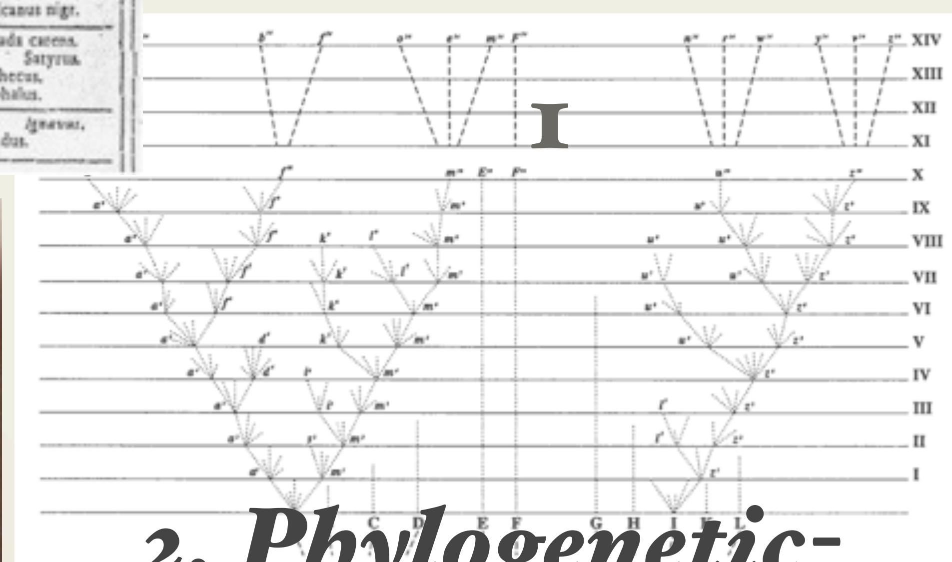
ANTHROPOMORPHA. Dentes primores 4. utrinque: vel nulli.

Homo.	Nosce te ipsum.	H { Europæus albesc. Americanus rubesc. Asiaticus fuscus. Africanus nigr.
Simia.	Anteriores. Posteriores. Digiti 5. . . . 5. Posteriores anterioribus similes.	Simia cauda carens. Papio. Satyrus. Cercopithecus. Cynocephalus.
Bradypus.	Digiti 3. vel 2. . . 3.	Ai. Ignavus. Tardigradus.

1. Linnaean

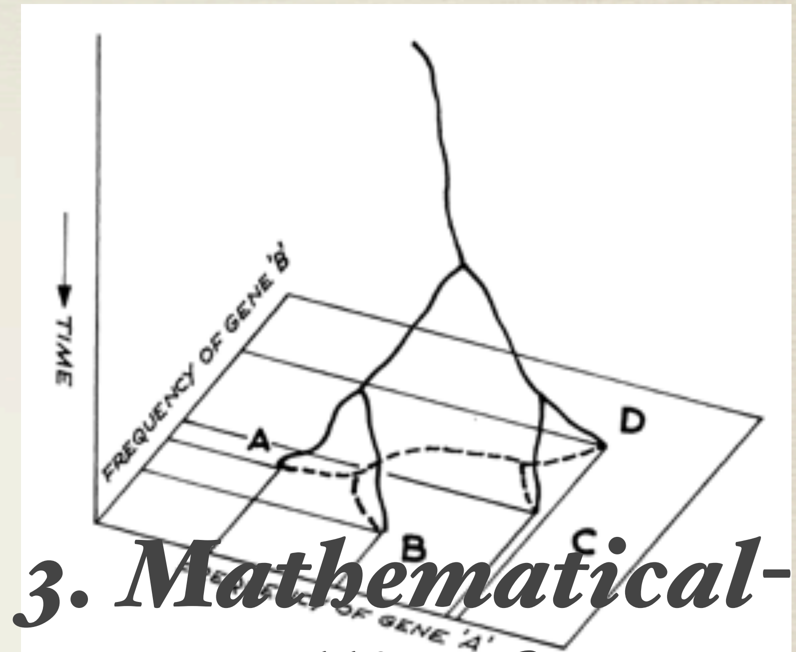

Order I
Family A
Genus 1
species a
species b
Genus 2
species c
Family B
Genus 3
species d
Order II

Linnaeus (1707-1778)



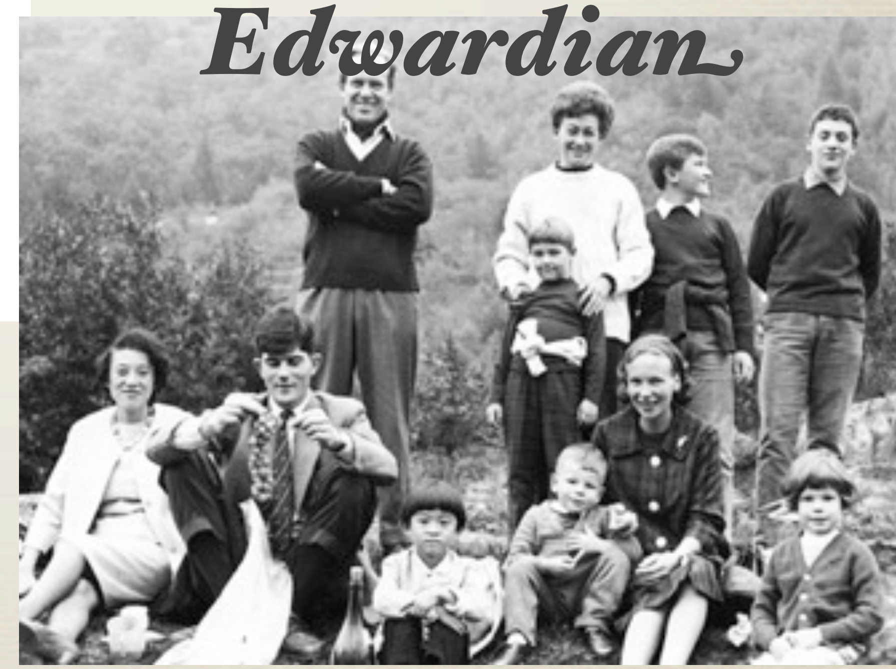
2. Phylogenetic-Darwinian

Charles and William Darwin, 1842



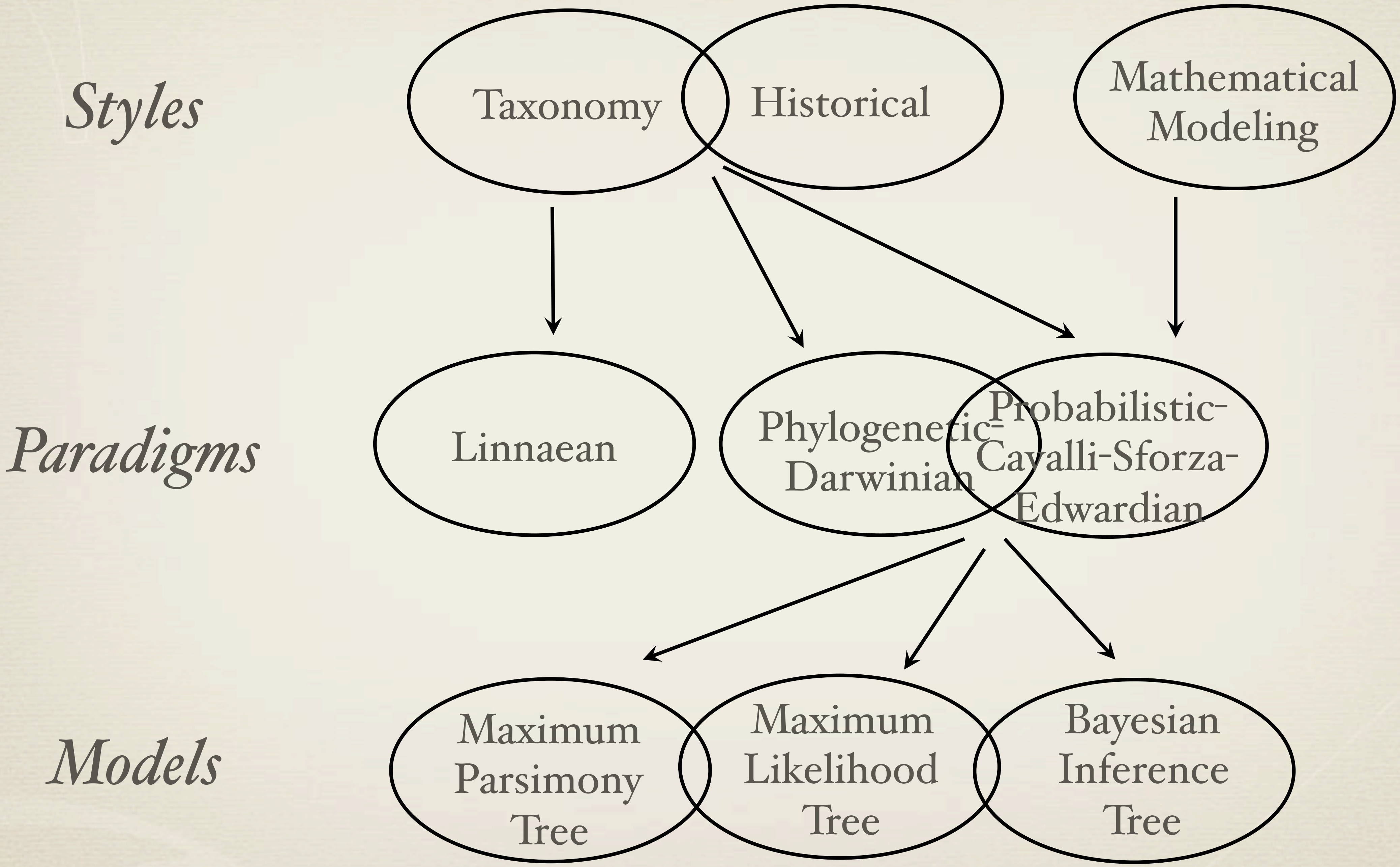
3. Mathematical-Cavalli-Sforza-Edwardian

Cavalli-Sforza & Edwards 1967



Italy, 1963: standing—Luca and Alba Cavalli-Sforza and three of their children; seated—Hiroko Kimura, Anthony Edwards, Akio Kimura, and Thomas, Catharina, and Ann Edwards. Photograph by Motoo Kimura; reproduced by courtesy of Hiroko Kimura.

Dynamics of Pluralism: Systematics



CONCLUSION
SUMMARY, RELEVANCE, AND THE FUTURE

Summary

1. Pluralism of Categories

2. Dynamics of Interweaving: Hierarchical nesting

3. A Brief History of Systematics

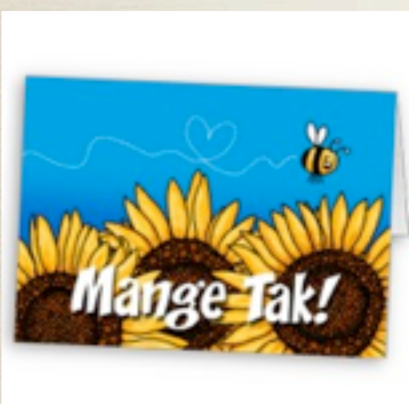
Relevance and the Future

1. Exploration of Dynamics of Interweaving: Multiple realizability & hybridization, theory/practice-tracking, culture individuation

2. Analysis and Meta-Analysis

3. Pluralism, Practice, and Realism

Acknowledgements



- ✓ Claus Emmeche
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