14. Controversies, Objectivity, Rhetoric

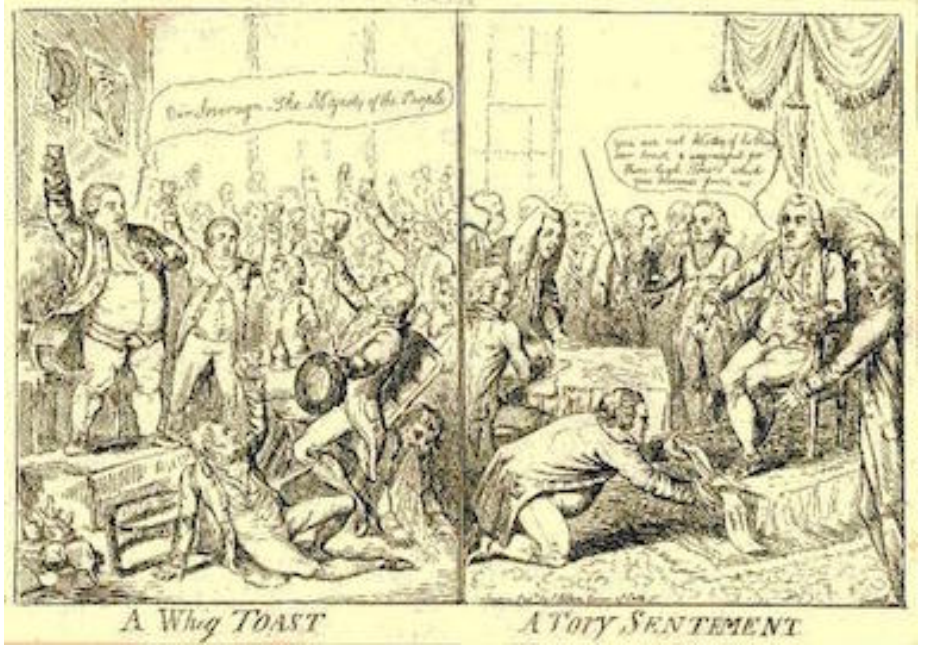
1. Controversy Studies

- *Central question*: How are debates in science resolved?

> *View I ("realist")*: Competing hypotheses are made to face crucial tests (experiments). The results of such tests are objective data that provide the basis on which to decide controveries in science.

- *Concerns*:
  - *Duhem–Quine Thesis*: Hypotheses cannot be tested in isolation; crucial tests that can decide once and for all between competing hypotheses are problematic.
  - *Whig history*: The history of _____ (science; politics; etc.) is a history of progress towards _____ (the true description of natural phenomena; constitutional monarchy; etc.).

> "There is a temptation to see the losing participants in controversies as unreasonable." (Sismondo 2010, pg. 121.)



View II ("constructivist"): Facts and artifacts ("objective data") are constructed and then "taken for granted". They become **black boxes** whose contingent histories are seen as irrelevant. Controversies occur during these contingent earlier stages in their construction.

- *Recall*: Lab work is characterized by *inversion*: The contingent nature of interpreting "raw data" is downplayed once the process is complete.

Claim: The contingent nature of the construction of facts and artifacts requires a *symmetrical approach* to studying controversies.

- *Experimenters' Regress*: "The experimental system is working when it gives the right answer, but one knows the right answer only after becoming confident in the experimental system." (Sismondo 2010, pg. 124.)

Charitable gloss: "What scientists take to be a correct result is one obtained with a good, that is, properly functioning, experimental apparatus. But a good experimental apparatus is simply one that gives correct results... there are no formal criteria that one can apply to decide whether or not an experimental apparatus is working properly." (Franklin 2015, section 1.2.1.)*

*Franklin, A. (2015) "Experiment in Physics", in E. Zalta (ed.) *The Standford Encyclopedia of Philosophy.*

Ex 1. Joseph Weber and gravitational waves.

Weber, J. (1969) 'Evidence for discovery of gravitational radiation', *Physical Review Letters 22*, 1320.

- 1969. Weber reports evidence for gravitational waves.

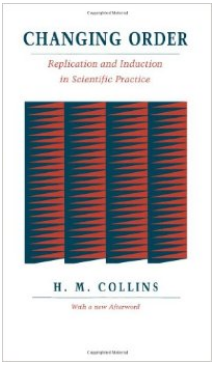
Experimental setup:

- Solid aluminum cylinder suspended on steel wires.
- Gravitational waves should set cylinder vibrating at resonant frequency (~1660 hertz).
- Thermal motion of aluminum atoms should produce background vibrations of ~$10^{-16}m$.
- Calibrate cylinder by defining threshold for background noise; then attempt to detect signals above threshold.

- 1969 claim: Two cylinders (Maryland and Chicago) detected simultaneous signals above threshold ("coincident events") 24 times over 81 day period.
- 1970 claim: 311 coincident events detected over 7 month period.
- *But*: Six other labs can't replicate these results.
- 1970s: General consensus that Weber's data analysis was faulty: no precise definition of threshold frequency, programming error, possible selection bias.

Collins' (1985) claims:

- *The six negative results cannot be considered replications.*
- *Weber's apparatus cannot be subject to standard calibration techniques since it was new and was used to try to detect a previously unobserved phenomenon.*



H. Collins (1985) *Changing Order: Replication and Induction in Scientific Practice*

- *Thus*: Can't decide between Weber and rivals on epistemological or methodological grounds ("reasoned judgement").
- *Rather*: Decision was made on social grounds: career, social, cognitive interests of the participants.
  - *Ex*: *Weber was an electrical engineer-turned-physicist encroaching on relativitists.*

Franklin's (2015) counter-claim: Critics *were* justified.

- *Critics used Weber's nonlinear algorithm to analyze their data.*
- *Critics calibrated their apparatuses by inserting acoustic pulses of known energy and then detecting signal, while Weber could not detect calibration pulses.*
- *Problems with Weber's analysis (programming error, selection bias).*

Allan Franklin

- *Franklin's conclusion*: No formal criteria to judge experiments, but this does not preclude rational criteria for justification.

- Why controversy studies are important:

> In the midst of a controversy, participants often make claims about the stakes, strategies, weaknesses, and resources of their opponents. Therefore, researchers in STS have access to a wider array of information when they look at periods of active controversy than when they look at periods after controversies have been resolved." (Sismondo 2010, pg. 125.)

- Symmetrical approach to controversies entails *rhetoric and persuasion* play essential roles in their resolution.

- *Rhetorical task*: Convince audiences of the legitimacy of your position, and the illegitimacy of your opponent's.
  - *Make your work appear more scientific, or central to key traditions.*
  - *Pledge allegience to the relevant disciplines, and show your opponent does not have such allegience.*
  - *Appeal to reputations.*
  - *Invoke norms of scientific behavior (universalism, communism, disinterestedness, organized scepticism).*

2. Standardization and Objectivity

- Factors in research that require standardization:
  - *mutual dependency*
  - *pressure to produce isolatable and transportable facts*

- *Standardized technologies*: black boxes that are easily transportable from lab to lab.

View I ("realist"): Standardization of experimental techniques allows objective facts and artifacts to be transported (reproduced) in different circumstances.

View II ("constructivist"): Standardization of experimental techniques is part of the way objective, transportable facts and artifacts are *constructed*.

- Standardization involves *objectivity*, in some sense...

- Sismondo's (2010, pg. 139) two senses of objectivity:

> "Absolute objectivity is the ideal of perfect knowledge of some object, knowledge that is true regardless of perspective... the 'view from nowhere'."

> "Formal or 'mechanical' objectivity, on the other hand, is the ideal of perfectly formal procedures for performing tasks."

- Let's distinguish between knowledge (*epistemology*) and rule-following (*methodology*).

> *Absolute (epistemological) objectivity*: A characteristic of *knowlege*; namely, perfect faithfulness to *facts* in a completely perspective-independent, value-neutral, and unbiased manner.

> *Formal (methodological) objectivity*: A characteristic of *rule-following*; namely, perfect faithfulness to *rules* in a completely perspective-independent, value-neutral, and unbiased manner.

- Presumably, absolute objectivity entails formal objectivity.
  - *If scientific knowledge is absolutely objective, then scientific methodology is formally objective.*

Can we have formal objectivity in the absence of absolute objectivity?

- Why would it be important to be able to objectively follow a rule?

> *Ex.* History of standardization of units of measure
> - *Measurement required both local knowledge and expertise in how to apply it.*
> - *Standardization was an attempt to eliminate the necessity of expertise.*
> - *Standardization as a way of formalizing aspects of tacit knowledge.*

- *Thus*: In the absense of absolute objectivity, formal objectivity is a way to regulate scientific practice.

- *Also*: A way to respond to challenges to authority.

> "...when groups of experts face strong challenges, they can respond by creating formal rules for their behavior."

Ex. 15th–16th century professional guilds in England:

- 1429. *Worshipful Company of Grocers.*
- 1518. *Royal College of Physicians.*
- 1540. *Company of Barber-Surgeons.*

Problem with formal objectivity: Formal rules must be interpreted, and there can be no formal rules for the interpretation of formal rules.

- *Why?* Recall Wittgenstein on rule-following:
  - *To identify a chair requires not just the application of a formal definition, but being indoctrinated into a Form of Life.*

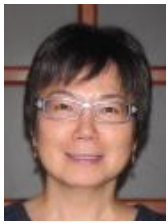
- *Idea*: Rule-following is a type of tacit knowlege, and tacit knowledge cannot be formalized (in all respects).

- *But*: How is tacit knowledge transferred, if not formally?
  - *If "discretely", then in principle formally.*
  - *If not "discretely", then by a "mysterious force"?*

Sismondo's solution:
- *Rules do not govern actions; rather, rules serve as goals towards which actions are directed.*
- *Thus: People do not follow rules; rather, people achieve rules.*

Ex. Rule: Complete the script in a phone interview so that the subjects' responses can be used for research.
- *Rule allows interviewers to deviate from the script to keep the subject talking.*

Ex 2. Fujimura, J. (1988) 'The Molecular Biological Bandwagon in Cancer Research'



Joan Fujimura

- *Goal*: Analyze the development of a *bandwagon* and a *package* around a molecular biological approach to the study of cancer in the US.

> *Scientific bandwagon*: commitment of resources of large numbers of people, labs, organizations, etc., to one approach to a problem.

> *Package of theory and technology*: a clearly defined set of conventions for action that helps reduce reliance on discretion and trial-and-error procedures.

- *Package of interest*: The oncogene theory of cancer (cancer is caused by normal cellular genes that somehow turn into cancer genes ("oncogenes")), and recombinant DNA technologies.
  - *Question: How did members from different social worlds come to practice a common approach to studying cancer in the mid- to late 1980s?*

> *Main premise*: Scientific information is constructed through negotiations among actors working in organizational contexts. Conceptual change in science is based in individual and collective changes in *the way scientists organize their work.*

Three interdependent sets of scientific activities:

1. Problem-solving.

- *"Rarely standardized."*
- *Requires pulling together of diverse elements including funding, lab space and infrastructure, staff, skills, technologies, research materials, audiences for experimental results, etc.*

2. Career-building.

- *Scientists are judged by publications and students.*
- *Organizations are judged by productivity.*
- *Goals: Maintaining existence/job, increasing power/status/credibility.*

3. Line-of-research-building.

- *Constrained by #1 and #2.*
- *Aim: To "construct doable programs which will produce novel information and marketable products within short time frames".*

- *One way to accomplish these goals*:

"provide a way of organizing work that facilitates the construction of *doable problems* for scientists, research institutes, and commercial labs."

Cancer. Encompasses over 100 different diseases, all characterized by uncontrolled cell growth.

- Pre-1970s. Field dominated by
  - *endocrinology, immunology, classical genetics, biochemistry, chemotherapy.*
  - *limited role played by molecular biologists.*

- 1970s. Development of recombinant DNA technologies.
  - *Makes possible the artificial recombination of DNA of different species.*
  - *Cloning, sequencing, mapping, expression of genes.*
  - *1977. Experiments that inserted eukaryotic DNA into bacterial DNA. Can then grow the bacteria to produce copies of original DNA.*

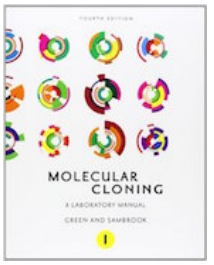
- *Oncogene theory*: cancer is a disease of the DNA.
  - *Pre-1983. NIH had no category under funded projects for oncogenes.*
  - *1983. $5.5 million for 54 oncogene projects.*
  - *1987. $103.2 million for 648 oncogene projects.*

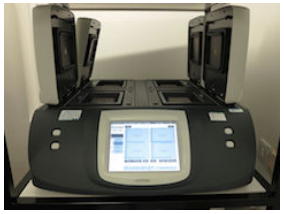
Eukaryote: organism whose DNA is enclosed in cell nucleus.

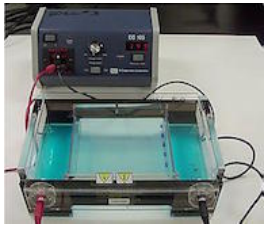
Prokaryote: organism whose cells lack nuclei (bacteria, viruses, algae).

A. Standardizing the package:

"Standardized technologies are tacit knowledge made explicit and routine via simplification and the deletion of the contexts in which the technologies were developed."







- Pre-fabricated biological materials (reagents, probes, cell lines, antibiotics, agarose and polyacrylamide gels).
- Procedural manuals (eg. 1982 *Molecular Cloning: A Laboratory Manual*, Cold Spring Harbor).
- Computing protocols.
- Instruments that automate procedures (DNA synthesizers and sequenators, centrifuges, electrophoresis systems).

B. Marketing the package:

- Claiming to account for findings in many other lines of cancer research.
- Framing new doable problems on oncogenes.
- Establishing annual meetings of oncogene researchers.
- Distributing instruments to other labs and suppliers.

C. Buying the package:

- Oncogene theory offers the chance to pursue research on human cancer.
- Provides a pathway to exploring new, uncharted territory.
- Relatively economical start-up costs.
- Reinvigorates "dead-end", "old-fashioned", "road-blocked" research.

Group	**Incentives**
Tumor virologists	- work more closely with human, as opposed to animal, cancers. - National Cancer Institute's Viral Cancer Program: Heavily criticized and broken up in 1980.
Molecular biologists	- a means to insert themselves into cancer research.
National Cancer Institute	- reasons similar to tumor virologists.
New investigators, established researchers	- career development concerns. - constructing doable programs. - becoming a well-funded area. - relatively short time-frames (2-15 articles per year).
Private industry	- get in on the ground floor

- 1984. "...modern biology was molecular biology".
- Cancer repackaged as a disease of the cell nucleus, as opposed to a disease of the cell, the immune or endocrine system, the entire organism, or the interaction between organism and environment.

3. Rhetoric of Science and Technology

- *Rhetoric*: The study of persuasive forms of discourse.
- *Goal of scientific discourse*: establishment of *facts*.
  - A fact lacks *historicity* and *modality*.

whether they be absolutely objective, or socially constructed

The art of scientific discourse: To move a statement from a heavily-modalized position to a less-modalized position (i.e., from "it could be the case" to "it *is* the case").

- *Recall*: Process of publication:

$$\textit{internal report} \Rightarrow \textit{initial submission} \Rightarrow \textit{final publication}$$

Rhetorical tactics:

- Use of citations as a method of legitimization: "stacking allies in such a way that the reader feels isolated..."
- *Empirical repertoire*: Emphasizes lines of empirical evidence and logical relations among facts. Underwrites accepted claims.
- *Contingent repertoire*: Emphasizes idiosyncratic causes and social or psychological pressures. Deployed against rejected claims.
- Highest complement: argument is *logical*.

Challenging a claim requires "breaking up alliances".

Metaphors as Rhetorical devices:

- 20th century primatology: reflection of concepts of gender in Western societies.
- 19th century thermodynamics: reflection of religious concepts in Presbytarian Scotland.
- Internet as "information highway".
- Brain as telephone switch station; brain as digital computer; brain as distributed network.
- Genes as information.

energy = finite "gift of grace" from God; puny humans can transform it and distribute it, but necessarily lose some of it in the process

2nd Law: Puny humans seek to maximize virtue of useful work and minimize vice of idleness/waste

Highway infrastructure serves the public good.

- *Prevalence of metaphors*: Literal language lacks the resources for easy application to new realms.
- *Question*: "...how can inquiry influenced by metaphors current in the wider culture, as so much of science is, be taken as representing?"

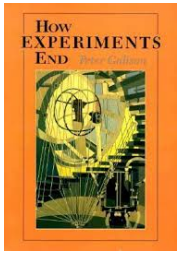
4. The Unnaturalness of Science and Technology

Francis Bacon
(1561–1626)

- 17th century: Development of experimental science.
  - "...a strange and fragile way of gaining knowledge about the natural world".

Standard View: Experiments function as a way of deciding between theories. Priority given to theories: theorists sit above experimentalists.

Alternative View: "Experiments have a life of their own."



Gallison, P. (1987)
How Experiments End

- *Experimental system*: A combination of tools and techniques with which to run any number of varying studies.
  - *drosophila*
  - zebra fish
  - *C. elegans*
  - laboratory rat: biobreeding, Brattleboro, hairless, knockout, Lewis, Long-Evans, RCS, shaking Kawasaki, Sprague Dawley, Wistar, Zucker

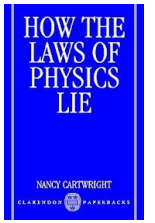
Question: *How "natural" is experimental knowledge?*

Claim: "Experimental knowledge is not knowledge directly about an independent reality, but about a reality apparently constructed by experiments."

- Experiments require continual maintainence of order: is this controlled order artificially imposed, or is it a reflection of natural order?
- Is replicability an experimental virtue?
  - *LHC experiments: only one chance!*

Question: *How "natural" is theoretical knowledge?*

Claim: Theories are *idealizations* of the real world. Scientific laws are *ceteris parabus* ("all things being equal") statements.



Cartwright, N. (1983) *How the Laws of Physics Lie*

- *Ex*. Newton's 1st Law:

"Every body continues in its state of rest, or of uniform motion in a right line, unless it is compelled to change that state by forces impressed upon it."

- *Rephrase*: "If it is not acted upon by forces, every body continues in its state of rest, or of uniform motion in a right line."
- *But*: This is trivially true! There is no such thing as an ideally isolated body (i.e., every body is acted upon by external forces).

"Like experimental knowledge, theory is about cleansed and purified phenomena, abstractions away from the truth." (Sismondo 2010, pg. 163.)

Is this a fair critique?

Kind Essentialism: Natural kinds exist to which things belong.

Anti-Essentialism (Nominalism): Natural kinds do not exist (or: natural kinds are conventional).

- *If kind essentialism is true, then it makes sense for theories to abstract away from concrete particular things.*
- *If nominalism is true, then such abstractions are not ontologically significant.*

How to understand the objects of scientific knowledge:

1. *Construtivist*: As constructions of researchers as they transform disorderly nature into orderly artifacts. Order is imposed on nature by science.
2. *Realist*: As revealing a deeper order which is absent in surface manifestations of nature. Science is an activity that discovers worlds that lie beneath, or are embedded in our ordinary one.

Irreconcilable? "On the one hand, constructions use available resources, and so depend on the affordances of those resources. Thus even constructions reveal something like a deeper order. On the other hand... reality is not a self-evident concept and may ultimately refer to the outcome of inquiry." (Sismondo 2010, pg. 167.)

Example 3. Gross, A. (1990) 'The Origin of Species: Evolutionary Taxonomy as an Example of the Rhetoric of Science'

Aim: To provide *rational* and *rhetorical* reconstructions of the concept of a species.

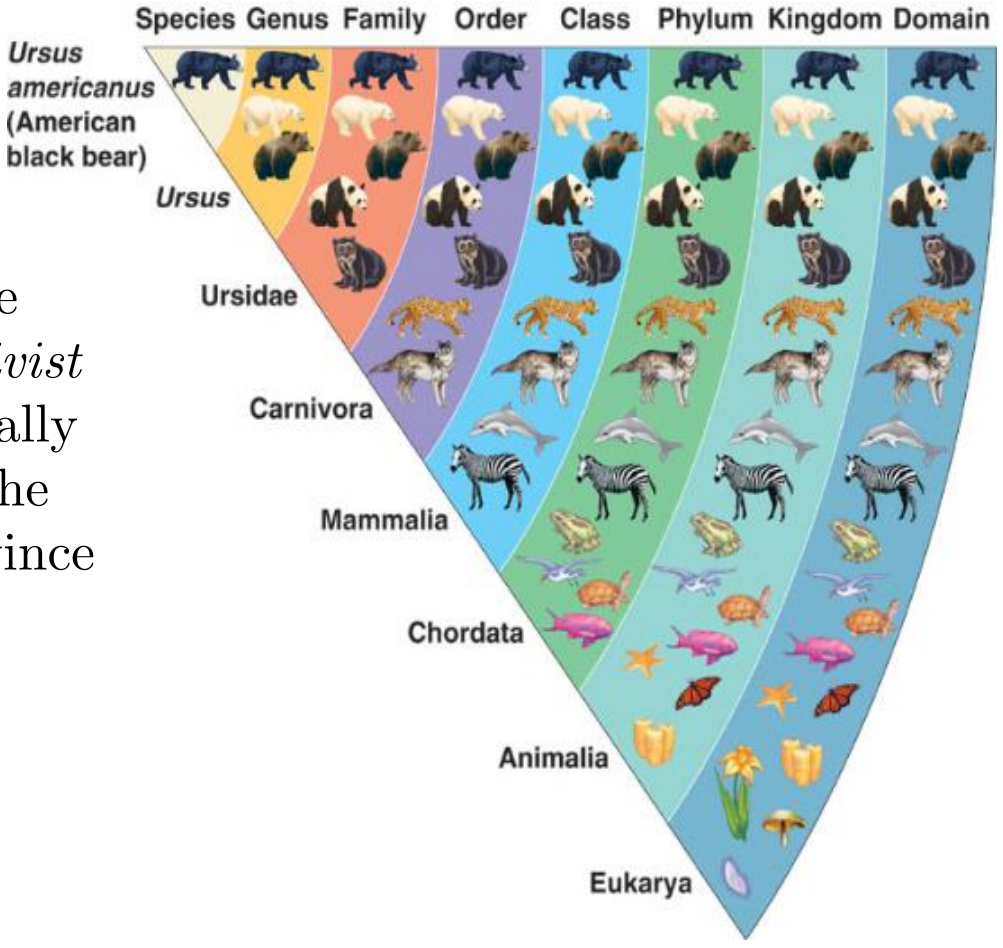
What the heck is he talking about?

Confused Philosopher

Suggestion:

(a) A "rational reconstruction" of the concept of a species is a *realist* account of how the concept is employed by taxonomists.

(b) A "rhetorical reconstruction" of the concept of a species is a *constructivist* account of how the concept is socially constructed by taxonomists, and the rhetorical devices they use to convince their peers of instances of its application.



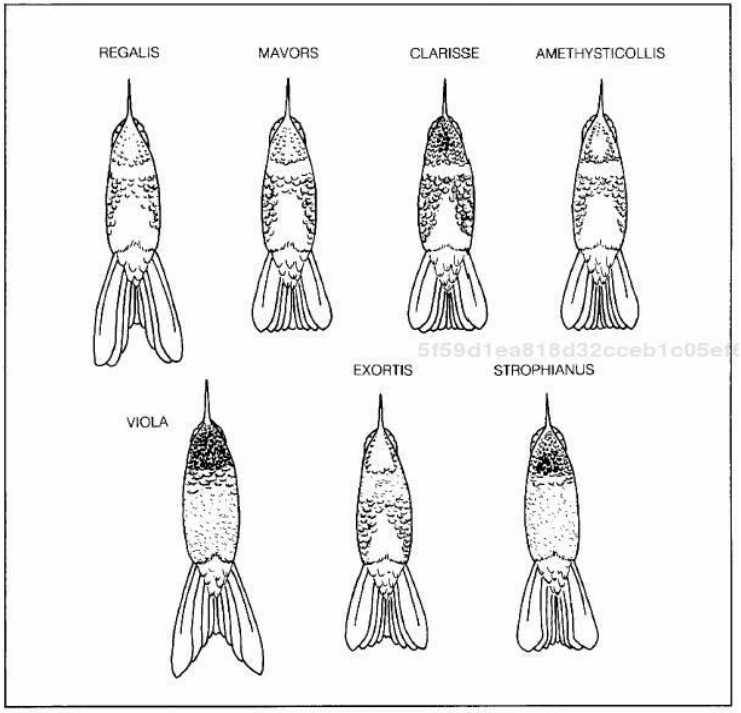
(a) Rational reconstruction of "species": 2 Steps.

Step 1. *Establishing a general family resemblance and particular differentiating characteristics (reconstructing a "taxonomical species").*

> *Recall*: Wittgenstein's problem with following a rule (applying a definition).
> - *Chairs (and in general, species) can only be said to have a "family resemblance".*
> - *This family resemblance cannot be formally encoded in a rule/definition; rather, it must be tacitly learned by members of a given community.*

- *Ex*: Fitzpatrick, *et al.* (1979) 'A New Species of Hummingbird from Peru'.
  - New species *regalis* ("royal"), belonging to genus *heliangelus* ("sun angel").

Domain:	*Eukarya*
Kingdom:	*Animalia*
Phylum:	*Chordata*
Class:	*Aves*
Order:	*Apodiformes* (swifts & hummingbirds)
Family:	*Trochilidae* (hummingbirds)
Genus:	*Heliangelus* (sun angel hummingbirds)
Species:	*Regalis* (royal sun angel hummingbirds)



"A broad, pale buffy breast band separates the smaller throat spots from larger and more numerous discs on the breast and flanks. In a few specimens the posterior border of the breast band is entirely defined by a broad row of these discs. The belly is free of dark spots in all specimens. The downy crissum is white as in males, and the undertail coverts are dusky, edged Cinnamon."

Step 2. *Providing an evolutionary explanation of the newly identified species (reconstructing an "evolutionary species").*

- Explains problematic observations that arise in the process of identification.
- Licenses prediction.

Ex. Problem: The male *regalis heliangelus* has monochromatic plumage, while other members of the genus *heliangelus* do not.

- *Explanation in terms of evolutionary convergence*: The plumage of the male *r. heliangelus* is similar to those of other species that occupy similar ecological niches.

Royal (*regalis*)

Orange-throated (*mavors*)

Amethyst-throated (*amethysticollis*)

Purple-throated (*viola*)

(b) Rhetorical reconstruction of "species"

"Presence": A rhetorical device in literary theory by means of which "...writers place 'certain elements' in their discourses, those on which they 'wish to center attention', in 'the foreground of the reader's consciousness'."

- Two ways presence is created for species in taxonomy:
  - *overdescription*
  - *multiple sensory perspectives*

Claim: The type of presence that scientific discourse attempts to create is "referential presence".

- *Idea: Scientific discourse attempts to persuade us that its terms actually refer to real things.*

- How "referential presence" is established for species (how *taxonomical* species are rhetorically created):
  - *statistical inference (from a small collection of specimens, we infer a new species)*
  - *naming (conferring a distinct name to the new species)*
  - *artistic rendering*

- How *evolutionary* species are rhetorically created:

Gross's two versions of evolutionary theory:

- *Strong version*: The concept of species "...is an integral part of a formulation that aspires to make quantitatively precise forecasts of events in space-time, events directly inferred from mathematically expressed physical laws."
- *Weak version*: The concept of species "...is an integral part of a formulation that brings together a large and otherwise disparate number of phenomena in the natural world under a single conceptual umbrella."

Charitable gloss:

- *Strong version:* Evolutionary theory as a falsifiable theory.
- *Weak version:* Evolutionary theory as a way to systematize observations, not necessarily in order to make predictions.

- *Claim*: Many articles in taxonomy profess to the strong version, but really only provide evidence for the weak version.

"One can only conclude that falsifiability is invoked... to give a mistaken impression of the strength of particular taxonomical claims." (Gross 1990, pg. 106.)

"...a paradox inherent in any taxonomic affirmation of evolutionary theory"

"If the theory is right, species cannot be natural kinds, entities with atemporal identities, like genes or electrons: full knowledge of intermediary varieties would demonstrate their wholly historical nature." (Gross 1990, pg. 106.)

"In other words, any version of evolutionary theory eventually leads to the disappearance of the species as a legitimate natural kind. The evolutionary species is a rhetorical construct, an oxymoron created only by avoiding the full implications of the theory on which its existence apparently depends." (Gross 1990, pg. 106.)

Questions

- How is this a paradox? Why is the evolutionary view that species are not natural kinds (i.e., species are not "atemporal") paradoxical with respect to taxonomy?
- Does the claim that species cannot be natural kinds entail that species are rhetorical constructs?

Realist alternatives to species (kind) essentialism: (Ereshefsky 2010)

- species as individuals linked *via* a common lineage
- species as sets of individuals
- species as "homeostatic property cluster" kinds