

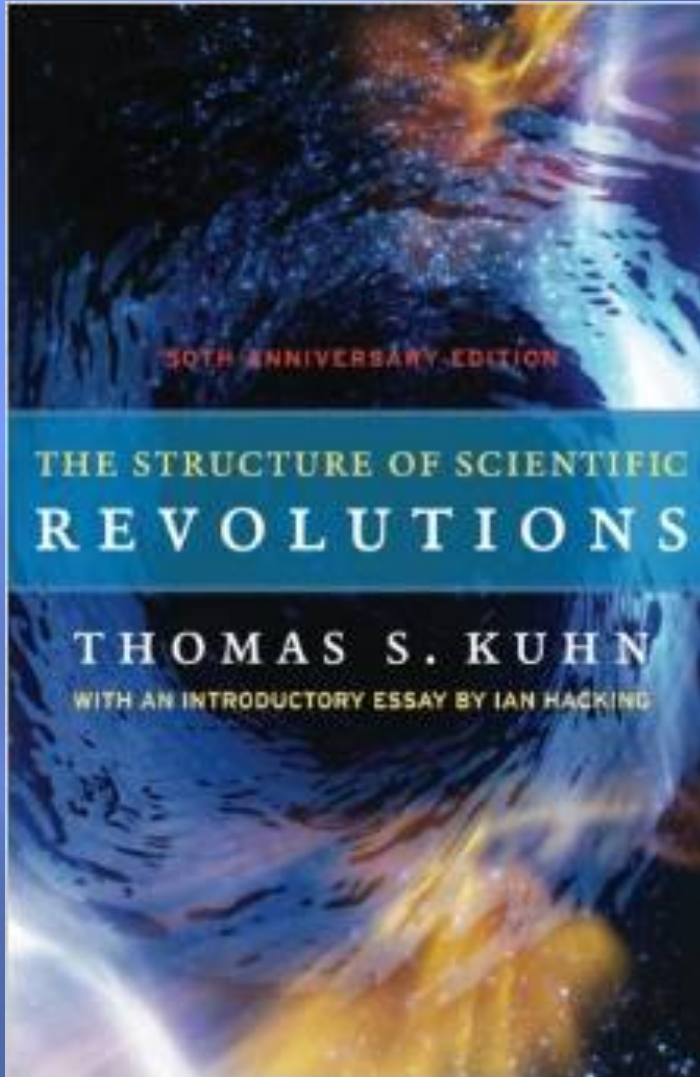
Structure of Scientific Revolutions:

Are we past that?

Science Circle
November 28th 2020

Stephen Gasior, Ph.D.
a.k.a. Stephen Xootfly

Scientific Revolutions



Thomas Samuel Kuhn Ph.D.
(July 18, 1922 – June 17, 1996)
American physicist, historian,
and philosopher of science

Scientific Revolutions

(Prescience)

I. Paradigm

normal science

anomaly

II. Crisis

questioning

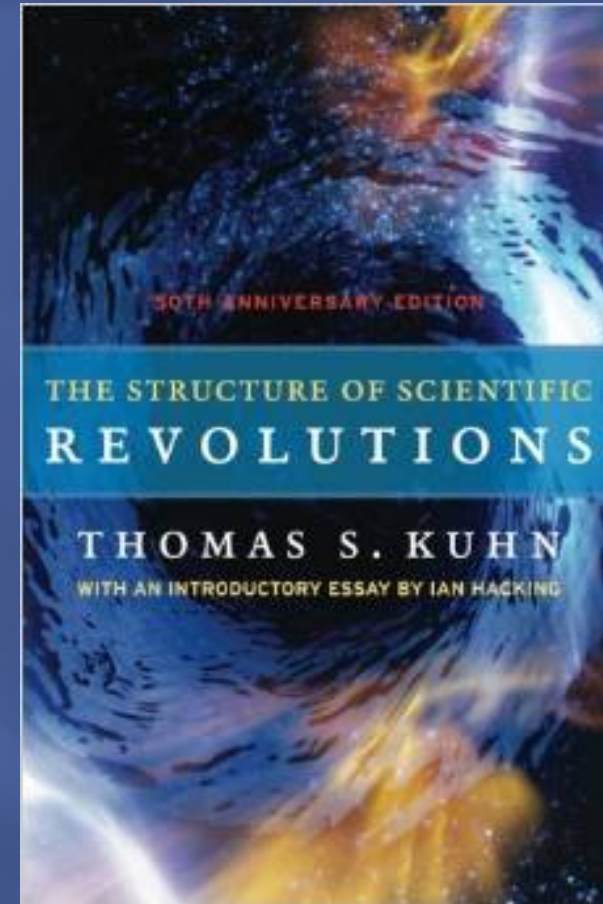
confirming

resolution

III. New Paradigm

"Objectivity, Value Judgment, and Theory Choice."

- Accurate - Consistent - Broad Scope - Simple - Fruitful



Scientific Revolutions

(Prescience)

I. Paradigm

normal science

anomaly

II. Crisis

questioning

confirming

resolution

III. New Paradigm

Repeat as necessary



"Objectivity, Value Judgment, and Theory Choice."

- Accurate - Consistent - Broad Scope - Simple - Fruitful

Scientific Revolutions

Example

I. Phlogiston Theory (combustable element in material-Alchemy) | Air is Nothingness

burning candles in boxes with mice snuffs the flame and kills the mice

burning candles in boxes with plants takes longer to snuff the flame
and plant doesn't die (Joseph Priestly)

changes in weight (up or down) after combustion

II. Crisis

Experiments understanding chemistry and combustion

(Antoine-Laurent Lavoisier and Carl Sheele)

III. Oxidation | Chemical Basis of Air — O_2/CO_2

The Invention of Air: A Story of Science, Faith, Revolution, and the Birth of America by Steven Johnson

Scientific Revolutions

I. Miasma Theory | Disease is Airborne

extension of Four Humors

John Snow's investigation of cholera on Broad St/Thames water maps

Contagion Theory in which contact spread disease

II. Crisis

other ways to treat epidemics and sickness (Lister, Robert Koch, Louis Pasteur)

III. Germ Theory

The Ghost Map: The Story of London's Most Terrifying Epidemic - and How it Changed Science, Cities and the Modern World

ALSO by Steven Johnson

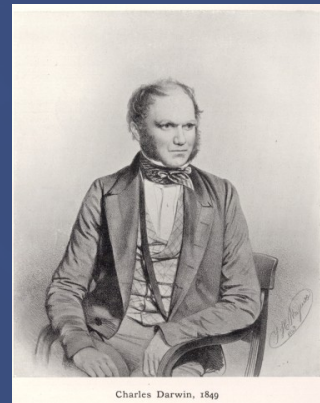
Scientific Revolutions

Natural Selection

Individuals in a population vary in their heritable characteristics. Organisms produce more offspring than the environment can support.

Individuals that are well suited to their environment tend to leave more offspring than other individuals.

Over time, favorable traits accumulate in the population.



Charles Darwin, 1849

Scientific Revolutions

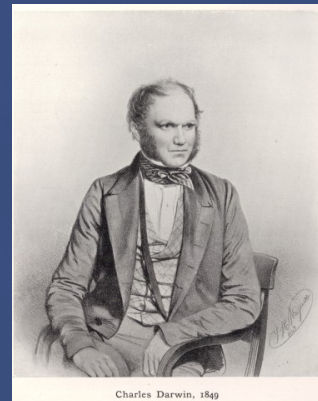
Natural Selection

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random mutations **“random” environment**

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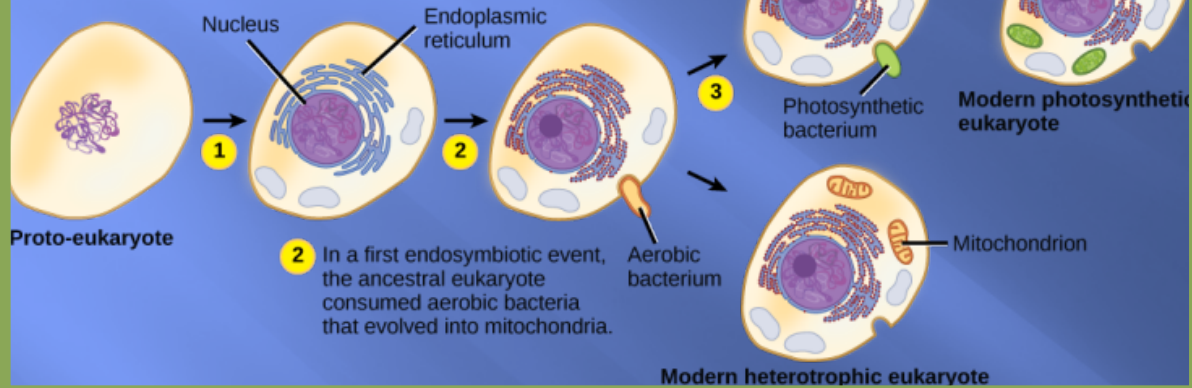
Charles Darwin, 1849

A biological anomaly

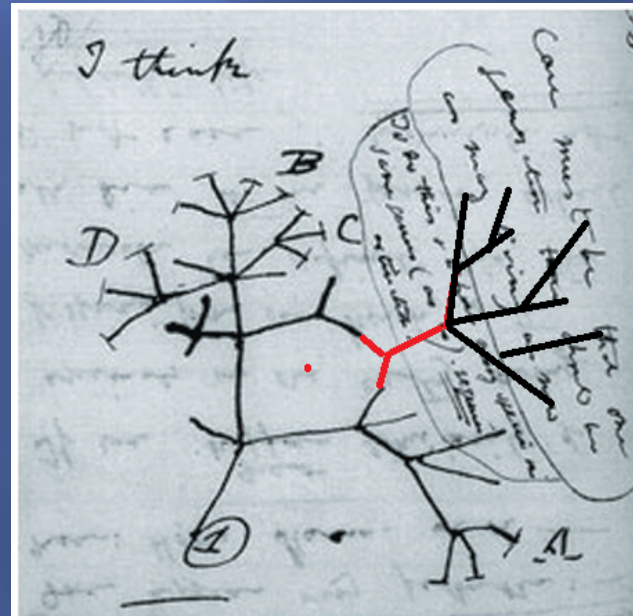
The ENDOSYMBIOTIC THEORY

- 1 Infoldings in the plasma membrane of an ancestral prokaryote gave rise to endomembrane components, including a nucleus and endoplasmic reticulum.

3 In a second endosymbiotic event, the early eukaryote consumed photosynthetic bacteria that evolved into chloroplasts.



Sagan, L. (1967). On the origin of mitosing cells. *Journal of theoretical biology*, 14(3), 225-IN6.



The Uniqueness of Biology

Complexity and Organization

Chemical Uniqueness

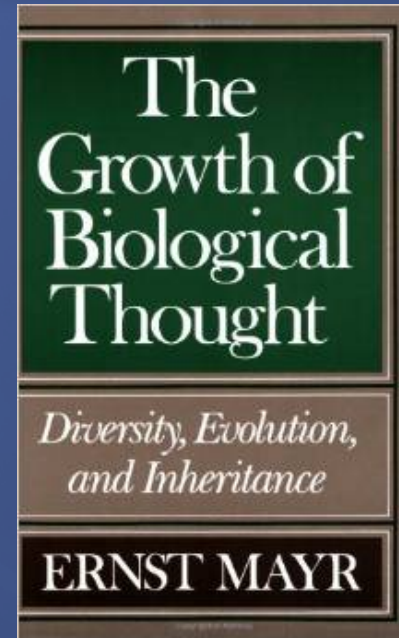
Quality (not Quantity)

Uniqueness and **Variability**

Genetic Program

Historical Nature / Natural Selection

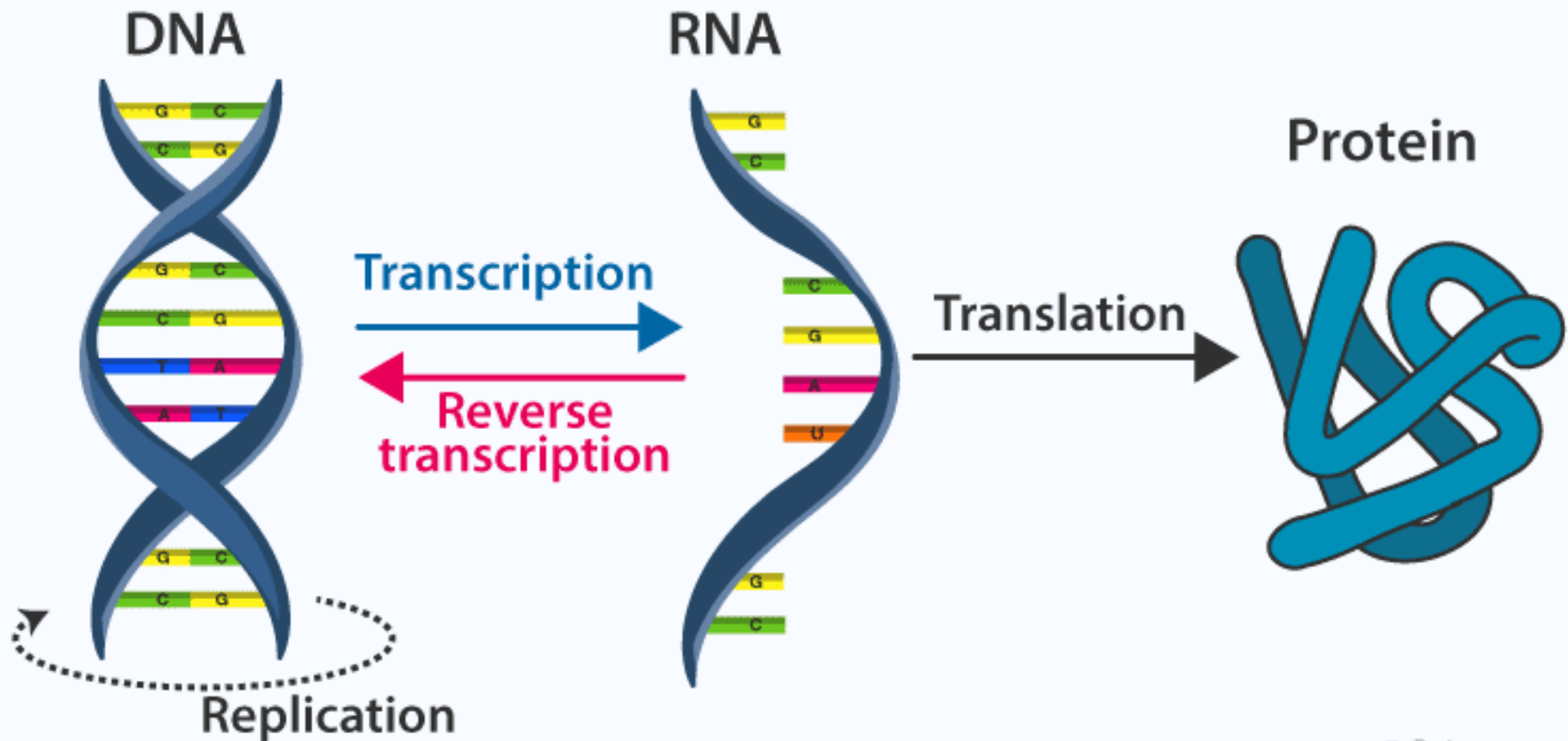
Indeterminacy (aka Unpredictable)



Mayr: Evolutionary
biologist,
taxonomist, tropical
explorer,
ornithologist, and
historian of science

The Fundamental Unit of Biology

CENTRAL DOGMA : DNA TO RNA TO PROTEIN



Progress In Science

Tools of Science

Observation

- I. More comparative, taxonomy/classification
- II. Brightfield Microscope, centrifuges, Electron Microscope, chemical isolations, recombinant DNA
- III. We have molecular microscopes, sequences, and understand how DNA-phenotype works, computer modeling, DNA synthesis
(can manipulate the fundamental unit)

Field of Science

Profession of Science

Creative Making Up stuff

I. Beginning of societies, journals, collaborations

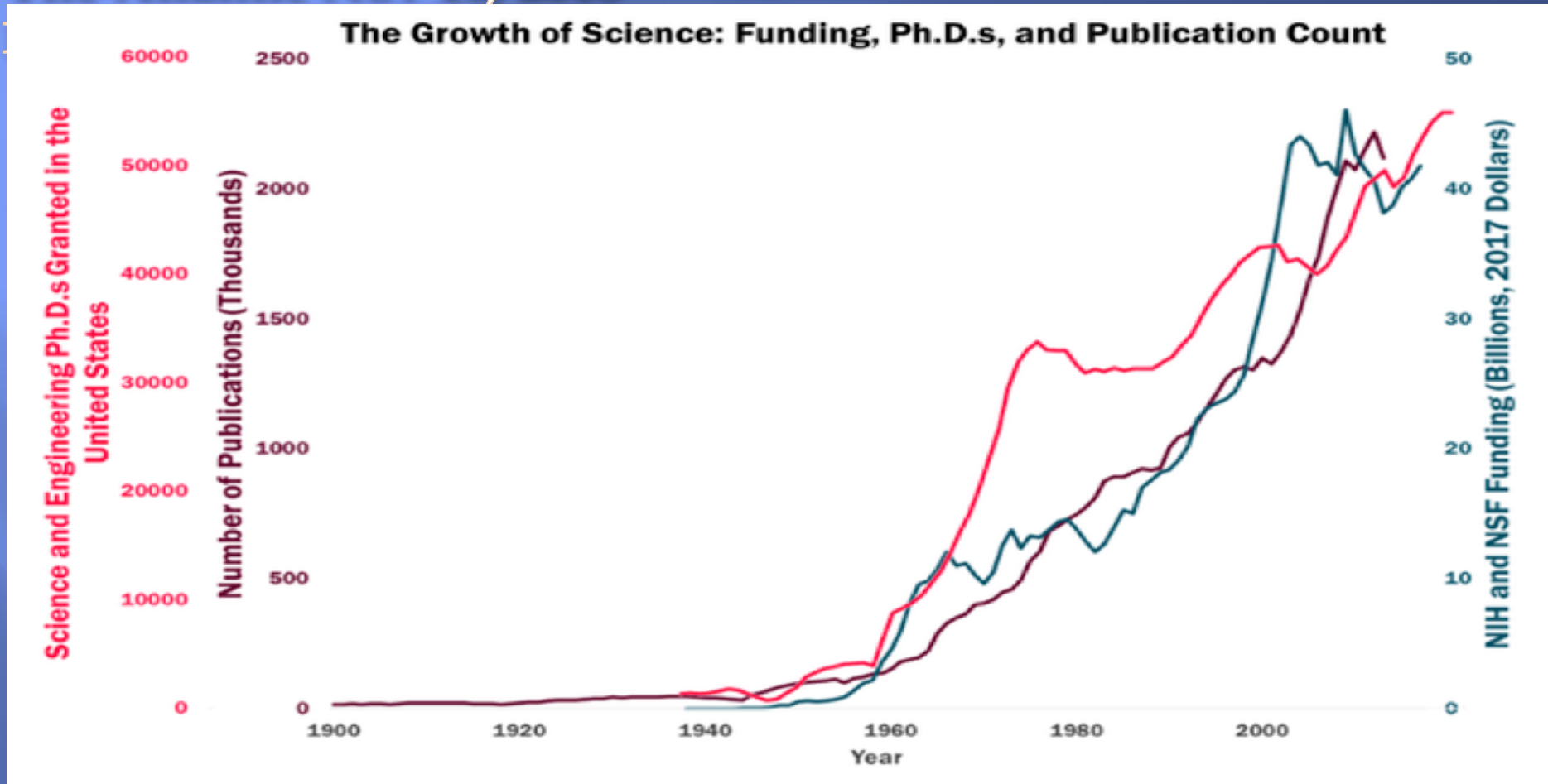
II. Gov. Institutions and Funding, Training programs, Museums, Conferences (penalties for fraud)

III. Highly developed dissemination and communication of science, Philosophy of Science
(understanding of the process/scientist unit
high level of scrutiny and review)

OMG So Much Science

“Science Is Getting Less Bang for Its Buck”

The Atlantic Nov 16, 2018



<https://www.theatlantic.com/science/archive/2018/11/diminishing-returns-science/575665/>