

Three Research Levels

Lui Lam

San Jose State University, California

任何学科研究的三个层次

气体：一个例子

经验层次
Empirical

气体定律：

$$P V = k T$$

唯象层次
Phenomenological

From “conservation of momentum” and a few simple assumptions about the material (without the knowledge that gas are made up of molecules), can derive

Navier-Stokes 方程：

$$\rho [\partial \mathbf{v} / \partial t + (\mathbf{v} \cdot \nabla) \mathbf{v}] = - \nabla p + \mu \nabla^2 \mathbf{v} + \mathbf{f}$$

从下而上层次
Bottom-Up

1. 气体运动学理论 [can re-derive the above equation and relate the parameters (ρ, μ) to molecular properties]
2. Monte Carlo 计算机模拟 (从分子出发)

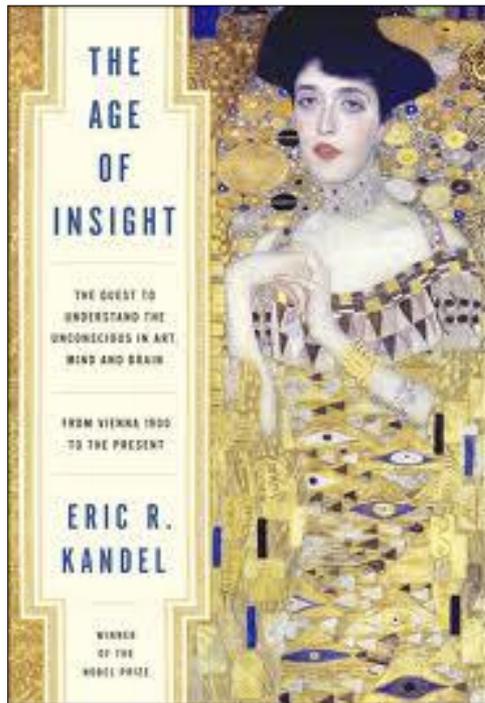
需要问为什么

为什么人文学看起来不像科学

In **any** scientific study, there are **three** research approaches/levels:

- Empirical
- Phenomenological
- Bottom-up

Humanities (since Plato) are mostly at the empirical and phenomenological levels, with some exceptions in last few decades.



2012

- A book showing all three approaches in the study of a humanities subject:
Vienna portraiture
from 1900 to present



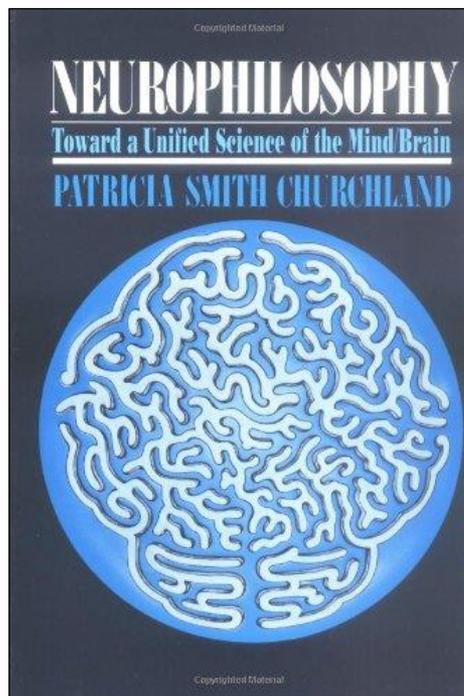
Eric Kandel

Nobel Laureate
Neurobiologist
Columbia University

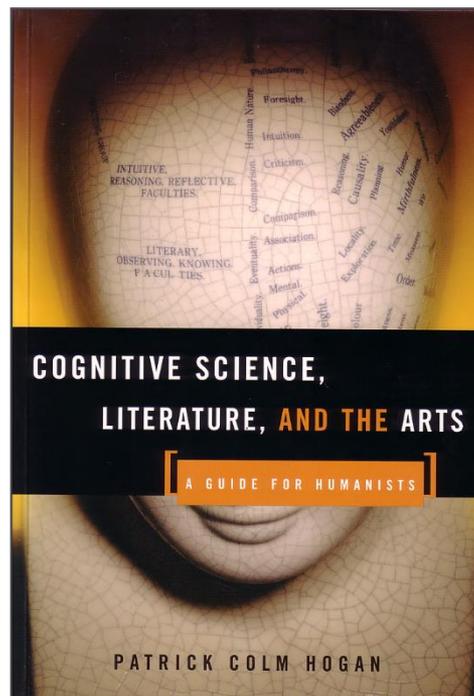
如何提升人文学研究水平

- 通过人文学学者与自然科学家的合作
- 更多的从下而上层次研究

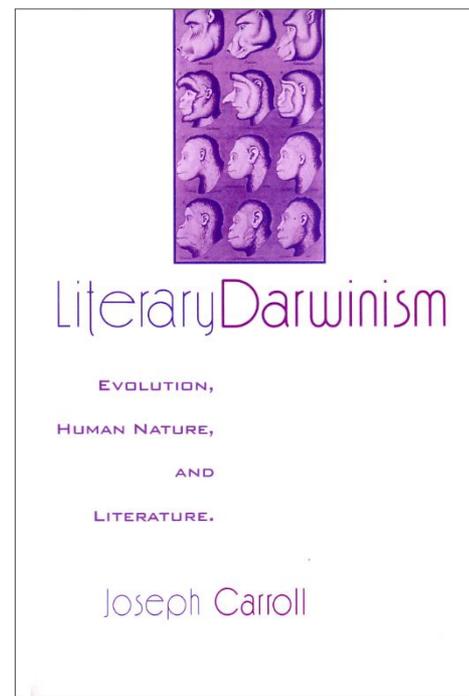
文理交融的书（人文学学者写的）



1986



2003



2004

历史研究的三个层次

	Physics (gas)	History
Empirical level Collect data	✓	✓
Summarize data	✓	✓
→ empirical laws	$PV = kT$	Dynasty lifetime, etc.
Phenomenological level	Navier-Stokes equation	Active walk, etc.
Bottom-up level	Molecular dynamics	Computer simulation

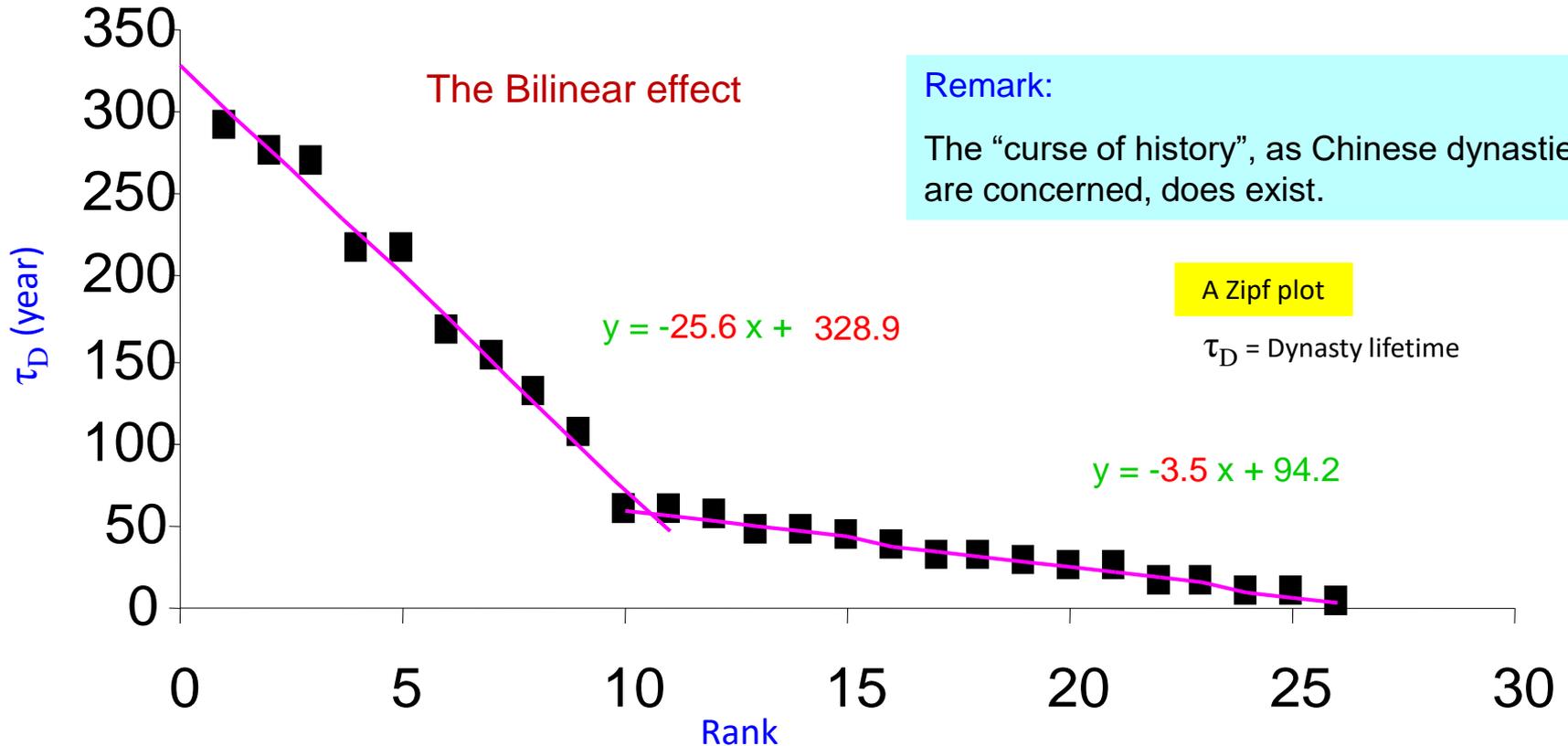
Lessons from physics research

- You don't have to know things in detail.
- Simplify by keeping only the relevant factors.
- For a **stochastic system** (like history) one has to ask different questions (i.e., historians have been asking the wrong questions).

一条定量的历史定律

A quantitative law with prediction in Chinese history

A Quantitative Law: A Chinese dynasty can survive every 3.5 years if it lasts less than 57 years; beyond that, every 25.6 years (i.e., dynasty lifetime is discrete, or “quantized”).



A quantitative prediction (assuming dynasties fall into the bilinear type):

Any dynasty after Qing, if exists, will either

1. last 290 years or less and fall on the two lines, or
2. end definitely and exactly in its year 329.

艺术研究的三个层次

In **any** scientific study, after

- observing and collecting data, and
- analyzing data

In **arts**, done mostly by artists, writers, musicians, movie directors and actors, ...

See, e.g., J. Lehrer, *Proust was a Neuroscientist* (2007)

there are three levels/approaches to go further:

Approach	Gas	Arts
Empirical	Gas law	Done by some artists, art critics and historians; Physics—fractals
Phenomenological	Navier-Stokes equation	Done by some historians/ philosophers; Evolutionary theory (Darwin)
Bottom → up	Molecular picture (called “microscopic” method in physics)	Biology— evolutionary theory (genes) , cognitive science; Physics—statistical analysis, ...

John Barrow, *The Artful Universe* (1995); *Physics World*, “Physics Meets Art and Literature”, Dec. 2002 (special issue).