

# Three Research Levels

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# 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 ( $\rho, \mu$ ) to molecular properties]
2. Monte Carlo 计算机模拟 (从分子出发)

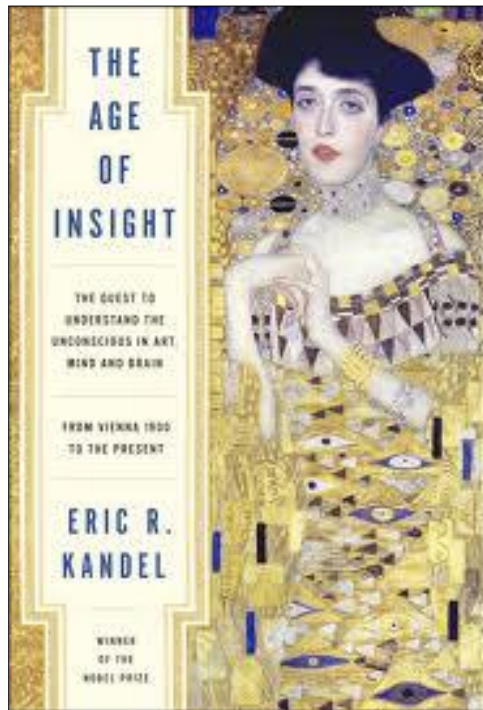
需要问为什么

# 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



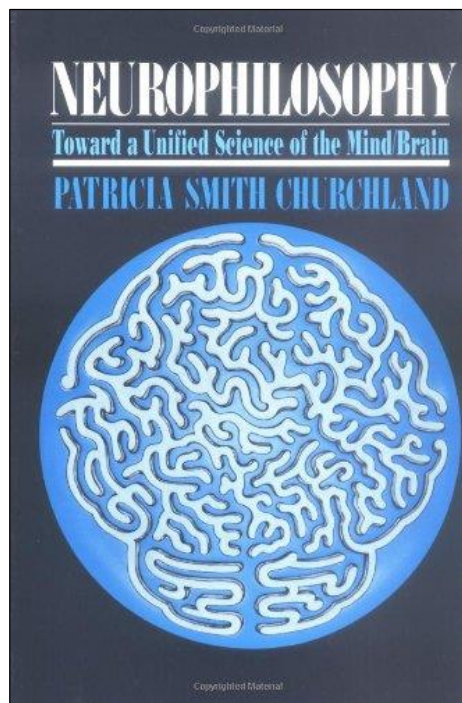
**Eric Kandel**

Nobel Laureate  
Neurobiologist  
Columbia University

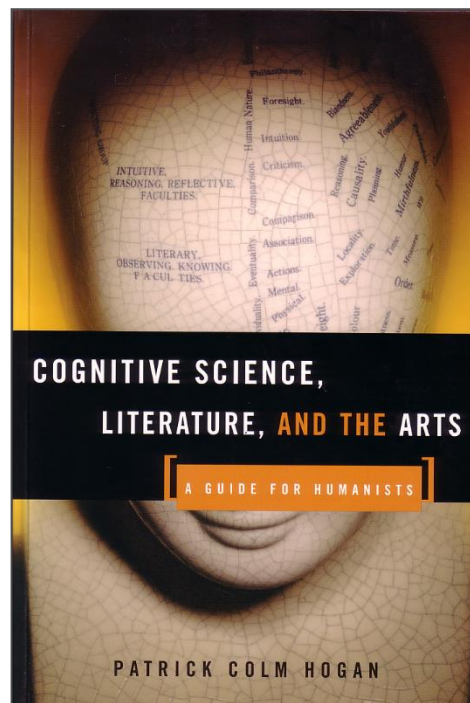
# 如何提升人文学研究水平

- 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

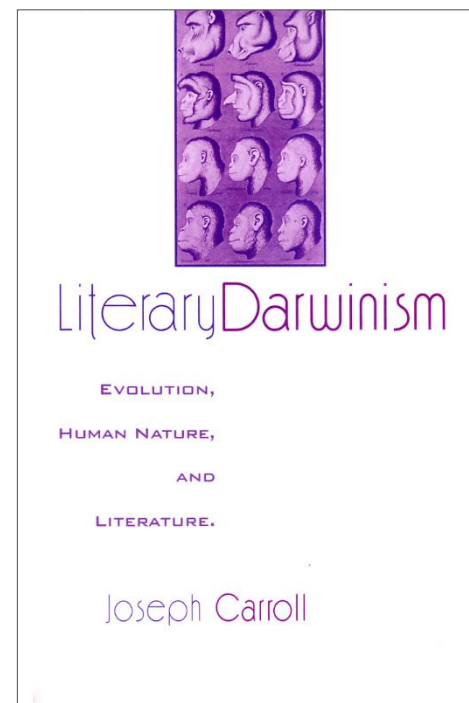
## 文理交融的书（人文学学者写的）



1986



2003



2004

# 历史研究的三个层次

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

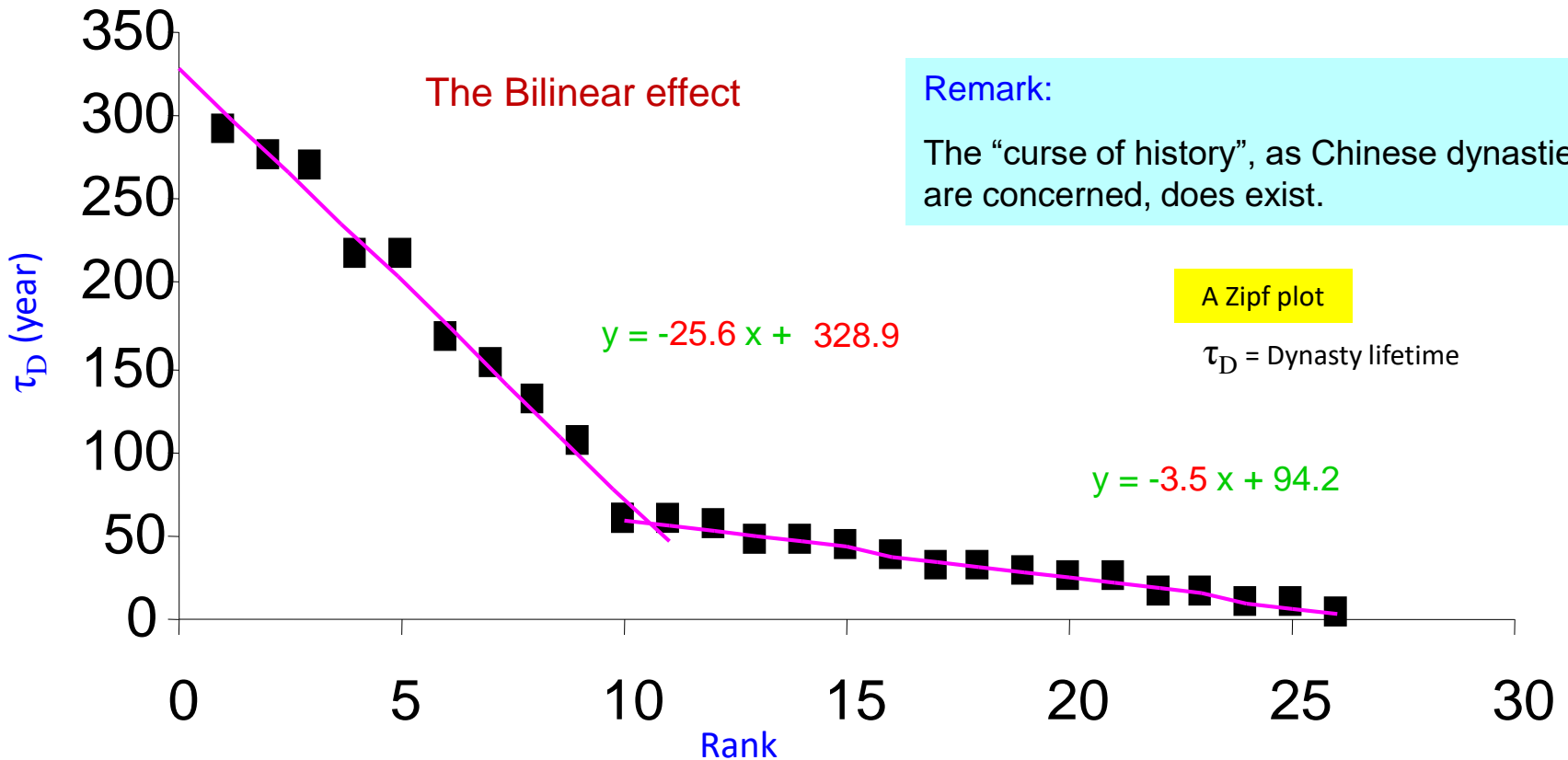
## Lessons from physics research

- 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; <b>Evolutionary theory (Darwin)</b>
Bottom → up	Molecular picture (called “microscopic” method in physics)	Biology— <b>evolutionary theory (genes)</b> , cognitive science; Physics—statistical analysis, ...

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