

Engaging with the History of Astronomy

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Why History?

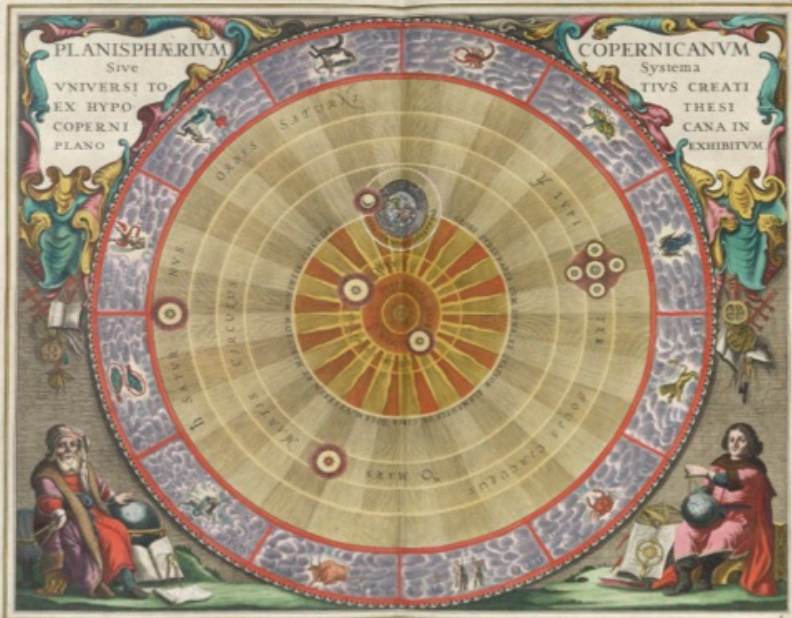
- Non-science majors need to learn about the nature of science, not just the results of science. To do this they should either DO science, or else learn how science has been done (or both).
- Starts with the easiest material.
- Emphasizes that science is done by humans. Science is part of our intellectual heritage like literature, fine art, etc. (“Science appreciation”)
- Provides a narrative structure that is coherent and appealing.

Example Courses

- Mike Crowe, Notre Dame U, *The Extra-Terrestrial Life Debate, Theories of the World..., Modern Theories of the Universe..., Mechanics...*
- Alan Hirshfeld, U Mass Dartmouth, *Astronomy Activity & Laboratory Manual* (great for large enrollment courses!)
- Chris Graney, Jefferson Community & Technical College, *The Known Universe* (lulu.com)
- James Evans, U of Puget Sound, *History and Practice of Ancient Astronomy*
- My courses: *The Copernican Revolution, The Scale of the Universe*

The Copernican Revolution

Planetary Astronomy from Aristotle to Newton

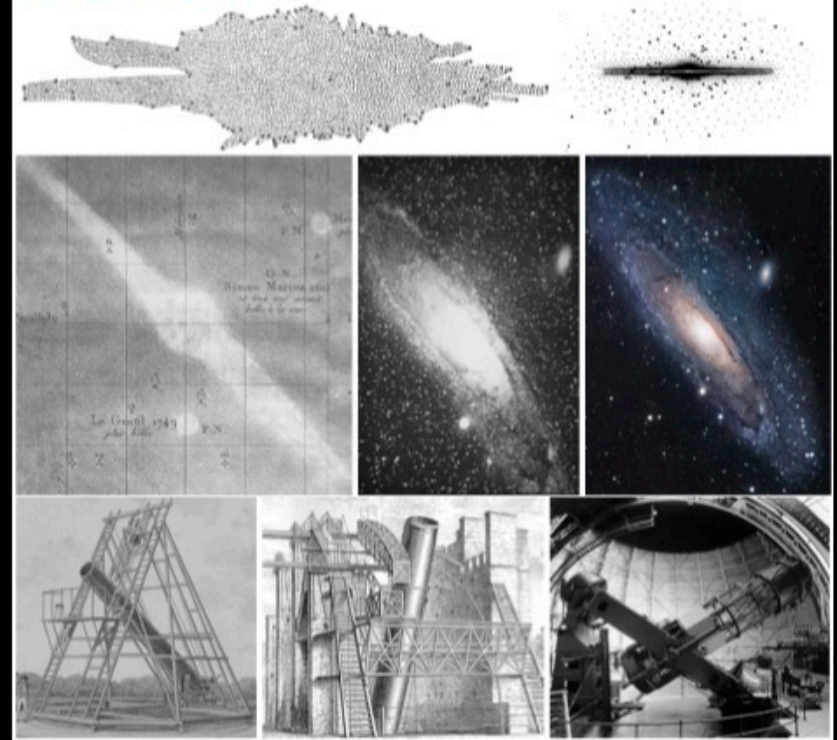


Paul Wallace & Todd Timberlake

Astronomy of the 17th Century!

THE SCALE OF THE UNIVERSE

DISCOVERING OUR PLACE AMONG THE GALAXIES



TODD TIMBERLAKE

Celestial Sphere to Expanding Universe

Sample Activity

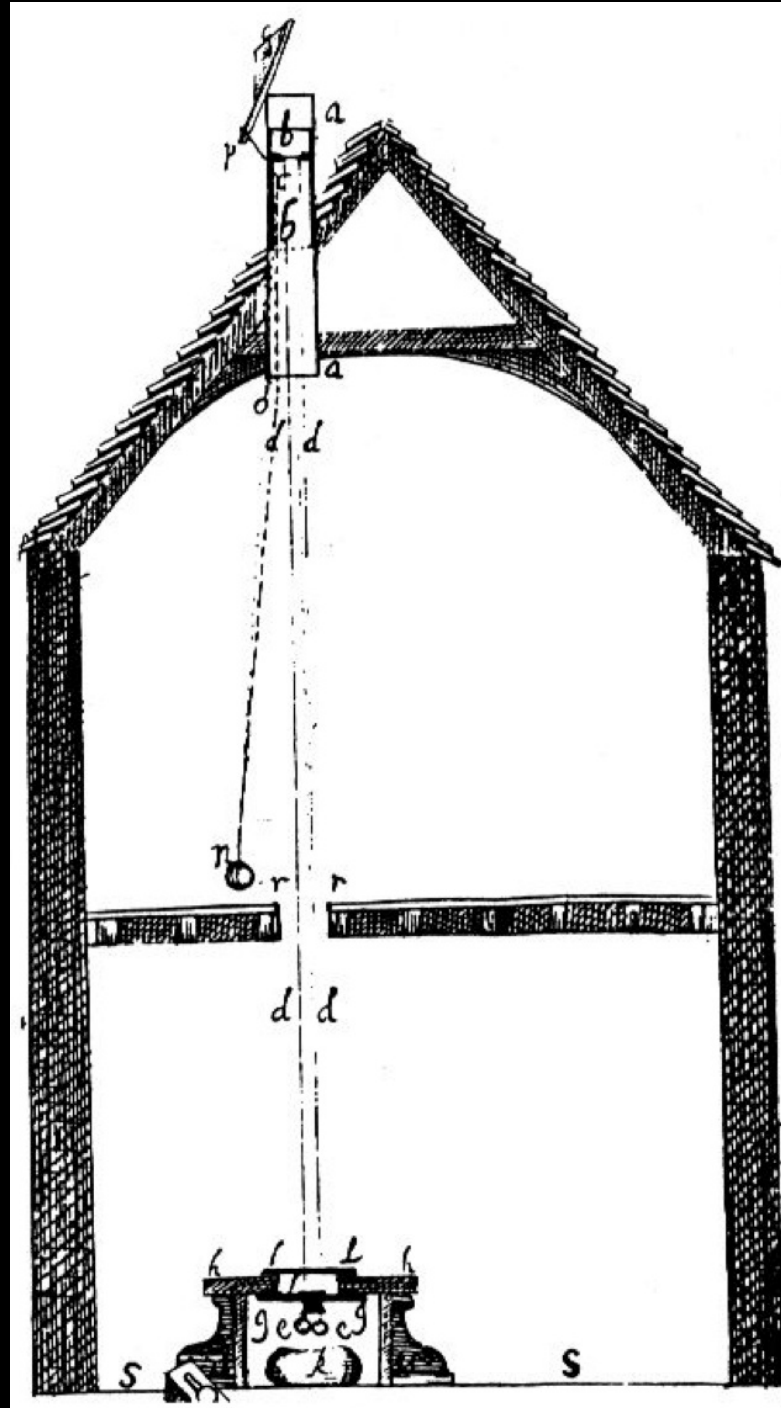
- In my courses, students work in groups to complete activities that try to recreate historical episodes.
- Most activities involve computer simulations: *Stellarium* or *CLEA* programs for simulated observations, *EJS* models to visualize how theories relate to observable data.
- In many activities students deal with real historical data, and must evaluate theories or answer questions on the basis of this data.
- Here's one example (at high speed!).

Parallax and Aberration

- Annual parallax (*AstronomicalParallax2D*).
- Pattern of annual parallax for gamma Draconis (*AstronomicalParallax3D*).

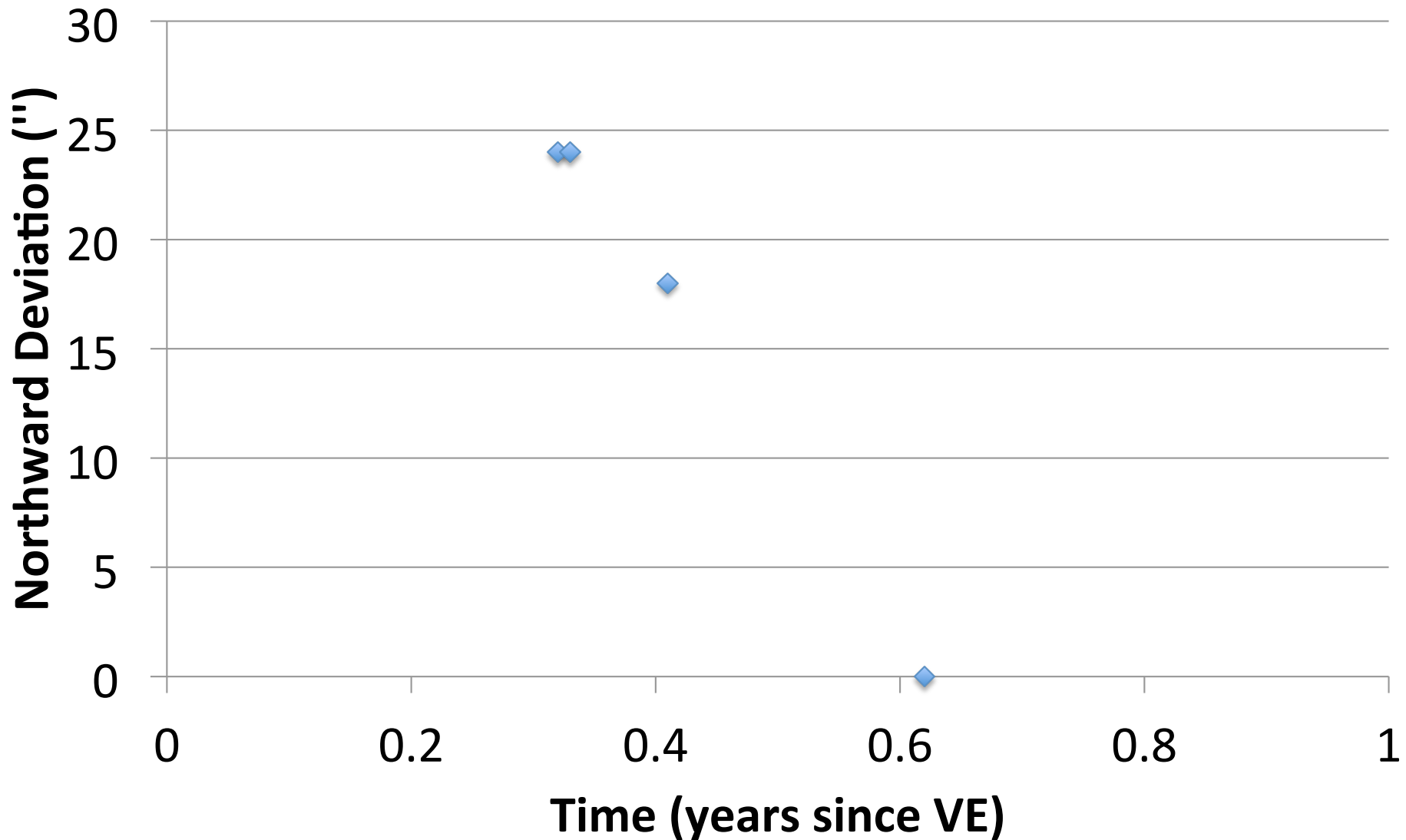
Hooke's Measurement of Parallax (1674)

- Used zenith telescope to measure north-south deviations of Gamma Draconis.



Hooke's Data

Hooke's Gamma Draconis Data



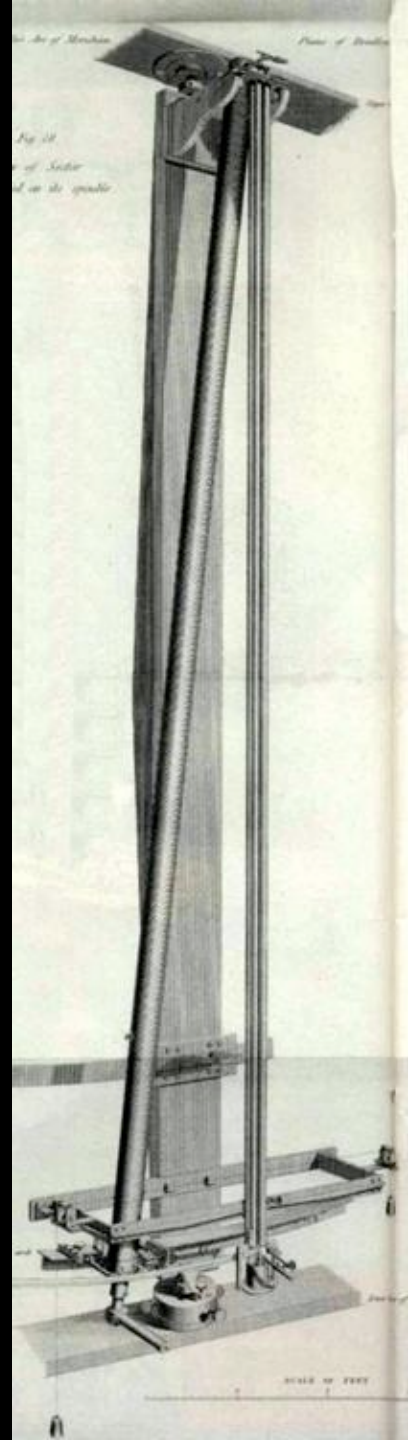
What do you think?

- Did Hooke measure the parallax of Gamma Draconis? He thought he did.
- His conclusions are based on only 4 observations. He never followed up because of constant problems with his telescope and his health.
- His contemporaries were skeptical.



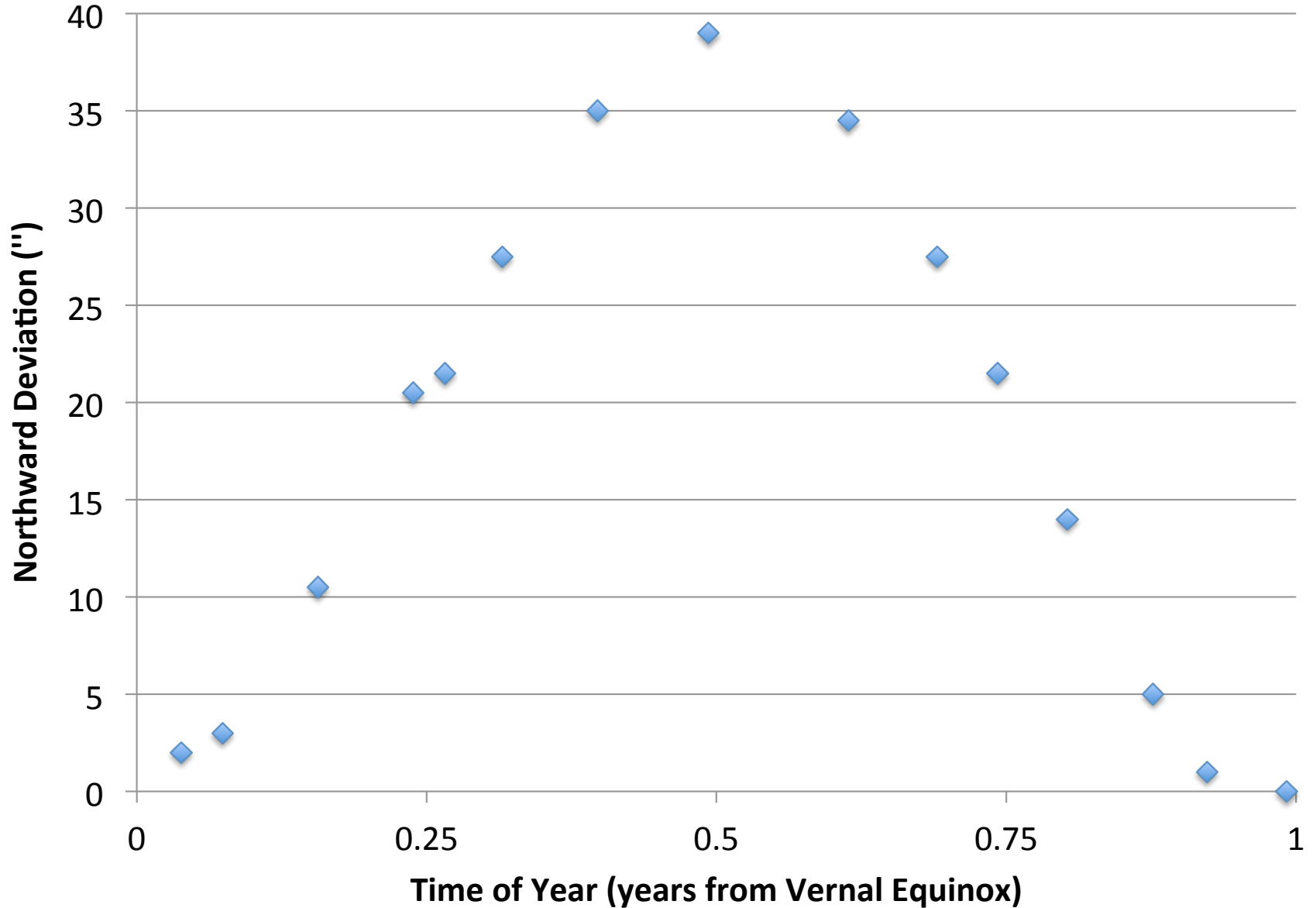
James Bradley

- Tried to replicate Hooke's measurements of Gamma Draconis (1725-1728).



Bradley's Data

Gamma Draconis



Bradley's Explanation

- Bradley knew of Römer's determination of the finite speed of light based on delays in eclipses of Jupiter's moons.
- He guessed that the deviations in gamma Draconis were tied to Earth's *velocity*, not its position.
- The theory he developed is now known as the aberration of light (*StellarAberration2D*).
- Pattern for Gamma Draconis (*StellarAberration3D*).

Questions/Comments

- Do Bradley's data and explanation provide evidence for Earth's orbit around the Sun?
- Do Bradley's data and explanation provide evidence for the finite speed of light?
- Could anyone have measured parallax before knowing about aberration? (Recall: parallax decreases with distance, aberration does not depend on distance.)
What did Hooke measure?
- A failed search for a geometrical effect led to the discovery of a physical effect.
- Aberration was used to estimate the speed of light, and later (in conjunction with terrestrial speed of light measurements) the Astronomical Unit.

Conclusions

- Using history to teach astronomy can...
 - Make the class more interesting for students.
 - Illustrate important concepts about the nature of science by showing how science was actually done.
 - Help students develop a deep understanding of *some* important concepts.
 - Give students an appreciation for science.
 - Move students beyond memorization, to analysis and even evaluation.

Materials Available

- **Stellar Parallax and Aberration package:**

www.compadre.org/osp/items/detail.cfm?ID=12029

- **The Copernican Revolution:**

facultyweb.berry.edu/ttimberlake/copernican/

- **The Scale of the Universe:**

facultyweb.berry.edu/ttimberlake/galaxies/

- **Other EJS astronomy simulations:**

www.compadre.org/osp/