

Sir Isaac Newton

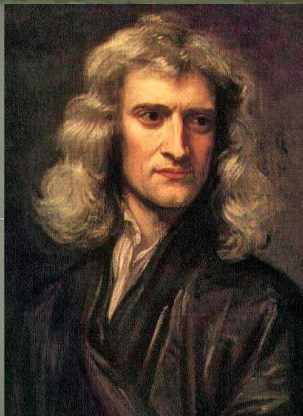
Revolutions in Science and Technology Paradigms

Dr. Steven Daniels
October 28, 2013

Outline

- Introduction
- Math
- Gravitation
- Optics
- Royal Mint
- Conclusions

Sir Isaac
Newton
(1642-1727)



PHILOSOPHIÆ
NATURALIS
PRINCIPIA
MATHEMATICA.

AUCTORE
ISAACO NEWTONO, EQ. AUR.

Editio tertia aucta & emendata.

LONDINI:
Apud GUIL. & JOH. STURT, Regiæ Societatis typographos.
MDCCLXXVI.

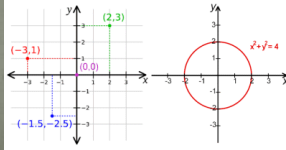
René Descartes

(1596 - 1650)

- one must therefore convince himself that all the sciences are linked together and that it is easier to learn them all as one than to isolate them from each other."



Cartesian Coordinates describe the position of a point in two dimensions by giving its horizontal and vertical locations, thus allowing a series of points generated by an algebraic equation to be plotted visually as a line or curve on a graph



René Descartes

(1596 - 1650)

- Descartes was primarily a philosopher and mathematician
- Descartes' studies led him to believe that the entire universe, except for God and the rational mind, operated on mechanical principles.



Galileo
(1564-1642)

Galilean Math

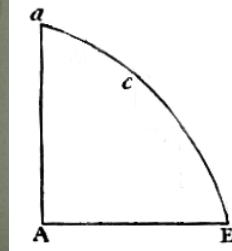


The ratios of the distances increase by odd numbers.
1, 3, 5, 7, 9...
This progression is always the same for any angle.



L E M M A II.

If in any figure $AacE$ (Pl. 1. Fig. 6.) terminated by the right lines Aa , AE , and the curve acE , there be inscrib'd any number of parallelograms Ab , Bc , Cd , &c. comprehended under equal bases AB , BC , CD , &c. and the sides Bb , Cc , Dd , &c. parallel to one side Aa of the figure; and the parallelograms $aKbl$, $bLcm$, $cMdn$, &c. are completed. Then if the breadth of those parallelograms be suppos'd to be diminished, and their number to be augmented in infinitum: I say that the ultimate ratio's which the inscrib'd figure $AKbLcMdD$, the circumscribed figure $AalbmcdnE$, and curvilinear figure $AabcdE$, will have to one another, are ratio's of equality.



If in any figure $AacE$ (Pl. 1. Fig. 6.) terminated by the right lines Aa , AE , and the curve acE

there be inscrib'd any number of parallelograms Ab , Bc , Cd , &c. comprehended under equal bases AB , BC , CD , &c. and the sides Bb , Cc , Dd , &c. parallel to one side Aa of the figure

Divide the area up into rectangles

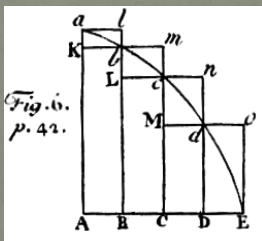
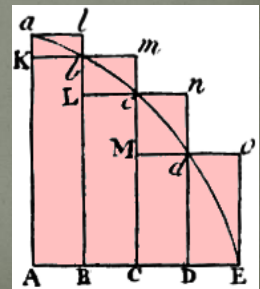
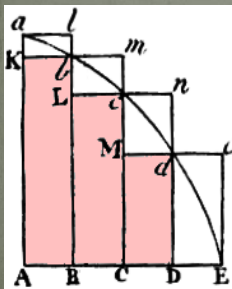
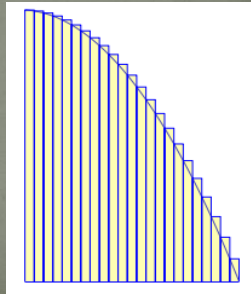
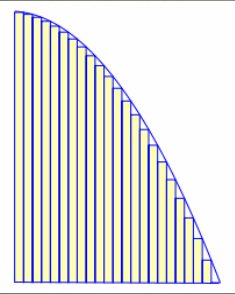


Fig. 6.
p. 42.

Need to consider whether they are inside or outside of the curve.

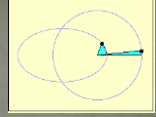


Now move to the infinitesimal



Johannes Kepler (1571-1630)

- The Copernican Revolution had determined the Heliocentric Universe
- Using the precise data that Tycho Brahe had collected, Kepler discovered that the orbit of Mars was an ellipse



Newton's Universal Law of Gravitation

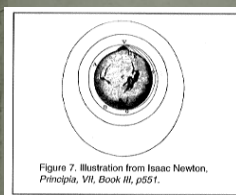
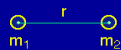


Figure 7. Illustration from Isaac Newton, *Principia*, VII, Book III, p.551.

Law of Universal Gravitation

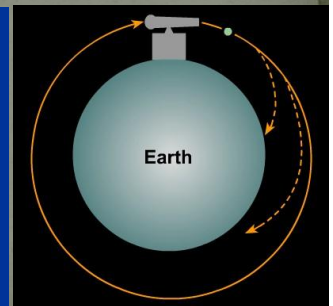
Every object in the Universe attracts every other object with a force directed along the line of centers for the two objects that is proportional to the product of their masses and inversely proportional to the square of the separation between the two objects.

$$F_g = G \frac{m_1 m_2}{r^2}$$



F_g is the gravitational force
 m_1 & m_2 are the masses of the two objects
 r is the separation between the objects
 G is the universal gravitational constant

Newton's Universal Law of Gravitation

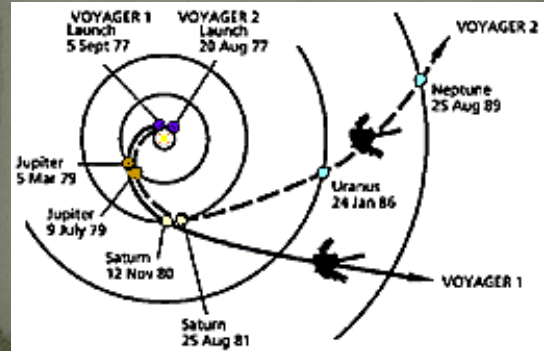


Newton's Orbital Cannon

Modern Space Travel



Orbits



OPTICKS:

OR, A
TREATISE
OF THE
REFLEXIONS, REFRACTIONS,
INFLEXIONS and COLOURS
OF
LIGHT.
ALSO
TWO TREATISES
OF THE
SPECIES and MAGNITUDE
OF
Curvilinear Figures.

LONDON,
Printed for S^{AM} SHUTE, and BENEJ. WATFORD,
Transcriber to the Royal Society, at the Trinity, close to
St. Pauls Church-yard. MDCCLV.

Galileo (1564-1642)

- Created the Galilean Telescope
 - 3x magnification to start improved up to 30x
- Many contributions in Astronomy

Johannes Kepler (1571-1630)

- In his books *Astronomia Pars Optica* and *Dioptrice* he earns credit for being the first to:
- Investigate the formation of pictures with a pin hole camera;
- Formulate eyeglass designing for nearsightedness and farsightedness;
- Explain the use of both eyes for depth perception.
- Describe: real, virtual, upright and inverted images and magnification;
- Explain the principles of **how** a telescope works;



René Descartes (1596 - 1650)

- In his study of optics he discovered the fundamental law of reflection- that the angle of incidence equals the angle of reflection.
- On Rainbows – “Having taken my pen and calculated in detail all of the rays that fall on the various points on a drop of water”



Newton's Optics

- Added colors to the Rainbow theory
- Studied the Prism
- Refrangibility of Light
- Study of the light spectrum
- Telescope

Telescopes

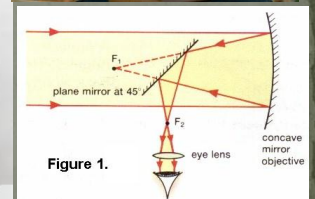
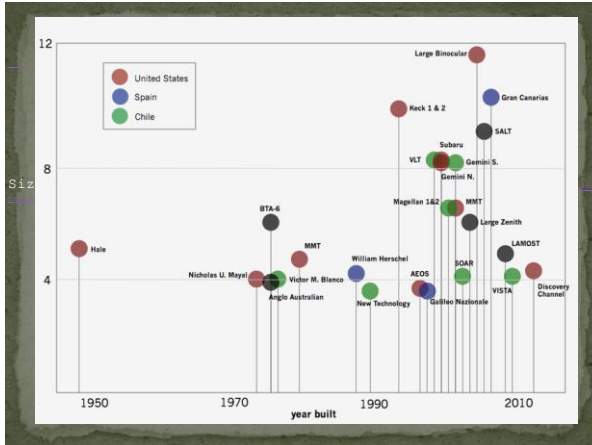


Figure 1.



Royal Mint

- In his lifetime he was better known for heading the Royal Mint
- Prosecuting counterfeiting
- Great Recoinage of 1696
- Changed from silver standard to gold standard
- Invented milling edges of coins



Coin Edges



Forgery: Wrong inscription
Thin in Top half

Forgery: Crude lettering
widely spaced

Genuine:
Even reeding.

Forgery: Letters close to edge
and too closely spaced.
Uneven reeding.

"If I have seen further than others, it is because I was standing on the shoulders of giants."

A Limerick

Isaac Newton

A Calculus fit to compute on
White light, and a head to drop fruit on
A mind to absorb it
and soar into orbit
---That's all it takes to be Newton

Questions

References

- <http://www.library.usyd.edu.au/libraries/rare/modern/ny/newton3.html>
- <http://www.inmath.com/blog/what-did-newton-originally-say-about-integration/4878>
- <http://www.tutorvista.com/content/physics/physics-1/gravitation/acceleration-due-to-gravity.php>
- <http://labspace.open.ac.uk/mod/resource/view.php?id=447939>
- <http://library.thinkquest.org/3531/mathhist.html>

References

- http://www.storyofmathematics.com/rwth_descartes.html
- **Descartes' Natural Philosophy** edited by Stephen Gaukroger, John Schuster, John Sutton
- <http://kepler.nasa.gov/Mission/JohannesKepler/>
- <http://csep10.phys.utk.edu/astr161/lect/history/newtongrav.html>
- <http://www.egglescliffe.org.uk/physics/astronomy/tdf/escape/newtontele.html>
- http://tytropes.org/pmwiki/pmwiki.php/Main/IsaacNewton?from=Main_SirIsaacNewton

References

- <http://www.jpl.nasa.gov/basics/bst4-1.php>
- <http://www.coins-of-the-uk.co.uk/pics/decip.html>
- http://en.wikipedia.org/wiki/Isaac_Newton