Robert Hooke (1635-1703)

Arguably the greatest experimental natural philosopher of the 17th century
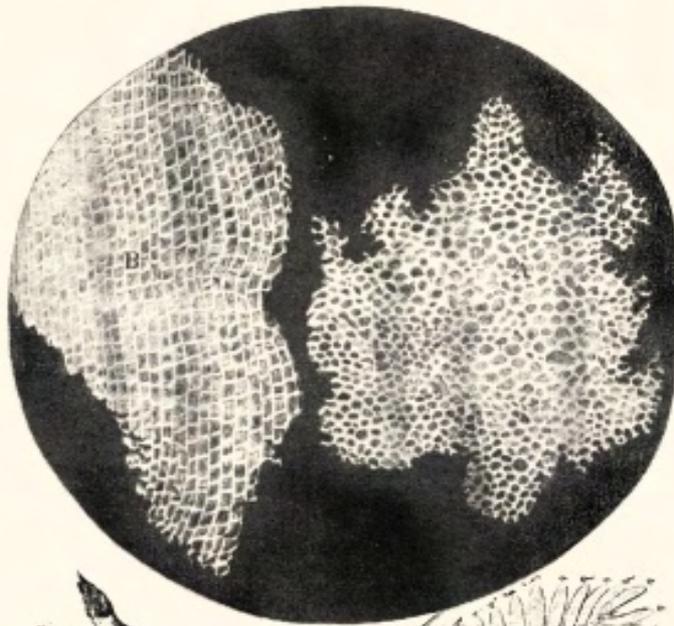
- His most famous work is *Micrographia*, in which he coined the term "cell" for a basic biological structure.

Biography

- Robert Hooke, the son of a clergyman in Freshwater on the Isle of Wight, was born on July 18, 1635.
- When he was 13, he left an orphan with a modest inheritance, and entered Westminster School.
- Later he earned his way
- as a chorister at Christ Church, Oxford, and attended Westminster College, graduating with his master's degree in 1663.

□ Isle of Wight

Biography

- Hooke remained at Oxford, where he became assistant to Robert Boyle.

- Together they conducted many experiments on the effects of reduced air pressure, using an air pump that had been designed and constructed by Hooke.
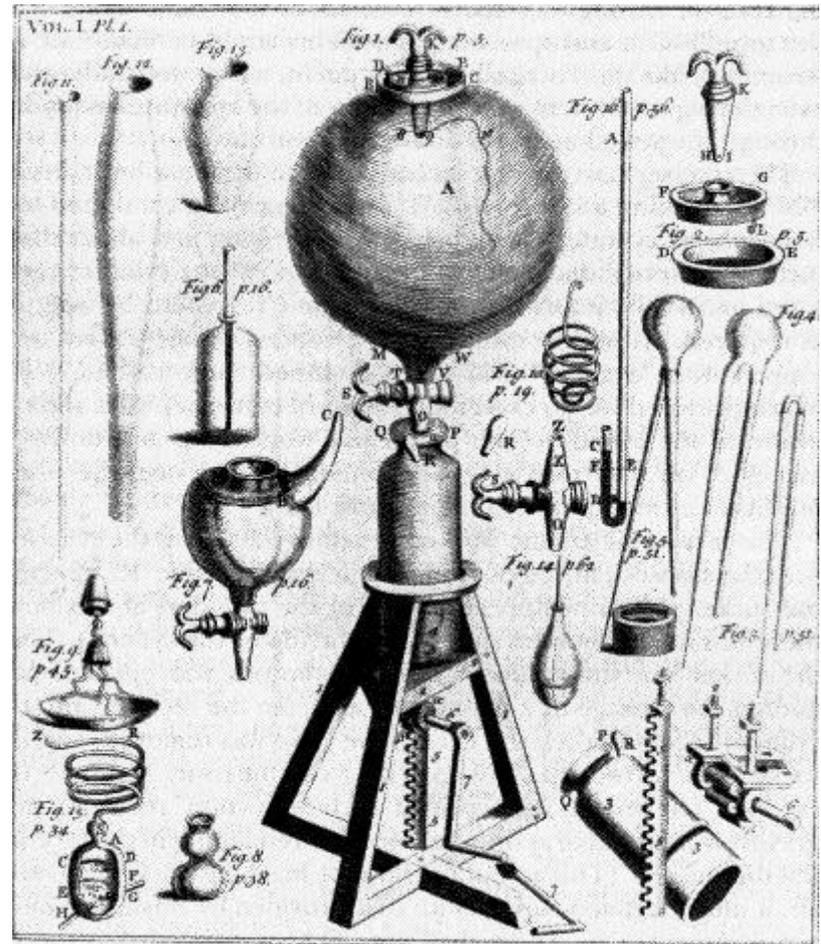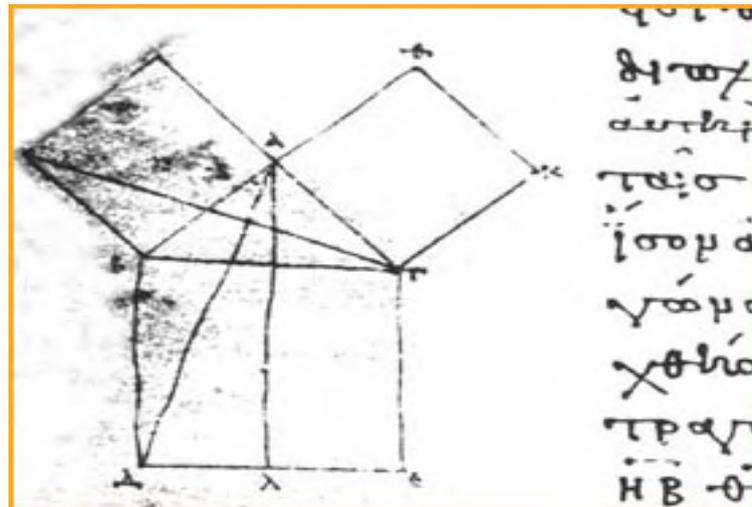
Biography…

- In 1662 Hooke became curator of the newly founded Royal Society, his duties being to produce three or four significant experimental demonstrations for each weekly meeting of the society.

- He was ideally suited for such work, and his career thereafter was immensely active and fertile.

Founded in 1660, the Royal Society is the independent scientific academy of the UK, dedicated to promoting excellence in science.

Biography…

- At Westminster Hooke was said to have acquired mastery of ancient languages, learned to play the organ, 'contrived severall ways of flying', and mastered the first six books of Euclid's *Elements*.

Biography…

- 1665 he was appointed Professor of Geometry and carried out astronomical observations, and was also elected FRS. In 1677 he became the Secretary to the Royal Society.

Hooke versus Newton

- In his *Attempt to Prove the Motion of the Earth* (1674), he offered a theory of planetary motion based on the correct principle of inertia and a balance between an outward centrifugal force and an inward gravitational attraction to the Sun.

- In 1679, in a letter to Newton, he finally suggested that this attraction would vary inversely as the square of the distance from the Sun.
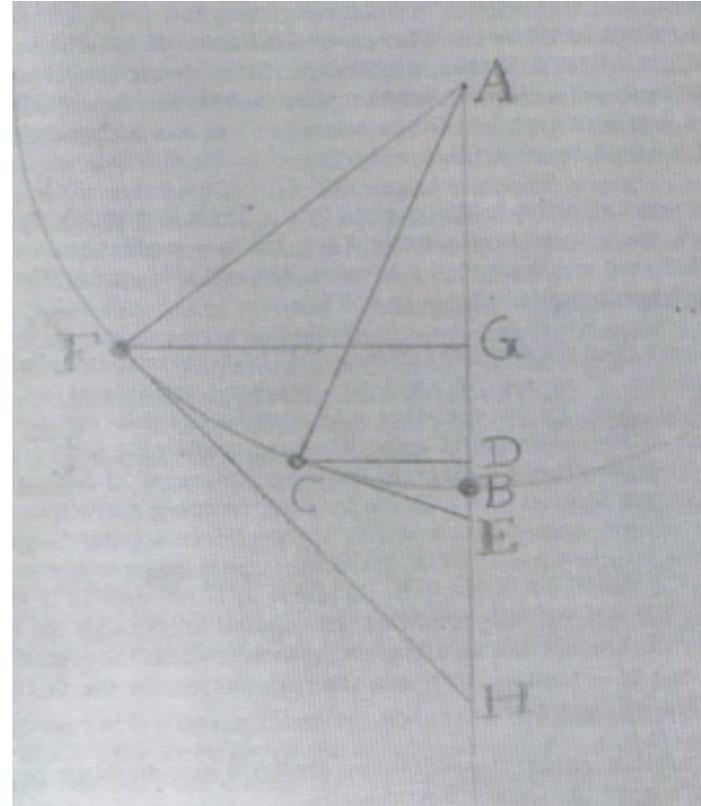
- Hooke expressed the prophetic character of the New Science very succinctly in the Preface to *Micrographia* in 1665:

  And as at first, mankind fell by tasting of the forbidden Tree of Knowledge, so we, their Posterity, may be in part restor'd by the same way, not only by beholding and contemplating, but by tasting too those fruits of Natural Knowledge, that were never yet forbidden. [2]

Today

- Amazingly no authenticated portrait of Hooke exists today.

- A small memorial can be found in Westminster Abbey, installed in 2005, 302 years after he died.

Today

- The year 2003, the 300th anniversary of the death of Dr Robert Hooke FRS, saw a wonderful flowering of both scholarly and more popular interest in his life and scientific achievements.

- Conferences were held at the Royal Society (in conjunction with Gresham College, London, where Hooke had been Professor of Geometry between 1665 and 1703) and at

- Oxford University, where Hooke had studied and worked at Christ Church between 1653 and 1662.

Video of Hooke's *Folio*

- http://video.google.com/videoplay?docid=251952904822976995&hl=en-GB
- Rediscovering Robert Hook: A video
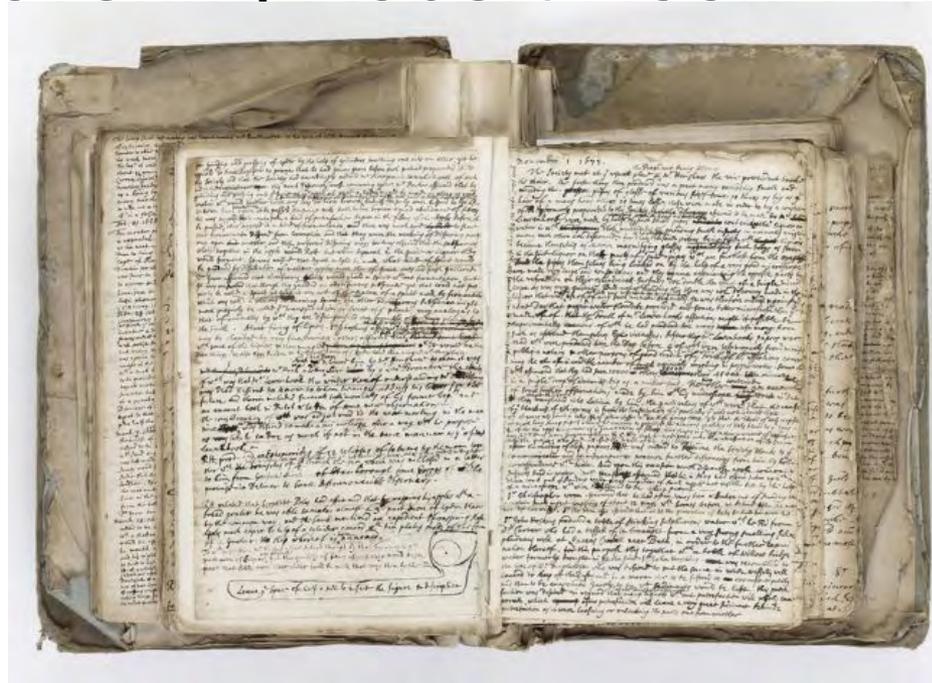
Boyle discovered his law with the help of Hooke

Dr. Hooke, the physicist

A founding member of the Royal Society from 1663, Hooke was accomplished in astronomy, biology, physics and architecture.

 His skill as an instrument maker gave him an edge over his contemporaries.

Royal Society Building in London
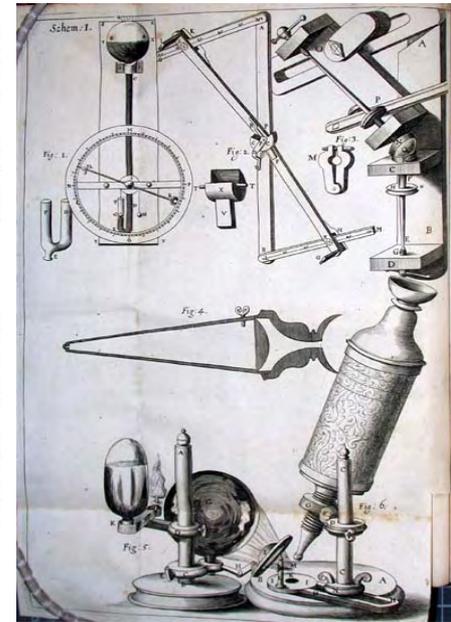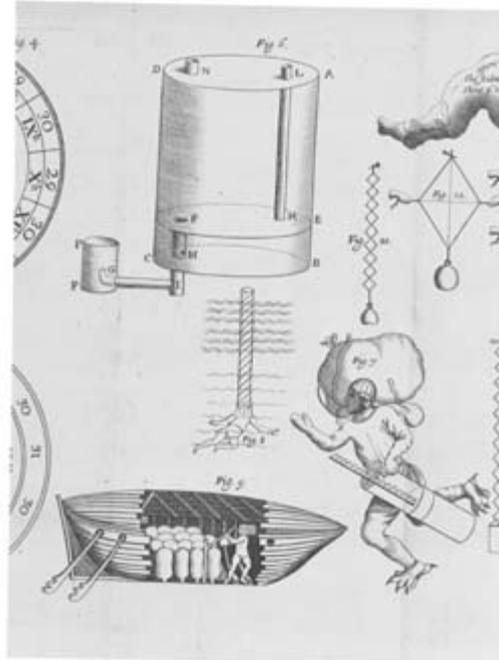
Dr. Hooke's, the physicist

Hooke's studies of springs and elasticity I led to his enunciation of "Hooke's Law" :

"Ut tensio sic vis."
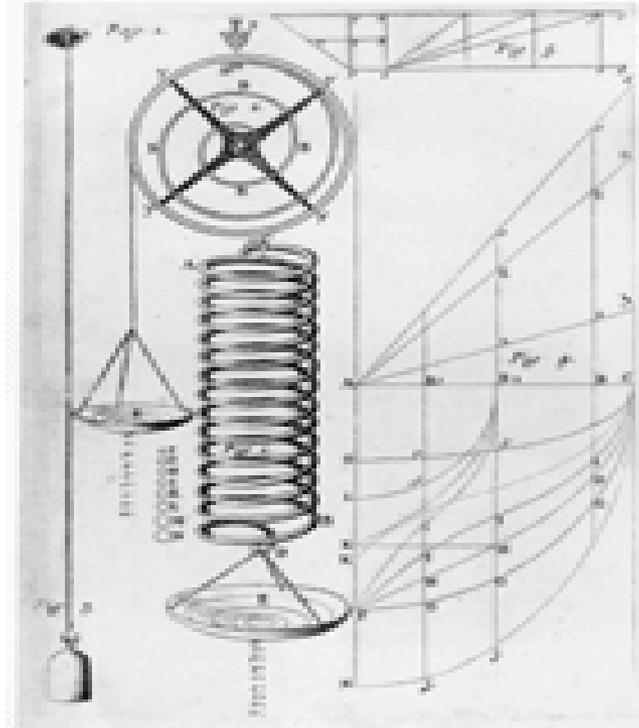
Hooke's law

- **Hooke's Law:**

    A spring's extension is proportional to the weight hanging from it.
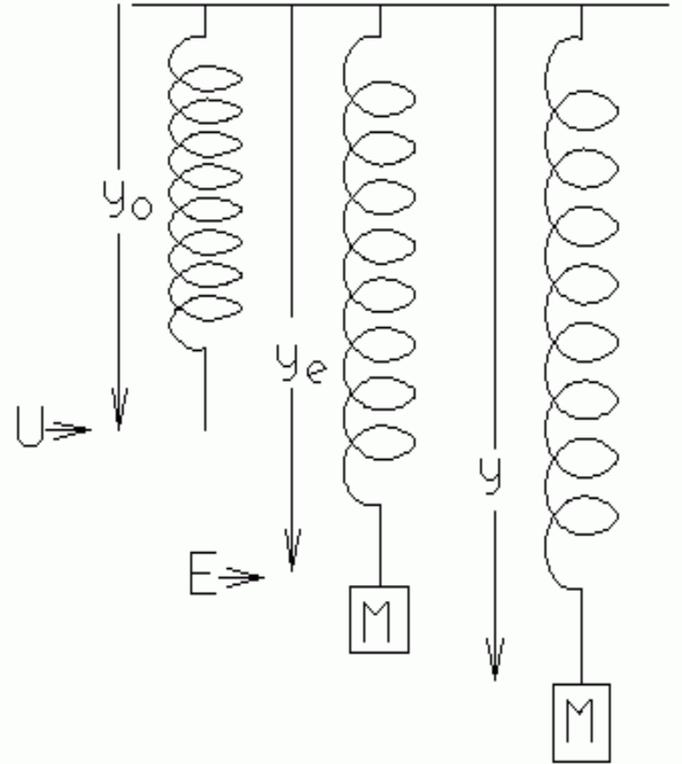
A text book description of Hooke's law

A text book description of Hooke's law

Force - Extension Graph

Elastic Limit
This is reached when the
graph line starts to curve

Extension

Stretching force

© 2005, 4physics.com
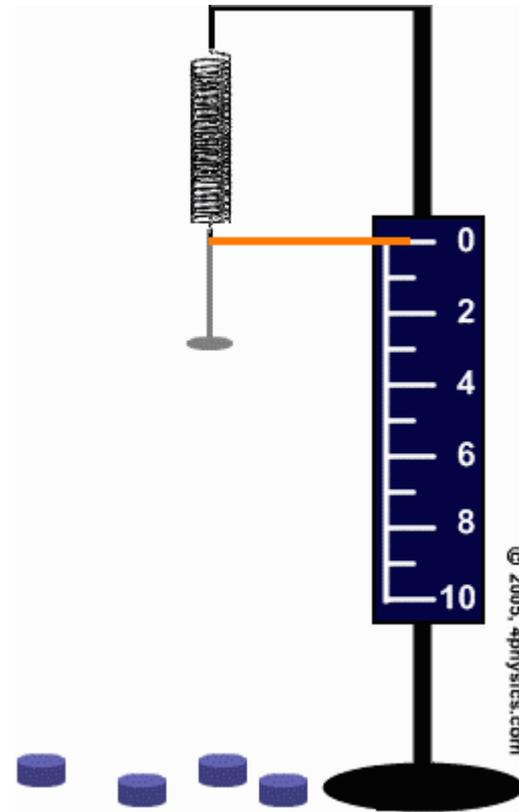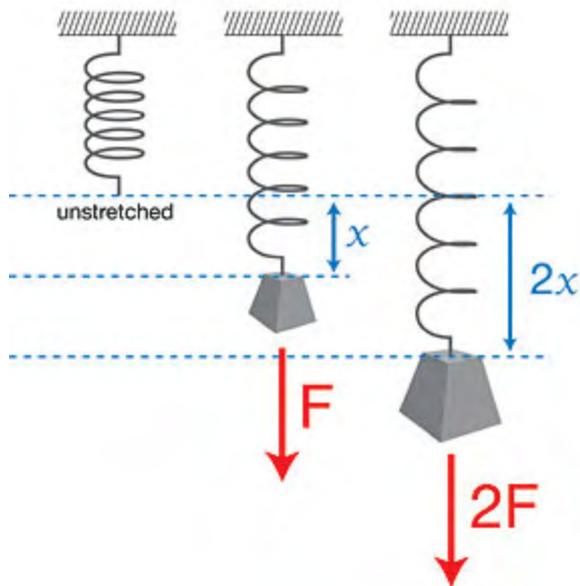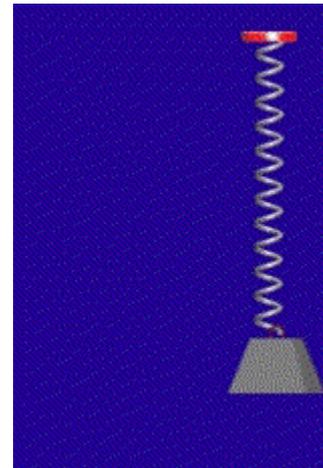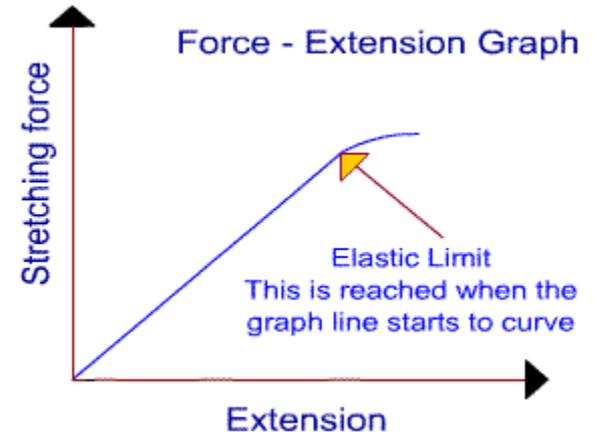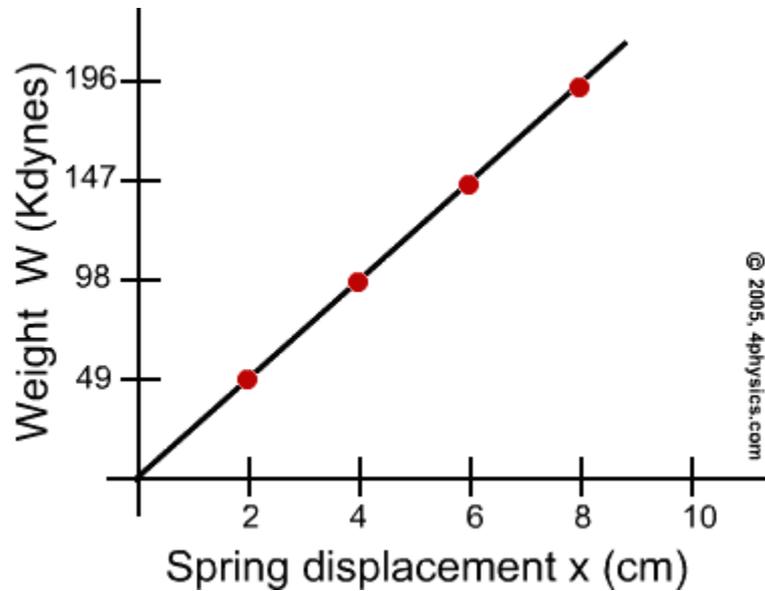
Hooke's law and the motion of a pendulum
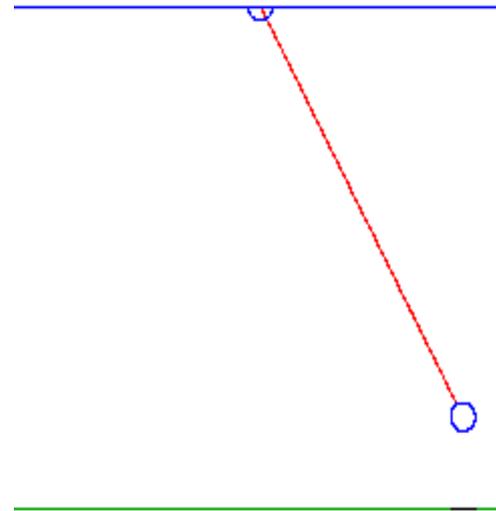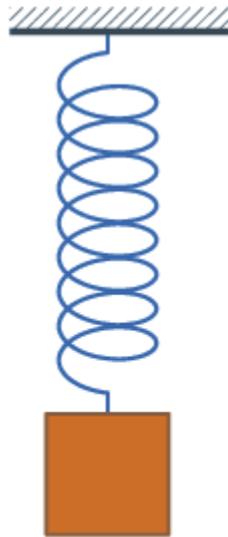
Hooke's law and SHM

Hooke's law, F = -kx is the condition required for simple harmonic motion (SHM):

The pendulum

(small displacement),

an oscillating spring,

an object falling through

a tunnel, all obey this law.

Robert Hooke's attempt to prove the motion of the earth (London, 1674).
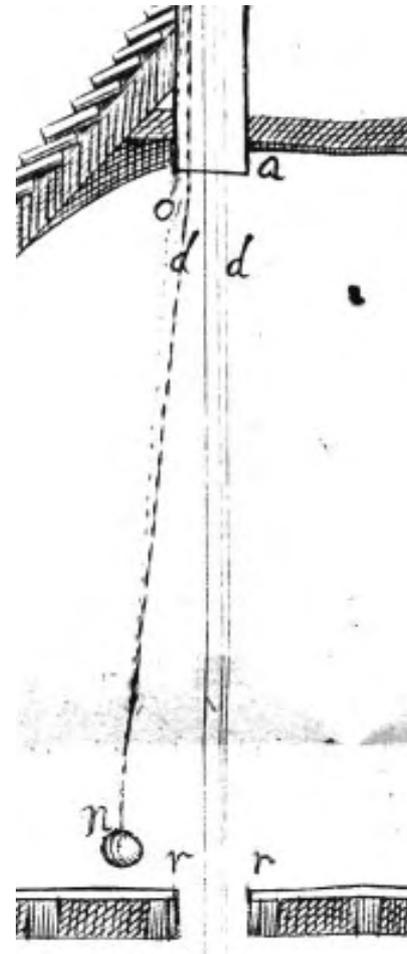
Hooke's gravity train

- Hooke's calculations showed that if the technology could be developed to bore holes through the Earth, a vehicle with sufficiently reduced friction could use such a tunnel to travel to another point anywhere on the Earth within three quarters of an hour, regardless of distance.

A thought experiment that Hooke would have enjoyed

A thought experiment:

An period of an object falling in a frictionless tunnel through the earth and returning, the period of a pendulum with a length of an earth radius, and the period of a satellite in a circular orbit (close to the surface of the earth) all would be about 86 minutes.

Hooke's law and the gravity train
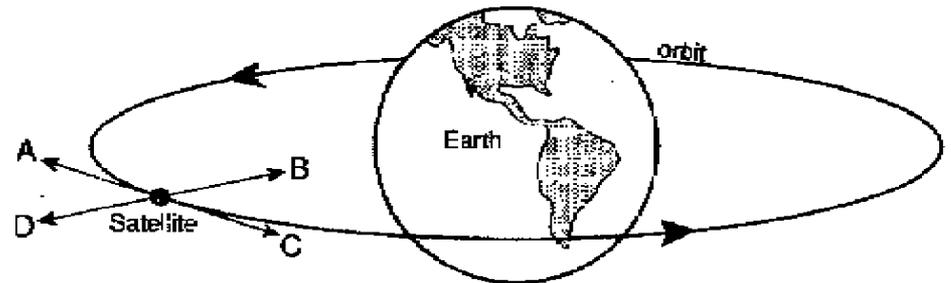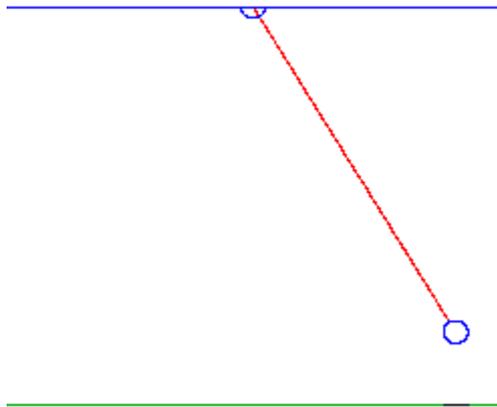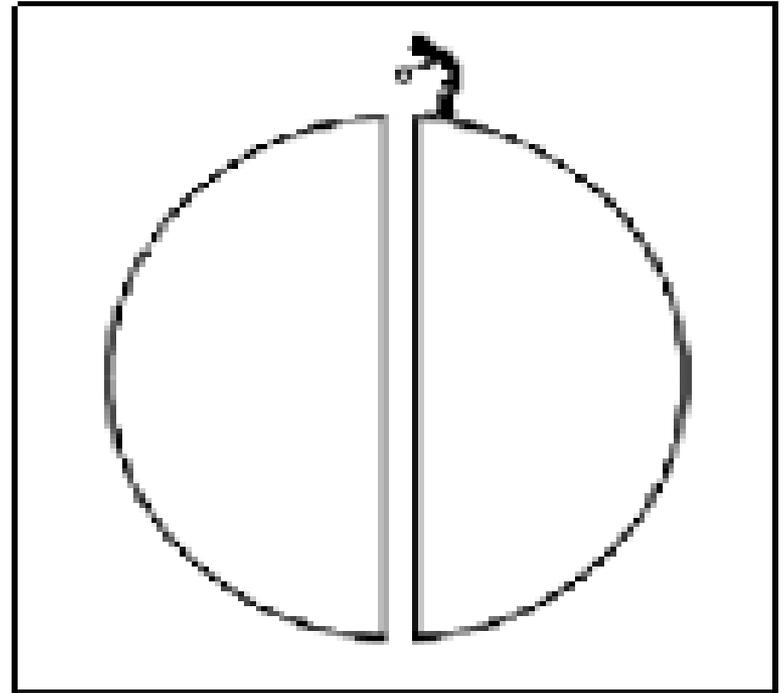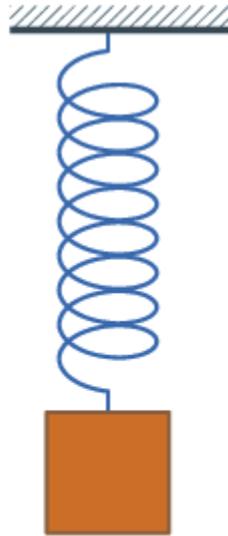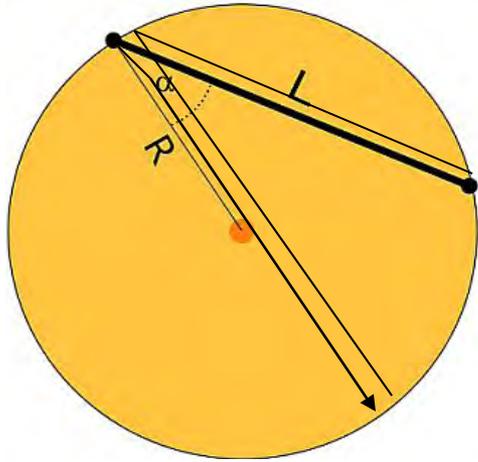
●Robert Hooke's researches over nearly 40 years covered a wide variety of Natural Philosophy.

● Hooke suggested a wave theory of light in his *Micrographia* (1665) comparing the spreading of light vibrations to that of waves in water. .

Dr Hooke, the inventor and the instrument maker

- He is credited with inventing the balance spring that allowed for the making of small, accurate timepieces.

- He also invented a reflecting microscope, the universal joint, and a variety of clocks, barometers and optical devices.

Dr. Hooke, the architect

Montague House. Designed by Hooke for private clients.

- Although not a surveyor or architect by profession, Hooke was named London's Surveyor after the Great Fire of 1666 and, with Christopher Wren, given the task of rebuilding the city.

Monument designed by Hooke to commemorate the 1666 Fire

Dr. Hooke, the architect

- He worked as an architect with Sir Christopher Wren in designing the
- Royal Greenwich Observatory,
- Bethlem Royal Hospital and the reconstruction of today's St. Pauls Cathedral
- In fact, Hooke created the method of construction of the triple dome.

Dr. Hooke, the architect

St Paul's cathedral

Royal Greenwich Observatory

Dr. Hooke, the astronomer
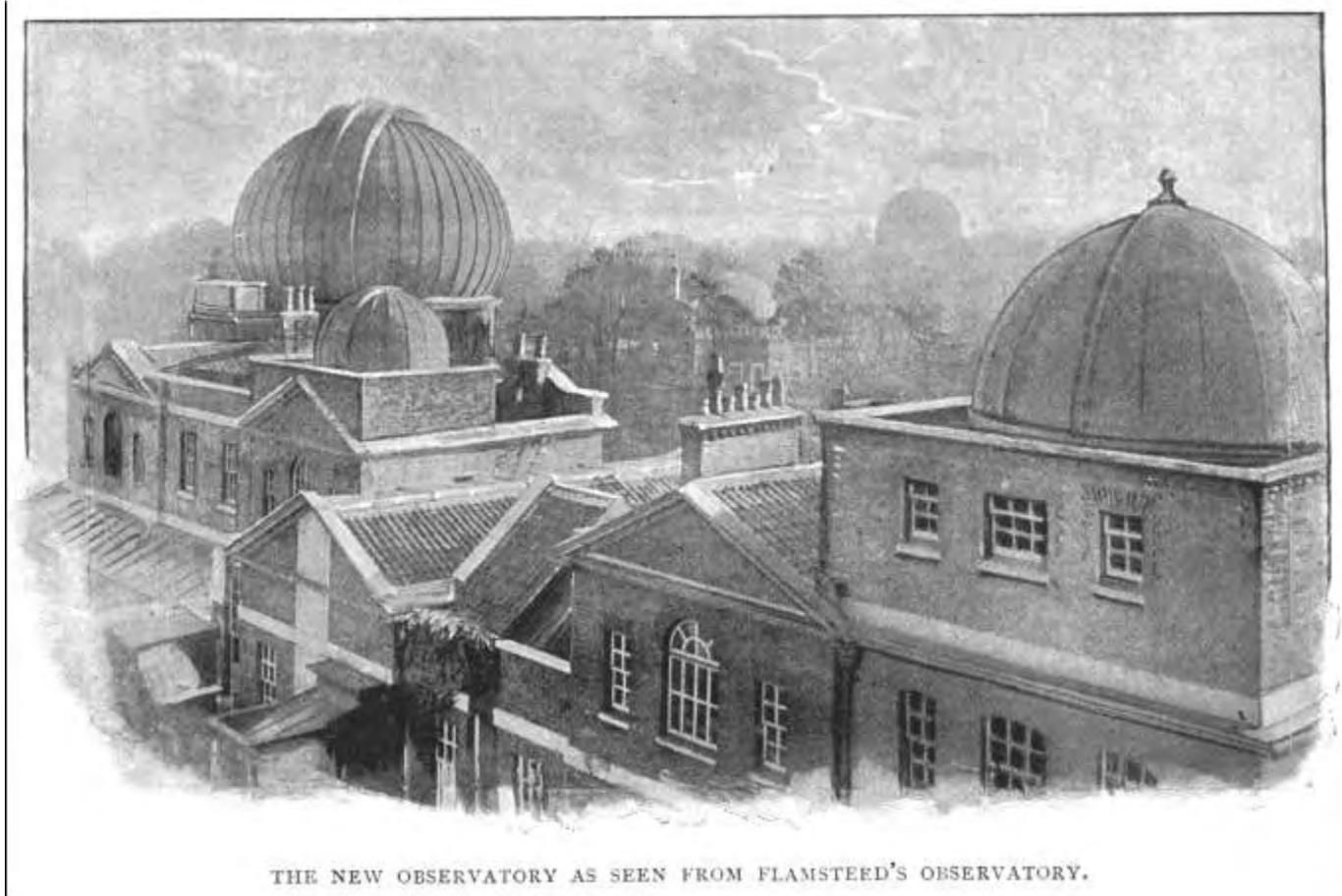
THE NEW OBSERVATORY AS SEEN FROM FLAMSTEED'S OBSERVATORY.

Dr. Hooke, the astronomer

- *The whole vast system of celestial movements, which had long seemed to men irregular and uncontrolled, now fell, every one of them, into its place, as but the necessary manifestations of one grand, simple order.*

Dr. Hooke, the astronomer

- *The whole vast system of celestial movements, which had long seemed to men irregular and uncontrolled, now fell, every one of them, into its place, as but the necessary manifestations of one grand, simple order.*
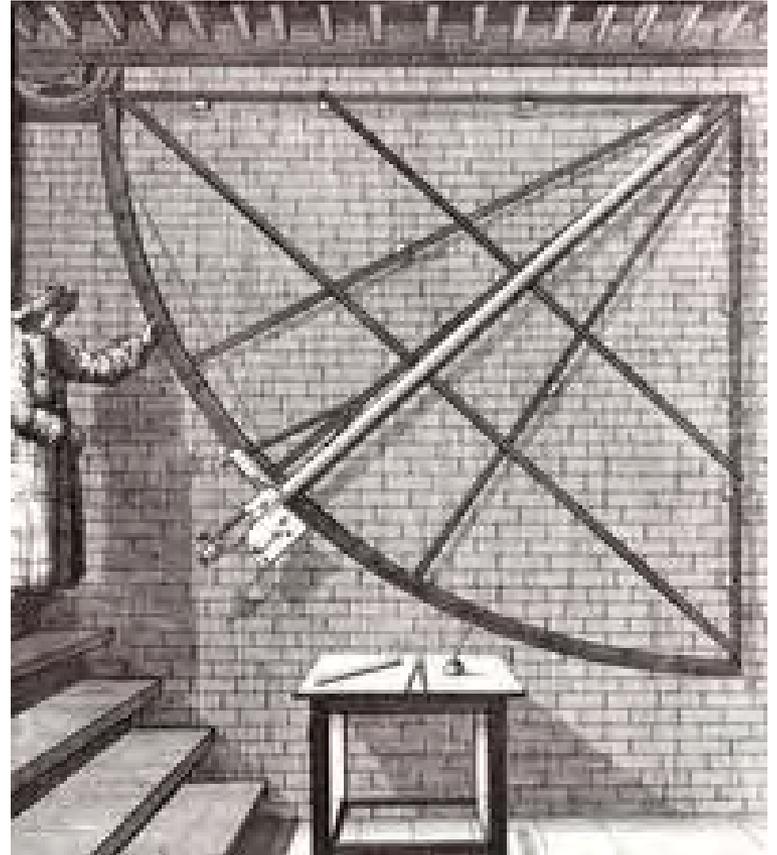
Dr. Hooke,
the astronomer

- Hooke showed that the ebb and flow of the tides was due to the attraction of both sun and moon.

High tide

Sun

Earth

Moon (new)

Moon (full)

(a) Spring tides

Low tide

Moon (third quarter)

High tide

Sun

Low tide

Earth

Moon (first quarter)

(b) Neap tides
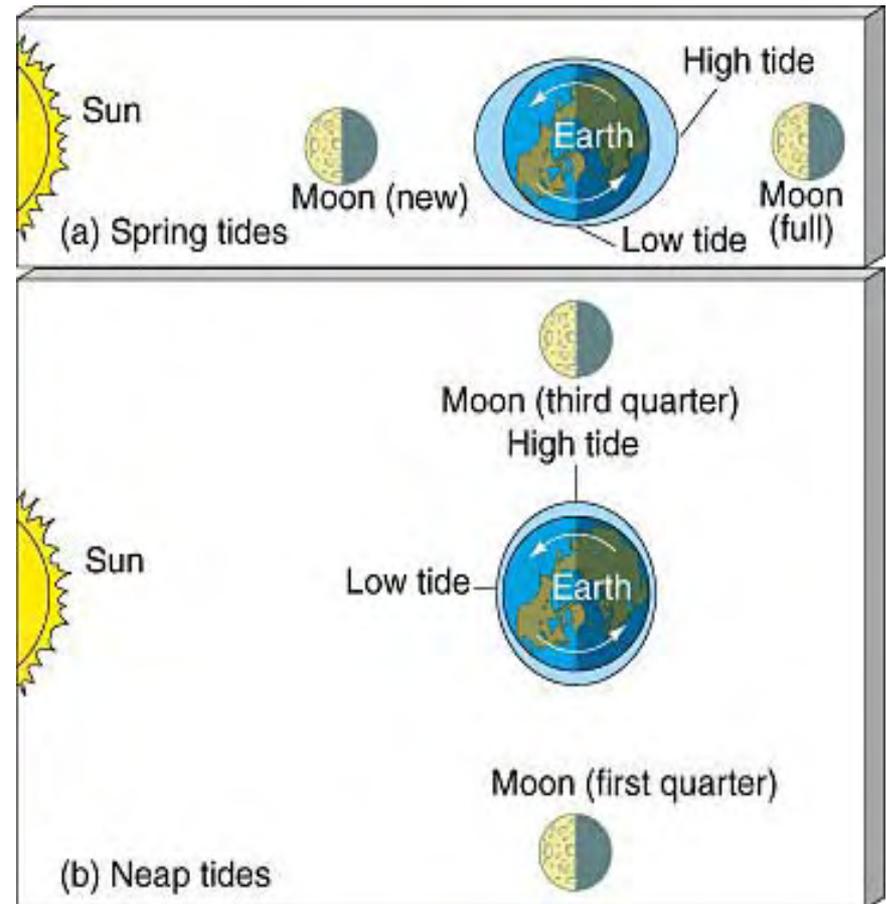
Dr. Hooke,
the astronomer

He pointed out certain irregularities which must take place in the motion of the moon, due to the influence of the sun upon it.

3 First Quarter

Waxing Gibbous 4

2 Waxing Crescent

Light from Sun

90°

5 Full

1 New

Moon's Actual Position

6 Waning Gibbous

8 Waning Crescent

7 Third Quarter

1 2 3 4 5 6 7 8

What We See
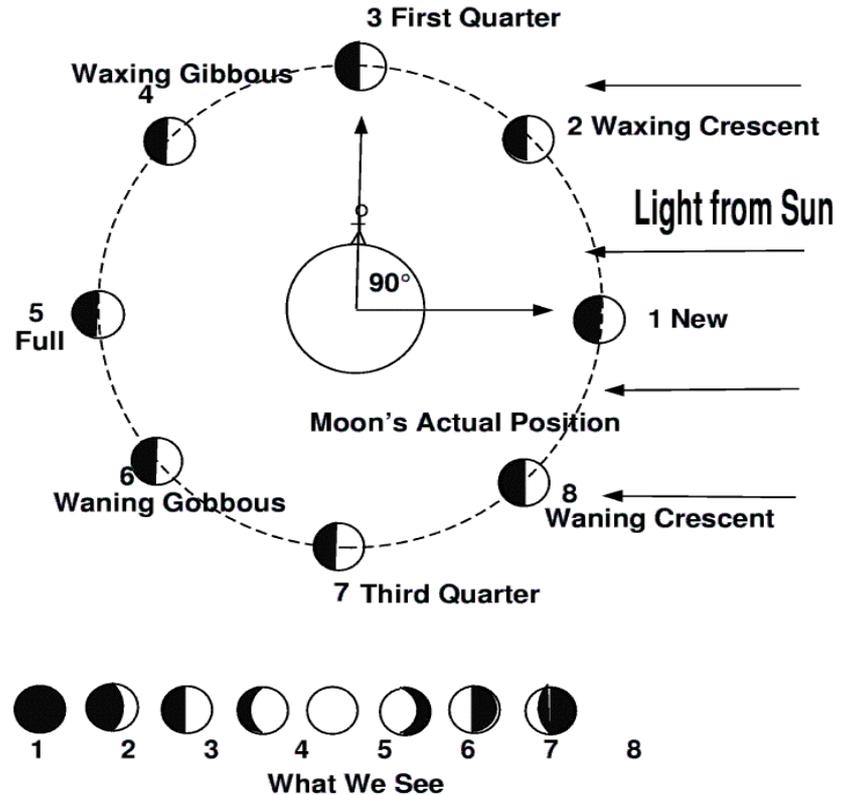
Dr. Hooke, the astronomer

- *He deduced the relative weights of the earth, the sun, and of Jupiter and Saturn, the planets with satellites.*
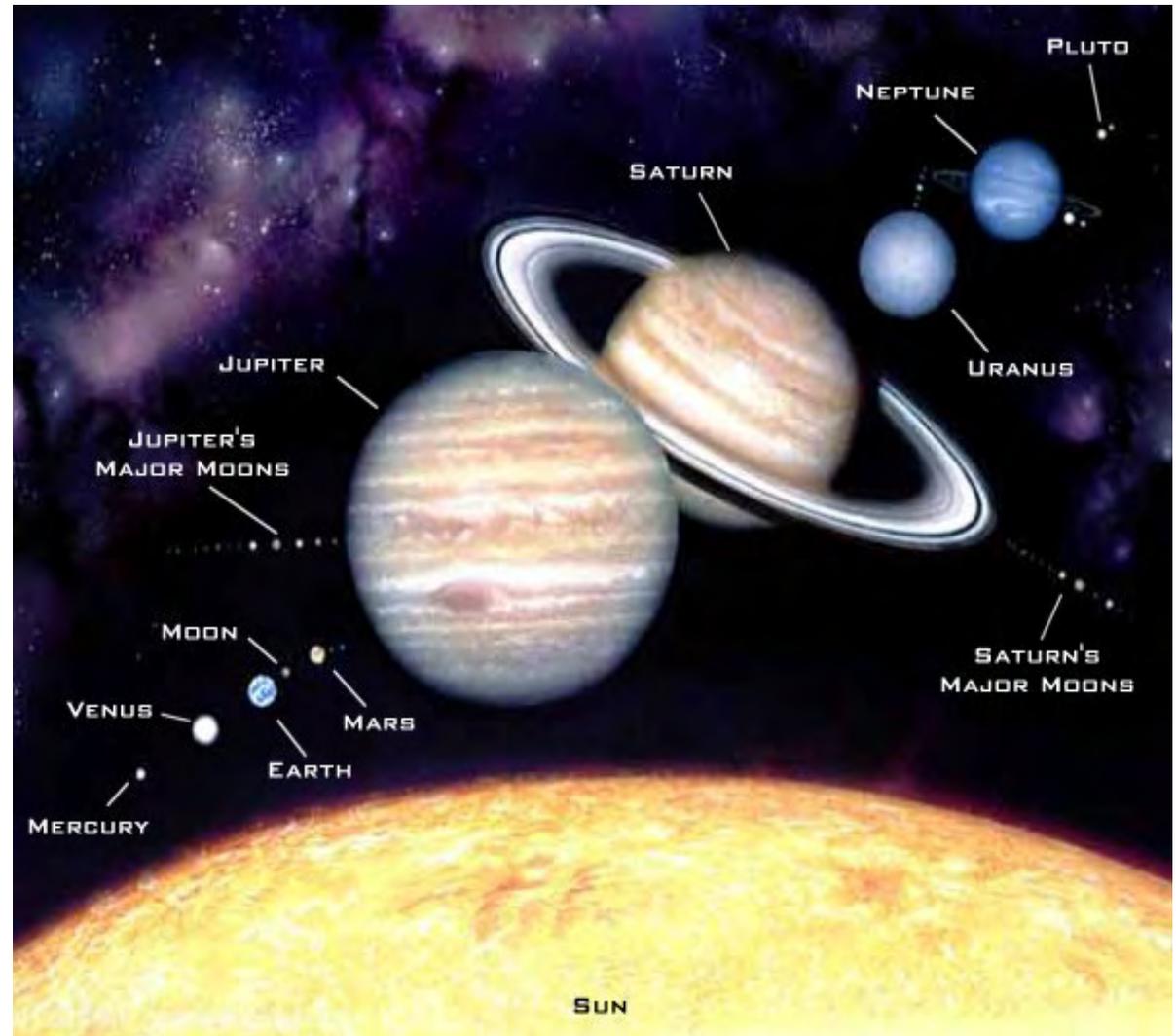
Dr. Hooke, the astronomer

- *He showed, too, what was the cause of that swinging of the axis of the earth which gives rise to precession.*

Earth's Axis of Rotation goes in a circle in space every 24,000 years
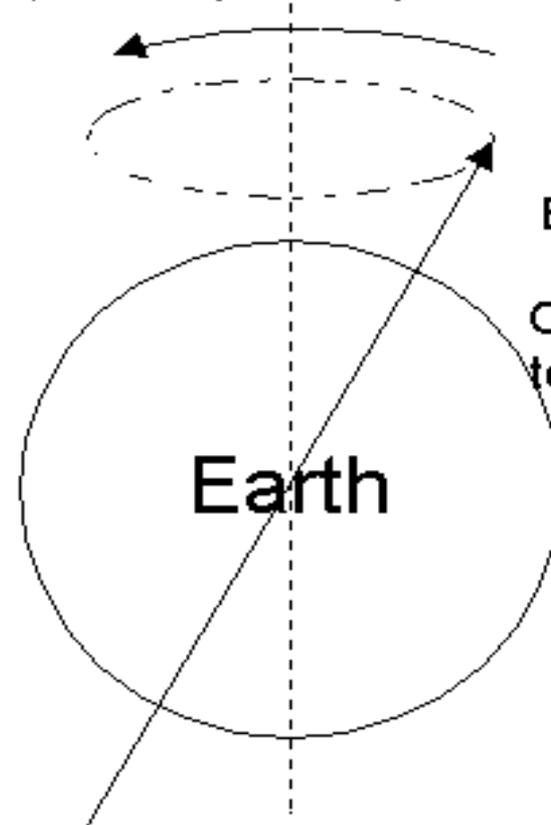
Earth's Axis of Rotation - it Currently points to the Pole Star

Earth

Dr. Hooke, the astronomer

- *He argued also that comets, which had seemed hitherto to men as perfectly lawless wanderers, obeyed in their orbits the self-same law which governed the moon and planets.*

Dr. Hooke, the astronomer

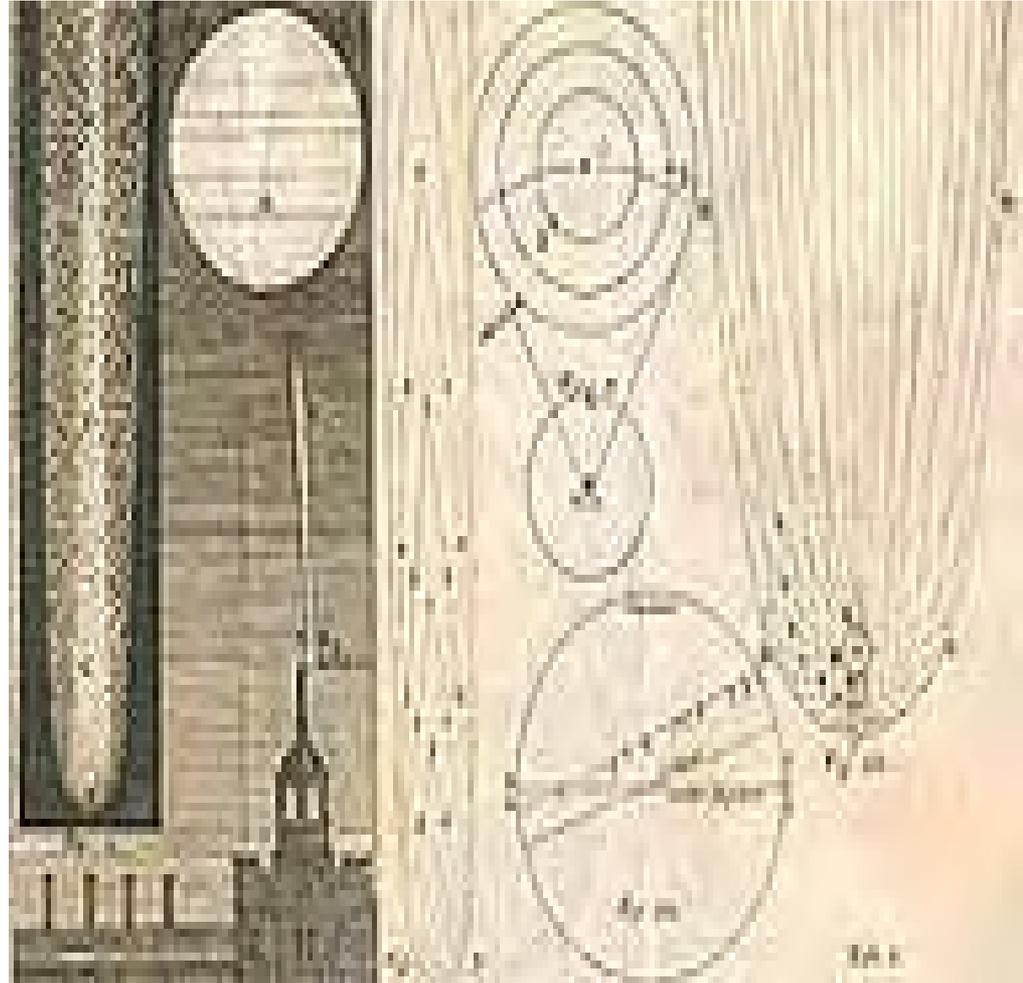- Hooke discovered in 1664 that Gamma Arietis was a binary star...
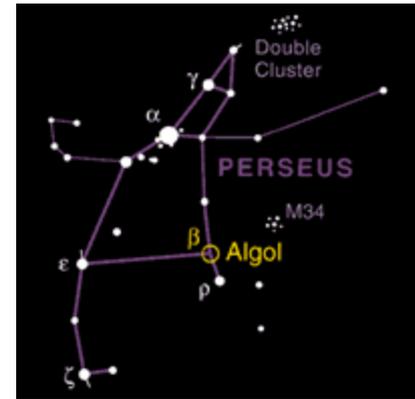
- It was in a letter to Hooke that Isaac Newton wrote his famous line:

If I have seen further it is by standing on the shoulders of giants.

Hooke, the adversary of Newton

- It was in a letter to Hooke that Isaac Newton wrote his famous line:

If I have seen further it is by standing on the shoulders of giants.

Newton's unfair treatment of Hooke

When Newton became the president of the Royal Society in 1703, he destroyed all vestiges of Robert Hooke.

Recent historical research has shown that the famous remark made by Newton

If I have seen further it is by standing on the shoulders of giants.
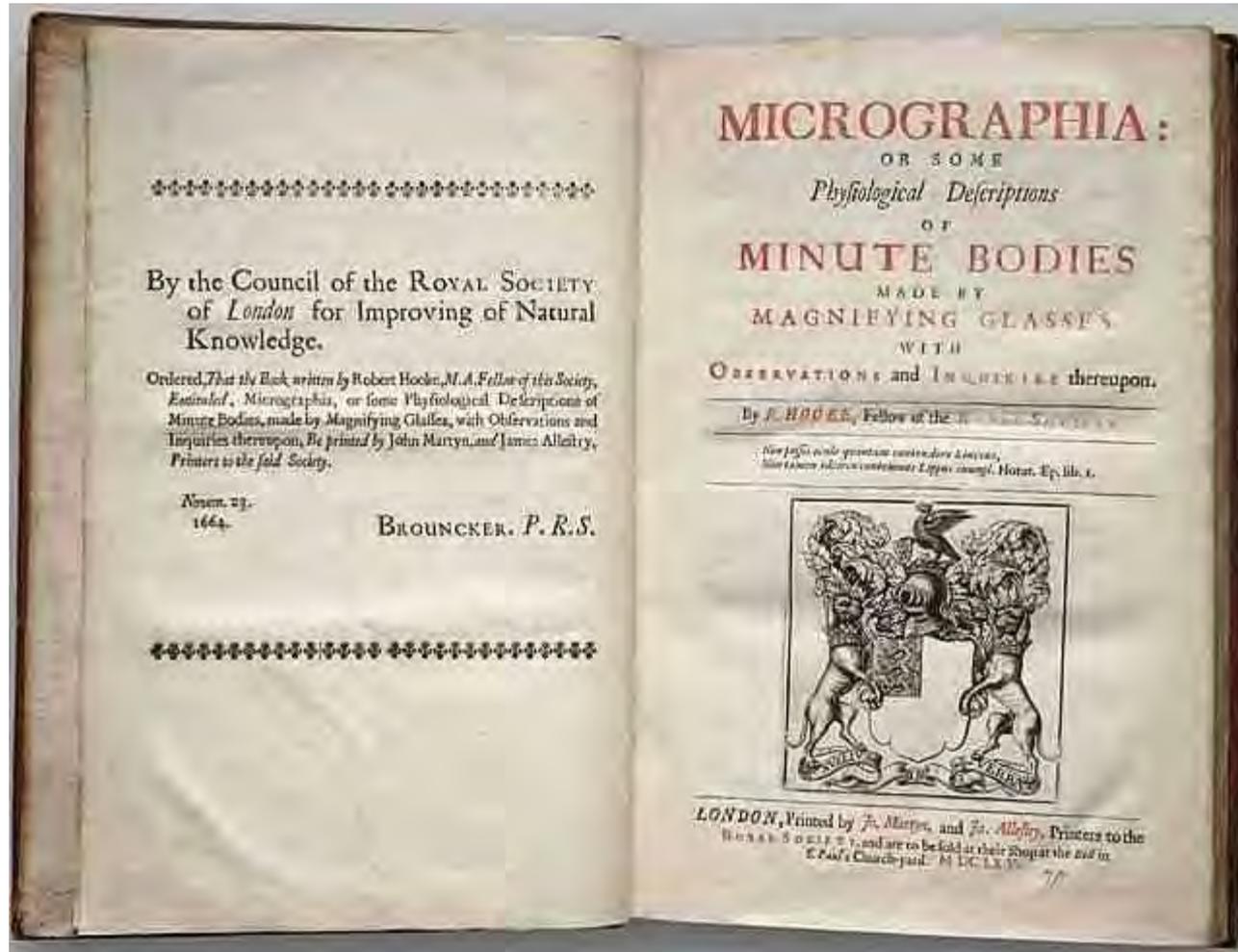
was an ironic one. In the past, it was thought that the remark showed the humility of a great thinker.

It turns out, rather, that it was an ironic remark made by an arrogant man.

Pictures

Pictures…

Websites

- http://home.clara.net/rod.beavon/leonardo.htm Excellent detailed biography by Allan Chapman

- http://galileo.rice.edu/Catalog/NewFiles/hooke.html   Excellent time line of Hooke

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