Isaac Newton
Home: England
Lived: 1643 - 1727

- as warden of the Royal Mint, disguised himself as one of ill repute - to spy on criminal activity
- elected as Justice of the Peace so he acted as judge & jury to convict coiners
- member of English Parliamant
- wrote religious texts, interpreting the Bible (dated Creation to 4000 BC)
- studying alchemy (medieval chemistry - the transformation of matter), frequently tasted his concoctions
- Master of the Mint, President of the Royal Society, knighted by Queen Anne in 1705
- His book Principia was subtitled - “how the universe works”
- whatever he did, he did with abandon

Isaac Newton - Wikiquote

Newton's birthplace and home away from the Plague, and apple tree of gravitational inspiration

The book *The Mysteries of Nature & Art* was his inspiration for many gadgets & inventions (sundials, windmills, treadmills, - hammered pegs in walls to mark the minutes of the day, solstice, equinox, etc

Clever, but school reports read "idle, inattentive". An uncle persuaded his mother to send him to university.

Initially studying law, then astrology, then math to understand the astrology. He read voraciously, Descartes, Viete, Wallis.

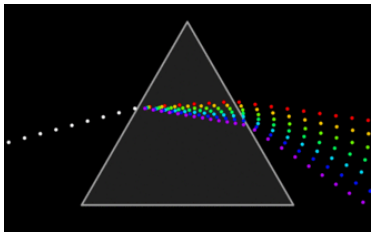
Early in Cambridge, Newton was not well known, but during the Plague Years: 1665 - 1666, he retreated to his home and was his most productive.

Here, he developed his law of gravity, laws of mechanics, differential & integral calculus, optics

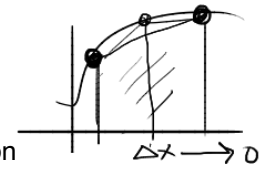
He published nothing, returned to Cambridge for his Masters, was elected a Fellow of Trinity College, eventually Lucasian Professor when Isaac Barrow resigned, then Fellow of the Royal Society in 1672.

1690: his works on the Bible (predicted the world will end in 2060, estimated size of the Ark of the Covenant) & alchemy, Mint, President of the Royal society, knighted,

some reports indicate he lost a fortune to the collapse of the South Sea Bubble, went to live with niece where he died in his sleep, likely b/c of mercury poisoning due to his experiences with alchemy, which could explain his eccentricity in his old age.



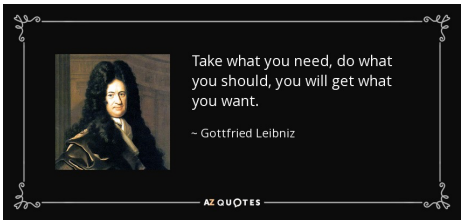
Newton was reluctant to publish, disliking criticism.
This eventually led to priority disputes.



Calculus:
- Archimedes and method of exhaustion
- John Wallis and the infinitesimal

Newton in his attic:
“glass prism splits white light into colors”

also Newton:
“if I have seen farther than most me, it is because I was standing on the shoulders of giants”



- English Newton’s fluxions - to flow, an interval flowing to 0

- But Newton used geometry in Principia (published at the request of Halley), not calculus (although he had created it, and discussed it with colleagues)
- German Leibniz’s used infinitesimals, a nonzero quantity that can get arbitrarily small. (He published his works first)

- The Royal society got involved, Leibniz eventually backed down, “I won’t argue with an idiot”.

$$\frac{dy}{dx}$$

The economist John Maynard Keynes called Newton

“the last of the magicians … the last wonderchild to whom the Magi could do sincere and appropriate homage.”

Today, we ignore Newton’s mysticism, but it’s important.

Before Newton, human understanding of Nature was entwined with the supernatural.

After Newton, we recognize that the universe runs on deep mathematical patterns.

Newton was a transitional figure with a foot in each world, leading humanity from mysticism towards rationality.

John Machin (1706)

1. Professor @ Gesham College
2. Claim to fame: quickly converging series for pi
3. Used it to get pi to 100 decimals
4. He was also a member of the commission which decided the Calculus priority dispute between Leibniz and Newton in 1712.

Machin's Formula: $\frac{\pi}{6} = 4\arctan\left(\frac{1}{5}\right) - \arctan\left(\frac{1}{239}\right)$

Start: $\arctan\left(\frac{a_1}{b_1}\right) + \arctan\left(\frac{a_2}{b_2}\right) = \arctan\left(\frac{a_1 b_2 + a_2 b_1}{b_1 b_2 - a_1 a_2}\right)$

$$\tan(A+B) = \frac{\sin(A+B)}{\cos(A+B)} = \frac{\sin A\cos B + \sin B\cos A \;\div\; \cos A\cos B}{\cos A\cos B - \sin A\sin B \;\div\; \cos A\cos B} = \frac{\tan(A)+\tan B + \tan(B)\tan A}{1 - \tan A\tan B}$$

$$2\arctan\left(\frac{1}{5}\right) = \arctan\left(\frac{1}{5}\right) + \arctan\left(\frac{1}{5}\right) = \arctan\left(\frac{5+5}{25-1}\right) = \arctan\left(\frac{10}{24}\right) = \arctan\left(\frac{5}{12}\right)$$

$$4\arctan\left(\frac{1}{5}\right) = 2\arctan\left(\frac{1}{5}\right) + 2\arctan\left(\frac{1}{5}\right) = \arctan\left(\frac{5}{12}\right) + \arctan\left(\frac{5}{12}\right)$$

$$= \arctan\left(\frac{60+60}{12\cdot 12 - 5\cdot 5}\right) = \arctan\left(\frac{120}{119}\right)$$

$$4\arctan\left(\frac{1}{5}\right) - \frac{\pi}{4} = \arctan\left(\frac{120}{119}\right) - \arctan(1)$$

$$= \arctan\left(\frac{120}{119}\right) + \arctan\left(\frac{-1}{1}\right) = \arctan\left(\frac{120-119}{119-120(-1)}\right)$$

$$= \arctan\left(\frac{1}{239}\right)$$

$$4\arctan\left(\frac{1}{5}\right) - \arctan\left(\frac{1}{239}\right) = \frac{\pi}{4}$$