Gottfried Wilhelm Leibniz (1646-1716)

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Prodigy: entered university at age 15; refused the degree of Doctor of Laws at the Univ. of Leipzig in 1666 because he was too young. Transferred to the Univ. of Altdorf and got his doctorate 5 months later.

Worked as a civil servant, diplomat, and/or librarian to the Electors of Mainz (at first) and Hanover (later on), and did research & scholarship on the side.

Wrote (not always for publication) on philosophy (→ rationalist, like Descartes & Spinoza), law, politics, theology, etc, as well as mathematics.

As a mathematician he was very versatile and did not publish all of his work.

eg He did a lot of work on formal logic, inventing a form of symbolic logic, Boolean algebra, and base 2 numbers; very little of which was published.

He also worked on linear algebra:

- Did what amounts to Gaussian elimination to systems of equations written down as matrices of coefficients.
- He also invented determinants, and used what was later called Cramer's Rule to solve systems of linear equations.

c. 1684

He also worked on series, he rediscovered Gregory's series

$$\arctan(x) = \int_0^x \frac{1}{1+t^2}\,dt = x - \frac{x^3}{3} + \frac{x^5}{5} - \frac{x^7}{7} + \cdots$$

$$= \sum_{n=0}^{\infty} \frac{(-1)^n x^{2n+1}}{2n+1}$$

(Leibniz in 1676)

(James Gregory had previously published this in a different form $\theta = \tan(\theta) - \frac{\tan^3(\theta)}{3} + \frac{\tan^5(\theta)}{5} - \cdots$ in 1668, as had Madhava of Sangamavama (c. 1340-1425) from Kerala in India.)

$x=1$ gives Leibniz formula for π: $\frac{\pi}{4} = 1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \cdots$

Mainly remembered for his work on calculus

- First mentions of differentials in his notes seem to be from 1675 or so, and used them in a letter to Newton in 1677.
- He published his version in 1684, had a somewhat different intuitive basis than Newton did (although both were aware within a few years that the methods were equivalent) Where Newton based his version on intuitions of motion & flow, Leibniz based his on infinitesimals not unlike Cavalieri's indivisibles. He also devised a very different (and more flexible) notation: $\frac{dy}{dx}$ for derivatives & $\int_a^b \_\_ dx$ for integrals is his.

At first nobody seemed to have a problem with the idea that Leibniz invented calculus independently of Newton...

The Priority Dispute

Seems to have started in 1704 when an anonymous article on Newton's work on integration implied that Newton had plagiarized Leibniz... Newton took offense... and Leibniz had an ego too.

Leibniz had visited England (in his capacity as a diplomat) in 1673 [became a fellow of the Royal Society] and again in 1676. He may very well have seen one Newton's manuscripts (or received a copy from someone across the Channel who got it from someone in England). At some point he made extracts of one of Newton's manuscripts (found in his papers in his handwriting) decades after his death. However these extracts are impossible to date...

Newton organized a committee of the Royal Society to investigate the allegations and stacked it...

Later on he wrote an anonymous review of this report, agreeing with it...

The dispute, however, was largely carried on by third parties, such as the Bernoulli brothers. This soured relations between scientific communities in England & the Continent for generations.

The modern consensus is that they both deserve the credit. Moreover, the basic ideas were percolating through the mathematical community in Europe at the time and it's likely only a matter of time before they got assembled into calculus.