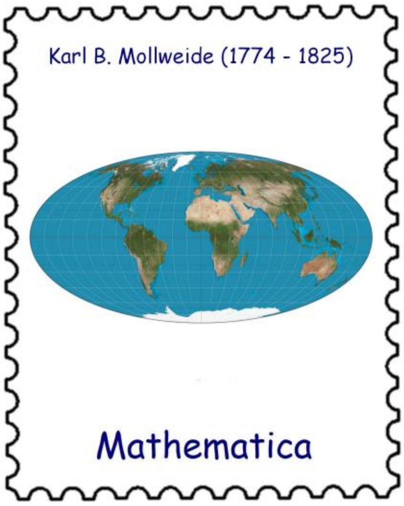
KARL B. MOLLWEIDE (February 3, 1774 – March 10, 1825)

by HEINZ KLAUS STRICK, Germany

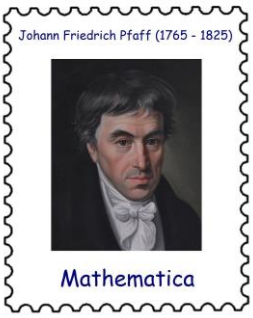


Although KARL BRANDAN MOLLWEIDE was a university lecturer for over two decades, no portrait of him exists, and most of us will never have heard his name.

If you enter the name in a search engine, you will find two terms that are firmly associated with his person:

- in *cartography*, the MOLLWEIDE projection, which is depicted in the *Mathematica* stamp, and
- in *trigonometric formulas*.

KARL BRANDAN MOLLWEIDE grew up in Wolfenbüttel, initially without showing any particular interest in mathematics, until at the age of 12 he discovered books on algebra and differential calculus at home and began to work through them. When he independently calculated the time of the next solar eclipse at the age of 14, his mathematical talent was noticed.



From 1793 onwards, he studied mathematics under JOHANN FRIEDRICH PFAFF at the University of Helmstedt, where he received his doctorate in 1796. PFAFF offered him a teaching position, which he was only able to take up for one year due to health problems.

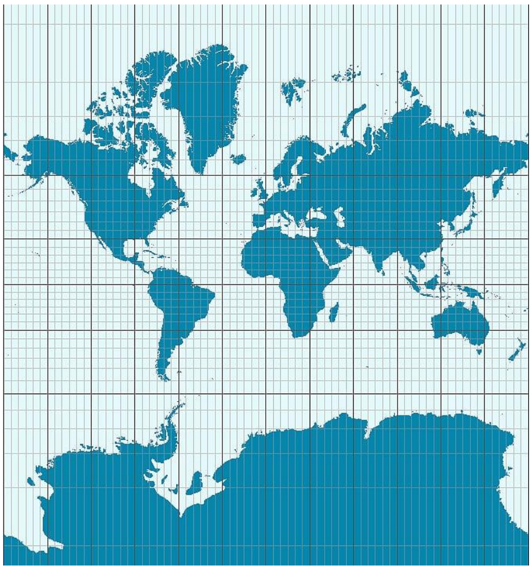
After a longer period of recuperation, MOLLWEIDE accepted a position at the *Pädagogium* in Halle and he worked as a teacher trainer for eleven years.

During this time, he was concerned, among other things, with the problem of how a world map could be appropriately designed.

As CARL FRIEDRICH GAUSS would prove in 1827, it is fundamentally impossible to produce a map of the earth that is true to length (*equidistant mapping*), true to area (*equivalent mapping*) and true to angle (*conformal mapping*).

Maps always have distortions.

The projection developed by GERARDUS MERCATOR around 1569 (and named after him) is *conformal*. The images of the meridians are vertical straight lines parallel to each other.



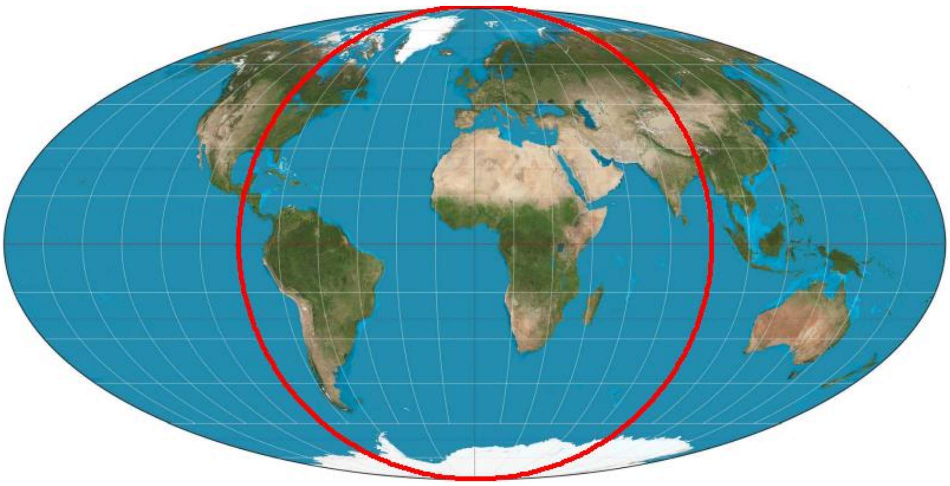
In order for shipping routes to be plotted as straight lines, the distances between the latitude circles must be continuously increased with increasing latitude.

With the MERCATOR projection, distances and area sizes become more distorted the further one moves away from the equator.

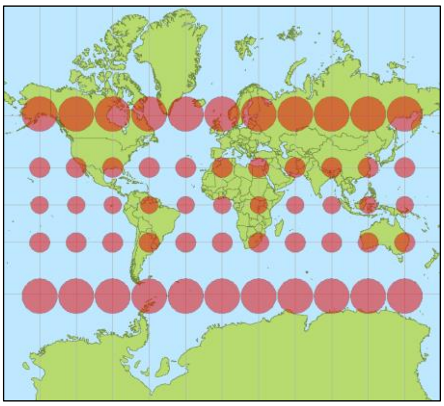
MOLLWEIDE's idea is to depict the globe as an ellipse (which does more justice to the round shape of the earth than a map in the shape of a rectangle).

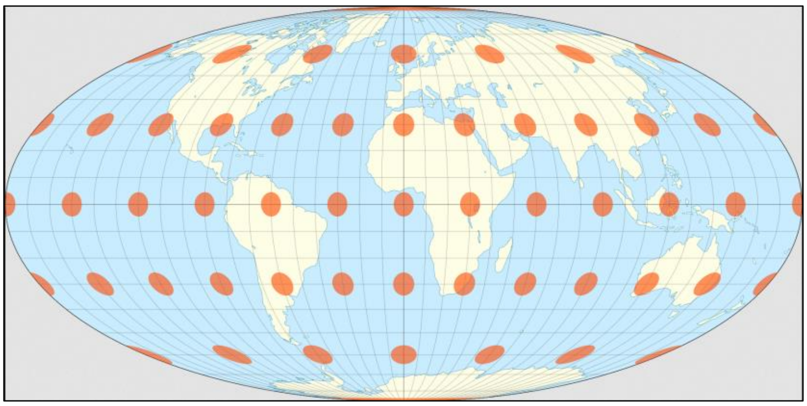
In the map according to a true-to-scale MOLLWEIDE projection, the equator and the prime meridian form the main axes of the ellipse; the axis lengths behave as 2 to 1. The 90° meridians of eastern and western longitude form a circle, the 180° meridian the outer edge of the map. The remaining meridians complement each other in pairs to form ellipses. The area $4\pi R^2$ of a MOLLWEIDE ellipse corresponds to the surface of a sphere with radius R; the following applies to the point coordinates: $-2\sqrt{2}\cdot R \le x \le 2\sqrt{2}\cdot R$ and $-2\sqrt{2}\cdot R \le y \le 2\sqrt{2}\cdot R$.

The representation of the Earth in the MOLLWEIDE projection is still used today, especially when overviews are to be made with regard to vegetation or climate.

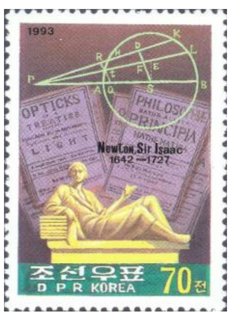


Note: The French mathematician NICOLAS AUGUSTE TISSOT (1824 – 1897) had the idea to illustrate the distortions with the help of circles. The following Wikipedia illustrations by STEFAN KÜHN and JUSTIN KUNIMUNE clearly show the differences between a MERCATOR projection (on the left) and a MOLLWEIDE projection (on the right).



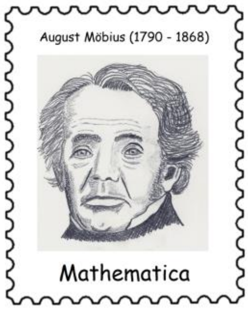


In Halle, MOLLWEIDE also wrote numerous papers in defence of NEWTON's colour system, thus proving to be one of the most determined opponents of GOETHE's theory of colour.



In 1811, he accepted a professorship in astronomy at the University of Leipzig; his responsibilities included the expansion of the observatory. However, conditions at the beginning of his tenure were extremely unfavourable: NAPOLEON's troops had just returned from Russia and encountered the troops of the allied armies of Prussia, Austria and Sweden near Leipzig.

After the so-called *Battle of the Nations*, the castle in which the observatory is housed, of all places, was needed for a long time as a military hospital and as an infirmary, so that no practical astronomical work was possible.



(drawings © Andreas Strick)

When MOLLWEIDE was offered the vacant chair of mathematics in 1814, he took it over in the hope of soon being able to relinquish the chair of astronomy.

One of MOLLWEIDE's first students was AUGUST MÖBIUS, who attended lectures by CARL FRIEDRICH GAUSS in Göttingen at the same time. After his doctorate with PFAFF, who was now working in Halle, MÖBIUS was then appointed to the astronomy chair in Leipzig, thus relieving MOLLWEIDE.

MOLLWEIDE's lectures covered the entire spectrum of subjects usually taught at the time: Arithmetic, algebra and especially geometry (trigonometry, stereometry including geographical location, analytical geometry); his students admired his ability to draw a circle on the blackboard without any aids. As a teacher he was devoted to his students, as a reviewer of scientific articles he was feared for his accuracy. He himself published numerous articles in various journals, including on topics in calculus, which he rarely offered in his lectures, however, because – as he said – this involved too much blackboard writing.

When the previous editor died, he took over the editing of the multi-volume *KLÜGEL's Mathematical Encyclopaedia*, but could not finish this work because of his early death.

Another focus of his research work was the evaluation of rather difficult-to-understand writings of antiquity; he was the editor of a new edition of EUCLID's *Elements*, being the first mathematician to use the "$\cong$" symbol for the presence of a congruence, which is still common today.

MOLLWEIDE did not marry until he was 40 years old, and his marriage remained childless. The rather sickly man, prone to hypochondria, went grey at a young age, yet died surprisingly at the age of 51 from – as it is said – a dry cough.

As already mentioned, MOLLWEIDE's name is also associated today with the following trigonometric formulas, which he published in a paper in 1808:

$$\frac{\sin\left(\frac{1}{2}(\alpha-\beta)\right)}{\cos\left(\frac{1}{2}\gamma\right)}=\frac{a-b}{c} \quad \text{and} \quad \frac{\cos\left(\frac{1}{2}(\alpha-\beta)\right)}{\sin\left(\frac{1}{2}\gamma\right)}=\frac{a+b}{c}$$

as well as corresponding formulas with cyclically reversed quantities.

Independently of MOLLWEIDE, these relationships were also discovered by JEAN-BAPTISTE DELAMBRE (1807) and generalised by GAUSS (1809) for spherical triangles; but several other mathematicians living before then had also derived these formulae (or equivalent ones), including ISAAC NEWTON and THOMAS SIMPSON.

Why these equations – less in German-language than in English-language literature – bear the name MOLLWEIDE can no longer be clarified. One possible reason could be that the better known mathematicians GAUSS and MÖBIUS quoted their contemporary MOLLWEIDE in several articles and thus the assignment of the formulas to MOLLWEIDE came about.

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https://www.spektrum.de/wissen/karl-b-mollweide-der-beliebte-kartograf/1840666

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