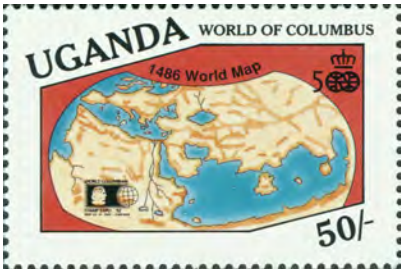
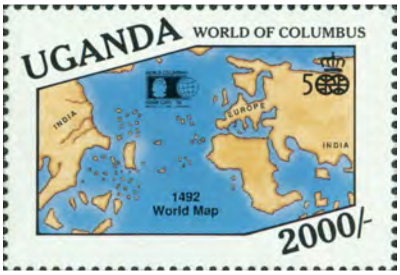
Gerardus Mercator (March 5, 1512 – December 2, 1594)

by Heinz Klaus Strick, Germany

The Belgian stamp of 1962 shows Gerardus Mercator. In his hands he holds a globe with the outlines of America and East Asia. Mercator is considered the most important *cosmographer* of the 16th century (that is: "world describer"; from the Greek *kosmos* and *graphein*). His work became the basis for the development of the science of geography and cartography.

In order to become independent of Arab, Ottoman and Venetian intermediaries, Portuguese navigators had begun to seek new routes to India. Under Henry the Navigator the coast of West Africa had been explored, and Bartolomeu Dias was the first to sail round the southern tip of Africa in 1487. After the *Reconquista*, the Spanish also appeared on the scene and on their behalf, the Genoese Christopher Columbus sailed west in 1492 to find a new sea route to India.





On the basis of Claudius Ptolemy's *Geographia* this was based on the assumption that Europe's east-west distance from Asia was too small. Around 150 AD, Ptolemy had introduced the system of terrestrial longitude and latitude, which is still used today, and had recorded the coordinates of numerous places on the known globe in a catalogue. Since then, it was assumed that only about half of the earth was "known" (Europe, Asia and Africa).
Thus the globe of the Nuremberg cloth merchant Martin Behaim from 1492 shows only the "known" part of the earth, the back of the globe is not inscribed (stamp on the left).
The world map by Martin Waldseemüller from 1507, however, already contained the newly discovered continent. The name *America* comes from Waldseemüller, because in his opinion the navigator Amerigo Vespucci had the greatest success in outlining the shape of the new continent.

The rapid development of cartography began with MARTIN WALDSEEMÜLLER's world map *Universalis Cosmographia*. In contrast to the earlier customary production of maps as hand drawings, these maps could now be printed – with an edition of about 1000 copies. (Only one has survived and it can be viewed as a world heritage document in the Library of Congress in Washington).

Rulers and trade organisations commissioned cartographers to produce new maps. When they received the ruler's licence to print, they were allowed to offer the maps at fairs, e.g. at the Frankfurt Book Fair.

The attempt of the maritime powers Portugal and Spain to keep secret the knowledge of the exact course of coastlines and passages was broken, above all in the Netherlands, which was then still under Spanish rule. With each expedition, knowledge of the earth grew, as can be seen from the following maps of Africa.

Fracanzano 1508

Waldseemüller 1513

Waldseemüller 1516

Fries 1522

Caneiro 1502

Cantino 1502

Contarini 1506

Waldseemüller 1507

Münster 1540

Gastaldi 1564

Mercator 1595

Ortelius 1570

GERARDUS MERCATOR's parents, the shoemaker HUBERT KREMER and his wife EMERENTIA lived in difficult economic circumstances in Gangelt (Duchy of Jülich). During a visit to Rupelmonde (near Antwerp), where HUBERT's brother GISBERT was a priest, GERARD was born as their seventh child. A few years later the family moved to Rupelmonde, and GERARD was able to attend a Latin school there. His uncle took care of the school education of the children, especially after their parents died.

At the age of 15, he sent GERARD to 's-Hertogenbosch to prepare for university studies with the *Brethren of the Common Life*. In 1530 GERARD enrolled at the *University of Louvain* and from then on called himself GERARDUS MERCATOR. In 1532 he completed his studies of philosophy with the title of *Magister Artium*.

During his studies, MERCATOR had already noticed contradictions between the teachings of ARISTOTLE and the statements of the Bible. However, to say this publicly would have been heresy.

Thus he sought another basis for a future professional activity. In 1534 he began to study mathematics in Leuven with GEMMA FRISIUS (whose real name was REGNIER GEMMA), the professor of medicine, mathematics and astronomy. He was famous for his astronomical instruments, which he built with great skill, and for his 1530 book *De principiis astronomiae et cosmographiae*.

In this description of the world, he was the first to indicate how a clock could be used to determine the longitude of any place on earth:

> *Provided that this clock always indicates the correct time at a place of comparison, regardless of external influences such as atmospheric pressure, humidity and vibrations, then the geographical longitude of the place can be calculated from the difference between the indicated time and true local time.*

However, this idea was not put into practice until 1759, when the English watchmaker JOHN HARRISON built a watch that deviated by only 5 seconds on an 81-day sea voyage.

GEMMA FRISIUS was also ahead of his time with his idea of creating a network of surveying triangles (triangulation). This was only systematically implemented by WILLEBRORD VAN ROIJEN SNELL (SNELLIUS) from 1615 onwards.

MERCATOR successfully completed his studies of mathematics, so that he was soon able to take over teaching himself. He also worked in the workshop of GEMMA FRISIUS, was involved in the production of a globe ordered by Emperor CHARLES V, and learned the craft of the engraver, since his main task was to make printing plates for the carefully inscribed maps.

The large number of orders provided MERCATOR with a secure income so that he was able to marry. His happy marriage to BARBARA SCHELLEKENS produced six children.

From 1537 onwards, MERCATOR independently published maps, first of the Holy Land, then a world map and a very detailed map of Flanders, which for the first time realistically represented the distances and sizes of the country and its cities. MERCATOR succeeded in this because he carefully compared all the sources at his disposal and checked whether the information was plausible and consistent.

The great care he took, his craftsmanship in the production of the printing plates and, last but not least, his ability to provide the maps with a wealth of information in crisp, clean italics made MERCATOR famous beyond the borders of Flanders.

He was in correspondence with many personalities – including those from Protestant countries. Whether because of this or because of his numerous travels, suspicions of espionage arose. When MERCATOR visited Rupelmonde again in 1544, he was accused of Lutheranism and imprisoned in the castle. It could not be proved that he had committed heretical acts, but he was released from prison after seven months, only after the intervention of influential personalities. In the meantime, his family was impoverished, as during this time there was no income. His relatives even had to pay for the costs of his imprisonment.

The experiences of his time in prison certainly played a role when he accepted an offer from Duke WILLIAM THE RICH (Duchy of Jülich-Kleve-Berg) in 1552 and moved to Duisburg. There, supported by his sons, he was able to carry out his work undisturbed as the *Ducal Court Cosmograph*. The prospect of a chair for cosmography at a planned university in Duisburg also contributed to his decision. However, the foundation of the university did not come about, as the Emperor's promised approval never arrived.

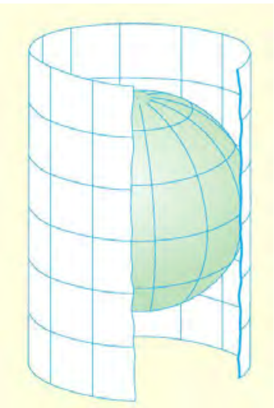
In the course of the years, important maps were published: a map of Europe (1554, size: 159 cm × 132 cm) consisting of 15 sheets, in which, for the first time, the position and size of the countries of Europe were adequately represented; a map of Lorraine, of the British Isles, and then, in 1569, probably his most famous map: a world map in the format 132 cm × 208 cm with a new type of graded grid design – the MERCATOR projection, which was soon generally referred to as such.

In 1537, the Portuguese mathematician and astronomer PEDRO NUNES had published a treatise on the usefulness of nautical charts on which the circles of longitude and latitude are plotted as a rectangular coordinate system, as this could simplify the navigation of ships.

The shortest sea route between two ports runs along a great circle (a circle on a spherical surface with a maximum circumference comparable to the equatorial line), but for such a route the direction of travel must be constantly adjusted, because the angle changes constantly in relation to the direction of the magnetic north pole. In contrast, the route with a fixed navigation course results in a line that runs "spirally" around the earth and asymptotically heads for the north or south pole of the earth. MERCATOR had already drawn such *loxodromes* (Greek *loxos* = oblique, *dromos* = run) on a globe in 1541.

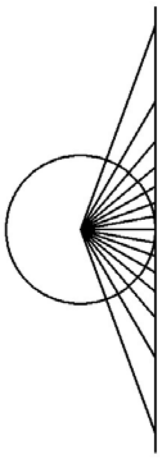
But now MERCATOR succeeded in doing what NUNES had tried in vain, namely to produce a map on which the routes with a fixed course could be drawn as straight lines.

For centuries, mathematicians had tried in vain to solve the problem of how points lying on the curved surface of a sphere could be mapped onto a non-curved plane in such a way that both distances between points and directions could be read on the map and, if possible, the area relationships should also be preserved. CARL FRIEDRICH GAUSS found an answer in 1827: From his *theorema egregium* (literally: important theorem) it follows that it is *impossible* to produce a map of the earth which is true to length (equidistant), true to area (equivalent) and true to angle (conformal). Maps always have distortions – you have to decide which property is important for your purpose.

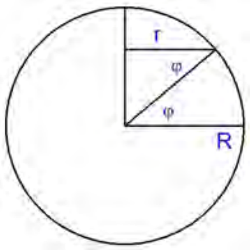


(source: Klett-Perthes)

In a cylindrical projection, a cylinder is placed at the equator around the earth (assumed to be spherical); the points of the spherical surface are projected (from the centre of the sphere) onto the surface of the cylinder. The images of the longitudinal circles are vertical lines parallel to each other, while those of the parallels are vertical. However, the distances between the latitude "circles" become larger and larger with increasing geographical latitude: the *y*-coordinate of a pixel with the geographical latitude φ is given by $y = R \cdot \tan(\varphi)$ with $R \approx 6370$ km (the earth's radius). Points near the pole are shown "at infinity", i.e. they are not shown at all.



However, a world map produced in this way does not preserve angle. The radii r_φ of the parallels of latitude become smaller with increasing geographical latitude; the following applies: $r_\varphi = R \cdot \cos(\varphi)$. While at the equator the distance between two adjacent meridians of longitude is still 60 nautical miles = $\frac{2\pi \cdot R}{360} \approx 111$ km, in Mainz for example ($\varphi = 50°$) it is only about 71 km.



In cylindrical projection, the strips between two adjacent meridians of longitude which converge at the poles are continuously stretched by a factor of $\frac{1}{\cos(\varphi)}$ so that the meridians become parallel straight lines. In order to maintain angular sizes, the distance between adjacent width circles must also be continuously stretched with this factor. Mercator – in the 16th century – did not have the prerequisites to describe such a continuous mapping mathematically so he broke down the necessary continuous process into many small steps and thus arrived at the world map on which the routes with a fixed course course could be drawn as a straight line. Only two centuries later was it possible to describe the y-coordinate of a point on a Mercator map by a formula: $y=\int_0^{\varphi}\frac{1}{\cos(x)}\,dx=\ln\left(\tan\left(\frac{\varphi}{2}+\frac{\pi}{4}\right)\right)$

(source: Wikipedia)

On one of his journeys Mercator met Abraham Ortelius (actually: Ortels) from Augsburg, who traded in maps, and encouraged him to produce maps himself. In 1570 his collection *Theatris Orbis Terrarum* (Theatre of the World) was published. It was not as carefully drawn as Mercator's, but it was more up-to-date: if you waited too long in those days for information from new expeditions, you could easily lose your market. The maps of Ortelius sold much better than those of Mercator, but this did not affect the friendship between the two.

From the very beginning of his work as a cartographer, Mercator wanted to publish the data from Ptolemy's *Geographia* – too many authors had edited or mistyped the original data since antiquity. In 1578 he published 28 maps according to Ptolemy's data which then, in 1585 together with 51 new maps of France, Germany and the Netherlands, formed an *atlas* (this term, which he used, has been common since then). In 1589 further maps of Southern and South-Eastern Europe followed (his map of Cyprus is printed on the right).

Increasingly, he also dealt with theological questions, studied the views of the Reformer Calvin and wrote the *Chronologia ab initio mundi* (World History since the Creation of the World).

A stroke in 1590 prevented him from continuing to work on maps and he could no longer achieve his goal of publishing the *Tabulae Geographicae* (An atlas with maps of all the countries of the world). Although he recovered temporarily, he died at the age of 82 after another stroke.
His sons finished his work on 34 more maps; and in 1595 they published the world atlas planned by their father.

The Romanian stamp from 2004 shows Mercator and the Dutch cartographer Jodocus Hondius, who bought the atlas printing plates in 1604 and offered them for sale together with his own maps, and posthumously published Mercator maps of South America and Africa.

The Belgian stamp from 2012 also reminds of this contract.


NOVA TOTIVS TERRARVM ORBIS GEOGRAPHICA AC HYDROGRAPHICA TABVLA Auct: Henr: Hondio
CARTOGRAFIE
3
BELGIË BELGIQUE
MERCATOR (1512-1594)
BELGIQUE BELGIË
3
HONDIUS (1563-1612)
CARTOGRAPHIE


Abraham Ortelius (1527–1598), Theatre, oft toonneel des aerdt-bodems: waer inne te siene sijn die landt-tafelen der geheelder weerelt: met een corte verclaringe der selver, 1571 (1570)
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Nederland 2020
INTERNATIONAAL
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1
Gerard de Jode (1509–1591), Speculum orbis terrarum, 1578
Gerard Mercator (1512–1594), Gli XVII provincie de gli Paesi Bassi, come Fiandra, Brabantia, Hollanda & Zelanda etc. con gli termini de gli paesi vicini, 1585
1
Nederland 2020
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INTERNATIONAAL
Nederland 2020
1
Jodocus Hondius (1563–1612), Gerardi Mercatoris Atlas sive cosmographicae meditationes de fabrica mundi et fabricati figura, 1619 (1606)
Willem Jansz. Blaeu (1571–1638), Atlas major, sive Cosmographia Blaviana, qua solum, salum, coelum, accuratissime describuntur, 1662 (1630)
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Nederland 2020
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Johannes Janssonius (1588–1664), Ioannis Ianssonii Atlas contractus, sive Atlantis majoris compendium, 1666 (1638)

The following maps of the world are designed as a Mercator projection, as equal area projections which was invented by Samuel Wittemore Boggs and a projection type invented by Johannes Stabius about 1500 (equal area & equidistant).

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https://www.spektrum.de/wissen/gerardus-mercator-1512-1594/1065130

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