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Lowlands Sixteenth Century Cartography: Mercator's Birth Pentecentennial

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Abstract

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The 500th anniversary of Mercator's birth ought to be celebrated as a milestone in the history of cartography and navigation. Not because he is one of the mapmakers of the 16th century, but because he contributed perhaps most significantly to the progress of navigation. Although he was born in a small Flandrian town, his name remains associated with Antwerp. His studies at the famed university of Louvain (Leuven-Lovanium) were financed by a clerical relative, and his work was buttressed by that of Ortelius, his associate. The Mercator projection proved to be a priceless gift to ship captains. Earlier in the same century a painter of renown, Peter Pourbus, in the service of the Sire of Moerbeke and of Holy Roman Emperor Charles V, engaged in mapmaking using an approach worthy of modern cartographers. In the northern Lowlands, mapmaking had already made great steps forward in earlier times.

ADDITIONAL INDEX WORDS: *XVII Provinces, Rupelmonde, UNESCO, Zwin, Dutch cartography.*



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INTRODUCTION

The 16th century is among the Renaissance's most productive periods of mapmaking, with the Netherlands occupying a predominant position, at least in Western Europe (Ristow, 1962). Maps were also a topic of major concern in England, where they were widely used by ship captains. Three southern Netherlands individuals contributed to the development of methodology, cartography *sensu largo*, navigation, oceanography, and even geophysics. Two of them, Mercator and Ortelius, appear on the logo of the geographical society founded in the 19th century, the *Société Royale de Géographie d'Anvers*, named after the city where they found their vocation and reached their fame.^{1,2} The third one, Peter Pourbus, worked mainly in Bruges, where he had moved from Gouda, in the then recently independent northern Lowlands (United Provinces).³ The period is also a milestone for coastal cartography, since apparently some maps of that century show for the first time

bathymetrics—depth lines—along coasts and in inlets (the first mapmaker to do so was apparently Pourbus), and an ocean dedicated map (Pacific) was placed on the market (drawn by Ortelius).

ON THE MAP

At one time Rupelmonde, a small city and port on the confluence of the Rupel and Scheldt rivers⁴ (Figure 1), held a nonnegligible role in the Land of Waes (now Waas), an area in the county of Flanders but dependent on the sovereignty of the Holy Roman Emperor (this dependency was shown on its coat of arms by an eagle). Rupelmonde had a castle (also on the coat of arms) that served as a residence of the count, a court of justice, and a prison. The small harbour was subject to sedimentation, and a small basin was dug close by to remedy this handicap. In the 16th century it became the retaining basin for a tide mill (known for many centuries after its construction as the Spanish Mill because tide mills were known to be quite common in Spain in the 16th century). This is the only such mill still in existence in the Flemish region of Belgium, and not only has it been restored, it is in working order. It now accommodates five bed and breakfast rooms (Figure 2a–c). The heirs to the throne of Belgium⁵ made an official visit to Rupelmonde on the

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¹ The *Société Royale de Géographie d'Anvers* was founded around 1872.

² Though he is often associated with Antwerp, Mercator lived and worked for most of his life and made his considerable fortune while a citizen of Duisburg. A *cremer*, in modern Flemish *een kramer*, is a marketplace (ambulatory) salesman, in Latin a *mercator*. See also the related article by Asbroek (1946).

³ Today a city in the Kingdom of the Netherlands. Old spelling: 's-Hertogenbosch and on French language maps Bois le Comte.

⁴ Rupelmonde, in Flemish and Dutch, means "mouth of the Rupel River." Scheldt is Schelde in Flemish, Escaut in French, and Scaldis in Latin.

⁵ After the abdication of King Albert II, the heirs acceded to the throne and became King Philip I and Queen Mathilde on July 21st 2013.



Figure 1. Location map (Antwerp, Rupelmonde, Zwin).

occasion of the pentecentennial anniversary of the birth of one of world’s most celebrated cartographers. Gerhard De Cremer, alias Gerardus Mercator, was born in Rupelmonde in 1512 (Figure 3). The town might be small, but its several claims to fame placed it on the map.

PETER POURBUS

The contributions of the artists who were born and/or worked in the XVII Provinces to cartography have been perhaps somewhat neglected. A rather recent UN Educational, Scientific, and Cultural Organization (UNESCO) publication (*700 Years of Dutch Cartography*, 2005) has, to some extent, remedied the situation (Figures 4–6). Yet the designation Dutch (or Netherlandish) is misleading, since mapmaking has been an endeavour of Flemings as well (Asbroeck, 1946; Charlier, 2010; Crane, 2002), with such figures *de proue* as Geeraert De Cremer (or De Kremer), more commonly known as Gerardus Mercator (1512–1594; Figure 3) and Abraham Ortel or Oertel (or Ortelius; 1527–1598; Figure 7; Hessels, 1887; Wauwermans, 1895, 1901), genitors of the *Theatrum Orbis Terrarum* (published in Antwerp in 1570 by Gilles Coppens of Diest; Asbroeck, 1946). With Bruges, once one of the wealthiest cities and harbour of the



Figure 3. Portrait of Gerardus Mercator. Public Domain document. Copyright Creative Commons Attributive Share Alike 2.5 Generic License <http://creativecommons.org/licenses/by-sa/2.7>.



Figure 2. (a) So-called Spanish mill, dating from the 16th century, only remaining tide mill in Flanders (Rupelmonde, Province of East Flanders, Belgium). (b) Retention basin of the tide mill (restored) (c) New 6 m diameter tide mill wheel. Photographs owned by and reproduced courtesy of Official Tourism Office of the city of Rupelmonde-Bazel-Kruibeke.



Figure 4. 16th century map. Copyright Creative Commons Attributive Share Alike 2.5 Generic License <http://creativecommons.org/licenses/by-sa/2.7>.

Western world, and Antwerp, once the largest city in the entire world, the outlets for geographical products were numerous. Both cities were at one time or another centres of mapmaking.

It is less common to find a painter of talent who headed a dynasty of famed painters.⁶ Pierre (or Pieter) Pourbus⁷ was born in Gouda (northern Lowlands)—now in the Netherlands—but worked mostly in the southern Lowlands (Bruges; Pourbus and De Smet, 1947). His date of birth has been reported variously as 1501, 1510, and 1523; he died in 1584. Emperor Charles retained Pourbus for mapmaking in the Zwin area. He was a portraitist of high reputation. But he spent no less than 30 years in cartographic activities, making maps with what may be labelled *minutiae*, using modern methods. He worked, among others, especially for the Sire of Moerkerke de Watervliet (a town near Damme, one of the foreports of Bruges), who was involved in legal disputes with the Free of Bruges (in French, *le Franc de Bruges*; in Flemish, *het Vrije van Brugge*) about matters of land ownership and property boundaries. This nobleman had also been at the origin of an exodus of impoverished Flemings to the Azores, which was

designated for a long period of time thereafter as the Flemish Islands,^{8,9} and some of which still show traces of the Netherlandish culture.

Pourbus collected information from surveyors, pilots, and fishermen; climbed church and belfry towers to have the best vantage positions for his measurements; and crossed by boat the Zwin Inlet to reach Cadzand Island. He had been retained by Emperor Charles V (1500–1578) to survey and map the Zwin Region; Charles wanted to assess the likelihood of enemy ships sailing up the Zwin inlet to threaten Bruges. Thus Pourbus provides on his maps information on the depth of the coastal sea and of the Zwin on his mostly 1:12,000 scaled maps. Though the original maps have long disappeared, excellent reproductions exist that provide detailed information on the 16th century Zwin region (Figure 8).

GERHARDUS MERCATOR

If Pourbus influenced the history of painting and of mapping, Mercator did so in cartography, sailing, and even future air

⁶ Frans Le jeune, Frans II le jeune.

⁷ There are at least six different spellings of his family name, depending on the language used.

⁸ Cf. Mining the sea for energy (Charlier, in press).

⁹ Moerkerke was a *seigneurie* (lordship) of the County of Flanders whose ruler was the sister of the King of Portugal. Her request to her brother to devolve the islands to her was acquiesced upon by the king, and the population transfer proceeded. The de Watervliet family has descendants to this day. The lead author of the present paper was a coprisoner with Jean Veranneman de Watervliet; both were imprisoned by the German occupation powers in World War II for resistance activities in 1943–1944.



Figure 5. Original map of the 16th century. Owned and reproduced by courtesy of Enzo Pranzini.

navigation (Wauwermans, 1895). He considered himself a scientific geographer rather than a map merchant, who nevertheless rose to fame, among other things, for his world maps of 1569 and 1587; he also dabbled in astrology and cosmography (cosmos map remained incomplete) and in cosmotheology (Breusing, 1869, 1885; Wauwermans, 1895).

Although he was not a painter, the high artistic value of the work of another southern Lowlands Belgian famous 16th century cartographer was frequently underscored by geographers (Crane, 2002). Gerard De Cremer, better known by his Latinised name of Gerhardus Mercator (Ristow, 1962; Snyder, 1987), passed the half millennium date for his birth in 2012.

Born on March 5, 1512, in the sleepy Flandrian Rupel River town of Rupelmonde, where the Rupel River joins the Scheldt River on its way to the North Sea, nearly a hundred kilometres farther downstream. The place remained until the mid-twentieth century a rather forlorn borough of the Land of



Figure 6. Cartographic document, Netherlandish. Copyright Creative Commons Attribution Share Alike 2.5 Generic License <http://creativecommons.org/licenses/by-sa/2.7>.

Waes, where progress only hesitantly ventured in. It boasts today a museum featuring, among other things, the remnants of one of the rare tide mills of the southern Lowlands. His birth there was coincidental because his parents were visiting relatives in Rupelmonde when his mother went into labour. Mercator's family returned to Rupelmonde in 1518 after his father ran into financial difficulties with his shoemaking business in their home town of Duisburg, in the Duchy of Cleves. Mercator's uncle was dean of the local church and provided him with an opportunity to attend school.

The priest financed Mercator's secondary education in 's-Hertogenbosch.¹⁰ Upon completion of that level of education, Mercator was sent to the University of Louvain, by then a famed nearly century-old institution, where the young man studied philosophy and earned a master of arts degree.¹¹ Educated men of lower income families commonly selected an ecclesiastical career in those days, and Mercator doubtless considered that path under pressure of his uncle and financial need.

De Cremer is claimed by several national groups. We consider him Belgian because of his place of birth (even though his birth happened to occur during his parents' visit); to the Flemish he is a Fleming, since Rupelmonde is in today's Flanders Region of Belgium; to the Dutch he is Dutch because he attended secondary school in 's-Hertogenbos(ch), today a commune (municipality) in the Netherlands; to the Germans he must be considered German because his work and activities took place mostly in Duisburg, then in an independent German duchy, wherefrom his parents originated, and where he passed away (Breusing, 1869, 1885). He and Ortelius have their images on the *sigillum* of the Royal Antwerp Geographical Society. Celebrations were held in about every town where he once set foot.

Mercator's remarkable "Map of England" was engraved and printed in 1564 (Figure 9). In 1599 English geographer Edward Wright published an explanation of the cylindrical Mercator projection. This explanation was reprinted in 1610.

Mercator's most voluminous and monumental work is his *Atlas*. The title honours a legendary Mauritanian king, cartographer, philosopher, and mathematician. The *Atlas* was published over a period of years. Because the printer omitted a title page, some chapters he had singled out were published separately in more elaborate versions. Thus the *Evangelicae historiae quadripartita monas, sive harmonia quatuor evangelistarum* (publ. 1592) was originally part of the *Chronologia* dealing with the birth and life of Jesus Christ. The *Chronologia hoc est temporum demonstratio exactissima ab initio mundi usque ad annum Domini 1568 ex eclipsibus et observationibus astronomicis omnium temporum sacris quo-*

¹⁰ After and condensed from work by Weisstein and others.

¹¹ The university, except for a short hiatus related to the French Revolution (end of 18th century) and the ensuing occupation of the Lowlands by the French, exists to this day, though split up in two separate entities (Kat[h]olieke Universiteit Leuven K.U.L. and Université Catholique de Louvain relocated at Louvain-la-Neuve [U.C.L.] of instruction (Flemish–Dutch or French). This Catholic university was strongly secularized after War World II. The city is known as Lovanium in Latin and Louvain in French; there is also a town called Louvain in Texas, and a Lovanium in the Democratic Republic of Congo was for a time the seat of a Catholic university.

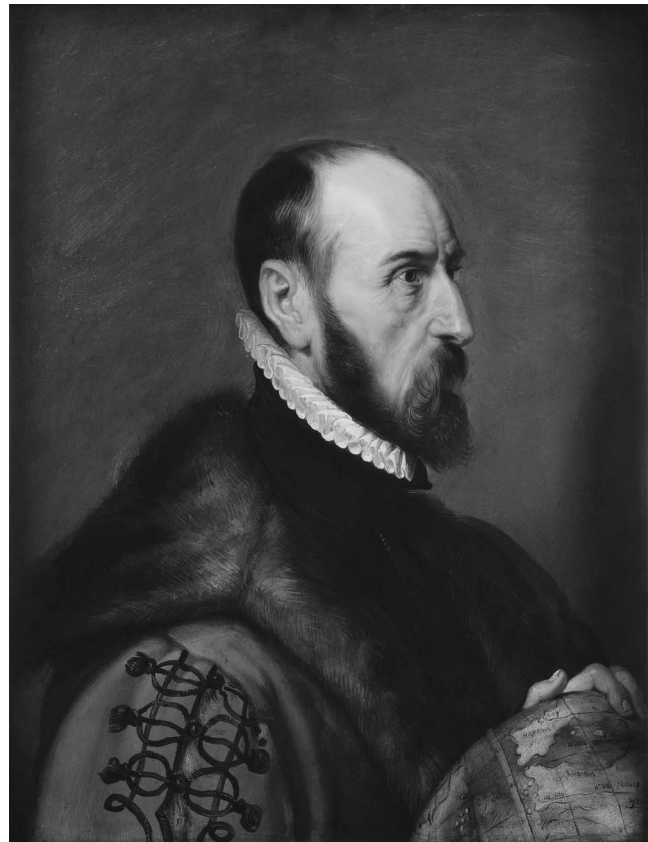


Figure 7. Copy of Peter Paul Rubens' painting of Ortelius. Copyright Creative Commons Attribution Share Alike 2.5 Generic License <http://creativecommons.org/licenses/by-sa/2.7>.

que bibliis et optimis quibusque scriptoribus summa fide concinnata was a collection of maps of Scandinavia, Eastern Europe, Africa, Asia, the North Pole, and the world: no less than 107 maps representing the most comprehensive coverage of the geographical knowledge of the 16th century. The *Chronologia* is the repository of the best and most original productions of the cartographic achievements of antiquity (Breusing, 1878). Mercator worked with many celebrated men of the time, including Frisius and Myrica. Not only was he a cartographer and globe maker, he was a famed engraver of brass plates, and he even spent seven months in prison for heresy (Figure 10). Although the time spent in prison by Mercator may seem short, his life was in serious jeopardy: he was suspected by the Inquisition Court to have Lutheran leanings, worse, to belong to a group of practicing Lutherans. Antwerp was after all a stronghold of Protestants. The University of Louvain (Lovanium) authorities, however, wielded such power that the Court released Mercator. It was a narrow escape: those arrested with him were convicted of heresy and either decapitated or burned at the stake and a woman was buried alive. Though Mercator remained three more years in Antwerp, he moved to Duisburg which had chosen to adhere to the Lutheran reform.



Figure 8. Facsimile reproduction of the Zwin Area painting, probably ordered by Charles V, by Peter Pourbus. Courtesy of Jacques de Groot, Zwin scholar.

Mercator's name was given to streets in Antwerp and other cities, and to a Belgian training ship that was retired, refurbished, and moored as a museum in Ostend. Museums with Mercator memorabilia exist in Duisburg (Germany), St Niklaas (Belgium), and Urbania (Italy).

Mercator died in 1594 in Duisburg before his work was entirely printed. He was a strong man who succumbed only after his third cardiac incident, having recovered from the two preceding ones, each time taking up his work again. His son Rumold Mercator (1545–1599) published some of his father's maps posthumously.

THE MERCATOR PROJECTION (*CF* FOOTNOTE 9)

Mercator's work addressed the difficult problem of how to represent a sphere on a flat surface. He worked it out, *in partim*, by using a go-between cylinder. His cylindrical projection caused considerable deformation of land masses in the northernmost and southernmost regions. For those regions, Mercator's projection provided, and still provides, an ideal tool for navigators and aircraft pilots to trace their travel route. Various modifications have been brought to it to remedy its weaknesses (Greenhood, 1957; Snyder, 1987).



Figure 9. Mercator map of Europe (in the public domain). Copyright Creative Commons Attribution Share Alike 2.5 Generic License <http://creativecommons.org/licenses/by-sa/2.7>.

The cylindrical projection is the easiest to draw, because when in an equatorial projection, the coordinate grid consists of equidistant lines intersecting at right angles. Mercator ensured the conformity of his maps by a mathematical formula that spaces the parallels farther apart as they get closer to the poles. Slight adjustments are applied to the transverse and oblique projections. The projection's name is indelibly attached to that of Mercator, but also to that of famed Antwerp printer and engraver Plantin¹² (Rooses, 1880).

Eric Weisstein (2013) and Robert Israel (2003) provide a mathematically simplified explanation of the projection. The projection has, throughout five centuries, been subject to critique, adaptation, and various modifications. Equations for the projection, the oblique, the transverse, and the modified or universal transverse Mercator projections are extracted from

¹² His name is also spelled Orthell and Orthellius. He was named geographer to Philip II, King of Spain in 1575, after the abdication of Charles V (1555).

his paper. Great circles are curved lines brought upon a globe, while loxodromic curves (loxodromes) are straight lines. Placing the x -axis of the projection on the equator and the y -axis at longitude λ_0 , where λ is the longitude and ϕ is the latitude

$$x = \lambda - \lambda_0 \quad (1)$$

$$y = \ln \left[\tan \left(\frac{1}{4} \pi + \frac{1}{2} \phi \right) \right] \quad (2)$$

$$= \frac{1}{2} \ln \left(\frac{1 + \sin \phi}{1 - \sin \phi} \right) \quad (3)$$

$$= \sinh^{-1}(\tan \phi) \quad (4)$$

$$= \tanh^{-1}(\tan \phi) \quad (5)$$



Figure 10. Ruins of Rupelmonde Castle. Towers. Mercator was imprisoned there for 7 months on suspicion of heresy, released probably upon intervention of the University of Louvain authorities. Photograph provided by the Official Tourism Office of the town of Rupelmonde-Bazel-Kruibeke.

$$= \ln(\tan \phi + \sec \phi) \tag{6}$$

The inverse formulas are

$$\phi = 2 \tan^{-1}(e^y) - \frac{1}{2} \pi \tag{7}$$

$$= \tan^{-1}(\sinh y) \tag{8}$$

$$= \text{gd}(y) \tag{9}$$

$$\lambda = x + \lambda_0 \tag{10}$$

where $\text{gd}(y)$ is the Gudermannian function.

An oblique form has equations

$$x = \tan^{-1} \left[\frac{\tan \phi \cos \phi_p + \sin \phi_p \sin(\lambda - \lambda_0)}{\cos(\lambda - \lambda_0)} \right] \tag{11}$$

$$y = \frac{1}{2} \ln \left(\frac{1+A}{1-A} \right) \tag{12}$$

$$= \tanh^{-1} A \tag{13}$$

with

$$\lambda_p = \tan^{-1} \left(\frac{\cos \phi_1 \sin \phi_2 \cos \lambda_1 - \sin \phi_1 \cos \phi_2 \cos \lambda_2}{\sin \phi_1 \cos \phi_2 \sin \lambda_2 - \cos \phi_1 \sin \phi_2 \sin \lambda_1} \right) \tag{14}$$

$$\phi_p = \tan^{-1} \left[-\frac{\cos(\lambda_p - \lambda_1)}{\tan \phi_1} \right] \tag{15}$$

$$A = \sin \phi_p \sin \phi - \cos \phi_p \cos \phi \sin(\lambda - \lambda_0) \tag{16}$$

and the inverse formulas (equations)

$$\phi = \sin^{-1} \left(\sin \phi_p \tanh y + \frac{\cos \phi_p \sin x}{\cosh y} \right) \tag{17}$$

$$\lambda = \lambda_0 + \tan^{-1} \left(\frac{\sin \phi_p \sin x - \cos \phi_p \sinh y}{\cos x} \right) \tag{18}$$

Deetz and Adams (1934), and later Snyder (1987), provided a transverse form of the projection, given by the equations

$$x = \frac{1}{2} \ln \left(\frac{1+B}{1-B} \right) \tag{19}$$

$$= \tanh^{-1} B \tag{20}$$

$$y = \tan^{-1} \left[\frac{\tan \phi}{\cos(\lambda - \lambda_0)} \right] - \phi_0 \tag{21}$$

$$\phi = \sin^{-1} \left(\frac{\sin D}{\cosh x} \right) \tag{22}$$

$$\lambda = \lambda_0 + \tan^{-1} \left(\frac{\sinh x}{\cos D} \right) \tag{23}$$

where

$$B = \cos \phi \sin(\lambda - \lambda_0) \tag{24}$$

$$D = y + \phi_0 \tag{25}$$

The “universal transverse Mercator projection” maps the sphere into 60 zones of 6° each, with each zone mapped by a transverse Mercator projection with a meridian in the centre of the zone. The zones extend from 80°S to 84°N.

The ellipsoidal Mercator projection produces a conformal projection for ellipsoidal model of the Earth or other bodies. It is calculated as follows:

$$x = R(\lambda - \lambda_0) \tag{26}$$

$$y = R \ln \left[\tan \left(\frac{\pi}{4} + \frac{\phi}{2} \right) \left(\frac{1 - e \sin \phi}{1 + e \sin \phi} \right)^{e/2} \right] \tag{27}$$

$$dx = R d\lambda \tag{28}$$

$$dy = R \frac{M(\phi)}{N(\phi)} \sec \phi d\phi \tag{29}$$

where

$$N(\phi) = \frac{R}{\sqrt{1 - e^2 \sin^2 \phi}} \tag{30}$$

$$M(\phi) = \frac{R(1 - e^2)}{(1 - e^2 \sin^2 \phi)^{3/2}} \tag{31}$$

and e is the first numerical eccentricity of the ellipsoidal Earth. The scale factor of the projection is $N(\phi) \cos \phi$.

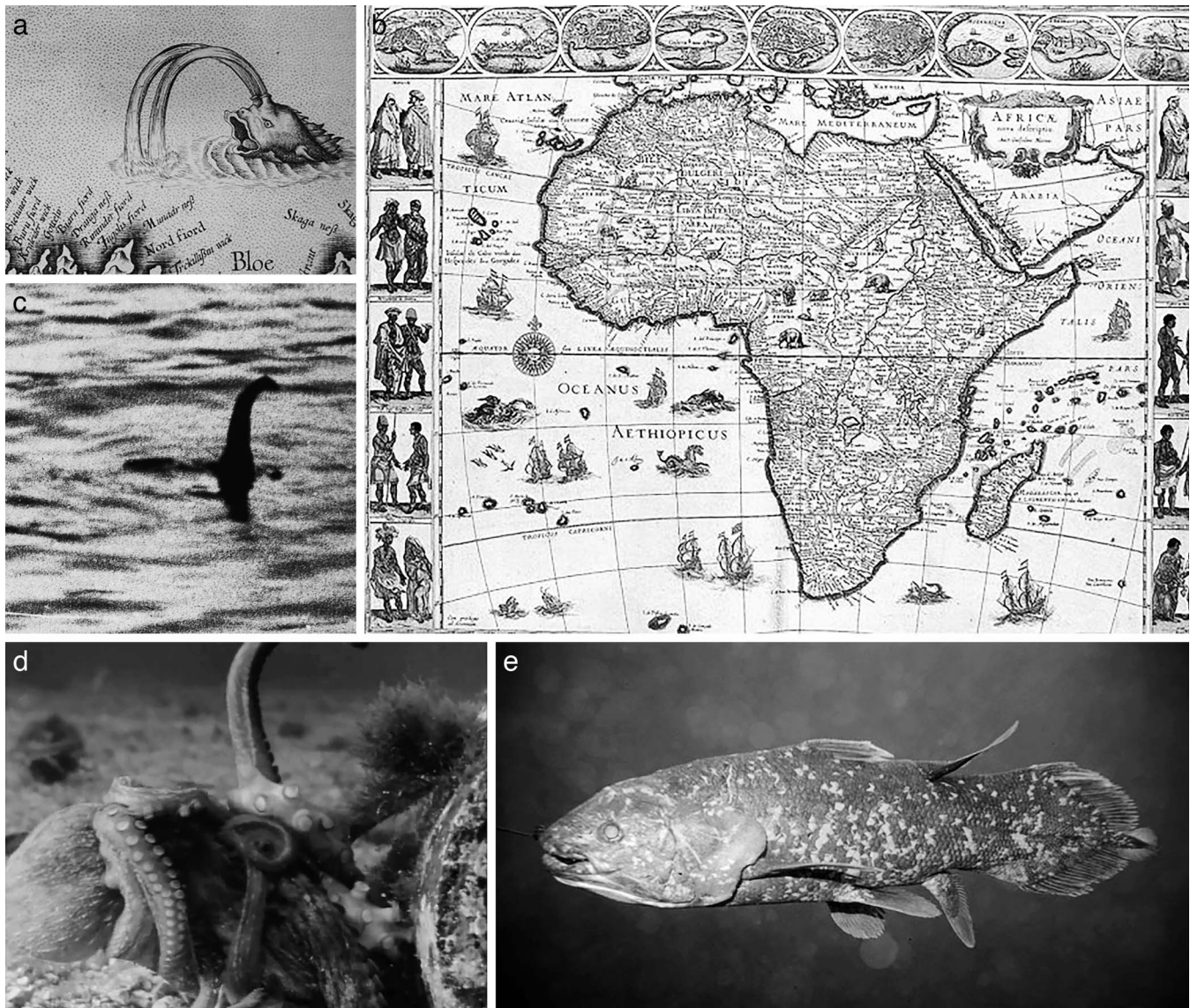


Figure 11. (a) and (b) Illuminations of maps, extracts of several maps, among others, of Mercator and Ortelius. Copyright Creative Commons Attribution Share Alike 2.5 Generic License <http://creativecommons.org/licenses/by-sa/2.7>. (c) Though the perpetrators of the Nessie hoax admitted their deed already in 1925, a group of Scottish schoolchildren maintain steadfast having seen Nessie on a school outing to Lock Ness in 2014. (d) Jacques Cousteau gave ambiguous answers when queried about the sea monster he “identified” near Djibouti. Barring further information on the topic, the sighting should be held to be a hoax. One could also contact his grandson Fabien Cousteau, currently residing in Santa Barbara, CA, USA. (e) The coelacanth, sometimes taken for being a sea monster, is truly a living fossil and has been inhabiting the Comoran and Indonesian waters since the Paleozoic. The largest fish ever to ply the ocean was the Oligocene–Miocene *Megalodon*; the largest contemporary fish is deemed to be the white shark [*Carcharodon carcharias*].

Some mapping systems use spherical instead of ellipsoidal formulae and thus are not conformal. Details are available in several entries in encyclopedias and can also be found on the webpages of Israel (2003) and Weisstein (2013).

The Mercator projection exaggerates areas far from the equator. It is still commonly used for areas near the equator, where distortion is minimal, and it is used commonly for navigation, due to its unique properties, but is not suited to general reference world maps because of its land area

distortion. Mercator himself used the equal-area sinusoidal projection to show relative areas. Current atlases no longer use the Mercator projection for world maps or for areas distant from the equator, but they use other cylindrical projections or forms of equal-area projection.

Arno Peters proposed what is now usually called the Gall–Peters projection as an alternative to Mercator. The projection is a specific parameterization of the cylindrical equal-area projection. A 1989 resolution by seven North American

Table 1. A list of Dutch cartographers not previously mentioned in the article, some of whom may have held other positions, such as publishers, printers, engravers, etc. Not included in this list are Mercator, Ortelius, Hondius (Figures 19a–b), Frisius (Figure 20), and de Jode. The alphabetical list takes in persons who lived or were born or died in the 16th century.

Cartographers	Years
Joost Janszoon Bilhamer	1541–1590
Willem Janszoon Blaeu	1571–1638
Joan (Joannes) Blaeu	1596–1673
Henricus Hondius	1596 or 1597–1605 or 1606
Willem Hondius	1598–1652
Isaak de Graaf	1668–1793
Hessel Gerritszoon	1581–1632
Johannes Jansonius	1588–1664
Jacob Roelof van Deventer	1510–1575
Johanns Ruysch	1466–1530
Petrus Plancius	1552–1622
Lucas Janszoon Waghenaer	1533 or 1534–1695 or 1606
Pieter van der Aa	1609–1633
Claes Janszoon Visscher	1587–1652

geographical groups decried the use of all rectangular-coordinate world maps, including the Mercator and Gall–Peters.¹³

Mercator nurtured a grandiose plan of mapping the earth and the celestial universe, but his actual achievements fell quite a bit short of the monumental intended *œuvre*, efforts to posthumously fill the gaps by his son Rumold and by some of his collaborators notwithstanding. This is particularly true of his contributions to the field of cosmotheology, a term coined reputedly by Immanuel Kant (1724–1804) several centuries after the cartographer’s death.

Cosmotheology is transcendental theology aiming either at inferring the existence of a Supreme Being from a general experience, without any closer reference to the world to which this experience belongs; ontotheology is transcendental theology that endeavours to cognize the existence of a Supreme being, through mere conceptions, without the aid of experience. Kant is thus credited with this distinction upon which he expanded in Section VII of *Critique of Pure Reason* (Kant, 1998), originally published in his native Königsberg (now known as Kaliningrad after annexation by the Soviet Union in 1945, and currently a Russian enclave on the Baltic Sea.)

Mercator intended to discuss the celestial and the terrestrial world as a whole. This subject was later also broached by Isaac Newton in his *Meditationes Philosophicae*. The label cosmographer has thus been given to Mercator by some of his biographers, though cosmotheology is a facet of his *œuvre* that has retained their least attention, perhaps because it is its least “scientific” and Mercator wanted to be regarded as a scientific geographer rather than a “map-maker.” Some map-makers—

¹³ The Arno Peters James Gall is an equal area projection, also known as cylindrical equal area projection. It has been described in an entry in the Wikipedia Encyclopedia, traceable under Gall–Peters projection. It has been at the heart of an enduring controversy, particularly on which of the two map makers is the original developer. Snyder (1987) discussed this matter further.

de facto geographers—called themselves “cosmographers” during the 16th and 17th centuries.

Many major online street mapping services use a variant of the Mercator projection for their map images. Despite its obvious scale variation at small scales, the projection is well suited as an interactive world map that can be zoomed seamlessly to small-scale (local) maps, where there is relatively little distortion due to the projection’s near conformity.

The major online street mapping services tiling systems display most of the world at the lowest zoom level as a single square image, excluding the polar regions. Since the Mercator coordinate x varies over 2π , the other coordinate is limited to $-\pi \leq y \leq \pi$. With

$$\frac{1}{2} \ln \left[\frac{1 + \sin(\phi)}{1 - \sin(\phi)} \right] = \pm \pi \rightarrow \phi = \pm \arcsin \left(\frac{e^{2\pi} - 1}{e^{2\pi} + 1} \right) \quad (32)$$

the corresponding latitude extremes are $\phi = \pm 85.05113^\circ$. Latitude values outside this range are mapped using a different relationship that does not diverge at $\phi = \pm 90^\circ$.

ABRAHAM ORTELIUS

Unlike Mercator, Ortelius (Figure 7) came from a well-to-do Augsburg (Bavaria) family that moved to Antwerp for religious reasons. He travelled through most of Western Europe, at which time he met his contemporaries in the field of mapping. Abraham Ortelius became a very important citizen of Antwerp, he received the same city recognition award as Peter Paul Rubens, and upon his death he was entombed in the church of St Michael facing City Park in the heart of the town.

Ortelius started his professional career as an illuminator (enluminator) of maps (see next section)—a profession still alive in the late 19th century¹⁴—which provided insufficient income for decent subsistence, and he rounded off his income as a book and maps salesman attending book fairs (Figures 11 and 12). At the Frankfurt am Main book fair he met Mercator and started accompanying him. Mercator encouraged him to focus on scientific geography. His major achievement in that domain was hypothesizing continental drift as many as five centuries before Alfred Wegener (1915). His thoughts on the subject were introduced by Plantin (1520–1589) in the 1596 edition of *Thesaurus Geographicus* that preceded his death by a year. The *Thesaurus* was an extension of *Synonymia Geographica* that Plantin had printed in 1578 (Rooses, 1880). He may be rank amongst the earliest oceanographers—or “marine cartographers”—since his was the first ever dedicated map of the Pacific Ocean (Figure 12; footnote 10). If some of his maps contain errors, they nevertheless include most of the geographic knowledge of the time.

If Mercator introduced the term atlas, the first true atlas is probably Ortelius’s *Theatrum Orbis Terrarum*, a collection of

¹⁴ A relative of the authors of this article was an enluminator as late as the end of the 19th century. Auguste Jérôme Simonette (Simonet) hailed from Lyon, France (date of birth and of death unknown, both second half of 19th century). He plied his trade around Duluth, Minnesota. He left no trace after a trip to visit his family in France. His son, John Jerome (1891–1994) rose to become vice-president of the Soo (Sault-Ste-Marie) Line Railroad.



Figure 12. Ortelius' map of the Pacific Ocean (*Maris Pacifici*). Copyright Creative Commons Attribution Share Alike 2.5 Generic License <http://creativecommons.org/licenses/by-sa/2.7>.

53 maps put on the market by Gilles Coppens, who hailed from Diest, a Campine (in Flemish, *Kempen*) town, and had his printing shop in Antwerp. Close to 30 editions were made before 1598. Ortelius credited source materials to no less than 183 authors. Several biographies and memoirs about Ortelius and his printer Plantin (Rooses, 1880) have been published; many of these provide precious information about the maps he produced. (Depuydt, 2004; Hessels, 1887; Wauwermans, 1895, 1901).

Ortelius as cartographer and Plantin as printer and publisher had competition in their respective fields, right in Antwerp (Figures 13–17). Often the same party competed in several specialties; several of the Renaissance figures have reached fame, even if they are less known to contemporary scholars. For instance Gerard de Jode (Gerard the Jew) produced fewer maps than Ortelius—his work got delayed in publication—but as a result they call for higher prices at today's auctions. Jan Moretus (1543–1610; also known as Jan Moerentorf; Joannes Moretus) worked for Plantin; he married his boss's younger daughter, and at the death of Plantin took

over the business. They worked so closely that an avenue and a museum in Antwerp bear both their names (Plantijn-Moretus lei and Plantijn-Moretus Museum).

The de Jode family in Antwerp were keen competitors of Ortelius. Both father and son worked on producing and publishing an atlas of a quality equal to Ortelius's atlas. Gerard de Jode (1509–1591) was apparently the first to make a map dedicated to W and NW America. His work was taken up by his son Cornelis de Jode (1568–1600), who like other 16th century cartographers was also an engraver (*cf.* Mercator and others), publisher, and printer (*cf.* Ortelius; Table 1).

MAPS OF THE 16TH AND 17TH CENTURIES (FIGURES 4–6, 11, 13–18)

Maps were frequently ordered by rulers for military and/or civilian purposes. Several were thus put on order by Charles V and his son Philip II. Such work was also commissioned by earlier kings and princes: for instance, Roger, king of Naples, did so in the 13th century. Emperor Charles V (1500–1557) wanted to protect Flanders and Zeeland, of which he was



Figure 13. Facsimile of map of Zeeland by Jacob van Deventer, 1560, produced on orders of Philip II, Sovereign of the Lowlands; included in the *Theatrum*. Copyright Creative Commons Attribution Share Alike 2.5 Generic License <http://creativecommons.org/licenses/by-sa/2.7>.

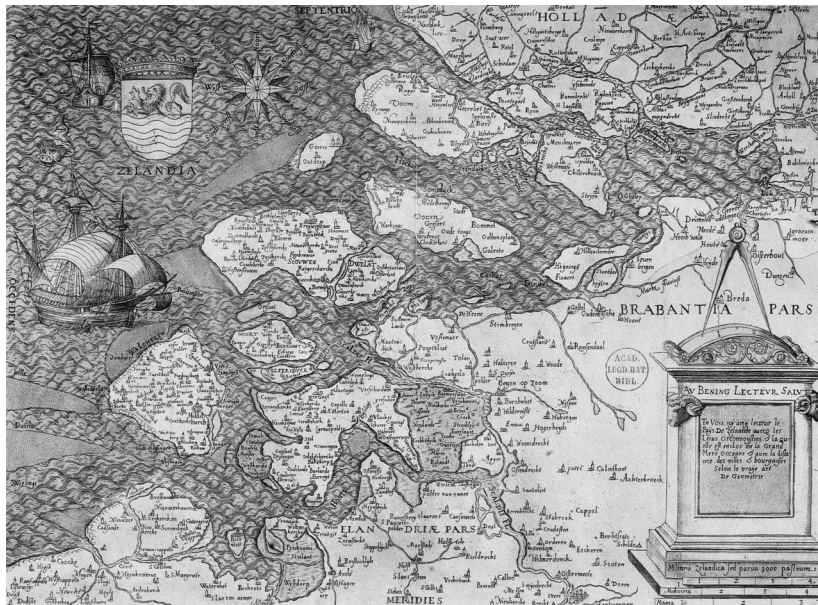


Figure 14. Facsimile of city map of The Hague, one of a series, 1560, Zeeland, by Jacob van Deventer, produced on orders of Philip II, Sovereign of the Lowlands. Copyright Creative Commons Attribution Share Alike 2.5 Generic License <http://creativecommons.org/licenses/by-sa/2.7> Holland Agenda 2005 Amsterdam.

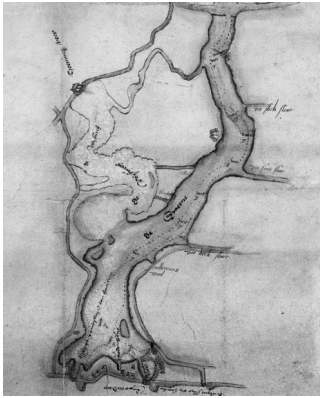


Figure 15. Facsimile of map of Spaarne River, near Haarlem, by Peter Bruinsz. First time a depth line, dotted here (isobath) is shown (1584). Copyright Creative Commons Attributive Share Alike 2.5 Generic License <http://creativecommons.org/licenses/by-sa/2.7>.

sovereign, against potential invaders from the North Sea (Figure 8). So did Philip II, when he was King of Spain and ruler of the Lowlands (Figures 13 and 14), and he also wanted to know the layout of such cities as The Hague (in Dutch Den Haag, current seat of the Dutch government; Figures 14 and 15). Ship captains were eager to gather knowledge about the coastline (Figure 16), and lawyers were keen on tracing boundaries of properties (Figures 15 and 17). Precise maps had made their appearance, replacing often only vaguely accurate documents, drafted with approximation at best.

Mercator was first to engrave italics and to introduce them on [his] maps to indicate place names. This habit remained in use for several centuries. As already mentioned, the first dedicated map of an ocean (Pacific) was published (Figure 12). Strangely, the South Atlantic was indicated as Ethiopian Ocean, though Ethiopia is at the opposite side of the continent.

Maps of the times were commonly enhanced with artistic illustrations on their borders representing indigenous personages or views of distant lands (Walton, 1962), and from the oceanic expanses emerge sirens, dragons, and leviathans. The map of Iceland attributed to Mercator shows a marine monster clearly inspired from ideas about whales (Figure 11a), and another map, this one attributed to Ortelius (Figures 7 and 11), though published in the first quarter of the 17th century, is enluminated with a fauna occasionally reminiscent of Poseidon's equestrian harness in the waters bathing subequatorial Africa. Monsters of the deep were frequently depicted on maps, states van Duzen (2013), and motivation for the choices ranged widely. He maintains that the whimsical aspect of the sea monsters was aimed at luring potential map buyers. Examples include Mercator's 1572 map of Europe and Ortelius' 1570 (1564) *Theatrum*. Mercator was a talented engraver; this did not escape the Mechlin (in Flemish/Dutch/German Mechelen, in French Malines) globe maker Gaspar van de Heyden, also known as Myricius or Gaspar a Myrica (De Smet, 1968) who called on Mercator to work with him on his engraving of globes.



Figure 16. Facsimile of Chart of SW coast of the Netherlands drawn by Lucas Jansz Waghenaar, 1584. Copyright Creative Commons Attributive Share Alike 2.5 Generic License <http://creativecommons.org/licenses/by-sa/2.7>.

Illuminations of sea monsters are depicted in a composite illustration used in the 125th anniversary issue of *National Geographic Magazine*. The threatening creatures yielded their map space to accommodate pictures of ships (see Pourbus's Zwin painting, Figure 8). It is held by some authors (van Duzen) that some illuminators actually believed in the existence of dangerous sea monsters, even though the sites where they were depicted and shape and form they had were figments of the artists' imaginations. Sea monsters were reputed to have swallowed mariners, cargoes, even entire ships, lock, stock, and barrel!

The superstitions of seamen are a well-recorded phenomenon, which is understandable because the waters that surrounded them were frightening at night and strewn with all kinds of dangers. The perusers of old maps will certainly have observed illuminations showing terrible monsters surging from the deep, enlacing ships, and trying to draw them underneath.

Stories about mythical animals from the sea abound. Originally published in *Americae Sive Qvartae Orbis Partis Nova Et Exactissima Descriptio*, the 1562 map by Diego Gutiérrez can now be found at the U.S. Library of Congress (Hébert, 2001). On it a winged fish (upper right) resembles an (extinct) Iniopterygian. On the left half another animal has a sea-serpent's tail, mammalian face, winged arms, and front flippers. The 16th century ocean was a mostly unknown realm, and maritime travel was perilous. Hence sailors worried about sea creatures. Frightening sea tales have not vanished with the dawn of the age of technology (van Duzen, 2013).

The "monstre de Cousteau" (*Le monde de l'inconnu*, 2014), (Barloy, 1987), (Cousteau, s.a.), (Nolane, 1996), also referred to as the Mystery of Cousteau, the Legend of Djibouti, etc. is a tale reported sporadically by military personnel stationed on the Horn of Africa Republic of Djibouti, and with insistence during the 1995-1996 time span. A marine creature some 30 metres long would have been seen and presumably inhabited the interior sea "Gulf of Tadjoura" 's deep of G[h]oubet. A steel case containing the carcass of a camel is supposed to have been lowered in it and when pulled back up was shown to have been

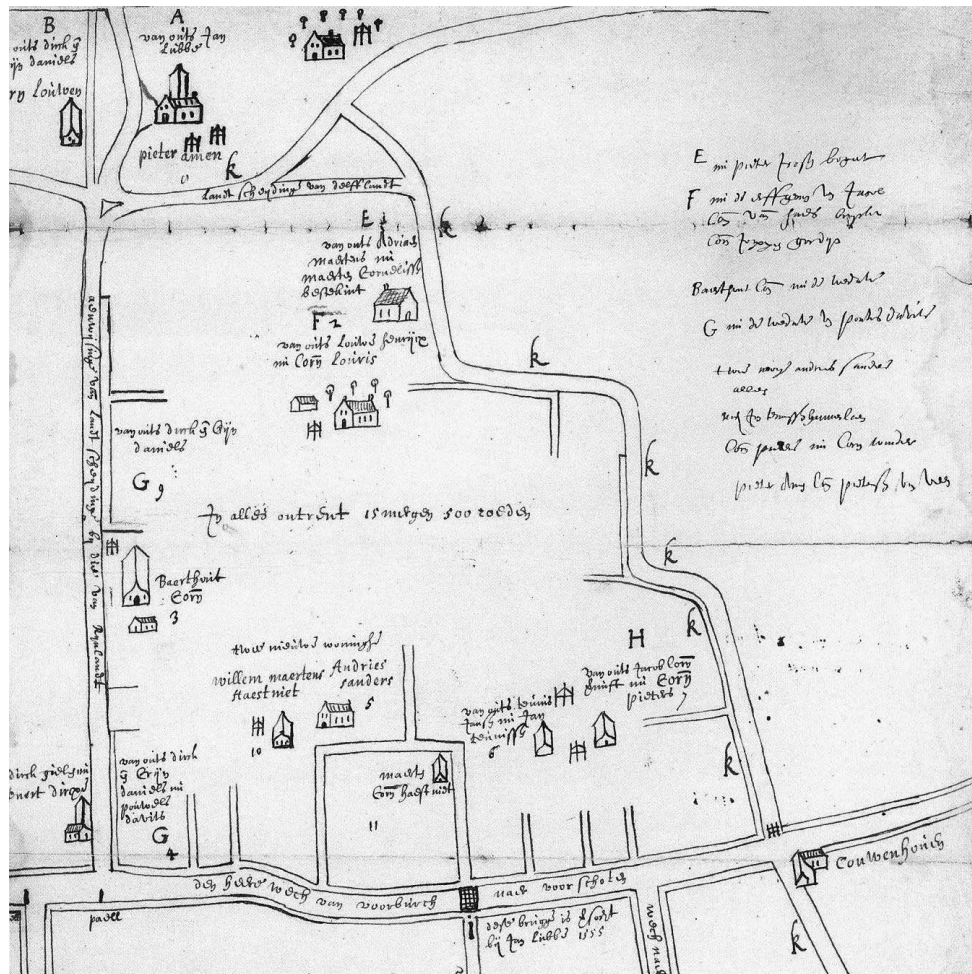


Figure 17. Facsimile of map of boundary between Delft and Rhineland used in a dispute between the two water boards (wateringen) 1579. Copyright Creative Commons Attribution Share Alike 2.5 Generic License <http://creativecommons.org/licenses/by-sa/2.7>.

totally crushed by an animal whose jaw imprint was about one meter wide. Cousteau came to investigate the matter, claimed to have seen and filmed the animal. He refused however to show the picture giving as a reason that humanity was not ready for such a disclosure, that the film was of poor quality and would damage his reputation. Cousteau’s team, and reputedly himself, denied the existence of any creature, monster or other, and its existence was decried as a hoax. What was seen was probably a giant manta that indeed lives in the gulf (Charlier et al., 2011).

Two more sea monsters were “discovered” and are in good health. First is the coelacanth, a living fossil. It dates back to the earliest geological times—fossil group *Latimeria*—a descended from the Crossopterigians, and, although very elusive, it can be found in the waters off the Comores and Celebes Islands. Then there is the recently (2011–2013) discovered sea monster off the New Jersey coast. In fact it is a voracious fish. The river species or fluvial lamprey has been known for some time (*Lampetra*). But the sea lamprey, which forays up-river, unleashed the sea monster furore. The eel-like 1-m-long fish (Cyclostome) thrives

off the mouth of the Raritan River and comes in two species (*Petromyzon* and *Eudontomyzon*). The monster of the Loch Ness (Scotland) proved to be a total hoax, although Scottish schoolchildren claim to have sighted it in May 2013.

CONCLUDING THOUGHTS

This paper has focussed on the best known cartographers of the 16th century (Figures 13 and 14) on the occasion of the 500th anniversary of Mercator’s birth. There are others, of course, some of them cursorily mentioned herein. The 16th century was a milestone for maps. On July 4, 2012 (befittingly on U.S. Independence Day), German historians announced on Super Channel¹⁵ that a map dating back to the 16th century with the indication “America” had been found. Until the 16th century that area had usually been shown as Nova Belgica. The University

¹⁵ Brussels English language TV distribution network that sends out on its channel 15.

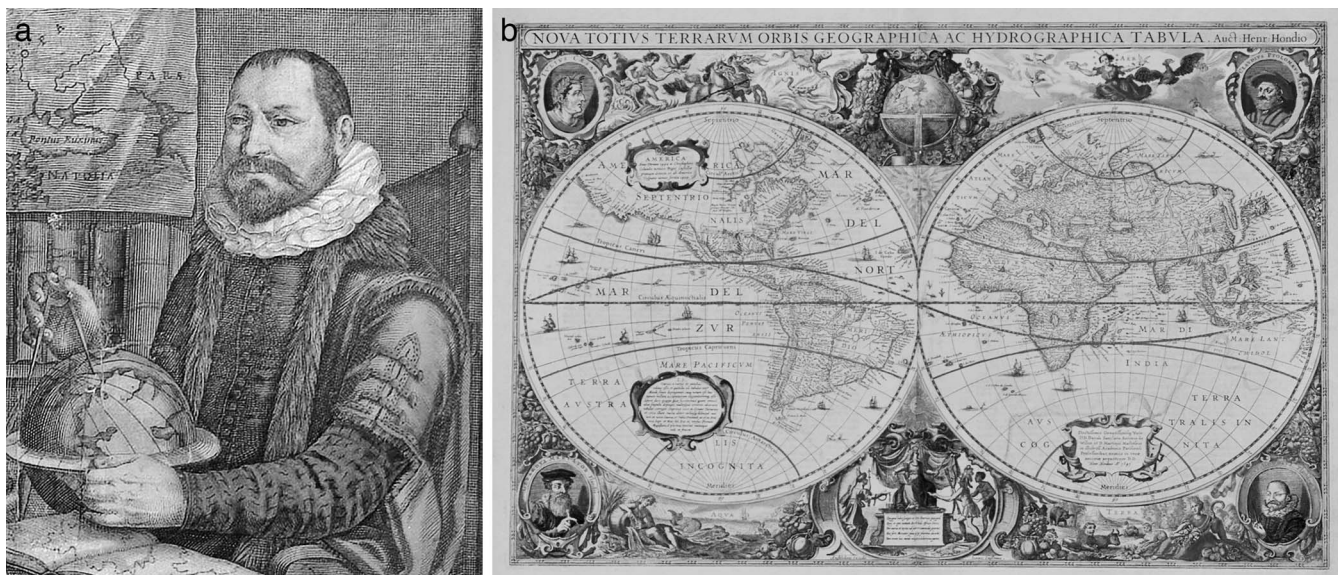


Figure 18. (a) Portrait of Hondius; (b) Wall map by Hondius. Public domain.



Figure 19. Engraving of the likeness of Frisius. Copyright Creative Commons Attribution Share Alike 2.5 Generic License <http://creativecommons.org/licenses/by-sa/2.7>.

chose this time to change its name that included that of Mercator to a simpler and more austere Universitaet Duisburg.

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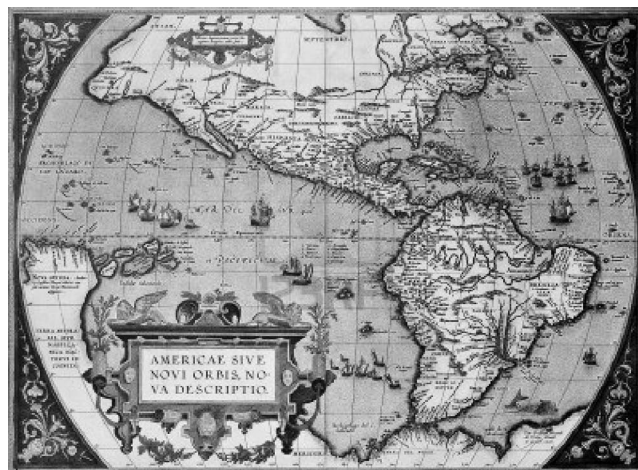


Figure 20. Map by Ortelius, 1584. Theatrum. Typus orbis terrarum.

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□ Résumé □

La cartographie nord néerlandaise et flamande, connurent un lustre exceptionnel au seizième siècle. Cartographie et géographie deviennent d'ailleurs plus «scientifiques». On célèbre en 2012 le 500e anniversaire de la naissance de Gérard de Cremer (Gerhardus Mercator), fortuitement venu au monde dans la petite ville de Rupelmonde (Pays de Waes, Flandre). Mercator représente une borne dans l'histoire de la cartographie et de la navigation. Son nom est associé à celui d'Anvers (Marcgraviat du Duché de Brabant) alors la plus grande ville du monde. Toutefois une très grande partie des activités de Mercator se concentrent plutôt à Duisbourg (Allemagne). Il fit des études au collège de Bois le Comte (aujourd'hui Pays Bas) et ensuite à l'université de Louvain, grâce à la munificence de son oncle, doyen de l'église de Rupelmonde. On doit à Mercator la projection cylindrique, son Atlas et plusieurs ouvrages. Il fréquenta, et collabora, avec plusieurs grands personnages de son époque, tels Ortelius, Frisius et autres. L'article fait aussi état des travaux du peintre brugeois Pourbus, qui fut également cartographe au 16^{ème} siècle.