

WAS LEONARDO DA VINCI'S WORLD MAP THE FIRST TO NAME AMERICA? A QUINCENTENNIAL REAPPRAISAL

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Abstract

In addition to his better known artistic, scientific and engineering talents, Leonardo da Vinci has an extensive reputation as a cartographer, drawing maps for a wide range of hydro-engineering projects for the rulers of Florence, Milan, Arezzo and the Vatican, amongst others. However, he is not generally acknowledged as authoring a world map (or mappamundi) spanning the globe, which was the domain of a few specialized cartographers of the era. Nevertheless, there is a world map among his papers in the Royal Library, Windsor, which has the correct overall configuration of the continents, including an ocean at the north pole and a continent at the south pole. Moreover, it has a unique cartographic projection onto eight spherical-geometry triangles that provide close to isometric projection throughout the globe. This quincentennial anniversary year of his death in 1519 is an appropriate moment for a reappraisal of this contribution to global cartography. Although the authenticity of this world map has been questioned, there is an obscure page of his notebooks in the Codex Atlanticus containing a sketch of this precise form of global projection, tying him securely to its genesis. Moreover, the same notebook page contains sketches of eight other global projections known at that time (early C16th), from the Roman Ptolomaic conic section projection to Rosselli's (1508) oval planispheric projection. This paper reassesses the dating of Da Vinci's unique mappamundi to suggest that it predates that of Waldseemüller (1507), and may thus have been the first map to name both America and Florida.

Global Awareness in Da Vinci's Youth: A quincentennial reappraisal

Although Leonardo da Vinci was well known as an accomplished cartographer for the Renaissance rulers Ludovico Sforza in Milan, Piero Soderini in Florence, Cesare Borgia in the Arezzo region, and Pope Leo X at the Vatican, he is not generally recognized for such activities outside Italy. This quincentennial anniversary year of his death in 1519 is an appropriate moment for a reappraisal of this contribution to global cartography. How did his interests in global cartography arise? An interesting link to a larger scale conception is the presence of Paolo di Pozzo Toscanelli in the Florence of da Vinci's youth. Toscanelli was a mathematician, astrono-

mer, cartographer and diplomat who had been one of the progenitors of perspective geometry in discussions with Brunelleschi early in the century (Vasari, 1550), then worked with Nicolas di Cusa to produce the classic Renaissance text on squaring the circle and other philosophical matters (di Cusa, 1457) before turning his attention to cartography, for which he was in demand well beyond the shores of Italy, providing maps of the Mediterranean to rulers such as King John of Portugal in 1460 (Wagner, 1894)



Figure 1. Left: An oblique view of the Duomo of Santa Maria de Fiore, Florence, designed by Arnolfo di Cambio in 1294, with the dome built by Brunelleschi from 1418-1436. Right: the 22 m high lantern was completed by Michelozzo in 1461, and the 4 tonne gilded copper ball was added by Verrocchio and Leonardo da Vinci in about 1469.

As an astronomer, Toscanelli calculated the orbits of the comets of 1433, 1449-50, 1456 (later known as Halley's comet), 1457 (two), and 1472 (Uzielli, 1894). Moreover, he took the lead in installing the world's first astronomical gnomon in the Florence Duomo, an aperture near the top of the dome providing a sunbeam to track the movements of the sun on a gnomon in the floor and determine the timing of movable Catholic festivals such as Easter. The unveiling of this remarkable intersection of science and religion took place to great public fanfare in the late 1470s, when da Vinci would certainly have been present as the prime member of the Verrocchio studio, and may even have performed musically to celebrate it (as he was famous in his youth for composing extempore songs at public events). Da Vinci himself has a close connection with the Duomo at that time, as an impressionable youth in his late teens. In 1468, his master Verrocchio received a commission from the Medici to

install a gilded copper sphere on top of the lantern surmounting the Duomo (Figure 1). The golden sphere, again representing a kind of global consciousness, weighed over four tonnes and required extensive use of hoisting machines that remained from when Brunelleschi was erecting the dome itself. As Verrocchio's chief apprentice at the time, da Vinci would have been intimately involved in every phase of the operation, and would have had the opportunity to inspect Toscanelli's gnomon aperture for himself while working at the top of the dome. He would also have been vividly aware of the god-like view of Florence and the surrounding countryside from the 300 ft height of this crow's nest location, which may have played a role in his lifelong obsession with cartography and with flight, in terms of both the analysis of the flight of birds and of the design of a human flying machine. A further link of da Vinci to global cartography is found in a 1483 fresco by his friend Donato Bramante from his early years in Milan (Figure 2, right). The painting depicts Heraclitus and Democritus, representing philosophical pessimism and optimism respectively, flanking a geographically detailed depiction of the globe (a decade before Columbus voyage, proving that the world was spherical). The two figures are generally accepted as depictions of da Vinci on the left and Bramante himself, on the right, consistent with the idea that da Vinci brought the global interests that he had developed in Florence with him to Milan when he relocated there in 1482. The final association comes in a sketch by Michelangelo of a philosopher holding a globe (Figure 2, right) that is often considered to be a portrait of the aging Leonardo da

Vinci (especially as it seems to be the model for Vasari's portrait of him in his *Vitae*).



Figure 2. Left: 'Crying Heraclitus and Laughing Democritus' by Bramante (1483). Right: 'The Philosopher (a possible portrait of Leonardo da Vinci with a globe)' by Michelangelo (~1515).

Da Vinci's World Map

Despite these associations, Leonardo da Vinci is not generally acknowledged as authoring an atlas (or *mappamundi*) of the geography of the world (Veltman, 1986). Nevertheless, there is a world map among his papers in the Royal Library, Windsor (Figure 3, below), which is one of the very first maps to name the Americas, and has the correct overall configuration of the continents, including an ocean at the North Pole and a continent at the South Pole. At that time (as subsequently), a variety of projective conventions had been developed to depict the curved surface of the globe onto the planar surface of a sheet of paper. Da Vinci provides his own unique solution to this insol-



Figure 3. Da Vinci's octant world map projected onto Reuleaux triangles (~1508). Note the correct configuration of an ocean at the north pole and a continent at the south pole (at the centers of the left and right florets, respectively). Royal Library, Windsor.

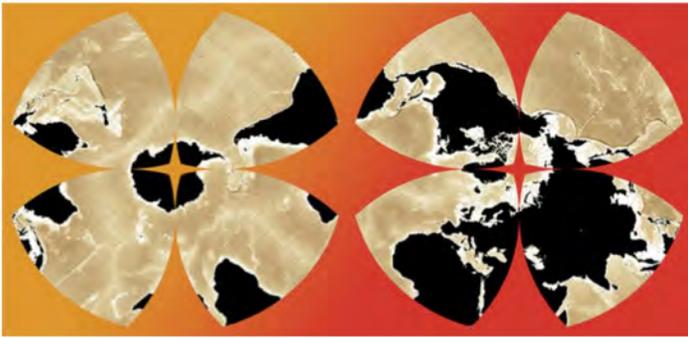


Figure 4. Modern projection of the globe onto da Vinci's octant projection from NASA Blue Marble (Burchill, 2007).

uble problem, which had been vexing cartographers since the time of the Greek geometer Ptolemy and before. By breaking the surface into eight octant petals in two florets (Figure 3) he developed a unique projection that had by far the most isometric mapping geometry to that date (although at the cost of a set of crosscuts that split up the continents).

Da Vinci's projection may be compared with a modern mapping to the same projection (Figure 4, above). This mapping makes it clear that, although he has the right general idea, da

But can we accept the usual date of 1514 for Leonardo's world map? Comparison of the world maps from this period suggests an earlier dating for Leonardo's world map, based on the progression of knowledge that they reveal about the Western hemisphere. In 1492, just before Columbus' return from the West Indies, the first known world globe, the Erdapfel ('earth apple') of Martin Behaim shows only Japan ('Cipangu'), the East Indies, and a scattering of islands in the oceans between Europe and Asia, consistent with the lack of knowledge of the Americas prior to Columbus (Figure 5A). The stereographic reconstruction of da Vinci's *mappamundi* (Figure 5B) adds the northeastern coast of South America as an isolated continent, the island of Isabella (Cuba) and Hispaniola (Dominica), and an island form of 'Terra Florida'¹. The corresponding stereographic plot from the Hunt-Lenox brass globe (in the New York Public Library), of uncertain dating, shows a more extended South American continent but no Florida (Figure 5C)². By the time of Vespucci's description of the continent, as depicted by Waldseemüller in the commemorative inset to his 1507 map (Figure 5D), the South American continental region is connected to Florida by the coast of Central America, although the land beyond the coast is clearly indicated ('*Terraincognita*') as

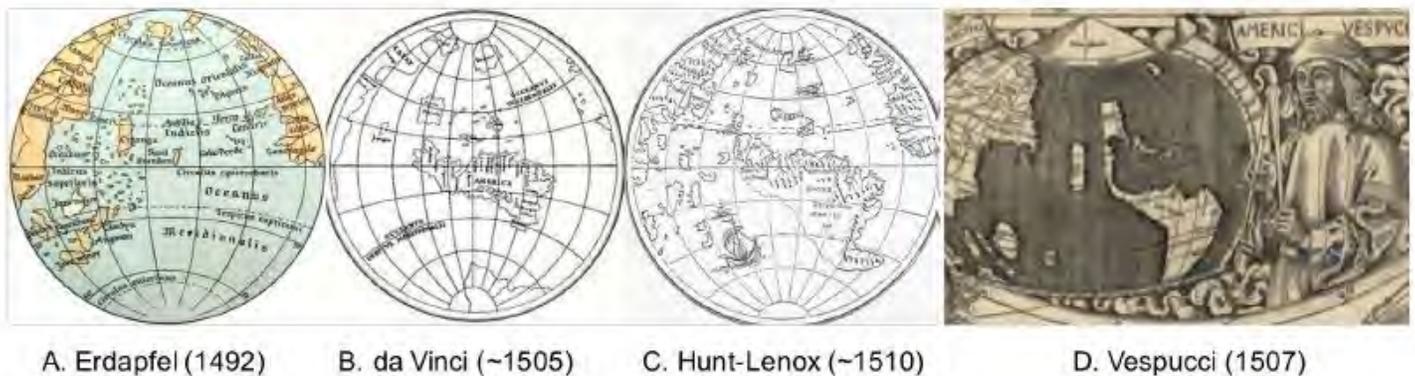


Figure 5. Depictions of the state of knowledge of the Western hemisphere in world maps around the turn of the 16th century, in three modern stereographic reconstructions and one reproduction. A: the Erdapfel of Martin Behaim; B: the da Vinci octant *mappamundi*; C: the Hunt-Lenox globe. D: the inset in the Waldseemüller map of 1507 commemorating Amerigo Vespucci's supposed voyage of 1503, which added the coast of Central America and Florida as a peninsula to the South American coast of earlier discoveries.

Vinci has substantially exaggerated the size of Europe and has the Americas much too far to the west (somewhere near Hawaii). Nevertheless, he shows India, Malaysia, China, Japan and even the Russian Far East peninsula in approximately the right proportions, implying that he must have had access to some information from sailors of the oriental sea routes. Remarkably, also, he has approximately the correct dimensions for both the Arctic Ocean and the landmass of Antarctica (at the centers of the right and left florets, respectively), something achieved by no other cartographer of the era, or for the next two centuries! The Arctic is particularly surprising in view of the fact that the Arctic, at that time, was continuously covered in a thick layer of ice.

unexplored. This configuration is very similar to those in the Caveri map, the Rosselli map, and the Sylvanus map of the same period, all dated to soon after Waldseemüller's.

According to Fite & Freeman (1926), however, the name of "Florida" (Terra Florida), was probably used for the first time on Leonardo's globe, where it is correctly placed opposite Cuba although in form of "an island". Given the association of Ponce de Leon with the discovery of Florida, this suggests a dating to after de Leon's return from accompanying Columbus' expedition to Florida in 1493, but before the Waldseemüller map of 1507, which already has Florida as a peninsula to North America. If we assume a meaningful connection between da Vinci and Waldseemüller through Vespucci, implies that 1507 is actually

the *terminus ante quem* for the depiction of Florida as an island. The implication of the progression of ‘American’ configurations in these maps (Figure 5), therefore, is to date da Vinci’s world map to the period after Vespucci’s publication of a thousand copies of the account of his 1503 voyage in Florence in an open letter to Piero Soderini in 1504 (Lester, 2009), but **before** its integration into the (slightly truncated) world map of Waldseemüller in 1507. On this dating, da Vinci’s world map would actually be the first in history to use the designation of ‘AMERICA’ for the western landmass, and also the term ‘Terra Florida’ for the land north of Cuba³.

Attribution to Leonardo da Vinci

Despite the fact that it was found in his collection of papers from those assembled by his pupil Francesco Melzi after his death, the attribution of this *mappamundi* to Leonardo da Vinci has long been questioned by most da Vinci scholars (Major, 1865; Nordenskjöld, 1889; Snyder, 1993), and has consequently been omitted from almost all books on his oeuvre (the sole exception being a passing mention in Veltman (1986)⁴). The line of the coastline is considered too curly and the notations too plain to match da Vinci’s other works; thus, although it is occasionally acknowledged as his overall conception, the execution is commonly considered to be the work of a pupil. It should be noted, however, that all the features discussed to this point are those of conception, and thus should be accepted as relating to his autograph contributions to the design of the map, even if it is a copy of his original. More recently, key evidence of da Vinci’s ownership of the world map has emerged from references to it in the *Codex Atlanticus* (Cecchi, 2003). He was a good friend of the rich merchant’s son Giovanni di Amerigo di Benci, brother of the 17-year-old Ginevra di Benci whose portrait da Vinci had painted in about 1473 (now in the National Gallery, Washington DC). The two young men evidently had a close working relationship, because da Vinci has notes among his papers in the *Codex Atlanticus* about exchanging books, precious stones and supplies (such as “brass for eyeglasses”) with Giovanni Benci. It was to Benci that da Vinci entrusted his most ambitious work of that period, the full-scale cartoon for the unfinished ‘Adoration of the Magi’, when he left Florence for Milan in 1482. Of particular relevance here is the scribbled reference in his notes to “my world map that is with Giovanni Benci” (Bambach, Stern, Manges, 2003), providing unequivocal evidence of his involvement in global cartography at some point in his career. A key link to da Vinci’s works is a remarkable page from his notebooks containing an intensive exploration of what seems to be all the known cartographic projections of the globe at that time (reproduced in Figure 6, above right). Each miniature sketch represents a different projection geometry, with several of them showing projection lines or shadows, clearly indicating that he understood them as geo-

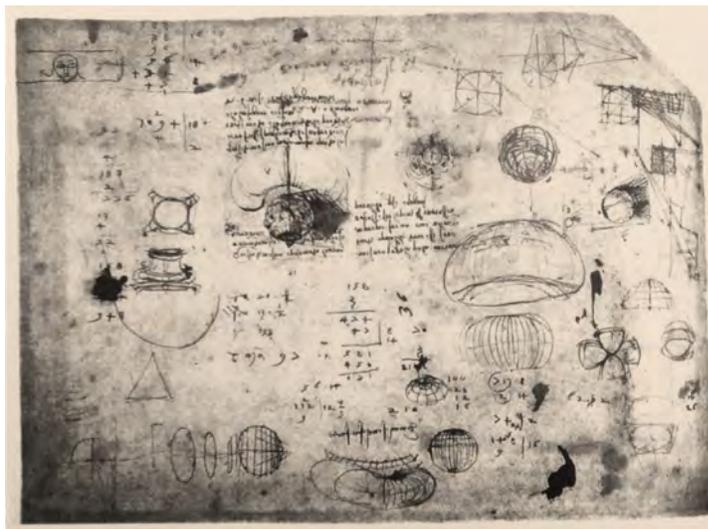


Figure 6. A page of Leonardo da Vinci’s cartographic notes showing a variety of projections of the terrestrial globe (*Codex Atlanticus*, 521r, 1478-1519). Note the shadowed depiction of a hanging globe near the center.

metric projections of the globe, not simply images from some maps that he may have had to hand. In particular, da Vinci includes (at lower right) a clear reference to the octant triangular projection, tightly coupling this evidently autograph sheet to the conception underlying the *mappamundi*. Taken together with Figure 3, this notebook page seems to remove any grounds for questioning da Vinci’s authorship of the unique *mappamundi*. Even if it is in fact a copy by a pupil, no pupil is likely to have had the kind of knowledge required to make major modifications, so we are safe in assuming attributing the conception to da Vinci himself.

To highlight the variety of projections considered in this notebook page, they have been isolated in Figure 7 (next page) and annotated with the originator of each form of projection (as far as they are known). Three date back to Roman times, as represented by the *Geographia* of Claudius Ptolemy, which had recently (in 1410) been translated and distributed by Jacopo da Scarperia, and of which da Vinci was known to have owned a printed copy with illustrations. He must have been among the many whose global conceptualizations were expanded and regularized by this systematic presentation of geographic information. Few, however, are likely to have gone into such depth in the analysis of the forms of projective geometry, and the scope of da Vinci’s analysis is a further reason for assuming that he most likely sought out the counsel of an experienced cartographer like Toscanelli for discussions of these ideas.

Further evidence that da Vinci had a larger conceptualization of global exploration is found in an allegorical drawing of unknown date, but undoubted provenance (Figure 8, next page). (Notice the characteristic Vinciesque rocks in the background

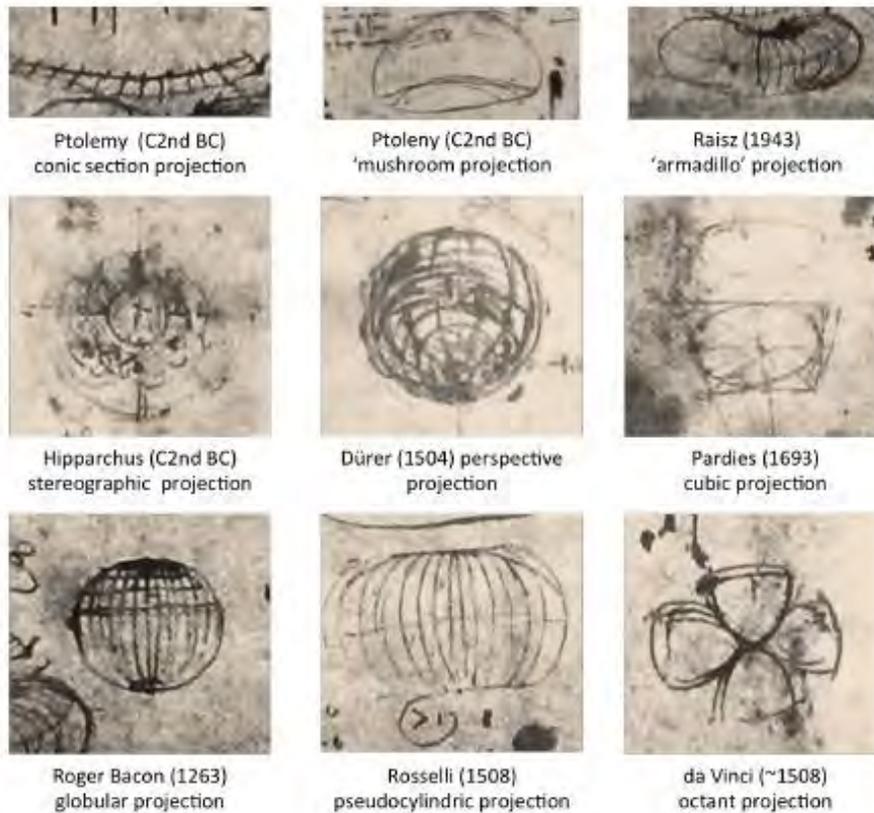


Figure 7. Identification of the precursors or earliest known examples of nine different projections explored by Leonardo da Vinci in his notebook page. For those projections dated later than 1508, his drawings should be effectively considered the original precursors.

at left.) This drawing shows a seafaring animal (apparently a wolf) using a compass-like device to target an eagle perched on a globe. The emblem of Isabella, the Queen of Spain in that era, has been inset for comparison, supporting the suggestion that the navigation target represents the Spanish throne (which was the actual patron of both Columbus' and Vespucci's voyages to the Indies). The suggested interpretation is that this image represents the conceptualization of global exploration under the Spanish aegis, and that da Vinci was indeed somehow involved in that enterprise. One can imagine that, in enthusiastic discussions of global geography with Toscanelli, da Vinci was the one pushing to ask how the continents were located in relation to the Atlantic Ocean, with Toscanelli bringing his cartographic experience to bear on the details of the answer. Da Vinci was also an acquaintance of Amerigo Vespucci, who was a cousin of the Medici and also of Simonetta Vespucci, whose wedding to another cousin Marco Vespucci at the Medici

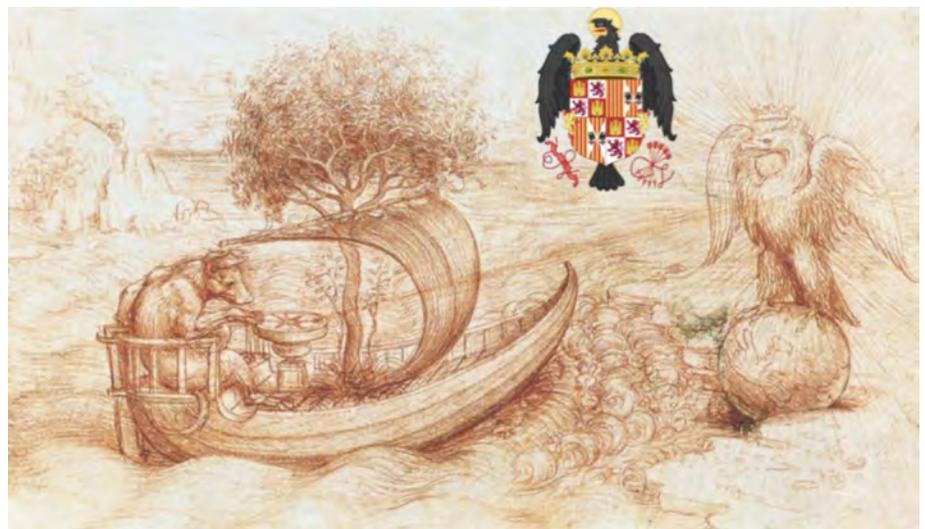


Figure 8. Allegorical drawing of a voyage of discovery (Leonardo da Vinci, Royal Library, Windsor). Inset: emblem of Queen Isabella of Spain.

Notes

- 1 The Jagiellonian globe from the same period matches da Vinci's configuration in these respects, although the apparent match to the 'island' Florida is unmarked. Its dating,

Palace in that same year (1469) was the inspiration for Botticelli's famous paintings of the 'Birth of Venus' and 'Primavera'.

Jumping forward several centuries, we find that Cahill (1909) developed a connected version of the da Vinci octant projection to map the challenge of a flight around the world (Figure 9, next page) for the San Francisco Pan-Pacific Exposition of 1915. How da Vinci would have appreciated this combination of two of his lifelong interests! To provide more extended connection regions, Cahill slightly distorted the da Vinci octants into figures with straight-edged segments, then connected them into four pairs of north-south quasi-octants into a "butterfly map" that allowed all the continents except Asia and Antarctica to appear as connected landmasses. Several of the continents are rotated to extreme angles relative to their natural north-south axes, however.



Figure 9. Connected quasi-octant map by Bernard J. Cahill (1909). Note that the coastline of Antarctica is still only partially mapped, even

however, is speculative, and the match to the detailed configuration of the world coastlines is not close enough to suggest that they are by the same hand.

- 2 Given the widespread publication of the Waldseemüller map, lack of indication of Central America and Florida in the Hunt-Lenox globe would push its dating earlier than the 1507 of Waldseemüller's map.
- 3 Note that this revised dating for da Vinci's world map nullifies the suggestion in Tyler (2018) that it would have benefitted from his consultation with the Portuguese ambassador in Rome in 1514.
- 4 In the Codice Atlantico we find sketches of a globe being unfolded that is not far from Waldseemüller's pseudo-Ptolemaic, cordiform projection (1507). Veltman (1986).

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Portion of octant displaying the placename "America"

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Christopher Tyler's scientific interests are in visual perception and visual neuroscience. His research has contributed to the study of form, symmetry, flicker, motion, color, and stereoscopic depth perception in adults and he has developed tests for the diagnosis of eye diseases in infants and of retinal and optic nerve diseases in adults. He has also studied visual processing and photoreceptor dynamics in other species such as butterflies and fish. With regard to Leonardo da Vinci, Tyler's interest has been on octant projection, a type of projection proposed for the first time, in 1508, by da Vinci in his *Codex Atlanticus*. and illustrated in his World Map.