# The Da Vinci Globe

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*To be allowed to see the beginning of the early modern through the eyes of Leonardo da Vinci is a gift of Fortune.*

—Professor Dr. Stefaan J. Missinne

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# PREFACE

The origin of this monograph can be traced back to the first exciting weeks after the discovery of the small unrecognised treasure in London, in June of 2012.

The serendipitous finding of an artefact of Leonardo da Vinci from 1504 is a mesmerizing thrill, ever expanding and growing. Numerous international academics and visitors, who have accepted an invitation for a private viewing, have expressed their positive sentiment and wonder at such an amazing discovery. Their suggestions and advice prompted me to write this book.

Trying to find a world-leading authority on Renaissance globes is not easy. There are not many surviving globes from the early-sixteenth century, for one thing. Finding an independent and qualified expert on Leonardo da Vinci *and* on Renaissance globes is quite impossible.

To research the life, cartographic works, techniques, comparatives and similarities of Leonardo da Vinci, I completely absorbed the available bibliographic knowledge in order to read, capture, consult, discuss, review, correct, learn and formulate. This research brought me to leading libraries in Florence, Rome, Milan,Vinci, Paris, London, Venice, New York and many others.

The resulting book is unique in many ways. Leonardo thought in pictures, so I decided to include numerous Da Vinci drawings, phrases and pictures of the Ostrich Egg Globe and its details (© stefaan missinne 2018).

Leonardo was one of the first, scientifically, to build empirical models to support his theories, so I used his approach; where he three-dimensionally drew what he saw, so I too decided to think and formulate like Leonardo.

This discovery of the globe of Leonardo da Vinci may turn out to be one of the most important cultural events in the first two decades of the twenty-first century. Its significance could be seen as equal to the discovery of the Stone of Rosetta, the scrolls from the Holy Sea or the Venus de Milo in previous centuries.

A discovery as wonderful yet unusual as this may take many years to work its way into the research world. The beauty of Da Vinci is that despite criticism, such attention only serves to heighten the experience, to make the image more classical, and to continue the experimentation. The curiosity of technique and the evidence offered might prove to be a bitter pill for some academicians to accept. Established theories are called into question. Yet, this is something that Da Vinci himself excelled at.

The timing of this book is not coincidental. Its publication takes place the year prior to the many worldwide commemorative exhibitions and events planned for the 500-year anniversary of Leonardo´s death on May 2, 1519.

As a very open minded and curious child, I admired a small globe on a wooden stand in our family home library in Belgium. Once the top screw of the inclined metal axis was lost, and I could hold the small world in my hand. No longer was north upside. Also, I could now easily examine the southern hemisphere which became to me an eye opener of new knowledge.

Most certainly, more than five hundred years ago, upon demonstrating this small globe, showing an open seaway from Florence´s Arno to the new world, the same sense of astonishment must have captured the souls of his Tuscan friends such as Giovanni d´Benci.

This astonishing feeling of holding the world in the palm of one's hand *like a tilting toy* can be repeated every day and any day by everyone, somewhere on earth. Leonardo was historically the first ever to make and hold it.

Numerous people have supported me, and I especially wish to thank my parents for allowing me to uncover and to become an independent thinker and world traveler from an early stage on.

Discovering the Da Vinci Globe allows me to share this experience with my readers. Since my find which was published in the worldwide news in 2013, the list of acknowledgments has become longer and longer, and I am grateful to all who have kept the research progress secret.

I would like to to thank the testing laboratories in Vienna, Munich, Mannheim, Zurich, Berlin, Ravenna, Tulln, Wiener Neustadt and Innsbruck and the written irrevocable endorsements of both the Ostrich Egg Globe and its identical copper cast twin, the Lenox Globe, amongst others from the Head of the Archive of the Vatican State. I particularly wish to thank my family for supporting such a research endeavor, of being encouraging and understanding, and for providing an emotional environment which allowed me to think and understand Leonardo.

The heavy costs of such seven year long research were borne lightly making their support even more crucial to the completion of this work.

Finally, I owe special thanks to numerous esteemed Leonardo da Vinci scholars in general and from Italy in particular and visiting Ambassadors to Austria, together with their spouses, from Belgium, France, Spain, Portugal, Brazil etc. and other foreign dignitaries who have shared the thrill of this discovery from the Italian Renaissance. Indeed, their questions, expressions of curiosity and learned expertise have fuelled the fire of this research book by asking numerous questions, the making of erudite suggestions, and the referral to other unique and independent researchers.

I wish to share the results of the painstaking research, and the sensation of this veritable icon, which Leonardo in 1504 calls *my globe* with the readers of this book. A film documentary and a non-fiction book are in the works to be completed.

Finding the Da Vinci Globe is a tremendous experience. Noting the new and unusual geographies shows the true curiosity of the mind of a universal Genius.

To accomplish both tasks heralds a special genius which I hope to share with you for generations to come.

Professor Dr. Stefaan Missinne, Vienna June 2018.

# INTRODUCTION AND METHODOLOGY

The present book is based on research that started in 2012 and which was completed in 2018. The initial phase of the research concentrated on the scientific examination of the Ostrich Egg Globe, substantiated by cartographical data. I therein refer to the discovery of the Ostrich Egg Globe and subsequent publication in the Portolan that followed. For authentication, interdisciplinary research was combined with desk and intensive field research. This was supplemented by data from experts in different disciplines such as in the history of cartography, mathematics, the history of art, the history of the Italian Renaissance, casting techniques, physics, cosmography, iconography, graphology, etc.

Worldwide attention to the discovery of the oldest engraved globe in the world, for example in journals such as *Nature*, *Wired*, etc. was fuelled by the publication of an article on page three of the Washington Post in August 2013. Genuine interest resulted in a flood of requests for additional information: the astonishment was worldwide. This initial work was followed by further research concentrating on additional Italian sources. Personal contacts with experts on Leonardo da Vinci, such as Prof. Carlo Pedretti and Italian Renaissance cartography experts such as Univ. Prof. Dr. Leonardo Rombai, were established.

This culminated in a demonstration of the findings for the Italian Geographical Society, at the invitation of Prof. Dr. Leonardo Rombai in Rome in 2014. At this time, the research on Leonardo and his works came to the forefront as I was offered the role of scientific advisor on Leonardo for an exhibition in Nuremburg. In addition, I appeared on German television and, subsequently, on Belgian TV.

At the exhibition in Nuremburg, several presentations were given on the chemical research performed by Leonardo, as well as on a miniature skull attributed to him. The findings on the latter were published in the *Wiener Medizinische Wochenschrift*, a medical journal published by Springer Publishing. During the second phase of my work, the Washington Map Society agreed to publish a few auxiliary research findings on the Ostrich Egg Globe.

An article on the oldest American Birth Certificate ca. 1507 was published 2015 in SCIRP by Scientific Research Publishing. This article was downloaded worldwide more than 4,000 times over a period of two years (an average of more than 5 times a day). This was followed by an invitation, from the Armenian embassy in Austria, for me to give a public presentation on the discovery of the word "*ARMENIA*" on the Ostrich Egg Globe; this lecture was delivered at the symbolic venue of the Austrian National Library in Vienna. The international attention aroused by this article ultimately created the initiative to write this book.

In the history of art "*Leonardo da Vinci*" is a magic name, automatically drawing the intense attention of the scholar, while also being a magnet for critique. In the academic field of art history, there are many important figures: Pedretti, Kemp, McCurdy, Kwakkelstein, Bambach, Clayton, Zöllner, Richter, Starnazzi, Bernardoni, Clark, Brown, Galluzzi, Villata, Camerota, Shell, Caruso, Veltmann, Marani, Suida, Vecce: just to name those who always "turn up." Each one of these art historians has concentrated on specific aspects of Leonardo's *oeuvre*, such as his drawings, his paintings, his codices, etc.

Their academic connoisseurship—the validation of the attribution based on an expert's eye and the application of the standard repertoire of art-historical argumentation and counter argumentation—may be somewhat limited and, thus, difficult to apply to a globe. As a consequence, the interdisciplinary research on particular objects, such as a globes or scientific instruments, remains a much undeveloped field, particularly with regard to Leonardo da Vinci. Hence, reading a globe as a piece of art is something of a novel experience.

The discovery of an early 16$^{th}$ century object, possibly originating from the workshop of Leonardo, raised some so-called "red flags." The latter included certain assumptions made about the Ostrich Egg Globe: a 19$^{th}$ century scrimshaw; a 20$^{th}$ century forgery of the Lenox Globe; a copy made using a fax machine; a plastic replica of the Lenox Globe; and even a recent work by a carpenter. These are known as "pars destruens," or demolishing parts, all of which could have been dismissed, are nevertheless considered and discussed in this publication.

The arguments in defence of Leonardo's paternity of such "pars construens" are also the subject of this book. These include: the logic of the globe in Leonardo's artistic works; the authorship proposal; the iconographical vocabulary of the ostrich egg; the finding of a unique world map showing America among his codices; the experimentation with new techniques and materials; the geographical scale of the globe with Leonardo's calculation of the diameter of the world; the stylistic characteristics of details such as those from ships and monsters of the globe; the hairstyle of the drowning sailor; the finding of arsenic in a red copper micro droplet on the egg shell and the left-handed hatching, some of which is crossed; the solving of the problem as to the origination of the phrase "*here are dragons*," and "*ANFURION*," etc.

The codices of Leonardo, as primary sources, were studied in great detail. This was combined with a critical analysis of the existent literature, the systematic translation of texts, as well as fresh literary criticism of my own. This research specifically excluded a nation-based approach. I primarily concentrated on the period of Leonardo's intensive studies of geometry. The interdisciplinary approach adopted was supplemented with a critical historiographical assessment, studying recent publications on Leonardo's inventions and numerous scientific techniques such as computer tomography (CT), x-ray fluorescence (XRF), carbon-14 dating (C-14 analysis), strontium isotope tests (MC ICP MS) and electron microscope analysis (CED-REM).

Numerous books have been published on Leonardo and his works. The competition among the above-mentioned art historians to stand in the shadow of the light of Leonardo is fierce. Such interest, however, is not always purely academic, and this has led to long and intense discussions. As to my own research area, the still-dark aspect of Leonardo's experimentation with globes, this has been ignored.

It was Professor Carlo Pedretti, my mentor, who was willing to give the initial impetus to my research in the second of the three above-mentioned phases. Without his support and academic understanding, it would have been impossible to complete this book. Thank you Dr. Carlo Pedretti, as I also thank the many academics and globe specialists in the list of acknowledgements.

Instead of the word "*folio*" I utilise the word "*page*" throughout this book. The reason for this is that while "*folio*" does mean leaf, it has an additional meaning: size (fo), which refers to a method.

As Leonardo never published a book during his lifetime, the sizes of his codices all differ, and the recto or verso of the page is identified: another reason why I chose to use the word page instead of folio.

Another methodological characteristic of this book is that pictures are used where possible. As the common saying expresses it: "a picture speaks a 1000 words." Lastly, all references to Leonardo and to the codices used in this publication can be traced online at www.leonardodigitale.com. Wherever possible, the vernacular Renaissance Italian inscribed by Leonardo was checked and translated before being used. To understand Leonardo and his works it is necessary to understand the iconographic finesse of his artistic message, and be able to "read between the lines" of what is apparent. Appendix I offers a summary of the material evidence that was discovered. Appendix II offers the Italian vernacular spelling used by Leonardo in his codices. Mirror writing being his favourite, there is a method available (on the webpage mentioned above) to turn his writing around, a feature that helps researchers unveil and shed light on the dark secretiveness of Leonardo's brilliant mind. An extensive timeline of Leonardo's Ostrich Egg Globe, from initial visionary experiments to finished artifact and Vincian codices and manuscripts and copies thereof, is presented in Appendix III. What turns out to be a real detective story, ends with a host of remarkable and significant conclusions.

# CHAPTER I

# PHYSICAL DESCRIPTION OF THE OSTRICH EGG GLOBE AND THE OSTRICH EGG IN THE ITALIAN RENAISSANCE

The Ostrich Egg Globe is approximately 11 cm in diameter. This size amounts to 1/5$^{th}$ of a Florentine Braccio of 55.12 cm. Eleven centimetres simultaneously embosses the Renaissance dimension of 1 ½ Palmus Minor, which is 1 ½ the size of lower-half hand palms, or the width of 6 fingers.

Picture: the late Prof. Rudolf Schmidt,[1] connoisseur of scientific instruments and globes, former President of the Coronelli Society, and the biggest globe collector in the world, inspecting the Ostrich Egg Globe in Vienna, November 2012. © Stefaan Missinne 2012.

The Ostrich Egg Globe is not ovoid, but is constructed by using the lower halves of two different ostrich eggs. It is a very haptic and intriguing object. The condition of the Ostrich Egg Globe is good, but it does show a history of *not* having been treated according to its real significance.[2] The provenance of the artistic object has been traced back as far as possible. This so-called "cartographical curiosity" escaped notice of so many cartographic experts, and was ultimately discovered late on Saturday afternoon, June 16$^{th}$, 2012, at the London map fair: an event organized annually

[1] Prof. Rudolf Schmidt (1924-2013) offered me, in the second half of 2012 as the elder person, his informal "*du Wort*" which means the befriended "*you word*" to address a familiar third person during the meeting in which I showed him the Ostrich Egg Globe. At that time we had known each other for more than 20 years.

[2] For a book on ostrich eggs in European art chamber collections see, S. Bock, *Ova struthionis. Die Straußeneiobjekte in den Schatz-, Silber-, und Kunstkammern Europas,* Freiburg i. B.: Verlag S. Bock, 2005. The foregoing work is based on a dissertation but does lack some significant samples of early artistic work of ostrich eggs in Italian art chambers such as the ostrich egg cup (Inv. BG 1817(II) no. 18) in the Museo degli Argenti in Florence. See, T. Sutton, *The Classification of Visual Art: A Philosophical Myth and its History*, Cambridge, 2000 and E. Dekker; P. v. d. Krogt, *Globes from the Western World*, Zwemmer, London, 1993.

by the International Map Collectors Society.[3] The Dutch dealer, who sold the globe as a 19th century scrimshaw artefact, said that he had purchased it early that same day from another dealer, and that he was informed that it had been part of an important European collection for many decades.[4] It is well worth comparing the provenance of the Ostrich Egg Globe with that of the Lenox Globe.

The research devoted to tracing the provenance of the Lenox Globe ends on the Quai Voltaire, near the French Royal Palace. In ca. 1854, in an antiques shop on the bank of the River Seine, the architect R. W. Hill, who worked for James Lenox, purchased the copper globe for "a song."[5] So it seems that, in both cases, these artefacts escaped notice and were erroneously mis-identified by their seller. In addition, one may confirm that, in both cases, the artefact was sold subsequent to a crisis or a war. In France, in the aftermath of the Napoleonic wars, metallic and other raw materials were extremely scarce, whereas in England after the Second World War, people were so desperate for any additional income, so many "*antiques*" and articles considered valuable were sold.[6]

Neither the Lenox nor the Ostrich Egg Globe has a mounting.

The bottom half of the Ostrich Egg Globe shows a circular discolouring from having been put on a wooden circular object. Small white calcium "dots" are visible in some of the engravings on the Ostrich Egg Globe. These only show in certain locations, such as in the Caribbean, or in northern Europe and Asia. The fact that they randomly protrude, and are relatively small, is a signal that they are the result of heat treatment during casting.

The ostrich eggs so utilized must have been selected on the basis of their colour, their material, their unique iconographic significance[7] and, last but not least, their diameter.

The last is crucial. As the eggs are hollow and spherical, a good fit saves costs and materials during the lightweight casting process.

The lower half of the globe has a hole at the bottom. This is where the egg dotter from the bottom of the lower ostrich egg exited the egg.

The North Pole of the Ostrich Egg Globe does not have a hole from the extraction of the ostrich egg: it is complete. This means that the egg dotter of the upper ostrich egg was extracted after cutting the upper ostrich egg in half.

In other words, both Ostrich egg halves were not only chosen on the basis of their similar diameters and degree of fit, but also so that they might portray the diameter of the existing Renaissance world once joined together. As there are no traces, marks or scars from the leather straps used for carrying the eggs on the surface of the globe, this is proof that they came from a domestic source.

Another proof is that only one of the two egg halves has a hole at the bottom, and the second lower half is intact. This is irrefutable evidence that these egg shells did not come from Africa, as African ostrich eggs were transported empty, hanging in leather straps.

As an African source for the eggs can be excluded then, only a European provenance remains possible. [8]

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[3] P. Temple, "Mapping the price of Atlases," *Financial Times*, August 3rd, 2012.

[4] S. Missinne, A newly discovered early 16th century Globe Engraved on an Ostrich Egg: The Earliest Surviving Globe Showing the New World, *The Portolan*, Issue 87, 2013, p. 8. Three rather peculiar aspects of the sale were combined. The first was that the globe dealer had to look-up the buyer in the late afternoon and not vice-versa. In addition, the calculated purchase and analysis was completed in only ca. 5 minutes, after using a 2 euro vintage black glass eye magnifier (1 in - 10 x, Bausch & Lomb Upticalco Rochester NY USA) to inspect the surface of the land masses and intricate waves of the astonishing object. The very brief time to decide upon the purchase was fuelled by the mere disbelief that no one had recognised and/or bought this. The third peculiarity was the fact that a black and white picture (in the book by E. L. Stevenson, *Terrestrial and Celestial Globes,* Yale University Press, 1921, p. 73) of a strange looking, standless and small globe, came into my memory at the time of seeing the object through the magnifying glass.

[5] R. W. Hill, The Lenox Globe, *Bulletin of the New York Public Library*, Vol. 41, Nr. 7, July 1937, pp. 523-525.

[6] See, R.M. Hartwell, *The Causes of the Industrial Revolution in England*, Routledge Library Editions: The Industrial Revolution, London, 2017. Apparently, the owner of the Lenox was offered by the British Library the value of 2000 English Pounds, which was for the late 1880's an extremely high sum.

[7] E. von Philippovich, *Antiquitäten und Kuriositäten*, Klinkhardt & Biermann, Braunschweig, 1966 and S. Bock, op. cit., p. 2.

[8] There are numerous cases where the provenance of an important globe or map "*begins*" in the 19th or 20th century. An example is the Cantino map dating from 1502 that was found by Dir. Giuseppi Boni in 1859 in the window of a butcher's shop in Modena. See E. Roukema, "Brazil in the Cantino Map," in *Imago Mundi*, 1963, Vol. 17, pp. 7-26. The Caveri Portolan dating from ca. 1504 and which is kept at the French National Library was found in Paris in 1890.

Picture: North Pole on the Ostrich Egg Globe. Observe the wavy undulations and the ecliptic North Pole to the right of the magnetic North Pole. © Stefaan Missinne 2017. Photograph courtesy of Geert Verhoeven.

During the investigation on the globe, and purely by coincidence, a coloured manuscript painting of a 14th century ostrich was found with the help of the Il Bulino company in Modena, Italy. The manuscript pictures an ostrich in Pavia in the garden of the Viscount of Milan.[9]

The Struzzeria of the Viscounts of Milan in Pavia[10] is the only known European source for unhatched ostrich eggs in the 14th[11] and 15th centuries.[12]

It followed the 14th century "Ménagerie" tradition of the Viscount of Milan in the gardens of the palace of Azzone, in Milan. In the second half of the 16th century this "tradition," which included ostriches in captivity, was continued in Florence.[13]

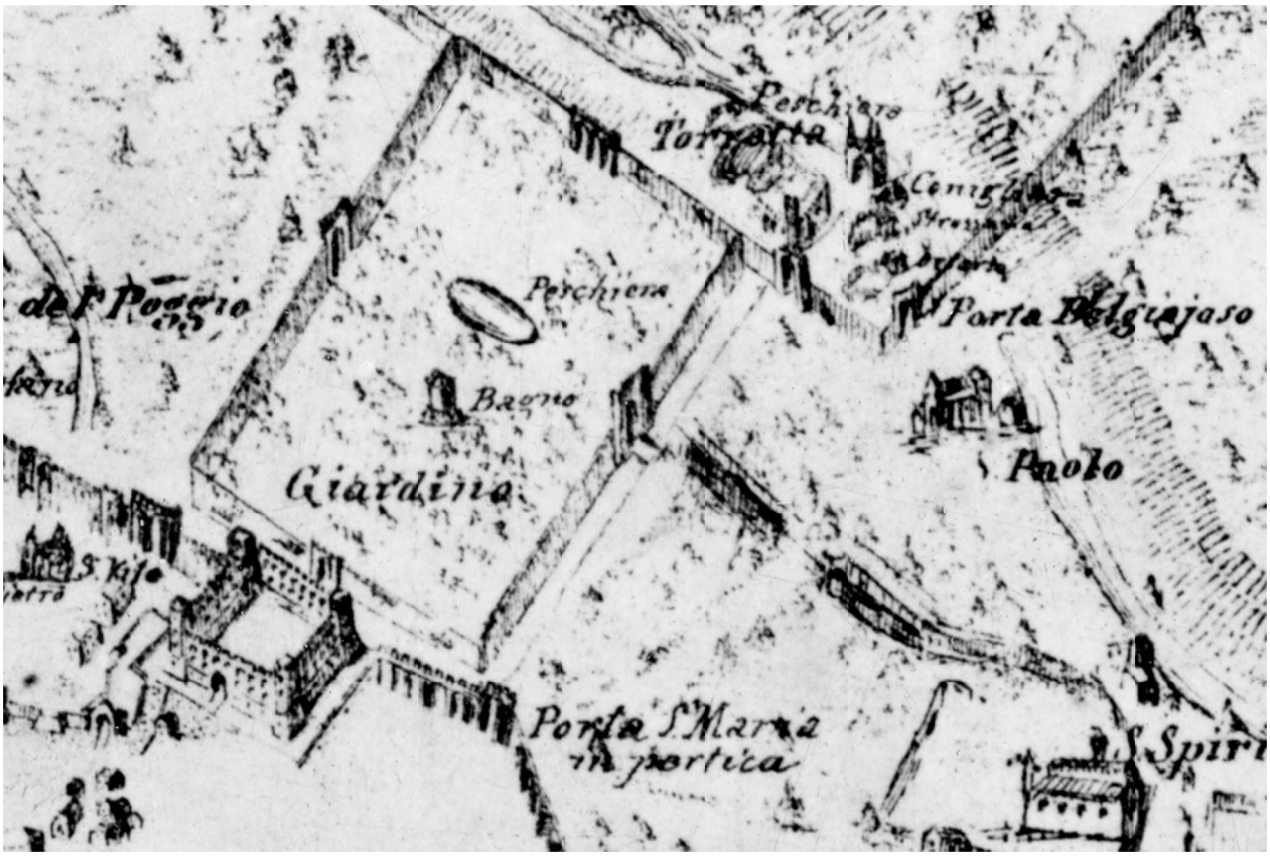
[9] The facsimile is titled *Sphaerae coelestis et planetarum descriptio* (De sphaera) del sec. XV (ca. 1470): conservato alla Biblioteca *estense di Modena*, Il Bulino, Modena, 1995; the accompanying volume of commentary, edited by Gianni Venturi, is titled *De sphaera: commentario all'edizione in facsimile del codice miniato* α.*X.2.14 = lat. 209 della Biblioteca estense universitaria di Modena,* Il Bulino, Modena, 2010.

[10] Davide Tolomelli from the Civil Museum of the Viscount Castle in Pavia cites il Magenta: *I Visconti e gli Sforza nel Castello di Pavia*, Milano 1883, p. 120 and the written document dated 1453 kept at the conservato all'Archivio di Stato di Milano with the citation: "*la truzzara quale responde verso la strata de Sancta Maria impertica*," which means: The captive area of the ostrich birds in Pavia is near the street of Sancta Maria im Pertica (i.e. the present Via Santa Maria alle Pertiche). Stefano Breventano quotes a third source: "*Istoria delle antichità di Pavia*," published in 1577. He refers to: "*struzzaria, dove stavano rinchiusi molti* struzzi," which means: "*the ostrich bird garden where numerous ostriches were kept enclosed*". I thank D. Tolomelli for his personal E-Mail dating from March 17th, 2017.

[11] See, R. Maiocchi, *Codice diplomatico artistico di Pavia. Dall'anno 1330 all'anno 1550*. 2 vols., Tipografia gil Cooperativa di B. Bianchi, 1996, Pavia, (1937-1949). Index published separately: R. Cipriani, *Indice del Codice diplomatico artistico di Pavia dall 'anno 1350 al 1550 pubblicato da Mons. R. Maiocchi.* Instituto Lombardo di Scienze e Lettere, 1996, Milano.

[12] See, D. Vicini, *Il Castello Visconteo di Pavia*, Edizioni Antares, Pavia, 1991.

[13] G. Loisel, *Histoire des Ménageries de l´Antique à nos jours*, Vol. 1, Paris, 1912, p. 200.




Picture: Parco Visconteo in Pavia with the Struzzeria (Ostrich breeding place) located above the Porta Belgiajoso and adjacent to the Conigliaria (rabbits). Note the Porta S. Maria in Portica to the right of the Castle of Pavia[14] © Musei Civici del Castello Visconteo 2018.

Both Giorgio Vasari's (1511-1574) painting at the Capodimonte Museum in Naples and the drawing in the Devonshire Collection, at Chatsworth, of Farnese Justice, dating from 1543, illustrate the existence of an ostrich bird laden with the twelve biblical tablets.[15]

[14] C. Magenta, *I Visconti e gli Sforza nel Castello di Pavia*, 2 vols., Milano 1883.
[15] See L. de Girolami Cheney, "Giorgio Vasari's Justice: Political Glory for the Farnese family," *Iconograzia 10/2016, November 11th, 2016.*

Picture of an ostrich and a mastiff from the garden of the Viscount in Pavia: pen and ink, watercolour, and white heightening. Quaderno di Disegni, late 14th century. Courtesy of Bergamo, Biblioteca Civica Angelo Mai e Archivi storici comunali, Giovannino de' Grassi, *Taccuino di disegni*, ms., sec. XIV, c. 2v. .[16]

A rather famous painting with an ostrich egg hanging from a huge Jacob's Shell, the symbol of the divine conception of Mary, is by Pierro della Francesca (1420-1492). The Diptych is called: Enthroned Madonna and the Saints adorned by the kneeling Frederico Montefeltro (1422-1482), Lord of Urbino.

[16] This picture provided by the company Il Bulino, Modena, Italy. Notice the high level of detail which provides evidence that this drawing was made from a real ostrich. This is in contrast with the depiction of the idealised ostrich "*Ostrych*" holding a large nail in its beak as in bestiary called the *Tudor Pattern Book*, Bodleian Library Ms Ashmole 1504, fol. 40r dating from between 1520 and 1530. For more depictions of ostriches in bestiaries, I refer to www.larsdatter.com/ostriches.htm accessed October 1st, 2017.

Picture: Pierro della Francesco, The Brera Madonna, Tempera on Panel, Pinacoteca, Brera, Milan. Public Domain.

The painting dates from ca. 1472-1474 and was kept at the Castle in Urbino. In this famous painting, a large ostrich egg is hanging from the shell in the chapel above the virgin, who personifies the church.[17] In the bible, "*the wonders of power and providence of God in many of his creatures*" is printed. I refer to the Book of Job 39:13-17 which refers to ostriches.

[17] H. B Werness, "The Continuum Encyclopaedia of Animal Symbolism in Art," *Continuum*, New York & London, 2006, p. 157.

Picture: The Brera Madonna, Altarpiece – Detail, Pierro della Francesca, Tempera on Panel, Pinacoteca, Brera, Milan. Public Domain.

The aspect of anamorphosis was taught by Pierro della Francesca (ca. 1420-1492), author of "*De Prospectiva Pingendi"*[18] to Luca Pacioli (1445-1517)[19]. The foregoing was the mathematics teacher of Leonardo with whom he worked in Milan in 1509.[20]

In Codex Arundel Ms 263,[21] page 94 verso, Leonardo draws a large egg with a dotter and explains how the dotter is "*hanging*" in the middle of the egg white. This is described in Libro I of "*Della Pittura*" making use of the wording *guscio dell´uovo i.e.* "*egg shell*" by Leon Battista Alberti published 1435 and admired by Leonardo.[22] This may have inspired Leonardo to experiment with Ostrich Egg Shells.

Leonardo explains why the earth is "*hanging*" in the centre, representing the centre of the universe: *"perché la terra è assista nel miluogo di tutti i cerchi e di tutti i torniamenti, cioè il fondo de'cieli e degli elementi*."

[18] See too, J. V. Field, *Pierro della Francesca, A Mathematician's Art,* Yale University Press, Yale, 2005.
[19] See, G. M. Ziegler, *Mathematik. Das ist doch keine Kunst*, Knaus Verlag, München, 2013.
[20] Ross King, *Leonardo and The Last Supper*, Bloomsbury, London, 2012, pp. 162-164 and footnote 27 of chapter II.
[21] See, the *Catalogue of Manuscripts in The British Museum, New Series*, 1 vol. in 3 parts, London, British Museum, 1834-1840, I, part I: *The Arundel Manuscripts* and Philip Howard, *The British Library: A Treasure House of Knowledge,* London, Scala Publishers, 2008, no. 41.
[22] The formulation by Alberti is: "*Dicono la spera essere uno corpo ritondo, volubile in ogni parte, in cui mezzo siede uno punto, dal quale punto qual si sia parte estrema di quel corpo all'altre simile sia distante. La superficie cavata sarà dentro, sotto l'ultimo estremo della superficie, sperica, quasi come drento il guscio dell'uovo. La superficie composta sarà quella che per uno verso sia piana, per un altro verso sia cavata o sperica, qual sono drento i cannoni e di fuori le colonne."* Source: Leon Battisti Alberti, *Della Pittura*, Libro I p. 4, 1435. Accessed online December 27th, 2017:
https://www.liberliber.it/mediateca/libri/a/alberti/de_pictura/html/libro01.htm. The English translation is as follow: "*The flat plane is that which a straight ruler which will touch in every part if drawn over it. The surface of the water is very similar to this. The spherical plane is similar to the exterior of a sphere. We say the sphere is a round body, continuous in every part; any part on the extremity of that body is equidistant from its centre. The hollowed plane is within and under the outermost extremities of the spherical plane as in the interior of an egg shell. The compound plane is in one part flat and in another hollowed or spherical like those on the interior of reeds or on the exterior of columns*." Viewed on line December 27th, 2017.
http://www.noteaccess.com/Texts/Alberti/1.htm

Picture: Egg with dotter compared to the earth as the centre of the Universe. The British Library Board, Codex Arundel Ms. 263 page 94 verso.

There are many drawings by Leonardo[23] depicting a world as seen from a suspended weight resembling a hanging egg, e.g. as represented in his Codex Atlanticus, page 318 recto dating from ca. 1499-1500. This significance of this cannot be underestimated. The Codex Atlanticus is a unique and highly instrumental manuscript notebook consisting of twelve large volumes by Leonardo da Vinci dating from 1478-1519.

Leonardo da Vinci had access to the paintings and research of this Pierro della Francesco (ca. 1420-1492) a significant pivotal early Renaissance painter, art historian and mathematician.[24] Leonardo did spend time at the Castle of Urbino,[25] its famous library and "*studiolo*," a study room.[26]

[23] For Leonardo's life, inventions, paintings, etc. see the 985 bibliographical references originally compiled by Maureen Cobb Mabbot, *Catalogue of the Lieb Memorial Collection of Vinciana*, 1.12.1936. www.library.stevens.edu
[24] See, P.C. Marani, *Leonardo, una carriera di pittore,* Federico Motta Edit, Milan, 1999.
[25] See, E. GAMBA, Proviamo a rileggere il "Doppio ritratto" di Luca Pacioli, in F.M.Cesaroni, M. Ciambotti, E. Gamba, V. Montebelli, *Le tre facce del poliedrico Luca Pacioli*, pp. 81-97.
[26] See, U. Roman d´Elia, *Raphael´s Ostrich*, Penn State University Press, 2016.

Picture: A hanging astrolabe and armillary sphere in the inlaid woodwork of the studiolo at the Castle of Urbino. Picture courtesy of Robert Kirkbride 2008.

Leonardo drew and noted down "*fortezza d'Urbino*" or Fortress of Urbino on page 40 recto, page 78 verso in the Manuscript L, dating from 1502-1503.[27]

In his Codex Atlanticus, page 349 verso, Leonardo refers to the Copy of Archimedes he had seen in the magnificent library of the former Duke of Urbino, Federico de Montefeltro (1422-1482). The latter had as motto the ostrich that bites a nail, a signal of very tough endurance. The celebratory ostrich is depicted in the woodwork of Montefeltro's studiolo, which Leonardo visited while in Urbino.

Urbino is the birthplace of Raffaelo Sanzio da Urbino who was born in 1482. Between 1504-1508, the young Raffaelo is known to have paraphrased[28] some of the work of Leonardo.[29]

Possibly the Ducal palace and its richness in decoration influenced the specific choice to paint an ostrich.

This kind of decoration can be seen in the fresco by Raffaelo dating from 1519 in the Papal Sala di Constantino, where Lady Justice holds the traditional attribute of the scales in one hand, but the other is curled around the long neck of an ostrich.[30]

According to Manuscript L, page 78 verso, on August 1st, 1502, Leonardo was in the library of Pesaro. It is not the only reference to him spending time in different libraries.

[27] The abbreviations used refer to the codices of Leonardo da Vinci that can be followed online on: www.leonardodigitale.com. For the dating of the codices I consulted Paretic, *Codex Atlanticus*, A Catalogue of its newly-restored sheets, Vols. I -VI and Vols. VII - XII, Library of Congress, Nr. 75-5344, 1979. For Renaissance Studioli see, R. Kirkbride, *Architecture and Memory, The Renaissance Studioli of Federico da Montefeltro*, Columbia University Press, New York, 2008.

[28] R. Jones and N. Penny, *Raphael,* New Haven and London, 1983, p. 29; Paul Joann Ides, *The Drawings of Raphael,* Oxford, 1983, p. 70; Jug Meyer Zorn Capelin, *Raphael in Florence,* London, 1996 , pp. 61–73.

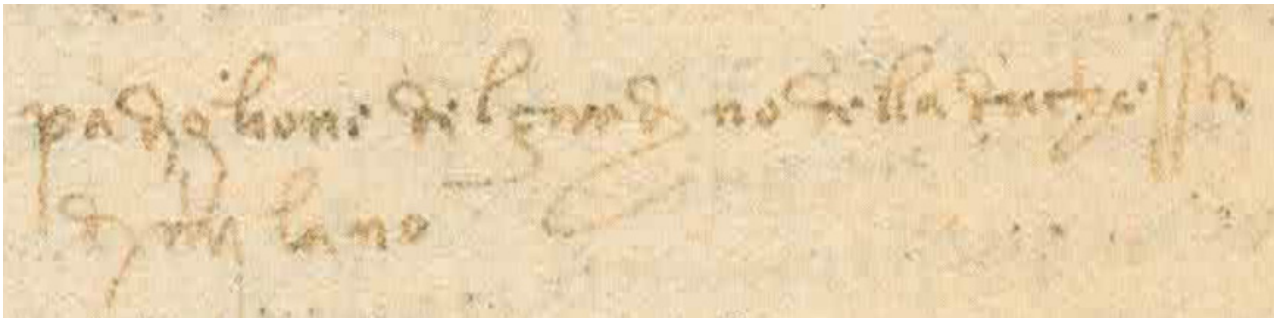
[29] See, S.Oswald, *Leonardo da Vinci, the artist the man*, revised with the aid of William Rankin and others, New Haven, Yale University Press, 1916.

[30] See, U. Roman Delia, *Raphael's Ostrich*, Penn State University Press, 2016.

It is known, for instance, that he visited the city of Pavia on numerous occasions,[31] and it is most likely that he also visited the famous library tower of the Visconti-Sforza Castle.[32] The first recorded visit was in 1490, accompanied by Francesco di Giorgio Martini.[33]

Picture: Library tower of the castle in Pavia. © Stefaan Missinne 2017.

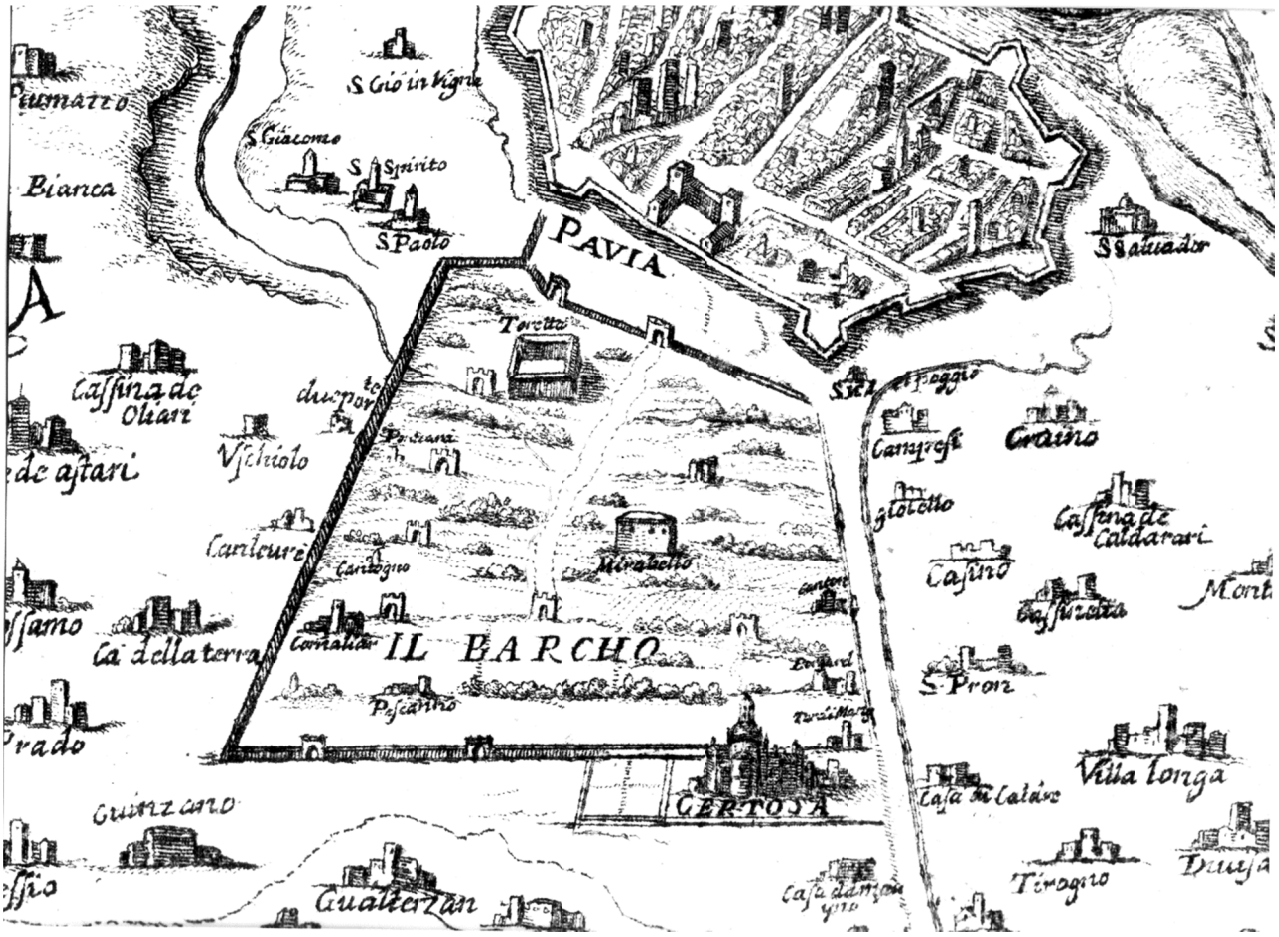
This was followed by a visit in 1496 when Isabelle d'Este[34] was entertained by a performance of Timone, in a production by Bellincioni and Leonardo.[35] The huge garden and park, containing a variety of exotic animals including ostriches, is situated to the north of the Castle; so coming from Milan in order to reach the Castle of Pavia, one would have to pass by the garden and the park.[36] In ca. 1490 Leonardo writes about exotic animals, likely being affected by his visit to the park and the garden of the Castle of Pavia.[37] Leonardo mentions the garden in Manuscript B, page 12 recto.



Picture: Pavilion of the garden of the Duchess of Milan. Ms B, page 12 recto.

[31] See, F. Capra, *Learning from Leonardo: Decoding the Notebooks of a Genius*, Barrett-Koehler Publishers, San Francisco, 2013.
[32] See, C. Amoretti, *Memorie Storiche sur la vita gli Studi et le opere di Leonardo da Vinci*, Gusty Ferrari Editrice, Milano, 1804.
[33] B. Marten et al., *Festungsbau: Geometrie – Technologie – Sublimierung*, Lukas Verlag, Berlin, 2012, p. 118.
[34] C. Rerate, "Les Relations disable d'être avec Leonardo de Vinci d'êtres des documents retunus par Armand Basket", 1888, in *Gas Beaux-Arts I*: pp. 118-131.
[35] M. Kemp, Oxford University Press, Oxford 2006, pp. 138-139. Most certainly, the courtly spectacles using exotic animals impressed Leonardo during his stay in Pavia and Milan.
[36] P. Vicario, E. Solti, G. Piazza, Leonardo da Vinci e Pavia, Typographic Tidiness Di C. Busch, Pavia, 1952 and Scylla GC, Leonardo e Pavia, *Letter Vinci Ana* XXV/1995: pp. 1-46, Gaunt, Firenze, 1996.
[37] See, C. Pedretti, *The Literary Works of Leonardo da Vinci,* Volume I., University of California Press, 1977.

In this manuscript Leonardo refers to the "*zardino della Duchessa di Milano*"[38] which means "*the garden of the Duchess of Milan.*" Leonardo makes a drawing of a garden pavilion in Pavia;[39] the date of the drawing is ca. 1497.[40] Particularly during the second half of 1490, Leonardo resided in Pavia with Francesco di Giorgio, during which time he consulted a Witelo Manuscript.[41] In his Codex Atlanticus, page 611 recto he makes reference to this mathematical book "*Vitolone*" from that same library.[42] Isabella d'Aragón (1470-1524), daughter of the King of Naples, who married Gian Galeazzo Maria Sforza in 1489,[43] and whose wedding decorations were designed by Leonardo, resided at the Castle of Pavia.[44]




Picture: Copper engraving of the huge garden between Certosa di Pavia and Pavia. Musei Civici del Castello Visconteo. Note that the "*Parcho*" is about the size of the whole city of Pavia.[45] Picture courtesy of Pavia, Musei Civici, inv. SP A 55.

For Leonardo this mathematical book must have been very important, as he consulted this work again many years later, in Florence.

At about the same time as these lengthy visits to the Castle of Pavia, his writings and drawings of exotic animals included ostriches.[46]

[38] Leonardo applies the word "*Zardino*" as if he wants to refer to the Latin "*zardinum magnum*" i.e. the huge garden as described by Gigliola De Martini, *Itinerari del Castello Visconteo,* Comune di Pavia, Musei Civici del Castello Visconteo, Luigi Ponzio e figlio, 2006, p. 4.

[39] L. Cerri, *Le trace di Leonardo in Lombardia*, Progetto Leonardo cultura nel territorio, http://www.leonardocultura.com/doc/Le_tracce_di_Leonardo_in_Provincia_di_Pavia.pdf, accessed online 8.8.2017.

[40] C. Pedretti, *The Literary Works of Leonardo da Vinci*, Vol. I, op. cit., p. 53.

[41] See, E. Solmi, *Le fonti dei manoscritti di Leonardo da Vinci, Scritti Vinciani*, Firenze, 1976.

[42] E, McCurdy, *The Mind of Leonardo da Vinci*, Dover Publications, Mineola/New York, 1928, p. 333.

[43] E. Müntz, *Leonardo da Vinci*, Parkstone Press USA, New York, 1898, reprint, p. 123.

[44] B. Nardini, *Leonardo, Portrait of a Master*, Giunti, Milano – Firenze, 1999, p. 76 and p. 180.

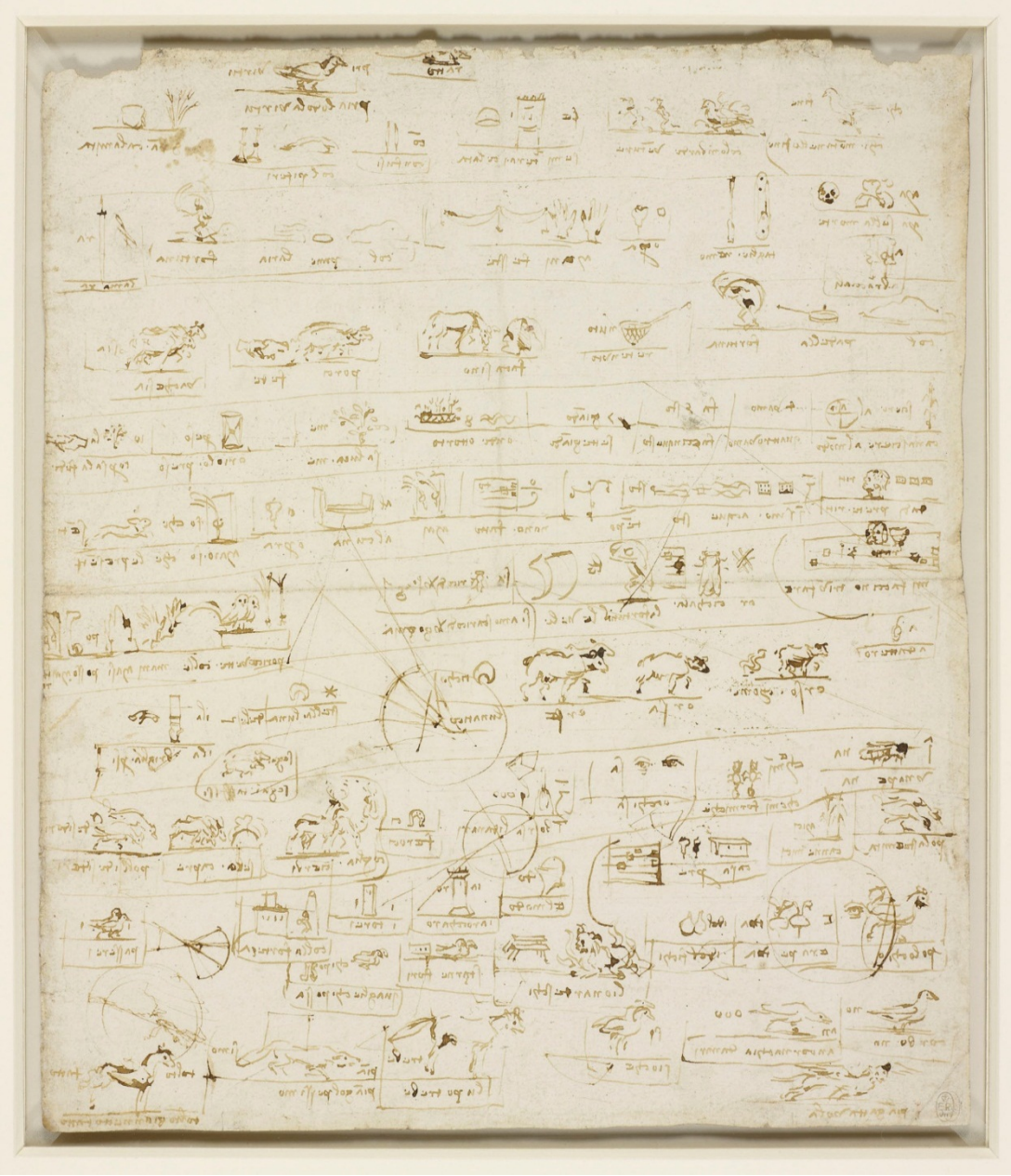
[45] Detail of the engraving by Giacomo Cotta (Gorlago, Bergamo, 1627 - Bergamo 1689), based on a drawing by Ludovico Corte with the title *Principato di Pavia*, copper engraving printed by Ottavio Ballada in 1654, mm 422 x 670, in particular with the vedute of the park Visconteo. Pavia, Musei Civici, inv. SP A 55.

[46] See, C. Vecce, *Leonardo: Favole e Facezie, Disegni di Leonardo dal Codice Atlantico,* De Agostini, Novara, 2013.

Leonardo refers to the ostrich in Codex Atlanticus, page 729 verso, and states in his Codex Manuscript H, page 13 verso, dating from 1493-1495:

> "*The Ostrich: This bird converts iron into nourishment, and hatches its eggs by its gaze – armies under commanding captains*."

The topic of the invisible force of the gazing and the virtue of the eye is a topic that interests Leonardo, as I will review later in this book.

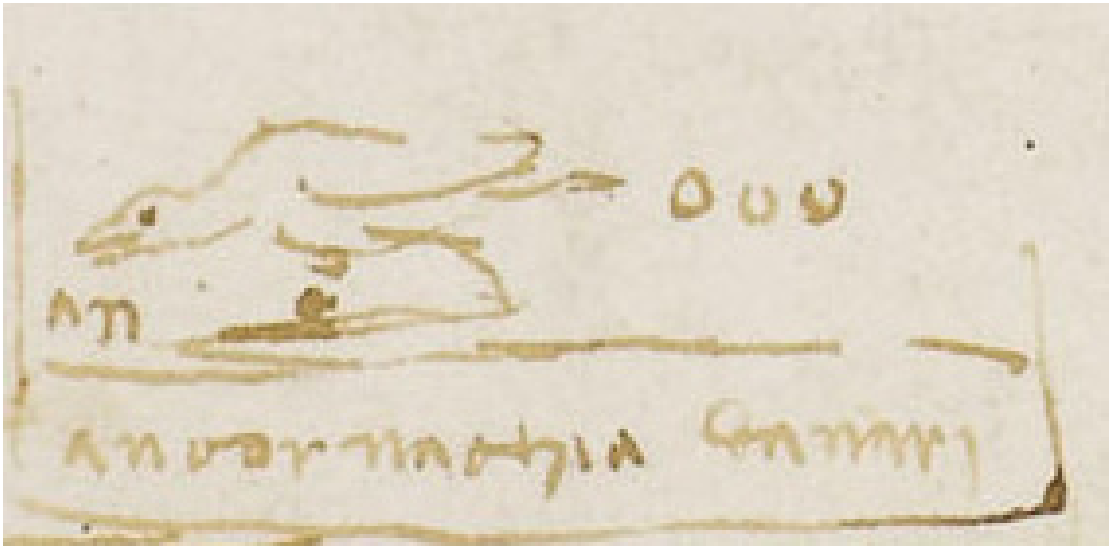


Picture: A sheet of pictographs drawn over astronomical studies, ca. 1487 – 1490. Pen and ink | RCIN 912692 Royal Collection Trust / © HM Queen Elizabeth II 2018.

The rich variety of interpretations of this living monster and the ways in which it was depicted include the embodiment of vices and virtues such as of fortune, gluttony, justice, stupidity, perseverance, heresy, etc.[47]

Evidently Leonardo not only knew about ostriches and their eggs, he drew them pictorially in the form of a Rebus Puzzle on page RCIN 912692 recto, dating from 1487-1490. These are kept in the Royal Collection at the Windsor Castle. Leonardo drew and wrote about numerous other exotic animals.

[47] See, U. R. d'Elia, *Raphael's Ostrich*, Penn State University Press, 2016.



Picture: Detail of an ostrich gazing at its eggs. Eggs on a sheet of pictographs drawn over astronomical studies dating from ca. 1476-1490 Pen and ink | RCIN 912692 Royal Collection Trust / © HM Queen Elizabeth II 2018.

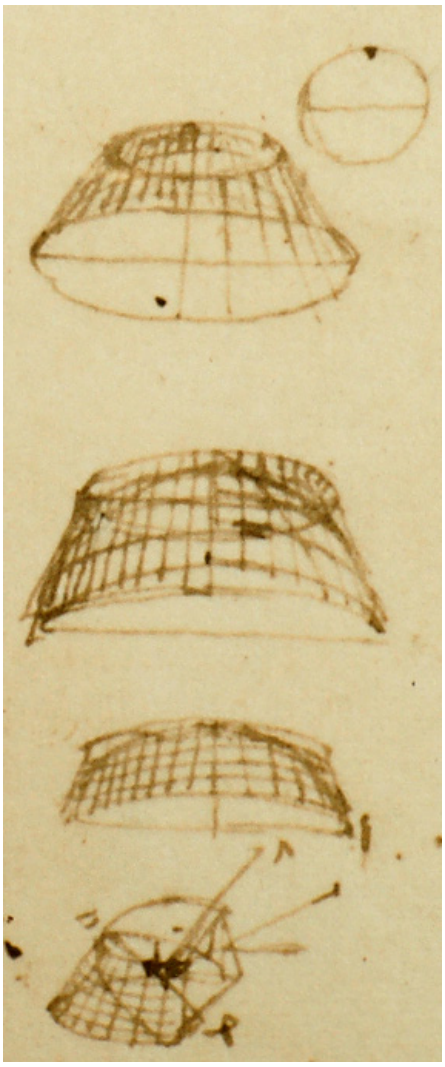
In the painting of Leda and the Swan, after Leonardo's[48] Chatsworth drawing dating from ca. 1504 - 1506, a painting believed to be by Melzi (ca.1508) depicts four children "hatching" from large eggs.

Picture: Detail of the children's birth and eggs, in the painting Leda and the Swan after Leonardo´s Chatsworth Drawing, by Melzi ca. 1508. Picture courtesy of the Galleria degli Uffizi.

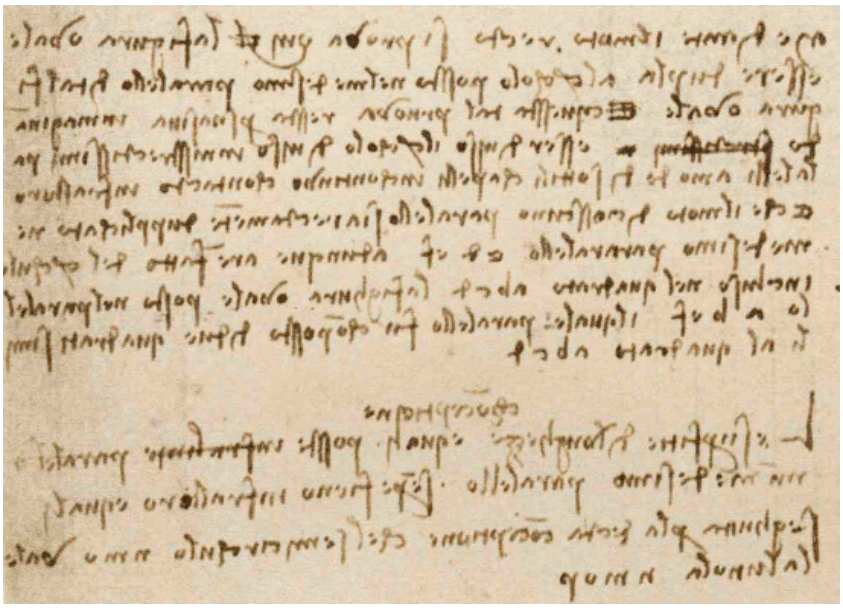
[48] See, C. C. Bambach, *Leonardo da Vinci, Master Draftsman*, The Metropolitan Museum of Art, New York, Yale University Press, New Haven and London, 2003.

Picture: Children's birth and numerous large hatched eggs in the painting Leda and the Swan, after Leonardo's Chatsworth Drawing, by Melzi ca. 1508. Picture courtesy of the Galleria degli Uffizi.

As additional support, Leonardo projects a conjoined globe from an oval form like an ostrich egg in his Codex Atlanticus, page 513 recto, dating from ca. 1490 and in Codex Atlanticus, page 551 recto.



Picture: Detail of a conjoined globe projection from Codex Atlanticus, page 551 recto.



Picture: Da Vinci offers the geometric basis for the projection of a globe from two oval forms. Codex Atlanticus page 1032 recto.

In Codex Atlanticus, page 1032 recto, he offers the geometric basis for the projection of a globe from two oval forms.

The Italian transcription is:

> "*De quadratura (della) figura ovale. Dopo la notizia della quadratura del circolo fia possible immediate dara la quadratura della figura ovale, la qual figura ho posta qui di sotto in n m p S, e questa tal figura è doppia al circulo a b c d, com`è provato. Adunque farano un circulo duplo al pedretto circolo e così sia quadrato, e tal quadratura sare´ equale alla figura ovale. El medesim si farà col moto delle parte d´una spera al comporre il corpo ovale, eccetera.*"

In English:

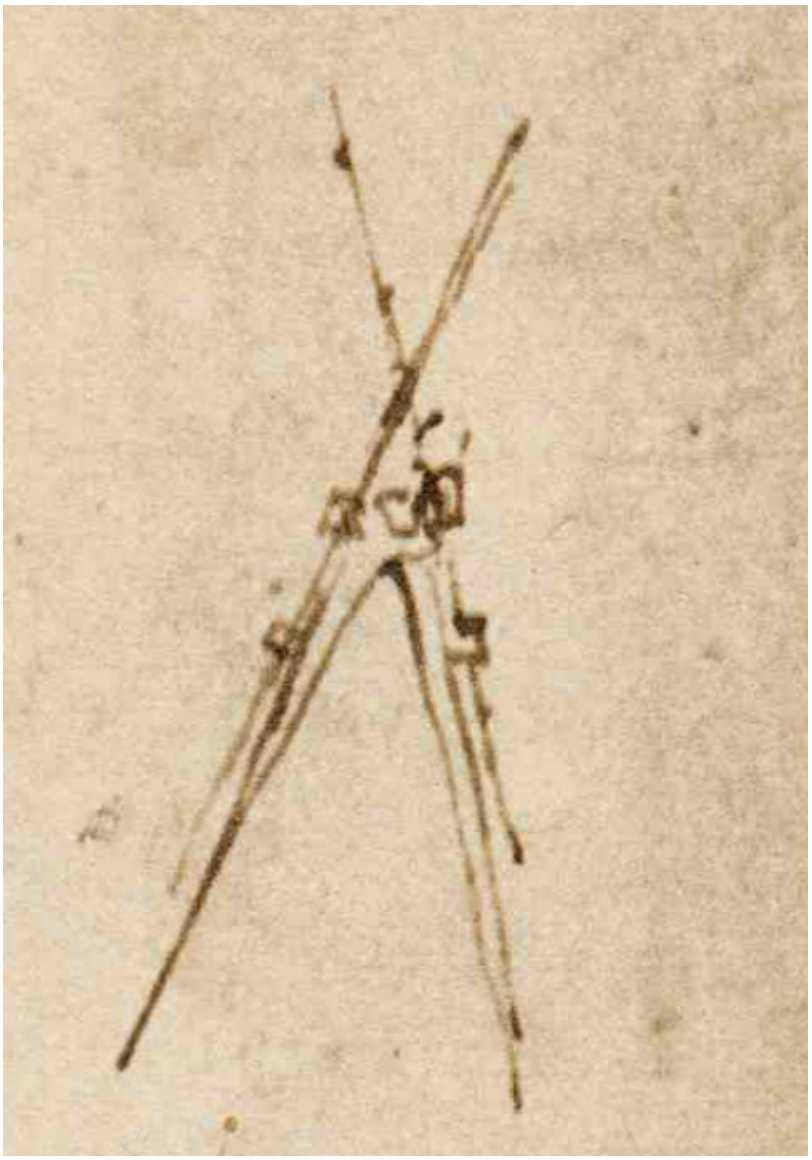
> "The squaring of the circle, following the notice, is possible immediately upon squaring the oval figure, which I have drawn below in n m p S, and this figure is the double of the circle a b c d, as is proven. Subsequently we will make a double circle from the existent circle and so it will be squared, and this squaring will be equal to the oval figure. The in-between will be constructed applying these parts of a sphere formed upon the oval corpus etc."[49]

In the foregoing, Leonardo describes how he is planning to square an oval figure. It offers the reader the theoretical basis for constructing a circular object based on an oval corpus and vice versa.


Picture: Anonymous engraving, 18.2 x 10 cm, of the pregnant (world) elevated Geometria XXIII. She personifies the Science for which she is named. It is plate 24 from an E-series of 15th century Tarocchi, a precursor to Tarot cards. Picture courtesy of the Metropolitan Museum of Art, Elisha Whittelsey Collection, the Elisha Whittelsey Fund. Public Domain. 1992.1055.1.

[49] I thank the expert Marisa Addomine for her kindness in providing a literary translation of the vernacular Italian text.

Leonardo draws an important object for transferring geometric proportions: the "*compasso*," which is the compass of proportions,[50] appears as a drawing in Codex Forster I, page 4 recto, dating from 1490-1505 and in Codex Atlanticus, 1032 recto, dated ca. 1505.[51]

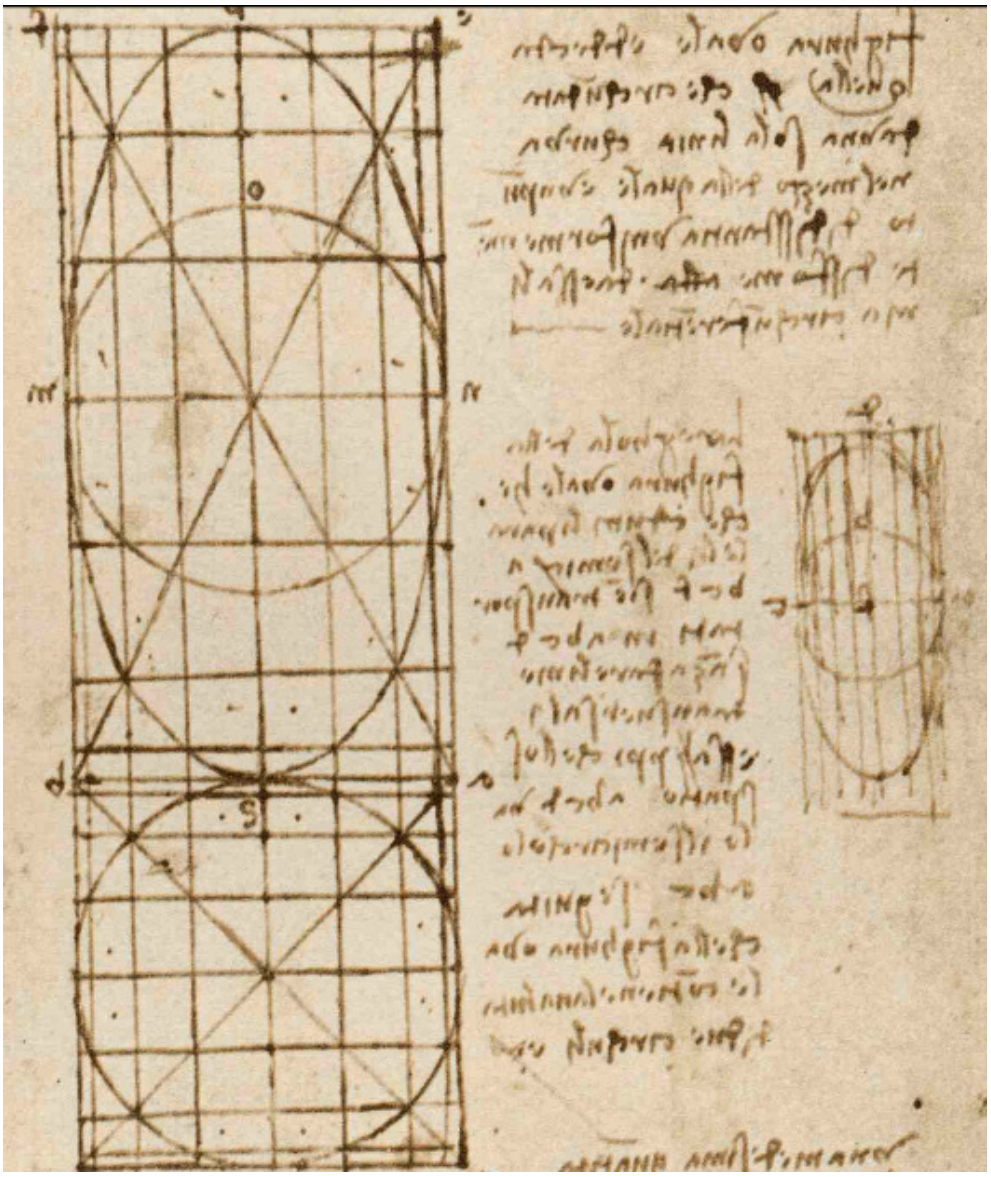


Picture: Leonardo's Compasso, Codex Atlanticus, page 1032 recto.[52]

[50] J. Riera i Sans, A. Cresques, *Jew of Majorca, Master of Mappaemundi and Compasses*. English translation of: A. Cresques, "jueu de Mallorca, mestre de mapamundis i de brúixoles," in *L'Atlas Català*, Diàfora, S.A., 1975, pp. 1-27.

[51] See, C. Pedretti, *Leonardo da Vinci Codex Atlanticus: A Catalogue of its Newly Restored Sheets*, Part Two – Vols. VII-XII. Johnson Reprint Corporation, Harcourt, Brace Jovanovich Publishers, 1979.

[52] See, F. Camerota, G. Strano, *Il Compasso Geometrico e Militare di Galileo Galilei,* Instituto e Museo di Storia della Scienza, Firenze, 2004.



Picture: The oval figure contains the value of two circles Codex Atlanticus, page 1032 recto.

Leonardo writes: "*della spoglia della spera*" which means, "*from the stripping of the global sphere*" in Codex Atlanticus, page 518 recto and makes this special drawing: