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Spain and the Low Countries: Aspects of the scientific relationship in the sixteenth century**

THE SCIENTIFIC REVOLUTION of the sixteenth and seventeenth centuries has traditionally been regarded as one of the most important landmarks of Western History. For a variety of reasons, its history has been written, for the most part, from the perspective of the North Atlantic world: England and France take centre stage, while developments in the Low Countries, Germany and Italy follow close behind. The Iberian world, on the other hand, has been almost completely absent from the dominant narrative, despite the fact that for the past forty years, an immense amount of research has been generated (mainly in Spain and Portugal) on the subject of Iberian scientific activity.[1]

Just over a year ago, a symposium took place in Valencia whose title was "Beyond the Black Legend. Spain and the Scientific Revolution." There were historians from the United States, Italy, Belgium, Portugal and Spain. Our aim was to encourage a more balanced assessment of Iberia's role in the history of early modern science. Also, to test current interpretations of the Scientific Revolution, and to pose the question of whether or not an account of the Scientific Revolution and the origins of modernity that omits Iberian can have any meaning at all. The publication of the Proceedings which will comes out at the end of this year and its consequent reaction, will show how much we achieved our objectives.[2] Now in the present symposium, we have the opportunity to continue discussing the general theme of the Iberian world and the development of modern and contemporary science by means of the various presentations.

Certainly, the historiographical renovation during the last decades, both in themes and in methods or procedures and objectives of the history of science, with greater and better attention to factors including cultural, social, economic, ideological, and political ones, have favoured, in principle, the interest in the "Iberian case".[3] Another advantage has been the growing interest to tackle the complex relation and mediations between the local (where science is carried out) and the universal (the aim of scientific discourse). The latter, has given greater focus to the development of scientific activity at different levels or geopolitical or cultural aspects (or themes related to them): the city, the region, the kingdom, the emerging nations, empires. And one would also have to add the insistence of practical science, and, along with this, a greater attention to experimental practices, instruments, and images (iconography), and, in general, to the material culture of science.

Nevertheless, we still do not have comparative studies, based on suitable, homogenous criteria of comparison which allows a balance between the general processes and the culturally specific. As is well known, the nightmare of any editor of comparative studies is to get the authors to use criteria

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[1] See V.Navarro Brotons, "Espanya i la Revolució Científica: Aspectes historiogràfics, reflexions i perspectives", in: *Actes de la VII Trobada d'Història de la Ciència i de la Tècnica* (Barcelona: Societat Catalana d'Història de la Ciència i de la Tècnica, 2003), pp. 15–32; V. Navarro Brotons, W. Eamon, "Spain and the Scientific Revolution: Historioghraphical Questions and Conjectures", in: V.Navarro, W. Eamon, *Beyond the Black Legend. Spain and the Scientific Revolution* (Valencia: Instituto de Historia de la Ciencia y Documentación "López Piñero", 2007), pp. 27–41.

[2] V. Navarro Brotons, W. Eamon (eds.), *Beyond the Black Legend. Spain and the Scientific Revolution.*

[3] But see J. Cañizares Esquerra, J. "Iberian Science in the Renaissance: Ignored How Much Longer?", *Perspectives on Science, 12* (2004), pp. 86–124.

which will then allow such a comparison. We can cite as an example the book edited by Porter and Teich on the *Scientific Revolution in National Context*.[4] This book, a pioneer in this type of approach, does not go beyond a collection of very interesting writings but without an authentic, comparative perspective and without tackling the problem of defining the European nations studied in this period: "Italy", "German Nations", "Poland", "Spain and Portugal" etc. However, we are in complete agreement with the editors of this work that the processes of global scientific change cannot be isolated and understood without taking into account questions of language, education, communication networks, institutions, economy, social relations, politics, religion, patronage and other comparable elements. Nevertheless, as Pyenson states, this book does not make it clear that "nation" is a unit of analysis better than linguistic communities, regions, defined or definite geographical areas or cities.[5]

If we speak about Spain for example, a basic premise is to define what we mean by this name in the 16th and 17th centuries. The usual definition is to understand Spain as the combination of the various kingdoms of the period that make up the present Spain of our times, bearing in mind all the enormous administrative differences and other factors. As José Antonio Maravall has pointed out, when referring to Spanish monarchy, we have to distinguish between three different levels: each peninsular kingdom, the combination of the kingdoms of Hispanic tradition and the imperial conglomerate that had been built up under the Spanish Crown. With reference to science and technology, the three levels affect scientific activity: the imperial project, the building of a modern state and the diversity of the peninsular kingdoms with their own social-political organisation and their own cultural traditions.[6]

The present work, focused on certain aspects of the scientific relations between the Low Countries and the peninsular kingdoms of the Spanish monarchy in the 16th century, aspires to contribute some facts and thoughts and to trigger and develop an ample programme of work in this direction of comparative studies and the diffusion of knowledge.

The political circumstances of the countries that concern us, that changed considerably throughout the century, conditioned the relations that we are studying. But, in spite of the adverse, political and ideological context, especially in the last third of the 16th and the first decade of the 17th, these relations were maintained and in some cases intensified. They were particularly intense in the fields of natural history, botany, medicine, as well as astronomy, geography, cartography and the art of navigation.

These relations can be studied according to different aspects as:

1. The patronage relationship between Spanish monarchs, nobles / aristocrats and the scientists and technicians of the Low Countries or scientific-technical services tendered by scientists and technicians of the Low Countries to Spanish monarchs or governors.
2. Circulation, diffusion and use of works, objects, instruments etc from either Spanish or Low Countries technicians or scientists.
3. Friendship, collaboration, teacher-pupil between the scientists or technicians of the two countries.
4. Influence of any type of works or contributions of scientist or technicians of the two countries.
5. The general circulation of knowledge through books, objects or instruments, oral communication through personal contact or correspondence.

In this work, we are concerned with certain aspects of the scientific-technological relations in questions concerning astronomy, geography, cartography and the art of navigation.

In the field of cosmography (astronomy and its applications and geography) and in the nautical field, we have to first point out the enormous influence in Spain of Reiner Gemma Frisius, both in his teaching in Louvaine and in his work (texts, cartography, and instrument design).

[4] R. Porter, M. Teich (eds.), *The Scientific Revolution in National Context* (Cambridge, Cambridge University Press, 1992).

[5] L. Pyenson, "An End to National Science: The Meaning and the Extension of Local Knowledge", *History of Science*, *40* (2002), pp. 252–288.

[6] J.A. Maravall, *Estado moderno y mentalidad social. Siglos XV a XVII*, 2 vols. (Madrid: Revista de Occidente, 1972).

Gemma Frisius was professor of medicine at the University of Louvaine, and at the same time, around 1543, began to give private maths lessons in his house.[7] Among those who attended the classes were two distinguished Spanish authors of scientific works, Juan de Rojas and Jerónimo Muñoz. Rojas, who hailed from an old, noble, Spanish family, travelled to the Low Countries with Charles the Fifth and Prince Philip. Rojas studied mathematics with the physician and humanist Justus Velesius (whom Rojas himself encouraged to teach this disciplines) and then (or at the same time) with Gemma Frisius. On returning to Spain, he published a work entitled *Commentariorum in Astrolabium* (1550) in which he describes a universal astrolabe based on an orthographic projection of the celestial sphere over the colure of the solstices. In this work, Rojas continually says how indebted he is to Gemma Frisius and he also includes six chapters of an important Gemma Frisius text concerning the geodesic triangulation, *Libelus de locorum describendum ratione* (1550) with his own commentaries. While elaborating his treatise, Rojas also collaborates with Hugo Helt, born in Groningen, educated in Louvaine and living in Spain around 1545. According to what Rojas himself says in the preface of Book 6 of his work concerning the construction of the astrolab, this aspect of the work is based on a description supplied by Helt. Previously in 1549 in Salamanca, Helt had published a book entitled *Declaración y uso del relox español entretexido en las armas de la muy Antigua y esclarecida casa de Roias*, in which he had the help of the outstanding humanist Francisco Sánchez de las Brozas, who translated it into Spanish from the Latin. The work is dedicated to the Marquis of Poza, Juan de Rojas's father. The aim was to describe an instrument, that, more than a sundial, as the title suggests, is a type of simplified astrolabe.[8]

Gemma Frisius' important text on the geodesic triangulation technique, was included in all the re-editions of the *Cosmographia* by Pedro Apiano, based on what Frisius produced in 1533 adding his own material. Was also included in Gemma's *De principis astronomiae* (1547).[9] Thanks to this and Rojas's work, this text achieved considerable diffusion in Spain. It appears that it was used by Pedro Esquivel to complete the map of Spain that was ordered by Philip the Second in the decade of 1560–1570.[10] Jerónimo Muñoz describes it in detail in his treatise, a conserved manuscript of astronomy and geography, prepared for his classes in Valencia.[11]

[7] On Reiner Gemma Frisius, see H. De Vocht, *History of the Foundatioin and the Rise of the Collegium Trilingue Lovaniense, 1517–1550*, 4 vols., Leuven, Bibliothèque de l'Université, 1951–1955, vol.2, pp. 542–565; A. De Smet, "Gemma Frisius", *National Biographisch Worddenboek*, vol. 6, pp. 315–331; R. Karrow, Jr., *Mapmakers of the Sixteenth Century and Their Maps*, Chicago, Speculum Orbis Press 1993, pp. 205–215; F. van Ortroy, *Bio-biblographie de Gemma Frisius, fondateur de l'Ecole belge de géographie, de son fils Corneille et de ses neveux les Arsenius...* (Brussels: Lamartin, *Acad. Royale des Sciences, des Lettres et des Beaux Arts, Brussels. Mém. Collection* in 8º, Serie 2, vol. II (1920), pt. 2; reed: Amsterdam, Meridian Pub. Co., 1966); S.Vanden Broecke, *The Limits of influence. Pico, Louvain, and the Crisis of Renaissance Astrology* (Leiden, Brill, 2003).

[8] On Rojas, see V. Navarro Brotons, "Juan de Rojas Sarmiento", in: J.M. López Piñero, T.F. Glick, V. Navarro Brotons, E. Portela Marco (eds.), *Diccionario histórico de la ciencia moderna en España.* 2 vols, Península, Barcelona, 1983, vol. II, pp. 263–264. On Rojas and Velsius, see S.Van den Broek, "Humanism, Philosophy ant the teaching of Euclid", *Lias, 25* (1998), pp. 43–68. On Helt, see F. Maddison (1966), "Hugo Helt and the Rojas Astrolabe Projection", *Revista da Facultade de Ciéncias da Universidade de Coimbra, 39* (1966), pp. 195–251.

[9] On Gemma Frisius and the trinagulation technique, see A. Pogo, "Gemma Frisius, his method of determining differences of longitude by transporting timepieces (1530) and his treatise on triangulation (1533)," *Isis, 22* (1938), pp. 469–506; N.D. Haasbroek, *Gemma Frisius, Tycho Brahe and Snellius and their triangulation* (Delft: The Netherlands Geodetic Commision, 1968).

[10] G. Parker, "Maps and Ministres: The Spanish Habsburgs", en D. Buisseret (ed.), *Monarchs, Ministres and Maps* (Chicago: The University of Chicago Press, 1992), pp. 124–153; On Esquivel and the map of Spain, see M. Esteban Piñeiro, "Esquivel. Un ejemplo de la ciencia aplicada en la España del siglo de Oro", in: L. Jiménez Moreno, coord., *La Universidad Complutense Cisneriana. Impulso filosófico, científico y literario. Siglos XVI y XVII*, (Madrid: Ed. Complutense, 1996), pp. 261–285.

[11] See V. Navarro (ed.), *Jerónimo Muñoz: Introducción a la Astronomía y la Geografía*.Transcription and Spanish translation by Víctor Navarro, Arsenio Pastor, Encarna Pastor and Vicente Salavert. Preliminary studies by Víctor Navarro and Vicente Salavert (Valencia: Consell Valencia de Cultura, 2004).

As already stated, Jerónimo Muñoz, one of the most outstanding Spanish scientists of the sixteenth century, must have attended Gemma Friusius'classes in Louvaine, whom he addresses in his work as "institutor noster".

Muñoz, moreover, in the treatise cited says to have frequently used the geodesic triangulation technique in his cartographical works and illustrates the procedure by means o a triangulation between Valencia and different places to the north of the city. Likewise, Pérez de Moya, an outstanding scientific popularizer, also describes it in his *Tratado de Mathemáticas* of 1573 and, in the University of Salamanca, Hernando de Aguillera, professor of mathematics and astronomy between 1561 and 1575, must have explained the technique in his classes because he used the text of *Cosmography* of Pedro Apiano – Gemma Frisius.[12]

Regarding the influence of Gemma Frisius on Jerónimo Muñoz, we will add that there is an ample treatise, in the form of a manuscript, dedicated to the planisphere, or astrolabe described by Rojas and its different applications, as well as other descriptions of instruments based on the teachings of Gemma Frisius, such as the astronomic ring designed by this.[13]

Concerning navigations, the pioneers in this new nautical art, as is well known, were the Portuguese; it began in the second half of the fifteenth century, modern, astronomical navigation, creating the nautical "regiments" and published the first nautical guides. In Spain, institutions were formed such as the Casa de la Contratación de Sevilla, where these new navigational techniques were considerably developed and where classes were given to pilots. From this environment, a number of relevant works were written, some of which, such as the treatises on the art of navigation by Pedro Medina (1545) and Martín Cortés (1551) were translated into different languages and edited on numerous occasions in different countries in Europe. Medina's work in particular, was translated into Dutch and edited in Antwerp in 1580 and in Amsterdam in 1589 and 1598.[14] Along with Medina's work, they edited, as an attachment, a *Instrucción sobre los puntos principales de la navegacíon*, also into Dutch, authored by the scientist Michel Coignet who was a native of Antwerp. In the following year, Coignet published this same text amplified. From the first chapter, Coignet demonstrates that he is familiar with the Spanish writers, whose works he quotes along with Pedro Apiano's and Gemma Frisius', incorporating or discussing their different doctrines or procedures.[15] A similar influence of the Spanish writers can be seen in the *Spieghel der Zeevaerdt* (Leiden 1584/85) of Lucas Jansz Waghenaer de Enkhuize, a magnificent collection of nautical maps accompanied by a general revision of the art of navigation. At the end of the century, in 1598, the *Compendio del arte de navegar* by Rodrigo Zamorano was edited in Dutch in Amsterdam.[16]

Philip the Second and his ministers sponsored various cartographical activities, for various reasons, including the importance for the administration and control of the territories under his control, for possible military uses and for its symbolic value. Thus, the great cartographer Jacob van Deventer,

[12] J.M. López Piñero, V. Navarro Brotóns, V. (1998), "Las relaciones científicas entre los Paises Bajos y España durante el Renacimiento", in: *Los instrumentos científicos del siglo XVI. La corte española y la escuela de Lovaina* (Madrid: Fundación Carlos de Amberes), pp. 13–27; V. Navarro Brotons, "The teaching of the Mathematical Disciplines in Sixteenth-Century Spain, *Science and Education* (Springer), *15* (2006), pp. 209–233.

[13] J. Muñoz, *De planispherii parallelogrami inventione.* A copy by Francisco Peña in the Biblioteca Apostólica Vaticana, Ms. VL 6997 fols. 1r–71v; copy by Francisco Juan Rubio in the la Bayerische Staatsbibliothek, Clm 10674, fols. 278r–336v). See a list and description of Muñoz' manuscripts, in V. Navarro Brotons, E. Rodríguez Galdeano, *Matemáticas, cosmología y humanismo en la España del siglo XVI. Los* Comentarios al Segundo Libro de la Historia Natural de Plinio *de Jerónimo Muñoz* (Valencia: Instituto de Estudios Documentales e Históricos sobre la Ciencia, 1998).

[14] V. Navarro Brotons, "Astronomy and Cosmography 1561–1625. Different Aspects of the activities of Spanish and Portuguese mathematicians and cosmographers", in: Luis Saraiva and Henrique Leitao, *The Practice of Mathematics in Portugal* (Coimbra: *Acta Universitatis Conimbrigensis*, 2004), pp.225–275.

[15] C. Verlinden, « Michel Coignet et son "Instruction nouvelle des points les plus excellents et nécessaires touchant l'art de naviguer" (Sanvers, 1581) (Lisboa: Centro de Estudios de História e Cartografia Antiga, Série Separatas 175, 1985).

[16] See C. Koeman, *Flemish and dutch conttributions to the Art of Navigation in the XVIth Century* (Lisboa: Centro de Estudios de História e Cartografia Antiga, Separatas 213, 1988); C.M. Parr, *Jan van Linschoten: the Dutch Marco Polo* (New York: T.Y.Cromwell, 1964).

founder of the cartographic school of the Low Countries, was appointed "royal geographer" and was entrusted in 1559 to make maps of all the cities in these territories: Deventer made a total of almost 300 maps. For the same period, Philip the Second entrusted Anton van den Wingaerde to do a similar work in Spain. The result of this was 62 maps of 50 Spanish cities and sketches of various others. Another distinguished cartographer in the service of the Brussels government was Christian Sgrooten. In 1568, the Duke of Alba gave him the task of the "description of the cities and countries of His Majesty, its limits and territories": the result is two great manuscript collections, kept in both Brussels and Madrid, each one including 38 maps of the Low Countries and Germany.[17]

One of the greatest undertakings of the time, carried out in the Low Countries and related to cartography and geography was the work of Abraham Ortelius which can be considerd as the first modern world atlas: *Theatrum Orbis Terrarum*, whose first edition appeared in 1570. Ortelius's work, in this and subsequent editions, was a considerable effort of synthesis of the most recent cartographical knowledge of the time. In this sense, it used, either directly or indirectly the works of Spanish and Portuguese cartographers and geographers, related both to the Peninsular and other regions of the world explored or mapped by these authors. The Spanish authors that are included by Ortelius in this catalogue are Arías Montano, Gerónimo de Chaves, Diego Gutiérrez, Pedro Medina and Diego Mendoza or Méndez (author of a map of Perú that still has not been identified), a list that does not exhaust all the Spanish authors used in the *Theatrum*. The map of Spain in the first edition of Ortelius's *Theatrum*, is based on the one elaborated by Clusius, who in turn based his on former sources. However, in the successive editions, Ortelius improved the map thanks to Arías Montano, who sent him different maps of Spain and Portugal and from the overseas colonies or some particular information on this subjetcs. Furthermore, permission was given to Ortelius's collaborators to visit Spain and to make their own maps. In 1573, Montano succeeded in having Ortelius named as "royal geographer".[18] In 1574, Arias entered the *Album amicorum* of Ortelius with the following verses:

> If Montano could do for his friends everything he wants, and serve them for a specific aim, believe me dear Ortelius, nobody would be more esteemed than you and nobody would be happier than Montano.[19]

Another of Ortelius's sources of information was Fadrique Furió Ceriol who also features in the Album Amicorum of the Dutch author. Furió was born in Valencia and studied in Paris and Louvaine where in 1553, he published *Institutiones Rhetoricarum*. In his work *Bononiae* (1556), he defended the translation of the bible in the vulgar tongue, which caused him numerous problems. In 1559 in Antwerp, he published his *El Concejo y consejeros del Príncipe*, in the printing press of Martin Nucio, editor of numerous books in Spanish or Latin by Spanish authors, such as the *Sylvia* by Pedro Mexia, el *Libro de los inventores del arte de marear* by Antonio de Guevara or the *Observationes to the Historia Natural of Pliny* by Fernando Núñez de Toledo. Furió was especially interested in the affairs of the Low Countries, and around 1566, working in the service of Philip the Second, offered an intelligent and acceptable assessment of the political situation, favouring the moderate position of the Ebolist party. Although it is not certain that he belonged to the "Charitatis family", he had many friends among the members of this "family". He was also a friend of Andreas Schott, the Jesuit humanist of Antwerp who traveled through Spain, correspondent of Ortelius and author of the *Bibliotheca Hispanica* and Hendrick Cock of Goronchem (Gorcum), living in Spain since 1574, author of the map of Spain used by Ortelius for his *Hispaniae Veteris Descriptio*. Cock worked in a *Biblioteca* for Spanish authors that remained unpublished, but was used by Schott.[20]

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[17] J. Keuning, "XVIth Century Cartography in the Netherlands", *Imago Mundi*, *9* (1952), 35–63; D. de Vries, "Official Cartography in the Netherlands", in: *La Cartografia dels Països Baixos* (Barcelona: Institut Cartogràfic de Catalunya, 1994), pp. 17–71; Karrow, *Mapmakers of the Sixteenth Century.*

[18] See P.H. Meurer, *Fontes Cartographici Orteliani.* "*Das Theatrum Orbis Terrarum" von Abraham Ortelius und seine Kartenquellen* (Weinheim, *Acta Humaniora*, 1991).

[19] A. Ortelius, *Album amicorum*. Cambridge, Prembroke Collegeb, edited by J.Puraye (Amsterdam: A.L. Van Gendt & Co., 1969).

[20] On Furió Ceriol, see H. Méchoulan, M. Almenara, "Elementos históricos y cronológicos para una biografía", in: Fadrique Furió Ceriol, *Obra Completa*, *I* (Valencia: Edicions Alfons el Magnànim, 1996), pp. 15–47.

In the 1584 edition of Ortelius's *Theatrum*, he included a map of the Valencian Kingdom, the oldest in existence of this country. Ortelius very probably elaborated it from the information given to him by Furió Ceriol as is suggested by the correspondence between Arias and Ortelius and the note included by Ortelius himself in the *Theatrum* concerning the inhabitants of the country of the Valencian Kingdom, in which Ortelius cites Furió Ceriol as his source.[21] In any case, and as we have shown in other works, the principal source of the map published by Ortelius was Jerónimo Muñoz, who worked intensely in the geography and cartography of the Valencian Kingdom, demonstrating the worth of the triangulation technique described by Gemma Frisius. There are various Muñoz's writings on this theme which has allowed us to establish our hypothesis. Furthermore, it appears that Muñoz drew a map of Valencian Kingdom which up to the present time, we have been unable to locate.[22]

As Jean-Marc Besse has pointed out, cosmography was both the "chambre d'echo" (the echo chamber or soundbox) and the work of an intellectual community.[23] The so-called "Republic of Letters", that was experiencing its initial stages then (in the Renaissance). Via correspondence or direct contact, an intense interchange of information was carried out — texts, ideas, information, data, maps — it was instituting a universal space of communication. Cosmography of this period had dimensions which were both scientific and political, aesthetic and ethical, philosophical and religious. The intellectual personalities of certain figures such as Abraham Ortelius, author of the *Theatrum orbis terraum*, among other works, were a good representative of these dimensions. They also represent the culture of tolerance that was practiced in the Low Countries, by a group of intellectuals united in the belief of human unity above personal religions and politics and united in the belief of civil and moral peace, based on the spirit. The enterprise of carrying out the *Theatrum orbis terrarum* personifies this mission, but also the undertaking of the *Poliglot Bible* can be considered to be furnished by similar ideas, the same as Ortelius's *Album amicorum* which clearly represent the ecumenical beliefs of those intellectuals. The relationship between intellectuals such as Ortelius, Plantín, Montano, Cornelius, Gemma and Guillaume Postel are very well known although they deserve further study in relation to scientific questions and in the framework of their concerns and ideals. Other relationships are not so well known and need to be investigated. Here we want to insist — to conclude — in the case of Jerónimo Muñoz, probably encouraged by similar ideals, although because of his discretion, a typical characteristic of the members of the "familia charitatis", we can only formulate a hypothesis. According to our conclusions in previous works, his cosmological ideas have a strong Stoic influence, and in the few theological-religious texts preserved of Muñoz, one perceives a criticism, albeit concealed, of the Church as an institution. Furthermore, let us recall some information: one of Muñoz's teachers in Louvaine was Gemma Frisius; Muñoz was a Hebrew teacher in Ancona. On returning to Spain, in Valencia and Salamanca, apart from his chairs in mathematics and cosmography, he also taught Hebrew; his important text on the supernova of 1572 was very soon translated into French by Gui Lefévre of the Boderie, a Hebraist, a pupil of Postel and a collaborator in the Polyglot Bible; this text on the nova was quoted and discussed also by Cornelius Gemma; and as we have indicated, his geography works were known to Ortelius, probably through Furió Ceriol (a Valencian, like Muñoz), and Ortelius used them to produce the map of the Kingdom of Valencia. A good example suggestive then of the complicated network of relationships, interchanges and influences between the Low Countries and Spain.

[21] See the correspondence between Arias and Ortelius, in: J.H. Hessels, *Abrahami Ortelii ... et virorum eruditorum ad eundem et ad Jacobum Colium Ortelinaum ... epistolae*, Cantabrigiae (Ecclesiae Londino Batavae Archivium, 1), 1888. On Ortelius, see also G. Mangani, *Il "mondo" di Abrahamo Ortelius. Misticismo, geografia e collezionismo nel Rinascimento dei Paesi Bassi* (Ferrar: Franco Cosimo Pannini, 1988); J. M. Besse, *Les grandeurs de la Terre. Aspects du savoir géographique à la Renaissance* (Paris: Ens, 2003).

[22] See Navarro, Rodríguez, *Matemáticas, cosmología y humanismo*, and the preliminar study to our edition of Muñoz' *Introducción a la Astronomía y la Geografía*.

[23] Besse, *Les grandeurs de la Terre.*