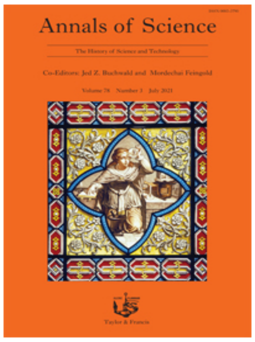

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A *mestizo* cosmographer in the New Kingdom of Granada: astronomy and chronology in Sánchez de Cozar Guanientá’s *Tratado* (*c.*1696)

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A *mestizo* cosmographer in the New Kingdom of Granada: astronomy and chronology in Sánchez de Cozar Guanientá's *Tratado* (*c.*1696)

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ABSTRACT

This article interprets a recently recovered manuscript, *Tratado de astronomía y la reformaçión del tiempo,* composed by Antonio Sánchez in New Granada *c.*1696, in the context of the Spanish and Renaissance cosmographies. Sánchez's *Tratado* proposes a spherical astronomy, in which celestial bodies – including comets — move in orbs containing pyramidal knots that explain the changing speed observed in the motion of planets. From this astronomy and following the peninsular style of *repertorios*, Sánchez derives two major conclusions: the corrected length of the solar year and a revised birth date of Jesus. Taking as center of reference Vélez, where Sánchez was based, these claims led to conclusions in domains ranging from calendric astronomy to eschatology, including the incorporation of the indigenous peoples into salvation narrative and a demonstration of the arrangement of the celestial orbs at the Last Judgment. Sánchez's *Tratado* constitutes an expansion of the Spanish mathematical cosmography that sheds light on the production of knowledge in the Spanish-American world and, at the same time, provides elements to reassess our understanding of the global circulation of Renaissance and early modern ideas.

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Introduction

In August 2019, Colombian news reported the retrieval of a manuscript in the National Library of Colombia dating from the seventeenth century. The finding of the *Tratado de astronomía y de la reformaçión del tiempo (Treatise on astronomy and the reformation of time)* was heralded as opening up a new chapter in the history of science in the country.[1] According to clues left in the manuscript,

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[1]Nicolás Bustamante, 'El Manuscrito Que Reescribe La Historia de La Ciencia En Colombia', *El Tiempo*, 18 August 2019, https://www.eltiempo.com/vida/ciencia/inedito-manuscrito-de-astronomia-reescribe-la-ciencia-en-colombia-395840.

the *Tratado* was written by Antonio Sánchez de Cozar Guanientá, a priest descending from *conquistadores* and *caciques* (indigenous rulers), in Vélez — an important city in the colonial exploration of routes between Santa Fé (present-day Bogotá) and the Atlantic world. The manuscript was not entirely unknown to the intellectual history of Colombia. In 1867, Vergara y Vergara praised Sánchez's work as 'erudite in the knowledge of astronomy', contemporaneous to 'the great truths discovered by Galileo and Kepler, Tycho Brahe and Bacon, Descartes and Newton that flourished in the same seventeenth century' in Europe.[2] However, Vergara explained that these truths 'could not have treached the colony' and, therefore, Sánchez's astronomy ranged from 'very likely theories to the most ridiculous'. 'The great truths' of astronomy — claims Vergara — only landed in New Granada one century later with the Spanish priest José Celestino Mutis (1732-1808).[3] Recent studies also noticed the existence of the manuscript but did not offer substantial analysis of its contents or its significance.[4] The article that recently triggered the wider news-media interest presented a descriptive summary of the *Tratado*, reconstructing Sánchez's calculations, and claiming that the work was 'entirely Ptolemaic and still immersed in strong Scholasticism, although […] it contained a brushstroke of originality'.[5] The assumption that medieval Scholastic was hegemonic until the arrival of José Celestino Mutis in the eighteenth century frequently pervades studies on New Granada, concealing the circulation of Renaissance and early modern disciplines and trends, hitherto unattended. This assumption mirrors the now widely-questioned Spanish *Black Legend*, by taking for granted that local forms of knowledge were isolated and regressive given their intimacy with Catholicism and its control mechanisms, such as the Inquisition. Nevertheless, studies on Iberian science have exposed the *Black Legend* as misleading, and have delineated the complexity of scientific activities in the Spanish-American world during the sixteenth and seventeenth centuries.[6] In so doing, they have brought to light works, networks, and institutions once neglected by a dominant restrictive view of knowledge in the early modern period.[7]

[2]José María Vergara y Vergara, *Historia de La Literatura En Nueva Granada. Desde La Conquista Hasta La Independencia (1538-1820)*, vol. 1 (Bogotá, 1867), 137.

[3]Vergara y Vergara, 1:138; Cf Sergio H. Orozco-Echeverri and Sebastián Molina-Betancur, 'José Celestino Mutis' Appropriation of Newton's Experimental Physics in New Granada (1761–1808)', *History of Science* 57 (2019): 291–323.

[4]R Pinzón and Antonio Sánchez, 'Tratado de Astronomía y de La Reformación Del Tiempo', *Cuadernos de Filosofía Latinoamericana* 54–55 (1993): 155–67; José del Rey Fajardo and Germán Marquínez Argote, eds., *Breve Tratado Del Cielo y Los Astros (1663-1736)* (Bogotá: PUJ, 2004), 115; José Luis Guevara, *La Fábrica Del Hombre. Historias de Viajes y Usos de Los Libros Del Nuevo Reino de Granada En El Siglo XVII* (Bogotá: PUJ, 2015), 95–97.

[5]Gregorio Portilla and Freddy Moreno, 'Un Manuscrito de Finales Del Siglo XVII: Primera Manifestación de Un Estudio Astronómico y Cronológico Autóctono En Territorio Neogranadino', *Revista de La Academia Colombiana de Ciencias Exactas, Físicas y Naturales* 43 (2019): 258.

[6]See Víctor Navarro-Brotons and William Eamon, eds., *Más Allá de La Leyenda Negra. España y La Revolución Científica* (Valencia: CSIC, 2007).

[7]See, for example, Jorge Cañízares-Esguerra, 'On Ignored Global "Scientific Revolutions"', *Journal of Early Modern History* 21 (2017): 420–32; Maria Portuondo, *The Spanish Disquiet: The Biblical Natural Philosophy of Benito Arias Montano* (Chicago: Chicago University Press, 2019).

This article locates the *Tratado* within the mentioned context of renovation of Spanish-American studies on science and knowledge. In so doing, we investigate unexplored aspects of the expansion of Spanish cosmography beyond traditional centers of political power in the Spanish-American world, such as Madrid, Seville and Mexico. At the same time, we show that the production of knowledge in New Granada was not confined to *colegios* and universities, nor limited to exercises typical of Scholasticism.[8] In this way, the *Tratado* attests to the circulation of disciplines such as mathematical cosmography and astronomical chronology, indicating unattended and important aspects of the broad reach of Renaissance and early modern ideas and practices. We do this in four sections. In the first, we present some elements of Renaissance and early modern cosmography, especially the emergence of cosmographical *repertorios* (or *reportorios) de los tiempos* in Spain, whose structure inspired Sánchez. Several *repertorios* circulated before the effervescence of cosmography, but under its influence, these became relatively large books summarizing cosmography and displaying tables of astronomical positions used for a wide range of practical tasks. Although *repertorios* usually began with general elements of astronomy, the results were primarily directed at local audiences, tailored to the location from which the position of the celestial bodies was calculated. Accordingly, in the second section, we present an overview of Sánchez's autobiographical elements, including his location, as a framework for understanding the *Tratado*. In contrast with other Spanish-American territories such as Seville, México or Lima, where cosmography was connected to royal institutions, Bogotá's *Audiencia* (High Court) did not include an appointed cosmographer — nor, of course, was there such an appointment for Vélez. In the last two sections, we interpret the *Tratado* by describing Sánchez's cosmos as a local development of Spanish cosmographies, from which he derived calendrical, chronological, and astronomical consequences. The characteristics binding this work to the Renaissance and early modern practices are elaborations encompassing local perspectives with Spanish cosmography. From a wider point of view, these elaborations shed light on the expansion of cosmography by adapting and modifying knowledge coming from European sources to local concerns. In this way, the analysis of the *Tratado* contributes to reassessing the broader scope of the circulation of knowledge and sheds new light on the complex interrelationship between religious ideas, natural philosophy, and cosmography that emerged in, but was not restricted to, Europe during this period. This wider circulation and modification of Renaissance and early modern ideas and practices calls for a reconsideration of our understanding of the reactions to the crisis of knowledge in the early modern period, traditionally restricted to European scenarios.

[8]José del Rey Fajardo, *Libro de grados de Universidad y la Academia. Libro I 1634-1685: Actas de la Universidad Javeriana colonial.* (Bogotá: PUJ, 2013); Rey Fajardo and Marquínez Argote, *Breve Tratado*.

In its current form, the manuscript of the *Tratado* contains 122 double-sided folios that were cut to pages of 21×13.5 cms and bound in a single volume, probably in the nineteenth century.[9] The manuscript lacks a title page and starts off with three introductory texts: a dedicatory to the King of Spain, 'Catholic and Royal Majesty; promoter, preserver and defender of our Holy Catholic Faith' (ff. 2r-6v) asking for the King's permission to publish the work and patronage for recognising the work as a contribution from this 'New Kingdom'; a 'Letter and Prologue to the Censor' (ff. 7r-9v) in which the Censor is asked to assess whether Sánchez deserves any reward for his contribution and also to intercede before the King in his favour; a 'Prologue to the Reader' (ff.10r-12v) introducing the central contributions of the work — the corrected length of the solar year and the calculation of the true date of the birth of Jesus — and their benefits for the correction of the Gregorian calendar. After these introductory texts, the manuscript is divided in three parts, correspondingly named 'First [Second, Third] Treatise on astronomy and on the reformation of time'. The first treatise (ff. 13r-44v), comprising thirteen chapters, presents a vocabulary of astronomical and cosmographical terms and a brief but suggestive description of the *machina mundi* in terms of a singular view of the celestial orbs containing pyramidal knots. The second treatise (ff.78r-95v), made up of seventeen chapters, develops the reformation of time by dealing with 'time and its divisions', including Sánchez's own account of the duration of the solar year, the calculation of equinoxes and solstices, and the duration of the months and days. With these elements and relying on biblical hermeneutics, Sánchez calculates the date of the birth of Jesus in the year 3821 after the creation of the world. Based on this new date, Sánchez rearranges the chronology of human history, highlighting major biblical events and projecting the second coming of Christ and the last judgment. The third treatise (ff. 96r-123v), comprising eight chapters, presents the major benefit of this reformation of time, namely, a reform to the Gregorian calendar, in order to obtain the correct date of the celebration of Easter. This last treatise includes long tables of ephemerides (calculations of the eclipses of the Sun and the Moon and 'lunarios' or tables of the Moon) and a table of latitudes and longitudes of Spanish-American locations using the city of Vélez as the centre of calculation. From internal references we can gather that a few chapters of the manuscript have been lost, as we explain later in more detail. With these exceptions, the manuscript seems to fully develop the topics announced in the introductory texts and there is no reason to think that the *Tratado* contained any other introductory text or treatise.

[9]Antonio Sánchez, 'Tratado de Astronomía y de La Reformación Del Tiempo' (1696), RM245, Biblioteca Nacional de Colombia.

Cosmography and repertorios de los tiempos

Cosmography emerged in fifteenth-century universities, based on the recovery of Ptolemy's *Geographia*, although it subsequently incorporated elements from astronomy — Sacrobosco's *sphera* and the *Theorica planetarum* —, natural philosophy, medieval optics, and other ancient authorities on geography.[10] While the term cosmography suggested the study of the whole cosmos, Renaissance cosmography moved towards the explanation of the inhabited earth by projecting the celestial spheres onto it, a goal closer to what would later be classed as geography.[11] Cosmographical explanation encompassed calculations based on the mapping of heavenly referents on earth and qualitative descriptions of territories and their inhabitants. Thus, cosmography integrated astronomy, geography, cartography, natural history, and consequently a wide range of practices, from the observation of eclipses to the elaboration of maps, as well as the translation of ancient sources.[12] Although these disciplines came to be differentiated over the sixteenth century, their practitioners were generally denominated 'cosmographers'.[13]

Over the sixteenth century, cosmographical knowledge was challenged by stories of explorers and merchants travelling from Europe to Africa, America, and East Asia. Ancient and medieval debates picked up by Renaissance cosmographers, such as the borders of the habitable world, the form of the Earth, and the location of climate zones, conflicted with these reports.[14] In Portugal and Spain, naval powers of Europe and gathering points of novelties, cosmography came to be seen as a way of improving navigation by training pilots in mathematics and by perfecting navigation instruments. The training would allow them to calculate latitudes and longitudes by using improved instruments, tracing maritime routes, forecasting the tides, and locating specific ports and towns in lands newly conquered.[15] Although pilots were suspicious of the benefits of mathematics, cosmography became a matter of state in sixteenth-century Spain, acquiring significant positions in the institutions in charge of the exploration and control of the New World, such as the House of Trade of Seville *(Casa de la contratación)* and the Council of the Indies

[10]Klaus Vogel, 'Cosmography', in *The Cambridge History of Science. Early Modern Science*, ed. Katharine Park and Lorraine Daston, vol. 3 (Cambridge: CUP, 2006), 469–96.

[11]Richard Oosterhoff, *Making Mathematical Culture: University and Print in the Circle of Lefèvre d'Étaples* (Oxford: OUP, 2018), 133–50.

[12]Vogel, 'Cosmography', 469–71.

[13]Mariano Cuesta Domingo, 'Alonso de Santa Cruz, Cartógrafo y Fabricante de Instrumentos Náuticos de La Casa de Contratación', *Revista Complutense de Historia de América* 30 (2004): 7–40; Cf. Vogel, 'Cosmography', 471.

[14]Anthony Grafton, *New Worlds, Ancient Texts. The Power of Tradition and the Shock of Discovery* (Harvard: Harvard University Press, 1992), 95–157; Antonio Barrera-Osorio, *Experiencing Nature: The Spanish American Empire and the Early Scientific Revolution* (Austin: University of Texas Press, 2006), 101–27; Daniela Bleichmar et al., eds., *Science in the Spanish and Portuguese Empires. 1500–1800* (Stanford: Stanford University Press, 2009), 59–111; Maria Portuondo, *Secret Science: Spanish Cosmography and the New World* (Chicago: University of Chicago Press, 2009), 19–59.

[15]Alison Sandman, 'Cosmographers vs. Pilots: Navigation, Cosmography, and the State in Early Modern Spain' (University of Wisconsin-Madison, 2001).

(*Consejo de las Indias*). By the end of the sixteenth century, Philip II supported the creation of the Academy of Mathematics *(Academia de Matemáticas)* in Madrid, which promoted education and training in a wide range of mathematical disciplines in close proximity to the Royal Court.[16] Cosmography in Spain evolved while embedded within the interests, forms of control, and practical demands of these institutions, which inevitably transformed the Renaissance discipline.

This Spanish transformation of cosmography should not be taken as the application of theories — astronomical or cosmographical — to the solution of practical concerns — tracing reliable routes of navigation or locating territories. On the contrary, solutions to these problems were implied in the nature of the practice of cosmographers, for they would now explain unchartered seas and territories, the apparition of comets and novae, not to mention the principles of the art of navigation. Thus, cosmography moved in interrelated directions: the improving of navigation and the expansion of knowledge of the New World. The improvement in navigation found place, for example, in the House of Trade, which incorporated a Chair of Cosmography in 1552, and a Cosmographer Major in 1563, although since its first decade of operation the House appointed a Pilot Major in charge of the master-chart *(Padrón real)* containing all the sea routes; some private and informal teaching of cosmography was common since 1523.[17] Cosmographers produced translations and works in mathematics, navigation, astronomy, and cosmography for training pilots and for pleasing intellectual elites.[18] On the other hand, the cosmography at the Council of the Indies launched several projects to collect and organize information of the New World.[19] Although these projects have earlier roots, the Council of the Indies appointed a Cosmographer-Chronicler Major in 1571, who was required to make 'the cosmography tables of the Indies, registering by their longitude and latitude, and by the number of leagues — according to the art of geography — the provinces, seas, islands, rivers and hills, and other places'.[20] These tables included 'the eclipses of the moon and other signs, to calculate the longitude of the land', for which the cosmographer should 'send memory of the date (*tiempo*) and hours in which it is required to observe [the eclipse] in the Indies by the governors, including instructions and instruments'. At the same time, the

[16]M Vicente and M Esteban, *Aspectos de La Ciencia Aplicada En La España Del Siglo de Oro* (Valladolid: Junta de Castilla y León, 2006), 1–34.

[17]Antonio Sánchez Martínez, 'La Institucionalización de La Cosmografía Americana: La Casa de La Contratación de Sevilla, El Real y Supermo Consejo de Indias y La Academia de Matemáticas de Felipe II', *Revista de Indias* LXX (2010): 724.

[18]Barrera-Osorio, *Experiencing Nature*, 29–55; Portuondo, *Secret Science*, 95–102.

[19]Howard F. Cline, 'The Relaciones Geográfica of the Spanish Indies, 1577-1586', *The Hispanic American Historical Review* 44 (1964): 341–74; Vicente and Esteban, *Aspectos de La Ciencia*, 383–413; Portuondo, *Secret Science*, 141–71.

[20]Ordenanzas Reales del Consejo de Indias, 1571, Ord. 117 en J.M. López Piñero, V Navarro-Brotons, and E Portela Marco, eds., *Materiales Para La Historia de Las Ciencias En España: S.XVI-XVII* (Valencia: Pre-textos, 1976), 74.

Cosmographer-Chronicler would keep the inventory of the 'general history, with great precision and truth, of customs, rites, antiquities, facts and events' as well as the 'natural history of herbs, plants, animals, birds, fishes, and other things worthy of knowledge'.[21]

The institutions for governing the transatlantic empire provided a connection between cosmography and the practical concerns of colonisation and administration of the New World.[22] This encounter generated important changes in cosmography, but it also brought to these institutions a set of disciplinary assumptions rooted in the Renaissance universities.[23] These assumptions, largely overlapping, became the basics required to understand and practise cosmography: (1) the 'spheres' or the introduction to Ptolemaic astronomy via Sacrobosco's *sphera* — as varied as its translators and commentators in Spain;[24] (2) the *Theorica planetarum* that abridged the *Almagest,* and translations and commentaries of Peurbach's *Theoricae novae*;[25] (3) the 'Tables', registering the parameters for calculations, such as the *Alfonsine tables* and Reinhold's *Prutenic tables*; (4) finally, the mathematical principles for projecting spheres onto flat surfaces, mainly for the calculation of longitudes and latitudes, based on Ptolemy's *Geography* and on Apian's works, commented upon and paraphrased by Spanish cosmographers.[26] This structure is visible in the curricula of some mid-sixteenth century universities, where the medieval *corpus astronomicum* served as the foundation for the basics of cosmography.[27] According to the 1561 Statute of the University of Salamanca, the first year for the chair of astrology should read 'Sphere and theorica of planets, and some tables; as a substitution, astrolabe'. For the second year, some of Euclid and Ptolemy's *Almagest,* or 'its *Epitome* by Regiomontanus, or Geber, or Copernicus […] as a substitution, sphere'. For the third year, 'Cosmography, or Geography, an introduction to Judiciary [astrology] and Perspective, or an instrument

21 Ordenanzas … , 1571, Ords. 119–120 in López Piñero, Navarro-Brotons, and Portela Marco, 74–75.

22 José Pardo Tomás, *Un Lugar Para La Ciencia. Escenarios de Práctica Científica En La Sociedad Hispana Del Siglo XVI* (Tenerife: Fundación Canaria Orotava de Historia de la Ciencia, 2006), 48–50.

23 Víctor Navarro-Brotons, 'The Teaching of the Mathematical Disciplines in Sixteenth-Century Spain', *Science & Education* 15 (2006): 209–33; Víctor Navarro-Brotons, 'Aspects of the History of Cosmography in Spain in the Last Decades of the Sixteenth Century (until 1606)', *Archives Internationales d'Histoire Des Sciences* 59 (2009): 555–74.

24 Kathleen Crowther, 'Sacrobosco's Sphera in Spain and Portugal', in *De Sphaera of Johannes de Sacrobosco in the Early Modern Period. The Authors of the Commentaries*, ed. Matteo Valleriani (Cham: Springer, 2020), 161–84; See also Díaz Cedillo, *Ydea Astronomica de La Fabrica Del Mundo y Movimientos de Los Cuerpos Celestes. Traduccion de De Revolutionibus I-III de Nicolás Copérnico*, ed. Miguel Ángel Granada and Félix Gómez Crespo (Barcelona: Universitat de Barcelona, 2019), 21–34; Víctor Navarro-Brotons and Enrique Rodríguez, *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: CSIC, 1998), 42–71.

25 Olaf Pedersen, 'The Origins of the "Theorica Planetarum"', *Journal for the History of Astronomy* 12 (1981): 113–23. Outstanding cosmographers such as Cedillo Díaz, Santa Cruz, and García de Céspedes translated and commented Peurbach's (Purbachio) *Novae Theoricae;* Vicente and Esteban, *Aspectos de La Ciencia*, 151–54; Cedillo, *Ydea Astronomica*, 112; Navarro-Brotons and Rodríguez, *Matemáticas, Cosmología y Humanismo*, 72–75.

26 Apian's *Liber cosmographicus* circulated in Spain (1548) including works by Gemma Frisius. Peter Apian and Gemma Frisius, *Libro de La Cosmographia de Pedro Apiano … Augmentado Por El Doctissimo Varon Gemma Frisio … Con Otros Dos Libros Del Dicho Gemma, de La Materia Mesma* (Amberes, 1548).

27 Olaf Pedersen, 'The Corpus Astronomicum and the Traditions of Mediaeval Latin Astronomy', *Studia Copernicana* 13 (1975): 59–96; See also Oosterhoff, *Making Mathematical*, chap. 5.

chosen by the students'.[28] A similar arrangement, starting with Sacrobosco, including some *theoricas*, and positional elements of geography, was the core of the teachings at the House of Trade, when the chair of cosmography commenced in 1552.[29] The extension of this set of basics of cosmography beyond universities renovated and produced genres of writing, such as the treatises on the art of navigation and the *repertorios*.[30] The treatises on navigation have received considerable attention so here we only notice, following Portuondo, that these not only included practical guides for navigation, but also an attempt 'to establish the art of navigation on a theoretical footing consistent with established principles of natural philosophy', drawing elements from Sacrobosco and Ptolemaic cartography.[31]

The *Repertorios de los tiempos* encompass astronomical, agricultural, ecclesiastical, medical, and calendrical problems rooted in the Medieval Latin West and in Arabic and Jewish traditions influential in the Iberian Peninsula and Europe.[32] *Repertorios* differed from almanacs and yearly horoscopes, the most common printed materials on these topics circulating in Europe. While these latter were shorter and their use was limited in time — usually restricted to the religious calendar, the seasons, and the eclipses for the year —, *repertorios* contained tables covering longer periods and provided astrological generalities adjustable to different times and locations.[33] Before the rise of cosmography as a prominent discipline, some *repertories,* such as the one by Andrés de Li (*c.*1495) and the augmented versions of it by Sancho de Salaya (1536) circulated widely in Spain.[34] However, the integration of Spanish cosmography into the *repertorios* promoted a singular, Catholic view of the cosmos as spatially organized by mathematics and temporally ordered by the measurement of time — a time embracing astronomical measures, the religious and civil calendars, and the biblical and prophetical eras.[35] In this way, *repertorios* reflected singular

[28]Eugenio de Bustos Tovar, 'La Introducción de Las Teorías de Copérnico En La Universidad de Salamanca', *Revista de La Academia de Ciencias Exactas, Físicas y Naturales* 67 (1973): 243–44.

[29]Sandman, 'Cosmographers vs. Pilots', 212–91.

[30]Portuondo, *Secret Science*, 48–61; Sandman, 'Cosmographers vs. Pilots'; Martha Tappan, 'Representaciones de La Tierra En Un Género de Escritura Del Siglo XVI', *Fuentes Humanísticas* 26 (2013): 7–24.

[31]Portuondo, *Secret Science*, 50; See also J.M. López Piñero, *El Arte de Navegar En La España Del Renacimiento* (Madrid: Labor, 1986); J.A. Bennett, *The Divided Circle: A History of Instruments for Astronomy, Navigation, and Surveying* (Oxford: Phaidon, 1987); Margaret E. Schotte, *Sailing School. Navigating Science and Skill, 1550-1800* (Baltimore: John Hopkins University Press, 2019).

[32]Bernard Goldstein, 'Astronomy and the Jewish Community in Early Islam', *Aleph* 1 (2001): 17–57; Sacha Stern and Charles Burnett, eds., *Time, Astronomy, and Calendars in the Jewish Tradition* (Leiden: Brill, 2014); Juan Vernet, *Astrología y Astronomía En El Renacimiento* (Madrid: El Acantilado, 2000), 70–84.

[33]Mathilde Albisson, 'En Mala Estrella: Los Pronósticos Astrológicos y Repertorios de Los Tiempos Censurados Por La Inquisición Española (1632-1707)', *Studia Historica: Studia Moderna* 41 (2019): 254–55; Tayra Lanuza-Navarro, 'Astrological Literature in Seventeenth-Century Spain', *The Colorado Review of Hispanic Studies* 7 (2009): 119–36.

[34]Laura Delbrugge, 'A Critical Edition of Andrés de Li's Repertorio de Los Tiempos (1495)' (PhD Thesis, Pennsylvania, The Pennsylvania State University, 1996); Víctor Navarro-Brotons et al., eds., *Bibliographia Physico-Mathematica Hispanica (1475-1900)*, vol. 1 (Valencia: CSIC, 1999), 176–82; 266; Ciro Flórez Miguel, 'Las Ciencias y La Universidad de Salamanca Siglo XV', in *Salamanca y Su Universidad En El Primer Renacimiendo. Siglo XV*, ed. Luis Rodríguez and Juan Polo (Salamanca: Ediciones Universidad, 2011), 179–202.

[35]Cf Tappan, 'Representaciones de La Tierra'; Lanuza-Navarro, 'Astrological Literature in Seventeenth-Century Spain'; Albisson, 'En Mala Estrella'.

characteristics of the Spanish reactions to the more general Renaissance concerns with the prevailing natural philosophical systems to explain the natural world.[36]

The first *repertorio* integrating cosmography was Jerónimo de Cháves's *Chronographia o reportorio de los tiempos (Chronography or repertory of the times),* published in Seville in 1548. Jerónimo de Cháves (1523-1574) was the son of Alonso de Cháves (*c.*1492-1587), a cosmographer, master of instruments, and Pilot Major of the House of Trade. Before the *Chronographia,* Cháves published an annotated translation of Sacrobosco's *Sphera* (Seville, 1545), and in 1552 he was elected as the first professor of cosmography at the House of Trade.[37] Cháves's *Chronographia* aims to 'refute the *repertorios* made common thus far, because they lack important and necessary things, and many others are frivolous or lack foundation';[38] the *lunarios* (tables of the moon) were 'incorrectly verified' and the eclipses were located 'at pleasure by the printer'. While previous writers of *repertorios* were moved by the 'love of money', Cháves's interests originated in the virtues of the 'sciences and the true mathematical and liberal arts'.[39] Consequently, he calculated the tables, eclipses, and the *lunario,* whereas the remaining aspects of the work, as in treatises on navigation, came from 'experience or from very serious, reliable authors' — pilots and travellers, but also mathematicians and ancient authorities.[40] Apart from improved calculations, Cháves's *repertorio* introduced cosmography to explain time in terms of the motion of celestial bodies. Accordingly, the work is shaped by the basics of cosmography in four treatises. The first deals with time and its divisions, including a general chronology, and chronologies of the Roman emperors, popes, and the kings of Spain. The second treatise describes the *machina mundi* with elements from Sacrobosco and the *theorica,* starting with the four elements and their region, and then ascending to the heavens up to the *primum mobile*, concluding with the signs of the zodiac and their influence on earth. The third contains the 'diversity of cycles and calendars, and the derivation of the moveable feasts', particularly the calculation of the date of Easter, and a catalogue of eclipses.[41] The last treatise deals with medical astrology, mostly with the calculation of dates for bloodletting and the climacteric years. The book concludes with an extensive table of longitudes of places in Europe and the New World calculated from Seville.[42] Cháves's *Chronographia* circulated extensively, setting a new standard for *repertorios.* The book was reprinted

[36]Portuondo, *The Spanish Disquiet*, 13–29.
[37]Jerónimo de Cháves, *Tractado de La Sphera Que Compuso El Doctor Ioannes de Sacrobusto* (Sevilla, 1545); See Crowther, 'Sacrobosco's Sphera in Spain and Portugal', 173–75.
[38]Jerónimo de Cháves, *Chronographia o Reportorio de Los Tiempos, El Más Copioso y Preciso Que Hasta Agora Ha Salido a La Luz* (Sevilla, 1557), fig. iiij r.
[39]Cháves, iiij v.
[40]Cháves, fol. iiij v.
[41]Cháves, fol. lxxxviij r.
[42]Cháves, fol. clcxxxj.

between fifteen and eighteen times, including an extremely popular counterfeit edition that reached New Spain.[43] Similarly, the *Chronographia* inspired Portuguese *repertorios,* such as André do Avelar's *Reportorio dos tempos* (Lisbon, 1585), presented at the time as 'a mere Portuguese translation' of Cháves.[44] The book was also the main source of the German-émigré Enrico Martínez's *Reportorio de los tiempos y historia natural de la Nueva España* (*Repertory of the times and natural history of New Spain*) (1606) and of the Peruvian Felipe Guamán Poma de Ayala's *El primer nueva crónica y buen gobierno* (*The First New Chronicle and Good Government*) (c. 1615).[45]

The influence of Cháves's *Chronographia* did not directly reach Sánchez, for there is no traceable reference in the *Tratado*. However, the *Tratado* closely follows the structure, contents, and methods of another popular cosmographical *repertorio,* shaped under Cháves's cosmographical form: Rodrigo Zamorano's *Cronología y repertorio de la razón de los tiempos* (*Chronology and repertory of the reason of the times)*, appeared in Seville in 1585. Zamorano (1542-1620) embodies the complexities of Spanish cosmography, combining the erudition of Spanish universities with a career at the House of Trade that led him to simultaneously occupy all the major positions in cosmography: professor of cosmography (1575), cosmographer (1579), and Pilot Major (1586). In 1576, Zamorano published a Spanish translation of the first six books of Euclid's *Elements,* which attracted the attention of the University of Salamanca, offering him the professorship of mathematics — which he declined —. In 1581, his *Compendio del arte de navegar (Compendium of the art of navigation)* appeared, which belongs to the navigational manual genre, covering the topics of the chair of cosmography at the House. The *Compendio* appeared in six editions up to 1591 and was translated into English by Edward Wright in 1610.[46]

In the Preface to *Cronología*, Zamorano claims that his interest was to correct the 'order of calculating times' that was altered by the introduction of the Gregorian reform in 1582. As this new calendar removed ten days to fix the date of the vernal equinox, 'everything contained [in the old *repertorios*] has

[43]Anonymous, *Repertorio de Los Tiempos … Con Toda Diligencia Cuydado, Por Un Religioso Dela Horden Del Glorioso Doctor Sant Bernardo* (Valladolid, 1554); Soledad González, 'Guaman Poma y El Repertorio Anónimo (1554): Una Nueva Fuente Para Las Edades Del Mundo En La Nueva Crónica y Buen Gobierno', *Chungara, Revista de Antropología Chilena* 44 (2012): 377–88; Sophie Plas, 'Une Source Européenne de La Nueva Coronica y Buen Govierno de Guaman Poma', *Journal de La Societé Des Américanistes* 82 (1996): 97–116; Tappan, 'Representaciones de La Tierra'.

[44]Roberto de Andrade Martins, 'André Do Avelar and the Teaching of Sacrobosco's Sphaera at the University of Coimbra', in *De Sphaera of Johannes de Sacrobosco in the Early Modern Period: The Authors of the Commentaries*, ed. Matteo Valleriani (Cham: Springer, 2020), 313–58.

[45]Tappan, 'Representaciones de La Tierra'; Plas, 'Une Source Européenne'; Edmundo O'Gorman, *La Invención de América* (Mexico: FCE, 1999); Francisco de la Maza, *Enrico Martínez, Cosmógrafo e Impresor de Nueva España* (Mexico: Ediciones de la Sociedad Mexicana de Geografía y Estadística, 1943).

[46]Portuondo, *Secret Science*, 99–100; Rodrigo Zamorano, *Los Seis Libros Primeros de La Geometría de Euclides.* (Sevilla, 1576); *Compendio Del Arte de Navegar* (Sevilla, 1581).

changed'.[47] However, his intention was not limited to adjusting the 'old *computes*' according to the Gregorian calendar; he also wanted to write a new *repertorio* including 'all the subjects comprised in previous ones' and adding 'more resolute and more exact truths',[48] for preceding *repertorios* contained 'several and enormous errors (…) given the absence of Astronomy in them'. Accordingly, Zamorano's *Cronología* is divided into five books. The first deals with 'the causes of time, which are the heavens and their movements, with their properties and those of the elements', that is, an explanation of the *machina mundi* grounded in spheres and *theorica*. The second presents 'the difference of times used by people to count the duration of things'. In the third book Zamorano studies the '*computus* of times' that the Roman Church employs for its celebrations, 'reducing the calculations to clear and perpetual tables', including some 'rules' to learn by heart with the help of hands and without requiring any book. The table of longitudes endsthe third book and the point of reference is, again, Seville.[49] The fourth book contains the 'signs' of the seasons and the winds, and also meteorological considerations. In this context, Zamorano discusses the nature of comets — a topic which Sánchez discusses at length in his *Tratado* —, showing his agreement with Girolamo Cardano in the sense that 'comets are generated not only in the region of the elements but also in the heavens'. Here Zamorano echoes views disseminated in Spain by Jerónimo Muñoz (1520-1591), a celebrated Valencian mathematician and astrologer who openly challenged the Aristotelian cosmology and the view of the cosmos as composed by orbs and, in its place, formulated a neo-stoic theory of the cosmos as a *continuum*.[50] In the fifth and final book, Zamorano displays his 'chronology and the discourse of the times and years in which the most notable things occurred in the world', including a catalogue of the popes, the Roman emperors, and the kings of Spain. Zamorano's *Cronología* renovated the genre of *repertorios* by introducing original methods of calculation, new observations, and an updated version of chronologies and calendars after the Gregorian reform. Although Cháves's *Chronographia* set new standards for the genre, Zamorano's work adapted it to the challenges introduced by the Gregorian reform, the latest developments of cosmography, and Renaissance erudite ideas.

Despite its title and the novelty of some of its tenets, the *Tratado* displays characteristics of cosmographical *repertorios* rather than those of early modern astronomical treatises:[51] the topics and the approach to them are

[47]Rodrigo Zamorano, *Cronología y Repertorio de La Razón de Los Tiempos. El Más Copioso Que Oi Se Ha Visto.* (Sevilla, 1585), 'Al curioso y discreto lector'.
[48]Zamorano, 'Al curioso y discreto lector'.
[49]Zamorano, 242.
[50]Portuondo, *Secret Science*, 100; Víctor Navarro-Brotons, *Jerónimo Muñoz: Matemáticas, cosmología y humanismo en la época del Renacimiento* (Valencia: Universidad de Valencia, 1998), 113–71.
[51]On the characteristics of the astronomical treatise see Robert Westman, *The Copernican Question : Prognostication, Skepticism, and Celestial Order* (Berkeley: University of California Press, 2011), 25–61.

traditional of *repertorios*, such as abridged elements of spheres and *theorica*, definitions of time, chronology, *computus,* calendars; it provides a broad, conceptual description of the celestial orbs, touching upon some novel factors, but limiting the exposition to a summary presentation followed by a more detailed treatment of the astronomical measurements of time, chronology and calendrics; it relies on first and (mostly) second-hand sources common to the genre: Aristotle, Ptolemy, Macrobius, Al-Farghani, Clavius, Cortés, Zamorano, Pérez de Moya, Copernicus, Regiomontanus, the *Alphonsine* and *Prutenic Tables*. The topics are structured in three 'treatises': the first summarising the basics of cosmography; the second with the astronomical measures of time and geography, chronology, and *computus;* and the third with a reform to the calendar, tables of conjunctions, and the table of longitudes of the Spanish world calculated from Vélez. Finally, the *Tratado* highlights as its major achievement two conclusions falling within the scope of *repertorios* and their Renaissance roots: an improved calculation of the central date in human history, the birth of Jesus, and a calendrical correction. Despite Sánchez's innovative sketch of the celestial orbs in his summary of astronomy, he focusses his attention on, and portrays as the centre of his work, these chronological and calendrical accomplishments. Thus, following the style of cosmographical *repertorios*, these results are presented as connected to the elements of spherical astronomy — including new calculations and observations made from the New World — which provide an astronomical and natural-philosophical explanation of the celestial motions in consonance with the physical information scattered throughout the Bible. Before moving on to the analysis of the *Tratado,* we review some basic aspects of Sánchez's biographical elements and of New Granada which contrast with the traditional centres of power where *repertorios* were usually produced. Given the local focus of *repertorios* — they were based on calculations from and applicable, in principle, to specific locations —, these works reflect concerns of the places where they were written.

A *mestizo licenciado* at the centre of the New Kingdom

The only information concerning the identity of the author of the *Tratado* comes from his self-presentation scattered through the introductory texts to the work. The comparison of this information against archives has proved highly inconclusive, as we shall see. In the prologues to the *Tratado*, Sánchez claims to be born in Mochuelo, a place on which the city of San Gil was later erected,[52] and lived in the city of Vélez at the time of writing the *Tratado*.[53] Additionally, Sánchez claims to be a priest in Vélez, although there are no

[52]San Gil became a villa in 1689. 'Licencia Para Fundar Población En La Provincia de Guane' (1689), Sección Colonia, Miscelánea:SC.39, Archivo General de la Nación de Colombia.
[53]Sánchez, 'Tratado', 9v.

indications of whether he was a parish priest or he was associated with a religious order. There are no major hints about his age, except for a claim that he worked on the *Tratado* for two decades, from 1676. However, in the dedicatory to the King, he devotes some folios to trace his genealogy, concluding that he was a descendant of the first *conquistadores* and of the *cacique* Guanientá:[54] 'By chance, I belong to the family and the blood of the indigenous people that ruled these kingdoms before the graceful dominion of your Holy Crown over them'.[55] Sánchez claims to be the son of the *conquistador* Martín Sánchez de Cozar and Isabel Gómez Pavón. His mother was the great-granddaughter of Juana Paché, daughter of *cacique* Guanientá, who had an illegitimate daughter with the *conquistador* Francisco de Murcia, appointed *encomendero* of the former lands of the *cacique*.[56] Nevertheless, we have been unable to verify most of this genealogy. There is some evidence that Francisco de Murcia was *encomendero* of Sutaytausa, not of Vélez.[57] Likewise, a document referring to Sánchez's mother (or to a person bearing the same name), dated 1668, describes her as 'a noble, poor, alone widowed woman, *vecina* of the city of Vélez'.[58]

Sánchez's self-representation as *mestizo* locates his work in a different context to that of the Spanish *repertorios*, irrespective of the accuracy of the genealogical tree. Racial disputes in New Granada led to radical social divisions and clashes in which the indigenous peoples were often the losing party. *Criollos* and *mestizos* struggled to assert their Spanish ancestry, tampering with their family names or just neglecting them.[59] Sánchez's insistence on his indigenous background is unusual. Two reasons might have led him to this claim. First, the legitimation of his family as inheritors of the treasures buried with the *cacique* and the possibility to be appointed as *encomenderos* of the region under the jurisdiction of the tribe.[60] Echoing the legends of the *conquistadores,* Sánchez describes Guanientá's treasure as including a palace of which there are still 'four corners of carved solid marble', from which the *cacique* ran away 'on the shoulders of his vassals (…) on a chair of gold and a crown of the same [material]' when the *conquistadores* arrived.[61] Second and most important, Sánchez's self-representation as a *mestizo* of honourable ancestry incarnates the inclusion of the New World and its inhabitants into the history of redemption,

[54]Sánchez writes Guanienta (sic), although every reference to the *cacique* by the *cronistas* arriving with the *conquistadores* called him Guanentá. See Juan de Castellanos, *Historia del Nuevo Reino de Granada*, ed. Antonio Paz y Meliá, vol. I (Madrd, 1886), 308.
[55]Sánchez, 'Tratado', 4r.
[56]Sánchez, fols 4r–5v.
[57]Juan Flórez de Ocariz, *Libro primero de las geneaologias del Nuevo Reyno de Granada* (Madrid, 1674), 77.
[58]'Moncora, Bularegua, Soratá, Otros: Diligencias de Visita' (Bogotá, 1668), fol. 702r, Visitas: SC. 62, Archivo General de la Nación de Colombia.
[59]Roger Pita Pico, 'Vestigios de la lengua guane: una aproximación al fenómeno del mestizaje idiomático en Santander', *Lingüística y Literatura* 63 (2013): 295–316; Santiago Castro-Gómez, *La Hybris Del Punto Cero: Ciencia, Raza e Ilustración En La Nueva Granada (1750-1816)* (Bogotá: PUJ, 2005).
[60]Sánchez, 'Tratado', fols 2r–6v.
[61]Sánchez, 4r.

by means of conversion to Christianity, commanded by the King of Spain. Under this light of colonisation as a spiritual process of evangelisation, it is central to Sánchez's narrative to assert not only his indigenous genealogy, but the inclusion of the Americas and its inhabitants within the history of Christianity as a historical step towards the last judgment, the one he depicts with Sacroboscian celestial orbs. In this way, Sánchez's self-representation operates as way to connect his geographical and historical awareness with the astronomical and chronological findings that we explain in this paper. Addressing to the King in the dedicatory, Sánchez's explains

> Now we appreciate more being your vassals than what we were when dominating others. Because that freedom and dominance lacked the light of the Gospel, while this servitude and vassalage is with such a light: through the invincible weapons of our Catholic monarchs your predecessors in glorious memory, we were told, by the mercy of the supreme and true god, that after so many thousand years all these nations, so numerous and extended, remained in the sad darkness of God's gentility. But now we enjoy this benefit, and we have more insofar the spiritual is better than the material.[62]

In this light, the emphasis on his own genealogy also explains the historical nature of the urgent findings that he attempts—and fails—to communicate to the King, defender of faith: the correction of chronological history, based on a new date of the birth of Jesus, and the correction to the calendar.

Another clue concerning Sánchez's identity comes from his signature: 'Ldo. [Licenciado] Atto [Antonio] Sánches de Cozar Guanienta'.[63] Contrary to the idea that Sánchez was an autodidact,[64] the signature makes it clear that Sánchez was a *licenciado*. Under supervision of the Holy See and the Council of Indies, universities in New Granada conferred degrees of *bachiller, licenciado, maestro* and *doctor,* so we may assume that Sánchez received also formal education of *bachiller*, compulsory to achieve the more advanced degree of *licenciado*.[65] An independent source reinforces this conclusion: Juan Flórez de Ocariz's genealogical reconstruction of the family trees of the Spanish *conquistadores*.[66] The second book registers that Martín Sánchez and Isabel Gómez — names identical to Sánchez's parents — had two daughters, María de Cozar and Cecilia Gonzalez, and other children: 'Alonso Sarmiento, *vecino encomendero* of the city of Vélez (…) was married to Sicilia [Cecilia] Gonzalez (legitimate daughter of Martín Sánchez de Cozar, and Isabel Gómez de Sanabria), *vecinos* of the same city, with young children, the oldest being a scholar (*colegial*) of San Bartolomé at Santa Fé'.[67] In the absence of a

62Sánchez, 'Tratado', 4v.
63Sánchez, fols 6v; 9v.
64Portilla and Moreno, 'Un Manuscrito', 258.
65Rey Fajardo, *Libro de grados*, 39.
66Flórez de Ocariz, *Libro primero*; Juan Flórez de Ocariz, *Libro segundo de las geneaologias del Nuevo Reyno de Granada* (Madrid, 1676); See Guevara, *La Fábrica Del Hombre*.
67Flórez de Ocariz, *Libro segundo*, 290.

first name, it is not implausible that the scholar mentioned was the author of the *Tratado*. The *Genealogías* were published between 1674 and 1676, but the manuscript was completed around 1670,[68] so Martín Sánchez de Cozar's older son could not have been a scholar at the *Colegio* de San Bartolomé before 1670 — a date consistent with the estimated starting date of the writing the *Tratado* in 1676.[69]

This possible connection with the *Colegio* de San Bartolomé should not be overlooked, although we lack significant evidence to assert it beyond reasonable doubt. Founded by the Jesuits in 1604, San Bartolomé became an influential *colegio* and, in 1623, its *Universidad Javeriana* (Xaverian University) was authorized to confer degrees.[70] The Jesuits adopted the *Ratio studiorum*, including lectures on mathematics that were absent in *colegios* led by other religious orders.[71] Some of the most important sources of Sánchez were typical of the Jesuit education especially the study of Clavius's commentary to Sacrobosco's *Sphaera*.

The historical connections between Sánchez and the city of Vélez, a geographical referent present in his work both for self-representation but also for calculation, are also far from clear. In the sixteenth century, Vélez was a relatively small city of trade, forming with neighbouring Spanish settlements a network dedicated initially to the exploitation of gold. Once the mines were exhausted, the city kept a considerable infrastructure of *encomiendas* and landowners that shifted the economy to the production of cotton, sugar, tobacco, and the fabrication of textiles.[72] Despite its small size, Vélez and its network rivalled Santa Fé in importance, to the point that some claimed that Vélez should take the place of capital of the New Kingdom.[73] Sánchez's choice of Vélez as reference point of calculation seems to suggests as well that Vélez is the centre from which the New Kingdom connects with the world.[74]

In the second half of the sixteenth century, cities, parishes and villages that Spaniards created to the north of Santa Fé (Figure 1) constituted a network that gained importance in trading with the Atlantic world. Small cities such as Vélez and San Gil, as well as Tunja, Socorro, and Pamplona, constituted a strong gold-mining economy, reinforced with large *encomiendas*, where the agricultural activities produced most of the supplies for the newly created Andean Spanish cities.[75] Juan López de Velasco, Cosmographer of the Council of the Indies, reports that at this time Vélez was populated by around a hundred

[68]Flórez de Ocariz, *Libro primero*, 53.
[69]Sánchez, 'Tratado', fol. 6r.
[70]Rey Fajardo, *Libro de grados*, 21–24.
[71]José del Rey Fajardo, 'La Implantación Del Ratio Studiorum En La Provincia Del Nuevo Reino de Granada', *Revista Portuguesa de Filosofía* 55 (1999): 275–317.
[72]Darío Fajardo, *El Régimen de La Encomienda En La Provincia de Vélez* (Bogotá: Universidad de los Andes, 1969); Germán Colmenares, *Historia Económica y Social de Colombia, 1537–1719* (Bogotá: La Carreta, 1973), 156–87.
[73]Anthony McFarlane, *Colombia before Independence: Economy, Society, and Politics under Bourbon Rule*, Cambridge Latin American Studies (Cambridge: CUP, 1993), 52–53.
[74]Sánchez, 'Tratado', fol. 114r.
[75]Colmenares, *Historia Económica*, 53–53.

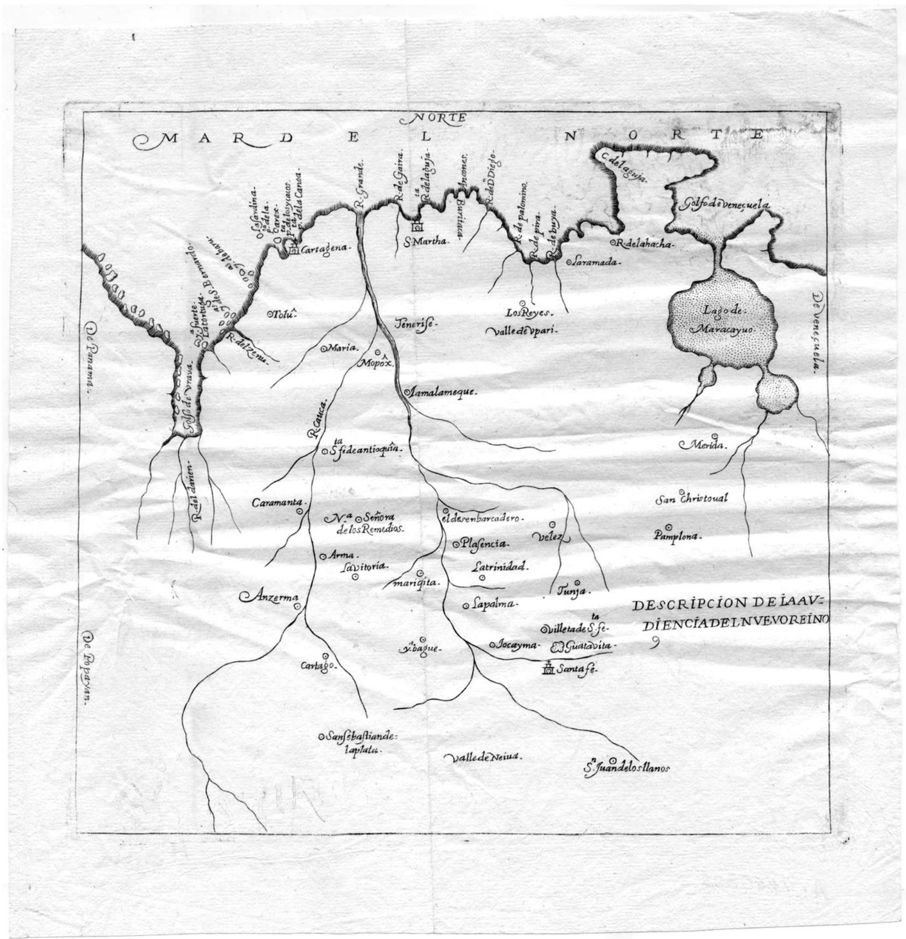


Figure 1. Description of the Audiencia of the New Kingdom, Juan López de Velasco (c.1601). (North to the top). The 'Mar del Norte' is the Atlantic Ocean. This map depicts the Magdalena river (Río Grande) as the main artery of the territory, with Cartagena and Santa Marta on each side of the estuary. Following the path of the river downwards, in the second branch emerging to the right, notice the route from Vélez to the Magdalena river; below them, Santa Fé (Bogotá). *Colección de cartografía histórica, Biblioteca Luis Ángel Arango, Banco de la República de Colombia*.

Spaniards, thirty-eight *encomenderos*, and seventy-four indigenous settlements. The city had one governor and a 'monastery of Franciscans with six priests'.[76] Additionally, 'there are several gold mines in what is called the Golden River' and 'a port to the *Río Grande*' providing a direct route to the Atlantic (Figure 2).[77] When the mines and ores in this area proved to be less productive than those south of Bogotá, the northern towns already had a well-structured agricultural economy, and a highly-defined society that supported the claims

[76]Juan López de Velasco, *Geografía y Descripción Universal de Las Indias … Desde El Año 1571 al de 1574 …* , ed. Justo Zaragoza (Madrid, 1894), 372.
[77]López de Velasco, 372. Cf. Colmenares, *Historia Económica*, 73–103.

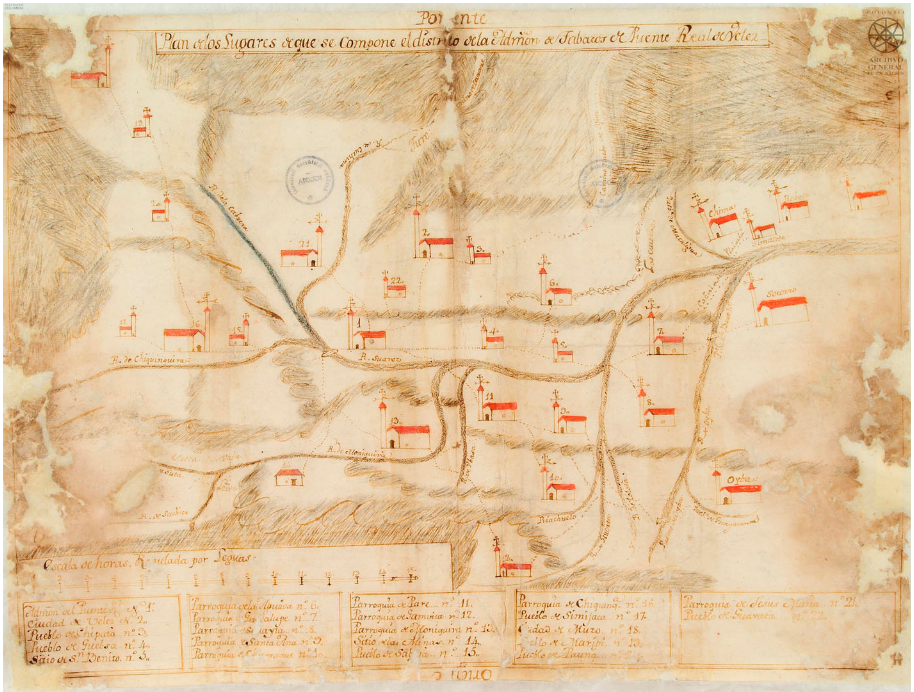


Figure 2. Vélez Administrative district of Tobaccos (1700). This map (west to the top) depicts the network around Vélez related to the production of Tobacco, an important product of trade with the Atlantic world. The city of Vélez is number 2, (top-centre). *Archivo General de la Nación, Colombia.* CO.AGN.SMP.4, REF.526A.

of centres such as Vélez to be the capital of the *Audiencia*. However, as McFarlane noticed, 'helped by the *audiencia*, the *encomenderos* and merchants of Bogotá secured the development of the *camino real* from Honda and made this trail the main route for supplying the Eastern highlands'.[78] Despite the unsuccessful attempts of establishing the capital of the *Audiencia* in Vélez, these efforts and struggles were reflected in a local awareness of centrality that we read, for example, when Sánchez assumed Vélez as the centre of calculation of the longitudes connecting New Granada with the world (Figure 3). However, it is important to notice that the table of latitudes and longitudes is presented as part of the tools to calculate 'the equation of hours and minutes in which the full moons and conjunctions with the Sun take place in the most notable places'.[79] In other words, the table is introduced in the context of a wider chronological and calendrical argument rather than as an independent instrument for the calculation of geographical distances for travellers or merchants.

As we have seen, the historical references to the author of the *Tratado* and to Vélez in the context of the work are far from evident, in part because they

[78]McFarlane, *Colombia Before*, 52.
[79]Sánchez, 'Tratado', fol. 113r.

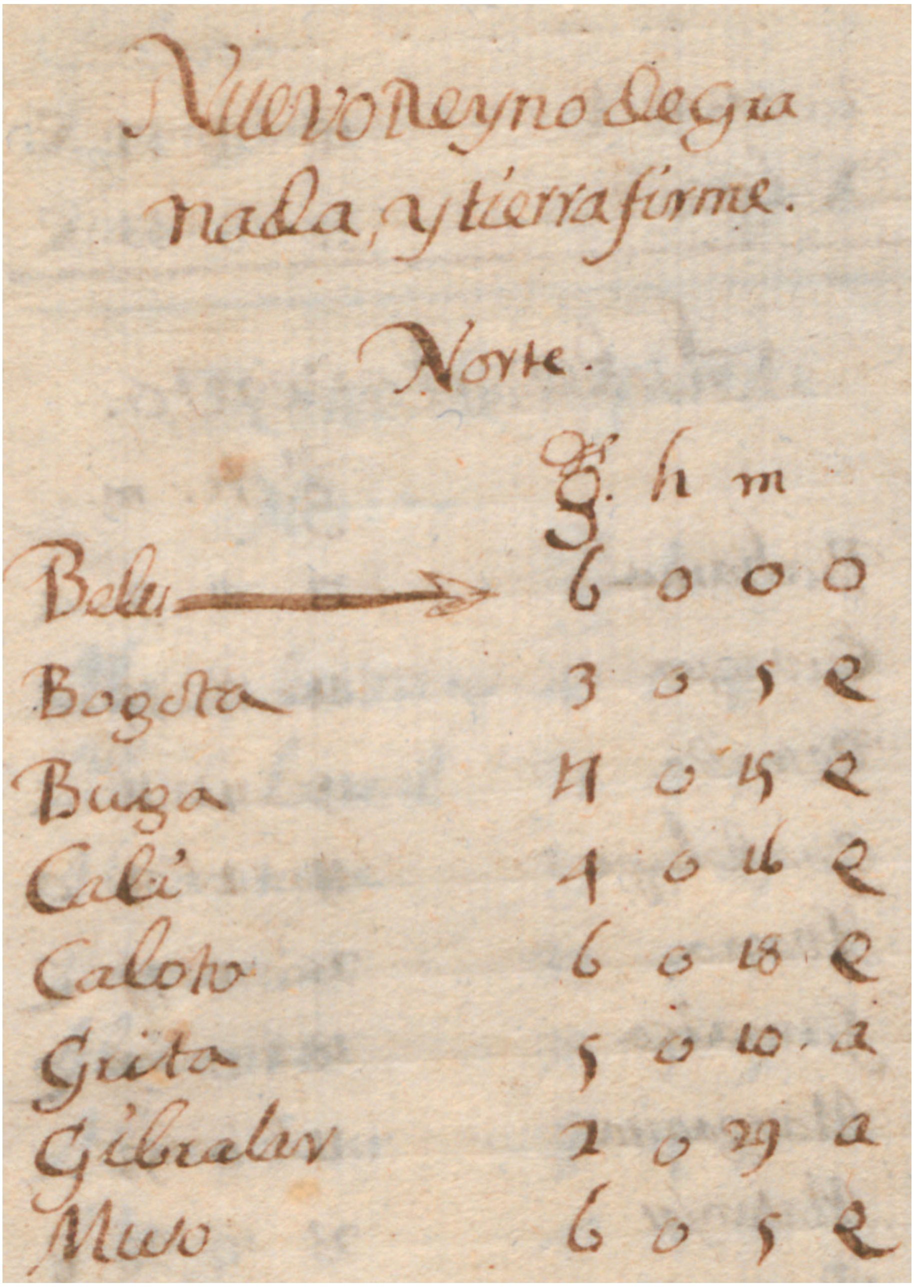


Figure 3. Heading of the table of longitudes. The 0 after Vélez's longitude indicates that nothing should be added (a) or reduced (q) to determine its longitude, as in the remaining cases, because Vélez is the centre of calculation. Sánchez usually writes 'Vélez' but the choice of 'Beles' here seems to match better on top of Bogotá, preserving the alphabetical order. Sánchez, *Tratado*, f.114v. *Biblioteca Nacional de Colombia*.

come from autobiographical hints that Sánchez left in the introductory texts to his work; these clues have proved hard to verify in historical records. However, these scattered autobiographical elements and the references to the region of Vélez provide a historical and geographical framework to appreciate the *Tratado*.

Spheres, knots, and the astronomy of the last judgment

Following the order of *repertorios,* Sánchez's *Tratado* opens with definitions concerning spheres and *theoricas,* presented as the study of 'the world and its parts' and 'the true fabric of the heavens, as deduced from its natural motions'.[80] However, instead of repeating the common places of the basics of cosmography, Sánchez develops an original explanation of the natural causes of motion in the world, as it was created from the beginning of times and also of the locking of the celestial orbs that will take place on the second coming of Jesus. Here, spherical astronomy approaches natural philosophy and acquires a historical dimension derived from the Bible as source of chronological and astronomical information. In so doing, Sánchez's works develop trends that were prominent in his Spanish and European sources.

As was customary in Medieval and Renaissance cosmologies,[81] Sánchez's cosmos is structured in heavens or orbs. However, in Sánchez these heavens are 'hulls of crystalline, incorruptible matter, of spherical shape, separated (*discontiguos*) one from the other, and continuous in their parts without any interruption'.[82] These orbs or heavens are concentric, starting from the empyrean and moving down to that of the moon, in whose centre lay the four elements, including the mix of water and earth forming the terraqueous globe. With the single exception of the empyrean heaven, all the remaining spheres have 'a pyramidal knot (*ñudo*) pointing towards the earth', including the heaven of the fixed stars whose knot is situated in the constellation of Aries.[83] The remaining heavens enclose in their knot their respective celestial body: Saturn, Jupiter, Mars, Sun, Venus, Mercury, the Comets, and the Moon, in strict order. While the heavens are concentric, they remain separated because of these pyramidal knots; that is, heavens are in contact only where the knot of the superior sphere touches the surface of the inferior heaven. Thus, heavens are not 'contiguous like the skins of an onion (as ancient astrologers imagined)', but rather 'bodies free in the air' (*sueltos en el ayre*).[84] In so doing, Sánchez moves away

[80]Sánchez, 20v; 22r.
[81]Edward Grant, *Planets, Stars, and Orbs: The Medieval Cosmos, 1200–1687* (Cambridge: CUP, 1996).
[82]Sánchez, 'Tratado', 13r.
[83]The idea of knots was recurrent in Renaissance astronomy as a metaphor. Clavius explains that stars do not move like birds in the air but 'according to the motion of the orb in which they are fixed, like a knot in a board'. Sánchez made of these knots three-dimensional protuberances of the spheres with physical functions, and of the orbs, celestial spheres moving in the air. James M. Lattis, *Between Copernicus and Galileo: Christoph Clavius and the Collapse of Ptolemaic Cosmology* (Chicago: University of Chicago Press, 1994), 86–105; Grant, *Planets, Stars, and Orbs*, 348–70.
[84]Sánchez, 'Tratado', 25r.

from the traditional Aristotelian view ('ancient astrologers') and aligns with Renaissance cosmological elements of Cardano, Zamorano, and Muñoz. Apart from this singular form, these spheres have a 'measured weight' (*peso medido*). This means that the natural order of the heavens is 'the vast weightiness (*vasta pesadumbre*)' by which all of them, including the Empyrean heaven, are directed towards a point at the centre of the cosmos, the central point of gravity (*el punto céntrico de la gravedad*). This point is 'stable and indivisible' and, because of this, it is the 'foundation of the stability of all weight that we feel and know, but that we do not see'.[85] Contrary to the Aristotelian idea that heaviness is a quality only of some of the four elements, Sánchez extends it to the celestial bodies with significant cosmological implications, although celestial bodies remain 'incorruptible'.

Another important novelty of the *Tratado* is the introduction of a new heaven where comets circulate around the Earth, between the Moon and Mercury. Sánchez denominates this the unknown (*incógnito*) because 'hitherto it was unknown'.[86] Renaissance and early modern debates on the nature of comets had led to important qualifications of the cosmology of nested orbs, particularly after Tycho Brahe's denial of the reality of the celestial spheres.[87] In Spain, Muñoz's observations of the 'comets' of 1572 and 1577 — that reached Brahe and his network of correspondents — were instrumental in his adoption of a Neo-Stoic cosmos denying the existence of the spheres.[88] The *repertorios* and Spanish cosmographical works of the sixteenth and seventeenth centuries commonly portrayed the cosmos as composed of nested orbs, including some discussions on the celestial or terrestrial nature of the comets without any significant consequence for the organization of the celestial spheres. In contrast, Sánchez postulates the existence of a new heaven where comets spin around the Earth based on his observations of the comets of 1681 and 1682.[89] Sánchez does not offer details on the first comet, and the entire argument is based on calculations of the second. He collects observations of the comet between 4 January and 15 February. From these, he calculates that the comet moved one degree and twelve minutes every day and, therefore, 'it

[85]Sánchez's terminology may suggest a quasi-Newtonian universe, in which all bodies are under the influence of gravitation. (Portilla and Moreno, 'Un Manuscrito', 267.) However, Sánchez's weight and the central point of gravity are closer to the Aristotelian theories of motion in which *some* bodies have a natural tendency to move downwards to the centre of the cosmos. We translate *peso* for weight, instead of *heaviness,* because Sánchez's conception is terminologically connected to the biblical sentence according to which God created the world 'in measure and number and weight' (Wisdom 11:20, KJV). Explaining the motion of celestial bodies, Sánchez mentions that 'this is the case, because God created all things under the natural order of number, weight, and measure' (*devajo de un orden natural de numero, peso, y medida)*. Sánchez often employs the formula 'measured weight' (*peso medido)* as synonymous with a perfect disposition of the cosmos by God's wisdom in this biblical sense, and definitively not with an attractive property of particles of matter. Sánchez, 'Tratado', 13v.

[86]Sánchez, 'Tratado', fol. 15r-v.

[87]Grant, *Planets, Stars, and Orbs*, 345–70.

[88]See Jerónimo Muñoz and Víctor Navarro-Brotons, *Libro Del Nuevo Cometa* (Valencia: Valencia Cultural, 1981).

[89]For a contrast between Sánchez's observations and contemporary data on these comets (Kirch and Halley) see Portilla and Moreno, 'Un Manuscrito', 268–69.

moves 3 min of degree every hour, and advances 14 signs and 18 degrees every year, and thus, it will complete a revolution around the zodiac in 300 full days'.[90] This would prove that this comet revolves around the Earth. Sánchez's infers the location of the unknown heaven — between the Moon and Mercury —, from observing the Moon passing twice 'below the comet', and from the estimate of the length of the revolution of the comet around the Earth in three hundred days. Unfortunately, important details of the structure of the world are lost, for the manuscript contains just a fragment of chapter 2 ('of the world and its parts') and almost one entire folio at the end of chapter 4, the name of which is unknown. Chapter 3 is not preserved either, for the manuscript resumes with a concluding paragraph of chapter 4 and the heading of chapter 5. From the last paragraph and the catchword at the foot of folio 21v (chapter 2) it is clear that the next folio contained Sánchez's illustration (*demostración*) of the *machina mundi*, the cross-section of the cosmos typical of Renaissance and early modern astronomical works.[91] From internal references, we gather that there is another lost chapter at the end of the manuscript, dealing in more detail with the nature of comets and their motion in the unknown heaven.[92] These parts may have been lost by accident, although we speculate that someone may have found them inappropriate and removed them, for the lost fragments addressed rather unorthodox topics.

This absence of details on the nature of the cosmos contrasts with the explanations of the motion of the *machina mundi* by natural causes, where Sánchez introduces his singular idea of orbs with pyramidal knots, in contrast with the Medieval and Renaissance traditions of the *theorica*.[93] Where these traditions, based on Ptolemy, postulated orbs of varying thickness accounting for the observed irregularities in the motion of planets, Sánchez introduces orbs with pyramidal knots, the measured weight, and the central point of gravitation. This theory starts by claiming that 'according to the experiments of the way heavens move (*según los experimentos del modo de moverse los çielos*),' it follows that 'their fabric' is of such a thickness that, by God's design, each heaven was unhinged (*desquiçiado*) from its stability by the measured weight of its planet and knot. Were celestial spheres perfectly circular — without knots — they would remain in balance and, therefore, at rest. However, the celestial observations *(experimentos)* show that planets move in irregular paths, including changes in speed and retrogradations. The cause of these irregularities is that spheres began to move and keep moving in an unbalanced way by the weight of their knots and the planets therein. This is proved by a thought experiment:

[90]Sánchez, 'Tratado', 25r.
[91]'Next, the illustration (*demostración*) of the fabric of the entire composition of the world'. The catchword is FA- in capitals, that should have read FÁBRICA in the next page, consistently with Sánchez's headings.
[92]When defining the nature of planets, Sánchez claims that 'their definition is left for Ch. 9 of 3 treatise which deals with comets'. The manuscript we have ends in chapter 8 of that treatise. Sánchez, 'Tratado', 15r.
[93]Grant, *Planets, Stars, and Orbs*, 271–323; Pedersen, 'The Origins of the "Theorica Planetarum"'.

> Let us suppose that we could dig into the earth in such a way that we reach to this central point [of gravity] with a hollow sphere, perfectly round (whose thickness should be uniform in all its parts, of equal width) and we drop it there. It would necessarily stay at rest and calm in the air, and without any motion, because no part of its body would be heavier towards the central point. [This point] would instantly coincide with the centre and semi-diameter of the sphere (…) If we put later some weight only on one of its sides, such as a small piece of wax, measured in such a way that it is enough for unhinging the sphere from the stability in which it should be, the sphere would rotate immediately; because the weight of the wax that was added, would cause the sphere to move trying to find the central point [of gravity] as its own centre. And, being unable to find it by the impediment of [having] more weight on one side of the sphere than on its opposite part, necessarily and infallibly it shall continue in infinite circulations, although not with the observance of the rotation of the tropics but like that of the planets in their heavens.[94]

Sánchez explains that God followed this 'axiom' when he determined the location and weight of spheres, knots, and celestial bodies.[95]

The pyramidal knots explain the origin of motion in the universe — a natural imbalance in the weight of the spheres — and the irregularity of that motion which contrasts with the regular 'rotation of the tropics' in the thought experiment. This is illustrated by detailed descriptions of the celestial bodies, accounting for the singularity of their paths and their distances from the Earth. The Sun, Venus, and Mercury exhibit a similar pattern of motion as they do not retrograde, rotate, or stop (Figure 4), while the heaven of the stars, Saturn, Jupiter, and Mars move irregularly. 'The moment when the knot of Aries comes upon the heaven of Saturn is when Saturn enters into the sign of Cancer (which is a distance of 90 degrees)'. At this point, the contact between the knot of Aries and the heaven of Saturn causes Saturn to either retrograde or stop. However, when Saturn passes by Scorpio, Sagittarius, and Capricorn, the knot of Aries pushes up the sphere of Saturn, accelerating its movement, just like when 'someone pushes something that is hanging in the air'.[96] In contrast with the Scholastic nested orbs or the angelic intelligences of Spanish *repertorios*, in which motion is transferred from the *primum mobile* down to the heaven of the Moon, Sánchez explains motion as the result of the weight and the mutual interaction of the spheres by their knots. Thus, celestial motion is not transmitted but derived from the natural constitution of the cosmos and its parts which, by their specific form, further interact to generate the varieties observed in the skies. This account renders unnecessary the *primum mobile* and the angelical intelligences postulated to explain the

[94]Sánchez, 'Tratado', 24r-v.
[95]Sánchez's reasoning borrows elements from the Renaissance debates on the difference between the centre of gravity and the centre of magnitude of the earth that played an important role in explaining how earth and water formed the Earth. Sánchez may be familiar with the debate from Juan Pérez de Moya, *Tratado de Cosas de Astronomía, y Cosmographia, y Philosophia Natural* (Alcalá, 1573), 137–38. Cf. Vogel, 'Cosmography', 476–80; Edward Grant, *In Defense of the Earth's Centrality and Immobility: Scholastic Reaction to Copernicanism in the Seventeenth Century*, vol. 74 (Philadelphia: American Philosophical Society, 1984).
[96]Sánchez, 'Tratado', fol. 25r.

Figure 4. Detail of Sánchez's celestial spheres of Mercury, the unknown heaven, the Moon, and the Earth. Note that spheres are 'free in the air', except for their point of contact at the pyramidal knot. Sánchez, *Tratado*, f.30v. *Biblioteca Nacional de Colombia*.

motion of the planets, as it was 'imagined by the ancients'.[97] These explanations were noticeable in Sánchez's sources, particularly in Juan Pérez de Moya and Alejo Venegas, prominent figures of the Spanish Renaissance.[98]

The explanation of the motion of the *machina mundi* is completed by an account —relying on the same causes— of the configuration of the world after the last judgment. Aligned with Spanish humanists' sixteenth century practices, such as those of Alejo Venegas or Benito Arias Montano, Sánchez's resorting to the Bible as a source of information about the natural world

[97]Sánchez, fol. 15r.
[98]Pérez de Moya: 'As heavens are neither light nor heavy (*pesados*) (as proved by Aristotle), they would not have local motion by their own nature, or move in circles, but only by means of an intelligence (that we call Angel) moving them. This is shown by Aristotle where he claims that there are as many intelligences moving the heavens as celestial orbs exist'. *Tratado de Cosas*, 34. And Venegas: 'Every heaven is moved by an angel whom ancients denominated intelligence … Were we to weigh the heavens, they would not weigh one ounce or a needle: they are so solid and compact that neither steel nor diamond could leave a mark on them.' *Primera Parte de Las Diferencias de Libros Que Ay En El Vniuerso* (Toledo, 1546), fol. rciiii.

underpins the validity of his astronomical and physical conclusions.[99] But Sánchez's Catholic approach encompasses a wide range of religious and theological texts, apart from the Bible, which are interpreted under the light of his reformed spherical astronomy. In this way, Sánchez's astronomy acquires a theological and religious dimension, founded upon physical readings of the Bible and Catholic texts, such as St. Jerome's *Homilies*, liturgical chants of Gregorian origin, and Patristic sources. The natural causes that generate celestial motion are the same causes by which 'the stars that shall fall from the starry heaven' will cause the heavens to remain immobile from the last judgment: the celestial spheres with their pyramidal knot and their measured weight. The starting point of Sánchez's argument is Matthew 24. 29, which is, in turn, a reference to prophet Isaiah 13. 10: 'after the tribulation of those days shall the sun be darkened, and the Moon shall not give its light, and the stars shall fall from heaven, and the powers of the heavens shall be shaken. And then shall appear the sign of the Son of man in heaven'. Sánchez's interpretation is that, given that the motion of the heaven of the fixed stars was caused by the weight of its knot in Aries — which contained a larger concentration of stars and coagulated waters than the rest of the sphere — these stars and waters shall fall by their own weight, out of their knot, over the heaven of Saturn, obstructing its motion. The heaven of Saturn would stop and remain 'fixed and immobile', in eternal stability like the empyrean heaven. Moreover, when the stars from Aries fall around the sphere of Saturn and push it, blocking its motion, the knots of Saturn shall move upwards pushing the knot in Aries, locking these and all other spheres 'until the end of the world'.[100] Sánchez clarifies that the biblical text is not specific concerning the number of stars that shall fall, but they will be enough to 'dissolve the starry heaven' and to fill the cavities of the heaven of Saturn, impeding its motion. That there are cavities in the heavens or space between celestial spheres, as required by the pyramidal knots, is also implied by Saint Jerome's *Homily* 29 which, referring to Habakkuk, makes it clear that when Jesus ascended to the heavens the Sun elevated (*elevatus est Sol*). Therefore, Sánchez concludes, there have to be celestial cavities, for otherwise the Sun would not have moved upwards in the ascension without disarranging the heavens or, at least, without pushing them. Making use of this reference to the Ascension, Sánchez explains that when Jesus comes back to earth he would carry a banner of the Holy Cross and then, the last judgment shall start. At that moment, there shall be a 'universal purification of the fire of the heavens' that shall burn and embrace the earth,

[99]On the role of the Bible on the Spanish natural philosophy of the Renaissance see Portuondo, *The Spanish Disquiet*, 30–55. The use of the Bible was not restricted to Spain nor to Catholic intellectual circles but played a central role in the emergence of Protestant natural philosophies throughout Europe. The literature on this is vast, but see, for example, Peter Harrison, *The Fall of Man and the Foundations of Science* (Cambridge, UK; New York: Cambridge University Press, 2007).

[100]Sánchez, 'Tratado', 32v.

according to the Second Epistle of Saint Peter.[101] This means that all the water of the earth shall rise to the 'middle region' — the space between the terraqueous globe and the heaven of the Moon — and these waters will form a celestial hull (*casco çeleste*), 'purer than crystal'. Then the earth, deprived of water, shall move to its own centre of stability coinciding with the central point of gravity. Finally, the Moon will shine like the Sun, and the Sun will shine seven times more, rendering the stars invisible. In the Catholic tradition that Sánchez evokes here referring to Saint Gregory, the rise of the Sun represents the justice of Jesus and the rise of the Moon the triumph of the Catholic church. However, 'in the literal sense, this means the 2 great material luminaries (*litera* [*sic*] *gesta docet*)'.[102] Although other *repertorios* and Renaissance astronomical literature make reference to the last judgment as the *terminus ad quem* of history, only Sánchez provides — as far as we are aware — a detailed account of this episode based on his reformed astronomy, developing an argumentative strategy encompassing astronomical calculations, the visual apparatus of Sacroboscian cross-sections of the cosmos, and Catholic hermeneutics. Figure 5.

Vernal equinox and the birth of Jesus

Sánchez's proposal to reform the Gregorian calendar reflects features of the chronological and computistical traditions of the *repertorios,* that summarized Renaissance and early modern debates on the calendar. At least since the twelfth century, the determination of the correct date of the passion of Jesus had led several European mathematicians and astronomers to develop sophisticated computistical techniques and philological strategies in order to reconcile Christian chronologies with the lunisolar Jewish calendar used during the times of the birth, passion, and death of Jesus.[103] Thanks to the introduction of new astronomical techniques brought from the Arabic world via the Iberian Peninsula and to the development of a more comprehensive understanding of the Jewish calendars, scholars such as Roger Bacon, Paul of Middleburg, and Peter de Rivo advanced historical chronologies, incorporating features of astronomical dating into the medieval traditions. Their work made possible the transformation that led to the establishment of scientific chronology as an independent disciplinary field in the hands of Joseph Scaliger in the sixteenth century.[104] The astronomical techniques introduced into chronology include,

[101]'Seeing then that all these things shall be dissolved, what manner of persons ought ye to be in all holy conversation and godliness. Looking for and hasting unto the coming of the day of God, wherein the heavens being on fire shall be dissolved, and the elements shall melt with fervent heat?' (II Peter 3. 11-12).

[102]Sánchez, 'Tratado', 33v.

[103]C. Philipp E. Nothaft, *Dating the Passion: The Life of Jesus and the Emergence of Scientific Chronology* (Leiden: Brill, 2012), 261–82.

[104]Nothaft, 155–202; Anthony Grafton, *Joseph Scaliger. Historical Chronology.*, vol. 2, 2 vols (Oxford: Clarendon Press, 1993).

Figure 5. Illustration of the locking of the heavens from the last judgment. Tratado, f.34r. *Biblioteca Nacional de Colombia*.

for example, the use of an eclipse-based system for determining with precision the main events occurring during the life of Jesus, as well as the improvement in precision in identifying several lunisolar calendars. This latter made possible the development of diverse interpretations of historical chronologies of the Alexandrian and Dyonisiac eras, as they were used by the Jews at the time of Jesus's public ministry.[105] In the Spanish world, these techniques became

[105]Medieval chronological investigations on these eras largely depended upon the so-called Ptolemaic canon included in the *Almagest*, where Ptolemy presented a chronological table of kings and monarchies. Different Christian versions of the canon were advanced, in order to include the Christian history of salvation in this

involved in the increased use of and interest in mathematics and its relationship with theological matters in the fifteenth century, as appears in the works of Alfonso 'El Tostado' and Paul of Burgos, who remained as central figures in historical-chronological studies in Europe until the mid-sixteenth century.[106]

Along with the development of scientific chronology as an independent field, the sixteenth century witnessed the last stages of a long-standing debate regarding the reform of the Julian calendar. The 1582 Gregorian calendar was the result of four centuries of proposals to reform the calendar which definitely bridged calendric and chronological questions in the Christian world.[107] In this sense, after the introduction of the Gregorian reform and throughout the seventeenth century, the efforts of mathematicians interested in calendrics — including several authors of Spanish *repertorios*— focused on publishing historical and perpetual calendars adjusted to the new reform. Although the *Tratado* was written almost a century after the introduction of the Gregorian reform to the calendar in the Catholic world, Sánchez's calendric reform still considered it a question open to debate and, consequently, addresses lunisolar cycles, the problem of eclipse-dating after the miraculous eclipse during Jesus's crucifixion, and re-wrote historical chronologies.

The spherical astronomy accounting for the motion of the *machina mundi*, including relevant information from the Bible, provides elements to reform the calendar which Sánchez considers necessary for correcting the calculation of the date of Easter and the dividing point in human history: the birth of Jesus. For Sánchez, the specific problem with the Gregorian calendar was the mismatch between the astronomical year and the duration of the year of the calendar that resulted in the introduction of an incorrect number of leap years, altering human history, and the calculation of Christian moveable feasts — a serious threat to the salvation of humanity. The correction of the measurement of times and the calendar, together with the reestablishment of the correct dates of human and religious history, constitutes the *reformaçión del tiempo*.

Sánchez's reform of the calendar is intertwined with his presentation of the measures of time, typical of *repertorios*. It is also embedded with his account of the chronology of biblical events and the calculation of the date of Easter. The foundations of Sánchez's reform are laid on the examination of the general measures of time, closely following Zamorano, but modifying the definitions according to his own approach. Sánchez defines eternity and aevum — the duration of things created but not having an end in time —, which constitute the theological frameworks to classify 'spirits, angels, the empyrean heaven, and the embryo (*embrion*), which is the matter from

chronological account. See Leo Depuydt, '"More valuable than all gold": Ptolemy's royal canon and Babylonian chronology', *Journal of Cuneiform Studies* 47 (1995): 97-117.

[106]Nothaft, *Dating the Passion*, 203-222.

[107]John D. North, 'The western calendar – "Intolerabilis, horribilis, et derisibilis"; four centuries of discontent". in *Gregorian Reform of the Calendar. Proceedings of the Vatican Conference to Commemorate its 400th Anniversary 18582-1982*, ed. G. V. Coyne et. al. (Vatican City: Pontifica Academia Scientiarum, 1983), 75-116.

which God formed most things'.[108] Consequently, time is the 'duration of aevum, that is, the duration of the century (*çiglo*) from the first instant of the motion of light until its end, which will occur on the final day of the last judgment'.[109] The divisions of time are functions of the motion of the Sun and the Moon, individually and in their conjunctions. Considering only the motion of the sun, the first division is the day, estimated in '24 h, 57 s, 32 thirds, 3 quarters, 11 fifths, 15 sixths and something more than 31 sevenths'.[110] The second is the year, defined as the time needed for the Sun to complete a revolution starting from the vernal equinox. This revolution takes '365 days, 5 h and 50 min', by reasons that we shall see later on.[111] The third division is the synodic month, further divided in two: the period in which the Moon describes a complete revolution from an established point and the time between conjunctions. Whereas the former takes place in 27 days, 7 h, 43 min, 5 s, and 48 thirds, the latter occurs in 29 days, 12 h, 42 min, 3 s and 12 thirds.[112] The determination of time by the conjunction of the Sun and the Moon generates three cycles. Firstly, a cycle of 19 years in which the Moon completes 235 lunar cycles. This 19-years cycle served as foundation for assigning a number to every year known as the golden number, central to the liturgical calendar.[113] Secondly, a cycle of 62 years in which the Sun and the Moon have their conjunctions and oppositions at the same times of the natural year.[114] Lastly, the cycle of 144 years that ancient astrologers called the 'great circulation of the sun' which is 'the one that [the Sun] performs every 144 years, when returning to the zenith of the Ager Damascenus at the equinoctial point of the equinoctial line in first degree of Aries'.[115] In this cycle, Sánchez found the key to reform the calendar. In his account, this 144-years cycle marks the period in which a 'simulation' (*simulación*) of the leap year should be produced. Simulating a leap year means, for Sánchez, that a year that is supposed to be a leap year of 366 days — being divisible by four — should be taken, instead, for a regular year of 365 days.[116] By 'simulating' a leap year every 144, the Sun will match the vernal point at the zenith of the Ager Damascenus, making the bissextus unnecessary, for that additional day was already 'produced by the remainders of the 36 leap years that were sometimes intercalated' in the cycle of 144 years.[117]

[108]Sánchez, 'Tratado', 45r.
[109]Sánchez, 45v.
[110]Sánchez, fol. 46r.
[111]Sánchez, fol. 46r.
[112]Sánchez, fol. 46v.
[113]C. Philipp E. Nothaft, *Scandalous Error: Calendar Reform and Calendrical Astronomy in Medieval Europe* (Oxford: OUP, 2018), 56–64.
[114]Sánchez, 'Tratado', fols 46r–46v.
[115]Sánchez, 46v. Pérez de Moya defines the Ager Damascenus as the field in which 'God created man, between Palestine (Syria) and Iudea, and in this same land he wanted to be born and redeem the world (by dying) and in that land shall probably take place the universal judgment' Pérez de Moya, *Tratado de Cosas*, 159.
[116]Sánchez, 'Tratado', fol. 46v.
[117]Sánchez, 46v.

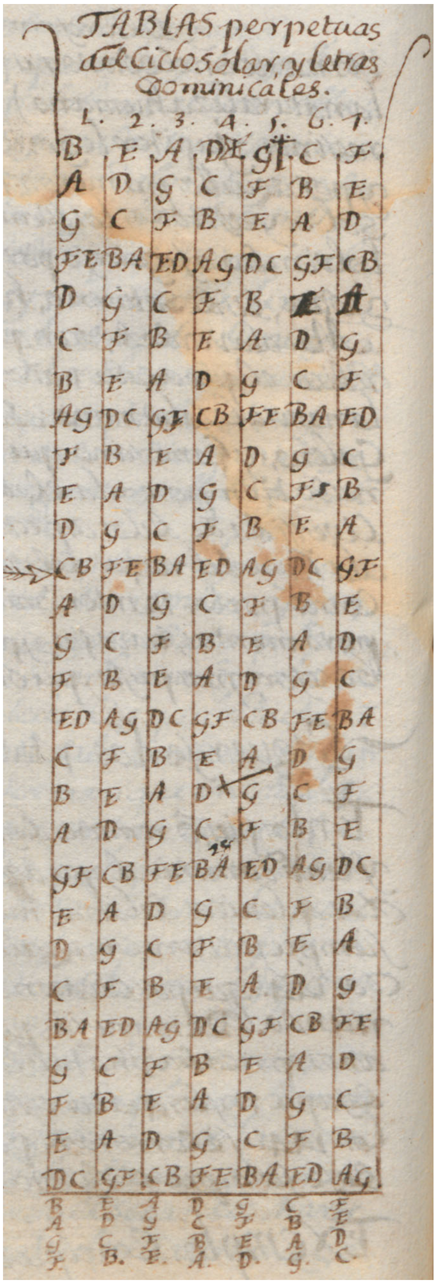
The measure of the great circulation of the Sun rests on the exact duration of the solar year which, in Sánchez's view, requires corrections. The first step in the argument is evaluating previous calculations as they appeared in Zamorano's *Cronología*.[118] While Hipparchus and Ptolemy defined the duration of the solar year in 365 days, 5 h, 55 min and 12 s, Al-Battani reckoned it in 365 days, 5 h, 46 min and 24 s. By the time of the Gregorian reform, 'Copernio (*sic*) and the *Prutenic tables* of our King Alfonso (*sic*)' gave the same values as Hipparchus and Ptolemy.[119] As a result, 'astrologers' working on the Gregorian reform defined the mean year in 365 days, 5 h, 49 min and 16 s, and therefore, they introduced an inaccurate rule for leap years.[120] However, over hundred years after the reform was introduced in 1582, Sánchez noticed that 'the aspects and conjunctions and the full moons' do not match the Sun. Thus, 'our King Alfonso X missed 44 s to determine the entire quantity [of the year]'.[121] The correction consists in evaluating the mean annual motion of the sun through the zodiac, measured from the point of the vernal equinox — the first degree of Aries. The path of the Sun calculated by the Gregorian reformers fell behind the actual distance which the Sun travels when it is about to complete the period of four years before the introduction of a leap year:

> As the natural motion of the sun from west to east through the zodiac (which the astrologers call mean motion) takes 59 min, 8 s, and 14 thirds of degree, in one year [the sun] travels 11 signs, 29 degrees, 45 min, 5 s and 10 thirds (falling behind the first degree of Aries by 14 min, 54 s, and 50 thirds). Consequently, given that in 4 years [the Sun] would have travelled 47 signs, 29 degrees, no minutes, 20 s, and 40 thirds (falling behind the first degree of Aries by 59 min, 39 s, and 20 thirds, and given that because of this delay a leap year should be simulated), the quantity of the year should be no more and no less than 365 days, 5 h, and 50 min.[122]

Sánchez does not provide the source of these numbers. In any case, his method for determining the solar year consisted in the multiplication of the distance travelled by the Sun in one day by the 365 days of the year, and then this result by four years, corresponding to the period in which a leap year should take place. Here Sánchez found the missing seconds that, once added, would balance the calendar with the solar year and ultimately would re-establish the date of the vernal equinox.

From these conjunctions Sánchez also derived the principles for correcting the liturgical calendar, particularly a set of perpetual tables for the dominical letter, the epacts, and the golden number. Based on these tables — which are

[118]Zamorano, *Cronología*, 99r–103r.
[119]Sánchez, 'Tratado', 74r. Zamorano's equivalent passage reads: 'Our king Alfonso, Erasmus Reinhold, Copernicus (*Copernico*), and other great astrologers'. Zamorano, *Cronología*, 91v. Sánchez's error suggests that he used the 1594 edition of the *Cronología* containing this typo. Sánchez wrongly attributes the *Prutenic tables* to the King Alfonso. Portilla and Moreno, 'Un Manuscrito', 262–63.
[120]Sánchez, 'Tratado', fols 74r–74v.
[121]Sánchez, fol. 74v.
[122]Sánchez, 74v–75r.


TABLAS perpetuas del Ciclo solar, y letras Dominicales.

1.	2.	3.	4.	5.	6.	7.
B	E	A	D	G	C	F
A	D	G	C	F	B	E
G	C	F	B	E	A	D
FE	BA	ED	AG	DC	GF	CB
D	G	C	F	B	E	A
C	F	B	E	A	D	G
B	E	A	D	G	C	F
AG	DC	GF	CB	FE	BA	ED
F	B	E	A	D	G	C
E	A	D	G	C	F	B
D	G	C	F	B	E	A
CB	FE	BA	ED	AG	DC	GF
A	D	G	C	F	B	E
G	C	F	B	E	A	D
F	B	E	A	D	G	C
ED	AG	DC	GF	CB	FE	BA
C	F	B	E	A	D	G
B	E	A	D	G	C	F
A	D	G	C	F	B	E
GF	CB	FE	BA	ED	AG	DC
E	A	D	G	C	F	B
D	G	C	F	B	E	A
C	F	B	E	A	D	G
BA	ED	AG	DC	GF	CB	FE
G	C	F	B	E	A	D
F	B	E	A	D	G	C
E	A	D	G	C	F	B
DC	GF	CB	FE	BA	ED	AG
B A G F.	E D C B.	A G F E.	D C B A.	G F E D.	C B A G.	F E D C.

Figure 6. Dominical letters. Sánchez, *Tratado*, f. 59r. *Biblioteca Nacional de Colombia*.

integrated with his reform to the calendar —, Sánchez fixed the date of the birth of Jesus and corrected the calculation of the Christian Easter, which would never coincide with the Jewish Passover.

The table of the dominical letters (Figure 6) — a letter assigned to every year depending on which day of the week the year starts on — is explained while

Sánchez comments the symbology of the number seven.[123] In this number, Sánchez finds the key to establish correspondences between the days of the week in which the world was created, the ages of history, several biblical events, and total duration of the world which is of seven thousand years.[124] So, the perpetual table of dominical letters contains seven columns; each column corresponds to a 144-year cycle. The first column contains the dominical letters between the year of the creation and the year 144, when the first simulation of the leap year should occur. Thus, B corresponds to the year 1, because the days began when God created the light on Sunday, 20 March. According to *Genesis*, 'the light acting as the Sun established the [beginning of] time on 20 March; and God created the great luminaires on the 23 (March).'[125] Thus, A corresponds to the second year, G to the third, and, provided that the fourth year should include a bissextus, it has two dominical letters, FE — F running from January and February, and E for the remainder of the year. The cycle runs until the bottom of the column, when DC corresponds to the twenty-eighth year. For the next year, it is necessary to restart the counting from the top of the column until reaching 140. The four letters below each column, outside the table, correspond to the last four years of the cycle: B to 141, A to 142, G to 143, and F to the year 144. Because the year 144 simulates a leap year, it only takes one dominical letter. The next cycle, from 145 to 288, follows the dominical letters of the second column, and so on. When the counting reaches the end in the seventh column, it simply restarts in the first. Because Sánchez's table incorporates his calendric reform, he presents it as perpetual, except for the 68CE — 3888 counting from the creation — the first simulated leap year after the coming of Jesus, whose dominical letter shall be C only, not CB.

The second element for the liturgical calendar is the table of epacts and their correspondence with the golden number.[126] Epacts indicate the number of days in which the synodic and solar years differ. Meanwhile, the golden number for the years of the creation can be easily calculated, for it is enough to divide the number of the year by 19, the duration of the cycle. The golden number is the remainder, not the quotient; when there is no remainder, the golden number is 19.[127] Sánchez draws two different tables of epacts correlated with the golden number: one table contains the epacts from the year of the creation until 3744, the last simulation of the leap year before the birth of Jesus (Figure 7); the second contains the epacts starting from the year 68CE until the end of the world.[128]

[123]Sánchez, 59v–60r. According to the Christian use, the dominical letter corresponds to a letter assigned to the first Sunday of the year, from the sequence A to G, commencing with A for the 1 January. If 1 January is Saturday (A), the first Sunday gets B and therefore, B will be the dominical letter for that year. On the medieval backgrounds of this see Nothaft, *Scandalous Error*, 15–16.
[124]Sánchez, 'Tratado', 56r–59r.
[125]Sánchez, fol. 61r.
[126]On the difference between the Julian and the Gregorian epacts, see Nothaft, *Scandalous Error*, 294.
[127]Sánchez, 'Tratado', 69r.
[128]Sánchez, fols 61r–64r.

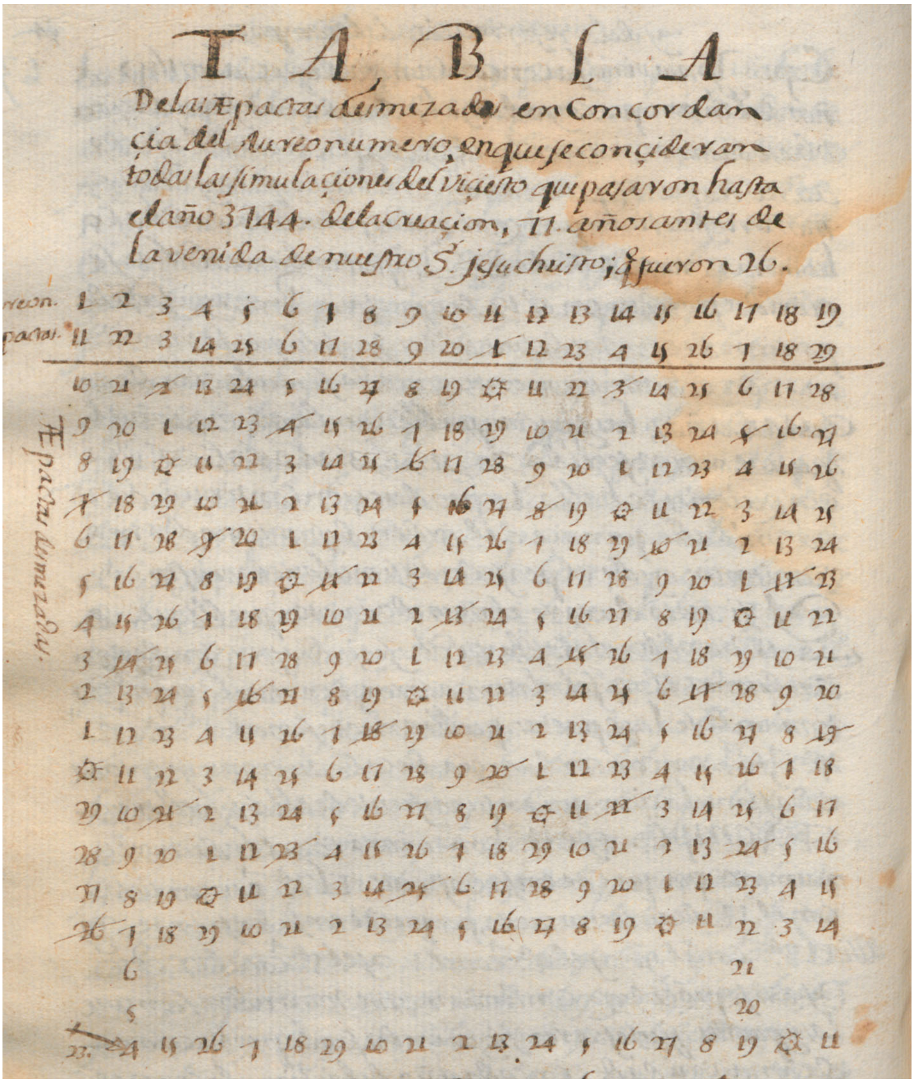


Figure 7. 'De-monthed' epacts and their correspondence with the golden number. Sánchez, Tratado, f.63r. *Biblioteca Nacional de Colombia*.

The first row displays the golden numbers (1–19). The second, over the horizontal line, shows the epacts corresponding to the first cycle of 144 years. The table should be used horizontally, from left to right, and once one arrives at the end of the row, the counting restarts in the same row. Thus, for instance, the epact for the year 1 is 11.[129] By adding up the eleven days in which the solar exceeds the synodic year in two years, the resulting epact is 22 for the golden number 2. Sánchez calculates the synodic month in 30 days, so when the

[129]Sánchez, 61r. This initial difference started when God created the light 'on 20 March at the zenith of the Ager Damascenus' and placed the Sun 'at the centre of the light' on 23, and the moon at 65 degrees, 54 min, and 40 s east of the Sun. Sánchez, 55r.

result of the addition exceeds 30, this number should be reduced, and the residue is the epact for the year. Consequently, the third year has an epact of 3, not of 33. The accumulation goes on until the year 19, epact of 29. Because the 19-year cycle restarts, the year 20 has an epact of 11, resuming at the beginning of the row. This procedure should be extended until the year 144 (golden number 11, epact of 1). From the third row and below, right under the line, Sánchez presents the 'de-monthed epacts' (*epactas desmesadas*), that is, the epacts with reduced months according to the simulation of the leap years. Sánchez does not reveal his formula for the reduction of months; he only comments that epacts should be cut by one unit 'every second or third' simulation, not after every simulation as 'some have considered it'.[130] Therefore, the 'de-monthed' epact corresponding to the golden number of every simulated leap year of the 144-year cycle is crossed out. Take the case of the year 288, the second simulation, whose golden number is 3. If we check the values in the second row, the corresponding epact is 3; however, it is a simulated leap year and, therefore, we should move down to the next row to find the corresponding 'de-monthed' epact of 2. For every period of 144 years, we should stick to the values in the same row of the 'de-monthed' epact starting the cycle, and moving down only when the epact of the simulation initiating the cycle falls within the following row.

The determination of the date of the birth of Jesus, which restarts the counting of eras, occurs in different parts of the *Tratado*.[131] Sánchez does not offer one single chain of reasoning leading to the date but, on the contrary, he postulates the date — with calendric implications such as epacts, golden number, and dominical letter — and then he shows its agreement with several aspects, such as a revised chronology of biblical events, the astronomical information of the gospels, and other dates suggested by scholars.

The first mention of the year 3821 as the date of the birth of Jesus occurs when explaining the use of the first table of epacts that we just analysed. When reaching the twenty-sixth simulation, 3744, Sánchez calculates a golden number of 2 with the epact of 26 (crossed out). Without further ceremony, Sánchez explains that following the last row of epacts (starting with the cancelled number 26, golden number of 1), if we count from the number 7 (next to the cancelled 26) 'the 77 years before the coming of Our Lord', we fall again in the epact of 7. However, Sánchez explains that Augustus decided to move the vernal equinox to 25 March 'with 3 simulations', twelve years before the coming of Jesus, so that the epact of 7 shall be diminished in 3 units. Therefore, Sánchez introduced a last row of modified epacts (bottom of the image) pointing to 4 with an arrow, indicating the concurrence 'of this epact of 4 with the golden number 2 in the year 3821 in which his Divine

[130]Sánchez, 'Tratado', 61v. The reduction of the epact by one unit was part of Luigi Lilio's reform in correlation to the 19-years cycle. See Nothaft, *Scandalous Error*, 294–95.
[131]Sánchez, 'Tratado', 62r-v, 64–65, 68-72.

Majesty was born' (Figure 7). In fact, if we add 77–3744, we obtain 3821 to which corresponds a revised epact of 2. Appealing to the age of Jesus at the time of his death according to the gospels ('33 years, 3 months, and 14 h'),[132] Sánchez infers that the year of 3855 was 'his holy death' and calculates a golden number of 17 with a corresponding revised epact of 19. This epact of 19 could only be on the 'fourteen days of the first moon of that year [of 3855] on 24 March, Thursday of the Last Supper of Christ'. The next day in which 'his death occurred, Friday, there was a conjunction', a 'supernatural eclipse' that modified the concordance of epacts and golden numbers.[133]

This initial mention of 3821 is reinforced by the determination of a possible period of the occurrence of the event based on biblical records. Sánchez's chronology divides history into seven ages, according to major biblical events: 1. From the creation to the universal deluge; 2. From the universal deluge to the call of Abraham; 3. From the call of Abraham to Moses; 4. From Moses to the captivity of Jerusalem; 5. From the captivity of Jerusalem to the coming of Jesus; 6. From the coming of Jesus to the end of the world; 7. From the end of the world to eternity.[134] Consequently, the birth of Jesus has to be consistent with

> the year when Nebuchadnezzar II (…) besieged Jerusalem and took Jehoiakim and others to Babylon, replacing him with Zedekiah. And with the year when this same Nebuchadnezzar himself desolated, destroyed, and looted Jerusalem, and [with] the captivity of Babylon, mentioned by Jeremiah Chap. 25, which lasted 70 years. And with the year that Daniel prophesied the 10 hebdomads and that of his last vision. And [with] the year when the first reconstruction [of the temple of Jerusalem] started and was not continued, and with that in which Nehemiah finished it.[135]

In Sánchez's calculation, Nebuchadnezzar II's invasion of Jerusalem occurred in 3351, the captivity of Jerusalem in 3362, and Daniel's hebdomads end in 3888 (68 CE).[136] The interpretation of Daniel is supported on Christian authorities, such as John Chrysostom, Anacletus, and Alonso Villegas, the Spanish translator of the *Flos sanctorum*.[137] Sánchez reasons that the year could not be but 3821, for 'in many years before or after [these dates of the fifth age] there was no other with a golden number of 2, epact of 4, dominical letter of B, and the vernal equinox on 25 March'.[138]

The consonance of the year with the astronomical reading of the gospels also favours the year 3821. Sánchez turns to biblical reports on Jesus: 'the day of his [Jesus's] incarnation was Friday, 25 March, day of conjunction, not only of the

[132]Sánchez, 62r.
[133]Sánchez, 62r.
[134]Sánchez, 66v.
[135]Sánchez, fol. 65r.
[136]Sánchez, fol. 66; Cf. Zamorano, *Cronología*, chap. 5.1.
[137]'The 70 hebdomads of 490 common lunar years, each lunar year containing 12 lunations, correspond to 475 years, 3 months and 20 days'. Sánchez, 'Tratado', 68v. This would lead to the 3413 when Darius became King of the Persian, which is the start of the count of Daniel's hebdomads.
[138]Sánchez, 68r.

Sun with the Moon, but also of the divinity with humanity'.[139] Also, the birth occurred on Sunday (dominical letter B), 25 December. Furthermore, the gospel of Matthew proves (*compruevase*) that at the moment of his death Jesus was '33 years, 3 months, 14 h, and 14 min' old, for the gospel said: 'And about the ninth hour Jesus cried with a loud voice'.[140] If we add his age up to the year of his birth we obtain (again) 3855, epact of 19, golden number of 17, dominical letter B. This is consistent with the astronomical information that Sánchez gathers from the gospels. If the Last Supper was on a Thursday and Jesus died one day after, on the Passover (in which the vernal equinox coincided with the full moon), therefore, Jesus died on Friday, 25 March, dominical letter B — the same dominical letter for the year of creation. The astronomical information concerning the Passover comes from 'the four gospels: *Primo die azymorum quando Pascha immolabant*'.[141] The date of the passion of Jesus is central for understanding the epacts and the golden number. From the day and hour of the death of Jesus, the great luminaries 'restarted again, with the aspects of their conjunctions and full [moons], from that eclipse of the sun and the moon that Saint Dionysius the Areopagite described, saying that on that day and at that time he saw the moon rising from east to west, and then the Moon went below the Sun'.[142] Sánchez interprets this eclipse as supernatural — developing a line of reasoning going back to Sacrobosco's *Sphera* —,[143] but considers that it can explain its effects in astronomical terms: the supernatural motion of the Moon in such a short period, in order to remain in conjunction with the Sun, amounts to '15 days of its natural motion'.[144] In other words, the fact that the eclipse was supernatural does not mean that it could not be explained in mathematical terms, although its cause was a supernatural intervention in the natural order. Thus, the epact of 3855 changed on 25 March, from 19 to 4, although the year kept the same golden number. Consequently, this supernatural eclipse modified the conjunctions of the Sun and the Moon, and therefore, the sequence of correspondences between the epacts and the golden number — an episode central to understand the history of astronomical conjunctions.

A final discussion concerning the date of the birth of Jesus occurs when Sánchez examines ten alternative dates found in works by theologians, mystics, and cosmographers, showing that these dates were incompatible with his calendrical conclusions. The reasoning is based on a proof from 'the practical arithmetical truth' which consists in the new way of calculating the

[139]Sánchez, 68r.
[140]Sánchez, 68v. Matthew 27. 46. This passage is in chapter 27, not 26.
[141]Sánchez, 70v. Equivalent passages can be found in Mark 14, Luke 22, Matthew 26, and John 13.
[142]Sánchez, 68v.
[143]Cf. Lynn Thorndike, *The Sphere of Sacrobosco and Its Commentators* (Chicago: Chicago University Press, 1949), 117.
[144]Sánchez, 'Tratado', 68v.

golden number for the years after the coming of Jesus starting from 1.[145] We mentioned that the golden number was calculated by dividing the number of the year by the 19 years of the cycle, being the golden number the remainder of that division. This method worked until the coming of Jesus in 3821, golden number 2, when the chronology restarted. In order to obtain the golden number 'for the years of the Lord' it is necessary to add one year to the number of the year before the division. The cause of this addition is that the year of his birth 'concurred [with] the golden number of 2. And because we, Christians, only count the years of the Lord starting at one', it is necessary 'that we always add to the years of the Lord such a year that we left there'.[146] This shall keep the 'direct concurrence' of the new Christian chronology with the golden numbers starting at 2 that was calculated from the years of the creation. In other words, the addition of one year guarantees that the golden number calculated for any year 'of the Lord' preserves correspondence with the golden number of 2 obtained for year 1. With this result, Sánchez argues that any of the dates provided by others has this golden number.[147] The most accepted date by the Church, Sánchez claims, was 5199 revealed by Mary of Jesus of Ágreda, a prolific Spanish religious writer, famous for her reports of the New World made from Spain thanks to her gift of bilocation.[148] The golden number for Ágreda's date is 12 and therefore 'it would be necessary to add 11 years to the years of the Lord to obtain the golden number for every year'. But this 'cannot be the case', as it 'contradicts the arithmetical truth', in the sense that 11 has no relevance for Christian chronology, while 1 corresponds to year of the birth of Jesus.

Finally, all these elements points to the calculation of Easter. Interpreting the precepts of the Council of Nicaea under the principles of his reform, Sánchez claims that Easter should be celebrated on the Sunday following the first full moon after the vernal equinox. This moon shall always fall within the first 30 days after the vernal equinox. In order to establish an exact parameter for calculating this moon perpetually, the vernal equinox should be fixed on 21 March — a date which Sánchez's reform to the calendar preserves. On this, 'the Sun retrocedes' in cutting the equinoctial line 'from the noon of the 21 [March] to the noon of the day 20' by 40 min left over by the leap years intercalated every four years. So that, because every 144-years cycle contains 36 leap years, after the thirty-fifth 'the Sun cuts the equinoctial line almost at the point of noon of the day 20'. Therefore, the 144 should simulate a leap year, causing the sun to 'cut the [equinoctial] line at the point of noon of the 21

[145]Sánchez's conception of arithmetic as the nature of reasoning comes from Pérez de Moya, reinforced by Venegas's presentation of Pérez de Moya's *Arithmetica*. Vicente and Esteban, *Aspectos de La Ciencia*, 17–26.

[146]Sánchez, 'Tratado', 69r–69v.

[147]Sánchez, 70r.

[148]See Katie MacLean, 'María de Agreda, Spanish Mysticism and the Work of Spiritual Conquest', *Colonial Latin American Review* 17 (2008): 29–48.

[March]' by avoiding the additional day.[149] From the knowledge of the astronomical events generated by the crucifixion, Sánchez calculates that by the year 1582, when the reform was introduced, the reformers should have reduced 11 days in March instead of 10 days in October:

> Based on the knowledge of the conjunction of the day of his [Jesus] holy death, I say precisely that, in order to set the point of the vernal equinox of the sun on 21 March in the year of the reform (…), they should have simulated 11 days with 11 dominical letters which correspond in the calendar to [the days] from 11 to 21 March (including this day), just by starting the count of [the day] 21on 10 March and then continuing the counting until the 31 [days] which constitute that month. And then, they should continue with 1 April, changing the dominical letter G for the D, not for C as they did. In so doing, the calendar would be perfect (*ubiera quedado en perfecçion*).[150]

Sánchez's *reformaçión* carries chronological and astronomical consequences for human history as the framework for fulfilling the Christian promise of redemption. His calculations indicate that, since the times of Jesus's death, 'just in a few, or in any year' the holy day of Easter and the moveable feasts have been celebrated 'in the days of the months in which they should have'. Therefore, 'by not celebrating the holy day of Easter and the moveable feasts' at the correct times as was instructed to Christians, 'we cannot expect in this century (*çiglo*), peace, concord, health, or sustenance'.[151]

Conclusion

In this paper, we argued that Sánchez's *Tratado* should be understood as part of the globalization of late sixteenth and early seventeenth-century Spanish cosmography and, particularly, as a local transformation of the cosmographical genre of *repertorios de los tiempos*. The interpretation of the *Tratado* against this background pointed to new lines of research on the local (Neogranadian) dynamics of production of knowledge in astronomy, cosmology, and chronology. At the same time, this interpretation of Sánchez's work extends our understanding of the Renaissance and the early modern circulation and production of knowledge, particularly concerning the changing interactions and disciplinary transformations of mathematics, natural philosophy, and natural theology, outside traditional European and even well-documented colonial settings such as Lima and Mexico. The *Tratado* put forward ambitious claims interpreting astronomical, natural-philosophical, and theological (European) sources under the light of the pressing intellectual and social concerns that a *mestizo* priest considered central to making sense of the natural world from his own perspective. This was done in a place distant from the centres of colonial and

[149]Sánchez, 'Tratado', 74v.
[150]Sánchez, 79r–80v.
[151]Sánchez, 80v.

imperial power, from the production and trade of books, and from consolidated scenarios of intellectual debate, such as courts, *colegios,* and universities.

Concerns widely shared by mathematicians, natural philosophers, and scholars in the Renaissance and the early modern period, that became prominent in the reactions to the crisis of Scholastic — and that in some places led to the 'New Science' — were interpreted, reworked or even deepened in Sánchez's *Tratado*.[152] On the one hand, the *Tratado* encompasses local, first-hand elements with global, abstract components in the construction of central claims that Sánchez expects to be universally acknowledged, as opposed to the 'imaginations of the ancients'. On the other hand, but deriving from this, the work exhibits continuous tensions between original claims and several sources of authority — such as Renaissance disciplines, authors, and practices; diverging astronomical observations; individual accounts (experiences); biblical hermeneutics —. Consequently, our analysis of the *Tratado* reveals the colonial circulation of Renaissance and early modern ideas and practices converging in Sánchez's own elaborations, particularly on the natural causes of motion, the nature and place of comets, the fixed date for the birth of Jesus, the inclusion of indigenous peoples in the narrative of salvation, and the reform to the Gregorian calendar. In other words, the *Tratado* displays characteristics of the Renaissance and early modern concerns about knowledge that Sánchez reinterpreted in function of his geographical and historical awareness: his self-representation as *mestizo,* the use of his own astronomical observations and calculations, and the determination of Vélez as the meridian of reference for calculating longitudes and astronomical events. But these local elements are ultimately subsumed under the Christian eschatology that endowed this cosmos with a Catholic understanding of time and history, encompassing spherical astronomy, biblical hermeneutics, and Christian chronology, in critical dialogue with the Spanish and Renaissance intellectual traditions on which Sánchez relies.

In short, the cosmographical projection of the heavens onto the earth drew mathematical guides to understand the geography of new lands; but in Sánchez, as in other Renaissance and early modern cosmographers and astrologers, this projection also mapped onto the earth the theological and religious dimensions attributed to the heavens in Christian traditions. In the particular case of Sánchez, the history of the cosmos — from the creation to the last judgment and divided by the coming of the Messiah —, contains the signs that properly interpreted with the 'arithmetical truth', reveal the structure of the world and, by its motions, the right measurement of time, leading to the restitution of the correct form of celebrating the Christian feasts. From this perspective, Sánchez's intellectual resources, practices, and concerns are not antithetic to

[152]An overview of these concerns, particularly in the Spanish context, can be found in Portuondo, *The Spanish Disquiet*, 2–12.

many of the natural philosophies and intellectual projects that we identify with the emergence of the 'New Science', especially in the north of Europe. This shall not be read as a suggestion of the *Tratado* being, at some extent, on the path leading to modern science. It is rather an indication of the varied and complex paths that Renaissance and early modern intellectual traditions reached, stimulating alternative understandings of nature.

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