Humanist Demography: Giovanni Battista Riccioli on the World Population

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Abstract: The origins of demography as a scientific discipline are usually seen as intimately connected to the organisational and economic needs of the early modern state. This paper, by contrast, presents an early demographic enterprise that falls outside this framework. The calculations performed by the Italian Jesuit Giovanni Battista Riccioli in an appendix to his *Geographia et hydrographia reformata* ("Geography and hydrography brought up to date," 1661) are the first systematic attempt presently known to arrive at an estimate of the entire world population. Yet they appear to have no political purpose and rather belong to a learned, bookish tradition of demographical thinking that may be termed "humanist". The article starts from a summary of Riccioli's life, of the book wherein his demographic exercise is contained and of this exercise itself. Thereafter, Riccioli's motives, sources, methodology and results are discussed. By way of conclusion, some preliminary reflections on the place of Riccioli and the humanist tradition in the early modern history of demography as a whole are offered. Two appendices present a translation of the *Coniectura* and tabulate its literary sources in order to provide some possible starting points for a study of the aforementioned tradition.

Keywords: applied mathematics; history of demography; world population; sources; early modern state; humanism; Jesuits; Latin; translation

1. *Introduction*

Demography, "the study by statistical methods of human populations, involving primarily the measurement of the size, growth and diminution of people, the proportions living, being born or dying within some area or

region and the related functions of fertility, mortality and marriage",[1] is a major field of applied mathematics today. In premodern times, by contrast, there was no word for "demography" (an expression invented only in 1855),[2] and demography as a distinct scientific discipline was non–existent. Indeed, demographical practice seems to have preceded demographical thinking by millennia. For military and financial reasons, censuses were already held in the Ancient Near East, Roman antiquity and ancient China and Japan,[3] but aside from such practical concerns, the quantification of populations was not given much serious thought. While the Bible and ancient historians often number populations of cities or casualties in battle, the respective figures are meant to impress rather than to inform.[4] On the other hand, a substantial body of thought about population questions, including topics such as marriage, fertility and birth rates, has been documented for the later Middle Ages,[5] but this thinking rarely resorts to figures.

According to standard accounts of the history of the discipline, demography properly speaking originated as a response to the administrative and economic needs of the early modern state.[6] This origin is epitomised in the person of John Graunt who is often declared to be the true founder of the discipline.[7] Graunt's *Observations Made upon the Bills of Mortality* (1662), in which he systematically extracted as much useful information as possible from London's registers of deaths and produced the first life table on this basis, was written with the expressed intent to contribute to "good, certain and easie Government".[8]

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[1] Peter R. Cox, *Demography*, 4th ed., Cambridge: Cambridge University Press, 1970, p. 1.

[2] Cox, *Demography*, p. 1.

[3] In general, see Jacques Dupâquier and Michel Dupâquier, *Histoire de la démographie. La statistique de la population des origines à 1914*, Paris: Perrin, series "Pour l'Histoire", 1985, pp. 28–38; for China in particular, John D. Durand, "The Population Statistics of China," *Population Studies* 13 (1960), pp. 209–256.

[4] David Wootton, *The Invention of Science. A New History of the Scientific Revolution*, New York: HarperCollins, 2015, pp. 259, 624.

[5] Peter Biller, *The Measure of Multitude. Population in Medieval Thought*, Oxford: Oxford University Press, 2000.

[6] Dupâquier and Dupâquier, *Histoire de la démographie*, esp. pp. 106–198; *Éric Vilquin, "Histoire de la pensée démographique jusqu'en 1940," in Graziella Caselli, Jacques Vallin and Guillaume Wunsch (eds.), Démographie: analyse et synthèse, VII. Histoire des idées et politiques de population*, Paris: Éditions de l'Institut National d'Études Démographiques, series "Démographie: analyse et synthèse" 7, 2006, pp. 11–53, esp. pp. 24–30.

[7] E.g., Cox, *Demography*, p. 8: "It is generally accepted that Graunt was the founder …"; Vilquin, "Histoire de la pensée," p. 29: "C'est en 1662 qu'est née la démographie".

[8] John Graunt, "Natural and Political Observations Mentioned in a following Index and made upon the Bills of Mortality," reprinted in *The Earliest Classics: John Graunt and Gregory King*. With an Introduction by Peter Laslett, Farnborough: Gregg, series "Pioneers of Demography", 1973, p. 74. On Graunt and other 17th/18th century English thinkers in his environment such as William Petty and Gregory King, see e.g. Philip Kreager, "New Light

Without denying the pivotal role of this politically inspired tradition, the present article focuses on a demographical exercise that stands outside it. Rather, it belongs to a learned, bookish, non–utilitarian and mostly Latin strand of early modern demography, to which little interest has been paid so far and which I would like to call, for lack of a better term, "humanist". Comprising less than 4½ pages, the text in question was authored by the Italian Jesuit Giovanni Battista Riccioli (1598–1671) and bears the title *De verisimili hominum numero superficiem terrae inhabitantium coniectura qualicumque conatu attentata et corollaria ex hoc numero deducta* ("A tentative guess, made by any effort whatsoever, regarding the probable number of people inhabiting the surface of the Earth, and corollaries deduced from this number"). As the title suggests, this short text contains an estimate of the world population as a whole—the first serious attempt in this field that is presently known.[9]

The *Coniectura* has had a somewhat paradoxical fate so far. In at least one case, regarding the population of Africa, Riccioli involuntarily created a demographic orthodoxy of sorts that survived until the second half of the 20th century.[10] At the same time, the text is often cited as an example of scientifically worthless guesswork, just mentioned in passing or ignored altogether in works of historical demography.[11] The only real account of the *Coniectura* has been given in a 1977 article by Marie–Élizabeth Ducreux. Ducreux provides a good overview and diligently tabulates Riccioli's figures. However, her brief

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on Graunt," *Population Studies* 42 (1988), 129–140; Ted McCormick, *William Petty and the Ambitions of Political Arithmetic*, Oxford: Oxford University Press, 2010; Ted McCormick, "Political Arithmetic and Sacred History: Population Thought in the English Enlightenment, 1660–1750," *Journal of British Studies* 52 (2013), pp. 829–857; Paul Slack, "William Petty, the Multiplication of Mankind, and Demographic Discourse in Seventeenth–Century England," *The Historical Journal* 61 (2018), pp. 301–325.

[9] For some further estimates made between 1680 and 1741, see Marie–Élizabeth Ducreux, "Les premiers essais d'évaluation de la population mondiale," *Annales de démographie historique* 1977, pp. 421–438, at pp. 422–423, 429, 438; Jean–Marc Rohrbasser, "Qui a peur de l'arithmétique? Les premiers essais de calcul sur les populations dans la seconde moitié du XVIIe siècle," *Mathématiques et sciences humaines* 159 (2002), pp. 7–41, at p. 27 n. 71

[10] Jean Stengers, "De la créance accordée aux chiffres sans valeur," *Revue belge de philologie et d'histoire* 82 (2004), pp. 215–227, at pp. 215–217.

[11] Scientifically worthless: see e.g. Marcel Reinhard, André Armengaud and Jacques Dupâquier, *Histoire générale de la population mondiale*, 3rd ed., Paris: Montchrestien, 1968, p. 154 (who call the author "Pericioli"—a malapropism of "père Riccioli"?): "total manifestement exagéré" of the world population; Catherine Coquery–Vidrovitch, *Africa. Endurance and Change South of the Sahara*, Berkeley et al.: University of California Press, 1988, p. 17 ("a Jesuit who attached much importance to the mystical value of numbers"); David P. Henige, *Numbers from Nowhere. The American Indian Contact Population Debate*, Norman, OK: University of Oklahoma Press, 1998, p. 24 ("Riccioli assigned people to various parts of the world in practically geometrical fashion"). Mentioned in passing: Rohrbasser, "Qui a peur de l'arithmétique?", p. 27 n. 71. Ignored: Jean–Noël Biraben, "Essai sur l'évolution du nombre des hommes," *Population* 34 (1979), pp. 13–25; Vilquin, "Histoire de la pensée".

treatment is marred by a number of misunderstandings.[12] What is more, it fails to analyse Riccioli's motives and methods and to place his work into its historical context.

In what follows, I begin with a summary of Riccioli's life, of the book wherein his demographic exercise is contained and of this exercise itself. Thereafter, Riccioli's motivation, his sources, methodology and results are discussed. I conclude with some very preliminary reflections on the place of Riccioli and the tradition he represents in the history of demography as a whole. Two appendices present a translation of the *Coniectura* and tabulate its literary sources in order to give on overview of them and to provide some starting points for a study of the aforementioned tradition.

1. *Author, Publication Context, Content*

Riccioli was born in Ferrara in 1598. He attended the local Jesuit school, entered the Society of Jesus at the age of 16 and studied philosophy and theology at the scientifically progressive, experimentally–minded college at Parma from 1620 to 1628. After his ordination, he taught logic, physics, metaphysics and theology at Parma, Mantua and Bologna, but cultivated his scientific, especially astronomical interests, all along. Since the 1640s, he was partly relieved of his teaching duties and given the opportunity to establish an astronomical observatory in Bologna. Until the end of his life in 1671, he stayed in Bologna, conducting research and maintaining a vast correspondence with colleagues from Athanasius Kircher to Christiaan Huygens. Besides astronomy, he was active in the fields of physics, mathematics, chronology and geography as well.[13]

The books for which Riccioli is best known today are his astronomical encyclopaedia *Almagestum novum* (1651) and its later update, the *Astronomia*

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[12] Ducreux, "Les premiers essais," pp. 424–428 and pp. 430–432, 434–438 (charts). Misunderstandings: "Conjectures de toutes sortes" (p. 424) is a mistranslation of the title's *coniectura qualicumque conatu… attentata*; Riccioli does not say that the global population "atteint vers 1660 1 milliard d'habitants" (p. 425), but mentions this figure as an upper limit; there is no "historien byzantin" named Suidas (pp. 425–426; see appendix 1); the Florentine historian Matteo Palmieri is no "voyageur" (p. 426); that Riccioli should have mistaken the "nouveaux baptizeés" of south–east Asia for the region's entire population (p. 427) is hardly credible; the text has six, not four, corollaries; in them, Riccioli calculates the number of persons having lived since the Creation, not the Flood; he does not think them sufficient to cover the surface of the entire Earth—quite the contrary; he does not commit himself regarding the number of angels (all p. 428).

[13] For an overview of Riccioli's life, works and scientific activities, see Maria Teresa Borgato (ed.), *Giambattista Riccioli e il merito scientifico dei gesuiti nell'età barocca*, Florence: Olschki, series "Biblioteca di Nuncius. Studi e testi" 44, 2002; eadem, "Riccioli, Giovanni Battista," *Dizionario Biografico degli Italiani* 87 (2016), on-line article [accessed 18 May 2018], http://www.treccani.it/enciclopedia/elenco–opere/Dizionario_Biografico.

reformata (1665).[14] However, he also left an *opus magnum* in his second–best discipline, geography, namely the *Geographia et hydrographia reformata* ("Geography and hydrography brought up to date"), which appeared in 1661 in Bologna and a second time, revised and upgraded, in 1672 in Venice. This work, whose title designates it as a geographical counterpart to the *Astronomia reformata*, is another massive encyclopaedia, comprising 640 and 691 pages in the first and second edition respectively and divided into twelve books. After book I, which serves as an introduction and gives an overview of the surface of the Earth, book II treats measures of length, book III, travel routes by land and sea, and book IV, land surveying. Books V–VIII are concerned with geodesy and measurements of altitudes, latitudes and longitudes respectively. Book IX provides a catalogue of geographic positions. Book X reviews maritime geography and introduces the reader to the art of navigation. A dictionary of place names is given in book XI. The final book discusses the determination of the position of the sun and of local time.

The *Coniectura* appears in identical form in both editions as an appendix, which occupies pp. 630–634 and pp. 677–681 respectively. It is arranged in seven *excursiones* ("walks" or "strolls") leading the reader through the ancient Roman Empire (I), Italy (II), Spain, France, Germany, England (III), Greece, the Balkans and the rest of Europe (IV), Africa (V), Asia (VI), America and the so–called Terra Australis (VII).[15] For each of these regions, a rough population estimate is given, and these estimates are added up at the end of section VII. Finally, six corollaries discuss the number of people being born per year, the number being born and dying per century, the number born since the Creation, the space available for each person if none of them had ever died, the number of human bodies and the time that would be needed to entirely cover the Earth's surface, and the number of angels.

2. *Motives*

What motives induced Riccioli to compile the *Coniectura* in the first place is hard to tell, but some educated guesses can be made. Practical motives may safely be ruled out. Not only are none apparent, but Riccioli himself describes the composition of the text as an amusing game in a final epigraph: *Lusimus in numeris, sed non illusimus orbi* ("I have toyed with numbers, but not deceived the world").

Nevertheless, Riccioli's interest in population questions was serious and long–standing. Over the years, he had collected much more evidence than he

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[14] A striking revaluation of Riccioli as an astronomer and of his *Almagestum novum* has recently been provided by Christopher M. Graney, *Setting Aside All Authority: Giovanni Battista Riccioli and the Science Against Copernicus in the Age of Galileo*, Notre Dame, IN: University of Notre Dame Press, 2015.

[15] The *Coniectura* is always cited by section and, if necessary, paragraph.

could work into the *Coniectura* (see below, "Methods"). Stimuli for this interest could have been provided by the widespread practice of holding censuses in early modern Italian cities[16] and by the worldwide missionary activity of the Jesuits, who were always eager to count how many people they had proselytised.[17] Both the censuses and the global Jesuit network certainly provided Riccioli with data, as we will see in a moment. Work on the *Geographia* itself, a book of global reach involving a good deal of advanced mathematics, might have suggested that to work out an estimate of the world population would be a comparatively easy and worthwhile exercise. Finally, a trivial circumstance could have played a certain role, too: As said before, the first edition of the *Geographia* comprises 640 pages, that is, 40 sheets of 16 pages. The text of book XII only runs to p. 630, and with an *Index rerum* and *Errata* filling pp. 635–640, there were still a few pages left. The *horror vacui* which is in evidence in many early modern prints will have suggested that these should not be left blank[18]—which provided Riccioli with a convenient outlet for his calculations.

3. *Sources*

The *Coniectura* contains a striking multitude of figures. Riccioli's own calculations apart, he lists over 330 figures relating either directly or indirectly (via sizes of armies, perimeters of cities and the like) to the population of places and areas. Where he has got all these figures from, he does not always bother to tell, and if he does, they sometimes simply come from his "notebooks" (*schedae*). Nevertheless, the number of sources explicitly named still remains impressive. They basically fall into three categories, namely census lists, fellow Jesuits, and books. The latter account for the vast majority of the figures given: over 60 authors and texts are cited, many of them repeatedly.

Turning to the actual information, however, the picture becomes much less impressive. The amount of reliable data contained in the sources is meagre.

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[16] For censuses in early modern Europe in general, see Dupâquier and Dupâquier, *Histoire de la démographie*, pp. 76–102, for Italy in particular, Peter Burke, *The Historical Anthropology of Early Modern Italy. Essays on Perception and Communication*, Cambridge: Cambridge University Press, 1994, pp. 27–39.

[17] A good example of this interest is provided by the *Relations des Jésuites de la Nouvelle France*, edited annually in Paris from 1632 to 1673, where numbers of baptisms are routinely given. See Lucien Campeau (ed.), *Monumenta Novae Franciae*, 9 vols., Rome: Institutum Historicum Societatis Jesu, series "Monumenta historica Societatis Jesu", 1967–2003.

[18] The practice of filling empty pages at the end with more or less random material was widespread and sometimes was even made explicit; see, e.g., Johann Heinrich Stuß, *Commentatio de epopoeia Christiana*, Gotha: Reyher, 1752, last page: "Not to leave this page empty (*Ne vacet pagina*), I attach another section from Klopstock's *Messias* in Latin translation." I have not been able to find any literature on the phenomenon.

The most valuable information comes from a number of censuses, especially Italian ones, which sometimes cover whole regions such as the Kingdom of Naples, the Papal States, Tuscany and Venice with its Terraferma (II 4–5, 7–8). Although not even these can always be taken at face value,[19] at least their magnitudes seem to be basically sound. A fair amount of French and some Belgian data presumably also stem from censuses, although Riccioli expressly says so only in the latter case (III 2, 3). Other instances are much more problematic: The interpretation of the ancient Roman censuses (I) is disputed, and almost everything is unclear about the Chinese census of 1651 (VI 11).[20]

The validity of information from Jesuit sources is hard to judge, especially when it concerns the non–European world, as in VI 7. Within Europe (II 5, III 2), such information may be based, again, on census data.

Literary sources are the most problematic. First, they are chronologically spread over more than two millennia. In addition to two dozen early modern works, half a dozen medieval ones are adduced, and no less than 34 come from Judeo–Christian and Greco–Roman antiquity. Their relevance to Riccioli's attempt to estimate the world population of his own day is open to question, to say the least. Second, the figures given are often patently exaggerated regarding exotic places such as Thailand (VI 8) and especially for antiquity. That ancient Sybaris should have been able to arm 300,000 cavalry in the 6th century BC, as asserted by Diodorus and Strabo (II 2), is simply absurd. The same goes for such circumstantial information as regards the walls of ancient Babylon, which allegedly were 360–480 stadia (c. 65–87 km) long, 50–200 cubits (c. 50–100 m) high and 32–100 feet (c. 10–30 m) thick (VI 5)—figures resulting in a total volume twelve to one hundred times bigger than that of the Great Pyramid of Giza.

4. *Methods*

How did Riccioli amass his figures, and how did he deal with them? As already mentioned, he appears to have gathered pertinent material of various kinds over a longer period, only part of which is presented in the *Coniectura*.

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[19] Burke, *Historical Anthropology of Early Modern Italy*, pp. 27–39.

[20] On the Roman censuses, see Walter Scheidel, "Demography," in Walter Scheidel, Ian Morris and Richard Saller (eds.), *The Cambridge Economic History of the Greco–Roman World*, Cambridge: Cambridge University Press, 2007, pp. 38–86, at pp. 45–47. Premodern Chinese censuses are always incomplete, the degree to which they are so cannot be ascertained and it sometimes is not even clear what is actually counted (Durand, "Population Statistics"). Moreover, Riccioli's source for the results of the 1651 census—for which Durand, p. 236 records 10,633,326 *ting* (fiscal units, presumably often households)—is obscure. He invokes Martini's *Novus Atlas Sinensis* (1655), but this work contains nothing of the kind. Michel Cartier (*apud* Ducreux, "Les premiers essais," p. 437) seems to say that Riccioli's chart is originally the work of Michał Boym SJ (1612–1659), but no evidence is given.

Phrases like *reliqua in meis schedis reservo* ("the other figures I keep in my notebooks", II 7) occur several times in the course of his exposition.[21] These *schedae* refer to a typically humanist technique of information management, namely the keeping of commonplace books, where interesting facts, sentiments and phrases which one encountered in one's reading were preserved. This technique was learned in early modern schools, and people continued to use them for their own ends in later life.[22]

Equally humanist is Riccioli's predilection for erudite information, regardless of its relevance for his overall question—a predilection that presumably underlies the aforementioned chronological spread of his sources. Even if his nonchalance in this respect may partly be ascribed to his belief that the world population has by and large remained stable over the course of history (corollary II), such a belief cannot explain the prolonged discussion of the ancient Roman Empire (I), since Riccioli repeatedly states that the population of the respective region has greatly diminished since antiquity.[23] Also apart from the Roman Empire, things ancient are given preferential treatment, as is shown *ex negativo* by the explicit omissions of material gathered in Riccioli's notebooks: these omissions almost exclusively concern contemporary material, usually census data—precisely what a modern reader would regard as most pertinent—hardly ever information about antiquity.[24]

As to Riccioli's way of dealing with the sources he chooses to present, two strategies deserve mention: source criticism[25] and extrapolation. The former is deployed rarely. In most cases, it simply is not feasible for Riccioli to check his sources and he does not have much space to discuss their credibility. That this withholding of judgement does not necessarily imply assent is evident from his treatment of contradictory sources, as in the above–mentioned case of the walls of Babylon where he gives seven values from eleven authors without

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[21] See II 5, II 8, III 2, V 3, VI 7, VI 11.

[22] On early modern commonplace books and their imprint on the era's mindset, see Ann Moss, *Printed Commonplace Books and the Structuring of Renaissance Thought*, Oxford: Clarendon Press, 1996.

[23] I 1, I 2, II 2. On "la légende du dépeuplement du monde" in the 17th and 18th centuries, see Dupâquier and Dupâquier, *Histoire de la démographie*, pp. 108–109, on its uneasy coexistence with the notion of demographic stability in Riccioli, Ducreux, "Les premiers essais," p. 425. The population of Rome had been the subject of learned discussion since the late 16th century (e.g., Giovanni Botero, *On the Causes of the Greatness and Magnificence of Cities*, 1588. Translation and Introduction by Geoffrey Symcox, Toronto et al.: University of Toronto Press, 2012, pp. 78–80; Justus Lipsius, *Admiranda sive de magnitudine Romana libri IV*, Antwerp: Plantin, 1598, book 3, chs. 2–3).

[24] See II 5, II 7, II 8, III 2, V 3. The only exception (I 1) concerns Roman census data.

[25] On the rise of source criticism in early modern historical thinking, see Anthony Grafton, *Forgers and Critics. Creativity and Duplicity in Western Scholarship*, London: Collins & Brown, 1990; idem, *What Was History? The Art of History in the Early Modern Period*, Cambridge: Cambridge University Press, 2007.

comment. If a rare opportunity for critical intervention presents itself, Riccioli can be quite eager to take it. Concerning one of the Augustan censuses (I 2), reported as resulting in 410 x 10,000 (μυριάδες υι') = 4.1 million in the Byzantine lexicon *SUDA* (α 4412), the very wording of the source comes under scrutiny—a reflection of Riccioli's humanist schooling which has accustomed him to the close reading of classical texts.[26] His conclusion—the Roman Empire really had not 4.1, but 410 million inhabitants—is certainly wrong,[27] but he displays considerable sophistication as a textual critic in the process. In another case, intervention is prompted by internal contradiction. Riccioli rejects the statement that Paris counts 18,000 hearths and 500,000 inhabitants on the ground that this would presuppose the average Parisian family to have some 28 members (III 2).

Riccioli's second strategy, extrapolation, is more important given his sheer lack of sources for most parts of the Earth. If he has no figures for a certain region, he may give an estimate based on other regions of about the same size and kind. Such is the case for the present–day Balkans, for which 16 million inhabitants are postulated "on the basis of the extension of these regions, if one compares them to other, similar parts of Europe" (*ex magnitudine regionum collata cum aliis Europae partibus similioribus*, IV 1). In other cases, Riccioli indulges in even freer forms of extrapolation. After the ancient evidence for Africa's Mediterranean coast and Egypt has duly been given, all of this is set aside and the continent is allotted 100 million inhabitants or somewhat less, because it is much bigger than Europe, but its hinterland is only thinly populated (V 4). The situation is similar for Asia (VI), where Riccioli's overall estimate is based only on his data for China and for a few cities and armies here and there in other parts of the continent. It is even worse for the Americas, where his only figures concern the three cities of Mexico, Cuzco and Lima (VII 1), and more desperate still for the so–called Terra Australis (ibid.), the big southern continent postulated for theoretical reasons by Ptolemy in the 2nd century AD and still accepted as a reality in the 17th.[28] In all these cases, Riccioli's estimates just reflect his feeling of how many inhabitants a very large, but thinly populated landmass might have.

In performing operations such as these, however, Riccioli is never lulled into a false sense of security—quite the contrary. He is fully aware of the fact that he is building on shaky foundations and candidly admits to it. Already in

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[26] The supreme importance of reading and interpreting classical texts is documented in the Jesuit *Ratio studiorum*; see Ladislaus Lukács (ed.), *Ratio atque institutio studiorum Societatis Jesu 1586, 1591, 1599*, Rome: Institutum Historicum Societatis Jesu, series "Monumenta paedagogica Societatis Jesu" 5, 1986.

[27] Modern estimates of the Empire's maximum population in the 2nd century AD tend towards 60–70 million (Scheidel, "Demography," pp. 47–48).

[28] See William Lawrence Eisler, *The Furthest Shore. Images of Terra Australis from the Middle Ages to Captain Cook*, Cambridge: Cambridge University Press, 1995.

the title, he calls his endeavour a "guess" at the "probable" number of people living on the planet and moreover specifies that this guess is "made by any effort whatsoever"—that is, even by unreliable methods, if no reliable ones can be applied. At the very end, the same point is restated in similar words. And throughout the *Coniectura*, figures are qualified by expressions such as "I would not like to believe" (*non crediderim,* V 4) or "I am inclined to think" (*subit opinari,* VI 12).[29]

5. *Results*

Leaving aside the exaggerated estimate of 410 million inhabitants for the Roman Empire as well as the playful corollaries, both of which stand apart from the rest of Riccioli's essay, his results can be summarised and compared to a modern estimate as follows:

Geographical unit	Riccioli's estimate	Modern estimate[30]
Europe	99–100 million	105 million
Africa	probably somewhat under 100 million	108 million
Asia	c. 500 million	412 million
America	probably less than 200 million	12 million
Terra Australis / Australia, Oceania, Antarctica	probably less than 100 million	3 million
WORLD	less than one billion	640 million

So Riccioli is not far off the mark for Europe, Asia and Africa. He is grossly wrong for America (which may have had some 50 million inhabitants at the time of its discovery, but suffered a demographic collapse afterwards, of which Riccioli cannot be expected to have been aware)[31] and for the modern equivalent of the Terra Australis. Yet he appears to be basically right, at least as far as

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[29] See further I 2 ("not implausible"; "Let this be said in a way that does not preclude better judgement"), II 10 ("perhaps"), III 3 ("But now?"), IV 1 ("it seems"), IV 2 ("perhaps"), VI 4 ("if we suppose"), VII 1 ("will seem").

[30] Extrapolated from figures given for 1600 and 1700 by Biraben, "Essai sur l'évolution," p. 16. Further estimates can be found in John D. Durand, "Historical Estimates of the World Population: An Evaluation," *Population and Development Review* 3 (1977), pp. 253–296.

[31] The magnitude of the collapse is disputed, but it seems reasonable to assume that America lost some 90% of its pre–Columbian population in the one and a half centuries after its discovery; see Linda A. Newson, "The Demographic Collapse of Native Peoples of the Americas, 1492–1650," *Proceedings of the British Academy* 81 (1993), pp. 247–288.

the overall magnitude is concerned, for the world population as a whole—especially so if it is taken into account that modern estimates also come with an indifference range of 10–20%.[32] Despite Riccioli's chronological carelessness and his large amount of exaggerated and immaterial figures, his method of extrapolating from what he knew about Europe and believed to know about China eventually served him well. In a time when educated Londoners used to believe that their city had several million inhabitants, while it really had less than half a million,[33] the relative correctness of his result can be called remarkable.

6. *Riccioli and early modern demography*

By way of conclusion, I would like to return to the history of demography in general and to place Riccioli and the humanist tradition to which he belongs in this wider context. A brief comparison between Graunt, whose name is tantamount to the emergence of the discipline today, and Riccioli will be helpful to this end.

Graunt is a citizen of London, the capital of one of the furthest evolved early modern states. As already intimated at the beginning, his work develops in the context of this state and serves its needs. It is strictly practical in its aims: the authorities are to be better informed about their subjects so that they can exert "good, certain and easie Government". To achieve this goal, Graunt firmly restricts his investigation to the place and to the sources where the most useful information is to be found—London and its bills of mortality. From these he extracts as many hard, precise, numerical facts as possible. Things beyond London, let alone England, do not concern him. Therefore, it is not a problem that he is no learned man (he is a haberdasher by profession) and cannot communicate with the world outside England, since he knows no Latin. He only writes for Englishmen, so English is just fine.

Riccioli, by contrast, has no political agenda and no practical aims. He seems just curious, sometimes (especially in the corollaries) even playful in what he does. His reflections are cosmopolitan, as are his order's aspirations. His calculations and estimates are interwoven with non–demographic interests, for example antiquarian and religious ones (the latter admittedly an aspect he shares with some of the English thinkers in the wake of Graunt).[34]

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[32] Durand, "Historical Estimates," esp. p. 284.

[33] Graunt, "Observations," p. 59; Wootton, *Invention of Science*, p. 261.

[34] Riccioli's calculations culminating in corollary V (another 19,552 centuries would be needed to entirely cover the surface of the planet with the bodies of all people ever been alive) seem to oppose the notion that the earth is too small to hold all the bodies that are to rise on Judgment Day. This idea is explicitly ascribed to religious sceptics and countered by William Petty (Slack, "Multiplication of Mankind", pp. 302–303). On the religious subtext of

They are born out of a learned, humanist worldview and remain intimately connected to it. Accordingly, his demographic enterprise is not made the subject of an independent publication, but hidden in a work on a different subject. Riccioli's sources are much more disparate and scrappy than Graunt's. Precise figures and hard facts are not to be had, they have to be replaced by plausible reasoning and educated guesses. Last but not least, Riccioli not only writes *about* the whole world, but also *for* it—or at least for its learned part: the transnational Republic of Letters, the *res publica litteraria*. That is why he writes in Latin.

Today, however, the language choice—Graunt's parochial English, Riccioli's cosmopolitan Latin—ironically works exactly the other way round. Nowadays, everyone can read Graunt, but few Riccioli. Graunt has become a classic, Riccioli is quoted second–hand at best. A look at the last part of appendix 2 suggests that he shares this fate with a considerable number of 16th and 17th century authors with a humanist background such as Giovio, Lipsius, Salmerón, Dudley and Nicolosi, whose demographical thinking is recorded in historical, antiquarian, geographical and religious writings.[35] Closer study of them might reveal that the roots of early modern demography are actually more diverse than usually assumed.

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demographic thinking in early modern Britain in general, see McCormick, "Political Arithmetic and Sacred History".

    [35] Only two of the 24 early modern works cited by Riccioli, Bodin's *Six livres de la république* and Botero's *Relationi*, can be found in the bibliography of important works up to 1914 given by Dupâquier and Dupâquier, *Histoire de la démographie,* pp. 422–429.

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Appendix 1:
Translation of Riccioli's *Coniectura*

Riccioli's marginalia are integrated into the text in bold and in brackets. Insofar as they are instrumental in structuring the text, they are placed at the beginning of new paragraphs and numbered consecutively in order to facilitate referencing. Authors and works are highlighted by small caps. Figures are written in ciphers wherever possible. A few misprints have been tacitly corrected.

Appendix: A tentative guess, made by any effort whatsoever, regarding the probable number of people inhabiting the surface of the Earth, and some corollaries deduced from this number

I. *The first stroll, leading through the census of Rome and the ancient Roman Empire*

1. In the first census and count in Rome, made under Servius Tullius, 80,000 male adult citizens were recorded according to Livy. Under the first consuls, 130,000 persons wore the men's toga. Later, however, as I am convinced on the basis of censuses which I have collected from Livy, Florus, Dionysius and Eusebius but do not adduce here for the sake of brevity, the census never recorded a lower, but always a greater number than the two just mentioned, to such a degree that 900,000 citizens were counted after the war against the Marsi. In the year 752 of the City, 4,164,000 heads were counted in Rome under Augustus, as Eusebius and more or less also Augustus' own stone inscription from Ankara have it. In the subsequent census, organised by Augustus together with his adopted son Tiberius, there were found at Rome, according to Eusebius and Simon Cassius, "90 x 370,000" citizen heads, that is, 90 x 100,000, as we must infer according to Roman custom, plus 370,000, which makes 9,370,000. Salmerón, however, in vol. 2, treatise 32 of his *Gospel commentary*, applies the adverb "90 x" directly to "300,000", so that

the result is 27,000,000 people. The reason thereof is that he confounds this census, which Eusebius explicitly restricts to Rome alone, with the census of the entire Roman world. But the latter census was much bigger than 27 million, and I find that there was never a greater number of Roman citizens than at this time. For as Tacitus has it, 6,900,064 heads were counted in Rome, or, as Eusebius, 6,944,000, that is, c. 7 million. No wonder that this number increased so strongly under the Emperors. Firstly, Rome with its suburbs extended as far as Ostia. Under Aurelian, its circumference measured 55 miles, before it was ravaged by the Goths and its circumference reduced to 22 miles [**Lipsius, *On the Greatness of Rome*, b. 3, ch. 3**]. Secondly, it is a fact that even conquered enemies and many freed slaves were made Roman citizens, as Claudian elegantly writes in his praise of Rome: "She alone received the conquered at her bosom, like a mother, not a mistress, and called those subdued by her 'citizens'." Rutilius Gallicanus addresses Rome as follows in his travel poem: "You have created one single homeland for different people. It was for their own good to be subdued against their will by your dominion. In offering the conquered to participate in your own rights, you made into a city what was the world before." But alas, how much was Rome diminished later: As Giovio testifies, its citizens and other inhabitants were not more than 85,000 under Leo X, and their number is not much greater today.

[**2. Census of the Roman Empire**] The census of the Roman Empire conducted by Augustus is described under the heading ἀπογραφή by Suidas as follows (I translate into Latin): "But the autarch Caesar Augustus chose twenty men of most impeccable lifestyle, distinguished by their excellent character, and sent them out into all the provinces of his subjects. By these men, he had drawn up a list of all people and their professions and ordered that a sufficient and just part of their income be paid into the treasury." Later, Suidas adds under the heading Αὔγουστος: "Augustus Caesar counted all inhabitants of the Roman Empire, every single man, because he wanted to know how many they were. And it was found that the Roman territory was inhabited by μυριάδες υι' χίλιοι ιζ ἄνδρες [men]"—although in the aforementioned passage, Suidas has ἀνθρώπους [people]. For in this census, as also in others not conducted solely for the sake of war and military service, women, slaves, maidservants, merchants and any kind of artisans used to be counted along with the men, as Dionysius of Halicarnassus recounts in his fourth book. Through a special regulation in Ulpian it is certain "that in the provinces of Syria, males over fourteen, females over twelve were bound to pay head tax". But in other places, they were not bound to do so before twenty, as Lipsius [***On the Greatness of Rome*, b. 2, ch. 3**] reports, adding that the family men paid for their slaves and children—and, one should add further, for their wives and maidservants. From the *Gospel*, it is evident that the edict of Augustus included women, too. That is why Joseph went to Bethlehem, "to be taxed with Mary his espoused wife, who was pregnant". But the meaning of

υι᾽ μυριάδες in Suidas is not yet clear and certain. It is certain, however, that all those who have understood this term as 410 x 10,000 have been wrong with Aemilius Portus from Crete, who has recently Latinised and annotated Suidas, with the author of the *Theatre of Human Life* s.v. "Census", and with Spondano and Raynaldi in their *Materials Regarding the Annals of the Church*. Firstly, it is true that the letters "ypsilon iota", written without any accent below or above or only with one accent above, signify 410, but if written with a double accent above, as in my codex of Suidas, which has been emended by Aemilius Portus, they denote a much bigger figure. Secondly, a myriad, that is, 10,000, times 410 gives only 4,100,000, while it is clear from the above that Rome alone had more than 4 million inhabitants back then, and accordingly Italy alone a great many million, let alone the whole Roman world. Moreover, Spondano erroneously confounded the census which took place in Rome and resulted in 4,164,000 citizens, as Eusebius states expressly, with the census conducted in the other provinces of the Roman Empire through various officials. True, Lipsius understood Suidas as speaking of 410 myriads in the passage cited above, because he did not pay attention to the above–mentioned double accent, but he declared that this figure was simply wrong and much too small for a census of the whole Roman Empire, while leaving the emendation to those skilled in the art of divination. This, I am not, but I nonetheless believe that the two aforementioned accents above the "ypsilon iota" have the same function as two zeroes in our system: they multiply the number below by 10 x 10, and therefore not 410, but 41,000 myriads are meant in this place, that is, 410 million. If to this figure are added the χίλιοι ιζ, that is, 1,017, the total of the census of the whole Roman world conducted in accordance with Augustus' edict, including both sexes as well as children and the old, should have been 410,001,017 people. This total is not implausible if one considers that nearly the whole of Europe as well as a quite substantial part of Asia and Africa together with the respective islands had already been subdued by the Romans. For if these two small accents would signify a multiplication by ten only, resulting in 4,100 myriads, this would have to be written as δρ᾽, that is, "delta" and "rho", and with an acute accent under the letters, according to Greek custom. Moreover, 4,100 myriads would make 41 million only, thus a much smaller figure than would befit the number of people of the whole Roman world as it was at the time, since Rome and Italy alone had c. 20 million then, and ancient Gaul the same number again. If, on the other hand, the number indicated by "ypsilon iota" had to be multiplied by 10^3, that is, by 1,000, this used to be indicated not by a double accent above, but by a single accent below according to Greek custom. Moreover, 410 myriads multiplied by 1,000 would be 410,000 myriads, which would make 4,100,000,000 people, that is, 4,100 million, a figure greatly exceeding the total of all people that were alive then, let alone in the Roman Empire alone. Let this be said in a way that does not preclude better judgement.

[**3. The Roman armies**] Regarding the Roman armies, it can be ascertained from Appian that under Emperor Hadrian, they had 200,000 infantry, 40,000 cavalry, 300 elephants, 3,000 war chariots and 300,000 suits of armour in their magazines, as well as 3,580 ships. The Circus Maximus with its twelve gates contained 300,850 spectators.

II. A stroll through Italy

[**1. Census of Italy**] How astonishing is the vicissitude in the life of mortal men! To see the whole of Italy now reduced to the number which Rome alone could muster under Augustus, that is, to c. 9 million people, as is the opinion of Botero in part 2, b. 1 of his *Relationi* and of Giovan Battista Nicolosi on p. 249 of his *Ercole geografico*! Sabellico even concedes to Italy only 7 million in b. 2 of his seventh *Ennead*. But it is no wonder that people have shared the lot of cities, as the poet aptly sings: "And we, unhappy folk, complain that human limbs are dissolved by time, while we see empires and cities die?"

[**2. How many Italian cities?**] Aelianus once counted 1,166 cities in Italy. One of them was Sybaris, which could arm 300,000 men against the Crotonians before its complete destruction, as Diodorus, b. 12 and Strabo, b. 6 record. But in the 11th century AD, Guido, a priest from Ravenna, counts 700, and finally, in our own time, one counts 434, 300 bishop's sees and c. 20,000 villages.

[**3. Census of Sicily**] Not included in these figures, however, is Sicily, to which 1,300 chiliads or thousands of people are usually attributed. In earlier times, the number was 1,500, and 200 for Palermo alone, which now has 120. In Messina, there are 60, in Trapani, 35, in Syracuse, 30, etc. In Agrigento, there are even less, and yet in the time of Empedocles it was called, as we learn from Laertius, b. 8, μέγα ἄστυ, a great city, because it contained 800,000 people within its walls. But in the time of Diodorus Siculus (see his b. 13), the population was no more than 20 myriads, that is, 200,000, including immigrants.

[**4. Census of the Kingdom of Naples**] The whole census of the Kingdom of Naples, as recorded by Scipione Mazzella in 1556 AD, contains 1,463 settlements and within them 483,478 hearths. In this kingdom, each hearth is reckoned to have five people, from which it follows that there were 2,417,390 people. In this number, Mazzella says, clerics, widows, prostitutes, beggars and other persons unfit for work are not included, and even less so the citizens of Naples, since they have tax immunity. If one adds those, there may easily have been 3 million in the whole kingdom. Naples alone fed 360,000 people with bread sold on the market in the time of Mazzella, without reckoning the monasteries and other places where they bake their own bread at home. In our time, as Nicolosi says, it fed 500,000 people with the heaps of bread

piled up for sale at the market, but after the recent plague, this figure dropped to under 250,000.

[**5. Census of the Papal States**] The Papal States in Italy may hardly count 2½ million people. In my notes, I have the census of a great many cities, collected from members of our Society and from others. But I think I should not add to the weight and the price of this book by a long string of figures, which are moreover subject to astonishing variation after devastations by wars, plagues and famines—if I would say, for example, that Forlì numbers 13,000 within its walls and 24,000 including its territory, Faenza, 11,000, but 56,000 with its territory and bishopric, and so on about others. However, I would like to record that Ferrara numbered over 70,000 people under the Dukes d'Este, but now, just 20,000 (70,000 including its territory).

[**6. Census of Bologna**] In 1587, Bologna had 72,000 people within its walls, 19,500 in the suburbs, and 170,000 in the rest of the bishopric or territory, as is evident from the archbishop's archive. The territory's circumference is 180 miles, and it has 308 settlements, including hamlets. In 1589, the number of people within the walls reached 90,000, but it was diminished after the ensuing famine and fell to 79,381 in 1598, 207,796 including the territory. The number was more or less the same in 1600, but in 1630, the plague took away 23,691 heads within the city and 18,000 without in the countryside. After that, 26,948 males and 29,255 females were counted in 1654, 26,991 males and 30,432 females in 1657. In the countryside, the figures were 76,996 males and 90,815 females. The number of all inhabitants of both sexes together was 225,234. In the present year 1661, there are over 60,000 in this city. About Rome, I have already spoken.

[**7. Census of Tuscany**] To Tuscany, which is less extensive today than Etruria was in antiquity, Nicolosi gives 1,100,000 people in the *Ercole geografico*. The Florentine Palmieri says in his chronicle that 90,000 people were counted in Florence in 1339, and significantly more in 1348, so that the plague could take away over 100,000. After that, the inhabitants were reduced to 80,000 and at some later moment to 46,000. The other figures I keep in my notebooks.

[**8. Census of the territory of Venice**] In Venice's Terraferma, one presently counts 494,325 habitations, and within them 2,636,900 people, in Venice itself, 260,000 and 60,000 in the *ducato*, in Padua, 35,000 and 220,000 in the countryside, in Verona, 44,000 and 190,000 in the countryside, in Udine, 20,000 and 210,000 in the countryside, which is also called the "patria", in Brescia, 45,000, but in the bishopric at least 755,000 and often more, and so on regarding the other places, of which I have a long list.

[**9. Census of Milan and Genoa**] Milan numbered 310,000 inhabitants in 1601, but only 100,176 in 1658, excluding the clergy, monks and nuns. Genoa, which once had over 200,000 people, was already reduced to

120,000 before the recent plague and to 55,000 after. Corsica had 75,000 in the time of Botero, Turin nearly 40,000. Asti, which once had 40,000, has hardly 6,000 now. Mantua once had 35,000 or even 40,000, now it hardly has 12,900; when Mantua possessed Viadana, this city had 6,000 (15,000 including its territory). Parma counted 33,000 souls in 1628, which number was reduced to c. 13,000 after the plague of 1630. The same happened to Piacenza, Modena and many other places, from which I keep my pen away.

[**10. Plausible census of Italy**] I thus conclude that Italy, together with Sicily and the other islands, has more than 10 million and perhaps reaches 11 million.

III. *A stroll through Spain, France, Northern and Southern Germany, England and the neighbouring regions*

[**1. Census of Spain**] To Spain, Nicolosi attributes 9 or at most 10 million people following Botero. It has 93 big cities and 179,000 clergy, including monks and nuns. In Madrid, there are c. 150,000 people, in Granada, 180,000, and a little more in Seville. About Lisbon, I had heard much greater things, but Nicolau de Oliveira counted only 110,800 souls in it in 1629, and Aegidius Jansson in his *Journey through Portugal* even only 72,786 in 1646, but, as I believe, without the suburbs, etc. Sardinia numbered more than 600,000 souls before the plague of 1657. Nearly all of them were dead after the plague.

[**2. Census of France**] To France, Botero attributes 15 million people, and Nicolosi the same number on pp. 152 ff. of his *Ercole geografico*. He adds, in accordance with Maginus, that 25,000 settlements are counted in it, and that in Paris, without its many big suburbs, one counts 18,000 hearths and 500,000 people. The latter number, derived from Jean Bodin, I think false given the number of hearths. Personally, I have learned from our Society's procurators for France that 1,400,000 people were found in Paris, including the suburbs, under Henry IV, and 1,200,000 before him, and in the whole of France without Lorraine, Alsace, Artois and the region of Perpignan, c. 20 million. However, Paris has gone into some decline and has been reduced to 400,000, as Lipsius reports in b. 3, ch. 3 of *On the Greatness of Rome*. The cities of France number 865, its bishoprics 110, its archbishoprics 15. Its monasteries are most numerous, too. Thus, the French Church collects c. 104 million French livres in taxes. Cities of first rank are, after Paris, Toulouse with 200,000 heads, Bordeaux with 85,000, Lyon with 200,000 some time ago and c. 120,000 now, Marseille with 70,000 some time ago, about the same number as has Nevers, Rouen with 200,000, Orléans with 50,000, Bourges and Poitiers with 40,000. La Rochelle, which once had 50,000, was later reduced to 35,000. The rest, I keep to myself.

[**3. Census of Northern Germany**] Within its extension of 250 German miles, Belgium contains 208 walled cities, 150 smaller towns, 63,000 villages and hamlets. Thus, the whole of Flanders appears as one continuous city. The bishopric of Cologne had 1,760 parishes, 350 monasteries and 17,000 priests under Emperor Sigismund. In Liège, 200,000 inhabitants were counted a few years ago, in Antwerp, 100,000, in Leuven, 70,000, and so on. Botero attributes 3 million people to Northern Germany. Southern Germany counts 1,212 cities, Bohemia alone, 184. To Vienna, c. 200,000 people are attributed, 125,000 in later times. For the whole of Germany without Denmark, the figure is at least 19 million, if one accepts Botero's estimate. In this number, Denmark's 195, Sweden's 134, and Poland's 121 cities are not included. Of these, Gdańsk numbers c. 80,000 people, and in Lithuania, Vilnius has c. 300,000 men that can bear arms. England has 323 cities, Scotland 94, 45 of which have their own territory. To the whole of Britain, Botero attributes 3 million people. In 394, the Goths or Cimbri under their king Radagaisus accompanied Alaric, king of the Visigoths, with 200,000 soldiers from their northern regions, and in 451, Attila, king of the Huns, mustered an army of 700,000 soldiers. Earlier, Gaius Marius had already killed 300,000 Cimbri. But now?

IV. *A stroll through Greece, Thracia and the rest of Europe*

[**1. Census of Athens and Byzantium**] In Athens, as Athenaeus refers in b. 6, 21,000 citizens, 10,000 immigrants and 400,000 slaves were counted in the first year of the 110th Olympiad under Demetrius. Now, one would hardly count 32,000 inhabitants. Byzantium, which was destroyed by the Emperor Severus, later rebuilt by Constantine and enlarged by Theodosius the Younger, had a circumference of c. 50 miles including the suburbs. It had 600 churches and was richer and more populous than Rome, as Sozomen states. However, after its capture by Mehmed II, its circumference was reduced to 13 miles, and its inhabitants to 900,000, and to 700,000 later on, a number also given by Lipsius, b. 3, ch. 3 of *On the Greatness of Rome*. Galata is inhabited by c. 5,000; Botero adds in part 1, b. 1 of his *Relationi Europei* that three of its six districts belong to the Turks, two to the Christians, one to the Jews. Concerning the rest of Thracia, Macedonia, Dalmatia and Illyria, I have no reliable information, but it seems that their population can be reckoned on the basis of the extension of these regions, if one compares them to other similar parts of Europe. In doing so, one should also consider the most numerous islands of the Adriatic, the Ionian and the Aegean Sea. Among these, Aegina, whose circumference measures 180 stadia or 20 miles according to Strabo and Pliny respectively, numbered 47 myriads of Myrmidons, that is, 470,000 people, during the 8th Olympiad, as Pindar's scholiast reports.

[**2. Census of Europe**] So to put together what has been said so far and to reckon the rest of Europe, for better or worse, on this basis: If we concede to Italy, together with Sicily and the islands around it, 11 million people, to Spain, 10, to France, 19 or 20, to England, Scotland and Ireland, 4, to Northern Germany, together with Holland and Zeeland, 4, to Southern Germany, 20, to the North of the Balkans, Dalmatia and Greece with its islands, 10, to Macedonia and Thracia together with Mysia, 6, to Poland, Lithuania and Pomerania, 6, to Denmark, Gotland, Sweden, Norway and Livonia and the other northern regions, 8, the total will come to 99 and perhaps, including the other islands, to 100 million people.

V. *A stroll through Africa*

[**1. Census of Egypt**] Some estimate the population of Egypt based on the information from 2 Chronicles 12 that its king Shishak armed 1,200 war chariots and 60,000 cavalry against Jerusalem. Diodorus reports in b. 1, ch. 3 that Egypt had more than 3,000 cities under Ptolemy I. Among them, Thebes, the capital of the Thebais, had 100 gates. Together with its suburbs, its length was 400 stadia, as Stephanus of Byzantium has it under "Diospolis", or 420 stadia, as Eustathius has it. Elsewhere, one finds that its length was 80 stadia according to Strabo and its circumference 140 stadia according to Diodorus. In this region, so Stephanus records, there were 13,030 settlements with 3,700 acres of land allotted to each and 700 myriads, that is, 7 million people. The same number—or, as Josephus reports in b. 2, ch. 16 of his *Jewish War*, "750 myriads people, which is evident from the head tax every single person has to pay", so 7½ million—was also ascribed to Egypt as a whole.

[**2. Thebes and Alexandria**] Moreover, an inscription mentioned by Tacitus in b. 2 of the *Annals* informs us that Thebes counted 700,000 men of the age fit for military service. But Alexandria, according to Diodorus' testimony, had 300,000 free citizens and many more slaves, not to mention immigrants. Its circumference was 15 miles according to Pliny, its length 30 stadia according to Josephus and Strabo. Memphis, confounded with Cairo by some, had a circumference of 9 miles.

[**3. Carthago**] The circumference of the original Carthago measured 360 stadia (a figure to be understood to include the suburbs), its walls were 25 cubits thick and 40 high, as we know from Diodorus, b. 32. At the onset of the Punic Wars, it counted 700,000 citizens and possessed 300 cities in the lands controlled by it. Hannibal led 90,000 infantry, 12,000 cavalry and 37 elephants into Italy against the Romans. But according to 2 Chronicles 14, Zara, king of the Ethiopians, moved against the Jews with one million soldiers (however, this Ethiopia perhaps belongs to Asia). In my notebooks, I find that 19,000 hearths and over 95,000 people are counted in Fès, that the plague

killed 250,000 in Marrakech in 1598, and that one counts c. 80,000 people in Algiers. In 1584, the king of Angola mustered 1,200,000 Ethiopians against the Portuguese.

[**4. Census of Africa**] For the rest, it is true that Africa is more than twice as large as Europe, but because its interior is full of enormous wastelands, I would not like to believe that it surpasses Europe in its population nor that it greatly exceeds 100 million, if it attains that number at all.

VI. *A stroll through Asia*

1. If one wants to perambulate Asia, it is fitting to start in Palestine, to which country Moses led from Egypt, as Numbers has it, 603,550 sons of Israel able to bear arms, not reckoning boys and youths under twenty, women and Levites. But as 1 Kings 15 has it, the army of Israel comprehended 200,000 infantry and 10,000 men of Judah. In 2 Kings 24, Joab mustered 800,000 brave men of Israel, who could draw the sword, and 500,000 of Judah, following the order of David. This was no complete census, however, and men under twenty were not counted, as is evident from 1 Chronicles 27 and Numbers 23. But David himself killed 40,000 Syrian cavalry and 700 charioteers on the battlefield, as one learns from 2 Kings 20.

[**2. Census of Jerusalem**] In Jerusalem, there once used to live one million, but during Easter, 3 million flocked together there, as one reads in St. Augustin's *Sermon* 204, *On Time*. This is confirmed by the count of sacrificial animals made under Cestius. If one believes Josephus, *Jewish War*, b. 7, ch. 17, 1,100,000 of these animals perished during the Roman siege along with 97,000 humans.

[**3. Army of Holofernes**] Nebuchadnezzar, king of Assyria, sent an army of 120,000 infantry and 12,000 cavalry under Holofernes, and later on another 22,000 (*Judith* 1 and 7). Under Hezekiah, the Lord's angel killed 185,000 from the camp of Sennacherib, king of the Assyrians (2 Maccabees 15).

[**4. Niniveh**] Furthermore, Niniveh or Ninus (I am speaking of the one beyond the Tigris in Assyria, which the Nubian Geographer places in the region of Mausel or Mosul, at the junction of the Tigris and the Great Zab), this Niniveh, I said, is called "A big city of three days' journey" in *Jonah* 3—regarding its circumference, that is, as one learns from Aben Ezra, St. Jerome, St. Cyril and finally also from Theodoretus. But according to Diodorus, b. 2, its length and breadth was 150 and 90 stadia respectively, its circumference 480 stadia. The height of its walls was 100 Babylonian feet, their breadth sufficient for three chariots, as Eustathius has it in his *Commentary on Dionysius*. Now in this city, as Bochart, *Geographia sacra*, b. 4, ch. 20 says, 120,000 children were mustered who could not distinguish their left from their right hand, that is, children under two years. If we suppose that

they made up one fifth of the city, there may have been 600,000 inhabitants of Niniveh, [**Seleucia**] the same number as Seleucia had in Pliny's time.

[**5. Size of Babylon**] Babylon had no less inhabitants either. In constructing its walls, 200,000 people built one stadium per day, so that they were finished within one year. In this case, the circumference of ancient Babylon would have been not 360 stadia, as Ctesias says in Diodorus, b. 2, but 365, as Clitarchus says, although (perhaps because the walls were amplified or made to include the suburbs as well) Curtius, b. 2 reports 378, Strabo, b. 16, 385, Cassius Dio, 400, Orosius, b. 2, ch. 6, 470, Herodotus, b. 1, and Apollonius, b. 1, ch. 18, 480 stadia, that is, 60 miles, as also Pliny, b. 6, ch. 26, and Capella, b. 6. The height of the walls was 50 cubits according to Strabo and Diodorus, 100 according to Curtius and Apollonius, 50 klafter, that is, 200 cubits, according to Ctesias and Herodotus, but 200 feet according to Pliny and Capella; their thickness, 32 feet according to Strabo and Curtius, 50 according to Pliny and Capella, 50 cubits according to Herodotus and Orosius, 100 feet according to Apollonius. They had 250 towers, which were 10 feet higher than the walls themselves, and 100 bronze gates.

[**6. Army of Xerxes …**] But to return to the number of people: According to Herodotus, b. 7, the army of Xerxes, which was led against the Greeks, transferred from Asia to Europe and counted myriad by myriad on a field close to the city of Myriandros, consisted of nearly 7,300,000 soldiers, so that the rivers were not sufficient to provide them with drink, nor were 600,000 bushels of grain enough for their daily food (Alessandro Alessandri, *Genialia dierum*, b. 7). [**… of the Huns …**] Later, in 374 AD, the Huns led 1,800,000 soldiers out of Scythia. [**… of Timur …**] But Timur, a Parthian by descent, crossed the Euphrates with 400,000 cavalry and 600,000 infantry and conquered the Anatolian peninsula, killing 200,000 people from the army of Bayezid, as Pius II reports. [**… of the Muscovite …**] At present, the Grand Duke of Moscow can muster 300,000 cavalry for battle. [**… and of Suleiman**] The Turkish Sultan Suleiman even had 350,000 warriors when assaulting Hungary in 1566.

[**7. Census of some cities in Persia, Syria and India**] Some of my fellow Jesuits, who have travelled in India, Syria and part of Persia, have informed me that Persepolis, nowadays called Shiraz, held 200,000 inhabitants within a circumference of 20 miles a few years ago and that Tabriz, the capital of Media, whose circumference is 16 miles, also holds 200,000 people. For Isfahan, the figure is 300,000, including women, and it is the same for Aleppo, including immigrants. In Cyprus, there are c. 170,000, in Kolkata, 40,000, in the city of Diu, just as many, in Surat, 55,000, in Kanyakumari, 45,000, in New Babylon or Baghdad, 50,000, in Travancore, just as many; finally, in Goa, whose

circumference is 9 miles and breadth 3 miles, and in Machilipatnam, 60,000, in Cochin, 80,000, and so on with further figures kept in my notebooks.

[**8. Census of Odina and other cities**] In the kingdom of Thailand, the city of Odina with its 400,000 habitations or hearths contains c. 2 million, including immigrants. The king of Hanthawaddy Pegu has attacked this city more than once with one million soldiers (Botero, *Relationi*, part 2, b. 2).

[**9. The armies of the kings of the Mughal Empire and of Cambay**] Concerning the Mughal Empire and its king's army, I have heard figures of up to 400,000. The king of the Karnata Empire brought together such a numerous army against Hidalcão that they dried up rivers when drinking from them, as Johannes Bonus from Portugal reports. Bahadur, king of Khambat, mustered 150,000 cavalry, 500,000 infantry and over 200 tower–bearing elephants against the queen of Sanga and the king of the Mughal Empire.

[**10. Borneo**] In the city of Borneo on the homonymous island, one counts 30,000 houses. In Cathay, the city of Cambaluc comprises an innumerable multitude within a circumference of 20 miles—but at this point, we have to move into the kingdom of the Sinenses, that is, into China.

[**11. Census of China**] For China is so densely populated that a perpetual market day appears to be held to one travelling from one city to the next. Dudley, *Dell'Arcano del mare*, b. 6, p. 37, says that Nanjing alone has 2 million people and Beijing just as many, and that at the beginning of this century, there were 58 million souls in this kingdom, not counting soldiers and officials. In my remarks, I find that this kingdom has 16 provinces, 1,593 quite big cities, 591 metropolises and c. 70 million people. In Father Martino Martini's *Atlas of China*, however, I find that there are 15 Chinese provinces, 150 cities of first rank, 1,226 others with walls, and 10,127,487 families. Each paterfamilias must distinctly display on a board in front of his house the number of people in his family, so that a census can be held without delay. In this way, a census has been held in 1651 AD, and there were found to be 58,914,284 men—or, as I conclude from the totals to be cited below, 58,916,783. Boys, women, soldiers, officials, shavelings, eunuchs and the royal family were not taken into account, since they pay no taxes. From the respective taxes and other sources, the Emperor has annual revenues of 150 million gold coins or scudi, 60 million of which are stored in his treasury, while the rest is used for various purposes, especially for the army. According to the estimate of Father Martinus, if those not counted, as said before, were counted, c. 200 million inhabitants would be found in China. In the same year 1651, one million soldiers were delegated to the custody of the Great Wall. But I want to present the 1651 census separately for every single province.

Provinces	Families	Men (without boys, women, soldiers, officials, shavelings, eunuchs and the royal family)
Beijing	418,989	3,452,254
Shanxi	589,959	5,084,015
Shaanxi	831,051	3,934,176
Shandong	770,555	6,759,675
Henan	589,296	5,106,270
Sichuan	464,129	2,204,170
Huguang	531,386	4,833,590
Jiangxi	1,362,629	6,549,800
Nanjing	1,969,816	9,967,429
Zhejiang	1,242,135	4,525,470
Fujian	509,200	1,802,677
Guangdong	483,360	1,978,022
Guangxi	186,719	1,054,760
Guizhou	45,305	231,365
Yunnan	132,958	1,433,310
	10,127,487	58,916,783

So China alone has twice as many people as the whole of Europe, if, as I plausibly assumed in section VI, the latter does not exceed c. 100 million.

[**12. Census of the whole of Asia**] From this, and taking into account the vast kingdoms in the rest of Asia as well as the islands of the Eastern Ocean, I am inclined to think that the whole of Asia contains five times as many people as Europe, thus c. 500 million.

VII. A stroll through America and the rest of the Earth

1. In North America, the city of Mexico has more than 30,000 houses or hearths and is inhabited by 500,000 Indians and 4,000 Castilians according to ANTONIO DE HERRERA. In South America, Lima has 12,000 slaves, its Spanish women alone are 24,000. Cuzco has 50,000 people, and 200,000 in its territory. But the interior of the Americas is not entirely known yet, and the Southern Continent remains undiscovered so far. Therefore, if one gives 200 million to both Americas together and 100 million to the Southern Continent, one will seem rather to surpass the true figure than to remain below it.

[**2. Census of all people**] Thus, the total of the whole human race presently inhabiting the Earth's surface does not seem to exceed one thousand million.

Corollaries

I. [**Number of people being born**] If one supposes that there are one thousand million people on the entire globe, as said before, and if the same happens across the entire globe as in Bologna, where around one fifteenth of the total number of inhabitants is born every year, as confirmed by the observation of many years, and if a lesser number in some places is made good for by a surplus elsewhere, then it follows that c. 66 or at a maximum 70 million are born every year. In some places, for example in Seville, far more women than men are born, in others, more men, and in still others, such as in Bologna, the figures for both sexes are more or less the same.

II. The number of people in one single city usually remains nearly the same, as long as its territory and the fields, from which the sustenance of the population depends, are not expanded, and as long as there are no defeats in war, plagues and famines. [**Number of births and deaths in a century**] In Bologna, for example, the number of people used to be between 60,000 and 70,000, in Florence, between 70,000 and 80,000, etc. So as many people die as are born—perhaps not in one and the same year, but if times of military defeats, plague and famine are also taken into account. From this, it follows that in every century similar to our present one, 7,000 million, that is, 7,000,000,000 people are born and the same number decease or die. In this process, the lesser numbers of some years are always compensated by a surplus in others, if one takes corollary I as a basis.

III. Let us suppose that the number of people has always remained the same after Noah's Flood, as Ocellus the Pythagorean holds (although my most learned fellow citizen Alfonso Pandolfo asserts that it has decreased in his *Disputations about the End of the World*, question 2, ch. 3 of the Pythagorean disputation) or that it has increased more and more, until it reached an apogee, whether this was in the times of Alexander the Great or of Augustus, and has then decreased until our present times, but in such a way that the decrease in our hemisphere has partly been compensated by an increase in the southern one, because people have migrated there from our regions and have begun to inhabit islands and continents that had been uninhabited and wild before. Let us, then, compensate decreases by increases in this way, and generalise the number of people alive at present and multiply them by the centuries elapsed since the Flood, as if the world had remained in the same state in this respect, which is a quite plausible reasoning. [**Number of people from the beginning of the world to the present century**] Let us make these assumptions, I said, and reckon further that c. 4,000 years, that is, 40 centuries, have elapsed since the Flood, which took place in the year 2396 BC, until the year 1600. If 40 is multiplied by 7,000,000,000 (see corollary II), it follows that c. 280,000,000,000 people have been born from the Flood to AD 1600. Even if one adds to this number those born from the beginning of the world to the

Flood, that is, during c. 1700 years, in Asia and the adjacent regions, the total will barely reach 300,000,000,000, that is, three hundred thousand million.

IV. Let us suppose that the aforementioned people had never died, but had remained on the surface of the Earth. Now this convex surface, including the water, comprises 274,329,770 Roman square miles (see b. 5, ch. 35), but only one half of this, 137,164,885 square miles, can be taken to be the inhabitable surface of the Earth. If we divide 300,000,000,000 people by this number, the result would be 2,187 people per square mile; but let it be 2,200. One person being recumbent or lying down with hands and feet outstretched covers one square pace, and a square mile contains 1,000,000 square paces. [**The Earth would have enough space for all the people born so far**] If you divide this by 2,200, every single person receives 454 square paces—one to lay down his body, as said before, the rest for his house, garden, land, etc. If we gave every single person's lot the form of a square, the square's side would be 21 paces plus a small fraction, or 10½ x 10 feet.

V. So the surface of the Earth without the waters is 137,164,885 square miles, that is, 137,164,885,000,000 square paces. To cover this area, one needs just as many people lying down with their arms and legs outstretched. Let us posit that only 300,000,000,000 people have been born until the beginning of the present century. Subtracting them from the number of the aforementioned squares leaves 136,864,885,000,000 squares empty. I have also posited that c. 7,000,000,000 people are born per century. Thus, the aforementioned empty squares and the respective number of people necessary to fill them need another 19,552 centuries.

VI. Let us assume once more that 300,000,000,000 have been born so far. As it was revealed to St. Bridget (b. 4, ch. 11), "if all people, from those who have been born since Adam until the last one to be born at the end of the world, would be counted, one would find more than ten angels for every single human being". It follows that there are over 3,000 x 1,000 million angels, since there are still people waiting to be born—although St. Gregory of Nyssa says in ch. 17 of *On the Creation of Man* that the number of angels is more or less infinite, and St. Dionysius Areopagita in chs. 13 and 14 of *On the Celestial Hierarchy* that it is known to God alone. The same should also be said of the people born and to be born in the future. For I have only strived after plausibility by mere conjecture and any means whatsoever, as indicated in the title of this appendix, and have toyed with numbers, but not deceived the world.

THE END

Appendix 2: Riccioli's literary sources

The sources are listed in roughly chronological order. Dates refer to works, if possible, to lifetimes otherwise. They are often conventional. Which works are meant by Riccioli, is in many cases inferred by me.

AUTHOR	TITLE	DATE	REMARKS
	Old Testament	8th–1st c. BC	1 and 2 *Chronicles,* 1 and 2 *Kings, Numbers, Judith,* 2 *Maccabees, Jonah*
Herodotus	*Histories*	440 BC	
Ctesias	*Persika*	5th/4th c. BC	transmitted in Diodorus
Clitarchus	*History of Alexander*	4th c. BC	
ps.–Ocellus Lucanus	*On the Nature of the Universe*	1st c. BC	
Diodorus Siculus	*Bibliotheca historica*	60–30 BC	
Dionysius of Halicarnassus	*Roman Antiquities*	late 1st c. BC	
Strabo	*Geography*	early 1st c. AD	
Livy	*Ab urbe condita*	up to 17	
Quintus Curtius Rufus	*Histories of Alexander the Great*	1st c.	
Pliny the Elder	*Natural History*	70s	
Flavius Josephus	*Jewish War*	75	
Luke	*Gospel of Luke*	80–110	
Tacitus	*Annals*	beginning of 2nd c.	
Lucius Annaeus Florus	*Epitome of Roman History*	early 2nd c.	
Appian	*Roman History*	mid–2nd c.	

Ulpian		170–223	transmitted in *Digest*
Athenaeus of Naucratis	*Deipnosophists*	around 200	
Claudius Aelianus	*Various History*	early 3rd c.	
Cassius Dio	*Roman History*	early 3rd c.	
Diogenes Laertius	*Lives of the Philosophers*	3rd c.	
Eusebius	*Chronicle*	early 4th c.	
Gregory of Nyssa	*On the Creation of Man*	second half of 4th c.	
Claudian	*On Stilicho's Consulship*	400	
Jerome		347–420	
Cyril of Alexandria		376–444	identification probable, but not certain
Theodoret of Cyrus		393–458/466	
Rutilius Claudius Namatianus	*On His Return*	416	cited as "Gallicanus"
Martianus Capella	*On the Marriage of Mercury and Philology*	410–430	
Augustine of Hippo	*Sermons*	early 5th c.	
Sozomen	*Ecclesiastic History*	mid–5th c.	
ps.–Dionysius Areopagita	*On the Celestial Hierarchy*	5th/6th c.	
Stephanus of Byzantium	*Ethnica*	first half of 6th c.	
Apollonius			identification uncertain
	Scholia on Pindar	Hellenistic to Byzantine era	
Guido of Pisa	Reworking of the *Ravenna Cosmography*	700 / 1119	called "Guido, a priest from Ravenna"
	SUDA	10th c.	cited after Latin edition by Aemilius Portus (1619) as an author called "Suidas"
Abraham ibn Ezra		1089–1167	

Muhammad al–Idrisi	*The Book of Pleasant Journeys to Faraway Lands*	mid–11th c.	cited as "Nubian geographer" after the title of the 1619 Latin edition
Eustathius of Thessalonica	*Commentary on Dionysius of Alexandria*	mid– to later 12th c.	
Bridget of Sweden	*Revelationes*	1303–1373	
Matteo Palmieri		1406–1475	
Marcantonio Sabellico	*Enneades sive rapsodia historiarum*	1504	
Alessandro Alessandri	*Genialia dierum*	1522	non–existent b. 7 cited, b. 6 ch. 25 meant
Jacopo Sannazaro	*De partu virginis*	1526	cited as "the poet"
Paolo Giovio	*Historiae sui temporis*	1550–1552	
Jean Bodin	*Les six livres de la république*	1576	
Giovanni Botero	*Delle cause della grandezza delle città*	1589	
Giovanni Botero	*Relationi universali*	1591–1598	first part cited as *Relationi Europei*
Justus Lipsius	*Admiranda sive de magnitudine Romana libri IV*	1598	
Alfonso Salmerón	*Commentarii in evangelicam historiam et in acta apostolorum*	1598–1601	
Scipione Mazzella	*Descrittione del Regno di Napoli*	1601	
Antonio de Herrera	*Descripción de las Indias Occidentales*	1601	
Nicolau de Oliveira	*Livro das Grandezas de Lisboa*	1620	wrongly dated to 1629
Henri Spondanus	*Annalium Baronii continuatio*	1639	
Robert Dudley	*Dell'arcano del mare*	1645–1646	
Samuel Bochart	*Geographia sacra*	1646–1651	
Odorico Raynaldi	*Annales ecclesiastici ab anno 1198*	1646–1677	
Martino Martini	*Novus Atlas Sinensis*	1655	

Martin Zeiller	*Hispaniae et Lusitaniae itinerarium*	1656	misattributed to Aegidius Jansson, the printer, and dated 1646
Alfonso Pandolfo	*Disputationes de fine mundi*	1658	
Giovan Battista Nicolosi	*Dell'Ercole o Studio geografico*	1660	
Simon Cassius			unidentified
Maginus			unidentified
Theatrum vitae humanae			unidentified

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