What Do You Need a Mathematician For? Martinus Hortensius's "Speech on the Dignity and Utility of the Mathematical Sciences" (Amsterdam 1634)

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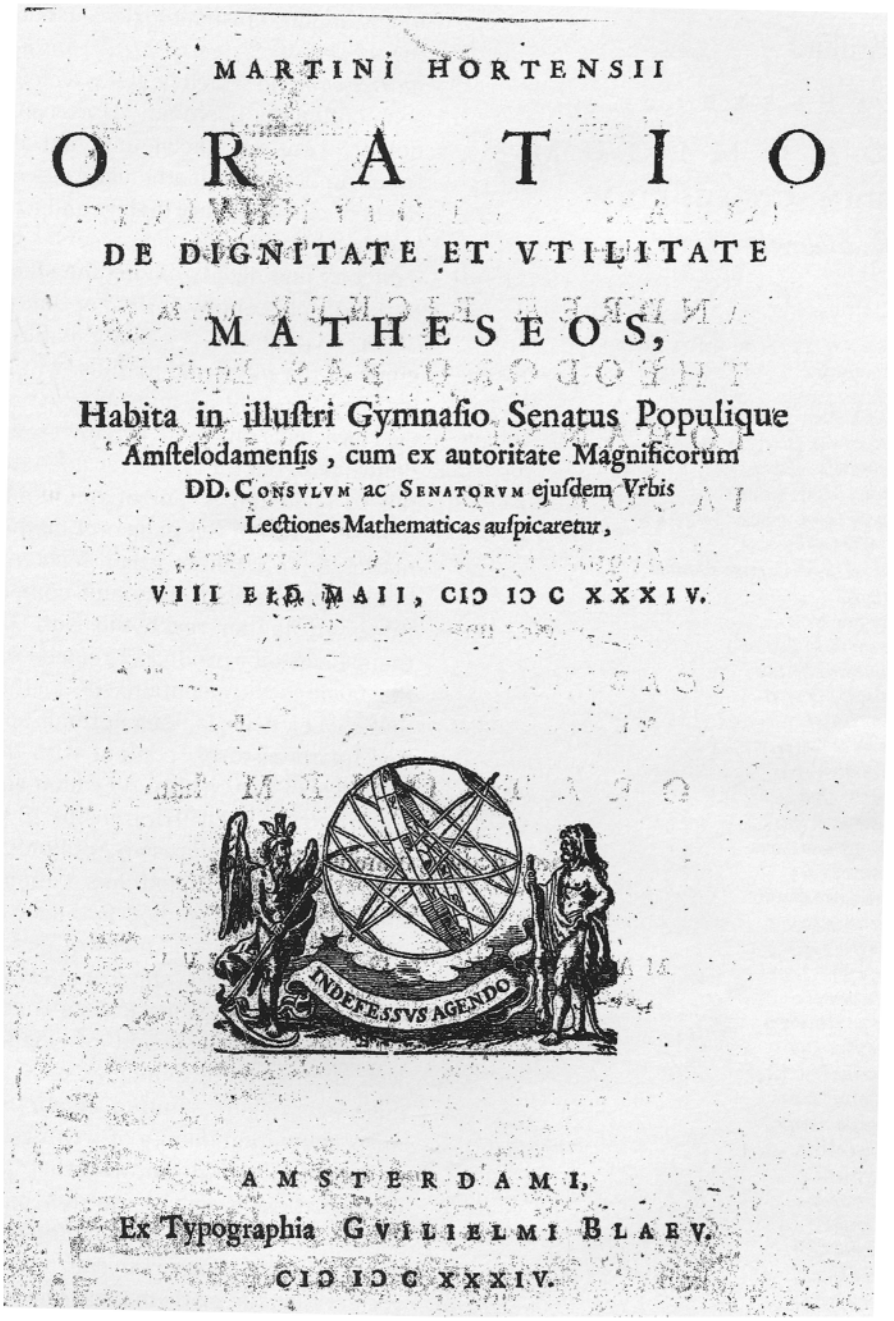
In early modern Europe the term *mathematical sciences* was used to describe those fields of knowledge that depended on measure, number, and weight—reflecting the much-quoted passage from the *Wisdom of Solomon* 11, 20: "but thou hast ordered all things in measure and number and weight." This included astrology and architecture as well as arithmetic and astronomy. These *scientiae* or *disciplinae mathematicae* were generally subdivided into *mathematicae purae*, dealing with quantity, continuous and discrete as in geometry and arithmetic, and *mathematicae mixtae* or *mediae*, dealing not only with quantity but also with quality—for example astronomy, geography, optics, music, cosmography, and architecture. The mathematical sciences, then, consisted of various fields of knowledge, often with a strong bent toward practical applications. These fields became independent from one another only through the formation of scientific disciplines from the late 17th to the early 19th century, i.e., in the aftermath of the Scientific Revolution.

One of the important preconditions for this transformation was the rapidly changing status of the mathematical sciences as a whole from the mid-16th through the 17th century. The basis for the social and epistemological legitimation of the mathematical sciences began to be laid by mathematicians and other scholars in the mid-16th century. Their strategy was essentially twofold: in the wake of the 16th-century debates about the certainty of mathematics and its status in the hierarchy of the scientific disciplines (*quaestio de certitudine mathematicarum* [Mancosu 1996; Remmert 1998, 83–90; 2004]), the *mathematicae purae* were taken to guarantee the absolute certainty and thereby dignity of knowledge produced in all the mathematical sciences, pure and mixed; the *mathematicae mixtae*, on the other hand, confirmed the utility of this unerring knowledge.

Throughout the 17th century, the legitimation of the mathematical sciences was pursued in deliberate strategies to place the mathematical sciences in the public eye. These strategies often involved the use of print media in one way or another—through mathematical textbooks, practical manuals, books of mathematical entertainments, editions of the classics, encyclopaedic works, and orations on the mathematical sciences [Dear 1995; Mancosu 1996; Remmert 1998]. The *Oratio de dignitate et utilitate Matheseos* (*Speech on the dignity and utility of the mathematical sciences*) by Martinus Hortensius belongs to the latter genre (see Fig. 1). To praise and promote the mathematical sciences in inaugural lectures was common practice, and quite a few such orations eventually found their way into print.[1] As Hortensius's speech reflects most of the standard arguments employed in the process of legitimation—and doubly so as he is clearly seeking not only to legitimate his discipline but at the same time to be hired by the city fathers of Amsterdam on a permanent basis—it is an excellent example to allow us an overview of an elaborate array of arguments from the classical Greek tradition to contemporaneous develop-

. . . deliberate strategies to place the mathematical sciences in the public eye.

[1]For a selection of these and related pieces see the bibliography II; cf. the discussion in [Remmert 1998, 152–165; Swerdlow 1993].


MARTINI HORTENSII

ORATIO

DE DIGNITATE ET VTILITATE

MATHESEOS,

Habita in illuſtri Gymnaſio Senatus Populique
Amſtelodamenſis, cum ex autoritate Magnificorum
DD. Consvlvm ac Senatorvm ejuſdem Vrbis
Lectiones Mathematicas auſpicaretur,

VIII Eid. Maii, CIↃ IↃ C XXXIV.

INDEFESSVS AGENDO

AMSTERDAMI,
Ex Typographia Gvilielmi Blaev.
CIↃ IↃ C XXXIV.

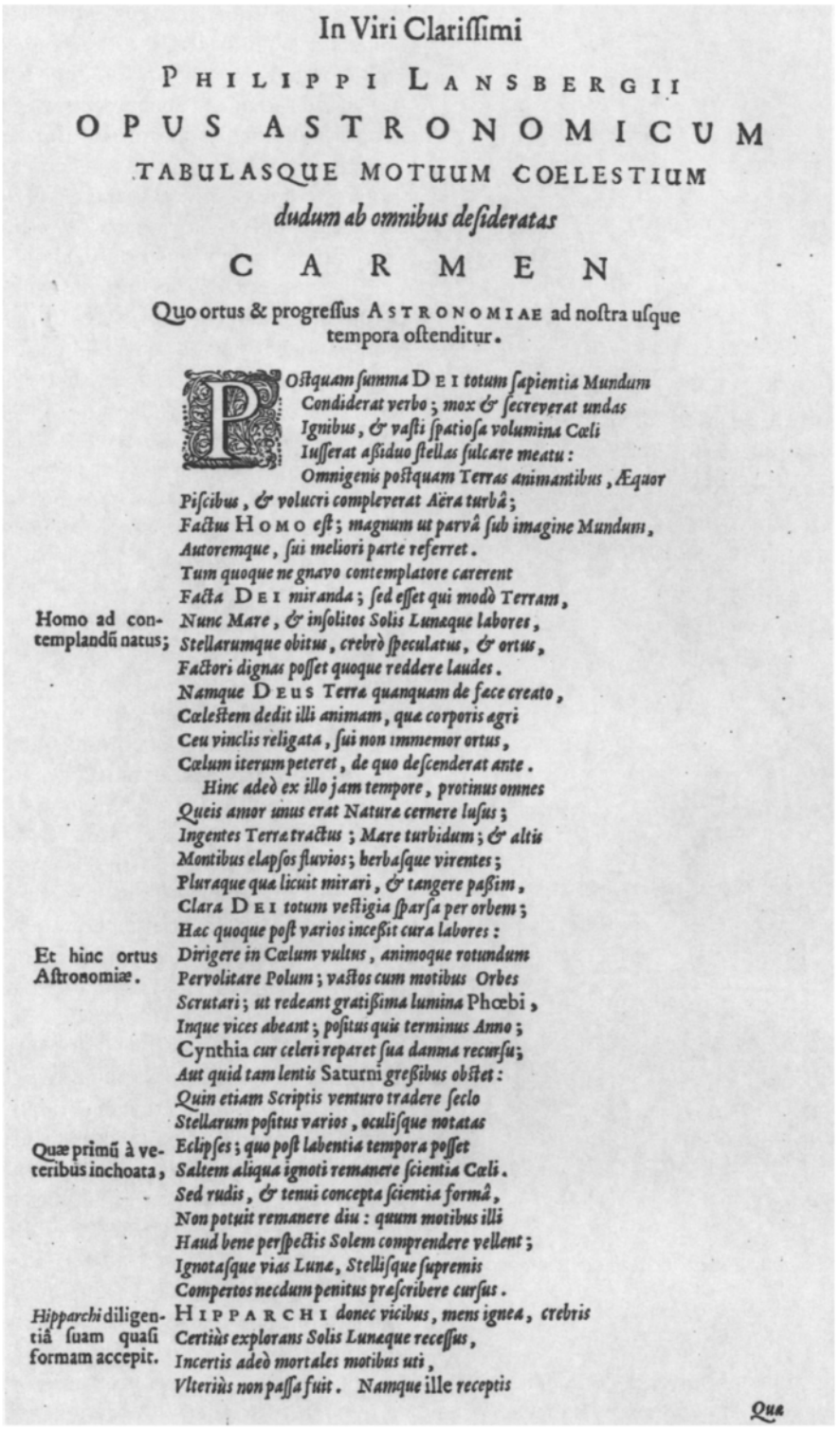
Figure 1. Title-page of Hortensius's *Speech on the dignity and utility of the mathematical sciences*, Amsterdam 1634.

ments in astronomy, including Galileo's astronomical observations.

Hortensius (1605–1639) was born as Maarten van den Hove in Delft in 1605. He was a student in the Latin school at Rotterdam, where he probably came under the influence of the natural philosopher Isaac Beeckmann. In 1625 he went to Leiden, but it was only in March 1628 that he registered as a student at the prestigious University of Leiden, where the well-known mathematician Willebrord Snel taught from 1613 to his early death in 1626. It was probably under Snel's guidance that Hortensius turned to the mathematical sciences and made astronomical observations in Leiden. After Snel's death Hortensius came in contact with the reformed minister, physician, astronomer, and ardent propagator of the Copernican system, Philipp Lansbergen (1561–1632), with whom he collaborated closely in editing and translating some of Lansbergen's works from Dutch into Latin. In 1633 Hortensius moved from Leiden to Amsterdam, hoping to get a position at the city's recently founded *Athenaeum illustre*. Several of these "illustrious schools" had been founded throughout the Dutch Republic in the 1630s in order to prepare students for the universities (Deventer, Amsterdam, and Utrecht), or even to compete with them. Of these only the Amsterdam *Athenaeum illustre* rose to a more prominent position, as the founding fathers used the immense wealth of the city of Amsterdam to hire away professors from Leiden. In May 1634 Hortensius began to teach in Amsterdam, delivering his inaugural lecture on the *Dignity and utility of the mathematical sciences*. If we are to believe his personal testimony, his daily lecture courses were a success and attracted quite a few listeners. At any rate, the city authorities hired him as a full professor in early 1635 [van Berkel 1997; Remmert 1998, 154–158].

In the years that followed, Hortensius's scientific reputation grew continuously. He was known as a convinced Copernican and an admirer of Galileo, corresponding with such distinguished scholars as Fabri de Pereisc, Galileo, Pierre Gassendi, Hugo Grotius, Constantin Huygens, Marin Mersenne, and Wilhelm Schickard. Much of his energy between 1635 and 1639 was absorbed by a futile plan to bring his hero Galileo to the Dutch Republic. At the height of his fame, Hortensius received a professorship in Leiden, but he died shortly after moving there in August 1639. Although he is not among the great luminaries of 17th century science—Descartes even considered him "very ignorant"[2]—his appointment at Leiden shows that he was highly esteemed in the Dutch republic of letters. In his *Speech on the dignity and utility of the mathematical sciences* as well as in his other writings, in particular the *Canto on the origin and progress of astronomy*, his

[2]Descartes to Mersenne, March 31, 1638: "il est tres ignorant" [Berkel 1997, 219].



In Viri Clariſſimi

PHILIPPI LANSBERGII

OPUS ASTRONOMICUM

TABULASQUE MOTUUM COELESTIUM

dudum ab omnibus deſideratas

CARMEN

Quo ortus & progreſſus ASTRONOMIAE ad noſtra uſque tempora oſtenditur.

POſtquam ſumma DEI totum ſapientia Mundum
Condiderat verbo; mox & ſecreverat undas
Ignibus, & vaſti ſpatioſa volumina Cœli
Iuſſerat aſſiduo ſtellas ſulcare meatu:
Omnigenis poſtquam Terras animantibus, Æquor
Piſcibus, & volucri compleverat Aëra turbâ;
Factus HOMO eſt; magnum ut parvâ ſub imagine Mundum,
Autoremque, ſui meliori parte referret.
Tum quoque ne gnavo contemplatore carerent
Facta DEI miranda; ſed eſſet qui modò Terram,
Homo ad contemplandũ natus; Nunc Mare, & inſolitos Solis Lunæque labores,
Stellarumque obitus, crebrò ſpeculatus, & ortus,
Factori dignas poſſet quoque reddere laudes.
Namque DEUS Terræ quanquam de face creato,
Cœleſtem dedit illi animam, quæ corporis agri
Ceu vinclis religata, ſui non immemor ortus,
Cœlum iterum peteret, de quo deſcenderat ante.
Hinc adeò ex illo jam tempore, protinus omnes
Queis amor imus erat Naturæ cernere luſus;
Ingentes Terræ tractus; Mare turbidum; & altis
Montibus elapſos fluvios; herbaſque virentes;
Pluraque quæ licuit mirari, & tangere paſſim,
Clara DEI totum veſtigia ſparſa per orbem;
Hæc quoque poſt varios inceſſit cura labores:
Et hinc ortus Aſtronomiæ. Dirigere in Cœlum vultus, animoque rotundum
Pervolitare Polum; vaſtos cum motibus Orbes
Scrutari; ut redeant gratiſſima lumina Phœbi,
Inque vices abeant; poſitus quis terminus Anno;
Cynthia cur celeri reparet ſua damna recurſu;
Aut quid tam lentis Saturni greſſibus obſtet:
Quin etiam Scriptis venturo tradere ſeclo
Stellarum poſitus varios, oculiſque notatas
Quæ primũ à veteribus inchoata, Eclipſes; quo poſt labentia tempora poſſet
Saltem aliqua ignoti remanere ſcientia Cœli.
Sed rudis, & tenui concepta ſcientia formâ,
Non potuit remanere diu: quum motibus illi
Haud bene perſpectis Solem comprendere vellent;
Ignotaſque vias Lunæ, Stelliſque ſupremis
Compertos necdum penitus præſcribere curſus.
Hipparchi diligentiâ ſuam quaſi formam accepit. HIPPARCHI donec vicibus, mens ignea, crebris
Certiùs explorans Solis Lunæque receſſus,
Incertis adeò mortales motibus uti,
Vlteriùs non paſſa fuit. Namque ille receptis

Qua

Figure 2. First page of Hortensius's *Canto on the origin and progress of astronomy* of 1632.

learning in astronomy and the mathematical sciences is on display [Hortensius 1632] (Fig. 2). Also, Hortensius proved himself to be very well versed in classical writings and traditions—an aspect of scholarship not to be discounted in an academic world that still felt a considerable humanistic impulse.

Hortensius and his contemporaries saw metaphysics, physics, and mathematics as parts of theoretical philosophy, and in his *Oratio* he flatly asserted that "among these mathematics excels by its certainty." The notion that mathematics guaranteed the highest degree of certainty humanly attainable was a long-standing epistemological debate, the *quaestio de certitudine mathematicarum*, on which he takes a clear, self-confident position. Hortensius boldly opens by exclaiming that no "one can deny that mathematics is, indeed, of extraordinary dignity and that "mathematics guards and preserves its sublimity and dignity among the allied parts of philosophy." He continues: "That Goddess [= mathematics], guide of the mind and actions, whom we ought to rely on and obey, whatever we have in mind, whatever we conceive in our minds; never does she fail to shed the gleam of her noble majesty through the palace of mathematics. [. . .] Where other sciences, being full of uncertainty and conjecture, can neither reach the truth by themselves, nor produce a remedy for the falsities they contain, the mathematical sciences, lacking nothing, suffice for themselves; content with the guidance of nature only, they hunt and capture truth itself" [Hortensius 1634, 6]. Hortensius conjures up Apollonius, Aristotle, Euclid, Hipparchus, Pappus, Plato, Ptolemy, Proclus, Pythagoras, Thales of Miletus, and many others to prove the antiquity and early excellence of the mathematical sciences. But, he says, "the height of science was attained by Archimedes of Syracuse, everywhere admired, celebrated in so many monuments of writings."

Before he turns to showing that "the mathematical sciences do not lack practical advantage and utility," he asks, "Among pleasures, can any be greater than the mathematical sciences [for] stimulating the mind itself and flooding the inmost feelings of the spirit with fullest joy? The knowledge of history and the reading of tales offer occasions of delight. The study of politics, ethics, logic, all have their pleasures. But the joys of the mathematical sciences are so strong, so keen, that they attract like something seductive and excite the highest alacrity in the minds of their students." The mathematical sciences, according to Hortensius, "ought to be cultivated and honoured by us and their reputation enhanced, so that through them, aspiring to the knowledge of the stars in the sky, we may watch more carefully that book of na-

ture[3] and we may read it more attentively. [. . .] Plato also said that eyes were given to men to watch the stars, but also arithmetic and geometry were given as added wings, by which he might fly into the highest spaces of the world" [Hortensius 1634, 7f] (Fig. 3).

Still, merely praising the dignity and antiquity of the mathematical sciences was clearly not sufficient to convince the city authorities who supported the *Athenaeum illustre* to invest in them, i.e., to hire Hortensius. Accordingly, after playing the humanistic parlour game of alluding to the classics for a while, he takes up the utility and practical advantage of the mathematical sciences. "These [the mathematical sciences] we have shown to surpass the other sciences in the contemplation of things, by their certainty, their nobility of subject and their comfort and pleasing quality; so we will make clear that they confer the most noble benefits also upon men."

Hortensius distinguishes between "the advantage of the mathematical sciences [. . .] in general, to what extent it spreads itself through all orders of disciplines and faculties, and in particular cases, according to what belongs to each part [i.e., the utility of specific branches as arithmetic or astronomy]." He discusses how the four university faculties—philosophy, theology, law, and medicine—all depend on the mathematical sciences. As we would expect, he reminds his audience that "Plato filled the books of his own philosophy with mathematical reasoning [. . . and that] you will find written on the doorway of the Academy *let no one ignorant of geometry enter.*" In the books of Aristotle too, he points out, "there are infinite matters from which no one can extricate himself without skill in the mathematical sciences" [Hortensius 1634, 10].

Let us skip Hortensius's examples of the importance of the mathematical sciences for theology, law, and medicine, and turn to those which "contain particular benefits, not at all to be passed over in silence" [Hortensius 1634, 13]: practical arithmetic, geodesy, military architecture, mechanics and statics, music, optics, astronomy, geography and navigation. It is in the passage on optics that his Copernican fervour shines through most brilliantly, conveying the feeling that the ancients have now been most assuredly surpassed. He boasts that

"this is the science that has put ladders on the world and informed astronomers of the distance and size of the sun, moon, and planets. This has brought more light to our century than was given to all the schools of philosophy before us to know. I look back to that instrument, recently invented, which they call a dioptric tube [i.e., the telescope], by which we see things far off as if they were close up. We have uncovered a world in the world, indeed Jupiter, accompanied by four planets orbiting around it at certain intervals and periods of time."

The notion that mathematics guaranteed the highest degree of certainty humanly attainable was a long-standing epistemological debate . . . on which he takes a clear position.

He is taking Galileo's observation of the four moons of Jupiter as clear support for the Copernican system because they do not revolve around the earth. Hortensius goes on to say, "By this instrument, we perceive that Venus, brightest of the planets, fades away into horns like the moon, that Saturn has a triple globe, that Mercury with its obscure body receives, with the rest of the planets, all its light from the sun. Among the ancients there is no mention whatsoever of all these matters nor any trace of their investigation" [Hortensius 1634, 16].

In the context of Amsterdam's reputation as a leading centre of trade, Hortensius pays particular attention to the advantages of practical arithmetic, geography, and navigation. But before turning to these prosaic and material aspects, let's hear what he says about music as part of the quadrivium in the liberal arts. This short passage, between those on mechanics and optics, is a wonderful example of how he draws on the classics as well as on the Bible. "Music," he explains, "has various benefits, and a charm not to be despised. For (I small here pass over instruments of every kind that touch the minds of listeners with singular pleasure), it facilitates the tempering of men's emotions. It excites noble minds to great actions; it softens the ferocity of behaviour and makes it smooth. Wherefore among the poets Orpheus managed to calm wild animals, lions, tigers, by the sound of his lyre; and Amphion the founder of Thebes even managed to move stones." However, music is not only one of the supreme pleasures of life but also has practical applications: it "also has great power to cure disease, which, although this is almost unknown today, was not unexplored by the ancients. For they, if we are to believe Martianus Capella, cured fevers and wounds by incantation. Asclepiades healed with the trumpet. Theophrastus used the flute with mentally disturbed patients. Thales of Crete dispelled diseases by playing on musical instruments. There is an example of this in the Bible, where David soothed the maddened Saul by singing to the lyre" [Hortensius 1634, 15]. In this perspective, music is a microcosm combining the dignity and utility of the mathematical sciences.

Leaving these rather fabulous flights,

[3]The juxtaposition of the book of Revelation and the book of nature was standard in the 17th century, and their relation stood at the core of many debates, including the Galileo affair.

Figure 3. Frontispiece of Andrea Argoli's *Primi mobilis tabulae* (Padua 1667). The image of arithmetic and geometry as being wings to astronomy was widespread in the 16th and 17th centuries.

Hortensius returns to the concrete when he discusses the advantages of practical arithmetic, which are so great

"that they can hardly be described in words. Human society stands on this, and the life of men is eased by mutual exchange of goods. Without this, no state is governed, no family ordered, no war waged, nor the fruits of peace gathered. This trains men and makes them attentive to affairs, and not easily liable to be defrauded by another. I ask my listeners, gaze upon your city and you will have a living example of the value of practical arithmetic. The greater part of the citizens engages in trade with Italy, France, England, Germany, Africa, and India, with the greatest variety of weights, coinage, and measures. If anyone should ask them by what art their laden goods return safely, they will answer that it is computation, by which in exchanges and comparisons of merchandise, they overcome every problem and obscurity, and, having kept a calculation of what is received and spent, they keep their wealth in its original state, or enlarge it. If anyone should enquire about the profit of the art, they will confess that so many conveniences are comprehended in it, that they could do without it only with clear loss of their possessions and harm to their families" [Hortensius 1634, 13].

Geography, of course, is also indispensable for a trading people because it "comprehends and expresses the whole world on a small table. . . . Lack of experience of places has destroyed military power and led the most prudent (in other respects) and brave leaders into ruin. The same thing has repeatedly overturned the fortunes of merchants, as, on the other hand, exploring securely the site and attribute of regions and places and knowing the condition of the merchandise there has brought them great riches" [Hortensius 1634, 15]. Hortensius reaches the apogee of his argument for the utility of the mathematical sciences in his praise of navigation. It is navigation, he reminds his audience, "that teaches and enables us to travel by ship to regions separated by the whole sea and to frequent foreign peoples widely dispersed in all directions. Trusting to this art, mortals, among sea monsters and savage storms, among rough straits and a thousand dangers of death, commit huge treasuries of gold and silver to the unstable ocean, and convey home in a light piece of wood the wealth of India and exotic merchandise of Africa. Not only individual affairs depend on navigation, but also both the continuation and the fall of the fates of kings and states."

". . . after the knowledge of the mathematical sciences increased here, . . . we filled all the seas with our voyages. . . ."

He outlines the importance of navigation for the rise to power of Venice and Genoa, and the Spanish and Portuguese empires. However, these were now superseded by the Dutch, whose success is also rooted in navigational skills: "we Dutch, having struck off the Spanish yoke, when we began to approach the remotest shores of the world, were inferior in eagerness and success to none of the others. At one time we hardly ever entered the Atlantic Ocean, but sustained life on moderate voyages; [. . .] But after the knowledge of the mathematical sciences increased here, and the navigational art began to be practiced more intensively, we filled all the seas with our voyages; we came to the richest lands of the East and West Indies, saw them and snatched them away from the foreigners; we circumnavigated the globe; we discovered lands; we found new straits; [. . .] So we have contracted the market of all merchandise within the angle of the world, Holland, and we have stabilized it." His conclusion comes in an almost mathematical guise: "What God did so that Holland might daily expand so much, so much advantage have the mathematical sciences contributed to navigation, navigation to trade, and trade to the solid and firm prosperity of our country." On this basis, that the mathematical sciences are essentially equal to prosperity, he appeals to the authorities of Amsterdam to promote further the study of the mathematical sciences: "You rule a city which is very famous and powerful in the whole world. Its expansion came from the study of the mathematical sciences, especially astronomy and navigation. Use the city's energy so that the mathematical sciences never lose their strength" [Hortensius 1634, 17f].

In his concluding remarks, Hortensius addresses his arguments for the utility and dignity of the mathematical sciences specifically to the merchants: "You [. . .] will have a pleasant time employing these studies, by whose benefit your wares, entrusted to the vast sea, go out and return safely. Do not object that your lives are full of cares and anxiety, and cannot admit mathematical contemplation; you will often find a small space of time in which you may dilute the worrisome troubles of business with the pleasure of the mathematical sciences. Thales, one of the Seven Wise Men of Greece, had time for both mathematical studies and trade. For, having foreseen the richness of the olive crop, he hired every press and mill in Miletus; and afterwards when he leased them out at huge prices, he showed his friends not only that a wise man could be rich if he chose, but also that philosophical and mathematical studies are not at all foreign to trade" [Hortensius 1634, 19].

Hortensius's *Speech on the dignity and utility of the mathematical sciences* is filled with such classical allusions and quotations, proclaiming not only the dignity and practical utility of the mathematical sciences but also their antiquity. It made a convincing case in the prosperous city of Amsterdam in the Dutch Golden Age.

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Volker R. Remmert was trained as a mathematician and as a historian. Apart from the history of early modern European science and culture, his main research interests are in the history of mathematics and science in the first half of the twentieth century, especially the Nazi period. Together with Annette Imhausen (Cambridge/UK), he is currently preparing an English translation and commentary of Hortensius's speech. Here he is seen with his son Floris at the Frankfurt Book Fair.