Chapter 9
Duytsche Mathematique and the Building of a New Society: Pursuits of Mathematics in the Seventeenth-Century Dutch Republic

Fokko Jan Dijksterhuis

Abstract In the seventeenth-century Dutch Republic mathematicians and mathematics acquired notable social and intellectual prestige. They contributed to the establishment of a new state, first through practical projects of fortification, navigation, land management, and later also through learned pursuits in academia and cultural circles. It can be said that the Republic provided particularly fertile grounds for academic pursuits, through its make-up of distributed wealth and power and its economic characteristics. The various towns and provinces provided various settings and opportunities to aspiring mathematicians. This chapter compares two notable sites, the provinces of Holland and Friesland, whose parallels and particularities put into perspective the interactions between mathematics and society in the Golden Age of the Dutch Republic.

9.1 Introduction

In its Golden Age, the Dutch Republic had a favourable climate for the pursuit of mathematics. Practitioners found employment with towns and provinces in the development of the new society, savants cultivated the metamorphosizing mathematical *scienze*, the cultural and political elite appropriated the new *esprit géométrique*. People engaged in mathematics were a motley company, ranging from arithmetic teachers like Willem Bartjens, to surveyors like Jacob van Wassenaer, from professors like Adriaan Metius, to 'amateurs' like Christiaan Huygens, statesmen like Johan de Witt, and so on. Mathematics in the early Dutch Republic was a multifaced enterprise that yielded a large variety of intellectual and material production. The pursuit of mathematics flourished on a marked interest of the social elite in things mathematical, because of its utilitarian as well as its cultural value.

F.J. Dijksterhuis (✉)
University of Twente, Enschede, The Netherlands
e-mail: f.j.dijksterhuis@utwente.nl

L.B. Cormack et al. (eds.), *Mathematical Practitioners and the Transformation of Natural Knowledge in Early Modern Europe*, Studies in History and Philosophy of Science 45, DOI 10.1007/978-3-319-49430-2_9

I will sketch how mathematicians and mathematics acquired social and intellectual prestige in the Dutch Republic in the seventeenth century. Two phases can be discerned: societally oriented, practical mathematics in the early seventeenth century, expanded towards scholarly inclined pursuits towards the middle of the century. At the start of the century mathematicians placed themselves in the service of the Stadholders and successfully acquired a central role in state building. Textual pursuits played a noticeably prominent part in this. The term 'Duytsche Mathematique' comes from the program of the engineering school established in Leiden in 1600 and denotes the teaching of mathematics theory in the vernacular. In the middle of the century some mathematicians distanced themselves from the practical context of surveying and fortification and seized opportunities to tie in with the elite's cultural interest in things mathematical. Through this route, mathematics became a contributing factor to the budding new philosophies of the seventeenth century. This development was historically tied to the Leiden 'Duytsche Mathematique', which therefore forms a natural focus for a discussion of the role of practical mathematics in the transformations of natural knowledge in the seventeenth-century Dutch Republic.

However, the 'Duytsche Mathematique' cannot be the sole focus, for it was a Holland affair. The Republic consisted of different provinces and there mathematics was pursued as well. The Republic was not a social and political unity.[1] Besides being an association of seven provinces (and several subordinate territories) and having its political power divided among several institutions, no less than two Stadholders led the revolting provinces. During the second half of the sixteenth century the provinces of the Low Countries had revolted against the Spanish rule to secure local priviliges and religious freedom.[2] The first stage of the revolt was led by William of Orange (1533–1584) from the Nassau house in the German empire, until he was assassinated by an anti-protestant militant. In 1584, Willem Lodewijk of Nassau (1560–1620) had become the first Frisian Stadholder. His nephew Count Maurits of Orange (1567–1625) became Stadholder in the Hague the next year.[3] Willem Lodewijk and Maurits had grown up together in Nassau and side by side they pursued the tasks of govermentally and militarily establishing and securing the new state. They were important innovators of warfare in which their particular interests largely complemented each other. The two Stadholderly courts of The Hague and Leeuwarden, and the respective universities in Leiden and Franeker, were two distinct social, political and cultural centers. The pursuit of mathematics in both centers displayed basic similarities as to the goals and values, but differed in

[1] J. Israel, *The Dutch Republic. Its Rise, Greatness, and Fall 1477–1806* (Oxford: Oxford University Press, 1998), 276–306.

[2] O. Mörke, *Wilhelm von Oranien (1533–1584). Fürst und "Vater" der Republik* (Stuttgart: Kohlhammer, 2007).

[3] Friesland and Groningen (and Drenthe) chose Willem Lodewijk; Holland, Utrecht, Gelderland, Overijssel and Zeeland Maurits.

its institutional and conceptual realization.[4] I present a twin-image of Holland and Friesland in order to show in a historically rich way how mathematics developed within Dutch culture.

9.2 Establishing Mathematics for a New Society

Willem Lodewijk tried to build up a 'modern' society in Friesland. In his state building, he stimulated the development of an intellectual life with two nuclei: Calvinist theology and practical mathematics.[5] The first was connected with the establishment of a Reformed society that had liberated itself from the Spanish king. The second was important because of the efforts the continuing war with Spain required from the Stadholders. In the formation of a strong community of faith and a powerful army, Willem Lodewijk also sought intellectual reinforcement. He had a marked interest in the classics, having studied with Lipsius in Leiden and he extensively read Roman military texts.[6] On this basis he introduced the volley technique, which in its turn fundamentally changed battle tactics.[7] Willem Lodewijk's penchant for scholarship was also seen at the Stadholderly court. He gathered scholars and ideas round him and organized 'Erasmian' tables: serious conversations over an abstemious meal where the emphasis was on concrete matters rather than lofty ornamentations.[8]

Willem Lodewijk not only saw to it that mathematics intellectually and practically furnished his new society, but also that it fashioned his own claims of sovereignty over this new society. The rector of the Groningen University, Ubbo Emmius (1547–1625) acted as Willem Lodewijk's chorographer. He wrote extensive geographies and histories of Friesland in which he established the geographical and historical identities of the Frisians and their Stadtholder emphasizing their ancient roots.[9]

In the 1580s Willem Lodewijk developed the school in Franeker into an official university that was formally established in 1585. The intellectual themes underlying his societal conception stood central: Calvinist theology and practical mathematics.

[4] See also, K. van Berkel, "Het onderwijs in de wiskunde in Franeker in vergelijkend perspectief," *It Beaken* 47 (1985):220–222.

[5] W. Bergsma, "Willem Lodewijk en het Leeuwarder hofleven," *It Beaken* 60 (1998):199–201 and 215–222. Israel, *Dutch Republic*, 569–572.

[6] Israel, *Dutch Republic*, 267–171. Ch. van den Heuvel, "Wisconstighe Ghedachtenissen. Maurits over de kunsten en wetenschappen in het werk van Stevin," in *Maurits, Prins van Oranje*, ed. K. Zandvliet (Zwolle: Waanders, 2000),113–116.

[7] G. Parker, *The Military Revolution. Military Innovation and the Rise of the West, 1500–1800* (Cambridge: Cambridge University Press, 1988), 18–20. The volley technique is the coordinated firing by a group of soldiers: the first row fires, steps to the back to reload, and lets the second fire. With some five rows a continuous firing is possible. The technique requires highly trained soldiers.

[8] Bergsma, "Willem Lodewijk en het Leeuwarder hofleven," 215–227.

[9] U. Emmius, *Guilhelmus Ludovicus Comes Nassovius* (Groningen: Johannes Sassius, 1621).

Adriaan Metius (1571–1635) was instrumental in giving shape to the latter pillar.[10] In 1598 Willem Lodewijk recruited Metius for the chair of mathematics in Franeker. He was the second son of Adriaan Anthonsz, the chief fortificationist of Maurits' and Willem Lodewijk's armies. He had studied in Franeker in 1589, switching to Leiden in 1594 to pursue his interest in mathematics. He studied with Rudolph Snellius (1546–1613), the father of Willebrord. Metius stayed with Tycho at the Hveen observatory for some time to be initiated in instrumental astronomy. Thereafter he gave private courses at the German universities Rostock, Marburg and Jena, before returning to the Republic where he assisted his father briefly.[11] In 1598, Willem Lodewijk advised him to register again in Franeker, holding out to him the prospect of a professorate in mathematics. The same year Metius was appointed extraordinary professor of mathematics, becoming full professor in 1600. On this occasion Metius received permission to lecture in both Latin and Dutch and to promote any candidate in mathematics. The permission to teach in the vernacular opened the possibility of educating engineers and surveyors, an activity that clearly met Willem Lodewijks aspirations. Metius' students of practical mathematics were not automatically licensed as practicing surveyors, though, they first had to be admitted by the 'Hof van Friesland'. After Metius' death in 1635, a surveyor school was institutionalized at Franeker University in 1641.[12]

In addition to his teaching activities Metius shaped his professorate, as well as his patronage relationship with Willem Lodewijk, in a range of textbooks. In these he explained established knowledge of practical mathematics and introduced recent theoretical and practical developments to his Frisian public. *Arithemeticae & Geometriae Practica* (1611/1625/1626) contained an exposition of surveying, in which Metius discussed the construction and operation of the measuring chain and the astrolabe and introduced the method of triangulation. Metius provided a basic network for the Frisian cities, apparently following the example of Willebrord Snellius' triangulation project in Holland.[13] He further treated Galileo's proportional compass and the 'Old-Dutch Fortification System'. Metius' textbooks provided – in variable degrees of abstraction – a scholarly rendering of practical affairs of

[10]One Johannes Roggius had preceded him, but he had only stayed for a short time and left after internal controversies at the university. The historical overview in this paragraph draws primarily on Berkel, "Onderwijs," 215–216.

[11]Arjen Dijkstra, *Between Academics and Idiots: A Cultural History of Mathematics in the Dutch Province of Friesland (1600–1700)*, Ph.D. thesis, Universiteit Twente, 2012. See also H. Terpstra, *Friesche Sterrekonst. Geschiedenis van de Friese sterrenkunde en aanverwante wetenschappen door de eeuwen heen* (Franeker: Wever, 1981) 55–59.

[12]P.J. van Winter, *Hoger beroepsonderwijs avant-la-lettre. Bemoeiingen met de vorming avn landmeters en ingenieurs bij de Nederlandse universiteiten van de 17^e^ en 18^e^ eeuw* (Verhandelingen der Koninklijke Nederlandse Akademie van Wetenschappen, Afd. Letterkunde, Nieuwe Reeks, deel 137) (Amsterdam: Noord-Hollandsche Uitg. Mij., 1988), 46–54.

[13]H.A.M. Snelders, "Alkmaarse natuurwetenschappers uit de 16de en 17de eeuw," in *Van Spaanse beleg tot Bataafse tijd. Alkmaars stedelijk leven in de 17de en 18de eeuw* (Alkmaarse historische reeks, 4) (Zutphen, 1980) 101–122.

navigation, surveying and the like. The publications in Latin tend to be more theoretical, whereas the publications in Dutch are more practically-oriented. For example, in *Manuale arithmeticae & geometricae practicae* (1633), a translation and adaptation in Dutch of the *Practica*, the theory of arithmetic and geometry is stripped down to its bare essentials, giving full emphasis to guidelines of reckoning, surveying and fortress-building. The *Manuale* also added an exposition of Napier's rods. In this way Metius introduced recent developments in practical mathematics in Friesland.

It will come to no surprise that Metius was quick to introduce the telescope to Friesland. He first discussed the instrument in his *Institutiones astronomicae & geographicae* (1614), a Dutch edition of *Institutiones astronomicarum* (1608). Metius' journalistic swiftness does not come as a surprise if we bear in mind that his brother Jacob was a builder of telescopes and some held him to be the inventor of this instrument.[14] In the *Institutiones*, Adriaan described telescopic observations made by his brother: sunspots, Jupiter's satellites and the stars of the Milky Way, and so on. He emphasized the novelty of these observations "which have been known to no authors, as being seen only by the distant views (telescopes) that have been found by my brother Jacob Adriaanz. about 6 years ago."[15] Jacob appears to have been a very secretive person who showed his instruments, in particular the later improved ones, to hardly anyone. The contrast with the natural communicator Adriaan can hardly have been more marked.[16]

Willem Lodewijk brought Metius to Friesland to cultivate mathematics for the benefit of the conduct of war and civic administration, an assignment Metius carried out dutifully by elaborating a body of practically-oriented knowledge that kept pace with recent developments of practical mathematics. In his teachings he introduced state-of-the-art practical mathematics to the new society. In the 1626 *Arithmetica* he explained that lands that did not have the natural resources to develop a good life, could nevertheless realize this by developing the arts of navigation and the like.[17] He acquired Tychonian instruments that established Franeker as a site of astronomical observation.[18] Metius did not just serve his patron, he also pursued his own career.

---

[14] A. van Helden, *The Invention of the Telescope* (Transactions of the American Philosophical Society held at Philadelphia for promoting Useful Knowledge. Volume 67, part 4) (Philadelphia, 1977), 5–6.

[15] A. Metius, *Institutiones Astronomicae et Geographicae* (Franeker, 1614), 3: "dewelcke by ghene Autoren zijn bekent gheweest, dan werden alleene ghesien door de verre ghesichten, die by mijn Broeder Jacob Adriaenz. over omtrent 6 jaren ghevonden zijn geweest."

[16] Recently, Huib Zuidervaart has mapped the life and work of Jacob Metius in much detail, using new sources and qualifying older claims considerably. H. Zuidervaart, "The 'Invisible Technician' Made Visible: Telescope making in the Seventeenth and early Eighteenth-century Dutch Republic," in *From Earth-bound to Satelite. Telescopes, Skills and Networks*, ed. G. Strano, et al. (Leiden: Brill, 2011): 41–102.

[17] A. Metius, *Arithmeticae libri duo et Geometriae* (Leiden, 1626), 124.

[18] A. Dijkstra, "A Wonderful Little Book. The Dissertatio Astronomica by Johannes Phocylides Holwarda (1618–1651)," in *Centres and Cycles of Accumulation in and around the Netherlands in the Early Modern Period*, ed. L. Roberts (Berlin: Lit, 2011): 73–100.

His textbooks informed the new Frisian state as well as they fashioned his academic ambitions. Metius became a well-known mathematician and a respected educator, attracting students from all over Europe. When Descartes came to the Low Countries in 1629, he first settled in Franeker and kept company with Metius.[19]

As a mathematician Metius attracted the attention of statesmen and acquired a key role in the building of the new state. This explicitly included theoretical aspects of mathematics aimed at reinforcing mathematical practice, in the same way academic theology would reinforce Calvinist preaching. The opportunity to do so was created by the changes in warfare brought about by the specific nature of the Dutch fight for independence. The defense system was characterized by a tight network of fortifications and fixed garrisons that called for pervasive engineering and a high degree of discipline.[20] The textual bias of army organization can be seen in the use of illustrated instructions to implement standardized drilling throughout the ranks.[21]

9.3 Establishing Duytsche Mathematique

The Holland counterpart of Metius was Simon Stevin (1648–1620), who established a prominent role for mathematics through his relationship with Count Maurits. The pairs Stevin–Maurits and Metius–Willem Lodewijk had similar ambitions regarding the use of mathematics in statebuilding. However, their relationships differed and the realization of mathematics initiatives in Holland and Friesland differed accordingly. In the first place, Stevin was not at a university, and the teaching of practical mathematics would be organized within a separate institution. Secondly, Stevin was more directly involved in military affairs and fortification in particular. Lastly, his relationship with Maurits was more personal and they collaborated directly on mathematical topics.[22] The contact between Stevin and Maurits probably went back to the early 1580s when they both studied in Leiden. Maurits was directly interested in mathematics and even made some original contributions.[23] Willem Lodewijk's main interest was classical military reading and he left mathematics to Metius. Furthermore, Willem Lodewijk always sought practical applications of his readings, whereas Maurits had a prediliction for theoretical experiments and

[19] W.R. Shea, *The Magic of Numbers and Motion. The Scientific Career of René Descartes* (Canton, Mass.: Science History Publications USA, 1991), 191.

[20] F. Westra, *Nederlandse ingenieurs en de fortificatiewerken in het eerste tijdperk van de Tachtigjarige Oorlog, 1573–1604* (Canaletto: Alphen aan de Rijn, 1992), chapters 7, 9 and 11 in particular.

[21] Parker, *Military Revolution*, 18–23.

[22] Heuvel, "Wisconstighe Ghedachtenissen," 107–108.

[23] *Ibid.*, 108–110.

f.j.dijksterhuis@utwente.nl

elaboration.[24] In 1593 Stevin formally entered Maurits' service as an engineer as well as personal teacher. Their intellectual exchange was embodied in Stevin's *Wisconstighe Ghedachtenissen* (*Mathematical Thoughts*, 1605–1608).

From the perspective of mathematics, the collaboration between Stevin and Maurits was crowned by the establishment in 1600 of an engineering school in Leiden.

> As it has pleased His Excellency, Count Maurits of Nassau, Stadholder of Holland, and Captain General, that, for the benefit of the state, here in the university should be taught in good Dutch language the art of counting and surveying, principally for the advancement of those who should want to become engineer...[25]

Although it was connected to the university, the engineering school was a separate institution. The chair of practical mathematics was new and existed independently of the university chair of mathematics, held by Rudolph Snellius at that time. In contrast, in Franeker instruction in practical mathematics was given at the university, by the professor of mathematics, Metius. Stevin drew up the curriculum for the instruction in practical mathematics, but he would not carry it out. Ludolf van Ceulen and Simon van der Merwen became the first professors.[26] The reasons for establishing a separate institution rather than assigning the teaching of mathematics in the vernacular to the professor are complex and are yet to be investigated in detail. On the one hand, Maurits may have had a kind of *Ritterschule* in mind as they existed at many German courts. On the other hand, the climate at the university had recently turned rather against practical pursuits after the strong humanist direction advocated by Joseph Scaliger (1540–1609) had become dominant.[27]

Maurits and Stevin called the engineering training the 'Duytsche Mathematique'. Stevin wrote the program that accompanied Maurits's request to the university curators. It was to teach surveyors and fortificationers a body of mathematics theory in Dutch concentrating on practically relevant topics. It deserves notice that it was not self-evident that fortificationists would be taught mathematics theory, rather than be trained in the field.[28] The establishment of the 'Duytsche Mathematique' bears

[24] *Ibid.*, 117–119.

[25] P. Molhuysen, *Bronnen tot de geschiedenis der Leidsche Universiteit*. Vol. 1 (Rijksgeschiedkundige Publicatiën 20) (Den Haag, 1913) 122. "Alsoo Sijne Excellentie, Grave Maurits van Nassau, Stadthouder van Hollant, ende Capiteyn Generael, tot dienst van den lande goetgevonden hadde, dat in de Universiteit alhyer soude worden gedoceert in goeder duytscer tale die telconste ende lantmeten principalycken tot bevordering van de geenen die hen souden willen begeven tottet ingenieurscap ...."

[26] Winter, *Hoger beroepsonderwijs*, 14–16.

[27] H. Hotson, *Commonplace Learning. Ramism and its German Ramifications, 1543–1630* (Oxford: Oxford University Press, 2007).

[28] J.A. Bennett, "The Challenge of Practical Mathematics," in *Science, Culture and Popular Belief in Renaissance Europe*, ed. Stephen Pumfrey et al. (Manchester: University of Manchester Press, 1991),180–182. E. Taverne, *In 't land van belofte: in de nieue stadt. Ideaal en werkelijkheid van de stadsuitleg in de Republiek. 1580–1680* (Maarssen: Schwartz, 1978), 49–81.

the mark of Stevin's particular conception of the pursuit of mathematics, aimed at integrating '*Spiegheling*' (contemplation) and '*Daet*' (action).[29] This combination of theory and practice was the heart of Stevin's program of the 'Duytsche Mathematique'. Stevin's curriculum prescribed in detail what mathematics the instructors should teach.

> To this end one will teach arithmetic or counting and surveying but only so much of each as is required for practical, common engineering.[30]

For example, regarding the determination of areas Stevin stipulated:

> The measuring of circles with segments of that sort, further the area of spheres. The shapes named ellipsis, parabola, hyperbola and the like, that is not necessary here, because engineers are very seldom made to perform such measurements; but only they shall learn with straight planes, after that curvilinear in surveyor's manner, measuring thus a plane by various division, like in triangles or other planes to see how this matches with that.[31]

Despite the different ways in which the pursuit of mathematics was organized in Holland and Friesland, the 'Duytsche Mathematique' reflected conceptions of useful knowledge similar to those of Willem Lodewijk and Metius. The new Republic, in the middle of liberating itself from Spanish rule, did not just need skillful hands, but hands that were also informed by learning. Action with contemplation, as Stevin said.

The alliance between Holland and Friesland was illustrated by two books on surveying published in the same year the 'Duytsche Mathematique' was established. *Practijck des Lantmetens* (*Practice of Surveying*, 1600) and *Van het gebruyck der geometrische instrumenten* (On the Use of Geometrical Instruments, 1600) were published by the Jan Pieterszoon Dou from Holland and Johan Sems from Friesland together. They expounded similar conceptions about theory and practice in surveying as Stevin and Maurits held. Their books sold well and were standard repertoire for surveyors, but did not realize their aim at establishing an official training for surveyors. The 'Duytsche Mathematique' was a training for military engineers and would not provide formal qualifications for surveying.

The 'Duytsche Mathematique' nicely illustrates the close tie between mathematics, discipline and defense. The first professor was Ludolf van Ceulen (1540–1610). The lessons would be given in the Faliebegijnkerk, where the university library and

[29] K. van Berkel, "The Legacy of Stevin. A Chronological Narrative" in *A History of Science in the Netherlands. Survey, Themes and Reference*. ed. Klaas van Berkel, Albert van Helden, Lodewijk Palm (Leiden: Brill, 1999), 16–20.

[30] Molhuysen, *Bronnen*, 389*: "Hyer toe sal men leeren die arithmeticque oft het tellen ende het landtmeten maer alleenlyck van elck soe veel, als tottet dadelyck gemeene ingenieurscap nodich is."

[31] Molhuysen, *Bronnen*, 390*: "Het meten des rondts mette gedeelten van dien aengaende, voerts het vlack des cloots, de formen genaemt ellipsis, parabola, hyperbole ende diergelijcke, dat en is hyer nyet nodich, wantet den ingenieurs seer selden te voeren compt, sulcke metinge te moeten doen; maer alleenlyck sullense leeren met rechtlinige platten, daer na cromlinige landtmetersche wijse, metende alsoe een plat deur versceyde verdeelinge, als in dryehoucken of ander platten om te syen hoe t'een besluyt met het ander overcompt."

f.j.dijksterhuis@utwente.nl

anatomical theater were already located. In the room under the library Van Ceulen had been giving fencing lessons since 1594. Van Ceulen was succeeded in 1615 by Frans Van Schooten Sr., who established a tradition in 'Duytsche Mathematique' that would sustain well into the century. The backbone of the program was the so-called Old-Dutch Fortification System, as it had developed under Maurits and had been codified by Stevin in *Sterctenbouwing* (*Stronghold construction*, 1594). In the winter van Schooten taught the theory of fortification, in the summer he attended field practice with the army.[32] Van Schooten Sr. started somewhat of a dynasty at the engineering school, being succeeded in 1645 by his son Frans Jr. who in his turn was succeeded by his half-brother Petrus in 1660, continuing the tradition of 'Duytsche Mathematique' until the 1670s.

9.4 Cultivating Mathematics for a New Philosophy

Although dutifully serving as professor of Duytsche Mathematique, Frans van Schooten Jr. (1615–1660) looked for new routes to realize the cultural capital of mathematics. Dutch society was changing by that time. The Revolt had been successful and although the war continued until 1648, the immediate threat had diminished. The focus of building work shifted from siege and fortification to land reclamation and city extension, altering the demand for mathematical skills. A civic society developed in which a patrician elite increasingly established a firm position and began acting like a new aristocracy. Van Schooten used his, and his family's, position as a stepping stone to move upward socially and culturally in this new society. He gave the Duytsche Mathematique a new twist, distancing it from the practical mathematics of his father and seeking alliance with the interests of the elite. Van Schooten studied at Leiden University, with Jacobus Golius (1596–1667), professor of Arabic and successor of Snellius at the chair of mathematics.[33] He started replacing his father at the Engineering School in 1635 until he succeeded him in 1645.[34] In the intervening years he had established relations within the Dutch elite and with prominent French mathematicians. He acquainted himself with the new mathematics of Descartes, Viète and Fermat. Or rather geometry, as the word mathematics was used in the seventeenth century for the less lofty practices of measuring and calculating.[35]

---

[32]Taverne, *In 't land van belofte*, 64–66.

[33]F. Dijksterhuis, "Moving Around the Ellipse. Conic Sections in Leiden (1620–1660)," in *Silent Messengers. The Circulation of Material Objects of Knowledge in the Early Modern Low Countries*, ed. Sven Dupré and Christoph Lüthy (Berlin: Lit, 2011): 89–124.

[34]J. Hofmann, *Frans van Schooten der Jüngere* (Wiesbaden: Steiner, 1962), 1–2.

[35]Compare Olmsted, John W., "Jean Picard's 'Membership; in the Académie Royale des Sciences, 1666–1667: the Problem and its Implications," in *Jean Picard et les Débuts de l'Astronomie de Précision au XVII^e^ Siècle*, ed. Guy Picolet (Paris: Édition du Centre National de la Recherche Scientifique, 1987), 85–116.

With Golius Van Schooten first met Descartes, who had come to Leiden in 1630. He quickly became one of Descartes' favorites and assisted him on several projects. He made the illustrations for the essays of *Discours de la Methode* and drew a template of a hyperbola for the grinding of a non-spherical lens. This latter project was organized by Constantijn Huygens, who was introduced by Golius to Descartes in 1635.[36] To Van Schooten the participation of Huygens meant a direct access to the Holland elite. Huygens was a prominent figure in the highest political and cultural ranks; he was secretary to the Stadholder, a renowned poet and composer, and the principal cultural intermediary in the middle of the seventeenth century.

The association with Golius created opportunities for Van Schooten to go beyond the milieu of the Duytsche Mathematique. Around 1639 he wrote an introduction to Descartes' geometry, a basic exposition of the new method of letter calculation.[37] Sending it to Mersenne, Van Schooten used it as his introduction to the Republic of Letters. He later published it as *Principia Matheseos Universalis* (1651). Around the same time he struck a deal with the Leiden publisher Elzevier to collect writings of the new French mathematicians. He traveled to France in 1641, where he copied several manuscripts of Fermat and Viète. It resulted in the publication of *Francisci Vietae Opera mathematica* with Elzevier in 1646.[38] The same year Van Schooten had published his first original work, *De organica conicarum sectioneum in plano descriptione*. It was an exposition of the kinematic generation of conic sections that combined artisanal and academic facets of mathematics. On the one hand it treated the practical drawing of ellipses, hyperbolas and parabolas, proposing new instruments useful for gardeners, architects and the like. On the other hand it elaborated the mathematical foundations and consequences of the procedures proposed, much in the way Mydorge and Descartes did, by embedding it in the classical theory of Apollonius. Thus *Organica* constituted a crossroads between the 'Duytsche Mathematique' of his father, the classical *geometria* of Golius, and the new *géométrie* of Descartes and Viète.[39]

Van Schooten was part of an extended circle of mathematicians courting the Dutch elite. All kinds of mathematicians competed over positions as teachers, advisors, examiners. To succeed his father in 1645, Van Schooten had to compete with Jan Stampioen (1610–?1689), the mathematics tutor of Constantijn Huygens's sons. When Van Schooten got the position, Stampioen sought revenge by securing a position as provincial examiner of surveyors who would judge the competences of

[36]W. Ploeg, *Constantijn Huygens en de Natuurwetensc* happen (Rotterdam: Nijgh & Van Ditmar, 1934), 36–38. F. Dijksterhuis, "Constructive Thinking. A Case for Dioptrics", in *The Mindful Hand. Inquiry and invention from the late Renaissance to early industrialisation*, ed. L. Roberts et al. (Amsterdam, 2007), 59–82.

[37]F. van Schooten, "Calcul de Mons. Des Cartes," in: Descartes, René, *Oeuvres de Descartes*, ed. Charles Adam and Paul Tannery, 2nd edn., 11 vols. (Paris: 1974–1986), vol 10, 659–680.

[38]Hofmann, *Frans van Schooten der Jüngere*, 2–3.

[39]Dijksterhuis, "Moving Around the Ellipse," 106–107.

f.j.dijksterhuis@utwente.nl

Van Schooten's students.[40] However, Van Schooten's mathematical pursuits went well beyond the original 'Duytsche Mathematique', leading abroad to the new geometry in France, using Latin rather than Dutch. He gathered the writings (and acquaintance) of prominent mathematicians and rendered them into a didactically appropriate form. The acme of Van Schooten's oeuvre would become his adaptation and translation into Latin of Descartes' *La Géométrie*.

The ambivalence between Van Schooten's official position as professor of 'Duytsche Mathematique' and his geometrical work was noticed by contemporaries as well:

> And in this church, where the English preach nowadays, in this beguinage, all days (except Wednesday and Saturday) from 11 to 12 o'clock, public lessons are given in the Dutch language, on the mathematical arts, for the convenience of the unlettered, like bricklayers, carpenters, and the like; who at that time find themselves here in crowds without coats but equipped with their sticks, aprons, etcetera; which then is very farcical to see. The professor, who gives Dutch lessons, nonetheless in his usual distinguished professor gown, or coat, (like al the other Latin professors do theirs,) is the very learned, and widely renowned sir Franciscus van Schooten.[41]

With his work in the new geometry Van Schooten developed extra cultural capital that extended beyond elementary mathematics, appealing to the intellectual interests of the patrician elite. In the 1650s, The professor of 'Duytsche Mathematique' began attracting a new kind of students: patrician sons aiming at an academic education rather than professional training. Van Schooten had acquired enough status to have the young Huygenses, the young De Witt, the young Hudde, the young Heuraet come and study with him. Why did they not go to the real professor, instead of this teacher of the masses?

The patriciate's ties with the Duytsche Mathematique are historically rooted in the early phase of the Dutch Republic. Yet, it increasingly distanced itself from the common businesses of navigation, surveying and fortification, turning themselves in 'nouveau' aristocrats with matching intellectual interests towards

---

[40] F. Dijksterhuis, "Stampioen Jr., Jan Janszoon (1610–after1689)," in *The Dictionary of Seventeenth and Eighteenth-Century Dutch Philosophers*. 2. vols., ed. W. van Bunge et al. (Bristol, 2003), 938–940. F. Dijksterhuis, "Fit to Measure. 'Bequamheit' in Mathematics in the Dutch Republic," in *Public Offices, Personal Demands. Capability in Governance in the Seventeenth-Century Dutch Republic*, ed. J. Hartman and J. Nieuwstraten eds. (Newcastle: Cambridge Scholars Publishing, 2009), 80–100. Van Schooten had also decided against Stampioen in the latter's controversy with Descartes.

[41] J.N. Parival, *De Vermaecklijckheden van Hollandt* (Amsterdam, 1660), 188–189: "En in die Kercke, waer de *Engelsche* nu predicken, in dit *Bagijne-Hoff*, worden alle dagen, (behalven 's Woensdaeghs, en Saterdaeghs) van elf tot twaelf uuren, openbare Lessen gedaen in de Neerlandsche Tael, in de *Mathematische* Konsten, tot gerief van de ongeletterden, als *Metselaers*, *Timmer-luyden*, en diergelijcke meer ; die haer dan met hoopen in die tijdt hier vinden : sonder mantels, maer met hare stocken, en schoots-vellen, &c. versien ; dat dan seer kluchtigh om sien is. Den *Professor*, die duytsche lessen voor haer doet, evenwel in sijnen gewoonlijcken aensienlijcken *Professor*-Tabbaert, ofte Rock, (soo wel als alle de andere *Latijnsche Professoren* de hare doen,) is den Hoogh-geleerden, en Wijdt-vermaerden D: Franciscus van Schooten."

the middle of the century.[42] For the new generations of patricians, mathematics became a cultural capital that went beyond its practical value. In the pursuits of De Witt, Hudde and Huygens we can see a particular mathematical ideology. They regarded mathematics as a model of rationality and a source of lucid thinking crucial to general education.[43] This conception of mathematics had its roots in the Renaissance.[44] Constantijn Huygens, Christiaan's father, was heavily influenced by Renaissance ideas.[45] The Dutch patricians studying with the professor of Duytsche Mathematique, however, had moved beyond a Renaissance notion of rational rhetoric to one that can be seen as an early instance of Enlightenment thinking, whereby reason steered by mathematics was the foundation of knowledge and judgment. I have the impression that, in the midst of the political and religious frictions that characterized the Dutch Republic in the seventeenth century, mathematics offered an intellectual haven to its future dignitaries.[46] In the meantime, a civic version of the 'Duytsche Mathematique' did not come into being. Despite the vast demand for mathematical skills in the large infrastructural projects of land reclamation and city extensions, no formal institution to train civil engineers was established by the patrician administrators.

We may say that Van Schooten had kept pace with this development and that his mathematics perfectly fitted the new inclinations of the patriciate. It was rooted in the Duytsche Mathematique but had outgrown it to become a new geometry of a more aristocratic stature. The result was Van Schooten's extended second edition of *Geometria à Renato Des Cartes* (1659–1661), which contained numerous contributions of his patrician pupils.[47] The *Geometria* constituted a further step beyond the 'Duytsche Mathematique' in comparison to the *Organica* of 1646. It was purely speculative mathematics, not oriented to practical issues of curve drawing (not to mention fortification).[48] In addition it pointed towards the new *physico-*

[42] L. Kooijmans, "Patriciaat en aristocratisering in Holland tijdens de zeventiende en achttiende eeuw," in *De Bloem der Natie. Adel en patriciaat in de Noordelijke Nederlanden*, ed. J. Aalbers (Meppel: Bloom, 1987), 98–103.

[43] Berkel, "The Legacy of Stevin," 52–59. On the role of mathematics in the education of 'honnêtes hommes' see M. Jones, *The Good Life in the Scientific Revolution. Descartes, Pascal, Leibniz, and the Cultivation of Virtue* (Chicago: University of Chicago Press, 2006).

[44] P.L. Rose, *The Italian Renaissance of Mathematics. Studies on Humanists and Mathematicians from Petrarch to Galileo* (Genève: Droz, 1975).

[45] F.J. Dijksterhuis, "Vader en Zoon. Over Constantijn en Christiaan Huygens," *Bzzlletin* 28 (1999): 18–22.

[46] Later in the seventeenth-century the mathematical approach in philosophy was criticized because of the association with Spinozism. The Newton-inspired 'physico-theology' provided an answer for the enlightened enthusiasts. See R. Vermij, "The formation of the Newtonian philosophy: the case of the Amsterdam mathematical amateurs," *The British Journal for the History of Science* 36 (2003): 183–200.

[47] Berkel, "The Legacy of Stevin," 54; Dijksterhuis, "Moving Around the Ellipse".

[48] Until the eighteenth century two dimensions were distinguished in the stratification of mathematics: subject matter and goal. Regarding the subject matter pure mathematics was contrasted with mixed, signifying the abstractedness of mathematical entities. Regarding the goals of mathematics,

f.j.dijksterhuis@utwente.nl

mathematics of motions, light and the like that Descartes discussed in the other essays of *Discours de la Methode*.

The collaboration of Van Schooten and his patrician pupils for *Geometria* was the basis for the further development of 'aristocratic' mathematics during the second half of the seventeenth century. Whereas De Witt and Hudde focussed on their administrative duties and kept their mathematics private, Christiaan Huygens steered clear of the diplomatic career his father had in mind for him and devoted his life to the sciences. He transformed Van Schooten's teachings into a new *physico-mathematica* exemplified in his *Horologium Oscillatorium* of 1673. In the development of Huygens' optical studies between 1650 and 1680 the transition can be traced from the mathematics of lenses and telescopes to the mathematization of the mechanistic nature of light. Elsewhere I have argued that Huygens' wave theory historically was an extension of his dioptrics, transferring the concepts and techniques of the mathematical study of rays and instruments to the realm of unobservable waves.[49] Rather than developing Descartes' natural philosophical program of mechanizing nature, Huygens extended mixed mathematics into new domains developing a particular kind of mathematico-philosophizing. His work with Van Schooten on the *Geometria* had formed the starting point of Huygens' mathematics, the *Geometria* in its turn being the product of Van Schooten's development as mathematician and his successful establishment of relationships with the Dutch elite. In retrospect, we see how new ways of philosophizing were rooted socially and culturally in the 'Duytsche Mathematique'.

9.5 Back to Friesland

To conclude, I give a brief sketch of the developments that took place in the meantime in Friesland. Franeker university had been established to furnish the two pillars of Calvinist theology and practical mathematics with intellectual underpinnings. In 1652 the *Friesche Sterre-konst* (*Frisian Astronomy*) of the Franeker professor of logic Johannes Phylocides Holwarda (1618–1651) was published, which can be regarded as the synthesis of Willem Lodewijk's vision. Holwarda elaborated astronomy into a Calvinist metaphysical scheme.[50] As a student he had used Metius' instruments and discovered a new celestial phenomenon, nowadays known as the variable star Mira Cetis.[51] With Metius' successor at the chair of mathematics,

the practical mathematics was contrasted to the speculative. See H.M. Mulder, "Pure, Mixed and Applied Mathematics: The Changing Perception of Mathematics Through History," *Nieuw Archief voor Wiskunde* 1990, 4–8: 27–41.

[49] F.J. Dijksterhuis, *Lenses and Waves. Christiaan Huygens and the Mathematical Science of Optics in the Seventeenth Century* (Dordrecht: Springer, 2004), 225–235.

[50] Terpstra, *Friesche Sterrekonst*, 65–74.

[51] Dijkstra, "A Wonderful Little Book".

f.j.dijksterhuis@utwente.nl

Bernard Fullenius sr. (1602–1657), he performed the astronomical observations of the *Friesche Sterre-konst*. In Holland, as we have seen, mathematics had been joined with the new philosophy of the day. In Friesland a similar course was taken towards contemplative pursuits, but here mathematics was connected to theology. The successor of Fullenius, Abraham de Grau (1632–1683) tried to combine the spectrum of philosophy into the currently developing 'historica philosophia' and set great store on mathematics.

The link with Huygens's *physico-mathematics* was established by Bernard Fullenius, jr. (1640–1707), who took his father's chair in 1684. Fullenius jr. was a Franeker patrician, comparable to Hudde and De Witt. However, in a move unthinkable for his Holland counterparts, he gave up his position as urban magistrate and became professor at the university. As professor of mathematics he established a network of savant exchange extending throughout the Republic. The nexus was formed by the secretary of the Frisian Stadholder, Philip Ernst Vegilin van Claerbergen, who introduced Fullenius in the 1680s to, among others, Christiaan Huygens.[52] Huygens found a kindred spirit, for Fullenius turned out to be well-versed in matters dioptrical, and in his will asked him to publish his posthumous papers.

The next phase concerns the development in the early eighteenth-century of the a natural philosophy founded upon mathematical principles and in which instruments stood central.[53] The nucleus were the informal societies that developed in the Holland cities in particular, but Friesland joined in in an interesting way. The pivot of early eighteenth-century mathematical culture in Friesland was Willem Loré (1679–1744), a protégé of Fullenius Jr. Loré was a man of humble origins who worked his way up by studying surveying in Franeker. He became lector under Fullenius teaching mathematics and surveying and government surveyor in 1707. Loré was the teacher of Wytze Foppes (1707–1778) and Jan Pietersz. van der Bildt (1709–1791) who started a line of Frisian telescope makers that continued through the entire eighteenth century. They too were of humble origins, originally being carpenters. Later members of this tradition also had their roots in the crafts, like the famous planetarium builder Eise Eisinga.[54] Besides having taught both carpenters, Loré played a stimulating role in their development as instrument makers and provided access for them and their products to the Stadholderly court. He became main assistant for the budding interest in the new philosophy at the Stadtholderly court. The then Stadholder, Willem IV, and his successor Willem V were highly interested

[52] A.F.B. Dijkstra, *Het vinden van Oost en West* (M.A.-thesis Groningen, 2007).

[53] Berkel, "The Legacy of Stevin," 68–76.

[54] H.J. Zuidervaart, Speculatie, *Wetenschap en Vernuft. Fysica en astronomie volgens Wytze Foppes Dongjuma (1707–1778), instrumentmaker te Leeuwarden* (Leeuwarden: Fryske Akad., 1995), 21–25; see also H.J.Zuidervaart, "Reflecting 'Popular Culture': The Introduction, Diffusion, and Construction of the Reflecting Telescope in the Netherlands," *Annals of Science* 61 (2004): 407–452.

f.j.dijksterhuis@utwente.nl

in the sciences and instruments in particular.[55] They facilitated the creation of a physical theater at the Franeker Academy and of the position of an assistant. At the court the princes held scientific salons and built up a collection of instruments. The collection (and the Franeker demonstrator) went to The Hague in 1748. The previous year Willem IV had become Stadholder of the whole Republic and he moved his court to The Hague.

9.6 Conclusion

With the move of Willem IV to The Hague the two original courts of Willem Lodewijk and Maurits were united. This brings my sketch of the development of mathematics in the Republic to a close. Loré symbolyzes the reunion of Holland and Frisian branches like the surveying books of Sems and Dou had stood for the alliance a century earlier. Mathematical practices evolved alongside societal developments and I have argued how mathematicians tried to capitalize on the interests of the ruling elite. In the early days of the Republic two prominent sites for this process were established in the form of the Stadholderly courts of Leeuwarden and The Hague and their universities in Franeker and Leiden. I have expressly followed the Holland and Frisian branches seperately to show how societal setting and mathematical practice co-evolved. Both branches followed quite similar courses as regards the mathematical subject matter and orientation. At first the primary focus was on state-building and practices of fortification, surveying and so on. Later on, more academic practices were added, reflecting the aristocraticizing tendencies of the Dutch elites. However, the societal settings of Friesland and Holland differed and this is reflected in differences in the implementation of ideals regarding mathematics and the institutionalization of mathematical practices. So, in Holland an autonomous engineering school was established for instruction of practical mathematics, which in Friesland was embedded within the university. In Holland 'aristocratic math' became the processing of the new, French geometry, whereas in Friesland an amalgam of mathematics and (Calvinist) theology arose. Holland and Friesland did not, of course, develop seperately and in mathematics too, much interchange took place. Letters were sent, men of letters and of numbers travelled, and so on, an aspect that I have not discussed in any detail for this occasion. The co-evolution of Holland and Frisian mathematical cultures will be matter for further study.

Acknowledgements I would like to thank Arjen Dijkstra and Tim Nicolaije for their valuable comments and suggestions. This article is part of the NWO-funded research project "The Uses of Mathematics in the Dutch Republic" (016.074.330).

[55] P. de Clercq, "Science at Court: The Eighteenth-Century Cabinet of Scientific Instruments and Models of the Dutch Stadholders," *Annals of Science* 45 (1988): 113–152.

f.j.dijksterhuis@utwente.nl

Lesley B. Cormack • Steven A. Walton
John A. Schuster
Editors

Mathematical Practitioners and the Transformation of Natural Knowledge in Early Modern Europe

Springer

Editors
Lesley B. Cormack
Department of History and Classics
University of Alberta
Edmonton, AB, Canada

Steven A. Walton
Department of Social Sciences
Michigan Technological University
Houghton, MI, USA

John A. Schuster
Unit for History and Philosophy of Science
University of Sydney
Sydney, Australia

ISSN 0929-6425 ISSN 2215-1958 (electronic)
Studies in History and Philosophy of Science
ISBN 978-3-319-49429-6 ISBN 978-3-319-49430-2 (eBook)
DOI 10.1007/978-3-319-49430-2

Library of Congress Control Number: 2017933848

Printed on acid-free paper

This Springer imprint is published by Springer Nature
The registered company is Springer International Publishing AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Contents