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Prosopography
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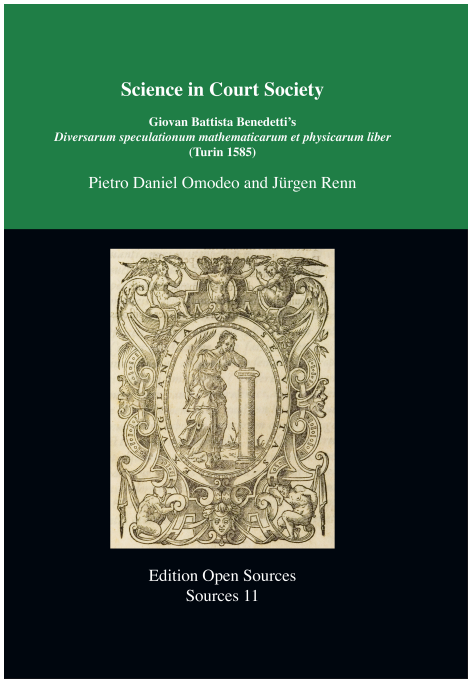

In: Pietro Daniel Omodeo and Jürgen Renn: *Science in Court Society : Giovan Battista Benedetti's Diversarum speculationum mathematicarum et physicarum liber (Turin, 1585)*
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Chapter 1
Prosopography

1.1 The Life and Career of a Renaissance Man

Giovanni Battista de Benedetti came from a patrician family of Venice. Although the title of nobility may appear superfluous to the historian of science, it was not so for him and his contemporaries. Benedetti often noted this in his publications, adding to his name the honorific "Patritius Venetus." Evidence for Benedetti's noble origins can be found in a document dated January 14, 1570. This is a patent through which Duke Emanuele Filiberto of Savoy conferred upon Giovanni Battista the privileges of Imperial nobility in addition to his previous titles:

> We make, create, and constitute the aforementioned Giovanni Battista Benedetti as a true noble of the Holy Roman Empire and of our Empire forever, alongside all his legitimate and natural sons and daughters (those who are already born and those that will be born). We will call and fully declare them such [nobles of the Holy Roman Empire]—although he and his predecessors are noble and were born from an ancient and noble progeny, as we are very well informed.[1]

In those years, the establishment of the Savoy court in Turin brought about a general transformation of the urban *patriziato* into an aristocratic class gravitating around the dukes.[2] This trend was parallel to the more general political-social shift from the civil humanism of the medieval municipalities toward the courtly culture of centralized territorial States.

On the occasion of the conferral of the patent on Benedetti, the cross of Savoy was added to his heraldic design along with the motto "sic vita veritas."[3] This motto, which indicated a conduct of a life dedicated to the search for truth, was the acknowledgment of his mathematical and philosophical excellence. In the preamble to the duke's patent of nobility, it was precisely Benedetti's devotion to the mathematical disciplines, the *humanae litterae*, and the philosophy that was extolled as an example to be imitated and a reason for the conferral of aristocratic privileges on him and his heirs.[4] In this case, scientific distinction led to higher social recognition and even served as a legitimation for it.

[1] Bordiga 1985, 752: "Habbiamo creato, fatto et costituito, facciamo creamo et costituiamo il detto Giovan Battista de Benedetti con tutti i suoi figliuoli maschi e femine legittimi, et naturali, nati et che nasceranno, et saranno procreati di legittimo matrimonio, con tutti loro posteri et heredi et successori in perpetuo veri nobili del Sacro Romano Imperio et nostri, et per tali li chiamiamo et dicchiariamo per dabondante (ancora ch'egli insieme coi suoi predecessori siano nobili e nati di antica prole nobili come siamo benissimo informati)."

[2] Stumpo 1998, 138.

[3] Bordiga 1985, 601.

[4] Bordiga 1985, 752: "Emanuele Filiberto per gratia di Dio Duca di Savoia Principe di Piemonte etc. Essendoche le attioni che tendono alla Virtù, come che da quella prendano accrescimento et perfettione, sono ammirate et havute in pregio: così gl'huomini che in quelle di continuo si essercitano vengono da ogniuno istimati et tenuti in particolare consideratione, la onde havendomi sempre fatto conto delle persone che dirizzassero ogni loro pensiero al bene operare, et quanto più si potrà, cercassero col mezo delle scienze, et arti liberali sicure et vere guide alla virtù di venire alla cognizione di esso doppo l'haver noi ricercato che

During the Renaissance, nobility was more important than professional appurtenances or academic titles. For instance, the celebrated Danish astronomer Tycho Brahe, himself an appreciative reader of Benedetti, held aristocratic lineage in higher esteem than any status linked to university professorship, including the position of imperial mathematician—an appointment which, by contrast, raised the status of his fellow countryman and opponent Nicolaus Reimarus Ursus, who was of low extraction.[5] Accordingly, Brahe always emphasized Benedetti's lineage when citing his work, for instance his letter on the superlunary location of the supernova of 1577. The capitalization as well as the reverence in this passage from the *Astronomiae instauratae progymnasmata* (posthumous, 1602) is telling:

> The small star of Cassiopeia would not shine as brightly as this nova over the whole surface of the Earth because of the dry fumes placed in-between, if they had been only under that one, and did not affect in the same manner the other stars next to it and augmented that unusual light. But the most excellent philosopher GIOVANNI BATTISTA BENEDETTI, THE VENETIAN PATRICIAN, eminently and skillfully demonstrated this with geometric arguments, in [his] outstanding work concerning mathematical and physical speculations (around the end of his letters). Writing to Annibale Raimondo […] he clearly showed the absurdity which necessarily follows from his false assumption [i.e., the sublunary position of the nova].[6]

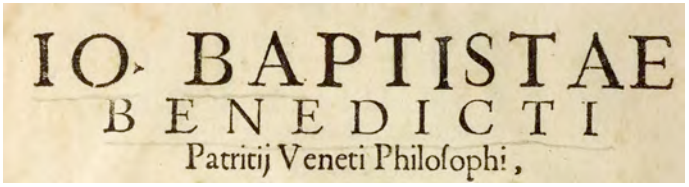
IO. BAPTISTAE
BENEDICTI
Patritij Veneti Philoſophi,

Figure 1.1: An example of the titles Benedetti added to his name in his publications. In the title page of *De gnomonum umbrarumque solarium usu* (1574), he called himself "Venetian Patrician, Philosopher." (Max Planck Institute for the History of Science, Library)

The prominence accorded to lineage is evident from Brahe's self-representation in the portrait at the beginning of his *Epistolarum astronomicarum libri* (1596), a collection of

in questo ne sotisfacesse, massime nelle discipline matematiche. Al fine ci è pervenuto nelle mani il nobile messer Giovanni Battista de Benedetti venetiano, nostro mattematico il quale havendo consumato la maggior parte dell'età sua nelle bone lettere et studij di filosofia, et fatto professione delle dette mattematiche, et così divinamente et per eccellenza riuscito che si può dire in quelle (tra gl'altri) essere singolare cosa che si porge tal contento, et la sua servitù a noi molto grata tale soddisfattione che lo giudichiamo degno che partecipi de gl'honori dovuti alle sue virtù acciò che gl'accresca l'animo di perseverare et altri siano invitati a seguitare li suoi vestigij."

[5]This is why Brahe was not and could not desire to be imperial mathematician to Rudolph II, as has often been wrongly thought. See Voelkel 1999.

[6]Brahe 1916, 250: "Accedit et hoc, quod Stellula illa Cassiopeae in toto Orbe Terrarum ob siccas illas fumositates interpositas non tam splendide apparuisset atque haec Nova, si sub hac sola constitissent, et non reliquas illi vicinas pari modo attingissent, lumineque insueto auxissent. Hoc vero ultimum egregie et solerter ex excellentissimo Philosopho IOHANNE BAPTISTA BENEDICTO PATRICIO VENETO in praeclaro illo Opere quod de speculationibus Mathematicis et Physicis inscripsit, circa finem inter Epistolas eius evidenter et dilucide, Geometricis rationibus demonstratur. Ubi ad hunc ipsum Annibalem Raimundum scribens, absurdum, quod ex eius falsa assumptione necessario sequitur, dilucide ostendit."

epistles that arguably took Benedetti's collection in the *Diversae speculationes* as a model. Brahe's image is encircled by the heraldic designs of the family and makes the signs of his nobility very visible. In the same epistolary, Brahe's letters directed to aristocrats appear more prominently than those addressing "simple" professors or practitioners. He attached greater importance to his correspondence with the patron of sciences, Landgrave William IV of Hesse-Kassel, than to exchanges with the latter's court mathematician Christoph Rothmann.[7] Similarly, in the *Diversae speculationes*, Benedetti published with pride his letters to dukes or to illustrious aristocrats.

Apart from his nobility, we do not know much about Benedetti's origins. According to a horoscope that he cast for himself (Figure 1.2), and was printed by the Neapolitan astrologer Luca Gaurico in *Tractatus astrologicus* (*Astrological Treatise*, 1552),[8] Benedetti's father was a learned *Hispanus*, or Spaniard. Based on this thin evidence, his biographer, Giovanni Bordiga, speculated that his family could have been merchants trading with Spain.[9] Other archival documents caused him to speculate about Benedetti's marriage, around 1585, and about the existence of a daughter called Lodovica from an earlier relationship or marriage. She married a certain Domenico Pipino of Racconigi. Benedetti built a sundial for this son-in-law (*magnificus Dominus Dominicus Pipinus generus meus*), as indicated in *De gnomonum... usu* (1574). Lodovica died young, long before her father, in 1580.[10]

For the greater part of his life Benedetti was a courtier. For several years he served duke Ottavio Farnese of Parma, whom he joined in 1558 as "*lettore di filosofia e mathematica*."[11] Later, from 1567 up to his death on January 20, 1590, Benedetti served the Dukes of Savoy Emanuele Filiberto and Carlo Emanuele I. His duties were typical for a Renaissance court mathematician and are akin to those of Leonardo da Vinci in Milan, Guidobaldo del Monte in Urbino, Galileo in Florence, and Kepler in Prague, to mention only a few well-known names.[12] Benedetti was required to advise his patrons on issues of mathematical expertise. His fields of competence included engineering and architecture.[13] In Parma and Turin he built sundials (such as the modern one in Figure 1.3). He was also responsible for the construction of a fountain in the ducal park (*Parco di Viboccone*, later *Parco Regio*), which was destroyed by the French army during the siege of 1706.[14] Moreover, he was consulted on astronomy and music, both traditionally considered mathematical disciplines. In Parma he carried out astronomical observations, which he also reported on in the *Diversae speculationes*. In two letters to the Parma choirmaster de Rore, Benedetti explained musical consonance and dissonance of two tones by the ratio of oscillations of waves of air generated by the strings of musical instruments.[15] He claimed that the frequency of two strings of equal tension must have an inverse ratio to the lengths of the strings, and thus proposed to describe the degree of consonance or dissonance of two tones mathematically. In Turin he wrote a proposal for the calendar reform in 1578, *De temporum emendatione*, later reprinted in the *Diversae speculationes* as the

[7] See Mosley 2007.
[8] Gaurico 1552, f. 76*r*.
[9] Bordiga 1985, 588.
[10] Bordiga 1985, 604–605.
[11] Bordiga 1985, 593–595.
[12] For the broad European context of patronage and the arts in the Early Modern Period, see Bedini 1999, Moran 1981, and Moran 1991.
[13] See Roero 1997 and Mamino 1989.
[14] Maccagni 1967a, 353–354.
[15] Benedetti 1585, 277–278.

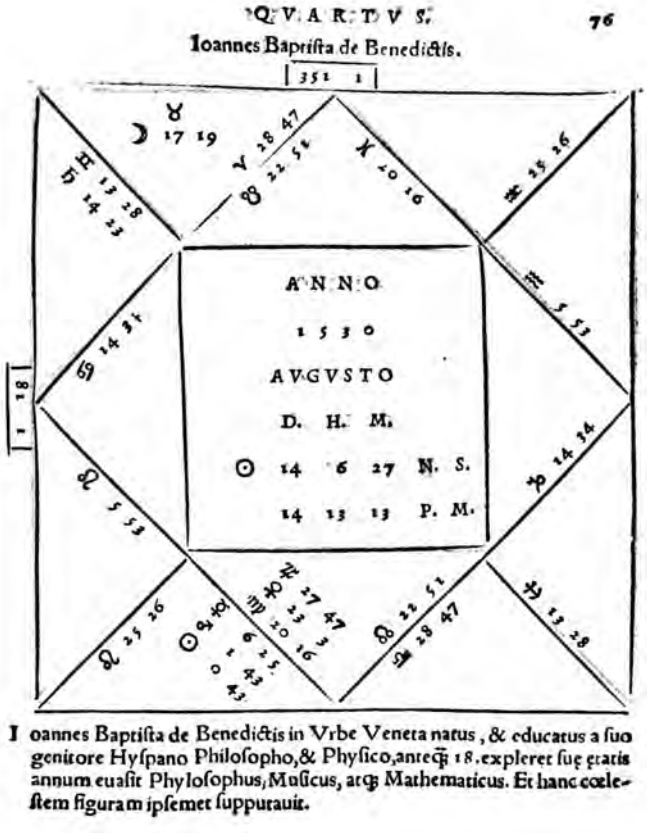

Figure 1.2: Benedetti's own horoscope, in Luca Gaurico, *Tractatus astrologicus* (1552), f. 76*r*. (Bayerische Staatsbibliothek)

first of his epistles (to Duke Emanuele Filiberto).[16] This proposal was also sent to Rome and was meant as an aid to Clavius's efforts to correct the calendar.[17] At the same time, he taught mathematics to Emanuele Filiberto and his son Carlo Emanuele I.

Courtly life included participation in literary culture. Baldassar Castiglione, in his idealization of the court of Urbino in *Il libro del Cortegiano* [*The Book of the Courtier*] (1528), launched the model of a courtier with a refined literary education.[18] Following such cultural dispositions, a courtier versed in mathematics could advocate the usefulness of his expertise for the interpretation and assessment of "scientific" questions raised by classical sources, even poems. This attitude explains the inclusion of a letter on Ovid in the collection of epistles in the *Diversae speculationes*.[19] It was addressed to a certain Pancrazio Mellano, perhaps a courtier, asking Benedetti's opinion about the astronomical references in Book 2 of the *Metamorphoses*, in which Ovid tells the myth of Phaeton. According to the myth, Phaeton rode his father Apollo's chariot one day but he was unable to control the horses and keep the sun on its regular path. Finally, he was thrown out of the chariot, took a bad fall, and died. In the poem Ovid described the solar path in some detail but, according to Benedetti, he mixed up daily rotation and annual motion along the ecliptic: "Ovid unduly passes from the daily motion to the annual" (*Quod Ovidius transcurrit*

[16] Benedetti 1585, 205–210.
[17] Benedetti's advice on the calendar reform is preserved in the Biblioteca Apostolica Vaticana under the signature cod. Vat. lat. 5645, 148*r*–150*r*. See Ziggelaar 1983, 211–214.
[18] Baldassar Castiglione, *Il libro del Cortegiano*, ed. Walter Barberis (Torino: Einaudi, 2017).
[19] Benedetti 1585, 417–418.

Figure 1.3: A modern sundial on the Church of San Lorenzo in Turin reminiscent of those designed by Benedetti. (Own photography)

a motu diurno, ad motum annuum praeter rem). To make his point clear, Benedetti listed the passages dealing with one or other of the two motions ascribed to the sun in ancient astronomy.[20]

As an exponent of the Turin elite, he was himself devoted to poems. For instance, the Milanese painter and writer Giovanni Paolo Lomazzo, who was linked to Savoy's court, celebrated Benedetti in verse as a philosopher, mathematician, and astrologer. In the first lines of a poem dedicated to him, Lomazzo declared himself delighted that Benedetti appreciated his paintings and cast his birth horoscope. Lomazzo's poem paints a vivid picture:

> Prudence and knowledge descend
> From Philosophy into [human] intellects;
> Which are perfect as far as their disposition is concerned,
> As each one receives its part of justice and reason.
> To Benedetti, he so wise
> And precious in the world,
> Belongs so much of this [philosophy]
> That it would be vain to try to equal him:
> So sublime does his value shine.
> All the more am I delighted that he appreciated

[20] Omodeo 2012b.

> My painting so much so that he considered
> The time and the point in which I was born in the world.
> Oh splendor of our time, the sound [of your voice] silenced
> Every scholar of your art, who had to direct his judgment elsewhere,
> As it was overshadowed by yours, which is so deep.[21]

Benedetti received no formal or academic education. Like other Renaissance self-taught men (e.g., Niccolò Tartaglia and Tommaso Campanella), Benedetti was even proud of being removed from the academic habitus and training centers. This is particularly evident from the anti-academic tone of some of his polemics. In the preface to his first scientific treatise, *Resolutio omnium Euclids problematum* (1553) (On the solution to geometrical problems using a compass with a fixed opening), the twenty-three year old Benedetti emphasized the fact that he had not had a "common" (*quod vulgus solet*) education at some gymnasium or school. He boldly wrote to his patron, the Dominican abbot and diplomat Gabriel Guzman, that:

> Until now I have advanced without any mentor or teacher (under the guidance of God). I have never frequented any gymnasium or school. I have not learned what the vulgar (I mean this word without arrogance) use to estimate erudition, [such as limiting it] to the time spent at school, thus setting an end to learning when the seven years [of regular studies] are ended. As long as I live, I will continue [learning].[22]

It is possible that Benedetti was educated privately by his father, depicted in Gaurico's *Tractatus astrologicus* as "*Hyspanus, Philosophus, et Physicus*" (see Figure 1.2). For his part, Benedetti acknowledged only one teacher, namely the reputed mathematician and scientist-engineer Niccolò Tartaglia (ca. 1500–1557), for introducing him to the first four books of Euclid's *Elements*, probably between 1546 and 1548. In the *Diversae speculationes mathematicae et physicae*, Benedetti mentioned Tartaglia again as one of the very few authors of mathematical works whom he deemed worth reading.[23] However, in the

[21] Lomazzo 2006, 177–178, III, 19, "Del Sig. Gio. Battista Benedetti Matematico":

> "De la Filosofia nasce e discende
> La prudenza e 'l saper de gli intelletti;
> Co' quali essendo nel dispor perfetti,
> A ognuno suo diritto e sua ragion si rende
> Di questa sì gran parte se ne prende
> Il saggio e raro al mondo Benedetti,
> Che d'agguagliarlo in vano è chi s'affetti:
> Tanto sublime suo valor s'estende.
> Però tanto godo io che sì gli piacque
> La mia pittura, e perciò egli volse
> L'ora et il punto nel qual nacqui al mondo.
> Splendor di questa etade al tuo suon tacque
> Ogn'un de l'arte tua, e altrove volse
> Il suo dir vinto dal tuo sì profondo."

[22] Benedetti 1553, f. 5*r*: "[…] huc usque progressus sum (Deo duce) sine monitore praeceptoreque ullo, nullum gymnasium unquam, nullamque scholam frequentavi, neque hoc studui, quod vulgus solet (sed absit verbo arrogantia) pro tempore in scholis transacto, eruditionem estimare, ac septennario finito finem studiis imponere, sed dum vivo, illa prosequi."

[23] One reads in the preface *ad lectorem* of the *Diversae speculationes* the following declaration: "In his autem meditandis, ex arithmeticis authoribus quos inspexi praecipuus fuit Nicolaus Tartalea, quippe quem

Resolutio omnium Euclidis problematum, he was quick to add that he had learned the rest of the *Elements* by himself:

> As it is honest and right to attribute to everybody his own merit, [I should acknowledge that] Niccolò Tartaglia taught only the first four of Euclid's books to me. I studied the rest alone with effort and diligence. In fact, for the one who wants to know, nothing is [too] difficult.[24]

Bordiga described such self-celebration as a sign of Benedetti's "pride in the assumed independence of his own thinking" (*orgoglio di creduta indipendenza del proprio pensiero*).[25] This is the same pride that would later lead to animosity with other prominent mathematicians such as Del Monte.

Moreover, in the preface to the *Resolutio*, Benedetti contrasted the simplicity of mathematics with the vanity of rhetoric. He went so far as to accuse learned and eloquent doctors of corrupting the sciences.

> Furthermore, mathematics does not require much [stylistic] splendor. If some language expert tried to improve its elegance, this would have no value, because a change of the mathematical language and of the scientific terminology could easily confuse the sense [of the reasoning] and render everything obscure. Therefore, I will follow the scholarly tradition and use plain words in my demonstrations, as I disapprove of deceptive elegance. In this respect, I follow the steps of the ancients who taught the sciences and the subjects themselves using plain words. Petty teachers (indeed, charlatans and babblers) corrupted this manner of teaching. Although they do not understand the subject, their babbling obtains the highest praise by the vulgar who regard them as learned scholars. This should not be surprising, considering that the most perfect and distinguished expertise in the sciences is attained by very few—despite the fact that many people write a great deal in all kind of sciences and arts, babbling a lot and capturing the attention of the uneducated with illusions and bombastic words.[26]

The same tone characterized Benedetti's next publication. Its title was intentionally polemical: *Demonstratio proportionum motuum localium contra Aristotilem et omnes philosophos* (1554). In fact, this booklet put forward a novel theory of motion. He

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fere omnia ab aliis scripta collegisse constat, nec alios ex praecipuis quos legere potui omittendos duxi, inter quos sunt Hieronymus Cardanus, Michael Stifelius, Gemma Frisus, Ioanna Novimagus, Cuthbertus Tonstallus, caeterique huiusmodi."

[24] Benedetti 1553, f. 5*v*: "Caeterum quia cuiusque quod suum est reddi debet, nam et pium et iustum est, Nicolaus Tartalea, mihi quatuor primos libros solos Euclidis legit, reliqua omnia, privato et labore et studio investigavi, volenti namque scire, nihil est difficile."

[25] Bordiga 1985, 588 (4).

[26] Benedetti 1553, f. 5*v*: "Adde quod Mathematicae disciplinae, neque tantum requirunt splendorem, neque si quis peritus linguarum contendat ad elegantiam rem reducere, egregium quid effecerit, quia mutato usu Mathematicae loquendi, ipsiusque scientiae terminis, sensum facile perturbaverit, et ex nihilo nihil apprehensum obtinuerit. Quare morem scholarum sequutus, obstentatione elegantiae explosa, verbis nudis in demonstrationibus usus sum, hac in parte veterum vestigia sequutus, qui nudis verbis scientias resque ipsas docebant, quem modum docendi, nobis devastarunt scioli vel potius circulatores, garruli, rebus ipsoque iudicio destituti, garrulitate siquidem apud vulgus, laudem summam consequuntur, et pro doctis circunferuntur, nec mirum, cum scientiarum perfecta exquisitaque perita, paucissimis detur, non obstante quod multi permulta de omnis generis et scientiis et artibus scribant, permultaque garriant, fucis suis, et ampullis imperitorum oculos perstringentes […]."

argued that bodies of the same material fall through a given medium with the same speed, and not with speeds proportional to their weights, as Aristotle held. This is the reason for Benedetti's declaration of war "against Aristotle and all philosophers" in the title. Benedetti employed the Archimedean concept of buoyancy to account for the dependence of the motion of fall on their specific rather than absolute weight. As we shall see, these ideas played an important role in the *Diversae speculationes*. The use of Archimedean notions to improve on Aristotle's physics was probably stimulated by Tartaglia's Italian translation (1543) of Book 1 of Archimedes's treatise on bodies in water.[27] Benedetti's challenge to Aristotle must have raised considerable discussion, as is shown by the fact that, in his *Demonstratio*, he discussed Aristotle's views and responded to his critics at length. In the second edition of the *Demonstratio* (13 February 1554 *more veneto*, in fact, 1555), he showed that the resistance encountered by a falling body in a medium depends not on its volume, but on its surface area. Benedetti moreover explained the acceleration of the motion of fall in terms of an increasing impetus of the falling body. He had already outlined his theory of fall in the dedicatory letter of the *Resolutio*, explaining this anticipation as a means of avoiding plagiarism.[28] Still, in spite of his efforts to secure priority for his ideas by repeated publication, they were plagiarized by the Flemish polymath Jean Taisner in 1562 and spread through Europe with no clear acknowledgement of their origin.[29] This prompted Benedetti to express his indignation and rage at Taisner in the dedicatory letter of his *De gnomonum… usu* (1574).[30]

As was to be expected by his irreverent tone, some of the first reactions to Benedetti's early writings were rather critical. As he reports in the preface to the second edition of the *Demonstratio* (1555), some Roman scholars objected that his treatment of motion was in disagreement with Aristotle (*illam [meam propositionem] neutiquam esse iuxta mentem Aristotelis*). Benedetti was informed about their disapproval by a Dominican friend, Petrus Arches, an expert of Hebrew and Greek letters cultivated in philosophy and mathematics.[31] Benedetti replied that those scholars worshipped Aristotle like a pagan god (*veluti coeleste quoddam numen*) and did not admit that their *auctor* could make mistakes. He claimed that he had not misunderstood Aristotle; rather, that he simply disagreed with him.

> I remember that he [the very educated Doctor Peter Arches]—after many different conversations on various subjects—told me that many in Rome considered that proposition of mine (which I sent to you, Reverend Mr. Guzman, among other ones) and they mostly reacted with surprise for I did not specify that it was by no means in accordance with Aristotle's mind. Such was the reaction of those who considered my demonstration very attentively.
>
> They could not concede that Aristotle was mistaken in any way, because they do not regard him as a human being. Rather, they confer upon him the celestial condition of a pagan divinity. And they see even slight disagreement as a sin. Therefore [they believe that] I committed (and still commit) heresy if, according to their judgment, I do not follow the pure and authentic mind of Aristotle's doctrine in any manner.
>
> Thus, in order to escape the allegation of such an error or [the rumor] that I am dissimulating and hiding something, especially as far as this issue is con-

[27] Archimedes 1543.
[28] Benedetti 1553, f. 10*v*. See Maccagni 1967a, 338–340 and Maccagni 1967b, 14–15.
[29] Taisner 1562, see the discussion in Maccagni 1967a, 344–455, n. 13.
[30] Benedetti 1574, f. 4*v*.
[31] Maccagni 1967b, 20–21, and 20, n. 14.

> cerned, I decided to publish this new booklet in which I present my opinion more clearly. In this manner, everybody should become aware that I correctly understood Aristotle and that I disagree with him on a particular issue with considered reason. This is an unpleasant task for me. In fact, it is only unwillingly that I dissent with such a great man. I know nobody who could rival his excellence in all kind of doctrines. Nevertheless, his teaching is to take as true that which is supported by stronger reasons. He himself followed this precept, as he stated in the *Ethics*: "Plato is my friend, Socrates is my friend, but truth is even more friend to me."[32]

It is evident from these passages that Benedetti regarded mathematics as a support for conclusive rational argumentation in the treatment of natural issues. Therefore, as a *mathematicus* he claimed for himself the right to be called a *philosophus*. Already in the short biographical indication accompanying his birth horoscope, he was said to be a "*Phylosophus, Musicus, atque Mathematicus*" (see Figure 1.2). In his publications, Benedetti often stressed his quality as "*philosophu*s" or "*filosofo*." Galileo would later add the title of "philosopher" to that of "court mathematician" in Medici's Florence.[33] However, in Benedetti's case, it is evident that adding the title of "*philosophus*" was not part of a strategy aimed at social advance but rather mirrored his cultural and philosophical commitment to a mathematical philosophy of nature with all its consequences, among them that Aristotelian physics was open to critique by means of mathematical reasoning.

Thus, Benedetti not only dealt with fields of mathematical inquiry that traditionally belonged to the domain of mathematics (such as mechanics, optics, mathematical astronomy, and musical theory), but also addressed issues considered beyond the limitations of mathematics, especially terrestrial and celestial physics. The title of the *Diversae speculationes mathematicae et physicae* is itself provocative, as it brings together mathematics and natural philosophy (or *physica*), considered to be separate fields, one dealing with the *quia* (the "phainomena") and the other with the *propter quid* (the "causes"). In this respect, Benedetti's methodology is very close to that of Nicolaus Copernicus, whose heliocentric system he admired. In Book 1 of *De revolutionibus orbium coelestium* (1543) and in the *Narratio prima* (1540), Copernicus and his pupil Georg Joachim Rheticus (1514–1574) reversed the Peripatetic hierarchization of physics over mathematics, urging a reform of natural philosophy and celestial and terrestrial physics in order to bring them into accord with the geokinetic and heliostatic innovations in mathematical astronomy. Beyond astronomy, the issue of the status of mathematics and its role in natural investigations was

[32] Maccagni 1967b, 20–21: "Memini eum [eruditissimum Doctorem Petrum Arches], post varia et diversa colloquia utro citroque inter nos habita, mihi retulisse quamplurimos Romae, conspecta mea illa propositione quae ultra reliquas tuae R[everende] D[omine] [Guzman]a me mittebatur, valde mirari solitos me addidisse illam neutiquam esse iuxta mentem Aristotelis, idque ab eis dictum ubi meam demonstrationem attentius considerarunt.

Ne vero Aristotelem ullo modo errasse concederent, cum illum non infra humanae conditionis terminum habeant, sed potius veluti coeleste quoddam numen sibi proponant, censeantque nefas esse si vel latum quidem unguem ab eo quis dissentiat, in hac potius haeresi fuisse, ac etiamnum esse, ut me germanum et genuinum sensum Aristotelicae opinionis nequaquam ex authoris mente assecutum existiment.

Ego vero ne mihi diutius talis impingatur error, neve quid maxime super hac re sentiam, aut dissimulem, aut reticeam, statui, hoc novo libello edito, meam sententiam clarius aperire, ut omnes intelligant me et Aristotelem ipsum antea recte intellexisse, et non temere hoc in loco ab eo discrepare, quod sane quanquam invitus facio (nec tamen libenter a tanto viro diversum sentio, quippe qui norim quam ille praeclarus extiterit in omni doctrinarum genere), docet tamen maiorem ratione veritatis habere, quo ipsemet facendum censuit, quam inquit in *Ethicis*: 'Amicus Plato, amicus Socrates, at magis amica veritas.'"

[33] Biagioli 1989, 49–50.

heatedly debated by philosophers and mathematicians during the Renaissance.[34] One ancient predecessor to praise mathematical physics was the Hellenistic "prince of astronomy and geography," Claudius Ptolemy. In the beginning of the *Almagest*, he pointed out the superiority of mathematics over theology and physics, and even argued for a possible extension of the method of mathematical astronomy to include the treatment of local motion in general, as well as theology and ethics.

> Only mathematics can provide sure and unshakeable knowledge to its devotees, provided one approaches it rigorously. For its kind of proof proceeds by indisputable methods, namely arithmetic and geometry. Hence we were drawn to the investigation of that part of theoretical philosophy, as far as we are able to the whole of it, but especially to the theory concerning divine and heavenly things. For this alone is devoted to the investigation of the eternally unchanging. For that reason it too can be eternal and unchanging (which is a proper attribute of knowledge) in its own domain, which is neither unclear nor disorderly. Furthermore it can work in the domains of the other [two divisions of theoretical philosophy, physics and theology] no less than they do. For this is the best science to help theology along its way, since it is the only one which can make a good guess at [the nature of] that activity which is unmoved and separated; [it can do this because] it is familiar with the attributes of those beings which are on the one hand perceptible, moving and being moved, but on the other hand eternal and unchanging, [I mean the attributes] having to do with motions and the arrangements of motions. For almost every peculiar attribute of material nature becomes apparent from the peculiarities of its motion from place to place. [Thus one can distinguish] the corruptible from the incorruptible by [whether it undergoes] motion in a straight line or in a circle, and heavy from light, and passive from active, by [whether it moves] towards the centre or away from the centre.[35]

Even after Copernicus, Ptolemy's methodological insights maintained their full importance and could guide scholars who intended to expand the realm of the application of mathematics far beyond the limits established by traditional philosophy. In the *Diversae speculationes*, Benedetti deepened the discussion of issues of natural philosophy such as the concepts of space, time, and motion, claiming for a mathematician a better and clearer insight into foundational problems of physics.

Astrology was another area of expertise for Benedetti. During the Renaissance, astronomy and astrology were never separated. Benedetti was expected to cast horoscopes and give astrological advice to his patrons, just as Brahe astrologically advised the King of Denmark, Kepler the Emperor, and Galileo the grand dukes of Tuscany.[36]

In Venice Benedetti frequented celebrated exponents of the astrological culture of the time, among them Annibale Raimondo of Verona and Francesco Giuntini. Raimondo reported about a meeting they had in the residence of the senator and poet Domenico Venier. On that occasion he and Benedetti tested Giuntini's astrological preparation:

> We gathered at Mr. Domenico Venier's place; his magnificence [came] first, followed by the most excellent Mr. Giovanni Battista Benedetti, many other

[34] De Pace 1993.
[35] Ptolemy 1984, 35–37.
[36] A very informed case study on astrology at Italian Renaissance courts is Azzolini 2013.

> gentlemen, myself (Annibale Raimondo), and finally the ex-reverend father Pacifico of Florence (now, as an ex-friar, known as 'excellent Mr. Francesco Giuntini'). As soon as the latter arrived, he was given the simple astrological chart of the revolution of the magnificent Venier, without any written indication around or below. The good father took countless and endless texts and aphorisms out of his scapular. He related them to the revolution as good as a physician might give prescriptions to sick people by saying 'God might help you.' Since the most excellent Mr. Benedetti and myself laughed uncontainably—thereby making the father believe that he could not have better done—the good father, who was already trotting, was spurred by our laugher to gallop so quickly that it became extremely difficult to bring him back to silence and prevent him from telling more stupidities.[37]

An astrological report by Benedetti, cast for Carlo Emanuele I (Turin, 19 October 1589), is still extant and preserved in the Civic Library of Turin (Coss. 4, ff. 1*r*-2*v*). It contains a day-by-day personalized astrological forecast for the month of November 1589. The days are qualified with adjectives such as "*buono*" (good), "*mediocre*," or "*cattivo*" (bad), but some are treated more specifically (the 9th of November is indicated as apt to "*negotii ingeniosi*," ingenious endeavors, whereas the 10th of November as "*buono in cose femminili ma nel resto cattivo*," that is, bad except for women's affairs). Benedetti signed this astrological letter as "*Matematico e Astrologiaro*."[38] This signature shows that his "professional" profile could vary depending on circumstances, since it depended in part on the kind of advice requested from him.

In the concluding letter of the *Diversae speculationes*, Benedetti envisaged a reform of astrology. He directed this letter to a German correspondent whose name he awkwardly Latinized as *Volfardus Aisestain*.

> As for the question whether or not I regard as true all that is written in the books of judicial astrology, I respond that I do not. I even believe that much is wrong […]. But you will be informed about all this in a special tract of mine, about which I told you on another occasion. In it, you will find many things I have proven through the evidence of many observations. I intend to publish that tract along with some other speculations of mine, if only I will have enough time to do that, before I meet the body of the adverse Mars as indicated by my horoscope. This is going to happen in 1592.[39]

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[37] Raimondo 1574: "Ritrovandosi nella camera del Clariss. M. Dominico Veniero prima la sua Mag.[,] lo eccellentissimo M. Gio. Battista Benedetti, molt'altri gentilhuomini, et Annibale Raimondo, che son quel io, vi sopraggiunse al'hora il Reverendo Padre Frate Pacifico Fiorentino de gli bene inculati, adesso per essersi sfratato lo Eccellente M. Francesco Giuntini, alquale, subito giunto, fu dato in mano la figura simplice del cielo della Revolutione del detto Mag. Veniero, senz'altra scrittura intorno, né appresso, il buono padre alhora mise mano al suo scapolario et cavò fuori testi, et afforismi senza fine, et senza fondo, allegandoli tanto a proposito della Revolutione, quanto facea quel buon medico le ricette che 'l dava ai suoi infermi, quando le dicea Dio te la mandi buona, et perché lo Eccell. M. Gio. Battista Benedetti et io se smassellavamo dalla risa, ben però in modo di maravigliarsi, come non fusse possibile a dir meglio di quello che dicea sua paternità, il buon padre per il nostro ridere sì come prima andava trottando, si misse a correr' de modo che fu gran fatica a poterlo tenere et farlo tacere che'l non dicesse più minchionerie." Cf. Corradeschi 2009, 111, n. 46. On Raimondo and Giuntini, see Ventrice 1989, 140–145.

[38] Roero 1997, 57–58.

[39] Benedetti 1585, 425–426: "Circa vero id de quo me interrogas, scilicet, utrum putem omnia vera esse, ea quae scripta reperiuntur in libris Astrologiae iudiciariae, respondeo quod non, imo puto plurima falsa esse […]. Sed diffusius haec omnia videbis in meo illo particulari tractatu, de quo tibi alias dixi, in quo multa

This passage concludes his major work. In it, Benedetti predicted, using astrological means, his own death for the year 1592, but he actually died in January 1590.[40] This fact aroused some doubts about his proficiency as an astrologer, especially from his successor as court mathematician, Bartolomeo Cristini.[41]

To sum up, Benedetti's persona and work had various facets, his interests ranging from mathematics to cosmology and from natural philosophy to literature. In a certain sense, he can be seen as a Renaissance polymath. However, his profile can be better encompassed by the title of "*mathematicus*," as long as we do not take it too restrictively. A Renaissance mathematician like Benedetti was an engineer and a technical inventor, as well as a theoretician and a natural philosopher; someone with teaching and civil duties who served as a counsellor, also for astrological matters. Being a court mathematician implied benefiting from high recognition and visibility in society. Thus, this professional and intellectual appurtenance had nothing to do with the rather low acknowledgment that mathematicians received at universities, where physicians, lawyers, and theologians were higher placed and received better salaries.[42] The cultural environment of Turin, with which Benedetti interacted in the most important years of his career, shall be addressed in the next section.

1.2 Benedetti's Works and Publications

Benedetti published his first work at the age of 23, the *Resolutio omnium Euclidis problematum* (Resolution to All of Euclid's Problems, Venice 1553), which offered the solution to "all" geometrical problems using a compass with a fixed opening. The work reacted to a challenge that emerged from a controversy between Niccolò Tartaglia and Lodovico Ferrari in the years 1546–1548 and inserted Benedetti into the scientific debates of his time. One year earlier the astrologer Luca Gaurico had already paid homage to him, including in his *Tractatus astrologicus* a horoscope of the promising mathematician cast by Gaurico himself.

In 1554 Benedetti published a *Demonstratio proportionum motuum localium contra Aristotilem et omnes philosophos* (Demonstration Concerning the Proportions of Local Motions against Aristotle and All Philosopers), which is not as famous for its polemical verve as for the presentation of an innovative theory of fall. As we have discussed in the preceding section, in this treatise Benedetti developed a theory of the motion of fall, first proposed in the dedicatory letter of the *Resolutio* of 1553. Benedetti maintained that bodies of the same material fall through a given medium with the same speed and not with speeds in proportion to their weights, as Aristotle and his followers claimed. Benedetti tried to overcome the fallacies of the Aristotelian theory of fall by employing the Archimedean concept of buoyancy, assuming that the motion of fall depends on their specific rather than absolute weight. As we have also discussed above, in the second edition of the *Demonstratio*, published in Venice in 1555,[43] Benedetti argued that the resistance incurred by a

videbis, quae omnia ab experientia, ex multis a me observatis, comprobata sunt, quem quidem tractatum cum quibusdam aliis meis speculationes in lucem producere cupio, si fieri poterit, antequam ad directionem mei Horoscopi cum corpore Martis Anaeretae perveniam, quae quidem directo circa annum millesimum quingentesimum nonagesimum secundum eveniet."

[40] Benedetti was not the first mathematician who tried to forecast his own death. Among his predecessors are famous the cases of Johannes Stöffler and Girolamo Cardano. Cf. Omodeo 2014b, 3–4.

[41] Vernazza 1783, 16–18.

[42] On the lower status of mathematicians, see Henry 2011.

[43] Benedetti [1554] 1555, see Benedetti 1985.

falling body in a medium depends not on its volume, but on its surface area. This is also the view that he presented in the *Diversae speculationum mathematicarum et physicarum liber*, published in Turin in 1585. He explained the acceleration of the motion of fall in terms of an increasing impetus of the falling body. Such examples show how he dealt with new challenging problems, which were difficult and sometimes impossible to solve using the mainstream theories of his time, by bringing forth and promoting new ideas.

After the *Resolutio omnium Euclidis problematum* and the *Demonstratio proportionum motuum localium*, composed when Benedetti was still in Venice, the next extant works stem from the time when he had already settled in Turin. First, he composed two works on gnomonics, one in Italian and one in Latin. The former is a manuscript preserved in the Civic Library of Carignano (Turin, Italy), entitled *La generale et necessaria instruttione per l'intelligentia et compositione d'ogni sorte [di] Horologij Solari*, which was presumably written between 1567 and 1573. The latter was printed under the title *De gnomonum umbrarumque solarium usu liber* (1574). Here Benedetti dealt at length with the construction of sundials with faces of varying inclinations and also with cylindrical and conical surfaces. At ff. 107*r*-*v* one finds a discussion of a sundial that perhaps can still be seen today on a wall of the Royal Palace in Turin.[44]

In 1574 Benedetti also wrote about a trigonometrical measuring instrument of his own invention, *Descrittione, uso, et ragioni del Trigonolometro*. It was never printed and is preserved in manuscript form in the Civic Library of Carignano along with the Italian work on sundials, *Intelligentia et compositione d'ogni sorte [di] Horologij Solari*.[45] His next scientific treatise, *De temporum emendatione opinio* (1578), proposed correcting and reforming the calendar. In 1578 the duke initiated a public disputation at the University of Turin where Benedetti argued with Antonio Berga about whether there was more water or more land on the earth, following an argument by Alessandro Piccolomini. The views which Benedetti brought forth against his opponent were published in Turin in 1579 under the title *Consideratione… d'intorno al discorso della grandezza terra et dell'acqua del eccellent[e] sig[nor] Antonio Berga*. This polemic was renowned, as can be seen in the Italian translation and commentary of Sacrobosco's *Sphere* by the theologian, astronomer, and astrologer Francesco Giuntini in Lyon: "The excellent philosopher, Mr. Giovanni Battista Benedetti, mathematician to the serene duke of Savoy, resolved this question very aptly, arguing against the philosopher Berga, a famous reader at the University of Turin. The latter argues against Mr. Piccolomini that there is more water than earth. Benedetti defends the opposite view, which corresponds to truth: that there is less water than earth."[46]

Next came Benedetti's defense of the reliability of the mathematical computations underlying astrological predictions in the context of a heated polemic on this issue that burst out in Turin 1580–1581. Benedetti first communicated his views in Italian, in epistolary form: *Lettera per modo di discorso… all'illustre sig. Bernardo Trotto. Intorno ad alcune nuove riprensioni, et emendationi contra alli calculatori delle effemeridi* (Letter

[44] Roero 1997, 47.

[45] Clara Silvia Roero published Benedetti's letter to Carlo Emanuele I (Turin, 19 October 1589), the index of the manuscript on gnomonics, as well as an excerpt from the manuscript on the mathematical instrument *trigoniometro* as appendices II and III of Roero 1997.

[46] Giuntini 1582, 95–96: "La qual questione ha resoluta molto dottamente lo eccellente filosofo, il signor Giovambattista Benedetti mathematico del serenissimo signor Duca di Savoia, contra il filosofo Berga, famoso lettore nella università di Turino: il quale contra l'opinione del signor Piccolomini defende che l'acqua è maggiore della terra: e il Benedetti defende il contrario in favore della verità: cioè che l'acqua è minore della terra."

in the Form of a Discourse… Addressed to the Illustrious Mr Bernardo Trotto Concerning Some New Criticism and Corrections against the Ephemerides Calculators) (1581). Benedetti later included a Latin translation of this letter in the *Diversae speculationes* (1585).[47] His commitment to astrological practice is testified to by an astrological report he wrote for Carlo Emanuele I, a handwritten letter (Turin, 19 October 1589) preserved in the Civic Library of Turin (Coss. 4, ff. 1*r*-2*v*).[48]

Finally, Benedetti had his major work, *Diversarum speculationum mathematicarum, et physicarum liber*, printed in 1585. It was issued again under slightly different titles in Venice in 1586 (*Speculationum mathematicarum et physicarum tractatus*) and, posthumously, in 1599 (*Speculationum liber*).

Two of Benedetti's manuscripts, preserved in the Biblioteca Nazionale Universitaria of Turin until 1904, are irreparably lost due to a fire that burst out in that year, destroying many valuable manuscripts. The first one was a collection of his letters, *Lettere di Giovanni Battista Benedetti, Veneziano, matematico del Duca Emanuele Filiberto e Carlo Emanuele I, in risposta ai quesiti fattigli dal Duca e da altri personaggi intorno alla matematica, fisica, musica e filosofia*.[49] The second one held similar content and was entitled *Lettere di Giovanni Battista Benedetti in risposta a quesiti di fisica e matematica* (Letters by Giovanni Battista Benedetti answering questions on physics and mathematics).[50]

Reprints of Benedetti's works are rather scarce. Excerpts on mechanics from Benedetti's work were included by Stillman Drake and Israel Edward Drabkin in their *Mechanics in Sixteenth-Century Italy: Selections from Tartaglia, Benedetti, Guido Ubaldo and Galileo* (Madison, Wisc.-Milwaukee-London, 1969). Carlo Maccagni's *Le speculazioni giovanili "de motu" di Giovanni Battista Benedetti* (Pisa, 1967) includes excerpts from the dedicatory letter of the *Resolutio omnium Euclidis problematum* and the text of the two editions of the *Demonstratio proportionum motum localium contra Aristotilem et omnes philosophos*.

[47] Benedetti 1585, 228–248, "Defensio ephemeridum."
[48] See Roero 1997, Appendix I.
[49] Peyron 1904, 73–74, Codex 83, N. II. 50.
[50] Peyron 1904, 95, Codex 94, N. III. 27.