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THE SOCIAL STATUS OF ITALIAN MATHEMATICIANS, 1450–1600

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This study stems from the belief that the epistemological legitimation of the mathematical method that characterized the Scientific Revolution involved and depended upon the social legitimation of mathematical practitioners. Unfortunately 'social status' is not an historiographical category that has received much attention by historians of early modern Italian science. Many scholars have carefully analysed Galileo's work and life but, by comparison, little has been studied of the socio-professional world of the mathematical practitioners who worked before or around him. As a contribution to the reconstruction of those scenarios and to an understanding of their role in shaping Galileo's strategies for the epistemological legitimation of the mathematical method, I am presenting an extensive bibliography* together with some considerations and interpretive patterns based on a preliminary study of that material.

Looking for evidence of the social status of mathematicians in Italy from 1450 to 1600, I have considered: (1) the teaching of mathematics in Italian universities and its status within the other disciplines of the curricula; (2) the public teaching of practical mathematics and geometry; (3) the professionalization of military engineering; (4) biographies of mathematical practitioners; (5) the status and diffusion of astrological practices; (6) the changing classification and hierarchy of liberal disciplines; (7) the development of the structure and function of Italian courts as a reward system for mathematical practitioners; and (8) the relationship between humanists and mathematicians.¹

Given the discouraging varieties-to-species ratio among mathematical professions emerging from the material listed in the bibliography, I have not attempted to identify *types* of early modern Italian mathematicians. Not only do synchronic typologies often turn out to be artificial taxonomies of dubious historical relevance, but in this case they are very difficult to develop unless one is willing to introduce arbitrary approximations. Consequently, I have opted for a genealogical approach which tries to map the *development* of the intricate

* The numbers in parentheses in the following pages refer to items in the bibliography. No references to items in the bibliography are given when these would be too numerous or when, as in the case of individual authors, their name can be found in the index of the bibliography.

pattern of mathematical practitioners that we encounter at the end of the sixteenth century.

I take the apparently chaotic proliferation of diverse professional figures of mathematicians at the end of the sixteenth century to indicate conditions of relatively high professional and (sometimes) social mobility. In particular, these conditions were experienced by those mathematicians who worked in the court environment and who were often required to play several different professional roles at once or at different stages of their careers. For instance, somebody like Ignazio Danti worked as an expert in gnomonics and an instrument builder, as a teacher of practical mathematics in Florence, as an astronomer specializing in calendrics, as a university teacher in Bologna, as the geographer of the Pope, as an engineer in charge of restructuring the Roman harbour of Fiumicino, and as a painter (and writer on perspective) member of the Accademia del Disegno at Perugia and of the Accademia di S. Luca at Rome (167, 215, 304, 377). He also wrote on fortifications.²

The changes in the range of opportunities for social mobility and in the varieties of professional niches available to mathematicians between 1450 and 1600 problematizes the very meaning of 'social status'. While it is relatively easy to define it around 1450 when the mathematicians' professional roles (and the social status associated with them) were generally clear-cut, we can no longer do so in the late sixteenth century when the production of one's socio-professional image took place through more complex trajectories and could no longer be measured simply in terms of one's income. At the end of the sixteenth century, a socially skilled higher artisan could become a member of some academy or *cavaliere* of some order as in the case of the painter Cigoli, the sculptor Giambologna, and the geographer Neroni (34, 47, 56, 98, 113, 169, 188, 340, 351, 550). Such status-carrying titles would have not been available to them had they lived at the end of the fifteenth century. Consequently, by 'social status' I do not mean merely wealth but rather something like 'access to power', that is, the possibility of obtaining social legitimization for one's socio-professional role.

THE PATTERN

The pattern of mathematical disciplines and professions existing inside and outside the university seems to have been quite stable in Italy during the later Middle Ages. As shown by the organization of the teaching of mathematics at Bologna and in other Italian cities, there were two disciplinary and professional types of mathematical practitioners who — although sharing a relevant portion of their mathematical knowledge — remained socially distinct. In the first group we find the book-keepers, the land surveyors, and the engineer-masons. Their professional culture was represented by the chairs "ad

arithmeticam et geometriam” and by the public teaching of the abacus (17, 23, 45, 117, 120, 156, 163, 237, 264, 387, 567, 568). Socially and professionally distinct from these practitioners we find the astrologer-physicians represented by the chairs “ad astrologiam” (86, 156, 177, 183, 190, 403, 418, 232). Although in some Italian cities arithmetic and basic geometry were not taught at universities but at various city-supported schools, the content and social status of the “culture of the abacus” was quite homogeneous and its social status consistently much inferior to that of the astrologer-physicians.

In some cities like Florence, the abacists and land surveyors had their own guild for a time, in other instances they grouped together with the masons or with the other elementary-level teachers (163, 387). Given their professional symbiosis with the physicians, the astrologers belonged to much more prestigious guilds. While university teachers of astrology were usually required to compile the city’s yearly horoscopes (the *tacui*) (156), the teachers of elementary arithmetics were often employed as the city’s official surveyors (156, 387). Therefore, at the beginning of the Renaissance, we find a quite literal socio-professional distinction between ‘terrestrial’ and ‘celestial’ mathematicians.

Different causes acted upon these two socio-professional groups to produce the transition from the binary scenario of 1400 to the much more complex one of 1600. With some evident oversimplification, I would gather these causes in four major groups:

- (1) Internal conceptual developments in mathematical, mathematics-related, and medical disciplines.
- (2) The revolution in warfare and fortification techniques around 1500.
- (3) Land reclamation, systematic cadastres, and rationalization of water management especially in the Po Valley.
- (4) The development of absolutist states in Italy and the related changes in the internal structure of the courts.

(1) The figure of the physician-astrologer such as Biagio Pelacani or Paul of Middelburg developed into that of the Galileo-like astronomer and the Harvey-like physician largely as a result of the conceptual developments and the cumulative increase of knowledge in both medicine and astronomy. The quite slow decline of astrology associated with this process of disciplinary branching is a very complex phenomenon that seems to depend not only on internal conceptual developments of astrology-related disciplines but also on a range of social factors that cannot be dealt with in the context of this paper (454, 507). In any case, the progressive disciplinary separation of astrology from medicine does not seem to have caused major changes in the social status of either the physician or the technical astronomer.

Instead, it is within the 'culture of the abacus', among that wide range of out-of-the-university teachers and practitioners of applied geometry and arithmetic, that we find important changes in social status during the 1400–1600 period. Quite probably, such changes were induced by external rather than internal developments.

(2) If we look at the content of the "libri d'abbaco" we find that it runs almost unchanged from 1200 to 1500, from Fibonacci to Pacioli. The first important conceptual changes take place only around 1540–50 with the work on algebra by Del Ferro, Cardano, Ferrari, Tartaglia, and Bombelli (526). Although the discovery of the solution of the third and fourth degree equations gave much visibility to those involved in the exchange of the "cartelli di matematica disfida"³ (87, 89, 261, 335, 338), it does not seem that it improved the social status of mathematicians to any noticeable extent (80, 82, 315). Similarly, it is quite difficult to evaluate what impact Tartaglia's work on ballistics may have had on the improvement of the social status of mathematicians. Whatever that impact might have been, by looking at Tartaglia's will it does not seem that the *Nova scientia* had turned him into a rich or socially distinguished person (193).

I believe that a far more important cause of the 'speciation' of 'lower mathematicians' into socio-professionally higher roles was the Italians' realization of the cannon's coming of age as a strategic weapon with Charles VIII's invasion of Italy in 1494. The realization that the political independence of the many Italian cities and small states could last only a half-day shooting was a political and cultural trauma (well described by Machiavelli) that found a partial but extremely prompt and welcome solution in the discovery around 1500 of the bastion — the cannon-proof system of fortification (275, 278, 280, 316, 327, 388, 397). Compared to that of medieval fortifications, the design of artillery-resistant bastions required mathematical skills superior to those typical of medieval and early-Renaissance empirical engineers or masons. This, together with the political pressure on the quick rebuilding or upgrading of most Italian fortifications, was probably the single most important cause of the conspicuous increase in size and status of the community of applied mathematicians (105, 139, 406, 408–10).

The introduction of these new fortification techniques triggered the transformation of the traditional empirical military engineer, such as Taccola, into a mathematically literate one, such as the Sangallos. More importantly, the cannon-syndrome and the introduction of the bastion forced the *milites*, the professional warriors of aristocratic origins, to begin to rely less on their horses and more on Euclid for their survival as a distinct social group. Francesco Maria della Rovere, Giulio Savorgnan, and Guidobaldo del Monte are good examples of this group of mathematically-literate aristocrats.

The cannon improved mathematics' social standing in different ways. It

certainly raised the social status of a good number of mathematicians, for we find that several sixteenth century military engineers were ennobled by their princes in recognition of their services (85, 105, 122, 269, 407, 410). Giovanbattista Benedetti was ennobled at the Savoia court, and Francesco Paciotti was made Count of Montefabbri by Francesco Maria II d'Urbino. Guidobaldo's father Ranieri who was the superintendent to the fortresses of the Duchy of Urbino, and who came from a very distinguished aristocratic background but was lord of no specific feud, was made Count of Montebardino by Guidobaldo della Rovere, Duke of Urbino (122, 311).

But the advent of the cannon and of the bastion raised the status of mathematics in less conspicuous but more pervasive ways. As a result of these changes in warfare technology, mathematics entered the education of young aristocrats, as clearly stated in Castiglione's *Book of the courtier* (116). Although we gather from Galileo and Magini's experiences as mathematics tutors of the Medici and Gonzaga that noble youths did not usually retain much of what they had been taught (196),⁴ at least they came to consider mathematics as a necessary if tedious ingredient of their culture (182).

I believe that the mid-sixteenth century transformation of the teaching of mathematics within the major Italian universities was connected to these developments in military technology. For instance, at Bologna, from 1557 to 1568, we find a new *ordinary* chair "ad praxim mathematicae" which in 1569 became an *ordinary* chair "ad mathematicam" absorbing the chair *diebus festis* "ad astronomiam" or "ad astrologiam" (156). Although astronomy and medicine-related astrology were still the focus of the teaching associated to the new chair, one of the early chair holders was Ignazio Danti whose professional background was in applied mathematics (geography, engineering). Danti was also a good astronomer, but his professional interests focused on gnomonics and calendrics rather than on astrology (87, 167, 215). He was not an exception but rather the first representative of a new trend. Danti's successors at Bologna were Cataldi — a former teacher at the Accademia del Disegno of Florence and Perugia — and Magini who, although an internationally known astronomer and astrologer, was also a professional geographer and a student of optics (10, 88, 196, 309, 370, 550).

Similar important changes in the content of the university teaching of mathematics that are probably related to the professionalization of military engineering can also be found at Padua after 1550. In fact, both Catena and Moletti (who had previously been a mathematics tutor to the Gonzaga) began to teach mechanics, hydraulics, and geography together with astronomy and astrology (114, 190, 191, 206, 426, 443).

Therefore, while in the university the 'culture of the abacus' approached that of the astrologers and astronomers, outside the university, on the bastions and at court, mathematics began to be associated also with the *milites* rather

than just with the book-keepers and land surveyors. This made it possible for some mathematicians to try to move from the low status of the *laboratores* to that, much higher, of the *bellatores*. As we will see, this association with the *milites*, especially with their élite, was a strategy differently employed by Commandino, Baldi, Benedetti, Tartaglia and Guidobaldo for the social and epistemological legitimization of mathematics and mathematicians.⁵

We are frequently reminded by the historiography of science that mathematicians tried to find an audience for their knowledge and a market for their skills among professional warriors. Actually, modern warfare was more than a market for sixteenth century Italian mathematicians. It gave them a chance to ennoble themselves and their discipline by partaking in the high social status of the *milites*.

(3) Although it is usually difficult to draw a clear line between the military engineers and other types of construction technicians before the middle of the sixteenth century, we can at least identify a wide range of non-military uses for mathematics. Some of them were connected to major reorganization of cadastres, land reclamation, and water management programs that took place in the sixteenth century. For instance, Ludovico Ferrari — Cardano's protégé — was put in charge of the cadastre of the Ducato di Milano (112, 249). Later in the century, Ignazio Danti was nominated "Cosmografo del Pontefice" and surveyed the northern part of the Papal States (being made Bishop of Alatri as a result) (167). A chair of "cosmography" was established at Ferrara in the 1550s (86, 381, 477), and Antonio Santucci taught cosmography at the Accademia del Disegno in Florence toward the end of the century (46, 550, 482). We also find scattered references to judge-geometers who dealt specifically with water and land-related lawsuits (86, 421).

References to disputes between cities on problems of water management are too frequent to list. In these cases, we find references to "idrostatici" — engineers specialized in waterworks (105, 512). We also have evidence of large scale land reclamation projects such as those of the Val di Chiana — where the algebraist Raffaele Bombelli made himself known (292) — or those of the Tuscan Maremma and of the marshes around Pisa managed by the Medici's corps of civil engineers — the "Capitani di Parte" (495, 496). One should also mention both the increased construction, mostly in the Po Valley, of a network of canals for transportation (259) which involved many engineers (Leonardo among them), and the beginning of a systematic approach to the water management in the Venetian laguna (124, 125, 178, 202). A few decades later, Galileo's disciple Castelli would be employed by Urban VIII on problems of water management in the Papal State.

In short, after 1450, we find a range of large-scale non-military projects which employed and trained a remarkable number of engineers. However, it

does not seem that these types of activities helped to improve the social status of civil engineers as much as the evolution of warfare techniques had done for their military colleagues.

(4) The development of absolutist states in Italy and the related changes in the structure of sixteenth century courts opened another range of possibilities for the improvement of the mathematicians' social status.

In their description of the historical development of northern Italian courts, Cattrini and Romani have pointed to a marked shift in the internal structure of courts in the first part of the sixteenth century (118). They have suggested that the "seigneurial court", typical of the Italian states of the early Renaissance (1400–1500), was still a quite unstructured body. It was a kind of extended family in which bureaucratic and administrative activities were mixed together with other more ideological ones, such as the representation and legitimization of the prince's power.

At the beginning of the sixteenth century, the seigneurial court gave way to the "bureaucratic-ritualistic court" which would remain characteristic of the baroque period. The bureaucratic-ritualistic court differed from the previous types because of the increased separation it introduced between functions of state management and representation of the prince's power. With the bureaucratic-ritualistic court we begin to find a differentiation between the "ufficiali" — usually bureaucrats of bourgeois origins like Galileo's interlocutor, the Medici secretary Belisario Vinta — and the upper "familia" — the court aristocracy. As a result, a status demarcation was introduced between scarcely visible administrators or technicians and the conspicuous courtiers whose etiquette-structured behaviour was instrumental for the representation and legitimization of the prince's increasingly absolute power.

Because of the distinction between administrators or technicians and court aristocracy, the bureaucratic-ritualistic court tended to enhance the status distinction between those mathematical practitioners whose work was necessary for the technical management of the state, and those who, instead, could contribute to the constitution of the prince's image with the production of *mirabilia* such as, for example, theatrical machines or Medicean Stars. But not all court mathematical practitioners could benefit from the opportunities for status improvement offered by that institution. Court teachers of mathematics did not usually play a relevant role in the construction and maintenance of the prince's image, and, as a result, their social status did not improve dramatically over that of the old abacists. However, even these less conspicuous mathematical practitioners gained some social legitimation from the court for it was considered a clear sign of higher social status not to open a workshop and sell to whomever would walk in, but to work at court and to have only one princely patron (101, p. 69).

Instead, the status of the “engineers of the ephemeral”, of the mathematical practitioners professionally associated with the visual artists, profited remarkably from the opportunities offered by the development of absolutist states and by the court structure that reflected such a political change. As shown by Michelangelo’s magnificent public funeral in 1564 in Florence, managed by the newly founded and Medici-controlled Accademia del Disegno, the social status of visual artists had improved remarkably thanks to their role in the increasingly professionalized management of the codes of the prince’s absolute power (25, 34, 47, 56, 65, 84, 528). The Florentine Giulio Parigi — a contemporary of Galileo — is an example of an engineer who specialized in the design of theatrical machines rather than fortifications (34, 401). But it is with Galileo that we probably find the best example of this kind of mathematical practitioners who were producers of courtly ‘mirabilia’. With his “impresa” for Cosimo II’s wedding, which presented a lodestone’s attractive force as a metaphor for the ‘naturalness’ of the Medici’s absolute rule, Galileo showed he understood that ‘scientific mirabilia’ were best rewarded if they fitted the discourse of the prince’s power.⁶ Similarly, he was able to obtain an exceptional reward from Cosimo II for the discovery of Jupiter’s satellites because of his familiarity with the Medici dynastic myths and imagery that, from the mid-sixteenth century, made ‘Jupiter’ and ‘cosmos’ into symbols for the founder of the dynasty — Cosimo I. Galileo did more than name the new stars after the Medici: he was able to present them as perfectly fitting the Medici discourse of the (problematic) legitimation of their absolute rule.

To sum up, the bureaucratic-ritualistic court was instrumental in improving the social status of mathematical practitioners in several ways, but we should not forget that the options for social legitimation it offered were not open to everybody. In a sense, the court relaxed certain socio-professional boundaries while making others more rigid. On the one hand, the court was space where the prince dictated his own hierarchies and where the guild-related hierarchy of professions or the university organization of liberal discipline need not apply. At court one’s social standing was determined by the prince’s favour and not by which guild one was registered in or which discipline one taught at the university. On the other hand, the baroque court introduced an increasingly sharp distinction between the “ufficiali” and other non-noble technical workers, and the “upper familia” — the court aristocracy. Titles such as “Matematico del Granduca”, “Ingegnere Ducale”, “Ingegnere Maggiore”, or “Cosmografo del Papa” are signs of a remarkable status *within one’s profession*, but they do not mean that the person was part of the court ‘upper familia’. Those titles do not imply that these mathematicians became court gentlemen.

The baroque court produced élites among mathematical practitioners, but — in general — it also kept these professional élites well separated from court social élites. In fact, when we find military engineers who had access to courtly upper families, as in the case of Paciotto da Urbino (269, 407), Muzio Oddi (269, 405, 480), or Guidobaldo dal Monte (311, 324), it usually means that they had an aristocratic background. They had access to the upper familia *qua* aristocrats rather than *qua* mathematicians.

An example may help to make this point clear. In January 1590, Guidobaldo — who was then the *Visitatore* of the Tuscan fortresses — arrived in Livorno by sea from Genova and was a guest in the Medici fortress. During meals, he was waited on by *staffieri* and his table was set with silver dishes and silverware. The four servants who accompanied him did not share his table. Instead, they had their meals in the *tinello*. Five of his horses were kept in the stable. He was a guest in the Medici fortress for twenty-eight days, until he left Livorno on 9 February with a horsecarriage made available to him by the Medici.⁷

Still in Tuscany, on September 1603, we find the *Cosmografo del Granduca* Matteo Neroni listed among those who ate at court in the *tinello* (the table-class at which Guidobaldo's servants ate their meals in Livorno).⁸ Margutte, the court dwarf, ate with him. These sources do not mention Ostilio Ricci — Galileo's former teacher — for he had died a few months before, but state that all the teachers of the pages (and Ricci was one of them) ate in the *tinello* as well.⁹ Between the *tinello* and the table of the Grand Duke (the table at which Guidobaldo's younger brother Cardinal Francesco Maria used to eat when in Florence) we find the *tavolino de' Camerieri*, the *tavolo delle Dame*, and the table of the household of Prince Virginio Orsini.¹⁰ The social distance between technicians and upper familia, between mathematical practitioners like Ricci and Neroni, and aristocratic milites-mathematicians like Guidobaldo, is strikingly reflected in the physical distance of their seatings at the Medici table.

However, there were mathematicians who managed both to get close to the upper familia and to take advantage of the court relaxation of disciplinary boundaries, ending up with titles that were exceptional for mathematicians. Galileo was one of them. In no other place than a court could Galileo have obtained the title of "philosopher". Certainly not at the university, where the same astronomical discoveries that made him into a courtly celebrity were attacked as a potential threat to the established hierarchy among liberal disciplines.

But Galileo was not the only mathematician who managed to cross the boundary between mathematics and natural philosophy thanks to the opportunities of professional legitimation offered by the court. At the Savoia court in Turin, Benedetti (another mathematician who trespassed into the philosopher's domain by developing a dynamics) obtained patents of nobility and the

title of “ducal philosopher” (174, p. 35; 422, p. 155). Westman’s work on the role of sixteenth century astronomers suggests comparable (although less marked) attitudes among northern European court astronomers. It may be worth noticing that the two Italian mathematicians who gained the title of philosopher at court had (or could claim) some degree of nobility. It could be that a somewhat patrician background helped them cross the social and disciplinary boundaries in order to gain legitimation as philosophers. It would be interesting to ask whether a ‘working class’ mathematician such as Tartaglia could have ever become the Philosopher and Mathematician of the Grand Duke, had he discovered the satellites of Jupiter.

These considerations on the opportunities for social legitimation offered by the baroque court help us understand an apparently unrelated phenomenon: the peculiar humanistic character of the late sixteenth century “Urbino School” of mathematicians. As I will indicate later, by playing humanists, by writing in Latin rather than Italian, Commandino, Guidobaldo, and Baldi were trying to drop the ‘mechanical’ connotation of their profession and to develop a courtly image for it. Although, unlike Galileo, they did not produce ‘mirabilia’, they still tried to utilize the possibilities for legitimation offered by the court by adopting its discourse, its ‘style’.

STATUS-CARRYING SIGNS

Although we may be tempted to consider both Guidobaldo and Tartaglia as belonging to similar categories of mathematical practitioners, for they both wrote on mechanics, encouraged the revival of knowledge of Archimedes’s work, and were interested in the application of mathematics to warfare technology, we cannot forget that they lived in two radically different worlds. What distinguished them was not just their different approaches to mechanics, but their remarkably different social identities and statuses. For the same reason, when we represent Cardano and Tartaglia as ‘algebraists’ because they were both working at the solution of third degree equations, we gloss over major differences in their socio-professional identities. Cardano was a university professor of theoretical medicine, while Tartaglia was a public teacher of practical arithmetic and geometry (203, 237). Similarly, how can we group professionally Danti and a physician-astrologer just because they both studied and used Sacrobosco?

Although it is quite possible to develop a typology that would relate mathematicians to intellectual traditions and to their canonical texts, such a map would say little about their social status and about their strategies for the social legitimation of their theories. Familiarity with the work of Euclid or Archimedes was not a relevant sign of social status or credibility. Thorough knowledge of the canonical texts of one’s discipline was not enough to give

access to environments such as courts' élites where professional and social credibility was distributed. But neither can we establish a rigid connection between the social status of a given 'type' of mathematicians and the social class they belong to. As shown by biographies of military engineers, individuals with quite different social backgrounds belonged to the same profession.

Besides these difficulties in integrating social status and intellectual tradition within the categories of a typology, we are also confronted with a true proliferation of types of mathematicians. For instance, first for lack of specialization among disciplines and then for the patronage-related necessity of playing different professional roles, we find a range of remarkably varied combinations of professional identities: teachers of mathematics and Greek (Luca Valerio), or oriental languages and mathematics (Raimondi), physicians, mathematics tutors, translators of mathematical texts (Commandino), mathematicians and theologians (Catena), poets and mathematicians (Torquato Tasso), humanistic historians and mathematicians (Bernardino Baldi), and grammarians-historians-mathematicians (Francesco Maurolico).

The scenario does not get less complex when we switch our attention from specific practitioners to professional categories such as that of 'military engineer'. In fact, we find that some of them were aristocratic warriors like Francesco Maria della Rovere, Giovanni de' Medici, or Galileo's student and friend Daniello Antonini, some were or had been gunners or low-ranking artillery officers usually of unimpressive social background, some — like the Venetian *proti* — were higher masons, while the rest were architects specializing in fortifications (34, 133, 139, 295). Moreover, not all these practitioners were continuously involved in warfare activities. Others, like Michelangelo or the Sangallos, did not devote their entire lives designing or building fortifications.

Instead of providing intricate and probably uninteresting 'natural histories' of Italian mathematicians according to social status or intellectual traditions, I propose to look at a series of status-signs whose combination may give some indication of the socio-professional identities of the practitioners who display them. I gather these status-signs under three major headings: (1) Places; (2) Disciplinary and professional traditions; and (3) Social background.

1. *Places*

Places are the contexts in which our subjects carried on their professional activities. In general, such places were: (a) the city; (b) the university; (c) the court; and (d) the fortress or the battlefield.

These categories give clues about the other socio-professional groups the mathematicians came into contact with and which shaped their possibility of access to social legitimization. For instance, there was an important difference

between being a *maestro d'abbaco* in a *bottega*, a teacher of arithmetic at the university, or an instructor of the court's *paggi*, despite the fact that the professional competence and training required for these activities were often the same. Similarly, the social status of a court astrologer such as Luca Gaurico was higher than that of an astrologer-physician practising in the city, although they may have held a doctorate in arts and philosophy from the same university. A similar relationship between place and status can be found among sixteenth century military engineers. Guidobaldo was the supervisor of the fortresses of the Grand Duchy of Tuscany for a few years, but, although in charge of the maintenance of fortifications, he was not the kind of military engineer who was excluded from urban or courtly life. He did not spend his entire life participating in military campaigns abroad or managing a fortress in some remote part of the Grand Duchy.

Although it would be problematic to identify a detailed hierarchy among these various places in terms of their status-enhancing features, there is no doubt that the court stood at the top of such a hierarchy.

2. *Disciplinary and Professional Traditions*

The disciplinary and professional traditions to which we can often relate the mathematicians of the period under study are (1) the tradition of medicine and astrology, and (2) that of the *bottega d'abbaco* — the often non-university teaching of practical mathematics. Although the distinction between these two traditions became somewhat blurred toward the end of the sixteenth century, it was quite sharp in previous periods. Consequently, it offers a reliable starting point for our analysis.

To the first tradition we can refer university professors of astronomy or astrology who usually taught medical students in an art faculty. Court astronomers or astrologers can be also placed within this 'higher' tradition. Instead, to the 'culture of the abacus' we can refer the professional figures of the *abbacist*, the land surveyor, the engineer, the "idrostatico", and the cartographer.

Association with one of these traditions is strongly indicative of a mathematician's status. This is particularly true in the early Renaissance when the distinctions between professional 'castes' were often rationalized in terms of different levels of nobility of intellectual traditions. The professional caste one belonged to was far more important in determining one's social status than either the actual knowledge required by his profession or the level of one's education.

For instance, although late fifteenth century teachers of elementary arithmetic at the University of Bologna were required to have university degrees, we

find that in the rotuli their names are only rarely preceded by a “magister”. Instead, professors of law are presented as “domini” and those of medicine as “domini et magistri” (156). Also, the stipends of arithmetic teachers — often one-tenth of those of physicians or jurists — did not reflect their academic training. Therefore, socio-professional status did not depend only on knowledge or formal training but also on the place that profession occupied within the hierarchy of university disciplines or of crafts within the urban guilds.

Around 1500, Euclid was taught in astrology courses within university curricula in medicine as well as by abacists such as Pacioli, but that did not help reduce the gap in social status between those two professional traditions. The gap in status between the ‘celestial’ and ‘terrestrial’ mathematicians cannot be explained simply in terms of different canonical texts or of *intellectual* traditions. Instead, it can be better understood as a result of traditional *social* taxonomies, of professional caste-systems and of the correspondent classifications of knowledge. Also, the status gap between these two professional castes of mathematical practitioners did not depend simply on the old distinction between mechanical and intellectual activities. In the many sixteenth century debates on the status of different arts (medicine, law, visual arts), ‘abstractness’ or ‘mechanicity’ became little more than rhetorical tropes which told more about the relative power of a profession that called itself ‘abstract’ and the other ‘mechanical’, rather than about the actual ‘abstractness’ or ‘mechanicity’ of the so-judged discipline.

The ‘nobility’ of the subject matter was also a factor in determining a discipline’s status. For instance, the astronomers’ subject matter was quite literally more ‘elevated’ than that of the abacist. In general, status of a given subject matter was also an issue of social connotation. For example, especially in the Middle Ages, the low status of the surgeons was a result of both the perceived empiricity of their craft and of the pollution generally associated with arts that handled blood.¹¹ Similarly, a recurrent theme in the fifteenth century debate between Italian lawyers and physicians about the relative status of their disciplines was that medicine had an inferior status because of the physicians’ unclean dealings with urine (in Renaissance England physicians were sometimes called “pissprophets”) (239, 508, 374). Galileo’s attempt to deconstruct the cognitive monopoly of theologians with the “Letter to the Grand Duchess” belongs to this tradition of debates on the relation between the status of professions and their subject matter. In the “Letter”, Galileo argued that theology could be said to be the “Queen of disciplines” only in relation to its subject matter. Instead, by considering its poor ‘method’ and the consequent uncertainty of its claims, theology could no longer be granted primacy over other liberal disciplines such as mathematical astronomy.

These debates about the cognitive and social status of the arts seem to display some recurrent features. The ‘conservatives’ (the professional groups with higher social status) tend to take *subject matter* as a sign of the discipline’s standing — like blood with the surgeons, urine with the physicians, or sacred scriptures with the theologians. Instead, the ‘challengers’ (being the surgeons, the physicians, or Galileo) base their claims for higher professional status on the public utility, level of certainty, and *method* of their disciplines.

Issues of method and subject matter did not only demarcate abacists from university or court astronomers. Similar issues were also invoked to justify the lower status attributed to mathematics in comparison to philosophy. Not only did mathematicians work mechanically (they *measured* and made *calculations*) but the subject matter of their discipline was ‘lowly’ too. Mathematics dealt with quantities, that is, with the accidents rather than with the essence of things. Quite differently, philosophers dealt with the essential qualities and drew logical conclusions from them. Therefore, the debate *de certitudine mathematicarum* that developed in Italy after 1550 was not a philosophical fashion that spread among university professors and academicians. By taking a sociological perspective, we can understand it also as the result of status-related tensions between mathematicians and philosophers. Attached to the cognitive status of mathematics and logic we find the socio-professional standing of their practitioners (150, 160, 234, 250–5, 289, 558).

I think that the stress mathematicians put on method and certainty of knowledge rather than on the subject matter of their discipline was not only aimed at obtaining cognitive emancipation. Emphasis on method may have worked as a slogan for the unification of the various mathematical professions which differed in subject matter, social status, or ‘guild association’. Galileo’s references to his colleagues as “matematici” rather than “astronomi”, “ingegneri”, “geografi”, or “idrostatici” may have something to do with this issue. In their successful attempt to gain social legitimation, the sixteenth century Italian artists adopted a similar strategy.¹² In *disegno* they found not only a professionally unifying common denominator for painting, sculpture, and architecture, but also a strong argument to support their claims of the ‘scientificity’ of their profession. Thanks to *disegno*, the visual arts found their theory and could put social distance between them and the mechanical crafts (47, 550).

In the case of the mathematicians, such a ‘call for unity’ under a common method was not simply an aspect of the process of professionalization but it may have contributed to the conceptual synthesis of the two traditions of ‘celestial’ and ‘terrestrial’ mathematicians. The well-known unification of terrestrial and celestial mechanics hinted at by Galileo and successfully achieved by Newton not only integrated two sets of problems and related theories but also sanctioned the unification of two different groups of

mathematical practitioners that had previously been kept separate also by a gap in social status.

Without some attention to the different social status associated with the caste of the physicians-astrologers and with that of the abacists-engineers, as well as to the tensions deriving from these social distinctions, we may miss the actual significance of apparently purely scientific disputes such as that between Tartaglia and Cardano. When Tartaglia attacked Cardano in the 1540s, the latter was no longer an obscure figure, but a controversial member of the medical élite. Whatever we may think of him, Cardano's professional reputation must have been outstanding if he was offered a chair of theoretical medicine at such a distinguished university as Bologna's and if he was invited to Edinburgh from Italy for a medical consultation (158).

It is significant that Cardano neither accepted nor explicitly dropped Tartaglia's challenge. He did not want to reply to a 'lowly' abacist and passed the matter to Ferrari. Ferrari was then an applied mathematician in charge of the cadastre of the Ducato di Milano to whom the victory over the better-known Tartaglia may have meant an improvement in professional reputation. A mathematical challenge between Ferrari and Tartaglia would have been *inter pares*.

Interestingly enough, Tartaglia did not send the answers to Ferrari's cartelli or his own new contro-cartelli to Ferrari but rather to Cardano. Tartaglia wanted a cross-caste "disfida": by defeating Cardano, he also hoped to gain social legitimization and to move (status-wise) from the culture of the abacus to that of the physicians. Instead, he would not have reached his goal by winning against his almost socially equal Ferrari.

Bortolotti believes that Tartaglia's initial rage was not triggered by Cardano's publication of his 'secret' — the solution of third degree equations. The disclosure of a secret was a gift whose customary value could compare to that of a victory in a dispute. Important favours could be exchanged for trade secrets. Probably, Tartaglia expected Cardano to introduce him into socially higher circles in exchange for the gift of the 'secret' which, instead, he did not (89). This violation of the tacit rules of gift-exchange may have been the major cause of Tartaglia's reaction.

As suggested by this example, the implications of the different social statuses associated with these two traditions informed the interactions among mathematicians and between mathematicians and other socio-professional groups. Finally, the width of the gap in social status among these two mathematical traditions cannot be overestimated if we find that in thirteenth century Florence, the College of Lawyers and Notaries stated that no heretic, perjurer, slave, jester, prison-guard, grave-digger, beggar or landsurveyor could be accepted as a member (163).

3. *Social Background*

In general, the social background of Italian mathematicians in the period under consideration can be associated with one of these social groups: (a) craftsmen, (b) physicians and urban professionals (c) small or landless aristocracy, and (d) urban patricians.

A preliminary survey indicates that those remarkably migrant sixteenth century military engineers tended to be members of the lesser aristocracy, younger or illegitimate sons of princes, and craftsmen. We also find a definite hierarchy between aristocrats and craftsmen within that same profession. Instead, very few members of the upper bourgeoisie became military engineers. By contrast, physicians-astrologers tended to be city dwellers, of bourgeois background, often sons of other physicians-astrologers. Sons of lawyers, merchants, bankers, are also found among physicians. Finally, abacists were — and generally remained — craftsmen.

Social background is also important in evaluating one's degree of influence within the profession or one's ability to cross disciplinary boundaries. For instance, Paolo dal Pozzo Toscanelli was a physician-astrologer by training, but his notoriety and conspicuous connections with culturally and politically influential figures certainly had something to do with his inherited wealth. We know that he set up a bank with his nephews, and that he was a partner with such wealthy Florentines as the Medici, Capponi, Soderini, and Guicciardini in a company for the exploitation of a copper mine at Montecatini Val di Cecina (520).

Social background made a major difference even among military engineers. It not only influenced their positions and stipends but — more importantly — it regulated their access to power through connections at court. For instance, it was the engineer-marquis-count Guidobaldo del Monte, rather than the craftsman-engineer Ricci, who secured Galileo the chairs at Pisa and Padova through his brother, the Medici-bound Cardinal Francesco Maria. In short, access to professional élites was usually regulated by criteria of social and economic status.

A SKETCH FOR A CASE STUDY: THE URBINO SCHOOL OF MATHEMATICIANS-HUMANISTS

I will now use some of the earlier considerations for an interpretation of the puzzling phenomenon of the mathematicians and humanists of the Urbino School.

Rose has produced a remarkably rich picture of the activity of this school but, I think, he has taken too 'realistic' an attitude about the concept of 'humanist' to the point of using it as an *explicans* rather than as an

explicandum. As a result, it almost seems that Commandino, Baldi, and Guidobaldo worked so hard at retrieving Greek texts from oblivion because they were humanists and that was what every good humanist should have done (440, 442).

Instead, the historiographical perspective of Drake and Drabkin's work on sixteenth century Italian mechanics puts emphasis on the technical dimensions of the mathematical texts of the period rather than on the socio-cultural context of their production (174). To them, sixteenth century Italian texts of mechanics fall easily into two distinct intellectual traditions followed in two different parts of Italy. Cardano, Benedetti, and Tartaglia are the representatives of the first tradition. They all operated in northern Italy — mostly between Venice and Milan — and shared a similar 'practical' perspective on mechanics and a common interest in dynamics. They also relied on the work of Jordanus and the impetists, and were often critical of Aristotle's theory of motion.

Drake and Drabkin have identified another 'school' centred in Urbino and constituted by Commandino, Guidobaldo, and Baldi. Unlike Cardano, Tartaglia, and Benedetti, this second group focused almost exclusively on the restoration of the classical tradition of Greek mathematics through philologically accurate translations from manuscripts. Archimedes's statics rather than Jordanus's dynamics was the foundation of their work in mechanics. In fact, looking back to Hellenistic science with a 'purist' perspective, the Urbino School dismissed all sorts of medieval contributions to mechanics and rejected in particular the work of Jordanus and of the medieval tradition of the science of weights. To Baldi, the teaching of Jordanus was barbarous and involved false (i.e. dynamical) assumptions (174, p. 50). What the two 'schools' had in common was a strong — though differently focused — interest in Archimedes's work.

These two schools had a peculiar interaction, one that is not made clear by Drake and Drabkin's 'intellectual history' paradigm. According to them, "no member of either group seems to have had a good word to say about any member of the other. Indeed, the two groups appear to have been scarcely aware of one another's existence..." (174, p. 13). I find it puzzling that a strongly critical attitude could exist side by side with ignorance of the competitors' existence. Drake and Drabkin seem to have read as actual ignorance what was only rhetorically presented as such. By taking into account issues of socio-professional status, we may instead uncover the more complex social dimensions of the interaction of these two 'schools' and of their quite different conceptual styles.

First, it is important to note that Urbino was a somewhat peculiar place for mathematics. Since the mid-fifteenth century, it had been a centre of military engineering well supported by a series of belligerent princes. During the

sixteenth century some of the Dukes of Urbino turned into professional warriors, usually at the service of the Republic of Venice and the Pope. As a result, the Urbino region produced many well-known military engineers such as Veterani, Centogatti, Commandino (father), Lanci, Castridi, Bellucci, Spaccioli, Vagnarelli, and the various members of the Paciotti and Oddi families (57, 404, 405, 407, 408, 410). Even Ostilio Ricci, Galileo's teacher, was from that region (544). Among the princes who lived in the period of the Urbino School, we find Francesco Maria della Rovere, nephew of Pope Julius II, General Captain of the Venetian army until his death in 1538, and designer of the new Venetian system of fortifications of the *terraferma* (139). Not only was Tartaglia's *Nova scientia* dedicated to him, but he was also the author of several questions answered in the *Quesiti et inventioni diverse*. His son, Guidobaldo II, followed the father at the service of the Venetian Republic to become the chief of the papal army in 1553. For a period, Commandino was his physician and the mathematical tutor of his son Francesco Maria, the future Duke of Urbino (26, 28).

Second, but no less important, Urbino had a relatively small but sophisticated court. It provided the scenario for Castiglione's *Book of the courtier*.

Third, Commandino, Baldi, and Guidobaldo were aristocrats born to families of professional warriors. While Baldi and Commandino came from old but not particularly wealthy families, Guidobaldo was a member of the Italian aristocratic élite. It seems that around 1014 a Ranieri del Monte was ruling over the whole of Tuscany (311, Tav. I). By the end of the sixteenth century the Del Monte family, by then grown into many branches reaching over Umbria, southern Tuscany, and the Marche region, still controlled important feudal benefices. But the family was too large to have enough lands to accommodate all its male members. As a result, a remarkable number of Del Montes were employed as professional warriors all over Europe. Giovanni Battista, who was influential in securing Galileo the job at Padua, ended his career as General Commander of the Venetian Infantry — a rank he obtained in 1587. He was 13 when he first fought in the Medici war against Siena. He then served the king of Spain, fought in north Africa, at the liberation of Malta, and became the Commander of the Guards of Pope Paul V. For a short period, he was also in France fighting the Huguenots (311, Tav. XII). Among the many Del Montes who had conspicuous military careers we find Francesco who was the General Commander of the Tuscan Infantry in the 1610s and Bartolomeo who was the Captain of the Tuscan Cavalry in the same period.¹³ Guidobaldo's uncle Montino was also a warrior. He fought for the Della Rovere, was the Commander of the Papal army in Umbria during the pontificate of Pius IV, and became Colonel of the Venetian Infantry in 1565 (311, Tav. VI).

Like his father and grandfather, Guidobaldo's son Orazio (a friend of Galileo in Florence during his stay there as a court page) ended his military career as Superintendent to Fortresses (this time for Venice) and died fighting for the Venetians in Candia in 1614 (311, Tav. VII). Therefore, it is not surprising to find that Guidobaldo's father Ranieri had been a colonel in the army of the Duke of Urbino and the superintendent to his fortresses. As we have seen, it was as a reward for his military services to the Duke that Ranieri was given the feudal benefice of Montebardino which he passed on to his oldest son, Guidobaldo (311, Tav. VII). Given the pattern of professional careers displayed by the Del Monte, it is not difficult to understand why Ranieri had the young Guidobaldo study mathematics with Commandino. However, Ranieri did not spend his entire life on the battlefield but participated in Urbino's courtly life. The poet Aretino dedicated one of his works to him (311, Tav. VII).

Commandino's ancestors had been *milites* as well. His grandfather served under Federico d'Urbino (after whom our Commandino was named). His father Battista is remembered as one of the engineers who designed the new fortifications of the city for Francesco Maria della Rovere, the Duke of Urbino to whom Tartaglia dedicated his *Nova scientia* (269). We also know that Commandino at some point of his career followed the Farnese in military campaigns both as a physician and as a mathematics advisor.

Similarly, in 1571 the young Guidobaldo participated in a military campaign led by Francesco Maria II against the Turks. Fortunately for the history of science, a serious illness he contracted at Messina on the way to the east put an end to his active military life. The feud of Montebardino which he had inherited from his father Ranieri allowed him *not* to pursue the military career typical of most of his relatives.

In short, both Commandino and Guidobaldo are good examples of that category of *milites* whose culture incorporated mathematics as a result of the increasing strategic importance of the cannon and the bastion. And, as typical of their social class, they were also dwellers in sophisticated courts, Urbino's among them. Therefore, they had a humanistic background and knew Latin and Greek, because humanism was the dominant court culture and the *studia humanitatis* were the standard pre-university training of their social group (561). But we also need to remember that both Commandino and Guidobaldo moved away from active military life. In particular, Commandino and Baldi's careers were typical of courtiers. Commandino spent most of his life in the entourages of princes, cardinals, and popes in such diverse places as Urbino, Parma, and Rome. And he must have been a skilled courtier if, until Clement V's death in 1534, he was his *cameriere secreto*.

If Guidobaldo seems less of a courtier than Baldi and Commandino it is because he was much more powerful than his two fellow mathematicians and

did not need to get a job at or through the court. As far as we know, Guidobaldo did not have 'jobs' in his life except that of *Visitatore* of the Tuscan fortresses which he kept for a few years only. He was a typical court aristocrat. By marrying Duke Guidobaldo della Rovere's illegitimate daughter Felice, Guidobaldo must have had privileged access to the Urbino court and, as we have seen earlier, he was treated as a distinguished visitor by the Medici as well. Also, we find him among the selected guests to the 1589 wedding between Ferdinando de' Medici and Cristina of Lorraine—the famous "Grand Duchess". Last but not least, he was the older brother of the powerful Cardinal Francesco Maria, and he must have been quite well known in courtly circles if Torquato Tasso wrote for him the sonnet *Misurator de' gran celesti campi* (311, Tav. VII).

My hypothesis is that the Urbino School's humanistic concern for restoration of Greek mathematics is a direct reflection of the 'courtier gestalt' of its members. The ennoblement of mathematics through the rediscovery and celebration of its famous classical ancestors was necessary to present their professional identity as fitting the upper crust of court society. The humanistic approach of the Urbino School constituted at the same time a philological program and a process of preservation and confirmation of socio-professional identities. This interpretation of the sociogenesis of the Urbino mathematical style is supported by the existence of analogous strategies for professional ennoblement (or prevention of corruption) developed by *milites* socially close to the Urbino School who also stressed the need for rediscovering and restoring the culture of their classical professional ancestors.

For instance, in the *Trattato delle fortificazioni de' nostri tempi* (c. 1553), another Urbinate, Gian Giacomo Leonardi, claimed that the problems with contemporary fortification techniques resulted from the corruption of the doctrine of Vitruvius and of the 'classical' Roman military engineers. He attributed such a corruption to medieval engineers—the 'empirics' of fortifications. The recipe for a perfect science of fortifications proposed by this *cavalier filosofo* was based on an integration of a restored Vitruvius with the mathematical techniques made necessary by the increasing strategic importance of artillery and bastions (139).

By looking at Leonardi's biography, we understand that the homology between his proposed Vitruvian renaissance and Commandino's Archimedean restoration with the exclusion (in both cases) of medieval 'barbarian' contributions is not casual. Leonardi—who had an aristocratic background—was the Urbino ambassador in Venice at the time Francesco Maria della Rovere was the General Captain of the Venetian army. Among his patrician friends we find Daniele Barbaro, the translator and commentator of Vitruvius. In Venice, he often acted as the official spokesman of his prince Francesco Maria and worked in close association with him at fortification planning and

construction supervising. His views on fortifications are usually considered a humanistic articulation of those of Francesco Maria. This makes his *Trattato* a significant piece of milites' 'philosophy' (or politics) of fortifications.

Leonardi had a clear view of the disciplinary and social hierarchy involved in the design and construction of fortifications. To him, the *Gran Capitano*, the aristocratic warrior was the head. The architect, instead, was the hand (139, p. 57). The architect's duty was limited to visualizing ("disegnare") the 'concept' developed by the *Gran Capitano*. He — together with many other aristocratic theorists of fortification — had no doubt: *res militaris* came before *res aedificatoria*. The milites came before and stayed above the technicians. If this order were violated, if "mindless architects" or "painters who call themselves engineers" (139, p. 57) were given priority over the milites, then fortifications (and social hierarchies) would crumble. To him, mathematics and the knowledge of the 'classics' such as Vitruvius were the foundations of the new science of fortifications. Such a knowledge demarcated the milites from the empirical would-be engineers who — Leonardi thought — were unable to give rational accounts for their technical choices.

This scenario suggests that, by association with the culture of the milites, mathematicians had a chance of sharing in their high social status. But this did not necessarily fit the milites' interests. If the milites needed to include mathematics (or seemed to do so) in their professional culture so as to be able to justify 'rationally' their higher social status by presenting themselves as having the 'scientia' necessary for the design of fortifications, they certainly were not interested in having lower mathematicians enter their privileged social group. That alleged familiarity with the 'scientia' of fortifications became a kind of ideological emblem of the milites rather than an actual professional skill is indicated by the emergence of a conspicuous group of aristocratic 'virtuosi' of fortifications. Probably, the sixteenth century fashion of collecting fortifications' drawings and plans may be also related to the emergence of these fortification virtuosi (304, 305).

But if *mathematics* entered the culture of the milites either as a skill or a *virtù*, the doors of their social group were closed for lower-class *mathematicians*. In fact, Leonardi's contempt of the empirical engineers (or Commandino and Guidobaldo's dismissal of Tartaglia and the followers of Jordanus) was also a strategy for the preservation of social distinctions. As a result, the non-milites engineers were presented by their aristocratic colleagues as more empirical than they actually were. In turn — as shown by Leonardi's text — the milites presented themselves as unrealistically 'theoretical'. Personally, I find it hard to believe that Leonardi or Francesco Maria della Rovere were *higher mathematicians* than military architects such as Sangallo, Sanmicheli or Michelangelo in any other sense than that they had a *higher social status*. Similar considerations may also apply to Leonardi's dubious

praise of the ancients' knowledge in fortifications. I would suggest that such a mythification of Vitruvius had more to do with his being Augustus Caesar's "Captain of Catapults" than with the technical relevance of his work (174, p. 251).

Leonardi's *Trattato* represents an attempt of mathematically literate *milites* to lower the status of the empirical mathematicians so as to raise (or to maintain) their own during an historical conjuncture in which technological changes created the possibility of a 'status pollution' between two distinct social groups.¹⁴ That the structural similarity of the responses of Leonardi and the Urbino School to the alleged 'empirics' of their profession is not a coincidence but rather the reflection of a common need to preserve their socio-professional identities challenged by technological changes is also supported by the fact that they belong to the same social group. In fact, we know that Leonardi's wife — the Countess of Montelabate — was Guidobaldo's brother's godmother (139, p. 209).

Also, the socio-historical meaning of the myth of the classic sources of the science of fortifications cannot be reduced by taking it as the result of Leonardi's idiosyncratic views. In fact, in 1542 the Accademia dei Virtuosi del Pantheon was founded in Rome with the sole purpose of discussing and praising Vitruvius's work (304). Among its members we find engineers, architects, and aristocratic milites. It is also significant that Barbaro, the translator and commentator of Vitruvius, was the son of a patrician commander of the Venetian fortress of Verona and — between 1539 and 1540 — a supervisor of the Venetian Arsenal (139, p. 210). Shortly, Vitruvius became a sort of cultural emblem for the milites as Archimedes did for the Urbino School. The quasi-mythical status that both Leonardi and the Urbino School conferred on their classical professional ancestors did not reflect only technical appreciation.

Other related forms of social change took place in that same period. Sixteenth century Italy experienced a process of so-called 'refeudalization' in which urban patricians of merchant origin were progressively transformed into court or landed aristocracy (62, 536). In that process, not only did they move their capital away from decaying commerce into real estate, but they also adopted aristocratic life style and values. This change was reflected in the reorientation of the education of the urban patricians towards milites' values. In some cities, military (or military-style) academies were opened (62, 63, 279). At one of them — the Accademia Delia at Padua — Galileo tried unsuccessfully to teach mathematics (191 vol. ii, 342).

The most significant example of this new educational trend was the numerous *seminaria nobilium* successfully introduced by the Jesuits in the most important Italian cities. Their curricula included aristocratic arts such as horse-riding, fencing and dancing as well as the usual humanistic and

mathematical disciplines (97, 142, 143, 191 vol. i, 197). Patrician teenagers who a few decades before would have been sent to work in the family's *banco* were now fashioned into court gentlemen by the Jesuits. Owing to the increasing prominence of court society and culture, the status of the milites became particularly appealing. As an instrument, mathematics entered their culture from the beginning of the century. Now, following this socio-cultural trend of refeudalization, it needed to be presented in a courtly style. The program of the Urbino School also reflected this concern.

That Commandino, Baldi, and Guidobaldo were not representative of an upward-moving new social or disciplinary group, but rather the members of a very old class in search of confirmation and improvement of its role in a changing court structure and technological context, is also suggested by the relative conservatism traceable in some aspects of their work. For instance, with the exception of Baldi's biographies of mathematicians, their texts were not originally written in Italian although their audience was not expected to be European. And this in a period when Italian was already the most widely-diffused printed language in Italy. In fact, in 1556, Commandino asked Ranuccio Farnese for financial support to complete the printing of Ptolemy's *Planisphaera*, arguing that the project was made expensive by the printers' unwillingness to take risks with texts written in Latin (439).

Similarly, if we read the *Cronica de' matematici* (28) by Baldi, whom we can consider the spokesman and historian of the School, we find that he systematically derides those authors whose poor handling of Greek, Latin, or even Italian exposes their mechanical, low-class background. Writing Tartaglia's short biography, Baldi says that he "cared so little about the literary form that his readers are moved to laughter",¹⁵ and, about the astrologer Prosdocimo de' Beldomandi, he says that "he did not know Greek, and because of this he was criticized by Francesco Barocci [a Venetian mathematical virtuoso friend of Commandino, Guidobaldo, and Clavius] in his *Cosmografia*",¹⁶ or that Pacioli "was a barbarian as far as language is concerned. In fact, he mixed vernacular and Latin terms together without any distinction with the result of corrupting both languages. For this reason, Annibal Caro [a humanist friend of Commandino at the Roman court] called his works 'ashes', because precious things were being hidden under them".¹⁷ Displaying a similar attitude, he says that Benedetti "has been criticized by the most sophisticated mathematicians [Clavius among them] because he did not adopt in his work that method and that purity required by mathematics which was introduced by the Greeks and developed by their followers".¹⁸

Contrary to the opinion of Drake and Drabkin, the members of the Urbino School were perfectly aware of what Tartaglia and Benedetti were up to. Cardano too is mentioned in Baldi's *Cronica*. Also, it is quite significant that the Urbino School expressed their distance from their northern 'colleagues'

mostly through short and dismissive remarks or critiques at a distance delivered by other mathematicians such as Commandino's friend Leonardi (439).¹⁹ Such an isolation was neither accidental nor caused by oversensitive egos. Instead, it reflected a strategy that structured not only their interaction with other mathematicians but, to some extent, also their conceptual framework. For instance, the schools' strong reaction against Jordanus's work and its empirical connotation had some influence on Guidobaldo's work on mechanics. He claimed quite explicitly that Jordanus (and by implication Tartaglia) "should not be reckoned among writers on mechanics" (174, pp. 45–46). Not only did Guidobaldo keep a distance from the socio-professional identity of Jordanus's followers, but he also dismissed their notion of what a 'proper' mechanics should be. Guidobaldo's demarcation is conceptual and social at the same time: what is a conceptually 'proper' approach is not separate from what is a legitimate socio-professional identity.

Consequently, Baldi and Guidobaldo's remarks on the 'low' mathematical practitioners are also expressions of the conservatism of mathematically-literate milites who tried to break the bridges from the embarrassingly 'mechanical' connotation of their culture by adopting a courtly and fashionable concern with linguistic purity which they then extended to cover mathematical 'style'. *Archimedes became their Cicero*. By associating themselves with him (or the mythical representation of him) they were able to present themselves as 'abstract', 'classical', and 'pure' as opposed to 'mechanical', in the same way that the elegant exercises of the martial arts put the crude reality of war in the far distance. In a sense, they wanted to introduce courtly *sprezzatura* into their professional identities.

Baldi's opinions show that the Urbino School wanted to break away not only from those mathematicians who were not their social peers, but also from Benedetti who — although allegedly of patrician origins and a decent Latinist — did not follow the proper, clean method taught by Archimedes. Their peers were elegant and often conservative mathematicians such as Clavius, the Jesuits' chief mathematician; Maurolico, a 'humanist-mathematician' and tutor of mathematics in aristocratic families in Messina; Raimondi, a teacher of mathematics at the Sapienza at Rome, Roman courtier, and director of the "Stamperia Medicea", a creation of Cardinal Medici to diffuse catholicism in the East (463); Luca Valerio, teacher of mathematics, Greek, and rhetoric at the Sapienza; Federico Delfino, a Venetian patrician who taught mathematics to other patricians like Barbaro and Barozzi, who — in turn — taught mathematics at Padua just for the pleasure of it and without asking for a stipend (444).

Their conservatism can be traced in their care in not overstepping the boundaries between statics and dynamics or between astronomy and philosophy. Not one of them (with the partial exception of Guidobaldo) believed or

supported Copernicus's hypothesis as true. Maurolico even went so far as to write that Copernicus should have been whipped for what he had said (448).

Their lack of "philosophical aggressiveness" may be related also to their concern to fit within and maintain the received socio-professional hierarchies rather than to upset them. In fact, they did not criticize Aristotle openly. Baldi even edited the pseudo-Aristotelean *Mechanics*. But it is in Guidobaldo's peculiar mediation between Archimedes and Aristotle (which reminds one of the medieval doctrine of the 'double truth') that we can read most clearly the Urbino School's respect for disciplinary boundaries. To Guidobaldo, there was no conflict between Aristotle and Archimedes. Aristotle did not concern himself with mathematical statics but his work helped establish the physical foundations of mathematical statics. In a perfectly complementary fashion, Archimedes was the authority in statics but did not (and Guidobaldo shared his master's caution) deal with dynamics (174, p. 15). Consequently, the Urbino School's criticism of Benedetti's "impolite" style does not come as a surprise. Benedetti had crossed the boundary between statics and dynamics, displayed his disrespect of Aristotle even in the title of his 1554 *Demonstratio proportionum motuum localium contra Aristotelem et omnes philosophos*, and, at the Savoia Court in Turin, used the title of "philosopher".

As Galileo would later try to distance himself from the astrologers — the black sheep of his professional family who were so embarrassingly close to him — the Urbino schools had to reject the tradition of the 'culture of the abacus' and that of "Jordanus the Barbarian". And, rather as happened to Galileo who went up a blind alley by denying the astrologically connoted role of the Moon in regulating the tides, the Urbino School paid something for its fear of conceptual (and social) pollution from the Tartaglia-like mathematicians.

For instance, Guidobaldo rejected Jordanus's correct theorem on the incline plane because it was "messy", and adopted the wrong but elegant one proposed by the classical Pappus (174, p. 46). The same distaste of anything that reminded him of Jordanus and his followers also had a problematic effect on his work on the lever, for he believed it inadmissible to take the lines of gravitational force as parallel even in a very limited arc of the Earth's surface such as the length of the lever (174, p. 46). Also, it is possible that Guidobaldo's aversion to the tradition of the science of weights contributed to preventing him from developing a dynamics (174, pp. 47–48).

Therefore, the different conceptual styles and the lack of intellectual dialogue between the Urbino Archimedean and the Jordanian schools of northern Italy were also influenced by their different social status and background. But it is also true that somebody like Giulio Savorgnan — an aristocratic miles from Friuli known for his interest in mechanics and warfare machines — seems to have been able to cross the boundaries between the two 'schools' and

to dialogue with both (295). Like his good friend Francesco Maria della Rovere, Savorgnan was the author of a number of questions included in Tartaglia's *Quesiti*, but later in his life he also supported Pigafetta's Italian translation of Guidobaldo's work on mechanics. I think it important to contextualize the sense in which Savorgnan 'dialogued' with both schools to show that his example does not represent an anomaly for the analysis presented above. Pigafetta's 1581 dedication of Guidobaldo's *Mechaniche* to Savorgnan helps in reconstructing such a context.

The dedication contains a very succinct history of mechanics which reflects the Urbino School's conceptual and social perspective as presented in Baldi's biographies of mathematicians. For instance, Pigafetta compliments Jordanus and Tartaglia for their role in keeping the study of mechanics alive rather than for the quality of their contributions. To him, it is only with Guidobaldo that mechanics ceased to be a craft and became a 'science'. Then, by claiming that in his dialogues Tartaglia "introduced many great persons as speakers though sometimes he made them say things of which they were ashamed" (174, p. 252), Pigafetta seems to indicate that Tartaglia's citing high-sounding names as his interlocutors was perhaps more of a self-advertising device than a safe indicator of his high-ranking connections. These somewhat dismissive remarks suggest that the questions and answers presented in Tartaglia's texts did not necessarily reflect a dialogue *inter pares* between Tartaglia and his interlocutors. No doubt, Tartaglia, Savorgnan, and Francesco Maria della Rovere discussed mechanics together. But when talking to Tartaglia it was as if the two milites were talking to one of the engineers they supervised — though an unusually ingenious one. What must have been a technical consultation structured by a strong social hierarchy between the two parts, was publicized as an informal, 'familiar' dialogue in Tartaglia's obviously self-legitimizing narrative. The communication between Savorgnan and Tartaglia was regulated not only by issues of power and credibility within the same profession, but also by a remarkably different social status.

The ephemeral character of Tartaglia's connection to Savorgnan is also suggested by Pigafetta's reminding the reader that in the *Quesiti* Tartaglia answered only a few of the many questions that Savorgnan had sent him. Such an oblique undermining of his professional abilities in the very dedication to Savorgnan suggests that his patron must have perceived his relationship with Tartaglia as episodic. If Tartaglia were a true client of his, Pigafetta's dedication would have sounded offensive to Savorgnan.

If patronage relationships can be seen as articulations of the fundamental social process of gift-exchange,²⁰ then we can say that Tartaglia was *asking for questions*. In fact, it is only after being asked questions that he could *offer answers* (as he had done with Cardano) hoping to receive a gift in return, that is, to establish a patronage relation. In this sense, the literary form of the

Quesiti et inventioni diverse offers a remarkable picture of Tartaglia's unfortunately unsuccessful strategies for social legitimation.

The dialogue between Guidobaldo and Savorgnan was structured by radically different assumptions. Their social status was comparable. Guidobaldo was not asking for Savorgnan's patronage and for the social legitimation associated with it. It was Pigafetta who was trying to become a client of Savorgnan's. Anachronism aside, Tartaglia's competitor for Savorgnan's patronage was not Guidobaldo but Pigafetta. But this does not mean that Guidobaldo's work in mechanics was 'disinterested'. As I have suggested above, Guidobaldo's choice of intellectual style and subject matter was instrumental in the preservation of his socio-professional identity. And Guidobaldo's social identity was commensurable with Savorgnan's. As a retired member of a powerful and ancient family of milites, Savorgnan was sensitive to the construction of an image of mechanics as 'scientia' — a representation that would have confirmed the legitimacy of the social role of his class in a period in which mechanics was becoming a necessary component of their professional culture. In these terms, Guidobaldo's work fitted Savorgnan's needs perfectly. As Pigafetta reminded him in the dedication, it was with Guidobaldo that mechanics ceased to be a craft and became a science.

To conclude, although Savorgnan communicated with members of both sixteenth century Italian 'schools' of mechanics, the kind of dialogue he established was radically different in the two cases. In particular, his interaction with Tartaglia was characterized by a major gap in social — and not just professional — status between them. But Savorgnan's apparent openness to both schools of mechanics could also have been related to the nature of his interest in mechanics and mathematics. Although he certainly made some use of mathematics in his life as a warrior, he certainly was not a professional mathematician like Benedetti, Tartaglia, Commandino, and Guidobaldo. Consequently, *he was not professionally compelled to choose* between Archimedes and Jordanus — between an approach to mechanics through statics and one through dynamics. His openmindedness may have been also a result of his being only marginally a mathematician.

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1. These subjects can be found as entries in the index of the bibliography. I have also listed texts dealing with other countries or time periods which may offer possibilities for comparative analyses. I have usually excluded material on Galileo because my major concern was to look before and around him. Also, comprehensive bibliographies on his work and life are available.
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3. Pamphlets of mathematical challenges.
4. G. Galilei, *Opere*, ed. by A. Favaro (Florence, 1890–1909), x, no. 132, p. 155.
5. My use of categories such as *laboratores* and *bellatores* is a conscious reference to studies in the tripartite social classifications initiated by Georges Dumezil and developed by Georges Duby and Jacques Le Goff.
6. G. Galilei, *Opere*, ed. by A. Favaro, x, 221–3.
7. *Archivio di Stato di Firenze* (from now on *ASF*), “Diari di Etichetta di Guardaroba 3”, 37: “Signor Guido Baldo del Monte arrivó in Livorno addí 12 di Gennaio, fu alloggiato in Fortezza, servito in argento da staffieri, con un piatto di sua tavola, 4 bocche in tinello, e 5 cavalli alle stalle, e partí il dí 9 di febbraio con una nostra lettiga.” The same information is recorded in “Diari di Etichetta 1”, 27.
8. *ASF*, “Carte Stroziane, Serie I, 30”, c.2r; “Carte Stroziane, Serie I, 29”, c.36v.
9. *ASF*, “Carte Stroziane, Serie I, 29”, c.1v, c.2r. In “Carte Stroziane, Serie I, 51”, c.25r: “Maestro Ostilio Ricci non mangia piú alla dispensa, ma viene convertito a denari.” In the same manuscript at c.35r we find that in 1603 Francesco Cantagallina, another Medici mathematician who would replace Ricci as mathematics teacher to the pages, asked to be admitted to the *tinello*.
10. *ASF*, “Carte Stroziane, Serie I, 29”, c.1v, c.2r.
11. J. Le Goff, “Licit and illicit trades in the medieval West”, *Time, work and culture in the Middle Ages* (Chicago, 1980), 59. Although this article (as well as “Labour, techniques, and craftsmen in the value systems of the early Middle Ages” and “Trades and professions as represented in medieval confessors’ manuals” included in the same volume) analyses earlier historical periods, it offers an interesting perspective on issues of socio-professional taxonomies.
12. This point came up during a discussion with Karen-Edis Barzman.
13. *ASF*, “Miscellanea Medicea 30, Inserto 19”, c. 3.
14. In “Trades and professions as represented in confessors’ manuals” Le Goff traces the breakdown of the ancient tripartite division of society (oratores, bellatores, laboratores) due to technological and commercial developments. One of his examples is from the Bible of Guiot de Provins which declared that “henceforth knights had to give precedence to crossbowmen, miners, stonecutters, and engineers”. Le Goff does not see this as a carnivalesque inversion of received social hierarchies but thinks that the “evolution of military technique compromised the professional supremacy of the feudal knight. Guiot de Provins exaggerates, anticipates, but he does reveal one tendency of public opinion.” The scenario of socio-professional fluidity made possible by the introduction of the cannon and the bastion seems to fall into the same category of processes of social change indicated by Le Goff (Le Goff, *op. cit.* (ref. 11), 117).
15. “Attese nondimeno cosí poco alla bontá della lingua che muove a riso talhora chi legge le cose sue”, B. Baldi, *Cronica de matematici* (Urbino, 1707), 133.
16. “Non hebbe cognitione della lingua Greca, onde per questa cagione . . . fu ripreso da Francesco Barocci nella Cosmografia”, *ibid.*, 96.
17. “Fu egli barbaro nella lingua, poiché senza alcuna scelta mescolava le parole volgari, e le latine, e l’une e l’altre corrompeva, il che diede occasione ad Annibal Caro di chiamar le opere di Fra Luca ‘Ceneracci’, poiché era in loro sepolto l’oro delle cose . . .”, *ibid.*, 107.
18. “. . . viene ripreso dai piu esquisiti di non haver osservato quel metodo, e quella purità nell’insegnare, che ricercano le matematiche e che e stato osservato dagli ottimi Greci, e dagli Imitatori loro”, *ibid.*, 140.
19. The friend of Commandino is Tommaso Leonardi, and not the Gian Giacomo Leonardi mentioned earlier. I have not been able to find whether the two were related.
20. M. Mauss, *The gift* (New York, 1967).

APPENDIX 1: BIBLIOGRAPHY

The large majority of the items included in the bibliography are secondary sources. The very few primary sources listed below either contain biographical information about their authors or deal with the status of mathematics and its relationship with other disciplines. A few works dealing with different countries and historical periods have been included as suggestions for comparative analyses.

Abbreviations:

BB = *Bullettino di bibliografia e storia delle scienze matematiche e fisiche*

DBI = *Dizionario biografico degli Italiani*

DSB = *Dictionary of scientific biography*

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APPENDIX: MATHEMATICS TEACHERS AT ITALIAN UNIVERSITIES

These lists have been drawn mostly from secondary sources. Only in a few instances have I had access to partial reproductions of actual *rotuli*. Incongruences among different sources dealing with the same institutions have not been uncommon. Although the interpolation of various sources has made these chronologies generally reliable, they should not be treated as documentary evidence.

Bologna

The teaching of mathematics at Bologna is well laid out in U. Dallari, *I rotuli dei lettori legisti e artisti dello studio bolognese dal 1384 al 1799* (Bologna, 1888–1924). I refer readers to that work also because, unlike most other Italian universities, Bologna had several chairs of mathematical disciplines (astrology–astronomy; abbachi–arismetriae; universitatis ad astronomiam diebus festis; ad praxim mathematicae) which often happened to be taught by up to four instructors at the same time. Consequently, it would be impossible to reproduce the information offered by Dallari's edition here without a very lengthy and redundant discussion.

Ferrara

1449–1456	Battista di Cremona (medicine and astrology)
1450–?	Georg Puerbach (astrology)
1455–1473	Pietro Buono Avogario (astrology)
1460–?	Regiomontanus
1467–1482	Domenico Maria da Novara
1486–1494	Simone Brami di Reggio (philosophy and astrology)
c. 1488	Baptista Piasi (medicine and astrology)
1489–?	Carlo Sosenna (personal astrologer of Ercole I)
1506–1507	Annibale Andreasi (mathematics)
1507–1508	Luca Gaurico (astrology)
1508–?	Pellegrino Presciani (astrology)
1511–?	Gianmaria Fiornovelli
c. 1545	Bartholomeus Zuccone (astrology)

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1553–1554	Girolamo Antiguaro da Castrocaro (cosmography)
c. 1555–?	Girolamo Brasavola (astrology) (taught logic in previous years and would teach medicine later)
1559–?	Antonio Flavio Giral di (cosmography and astrology)
1566–1588	Girolamo Romagnoli di Ferrara (medicine and astrology)
1573–1579	Torquato Tasso (sphaera and Euclid)
1585–1586	Bernardino Schiantoi (sphaera and Euclid)
1608	Forlani Ercole di Ferrara
1621–?	Gio. Antonio Ferri (mathematics)
1625–?	Giacomo Ruscelli (law, mathematics, hydrostatics)

Florence

1368–?	Ioannis de Mediolanun (astrology)
1424–1427	Giovanni di Bartolo (arithmetics)
1435–?	Pierus de Fulgineo (astrology, geometry, sphaera)
1475–?	Lorenzo Bonincontri Samminiatese (astrology)
1500–1503	Luca Pacioli (Euclid) (from 60 to 100 florins)
1501–1502	Marsilius magistri Antonii Rosati (astrology) (30 to 65 florins)
1512–1522?	Francesco Sirigatti

Naples

1465–1475	Johan de Actaldo (astrology and philosophy; he would later teach medicine) (80–180 ducats)
—	Silvestro Galiota (astrology; he would later teach medicine) (150–210 ducats)
—	<i>astrology no longer listed in the available rotuli at the end of 15th century.</i>
1490–1491	Luca Pacioli (arithmetics)
—	the rotuli begin to include a chair of “logica posteriore e geometria”
1512–1515	Mario de Benevento (logic and geometry)
1532–1533	Giovanni Battista Valenziano (mathematics)
—	the chair of maths is found only in this year’s rotulo. It would be reintroduced in 1606.
—	dramatic drop in the number of courses from 1530s to the late 1560s.
—	there are references to a chair in cosmography and logic in 1581.
1606–1651?	Chiaromonte Francesco

Padua

1307?–1314	Pietro d’Abano (astrology)
c. 1338	Guglielmo di Montorso (astrology)
1350–1356	Giovanni Dondi (astrology)
1359–1384	Giovanni Dondi (astrology and medicine) (he did not teach continuously after 1367)
1384–1411	Biagio Pelacani (philosophy and astrology) (he did not teach continuously)
1412?–1416	Biagio Pelacani (philosophy and astrology)
1422–1428	Prodocimo de’ Beldomandi (astrology)
1434–1436	Cando Candi
—	<i>a chair of arithmetics seems to be added to that of astrology</i>

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1436	Cando Candi, Frate Giovanni di Camposampietro, Antonio da Padua, Antonio di S.Germano
c. 1450	Peurbach (astrology)
1463–1464	Regiomontanus (astrology)
c. 1480	Paolo di Middelburg (astrology)
1492	Giacomo Filippo Aristofilo de' Fiorenzuoli da Viterbo
1493	Clementino de' Clementini
1494–1495	Francesco Capuano da Manfredonia (astronomy, astrology)
1495–1499?	Federico Crisogono
1498–1506	Benedetto Triaca or Tiriaco (astrology, logic, philosophy)
1499	Valerio Superchio (astrology, astronomy, philosophy, medicine)
1502?–1504	Luca Gaurico (astrology)
—	<i>1506, 27 June, the chairs of arithmetics and astrology are conflated.</i>
1506–1507	Bartolommeo Vespucci (astrology)
1508–1509	Benedetto Triaca (astronomy)
1509–1517	due to war, the Studio is closed
1519–1520	Baldassare Sanossarmo (astronomy and mathematics)
1518–?	Tommaso Rangone (astrology)
1520–1521	Federico Delfino (astrology) (Delfino was a practicing physican in Venice)
1521–1547	Federico Delfino (astrology and mathematics)
1547–1577	Pietro Catena (mathematics)
1559–1565	Francesco Barozzi (adjunct, non paid lecturer)
1577–1588	Giuseppe Moletti (mathematics) (came to Padua from Mantua where he was Vincenzio Gonzaga's tutor)
1592–1610	Galileo Galilei (mathematics)
1613–1622	Camillo Gloriosi (mathematics)
1624–1629	Sovero (mathematics)
1632–1657	Andrea Argoli (mathematics)

Pavia

1274–?	Giovanni Campari (astrology)
c. 1300	Pietro da Sarzana (astrology)
	Masino Codronchi da Bologna (astrology)
	Giovanni di Catalogna (astrology)
	Seregno Stegano di Milano (astrology)
	Luchino Pietrasanta (astrology)
1404–1407	Biagio Pelacani (astrclogy)
	Iosmaverio Focio da Cremona (astrology)
1440–?	Stephanus de Faventia (astrology)
	Antonius de Bernadigio (astrology)
1480–1482	Lazarus de Sigleriis (astrology) (earns f.30 while Iohanne de Marliano, ducalis-physicus earns f.1000)
1482–1483	Iohannes de Marliano joins Lazarus without any additional salary
c. 1485	Marsilio Cremaschi (astrology)

Perugia

1407–?	Ulisce Lanciarini da Fano (astrology)
1430–?	Angelo di Puccio (astrology)

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1492-?	Pietro Puzi (astrology and surgery)
1507	Sebastiano de Angelis (astrology and philosophy; before 1507 he also taught theology)
—	<i>introduction of a chair "ad docendum aritmeticham seu abicum et geometriam".</i>
1412-?	Antonio di Giovanni da Città di Castello (arithmetics)
1441-1443	Pietro Segni
1444-?	Pietro Segni
1458-?	Domenico di Iacopo
1469-1472	Iacopo di Francesco
1472-1473	Benedetto di Antonio
1473-?	Evangelista Cipriani da Norcia
1476-1479	Nicoló di Taddeo
1477-1480	Luca Pacioli (arithmetics) (30 florins)
1480-1484	Benedetto di ser Francesco
1486-1488	Luca Pacioli (arithmetics)
1500-1501	Luca Pacioli (arithmetics) (60 florins)
1510-1511	Luca Pacioli (arithmetics)
—	<i>the rotulo of 1524 lists a chair of astrology</i>
?-1554	Girolamo Bigazzini
?-1563	Vincenzo Menni
?-1581	Scipione Crispolti
1581?1584	Pier Antonio Cataldi
—	<i>the rotulo of 1600 lists a chair of "lettura di matematica in tempo di vacanza" and one of "lettura di sfera e matematica in tempo di vacanza".</i>
1600-1603?	Roberti, Girolamo
1603-1606?	Baldeschi Vincenzo (mathematics)
1606-1610?	Giovanni Battista Lauri
1610-1612?	Fra Tommaso da Civitella
1612-?	Cerqueto Vincenzo
1616-1617?	Giuseppe Neri
—	<i>by 1625, the "letture in tempo di vacanza" become "cattedre straordinarie". The mathematics teacher teaches Sacrobosco or Euclid.</i>
1617-1619	Giglioli Tommaso
1619-?	Neri Giuseppe
1619-1656	Mannucci, Vincenzo (former physician)
1633-?	Rossi Lemme

Pisa

—	<i>reopened in 1543 by Cosimo I; one chair interchangeably called "astrology", "astronomy", or "mathematics" is instituted for the first time.</i>
1543-1550	Giuliano Ristori da Prato (Carmelite) (Ristori was Cosimo's personal astrologer)
1547-1550	Francesco dell'Otonaio
1555-1562	Francesco dell'Otonaio
1560-1566	Filippo Fantoni (Camaldolensian)
1567-1581	Giuseppe Nozzolini
1587-1588?	Francesco Pifferi (Camaldolensian, later to the Studio in Siena)

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1582–1589	Filippo Fantoni
1589–1592	Galileo Galilei
1599–1613	Antonio Santucci
1613–1624	Castelli Benedetto

Rome

1489–1490	Luca Pacioli (arithmetics)
1514–1515	Luca Pacioli and Antonio da Fermo
?–c. 1527	Joannes Taisnerus Hannonius (b. 1509) (astronomy) (left the post to follow Charles V as a military engineer)
1514–?	Pier d'Arezzo (astrology) (100 florins)
1514–?	Luca Pacioli and Antonio da Fermo (arithmetics)
?–1528	Rodericum Lusitanum
1559–1576	Antonio Maria Pazzi (mathematics and philosophy) (100 golden liras)
1575–1576?	Giovan Battista Raimondi (50 golden liras)
1582–?	Joannes Petrus Pomerius (100 golden liras)
1587–1591	Maurizio Bresse (astronomy and geometry)
1591–1599	Marchesetti Giacomo (mathematics, 100 golden liras) (in 1605 he moved to the chair of eloquence with 300 golden liras)
1600–1618	Luca Valerio (Greek in the afternoon and mathematics <i>ad dies festibus</i> , 150 golden liras) (in 1603 he taught moral philosophy and mathematics, 300 golden liras)
1618–1622	Fabrizio Coccanaro da Tivoli (mathematics, 60 golden liras)
1622–1628	Andrea Argoli (mathematics) (moved to Padua)
1628–1643	Benedetto Castelli (mathematics, 150 golden liras initially, then 200 until 1643).

Siena

1321–?	Taddeo da Parma (medicine and astrology)
1341–?	Guccione da Siena
1485–?	Luzio Bellanti (philosophy and astrology)
—	<i>the chair of astrologia is established in 1492</i>
1600–?	Francesco Pifferi (camaldolese) (mathematics)
1621–?	Teofilo Galaccini (mathematics)

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