The Paduan School of Medicine: medicine and philosophy in the modern era

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Received for publication in June 2009.
Approved for publication in November 2009.

Translation by Derrick Philips.

REBOLLO, Regina Andrés. The Paduan School of Medicine: medicine and philosophy in the modern era. *História, Ciências, Saúde – Manguinhos*, Rio de Janeiro, v.17, n.2, Apr.-June 2010. Available at: http://www.scielo.br.

Abstract

This is a partial contribution to an understanding of the history of the reception and transmission of classical Hippocratic and Galenic texts in Italy's modern period. By examining *rotuli* and *puncti* of the School of Medicine of Padua University, which record the subjects and content taught in the period between 1500 and 1600, one can study the official curriculum of this famous school. Perusal of these documents shows the commitment of official medical training to tradition, especially with respect to Hippocrates, Galen, Avicenna and Aristotle.

Keywords: history of medicine; Paduan medical curriculum; medicine of the sixteenth and seventeenth centuries.

Before presenting the results of the research that is the scope of this article, I would point out that the official program of the School of Medicine of Padua is just one of the many pieces of evidence that reveal the medical training of the period and the commitment to the classical authors. Besides the official academic documents, the so-called *rotuli* and *puncti*, the majority of the editions of the time can also reveal part of the formation of the consumer medical public and its immediate interests, in relation to both theoretical teaching and clinical practice. In addition, private lessons, which are a tradition maintained since the beginning of the *studia* and that could have shed light on the content of medical training, were unfortunately not recorded. Thus, unlike in England, the notebooks of students available for analysis by historians are very rare in Italy. For this reason, the program content offered outside the university remains unknown, though we can put forward some hypotheses based on the major Latin and vernacular editions. The standard examinations may also point to the intellectual demands and the training of physicians of the period, although only as being representative of the official medicine of university curricula.

Considering these observations, it is more prudent to accept the information herein in a non-exclusive manner and see this analysis as a partial contribution to the understanding of the history of medical training of the time and the reception and transmission of classical Hippocratic and Galenic texts.

The University of Padua

In the sixteenth century, the University of Padua was considered the best European center for the study of medicine. Many non-Italian students, after obtaining a master of arts (M.A.), went there to study for a doctorate in medicine (M.D.). Although it was a Catholic University, it did not impose any religious restrictions, favoring the Protestant students who came from England and Germany. The social and political causes that led the University of Padua to become the leading teaching center of Europe in the sixteenth and seventeenth centuries, have been fully explored by many commentators, including Benetti and Piero (2002), Grendler (1995), Cipolla (1976), Bylebyl (1979) and Rashdall (1936). According to these authors, the institution's success was largely due to the respect for civil, political and religious liberties, as well as the institutional support of the Venetian Republic, and the wealth of Venice and its growing demand for well trained professionals.

The year 1222 marks the official beginning of the history of the Università degli Studi di Padova, following the mass transfer of students and professors from the city of Bologna. In 1399, the Universitas Iuristarum, in which civil law, canon law and theology were taught, was inaugurated. After that date and under the auspices of Francisco II of Carrara, the Universitas Artistarum was created, which included courses in astronomy, dialectics, philosophy, grammar, medicine and rhetoric. The students were subdivided according to their geographical origin: the *natio citramontana*, bringing together students from Italy, and the *natio ultramontana*, composed of students from other countries.

The old Università degli Studi di Padova, along with the universities of Bologna, Paris, Oxford and Cambridge, was one of the great cultural centers of the Western world. However,

unlike the others mentioned above, it did not emerge *ex privilegio*, in other words, by special permission of the popes or emperors, but as a spontaneous result of the civil culture, fostered by the constitution. Initially the university was organized as an open corporation for students and structured along ethnic lines (*citramontanos* and *ultramontanos*). As in Bologna, the students approved the statutes, elected the deans of the student body and chose the professors, who they themselves paid. In the fifteenth century, the responsibility of the choice of professors and their wages was transferred to the public authorities.

From the fifteenth to the seventeenth century, the university experienced a period of major development, sponsored by the tutelage of the Republic of Venice. There was a swift increase in philosophical thought, and growth of the School of Medicine and Anatomy as well as the sciences of astronomy, physics and mathematics, the latter driven by the work of Galileo Galilei. Between the fifteenth and sixteenth centuries, its most famous students were Niccolo Copernicus, Francesco della Rovere (Pope Sixtus IV), Giovanni Pico della Mirandola, Leon Battista Alberti, Paolo Toscanelli, Francesco Guicciardini, Pietro Bembo, Torquato Tasso, Paolo Sarpi, Bernardino Telesio, Tommaso Campanella, Robert Bellarmine, William Harvey, Gian Battista Da Monte and Gerolamo Cardano. In 1545 the first public university botanical garden was founded, and in 1594-1595 the first anatomical theater in Europe was built by Fabricio d'Acquapendente, a great anatomist and professor of William Harvey.

The University, then known as Studio, of Padua, consisted of two distinct courses: the University of the Jurists and the University of the Artists or of the Arts, in which training in medicine was included. It comprised a faculty of qualified professors in art and a College of Physicians and Philosophers, whose main function was to examine the future medical physicians and issue licenses for the exercise and practice of medicine in the city. The three most prestigious subjects in the arts course were: Medical Theory, Medical Practice and Natural Philosophy. This prestige attributed them the status of ordinary subjects, as we shall see, duly differentiated from the extraordinary subjects, usually given after lunch. In the sixteenth century, the university had five professors for each of the three subjects identified (Tomasini, 1986, pp.291-332).

In the cycle of three years of the course in medicine, there were at least five academic positions for each of the major subjects: in order of importance, the first and second ordinary professors and first, second and third extraordinary professors. The two ordinary professors were *concurrentes*, in other words they taught the same subjects at the same time of day, whereby the choice of the lesson to be assisted was at the student's discretion. The first two extraordinary professors were a similar pair but taught at different times than the ordinary professors, with a year's delay in relation to them. The third extraordinary professor taught in competition with the other two or on public holidays of the academic calendar (Bertolaso, 1959-1960, pp.1-15; Tomasini, 1986, pp.294-296, 300-301).

From 1509 to 1517, the University was closed due to the war of the Confederation of Cambrai. It reopened in 1518 and was then administered by the Venetian Senate, and experienced major change. Some professors who worked there before the war did not return to their posts. Due to this, others committed to the rising humanist medical movement, were hired. In curricular terms, this commitment involved a thorough review

of the medieval medical authorities, consisting in large part of apocryphal texts by Galen and Hippocrates. In Padua, the movement began to take shape with Niccoló Leoniceno de Ferrara, who wrote the work *Opuscula* (1532), and his student Giambatista da Monte, the professor responsible for the famous and prestigious Latin translation of Galen, published by the Giunta publishing house. Da Monte introduced the education and training of clinical practice in hospitals and private homes and his observations were gathered in his *Consilia* (1559).

The academic life

At the solemn opening of each academic year of Studio Patavino, the program and schedule of classes for students of arts were presented. The dean, accompanied by the political authorities of the city, as well as students and professors, headed for the *Duomo*, where Mass was celebrated. A professor or student then read the inaugural address. The speaker read the *rotulo* (initially a manuscript, and subsequently a printed scroll), which featured the cast of professors, the program and the schedule of lessons of that year (Bertolaso, 1959-1960, p.20; Favaro, 1922, pp.15-18). In the course in Medicine, the two most important subjects were the two theoretical and practical ordinary subjects of Medicine, and the ordinary subject of Philosophy. Initially, the professors of subjects were chosen by the students themselves, but due to the turmoil that each annual election generated, the Senate of Venice assumed the task. The professors enjoyed some latitude in outlining the course and the choice of texts. Each one stated at the beginning of the year, the topics to be taught. The Senate then approved or rejected the topics and texts, namely the *rotulo*. Each year the professors changed the topics of their lessons, but had to complete the syllabus in three years, which was the duration of the bachelor's degree in medicine. For this reason, when professors were popular, they had a faithful following of students for three consecutive years (Bertolaso, 1959-1960, p.20).

Besides the public lectures at the university, the professors gave private lessons after lunch, the themes, topics and readings of which were jointly defined, according to the particular interests of professors and students, thus being less tied to the official program of the School of Medicine, albeit complementary to the official syllabus. Little or hardly any documentation can be found in this respect, since the material was not officially recorded. One may, however, surmise that there was greater freedom to discuss issues vetoed in the official curriculum in these classes. It is quite likely that the major anatomical and medical innovations of the modern era were established in private lessons.

From 1367 to 1500, each subject taught was distributed over 12 or 14 teaching days. This division was indicated by the name of *puncta* (topics) or *puncta taxata* and was also officially dictated by the University. After 1600, this system was no longer applied and the professor had more freedom to decide what content was to be taught each day. The change came in 1614 when it was discovered that the teaching focused on the points that arose in the doctorate examinations, rather than the entire content required for each subject. For teaching purposes, the professors were then required to use a textbook or manual, stipulated at the beginning of the academic year and authorized by the dean for

use in the classroom. The comments on each book considered part of the core curriculum had to be given in ten lessons or topics. Students were banned from reading books not approved by the dean, the head professor or his deputy (Bertolaso, 1959-1960, p.21).

The medical curriculum and the courses offered

A list of subjects and topics (*rotuli* and *puncti*) offered in the sixteenth and seventeenth centuries, based on *Acta medicæ historiæ patavina* by Bertolaso (1959-1960), records the following information.

The course entitled Ordinary Theoretical Medicine (*Ad theoricam ordinariam medicina*), considered the most important subject in the medical curriculum, was taught in the first morning session, with over two hours duration, by two physicians specialized in theory. This consisted of Book I of the *Canon* by Avicenna in the first year, *Aphorisms* by Hippocrates in the second year, and *Tegni* by Galen in the third year. Immediately thereafter in the third morning hour, taught by three physicians and consisting of a full two hours of practical medicine, there was the subject of Ordinary Practical Medicine (*Ad theoricam ordinariam medicina*). This involved study of *De febribus*, related to Book IV of the *Canon* by Avicenna in the first year; *De morbis particularibus ad capite usque ad cor* ("Specific diseases between the head and the heart") in the second year; and *De morbis particularibus a corde infra* ("Specific diseases below the heart") in the third year. For students of the second and third years, Book IX of the *Almansor* by Rhazes[1] was read and reviewed, through to diseases of the members and to the end of the text, respectively.

The subject entitled Extraordinary Theoretical Medicine (*Ad theoricam extraordinariam medicina*) occupied the second hour after lunch. The professor of the extraordinary topic took up the subject taught in the morning by the ordinary professor, though in reverse order: *Tegni* by Galen in the first year, *Aphorisms* by Hippocrates in the second year and Book I of the *Canon* by Avicenna in the third year.

The subject entitled Extraordinary Practical Medicine (*Ad practicam extraordinariam medicina*) completed the cycle of the same ordinary subject after lunch, also in reverse order. They studied Book IV of the *Canon* by Avicenna, followed by Book IX of *Almansor* by Rhazes.

The subject entitled Extraordinary Theoretical Medicine given on public holidays (*Ad theoricam extraordinariam medicina diebus festis*) represented the third section of theory, which was the least attended by students or professors, and occupied the second evening hour. Issues that were not covered in the ordinary and extraordinary academic subjects were addressed, and the authors studied were those established for theoretical medicine: Avicenna, Hippocrates and Galen.

Since 1387, Surgery and Anatomy (*Ad chirurgiam et anatomiam*) had been taught by the same professor (Bertolaso, 1959-1960, p.29). Vesalius had started the tradition of the great masters of anatomy, paving the way for Colombo, Fallopius (1551-1562), Acquapendente (1565-1621), Montagnana and others. After 1662, the two subjects were definitively separated and a head professor was hired for each subject. The teaching of anatomy was conducted during the entire month of January, in the freezing European winter, in the

mornings and sometimes in the afternoons. For 26 days or more, classes were very popular and attended by all students in the school of arts, since all the other subjects were suspended. With the arrival of Vesalius, the text of Mondino was replaced by the accurate observation of dissected bodies. In 1549, Guidusius taught anatomy based on *Librum Galeni de ossibus*. At the time of Fallopius, Acquapendente and Johann Vesling (1632-1648), the lessons came to consist of teachings handed down on the basis of personal observations, and the authors previously studied often came to be criticized or scorned.

In the Surgery classes, during the third morning hour, two surgeons dealt with tumors in the first year, wounds and ulcers in the second year and dislocations and fractures in the third year. Galen's book entitled *De tumoribus praeter naturam*, and Book VI by Dioscorides, were used by Fallopius and were recorded in the *rotuli* of 1555. According to the *rotuli* of 1568, Acquapendente lectured on tumors and fractures, ulcers on the head in 1570, tumors and fractures in 1569, wounds, fractures and dislocations in 1571, wounds and fractures in 1572, bones, wounds and dislocations in 1573 and the parts that are similar and dissimilar and how they are affected, along with bones, anatomy, dislocations and fractures in 1594.

In Lectures on Simple Substances (*Ad lecturam simplicium*), namely Simple, uncompounded substances, the rudiments of botany and pharmacology were given. The teaching of botany began in 1533, with Bonafede (Bertolaso, 1959-1960, p.31). In 1545 a vegetable patch or public garden was created for the practical classes in botany, which in 1561 were called the Exhibition of the Simple Substances (*Ad ostensionem simplicium*). In 1594, Prospero Alpino introduced the manual entitled *De simplicium medicamentorum facultatibus*, which was studied concurrently with Books I, II and III of Dioscorides, that focused on aromatic plants, on remedies and animals, on wine, metals and "underground things," respectively; and VI, *De materia medica*, considered apocryphal, containing ideas about poisons and cures.

The subject On Book III of Avicenna (*Ad lecturam tertii libri Avicennæ*) complemented the topics of Ordinary and Extraordinary Practical Medicine and was the third most important subject on the curriculum. It dealt with the subjects of the two practical medicine topics, alternating texts of Book III of the *Canon* by Avicenna, and other topics such as fevers, "specific diseases between the head and the heart" and "specific diseases below the heart."

Before commenting on the content of these texts, I would like to outline the evolution of the *rotuli* at Padua University between 1568 and 1696-1697, highlighting the changes and amendments (as per Rotuli di professori..., 1520-1740).

1568 and 1574

The *rotulo* of 1568 records the following contents: Book I, chapter 1 of the *Canon* by Avicenna in the Ordinary Theoretical Medicine course; *Tegni* by Galen in Extraordinary Theoretical Medicine; Book IX of *Almansor* by Rhazes and *De afetibus causis* in Ordinary Practical Medicine; *Almansor* by Rhazes and "Specific diseases" in Extraordinary Practical Medicine (it is not clear if it was *De morbis particularibus à corde infra* or *à capite usque ad cor.*); "unoccupied position" (*locus vacat*) in the subject Points on Book III by Avicenna; "unoccupied position" in other Points on Book III by Avicenna.

Six years later, the *rotuli* of 1574 records: Book I, chapter 1 of the *Canon* by Avicenna in Ordinary Theoretical Medicine; the so-called Salernitan questions in Extraordinary Theoretical Medicine; "Specific diseases below the heart" in Ordinary Practical Medicine, and also "Specific diseases below the heart", and the chapter on the practice of *Almansor* by Rhazes, in Extraordinary Practical Medicine.

The only change observed in the period is in Extraordinary Theoretical Medicine with the replacement of *Tegni* by Galen with the study of Salernitan questions, which was generated by medical didactic literature based on scholastic learning and structured around questions and answers. Its greatest representative was Urso da Calabria, a professor from Salerno. The Salernitan questions brought together a collection on science and medicine written by an anonymous English author circa 1200. It was probably inspired by *Regimen sanitatis*, which since its inception had several titles, such as *Medicina Salernitana*, *De conservanda bona valetudine* and *Flos Medicinae Scholae Salerni*, and was the fundamental literary document of the School of Medicine of Salerno. The original nucleus contains almost three hundred verses, collected and commented in the thirteenth century by Arnoldo de Villanova, to which were added other aphorisms attributed indiscriminately to the School of Medicine of Salerno.

From 1611 to 1612: the inclusion of Aristotle

In 1611-1612, the *rotulo* records the following courses and readings. In ordinary classes in the first morning hour, the first chapter of Book I of Avicenna was read and reviewed in Theoretical Medicine. In the second morning hour on public holidays, in the subject known as first *fen* (section) of the *Canon* by Avicenna (*Ad lecturam 2 fen primi Cânon Avicenæ*), the treatises *De morbis, causis morborum & symptomatibus* (On diseases, causes and symptoms) and *De pulsibus & urinis* (On the pulse and urine) were studied. In the third morning hour in the subject of Ordinary Anatomy (*Ad anatomen cum ordinarijs*) anatomical inspection (*administrabit anatomem*) was performed. In Practical Medicine in the first hour after lunch, "Specific diseases below the heart" was read. In Ordinary Philosophy in the second hour after lunch, Books I and II of the *De anima* of Aristotle were studied. At 2 p.m. (in *pulsatio campanæ*[2]), in the botanical or medical garden for the subject On the Arrangement of Simple Substances, certain plants were examined using Book I of Dioscorides, which was about aromatic medicines.

With respect to extraordinary classes, in the first morning hour the *Posterior analytics* by Aristotle was studied in Logic (*Ad logica*). In the first morning hour on public holidays, Book II of *Meteororum* was studied in Classes on *Meteororum* and *Parva naturalia* of Aristotle (*Ad lect. Meteororum, ac. Parvorum naturalium Arist.*). In the second morning hour, "Specific diseases between the head and the heart" was studied in Extraordinary Practical Medicine. During the second morning hour *Rhetoric* by Aristotle was studied in Greco-Roman Humanities (*Ad humanitatem graeca & latinam*). In Extraordinary Theoretical Medicine, *Tegni* was read and discussed in the third morning hour and *Ars parva*, after lunch, both by Galen. In the first hour after lunch, Book III of *De anima (Tertium De anima*) was read in Extraordinary Philosophy (*Ad philosophia extraordinária*). In the first hour after lunch on public holidays, Book I of *Ethics* by Aristotle was studied in Aristotelian Moral Philosophy

(*Ad philosophia moralem Aristotelis*). In the third hour after lunch, "On wounds" (*De vulneribus*) was studied in Surgery (*Ad lecturam chirurgiæ*). After lunch on public holidays, *Aphorisms* by Hippocrates was discussed in Theoretical Medicine; also in the second hour on public holidays, the treatise "On fevers" was studied in About Book III by Avicenna.

Over the course of 38 years (1574-1612), several subjects were introduced in the medical curriculum, and these changes mainly reflect the professionalization and the importance of natural philosophy in medical training. Among the new subjects, the first *fen* of Book I of the *Canon* by Avicenna (*Ad lecturam 2 fen primi Cânon Avicenæ*) became a subject in its own right. Anatomy and Surgery were also raised to the status of curricular subjects. Natural Philosophy focused exclusively on Aristotle, with study of the following treatises: *De anima*, the *Posterior analytics*, Book II of *Meteororum*, *Parva naturalia*, *Rhetoric* and Book I of *Nicomachean ethics*. The ordinary subject of Botany and Pharmacology was included, in which Book I of Dioscorides about aromatic medicines was read. *Aphorisms* by Hippocrates was once again read on public holidays, and "On fevers" was included in the subject About Book III by Avicenna.

Although the curriculum of the late seventeenth century shows significant changes in medical theory, the classics including Hippocrates, Galen and Avicenna were retained, thereby showing the commitment of medical education in Padua to the classical tradition. Overriding proof of this commitment is witnessed in the examinations for a doctoral degree, which, according to the bylaws, consisted of a random selection of excerpts from the work of each of these authors.

Innovative aspects were introduced in the program of clinical practice, such as daily visits to hospitals, together with formal discussions of cases and systematic teaching of 'the urines' and 'the pulses.' In Anatomy, autopsies of fatal cases (pathological anatomy) and public dissections were introduced. In Botany, the major innovation was the introduction of classes in the botanical garden.

1648

In 1648, the following subjects and required reading were on record: In ordinary classes in Theoretical Medicine, *Aphorisms* by Hippocrates in the first morning hour; in Ordinary Anatomy, anatomical inspections on the day and time scheduled (*Administrabunt anatomem die & tempori debito*) in the third morning hour; in Practical Medicine, *De febribus* in the first evening hour; in Ordinary Philosophy, Books I and II of *Physics* by Aristotle in the second evening hour; in About the Arrangement of Simple Substances, Book V of Dioscorides, *De vino & mettalicis (in Horto incipio docere die 2. maii, hora 22*).

In the extraordinary classes, the *Posterior analytics* by Aristotle in the first morning hour in Logic; in Lessons on *Meteororum e Parva naturalia* by Aristotle, Book II during the first morning hour on public holidays; in Extraordinary Practical Medicine, *Ad corde infra*, in the second morning hour; in Greco-Roman Humanities *Tacitum & epigrammata graeca* in the second morning hour; in Theoretical Medicine, the first *fen*, *In pulsatione campanæ* by Avicenna in the first evening hour; in Extraordinary Philosophy, Book VIII of *Physics* in the first hour after lunch; in Aristotelian Moral Philosophy, *Nicomachean ethics*, in the first hour after lunch, and *De somnis & vigilijs* on public holidays; in Surgery, *De vulneribus*

praeter naturam, in the third morning hour; in Theoretical Medicine, *Ars parva* by Galen in the second evening hour on public holidays; in Lectures on Book III by Avicenna, *From the head to the heart* in the first morning hour on public holidays; in Mathematics, *Elements* by Euclid in the third evening hour.

In the 36 years between 1612 and 1648, the main changes were the introduction of *Aphorisms* replacing Book I of the *Canon* by Avicenna in the course on Ordinary Theoretical Medicine; the reintroduction of *De febribus* to replace "About specific diseases below the heart" in Ordinary Practical Medicine; the introduction of *Physics* (Books I and II) by Aristotle in Ordinary and Extraordinary Philosophy, replacing *De anima* (Books I, II and III); the substitution of Book I (aromatic medicines) by Dioscorides with Book V (on wines and metals); the replacement of *Rhetoric* by Aristotle with *Tacitum & Epigrammata Græco* in *Ad humanitatem græcam & latinam*; in the course on Extraordinary Theoretical Medicine, the replacement of *Tegni* by Galen with the first *fen* of the *Canon* by Avicenna; the reintroduction of *De somnis & vigilijs* by Aristotle, in Aristotelian Moral Philosophy; the substitution of *Aphorisms* by Hippocrates with *Tegni* by Galen in Theoretical Medicine on public holidays; and, lastly, the reintroduction of *Elements* by Euclid in Mathematics. It is important to stress the new Aristotle that was then read by future physicians – new in the sense that the texts introduced prioritized discussions on natural philosophy and method, and the acquisition and demonstration of knowledge, subjects close to the heart of Paduans of the period, such as Abano, Giulio Pace and Zabarella, among others.

1696-1697

Between 1696 and 1697, in the ordinary classes in Theoretical Medicine, *Aphorisms* by Hippocrates in the first morning hour; in Anatomy, inspections on the day and time established for the third morning hour; in Practical Medicine, *De febribus* in the first evening hour; in Philosophy, Books I and II of *Physics* by Aristotle in the second evening hour. In Lectures on Simple Substances, *De purgantibus, in pulsatione campanæ matutina*; in Demonstrations of Simple Substances, "*in Horto incipiet die 2 maii, hora*."

In the extraordinary classes, Book I of the *Posterior analytics* by Aristotle in the first morning hour in Logic; in Extraordinary Practical Medicine, "On the specific diseases below the heart" in the second morning hour; in Greco-Roman Humanities, the poetic form and tragedy of Aristotle in the second morning hour; in Theoretical Medicine on public holidays, unoccupied position; in Philosophy, Book VIII of *Physics* in the first hour after lunch; in Aristotelian Moral Philosophy, *Nicomachean Ethics* by Aristotle in the first hour after lunch on public holidays; in Surgery, *De vulneribus praeter naturam* in the third morning hour; in *Ad lecturam astronomiae et meteororum*, Book III of *Meteororum* by Aristotle, and *The theory of the planets according to ancient and modern hypotheses*, in the third morning hour; in *Ad lecturam tertij libri Avicenna*, "Specific diseases between the head and the heart" in the first morning hour on public holidays; in Mathematics, the *Elements* by Euclid in the third evening hour.

In almost half a century (1648-1697), the main changes were the introduction of the practical subject known as Demonstrations of Simple Substances, in which *De purgantibus* was read, and in Humanities, the reintroduction of the poetic form and tragedy of Aristotle,

the introduction of Discussion on Book III of *Meteororum* by Aristotle and *The theory of the planets according to ancient and modern hypotheses*.

In general terms, the curriculum of the School of Medicine of Padua University between 1568 and 1697 was not very different from the basic nucleus of the first medieval *Articellæ*, which covered the treatises of *Isagoge* by Joahnitius (Hunain ibn Ishaq), *Aphorisms*, *Prognostic* and *On regimen in acute diseases* by Hippocrates, *On urines* by Theophilus, *Pulses* by Philaretos and *Tegni* by Galen. There is, in fact, a simplification of the curriculum content, when compared with that of the previous century, which was recorded in the 1407 statutes of Bologna's School of Medicine that included the texts listed below. In the first year in Theoretical Medicine, the *Liber canonis* by Avicenna; the treatises *De differentiis febrium*, *De complexionibus*, *De mala complexione*, *De simplicibus medicinis*, *De diebus creticis*, *De interioribus*, *De regimine sanitatis* by Galen; *Aphorismata* by Hippocrates. In the second year, *Tegni*, *De accidenti et morbo*, *De crisi*, *De diebus criticis*, *De febribus ad glaucone*, *De tabe*, *De utilitate respirationis*, *De differentiis febrium*, *De mala complexione*, *De simplicibus medicinis* by Galen; *De viribus cordis*, *Liber canonis* by Avicenna; *Prognostica*, *De morbis acutis* by Hippocrates. In the third year, *Therapeutica*, *De virtutibus naturalibus*, *De diebus criticis*, *De accidenti et morbo*, *De crisis*, *De complexionibus*, *De febribus ad glauconem I* by Galen; *Aphorismata* by Hippocrates; parts I and II of volume 2 of the Introduction of *Colliget* by Averroes. In the fourth year, *Liber canonis* by Avicenna; *De interioribus*, *Regimen sanitatis*, *Therapeutica VII-XII*, *De virtutibus naturalibus* by Galen; *De natura* by Hippocrates; *Colliget* by Averroes.

In the first year in Practical Medicine, *Liber canonis* (Book III, *fanûn* or sections 1-3), by Avicenna. In the second year, *Liber canonis* (Book III, *fanûn* or sections 9-12), by Avicenna. In the third year, *Liber canonis* (Book III, *fanûn* or sections 13-16), by Avicenna. In the fourth year, *Liber canonis* (Book III, *fanûn* or sections 18-21), by Avicenna.

In the Surgery course, which lasted one year, *Chirurgia* by Bruno da Longobucco; *Chirurgia* by Galen; *Liber canonis* (Book IV, *fanûn* or sections 3-6) by Avicenna; *Ad almansorem* (Book VII) by Rhazes (Maragoli, 1966, pp.267-76). It is important to note that the new and numerous editions of the period attest to the continued interest in these authors, by then accompanied by their interpreters, many of whom were more erudite and essentially critical.

The works and their contents: the reception of Hippocratic and Galenic texts

In the comment below, I focus on the subjects of Theoretical Medicine and Practical Medicine, since it was precisely in this area that the Galenic and Hippocratic texts featured predominantly. In the sixteenth and seventeenth centuries, Theoretical Medicine was the most important subject in the curriculum, using Book I of the *Canon* by Avicenna; *Aphorisms* by Hippocrates; and *Tegni* by Galen. In the other Theoretical Medicine subjects: *Ad theoricam extraordinariam medicina* and *Ad theoricam extraord. diebus festis* or *Ad theoricam extraord. vespertinam*, the same topics were taught alternately, with the exception of 1574 when the Salernitan questions were discussed and, from 1612 onwards, when *Ars parva* (*Tegni*) by Galen, was introduced. The subject *Ad lecturam tertio libri Avicennae*, although considered the third most important theoretical subject, recorded readings related to practical medicine, such as Book III of the *Canon* of Avicenna, alternating with notions about fevers, specific

diseases between the head and the heart and specific diseases below the heart. The theoretical training was thus provided by the classics of Hippocrates, Galen and Avicenna, and the theoretical content focused on ideas about the body matter and its behavior in the face of illness and the environment, conceived in the classical and Alexandrian period and later interpreted by the Arab world.

Chapter 1 of Book I of the *Canon* by Avicenna was the first reading on the syllabus of Theoretical Medicine and it introduced notions of the Hippocratic-Galenic physiology of the four elements, four temperaments, four seasons, four humors, the organs, the spirits (natural, vital and animal), the forces, the faculties of the soul, the actions, as well as Galen's six non-natural factors (air, food and drink, sleep and wakefulness, motion and rest, evacuation and retention, feelings and emotions); and notions of pathology such as diseases and their causes, concepts of semiology, symptomatology, pulse and urine, the crises and critical days, the plethoras and prognosis. The material is quite similar to that of the introduction to *Tegni*, by Galen, and is entitled *Isagoge*. Written by Joahnitius, a physician and Nestorian translator of the ninth century, *Isagoge* was the inaugural chapter of the medieval manual *Articellæ* and summarized (with minor changes) the main concepts of Galenic medicine. Avicenna plays little part in the introduction, which is almost fully recovered in his first chapter of Book I of the *Canon of medicine*. The text begins with the presentation of the divisions between theoretical and practical medicine. The first of these was subdivided into three essential parts: natural, non-natural and anti-natural things. There were seven natural things: the elements (water, fire, earth and air); the mixtures (wet, dry, hot, cold, and their possible combinations); the humors (blood, phlegm or pituita, black bile and yellow bile); the body members (brain, heart, liver and testes, considered major members, and nerves, veins, arteries and spermatic vessels, deemed secondary members); the natural faculties (the potential of each body part, such as nutrition, growth and attraction); the functions (activity or action of the parties); the spirits (natural, vital and animal); as well as four additional natural things: the age brackets (childhood, adolescence, youth, maturity and old age); the color of the body parts; the state of the body, and sexual differences. With respect to non-natural things, all of which are outside the body, there are weather, exercise, bathing and diet, sleep and sexual activity and emotions or accidents of the soul. The anti-natural things, or diseases, are classified according to symptoms, appearance, parts of the body affected and their causes. Practical medicine, on the other hand, dealt with the conservation of health, which was preserved by considering the six natural things (air, food, drink, sleep and wakefulness, evacuation and retention, movement and rest) and the emotions; with the elimination of disease through dietary prescription; with medicine, taking into account the quality thereof or their effect against to disease, quantity (temperament and strength), dosage, time of administration and choice thereof; and, finally, with surgery.

Considered by some historians as the greatest physician of all time, Abu-Ali-Husayn ibn Abdallah ibn-Sina, known in the West as Avicenna, was born in Bukhara in Central Asia in 980 and died in 1073. He was the Prime Minister and physician at the court of the ruler of Bukhara and wrote over a hundred books, sixteen of which were about medicine. His work *Kitab al-Qanun fi al-Tibb*, known as the *Canon of medicine*, was translated into Latin for the first time in 1187, and was prescribed reading in university *studia* across

Christian Europe from the second half of the thirteenth century onwards (Ferre, 2003 p.168). The *Canon of medicine* is considered Avicenna's masterpiece and was a benchmark and the basis for medical studies in East and West for seven centuries, since it was widely taught in the majority schools. It was the first clear and orderly compendium of the medical knowledge of the time, written in a didactic way, in short paragraphs, comprising a medical encyclopedia of five books (now volumes). It synthesized the thoughts of Hippocrates and Galen, as well as Aristotle's biological conceptions, enriched with the author's observations. Its introduction in the medical curriculum of *studia* was linked to the introduction of the 'new Galen'[3], considered preliminary reading for a clearer understanding of medical thought.

In Book I of the *Canon of medicine*, as mentioned, Avicenna describes the general principles and theories of medicine, physiology, etiology, symptomatology, dietetics, preventive medicine, psychotherapy and therapeutics. There are also notions of the anatomy and pathology of various organs. In Book II, the therapeutic properties of single drugs are described and listed alphabetically; it also deals with the preparation of medicines as well as pharmacology. In Book III there are detailed descriptions of the diseases located in the body ("between the head and the heart"), all accompanied by a therapeutic proposition. Book IV is devoted to general diseases, signs and symptoms, diagnostics, prognostics, fevers, tumors, wounds, fractures, bites, poisoning, minor surgery and cosmetic care. Lastly, Book V is drafted in list form and describes medical prescriptions and medicinal preparations, listing 760 medical compounds. Books II and V, devoted to pharmacology, were omitted by Dioscorides, possible due to the difficulties in terminology and identification of the plants indicated. On the other hand, Books III and IV, organized in a didactic and pedagogic manner, served as valuable reference material in clinical practice, being widely used in universities and elsewhere.

For its part, the compendium known as *Aphorisms* had been the most widely known Hippocratic treatise since antiquity. Its inclusion in university medical training dates back to the medieval period, when it was also part of the manual *Articellæ*. Credited to Hippocrates, the compendium synthesizes the medical knowledge of ancient Greek physicians and was designed for memorization and practice. The text shows great affinity with the treaties of the School of Cos, namely *On regimen in acute diseases*; *Prognostics*; *Epidemics*; *On airs, waters and places*; *Humors*; *Coan prænotions*; and *On crisis*. The seven books or sections (*particole*) that compose it are made up of 412 'aphorisms,' a term coined by Rabelais when translating the work into the French language. The first book or section deals with diets and purgation; the second with sleep and health; the third with the influence of climate and temperature on health and infirmity in different age groups; the fourth returns to the theme of purgation in the context of diagnostics, especially by examining the urine; the fifth deals with spasms, epilepsy, diseases of the breast and cure thereof and ailments in women, a theme that brought together the greatest number of gynecological aphorisms of the treatise; the sixth, diagnostics, prognostics and therapies; and the seventh addresses symptoms and the identification of infirmities.

Tegni, by Galen, brings together the general principles of medicine and already in the old anthologies, such as *Articellæ*, it was considered essential reading for medical training.

The text had several Latin names, such as *Ars parva*, *Ars medica* and *Microtegni* but became better known as *Tegni (Techné) by Galen*. It served as an introduction to the Galenic medical system, by being a systematic exposition of the vast work of the author of Pérgamo, scattered throughout many texts. The introduction describes the different modes of exposition suitable for the art of medicine: that which derives the notion of an end, by means of analysis (decomposition); bringing together the analytical findings (composition); and the dialysis of a definition (separation), that Galen claimed to be a type of explanation or simplification (Galen, 1997, passage 305, p.345).

For Galen, dialysis permitted affirmations derived from conclusions based on practical demonstrations, making possible the creation of a set of true principles, including the definition of medical art as knowledge of health, disease and "what is neither one thing nor the other" (Galen, 1997, passage 308, p.346). Galen identified three categories to which this definition applied – the body, the causes and the signs – and divided the text into three parts. In the first, he considered the body in a state of health, morbidity and neutrality; in the second, he presented the Galenic doctrine of signs and symptoms; and in the third, he presented the theory of the Galenic causes in relation to morbid ailments. The order of exposition followed the logical order of clinical practice, because, according to Galen, diagnosis was only possible from observation of the signs, after consideration of which one could seek for the causes of states of health (passage 309, pp.346-347). The health of the body was conceived as a good blend of simple substances, namely the primary parts (elements and qualities) and a good proportion of the organs that they comprised (position, size, shape and numbers of parts). Illness was the result of a poor blend of elements, attributes and parts of the body. The signs enabled the diagnosis of the current condition, the prognosis of future states and mnemonic investigation of the past. The observation of the signs was performed on the basis of the principles of Galenic physiology: the brain, the heart, the liver and the testicles as well as their subservient parts – the nerves and spinal cord, the arteries, the veins and spermatic duct, respectively.

After considering the three possible states (health, disease and neutrality) for each of the main parts, Galen presented his famous theory of necessary causes of disease, immortalized by medieval medicine as the theory of the six non-naturals: the air and the environment, movement and rest, sleep and wakefulness, drinks and food, evacuation and repletion, and "what happens to the soul" (feelings and emotions). The text concludes with the presentation of other works by Galen and the order in which they should be read. In general terms, *Tegni* reflects the Galenic interpretation of certain Hippocratic treaties such as his comments on *On airs, waters, and places*, *Prognostics*, *On regimen in acute diseases* and topics about humors, among others.

If we consider that the three studies (*Tegni*, chapter 1 of Book I of the *Canon* and *Aphorisms*) repeated the same theoretical notions, we can deduce that theoretical teaching was a type of memorization of inherited notions that were to be reproduced without significant changes.

The practical subjects (Ordinary Practical Medicine and Extraordinary Practical Medicine) record teachings of Avicenna and Rhazes. The following texts were read: *De febribus* (Book IV of the *Canon*); "Specific diseases between the head and the heart" and "Specific diseases below the heart" (Book III of the *Canon*), and Book IX of *Almansor* by Rhazes.

Avicenna's theory of fevers and his description of specific diseases were also based on Galenic treatises[4], which were in turn based on Hippocratic[5] treatises. The advantage of Avicenna's text was its succinct and systematic character, ideally suited to teaching and memorization.

Liber ad Almansorem or *Nonus Almansoris*, by Rhazes, is one of the most important examples of the transmission of classical medical thinking. The sources of the first book on the purchase of slaves, and the third on dietetics, were Hippocrates, Galen, Oribasius, Aetius and Paul of Aegina; the fourth book contains the hygiene of Galen; the fifth focuses on dermatology; the sixth is also derived from the Greek authors, and addresses the diet of workers; the seventh is devoted to surgery, being almost exclusively derived from the surgical treatises of *Corpus hipocraticum* by Paul of Aegina, *Synopsis of Galen* by Oribasius, and the works of Aetius; the eighth deals with toxicology; and the ninth considers the diseases that affect the body between the head and the heart. This last chapter was featured the most in the curricula of the period addressed here. Rhazes extracted material from *De morbis*, by the (pseudo) Hippocrates, *De locis affectis*, *Methodi medendi* and, finally, *De compositione medicamentorum secundum locos*, all by Galen. The tenth book, also about fevers, is similarly based on Hippocrates, Galen, Aetius and Paul of Aegina. In a 1497 edition, published in Venice by Otinus de Luna, Papiensis, *Liber nonus ad Almansorem* by Rhazes, in the *incipit tabula*, describes almost one hundred diseases between the head and the heart, such as frenzy, apoplexy, paralysis, '*tortura ossi*,' melancholy, worms, pleurisy, 'tremors of the heart,' jaundice, dropsy, cystitis, hernias and 'podagra.'

The work of Aristotle and its importance for medical training

Humanist physicians and philosophers, like Taddeo Alderotti[6], Pietro D'Abano[7] and Agostino Nifo[8] reiterated the importance of natural philosophy for the teaching of medicine, as did Zabarella in the sixteenth century, and Pietro Castelli in the seventeenth century. This importance was presented under two aspects: one outlined the character of a science (and not just art or technique) of medicine which made it a branch of natural philosophy; the other, arising from the first, addressed the scientific statute of medical knowledge, namely its mode of acquisition and the way of justifying it.

According to Wallace (1988, p.202), what we now call a science was *philosophia naturalis* or *scientia naturalis* in the seventeenth century, and its scope covered all the material things that are presented to the senses. Mathematics and metaphysics were excluded from this philosophy. Aristotle established its content in *libri naturalis – Physics*, *De cælo*, *De generatione et corruptione*, *Meteorology*, *De anima*, *Parva naturalia* – and in the treatises on animals – *History of animals*, *Parts of animals* and *Generation of animals*. These works were the basis of studies of natural philosophy in the seventeenth century.

Furthermore, according to Wallace (1988, pp.202-210), Franciscus Toletus (1532-1596), an influential Spanish Jesuit theologian and philosopher, in his *Commentaria una cum quaestionibus in VIII libros de physica auscultatione*, published in 1574, recommended that the structure of the Renaissance school curriculum should respect the 'function' and the divisions of philosophy. The function of philosophy was to eliminate human ignorance

in three main areas: in the contemplation of truth, learning to live better and knowledge directed at fulfilling the material necessities of life. These areas should provide the main – *speculativa*, *practica* and *factiva* – divisions of philosophy: metaphysics was part of *speculativa* philosophy, which treated the common principles and properties of all beings; physics addressed what can be perceived by the senses; 'pure' mathematics was responsible for numbers and figures; 'intermediate' mathematics dealt with quantity and movements, such as music and perspective. *Practica* philosophy took care of all practical human affairs in terms of life, including ethics, economics and politics. And *factiva* or constructive philosophy, formerly called mechanical philosophy, included all the arts necessary for human life and pleasure therein, such as agriculture, navigation and singing.

Physics and natural philosophy dealt with the same natural entities and were divided according to the principles of natural things presented in the eight books of *Physics* by Aristotle. In *De cælo* the simple incorruptible entities (the celestial bodies) and corruptible entities (the elements, also dealt with in *De generatione et corruptione*) were addressed. Composite entities were divided into animate and inanimate entities, which were of two types: those that were in the upper regions (like rain and things found in the atmosphere) were explained in *Meteorology*, and the most perfect ones found in the earth (rocks and metals) were studied in *De mineralibus*. Composite animate entities were studied in *De anima*, *De plantis* and in the treatises on animals, as well as in *Parva naturalia* (Wallace, 1988, p.210).

In this manner, medicine, which should have been part of *factiva* philosophy – since it was an art – belonged to the areas of physics or natural philosophy. As stated earlier, in the first sections of the *Canon* Avicenna (1956, p.12) describes the contents of medical physiology as being "elements, temperaments, humors, organs and faculties," which taken as a whole represent "the natural philosophical principles of human life". Avicenna based himself on Galen, who followed the teachings of Aristotle and was inspired by Hippocrates.

In ancient times, the terms 'physics,' 'philosophy' and 'medicine' overlapped. Natural philosophy was the study of nature, from the Greek *physis*. *Physis*, in turn, gave rise to the term 'physician,' which also meant doctor.[9] And as the name implies, physics (or medicine) was one of the branches of the study of nature or natural philosophy. Physicians needed to study natural philosophy because the purpose of physics was to preserve health and prolong life, and since it was governed by natural principles, that aim could only be achieved through knowledge and mastery of these principles. Thus, philosophy, including logic and natural philosophy, were considered two propaedeutical subjects for medicine.

The connection between medicine and philosophy has a long history. For Aristotle and Galen, philosophy played an essential role in medical education and practice. In *De sanitate et morbus* and *De sensu et sensato*, it is claimed that the philosopher's task is to study the natural principle of diseases and health, and since diseases and health are considered properties of life, philosophers and physicians who have an interest in the scientific art of medicine must share the same goals, the former studied medicine and the latter based their medical theories on the principles of natural science (Aristotle, 1957). In the short treatise *Quod optimus medicus sit quoque philosophus* (The good physician is also a philosopher), Galen affirms the importance of philosophy and logic to medicine (Galen, 1997, paragraph 3, passages 59-63, pp.32-34).

In the sixteenth century, Taddeo Alderotti of the University of Bologna, and Pietro d'Abano of the University of Padua, stressed the importance of philosophy for the teaching of medicine. Pietro d'Abano was known as The Conciliator, due to the title of his book *Conciliator differentiarum medicorum et philosophorum*, published in Mantua in 1504, and later in Venice, which was systematically read the at the School of Medicine of Padua and was reprinted several times in the late seventeenth century. In the work, D'Abano explains and 'reconciles' the differences between physicians and philosophers. It is structured around 210 'differences' and contains the main Greek and Arab medical teachings and proposes ways in which these teachings could be reconciled with the natural philosophy of the time, which was essentially Aristotelian. In the first 'differences,' D'Abano says the three most important things for medical training are logic, natural philosophy and astrology (Schmitt, 1969, pp.13-15).

In Venice, in 1607, Pietro Castelli published *De optimo medico* in which he thoroughly and exhaustively describes the best education for physicians. In his opinion, medical training should be based on two kinds of knowledge: empirical knowledge, acquired through chemistry, botany, anatomy and surgery; and rational knowledge, based on philosophy. In his argument for the importance of philosophy to medicine, Castelli cites excerpts from *De sanitate et morbus* by Aristotle, and *Quod optimus medicus sit quoque philosophus* by Galen (Schmitt, 1985, p.14).

The majority of textbooks used in schools and universities confirms the strong Aristotelian program in the teaching of natural philosophy. Produced between 1600 and 1650, these manuals were developed on the basis of comments made by his immediate predecessors to *Corpus aristotelicum*. Among the authors most frequently used for the preparation of these manuals are Julius Caesar Scaliger[10], Philip Melanchton[11], Jacopo Zabarella and the Jesuits Franciscus Toletus, Benedict Pereira and Francisco Suarez. The works of Aristotle were carefully translated from Greek and reinterpreted and commented faithfully and painstakingly.[12]

The medical and anatomical *scientiæ* method

For Wallace (1988, p.205), the thirteenth century devoted much of its attention to the study of scientific methodology, which proliferated with the discovery of the Greek commentators on the *Prior* and *Posterior analytics* From the thirteenth through to the end of the sixteenth century at the University of Padua, D'Abano, Nifo, Pace and Zabarella theorized about the mode of reasoning to be used in *scientia*: the logic of discovery associated with demonstrative *regressus* and to methods of resolution and composition. By virtue of being professors of arts and medicine, they discussed the logical needs of their subjects.

Anatomists of the sixteenth and seventeenth centuries found themselves obliged to theorize about the philosophy of the anatomical method of justifying the new way of 'looking at nature.' If medicine is part of natural philosophy, it should follow the epistemological and methodological principles required for the constitution of demonstrable wisdom, namely the true *scientia*. As Aristotle taught, to demonstrate is to present the causes or principles of something. In the case of anatomy, it involves answering the questions

about what the body part is for and why it has a given function. Anatomists sought to achieve this goal by applying the *historia–actio–usus–utilitas* formula for the parts in their medical-anatomical research. However, was the result of such investigations considered to be demonstration in the Aristotelian sense? Did the anatomical demonstration have an equivalent status to that of Aristotelian demonstration? Most anatomists knew that the anatomical demonstration differed essentially from demonstrations in science, because their premises were based on the observation of specific facts rather than on universal principles. Anatomists shared the belief that anatomical observation was a special form of knowledge, whose epistemological status, equated with science, provided valuable and true knowledge. They believed that anatomical demonstration should begin with the universals, which were primarily developed on the basis of induction, which was a process initiated by the specifics of the senses. Yet again, Aristotle's *Physics* and the *Prior* and *Posterior analytics* were used as the main source.

Two major philosophical schools of thought prevailed at the University of Padua: one was Aristotelianism more connected to the 'School,' the greatest representative of which was Piccolomini; and the other was less 'Christianized' Aristotelianism that was strongly influenced by the comments of Averroes and Paduan Aristotelianism, whose central figure was Jacobo Zabarella.

The discussions about the logic of the science were initially established by the Paduan Aristotelian philosophers Zabarella and Pace. Giulio Pace (or Julius Pacius), who worked with Zabarella and taught at Padua at the same time that Harvey studied there, moved towards a new more humanistic and philological interpretation of Aristotle, prioritizing the Greek texts and the commentators Ammonius and Philoponus. In his writings, Pace disseminated a new way of acquiring knowledge, namely the method of *regressus*, which in his opinion should be used when the principles of a demonstration were unknown (as in anatomical research). The method is a process of knowledge acquisition that involves three phases: the first begins with reasoning directed to the discovery of causes from effects, and a part of this reasoning is the resolution or analysis of composite things in their primary principles; the second is the negotiation of the intellect, by which the causal principles discovered become more familiar to the mind; and the third, which is the opposite of the first, is the return of the primary principles to the effects observed. According to Pace (Pacius, 1596, p.422), this is a true demonstration, based on the causes (*to dioti*).

Pace, in fact, followed the teachings of Jacobo Zabarella (1533-1589). He was a student of Bernardino Tomitano, with whom he studied humanities, logic, natural philosophy and mathematics. After graduation, he published several books, among them: *Opera logica* (published in Venice in 1578 and in Cologne in 1597), which included *De methodis*, *De natura logica*, *De regressus* and *In duos Aristotelis libros Posteriores Analytica commentarii*, among other minor texts; *Tabulae logica* (Venice, 1580); *De naturalis scientiæ constitutione* (1586), an introductory text to his major work on natural philosophy, *De rebus naturalibus* (Cologne, 1590); besides various commentaries on the works of Aristotle as *In libros Aristotelis Physicorum commentarii* (Venice, 1601) and *In tres libros Aristotelis De Anima commentarii* (Venice, 1605). It is in *De naturalis scientiæ constitutione* (chapter 33) that Zabarella argues that "where the philosopher ends, the physician begins" (*ubi desinit philosophus, ibi incipit medicus*).

For Zabarella (1586), physiology, one of the branches of natural philosophy related to the body and its parts, provided the scientific knowledge through which medicine, which is an eminently practical art, could achieve its results, namely the restoration of health. Anyone wishing to know the structure of the human body had to follow the teachings of Aristotle in *Parts of animals* and not only in the *History of animals*, because the first gave the understanding of the function and purpose of internal parts and not merely the description of the structure of external parts, which was the scope of the second. For Zabarella, the logic derived from the *Posterior analytics* had to be applied to all theoretical and practical subjects, especially medicine. In *De methodis* and *De regressus*, Zabarella states that the fundamental logical method to be used in medical reasoning is the *methodus resolutiva* (a thesis supported by passages from Galen, Averroes and Avicenna).

Zabarella's discussion about the different ways of acquiring knowledge resulted in *regressus*, a mixture of the distinction between *to oti* and *to diota* knowledge of Aristotle, as well as the distinction between analytic and synthetic knowledge of Galen and the medieval *quia et propter quid*. The result was a dual method of obtaining new knowledge, starting with the specifics of observations. According to Zabarella, in *In libros Aristotelis Physicorum commentarii* (published in Venice in 1601 and Basle in 1622), *to oti* knowledge is superficial and an undeveloped mode of treatment that produces mere *historia*, such as the narratives without cause of those who produce histories and such as the *History of animals* by Aristotle (Zabarella, 1601, p.3). The second part of *regressus* is the discovery of the primary causal principles, and from them the explanation of the specifics of the observation. For Zabarella only this step can be considered *scientalis*, i.e. true knowledge, or the discovery of what is less known from what is best known.

In short, Zabarella's method presupposes: a 'demonstration that' (*quod*), through which we are led from the confused knowledge of the effect to the confused knowledge of the cause; a mental consideration, through which, from a confused knowledge of the cause, we acquire knowledge distinct from it; and a demonstration *propter quid*, through which we are led from the distinctly known cause to distinct knowledge of the effect. In the words of Zabarella (1597, 481b; free translation):

> The *regressus* is between the cause and the effect when they are convertible and the effect is better known to us than the cause. Because, as we always have to start from what is best known to us, we begin first to demonstrate the unknown cause starting from the known effect, and then return (*regredimur*) from the cause thus known to the effect to be demonstrated, being able to know the reason why it is so.

However, the 'demonstration that' (*quod*) corresponds to the report of *historia*, whereby, based on the description of the effect we seek to know the cause. By 'mental consideration' we can understand the quest for the establishment of the relationship between the description, the action and use of the parts. And the demonstration per se (*propter quid*) is nothing more than the presentation of the final cause or the purpose of the parts, in which the anatomist demonstrates how the parts and attributes of the organ, or of the parts supplied by the narrative of *historia* and *actio*, are appropriate for their function. Cognizant of the purpose of the part, the anatomist can explain (regress) the particulars

of the observable fact (size, figure, number, etc.), as a function of its principle or final cause. Thus, the anatomical demonstration is not demonstrable proof in the traditional sense, but a visual demonstration, as demonstrating anatomically is to demonstrate by dissection and not through any logical argument. The acceptance of such a logical method or 'proof' in anatomical science requires two epistemological beliefs: the first relates to the unrestricted confidence in the possibility of sensitive knowledge, namely confidence which is reflected in the maxim that the anatomical observations must be ocular, personal and reproducible; and the second states that reproducible experiments turn specific events into universal fact. Both in the first case and in the second, anatomists were able to find backing in the writings of Aristotle and Zabarella.

According to Risse (1983, p.175), the Aristotelian method of demonstration or proof in science, when applied to objects of experience, or the empirical world, has two underlying factors: a system of propositions; and an ordering of sensitive objects. Wisdom is knowledge based on principles, but in order to acquire knowledge it is necessary to know the principle beforehand. The method must then be twofold: the analytical induction of the universal based on the particular, i.e. knowledge of principles is reached from the concrete particular via universalization; and the synthetic deduction of the particular on the basis of the universal, in which a principle is presupposed and from it the conclusion is derived in a purely formal way. The synthetic deduction is only legitimate when the presupposed matter is verifiable. In other words, the analytic induction proceeds from the particular we know from experience, in order to extract what it is universal from it (*demonstratio quia*); the synthetic deduction proceeds from the universal, which is conceptually grounded, albeit distant from experience, and concludes why the particular 'is' or 'is like that' (*demonstratio propter quid*); and, finally, the deductive axiomatic demonstrable method concludes rigorously based on the definition made, not being based on knowledge of real objects.

According to Aristotle, the senses cannot judge the substance, the 'why' of something, being limited to judging that something particular was received in our impression from the sensitive organs; in other words, that something exists. This limited type of knowledge is naturally not science. The demonstration begins with the universals, initially developed based on induction, which is a process that begins with the specifics of the senses, i.e. with observation. It is necessary to use induction to get to the universals, thereby knowing the contents, which will, in turn, be the object of scientific demonstration. The content must begin, in the metaphysical sense, with the essence of what is being demonstrated, and the affirmation of that essence is a definition. Induction alone does not provides the essence, namely the raison d'être of a given thing. According to Aristotle, the essence is not the object of the senses; it is the object of understanding instead (Aristotle, 1984, chapter 13, passage 97b26).

Table 1: Subjects and textbooks of the Paduan School of Medicine (1500-1687)

Subjects	Content between 1500 and 1600	*Rotulo* of 1568	*Rotulo* of 1574	*Rotulo* of 1611-1612	*Rotulo* of 1648	*Rotulo* of 1696-1697
Ad theoricam ordinariam medicinæ	First year: Bk.I, of the *Canon*, by Avicenna; Second year: *Aphorisms*, by Hippocrates; Third year: *Tegni*, by Galen	Bk.I, chap.1 of the *Canon*, by Avicenna	Bk.I, chap.1 of the *Canon*, by Avicenna	Bk.I, chap.1 of the *Canon*, by Avicenna, in the first hour in the morning	*Aphorisms*, by Hippocrates, in the first hour in the morning	*Aphorisms*, by Hippocrates, in the first hour in the morning
Ad practicam ordinariam medicinæ	First year: *De febribus*; Bk.IV of the *Canon*, by Avicenna; Second year: *De morbis particularibus a capite usque ad cor*; Third year: *De morbis particularibus à corde infra*; Bk.IX of the *Almansor*, by Rhazes	Bk.IX of *Almansor*, by Rhazes; *De afetibus causis*	*De morbis particularibus à corde infra*	*De morbis particularibus à corde infra*, in the first hour after lunch	*De febribus*, in the first evening hour	*De febribus*, in the first evening hour
Ad theoricam extraordinariam medicinæ	First year: *Tegni*, by Galen; Second year: *Aphorisms*, by Hippocrates; Third year: Bk.I of the *Canon*, by Avicenna	*Tegni*, by Galen	Salernitan questions	Unoccupied position	First *fen*, *in pulsatione campanæ*, by Avicenna, in the first evening hour	Unoccupied position
Ad theoricam extraordinariam diebus festis	Avicenna, Hippocrates and Galen	No record of the subject	No record of the subject	*Aphorisms*, by Hippocrates, after lunch on public holidays	*Ars parva*, by Galen, in the second evening hour, on public holidays	Unoccupied position
Ad theoricam extraordinariam vespertinam	No record of the subject	No record of the subject	No record of the subject	*Tegni*, by Galen, in the third morning hour, and after lunch, *in pulsatione Campanæ*	No record	No record of the subject
Ad practicam extraordinariam medicinæ	Bk.IV of the *Canon* by Avicenna; Bk.IX of *Almansor* by Rhazes	*Almansor*, by Rhazes; *De morbis particularibus*	*De morbis particularibus a corde infra*; chap. on practice of *Almansor*, by Rhazes	*De morbis particularibus a capite usque ad cor*, in the second morning hour	*Ad corde infra*, in the second morning hour	*De morbis particularibus à corde infra*, in the second morning hour
Ad chirurgiam et anatomiam	*De tumoribus præter naturam*, by Galen; Bk.VI of *Aquacpendente de tumoribus et fracturis; de capitis et de*	No record of the subject	No record of the subject	*De vulneribus*, in the third hour after lunch	*De vulneribus præter naturam*,in the third morning hour	*De vulneribus præter naturam*, in the third morning hour; "On wounds"

Table 1: Subjects and textbooks of the Paduan School of Medicine (1500-1687)

Subjects	Content between 1500 and 1600	*Rotulo* of 1568	*Rotulo* of 1574	*Rotulo* of 1611-1612	*Rotulo* of 1648	*Rotulo* of 1696-1697
	ulceribus; vulneribus, luxationibus et fracturis; de ossibus, de partis similaribus et dissimilaribus et earumdem affect., de Anatome, Dioscorides					
Ad lecturam simplicium	Bk.VI of *De materia medica*, by Dioscorides, on poisons and cures (apocryphal); Bk.I, on aromatic plants; Bk.II, on remedies and animals; Bk.V, on wines, metals and subterranean things	No record of the subject	No record of the subject	Bk.I by Dioscorides, on os aromatic medications, at 2 p.m. precisely, in the medicinal garden	Bk.V by Dioscorides, *De vino & mettalicis*	*De purgantibus, in pulsatione campanæ matutina*
Ad ostensionem simplicium	No record of the subject	No record of the subject	No record of the subject	No record of the subject	*In Horto incipiet docere die 2. maii, hora 22*	*In Horto incipiet docere die 2. maii, hora 22*
Ad lecturam tertii libri Avicennæ	Alternating between texts of Bk.III of the *Canon*, by Avicenna, with "On fevers," "The specific diseases between the head and the heart" and"The specific diseases below the heart."	Unoccupied position	Unoccupied position	"On fevers," in the second hour on public holidays	*Capite usque ad cor*, in the first morning hour on public holidays	*De morbis particularibus à capite usque ad cor*, in the first morning hour on public holidays
Ad alius locus Tertij	No record of the subject	Unoccupied position	Unoccupied position	No record of the subject	No record of the subject	No record of the subject
Ad lecturam 2 fen primi Canon Avicenæ	No record of the subject	No record of the subject	No record of the subject	*De morbis, causis morborum, & symptomatibus; De pulsibus & urinis, diebus vacantibus*, in the second morning hour	No record of the subject	No record of the subject

Table 1: Subjects and textbooks of the Paduan School of Medicine (1500-1687)

Subjects	Content between 1500 and 1600	*Rotulo* of 1568	*Rotulo* of 1574	*Rotulo* of 1611-1612	*Rotulo* of 1648	*Rotulo* of 1696-1697
Ad anatomen cum ordinarijs	Together with Surgery	Together with Surgery	Together with Surgery	*Administrabit anatomem*, in the third morning hour	*Administrabunt anatomem die & tempori debito* (on a scheduled day and hour), in the third morning hour	*Administrabunt anatomem die ac tempori debito* in the third morning hour
Ad philosophia ordinaria	No record of the subject	*Physics*, by Aristotle	*De cælo*, by Aristotle	Bk.I and II of *De anima*, by Aristotle, in the second hour after lunch	Bk.I and II of *Physics*, by Aristotle, in the second evening hour	Bk. I and II of *Physics*, by Aristotle, in the second evening hour
Ad philosophia extraordinaria	No record of the subject	No record of the subject	No record of the subject	*Tertium De anima*, in the first hour after lunch	Bk.VIII of *Physics*, in the first hour after lunch	Bk.VIII of *Physics*, in the first hour after lunch
Ad philosophia moralem	No record of the subject	No record of the subject	Unoccupied position	Bk.I of *Ethics*, by Aristotle, in the first hour after lunch on public holidays	*Nicomachean ethics*, by Aristotle, in the first hour after lunch on public holidays; *De somnis & vigilijs*	*Nicomachean ethics*, by Aristotle, in the first hour after lunch on public holidays
Ad logica	No record of the subject	No record of the subject	No record of the subject	*Posterior analytics*, by Aristotle,in the first morning hour	*Posterior analytics*, by Aristotle,in the first morning hour	Bk.I of the *Posterior analytics*, by Aristotle,in the first morning hour
Ad lecturam astronomiæ et meteororum parvorum naturalium Arist.	No record of the subject	No record of the subject	No record of the subject	Bk.II in the first morning hour on public holidays	Bk.II in the first morning hour on public holidays	Bk.III; *The theory of the planets according to ancient and modern hypotheses* in the third morning hour
Ad humanitatem græca & latinam	No record of the subject	No record of the subject	No record of the subject	*Rhetoric*, by Aristotle, in the second morning hour	*Tacitum, & Epigrammata Græca*, in the second morning hour	*Poeseos formam in parte atque tragædiam præcipue Aristotelis trutina pensitabit* (The form of poetry and tragedy of Aristotle), in the second morning hour
Ad mathematicam	No record of the subject	No record of the subject	No record of the subject	No indication of text	*Elements*, by Euclid, in the third evening hour	*Elements*, by Euclid, in the third evening hour

NOTES

[1] Muhammad ibn Zakarīyā Abū Bakr al Rāzī (864?-925?).

[2] *In pulsatione campanæ*: as the bell tolls; for example, at six 'on the dot.'

[3] The new Latin translations of Galen's texts, notable among which are *De complexionibus*, *De malicia complexiones diverse*, *De simplici medicina*, *De morbo et accidenti*, *De crisi et criticis diebus*, *De ingenio sanitatis*, *De differentiis febrium, De interioribus* and *De regimine sanitatis* (Ballester, 1982).

[4] *On the pulse for beginners*; *To Glaucon on the method of healing*; and the comments on Hippocrates: *On the method of healing* (14 books), known as *Megatechne* or *Methodus medendi*; *On wounds*; *On head wounds*; *Epidemics* I (three books); *Epidemics* II (six books), *Epidemics* III (three books) and *Epidemics* VI (eight books).

[5] *Epidemics*, Books I and III; *Epidemics*, Books II, IV and VI; *On the diseases of women*, Books I and II; *On wounds*; *On diseases*, Books II and III; *On internal diseases*; *On affections*; *On diseases*, Book I; *Epidemics*, Books V and VII; *On fistulas*; *On the disease of virgins*; *On hemorrhoids*.

[6] Thaddeus Florentinus (1215-1295), professor of philosophy and medicine at Bologna.

[7] Pietro D'Abano (1257-1315), professor of philosophy and medicine at Padua.

[8] Agostino Nifo (1469/70?-1538), eminent physician and professor of philosophy at Padua, Pisa, Rome and Naples. He produced a vast medical and physical opus, including *De ratione medendi*, *De intellectu*, *Dialectica ludicra* and *Expositio super octo Aristoteles libris de physico audito* (Venice, 1552).

[9] In the sixteenth century, *physicus* and *physiologus* were terms usually used for the natural philosopher.

[10] Julius Caesar Scaliger wrote *De causis linguæ latinæ* (1540); *In II libros De plantis* (1556); *Poetices libri VII* (1556); *Animadversiones in VI libros De causis plantarum Theophrasti* (1566); and *Commentaria in De animalibus* (1584).

[11] Philip Melanchton wrote *Compendiaria dialectices ratio* (1520); *De dialectica libri quatuor* (1531); *Dialectices libri III* (1537); and *Erotemata dialectices* (1555).

[12] In the early sixteenth century, a large number of commentators on Aristotle were known as the Averroist Circles. Pomponazzi, Nifo, Alessandro Achillini, his student Boccadifero, Montecanti de Ferrara, professors Cremonini, Zabarella and Zimara of Padua, Buonamicci, Galileo's professor in Pisa, developed an extensive philosophical discussion about the relations of science, medicine and anatomy. For Averroes – the *commenttator* par excellence of Aristotle – natural philosophy was focused primarily on medicine and its natural questions.

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