CHAPTER 1

Introduction

Fabrizio Bigotti and Jonathan Barry

Anatomists have in effect discovered many elegant things, but the majority seems to be more curious than useful matters, and the origin of diseases should be pursued not so much by hands but by adopting a precise logic, which—except for Santorio amongst the earlier [priores], *and Descartes amongst the most recent* [novissimi]*—I find in very few authors.*
—G. W. Leibniz

Leibniz to Herman Conring (Hanover, 24 August 1677) in Gottfried Wilhelm (von) Leibniz, *Sämtliche Schriften und Briefe*, II.1 (Berlin: Academie Verlag, 2006), 563 (original quote with context): 'Quid enim est post studium pietatis cura sanitatis utilius. Nam in plerisque rebus nobis consulere possumus mediocri prudentia: at sanitatis conservationem fere casui committere coguntur homines,

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Few, concise remarks, rife with admiration. Leibniz's words bear witness to the influence that the Italian physician Santorio Santori (1561–1636) exerted on European medicine and natural philosophy. His works introduced quantification in the life sciences, his devices helped Giovanni Alfonso Borelli (1608–1679) to understand the vegetation of plants, Robert Boyle (1627–1691) to conceive his hydrostatic medicine, Giorgio Baglivi (1668–1707) to formulate his doctrine of fluids and solids, and Carl Linnaeus (1707–1778) his dietetics.[1] Santorio's masterwork, *Medicina statica* (Venice 1614), became the textbook for generations of physicians and a benchmark of experimental medicine. Praised by Herman Boerhaave (1668–1738) as the ultimate example of medical perfection, it set the groundwork for the studies of Archibald Pitcairne (1652–1713) on fevers, John Floyer (1649–1743) on asthma, James Keill (1673–1719) on digestion, Jean Bernoulli (1667–1748) on nutrition, Jean-Antoine Nollet (1700–1770) on electricity up to Lavoisier's and Séguin's researches on oxidation and metabolism.[2] In learned circles Santorio's authority was equally heralded to uphold the existence of atoms, to explain action at a distance as a stream of particles (*effluvia Sanctorii*) and to validate the belief in the resurrection of the dead.[3] And yet so pivotal a figure, likened to William Harvey for importance and to Descartes for clarity of method, is today little known, even by the most committed scholars.[4] While applying to all languages, the lack of studies is particularly conspicuous in the English-speaking world, where the only available monographs are translations of nineteenth-century Italian works, obsolete in their interpretative framework and full of misleading information.

1 A Tale of Oblivion and Rebirth

In part at least, Santorio himself was to blame for conveying such an image of obsolescence. At a quick glance, he might easily pass for the classic Renaissance Paduan physician, busy in providing students with commentaries to the canonical works of Hippocrates, Galen and Avicenna.

in tanta verarum causarum ignorantia, quidquid etiam felicitas seculi jactetur. Quanquam enim multa elegantia detexerint Anatomici, pleraque tamen curiosa magis quam utilia videntur, et morborum origines non tam manibus quam accurata ratiocinandi methodo assequi licet. Quam si Sanctorium ex prioribus, Cartesium ex novissimis eximas, in paucis scriptoribus agnosco' (italics added).

Santorio himself once joked about the fact that the destiny of commentaries is to fall into oblivion,[5] a prediction that has so far proved correct. His fame instead rested on his *Medicina statica* and in particular on its dual emphasis on insensible perspiration and the weighing of the body by using the weighing chair he invented. Although, as we shall see, these inventions rested on his wider corpuscularian philosophy and his experimental methodology, they took on a life of their own, not always necessarily associated with Santorio's philosophical outlook, and eventually eclipsed the latter. Changes in medicine which appeared to render the medical statics obsolete left Santorio in obscurity, and although recent scholarship—particularly thanks to the contribution of Lucia Dacome[6]—has helped to recover the importance of his statics, such a recovery has not, generally at least, been accompanied by the same interest in Santorio's output as a whole.

Indeed, the context and content of Santorio's works seem so at odds with each other that they have been regarded as a trick history played at his expense.[7] This way of looking at his legacy began in the nineteenth century with Charles Daremberg (1817–1872), to whom Santorio was 'a more or less forgotten relic of the ancient physiology':

> […] we cannot share the enthusiasm of Baglivi, Boerhaave and many other 17th- and 18th-century physicians for the medical statics. I do not believe that for this work alone one would erect a marble statue to Sanctorius today, as was done after his death. Sanctorius is more or less forgotten: it is not even read anymore. The whole edifice of his *Ars statica* is based on the old physiology. […] One would be astonished to find so many ingenious instruments in a commentary which is, moreover, entirely scholastic, if one forgot that Sanctorius was above all a *physicist* and a *mechanic*, always in search of novelties; so that *medical statics* is less the result of a medical system than the application of studies directed towards the work of mechanics proper.[8]

Many have borrowed this interpretation acritically,[9] though others have more recently delved into Santorio's works and acknowledged the groundbreaking nature of his ideas.[10] In spite of this, the overall attention devoted to the Venetian physician has hitherto been patchy and very limited in scope. The historiographical reasons for this are not difficult to recount.

Particularly damaging to Santorio's legacy have been attempts to read his ideas as an embodiment of Galileo's. The attempt was consistent with a reading of history as a progression towards the final triumph of the scientific method, which had eventually replaced Santorio's rudimental trials

with Lavoisier's precise chemistry. The life sciences sat at odds with the picture positivists were keen to sketch, and medicine in particular was regarded as an empirical pursuit led by outdated methods and theories. Thus, when the phenomenon of the 'insensible perspiration', to which Santorio's contributions had meanwhile been reduced, ceased to be a pressing concern for medical practice, Santorio was praised instead for having applied Galileo's methods to medicine.[11]

Not less problematic, in the least, is the contemporary attempt to counterbalance such an approach. If framing major scientific changes in terms of 'revolutions' does get away from *Whig history*, it sets the discussion of historical problems within a structuralist dichotomy (old/new, before/after, closed/open, etc.), which hinders any attempt to grapple with the complexity of historical sources. Worse still, in a Panglossian move that reduces everything to language and text, it advocates for the necessity of accommodating historical actors and empirical evidence to narratives and historiographic paradigms, thus requiring historians to locate events on the one side or the other of an imaginary threshold, which does not exist. As with all a priori approaches, it works best in challenging established accounts, but it is of little help when—as in this case—the task is that of evaluating the merits of historical figures that have been forgotten or whose contributions defy easy encapsulation. In this sense, the relevance of authors such as Santorio—but the same would apply to Daniel Sennert, as William Newman shows in his contribution—is that they are a constant reminder that there is 'no simple way' to deal with history. To approach early modern authors, texts must be studied closely and historical evidence used to enlarge and enrich our tentative characterisations of a period or a trend. Thus, in locating Santorio's legacy, we pose as reference the existence of a 'constellation of problems' that are shaped by both converging and diverging historical accounts, each in turn seen as the result of various actors, ideas, methods and aims admitting of different solutions, where the old and the new survive, commix and react, in a way that is impossible to distil into a unifying picture, be it a paradigm or an episteme.[12] Such an approach will lead to a better understanding of Santorio's intellectual legacy reversing the oblivion that has affected an author whose contributions are still reduced nowadays to the caricature of a man living on a weighing chair.[13]

This new approach ought to start necessarily from sketching afresh the main traits of Santorio's life, character and works. These, now enriched by substantial findings, will help us to reconstruct in turn the problems his research was moved by and the directions along which it developed.

2 Santorio's Life and Works

Sources for Santorio's life and personality are scarce and the most reliable ones are scattered throughout his works. The hitherto available biographical outlines depend on a patchy reading of Santorio's works and provide information that is either unreliable or—when it is—depends almost entirely on the biography published in 1750 by the physician Arcadio Capello, who had access to a series of original documents by Santorio's heirs living in Venice.[14] To the former group belong a series of documents written either as praises of Santorio's work and inventions or as part of large histories of the University of Padua,[15] while the latter is represented by a variety of nineteenth- as well as twentieth-century contributions.[16] Useful sources to reconstruct Santorio's intellectual profile can be found in Galileo's epistolary exchanges with his Venetian colleagues, in the official documents of the University of Padua, in the biographies of Sarpi written by Fulgenzio Micanzio (1570–1654) and Francesco Griselini (1717–1787), as well as in the *Iscrizioni Veneziane* by Emanuele Antonio Cigogna (1789–1868).[17] Important letters and documents, including Santorio's last will found in 1883,[18] were published by Modestino del Gaizo (1854–1921)[19] while a few others were discovered around 1960 by Maria Stella Ettari and Marco Procopio, in what has been so far the best monograph on Santorio.[20] A substantial number of documents and letters have finally resurfaced as a result of Fabrizio Bigotti's extensive research into European and American public and private archives, some of which will be used here. In the end, however, the most reliable details and character traits can be found in Santorio's works. In what follows, we have summarised the available data with the most recent discoveries and reshaped some of the conclusions previously reached by scholars.

2.1 Early Life, Travels and Setting in Venice (1561–1593)

The elder son of Antonio (c. 1520–1592/3) and the noblewoman Elisabetta Cordoni (or Cordonia), Santorio Santori was born in Capodistria—today Koper in Slovenia—on the borders of the Venetian dominion, on 29 March 1561.[21] He had two sisters, Diana[22] and Franceschina, and one brother, Isidoro (d. 1618).[23] The Santori family—also known as *Santorio*, *Santorii* or *De Sanctoriis*, Figs. 1.1 and 1.2—was originally from Spilimbergo in Friuli, where Santorio's grandfather, Isidoro, was a notary and a teacher at the local schools (1516–1518).[24]

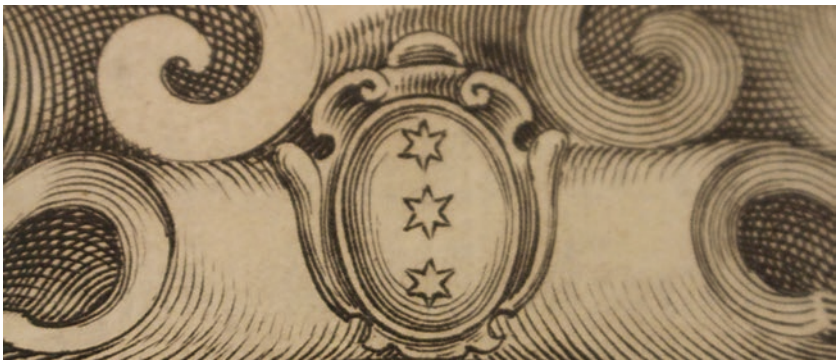


Fig. 1.1 Santorio's Coat of Arms as portrayed on the engraving by Jacopo Piccini (1659)

Fig. 1.2 Santorio's Coat of Arms in the Atrium of Palazzo Belgramoni-Tacco (seventeenth century). Regional Museum, Koper (Capodistria)

His son Antonio moved to Capodistria in 1548 when he was appointed 'bombardier and keeper in chief of munitions' (*bombardiere e sopramassaro delle munizioni*) by the Senate of Venice.[25] Although the position entailed responsibility mostly in administering munitions, supplying new weapons and instructing young apprentices in the art of artillery, Antonio also managed the proceeds of the local salt pans, which were called 'old and new Santorio' (*Santorio vecchio e nuovo*) as late as the early nineteenth century.[26] The Venetian authorities, reacting in part to a complaint from the school of bombardiers in Capodistria, officially reproached Antonio for neglecting his duties in 1583,[27] but an agreement was reached and Santorio's father was subsequently praised for his effort and commitment to his work.[28]

Antonio's knowledge of the practical aspects of mechanics and chemistry related to artillery,[29] as well as his profitable management of the family's business, helped to shape the mind-set of his son, both personally and intellectually. The invention of instruments such as the anemometer, conceived as a maritime tool to use to predict thunderstorms in open sea, and Santorio's reading of the bodily balance as a system of double bookkeeping (*additio et ablatio*) may well reflect this influence.[30] Furthermore, the family's long-standing tradition as notaries and lawyers was pivotal in shaping Santorio's approach to finance, which, by the end of his life, led him to accumulate a very large patrimony of 41,730 ducats, even if we only include the legacies Santorio himself provides in his testament.[31]

His first studies were probably undertaken privately, but due to a long-standing acquaintance between the Santori and Morosini families, in 1574–1578 he was received along with his brother Isidoro into the Morosinis' house in Venice.[32] There he studied with Andrea (1558–1618), Nicolò (1560–1602) and Paolo (1566–1637) Morosini and befriended Nicolò Contarini (1553–1631), the future Doge and one of the prominent members of the *Ridotto Morosini*. The curriculum in the Morosini family included mathematics, philosophy and classical letters as well as consort music.[33] Santorio himself tells us that in his youth he played brass instruments to expand his thoracic capacity, and it is not difficult imagining him involved in the performance of some of the then popular *ricercari* and *canzoni* by Andrea Gabrieli (1533–1585).[34] Coinciding approximately with the beginning of Morosini's political career (1578), Santorio enrolled in the *Regio transmarina* at the University of Padua, where he studied with Orazio Augenio (1527–1603), Bernardino Paterno (d.1587), Girolamo Mercuriale (1530–1606) and Jacopo Zabarella (1533–1589)[35]

and where he eventually graduated in philosophy and medicine. The year 1582, often taken as the year of Santorio's graduation, relies on a false conjecture made by Capello which unfortunately has been taken for granted by all subsequent scholars.[36] Lasting seven years, and beginning at approximately 1578, Santorio could only graduate in medicine in 1585.[37]

Aside from his prominent scientific studies, Santorio cultivated some literary interests. He was a member, and for a short period the president (c. 1586–1587), of the academy known as *Academia Palladia* or *dei Palladii* based in Capodistria.[38] This was a local gathering of young humanists interested in love poetry, music and classical studies. Santorio distinguished himself amongst the other members as most interested in natural philosophical studies, his name being quoted in relation to a dispute (*dubbio quarto*) on colours and their psychological effects.[39] Another glimpse into the kind of discussion Santorio was involved in during this early period is found in Santorio's later editing of the *Epistole d'Ovidio* (1604) by his friend Marc'Antonio Valdera (1567?–1604), a member of the group prematurely deceased.[40] The interests manifested in the *Academia Palladia* in Capodistria did not prevent Santorio from entertaining a more fruitful engagement with the Paduan scientific and cultural élite. In 1587–1588 we find him as a member of the circle of scholars and natural philosophers gathering around the humanist Gian Vincenzo Pinelli (1535–1601) where he met and befriended Paolo Sarpi (1558–1621), who played a key role in Santorio's personal, political and scientific development.[41]

By 1587, Santorio was a sufficiently renowned physician to be officially recommended on behalf of the University of Padua (thanks to the intermediation of the bishop Nicolò Galliero, 1528–1595), for a position in Poland at the service of a local prince,[42] probably in the quality of a military physician.[43] This position lasted five years and involved extensive trips also to Hungary and Croatia (Carlovac), allowing Santorio the freedom to occasionally come back to Venice.[44] The resumé of a letter sent to the judges and majors of Capodistria by their representatives in Venice provides evidence that in 1589 Santorio had departed for Poland but could occasionally travel back. Discussing a list of possible candidates recommended for the position of the local doctor in Capodistria, the representatives state that, while it had been difficult to speak to Santorio due to his being very far away from his homeland (*essendo egli stato lontanissimo*), they were nonetheless able to meet him a couple of times and that he would have accepted the position for 200 ducats.[45] From this and

Santorio's testimony, we can infer that the period Santorio spent abroad was approximately 1588–1592/1593. Indeed, as early as 1594 we find him back in Venice, as the recipient of Mercuriale's consult addressing Santorio's concerns about the cure of a melancholic disease afflicting the Venetian nobleman Arcangelo Agostino.[46] In keeping with Capello's account, scholars have fixed Santorio's return to Venice at around 1599, but 1594 is much more likely and is further corroborated by the epistolary correspondence between Santorio and the physician Eustachio Rudio (1548–1612). In it Santorio had informed his friend as to the hesitations felt in the Venetian establishment in following up on the promise to appoint Rudio at the chair of practical medicine in Padua, which eventually took place in 1599.[47]

By the early 1590s, Santorio had already developed his distinctive interests in quantification and experimental medicine. If we accept what he states in the preface of his *Medicina statica* (1614), and later again in his letter to Galileo (1615), he had been experimenting on himself as well as on different subjects for a period of 25–30 years.[48] This points to 1584 as the earliest date for the beginning of his trials, prior to any possible meeting with Galileo. Santorio's studies on optics also took shape around that period and he had the opportunity to refine his knowledge of applied mathematics as part of Pinelli's circle.[49] Pivotal to his early scientific development were the influences of his teacher Giacomo Zabarella, as well as those of Contarini and Sarpi. While Zabarella's works introduced Santorio to the purest form of 'Venetian Aristotelianism', which stressed logical rigour, method and natural philosophical explanations over more metaphysical and theological commitments typical of the late scholastics, Contarini emphasised the importance of empiricism and scepticism against the use of authorities in philosophical disputes, as exemplified in his *De perfectione rerum libri sex* (1576). This attitude was later sealed by the personality of Sarpi, to whom Santorio remained deeply attached throughout his life.[50] In the early 1600s Sarpi managed to enrol Santorio as the physician of the Convent of the Servites in Venice, and given the proximity of Santorio's house to the convent he was the first to assist Sarpi when he was attacked there by assassins paid by the Roman Curia on 5 October 1607.[51] The two shared a variety of interests, not only in medicine and anatomy, but also in distillation, quantification and optics. A case in point are Sarpi's early notes on the composition of matter, collected in the *Pensieri Naturali* as early as 1578, which form the background against which to read Santorio's approach to the same question in his first work,

(1603). Here Santorio pinpoints matter's most important features—as Sarpi before him—as 'position', 'shape' and 'number' (*situs*, *figura*, *numerus*). The influence was in any case mutual, for it seems that Sarpi later borrowed from Santorio in the making of his *Pensieri Medico Morali*.[52]

As someone whom Santorio had grown up with, Andrea Morosini exerted a more intimate influence on him. Animated by a profound sense of devotion to their studies, both men preferred to remain socially inconspicuous. Three years his senior, Morosini was to Santorio a model of moral and political integrity. This was partly due to Morosini's religious principles—in keeping with which Santorio had been educated—and political attitudes, admittedly more conservative than those of Sarpi or Contarini. Significantly, both men remained unmarried. Yet Santorio's inclinations towards celibacy were, unlike those of Morosini, of a more 'practical' kind. The scorn of romantic relationships, eschewed by Santorio as a form of insanity (*species humanae stultitiae, delirii species*),[53] was the main motivation behind the decision to remain unmarried, which never prevented him from engaging in 'less committed' relationships. In fact, to get a clue as to the kind of celibacy Santorio practised, one only needs to read section six of *Medicina statica*, 'On coitus' (*De venere*), where Santorio reports the results of his self-experiments on the effects of coitus on perspiration. Therein he recommends sexual intercourse (significantly with no mention as to whether it could be practised inside or outside marriage) as a healthy practice leading to a long life. By and large, his approach to the matter was extremely open. In some works, he goes so far as to engage with aspects of pederasty—widespread in the Venetian nobility of the time—which he handles without any apparent moral prejudice.[54] Santorio's critics were, of course, scandalised by such an attitude and some later commentators apologised to their readers for how sex was treated so openly in the text.[55]

Morosini, Contarini and Sarpi were to play an instrumental role in shaping Santorio's career and the political links he forged with the *intelligentsia* of Venice, first introducing him to the *Ridotto Morosini* and later leading to his appointment to the first chair of theoretical medicine in Padua (1611).

It is difficult to locate the activity of the *Ridotto* within a precise timeline. Its nightly gatherings, taking place at Morosini's house in San Luca over the Grand Canal (today Palazzo Cavalli), lasted approximately from 1578 to 1598. Andrea and Nicolò Morosini gathered around themselves the highest echelons of the Venetian nobility, including the future doges

Leonardo Donà (1536–1612) and Nicolò Contarini, Paolo Sarpi and his biographer Fulgenzio Micanzio (1570–1654), the future Bishop of Belluno Alvise (Luigi) Lollino (1552–1625), the mathematicians Francesco Barozzi (1537–1604) and Galileo Galilei (1564–1642), the physicians Alessandro Massaria (1510–1598) and Girolamo Fabrici d'Acquapendente (1533–1619) and, for a brief period in 1592, the philosopher Giordano Bruno (1548–1600).[56] The themes discussed were diverse, spanning from science to religion and politics. Micanzio and Lollino recall these gatherings as dedicated to ethics and natural philosophy, while being 'unpretentious and purely directed towards the attainment of truth'.[57] And yet the activity of the members of the *Ridotto* must be located also within a culture of secrecy characteristic of the Venetian society of the time, particularly with regards to political matters. Politically, in fact, the majority of the members of the *Ridotto* belonged to the most progressive party of Venice (the so-called *giovani*, meaning 'patricians of recent nobility') and were linked by strong opposition to Papal and Spanish policies, later to be reflected in their action during the Venetian interdict.[58]

2.2 Between Venice and Padua (1593–1611)

The ten years between Santorio's return to Venice and the publication of his first work (1603) are wrapped in obscurity. From an intellectual standpoint, the publication of the *Methodi vitandorum errorum omnium qui in arte medica contingunt libri XV* (Venice 1603) crowns the completion of Santorio's early studies and medical practice. The work, which Albrecht von Haller (1707–1777) defined as 'of great importance if little quoted' (*magni momenti opus etsi raro citatur*),[59] is divided into fifteen books, which is reminiscent of the articulation of Galen's *De methodo medendi*. Yet the work is not a commentary. Differential diagnosis and post-Vesalian anatomy set the general background against which Santorio defines the principles of a new method to avoid the errors committed by empirical doctors. This method is grounded in logic and in methodologically framed observation which, in order to be certain, must be universal (i.e. general propositions must be convertible in all cases), accidentality and individuality having no share in it.[60] To reach such certainty Santorio criticises both Galen's anatomy and those who are blind to his authority, he debunks occult qualities and redefines the rapport between universals and particulars. One of the points in targeting empirical doctors is to show that induction per se does not provide any certainty: if anything, it is prone to

logical fallacies and leads to the death of the patients. Individuals, on the other hand, ought not to be seen as qualitative distinct atoms but as temporal and spatial instantiations of universal properties (*distinguntur per hinc et nunc*) which are the same in all and are hence measurable.[61] Such properties are quantitative, being *figure*, *number* and *position*, and out of them all the perceptual qualities emerge, in a clocklike mechanism.[62] These premises allow the doctor to gather essential information about the arrangement of universal properties in individual subjects and so to draw a precise diagnosis sustained and mediated by the use of instruments such as the *pulsilogium*, a pendulum-regulated device that allows one to monitor variations in pulse frequency over time (see Figure 2.6).[63] The book gained immediate success and established Santorio as a medical authority well beyond Italy.[64] Throughout the seventeenth century, it still constituted a source for Joachim Jungius (1587–1657), Caspar Bartholin the Elder (1585–1629) and Gottlieb Wilhelm (von) Leibniz (1646–1716).[65] Despite this initial success, however, Santorio kept practicing in Venice as a private physician.

The years 1605–1607 saw the development and final settlement of the Venetian interdict, in which Venice defended successfully its liberty against the meddling of the Pope and his nuncii. Although Santorio kept a low profile throughout the unfolding of the political events, in 1610 his name was mentioned by Fulgenzio Manfredi (1560–1610)—a theologian who, initially close to Sarpi, later became an informant of the Roman Curia—as someone who read prohibited books and was acquainted with heretics. From both personal and official accounts we are informed that Santorio indeed was close to Sir Henry Wotton (1568–1639), the English ambassador in Venice, who the Roman Curia monitored closely as an active instigator of Protestant doctrines and smuggler of prohibited books in the Venetian nobility, via the mediation of Paolo Sarpi and his friends.[66] Manfredi reported Santorio as of close conversation with Sarpi and reveals that both Sarpi and Contarini were plotting to provide him with a chair in medicine at Padua.[67] And, on 6 October 1611, Santorio was indeed appointed to the chair of theoretical medicine and also became affiliated to the 'Collegio dei Medici Fisici' in Venice.[68] Although important, his political connections were considerably strengthened by the esteem of his colleagues. Amongst them was the Milanese doctor Lodovico Settala (1550–1633) who, when requested by the Senate of Venice to hold the same chair, declined, recommending Santorio as the most worthy candidate.[69] Santorio and Settala maintained a very close relationship

throughout their lives, further strengthened by the arrival in Padua of Settala's son Senatore (c. 1590–1636) to study medicine with Santorio. In a letter to his father, written in 1613, Senatore provides a first-hand account of Santorio's performance as a reader. He describes him as a teacher of great value, clear in his exposition, although not provided with as strong a voice in enunciation as his colleagues, by whom in any case he was little loved, due to his many medical innovations and inventions.[70]

Santorio's first work as a professor of theoretical medicine was the *Commentaria in Artem medicinalem Galeni libri tres* (Venice 1612, completed in 1611). Although it has so far attracted attention because of the passages in which Santorio describes the thermometer, this lengthy work (altogether more than 600 large folios) is relevant in its own right as it adds substantial new elements to Santorio's physiological and physical theories, experiments and observations as well as new details on his life and his encounters.

2.3 The Ars de Statica Medicina *and the Obizzi Controversy (1614–1615)*

Two years later, Santorio came to prominence as an international authority with the publication of his masterwork, the *Ars de statica medicina* (Venice 1614). This little book, dedicated to Nicolò Contarini, consisted of a series of aphorisms divided into seven sections. The first section introduces the general criteria to measure the insensible perspiration of the body (*de ponderatione insensibilis perspirationis*) and is followed by the other six, arranged according to the order of the six non-naturals (*sex res non naturales*), being those factors like air, exercise, sleeping and waking, food and drink, excretion, sex and the passions of the soul, which the human subject was believed to be in control of. At an initial stage, Santorio had thought to write a commentary to the statics, possibly to explain how he gained his results, but he soon realised that it was superfluous.[71] Given the familiarity of physicians with Hippocrates' aphorisms as well as the logical proximity of these latter to mathematical axioms, Santorio deemed the work clear enough to be published *in octavo*. Besides, commentaries to the work started circulating independently of Santorio's knowledge or will.[72] As he declared in a letter to Galileo dated 1615, anyone interested in the new method would be able to appreciate its rigour by engaging in the daily experimentations that the book describes and thus appreciate aphorisms as the best literary form to collect and record them. In other words, while the

necessary explanation of the method is supposed to come from experimentation, its general outline remains accessible—because of its clarity—to anyone interested in it. Beyond their adherence to intrinsic experimental needs, aphorisms are meant to be memorable, all the while inviting others to expand upon the knowledge enclosed in the short sentences—a strategy undoubtedly meant also to enlarge the repute of Santorio as a medical authority. Although Santorio does not supply enough details as to the conditions of his experiments, we know that in experimenting on himself he was assisted by fellow physician Girolamo Tebaldi da Oderzo (1575–1641), who was as keen as Santorio on the application of the new method.[73] Santorio performed his experiments on other subjects as well, by using a special weighing chair, later engraved as part of his *Commentaries on Avicenna's Canon* (1625) and included in the subsequent editions of the *Medicina statica* (Figs. 1.3 and 1.4)

According to its author, *Medicina statica* serves three different purposes: the first is *diagnostic*, allowing one to foresee the onset of diseases through variations in body weight; the second is *dietetic*, focusing on rationalisation of regimen; while the last is the *prolongation of life*.[74] All three targets are grounded in Santorio's experimental proof that the bodily equilibrium between ingested food and the sensible excretions is regulated by the dispersion of an insensible matter (*perspiratio insensibilis*) whose quantitative variations determine a state of health or disease in each individual.[75] The hypothesis on which the experiments are based is that, in normal conditions, the body tends to maintain the same weight.[76] As a consequence, the dispersion of a regular quantity of matter points to a healthy constitution, whilst sudden changes—all other parameters being invariant—reveal the onset of a latent disease.[77] *Latent* and *insensible* are important terms to Santorio as his statics aims at extending the perception of the doctor, making 'apparent' what is *latent* and 'sensible' what is *insensible*.[78] Thus, the quantitative measurement of the *perspiratio insensibilis* is intended less as a matter of investigation per se than as an indication of the present and future conditions of the body, with more minute calculations meant to sketch a reliable trend in the patient's health.[79] By calculating the peak of perspiration the doctor could measure the quantity of drugs to be administered at any given stage of the disease progression, while ascertaining the magnitude of it (*magnitudo morbi*).[80] In an age when the only possible non-invasive medical interventions were diet, bloodletting and purging Santorio's statics sparked a revolution: it showed that the most fundamental processes by means of which the organism preserves itself are

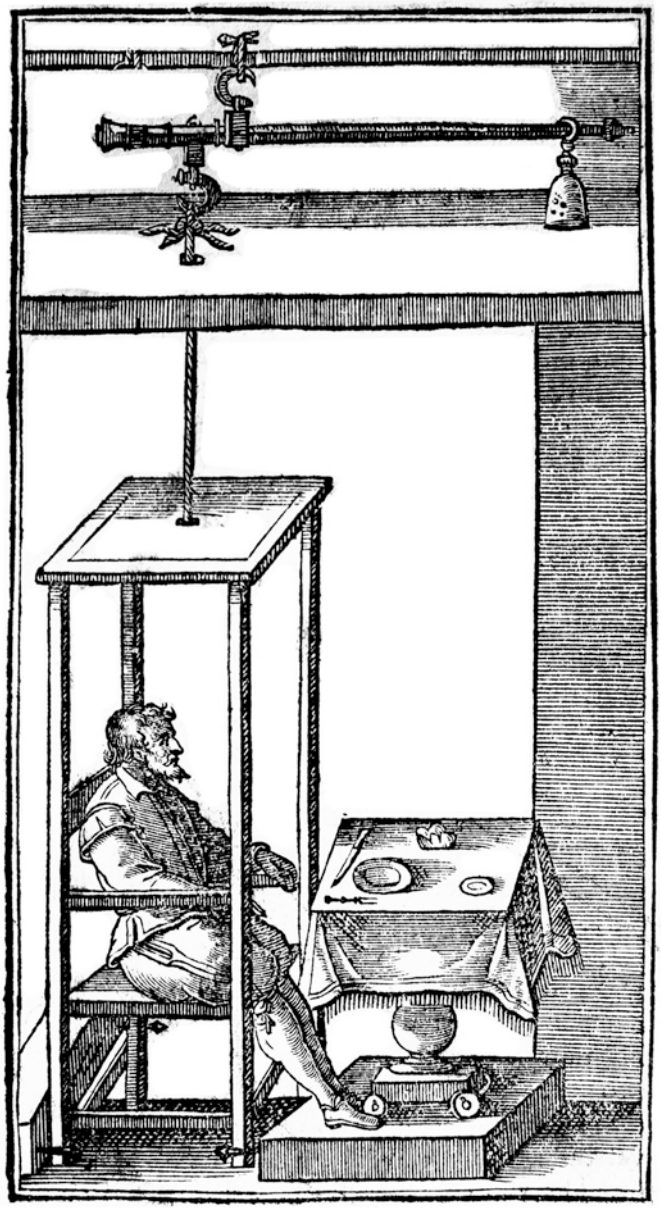


Fig. 1.3 Santorio in his weighing chair. From Santorio 1625, col. 781

Fig. 1.4 Ideal portrait of Santorio as sitting on his chair. Letterhead from Stephan Mack, *Scriptores Medico-Statici*, Ms 11100, p. 159, Österreichische Nationalbibliothek, Vienna

quantitative and must accordingly be analysed experimentally, rather than theoretically.[81] In this sense, the fundamental change in modern medicine brought about by *Medicina statica* was to convert the classical concept of equilibrium, as ideal as subjective, into a statical problem of balance between fluids and solids of the body, the effects of which could be tested and thus controlled. The work, however, was also meant to serve patients, insofar as the latter could use the statical measurements to obtain a median calculation of how much they needed to eat and drink per day, thus leading to the prolongation of life.

The prevailing focus on metabolism has led many scholars to interpret *Medicina statica* as a work concerned with problems and belonging to the framework of traditional medicine. Its emphasis on humours and diet can be certainly construed as in line with this interpretation, but a closer look shows that the conceptual structure underpinning Santorio's work has indeed changed. For while it is true that in ancient and mediaeval physics all natural transformations were conceived as either cooking processes or digestions (πέψις, *concoctio, digestio, assimilatio*), it is equally clear that medical statics presupposes a different meaning of digestion. This consists now of two acts, the 'distillation' (*elixatio*), which brings about the separation of humours into their elemental components, and the complementary act of 'dispersion' (*evacuatio*) of residues in form of perspirable matter.[82] It is therefore entirely relevant to Santorio's conception that he does not list the actions of 'emptying' and 'filling' the body (*inantio et repletio*) within the six non-naturals: these are not parameters to be measured but the very actions by means of which the body keeps its balance, a balance that is conceived quantitatively as regulated by mechanical actions.

In any case, but from a modern standpoint, there cannot be any doubt that Santorio, like many other men of the period, overestimated the applications of his discovery. Then as now, weight is only one out of the many parameters that are to be taken into account when sketching a reliable diagnosis. Nor is it true that diseases are first 'introduced' into the body by a weight change.[83] What's more, the very idea that all gains and losses in bodily weight should be compensated by an equivalent evacuation or addition lent itself to easy simplification, as happened in the seventeenth century when the use of diaphoretics became a kind of panacea, curing everything from fevers to asthma, up to epidemic diseases.[84] This was probably less Santorio's defect than his followers': Santorio regarded his *Medicina statica* as an 'art' and an 'instrument' which could assist medical practice not replace it with a priori deductions. Furthermore, it is a great loss that Santorio never published the tabulated data of his experiments, which could have provided vital insights into his method. In keeping with Obizzi's criticisms, Kurt Sprengel had already pinpointed this as a fundamental fault of Santorio's method.[85] To be sure, however, it was the standard *modus operandi* of his time: Galileo, Beeckman and Kepler constitute an exception only because we possess their manuscripts to supplement their published writings.

Despite the defects, of which later generations became more critical, the relevance of the *Medicina statica* in the history of medicine and science is difficult to overestimate, as the essays in this volume demonstrate. Santorio's work established the principle that in all natural bodies qualitative changes are constantly and necessarily associated with quantitative ones.[86] Given the role the human body still played in the understanding of the natural world at the beginning of the seventeenth century, *Medicina statica* had a major impact on the making of experimental sciences, especially in early modern chemistry, where it helped establish the principle of the conservation of matter.

If appreciated by many, the ground-breaking novelty of the work inevitably attracted criticisms, initially in a pamphlet articulated in three dialogues titled *Staticomastix, sive staticae medicinae demolitio* (Ferrara 1615), written by Ippolito Obizzi (c. 1550–after 1634). Obizzi uses *ad hominem* arguments to minimise the importance of *Medicina statica*, but at times he raises interesting objections,[87] notably that Santorio's statics does not take into account the causes and qualities of perspiration, thus making the quantitative analysis irrelevant as a parameter. Obizzi argues that the same quantity of perspiration can be obtained either by natural means (*secundum naturam*) or by unnatural means (*praeter naturam*), and that this difference cannot be detected by adopting Santorio's methods.[88] Obizzi also reproaches Santorio for not taking into due account the nature of individuals he measures. These become standardised subjects whose age, gender and conditions Santorio does not declare.[89] Obizzi is especially sceptical of Santorio's meticulous calculations in terms of ounces and scruples, which he finds impossible to measure. On a personal level, Obizzi criticises Santorio's open stance towards sex, which he finds impious and not suitable to priests, monks and other celibates.[90]

It took some time for Santorio to reply properly to these attacks. He indirectly did so in 1612—replying to the criticisms an unknown physician had voiced amongst common friends—and again in 1625, while finally coming out publicly against Obizzi in 1634, with his *Responsio ad Staticomasticen* consisting of seventeen aphorisms added as an eighth section to *Medicina statica*, thereafter included in almost all editions of the work.[91] Santorio's *responsiones* are concise but sharp: Obizzi is an astrologer who has no grasp of experimental method and condemns others' results on the grounds of *hypotheses* that have no experimental backing.[92] All his criticisms are due to the fact that he does not acknowledge the difference Santorio constantly makes between 'feeling lighter' (*ad sensum*) and 'being lighter' according to the measurement of the scale (*ad stateram*).[93] In fact Santorio had recognised the difference in the quality and nature of

perspiration, but had conceived both as measurable. In order to assess such difference he had invented instruments and devised experiments that were unknown to Galen or any of the ancients.[94] This latter point helps us to understand another essential principle that *Medicina statica* introduced into European medicine, namely the distinction between 'perceived' (*ad sensum*) and 'measured' (*ad stateram*) reality. The distinction resurfaced again in the correspondence of John Locke (1632–1704), where it was used by Nicolas Toinard (1628–1706) as an early version of the famous distinction between primary and secondary qualities.[95]

2.4 *President of the* Collegio Veneto *and Resignation from the Chair of Medicine (1616–1624)*

The academic years following the Obizzi controversy ran smoothly and Santorio enjoyed the gratitude and affection of his students. In the period 1616–1618 and again from 1622 to 1624, he was appointed as the president of the *Collegio Veneto*.[96] The *Collegio* was created in 1616 and advertised externally as an institution to grant poor students at Padua the opportunity to obtain a doctoral degree without sustaining the steep prices of the official procedure, but it also acted as an instrument of the Republic to allow Protestant students to bypass the papal imposition that compelled official students at Padua to profess publicly their Roman Catholic faith. Another aim was to abolish the arbitrariness of the *Conti Palatini*, who were previously given the authority to bestow doctorates *privatim* without requesting permission from the University of Padua or the Senate.[97] Those granted by the *Collegio* were prestigious and highly sought, as Santorio became internationally famous. Around 1614–1616, possibly marking the event of Santorio's appointment as the first chairman of the *Collegio*, he had his portrait made (Fig. 1.5). This portrait has been identified as Santorio in 2017 by Fabrizio Bigotti, for reasons of its close resemblance to the known engraving by Jacopo Piccini (Fig. 1.6), the height of the sitter, compatibility of the profile with the engraving of Santorio in his chair (1625) and the surviving skull kept in Padua, as well as important details showed by the burial at the Ateneo Veneto (such as beard and overcoat) (Fig. 1.7), as well as for the size of the little book *in octavo*, which is precisely the size of the *Medicina statica*.[98] Although the portrait features no marks or inscriptions, the man may be easily described as an academic whose age is also compatible with that of Santorio (who was 55 years old in 1616) while the painter, anonymous but conjecturally identified as Frans Pourbus II (1569–1622), has been

Fig. 1.5 Anonymous (Frans Pourbus II?) *Portrait of Santorio Santori*. (Identified by Fabrizio Bigotti in 2017). Oil on panel, 91 x 76. Antwerp, The Phoebus Foundation. © The Phoebus Foundation 2020

Fig. 1.6 Santorio Santori engraved by Jacopo Piccini in 1659. From Santorio 1660

Fig. 1.7 Santorio's burial at the *Ateneo Veneto* in Venice (originally from the cloister of the *Convento dei Serviti*). From Paola Rossi, 'La memoria funebre di Santorio Santorio', *Venezia Arti*, 17–18 (2003–2004), 51–56

previously described as a north-Italian painter, thus making the identification with Santorio's portraitist very likely. The later painting (whereabouts unknown), engraved by Piccini in 1659, was probably made by Tiberio Tinelli (1586–1639).[99]

In any case, around this period Santorio's name became so important that it led to forgeries of Paduan diplomas, such as a diploma now held at the Royal College of Physicians in London, where an unknown physician has altered the name and date of the diploma to make it seem that he had graduated in Padua with Santorio in 1628, when the Venetian physician had already left his position at least four years earlier.[100]

In his capacity as the president of the *Collegio*, however, Santorio faced the criticisms of the Papal nuncio Berlingero Gessi (1563–1639), who targeted Santorio for his intransigence in following the Senate's decrees thus bestowing academic degrees in medicine and law on Protestants, Jews, Greeks and many other non-Catholics.[101] It became clear to the nuncio that Santorio was acting as Sarpi's and Contarini's agent and that he was not easily intimidated.[102] Meanwhile, criticisms came also from the University of Padua: Santorio had in fact misinterpreted the duties associated with his new position in bestowing the doctorate on some students without requesting permission from the University.[103] The documents of the *Acta Nationis Germanicae* kept in Padua yield a picture of Santorio as a man drunk with power and confident in the strength of his political connections, making public displays of rage against those who have been awarded doctorates by the University in his absence.[104] But this view should be taken with a grain of salt, not least because Santorio was summoned a second time to the same role in 1622–1624 and the students of the *Natio Germanica* always manifested their sincerest support and admiration for him. In 1623 he was also accused of negligence in lecturing his students, but he was then fully and promptly exonerated.[105] The accusations were in fact levelled for political purposes. The conflict with the Papal nuncio and the progressive loss of political connections brought Santorio increasingly out of favour with Venice's political establishment, which started seeing him as a leftover of an outdated party and a hindrance to new conservative politics as the Senate started taking a more conciliatory approach towards the Pope and Spain. Thus, following the death of his friends Agostino da Mula (26 October 1621) and above all of Paolo Sarpi (15 January 1623), Santorio was denied the increase of salary he had demanded for the renewal of his appointment (to be raised from 1200 to 1500 florins) and accordingly resigned in 1624.[106] This was a deliberate decision reflecting the Senate's changed political attitude to the *Collegio Veneto*, and to him in particular.[107] The political intent

behind the decision became clear with the immediate replacement of Santorio with the Pope's physician Pompeo Caimo (1568–1631).[108] By 1625, Santorio was *civiliter mortuus*, having lost all academic privileges and honours.[109] However, the Senate granted Santorio his full salary for that year and a tax reduction—though not an annuity, as wrongly reported in all previous accounts.[110] Santorio kept practising privately as a doctor in Venice. Following his resignation, he was offered positions in Bologna, Messina and Pavia, which he refused to continue living in Venice.

One year after his resignation, Santorio published the *Commentaria in primam Fen primi libri Canonis Avicennae* (1625). The work, begun in 1623, is a collection of his lecture notes and displays for the first time a good number of Santorio's instruments.[111] Haller called the work *memorabile opus*, and indeed it represents the pinnacle of Santorio's scientific and experimental achievement.[112] Writing to his former student Senatore Settala on 27 December 1625, Santorio defines the work as plenty of 'new thoughts yet grounded on the authority of Hippocrates and Galen'.[113] The book not only shows engravings of various types of pulsilogia, thermometers, hygrometers and the weighing chair, but also instruments for tracheostomy and paracentesis, for palliative care as well as for optical experiments. As seen, these latter had been a long-standing interest for Santorio and we gather from his testament that a manuscript with 'A hundred problems of physiological optics' (*Cento problemi di ottica fisiologica*) was to be handed over to his colleague and friend Girolamo Tebaldi da Oderzo.[114] The *Commentaries on Avicenna's Canon* had a second reprint in 1626 which is very rare, but some copies present textual variations.[115] In one of these, kept in Padua, Santorio informs the reader about the structure of the forthcoming book on 'Medical instruments no longer seen' (*De instrumentis medicis non amplius visis*) that he planned to publish: a book showcasing large engravings with the construction of the new instruments and the ways to use them, most likely similar to the anatomical plates of his colleagues Girolamo Fabrici d'Acquapendente (1533–1619) and Giulio Casserio (1552–1616), with the engravings marked by letter on the one side of the plate followed by explanations on the back of it: a very expensive book both to print and to buy. As we shall see below, Santorio was looking for a patron who could help him to cover these expenses; he thought he had finally found one in Francesco Maria II Della Rovere (1549–1631) to whom he dedicated his last work in 1629.

2.5 The Final Years 1625–1636

With the exception of the *Methodi vitandorum errorum...libri XV* and the *Medicina statica*, Santorio's works were aimed at providing medical students with reliable textbooks. In 1629 he published the last of such textbooks, the *Commentaria in primam sectionem Aphorismorum Hippocratis* and the little book *De remediorum inventione*. From 1630 to 1634 Santorio devoted his endeavours to the reprint of previous published works. If actually undertaken, the intended publication of the book *De instrumentis medicis* was probably frustrated again by the death of Della Rovere in 1631. Furthermore, in 1630 plague broke out in Venice and Santorio was requested by the Senate to give his opinion on the nature of the epidemics. Much speculation has been devoted to why Santorio denied the true nature of the disease. As documented in the essay by Vivian Nutton and Silvana D'Alessio, the nineteenth-century historian Paolo Dolfin ascribed Santorio's refusal to acknowledge the plague to his political connections with the Senate and to the extraordinary pressure he was under not to compel the authorities to shut down ports and the commercial activities of the city.[116] If so, Santorio's decision would be somewhat mitigated by circumstantial considerations. Doctors were inclined to deny that sporadic epidemics could be identified as plague, not least as such calls were made regularly every year.[117] But it seems unlikely that pressure from the Venetian authorities could compel Santorio's judgement: Santorio was one of the few (and, according to certain testimonies, at some moments the only one) to openly deny that the epidemic disease was indeed a plague.[118] If his aim had been to shield his reputation from the possible reaction of the Senate, Santorio would have done better to join the majority party. In any case, throughout the spread of the plague Santorio remained in Venice, helping the authorities to fight its spread and actively assisting the poor of the city by organising the shifts of the corpse carriers.[119] In 1634 the advice that he had given and tested personally in fighting the plague was added to the first section of the *Medicina statica*: Santorio argues that plague is spread by an exhalation (*halitus*) and that all traditional remedies are vain, with the only effective precautions being either fleeing away or segregating those with the plague.[120]

Santorio spent his final years with his nephew Antonio (1600–1642), who became a physician in Venice on 16 October 1631,[121] and to whom he entrusted his final will, a task Antonio could fulfil only in part, for he died prematurely six years later. Santorio died in Venice on 25 (not 22 as many biographies have it) February 1636 in a house belonging to the Dardani family at the Fondamenta della Sensa over the homonymous canal.[122]

According to the official medical report he died from a urine disease (*mal d'orina*), but other accounts state that he remained many hours with very feeble or no pulse.[123] His remains were buried in a tomb in the cloisters of the church Santa Maria dei Servi, the church of the Servite convent wherein Santorio had served for many years as a physician and confidante of Sarpi. Santorio's bust, originally placed over the tomb, was removed from the church in 1815 following its partial demolition and is now kept at the Ateneo Veneto in Venice (Fig. 1.7). At the beginning of the nineteenth century, following the destruction of the Chiesa dei Servi, his bones were exhumed by the physician Francesco Aglietti (1757–1836) and Santorio's skull is now kept at Museum of the History of Medicine (MUSME) in Padua.[124]

The substantial fortune made by Santorio provided his descendants with the opportunity to become permanent citizens of the Republic of Venice (*cittadini originari*) in 1658,[125] and to acquire a large villa over the river Brenta, rebuilt in the nineteenth century as Villa Elvira, along with a palazzo in Venice at the Fondamenta Santorio at San Basegio, which was demolished at the end of the eighteenth century.[126] Santorio also left a considerable amount of money to the 'Collegio dei Medici Fisici' in Venice to give an annual Sanctorian Lecture, a practice that began with Santorio's colleague Girolamo Tebaldi, followed by Giacomo Grandi, Arcadio Capello—his most reliable biographer—and Nicolò Pollaroli and lasted for almost 150 years, up to 1774.[127]

3 'Not that Close': The Problematic Relations Between Santorio and Galileo

We have previously hinted to the relations between Santorio and Galileo, the nature of which has remained a puzzle to historians.[128] While the two knew each other personally, there was a certain distance between them, both in terms of ideals and characters. In fact, although Santorio and Galileo had similar interests and upbringing, the same friends, and even worked and lived for a while in the same places, neither ever mentions the other directly, not even when they would have had compelling reasons to do so.

In 1623 Galileo writes the *Assayer* (*Il Saggiatore*), and in a passage where he introduces his corpuscularian ideas, reference is made to the insensible perspiration of the body (*insensibile perpiratione*) as an example of the effluvium of corpuscles.[129] At the time Santorio was the unquestioned authority on this but his name is never mentioned. Santorio reciprocated this tacit dismissal, in 1625, and again in 1629, when he offered his students and readers a consideration of the merits and problems of the

Copernican theory.[130] Unlike others in Padua, Santorio takes the theory seriously and defends it against detractors and superficial objections, none of which prevents him from eventually dismissing Copernicanism on the grounds of observations made with the telescope. One of which is that, if the upholders of the Copernican theory are right in assuming that there is no difference between the terrestrial atmosphere and the skies, then we should expect to witness on the moon an atmosphere similar to the terrestrial one, with corresponding atmospheric events such as rain and winds as well as modification of the soil as due to these environmental factors. But Santorio argues that, looking at the moon 'with the lens recently invented' (*cum specillo nuper invento*), this is not the case.[131] Galileo's spectre lurks around the entire discussion, but neither his name nor his inventions are ever mentioned. Another episode is that known to Galileo's scholars as the 'episode of the notomista'. It was recounted by Santorio in 1603 and then Galileo reworked it slightly, some 30 years later (1632).[132] To deride those who are addicted to the authority of the ancients, Santorio tells us of a public anatomy where an important Aristotelian scholar of the time had denied that the veins originate from the liver and that the heart is surrounded by a fat substance (*pinguedo cordis*), thus preferring to blindly follow Aristotle's authority than his own senses. Galileo ascribed the occasion of the quarrel to the origin of the nerves, but the conclusions are the same as Santorio's. If the famous episode took place in Santorio's house—as is likely, due to the fact that he recounts it in the first person—it is interesting that Galileo does not quote him or his source.[133]

The safest conclusion these series of omissions would suggest is that the two were not close enough to feel comfortable in mentioning each other's names in published works. Unfortunately, there is more and it involves a question of priority in the invention of two instruments: the pulsilogium and the thermometer.

As seen, the *Ridotto Morosini* brought Galileo, appointed to the chair of mathematics at Padua in 1592, in close contact with Santorio and Sarpi although other occasions might have occurred earlier at the Pinelli's circle.[134] Instruments such as the *pulsilogium*, known as the earliest applications of the pendulum to medical practice, probably were conceived at these times if not in these meetings. Others, like the thermometer, were realised much later (c. 1610). On the grounds of such a continuity, scholars have often claimed that Santorio simply appropriated Galileo's inventions. We shall address the merits of such a claim in the next section but it

is important to highlight that the claim originated with Galileo himself, who had reclaimed both inventions through the account of his student and biographer Vincenzo Viviani (1622–1703) and in a letter now lost to Giovanni Francesco Sagredo (1571–1620).[135] Scholars have recently come to doubt many of Galileo's statements about the priority of his discoveries,[136] and new documents show that the *pulsilogium* was already known to the Paduan colleagues of Galileo as an invention of Santorio before Galileo first described his experiments with the pendulum to the mathematician Guidobaldo del Monte in 1602.[137] This would help explain why, while in Padua and Venice, Galileo never raised any question of priority as to the invention of such an instrument.

The thermometer was somewhat different and a more serious affair, in that it set the tone for much of the subsequent relations between the two. In this case, Galileo seemed to have claimed the priority of the invention immediately, if privately, to Sagredo.

The affair itself was a bit bizarre. Santorio—who must have made his instrument somewhere around 1610[138]—only claimed to have adapted to medical practice an instrument invented by Heron of Alexandria (c. 10–70 A.D.).[139] Galileo, on the other hand, never mentioned nor used the instrument in any of his experiments.[140] Santorio instead had used the thermometer for medical practice and showed it publicly to his students and colleagues in Padua since 1611, including his friend Agostino da Mula.[141] Da Mula came to visit Santorio on 30 June 1612 and told Sagredo about the thermometer.[142] The latter, in turn, reported the news to Galileo. Although Galileo's reply has not survived it is clear from what Sagredo says in his letter that Galileo claimed the invention. However, it seems that Sagredo himself later became wary of Galileo's claim. He had invited Galileo to send details and sketches of his thermometers, which Sagredo believed to be more advanced than the ones he had been able to make in the meantime after the indications provided by da Mula. Yet, Galileo never sent any details and Sagredo turned for directions to Santorio who, at this point, refused to give any.[143] It is against this backdrop that we ought to frame the only surviving document of the Santorio-Galileo relationship: a letter sent by Santorio dated 9 February 1615 (Figs. 1.8–1.10). As it has never been translated into English, it is worth summing up its content, however briefly.

The letter is meant to accompany a copy of Santorio's *Medicina statica*, published one year earlier (1614). Apologising for the delay in sending the copy of the work, apparently due to the bookseller who had forgotten to

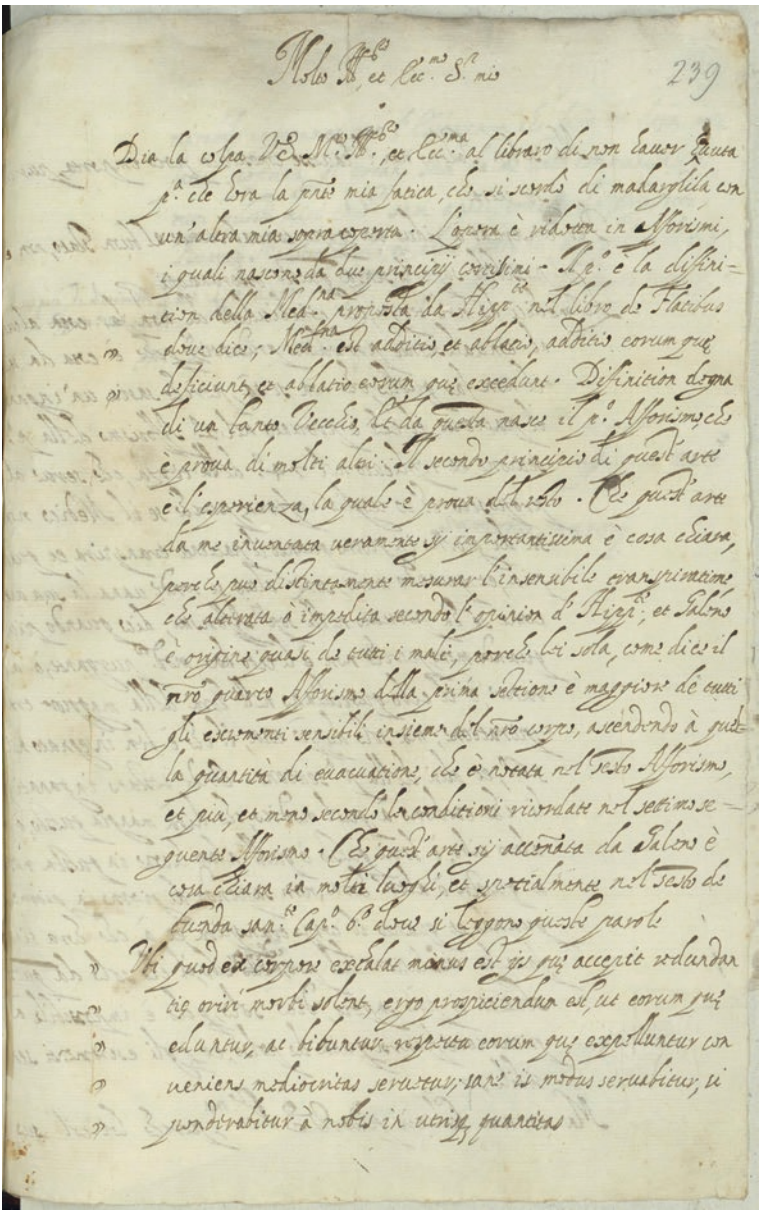


Fig. 1.8 Santorio's autograph Letter to Galileo—9 February 1615; MS Gal 89, c. 239r, National Library of Florence

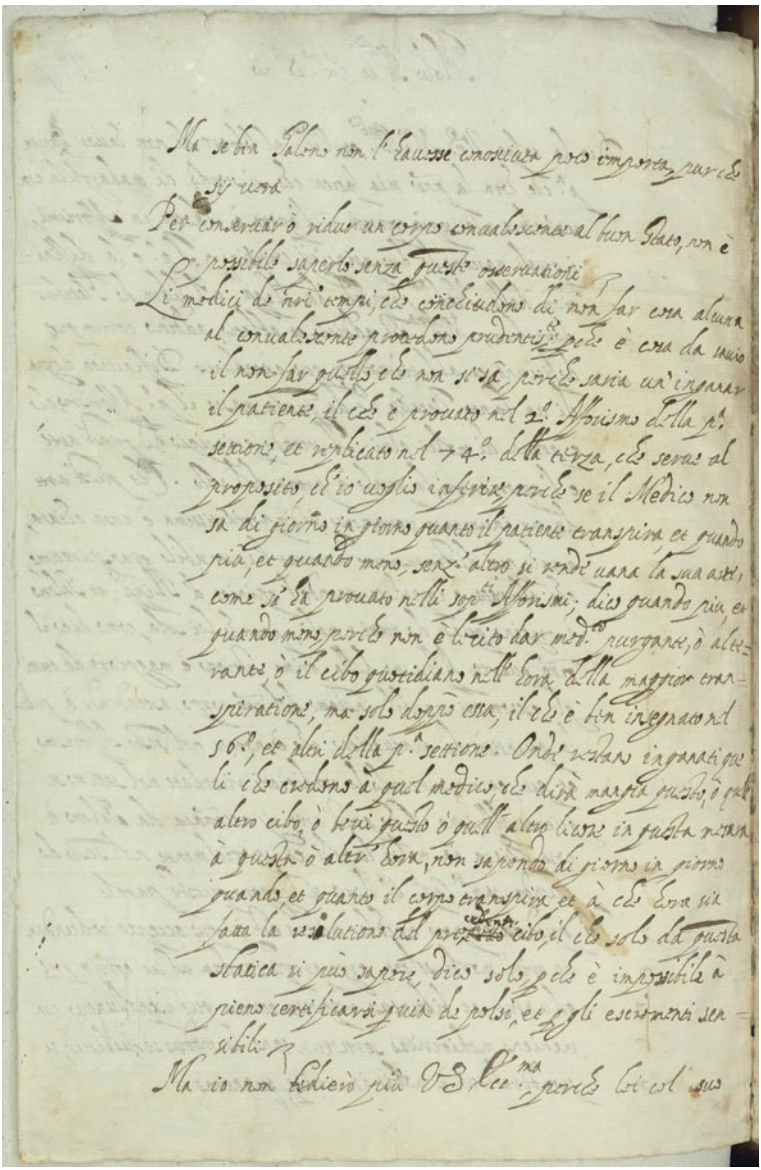


Fig. 1.9 Santorio's autograph Letter to Galileo—9 February 1615; MS Gal 89, c. 239v, National Library of Florence

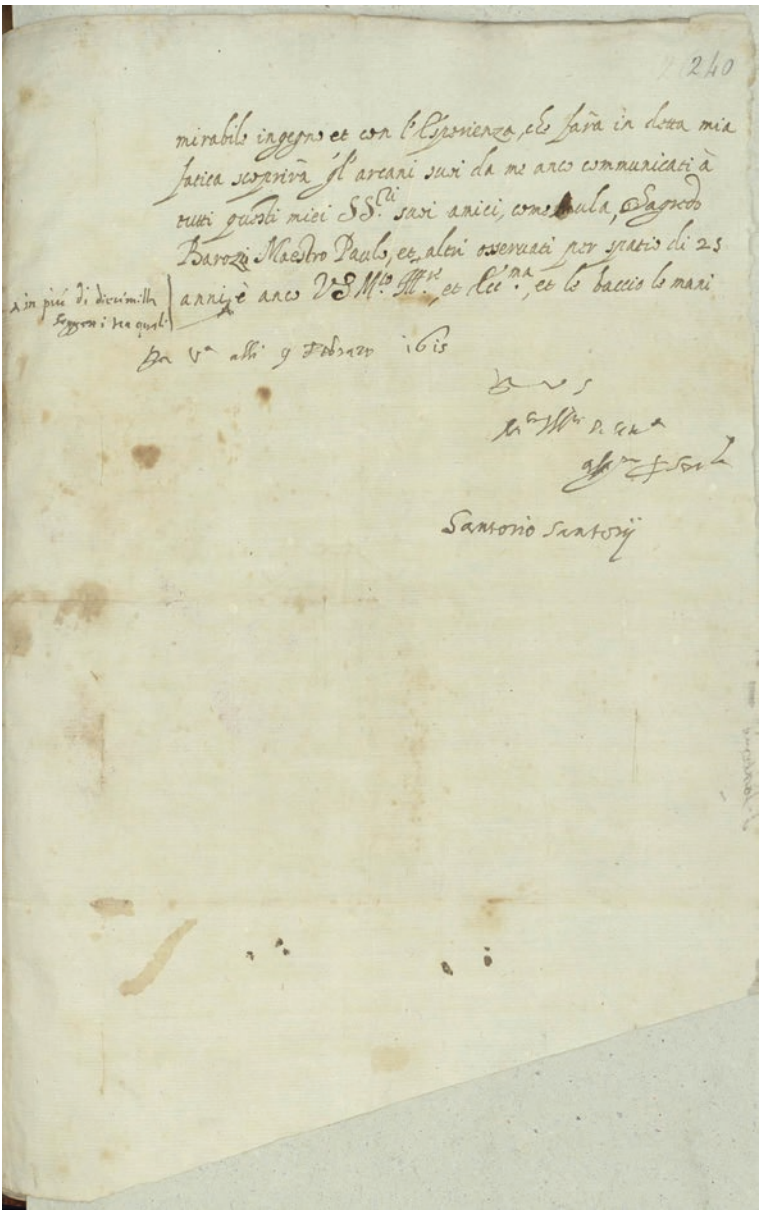


Fig. 1.10 Santorio's autograph Letter to Galileo—9 February 1615; MS Gal 89, c. 240r, National Library of Florence

send it, Santorio dwells upon the principles and importance of his research. The work is organised in aphorisms and it hinges on a principle of Hippocrates (*medicina est additio et ablatio*) but the rest is grounded in Santorio's experimental trials. After expounding on the importance of the results he had obtained, Santorio defends that he has no need to bother Galileo with providing further details, for his 'admirable ingenuity' (*ammirabile ingegno*) and the daily practice he will make according to the prescriptions of the text, will allow Galileo to understand them for himself. This otherwise usual exchange ends with Santorio stating that he had already shared the secrets (*secreti*) of the *Medicina statica* with Galileo's friends, most notably with Sarpi, Sagredo, Barozzi and da Mula. They all are well acquainted with Santorio's experiments which spanned 25 years and involved more than 10,000 experimental subjects, amongst which was Galileo himself. Looking at the way it was written, as an addition on the left-hand margin of the letter, and especially the abrupt change of tone, Santorio's last sentence can be construed as a warning to Galileo, a kind of 'And, by the way, be aware that'.[144]

The elements that are worthy of special attention in this letter are three. First, the detailed explanation provided by Santorio regarding the principles and implications of the *Medicina statica* suggests that these were relatively unknown to Galileo and thus that work did not depend in any substantial way on the latter's findings. A second element Santorio highlights is that, unlike the recipient of the letter, their mutual friends in Venice were all acquainted with the details (*secreti*) of Santorio's research programme. The most important element, however, is the final one. By emphasising the number of years throughout which experimentation was carried out and by detailing the number of subjects involved in it, which included Galileo, Santorio seems to be warning Galileo that he cannot claim priority on any part of the work, which contained direct reference to the invention of instruments such as the thermometer and the hygrometer.[145]

Galileo's friends in Venice were all aware that Galileo—to use the words of the merchant Fugger—was 'like the raven of Aesop, which likes to take pride of others' inventions'.[146] In the aftermath of the discovery of the *Medicean planets* (1610), da Mula complained that Galileo was boasting about da Mula's inventions and discoveries, and Sarpi himself played down the prominence of Galileo's invention and experiments with the telescope, an interest which—as seen—was shared by Santorio.[147] Seen through this

lens, one feels compelled to subscribe to the conclusions reached by Alistair Crombie on the matter:

> Galileo habitually made claims unsupported by any known evidence and frequently refuted by it. When he heard of a discovery or contribution to science he would claim that he had made it himself, even many years before, as with Santorio's thermometer (*Opere,* xi, 350, 506), and Bonaventura Cavalieri's demonstration of the parabolic trajectory of a projectile (xiv, 386). Sometimes he would appropriate the work without acknowledgment, as perhaps with Francois Viete's treatise on mechanics (…) and with Mersenne's formulation of the law relating the frequency of a pendulum to its length (…). He would use every rhetorical device to misrepresent the scientific competence and arguments of opponents, as he did with the Jesuit mathematician and astronomer Orazio Grassi in their dispute over comets, while obstinately rushing himself into some wrong headed and untenable conclusion. He was capable of ignoring almost completely fundamental contemporary theoretical and experimental discoveries, as he did with Kepler's astronomy and optics.[148]

While his friends knew that Galileo's borrowings were always elaborated on a personal base and eventually came out in writings in a much better shape, this was clearly not the case with the thermometer—whose use Galileo never fully appreciated—neither with the pulsilogium.[149] As we shall see, there are other motivations than the simply contextual ones to argue for Santorio's full authorship of these and other instruments.

Whatever the true nature of the Santorio-Galileo relationship was, resentment never prevented Santorio, or for that matter Sarpi and others in his Venetian circle, from professing the sincerest admiration for Galileo's achievements. Altogether, Santorio and Galileo had in common an inquiring mind and a strong sense of independence. Whereas they both were keen to liberate the academic curriculum from the tight spots of scholastic philosophy, they did so in different ways. Galileo was the revolutionary type, brilliant and intransigent, ideological and opportunistic, a courtier at times and a man of spirit. Santorio was instead a patrician, reserved and not inclined to direct polemics: each criticism he levels either at Galen or at Aristotle is always pondered with great care and against a precise target. The overthrow of medicine as a whole was of no appeal to him although—as the Obizzi controversy reveals—it was clear to those who understood the essence of Santorio's methods that these had the capacity to revolutionise it. As characters, therefore, Galileo and Santorio were squarely

opposed. Galileo practised astrology keenly, while Santorio held astrologers as nothing but quacks, seeking to disprove their assumptions once and for all in theory and experiments.[150] The difference in economic means contributed to emphasise such differences. Galileo was paid little and at times had to rely on the generosity of patrons and friends to fund his research. Santorio, who forged links of incredible strength with the Venetian nobility, could also rely on his personal earnings as a physician in Venice, which made him an extraordinarily wealthy man. Despite this, they both fell victims of a political ostracism which compelled Bishop Alessandro Bichi in 1636 to state:

> [T]he Venetians are terrible and don't care about anyone, having treated Mercuriale, Galilei, and Santorio even worse in the past, all of whom they left in desperation […].[151]

4 New Instruments for a New Medicine

With this proviso in mind we can finally address the context and problems posed by Santorio's instruments. Of the approximately thirty devices that Santorio invented, we can distinguish three general types, namely:

1. Instruments for quantification in medicine and natural philosophy (pulsilogia, thermometers, weighing chair, hygrometers, wind and water gauges);
2. Instruments intended to help clinical practice (portable bath, suspended and equipped bed, ice bag, dripping pot, humidifier, pneumatic cupping, quenching ball);
3. Instruments to be used in surgery (trochar, needle for paracentesis, device to stop bleeding from the nostrils, device to pull out objects accidentally falling in the ear).

For reason of economy of time and space we will be dealing here with the first group only, which can be understood as part of Santorio's programme of quantification in medicine. He conceived this programme as the measurement of the intensity of a phenomenon in terms of degree.

The starting point of Santorio's analysis is the recognition that a healthy organism maintains the same parameters unaltered throughout time (*homeostasis*), unless the process is hindered by the onset of some diseases. This prerequisite (or *praecognitum*, in the Aristotelian language of the time)[152] is used to define the disease as a distance from the region of

normality (*morbus est recessus*).[153] In keeping with this insight, Santorio's instruments are meant to provide a measure of such a distance (*varios dimetimur recessus*) and he considers them as devices that extend the perception of the physician beyond his usual limits by allowing him to spatially visualise the difference between normal and pathological conditions as well as necessary aids in order to avoid errors in diagnosis. They allowed Santorio to quantify the activity of the body in relation to its weight change, temperature, pulse and environmental conditions such as the temperature, humidity and atmospheric pressure of the air.

Though the applications are ground-breaking, the principle inspiring Santorio is ultimately a reworking of the Galenic rationale, which applied 'a range' (*latitudo*) to health and sickness on the basis of their duration over time (*latitudo sanitatis, neutralitatis, morbi*). Santorio is willing to acknowledge his debt to Galen and he considers his instruments as outcomes of such an idea, with *Medicina statica* itself seen as an 'instrument' able to confirm, a posteriori, the validity of Galen's insight:

> Galen […] teaches us how we can measure the quantity and strength of hot and cold in intemperate mixtures. He states that the quantity or the strength of the intemperate mixture will be as much as its distance from the natural state (*quantus est recessus a statu naturali*) […]. I make use of four instruments by means of which I ascertain the quantity of this distance (*de quantitate recessus*). The first one is an instrument that I invented and is called a pulsilogium, through which we grasp how much in each day each individual departs (*recedat*) from their best condition. The same result is provided by the second instrument, by means of which, by putting in movement a leaden ball attached to a suspended thread and, from its movement on the thread, and from the greater or smaller lengthening, anyone will be able to observe the natural motion of the pulse and its distance from the natural condition (*recessum a naturali*). By means of the pulsilogium I measure with great diligence the motion and rest of the artery and I can also compare this measure with the pulse of the previous days. With the third instrument I measure, by means of statical experiments, the various distances (*varios recessus*) in respect to the natural state. It is not useful to give here further information on the secrets of statics, as in a short time I will publish four hundred aphorisms on statical experiments [i.e. *medicina statica*]; the fourth instrument, which is wonderfully advantageous, is a sort of glass ampulla, with which we can measure (*metiri*) not only the temperament of the air, but also of any part of the body, and how is for every day the distance from the natural state (*recessus a statu naturali*).[154]

This praise should not be taken light-heartedly or as a circumstantial one: elsewhere Santorio spares no criticisms of Galen and his anatomy.[155] He sees his major medical achievement in bringing to completion the ancients' project while putting it on new mathematical bases.[156] Both tradition and innovation are thus equally present as complementary elements in Santorio's programme of quantification. In the light of this, attempts to present Santorio as the exponent of either the ancient physiology or modern experimentation fail, as the texts themselves stand against such simplifications. Pushed against his Galenic background—as when he addresses Obizzi's criticism—Santorio rejects Galen and states clearly that his instruments and experiment are born out of a new methodology, unknown to the ancients.[157] On the other hand, however, pressed into the service of a full-scale attempt to establish a new medicine, Santorio declines the invitation and declares that his discoveries are to be applied to medicine *aliquando et aliqua ex parte* ('sometime and in some respect').[158] This spared him from committing himself to bombastic claims, not infrequent in his era, amongst which there are those of Descartes—who sought to replace the body with a machine, unaware as he was of the limits of quantification—and equally those of Galileo, who presented himself to Sagredo as the 'inventor' of the thermometer, an instrument whose applications he never really understood.

One has only to compare the use of the thermometer in the two authors, to appreciate that Galileo had no idea of how to use it. Upon realising that the instrument could allow to discriminate between real and perceived temperature, Santorio started adopting it widely, for instance to show to what extent the humidity of the air enhances the subjective appreciation of cold[159] or to determine the temperature of compounds, for example salt and snow, thus allowing him to show that the presence of salt doubles the effects of snow on the thermometer.[160] But, of course, the most important applications came as part of the everyday medical practice, for Santorio soon realised that the new instrument led to an overthrow of the Galenic rationale:

> Furthermore, both Avicenna and Galen [*De temperamentis* Bk II] claim in this passage that our sense of touch is the judge of all <species> of heat: if the species of heat were different, the touch would not be the right judge of them. Indeed, with reference to the passage just quoted [*De temperamentis*

> Bk II] where he assigns to the touch the judgment about the equality of heat in children and young men, Galen urges us to touch many and different objects, that is to say water, at first not too hot and temperate, then the very limbs <of the body> yet according to this rule, which consists in comparing the weak to the weak, the stocky to the stocky, the fat to the fat and not the exercised people to those at rest or those fasting to those who are full. This way of measuring the degree of heat is certainly misleading. As for our part, we resort to the glass instruments […] which surely cannot mislead us. By means of these instruments we have tested whether heat is the same in children and young men. The experiment consists in placing the hand of a child and then of a young man on the glass bulb of the instrument for an equal interval of time; from this we understood that the water descent was the same in both ages which means an equality of heat.[161]

Faced with a similar problem, though eight years later (1633), Galileo finds a very different way to deal with it. The problem, proposed by Count Giovanni Bardi (1534–1612) and named after him 'Bardi's Problem', proposes to explore why a person feels cold when he goes into a body of water like a river during the summer, and even colder when he comes out, but, going back into the water, finally feels comfortable.[162] In his reply Galileo found no better way to investigate the temperature of air and water than ascertain it by naked hands.[163] In the light of what had already been done by Santorio, it is therefore wrong to conclude that 'The <Bardi's> problem, and even more so its solution, represent a paradigmatic logical model for the period before instruments had been invented to measure temperature',[164] for not only did such instruments exist, but they had been put to trial on similar matters before and quite successfully. Neither it is true that no attempts had been made to set standards for the new instrument[165] for Santorio himself had suggested in 1630 using the fire of a candle and snow to set the maximum and minimum range of the instrument.[166] This suggests that Galileo played, if any, a very minor role in the process of temperature measurement.

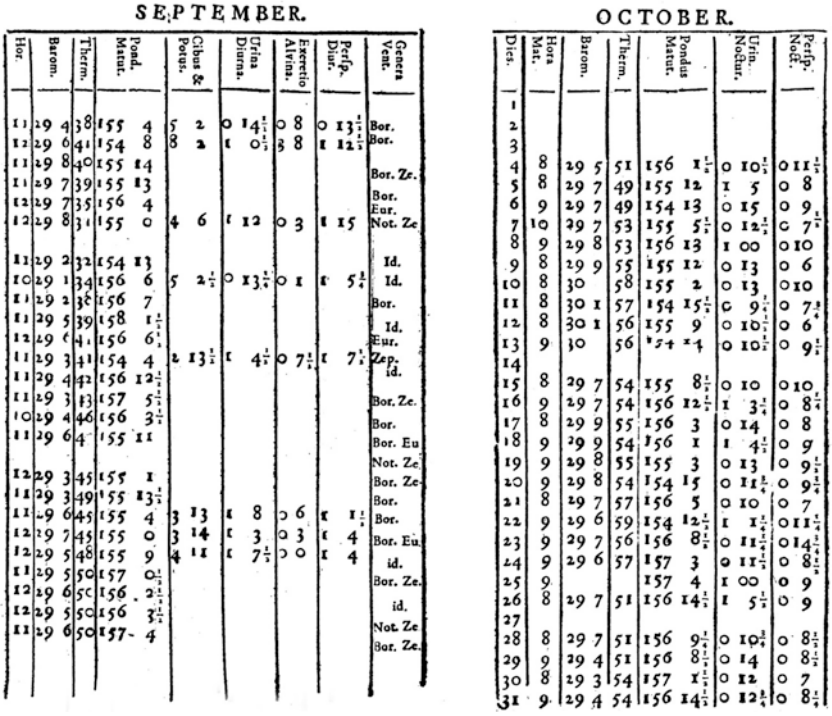
Despite this shortcoming, in the long run Galileo's reputation obscured Santorio's contributions to medicine and science. As seen this was partly due to the history of science relying on the history of physics, but much responsibility also lies with the 'unsolicited and superfluous' apology that later Italian scholars such as Antonio Favaro and his followers reserved for Galileo, making him the benchmark and the fountainhead of every discovery made around that period.[167]

5 Outlines for a Conclusion

Throughout this short introduction we have tried to show how Santorio's effort to quantify metabolism by measuring the 'insensible perspiration of the body' (*perspiratio insensibilis*) turns out to be part of a wider and fully fletched programme of quantification, which grapples with the homeostatic balance of the body in its complexity: from weight change to pulse frequency, from body temperature to the humidity of the air, to the ultimate structure of matter. Out of this programme developed consequences of primary import for the history of medicine and science as a whole. Thanks to Santorio, in fact,

- Equilibrium is defined as a standard problem of 'statics' consisting in the capacity of the body to re-balance daily losses and gains.
- The focus of medicine is shifted from the study of multiple Galenic faculties to the evaluation of a single, fundamental and quantifiable process (*metabolism*).
- Instruments of precision are invented and then applied in everyday practice to correct and replace the subjective appreciation of natural phenomena.

To these merits, a fourth one can possibly be added: through the mediation of admirers and followers, Santorio's work will open up the field to modern 'multivariate analysis'. Indeed, while the need to provide tabulated data set according to parameters such as weight and quality of the food ingested, pulse frequency, ambient and bodily temperature, humidity of the air and barometric pressure only became explicit after James Keill (1718) and Joseph Rogers (1734) published the results of their works (Figs. 1.11 and 1.12),[168] the initial impetus towards this very development came directly from Santorio, who had realised the dependence of metabolism upon those very factors, pointing out the need to study them as many experimental variables. Amongst these latter—to the extent it was known and experimentally accessible to him—there was also the influence of barometric pressure on bodily processes.[169]



SEPTEMBER.

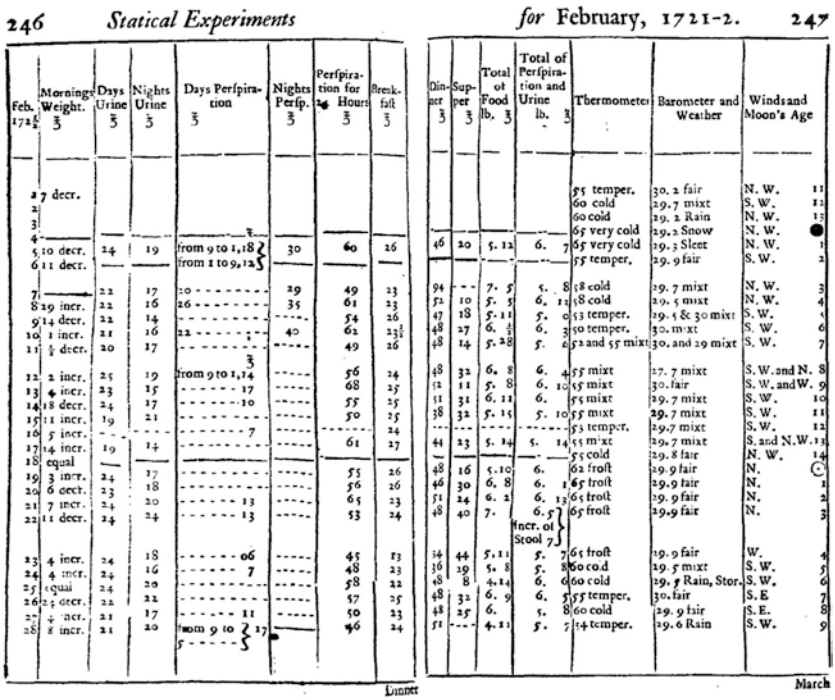
Hor.	Baron.	Therm.	Pond. Matut.	Cibus & Potus.	Urina Diurna.	Excretio Alvina.	Perfp. Diur.	Genera Vent.
11	29 4	38	155 4	58 2	0 14 1/2	0 8	0 13 1/2	Bor.
12	29 6	41	154 8	58 2	1 0	8 8	1 12 1/2	Bor.
11	29 8	40	155 14					Bor. Ze.
11	29 7	39	155 13					Bor.
12	29 7	35	156 4					Eur.
12	29 8	31	155 0	4 6	1 12	0 3	1 15	Not. Ze
11	29 2	32	154 13					Id.
10	29 1	34	156 6	5 2 1/2	0 13 1/2	0 1	1 5 1/2	Id.
11	29 2	38	156 7					Bor.
11	29 5	39	158 1 1/2					Id.
12	29 6	41	156 6 1/2					Eur.
11	29 3	41	154 4	2 13 1/2	1 4 1/2	0 7 1/2	1 7 1/2	Zep.
11	29 4	42	156 12 1/2					Id.
11	29 3	43	157 5 1/2					Bor. Ze.
10	29 4	46	156 3 1/2					Bor.
11	29 6	4	155 11					Bor. Eu
								Not. Ze
12	29 3	45	155 1					Bor. Ze
11	29 3	49	155 13 1/2					Bor.
11	29 6	45	155 4	3 13	1 8	0 6	1 1 1/2	Bor.
12	29 7	45	155 0	3 14	1 3	0 3	1 4	Bor. Eu
12	29 5	48	155 9	4 11	1 7 1/2	0 0	1 4	id.
11	29 5	50	157 0 1/2					Bor. Ze.
12	29 6	50	156 2 1/2					id.
12	29 5	50	156 3 1/2					Not. Ze
11	29 6	50	157 4					Bor. Ze.

OCTOBER.

Dies.	Hora Mat.	Baron.	Therm.	Pondus Matut.	Urin. Noctur.	Perfp. Noct.
1						
2						
3						
4	8	29 5	51	156 1 1/2	0 10 1/2	0 11 1/2
5	8	29 7	49	155 12	1 5	0 8
6	9	29 7	49	154 13	0 15	0 9 1/2
7	10	29 7	53	155 5 1/2	0 12 1/2	0 7 1/2
8	9	29 8	53	156 13	1 00	0 10
9	8	29 9	55	155 12	0 13	0 6
10	8	30	58	155 2	0 13	0 10
11	8	30 1	57	154 15 1/2	0 9 1/2	0 7 3/4
12	8	30 1	56	155 9	0 10 1/2	0 6 1/4
13	9	30	56	154 14	0 10 1/2	0 9 1/2
14						
15	8	29 7	54	155 8 1/2	0 10	0 10
16	9	29 7	54	156 12 1/2	1 3 1/4	0 8 1/4
17	8	29 9	55	156 3	0 14	0 8
18	9	29 9	54	156 1	1 4 1/2	0 9
19	9	29 8	55	155 3	0 13	0 9 1/2
20	9	29 8	54	154 15	0 11 1/2	0 9 1/4
21	8	29 7	57	156 5	0 10	0 7
22	9	29 6	59	154 12 1/2	1 1 1/4	0 11 1/4
23	9	29 7	56	156 8 1/2	0 11 1/2	0 14 1/2
24	9	29 6	57	157 3	0 11 1/2	0 8 1/2
25	9			157 4	1 00	0 9
26	8	29 7	51	156 14 1/2	1 5 1/2	0 9
27						
28	8	29 7	51	156 9 1/2	0 10 3/4	0 8 1/2
29	9	29 4	51	156 8 1/2	0 14	0 8 1/2
30	8	29 3	54	157 1 1/2	0 12	0 7
31	9	29 4	54	156 14 1/2	0 12 1/4	0 8 1/4

Fig. 1.11 Tabulated data from James Keill's *Medicina statica Britannica* (1718)

In the light of this, we can finally return to Daremberg's critical remarks and contend that we fully appreciate the early modern desire of Baglivi, Lister, Boyle, Leibniz, Linnaeus, and many others 'to erect a marble statue to Santorio'. The recognition that many of the ideas, instruments, experiments and practices that are considered central to the development of early modern science were shaped in substantial ways by Santorio and set an agenda for about two centuries, while improved versions of his instruments are still used in everyday clinics, makes us feel confident that more scholars will recognise in this figure the great experimentalist and thinker that motivated our efforts and admiration.


246 *Statical Experiments* *for* February, 1721-2. 247

Feb. 1721	Morning's Weight. ℔	Days Urine ℥	Nights Urine ℥	Days Perſpiration ℥	Nights Perſp. ℥	Perſpiration for 24 Hours ℥	Breakfaſt ℥
1							
2	7 decr.						
3							
4							
5	10 decr.	24	19	from 9 to 1,18 / from 1 to 9,12	30	60	26
6	11 decr.						
7		22	17	20	29	49	23
8	19 incr.	22	16	26	35	61	23
9	14 decr.	22	14		54	26	
10	1 incr.	21	16	22	40	62	23½
11	½ decr.	20	17		49	26	
12	2 incr.	25	19	from 9 to 1,14		56	24
13	4 incr.	23	15	17		68	25
14	18 decr.	24	17	10		55	25
15	11 incr.	19	21			50	25
16	5 incr.			7			24
17	14 incr.	19	14			61	27
18	equal						
19	3 incr.	24	17			55	26
20	6 decr.	23	18			56	26
21	7 incr.	24	20	13		65	23
22	11 decr.	24	24	13		53	24
23	4 incr.	24	18	06		45	13
24	4 incr.	24	16	7		48	23
25	equal	24	20			58	22
26	25 decr.	22	22			57	25
27	½ incr.	21	17	11		50	23
28	8 incr.	21	20	from 9 to 5	27	46	24

Dinner

Dinner ℥	Supper ℥	Total of Food lb. ℥	Total of Perſpiration and Urine lb. ℥	Thermometer	Barometer and Weather	Winds and Moon's Age
				55 temper.	30. 2 fair	N. W. 11
				60 cold	29. 7 mixt	S. W. 12
				60 cold	29. 2 Rain	N. W. 13
				65 very cold	29. 2 Snow	N. W. ●
46	20	5. 12	6. 7	65 very cold	29. 3 Sleet	N. W. 1
				55 temper.	29. 9 fair	S. W. 2
94	---	7. 5	5. 8	58 cold	29. 7 mixt	N. W. 3
52	10	5. 5	6. 12	58 cold	29. 5 mixt	N. W. 4
47	18	5. 11	5. 0	53 temper.	29. 5 & 30 mixt	S. W. 5
48	27	6. ½	6. 3	50 temper.	30. mixt	S. W. 6
48	14	5. 28	5. 6	52 and 55 mixt	30. and 29 mixt	S. W. 7
48	32	6. 8	6. 4	55 mixt	27. 7 mixt	S. W. and N. 8
52	11	5. 8	6. 10	55 mixt	30. fair	S. W. and W. 9
51	31	6. 11	6.	55 mixt	29. 7 mixt	S. W. 10
38	32	5. 15	5. 10	55 mixt	29. 7 mixt	S. W. 11
---	---	---	---	53 temper.	29. 7 mixt	S. W. 12
44	23	5. 14	5. 14	55 mixt	29. 7 mixt	S. and N. W. 13
				55 cold	29. 8 fair	N. W. 14
48	16	5. 10	6.	62 froſt	29. 9 fair	N. ⊙
46	30	6. 8	6. 1	65 froſt	29. 9 fair	N. 1
51	24	6. 2	6. 13	65 froſt	29. 9 fair	N. 2
48	40	7.	6. 5 / Incr. of Stool 7	65 froſt	29. 9 fair	N. 3
34	44	5. 11	5. 7	65 froſt	29. 9 fair	W. 4
36	29	5. 8	5. 8	60 cold	29. 5 mixt	S. W. 5
48	8	4. 14	6. 6	60 cold	29. 7 Rain, Stor.	S. W. 6
48	32	6. 9	6. 5	55 temper.	30. fair	S. E 7
48	25	6.	5. 8	60 cold	29. 9 fair	S. E. 8
51	---	4. 11	5. 7	54 temper.	29. 6 Rain	S. W. 9

March

Fig. 1.12 Tabulated data from Joseph Rogers' *Medicina statica Hybernica* (1734)

Notes

1. Giovanni Alfonso Borelli, *De motu animalium, pars secunda, editio altera* (Leiden: P. van der Aa et al., 1685), 260–263; Robert Boyle, *Medicina hydrostatica, or, Hydrostaticks applyed to the materia medica* (London: S. Smith, 1690), preface, pages unnumbered [1r-v]. For Baglivi, see Santorio Santori, *De medicina statica libri octo, accedunt Georgii Baglivi* […] *Canones de medicina solidorum, ad rectum staticae usum* (Rome: typis Bernabò, 1704), 151–159; Carl Linnaeus, *Diaeta naturalis* (1733), edited by Arvid Hjalmar Uggla (Uppsala: Almqvist & Wiksell, 1958); id., *Lachesis naturalis*, in *Linnés diætetik, på grundvalen af dels hans eget originalutkast till föreläsningar: Lachesis naturalis quæ tradit diætam naturalem, och dels lärjungeanteckningar efter dessa hans föreläsningar:* edited by Axel Otto Lindfors (Uppsala: Uppsala University, 1907).

2. Herman Boerhaave, *Methodus discendi medicinam* (Amsterdam: J. F. Bernard, 1726), 406: 'Nullus liber in re medica ad eam perfectionem scriptus est'; Archibald Pitcairne, *Apollo Staticus, or the art of curing fevers by the staticks invented by Dr Pitcairne* (Edinburgh: James Wardlaw, 1695), 19–24; id., *Dissertatio de curatione febrium quae per evacuationem instituitur* ([Edinburgh]: G. Mosman, 1695); John Floyer, *A Treatise of the Asthma* (London: R. Wilkin, 1698), 233–240, and 'Comments by Sir John Floyer, on the 'Medicina Statica Britannica' of James Keill in the third volume of his Essays and on the 'De Statica Medicina' of Sanctorius' (Queens College Library, Oxford, Ms. Oxford 567); Johann Bernoulli, *Disputatio medico-physica de nutritione* (Groningen: C. Zandl, 1699), §16 [pages not numbered]; James Keill, *Tentamina medico-physica ad quasdam quaestiones quae oeconomiam animalem spectant, accomodata: Quibus accessit Medicina statica Britannica* (London: G. Strahan and W. and J. Innys, 1718), foreword to John Friend; Jean-Antoine Nollet, *Recherches sur les causes particulières des phénomènes électriques, et sur les effets nuisibles ou avantageux qu'on peut en attendre* (Paris: Freres Guerin, 1753), 366–403, esp. 387; Antoine-Laurant Lavoisier and Armand Séguin, 'Premier Mémoire sur La Transpiration des Animaux (1790)' in *Mémoire de L'Académie de sciences année MDCCLXXXX* (Paris: Du Point, 1797), 601–612.
3. On the *corpuscula* or *effluvia Sanctorii* see Johan Chrysostom Magnenus (Magnen), *Democritus reviviscens sive de atomis* (Pavia: G. A. Magri, 1646), 167, 255, 269, 271; Robert Boyle, Royal Society, London, Boyle Papers, XXVI, Ms. 'Of the Atomicall Philosophy', 171; id., *Experiments and Considerations about the Porosity of Bodies in Two Essays* (London: S. Smith, 1684), 12–13; Martin Lister "Commentarius" in Santorio Santori, *De statica medicina aphorismorum sectiones septem cum Commentario Martini Lister* (Leiden, C. Boutesteyn, 1703), 2; Anne-Charles Lorry "Praefatio editoris" in Santorio Santori, *De medicina statica aphorismi. Commentaria, notasque addidit A.C. Lorry* (Paris: P.G. Cavelier, 1770), vii, 180–181. On the resurrection of the dead see the letter by Leibniz to Herzog Johann Frierdich von Hannover (Mainz, 21 May 1671) in *Die philosophischen Schriften von Gottfried Wilhelm Leibniz*, Edited by Carl Immanuel Gerhardt, Band 1, (Berlin, Weidemann Buchhandlung, 1875), 54. On action at a distance and *effluvia* see the letters by R[ené].-F[rançois] de Sluse to Christian Huygens (Liège, 8 September 1662) and by Christian Huygens to R[ené].-F[rançois] de Sluse (The Hague[?], 25 September 1662), in Constantjin Huygens, *Oeuvres complètes vol. 4* (The Hague: M. Nijhoff, 1891), 226, 239–240; Conrad Barthold Behrens, *Disputatio physica de penetrabili efficacia effluviorum in afficiendis corporibus animalium* (Helmstedt: heirs of H. D. Muller, 1681), § VII [page unnumbered].

4. Lister, *De statica medicina*, Lectoris S[alutem] [p. 1v unnumbered]: 'Tacuit quidem Harvaeus noster, suae rei certissimus, altoque silentio, ad viginti annos, immumeros adversarios vehementer. Ita se gessisse Sanctorium oportuit; nam utriusque experimenti eadem certitudo est'; Giorgio Baglivi in Santorio, *De medicina statica* (1704), 168, *Canon X*: 'Statice Sanctorii, et circulatio sanguinis Harvejana sunt duo poli, quibus universa regitur verae Medicinae moles, hisce inventis restituta, et confirmata: reliqua potius illam exornant, quam augent; præcipue quando de oraculo naturae pronunciata non sunt.'
5. Santorio Santori, *Commentaria in Artem Medicinalem Galeni* (Venice: G. A. Somasco, 1612), pt. I, col. 17B-C.
6. See Lucia Dacome, "Living with the Chair: Private Excreta, Collective Health and Medical Authority in the Eighteenth Century," *History of Science*, 39, 4 (2001): 467–500; ead., "Resurrecting by Numbers in Eighteenth-Century England," *Past and Present* 193 (2006): 73–110; ead., "Balancing Acts: Picturing Perspiration in the Long Eighteenth Century," *Studies in History and Philosophy of Biological and Biomedical Sciences*, 43 (2012): 379–391.
7. Owsei Temkin, *Galenism. Rise and Decline of a Medical Philosophy* (Ithaca: Cornell University Press, 1973), 160–161; Andrew Wear, "Contingency and Logic in Renaissance Anatomy and Physiology" (PhD diss., Imperial College London, 1973), 152–175; Mirko D. Grmek, *La première révolution biologique: réflexions sur la physiologie et la médecine du XVII^e siècle* (Paris: Payot, 1990), 71–89. While in themselves examples of excellent scholarship, Wear's and Grmek's appreciation of Santorio's method depends largely on the critical remarks of Charles Daremberg and on Castiglioni's biography (see note 16) showing no real confidence with the sources which eventually led scholarship away from the essence of Santorio's work. The case is different with Nancy Siraisi, *Avicenna in Renaissance Italy. The Canon and Medical Teaching in Italian Universities after 1500* (Princeton: Princeton University Press, 1987), 237–238, 322–324, 348–351 and, more recently, with Ian MacLean, *Logic, Signs and Nature in the Renaissance. The Case of Learned Medicine* (Cambridge: Cambridge University Press, 2002), *passim* who both present some sound analyses of Santorio's work and intellectual background although no new biographical information is provided.
8. Charles Daremberg, *Histoire des sciences médicales* (Paris, J.-B. Baillière, 1870), 740 and 747: '[…] nous ne puissions pas partager les élan d'enthousiasme de Baglivi, de Boerhaave et de beacoup d'autres médecins du XVIIe et du XVIII siècle pour la médicine statique. Je ne crois pas non plus que pour ce seul ouvrage on érigerait aujourd'hui a Sanctorius une statue de marbre, comme on l'a fait per après sa mort. Sanctorius est

à peu près oublie: on ne le lit même plus. Tout l'édifice de son *Ars statica* repose sur la vieille physiologie. […] On serait étonné de trouver tant d'instruments ingénieux dans un commentaire qui est d'ailleurs entièrement scholastique, si l'on oubliait que Sanctorius étai avant tout un *physicien* et un *mécanicien*, toujours en quête de nouveautés; de sorte que la *médicine statique* est moins la résultat d'un *system médical* que l'application d'études dirigée vers les travaux de la mécanique proprement dite.'

9. Wear, "Contingency", 175. Wear, dealing with the logical development of Santorio's method and experiments, tried most seriously to go beyond the conventional picture available to English scholars in the late 1970s, but his focus on Santorio's method and statics led him not to evaluate the larger picture offered by a new theory of qualities and individuals which the Venetian physician elaborated.
10. Siraisi, *Avicenna*, 238; Maclean, *Logic,* 336–337; Dacome, "Balancing Acts"; Simone Mammola, *La ragione e l'incertezza. Filosofia e medicina nella prima età moderna* (Milan: FrancoAngeli, 2012), 266–271.
11. This mistaken judgement is still found in most history of science textbooks, but for a classic statement see Alistair Crombie, *Augustine to Galileo. The History of Science A.D. 400–1650* (Cambridge, Massachusetts: Harvard University Press, 1953), 328–329.
12. See Daniel Garber, "Galileo, Newton and all that: if it wasn't a Scientific Revolution, what was it? (a Manifesto)," *Circumscribere*, 7 (2009): 9–18 and Fabrizio Bigotti, *Physiology of the Soul. Mind, Body and Matter in the Galenic Tradition of the Late Renaissance, 1550–1630* (Turnhout: Brepols, 2019), 269–287. As noted by Garber, categories such as 'scientific revolutions' end up conflating all 'non-Aristotelian' philosophers into the category of 'anti-Aristotelians' if not into *novatores*, while all the Aristotelians suddenly become the spokespeople of a closed universe, as fruitless as redundant.
13. Dacome, "Balancing Acts", 380: 'Santorio's work ended up being associated with the picture of a large Roman steelyard hanging from the ceiling, with a man sitting on a "weighing chair" in front of a laid table that displayed the remnants of an unfinished meal.'
14. Arcadio Capello, *De vita cl. viri Sanctorii Sanctorii olim in patavino gymnasio medicinam theoricam primo loco profitensis Sermo habitus … ab Arcadio Capello … accedit Oratio ab eodem Sanctorio habita in Gymnasio Patavino dum ipse primarium Theoricae Medicinae explicandae munus auspicaretur* (Venice: J.Tomasino, 1750).
15. Giacomo (de) Grandi, *De laudibus Sanctorii oratio* (Venice: G. F. Vavasense, 1671); Niccolò Comneno Papadopoli, *Historia Gymansii Patavini* (Venice: S. Coleti, 1726); Carlo Francesco Cogrossi, *Saggi della*

medicina italiana (Padua: G. Conzatti, 1727); Jacopo Facciolati, *Fasti Gymnasii Patavini* (Padua: G. Manfré, 1757).

16. Pietro Stancovich, "Santorio" in *Biografia degli uomini distinti dell'Istria*, Vol. 2, 235–259 (Trieste; Gio. Marenghi Tipografo, 1829); Arturo Castiglioni, *La vita e l'opera di Santorio Santorio capodistriano* (Bologna-Trieste: L. Cappelli, 1920) translated into English by Emilie Recht as 'The life and work of Santorio Santorio (1561–1636)' *Medical Life* 38 (1931), 729–85; Ralph H. Major, "Santorio Santorio," *Annals of Medical History*, 10 (1938), 369–381 (which is based entirely on Castiglioni); Mirko D. Grmek, *Santorio Santorio i njegovi aparati i instrumenti* (Zagreb: Jugoslavenska akademija znanosti i umjetnosti, 1952); id., "L'énigme des relations entre Galilée et Santorio" in *Atti del Simposio Internazionale di Storia, Metodologia Logica e Filosofia della Scienza "Galileo Galilei nella storia e nella filosofia della scienza,"* ed. Gruppo Italiano di Storia della Scienza (Florence: Barbera Editore, 1967), 155–62; id., *La première révolution biologique: réflexions sur la physiologie et la médecine*.
17. Fulgenzio Micanzio, *Vita del Padre Paolo* (Leiden: Ph. de Croy, 1646); Francesco Griselini, *Memorie anedote spettanti alla vita ed agli studi del sommo filosofo e giurseconsulto F. Paolo Sarpi servita* (Lausanne: M.M. Mousquet, 1760); Emanuele Cicogna, *Delle iscrizioni veneziane*, 6 vols. (Venice, G. Orlandelli and alii, 1824–1853).
18. See *La Concordia. Almanacco istriano per l'anno 1883*, anno I (Capodistria: C. Priora, 1882), 91–92.
19. Modestino Del Gaizo, *Ricerche storiche intorno a Santorio Santorio e alla Medicina statica* (Naples: A. Tocco, 1889); idem, *Alcune conoscenze di Santorio Santorio intorno ai fenomeni della visione ed Il testemanto di lui* (Naples, Tipografia della R[eale]. Università, 1891), 23–26; idem, "Le conoscenze in fisica di Santorio Santorio e l'efficacia delle scoperte del Galilei" in *Atti della Riunione di Venezia (1909) della Società Italiana di Storia Critica delle Scienze Mediche e Naturali* (Venice: A. Pellizzato, 1909), 92–102.
20. Lietta Stella Ettari and Marco Procopio, *Santorio Santorio. La vita e le opere* (Rome: Istituto Nazionale della Nutrizione—Città Universitaria, 1968).
21. Capello, *De vita Sanctorii*, VII. The *Registrum baptismatorum* for the year 1561 is no longer extant and we rely on Capello for Santorio's birthday. According to Giuseppe Vatova, *La colonna di Santa Giustina eretta dai capodistriani* (Capodistria: C. Priora, 1884), 48, Santorio's house was located in Campo Muzio (between the present Santorijeva ulica and Kette ulica).
22. See Santorio, *Commentaria* (1612), III, col. 130C-D: 'soror mea, quae appelabatur Diana, ingeniosissima sane'. The verb 'appellabatur' suggests that, in 1612, she had already died.

23. Isidoro Santori[o] becomes a notary like his grandfather; see Santorio, *Commentaria* (1612), III, 'Dedicatory Letter to Andrea Morosini' [p. 2 unnumbered]: 'Quae mutua vicissitudine inter nos fratremque meum ISIDORUM SANCTORIUM Iureconsultum a primis aetatulae accrescentis (ut ita dicam) primordiis intercessit familiaris consuetudo […]'. Unlike Santorio, he married in Capodistria in 1598, see Parish Church of Koper, 'Liber Matrimoniorum ab anno 1588 ad annum 1610', Libro 1, c. 36v: '309. Adi 8 detto [i.e. 8 Januray 1596]. La Sig[no]ra Laura Fig[lio]la del S[ignor] Thomaso Rimito, et Il[lutrissimo] S[ignor] Isidoro Santorio Dott.[ore] da me dec[an]o sono stati sposati nella Chiesa della Madon[n]a delli Servi […] il S[ignor] Santo Lugnano, et il S[ignor] Giulio Apollonio.'
24. Capello, *De vita Sanctorii*, VI(b), claimed that the Santori[o] family was originally from Cividal del Friuli (Udine). However the original document with the appointment of Antonio Santori[o] to the position of *bambordier* (1548, see n. 26) makes it clear he was from Spilimbergo (Pordenone). On Santorio's family in Spilimbergo see Enrica Capitanio and Nicole Dao, *I Catapan della Pieve di Dignano tra Medioevo e Età Moderna* (Aquileia: Glesie Furlane, 2003), 67.
25. On Antonio's appointment to bombardier dated 30 June 1548 see *La Concordia* (1883), 90. For his duties see Francesco Mauro, 'Relatio Viri Nobilis Francisci Mauro Potestatis et Capitanei Iustinopolis 22 Augusti 1559', part of 'Relationes Maritimarum a 1550 usque 1564 sept[embri]s' (former Codice Brera 223), c. 88, quoted in Tomaso Luciani, "Relazioni dei Podestà e Capitani di Capodistria," in *Atti e memorie della società istriana di storia patria*, 6, fasc. 1–2, (Parenzo: G. Coana, 1890), 67: 'Sopra ditta Piazza si attrova un loco idoneo nel quale è posta la monitione, nella quale sono bellissimi pezzi d'artegliaria, con altre sorte di arme le quali sono custodite, et governate da M.° Antonio Santorio Bombardiere provisionato di Vostra Serenità.'
26. Gedeone Pusterla, *I nobili di Capodistria e dell'Istria con cenni storici-biografico di Gedeone Pusterla*, 2 ed. (Capodistria: C. Priora, 1888), 16.
27. Alvise Morosini, 'Relatione del Nob.[il] Homo Ser Alvise Morosini ritornato di Potestà et Capitanio di Capo d'Istria. Presentata nell' Eccellentissimo Collegio à 17 marzo 1583′, part of 'Relazioni, Registro 1582' (former Codice Brera 198), cc. 55v-63r quoted in Luciani, "Relazioni," 387–388, 390–391. See also, 'Espositione di Bombardieri di Capo d'Istria, presentata nell'Eccellentissimo Collegio à 17 Marzo 1583 per il Nob.[il] Ho.[mo] Ser Alvise Morosini ritornato di Podestà et Capitanio di Capodistria', part of 'Relazioni, Registro 1582' (former Codice Brera 198), cc. 63v-64r quoted in Luciani, "Relazioni," 397–398. Complaints against Antonio Santorio's unorthodox management of the salt pans profits had been noted as early as 1574, see 'Libro Q Dei Consigli' quoted in Vatova, *Colonna*, 88–89.

28. Fairly good reports on Antonio's management are found throughout the period 1584–1593, see Luciani, "Relazioni," 400–437. From the 'Relatione del Nobil Homo Ser Vicenzo Morosini ritornato Podestà et Capitanio di Capodistria. Presentata nell'Eccellentissimo Collegio a' 7 Luglio 1593′, part of 'Archivio Generale Veneto, Collegio, Busta segnata Relazioni dei Rettori—Capodistria-Pola' we are informed that in July 1593 a new bombardier was appointed by the Senate of Venice because the previous one (Antonio Santorio) had passed away; see Luciani, "Relazioni," 437.
29. See for instance 'Relatione del Nob.[il] Homo Ser Giacomo Lion ritornato di Podestà et Capitanio di Capo d' Istria. Presentata adi 28 di Giugno 1584′, part of 'Relazioni, Registro 1582' (former Codice Brera 198), cc. 92r-93r quoted in Luciani, "Relazioni," 400–401. The responsibilities falling onto a Venetian bombardier are described and illustrated by Eugenio Gentili, *Il perfetto bombardiero et real istruttione di artiglieri* (Venice: A. De' Vechi, 1626).
30. Physicians' interest in the practical aspects of meteorology was neither infrequent nor marginal in the early modern period and especially in Venice was associated to the needs of the Venetian fleet. On Santorio's method and its similarities with double book-keeping see Johan Daniel Achelis, *Die Ernahrungs Physiologie des 17 Jahrhunderts* (Heidelberg: Universitätsbuchhandlung Heidelberg, 1938) 3–9 as quoted by Temkin who rightly urges caution given that similar experiments to Santorio's were made in the late Hellenistic period, see Owsei Temkin, "Nutrition from Classic Antiquity to the Baroque" in *Human Nutrition Historic and Scientific*, edited by Iago Galston (New York: International University Press, 1960), 88–89.
31. Ettari and Procopio, *Santorio Santorio*, 32. While difficult to equate to modern values, the sum Santorio had accumulated would roughly correspond today to £4,381,650; a single Venetian ducat being calculated as equal to £105.
32. Capello, *De vita Sanctorii*, VI.
33. Santorio, *Commentaria* (1612), II, 391D; III, Dedicatory Letter to Andrea Morosini [p. 2, unnumbered]; Capello, *De vita Sanctorii*, VI-VII.
34. Santorio, *Commentaria* (1612), III. col. 131.
35. On Paterno, Santorio Santori, *Commentaria in primam Fen primi libri Canonis Avicennae* (Venice: G. Sarzina, 1625), col. 710A-B; on Zabarella, Santorio, *Commentaria* (1612), I, col. 158A; on Augenio, Santorio, 'Oratio […] habita in Archilyceo Patavino' (1612) in Capello, *De vita Sanctorii*, XIX. On Mercuriale as a teacher of Santorio in Padua, see Mercuriale's replies to Santorio in Girolamo Mercuriale, *Consultationes et responsa medicinalia* (Venice: Giunti, 1624) III, Consultatio CVIII (Pisa,

25 May 1594): 175E. The consult is referred to, but not quoted, by Del Gaizo, *Ricerche*, 43 n.18.

36. Mirko D. Grmek, "Santorio Santorio" in *Dictionary of Scientific Biography* edited by Charles C. Gillispie (Detroit: Ch. Scribner's Sons, 2008), vol. 12, 101; Santorio Santorio, *La medicina statica* edited and trans. by Giuseppe Ongaro (Florence: Giunti, 2001), 6.
37. The registers of the *Acta graduum Universitatis Patavinae* bear no sign of Santorio's degree and the registries of the *Regio transmarina* of the University of Padua were dispersed in the eighteenth century. Capello, *De vita Sanctorii*, VIII bases the graduation date on the prolusion Santorio held the students in Padua 1612, following his appointment to the chair of theoretical medicine, which, Capello contends, shows that Santorio was 21 years old when he graduated in Padua but the document does not substantiate this claim and Santorio only makes reference to the duration of his studies in Padua, which customarily lasted seven years, see Santorio, 'Oratio […] habita in Archilyceo Patavino' in Capello, *De vita Sanctorii*, XXII.5. Evidence that Santorio must have graduated later than 1582 comes from other sources, particularly an account by Nicolao Comneno Papadopoli in 1726. His testimony is often misleading but he quotes a specific source showing that in 1583 Santorio was still a medical student enrolled in the *Regio Transmarina*; see Papadopoli, *Historia*, Bk III, 362: 'Quod certo, Patavii studuit, nam eius nomen *catalogis Transmarinorum*, ad quos Istri pertinebant, *ter legitur ab anno MDLXXXIII*. Doctoris insulas consecutus Venetiis medicinam fecit, si quis alius, foelicissime' (italics added). The date 1585 is also closer to Santorio's receiving a recommendation letter from the University authorities in 1587 discussed below (see n. 45).
38. On the history and activities of the *Academia Palladia* see Baccio Ziliotto, "Accademie e Accademici di Capodistria 1478–1807," *Archeografo triestino*, 7 (1944): 130–148, and for Santorio's participation, see particularly 144. On the same, Cavallini, "Musica e filosofia nell'Accademia Palladia di Capodistria:considerazioni sul dialogo Dieci de' cento dubbi amorosi (1621)," *Studi Musicali*, 16, 2 (1987): 231.
39. Girolamo Vida, *De' cento dubbi amorosi* (Padua: G. Crivellari, 1621), 58.
40. Marc'Antonio Valdera, *Le Epistole d'Ovidio* (Venice: F. Bariletto, 1604). In the dedicatory letter to Giacomo Contarini, he signs himself for the first time as *Santorio Santorij fisico*.
41. Griselini, *Memorie*, 42; Paolo Sarpi, *Opere*, edited by Gaetano and Luisa Cozzi (Milan-Naples: R. Ricciardi, 1969), 21–23. On Sarpi and Santorio see also Micanzio, *Vita*, 235: 'Santorio, che gli era antico amico di strettissima conversatione'.

42. Capello, *De vita Sanctorii*, IXa: 'In epistula Nicolai Galeri [sic] vicarii Patavini ad Principem quondam Polonum scripta nomine universitatis 13 Kal[endis] Novembris anno 1587 haec inter caetera de Sanctorio leguntur: "habemus virum valde excellentem, patria Justinopolitanum, nomine et cognomine Sanctorium etc. Hic scientia, fide et diligentia nobis omnibus probatissimus etc. ad hoc iter munusque suscipiendum facile adduci poterit".' Grmek's claim that Santorio was called to Poland by Prince Zrinsky, "Santorio," 101(b), is so far unjustified.
43. Evidence of this comes mostly from Santorio Santori, *Methodi vitandorum errorum omnium qui in arte medica contingunt libri XV* (Venice: F. Bariletto: 1603), VIII.12, ff. 163rD-163vB.
44. On Hungary see Santorio, *Methodi*, IV.5, f. 86vA-B; IV.9. f. 92rD; VI.6, f. 125rA; VI.10, 135vC, 136rD; VIII.10, ff. 159vC—160rA; VIII.12, f. 163vB; XV.7, f. 222vA-B; id., *Commentaria* (1612), II, col. 621D; on Poland, see ibid., III, col. 131C; id., *Commentaria* (1625), coll. 465A, 725D. On Croatia, see Santorio, *Methodi*, VIII.12, f. 163rD-163vA (referring to Carlovac) and *Commentaria* (1625), col. 246[D-E].
45. Pokrajinski Arhiv Koper, Fondo Gravisi, SI PAK KP 299 11 44, folder III, letter by Leandro Zarotti and Giovanni Vittorio to the Mayors of Capodistria (Venice, 30 July 1589). The original letter (referred to as 'Cancelleria del Sindacato di Capodistria nel libro S de' Consigli', pag. 24, An[no] 1589) is not currently accessible, as documents of the so-called Archive of Capodistria are currently the object of an international dispute between Italy and Slovenia. The transcription of the original document is found in the correspondence of Agostino Carlo Rubbi with Girolamo Gravisi kept at the Pokrajinski Archive of Koper.
46. Mercuriale, *Consultationes*, III, ff. 99v-100v.
47. Capello states that Santorio came back in Venice sometime around his forties (1600–1601), see *De vita Sanctorii*, IX(d): 'exeunte saeculo XVI, anno aetatis eius 40, circiter.' The correspondence with Rudio is no longer extant but is quoted by Rudio in Eustachio Rudio, *De naturali atque morbosa cordis dispositione* (Venice: G. Percacino, 1600), 'Dedicatory Letter by Rudio to Nicolò Contarini', [pp. 2–3 not numbered]: 'Verum eo tempore non defuerunt quidam solertissimi doctores, qui in dubium revocarent hoc illustrissimorum virorum consilium, de hoc mihi demandando munere, cum dicerent, periculum esse, ne si illud esset munus ad me delatum, auditoribus desererer, quippe qui iam edidissem mea scripta, quae cum in manibus discipulorum versarentur, non iuvaturos illos ex viva voce haurire eam doctrinam, quam in libris descriptam haberent: *quod mihi etiam significatum per litteras fuit a praeclaro viro Sanctorio Sanctorio, qui ob mirabile et perspicacissimum illius ingenium, ac scientiarum cognitionem, quae ad perfectum Philosophum atque Medicum per-*

tinent, (ut brevi illius scripta in lucem edenda probabunt) unice a te et merito diligitur' (italics added).

48. In Santorio Santori, *Ars Sanctorii Sanctorii de statica medicina* (Venice: N. Polo, 1614), 'Ad lectorem': 2 [not numbered] we read 30 years (*triginta annorum experientia*) whilst in the letter to Galileo (Venice, 9 February 1615), kept at the National Library of Florence, Ms. Gal. 90: c. 240, the period of experimentation is referred to as of 25 years (*per spatio di 25 anni in più di diecimilla soggetti*).
49. A glimpse into the possible topics discussed at Pinelli's circle is to be found in Sarpi's *Pensieri naturali* (pensieri 46–85) in his *Pensieri Naturali, Metafisici e Matematici*, edited by Luisa Cozzi and Libero Sossio (Milan: Ricciardo Ricciardi, 1996), 58–104 with the comments *ad locum* by the editors.
50. On Zabarella's influence see Ettari and Procopio, *Santorio Santorio*, 41–44; for the importance of his logic in the development of science, Wilhelm Risse, "Zabarellas Methodenlehre", in *La crisi del metodo aristotelico nel pensiero di Paolo Sarpi*, in *Aristotelismo veneto e scienza moderna*, edited by Luigi Olivieri (Padua: Antenore, 1983), 155–172. Nicolò Contarini, *De perfectione rerum libri sex* (Venice: G.-B. Somasco, 1576), Praefatio: 1–3 [not numbered]. On the *De perfectione rerum* see Gaetano Cozzi, *Il Doge Nicolò Contarini. Ricerche sul patriziato veneziano agli inizi del Seicento* (Venice-Rome: Istituto per la Collaborazione Culturale, 1958), 56–57 and William J. Bowsma, *Venice and the Defense of Republican Liberty: Renaissance Values in the Age of the Counter Reformation* (Berkeley and Los Angeles: University of California Press, 1968), 235. On Sarpi's natural philosophical method see Giovanni Santinello, "La crisi del metodo aristotelico nel pensiero di Paolo Sarpi," in *Aristotelismo veneto e scienza moderna*, edited by Luigi Olivieri (Padua: Antenore, 1983), 925–947 and Sarpi, *Pensieri*, xxxix, lxxvi, xcii, 141-142n, 605n which generally is still the landmark study for Sarpi's natural philosophy. On Sarpi's influence on Santorio, see Fabrizio Bigotti and David Taylor, "The Pulsilogium of Santorio: New Light on Technology and Measurement in Early Modern Medicine," *Society and Politics*, 11, no. 2 (2017): 8–10.
51. See the testimony by Alessandro Malipiero on 5 October 1607, in ASV, Consiglio dei Dieci, Processi Criminali, Processi Criminali Delegati, Dogado, filza 1, f. 4r: 'si montò in barca, et lo accompagnai à casa ciò è, al suo monasterio insieme col medico del monasterio che è il Santorio, et il barbier che lo ha medicato, il qual medico sopraggiunse la all'improvviso.' As appears from his testament, State Archive of Venice (ASV), ASV, Archivio Notarile, Testamenti, Giovanni Francesco Crivelli, B. 289, N. 537, Santorio resided in the nearby Rio della Sensa (for more see n. 123).

52. According to Luisa Cozzi, it is particularly the structure of Sarpi's work that follows closely Santorio's *Commentaria in Artem medicinalem Galeni* (1612), see Sarpi, *Pensieri*, LXXVI.
53. Santorio, *Methodi*, IV.5, f. 86B: 'qui capiuntur amore, qui re vera, *quedam species humanae stultitiae* orta ob consuetudinem obiecti amati'; see also Santorio, *Commentaria* (1612), II, 517A: 'vel dicendum amore captos (ut ego puto) esse aegros et extra latitudinem sanitatis: *amor enim est delirii species*, fitque ab imaginatione depravata' (italics added). For a criticism of Santorio's opinion see the letter by Ippolito Obizzi to Santorio Santori (Belluno, 1 July 1613) in Ippolito Obizzi, *De multiplici in medicina abusu* (Vicenza: R. Meietto, 1618), 29(b)-31(a). Santorio and Obizzi's opinions on love are both discussed in a letter by Giovanni Stefani to Ippolito Obizzi (1 September 1619) later collected in Giovanni Stefani, *Opera universa* (Venice: Giunti, 1653), 411–412.
54. Santorio, *Commentaria* (1612), III, coll. 101D-102A.
55. John Quincy, *Medicina statica, being the Aphorisms of Sanctorius translated into English with Large Explanations* (London: W. Newton, 1718), v: 'The sixth Section of Venery, I had some thoughts of leaving out; but for fear some would look upon the collection maimed thereby, and not be contented without all that *Sanctorius* himself thought fit to give to the Publick, I have inserted it in its place, and I hope in such terms as are as chast and inoffensive, as our language will bear.'
56. Antonio Favaro, "Un ridotto scientifico a Venezia al tempo di Galileo Galilei," *Nuovo archivio veneto*, 5 (1893), 199–209; id., "Giovan Francesco Sagredo e la vita scientifica in Venezia al principio del secolo XVII," *Archivio veneto*, 3/IV (1902), 316–321, 371; Cozzi, *Il Doge Contarini*, 57; id., *Paolo Sarpi tra Venezia e L'Europa* (Turin: Einaudi, 1979), 23–24, 137; Bowsma, *Venice*, 236–237; Giuseppe Trebbi, "Andrea Morosini" in *Dizionario biografico degli italiani*, 77 (Rome: Istituto dell'Enciclopedia Italiana, 2012), 103–106.
57. Letter by Andrea Morosini to Luigi Lollino (Venice, 13 December 1616) in Andrea Morosini, *Opusculorum cum ejusdem Epistolis, pars prima* (Venice: A. Pinelli, 1625), 213: 'tu pervigil, acer dies noctesque cum linguarum cognitioni, tum scientiis impense operam navabas, mutuis alloquiis, frequentibus congressionibus alebantur animi; in tuis, inque nostris aedibus de rerum natura, de moribus, de divinis rebus disputationes habebantur: aderant multi, quod perdiscendi studium attrahebat, ex nostra nobilitate aliquot […]'; see also Micanzio, *Vita*, 67–69.
58. On the politics of the *Giovani* see Cozzi, *Il Doge Contarini*, 5–14; Bowsma, *Venice*, 232–292.
59. Albrecht von Haller, *Bibliotheca medicinae practicae,* vol. 2 (Basle: J. Schweighauser, Bern: E. Haller, 1777), Bk VII, no. ccccxxxi, 351.

60. Santorio, *Methodi*, XII.4, ff. 186r D—186v A; XI.1, f. 171r A-B.
61. Ibid., XI.5, ff. 175v D—176r A; XII.6, f. 188v D.
62. Ibid. VIII.7, f. 157v C-D.
63. Ibid., V.7, ff. 109r D—109v B.
64. In his letter written on 6 March 1624 to renounce the chair of theoretical medicine in Padua, Santorio recalls his appointment as due to the attention his first work attracted at the University of Paris, see State Archive of Venice (ASV), Riformatori allo Studio di Padova 66, [f. 1r unnumbered page of Santorio's letter]: 'Mentre per molto tempo era vacata la lettura della Theorica ordinaria, che é il p[rim]o loco delle arti nello studio di Pad[ov]a et più necessaria di ciascun'altra lettione, fui io Santorio Santorij humiliss[i]mo servo di V.V., Ecc[ellen]ze sin l'an[n]o 1611 nominato, non già perche la procurasse, l'ambisse ne facesse officio alcuno, che anzi ne fui molto renitente, come sanno S.[ua] Ser.[eni]tà et l'Ecc[ellentissi]mo S[igno]r Proc[urato]r Nani, li quali allora erano Ri[formato]ri; ma perché essendosi ricercato per ogni studio di Christianità soggetto atto a tanto ministerio, s'hebbe dall'Ecc[ellentissi]mo Nani sopradetto, che era pur in questo tempo ritornato dall'ambasceria estraordinaria di Francia, che nell'Università di Parigi prima di tutto il Mondo era fatto estraordinario conto della mia qualsi sia scienza espressa fin all'hora ne miei libri, li quali con altri, che dopo hò mandati in luce sono per gratia d'Iddio ristampati in molte parti d'Europa.' A later copy of this letter is kept at the Museum Correr in Venice, MS Cicogna 2859: ff. 311r-312r, but lacks essential details as to Santorio's political and personal preoccupations, as does the copy provided in Ettari and Procopio, *Santorio Santorio* (1968), 147–148.
65. Jungius borrowed from Santorio's *Methodi vitandorum* not only in medicine but in physics, optics and logic: see Jungius Mss in the Staats- und Universitätsbibliothek Hamburg, Ms. NJJ: Pe. 53 | lat ('Doxoscopia Sporadica') f. 200r, where he quotes Bk VIII.13 about the effect of heat and putrefaction; Ms. Pe 72 a | lat, f. 196r, where he discusses Sanctorius' theory of transparency (*pellucidum*) following Bk V.10; and Ms. NJJ: Pe. 78 a | lat ('Medica II'), f. 20r, where Santorio is quoted along with Zabarella as an authority on the interpretation of Aristotle's logic, and f. 65r, where a quote from Santorio is used as a guide against the errors of empirical doctors. On Bartholin see Caspard Bartholin, *Controversiae anatomicae et affines, rariores et nobiliores* (Goslar: J. Hallervord, 1631), 508–109. On Santorio as a model for Leibniz's reasoning on probability in law and medicine, with some reservations, see G. W. Leibniz, *The Art of Controversies*, edited and translated by Marcelo Dascal (Dordrecht: Springer, 2008), 37.
66. On Santorio and Wotton see State Archive of Venice (ASV), Collegio, Secreta, Esposizioni Roma, 3 Marzo 1607, quoted in Horatio F. Brown,

Calendar of the State Papers and Manuscripts, Existing in the Archive and Collections of Venice and in other libraries of the Northern Italy, vol. 10 (1603–1607), London, 1900, p. 477: 'The Ambassador said that as regards the case of the English officer arrested at his request and reported to be very ill, he had sent Doctor Santorio to visit him, and he reported him very well. He repeated his charges against him and said that prison would not injure him, for he was quite used to it. He had been in prison in Germany for a long period and escaped by a miracle. He would, however, out of compassion beg for his release at the end of the week, but hoped that he would be banished from Venice after coming to the Ambassador's residence to hear the charges against him.' On the same see also Santorio, *Commentaria* (1612), III, 197B: 'Aderat Henricus Wottonius legatus regis Magnae Britaniae, et in omni doctrinarum genere usquequaque praefulgens: et alii percelebres Barones in cuius gratiam ego fusa oratione de anatomiae arcanis sermocinabat […]'. To be noted that Santorio's account refers to the year 1610 (197A: *anno elapso*).

67. Pietro Savio, "Per l'espitolario di Paolo Sarpi," *Aevum*, 10, 1 (1936): 30–35.
68. State Archive of Venice (ASV), Senato, Terra, Fascicolo I, Busta 200: 1611, à 6 di Ott[ob]re in Pregadi. On Santorio's aggregation to the 'Collegio dei Medici Fisici' see Alfonso Costa, "Studenti foroiuliensi orientali, triestini ed. istriani all'Università di Padova," *Archeografo triestino*, 20 (1895), 367, for which compare Biblioteca Civica, Padua, MS B. P. 14: Francesco Dorighello, "Notizie storiche dei collegii d'artisti e medici in Padova".
69. Bartolomeo Della Corte, *Notizie storiche intorno ai medici scrittori milanesi e ai principali ritrovamenti fatti in medicina dagl'italiani* (Milan: G. R. Malatesta, 1718), 139–140. A small part of the epistolary exchange between Senatore Settala and Santorio was discovered by Carlo Castellani in the State Archive of Milan, see Carlo Castellani, "Alcune lettere di Santorio Santorio a Senatore Settala," *Castalia*, 1 (1958), 27–32.
70. Letter by Senatore to Lodovico Settala (Padua, 11 January 1613), Biblioteca Civica, Padua, Ms. 66,941.
71. On Santorio putting together a commentary on his *Statics* see the letter by Lorenzo Pignoria to Paolo Gualdo (Padua, 26 December 1614) in [Anonymous], *Lettere d'uomini illustri che fiorirono nel principio del secolo XVII* (Venice: Baglioni, 1744), 179: 'Qui abbiamo un libro del Sig[nor]. Santorio composto in maniera d'aforismi, che tratta la materia della perspirazione, e riduce il tutto a peso di libbre, e di once: materia nova, nè più trattata. Va mettendo insieme un suo commentario sopra questa sua fatica, e se ne spera applauso grande.'

72. The first example was provided by the physician Francesco Arcadio, *Paraphrasi di Francesco Arcadio* […] *sopra la Statica medicina Santoriana* (Loano: F. Castello, 1618).
73. Ippolito Obizzi, *Staticomastix sive Staticae medicine demolitio* (Ferrara: V. Baldini, 1615), 24.
74. Santorio, *Commentaria* (1625): coll. 556A-558B.
75. Santorio, *Ars* (1614), I.2–3, c. 1v; I.9, c. 3r; I.16, c. 4v; I.39, cc. 9r-v; I.42, c. 10r.
76. Ibid., I.1, c. 1r; I.9, c. 3r; I.15, c. 4r.
77. Ibid., I.9, c. 3r; I.42, c. 10r.
78. Santorio, *Commentaria* (1612), III, col. 87B-D; Santorio, *Commentaria* (1625), col. 556A: 'Nostrum vero est investigare non recessus omnibus notos: sed illos, quibus praecognitis, sciamus praesagire, et morbos magni momenti divertere. Ideo Nos diutissme laboravimus, ut haec intelligeremus: imo in statica nostra tradidimus viam dignoscendi, an quod evacuatur respondeat ingestis […].'
79. See Jerome J. Bylebyl, "Nutrition, quantification and circulation," *Bulletin of the History of Medicine,* 51, 3 (1977), 377: 'However, in contrast to Botallo, it was transpiration per se that was of primary interest to Santorio. He was convinced that it is the most critical determinant of health and disease, and that it is subject to direct dietetic regulation as an alternative to such traditional remedies as bloodletting and purging. Meticulous attention to bodily weight enables one to keep track of this hitherto elusive factor of invisible loss, as well as to ascertain what things promote or inhibit its proper occurrence.'
80. Santorio, *Ars* (1614), I.2, c. 1v. On the *magnitudo morbis* Santorio, *Commentaria* (1612), III, coll. 170D-171-A.
81. Santorio was already aware of this, for he declares, Santorio, *Commentaria* (1612), III, col. 84E: 'Tertio docuimus, quomodo unusquisque possit quotidie dignoscere in quovis corpore excrementa, quae insensibiliter exhalant, esse maioris quantitates, et ponderis, quam sint omnes excrementorum evacuations sensibiles simul unite. Sed lector esset mente captus si his adeo novis fide[m] adhiberet, nisi experiretur: experiendi modu[m] Deo favente, vel brevi in lucem promemus.'
82. Santorio, *Commentaria* (1612), pt. II, coll. 525D-E, 604B, 608D, 610E; pt. III, col. 112D-E.
83. Santorio, *Ars* (1614), I.42, c. 10r.
84. Kurt Sprengel, *Versuch einer Pragmatischen Geschichte der Arzneikunde*, vol. 4 (Halle: G. G. Gebauer, 1801), 478–179 drawing from Obizzi, *Staticomastix*, 28 (Oppositio V); Francesco Puccinotti, *Storia della Medicina*, vol. 3 (Prato: Giachetti, 1866), 75–76; see also Del Gaizo, *Ricerche*, 23–24.

85. Sprengel, *Versuch*, 477–478.
86. Santorio, *Commentaria* (1612), II, col. 632C.
87. For details of Obizzi's controversy with Santorio see Fabiola Zurlini's contribution to this volume.
88. Obizzi, *Staticomastix*, 9.
89. Ibid., 26, 34; 65 (Oppositio XVII, Oppositio 64 [sic]).
90. Ibid., 68–69 (Oppositio 67 [sic]).
91. Santorio, *Commentaria* (1612), III, col. 95C-D; id., *Commentaria* (1625), coll. 79D-83D; id., *Medicina statica* (1634): cc. 69r-71v.
92. Santorio, *Ars* (1634), VIII.14, c. 71r.
93. Ibid., VIII.9, c. 70r; see also Santorio, *Ars* (1614), I.28–30, cc. 7r-v.
94. Santorio, *Ars* (1634), VIII.12, c. 70v.
95. Letter by Nicolas Toinard to Locke (Paris 25 March 1687) in *The Clarendon Edition of the Works of John Locke. Correspondence, Vol. 3*, Letters 849–1241 (Oxford: Clarendon Press, 1978), 156: 'Le contenu en l'article 11. m'est suspect, et cequi est dans le 12. est absolument faux *ad stateram*; car j'ay autrefois ouï dire à monsieur Roberval, grand mathematician et fort exact, que l'eau de mer ne pezoit pas plus d'une quarante deuxiême au dessus de celle de la Seine. Ansi cete pretenduë legereté n'est tout au plus qu'*ad sensum*. J'ay apris cete bele distinction d'*ad stateram* et *ad sensum* dans un petit livre *De staticâ medicinâ*, composé dans le siecle dernier par Santorio Santorini [sic] medecin de Padüe.'
96. State Archive of Venice (ASV), Riformatori allo Studio di Padova 64, deliberations dated respectively 9 May 1616 and 22 March 1622.
97. On the *Collegio Veneto* see Gaetano Cozzi in Sarpi, *Opere*, 566–574 and Giuseppe Ongaro in Santorio, *La medicina statica*, 13.
98. Relying on the medical report following the exhumation of Santorio's bones in 1809, we are reassured that Santorio was in fact a tall man, see Cicogna, *Delle iscrizioni veneziane*, vol. IV (G. Picotti, 1834), 671a-b. The similarity has been tested also by means of modern facial recognition technology (Betaface API) which showed a closeness of traits greater than 81.6%.
99. Carlo Ridolfi, *Le meraviglie dell'arte* (Venice: G.-B. Sgava, 1648), II, 294: 'ritrasse [i.e. Tinelli] etiandio Santorio Santori […]'.
100. Royal College of Physicians, London, MS 702.
101. State Archive of Venice, Collegio, Esposizioni Roma, 18; see also Gaetano Cozzi in Sarpi, *Opere*, 569–571.
102. As reported in a letter by Berlingero Gessi to the Cardinal Scipione Borghese (Venice, 27 August 1616), the Nuncio had warned Santorio of the risk of being excommunicated *latae sentitiae* (i.e. immediately), yet apparently this had no effect on him: see Vatican Secret Archive, Segreteria di Stato, Nunziatura di Venezia, Lettere di Monsignor Nunzio in Venezia

al Cardinal Borghese, 42D, c. 93r. We would like to thank Dr. Fabiola Zurlini who kindly transcribed this letter from the Vatican Archive.

103. Letter by Benedetto Caccia to the Riformatori (Padua, 3 January 1617) in State Archive of Venice (ASV), Riformatori allo Studio di Padova, 65; see also Marciana National Library (BNM), Venice, Cod. It. VII 2342 (9695), f. 30v and Centro per lo Storia dell'Università di Padova (CSUP), Padua, Ms. 477bis, c. 644.
104. Santorio's German students at times found his behaviour a bit abusive: see Centro per la Storia dell'Università di Padova, *Acta Nationis Germanicae artistarum* (1616–1636) edited by Lucia Rossetti (Padua: Antenore, 1967), 79, 148–151 and particularly 64 (anno 1619), which draws a vivid picture of the reasons behind the complaints: 'Promotus ipse (scil. Christophorus Albertius) fuerat antea ab illustrissimo Cremonino in philosophiae et medicinae doctorem una cum excellentissimo domino Iona Antonio Kilianstein et domino Arnoldo ab Einden, licentiam sive privilegium largiente illustrissimo doctore Roderico Fonseca, quoniam Sanctorius ordinarius praeses die, quam ipse praestituerat, non comparuerat, et natio nostra universa actui huic adfuerat doctoresque novos cum tubis tympanisque domum deduxerat. Sanctorius, postquam lucris Venetis opimus Patavium rursus appulit, privilegium doctorale subscribere renuit, simul in hac verba non sine indignis gestibus prorumpens: *Il tuo doctorato non val tanto, ego praeses sum non Cremoninus.* […] Indigne ferebant tyrannidem istam seniores ideoque, ne plane id multum auderet in privato conventu mutuo se cohortati decreverunt primis Sanctoris aliquot lectionibus se abstinere et amicis etiam, ut idem facerent, persuadere. Declinarunt itaque magna pars Germanorum auditores Sanctorii, alii brevius, alii diutius' (italics added). See also Ongaro in Santorio, *La medicina statica*, 13.
105. Capello, *De vita Sanctorii*, XII.
106. The deliberation (*parte*) was taken on 20 January 1623, see State Archive of Venice (ASV), Riformatori allo Studio di Padova, I, f. 372v. Santorio was refused a new appointment (or *ricondotta*) by 94 votes (green or *de nò*) against 35 (white or *de si*). Adding the vote of those 57 who asked to postpone the vote (red or *non sincere*), there were 151 votes against Santorio: see Gaetano Cozzi in Sarpi, *Opere*, 572. Upon realising that the Senate had not agreed to increase his salary (while granting this privilege to his deputy Nicolò Trevisano), Santorio wrote to the Riformatori on 6 March 1624 to quit his position, see n. 105.
107. As Santorio puts it, the promotion of his deputy was a matter of balance of power inside the *Collegio Veneto*, see his letter to the Riformatori (6 March 1624), in State Archive of Venice, Riformatori allo Studio di Padova 66, c. 1v: 'Hò letto continuam[en]te quasi 13 an[n]i con con-

corso posso dire di tutto il studio, ne mi sarà ascritto ad ardir che già mai habbi havuto altro lettor mio precessore più scholari di me, venendo alla mia Schola oltre li Italiani, Thedeschi, Francesi, Polachi, et altre Nationi da parte remotissime per udirmi, restando sempre pochi auditori *al mio concorrente benche Padoano che viene haver tanto poter nel Colleggio dove si dottorano li scholari*' (italics added).

108. See Gaetano Cozzi in Sarpi, *Opere*, 572. Pompeo Caimo was appointed without even one vote against. Decisive for Santorio's dismissal was the opposition of the patrician Pietro Contarini (1578–1632) as noted by Gino Benzoni, "Pietro Contarini," in *Dizionario biografico degli italiani*, 28 (Rome: Istituto dell'Enciclopedia Italiana, 1983), 269: 'Uomo di parte il Contarini, decisamente schierato col patriziato più conservatore—e lo s'avverte quando s'adopera perché Pompeo Caimo soppianti Santorio Santorio, il medico amico dei Sarpi, nell'ateneo patavino […]. È il nunzio stesso ad avvisare il 3 maggio 1624, che "quanto più" il Caimo "riuscirà grato" al papa e alla Curia "tanto più alcuni di questi tristi potenti di lingua continuano di calunniarlo in publico et in privato".'
109. Letter by Caspar Hoffmann to Wilhelm Fabricius Hildanus (Altdorf, 17 May 1625) in Fabricius von Hilden, *Observationum et curationum chyrurgicarum centuriae omnes* (Lion: J. A. Huguetan, 1641), Centuria IV, 208.
110. The final settlement of Santorio's salary was decided on 9 June 1624, see State Archive of Venice (ASV), Riformatori allo Studio di Padova 66. The tax reduction was granted to Santorio years later (1628), see Marciana National Library, Venice, Ms. It. VII 2342 (cod. 9695) 64v: '[1628] 12 Sett[embre] lng[resso] di Bened[etto] Salvatico Lettore di Pad[ova]/C. 112 Parte che Santorio doppo che lascio la lettura di Pad[ova] sia tansato da Tansadori minori.'
111. Letter by Johannes Rhode to Caspar Hoffmann (Padua, 3 December 1623) in Georg Richter, *Epistolae Selectiores* (Nuremberg: M. Endter, 1662), 803–804.
112. Haller, *Bibliotheca*, 553.
113. Letter by Santorio Santori to Senatore Settala (Venice, 27 December 1625), State Archive of Milan, Autografi 218, c. 1r: 'Mando à V.[ostra] S.[ignoria] li 2 libri sopra la p[rim]a di Avicen[n]a secondo mi ha scritto, et prego V.[ostra] S.[ignoria] che li lega con diligenza *p[er]che legerà pensieri novi fondati però nelle auttorità d'Hipp[ocrat]e et Gal[en]o nella th[or]ia, et nella esperienza'* (italics added).
114. For Santorio's testament (Venice, 24 December 1635), State Archive of Venice, Archivio Notarile, Testamenti, Giovanni Francesco Crivelli, B 289 N 537, c. 1v.

115. On which see Bigotti and Taylor, "Pulsilogium", 62, 91–93 and Fabrizio Bigotti, "The Weight of the Air: Santorio's Thermometers and the Early History of Medical Quantification Reconsidered," *Journal of Early Modern Studies* 7, no. 1 (Spring 2018): 79–80.
116. Paolo Dolfin, *Della peste. Opinioni dei medici di Venezia nel 1603* (Padua: Penada, 1843), 8–12; Ettari and Procopio, *Santorio Santorio*, 80–82.
117. In another consultation about plague, signed by Santorio along with Benedetto Silvatico and other prominent physicians at Padua (dating at approximately 1620), Santorio had conformed to the majority view and denied the presence of the plague in the city, see "An Caro boum sponte mortuorum, in cuius venditores proxime est animadversum inferre possit Pestem?," British Library, London, MS Sloane 2253, ff 91v-94v.
118. Fondazione Querini-Stampalia, Venice, Ms. Cl. IV 638 (998), Cecilio Fuoli, 'Vero racconto di tutto quello che è occorso l'anno 1630 […]', 102 '[…] da questi <i.e. *medici*> solo diferendo l'Ecc[ellentissi]mo Sig[no]r Antonio <*recte* Santorio> Santorio che tanti anni aveva letto medicina in prima Cattedra nello Studio di Padova, per altro accreditato letteratissimo, e si averò il Proverbio Veneto *far più un remo che s[t]ia che quattro che voghino*' (Italics added). On the same point see also Marciana National Library, Venice (BNM), Ms. It. VII 2342 (9695), c. 35r.
119. Marciana National Library (BNM), Venice, Ms. It. XI 58 (cod. 6295), Nicolò Pollaroli (?), 'De Laudibus Sanctorii Sanctorii Oratio Habita in Coll.[egio] Medicorum Venetor[um] IV Kal[endis] Decemb[ris] 1752', c. 125r. If we trust this account, then Santorio's observation that the numbers of plagued people correspond to one-third of the total population comes directly from his own experience in Venice because that is the number of the corpse carriers, see Santorio, *Ars* (1634), I.130, c. 18v.
120. Santorio, *Ars* (1634), I.127, c. 18r; I.138, c. 19v.
121. Marciana National Library (BNM), Venice, Ms. It. VII 2379 (9686), c. 24v.
122. Cicogna, *Delle iscrizioni veneziane*, vol. II (G. Picotti, 1827), 436–437: 'Adi 25 Febbraro 1635 M. V. (*more veneto*, that is 1636) L'ecc[ellentissi]mo Sig. Santorio Santorij med[ico] fisicho, de anni 76 da mal d'orina già anni uno nelle case del Dardani S[anto] Alv[ise].' From a pen annotation by Emanuele Antonio Cicogna found in the Museo Correr, Venice MS Gradenigo-Dolfin 66, f. 155. It appears that the Dardani houses located at Fondamenta Della Sensa no. 3235 were most likely destroyed in 1843.
123. Letter by Alessandro Bichi to Nicholas De Peirasc (Rieti, 26 May 1636) in Philippe Tamizey de Larroque, *Les Correspondantes de Peiresc,* vol. VIII (Paris: A. Piquard, Marseille: M. Lebon, 1885), 75.
124. Cicogna, *Delle iscrizioni veneziane*, vol. I (G. Orlandelli, 1824), 51b; vol. IV (G. Picotti, 1834), 671a–b. For the translation of the skull to the

University of Padua see Francesco Cortese and GianPaolo Vlacovich, "Di alcuni cranii di scienziati distinti che si conservano nel Museo Anatomico dell'Università di Padova e che appartennero alla sua scuola" in *Memorie del Reale Istituto Veneto di Scienze, Lettere ed Arti*, 21 (1879): 547–557. For a modern analysis of Santorio's skull see Alberto Zanatta, Giuliano Scattolin, Gaetano Thiene and Fabio Zampieri, "Phrenology between anthropology and neurology in a nineteenth-century collection of skulls" in *History of Psychiatry*, 27, 4 (2016), 482–492.

125. State Archive of Venice (ASV), Avogaria di Comun, 385/9.
126. Palazzo Santorio (today Villa Elvira) was acquired by Isabetta Santorio on behalf of Santorio's nephews, see State Archive of Venice, Condizioni di Redicima, 1661 (Tombelle), Cond. 618b, 220. We thank Dr. Luca Cacciavillani, the present owner of the Villa, for his courtesy and collaboration in providing Dr. Bigotti with original documents related to the Santorio family. For Palazzo Santorio at San Basegio see Museo Correr, Venice, Ms. Gradenigo-Dolfin 200, 1, f. 5r and Giuseppe Tassini, *Curiosità veneziane ovvero origine delle denominazioni stradali di Venezia* (Venice: Grimaudo, 1872), 652–653.
127. The complete list of the *Sanctoriani Lectores* is available at Marciana National Library (BNM), Venice, Ms. It. VII 2342 (cod. 9695).
128. The state of art on such relations is still at the point where Grmek left it in 1967, see Grmek, 'L'énigme'.
129. Galileo Galilei, *Il Saggiatore* (Rome: G. Mascardi, 1623), 198–200.
130. For the Copernican theory see Santorio, *Commentaria* (1625), coll. 118ff. On Santorio's own astronomical observations see Ibid., col. 113B-C.
131. Ibid., col. 141B which argument is taken over and refined in Santorio Santori, *Commentaria in primam sectionem Aphorismorum Hippocratis* (Venice: M. A. Brogiolo, 1629), 328–329.
132. Santorio, *Methodi*, III.15, f. 74v B-C; Galileo Galilei, *Dialogo di Galileo Galilei* […] *sopra i due massimi sistemi del mondo tolemaico e copernicano* (Florence: G.-B. Landini, 1632), Dialogo secondo, 100–101.
133. Ian MacLean, "Textauslegung und Hermeneutik in den Juristichen und medizinshen Fachern Des spatern Renaissance: *Auctoritas, Ratio, Experientia*" in *Theorie Der Interpretation Vom Humanismus Bis Zur Romantik—Rechtswissenschaft, Philosophie, Theologie. Beitrage Zu Einem Interdisziplinaren Symposion in Tuebingen, 29. September Bis 1. Oktober 1999* edited by Jan Schröder (Stuttgart: F. Steiner, 2001), 31–32.
134. On Pinelli's life and circle see Paolo Gualdo, *Vita Ioannis Vincentii Pinelli* (Augsburg: Ad insigne pinus, 1607) and Angela Nuovo, "Manuscript Writings on Politics and Current Affairs in the Collection of Gian Vincenzo Pinelli (1535–1601)," *Italian Studies*, 66, 2 (2011): 193–205.

135. Letter by Giovanni Francesco Sagredo to Galileo Galilei (Venice, 9 May 1615) in Galileo Galilei, *Opere*, edited by Antonio Favaro (Florence: Giunti Barbèra 1890–1909), vol. XII, 157; Vincenzo Viviani *Racconto istorico della vita di Galileo Galilei indirizzato da Vincenzo Viviani al Principe Leopoldo di Toscana* in Galileo, *Opere, Edizione Nazionale*, vol. XIX (1919), 112–121. For an up-to-date discussion of Santorio's pulsilogium, its use, invention and theory behind it see Bigotti and Taylor, "Pulsilogium".
136. Stillman Drake, *Galileo at Work. His Scientific Biography* (Chicago and London: University of Chicago Press, 1978), 20–21; Wolfgang Lefèvre, "Galileo Engineer: Art and Modern Science," in *Galileo in Context* edited by Jürgen Renn (Cambridge: Cambridge University Press, 2001), 21–22 n.20; Iochen Büttner, "The Pendulum as a Challenging Object in Early Modern Mechanics," in *Mechanics and Natural Philosophy before the Scientific Revolution* edited by Walter Roy Laird and Sophie Roux (Dordrecht: Springer, 2008), 227–228, esp. 228 nn. 15–16; Matteo Valleriani, *Galileo Engineer* (Dordrecht-London: Springer, 2010), 12–13 n26.
137. Bigotti and Taylor, "Pulsilogium", 58–60.
138. There is no trace of its invention in Santorio's writings earlier on similar issues of temperature, for instance, in Santorio, *Methodi*, III 4: f. 64r B-C.
139. Santorio, *Commentaria* (1625), col. 7A.
140. Even those who partially support Galileo's invention of the thermometer are compelled to concede that the instrument was not solely his invention. See for instance Valleriani, *Galileo*, 156–157: 'Galileo is one of several, who, more or less simultaneously at the beginning of the seventeenth century, and in different geographic locations, "invented" the thermoscope: the first instrument that could be used to obtain information about the degrees of heat and cold without appealing to the human senses. The thermoscope circulated for about ten years before being transformed into the thermometer. […]. But the thermoscope was not really invented: more accurately, it was the result of a conceptual reshaping process which took place at the beginning of the seventeenth century […]. The thermoscope is an ancient device, which was conceptually reshaped in order to meet needs and *desiderata* that emerged between the end of the sixteenth and the beginning of the seventeenth centuries, and remain established today.'
141. On Santorio demonstrating his instruments to students see Santorio, *Commentaria* (1612), III, 105A-B; id., *Commentaria* (1625): Ad lectorem [c. 1 unnumbered]. It is worth noting that, although published in 1612, the work was actually written in 1611.

142. Letter by Francesco Sagredo to Galileo Galilei (Venice, 30 June 1612) in Galileo, *Opere*, vol. VIII, 218.
143. Letter by Francesco Sagredo to Galileo Galilei (Venice, 9 May 1615) in Galileo, *Opere*, vol. XII, 157: 'All'istrumento per misurar li temperamenti io sono andato giornalmente aggiongiendo et mutando, in modo che quando havessi a bocca et di presenza a trattare con lei, potrei, principiando *ab ovo*, facilmente racontarle tutta l'historia delle mie inventioni, o, per meglio dire, miglioramenti. *Ma perche, come ella mi scrisse et io certamente credo, V.S. Ecc.ma è stata il primo auttore et inventore, percio credo che gli istrumenti fatti da lei et dal suo esquisitissimo artefice avanzino di gran lunga i miei onde la prego con prima occasione scrivermi qual sorte di opere fin hora ella habbia fatto fare*, che io le scriverò quel di più o di meno che fin hora s'è operato di qua et toccando in ogni nostra lettera alcuna cosa in questo proposito, io le scrivero alcune mie imperfette speculationi, le quali da perfetissimo suo giuditio et intiligenza saranno senza studio, et ancora con gusto, perfettionate. *Quello che si fa inventore di questi stromenti* [i.e. Santorio] *è poco atto, per non dir in tutto innetto, per instruirmi conforme al bisogno et desiderio mio,* si come io vanamente mi sono affaticato a dargli ad intendere la cagione de gl'effetti che si vedono in alcuni de' miei istrumenti (dirà cosi) compositi et moltiplicati. […]' (italics added).
144. A clue as to what Santorio actually means by *secreti* and why he is being very careful about not revealing too much to Galileo comes from the telescope affair, as reported by Giovanni Bartoli, in a letter to Belisario Vinta (29 August 1609) in Galileo, *Opere*, vol. X, 255. Around that period, the telescope was brought to Venice by a French man who was keen to sell it to the Senate, but at prohibitive cost. Although the offer was eventually declined, Sarpi had a chance to look at the instrument and to speak about it with Galileo, who, aided by some other recollections and by having seen a similar instrument before, was able to provide a new copy of the same instrument.
145. Santorio, *Ars* (1614), II.4, cc. 20v-21r.
146. Letter by Georg Fugger to Johannes Kepler (Venice, 16 April 1610), in Galileo, *Opere*, vol. X, 316: 'Novit et solet homo ille [i.e. Galileus] aliorum pennis hinc inde collectis, uti corvus apud Aesopum, se decorare.'
147. Cozzi, *Paolo Sarpi*, 225; Gatano Cozzi, "Agostino da Mula," in *Dizionario biografico degli italiani*, 32 (Rome: Istituto per l'Enciclopedia Italiana, 1986), 376–381.
148. Alistair Crombie, *Science, Art and Nature in Medieval and Modern Thought* (London and Rio Grande: Hambledon Press, 1996), 485–486.

149. For the context of Galileo's and Santorio's discoveries see Büttner, "Pendulum," 227–228; Valleriani, *Galileo*, 155ff.; Bigotti, "Weight," 99–100; id., *Physiology*, 238–239, 246, 277–278.
150. On Santorio and astrology see Santorio, *Commentaria* (1612), II, coll. 598C-599A, col. 749B-C; III, col. 21B-C; id., *Commentaria* (1625), Quaestio IX, coll. 72C-83D; Del Gaizo, *Ricerche*, 30–35; Wear, "Contingency," 250–256.
151. Letter by Allesandro Bichi to Nicholas de Peirasc (Rieti, 20 September 1636) in de Larroque, *Correspondantes*, vol. VIII, 91–92: '[L]es Vénitiens sont terribles, et ne se soucient de personne, ayant encore au trefois traitté plus mal le Mercuriale, le Galilei, et le Santorio qui se partirent tous desgoutés d'eux […].'
152. For the definition of *praecognitum* see Maclean, *Logic*, 118.
153. For the first occurrence of disease as a distance see Santorio, *Methodi*, IV.5, f. 85rD: 'Cum optimus medicus ultimas affectuum differentias consequi non possit, nisi recessum ab adventitia statu sciat metiri; et quilibet adventitius status a longa consuetudine sex rerum non naturalium suum initium trahat; par est, antequam consuetudinis definitionem excutiamus, ut luce exemplorum pertinentium ad omnes facultates corporis ostendamus quanta perennis rerum externarum consuetudo potentia, et virtute polleat, et quae sint illae animantium facultates, quae adeo mutentur ob longam aliquam consuetudinem, ut status adventitios et novas aquirant […].'
154. Santorio, *Commentaria* (1612), III, coll. 374B–375B.
155. As for instance in Santorio, *Methodi*, III.5, ff. 64rD–64vB: 'Exordiamur itaque a nonnullis erratis ad situm pertinentibus: errare igitur videntur nonnulli dicentes orificium ventriculi, quod in pyloron mittit esse in fundo, vel in decliviori regione situm et collocatum, causaque huius tam communis erroris fuit sapientissimus Galenus, quoniam eius auctoritas talis est, ut non solum in totius Europae tractus, verum in id quod Meridiana, et Septentrione finitur diffusa cultu observantiaque merito existimetur; hic vir igitur, cum ei non licuerit secare humana corpora, videns in brutis quibusdam animantibus pyloron esse in fundo ventriculi, credidit in libro de tuenda sanitate, et in 4. de usu partium capite 7. pyloron in hominibus quoque, a fundo ventriculi exordiri; quae opinio est falsa, et fuit multorum errorum origo: falsa est, quia relucatur experientiae, quoniam in humanis cadaveribus oculis cognoscitur, pyloron ab imo ventriculo non prodire, deinde reluctatur Vesalio, Columbo, et caeteris omnibus praclarissimis anatomicis, qui quotidie humana corpora secant; quare esse vecordis, et nebulonis illa reiiceret.' See also III.15, 74vC-D:

'[…] videas igitur, in quot absurda incidant, qui iurant in placita magistri […] Quare fuit possibile, ut Galenus, vel quia fuit homo, vel quia non secuit humana cadavera, in anatomia a veritate in paucis saltem deflecteret; quare cum Galenus neque meus fuerit affinis, et consaguineus, vel maiorum meorum avunculus, quod sciam, neque in sanctorum catalogo sit collocatus, qui afflatus divinitate fuerit locutus, non video, cur omnes non possint honorifice, si sensibus adversatur, eum relinquere.'

156. Letter by Santorio Santori to Senatore Settala (Venice, 27 December 1625) in State Archive of Milan, Autografi 218, f. 1r.
157. Santorio, *Ars* (1634), VIII.12, c. 70v.
158. Santorio, *Commentaria* (1625), col. 21C.
159. Santorio, *Ars* (1614), II.4, c. 21r.
160. Santorio, *Commentaria* (1625), col. 144A-B: 'Similiter, si instrumentum vitreum, quo dimetimur temperamenta calida et frigida, circundetur hac nive sali commixta, in parte superna aer inclusus duplo magis condensatur, quam si sola nive circundaretur; quod indicat refrigerationem maiorem fieri ratione vehiculi, quam ratione nivis […].'
161. Ibid., col. 357B-D.
162. Galileo, *Opere*, vol. VIII, 599. For a discussion of the deficiency of Galileo's approach with regards to Bardi's problem see Raffaello Caverni, *Storia del metodo sperimentale in Italia*, 6 vols (Florence: Stab. G. Civelli, 1891–1900) vol. 1, 274–278 and Valleriani, *Galileo*, 155–156.
163. Santorio Santori, *Commentaria in artem medicinalem Galeni* (Venice: M. A. Brogiolo, 1630), II, 762D on which Bigotti, "Weight," 74.
164. Valleriani, *Galileo*, 155.
165. Arianna Borrelli, "The Weatherglass and its Observers in the Early Seventeenth Century," in *Philosophy of Technology. Francis Bacon and His Contemporaries*, edited by Claus Zittel et al. (Leiden–Boston: Brill, 2008), 111.
166. Bigotti, "Weight," 74, 96.
167. See Giorgio Tabarroni in Raffaello Caverni, *Storia del metodo sperimentale in Italia* (London: Johnson reprint, 1972) vol. 1, vii: '[…] the critical perspective and the dispassionate (even if, naturally not infallible) examination of the sources that characterize this work [i.e. Caverni's] are clearly in contrast with the emphasis and tone of the writings of the Italian Galileans who, from Viviani to Favaro, have felt they had to serve, unsolicited and superfluous, as the extreme apologists or defenders of Galileo.'
168. See Keill, *Tentamina* and Joseph Rogers, "Medicina Statica Hybernica or Statical Experiments to Examine and Discover the Insensible Perspiration of Human Body in the South of Ireland," in his *An Essay on Epidemic*

Diseases […] to which is Added by Way of Appendix a Course of Statical Experiments, and Observations made by a Curious Person during a Twelve Months (Dublin: S. Powell, 1734), 190–312.

169. Santorio, *Ars* (1614), I.7, c. 2v; I.25–27, cc. 6r-v; I.67–68, c. 16r; II.4, cc. 20v-21r. On Santorio's appreciation of atmospheric pressure and its evaluation see Bigotti, "Weight," 83–92.

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