Chapter 4
Sanctorius's Work in Its Practical Context

Abstract This chapter spotlights the practical context of the *De statica medicina* and explores Sanctorius's use of instrumentation. The investigation of the form and style of the *De statica medicina* and its relation to the literary genre of *Regimina sanitatis*—a medieval tradition of rules of health—allows important conclusions to be drawn on how Sanctorius shared his practical experiences, on his intended audience, and more generally, on the purpose of the publication. Complementary to established knowledge on Sanctorius, the analysis of his use of instrumentation focuses here not on the measuring instruments, but on the various other lesser-known devices that he developed, ranging from surgical devices to a special sickbed. I examine the relation of these devices to Sanctorius's medical practice as well as to his teaching activities at the University of Padua. Even though—or exactly because—they were not part of the quantitative approach to physiology, their study helps to complement the picture of Sanctorius as a practicing physician. Moreover, it provides glimpses of the social context in which he developed and used his instruments and of how he used his head and hands in medicine. Finally, the results of this chapter allow the *De statica medicina* to be reviewed afresh within the broader practical context of Sanctorius's undertakings.

Keywords Early modern medical practice · Medical aphorisms · Medical instruments

The previous chapters spotlight the conceptual background of Sanctorius and analyze his work in relation to the medical tradition—Galenic medicine. Now, it is necessary to turn toward the practical and material resources of Sanctorius's endeavors in order to further investigate the processes that contributed to his innovative approach—the quantification of physiological phenomena. Like many of his colleagues, Sanctorius combined his activity as a university teacher of medicine with the practice of medicine. In doing so, he oscillated not only between these two occupations, but also between two important cities of Renaissance Italy: Padua and Venice. While the first was mainly known as a center of learning, with the University of Padua being one of the most famous universities in Europe at the time, the latter shined as the center of the mighty Republic of Venice and as a busy marketplace,

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where merchants from all over the world exchanged their commodities. Sanctorius's movement between these two worlds reflects in some ways the combination of theoretical and practical knowledge that shaped his works. On the one hand stands the professor of theoretical medicine, who wrote extensive commentaries on traditional university textbooks. On the other, the practicing physician, who devised an innovative weighing chair to observe the insensible perspiration of his patients.

However, as has become apparent, the categories of tradition and innovation cannot be clearly differentiated. Similarly, a simple dichotomy between theory and practice falls short of accounting for the complex interplay between the intellectual and the material, as well as their social dimensions. Instead of representing discrete and well-defined realms, these factors are one and the same phenomenon and should be analyzed as such (Valleriani 2017: vii). Therefore, it is the aim of the following chapters to deal with Sanctorius's introduction of quantitative research into physiology as something not distinct from, but complementary to the intellectual framework outlined in Chap. 3.

4.1 The *Ars … de statica medicina* and Its Practical Context

The starting point for the investigation is the analysis of the practical context of the *De statica medicina*. The published work of course does not offer a direct window onto Sanctorius's medical practice, and it has already been shown how strongly it was rooted in the medical tradition. Still, the choices Sanctorius made with regard to the presentation of his weighing procedures allow some important conclusions to be drawn on how he shared his practical experience. This sheds light on his intended audience and more generally, on the purpose of the publication. It gives a first insight into the way Sanctorius connected theory and practice.

4.1.1 The Aphoristic Form

Sanctorius wrote the *De statica medicina* in aphorisms. To modern eyes, these short and sententious sayings, which Sanctorius used in order to present the results of his weighing procedures, seem somewhat odd and foreign. In the preface of the *De statica medicina* he explained his choice of the aphoristic form with the following words:

> [it] seemed to me more reasonable to present [this art] in the form of aphorisms than in a descriptive form from beginning to end. [I did so], at first in imitation of our great Hippocrates, always priding myself on following in his footsteps; but then I was virtually driven by necessity to do so, since the same experiments, in which I was daily engaged for many years, through continual studies, virtually led me by the hand to this aphoristic form of the doctrine. Thus, I was able to arrange the aphorisms, which are interrelated to each other in this marvelous order, in exactly the same way as bees first pick at the honey of

> diverse flowers and then, after having worked on it, arrange it in a marvelous order in their hives by means of the combs (Sanctorius 1614: Ad lectorem).[1]

Hence, on the one hand, Sanctorius saw himself in the tradition of Hippocrates and on the other, he stated that his weighing procedures led him naturally to the aphoristic form. This suggests that there was a close connection between Sanctorius's practice and its formal textual presentation. In the *Commentary on Hippocrates*, Sanctorius gave more insight into his understanding of aphorisms. Discussing the term "aphorism," he distinguished three levels of meaning—separation, definition, and selection—which he claimed corresponded to three conditions of aphorisms. First, that they were distinct sentences without a determined order. Second, that they were arranged, defined, and authoritative sentences, and certain explanations of things. Third, that they were selected sentences, which contained within themselves great power. Sanctorius further specified that aphorisms were phrases that were poor in terms of words, but rich in terms of sense. Their wording and content were carefully chosen and purified. In this context, he again put forward the analogy to the bees' production of honey. Just as bees collected the sweetest honey from the most excellent flowers, Hippocrates had chosen for his aphorisms the divine phrases from his other works. His intention had been, so Sanctorius, to select from the entirety of medicine those phrases most appropriate to the physician's use. But according to Sanctorius, aphorisms were useful not only for the physician, but for other skilled fields as well. There was, however, one prerequisite: the aphorisms must be selected from the respective field, hence, for example, political aphorisms for politicians. Only then would they unfold their great power (Sanctorius 1629a: 3 ff., 9 f.). This implies that Sanctorius intended the *De statica medicina* for physicians. Yet, whether this was really the case will be scrutinized later.

Even though aphorisms did not have a predetermined order, they still had to be ordered and the way this was done was important. Sanctorius differentiated here between two kinds of order. There was a universal order, which gave books their condition and form, and this was the resolutive (analytical) or the compositive (composed, synthetic) order.[2] But there was also a particular, or accidental order,

[1] "… quam consultius iudicavi doctrina Aphoristica quam diexodica describere, primò ad imitationem magni nostri Dictatoris, cuius vestigijs insistere gloriosum semper duxi: deinde id feci quasi necessitate impulsus, quandoquidem ipsa experimenta, quibus quotidie assiduis multorum annorum studijs incumbebam, ita me ad hanc doctrinae formam Aphoristicam manu quasi ducebant, ut Aphorismos optimè inter se connexos miro hoc ordine digesserim, eo plane modo quo apes primum mel ex varijs floribus delibant, & deinde in apiarijs per aedicularum suarum favos elaboratum miro ordine disponunt." See: ibid.: Ad lectorem.

[2] Sanctorius here tied in with Renaissance discussions of medical method, which were largely based on Galen's works and influenced by various conceptions, such as Aristotelian methodology and geometrical methods. Without delving deeper into this vast and complex topic, resolutive order was understood in this context as a form of teaching (*doctrina*) which begins with the idea of an aim and proceeds by way of resolution (in modern terminology "analysis"), while the compositive order was thought to proceed by way of composition, i.e., composition of the things discovered by resolution (in modern terminology "synthesis") (Edwards 1976: 285, Sanctorius 1612a: 25, 33). For further information on Renaissance discussions of medical method, see: Randall Jr. 1940,

which was neither resolutive nor compositive, but served for any occasion and for the memory. And this was the type of order that Hippocrates had used in his *Aphorisms*, and it constituted an alternative form of teaching—the *doctrina aphoristica*. The great significance that Sanctorius ascribed to Hippocrates's *Aphorisms* is apparent from his statement that this work embraced all the solid precepts of the medical art. In the *Methodi vitandorum errorum*, however, he was also critical of the *Aphorisms,* concurring with Galen that not all of them contained eternal truth (Sanctorius 1603: 25v–26r; 1629a: 9, 12). So, what conclusions can be drawn from these statements with regard to Sanctorius's use of the aphoristic form in the *De statica medicina*?

First of all, it must be noted that Hippocrates and the Hippocratic writings gradually gained importance in Western medical circles from the second half of the sixteenth century on. Galen's credibility as an interpreter and guide to scholars in Hippocratic studies began to decline and Hippocrates came more to the fore, slowly but steadily dissociated from Galen and the Galenic doctrine. This change of view occurred in a multifaceted process, which I shall not discuss here.[3] What is of interest in this context is that Hippocrates's *Aphorisms* were especially influential and the focus of medical academic attention. The preeminence of the work is illustrated by the fact that it held its place as one of the three set texts for the lectures on medical theory at the University of Padua until 1767 (Smith 1979: 13 f.; Nutton 1989: 422–31). In light of these circumstances, Sanctorius's ambition to follow in the footsteps of the great Hippocrates, as expressed in his preface to the *De statica medicina*, and, too, his choice of the aphoristic style, can be interpreted as a sign of the growing popularity of Hippocrates and the long-standing interest in the Hippocratic *Aphorisms*, which reputedly began well before the Renaissance.

However, it should not be forgotten that Sanctorius was a Galenist and still accepted the unity of the systems of Hippocrates and Galen. Perusal of his *Commentary on Hippocrates* shows that he strongly relied on Galen's interpretations of Hippocrates's teachings, as he frequently referred to the former's commentaries not only on the *Aphorisms*, but also on other Hippocratic works (Sanctorius 1629a: e.g., 7 f., 335 f., 409 f.). It is therefore in a Galenic spirit that Sanctorius praised Hippocrates as the author of essential precepts and as an excellent and sincere man of great talent and intelligence (Sect. 3.1.2) (Sanctorius 1629a: 7, 9). Hence, it might have been a combination of both, the growing contemporary interest in Hippocrates as well as Galen's veneration of the "Physician of Kos," which made Sanctorius wish to imitate the great master.

Randall Jr. 1961, Gilbert 1963, Wightman 1964, Randall Jr. 1976, Mugnai Carrara 1983. Most of the controversy over method in medicine turned upon the interpretation of the opening passage of Galen's *Ars medica* and this is also the place where Sanctorius discussed the issue, see: Sanctorius 1612a: 4 f., 10, 17–46.

[3] An analysis of the process that led to the change in opinion about Hippocrates and the Hippocratic writings and their emancipation from Galen and his doctrine can be found in: Smith 1979: 13–60, see also: Nutton 1989.

Moreover, Sanctorius's discussion of the meaning and conditions of aphorisms shows that he ascribed great power to this style of writing. According to him, aphorisms were especially rich in terms of sense and presented the most useful distillation of a skill, in this case the medical art, which was otherwise explained with many and, often, superfluous words. Aphorisms provided the reader with already *digested* content. In analogy to the nourishment of the body, Renaissance dieticians conceived of the nourishment of the mind—by reading and understanding a book, for example—as a matter of ingesting and incorporating knowledge, transforming it into bodily substance. This is still reflected in modern usage, when books or movies are referred to as *difficult to digest* (Sanctorius 1625: 24; Albala 2002: 141). Accordingly, by offering digested content, aphorisms conveyed knowledge that was easy for their readers to ingest and incorporate. This made them most appropriate to the use of the audience.

When Sanctorius discussed whether Hippocrates's *Aphorisms* had an order, he hinted at the functions of the aphoristic form. The accidental order which, so Sanctorius, had been used by Hippocrates for the arrangement of his aphorisms, helped the physician to memorize their content and made the aphorisms suitable for medical practice, as they could be applied to any situation. "Accidental" referred here not to the order itself, but to its purpose, namely to provide order for occasions and accidents. Sanctorius did not specify how this order actually looked, but gave the example of the head-to-toe arrangement of diseases which he said was used by practicing physicians. In fact, this classification was followed in many practically oriented manuals in the Middle Ages and the Renaissance, which were essentially based on experience.[4] Sanctorius explained that this ordering of illnesses was similar to the accidental order which Hippocrates had used in his aphorisms. In this context, it is interesting to note that Sanctorius chose for the *De statica medicina* an organizing principle whose occasional character he highlighted. As was mentioned earlier, Sanctorius described the involvement of the human body with the six non-natural things as purely fortuitous (Sect. 3.1.1). Thus, on the one hand Sanctorius seems to have considered the doctrine of the six non-natural things as an accidental order, suitable for structuring accidents and occasions such as a physician encountered in daily practice. On the other hand, he conceived of the six non-natural factors themselves as occasional causes of disease, which could be aptly described in aphorisms. In his view, it would seem, the doctrine of the six non-natural things and the aphoristic form informed each other (Sanctorius 1629a: 9).

Consequently, the conveyance of useful and compressed content, in connection with an easy intelligibility, memorability, and practical applicability, were central to Sanctorius's choice of the form and structure of the *De statica medicina*. This implies that he intended the work as a practical handbook for the daily use of

[4] The ordering of diseases from head to toe goes back to the *Kitāb al-Manṣūrī* (The Book of al-Mansūr, early tenth century) by the medical encyclopedist Rhazes (al-Rāzī, ca. 865–932), which was known to the West as the *Almansor*. Until the sixteenth century, it was frequently used as a university textbook in courses on practical medicine (Siraisi 1990: 12, 131, Grendler 2002: 324, Straface 2011: 7).

practicing physicians. But since he published the *De statica medicina* when a professor at the University of Padua, educational purposes might equally have been at play. It seems then, that his usage of the well-known doctrine of the six non-natural things as a means of ordering his aphorisms was intended to guarantee on the one hand, that static medicine cover any occasion in dietetic practice, and on the other, that it be easy to memorize, familiar as the scheme was.

The Tradition of Medical Aphorisms Similar to the use of the six non-naturals as a structural element in a dietetic treatise, the use of medical aphorisms was nothing new or out of the ordinary. In fact, there was a tradition of medical aphoristic treatises that Sanctorius could tie in with. Given the persistent significance of Hippocrates's *Aphorisms* and the popularity of the work, the application of such terse statements by later physicians does not come much as a surprise. One of the most famous representatives of the medical aphoristic writers is Moses Maimonides (1138–1204). Probably around the end of the twelfth century, he wrote the *Aphorisms of Moses* (*Aphorismi Rabi Moysi*, in Latin), which is the most voluminous of the ten medical works he composed. It comprises approximately fifteen hundred aphorisms based mainly on the writings of Galen, including the latter's commentaries on the works of Hippocrates. Each of its twenty-five chapters deals with a different area of medicine, ranging from anatomy to physiology, drugs, and medical curiosities (Rosner 1998: 7–43; Maimonides and Bos 2004: xix–xxi). Interestingly, Maimonides revealed his reasons for using the aphoristic form in the preface to the work. He explained:

> People have often composed works in the form of aphorisms on [different] kinds of sciences. The science most in need of this is the science of medicine, because it has branches of knowledge that are difficult to conceptualize …, and [because] it has branches of knowledge that are difficult only with respect to remembering what has been written down about them …. As for the science of medicine, its conceptualization and the understanding of its concepts are not as difficult as in [the case] of the exact sciences. However, aspiring [to master] this science is difficult in most cases because it requires retaining a very large amount of memorized material, not merely of general principles but also [of] particulars, …. These works composed in the form of aphorisms are undoubtedly easy to retain; they help their reader to understand and retain their objectives. Therefore, the most eminent of the physicians, Hippocrates, has written his famous work in the form of aphorisms. Later on, many physicians followed his example and composed aphorisms, such as the *Aphorisms* of the famous al-Rāzī, the *Aphorisms* of al-Sūsī, the *Aphorisms* of Ibn Māsawayh, and others (Maimonides and Bos 2004: 1 f.).[5]

The citation shows that Maimonides considered the use of aphorisms especially suitable for medicine, not only due to the field's complexity, but also and most importantly, because the physician was required to know its contents by heart. Standing at the bedside of a patient, there was hardly time to pore over lengthy books. Thus, aphorisms should, so Maimonides, make it easier to grasp and memorize medical knowledge. The parallels to Sanctorius's argumentation are evident.

[5] The English translation is taken from the parallel Arabic-English edition of Moses Maimonides' *Medical Aphorisms*, edited, translated, and annotated by Gerrit Bos (Maimonides and Bos 2004).

However, there seems to be a tension between the conciseness and brevity of aphorisms and their easy intelligibility. Maimonides wrote further below in the preface, "the intention of one who has composed aphorisms has not been to encompass everything that one needs in the field of that science …" and "anyone who is like me or who is less knowledgeable than I am can benefit from them [the aphorisms]" (Maimonides and Bos 2004: 2, 4). But if aphorisms abridged or omitted content, the question comes to mind: How could they facilitate understanding for readers with no good grounding in Hippocratic–Galenic theory? Sanctorius did not seem to share this concern. Regarding the question of whether Hippocrates's *Aphorisms* served as an introduction to medicine, or were intended rather for advanced studies, he stated that they could be understood without the help of a teacher (Sanctorius 1629a: 11). This might be true for the *De statica medicina* as well. The clear practical orientation of the work may have pushed theoretical considerations into the background, contributing at the same time to Sanctorius's choice of the aphoristic form. The conciseness, memorability, and practicability of static medicine seem to have been more important to Sanctorius than its elaborate embedding in the theoretical context.[6] To follow his newly formulated rules of health, the information he provided in the aphorisms might well have been enough even for a less-educated audience, given that this audience too was most likely familiar with the aphoristic style. So, given the form of the *De statica medicina*, Sanctorius probably intended the work to be both: a handbook for experienced practicing physicians and a teaching tool or instruction manual for beginners.

Notwithstanding that Sanctorius did not refer to Maimonides in his works, it can be assumed that he was acquainted with the *Aphorisms of Moses*, as Latin editions of the work existed in his day. Originally written in Arabic, the work was translated into Latin in the thirteenth century and appeared as an incunabulum in Bologna in 1489, and in Venice in 1497, followed rapidly by numerous printed Latin editions.[7] The success and popularity of Maimonides' medical aphorisms in medieval western Europe may have drawn Sanctorius's attention to the work, albeit more than 300 years after the manuscript had first been published in Latin. In view of the fame and prestige of Hippocrates's *Aphorisms*, Sanctorius may have preferred to establish a direct connection between his static aphorisms and those of the great master, without bothering with other, more recent medical aphoristic writers. Maimonides, on the contrary, mentioned other followers of Hippocrates, who composed medical aphorisms: Rhazes (al-Rāzī, ca. 865–932), Abd Allāh ibn Muhammad al-Taqafī

[6] Ian Maclean has argued that the recommendation of the aphoristic form by medieval physicians foreshadowed some developments in the natural philosophy of the seventeenth century. Just as the presentation of medical precepts through the medium of aphorisms did not involve the elaboration of a complete system, in seventeenth century natural philosophy local explanations were suggested for phenomena, without any attempt to link these to a broader system of thought (Maclean 2002: 114). In his study on the *Aphorismi de gradibus* by Arnold of Villanova, McVaugh pointed out that late-thirteenth-century explanations and descriptions of medical practice only went into problems as far as was necessary to develop a solution, but did not try very seriously to incorporate these isolated cases into a general framework of medical thought (de Villanova et al. 1992: 89).

[7] For the bibliographical references, see: Dienstag 1983: 107 ff., Dienstag 1989: 455 f.

al-Sūsī (942–1012) and Mesue (Ibn Māsawayh, ca. 777–ca. 857). Interestingly, Sanctorius knew at least two of the three authors listed by the Jewish scholar, as he frequently referred to Rhazes and Mesue in his work (e.g., Sanctorius 1612a: 51, 468 f., 709; 1629a: 331, 500; 1629b: 120, 129). What is more, the name of Arnold of Villanova (ca. 1240–1311), another important proponent of medical aphorisms, appears in Sanctorius's commentaries, too. At the end of the thirteenth century, most probably in the 1290s, the renowned Catalan physician published the *Aphorismi de gradibus* (Aphorisms on measurement by degree), a treatise in which he set out a new theory of compound medicines (Sect. 5.2.2) (Sanctorius 1625: 410; 1629a: 389; de Villanova et al. 1992: 81 f.).

It is not my intention to dwell at any length on the different uses of the aphoristic form by these doctors, nor to compare them with Sanctorius's aphorisms. For the moment, it is enough to note that Sanctorius was certainly familiar with the tradition of medical aphorisms. Even though he did not discuss, and indeed rarely mentioned, the aphoristic works of anyone but Hippocrates, he must have been acquainted with them, at least to some degree. A systematic historical study on the use and function of medical aphorisms would help to contextualize the *De statica medicina* within this historical framework and possibly provide more insight into Sanctorius's adoption of the form. This, however, lies beyond the scope of this study. But the foregoing demonstrates that Sanctorius's use of aphorisms was closely related to the practical nature of the knowledge he conveyed in the *De statica medicina*, and that the two were interdependent. It is worth remarking here, that the appreciation of aphorisms not only as historical curiosities, but also as tools of medical education, is currently undergoing a revival.[8]

In his introduction to the 2001 edition of the *De statica medicina*, Giuseppe Ongaro opened up yet another aspect of Sanctorius's use of aphorisms, when he argued that it gives the work the character of a *Regimen sanitatis* (Sanctorius and Ongaro 2001: 40). In the next section, I will give an overview of these medieval hygienic writings and explore to what extent they are echoed in the *De statica medicina*.

[8] David Levine and Alan Bleakley have proposed a novel framework for aphorisms tailored to contemporary medical education and practice. In this context, aphorisms serve as rules of thumb in practice and as memory aids in medical education. The authors argue that aphorisms aid clinical judgement, reinforce professional behavior, and educate for narrative sensibility, which means to understand medicine not simply in technical-rational terms, but for example, to also listen carefully to patients' stories. Moreover, they identify aphorisms as a site of the clinician's identity construction and suggest that aphorisms be included in fictional accounts of medicine, such as television shows based on medical themes, to educate the public. See: Levine and Bleakley 2012.

4.1.2 The Medieval Regimina sanitatis

The medical literary genre of *Regimina sanitatis* is concerned with individual hygiene and served to give practical advice on diet and a healthy lifestyle. As innumerable and often very diverse texts are subsumed under its heading, the genre is somewhat complex and must be seen in the broader context of contemporary practical medical texts and dietary writings. It originated in the course of the second half of the thirteenth century and reached the peak of its popularity and diffusion at the end of the Middle Ages. However, dietary writings, more broadly conceived, continued to be in vogue well into the Renaissance, with output in the period from 1450 to 1650 proving the most prolific, numerically. This was a consequence not only of the invention of the printing press, but also of factors such as more widespread literacy or the medicalization of society.[9] Only in the later seventeenth century did the publications on diet decrease dramatically in number, the demand for dietaries apparently having been saturated by then.

Coming back to the medieval rules of health, a similar evolution of the genre can be detected. Initially directed to wealthy individuals, such as members of the civil or ecclesiastical nobility, or royalty, during the fourteenth century these writings came to be extended to the population in general, especially to the new urban social groups, such as merchants, craftsmen, or professionals. With the new consumers, a relatively large market for the genre began to grow and the regimens, originally mostly written in Latin, were increasingly translated into, or even written directly in the various vernacular languages. What is more, a growing number of them was composed in verse, which not only helped memorization, but also assisted the spread of the *Regimina*. Even though most of these texts were structured along the lines of the six non-natural things, the chapter on food and drink was particularly prominent and eventually became an independent medical genre in its own right. As mentioned above, these dietary writings gained particular importance and were popular until the end of the seventeenth century.

The authors of the *Regimina sanitatis* ranged from respected university physicians to anonymous writers, probably obscure doctors of no particular renown, whose names added nothing to the prestige of the work and were thus often overlooked and then forgotten. Contrary to this, the so-called *university* regimens were frequently linked to the teaching activity of their authors, which is why they addressed a larger audience from the start, and tended to consider all of the possibilities of human life, as for example the different ages, or complexions. During the plague of 1348, university physicians also composed so-called plague *regimina* to address laymen, reinforcing thereby the expansion of the medical literary genre (Sect. 3.3.1). Usually, the university regimens were not structured according to the six non-natural things, but contained scholastic elements, in particular *quaestiones*. Mostly published in the first half of the fourteenth century, these works combined

[9] For an overview of the broader cultural and social changes in the Western Middle Ages and early Renaissance as reflected in the history of medicine, see: Siraisi 1990.

profundity of content with simplicity of form. In contrast, the anonymous regimens appeared only later and were often characterized by the absence of an organizational scheme, especially in the fifteenth century (García-Ballester 1992: 119–22; Sotres 1998: 300–14; Albala 2002: 25–46).

The *De statica medicina* and Salerno's Regimen With the six non-natural things as organizational criterion, the *De statica medicina* followed the tradition of the medical school of Salerno. Situated in southern Italy, it was one of the first medical schools in Europe after the fall of Rome, famous for the expertise of its practitioners and key to the establishment of a standard education in medicine. In this context, Constantine of Africa (d. 1087) translated Arabic medical works into Latin, which profoundly influenced medieval hygiene and dealt with the topic in terms of the six non-natural things (Sect. 3.1.1). And in fact, in the *De statica medicina*'s section on food and drink Sanctorius referred to the *Regimen sanitatis salernitanum* (Salernitan Guide to Health). He explained that if unusual weight, gained from drinking the night before, would not be removed the day after, neither by the digestive power, nor by corruption, the following two verses were advised: "If drinking wine at night harms you, drink it again in the morning, and it will be medicine for you" (Sanctorius 1614: 47r).[10] This is one of the rare occasions, when Sanctorius gave insight into his literary sources in the *De statica medicina*, even citing directly from another work.[11] What is more, it hints at the connection between the *De statica medicina* and the genre of *Regimina sanitatis*.

The *Regimen sanitatis salernitanum* was a medieval medical poem and one of the most popular food and health guides up to and throughout the Renaissance. Its exact origin is, however, unknown. Probably, it was written by several anonymous authors associated with the school of Salerno, mostly in the late thirteenth century. Composed in catchy verse, it referred to the six non-naturals, but was not clearly structured along their lines. Rather, it was a miscellaneous collection of dietetic knowledge, uncomplicated and, often, witty, to which new verses were added progressively over the years (Wear 1993: 1288; Jacquart 1996: 224; Albala 2002: 24). Without overestimating its influence on the *De statica medicina*—the Salernitan poem was so famous and widespread that it was presumably known to most doctors—Sanctorius's citation of it shows that he was familiar with the genre of *Regimina sanitatis* and that he considered the work a reliable source, apt to complement his observations with the weighing chair. The orientation toward individual

[10] "Si nocturna tibi noceat potatio vini. Hoc tu manè bibas iterum, & fuerit medicina." See: Sanctorius 1614: 47r.

[11] Apart from the citation of the *Regimen sanitatis salernitanum*, Sanctorius directly mentioned the Roman encyclopedist Celsus (first century CE) and Hippocrates in the aphorisms of the *De statica medicina* (ibid.: 39v, 81r–81v). Furthermore, there are several indirect references to characters in the works of Hippocrates and Galen as well as one reference to "the philosopher," by which Sanctorius probably meant Aristotle (ibid.: 52v, 65r, Sanctorius 1634: 15r, 17r–17v, 40v). For the identification of Sanctorius's sources, see: Sanctorius and Ongaro 2001: 81, 85, 117, 129, 139, 157, 179.

hygiene and the use of verses to profit from the memory aids offered by rhythm are characteristics that the static aphorisms share with Salerno's regimen.

Similarities to University Regimens In other respects, however, Sanctorius's treatise more resembles the university regimens. First of all, his use of Latin suggests that he addressed the work to an audience within the realm of the university, to his students and colleagues. Outside of this context, the *De statica medicina* was reserved to learned physicians, scholars, or other well-educated, Latin-literate persons. Moreover, the aphorisms were designed for a broader public, not tailored to an individual's needs. Still, age and gender were seldom addressed by Sanctorius and it seems that his work was for the most part directed at middle-aged men.[12] Likewise, the medieval rules of health often overlooked childhood and old age and were mainly geared to a male audience. The activities Sanctorius mentioned in the section on exercise and rest imply that he envisaged a wealthy readership, who had time and money enough to play ball, dance, or travel in a palanquin. This is also supported by the fact that the *De statica medicina* did not refer to exercise performed by manual laborers. Interestingly, though, mental exercise, studying, and its relation to the affections of the mind was mentioned. Thus, the assumption that Sanctorius wrote the *De statica medicina* for a scholarly audience is further confirmed (Sanctorius 1614: 83r–84r; Sotres 1998: 314; Albala 2002: 151).

In this context it is important to bear in mind that Sanctorius was himself a university professor, when he published the *De statica medicina*. This urges the question: Was there a connection to Sanctorius's teaching activities? According to his own testimony, during his professorship at the University of Padua, he continually lectured on his instruments and static experiments in public as well as in private lessons. Furthermore, already 2 years before the publication of the *De statica medicina*, Sanctorius mentioned that one of his instruments, the thermoscope, could be admired by anyone who came to his house in Padua, and that he showed it to his disciples and taught them its use. The same instrument could also be detected in one of the static aphorisms. It seems then, that there was a connection between Sanctorius's lectures and the *De statica medicina*. But the latter being a published text, it is difficult to say to what extent it actually reflects Sanctorius's original university teaching. Were the procedures that he used in teaching only demonstrative, or did the students actively take part in his investigations? How was the balance between these innovative elements and more traditional features in his lectures on medical *theoria*? The relatively small role which insensible perspiration, the weighing procedures, and quantitative physiological reasoning more generally play in Sanctorius's voluminous commentaries imply that these aspects formed only a small part of his teaching overall. However, as the proceedings of the German Nation of Artists report, foreign students went to the University of Padua primarily for practical training and not for the formal lectures on the subject. In this light,

[12] The aphorisms of the *De statica medicina* that deal with age can be found here: Sanctorius 1614: 8v–9r, 19r, 31r, 42r, 74r, Sanctorius 1634: 12v–13r, 15r, 17v, 18v, 40v. Four aphorisms mention women; see: Sanctorius 1614: 15v, 69r, Sanctorius 1634: 13r–13v, 28v.

Sanctorius's statement that his lectures were crowded suggests that instrumentation and experimentation, in the sense of repeated and controlled observations, were an integral part of his teaching. But can we trust his words given the quarrels he had with the German students and the mysterious circumstances under which his professorship ended? Without being able to clarify these questions at this point, I will resume their discussion below, when dealing more closely with Sanctorius's quantitative approach to physiology and the practical and material dimensions of his work (Sanctorius 1612b: 62, 105; 1614: 21r; 1625: Ad lectorem; Bylebyl 1979: 351 f.).

Two further factors relate the *De statica medicina* to the category of university regimens. On the one hand, Sanctorius's later inclusion of the plague aphorisms reminds the medieval plague *regimina*, written by university physicians. On the other hand, the combination of profundity of content with simplicity of form, characteristic of university regimen, applies to Sanctorius's treatise as well. Thus, besides the parallels to Salerno's regimen, the *De statica medicina* also bears strong similarities to university regimens.

Health Handbooks and the Prominence of Food and Drink The practical orientation of the *De statica medicina* and the lack of theoretical considerations associate the work not only with the medieval rules of health, but also with other contemporary practical medical texts, such as the *Tacuinum sanitatis*, or dietaries.[13] These works combine theoretical knowledge with knowledge gained from practice and observation. As a counterpart to scholarly tomes, their authors wanted to present medical knowledge in an abridged and concise way. Practical advice was the focus, not theoretical debate. This trend responded to a public eager for self-improvement. People became increasingly diet conscious and were interested in knowledge that would guide them to lead a healthy life. Accordingly, the *De statica medicina* centers around prevention rather than cure, even though Sanctorius occasionally referred to sick bodies, too (Sanctorius 1614: e.g., 11r, 19v, 55r–55v; 1634: e.g., 13v, 15r).

Following the prominence of food and drink in the *Regimen sanitatis* literature, this non-natural pair also takes up an important place in the static aphorisms. As the second largest section of the work, it is surpassed only by the first section, which deals with the weighing of insensible perspiration. It is striking that it was especially to those two sections that Sanctorius added aphorisms in later editions of the *De statica medicina*. Of the ninety-three additional aphorisms, the plague aphorisms excluded, forty-four belong to the first section and twenty-three to the third, that is, food and drink.[14] This may reflect Sanctorius's own research agenda and its results, an issue which will be scrutinized in later chapters. At the same time, however, it

[13] The *Tacuinum sanitatis* was a genre of richly illustrated guides to health that was popular in Western Europe in the late Middle Ages and addressed to a courtly audience. Like most of the *Regimina sanitatis*, the *Tacuinum sanitates*, too, was structured in line with the six non-natural things. For more information, see: Arano 1976, Bovey 2005.

[14] While Sanctorius highlighted most of the aphorisms "added by the author" to the 1634 edition of the *De statica medicina*, he overlooked to mark up two new aphorisms and one deletion, see: Sanctorius 1614: 34v–35r, 50r–50v, 84r, Sanctorius 1634: 31r, 43v, 68v.

may also have been a reaction to the needs of the readership. The great demand for health handbooks dealing with food may have prompted Sanctorius to not only republish the *De statica medicina*, but also to expand this topic, in order to increase sales of the work. This underlines the practical character of the work, as practical texts of the time were often revised for and by their users. Moreover, the many modifications of the *De statica medicina*—the added aphorisms, the section on plague, the response to the *Staticomastix* (Sect. 3.1, fn. 2)—illustrate the importance of the work for Sanctorius and imply that the work was discussed controversially at the time and that there was an audience thirsty for more. In contrast to the lengthy commentaries, the small book offered Sanctorius the opportunity to react quickly to external circumstances, be it the defense of his static doctrine, or the plague.

Concluding this chapter, it must be stressed that despite the many similarities between the medieval regimens of health and the *De statica medicina* there are also important differences: the focus on insensible perspiration, the related reinterpretation of the six non-natural things, and the quantitative approach to physiological processes. While one occasionally encounters the measurement of meals in the Renaissance dietary literature (Pontormo and Nigro 1988; Cornaro 1591; Lessius 1613), Sanctorius's observation of weight changes in human bodies by means of a steelyard was an absolute novelty. Just as the static aphorisms were a combination of old and new ideas, so, too, the form and style of the *De statica medicina* merged different characteristics of established genres of practical medical texts, such as the *Regimina sanitatis* and dietaries, and peppered them with a new element: the presentation of research results based on observation and quantification. It may have been exactly this mixture, which guaranteed the *De statica medicina*'s great fame and long-lasting popularity.

4.2 The Use of Instruments

The practical orientation of the *De statica medicina* is closely connected to Sanctorius's use of instruments, first and foremost the huge steelyard with which he intended to weigh insensible perspiration. But this was by no means the only instrument that Sanctorius proposed. The *Commentary on Avicenna*, the only work in which Sanctorius published the illustrations and explanations of his medical instruments, discloses a variety of devices that go far beyond the purpose of measuring *perspiratio insensibilis* (Fig. 4.1).[15] The book even has a special index of instruments which is so uncharacteristic of the genre as to differentiate Sanctorius's commentary from the entire previous tradition of commentary on Avicenna's *Canon*. In the preface to the work, Sanctorius explained that this was motivated by the fear of

[15] Sanctorius did refer to some of his instruments in other works, but neither explained them in detail nor illustrated them. Instead, he directed the reader to the *Commentary on Avicenna*, or to the *Book on Medical Instruments* (Liber de instrumentis medicis), which he probably never published (Sect. 2.6). See: Sanctorius 1603: 26v, 109r–109v, Sanctorius 1612b: 59, 62, 105, 136, 229, 374, Sanctorius 1614: 20v–21r, Sanctorius 1629a: 24, 137, 153, 164 f., 209, 326, 373 f., 378.

plagiarism. As was mentioned above (Sect. 2.3), he found out that some of his students were copying his instruments and claiming them as their own inventions. In response to this, he hurried to add illustrations of the instruments to his next publication, which were therefore, he apologized, in a rather rudimentary style. Originally, he had planned to publish elaborate illustrations and descriptions of all of his instruments in a separate book with the title *De instrumentis medicis*, but his teaching activity distracted him from finishing the work (Sect. 2.6). Sanctorius stated that he included in the *Commentary on Avicenna* solely those instruments pertaining to physiology—the subject matter of courses on theoretical medicine that were based on readings of Avicenna's *Canon* (Sanctorius 1625: Ad lectorem; Siraisi 1987: 181, 209).

The index of instruments contains thirty-four different items, which range from clysters and cupping glasses to a special sickbed, hygrometers, and thermoscopes (Sanctorius 1625: index instrumentorum). Most of them can be roughly summarized in the following categories: surgical instruments, measuring instruments, instruments for the improvement and alleviation of the sick, and instruments to demonstrate optical phenomena (Fig. 4.1). Thus, Sanctorius's development and use of instruments was not exclusively related to his doctrine of static medicine, but formed part of a larger effort—to improve therapeutics. The variety of the devices suggests a long and miscellaneous medical practice, during which Sanctorius gained experience in various medical fields, before striving to advance their practices with his instruments. In doing so, he may have followed the Galenic ideal of the medical man who provides theoretical and practical expertise in physic, surgery, and pharmacology (Nutton 1985: 80).

Existing studies on Sanctorius have tended to focus on the measuring instruments, among them the famous steelyard to weigh insensible perspiration.[16] Contrary to this, I will start my analysis of Sanctorius's use of instrumentation by exploring some of the lesser-known instruments and their relation to the physician's medical practice and teaching activities. Even though—or precisely because—these instruments were not part of the quantitative approach to physiology, studying them helps complement the picture of Sanctorius as a practicing physician. What is more, it allows the *De statica medicina* to be reviewed afresh within the broader practical context of Sanctorius's undertakings.

4.2.1 Surgical Instruments and Anatomy

In the *Commentary on Avicenna*, Sanctorius presented six instruments that I categorize as surgical instruments (Fig. 4.1). These are a syringe to extract bladder stones (Fig. 4.2), several trocars (Fig. 4.3), an uterus speculum (Fig. 4.4), a device for

[16] E.g., Mitchell 1892, Miessen 1940, Mulcahy 1997, Bigotti and Taylor 2017, Bigotti 2018, Hollerbach 2018. One exception is a monograph in Croatian by Mirko Grmek, in which the author also considered some of Sanctorius's surgical instruments and instruments for the improvement and alleviation of the sick. See: Grmek 1952: esp. 31–61.

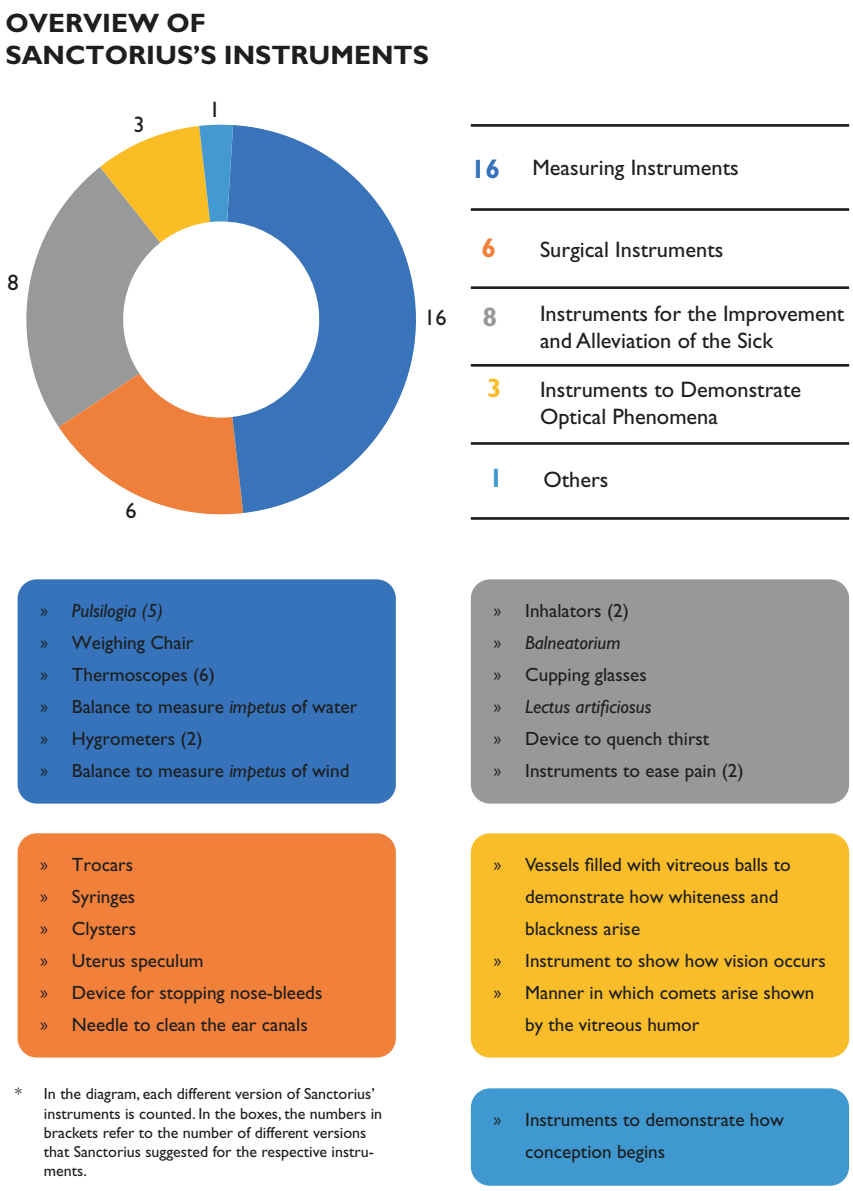

Fig. 4.1 Overview of Sanctorius's instruments

stopping nose-bleeds (Fig. 4.5), clysters (Fig. 4.6), and a special needle to remove cerumen from the ear canal (Fig. 4.7).[17] Of course, some of these instruments might

[17] The clyster on the right (Fig. 4.6) seems to be identical to the uterus speculum (Fig. 4.4) which is why I counted them as only one instrument in the circle diagram in Fig. 4.1.

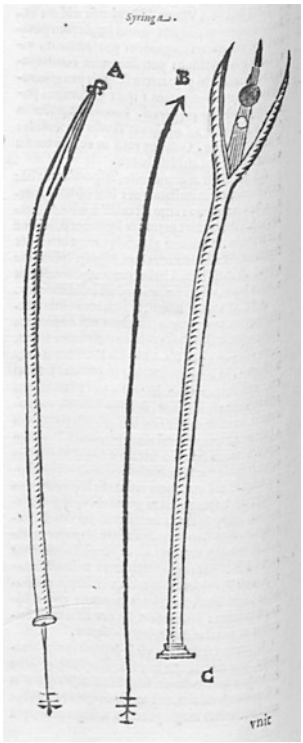

Fig. 4.2 A three-pointed syringe to extract bladder stones (Sanctorius 1625: 302). (© British Library Board 542.h.11, 302)

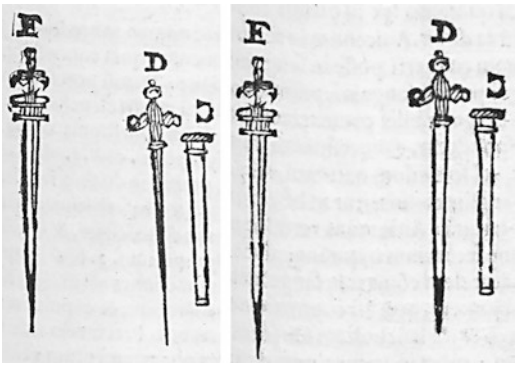

Fig. 4.3 Trocars used by Sanctorius to prevent suffocation and to draw off dropsical fluid through the navel (Sanctorius 1625: 363, 435). (© British Library Board 542.h.11, 363, 435)

Fig. 4.4 Uterus speculum to extract water from the uterus and to cure internal affections of the uterus (Sanctorius 1625: 435). (© British Library Board 542.h.11, 435)

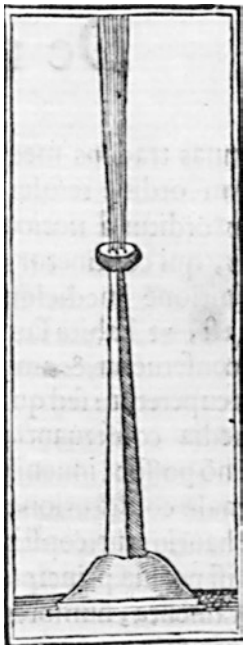

Fig. 4.5 A device for stopping nosebleeds (Sanctorius 1625: 596, 668). (© British Library Board 542.h.11, 596)

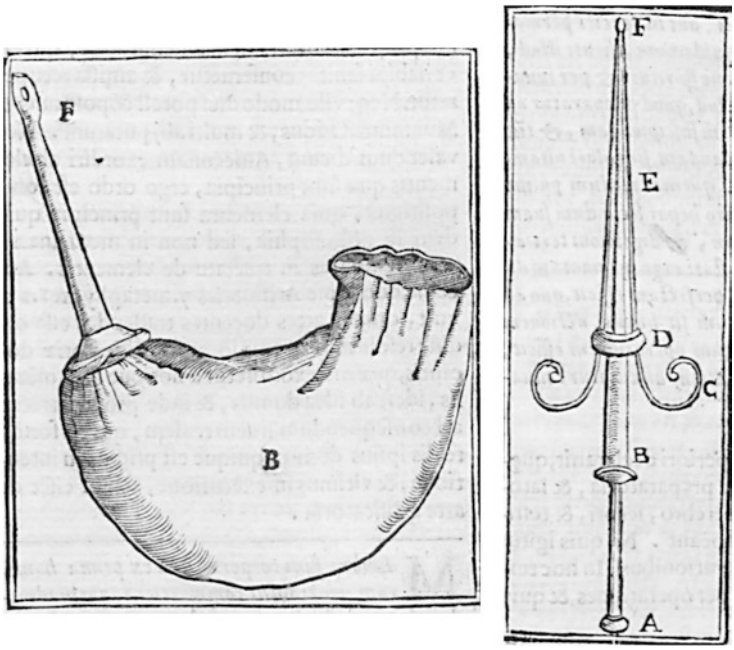

Fig. 4.6 Clysters (Sanctorius 1625: 596, 652). (© British Library Board 542.h.11, 596, 652)

have been used by physicians as well. However, with this classification I want to emphasize the role of "hands-on" medical practice and understand surgery as "the manual operations needed to restore health" (Grendler 2002: 322).

Thus, Sanctorius was clearly a medical man, who did not shy away from using his hands to perform operations himself. His expertise in surgery has already been mentioned (Sect. 2.6), and frequent references in his books to his surgical successes, along with the instruments, reinforce the impression that this field was an important part of his medical practice. In the description of one of his trocars, he wrote:

> But if there is no other remedy that helps infants and adults, who choke [because of excreta accumulated in the lungs], our perforation which is done below the larynx with instrument E revives the patient safely from immediate death to immediate health. If the choking matter is above the larynx, or above the perforation, … or in the lungs themselves, the perforation is useless. Instrument C is a perforated silver tube.[18] Instrument D is a pointed needle, which is inserted in instrument C … and this results in instrument E …. If we then want to perforate with this instrument, we have to ensure, first, that the patient leans the head backwards so that the trachea is distended. Then, after two, or three circles [probably fingers] beneath the larynx, we perforate the intermediate space of the circle. The following principle has to be followed, namely that as soon as the instrument begins to enter the cavity of the trachea, it needs to be immediately removed and the internal needle has to be separated from the tube, so that it does not sting the opposite part of the trachea. Done in this

[18] The letter C is printed inversely (Fig. 4.3).

Fig. 4.7 Instrument to clean the external ear canals (Sanctorius 1625: 764). (© British Library Board 542.h.11, 764)

> way, the tube is safely pushed inward. After that, inspiration and expiration freely occur through the perforated tube from which the needle has been removed, and all suffocation is prevented not only in angina, but in any similar affection (Sanctorius 1625: 363).[19]

Hence, Sanctorius gave his readers detailed information on how his trocar had to be used in order to prevent suffocation, without forgetting to explain how the patient should be positioned (Fig. 4.3). Interestingly, he did not describe how to hold down the patient, who must have squirmed with pain during the operation. Given the fact that the *Commentary on Avicenna* resulted from his teaching activity at the University of Padua, this begs the question to what extent these explanations reflect his courses on theoretical medicine. In Padua (as in other Italian universities),

[19] "Sed pro infantibus & adultis, qui suffocantur, si nullum aliud remedium iuvet, nostra perforatio facta infra laryngem cum instrumento E à subita morte ad subitam salutem tutò patientem revocat: dummodo materia suffocans sit à larynge supra, vel supra perforationem, quia si infra, vel in ipso pulmone existat vana redditur perforatio. Instrumentum C est fistula argentea perforata. Instrumentum D est acus mucronata, quae intromittitur in instrumentum C quo tamen acus longior est, & intromissa sit instrumentum E, quod cum illo sit ita unitum, ut tactui nulla occurrat asperitas: imo instrumentum E unum continuum, & non duo esse videntur. Dum igitur volumus dicto instrumento perforare, prius curamus, ut patientes inclinent caput retrorsum, hoc fine, ut aspera arteria distendatur: deinde sub larynge post duos, vel tres circulos, circuli intermedium perforamus: hac lege servata quod dum incipit instrumentum ingredi cavitatem tracheae statim retrahatur, & auferatur ab ipsa fistula acus interna, ne pungat partem oppositam tracheae: quo peracto fistula tutò intimius impellitur: inde per fistulam perforatam acu ablata, libera sit inspiratio, & expiratio, omninoque prohibetur suffocatio non solum in angina suffocante, sed in quocumque simili affectu: …". See: Sanctorius 1625: 363.

surgery was taught as a separate subject along with theoretical and practical medicine. However, surgery had been the least important medical university chair and grew in importance only in the sixteenth century, when it was combined with anatomy. But from this time on, anatomy began to oust surgery and grew increasingly distinct, until the two chairs were separated in the second half of the seventeenth century. One can imagine the surprise of Sanctorius's students, who expected to hear lectures on *theoria* but were instead confronted with explanations and maybe also demonstrations of surgical operations—a medical field which was neither prestigious nor popular within the university context (Facciolati 1757: 385–98; Grendler 2002: 322–34).

Still, there is also another side to this issue. Medical historians have argued that the contrast between surgeons and physicians was not as great as has often been suggested. Especially in Italy, where academic training was available for surgeons, a graduate with a degree in surgery would have much in common with a learned physician. He might have had the same lecturers and studied similar texts as the medical student proper. Moreover, students of surgery also took courses in other branches of medicine, and it is thus possible that among Sanctorius's audience were prospective surgeons, probably attracted by his novel method of teaching *theoria*. The outstanding importance that anatomy enjoyed at the time paired with an interest in practical training on the part of the students, might also explain why students were intrigued to learn more about the use of trocars, or clysters. The fact that Sanctorius was named as *promotore* by a doctoral candidate for his examination in surgery suggests that Sanctorius's expertise in this field was known to students, either through their own attendance at his lectures, through his reputation as a practicing physician, or through his *Commentary on Avicenna*, which was already published by then (Sect. 2.6). One of Sanctorius's students, Johan van Beverwijck, recalled in 1633 that he continually followed "his most famous doctor Sanctorius" on visits to the sick in Padua (Beverovicius 1638: 216); this, in the context of a discussion on the causes of kidney stones that is included in Beverwijck's work *De calculo renum & vesicae* (On kidney and bladder stones), which also contains a *consilium* (piece of advice) from Sanctorius on removing bladder stones.[20] It therefore seems highly likely that Sanctorius took his students outside the classroom and let them attend his medical practice, including surgical procedures, such as lithotomy (Sect. 2.6).

Teaching anatomy, rather than surgery, became increasingly important, as it was mostly anatomical research, which enabled professors to make new discoveries. However, as Vivian Nutton has pointed out, in the sixteenth century there was "humanist surgery," too, that is, surgery based on classical texts, which could lead to practical as well as intellectual benefits. Thus, also surgeons laid claim to successful innovation, from time to time, especially with regard to the invention of surgical procedures and instruments, control of pain, and wound management. Yet,

[20] "Quae mihi in memoriam revocarunt clarissimi Doctoris mei Sanctorii, quem Patavii olim ad aegros sectatus sum, …". See: Beverovicius 1638: 216.

it is difficult to say whether these were merely variations on techniques and instruments described in textbooks, let alone whether they substantially improved surgical procedures and their outcome (Nutton 1985: 75–87). With regard to Sanctorius, it is not my intention to investigate his claims to novelty and success in surgery, nor to discuss his surgical instrumentation and its practical application at any length.[21] But it is important to note that by highlighting the originality of his surgical instruments and techniques, Sanctorius might have aroused the interest of medical students who were not aiming for a degree in surgery. At a time when anatomical studies were flourishing, one can easily imagine that new approaches to dangerous operations such as the tracheotomy in children attracted attention. These, together with his other instruments, may well have lent his lectures an aura of novelty.

Whatever the reactions of the students may have been, Sanctorius's inclusion of surgical instrumentation in his *Commentary on Avicenna* shows that he considered surgical training important for aspiring physicians and wanted to share his experience in this field. To what extent this reflects his own interests, or educational purposes is difficult to say. In any case, the descriptions and illustrations of his instruments are closely connected to the passages of text and commentary in which they appear. The implication—given that the first part of the first book of Avicenna's *Canon* that Sanctorius commented on was used as a medical physiology textbook on courses in theoretical medicine—is that Sanctorius believed that surgical therapeutics might well be integrated into physiological theory (Siraisi 1987: 10, 210).

Leaving Sanctorius's teaching activities aside, for a moment, and focusing on him as a practicing physician, it was not uncommon in Italy for university-trained doctors to practice surgery. In fact, a physician skilled in surgery was often held in high regard. According to Richard Palmer, physicians and surgeons cooperated freely in Venice, and certain doctors were members, at separate times, of both medical colleges: the College of Surgeons of Venice and the College of Physicians of Venice.[22] However, while physicians were allowed to practice surgery, surgeons could certainly not practice medicine. This was prohibited by the statutes of the colleges and by civic law. Moreover, the salaries of surgeons were generally lower than those of physicians. In contrast, doctors in charge of the plague were usually surgeons, since the treatment of the disease was regarded as a primarily surgical operation. Still, despite these differences, there was a close relationship between the two branches of the profession in daily medical practice in Venice (Palmer 1979: 451–60).

Sanctorius's works show that he regarded this with a certain ambivalence. On the one hand, he frequently denounced errors committed by surgeons, or mentioned their inexperience. He contrasted this with his own surgical experience and the presentation of his instruments. Furthermore, his involvement in the treatment of the plague suggests that he was known and trusted for his surgical experience. Despite

[21] Pietro Castagna and Mirko Grmek ascribed the invention of the trocar to Sanctorius. See: Castagna 1951, Grmek 1952: 53–6.

[22] I refer here to collegiate surgeons, who were distinct from the guild of barber-surgeons and formed a professional elite in Venice (Palmer 1979: 456).

his previous denial of the existence of the disease in Venice (Sect. 2.7), he was assigned the care of a Venetian district—the *Sestiero di Cannaregio*. On the other hand, Sanctorius never explicitly referred to himself as a surgeon and was not a member of the *College of Surgeons of Venice*. In the *Commentary on Galen,* he explained how he had examined a corpse, while leaving the cutting to a surgeon. Thus, it is somewhat unclear to what extent Sanctorius was willing to get his hands bloodied and how often he asked for the assistance of a surgeon. In my opinion, Sanctorius saw himself as a physician, who fulfilled the Galenic ideal of the unity of medical knowledge (in physic, surgery, and pharmacology) according to which a medical man used his head and his hands alike, to carry out complicated and difficult tasks in all medical fields. Certainly, the higher social standing of physicians compared to surgeons may have made Sanctorius hesitate to refer to himself as a surgeon. From his publications, it is clear that Sanctorius had surgical experience and conducted surgical operations. But it remains unclear how much he was assisted by other surgeons, even though his frequent complaints about incompetent surgeons imply that he was constantly in touch with members of this profession (Sanctorius 1603: 37v–38r; 1612b: 220, 237, 335; 1625: 12 f., 36; ASVe-a (n.d.): 60r–61v).

All in all, Sanctorius's interest and experience in surgery was not uncommon at the time, for a university-trained physician in Italy. But his development of surgical instruments and their presentation in a university textbook on theoretical medicine was a new departure.

Anatomy The close connection between surgery and anatomy was already mentioned above. In his publications, Sanctorius stated that surgeons needed to have anatomical knowledge to properly carry out their work. Anatomists, on their part, needed to have skills in surgery.[23] In this context, Sanctorius mentioned an error made by famous anatomists regarding the surgical operation of lithotomy. He wrote:

> … Colombo slipped [into error] in the fifth book of his anatomy in Chapter 26, when dealing with the position of the muscles of the neck of the bladder. [In this book] he holds that a lithotomist, who has no knowledge of the bladder, sometimes cuts the muscle of the neck transversely, whereupon a new disease is introduced; for (as he says), the muscle having been cut, the urine can no longer be contained. Because this opinion was held by the most educated anatomists, I am ashamed to refute it. But if Colombo had ever observed a lithotomist's incision, he would have changed his opinion. There is no risk of the bladder neck being cut, in that case, as it lies at a distance of around half the span of a hand from the lithotomist's incision. Moreover, this latter wound [the incision] arrives only at the tube through which the urine is released. And it cannot penetrate any deeper since it is impeded by a syringe inserted beforehand by the lithotomist. Since Colombo never observed this, it is no surprise that he made an inexcusable error (Sanctorius 1612a: 662 f.).[24]

[23] Contrary to Sanctorius's emphasis on the importance of anatomical studies for surgeons, there were also attempts by Venetian surgeons in the late sixteenth century to distinguish learned surgery from anatomy. As Cynthia Klestinec has shown, anatomy had become a conflicted resource by then (Klestinec 2016).

[24] "… sicuti lapsus est Columbus lib. 5. suae anatomiae cap. 26. agens de musculi colli vesicae situ, ubi habet haec aliquando a Lithocomo, qui scitum vesicae ignorat, musculum cervicis transversim incidi, & inde novum morbum induci, quoniam dicit secto hoc musculo urinam non amplius posse contineri, quam sententiam licet fuerit Anatomici eruditissimi, pudet me refellere: quia si semel

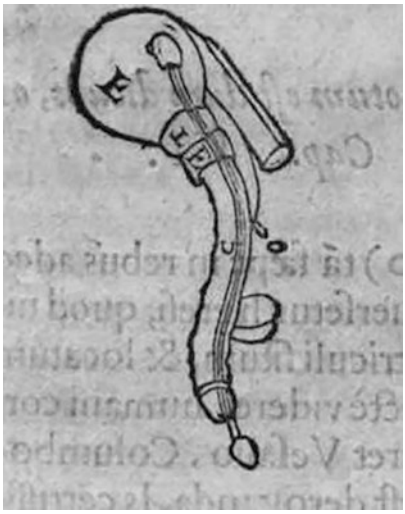

Fig. 4.8 Illustration of the bladder neck, indicating the point at which the lithotomist made an incision in order to extract a bladder stone (Sanctorius 1603: 65v). (Bayerische Staatsbibliothek München, 2 Med.g.149, p. 65v, urn: nbn:de:bvb:12-bsb10942689–8)

Hence, according to Sanctorius, the famous anatomist and surgeon Realdo Colombo (ca. 1516–1559), who succeeded Andreas Vesalius (1514–1564) as professor of surgery at the University of Padua in 1543, had never observed the work of a lithotomist, nor performed a lithotomy himself. Without discussing whether the criticism was legitimate, the citation shows that Sanctorius was of the opinion that even the most learned anatomists could learn something from lithotomists, medical practitioners who were often itinerant and probably had never entered a university. According to him, thus, surgical techniques were closely related to anatomical knowledge and only a combined expertise in both fields enabled the doctor to fulfill his duties, even though this meant leaving the universities' anatomical theatres and lecterns to become acquainted with the daily work of medical practitioners. To his first work *Methodi vitandorum errorum*, Sanctorius even added a figure (Fig. 4.8) that shows the bladder neck (E) and the point at which the lithotomist made his incision (o) (Sanctorius 1603: 65v; 1625: 12 f.; Colombero 1982).

Sanctorius's strong interest and expertise in lithotomy has already become apparent, in view of the fact that he composed a *consilium* on this surgical operation and presented a special syringe to extract bladder stones in the *Commentary on Avicenna* (Fig. 4.2, Sect. 2.6). This might well be connected to his medical practice, as in the Renaissance, many people suffered from stone in the bladder. How often Sanctorius actually performed a lithotomy, which involved a high level of risk, and how often he made use of his syringe is not known. In any case, he was familiar with the work of lithotomists and did not shy away from learning their skills. His inclusion of a figure that illustrates the sections of the bladder in relation to a male genital organ

Columbus inspexisset Lithotomum seccantem, mutasset sententiam: quia collum vesicae incidi non potest, cum distet à vulnere Lithotomi dimidij palmi interstitio circiter. Praeterea illud vulnur vulnus solum pervenit ad fistulam, qua defertur lotium: neque ultra penetrare potest: quia impeditur à syringa prius à Lithotomo immissa: quod cum non viderit Columbus non est mirum, si in errorem inexcusabilem inciderit." See: Sanctorius 1612a: 662 f.

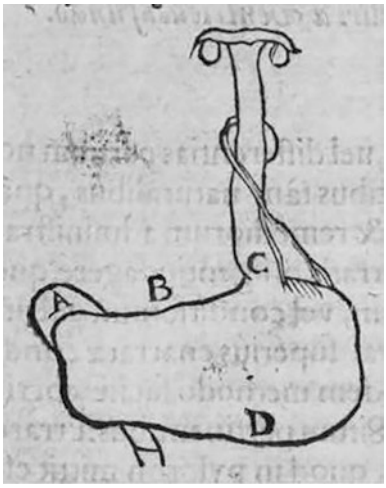

Fig. 4.9 Illustration of the stomach (Sanctorius 1603: 64v)

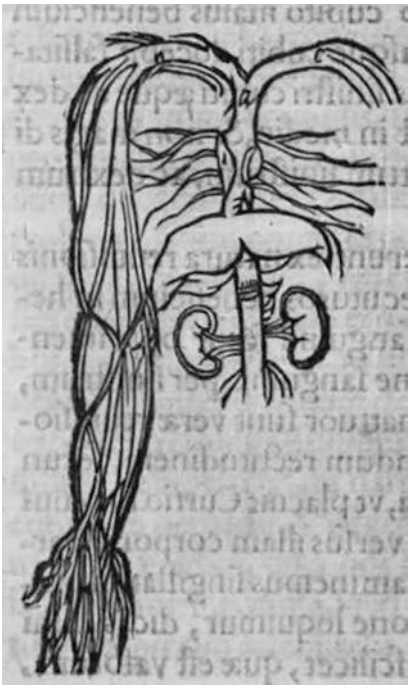

Fig. 4.10 Illustration of the veins of the arms, indicating their relation to the liver (Sanctorius 1603: 76r). (Bayerische Staatsbibliothek München, 2 Med.g.149, pp. 64v, 76r, urn: nbn:de:bvb:12-bsb10942689–8)

highlights his firm belief that anatomy and surgery were closely intertwined. Even though it is only a very rough illustration, it hints at Sanctorius's own anatomical experience—together with two other figures in the *Methodi vitandorum errorum*, one of the stomach and the other of the veins of the arms and their relation to the liver (Figs. 4.9 and 4.10) (Sanctorius 1603: 64v, 65v, 76r).

The illustration and discussion of the stomach (Fig. 4.9) is particularly interesting, because Sanctorius mentioned here an anatomical error made by Galen: the Greek physician had maintained that the pylorus was at the bottom of the stomach. But experience contradicted this, so Sanctorius, since one could observe in human cadavers that the pylorus was on the right-hand side of the stomach, nearly the span of a hand away from the bottom of the stomach.[25] And if, as Galen had thought, the pylorus was at the bottom of the stomach, its contents would easily spill out, Sanctorius continued. He concluded:

> We show in the figure of the stomach [Fig. 4.9] that things behave this way, as was observed by Vesalius and by other anatomists of our time. Is it not obvious to the senses that where A is, is the beginning of the pylorus? And is the position of D, which is the bottom part of the stomach, not distant from A? Thus, Galen saw in apes and dogs that the beginning of the pylorus was at the bottom [of the stomach] and believed that in the same was true of humans, too (Sanctorius 1603: 64v).[26]

The citation makes clear that Sanctorius accepted the achievement of Renaissance anatomists and agreed that they had successfully contradicted Galen. Perusal of Sanctorius's works reveals that this is not the only passage, in which he refuted Galen on anatomical matters. On the question as to whether the cerebellum or the cerebrum was harder, Sanctorius again followed "proper inspection" and the opinion of "Vesalius, Colombo, and many others" and held that the cerebellum was not harder than the cerebrum, which was contrary to Galen's teaching. According to Sanctorius, this error had resulted in further mistakes, such as the assumption that the nerves originated in the cerebellum, whereas they actually originate in the cerebrum. Other instances of Sanctorius contradicting Galen concern the position of the stomach and the kidneys, to name but two examples (Sanctorius 1603: 70v; 1612a: 279; 1612b: 144, 231; 1625: 331 f.).[27]

But, as was common among Galenic physicians and anatomists at the time, Sanctorius excused Galen's mistakes by pointing out his limited access to human cadavers. According to him, Galen had observed only two corpses in his lifetime, and imperfect (i.e., damaged) ones at that. What is more, in contradicting Galen, Sanctorius actually believed himself to be following one of the Greek physician's own important precepts, namely: "rather, those are imprudent, who put more faith

[25] In the illustration, the pylorus is marked on the left part of the stomach (instead of on the right) with the letter A. I think this is an error due to the inversion of the illustration for printing, even though the letters are illustrated correctly. In fact, this suggests that the letters were not part of the woodcut, but were printed separately. Another possible reason for the error might have been negligence on the part of the woodcutter, whose identity is not known to me and might therefore even have been Sanctorius himself.

[26] "Quod igitur ita se res habeat, ventriculi figuram observatam à Vesalio, & a caeteris anatomicis nostri temporis proponamus, an ne sensu patet ubi est a, ibi esse pylori exordium? an ne locus ubi est d, distat ab a, quod est ima ventriculi pars? videns igitur Galenus in simijs, & canibus esse pylori initium in fundo, credidit in eodem situ, esse quoque in hominibus." See: Sanctorius 1603: 64v.

[27] For another important instance, in which Sanctorius accepted recent anatomical findings and refuted Galen, see below, Sect. 4.2.3.

in authorities than in experience and reason" (Sanctorius 1603: 74v).[28] Thus, according to Sanctorius, the anatomists and he himself were following the teachings of Galen in trusting more to observation than to Galen's authority. It was in the Galenic spirit that they refuted Galen. In his *Methodi vitandorum errorum*, Sanctorius even complained that scholars at many European universities currently believed more in Aristotle, Galen, and Hippocrates than in what their own senses told them. Interestingly, Sanctorius still greatly relied, nonetheless, on established authorities in anatomical matters, as a look at his commentaries shows. Here, for example, his defense of the Galenic notion that the veins and, consequently, the heat of the blood originated in the liver and not in the heart paints an entirely different picture. Sanctorius referred to the problem in the traditional form, as a dispute between the philosophers and the physicians.[29] To support his view, he drew not on anatomical observations, but on the established authority of Hippocrates and Galen (Sanctorius 1603: 74r–74v; 1612a: 429; 1612b: 144, 231).

Hence, Sanctorius's criticism of trusting more in authority than in one's own senses can be turned against himself. Apparently, his willingness to accept very recent anatomical findings was limited to topics that did not touch upon the major traditional matters of controversy between Aristotelians and Galenists. As Nancy Siraisi has pointed out, Sanctorius, when arguing in his *Commentary on Avicenna* against the Aristotelian view of the primacy of the heart, relied almost exclusively on texts by Galen. Even with regard to experience (*experimenta*), he referred to Galen, explaining, for example, that, since a tortoise whose heart has been removed is still able to walk, movement and the senses must originate in the brain and not in the heart. A similar passage can be found also in Sanctorius's *Commentary on Galen* (Sanctorius 1612a: 251–5; 1625: 627–33; Siraisi 1987: 323 f.).[30]

The topic of *spiritus* is likewise connected to the issue of the anatomy and function of the heart and the brain. As was mentioned above (Sect. 3.2.6), the heart and the brain were the organs in which the spirits were generated, according to Galenic physiology, and the spirits were responsible for sensation, voluntary motion, and the heating of the body. In the sixteenth century, however, the anatomist Giacomo Berengario da Carpi (ca. 1460–ca. 1530) and shortly after him, Vesalius denied the existence of the retiform plexus (*rete mirabile*) in the brain, where the animal spirits were thought to be prepared. Even though both anatomists argued that it could not be observed in the human brain, Sanctorius held that the retiform plexus is

[28] "… illos potius, qui magis credunt auctoribus, quam experientiae, & rationibus, esse temerarios: …". See: Sanctorius 1603: 74v.

[29] Galen had differed from Aristotle on some basic issues, such as the seat and division of the soul, the relative functions of the brain, heart, and liver, as well as male and female seed. Here, Galen's authority conflicted with Aristotle's authority, which fueled a dispute between their respective followers. Generally, philosophers inclined toward their authority, Aristotle, and physicians toward theirs, Galen, even though there were many philosopher-physicians, who tried to find a compromise between the two (Temkin 1973: 73).

[30] On the role of authoritative argument as a form of knowledge in Renaissance medicine, see: Maclean 2002: 191 ff.

conspicuous. How he came to this conclusion, iscompletely unclear, however. With regard to the vital spirits, Sanctorius also followed the traditional theory, according to which blood passed from the right ventricle of the heart through pores in the septum to the left ventricle, where it, when mixed with inhaled air, served to generate vital spirits. Even though anatomists like Vesalius and Colombo denied the existence of the pores in the interventricular septum, Sanctorius claimed that he had personally been able to observe these pores in dissection, although he assumed that they must be more open in living bodies than in corpses (Sanctorius 1612a: 260; 1625: 746; 1629a: 363; Siegel 1968: 68, 70) (Sect. 3.2.6, fn. 34).[31]

Thus, Sanctorius endorsed recent anatomical findings only as long as they could be accommodated within Galenic theory. Any new material that did not fit within a Galenic framework was not integrated into his own work. When he observed human cadavers himself, he seems to have worn Galenic lenses, so to speak, through which he could detect the retiform plexus and the pores in the septum. Or, he might have actually relied on others' observations, of instead of his own, without mentioning it. In fact, Sanctorius's ambiguous attitude toward firsthand observation and his ongoing reliance on authority with regard to medical theory was typical for university-trained physicians and anatomists at the time. Original findings from observation were often not carried over into theory and Galenic medicine was still regarded as a reliable framework into which any novel observations should be integrated (Wear 1981: 233–53).

Regarding Sanctorius's own anatomical experience, it can be assumed that he observed and anatomized human and animal cadavers himself. In the *De remediorum inventione*, Sanctorius wrote for example that he had opened the body of several persons killed by malignant fever and thereby discovered in their liver a small, entirely blackish gangrene. In the *Commentary on Avicenna*, he described how he had observed the brain of a lamb, which was tepid, not cold, to the touch. Moreover, Sanctorius mentioned that he reproduced anatomical procedures previously conducted by others. In the *Commentary on Galen*, he referred to a dissection around 1611 by a certain Aloysius Regocia (life dates unknown), who removed the bowels from a cadaver to show that a clyster cannot pass through the upper parts of the intestine because of the valves between the colon and the cecum. In a later passage of his commentary, Sanctorius claimed to have performed the same demonstration himself, several times. Without going into the details of the procedure, it is interesting to note that it bears similarities to an anatomical demonstration of the ileocecal valve by Caspar Bauhin (1560–1624). The physician from Basel was the first to describe this valve in detail, and published his findings in the treatise *De corporis humani partibus externis* (On the External Human Body Parts, 1588). Even though Sanctorius did not mention Bauhin in his works, it can be assumed that by the time Aloysius Regocia performed his dissection, word of the discovery of the ileocecal valve had already been spread in Venetian–Paduan medical circles, just like Bauhin's

[31] Consequently, Sanctorius also refuted Realdo Colombo's hypothesis that blood passed from one side of the heart to the other via the lungs. For more instances of Sanctorius's defense of Galenic ideas against the work of sixteenth-century anatomists, see: Siraisi 1987: 309–44.

anatomical demonstration of it. Thus, Sanctorius was actively engaged in dissections that referenced recent developments in the field of anatomy (Sanctorius 1612b: 196 f., 293; 1625: 318; 1629b: 70; Stolberg 2010: 9 f.).

Sanctorius's mention of the anatomical demonstration by Aloysius Regocia is interesting also for another reason. Apparently, Sir Henry Wotton (1568–1639), the English ambassador to Venice, was present. Sanctorius wrote that with him there were also "other very distinguished barons, to whose pleasure I held a broad discourse on anatomy's hidden secrets" (Sanctorius 1612b: 197).[32] Hence, Sanctorius attended public anatomical dissections, which were conducted within the most illustrious circles of the Republic of Venice. In fact, Sir Henry Wotton was closely associated with Paolo Sarpi and supported him in defending the Republic of Venice in its diplomatic quarrel with the Papal Curia at the beginning of the seventeenth century.[33] As was mentioned earlier, Sanctorius was a close friend of Sarpi and also involved in a dispute with the Church regarding his presidency of the *Collegio Veneto*—the first institution to confer doctorates without ecclesiastical intervention (Sect. 2.4). Accordingly, Sanctorius discussed recent anatomical findings not only in the university context, with students and colleagues, but also in the highest political and diplomatic circles of the Venetian Republic, whose members were critical of the Church and the Pope (Wootton 1983: 93 f.).

Besides the anatomical procedures that Sanctorius claimed to have conducted, he also attended the annual public anatomies in Venice. In the *De remediorum inventione*, he praised Ioannes Baptista Doleonius (life dates unknown), the physician who was elected by the Venetian College of Physicians to lecture on anatomy in 1629, for his accuracy and conciseness. It should be recalled here that Sanctorius, too, had been proposed as a lecturer in public anatomy, in 1613, but had refused (Sect. 2.6) (Sanctorius 1629b: 35).

The preceding paragraphs have shown that Sanctorius considered anatomy as very important for the physician. In the opening section of the *Commentary on Avicenna*, he even included a defense of the place of anatomical studies in medicine and asked: "Should anatomy pertain to the physician?" (Sanctorius 1625: 101 ff.).[34] At a time when anatomy was an integral part of the medical university curriculum, this question seems somewhat obsolete. Still, Sanctorius obviously found it necessary to stress that anatomy was not based on the senses alone, but involved reasoning (*ratiocinium*), too, which did not mean, however, that anatomy properly belonged only to natural philosophy. According to Sanctorius, the physician had to use his hands and his head in anatomical studies. He did not go so far as to call anatomy a science on the grounds that the anatomist performed mental activities, but he claimed in the *Commentary on Galen* that the *medicus anatomicus* often

[32] "… & alij percelebres Barones in cuius gratiam ego fusa oratione de anatomiae arcanis sermocinabar: …". See: Sanctorius 1612b: 197.

[33] For more information on Paolo Sarpi's role in the Venetian Interdict, see: Cozzi and Cozzi 1984: 47–52.

[34] "Quaest. XV. An anatomia pertineat ad Medicum." See: Sanctorius 1625: 101 ff.

obtained mathematical certainty in his inquiry into diseases and causes.[35] It will be shown later, how this understanding of anatomy fit into Sanctorius's general concept of medical knowledge and his answer to the traditional question, as to whether medicine is an art or a science (Sect. 6.2) (Sanctorius 1612a: 736).[36]

While the presentation of surgical instruments and techniques on university courses in theoretical medicine was highly unusual, the inclusion of anatomy was not. In fact, physiology, an important subject matter of *theoria*, went hand in hand with anatomy, as physiological theory usually took its sensory information from anatomy. Textbooks like Avicenna's *Canon* dealt with topics for which anatomical considerations were highly relevant, such as the parts of the body, humors, or spirits. Accordingly, professors of theoretical medicine and their students could not remain indifferent to anatomical work. Still, it was of course not the responsibility of professors of theoretical medicine to give detailed lectures on anatomy or to conduct anatomical demonstrations. Thus, their willingness to integrate anatomical considerations into their teaching was determined by individual interests and competences, which in turn depended on past careers and the anatomical training they had received in their own student days. Moreover, teaching by means of commentary on classical textbooks meant that the appeals to anatomical experience were often limited to those aspects perceived to have some bearing on the standard topics of physiological debate (Siraisi 1987: 324–33; Cunningham 2003: 52).

Striking, in this context, is Sanctorius's emphasis on the importance of anatomy for medicine and his broad knowledge of ancient as well as contemporary anatomical work. Besides Vesalius and Colombo, he referred to numerous other sixteenth-century anatomists, among them André du Laurens (1558–1609), Gabriele Falloppia (1523–1562), Laurent Joubert (1529–1582), Leonardo Botallo (1530–1587) and Bartolomeo Eustachi (ca. 1500–1574).[37] Hence, Sanctorius's students could learn about the views of modern anatomical and physiological writers on a variety of topics, even if they also learnt that most of these authors were often wrong. But according to Sanctorius, reading books was not enough. In the *Commentary on Galen*, he

[35] Based on the authority of Aristotle, who presented mathematics as the demonstrative science par excellence in his work *Analytica posteriora* (Posterior Analytics, ca. 350 BCE), and of Averroes—as well as of all their Greek and Latin interpreters—mathematics was generally considered a certain science. However, in the second half of the sixteenth century, a dispute arose over the question of the causes and foundation of this certainty and the way in which it was interpreted (De Pace 1993: 9). For more information on this debate, see: ibid.

[36] Nancy Siraisi has written that Sanctorius defended in this *quaestio* "the standing of anatomy as a science" (Siraisi 1987: 327). I think this is misleading, as Sanctorius did not use the term *scientia* here, but rather referred to *ratiocinium* (reasoning), when explaining why anatomy pertained to the physician. Moreover, as will be shown below (Sect. 6.2), Sanctorius conceived of medicine not as a science (*scientia*), but as an art (*ars*), albeit one that could approximate, if not attain, certainty. This implies that anatomy, according to Sanctorius, likewise ranked among the *artes* (ibid.: 236 ff.).

[37] For references to these anatomists in Sanctorius's published works, see e.g., Sanctorius 1612a: 204, 260, 281, 286, 465, 528, 556, 565, 706, Sanctorius 1612b: 148, 200, 237–40, 302, Sanctorius 1625: 102, 615, 672, 746, 764, 799, Sanctorius 1629a: 342, Sanctorius 1629b: 158.

stated that it did not suffice to know the works of Galen and of modern anatomists; practice in the dissection of bodies was necessary, too. "One learns more in one day from this exercise, than from studying anatomy for years, without direct observation" (Sanctorius 1612b: 366), so Sanctorius.[38] Thus, he encouraged his students not only to attend lectures, but also to conduct dissections themselves, in line with his belief that anatomy is based on reasoned argument as well as on the senses.

We can therefore conclude that Sanctorius was very interested in physiological-anatomical problems, but usually defended the traditional Galenic assertions on anatomical points. As Nancy Siraisi has pointed out, Sanctorius "was indeed capable of writing on occasion as if 'Galen and anatomy' were almost interchangeable terms" (Siraisi 1987: 336). Even though he strongly emphasized the importance of the evidence of the senses, he frequently returned to authoritative positions, especially on matters of theory. Anatomical considerations appeared alongside other kinds of argument, and were not necessarily the most convincing form of evidence, per Sanctorius. Yet, anatomy was a medical field, in which he explicitly contradicted Galen, without, however, contesting the underlying Galenic framework. While this treatment of anatomy is fairly characteristic of the ways in which contemporary learned physicians responded to the new developments in this medical field, what stands out is that Sanctorius decidedly brought anatomy into the context of medical practice. In his lectures on theoretical medicine, he repeatedly appealed to his own anatomical experience and prompted his students to conduct dissections themselves. What is more, he demanded that anatomists and surgeons should directly pool their experience, given the strong correlations between anatomical knowledge and practical surgical skills. It remains unclear whether Sanctorius's reproductions of anatomical demonstrations found their way into the classroom, but alone the fact that a teacher on medical *theoria* referred to his personal experience of dissection can be considered unusual.

4.2.2 Instruments for the Improvement and Alleviation of the Sick

The devices, which I categorize as instruments for the improvement and alleviation of the sick, are two inhalators (Fig. 4.11), a mobile bath (Fig. 4.12), a perforated ball to quench the thirst of fever patients (Fig. 4.13), cupping glasses (Fig. 4.14), a hanging bed (Fig. 4.15) and two instruments to ease pain (Figs. 4.1 and 4.16). As this list suggests, the devices served multiple purposes, but were all used for dietetic-therapeutic measures. Some of them helped Sanctorius manage his patients' involvement with the six non-natural things. The inhalators, for instance, produced vapors that warmed, cooled, moistened, or dried the air, excited sleep, or were filled with remedies against certain diseases such as phthisis. They allowed Sanctorius to

[38] "… magis nam unica die in hoc exercitio addiscet, quam si anni spatio sine inspectione studeret anatomiae." See: Sanctorius 1612b: 366.

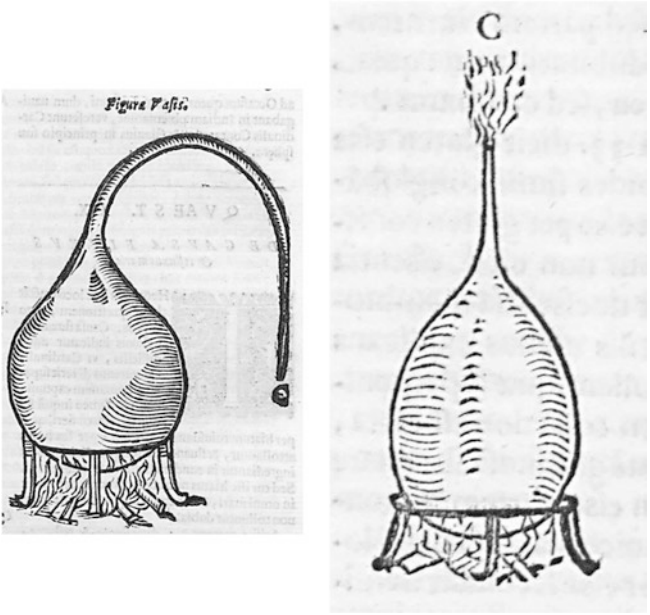

Fig. 4.11 Two inhalators to change the air (Sanctorius 1625: 129, 406). (© British Library Board 542.h.11, 129, 406)

artificially change the qualities of (i.e., condition) the air in a room, according to his patients' needs. The *balneatorium*, a mobile bath, served as a corrective for people with an overly dry complexion, such as occurred in hectical fevers. If different substances were added to the water, it could be used also to treat other afflictions. The hanging bed was supposed to rock the patient to sleep. Remarkably, despite their strong relation to the six non-natural things, Sanctorius did not consider the influence of these instruments on insensible perspiration, nor did he refer to them in the *De statica medicina*. This is especially interesting with regard to the hanging bed, as Sanctorius was not the first physician to suggest such a device (Sanctorius 1612b: 59; 1625: 129, 405 f., 439, 636, 674).

The physician Asclepiades of Bithynia, who was already mentioned in the context of the medical school of the Methodists (Sect. 3.2.11), is said to have recommended hanging beds as a form of passive exercise. According to Pliny the Elder (23–79 CE), Asclepiades devised suspended beds that could be rocked and thus served to mitigate disease or promote sleep. They helped render the pores and passages of the body more open and restore an interrupted flow of corpuscles, which was, according to Asclepiades, the immediate cause of most disease. In the sixteenth century, Girolamo Mercuriale described Asclepiades' hanging bed (*lectus pensilis*) on the basis of ancient reports, but asserted that few, or no physicians have dealt with the shape of the instrument, or its usage. According to him, the hanging beds were mostly unknown. However, with their description in his famous work *De arte gymnastica* (On the Art of Gymnastics, 1569), Mercuriale must have helped to popularize them (Mercuriale 1569: 176 ff.; Kamenetz 1977: 18; Wazer 2018: 83).

Fig. 4.12 The instrument *balneatorium*—a mobile bath (Sanctorius 1625: 405, 439). (© British Library Board 542.h.11, 405)

Thus, it can be assumed that Sanctorius was acquainted with Asclepiades's device, either through the work of Mercuriale (who had been Sanctorius's teacher at the University of Padua), or through the accounts of ancient authors like Plinius, or Aulus Cornelius Celsus (first century CE). But given that the descriptions of Asclepiades' hanging bed are rather imprecise and no illustrations of the device existed at the timeit might have served, at the most, as inspiration for Sanctorius's *lectus artificiosus.* According to Mercuriale, Plinius explained that ropes were attached to the four corners of the roof of the bed in such a way was as to raise it a little from the ground, so it seemed to hang in the air. Looking at the illustration of Sanctorius's hanging bed, it is clear that his device was much more sophisticated than this. The bed was not simply elevated by ropes. Instead, there was a crank mechanism above the bedroom ceiling to lift and lower the bed (Fig. 4.15). Moreover, as will be shown below, swinging was by no means the device's only function. What is striking, however, is that, contrary to Asclepiades, Sanctorius did not consider lying in a swinging bed as a passive movement, or as a form of transportation. He did not associate it with *perspiratio insensibilis*, or consider any impact it might have on the pores and passages of the body, even though he praised, like Asclepiades, its soporific effect. In view of the importance of sleep for the

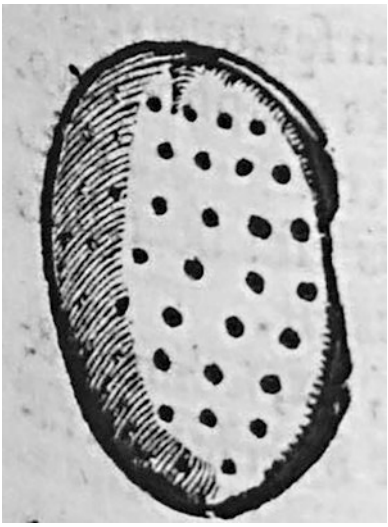

Fig. 4.13 Device to quench the thirst of fever patients (Sanctorius 1625: 499). (© British Library Board 542.h.11, 499)

excretion of insensible perspiration, one can but wonder why Sanctorius did not include the hanging bed in his program of static medicine (Mercuriale 1569: 177).[39]

In addition to therapeutics, the instruments in this category had a clear practical orientation. The *balneatorium* was mobile and could be used in the sickbed itself to prevent, as Sanctorius explained, the patients' strength being weakened by the movement required to carry them to the bath (Fig. 4.12). For this, he claimed, was why the sick had more inconvenience than relief from ordinary baths and, as a consequence, bathing had been abolished for the treatment of diseases such as hectical fevers. By contrast, the use of Sanctorius's instrument allegedly had neither harmful nor inconvenient effects. Sanctorius claimed that it enabled him even to heal patients' hectical fevers already declared incurable by other physicians. The *lectus artificiosus* bed had a mechanism that turned it into a chair, so allowing the patient to sit up during the day, without having to leave his bed (D).[40] This was important, so Sanctorius, because if sick persons lie all the time stretched out in bed, they become faint and their natural and animal faculties (Sect. 3.3.5, fn. 91) diminish dangerously. Moreover, the patient could also eat and go to the toilet in bed, as a table and a lavatory were installed in the device (C).[41] Attached to the ropes, which connected the bed to the crank above the ceiling, there were small spheres (*globuli aerei*) (B), which produced a sound, when the bed swung in the air, and helped

[39] Warm baths had been an important form of therapy also for Asclepiades, who used them to open the pores and provoke sweat. However, Sanctorius did not refer to similar effects with regard to his *balneatorium* and did not consider it in the context of *perspiratio insensibilis* (Sanctorius 1625: 405, 439, Benedum 1967: 95 f.).

[40] The following letters in brackets refer to the illustration of the *lectus artificiosus* in Sanctorius's *Commentary on Avicenna*, see Fig. 4.15.

[41] The table is not indicated by a letter, but is located under the arm of the chair in the front.

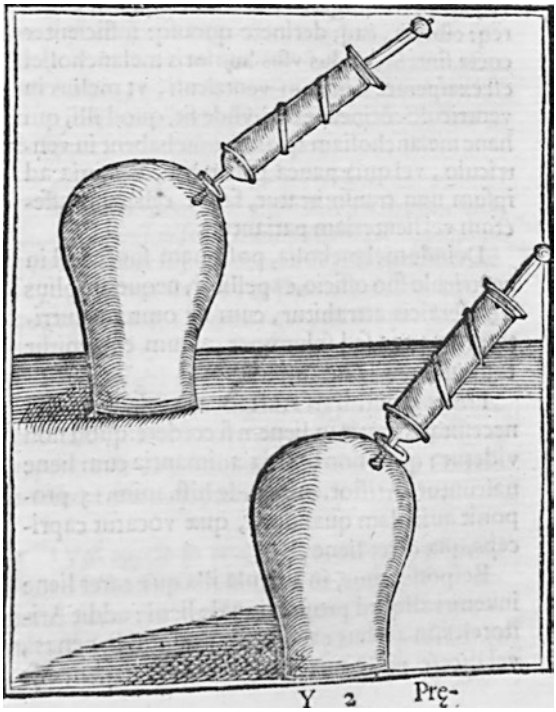

Fig. 4.14 Cupping glasses (Sanctorius 1625: 512, 680). (© British Library Board 542.h.11, 512)

induce sleep. Finally, the bed could be attached by means of bolts to another similar bed, so enabling the patient to easily be rolled from one into the other, for a fresh change of bedclothes. Sanctorius stated that he successfully used the bed for a lot of patients, among them paralyzed people, or people with podagra (Sanctorius 1625: 405, 636 f., 673).

I refer to these two instruments in some detail, because they reveal a further dimension of Sanctorius's instrumentation: the improvement of patient care. The mobile bath and the hanging bed were useful especially for critically ill patients with limited mobility, but they eased strain for the caregivers, too. No longer did they need to carry the weight of the patient, be it at bathing time or when changing the bedclothes. This and the attention Sanctorius paid to the many difficulties that bedridden patients faced in order to satisfy their basic needs, imply that he spent many hours at the bedside of the sick. By including the two devices in his lectures on theoretical medicine, he drew his pupils' attention to very practical aspects of daily medical life. It is, of course, doubtful whether Sanctorius really built and used these instruments. In the late sixteenth century, Mercuriale described hanging beds as a curiosity. Despite them being popularized through his work *De arte gymnastica*, it is very likely that they retained this status until Sanctorius's publication of the *Commentary on Avicenna* in 1625, and beyond. To my knowledge, there is no evidence of similar devices being used in Renaissance Italy. In any case, if Sanctorius used his hanging bed and the *balneatorium*, which was probably seen as being just

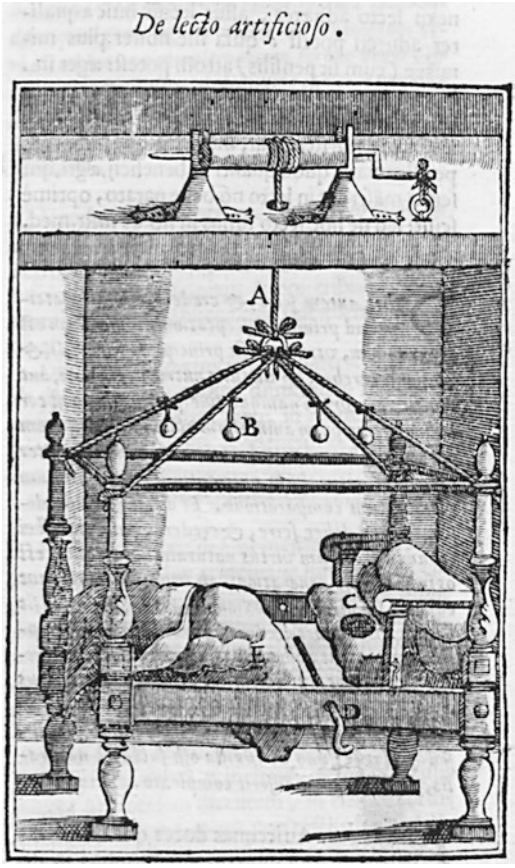

Fig. 4.15 The instrument *lectus artificiosus*—a hanging bed (Sanctorius 1625: 636, 674). (© British Library Board 542.h.11, 636)

as peculiar as the bed, it must have been within the walls of one of the *palazzi*, in which his wealthy Venetian clients lived (Mercuriale 1569: 176).

The two instruments that Sanctorius designed in order to ease pain were probably connected to his surgical activities, as control of pain was particularly important here (Fig. 4.16). Without describing the devices in detail, it is pertinent to mention a statement that Sanctorius made in the *Commentary on Hippocrates* with regard to one of them (Fig. 4.16, right). He explained that he had found a procedure to remove pain, which impressed anyone who saw it. He would take a cow's bladder filled with a lot of snow or ice and wrap it in a handkerchief, so that neither the sick person nor the attendants would notice it. Then, Sanctorius would suddenly apply the covered bladder to the aching part and the pain would immediately cease. He personally would have preferred not to have to cover up the bladder, but, as Sanctorius explained, this was necessary in view of the fact that people easily spurn the things they know. Hence, Sanctorius felt that he needed to impress his audience with tricks, because otherwise they would not approve of his healing methods. It is clear that the secrecy shrouding his use of the cooling cow bladder had nothing to do with

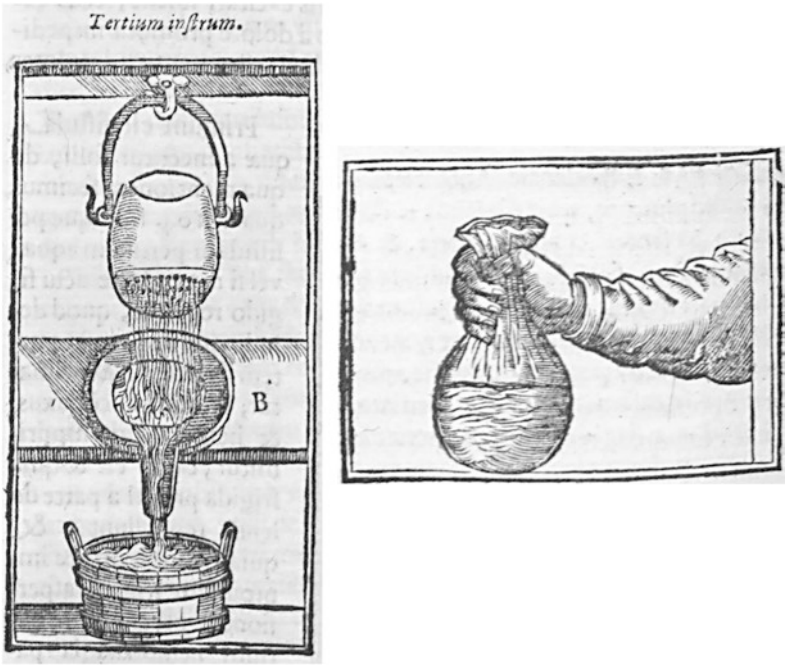

Fig. 4.16 Two instruments to ease pain (Sanctorius 1625: 668 f., 726). (© British Library Board 542.h.11, 668 f., 726)

protecting technical secrets, as he had already published the device and an explanation of it 4 years earlier, in the *Commentary on Avicenna*. Thus, it was rather the mockery of non-professionals that Sanctorius was concerned about. I will resume this discussion later, as it helps explain how Sanctorius's instruments were received, to whom they were addressed, and in which contexts they were used. For the moment, it is enough to note that the mechanisms driving the hanging bed or the famous weighing chair are hidden behind a ceiling (Fig. 4.15 and Fig. 7.23) (Sanctorius 1629a: 373 f.).

All in all, the therapeutic measures connected to Sanctorius's instruments for the improvement and alleviation of the sick are not original. In a later annotation to the *Commentary on Avicenna*, Sanctorius mentioned Galen as the source of his inhalator. He wrote:

> Such a vessel has been related by Galen in his *Method* (bk. 9, chap. 14) where he says that *in a hot and dry disease the air must be cold and humid*. He places it such that a cold breeze from the Euripus blows on it, calling it Euripus because of the tight channel through which the air comes out (Sanctorius 1625: 406).[42]

[42] "Simile vas p[ro]ponit[ur] a G[alen]o 9 meth[od]i 14 ubi dicit in morbo cal[id]o et sicco aer debet esse frig[idu]s et hum[idu]s. Subdit e[tiam] ut ex Euripo aura fr[igid]a inspiret—vocat Euripum ob viam angustam p[er] quam egred[itu]r aer." See: Sanctorius 1625: 406. The transcription and English translation are taken from: Bigotti 2017: 4.

In fact, in Sanctorius's time, instruments such as perfume-burners, or lanterns containing domestically produced scented substances were commonly used in households to sweeten the air by. The therapeutic use of baths, the pain-relieving effect of cold applications, and the soporific effects of sounds and rocking motions were well known (Cavallo 2011: 194). However, Sanctorius tried to refine these measures by means of his instruments and to facilitate their use in daily medical practice. It is remarkable that he integrated these instruments into courses on theoretical medicine, sensitizing his students to the very practical needs of patients as well as to the challenges their caregivers faced. It is likewise remarkable that, even though most of the instruments strongly relate to the six non-natural things, Sanctorius did not consider their effects on insensible perspiration. Notwithstanding that they were all used for dietetic-therapeutic measures and had a clear practical orientation, Sanctorius made no connection between his instruments for the improvement and alleviation of the sick and the *De statica medicina.*

4.2.3 Instruments to Demonstrate Optical Phenomena

The subject matter of Renaissance optics included a wide variety of topics, such as theories of vision, the nature of light and colors, or the anatomy and physiology of the eye. Perusal of Sanctorius's works shows that he was interested in the subject and in the *Commentary on Avicenna*, he presented three instruments to demonstrate optical phenomena (Figs. 4.1, 4.17, 4.18, and 4.19).

The first instrument (Fig. 4.17), consisting of two vessels filled with small vitreous balls, served Sanctorius to demonstrate how the colors black and white were generated. He explained that if the balls were filled with water (A), light could only penetrate at one point and the color black occurred. The reason for this was, so Sanctorius, that the light was pointed to only a small part, whereas in the other parts there was darkness out of which blackness emerged. If, however, the balls were only filled with air (B), light did not escape and no darkness occurred. In the *Commentary*

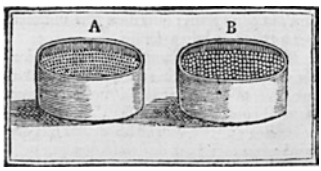

Fig. 4.17 Two vessels filled with small vitreous balls to demonstrate how whiteness and blackness arise (Sanctorius 1625: 460). (© British Library Board 542.h.11, 460)

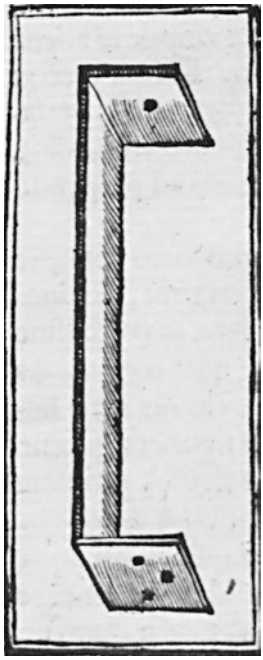

Fig. 4.18 Instrument aimed at showing that vision occurs through crosswise divided rays (Sanctorius 1625: 760). (© British Library Board 542.h.11, 760)

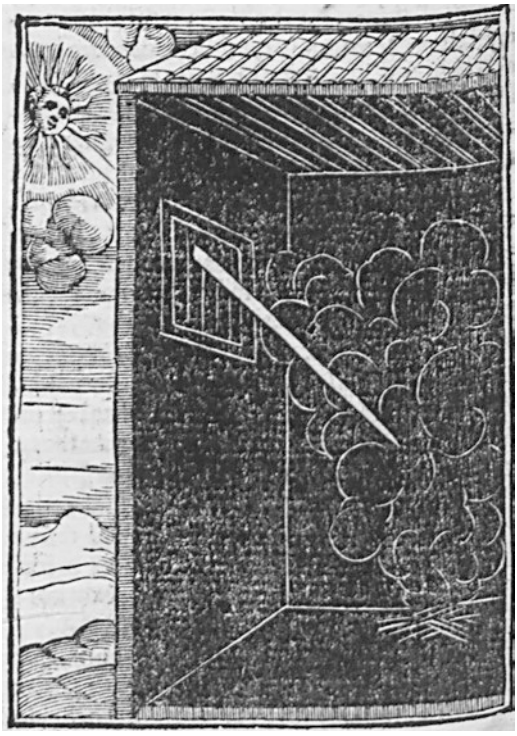

Fig. 4.19 Illustration to demonstrate through the examination of a comet's tail (*cometae caudati inspiciantur*) that the vitreous humor acts like a dark room and diminishes transparency (Sanctorius 1625: 762). (© British Library Board 542.h.11, 762)

on Galen, Sanctorius mentioned a similar experience and admitted that the generation of colors was very difficult to explain. But he followed, as he wrote, the *perspectivi*, who held that blackness emerged from the refraction of light from countless surfaces. Whiteness, on the contrary, occurred if light was refracted from only a few, but clean and polished surfaces. The generation of the colors black and white was particularly important to Sanctorius, as all other colors were derived from them. According to him, colors emerged not from the four primary qualities, but from a mixture of darkness and transparency (Sanctorius 1612a: 320 f.; 1625: 460 f.).

Sanctorius was referring here to the medieval optical (*perspectiva*) tradition, which was based on Aristotelian theories of light and colors. In this context, colors were usually identified as modifications of white light produced by refraction or reflection by other bodies. They were seen as innate properties of white light. Interestingly, Sanctorius not only refuted the idea of a link between colors and the four primary qualities, but also the view that colors came from a mixture of dense and rare. In doing so, he disagreed with one of his famous teachers at the University of Padua: Giacomo Zabarella. It is not my intention here to investigate Sanctorius's concept of colors and their generation at any length.[43] Rather, I want to call attention to the fact that Sanctorius was responsive to philosophical debates on the origin of colors, of which he most probably learned during his studies in Padua. It was an important topic to him, which he dealt with already early in his career and repeatedly in his published works. It was a field which he tried to support by means of *experimenta* (Sanctorius 1612a: 318 f., 322 f.; Mancosu 2006: 597–628; Baker 2015: 162 f.).

As early as the 1580s, Sanctorius held a public lecture in the Istrian Accademia Palladia with the title "What Every Color Really Means" (*Che cosa veramente significhi ciascun colore*). This text is largely unknown as it was not published under Sanctorius's name, but as part of a collection of public discourses held at the academy. Contrary to his other treatments of colors, the focus here is on the metaphorical meaning of colors and on the opinions of poets such as Vergil, Ovid, or Horaz on the subject (Sect. 2.2). In the *Methodi vitandorum errorum*, Sanctorius's first published book, the discussion of colors and their generation is dealt with in the framework of semiology. Sanctorius investigated to what extent colors indicate the nature and the course of a disease. He argued that, while a complexion could not be inferred from colors alone colors did have a certain importance in diagnostics. In the *Commentary on Galen*, he stated that hair color could lead to a knowledge of the complexion of the brain, insofar as it was part of a syndrome of signs that, taken all together, indicated the brain's complexion. Thus, Sanctorius's interest in colors was very broad, ranging from their generation, to their meaning as metaphors, to their value in diagnostics. The various experiences to which he referred follow those made by painters and dyers and connect to the works of the medieval perspectivists such as Alhazen (Ibn al-Haiṯam, d. 1041) and Witelo (ca. 1220/30–after 1277). A detailed analysis of these *experimenta* is, however, beyond the scope of this work

[43] For a more detailed account of Sanctorius's thoughts on colors, see: Del Gaizo 1891: esp. 24–7.

(Sanctorius 1603: 110v–113r; 1612a: 317, 322; Vida 1621: 76r–86v; Del Gaizo 1891: 25 ff.).

While, with regard to his concept of colors and their generation, Sanctorius remained in a traditional framework, there was another field of optics in which he departed radically from tradition. In the *Commentary on Avicenna*, he argued that the retina and not the crystalline humor (now called the crystalline lens) was the principal organ of sight. In doing so, he contradicted Galen's teachings as well as the opinions of many subsequent medical writers and the medieval perspectivists. In the discussion, he gave seventeen reasons for his opinion. In contrast to his usual treatment of questions (*quaestiones*), Sanctorius hardly referred to other authors, but presented most of the arguments as his own. What is more, he completely omitted the traditional position, leaving his audience simply with his stance on the topic. Only in the last paragraph did he give a hint at his sources, when he referred to Christoph Scheiner (1573–1650) and his "most accurate experiments and demonstrations" (Sanctorius 1625: 763).[44] Aristotle, Galen and Avicenna, on the contrary, had all been wrong, so Sanctorius, as they identified the crystalline humor as the principal organ of sight; and because Scheiner had tried to reconcile his own findings with those of Galen by pointing to a work in which the latter had ascribed some role in vision to the retina, he had evidently neither read nor understood Galen. Notwithstanding that Sanctorius defended Galen in most other matters, with regard to this question, he was sure that Galen had erred and was ready to openly dismiss his opinion. Again, it was in the context of a recent anatomical finding that Sanctorius refuted Galen (Sect. 4.2.1) (Sanctorius 1625: 758–63).

In fact, Modestino del Gaizo and Nancy Siraisi have argued that Sanctorius drew heavily on Scheiner's work *Oculus* (The Eye, 1619) in his *quaestio* on the subject of vision. "Sanctorius not only takes the new doctrine of vision from Scheiner, but also the words," concluded Del Gaizo, and Siraisi stated that Sanctorius's "main arguments are highly simplified, nonmathematical, and abbreviated versions of propositions put forward in Scheiner's technical treatise" (Del Gaizo 1891: 38; Siraisi 1987: 343).[45] Christoph Scheiner was a Jesuit mathematician active in Rome, who described in the aforementioned work how he had verified in anatomical dissections that the retina is the visually sensitive part of the eye while the crystalline humor functions as a lens. By scraping the rear surface of an eyeball, leaving only a thin layer, he could directly observe the inverted image on the retina. Already before Scheiner, the Swiss physician Felix Platter (1536–1614) had maintained that the retina was the principal organ of vision and Francesco Maurolico (1494–1575), a Sicilian mathematician, had treated the crystalline of the eye as a convex lens. Moreover, the Neapolitan polymath Giambattista della Porta (1535–1615) popularized in his optical works certain new optical subjects, such as the analysis of

[44] "… Scheiner … in suis experimentis, & demonstrationibus exactissimus, …". See: Sanctorius 1625: 763.

[45] "Santorio prese da Scheiner non pure la dottrina nuova della visione, ma persino le parole; …". See: Del Gaizo 1891: 38.

radiation through lenses and the camera obscura.[46] And there was, of course, Johannes Kepler (1571–1630), who proposed a new theory of vision based on an understanding of the eye as an optical instrument. It is therefore possible that Sanctorius was familiar with their works, too, even though Scheiner is the only contemporary author whom Sanctorius cited by name. However, it can be assumed that he was not acquainted with Kepler's work on the retinal image, published in 1604, or in any case did not grasp it, as Sanctorius held that the vitreous humor was responsible for the righting of the image, and not, as Kepler maintained, processes of reflection and refraction (Sanctorius 1625: 761 ff.; Del Gaizo 1891: 24–38; Siraisi 1987: 343 f.).

In view of Sanctorius's rudimentary treatment of the issue of vision and his strong dependence on the work of Christoph Scheiner, it is difficult to assert whether the optical experiences to which he referred in his argumentation in the *Commentary on Avicenna* were his own. Only in one instance did Sanctorius explicitly claim to be drawing on his personal experience, but it is quite possible that he was referring merely to a mental process. In order to demonstrate that the vitreous humor had the property to right an image, he used a vitreous lens, placing it in front of an opening in his house, which was situated next to a river, and observing underwater objects through it. These, he reported, appeared upright, and not reversed. With regard to the two further instruments with which Sanctorius proposed to demonstrate optical phenomena, he was less clear about his personal use of them (Figs. 4.18 and 4.19). The first served him to explain the refraction of visual rays in the eye according to the varying transparency of the media they traversed, i.e., the aqueous humor, or the crystalline lens. The second was rather an observation than an instrument, as according to Sanctorius, the examination of comets' tails illustrated that the vitreous humor acted like a dark room and diminished transparency.[47] However, it is very difficult to interpret this observation, since Sanctorius wrote of a comet (*cometa*), but the image shows only a sun (Fig. 4.19). Nevertheless, even without a detailed analysis and some ambiguities concerning the demonstrations cited, one can assume that Sanctorius made at least some optical observations himself.[48] In view of the flourishing glass industry in Venice, lenses must have been easily accessible to him. In addition, Sanctorius moved in social circles that included other scholars with an interest in optics. Paolo Sarpi, Galileo Galilei, and the Venetian patrician Agostino da Mula (1561–1621) were all very much involved in optical studies at the time and

[46] A camera obscura is an instrument, such as a darkened room, with a tiny hole in one of the walls, through which external light passes and projects an image, upside down, on the opposite wall (Mancosu 2006: 613).

[47] Sanctorius wrote: "Eadem ratione in cubiculo obscuro Cometa caudatus ostenditur, si radij Solis ingrediantur per foramen fenestrae, in quo sit fumus ex palea accensa, ibi Cometa caudatus pulcherrimus apparet, ut in icone." See: Sanctorius 1625: 762 f.

[48] For more information on the arguments that Sanctorius presented in favor of the retina as the principal organ of vision, see: Del Gaizo 1891: 27 ff., Siraisi 1987: 342 f. Among the optical observations and demonstrations that Sanctorius described is also one made with a camera obscura. See: Sanctorius 1625: 761.

frequented the *Ridotto Morosini*. Even though they did not always share the same opinions and Sarpi, for example, still considered the crystalline lens as the principal organ of vision, discussions with these scholars might have aroused Sanctorus' interest in optics. Furthermore, the home of the Morosini might have been a place, where he participated in optical observations (Sanctorius 1625: 760–3; Cozzi 1986; Sarpi and Cozzi 1996: e.g., xxxvii, XLI–XLII).[49]

To conclude, although Sanctorius did not make original contributions to optics and did not refer to all recent developments in the field, he still was among the few who accepted that the retina was the main organ of sight and thereby clearly and unambiguously contradicted Galen. By including this notion in his *Commentary on Avicenna*, he provided his audience with a rather advanced theory of vision, compared to those available at other universities at the time, as, for example, in Basel. In his last work, *De remediorum inventione*, Sanctorius highlighted the importance of optical knowledge for the practicing physician, as according to him, only those versed in optics were able to correctly recognize the meaning of colors in diagnosis. In this context, it is interesting to note that Sanctorius bequeathed in his testament a "copy of one hundred optical problems not communicated to others" to his friend Hieronymus Thebaldus.[50] The fate of this document is unknown, as are its contents, but Sanctorius's mention of it illustrates, once again, his pronounced interest in the subject of optics (Sanctorius 1629b: 121 f.).

4.3 A New Approach to *theoria*—Head and Hand?

In the dedication and preface to the *Commentary on Avicenna*, Sanctorius confidently proclaimed that he was offering a new approach to the teaching of theoretical medicine. Contrary to his predecessors, he did not base his explanations of the subject solely on reason and on the authority of Hippocrates and Galen, but confirmed theory by practice—by experience (*experimenta*), instruments, and static art. According to him, theory was meaningless and useless, if it was not confirmed, a posteriori, by practice. Correspondingly, practice could not be understood if it was not corroborated, a priori, by theory. The preceding paragraphs have shown that Sanctorius took this seriously. Practical experiences, observations, and instrumentation repeatedly enter the otherwise very theoretical physiological discussions regarding Avicenna's *Canon*. In this context, it has to be noted that physiology, as taught at the time at universities, was a highly theoretical discipline. Therefore, Sanctorius's inclusion of instruments in his teaching on physiology was a bold new

[49] Sanctorius does not seem to have been involved in the development and use of the telescope. In the *Commentary on Avicenna*, he mentioned the "newly invented spyglass," only then to dismiss its ability to make visible changes in the moon, as he was convinced of the division of the sublunary and the celestial spheres. See: Sanctorius 1625: 141, 154, Siraisi 1987: 274 f.

[50] "Allo Eccellentissimo Tebaldi le sia dato copia da mio nepote de cento problemi de optica non comunicati ad altri." See: ASVe-g (n.d.). The transcription is taken from: Ettari and Procopio 1968: 140.

departure, which set his *Commentary on Avicenna* apart from all the other commentaries on this traditional textbook (Sanctorius 1625: dedication, Ad lectorem).

Sanctorius's attempt to reform the teaching of *theoria* might be connected to his earlier career. In 1611, when he was appointed first ordinary professor of theoretical medicine at Padua, he was a man of fifty who had spent most of his adult life in medical practice. According to his own testimony, he had by then already been busy for years with his weighing procedures, endeavoring to measure insensible perspiration (Sect. 2.2). Moreover, 8 years earlier, in his first published book, *Methodi vitandorum errorum*, Sanctorius not only referred to some of his instruments, but also mentioned the work *De instrumentis medicis* that he aimed to publish next. Indeed, while working as a practicing physician, Sanctorius devised and used various instruments and already began conducting his famous quantitative studies of physiological phenomena. The fact, that he had planned to publish a book on his instruments at least since 1603, implies that this was an area of great interest to him. The professorship at Padua interfered with this aim, as the duties the position involved prevented Sanctorius from finishing the illustrations of his instruments. His novel way of teaching *theoria* was a means to combine his own interests, experiences, and physiological ideas with his obligation to lecture on Avicenna's *Canon,* which was a set text in his students' curriculum (Sanctorius 1603: 26v, 109v; 1625: Ad lectorem).

But there was also yet another dimension to this. Sanctorius held that the division of medicine into theory and practice in the university curricula was itself improper. In keeping with Aristotle and Galen, he argued that the purpose of theory was truth (*veritas*), while the purpose of medicine was operation (*opus*), that is, to preserve and to restore health. Moreover, so Sanctorius, the term *theorica* meant speculation and not operation, nor the act of making or doing (*factio*). Practice (*praxis*), on the contrary, meant action and therefore also differed from medicine, which was not active, but operative (*factivus*) and restoring (*resarcitivus*). However, Sanctorius admitted that medicine could be "somewhat" (*aliquo modo*) divided into theory and practice, as the physician first explored the truth and then directed it to action, that is, to the preservation or restoration of health. Still, medicine proper was by its nature not theory. Hence, Sanctorius's new approach to teaching theoretical medicine was also motivated by his rejection of the disciplinary division of medicine into theory and practice. Bound by the university statutes to teach the traditional set of texts laid down for courses on *theoria*, Sanctorius tried to challenge the disciplinary boundaries from within, by linking his lectures on Avicenna's *Canon* to practical applications and by using evidence drawn from *practica* to confirm theory. The result is a seemingly peculiar mixture of highly traditional theoretical discussions with completely new elements relating to medical practice (Sanctorius 1625: 37 ff.).

Sanctorius's effort to confirm physiological theory by means of practical evidence has to be seen against the larger backdrop of a revaluation of practical medicine that had begun in the fifteenth century. As was mentioned earlier, practical training gained considerably in importance in the sixteenth century and, indeed, became foreign students' main motivation for studying at the University of Padua (Sect. 4.1.2). Therefore, Sanctorius was certainly not alone in highlighting the

importance of the practice of medicine. However, his attempt to combine teaching by commentary with teaching by practical demonstration is exceptional. Hence, in Sanctorius's works the relation between theory and practice is ambiguous and cannot be described as a simple dichotomy. Notwithstanding that medical knowledge contained both, contemplation and action, he argued, it also differed from both, due to its operative and restorative character. Moreover, the previous sections have shown that empirical evidence must not necessarily result from personal firsthand experience, but might well be based on reports by others. This serves to further blur the lines in medical practice, between textual or theoretical knowledge, acquired using the head (as in: the mind), and experiential knowledge, acquired through hands-on practice. It is important to keep this in mind when addressing Sanctorius's quantitative approach to physiology.

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