Galen reconsidered.
Studying drug properties and the foundations of medicine in the Dutch Republic ca. 1550-1700

Saskia Klerk

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Galen reconsidered.

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Een nieuwe kijk op Galenus.

De studie van de eigenschappen van medicijnen en de grondslagen van de geneeskunde in de Nederlandse Republiek ca. 1550-1700
(met een samenvatting in het Nederlands)

Proefschrift
ter verkijging van de graad van doctor aan de Universiteit Utrecht op gezag van de rector magnificus, prof. dr. G.J. van der Zwaan, ingevolge het besluit van het college voor promoties in het openbaar te verdedigen op maandag 16 februari 2015 des middags te 4.15 uur

door
Saskia Klerk
geboren op 6 juni 1985
te Rotterdam

Promotor: Prof. dr. L.T.G. Theunissen

Contents:

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Early on during studying for my master degree, I was introduced to Prof. Harold Cook´s *Matters of exchange*, which I used in writing an essay for the first course of the master. In the following weeks there was ample opportunity to discuss the book in more depth when Cook was a research fellow at the Descartes Centre and gave the first Huygens-Descartes Lecture in Utrecht. Three years later, several of my fellow PhD-candidates and I joined him when he taught a master class at the Huizinga Instituut. Cook´s vision of the seventeenth-century Dutch Republic made an invaluable contribution to the cultural history of The Netherlands and provided an important reference point for this dissertation. I am greatly indebted to him for taking the time to share his experiences as a historian and human being.

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Introduction

Beyond the history of disciplines

This dissertation studies the role of the investigation of drug properties in Dutch medicine from the sixteenth to the end of the seventeenth century. This subject naturally belongs to the history of pharmacology, but studying it in its sixteenth- and seventeenth-century context requires an approach unrestricted by disciplinary boundaries. Historians have been pointing out for some time that the early modern histories of medicine, philosophy and the study of plants, animals and minerals should not be considered in isolation from each other. In 1988, Allen Debus wrote "I would argue that medicine was not then artificially separated from science as historians of science and medicine frequently present their subjects today". Instead, Debus suggested that through chemistry and chemical theories of medicine, the history of science and that of medicine were fundamentally connected.[1]

Alchemy and chymia have gained a considerable historiography of their own since Walter Pagel's foundational work and the connections between medicine and chymia have been investigated in some depth. Tracing this interaction has only recently become a topic that attracts the attention of historians of both disciplines. In recent years, considerable efforts have been made in crossing disciplinary divides by organising meetings that brought scholars from both fields together. As Lawrence Principe argued to his fellow historians of chemistry, "the broad dispersion of chymical thought into extremely diverse areas of human activity necessitates both a high degree of interdisciplinary [sic] and a willingness to expand the scope of our analyses and studies".[2]

A similar conference was organised on the interconnections between natural philosophy and medicine.[3] Earlier, historian Domenico Bertoloni Meli pointed out that key phenomena of the Scientific Revolution, such as the increase of mechanical thinking and experimentation, crossed demarcation lines between the medical and the physical sciences.[4]

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[1] Allen G. Debus, "Chemical philosophy and the Scientific Revolution", in: William R. Shea, ed., *Revolutions in science: their meaning and relevance* (Canton, MA 1988) 27-48, specifically 43.
[2] *Alchemy and medicine from Antiquity to the Enlightenment*, 22 September 2011- 24 September 2011, Centre for Research in the Arts, Social Sciences and Humanities, Peterhouse College, University of Cambridge. The course of this development is outlined in Lawrence Principe's introduction to *Chymists and chymistry. Studies in the history of alchemy and early modern chemistry* (Sagamore Beach 2007) ix-xiii.
[3] *Early modern medicine and natural philosophy*, 2-4 November 2012, Center for the Philosophy of Science, University of Pittsburgh.
[4] Domenico Bertoloni Meli, *Mechanism, experiment, disease. Marcello Malpighi and seventeenth-century anatomy* (Baltimore 2011) 18.

One of the clearest disciplinary distinctions made by historians has been that between medicine and botany. Along with Agnes Arber, historians of botany have recognised that most herbalists of the sixteenth century were physicians who began studying botany because of its connection to "the arts of healing". Arber discussed "the incalculable debt which Botany owes to Medicine". Medicine gave the original impulse to systematic botany and plant anatomy. However, according to Arber, the history of the herbal also showed that botany was eventually emancipated from medicine. No longer were herbs "merely classified according to the qualities which made them of value to man", but rather "according to the affinities which they present when considered in themselves, and not in relation to man".[5] Arber thus considered it possible for plants to be studied "in themselves" and that this excluded studying their medicinal qualities or other useful properties. In the same vein, historians have often not considered further how these two ways of studying plants were connected or became separated from each other.

Karen Reeds, for example, further minimalised the role of medicine in the development of botany.

> Only when physicians and other educated men found themselves interested in plants for reasons that initially had little to do with medicine did botany achieve the status in medical schools that its utility seemed to demand all along.[6]

This is a hypothesis rather than a conclusion however and it can be debated.

Earlier, Richard Palmer had emphasised the meeting of different goals within the sixteenth-century pursuit of plants. To a medically orientated audience he argued that botany as a discipline "combined aesthetic pleasure with the passion of the collector, and which was also imbued with an ideal – that of improving therapeutics".[7] In contrast to Reeds, he wrote that it was the "programme" to restore the plant knowledge held in Dioscorides' *De materia medica*, "which inspired the field trips, especially to the Eastern Mediterranean where Dioscorides had lived and worked, promoted the chairs of *materia medica* ── which were

[5] Agnes R. Arber, *Herbals, their origin and evolution, a chapter in the history of botany, 1470-1670* (Cambridge 1912[1]) 121.
[6] Karen Reeds, *Botany in Medieval and Renaissance universities* (New York 1991) 521.
[7] Richard Palmer, "Medical botany in northern Italy in the Renaissance", *Journal of the Royal Society of Medicine* vol. 78 (Feb. 1985) 149-157, specifically 150.

essentially lectureships on Dioscorides — and underlay the foundation of the botanical gardens".[8]

More recent historiography has moved beyond making a distinction between these two disciplines, by categorizing the study of plants, along with the study of animals and minerals, under natural history. Historians have shown that the work of some physicians on these subjects cannot be considered independently from medicine, nor as limited to purely medical purposes.[9] Investigating how drug properties were studied, allows us to examine how different ways of knowing nature interacted in the period best known for the Scientific Revolution.

Problematising Galenic pharmacology

The introduction to Prüll, Maehle and Halliwell's *A short history of the drug receptor concept* (2009) provided an overview of the history of pharmacology from Hippocrates of Cos (460–370 BCE), through Galen (ca. 129-199/217 AD) to Paracelsus (1493-1541), Jan Baptist van Helmont (1579–1644) and René Descartes (1596-1650), and via Robert Boyle (1627-1692) and Thomas Sydenham (1624-1689) to Freidrich Hoffmann (1660-1742) and Georg Ernst Stahl (1660-1734). According to this account, it was the criticism of Galen's pharmacology that set the development of modern pharmacology in motion.[10] While it points to Galen's work as the basis for discussions of drug properties in the sixteenth century, what made physicians start to criticise it in this way and in this period needs clarification. In my study of the investigation of drug properties, Galen will play a central role.

Until the middle of the seventeenth century, the work of the Roman physician, surgeon and philosopher Aelius Galenus or Claudius Galen provided the main authoritative framework for the study of drug properties. In his extensive writings, Galen considered many of the philosophical and medical authorities of Antiquity, creating a type of medicine that combined natural philosophy with medical practice. The by then legendary Greek physician

[8] Ibid., 151.
[9] Peter Dilg, *Das Botanologicon des Euricius Cordus. Ein beitrag zur botanischen Literatur des Humanismus* (Marburg 1969); Jerry Stannard, "Pietro Andrea Mattioli: sixteenth century commentator on Dioscorides", *University of Kansas publications. Library series* vol. 1 no. 32 (Lawrence, KS 1969) 58-81, specifically 66, 69; Lisbet Koerner, *Linnaeus: nature and nation* (Cambridge 2009); Esther van Gelder, *Tussen hof en keizerskroon: Carolus Clusius en de ontwikkeling van de botanie aan Midden-Europese hoven (1573-1593)* (Leiden 2011) 9, 87-88; Philippe Glardon, "L'histoire naturelle du XVIe siècle: historiographie, méthodologie et perspectives", *Generus* vol. 63 (2006) 280-298; Philippe Glardon, ed., *L'histoire naturelle au XVIe siècle: Introduction, étude et édition critique de la nature et diversité des poissons de Pierre Belon (1555)* (Geneva 2011).
[10] Cay-Rüdiger Prüll, Andreas-Holger Maehle and Robert Francis Halliwell, *A short history of the drug receptor concept* (Basingstoke etc. 2009) 5-9.

Hippocrates was his main medical source, while Aristotle (384–322 BCE) was his main philosophical one. In Galen's work, the medicinal properties of natural materials constituted one area in which medicine, philosophy and the study of plants, animals and minerals overlapped. Focusing on sixteenth- and seventeenth-century discussions about his pharmacology will thus show how changes in these fields were interconnected.

General overviews of medical history do not deal with the history of Galenic pharmacology in much more detail than Prüll, Maehle and Halliwell. Historians usually state that Galen's medicine assumed the existence of four humours and of four primary qualities that are prevalent in these humours. There is blood, in which hot and moist are most prominent, phlegm, which is cold and moist, black bile (cold and dry) and yellow bile (hot and dry). Imbalances of the primary qualities in the body were understood to cause diseases. Because the primary qualities were also present in plants in degrees from one to four, the ingestion of these plants could restore the balance in the human body, thereby restoring a person's health.[11] This description outlines the basic principle of Galenic pharmacology, but does not do justice to the scope and complexity of Galen's work on the subject, nor does it show how the principle was put into practice.[12]

In contrast, Vivian Nutton has provided a more thorough and nuanced account of Galen's pharmacological writings. Two of them were most important. The first is *On the properties of simples*, in which Galen investigated how and why individual substances worked in the way they did. The second is the two-part treatise *On the composition of drugs*, where he examined how these substances should be used in therapy. The first part did this from the perspective of the part of the body that was affected by the drug, the second from that of the available types of drugs.[13] Galen wrote several other works in which he dealt with some particularly problematic substances, but he also discussed drug properties in his therapeutic works. Though these works seem to contradict each other on some issues, according to Nutton, Galen's works on the properties of drugs "all formed part of a single overall conception of therapeutics and of a project that occupied him for more than half a century".[14] Writing about Roman medicine, historian Plinio Prioreschi acknowledged that the

[11] Nancy Siraisi, *Medieval & early Renaissance medicine: an introduction to knowledge and practice* (Chicago 1990) 145; Temkin, *"On second thought"*, 168-169; Owsei Temkin, "Galenicals and Galenism in the history of medicine", in: Iago Galdston, ed., *The impact of the antibiotics on medicine and society* (New York 1958) 18-37, there 22-23.
[12] Vivian Nutton, *Ancient medicine* (New York 2004) 242-245.
[13] On the properties of simples is *De simplicium medicamentorum temperamentis et facultatibus* in Latin and the two parts of *On the composition of drugs* are *De compositione medicamentorum secundum locus* and *De compositione medicamentorum per genera*.
[14] Nutton, *Ancient medicine*, 244; Sabine Vogt, "Drugs and pharmacology", in: R.J. Hankinson, ed., *The Cambridge companion to Galen* (Cambridge 2008) 304-322, specifically 310-314.

explanations offered in *De simplicium medicamentorum temperamentis et facultatibus*, "are complicated and unclear and the chapter on the Galenic qualities of medicaments is a very intricate one in Galenic pharmacology".[15]

Medical historians agree that the alleged simplistic understanding of Galenic therapy in the Middle Ages needs to be reassessed. From the perspective of medieval medical practice, Peter Jones has very recently shown that the medical practice of scholastic physicians was not a straightforward application of their academic training.[16] Michael McVaugh has examined the academic study of the properties of drugs in the work of Arnold de Villanova (ca.1238-ca.1310) and one of his students, Bernard de Gordon (ca.1260-ca. 1320). At the University of Montpellier, De Villanova developed a computational system to determine the amount of heat, cold, moist and dryness that should be present in compound drugs in particular medical cases. McVaugh argued that De Gordon was aware that this created a gap between the way compound drugs were prescribed by practicing physicians and what De Villanova's system said about the properties. De Gordon tried to overcome this gap by determining the primary qualities present in the composite drugs used by practicing physicians.[17]

Emilie Savage-Smith addressed the issue of the relationship between medical theory and practice in her paper entitled "Were the four humours fundamental to medieval Islamic medical practice?" She concluded her paper with another question and suggested that therapeutic care was not necessarily based on the same principles as nosology and aetiology:

> Are we, however, correct in glibly using 'humoral pathology' as a description of medieval medicine in general, as if that expression says all that needs to be said about both its theory and its practice? In other words, should not the adjective 'humoral' be restricted to the nosology and aetiology of the period - that is, to the classification of diseases and the theories of causation - and another sought to designate the qualitative balance that dominated therapeutic care. [sic][18]

[15] Plinio Prioreschi, *A history of medicine. Roman medicine* (Lewiston 1991) 437-438.
[16] Peter Murray Jones, "*Complexio* and *experimentum*. Tensions in late Medieval medical practice", in: Peregrine Horden and Elisabeth Hsu, eds., *The body in balance: humoral medicines in practice* (New York and Oxford 2013) 107-128.
[17] Michael R. McVaugh, "Quantified medical theory and practice at fourteenth-century Montpellier", *Bulletin of the history of medicine* vol. 43, no. 5 (Sep./Oct. 1969) 397-413.
[18] Emilie Savage-Smith, "Were the four humours fundamental to Medieval Islamic medical practice?", in: Horden and Hsu, eds., *The body in balance*, 89-106.

Historians have thus acknowledged that medieval notions about therapeutic intervention were not always closely related to those about the nature of disease and the body's functioning. It appears that the academic study of drug properties was supported by the ideal that nosology and aetiology, but also anatomy and physiology on the one hand, and therapy on the other, should be closely connected. This ideal proved to be important for the type of medicine that was developed in the sixteenth century as well.

The fact that Galen's pharmacological writings could be interpreted in a variety of ways becomes especially clear when we consider two descriptions of drug properties from the final two decades of the sixteenth century. Here we encounter an as yet unknown version of Galenic pharmacology. The authors were two physicians: Rembert Dodoens or Rembertus Dodonaeus (1517-1585) and Jan van Heurne or Johannes Heurnius (1543–1601), who after careers of practicing medicine, both became professors at the University of Leiden established in 1575.

Some aspects of their descriptions of drug properties were similar to the textbook description. Dodonaeus and Heurnius talked about warming, drying, cooling and moistening drugs. They also distinguished between different orders of strength of the properties of drugs. But Dodonaeus and Heurnius actually did not say much about the primary qualities or about their different degrees of strength. Instead, they talked about primary, secondary, tertiary and quaternary *faculties*. These faculties described how a drug worked in the body. Dodonaeus and Heurnius also wrote about the proper way to investigate the properties of drugs and about manifest and occult qualities as well. John Henry wrote about the importance of the disappearance of the distinction between occult and manifest qualities for the Scientific Revolution, but he drew examples from natural philosophy, not from medicine.[19]

Both Nutton and Prioreschi referred to the studies of Galenic pharmacology by Georg Harig, in Prioreschi's case "for a complex discussion of the intricacies of Galenic medicament qualities".[20] Harig's studies provide points of reference for what Dodonaeus and Heurnius were discussing. Harig presented what Galen had written about drug properties as a "system" by selecting and emphasising particular aspects of Galen's writings. According to Harig, Galen had written about drug properties besides the primary qualities, namely secondary and tertiary qualities. Like the faculties that Dodonaeus and Heurnius discussed, these secondary and tertiary qualities described how drugs worked in the body. Harig tried to make sense of

[19] John Henry, "Occult qualities and the experimental philosophy: active principles in pre-Newtonian matter theory", *History of science* vol. 24 (1986) 335-381; John Henry, *The Scientific Revolution and the origins of modern science* (London 1997) 52-53, 57.
[20] Prioreschi, *A history of medicine*, 437-438.

how practice and theory were connected to each other, an issue in which Galen was particularly interested.[21] As it turned out, Harig's approach to Galen was very similar to that of Dodonaeus and Heurnius. They too tried to provide a short overview of Galen's pharmacological writings by selecting what they found most essential.

My recognition of Heurnius' and Dodonaeus' desciptions of drug properties in Harig's account of Galenic pharmacology was not exceptional. Before publishing studies of "Galen's system", Harig described how Leonhart Fuchs (1501–1566) used this pharmacology in his herbals and more strictly in his medical works.[22] Christoph Schweikardt made use of Harig's study, when he examined the practical medicine of Gregor Horstius (1578-1636) and Jean Fernel (1497–1558). He discussed the adjustments Horstius made to Galenic pharmacology in response to Paracelsian medicine and in order to include the properties of chemical drugs.[23]

According to Maehle, physicians in the early seventeenth century started to consider the *modus operandi* of a drug more closely.[24] There are indications in the historical literature that already in the late sixteenth century, physicians were more particular in their discussions of how drugs worked in the body. Temkin for example investigated how Fernel, Laurent Joubert (1529-1582) and Thomas Erastus (1524–1583) considered the specificity of cathartic drugs.[25] This group of drugs was also of interest to Gregor Horstius (1578-1636) as Schweikardt has shown.[26] These studies suggest that investigating how Galenic physicians discussed the properties of drugs will establish a better understanding of how these properties were investigated during the seventeenth century.

The simplicity of the textbook understanding of Galenic pharmacology is appealing. It makes it easier to present what happened to Galenic medicine in the seventeenth century as a move from a holistic idea of the body to a more reductionist, mechanistic view. The studies

[21] Georg Harig, "Verhältnis zwischen Primär- und Sekundärqualitäten in der theoretischen Pharmakologie Galens", *NTM Schriftenreihe* vol. 10 (1973) 64–81; Idem, *Bestimmung der Intensität im medizinischen System Galens. Ein Beitrag zur theoretischen Pharmakologie, Nosologie und Therapie in der Galenischen Medizin* (Berlin 1974).
[22] Georg Harig, "Leonhart Fuchs und die theoretische Pharmakologie der Antike", in: Jan Burian and Ladislav Vidman, *Antiquitas graeco-romana ac tempora nostra* (Prague 1968) 505-511; Idem, "Zur Einschätzung des Kräuterbuches von Leonhart Fuchs", *Beiträge zur Geschichte der Universität Erfurt* XIV (Erfurt 1968/1969) 71-77.
[23] Christoph Johannes Schweikardt, *Theoretische Grundlagen galenistischer Therapie im Werk des Gießener Arztes und Professors Gregor Horst (1578-1636) ein Vergleich zu Jean Fernel (1497-1558), dem Leibarzt des französischen Königs Heinrich II* (Giessen 1995); Christoph Johannes Schweikardt, "How do cathartic drugs act? A case study on Gregor Horst (1578-1636) and his attempt to defend Galenist theory", *Vesalius*, IV 2, 69-78 (1998).
[24] Andreas-Holger Maehle, *Drugs on trial. Experimental pharmacology and therapeutic innovation in the eighteenth century* (Amsterdam etc. 1999) 133.
[25] Owsei Temkin, "Fernel, Joubert, and Erastus on the specificity of cathartic drugs", in: Allen G. Debus, ed., *Science, medicine and society in the Renaissance: essays to honor Walter Pagel* vol. 1 no. 1 (London 1972) 61-68.
[26] Schweikardt, "How do cathartic drugs act?", *Vesalius*, IV (1998) 9-78.

by Temkin, Schweikardt and Maehle complicate this view by showing that Galenic ideas about how drugs worked to cure, in the sixteenth century at least, were not as holistic as is sometimes assumed. But it was not just this aspect of Dodoneaus' and Heurnius' descriptions of drug properties that is striking. Their works also challenge the existing picture of Dutch medicine in particular, as Galen or his works hardly have a place in it. I will show that studying Galen's place in pharmacological investigations by Dutch physicians sheds new light on how his works were interpreted and appropriated by physicians in the sixteenth and seventeenth century.

Medicine in the Dutch Republic

In 1868 Jelle Banga published his *Geschiedenis van de geneeskunde en van hare beoefenaren in Nederland*, a chronologically arranged series of biographies of Dutch physicians from the early fifteenth century to Herman Boerhaave (1668-1738). Banga had a clear idea of what a good physician was and assessed the physicians he described according to that standard. He found traces of his ideal physician in all the physicians he described. In the introduction of his book, he pointed out what they all had in common.

> When one reads without prejudice, without reluctance our best writers, one will find that their ideas were no fictions, but rather, in the light of the available resources, conclusions from attentive observation and tested experience that always aimed at immediate use for the sufferer. That which repeated observation taught, was well thought-out and applied with trust in cases that seemed similar. Sense deception may have confounded them. This was inevitable. Still, all striving was for a rational empirical method of treatment. Hippocrates, who they read with the greatest esteem and attention, was their example.[27]

It is noteworthy that Dutch physicians were similarly portrayed in the most broadly conceived work about medicine in the early Dutch Republic since Banga's *History*. In his *Matters of exchange* (2007), Harold Cook combined the history of science and medicine with cultural history. Cook's approach brought together a broad range of sources, primary and secondary,

[27] Jelle Banga, *Geschiedenis van de geneeskunde en van hare beoefenaren in Nederland, vóór en na de stichting der hoogeschool te Leiden tot aan den dood van Boerhaave; uit de bronnen toegelicht* (Leeuwarden 1868[1]). Facs. with intr. Gerrit Arie Lindeboom (Schiedam 1975) VI-VII.

and showed how philosophy, both natural and political, commerce, natural history, anatomy, theology and to a degree also political history and literature could and should be considered together. Cook situated a number of leading Dutch physicians in the cultural life of the Republic. He emphasised the value they attached to experience and observation and their interest in practical medicine and the work of Hippocrates. Cook argued that the preoccupation of Dutch citizens with trade fostered an environment in which "matters of fact" were an especially valued kind of knowledge.[28] In Cook's account there was great continuity and uniformity in the kind of natural knowledge that the Dutch appreciated.

In the accounts of Banga and Cook, Dutch medicine had it's own particular character. Yet when we compare the work of Dutch physicians from different generations, we see that alongside the coherence that Banga and Cook emphasised, there was change and variation as well. The medicine of Johannes Heurnius (1543-1601) and Franciscus Sylvius (1614–1672) was not the same. Jacobus Bontius (1591–1631) investigated Asiatic medicine differently in the Dutch East Indies than Willem ten Rhijne (1647-1700)[29] and Andreas Cleyer (1634–1697/1698) did in Japan. Furthermore, besides a preoccupation with experience and observation, many Dutch physicians displayed an interest in reason and causes. It is this variation and the relationship between experience, reason and observation that I aim to investigate.

Thus the Dutch situation is particularly intriguing. How can the discussions of pharmacology by Dodonaeus and Heurnius be understood within the history of Dutch medicine? In order to answer this question it is helpful to consider some of the existing historiography on Galenism and Hippocratism in the sixteenth and seventeenth century.

Galenism and Hippocratism

Owsei Temkin's account of Galenism in particular has been influential. Temkin treated Galenism as a coherent medical philosophy with characteristics that can be clearly distinguished and traced through time. The subtitle of his work *Galenism. Rise and decline of a medical philosophy* (1973) indicates that according to Temkin a major change occurred in the seventeenth century. As he wrote, "Galenism was implicated in the downfall of

[28] Harold Cook, *Matters of exchange: commerce, medicine, and science in the Dutch Golden Age* (New Haven 2007).
[29] cf. Antonio Clericuzio, *Elements principles and corpuscles. A study of atomism and chemistry in the seventeenth century* (Dordrecht etc. 2000) 189-190 about ten Rhyne's adoption of the corpuscular theory.

Aristotelian physics".[30] Galenism either was affected by or effected changes in Aristotelian physics. However, it was not replaced by alternative philosophies or by seventeenth-century innovations.

> The defeat which the new mechanistic philosophy and the innovators in anatomy, physiology, and scientific cooperation inflicted upon Galenism can easily lead to the belief that iatromechanics and iatrochemistry, in alliance with new anatomical and physiological discoveries, supplanted Galenism.[31]

Temkin repeated this a few pages further on: "However strong the mechanistic orientation was, and its strength should not be underrated, it nevertheless was not strong enough to replace Galenism as a unifying medical philosophy".[32] In fact, according to Temkin, Galenism had an "afterlife" in the medicine of around 1700. Perhaps he had in mind the comment he made earlier on, proposing that although the medical system developed by Galen lost its authority in the course of the seventeenth century, most of the healing methods it used and supported, continued to be important in the practice of medicine.[33]

Temkin did not define Galenism very clearly and left its afterlife just as undefined.[34] At the same time, he regarded it as a medical philosophy that was accepted or rejected wholesale and did not change over time. Müller has indicated that this is how Galenism is usually, though inadequately portrayed. As he wrote,

> The expression "Galenism" is frequently used as a reference in medical historical writing, although an exact definition is lacking. Generally and without reservation any medicine that is supported by the teachings of Galen is implicated by this term. Since there are nevertheless several phases in the reception of Galen, and since the knowledge of galenic writings and the influence of Galen varied considerably, one should

[30] Owsei Temkin, *Galenism. Rise and decline of a medical philosophy* (Ithaca 1973) 161. In a paper from 1964 he discussed Galenism as a "scientific system" that "succumbed to the Scientific Revolution of the seventeenth century". See Owsei Temkin, "Historical aspects of drug therapy", in: Owsei Temkin, *"On second thought" and other essays in the history of medicine and science* (Baltimore and London 2002) 152-153 and in: Paul Talalay, *Drugs in our society* (Baltimore 1964) 3-16.
[31] Temkin, *Galenism,* 174.
[32] Ibid., 178.
[33] Ibid., 165.
[34] Ibid., 179-181.

> actually speak of many distinct Galenisms that were still rather fenced off from each other at first.[35]

In this regard, a comparison between Temkin's rendering of Galenism and the historiography on Hippocratism is enlightening. In David Cantor's account of that historiography, "Hippocratic values" too were regarded as "unproblematic and unchanging" and historians often told "stories of decline and degradation".[36] We find, then, an essentialist tendency in the historiography of both Galenism and Hippocratism.

There are important differences between these cases as well however. As Cantor mentioned, the historiography on Hippocrates concentrated on his epistemology and ethics. The historical writing on Galenism however has tended to focus not only on his epistemology, but also on his ideas on the body and disease. Furthermore, Hippocrates has a progressive reputation, while Galen is associated with the kind of medicine that had to be rejected before modern medicine could emerge. The decline of Hippocratism is seen as deplorable, while that of Galenism is regarded favourably. It puts a physician in a positive light to call him Hippocratic, while it denotes a physician as conservative and counterproductive when he is called Galenic.

How the writing of past physicians shaped these reputations was superbly examined in the essays assembled in *Reinventing Hippocrates* (2002). Andrew Cunningham especially investigated "how the old team of Hippocrates and his interpreter Galen became separated and how Hippocrates thrived on the separation while Galen became dismissed".[37] In the process, these historians presented Hippocratism as something that was continuously reinvented, as the title put it. In this way, the approach developed in *Reinventing Hippocrates* provided an alternative to the essentialism in the history of Hippocratism that we observed earlier.

Conflicts between Galenic physicians and competing medical practitioners have often been taken as the core issue to be investigated in the historical literature on seventeenth-

[35] Ingo Wilhelm Müller, *Iatromechanische Theorie und arztliche Praxis im Vergleich zur galenischen Medizin (Friedrich Hoffmann, Pieter van Foreest, Jan van Heurne)* (Stuttgart 1991) 37. "Der Ausdruck "Galenismus" wird als Schlagwort in der Medizingeschichtsschreibung häufig gebraucht, obwohl er einer exakten Definition entbehrt. Meist wird damit pauschal jede Medizin bezeichnet, die sich auf die Lehren Galens stützt. Da es jedoch mehrere Phasen der Galenrezeption gab, die Kenntnis der galenischen Schriften und der Einfluss Galens sehr differierten, müsste man eigentlich von vielen unterschiedlichen Galenismen sprechen, die freilich erst noch voneinander abzugrenzen waren."

[36] David Cantor, *Reinventing Hippocrates* (Aldershot 2002) 2.

[37] Ibid., particularly: Thomas Rütten, "Hippocrates and the construction of 'progress' in sixteenth- and seventeenth-century medicine", 37-88; Andrew Cunningham, "The transformation of Hippocrates in seventeenth-century Britain", 91-115, specifically 92.

century medicine in Britain.[38] The essays on the seventeenth and eighteenth century in *Reinventing Hippocrates* similarly take the competition between various groups of physicians in Britain as an important contextual circumstance in the appropriation of Hippocrates' name. One author explicitly viewed the choice between Galen and Hippocrates as a British phenomenon. Robert Martenson wrote:

> What interests me most is not so much why early Georgian Britain jettisoned the anatomical or Galenic tradition and its emphasis on aetiology and structure/function relationships to go 'Hippocratic' but, rather, why influential physicians and others during the Restoration felt they had to choose between Hippocrates and Galen – that is, between the 'natural history method' and the anatomical approach.

He observed that this did not seem to be the case for their predecessors, nor for their continental contemporaries.[39] Temkin did not make such geographical distinctions and his view of a decline of the Galenic tradition in the seventeenth century and its association with the dissolution of Aristotelian philosophy was an influential one.

It was for instance broadly repeated in the cover text to Roger French's *Medicine before science* (2003).[40] This states that the book's "main focus is on the European Latin tradition of medicine, reconstructed from ancient sources and relying heavily on natural philosophy for its explanatory power. This philosophy collapsed in the 'Scientific Revolution', and left the learned and rational doctor in crisis". French surveyed the history of medicine from Antiquity to the Enlightenment from the perspective of "the rational and learned doctor" who "wanted to be successful".[41] Although he did not speak of Galenism but of the western Latin tradition, similarly to Temkin he assumed that in the seventeenth century,

[38] Harold J. Cook, *The decline of the old medical regime in Stuart London* (Ithaca and London 1986); Harold J. Cook, *Trials of an ordinary doctor: Joannes Groenevelt in seventeenth-century London* (Baltimore 1994); Harold J. Cook, "Good advice and little medicine: the professional authority of early modern English physicians", *Journal of British studies* vol. 33 no. 1 (1994) 1-31; Margaret Pelling and Frances White, *Medical conflicts in early modern London. Patronage, physicians, and irregular practitioners 1550-1640* (Oxford 2003); Deborah E. Harkness, *The jewel house. Elizabeth London and the Scientific Revolution* (New York 2007) 57-96. Chap. 2: "The contest over medical authority. Valentine Russwurin and the Barber-Surgeons", in: Mark Jenner and Patrick Wallis, ed., *Medicine and the market in England and its colonies, c. 1450-c. 1850* (Basingstoke 2007).

[39] Robert L. Martensen, "Hippocrates and the politics of medical knowledge in early modern England", in: David Cantor, ed., *Reinventing Hippocrates* (Aldershot 2002) 116-135, specifically 124.

[40] Roger French, *Medicine before science: the rational and learned doctor from the Middle Ages to the Enlightenment* (Cambridge 2003).

[41] French himself might have been more nuanced in describing the main massage of his book. It was published posthumously.

Aristotelianism could no longer provide firm philosophical foundations for medicine as it was criticised from many different angles. Taking his lead from Webster, French characterised the period between the late 1620s and the second half of the seventeenth century as one of crisis for academic medicine.[42] According to him, physicians experienced a crisis of theory in this period as the authority of both Galen and Hippocrates, or what he called "the Latin tradition" declined.[43]

More than Temkin, French discussed different views of physicians on "the natural powers of things" in the late sixteenth and seventeenth century. He described these views mainly in terms of the difference between the Aristotelian elementary qualities, the Galenic concept of the power of "the whole substance" of a drug and neo-Platonic occult qualities.[44] In the final chapter, he referred back to these earlier discussions as he summarised the changes that had taken place in pharmacology at the end of the seventeenth century. Like Temkin, French claimed that one of the two areas of medical learning that had survived the crisis of medical theory was "knowledge of the powers of natural substances". French suggested that this type of knowledge had lost something as well, however. This was "the theoretical apparatus, the intension and remission of qualities, the doctrine of change of substantial form in the 'fermentation' of compounds and the mathematics of dosage."[45]

It may well have been the case that while changes in theory occurred, physicians continued to rely on the same properties of drugs as before, as both Temkin and French stated. From their accounts, however, this is not evident, since they did not specifically study the investigation of drug properties or its role in medicine. French's comments do confirm that Galenic pharmacology in the sixteenth and seventeenth century was more complicated than it is most often presented in historiography.

The historiography on Hippocratism offers a suitable approach to understanding how discussions of pharmacology, such as those by Dodonaeus and Heurnius, might fit in the history of Dutch medicine. The essays in *Reinventing Hippocrates* critically assessed how historiography shaped the reputations of both Hippocrates and Galen as later physicians appropriated their work and names. In my rendering of what happened to the consideration of drug properties in the sixteenth and seventeenth century, Galenism similarly should be seen as more fluid than as a unitary, unchanging medical philosophy. Charles Webster actually

[42] Charles Webster, "William Harvey and the crisis of medicine in Jacobean England", in: Jerome J. Bylebyl, ed., *William Harvey and his age. The professional and social context of the discovery of the circulation* (Baltimore 1979); French, *Medicine*, 157.
[43] French, *Medicine*, 4-5, 157.
[44] Ibid., 160.
[45] Ibid., 189-190.

considered such fluidity to be a sixteenth-century development. In his classic *The great instauration*, he argued that already in the sixteenth century, "Galenic medicine was less and less conceived as a closed and authoritative system" and added that contempt for the classical medical inheritance was shown in a wide range of vernacular medical works in the sixteenth century".[46] More recent analyses of the letters of sixteenth-century physicians extend this observation. These letters were a medium through which physicians engaged in a great variety of debates and they show the readiness of some to reject specific opinions of Galen. Nancy Siraisi has noted that the writers of these letters were "divided in their degree of openness to the critiques of Galen and other standard medical authorities". In the letters different opinions about the properties of medical materials were also exchanged.[47]

But this historiography does still invite further questions about the development of medicine in the Dutch Republic, to which a study of the investigation of drug properties can offer a partial answer. Martenson pointed out that the continental, and thus the Dutch situation was different from the English one, but how was it different? Was French right to suggest that Dutch physicians also experienced a "crisis of theory"? Was the rejection of Galenism indeed implicated in the downfall of Artistotelian physics, as Temkin declared? Or was there much rather continuity in how physicians investigated nature, as Banga's *Geschiedenis* and Cook's *Matters of exchange* put forward? Did perhaps something similar to the transformation of Hippocrates, as it was demonstrated in *Reinventing Hippocrates*, happen in the Dutch Republic? And finally, what did this mean for the study of drug properties? How were developments in this field of study related to the great changes in medicine, philosophy and the study of plants, animals and minerals that historians have called the Scientific Revolution?

The organisation of the dissertation

The year 1575 is a natural starting point of my investigations since the University of Leiden was established in that year. The establishment of this first university of the Northern Netherlands by the States of Holland was the direct result of the struggle of the city against the rule of Spanish king Philip II (1527–1598).[48] The university was not only situated near the place of government in The Hague, it was also under the administration of the States of

[46] Charles Webster, *The great instauration. Science, medicine and reform 1626-1660* (London 1975) 248.
[47] Nancy Siraisi, *Communities of learned experience. Epistolary medicine in the Renaissance* (Baltimore 2013) 11, 31-32.
[48] G.A. Lindeboom remarked on the importance of this context as well. Lindeboom, "Medical education in The Netherlands 1575-1750", in: Charles Donald O'Malley, *The history of medical education* (Berkeley etc. 1970) 201-216, specifically 201-202.

Holland and representatives of the city of Leiden. Culturally speaking, Jan Waszink regarded the university as a kind of court to the government in The Hague, where the future elite of Holland was educated.[49] The university is therefore inextricably tied to the formation of the Dutch Republic as an independent state with its own intellectual culture and institutions.

The medical curriculum of the university became influential both in the Republic and outside of it. My investigation of the study of drug properties in the Dutch Republic starts here. However, developments elsewhere and earlier in the sixteenth century needed to be examined as well. Besides the University of Leiden, several other institutions were established between 1575 and 1700 where medicine or aspects of it were taught. While the medical curriculum in Leiden functioned as the starting point in this dissertation, some of these other institutions will also make their appearance from time to time. Each chapter is dedicated to an episode in the history of pharmacology; the intermezzos link these episodes together.

First, I will consider how the properties of drugs and their investigation were discussed as part of the teaching of *materia medica* at the University of Leiden from the establishment of lessons on 'herbs' in 1587 to the year of the death of its second prefect, medical professor Pieter Paaw or Petrus Pavius (1564-1617). The introduction of such a course and the establishment of the first academic garden in the Dutch Republic in 1594 were in line with an academic tradition that developed in the sixteenth century. The garden also attracted students and added prestige to the university. How was the subject of *materia medica* as it was taught in Leiden situated between medicine, botany and natural history? Paaw combined these subjects in one course. He taught from Pietro Andrea Mattioli's (1501-1577) commentaries on *De materia medica* by Pedanius Dioscorides (40-90 AD). In the introduction, Dioscorides rejected philosophising about the properties of drugs and investigating their causes. Instead, he described how medical materials worked in the body. A few centuries after Dioscorides, Galen did investigate the causes of the properties of drugs. Matttioli included Galen's writings in his commentary.

In the first intermezzo, I introduce *Isagoges in rem herbariam* (1606), a work by Adriaan van den Spiegel or Adrianus Spigelius (1578–1625). Spigelius, a former student at the University of Leiden, moved to Padua some time after 1592 where he eventually became a successful practitioner of medicine and professor of anatomy. His first book, published in Padua in 1606, was on the study of plants, and it considered the appearance of plants separately from their medicinal properties. By relying on Theophrastus' work in writing about

[49] Jan Waszink, "The ideal of the statesman-historian: the case of Hugo Grotius", in: Jan Hartman, *Public offices, personal demands* (Newcastle 2009) 101-123, specifically 106-107.

the appearance of plants, Spigelius set an example for his student Aldophus Vorstius (1597-1663). In *Isagoges*, Spigelius described drug properties in largely the same way as three other authors connected to the University of Leiden. It is to these authors that I will turn in the next two chapters.

Like Spigelius, Dodonaeus, Heurnius and Gilbertus Jacchaeus or Gilbert Jack (ca.1585-1628) included an account of the properties of drugs within a Galenic framework. They focused on three aspects of Galen's writings on the subject: the faculties of drugs, taste and the way drug properties should be investigated through reason, experience and the senses. Besides introducing this particular way of discussing the properties of drugs, I investigate the different relationships to the study of plants in the work of Dodonaeus and Heurnius.

The investigation of the medicinal properties of plants and their appearance were interconnected in Dodonaeus' herbals and his *Stirpium historiae pemptades sex*. While the study of plants was central to Dodoneaus' study of drug properties, this was not the case for Heurnius. In his innovative and influential textbook *Institutiones medicinae* or "the principles of medicine" (1592), Heurnius and his former student Paaw assembled the most important parts of both the theory and practice of medicine into one volume and presented it as a consistent, comprehensive whole. By studying the *methodus medendi*, the rational method of healing already discussed by Galen, and by developing it further, Renaissance physicians hoped to overcome the division between medical theory and practice that was implemented in medieval universities and thus to restore the connection between the two as envisioned by Galen. Figuring out how drug properties were related to each other and how they worked to cure diseases became a core problem for maintaining a medical practice that was both rational and effective.

In the second intermezzo, I discuss the sixty-sixth aphorism of the first book of *Novum organum* (1620) by Francis Bacon (1561–1626). Bacon commented on current developments in medicine, physics and natural history, approving of some of these, while criticising others. He reflected on the way physicians like Dodonaeus, Heurnius, Spigelius and Jacchaeus studied the properties of drugs. This shows that Bacon was well aware that physicians paid attention to how drugs worked in the body and viewed this positively. In this respect, all who studied natural things should follow the example that physicians set.

Chapter three delves deeper into some especially problematic aspects of the representation of the properties of *materia medica* by Dodonaeus, Heurnius, Spigelius and Jacchaeus. I turn my attention to the way in which taste, reason and experience were interrelated according to them. In their discussions, they built on the work of such sixteenth-

century authors as Euricius Cordus (1486-1535), Fernel, Fuchs and Mattioli. Their discussions about the relationship between the senses, reason and experience will help us understand the seventeenth-century criticism of Galenic medicine. It will also indicate the importance of discussions about *materia medica* for ideas regarding the properties and the composition of matter proposed in this period. Knowledge from taste and the other senses has been characterised as a type of experience. In these sixteenth- and seventeenth-century texts, however, the senses were considered for their role in the process of reasoning about the properties of simple drugs. This way of investigating drugs was taught at the University of Leiden from the 1580s up to the 1650s. Yet after 1624 no new textbooks that described this way of investigating drugs were produced.

In the third intermezzo, I evaluate French's idea about the crisis of theory in seventeenth-century medicine as well as Cook's view of Dutch medicine as based in the Hippocratic corpus and practical medicine, in light of the foregoing chapters. An examination of Heurnius' teaching and writing on the origin of medicine shows, that Galen heavily influenced both his view of Hippocrates and his definition of the art of healing. In writing about the history of medicine, Heurnius defined the art of healing by its ability to identify causes. As we observed in the preceding chapters, the causes for the operations of drugs in the body, presented in his textbook, were considered problematic.

Keeping this in mind, I will next investigate how the Galenic framework for the understanding of drug properties was received from 1600 to 1655. I will first analyse how the brothers Van Ravelingen translated and reworked Dodonaeus' *Stirpium* description in their Dutch translation of it.[50] Some decades later, physician Johan van Beverwijck (1594-1647) used his historical and rhetorical education to defend learned medicine against the critique of Michel de Montaigne (1533-1592). He addressed the elite citizens of the Dutch Republic and presented a kind of medicine that would make him a household name in seventeenth century Dutch medicine. While Van Beverwijck was not very interested in matter theory, other physicians were. Both Isaac Beeckman (1588-1637) and Henricus Regius (1598-1679) explained the operations of drugs on the basis of a corpuscular view of matter. Contrarily, Albert Kyper (1614-1655), who became a professor in Leiden in 1650, was not interested in matter theory and did not engage in "subtle disputations". In his *Institutiones medicae* of 1654, he largely ignored the framework that his predecessors had designed for the understanding of drug properties. Although Regius and Kyper had very different views on the

[50] Rembertus Dodonæus, *Cruydt-boeck: volgens sijne laetste verbeteringe* (Leiden 1608).

relationship between physics and medicine, they agreed that the medicinal properties of drugs could only be established through experience.

From the 1660s onwards the properties of drugs and how to investigate them became a topic of debate in the Dutch Republic once again and perhaps even more than ever. Not only did Dutch physicians publish texts on this subject, the work of physicians such as Sylvius and Reinier de Graaf or Reijnerus de Graeff (1641-1671) provided starting points to study the properties of drugs. There is no doubt that discussions of drugs were part of much broader discussions about physiology inspired by chemical experiments, corpuscular theories of matter and by anatomical research. Some of these discussions have been investigated by others, while others still remain to be explored.[51]

Historians of pharmacy have pointed to the distrust towards apothecaries in the seventeenth century. Cartesian physician Theodorus Schoon (1653-?) used the suspicion of the practices of apothecaries and physicians to defend his independent position as a physician. In the final decades of the seventeenth century, he argued for the primacy of reason in investigating nature and advertised his own expertise in producing drugs. The physician who published a response to Schoon's critique still appealed to the Galenic tenet that the properties of drugs should be investigated through both reason and experience.

The last chapter will focus on the final quarter of the seventeenth century. Encouraged by the works of Thomas Willis (1621–1675), two Dutch physicians, Steven Blankaart (1650-1704) and Antonie de Heide (1646-circa 1702), considered how they could improve the knowledge of drug properties by the use of chemistry, reason, anatomy, analogy, magnifying glasses and drug testing. While they did not come to a definitive solution to their problem, their explorations show some of the challenges that physicians faced in using innovative ways

[51] Antonie Maria Luyendijk-Elshout, "Oeconomia animalis, pores and particles: the rise and fall of the mechanical school of Theodoor Craanen", in: Theodoor Herman Lunsingh Scheurleer, *et al.*, eds., *Leiden University in the seventeenth century: an exchange of learning* (Leiden 1975) 294-308; Edward G. Ruestow, *The microscope in the Dutch Republic.The shaping of discovery* (Cambridge 1996) 40 n. 25; Thomas Peter Gariepy, *Mechanism without metaphysics: Henricus Regius and the establishment of Cartesian medicine* ([S.l.]:[s.n.] 1991); Evan Ragland, *Experimenting with chemical bodies: science, medicine, and philosophy in the long history of Renier de Graaf's experiments on digestion, from Harvey and Descartes to Claude Bernard* diss. (Indiana University 2012) the research of Reinier de Graaf or Reijnerus de Graeff (1641-1671) into digestion provided starting off points to study the properties of drugs. Ragland discusses for example of the response of Johann Nicolas Pechlin (1644-1706) to the work of De Graaf in his *De purgantium medicamentorum facultatibus exercitation nova* (Leiden 1672). For the situation in Denmark see i.a.: Martha Baldwin, "Expanding the therapeutic canon: learned medicine listens to folk medicine", in: James Van Horn Melton, *Cultures of communication from Reformation to Enlightenment constructing publics in the early modern German lands* (Aldershot etc. 2002). She touches upon i.a. the work of Hermann Grube (1637-1698). This municipal physician at Haderslev dedicated his *Commentarius De modo simplicium medicamentorum facultates cognoscendi* (Copenhagen 1669) entirely to the subject of how to investigate the faculties of simple drugs. The letter from Thomas Bartholin (1616-1680) about this subject served as a preface to the book and provided an account of the current state of the discussion in Denmark.

of investigating nature to improve the practice of medicine and in establishing what principles this practice was based on.

Finally, in the conclusion, I shall draw together the different perspectives that the preceding chapters have offered on the importance of Galen's work for the investigation of drug properties in the Dutch Republic. The investigation of drug properties did not only reflect changes that occurred in fields of inquiry that are traditionally studied separately, such as natural philosophy, medicine, botany, chemistry and natural history. It contributed to these changes as well, as is shown by considering it more closely in its own right.

Chapter 1

Teaching materia medica at Leiden University. Between natural history, botany and the foundations of medicine (1587-1617)

Introduction

In the last decades many studies about the history of botany and natural history in the sixteenth century have pointed out the close relationship between botany, natural history and medicine. Some of these analyse the development of botany and natural history into academic fields of study in more detail. In her studies of the Universities of Montpellier and Basel for example, Karen Reeds considered universities as places where people with an interest in plants could meet and could take basic courses in the study of these plants as medical materials.[52] Paula Findlen has shown how botany and natural history developed as academic fields of study at Italian universities, arguing that being knowledgeable about materials became a basic requirement for Italian physicians during the second half of the sixteenth century. Especially Ulisse Aldrovandi's appointment at the University of Bologna to lecture on *fossilibus, plantis et animalibus*[53] was an important development in establishing natural history as an academic subject. Aldrovandi in particular exploited the connection of these materials with medicine by moving away from this subject and at the same time claiming the importance of his courses for it.[54]

In this chapter the connection between the study of medicine and the study of plants in an academic context is examined more specifically. I consider the teaching of the *materiae medicae* at the University of Leiden from the establishment of lessons on "herbs" in 1587 and the establishment of the first academic garden in the Dutch Republic in 1594 to about 1617. I will show how the subject of *materia medica* can be situated between the traditionally academic study of medicine and the newly introduced subjects of botany and natural history. I will argue that these three subjects offered sometimes-conflicting ways of investigating plants and their properties. Still, professor Pieter Paaw managed to combine them in one course with some measure of success.

A botanical garden or a place to teach medicine?

In the preface to his *Primitiæ anatomicae* of 1615, Paaw looked back on his performance as medical professor teaching anatomy and botany at the University of Leiden. Paaw had been

[52] A forthcoming study by Gillian Lewis should shed more light on the teaching of medicine, botany and natural history at the University in Montpellier in the sixteenth century.
[53] *Fossiles* generally referred to all materials dug up from the ground. See Martin Rudwick's discussion of Conrad Gesner's *On fossil objects*. Martin Rudwick, *The meaning of fossils. Episodes in the history of palaeontology* (London and New York 1972) 1-48, specifically 2, 23, 44.
[54] Paula Findlen, *Possessing nature. Museums, collecting, and scientific culture in early modern Italy* (Berkeley 1996) 253-255.

appointed as extraordinary professor of medicine in 1589 to assist professor Gerardus Bontius (1538-1599) in his teaching of botany. From that point onwards and for the remainder of his life, he continued to be involved with teaching botany and with the academic garden that was established there in 1594 as part of the medical faculty. Paaw insisted that without the consideration of the human body and of plants, all medicine was necessarily barren and lifeless. Field excursions, visits to the garden and lectures from Dioscorides' *De materia medica*[55] were all part of the picture he presented of his teaching program. He told his readers that, in the summer months, he taught his students how to recognise different plants, including many exotic and rare ones, and set forth "the nature, powers and the affinities" of these plants to his listeners. Furthermore, he carried out the "not inglorious work of medicine" in fields, dunes, forests, and marches with his students. In addition he explained Dioscorides in daily lectures, so that students would hear again what they had *seen* in the garden.[56]

Some questions still surround the teaching of the *materiae medicae* in Leiden however and I will consider these by focusing on Paaw's role as keeper of the garden and as teacher of medical students. Questions have been raised about the nature of the garden that Paaw taught in. The historians Gerard Suringar, Just Kroon, Harm Beukers and Claudia Swan viewed the garden primarily as a site for the teaching of medical students. The garden after all was part of the medical faculty and medical students could learn about the plants they prescribed as drugs there.[57] Hesso Veendorp and Lourens Baas Becking, but also more recent authors such as Leslie Tjon Sie Fat, Florike Egmond and Erik de Jong argued however that the garden and its associated buildings can be considered as botanical or even generally natural historical in

[55] Many editions of this work were published throughout the sixteenth century, most with commentary by Pietro Andrea Mattioli (1501-1577), first published in 1544.

[56] Petrus Pavius, *Primitiæ anatomicæ. De humani corporis ossibus* (Leiden 1615). Praefatio, *ij(r-v). Haec, ut aestivis; illa ut hibernis mensibus iuventus medicinae operata, pro anni tempore exerceretur, in humani corporis, & plantarum consideratione, sine quam necesse est, omnem medicinam ieiunam esse atque exsanguem. Utrumque feci hactenus strenuè ac pro virili. Hortus mihi concessus crevit insigni stirpium varietata, quarum plaeraeque rarae & exoticae. Eas ordine examinavi per aestatem, earumque naturam, vires, adfectionesque auditoribus meis ostendi, bis decurso aestivis mensibus hoc stadio. Etiam quum occasio id tulit (tulit autem quot annis ter, quarterue) modò in pratis, modò in collibus, modò in silvis & nemoribus, modò in locis palustribus non ingloriam operam medicinae studiosis praestiti. Eidem fini Dioscoridem quoque (gravem, Deus bone etc vetustum Scriptorum) explicavi quotidie: ut quae in horto vidissent spectatores, ea pro lectione audirent discerentque auditores, atque ita gemino sensu viam sibi ad nostram facerent disciplinam.

[57] Just E. Kroon, *Bijdragen tot de geschiedenis van het geneeskundig onderwijs aan de Leidse universiteit 1575-1625* (Leiden 1911) 29; Gerard C.B. Suringar, "III Over de beoefening der voorbereidende en hulp-wetenschappen bij de medische studie aan de Leidsche Hoogeschool, gedurende de eerste halve eeuw van haar bestaan, inzonderheid over den aanvang en de eerste lotgevallen van het botanisch onderwijs", *Bijdragen tot de geschiedenis van het geneeskundig onderwijs aan* de *Leidse hoogeschool* (Amsterdam 1860-1870) 1-55, specifically 15, 19, 21; Lindeboom, "Medical education", 202; Harm Beukers, "Studying medicine in Leiden in the 1630s", in: Kathryn Murphy and Richard Todd, eds., *"A man very well studyed". New context for Thomas Browne* (Leiden 2008) 49-66; Claudia Swan, *Jacques de Gheyn II and the representation of the natural world in The Netherlands ca. 1600* (Ann Arbor, MI 1997).

nature.[58] These authors have stressed that the content of the garden was not particularly medical. They have pointed to the presence of many rare and exotic plants in the garden and some have even suggested that the organization of the plants in the garden was "surprisingly modern".[59] Modern that is from a present botanist's point of view.

As we can see, both these characterizations of the garden are reflected in Paaw's comments on his teaching habits in *Primitiæ anatomicæ*. He pointed out that he could show many rare and exotic plants in the garden, but he also mentions that he would discuss the properties of the plants in his lessons there. The difference of opinion among modern historians about the nature of the garden seems to indicate that the combination of these two purposes may not have been so natural or complementary as Paaw made it appear. Was Paaw aware of any such tension? How did he deal with the relationship between medicine and the emerging academic subjects of natural history and botany? To answer this question a few related issues should be considered. For one, we can wonder what kind of knowledge of medicinal plants could be taught in the garden. What kind of plants was present there? Secondly, we should ask how Paaw's teaching program was put together. What examples did Paaw and his colleagues follow when they started teaching botany in Leiden? Furthermore, we have to look more closely to the role Dioscorides' text played in Paaw's teaching. How were the medicinal properties of plants presented in it and how was the text related to Paaw's teaching in the garden? Finally, we can consider the place of *materiae medicae* that were not based on plants within Paaw's teaching. Paaw did not mention such lessons in *Primitiæ anatomicæ*, but they were certainly part of his responsibilities according to his job description issued by the governors of the university.[60]

Findlen pointed out that, "the efforts of the first professors of natural history and the early custodians of museum and botanical gardens opened up the study of *materia medica* to a wider audience than it previously embraced".[61] The questions I posed in regard to the teaching of *materia medica* are also relevant therefore if we want to find out how the particular approach to plants and other natural materials that was developed in the sixteenth century, affected the way physicians saw and investigated the materials they used as drugs. If

[58] Hesso Veendorp and Lourens G.M. Baas Becking, *Hortus academicus Lugduno Batavus 1587-1937*, (Haarlem 1938) 38; Leslie Tjon Sie Fat, "'Clusius' Garden: a reconstruction", in: Leslie Tjon Sie Fat and Erik de Jong, eds., *The authentic garden: a symposium on gardens* (Leiden 1991) 3-12, specifically 7, 8; Erik de Jong, "Nature and art. The Leiden Hortus as 'Musaeum'", in: Tjon Sie Fat and De Jong, eds., *The authentic garden*, 37-60, particularly 21; Florike Egmond, *The world of Carolus Clusius: natural history in the making, 1550-1610* (London 2010) 158.
[59] Tjon Sie Fat, "'Clusius' Garden", 7.
[60] Philipp C. Molhuysen, *Bronnen tot de geschiedenis der Leidsche universiteit* pt. 1, GS 20 (The Hague 1913-1924) 112-114.
[61] Findlen, *Possessing nature*, 261.

a broader audience was introduced to studying the *materiae medicae*, what were they actually taught?

The foundation and content of the garden

The initiative to establish an academic garden had been taken in 1587, twelve years after the establishment of the university itself. Nothing had come of the plan however besides reserving a space for it behind the academy building. The efforts to establish such a garden from 1590 onwards were more successful. A prefect for the garden was eventually found in the person of renowned botanist Carolus Clusius (1526-1609), who arrived in Leiden in October 1593. In the spring of the next year, Theodorus Outgersz. Cluyt, also called Dirck Cluyt, was brought in as his assistant. Cluyt (1546-98), an apothecary from Delft, became responsible for the upkeep and daily running of the garden.[62] In his assignment the curators made it clear that the university garden was supposed to be of "service and progress of the study of medicine".[63] Clusius and Cluyt were particularly involved with the creation of the garden. In the spring and summer of that year they laid out and planted the garden with the help of some assistants.[64]

In their orders to the newly appointed ordinary professor of medicine Paaw in May of 1592, the curators of the university were not specific about what kind of plants should be in the garden. Paaw was told to assemble all kinds of shoots, herbs, shrubberies, flowers and other garden related things for the garden. Apparently Paaw's involvement with the establishment of the garden remained limited. As his assignment suggested, he was helped greatly by "garden and plant lovers".[65] Clusius and Cluyt carried a much greater responsibility for the organization and layout of the garden and for supplying plants for it. Clusius sent seeds to Leiden twice, in the autumn of 1592 and the spring 1593.[66] In 1594 Cluyt transferred most of the plants in his garden in Delft to Leiden. The content of the garden thus reflected

[62] Else M. Terwen-Dionisius, "De eerste ontwerpen voor de Leidse Hortus", in: Jannis Willem Marsilje *et al.*, eds., *Uit Leidse bron geleverd. Studies over Leiden en de Leidenaren in het verleden, aangeboden aan drs. B.N. Leverland bij zijn afscheid als adjunct-archivaris van het Leidse Gemeentearchief* (Leiden 1989) 392-400, 392; Ronald G.H. Sluijter, *'Tot ciraet, vermeerderinge ende heerlyckmaeckinge der universiteyt'. Bestuur, instellingen, personeel en financiën van de Leidse universiteit, 1575-1812* (Hilversum 2004) 64; Molhuysen, *Bronnen* pt. 1, 71, 83; Veendorp and Baas Becking, *Hortus academicus*, 27, 36.
[63] Kroon, *Bijdragen*, 81; Molhuysen, *Bronnen* , pt. 1, 295*.
[64] Veendorp and Baas Becking, *Hortus academicus*, 36; Egmond, *World of Clusius*, 157; Sluijter, *'Tot ciraet,* 64-65.
[65] Kroon, *Bijdragen*, 74; Molhuysen, *Bronnen*, pt. 1, 202. "Allen hoff minnaren en der cruyden liefhebberen".
[66] Molhuysen, *Bronnen*, pt. 1, 72, 76, 238*-242*, 258*-259*.

the interests of Clusius and Cluyt.[67] The garden contained plants that were especially known for their medicinal properties but also ones that were appreciated for their rarity and beauty. Based on a manuscript from 1594, known as the *Index stirpium*, Tjon Sie Fat states that, "the traditional medical plants are all there, but these form only about a third of the species in the garden. The other plants were put in to be studied for their own sake, and not because they were of use to man".[68]

Tjon Sie Fat does not list the "traditional medical plants" that he distinguished, and a note must be made on the distinction he makes between medicinal plants versus plants that were not studied for their useful properties. Interestingly, in the preface to his *Primitiæ anatomicæ*, Paaw did not make any distinction between plants that were used in medicine and plants that were not, nor did the garden have a section for medicinal plants set apart from the rest of the garden. This seems to reflect the fact that the distinction between growing a plant for its medicinal properties on the one hand and for its rarity and beauty on the other was not always as clear-cut as Tjon Sie Fat presented it. To give but one example, a rose could be appreciated and kept for its beauty; its pleasant smell could be used to improve bodily odour; its juice, the flowers, leaves and rose hips could be used as a remedy against a variety of afflictions, from diarrhoea, to heart tremor to headaches.[69] Roses then could be kept in a garden for both medical and not-strictly medical purposes. In most cases the categories of medical plants and plants studied and collected for their rarity and exoticism were not mutually exclusive. It is not possible to decide between the two, I would suggest, from looking just at a plant's species, as Tjon Sie Fat seems to have done. One clear exception was the tulip. No medicinal properties were attributed to this plant at the time.

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[67] Egmond, *World of Clusius*, 158, 160; Kroon, *Bijdragen*, 74. Tjon Sie Fat, "'Clusius' Garden", 5; Henriette A. Bosman-Jelgersma, "Dirck Outgaertsz Cluyt: farmaco-historische bijdrage", *Farmaceutisch tijdschrift voor België* vol. 53, no. 6 (1976) 525-548; Veendorp and Baas Becking, *Hortus academicus*, 34-36.

[68] Tjon Sie Fat, "'Clusius' Garden", 6, 7; Anon., *Index stirpium terrae commissarum sub extremum septembrem anni 1594 in Lugdunensi Academiae apud Batavos horto* (Leiden 1985) (photocopy of orig. ms). In the index the content of the garden is recorded as it was around the time of the establishment of the garden. The author is unknown. Since the handwriting doesn't completely match with Clusius', Hunger, Baas Becking and Veendorp assumed it was written by Cluyt. Based on internal evidence Tjon Sie Fat argued that whoever wrote the manuscript, Clusius was responsible for its content.

[69] Pietro Andreas Mattioli, *Commentarij in VI. libros*, *Pedacij Dioscoridis Anazarbei de medica materia* pt. 1 (Venice 1583). Rosa, 167, line 24. Dioscorides: 'Aridis rosis & in vino decoctis expressus liquor, facit ad dolores capitis, aurium, oculorum, gingivarum,…..'. 'Eadem sine expressione tusa, praecordiorum inflammationibus, humidis stomachi vitijs..' 'Folia uruntur in calliblephara. Flos, qui in medijs rosis invenitur, siccatus, gingiuarum fluxionibus efficaciter inspergitur'. Rosa pastilli: 569, line 9. Matt: 'Folia cor, ventriculum, iecur, & retentricem insuper facultatem corroborant: dolores ex calidate provenientes leniunt, & inflammationes auferunt. Ungues etsi propriam a scriptoribus non receperint dotem; inseruntur tamen utiliter lotionibus omnibus, & clysteribus ad inhibendas fluxiones.' 'Mulieribus monilium vice collo circundato usui sunt, ad retundendum grave sudoris virus". Rembert Dodoens, *Cruijdeboeck* (Antwerp 1563). BBB iiij v.: "Dat selve sap es oock goet ghebruyckt tseghen die cloppinghe ende bevinghe van der herten, ..." (heart tremor).

Documents such as the *Index stirpium* show that some species, particularly bulbous ones, such as tulips, daffodils, hyacinths, lilies, crocuses and gladiolas, but also anemones and irises, appeared in the garden in many different varieties. Even though sixteenth century herbals attributed medicinal properties to many of these species, their sheer variety indicates they were not kept in the garden primarily because of these properties.[70] This impression is confirmed by the letters which Outgert Cluyt (1577–1636), Dirck Cluyt's son, sent to Paaw during his travels in Marburg, Frankfurt, Montpellier, the Pyrenees and North Africa.[71] In 1602, Outgert was impressed by the great variety and colours of the plants growing outside Frankfurt. He also sent plants to Leiden, which he had collected during his travels. In a letter from 1604 he mentioned that he sends many plants of a daylily with white flowers and a mountain crocus, also tulips of certain type, three types of daffodils, and a type of hyacinth to Paaw.[72] Three years later, he sent bulbs and seeds to Leiden, which he listed at the end of the letter. Here again we find numerous bulbs of plants such as sea daffodils, hyacinths, daffodils and irises. We also find seeds of plants, which are not particularly medicinal, but not un-medicinal either, such as a variety of *Tithymalus* or Myrtle Spurge and *Cistus* or Rock Rose.[73]

In his letters, Cluyt singled out plants that were also present in the Leiden garden in many varieties and some that were mentioned by Clusius in his *Rariorum plantarum historia* (1601). It seems Cluyt wanted to contribute to the collection of these plants, from the "far-flung and remote places" he had visited, regardless of their medicinal properties.[74] This did not mean that these plants had no medicinal properties; just that this was not the main reason why Cluyt had collected them. He did not, for example, inquire after their medicinal

[70] Anon., *Index stirpium*; Rembert Dodoens, *Cruijdeboeck* (Antwerp 1554) ccxli, ff iii, r and ccxlvi, ffiii, v.
[71] Frans P. M. Francissen and Ad W. M. Mol, *Augerius Clutius and his "De hemerobio", an early work on Ephemeroptera* (Marburg 1984) 17; Veendorp and Baas Becking, *Hortus academicus*, 41.
[72] Letter by Outgert Cluyt to Petrus Pavius, 6 Apr. 1602, in: Molhuysen, *Bronnen,* pt. 1, 436*. "Forte ad urbem Franc. obtulerant sese haec folia trifolii mira varietate et colore udentia et viva speciosa satis, locum unum tantum notavi pedis undequaeque amplitudine porrectum, alio crescentem eo colore herbulam non vidi." Letter by Outgert Cluyt to Petrus Pavius, Juli 1604, in: Molhuysen, *Bronnen*, pt. 1, 439*. "Mitto ad te Liliosphodelum [sic] album florem gerentem, Crocum montanum autumnale, ava [sic] plures plantes [sic], ut Medicè loquar, item Tulipas narbonenses, Pseudonarcissos hisp. maiores, Narcissos Juncifolios Rutensium, Videatur D. Clusius Hyacinthos stellatos, Narcissos pallida corona, plurima semina huius anni, aliquot foliola Tarton-raire [sic], cuius miri sunt effectus; semen eius et Tragacenthae haberi non potest." With 'ut Medicè loquar' Cluyt seems to refer to his use of the word ava, meaning ana, which is Greek in origin and is usually used in drug recipes. Translated here as: 'of each several plants, so I say medically'.
[73] Letter by Outgert Cluyt to Petrus Pavius, Oct. 1607, in: Molhuysen, *Bronnen*, pt. 1, 442*- 443*. He was rewarded for these efforts to collect plants for the garden in 1608. Molhuysen, *Bronnen*, pt. 1, GS 20, 179.
[74] Letter by Outgert Cluyt to Petrus Pavius, Nov. 1603, in: Molhuysen, *Bronnen*, pt. 1, 438*. "…in his distantissimis & remotis locis…". Letter by Outgert Cluyt to Petrus Pavius, Juli 1604, in: Molhuysen, *Bronnen*, pt. 1, 439*. See n. 72. Carolus Clusius, *Rariorum plantarum historia* (Antwerp 1601). Clusius discussed the Hyacinthus stellatus (182-185), the Lilioasphodelius with white flowers (137), the Pseudonarcissus hisp. maiores (165), the Narcissus juncifolium (158-159), the Tulipa narbonensis (151) and the Crocum montanum mentioned by Cluyt. Petrus Pavius, *Hortus publicus academiae Lugduno Batavae eius ichnographia, descripto, usus Petri Pawi* (Leiden 1601). Asphodels, M2 r, Crocuses, M3 r, Hyacinths, M4 r, Narcissi, M5 v.

properties. Apparently, he did pay attention when the properties of a plant were unusual. In the letter from 1604, he did note that the small leaves of *Tarton-raire* or Oval-leaved Daphne, which he sent, had "extraordinary effects".[75] Cluyt's letters show that even though Clusius did not teach in the Leiden garden and his direct role in the garden was indeed very small after 1594, he still influenced its composition through his publications and the tradition of plant collecting he had helped establish.

In at least one other academic garden of the same period, the layout of a garden did divide plants, which were especially useful in medicine from those that were not. Initially, the garden Pierre Richter de Belleval (1564–1632) planted in Montpellier in 1593 did not make such a distinction. Instead the plants were planted in separate gardens according to their natural environment. But by September 1603 a *Jardin medical* had been added to this *Grand jardin*. In this garden, the plants "which are most used in medicine in these times" could be found, arranged in alphabetical order.[76] Only later gardens such as the *Jardin Royal des plantes medicinales* (1635) in Paris were erected with the expressed purpose of finding new ways to combat disease and in which specifically medicinal plants were supposed to be cultivated and their properties examined.[77] In Leiden however, the garden's function as a teaching ground for medical students was closely integrated with its function as a collection of many varieties of plants.

Teaching in the garden and through fieldtrips

Paaw was appointed extraordinary professor of medicine in February 1589 to assist the other two medical professors Bontius and Johannes Heurnius (1543-1601). From at least 1587, around the same time when the first plans for an academic garden were made, Bontius had been teaching anatomy in winter and herbs in the summer to medical students.[78] Specifically mentioned in Paaw's appointment is that the other professors could use him to "explain the

[75] Letter by Outgert Cluyt to Petrus Pavius, July 1604, in: Molhuysen, *Bronnen,* pt. 1, 439*. "…, aliquot foliola Tarton-raire, cuius miri sunt effectus;…..".
[76] Reeds, *Botany*, 80-92, specifically 82, 87. In his letter to Paaw from December 1602, Cluyt reported on his visit to the gardens. Letter by Outgert Cluyt to Petrus Pavius, Nov. 1603, in: Molhuysen*, Bronnen*, pt. 1, 436*-437*.
[77] Nicolas Robin, "Discussing the influence of scientific theories on the design of botanical gardens around 1800", *Studies in the history of gardens and designed landscapes* vol. 28 no. 3-4 (2008) 382-399, specifically 383; Reeds, *Botany*, 87-88; Rio Howard, "Medical politics and the founding of the Jardin des Plantes in Paris", *Journal of the society for the bibliography of natural history* vol. 9 pt. 4 (1980) 395-402, specifically 397-398; Arjen Looyenga, "Vroege botanische tuinen in Europa, met name in de Republiek", in: Ferry Bouman *et al*., eds, *Kruidenier aan de Amstel. De Amsterdamse Hortus volgens Johannes Snippendaal (1646)* (Amsterdam 2007) 13-64, 48-50.
[78] Molhuysen, *Bronnen*, pt. 1, 51.

herbs", but also for anything else for which he was "found to be capable".[79] Exactly how Bontius taught 'herbs' to his students and how Paaw assisted him in this, remains unclear from the records. Apparently the alternative, unspecified occupation that was mentioned in Paaw's job description was indeed found, since on 21 June 1591 Everardus Bronchorst mentioned in his *Diarium* that he attended a lecture by Paaw on Fernels' *Universa medicina*.[80] At the expansion of anatomy teaching and in preparation of the establishment of the garden in 1592, Paaw became ordinary professor in charge of teaching anatomy and botany.[81] From one of the few remaining *series lectionum* of this early period, from the summer semester of 1592, we can learn that Paaw taught Dioscorides' *De materia medica*.[82]

When Clusius came to Leiden, he had been exempted from his educational duties.[83] At Dirck Cluyt's appointment as assistant to Clusius in 1594, it became part of his tasks to assist the "professors of medicine, and others who have been assigned, or will be assigned to explain the herbs" by providing the "herbs, plants, shoots, flowers and such" which that person needed for his lessons.[84] From this description it appears that a clear distinction was made between two tasks. The professor determined the subject of the lessons and taught them; his assistant provided him with suitable materials.[85] It has been claimed that Cluyt taught in the garden[86], although he was expressly 'gevryt' or released from the duty of explaining the powers of the herbs in the summer months and those of minerals in the winter months.[87] An interesting request that was made after his death early in 1598, indicates only that his great knowledge of plants was much appreciated by students.

In the late spring, seventeen students asked for the appointment of his son Outgert, then nearly 21 years old, as his successor. They praised Dirck Cluyt for his knowledge as "simplicist" of field and garden herbs, of dried plants, minerals and the preparation of medicines. So much so, that they would not have had to visit another university so readily or

[79] Kroon, *Bijdragen*, bijlage VI; Molhuysen, *Bronnen*, pt. 1, 55.
[80] Everardus Bronchorst and J.C. van Slee, ed., *Diarium Everardi Bronchorstii sive Adversaria omnium quae gesta sunt in Academia Leydensi (1591-1627)* (The Hague 1898) 19. At the time Bronchorst (1554-1627) was professor of civil law in Leiden.
[81] Molhuysen, *Bronnen*, pt. 1, 68, 70.
[82] Ibidem, 191*-192*. "Catalogus Lectionum. March 1, 1592"
[83] Friedrich W. T. Hunger, *Charles de L'Escluse (Carolus Clusius): Nederlandsch kruidkundige, 1526-1609* (The Hague 1927-1943) 191-193; Veendorp and Baas Becking, *Hortus academicus*, 33; Sluijter, *'Tot ciraet*, 64.
[84] Kroon, *Bijdragen,* 81-82; Molhuysen, *Bronnen*, pt. 1, 294*-195*.
[85] This division of tasks was also in place from 1564 in Padua and also at the University of Perugia. Findlen, *Possessing nature*, 260-261. A similar situation in Montpellier is suggested by the curriculum description in a court decision of 1550. Reeds suggests however that Guillaume Rondelet (1507–1566) was more involved in seeking out and showing plants to students than this description implies. Reeds, *Botany*, 68-69; and i.a. Karl H. Dannenfeldt, *Leonhard Rauwolf. Sixteenth century physician, botanist, and traveller* (Cambridge, MA 1968) 27-28.
[86] Egmond, *World of Clusius*, 160; Cook, *Matters of exchange*, 119, 120.
[87] Molhuysen, *Bronnen*, pt. 1, *295-*296, 380*; Eric Jorink, *Het boeck der natuere. Nederlandse geleerden en de wonderen van Gods schepping 1575-1715* (Leiden 2006) 204, n. 94-95.

indeed at all. They also claimed he had drawn many foreign visitors to the university. The students claimed Outgert equaled or even surpassed his father in knowledge. He was recommended because he was the only person who understood the 'register' of the *hortus*; his Latin and Greek were good; he had knowledge of the 'seasons' of the herbs and because he was in great position to add to the garden, mainly because he was well connected to a number of famous 'herbarists'. The students presented the tasks that Cluyt would perform. He would open the garden an hour a day and be present there to instruct, would exhibit his dried plants and minerals[88] at least twice a week or when students wanted him to. He would also take the students on herborising trips in the dunes, peat bogs and woods and would teach them about the composition of medicine.[89] These recommendations do not only show the skills and knowledge Cluyt supposedly had, they also show the kind of activities and knowledge, which were appreciated by the students. To these also belonged the great availability Cluyt was prepared to offer. The ability to dry plants, prepare medicines, and the organisation of the field trips were not mentioned in the assignments to professors of botany issued by the university. But apparently these students appreciated Cluyt's efforts in these areas and were prepared to recommend him for the position. In effect, they presented to the government of the university what a prefect like Cluyt could do for the university.

But the request of the students was not followed by the curators.[90] Instead, the management of the garden was referred to Bontius and Paaw in August 1598. On this occasion the curators issued further specifications for the tasks Bontius and Paaw were responsible for. They were offered the joint prefecture of the 'medical garden'. One of them was to give lectures on "*Bottanices*" [sic], that is botany, on Wednesdays and Saturdays. It is made clear here that the lectures were suppose to be on Mattioli's edition of Dioscorides or someone else who wrote about *res herbaria*.[91] The other professor was to oversee the upkeep and cultivation of the garden. He would be present in the garden for at least one hour each day to examine the herbs and explain them to those who were interested. In the winter he should be at his house to do the same for the minerals. He should also do everything "to service, benefit, adorn and honor the university and the herb garden" and "what a faithful and diligent

[88] These he had inherited from his father.
[89] Molhuysen, *Bronnen*, pt. 1, 380*-381*
[90] Egmond, *World of Clusius*, 160-162; Henriette A. Bosman-Jelgersma, "Augerius Clutius (1578-1636), apotheker, botanicus en geneeskundige", *Farmaceutisch tijdschrift voor België* vol. 59 no. 2 (Mar.-Apr. 1982) 167-173, specifically 168-170; Veendorp and Baas Becking, *Hortus academicus*, 40. Molhuysen, *Bronnen*, pt. 1, 381*-382*.
[91] Molhuysen, *Bronnen*, pt. 1, 112-114, 113; Kroon, *Bijdragen*, 144-145.

Simplicista would allow".[92] It thus appears that the tasks of the late Dirck Cluyt and the teaching in the garden by the medical professor were now combined into one function under the charge of a medical professor. When Bontius died in September 1599, the task of teaching *materia medica* was consolidated further. It is mentioned on this occasion that Bontius had taken on the duties of the Wednesdays and Saturdays, but had not started any lessons.[93] The *series lectionum* of the summer semester of 1599 shows that Bontius had chosen to speak about Galen's *De simplicium medicamentorum facultatibus* on these occasions.[94] Both the teaching in the garden and the lectures now fell to Paaw. The administrators of the university decided that he would now receive 150 guilders annually on top of the 600 florins he had been earning since 1594 and was allowed to remain living in the house by the garden.[95]

As Paaw described in the preface to *Primitiæ anatomicæ*, his students joined him on trips to various kinds of environment, very similar to those mentioned by the students in their recommendation of Outgert Cluyt. The fieldtrips first mentioned in the students' request to appoint Cluyt, had apparently become part of the curriculum. There is some evidence that both Bontius and Paaw took students on fieldtrips in 1591 and 1592.[96] Paaw is not specific about what they did on these trips or what their purpose was, except that they did "the not inglorious work of medicine".[97] We can only assume that the students went to see plants in their natural environment, which was not possible in the garden. Students would also be able to examine the plants more close by and take them home if they liked, things they were not allowed to do in the garden according to the rules there.[98] These field trips already stood in line of a certain tradition by the end of the sixteenth century. As Cluyt's letters to Paaw and

[92] Molhuysen, *Bronnen*, pt. 1, 112-114, specifically 113-114; Kroon, *Bijdragen*, 145; Veendorp and Baas Becking, *Hortus academicus*, 41; Bosman-Jelgersma, "*Augerius Clutius*", 170. *Simplicista*, a common title for gatherers, or cultivators of simples. In the sixteenth century often used as an official title. Van Gelder, *Hof en keizerskroon*, 262 n. 193, 263; David Freedberg, *The eye of the lynx: Galileo, his friends, and the beginnings of modern natural history* (Chicago 2002) 247, n. 18; Findlen, *Possessing nature*, 411. In 1595 Dirck Cluyt had been called a 'simplicista' by the Leiden curators as well. Molhuysen, *Bronnen*, pt. 1, 90. The word 'simple' was originally used to signify unprepared drug ingredients or drugs consisting of one ingredient, in contrast to composite drugs. This means that the word was medical in origin. During the sixteenth century its meaning was expanded to include plants in general, while retaining its medical connotations. cf. Findlen, *Possessing nature*, 6, 241, 243, 247, 248, 252, 258, 265-269, 279, 281, 285, 389; Paul F. Grendler, *The universities of the Italian Renaissance* (Baltimore 2004) 343.

[93] Kroon, *Bijdragen*, 82-83.

[94] Molhuysen, *Bronnen*, pt. 1, 384*. "1599 Maart 1. *Series Lectionum*". Paaw is listed here as examining the plants in the public garden: "Stirpium nimirum examen in Horto publico."

[95] Molhuysen, *Bronnen,* pt. 1, 77, 122.

[96] Letters from Hoghelande to Clusius, 1591-03-02, 1592-08-12, Leiden University Library, VUL 101.

[97] Pavius, *Hortus publicus*, Praefatio, *ij v. See n. 56.

[98] Ibid. Praefatio, **7r. Visitors were allowed to look at the plants and smell them, but they were not allowed to handle delicate plants and those that were beginning to sprout, to break off or take anything from the plants, to take them out of the ground, or damage the garden in any way. Kroon, *Bijdragen*, 72. "II Ingressis, stirpes videre licet, odorari licet: tennellas, succrescentesve tractare laedereve non licet. III Ramos, flores, semina decepere: scapos confingere: bulbos, radicesve evellere; hortum injuria afficere, nefas esto." Trans. also in: Willem K.H. Karstens and Herman Kleibrink, *De Leidse Hortus. Een botanische erfenis* (Zwolle 1982) 26.

contemporary sources show, the interest in plants of teachers as well as students, involved in these excursions, extended beyond an eagerness to correctly identify drug ingredients.[99]

Further information about the teaching in the garden can be found in the first edition of *Hortus publicus* that was published by Paaw in 1601. This catalogue, of which an updated version was published in subsequent years, contained pages of boxes with numbers to designate the different sections of each plant-bed. In the back there was an alphabetical list of all the plants that were present in the garden that year. Paaw kept a copy of each edition, in which the plants were noted down according to their place in it.[100] As Paaw explained himself, students could use the catalogue to exercise their ability to recognise the plants in the garden and write down where each plant could be found.[101]

The catalogue published by Girolamo Porro (ca. 1520-after 1604) as *L'Horto dei semplici di Padova* (1591) and the one published by Henricus Regius (1598-1679), for the *hortus* of the University of Utrecht (1650) served a similar function.[102] These types of documents indicate that the correct identification of all types of plants was the main goal of the botanical teaching that was organised during the sixteenth century. The teaching of botany through visiting gardens and going on field trips in Leiden therefore fitted in well with established traditions at other universities. In the next paragraphs I will take a closer look at the relationship of these teaching practices with the main text Paaw read to his students, *De materia medica* by Dioscorides.

The medicinal properties of plants in *De materia medica*

There was a firmly established tradition of teaching *De materia medica* by the end of the sixteenth century.[103] At the same time it was not the only text that was used to teach students

[99] Reeds, *Botany*, 34, 68-71; Karl H. Dannenfeldt, "Wittenberg botanists during the sixteenth century", in: Lawrence P. Buck and Jonathan W. Zophy, eds., *The social history of the reformation* (Columbus 1972) 223-248, there 230-232; Egmond, *World of Clusius*, 161.
[100] Pavius, *Hortus publicus.* Editions in 1603, 1605, 1608, 1615, 1617; Veendorp and Baas Becking, *Hortus academicus*, 45-47.
[101] Pavius, *Hortus publicus*, *6v-*8v. The copy in the British Library (988.e.10) was examined by J. Heniger and contains notes by Matthew Dodsworth. Another example of the first edition is present in the Munich state library. See also reproduced in Claudia Swan, *Art, science, and witchcraft in early modern Holland. Jacques de Gheyn II (1565-1629)* (Cambridge 2005) 58, 108-110.
[102] Looyenga, "Vroege botanische tuinen", 57-59; Jos Kuijlen *et al*., *Paradisus Batavus: bibliografie van plantencatalogi van onderwijstuinen, particuliere tuinen en kwekerscollecties in de Noordelijke en Zuidelijke Nederlanden (1550-1839)* (Wageningen 1983) 15; Girolamo Porro, *L'horto dei semplici di Padova* (Padua 1977); Henricus Regius, *Hortus academicus Ultrajectinus* (Utrecht 1650).
[103] Grendler, *Universities*, 343, 350; Rafael Chabran, "The classical tradition in Renaissance Spain and new trends in philology, medicine and materia medica", in: Simon Varey *et al*., eds., *Searching for the secrets of nature: the life and works of Dr. Francisco* (Stanford, CA 2000) 21-32, specifically 28; Karen Reeds, "De materia medica, and inventing the indigenous: local knowledge and natural history in early modern Europe

about the medicinal properties of plants. In 1545, Guillaume Rondelet (1507-1566) discussed *De materia medica*'s second book together with the fifth book of Paulus Aegineta (ca. 625-ca. 690) about poisonous plants.[104] Galen's *De simplicium medicamentorum facultatibus* was the preferred text to teach this subject in 1530s Montpellier. This was also the text used by Luca Ghini (ca. 1490–1556) for his teaching in Pisa in 1539 where he showed the real simples to his students.[105] As we have seen, Bontius had also planned on teaching this text in Leiden, while the simples themselves were supposed to be shown during Paaw's lessons in the garden.[106]

From at least 1592 Paaw taught *De materia medica*. There is no mention of another text in the remaining documents, although the possibility of discussing other texts was left open to Paaw in the phrasing of his tasks. Of all the editions and commentaries of *De materia medica* published in the sixteenth century, the commentary by Pietro Andrea Mattioli was the most famous.[107] How were the medicinal properties of the plant materials presented in this edition?

De materia medica itself presented the properties of medical materials in a very particular way.[108] In his preface Dioscorides expressed his intension to "try to use both a different arrangement [different that is from his predecessors] and to list the materials according to the natural properties of each one of them".[109] Dioscorides included different varieties of plants, plant species or plant-based medical materials, because they had particular

(review)", *Renaissance quarterly* vol. 61, no. 2 (Summer 2008) 627-630; Reeds, *Botany*, 57, 61; Dannenfeldt, "Wittenberg botanists", 223-248, specifically 227, 229-231.

[104] Reeds, *Botany,* 57. *De materia medica*'s second book was on materials from "living creatures, honey, milk, animal fats, and the so-called grains; also vegetables, to which I have subjoined herbs that have sharp properties, since they are closely related, such as garlic, onion, and mustard, in order to group together items of similar properties". Pedanius Dioscorides of Anarzarbus, Lily Y. Beck trans., *De materia medica* (Hildesheim etc. 2005) 94; Mattioli, *De medica materia* (1583) pt. 1, 268. "In hoc autem secundo de animantibus, melle, lacte, adipe, frugibus, atque oleribus explicabimus, subnexis herbaceis, quae acri praedita sunt facultate, utpote quae cum ipsis cognatione iuncta sint: qualia allium, cepa, sinapi intelliguntur. Idque ideo, ne cognarorum vires disiunxisse videamur."

[105] Findlen, *Possessing nature*, 256; Reeds, *Botany*, 23, 51; Grendler, *Universities*, 350.

[106] Molhuysen, *Bronnen*, pt. 1, 384*. "1599 Maart 1. *Series Lectionum*". Bontius is listed here as lecturing on Galen's *De simplicium medicamentorum facultatibus*. Paaw is listed as examining the plants in the public garden: "Stirpium nimirum examen in Horto publico."

[107] See e.g. Jerry Stannard, "Pietro Andrea Mattioli: sixteenth century commentator on Dioscorides", *University of Kansas publications. Library series* vol. 1 no. 32 (Lawrence, KS 1969) 58-81, there 66, 69; Leah Knight, *Of books and botany in early modern England. Sixteenth-century plants and print culture* (Aldershot etc. 2009) 17-18. A copy of his commentary was present in the university library, Petrus Bertius, *Nomenclator. The first printed library catalogue of Leiden University library (1595)* (Leiden 1995) Fr; Mattioli, *De medica materia* (1583).

[108] Alain Touwaide, "La thérapeutique médicamenteuse de Dioscoride à Galien: du *pharmaco-centrisme* au *médico-centrisme*", in: Armelle Debru, ed., *Galen on pharmacology. Philosophy, history and medicine. Proceedings of the Vth International Galen colloquium, Lille, 16-16 March 1995* (Leiden etc. 1997) 255-282; John M. Riddle, forew. by John Scarborough, *Dioscorides on pharmacy and medicine* (Austin 1985); John Scarborough, *Pharmacy's ancient heritage: Theophrastus, Nicander and Dioscorides* (Lexington 1985).

[109] Dioscorides, Beck trans., *De materia medica*, 3; Riddle, *Dioscorides on pharmacy*, 96; Scarborough *Pharmacy's ancient heritage*, 72.

medicinal properties. Each chapter discussed a drug ingredient with different medicinal properties and drug ingredients with similar properties were placed close together.[110] Dioscorides differentiated between a great many particular drug properties or affinities, such as emollient, opening or dilating, ripening, cleansing or purging, pores stopping, astringent, sharp, putrefying, laxative, and soporific.[111] He also made clear his aversion against those who did not "judge the action of drugs empirically, but prattling about causes, […] attribute to each of them differences in particles and, what is more, confuse one drug with another".[112]

In contrast to Dioscorides, Mattioli also distinguished plant varieties even when they do not have different properties. Such is the case for the *Tithymalus*. Seven varieties are illustrated with specific names. These illustrations show that the varieties look very different from each other. It seems therefore that it would have been easy to identify them as completely different kinds of plants and confusion could arise about their medicinal properties. Here Mattioli makes it clear however that they are indeed of the same kind of plant and that they all have the same properties.[113] Mattioli added more precise information about varieties particularly when there was likely to be some confusion over their properties. Some varieties looked very different or came from different places but had the same properties. Others looked very similar, but had slightly different properties. Mattioli used different names to identify these varieties but discussed them in the same chapter and as part of the same group of plants.[114]

Galen (129-199/217 AD) incorporated some of it into his own system of pharmacology.[115] It is worth examining the interaction between these two authors however because Galen's comments on the medicinal properties of the plants feature prominently in Mattioli's edition. Dioscorides and Galen each presented medicinal properties somewhat differently, as especially John Riddle has emphasised. While Dioscorides focused on

[110] Mattioli, *De medica materia* (1583) pt. 2. Absinthium, 46-52; Riddle, *Dioscorides on pharmacy*, xxvii, 25, 32-37. Mattioli copies this custom; when varieties of a plant had diffent properties they were discussed under different chapters. See e.g. Mattioli, *De medica materia* (1583) pt. 2. Testiculus, 231-232.

[111] Riddle, *Dioscorides on pharmacy*, 32-34, 94-96, 100, 103, 112, 162, 163, 173. Scarborough warned against over defining "Dioscorides' notions of drug actions, since he apparently has gone to such pains not to use any theory to "explain" his drugs, but rather he attempts to build up a large body of data on pharmaceutical actions in patients so that he can verify his basic "drug affinity system. "Affinity" would have, thereby, two essential aspects: what the drug "did" in a patient, and how the drug "acted" against a specific ailment."

[112] Dioscorides, Beck trans., *De materia medica*, 2.

[113] Pietro Andrea Mattioli and Caspar Bauhin, *Petri Andreae Mattioli Opera, quae extant omnia*, (Frankfurt 1598) 863-866; Mattioli, *De medica materia* (1583) pt. 2, 587-595. Tithymalus Characias, Tithymalus Myrsinites, Tithymalus Paralius, Tithymalus Helioscopius, Tithymalus Cyparissias, Tithymalus Dendroides, Tithymalus Leptiphylios.

[114] See e.g. his comments on the iris. Mattioli, *Opera* (1598) B3 v-B4 v, 18-20; Mattioli, *De medica materia* (1583) pt. 1. Iris, 14-18.

[115] Cajus Fabricius, *Galens Exzerpte aus älteren Pharmakologen* (Berlin 1972); Vivian Nutton, "Focus: Islamic medicine and pharmacy. Ancient mediterranean pharmacology and cultural transfer", *European review* vol. 16 no. 2 (2008) 211-217, specifically 214; Riddle, *Dioscorides on pharmacy*, 37-38, 169-176.

describing the different properties of drugs and relating plants according to these properties, Galen devised a theory to explain these properties from Aristotle's four elements and a hierarchical scheme from primary to tertiary qualities to order them. Galen also differentiated between four degrees of strength in which the primary qualities (hot, dry, cold and moist) could be present in a drug. The secondary and tertiary qualities described the drug properties in terms of the more specific actions they performed in the body. Examples of the secondary qualities are dilating, dissolving and diuretic, which were explained from the prominence of the primary quality heat in a drug.[116] Vivian Nutton has pointed out that however different these approaches of Dioscorides and Galen were, they were also complementary. Dioscorides' model for understanding pharmacology "looked for medical plants and animals and described their effects". Galen's model for pharmacology was a "scheme of grades of drug action. Both models offered possibilities for further development".[117]

Some attention has been dedicated to how the generations after Galen handled this information about the medicinal properties of plants and the last word certainly has not been spoken about this subject. It seems though that many authors focused on the determination of the primary qualities, "to the degrees of intensity of action, and to the counterbalance of unwanted properties"[118] when they discussed medicinal plants.[119] There are some indications that they were not concerned and sometimes not aware of the distinction Riddle drew between Dioscorides' and Galen's treatment of medicinal properties.[120] In the late thirteenth century and early fourteenth century some European medical authors also briefly became interested in the possibility of determining the "complexion" of compound drugs. The "quantification of compound medicine and the computation of qualities and humours" was also the topic of discussion in a group of texts indentified by Ian Maclean. According to Maclean, these texts

[116] Fabricius, *Galens Exzerpte*; Gerhard Harig, "Das Verhältnis zwischen den Primär- und Sekundärqualitäten in der theoretischen Pharmakologie Galens", *NTM Zeitschrift für Geschichte der Naturwissenschaften, Technik und Medizin* vol. 10 (1973) 64-81; Gerhard Harig, *Bestimmung der Intensität in medizinischen System Galens. Ein Beitrag zur theoretischen Pharmakologie, Nosologie und Therapie in der Galenischen Medizin* (Berlin 1974); Riddle, *Dioscorides on pharmacy*, 37, 169, 172-173; Touwaide, "La thérapeutique médicamenteuse", 255-282.
[117] Nutton, "*Focus*", 211-217, specifically 217.
[118] Riddle, *Dioscorides on pharmacy*, 175.
[119] Edward Grant, ed., *A source book in Medieval science* (Cambridge, MA 1974) 779, n.18; Y. Tzvi Langermann, "Another Andalusian revolt? Ibn Rushd's critique of al-Kindī's pharmacological computes", in: Jan P. Hogendijk and Abdelhamid I. Sabra, *The enterprise of science in Islam. New perspectives* (Cambridge, MA and London 2003) 351-372; Nutton, "*Focus*", 217; Michael McVaugh, "An early discussion of medicinal degrees at Montpellier by Henry of Winchester", *Bulletin of the history of medicine* vol. 49 no.1 (1975) 57-71, especially from 61; Michael McVaugh, *Arnaldi de Villanova Opera Medica Omnia II Aporismi de gradibus* (Granada and Barcelona 1975) 3, 11, 32-33, 57-61, 124-136; Reeds, *Botany*, 15; Riddle, *Dioscorides on pharmacy*, 175. n. 22. Riddle cites *et al.* Lynn Thordike and Francis Benjamin, eds., *The herbal of Rufinus* (Chicago 1945); John Scarborough, "XIII Early Byzantine pharmacology", in: John Scarborough, *Pharmacy and drug lore in Antiquity. Greece, Rome, Byzantium* (Farnham etc. 2010) 213-232; Stannard, "Pietro Andrea Mattioli", 66.
[120] Grant, *A source book*, 779, n.18.

reflect "the uptake in late fifteenth-century Italian universities of the work of fourteenth-century Oxford mathematicians".[121]

In the preface to *De materia medica*, Mattioli does indicate that there is some difference between how Galen and Dioscorides studied the powers and properties simples. He explains that Galen had followed Dioscorides in everything but had, the pre-eminence of Dioscorides' descriptions having (to Galen's own admission) been abandoned, far surpassed everyone who had written about this subject.[122] This is the only place in the work where Mattioli mentions such a difference between Galen and Dioscorides. The difference is recognised, but put aside fairly quickly. It was apparently not of much significance for Mattioli's work. In the rest of the preface Mattioli stressed the necessity of knowledge of the medicinal properties of plants for curing diseases, a necessity recognised by both Dioscorides and Galen,[123] and the importance of considering their provenance and checking their genuineness. He stated the importance of repeated observation of the same medical materials and of discovering fraud by using taste, by examining the real material and by comparison.[124] Interestingly enough, this was his concern not just for simple drugs, but also for compound drugs.[125] Mattioli did not raise the more philosophical issue of how the compilation of the drug would affect the properties of the drug as a whole.[126]

This impression from the preface is reflected in the main body of Mattioli's edition. With each plant Mattioli first gives Dioscorides' description. The medicinal properties of the

[121] That is the way the qualities of the different drug ingredients combined to form a new balance of properties in a compound drug. McVaugh, "Quantified medical theory and practice", 397-413; McVaugh, "An early discussion"; McVaugh, *Arnaldi de Villanova*; Pedro Gil-Sotres, "The *Viridarium id est expositio antidotarii Nicolai Salernitani* by Stephanus Arlandi", in: Florence E. Glaze and Brian K. Nance, eds., *Between text and patient. The medical enterprise in Medieval and early modern Europe* (Florence 2011) 87-96; Ian Maclean, *Logic, signs and nature in the Renaissance. The case of learned medicine* (Cambridge etc. 2002) 17, 176-177.

[122] Mattioli, *De medica materia* (1583) pt. 1. Mattioli, *Opera* (1598) 2, line 20. "….gravissimus auctor Galenus: qui hac in re pre caęteris Dioscoridem secutus (ut eius luculentissima monumenta passim attestantur) in simplicium medicamentorum viribus, ac facultatibus indagandis, relicta (hoc etiam ipse fatetur) Dioscoridi historiarum palma, omnes, qui in hac materia scripserunt, longe admodum superavit."

[123] Ibid., (1583) pt. 1, 2. Praefatio, line 20: ″Quantum oporteat Medicos omnes, qui legitimum in arte nomen sibi comparare student, simplicium quorumcunque medicamentorum, quae medicinae usui competunt, cognitionem, ac facultatem sensibus exacte consequi, non modo hac praefatione declarat Dioscorides Anazarbeus in hac materia caeteris facile princeps; sed id quoque post Dioscoridĕ admirabili doctrina pluribus in locis memoriae prodidit gravissimus auctor Galenus." Ibid., Praefatio, line 44: "Nisi enim hoc modo instructus ad praesentis operis praesidia veniat, uerbotenus quidem medendi methodum sciet, opus vero nullum ipsa dignum perficiet." Ibid., Praefatio, line 49: ″Haec Galenus. Ex quibus satis medicis omnibus perspicuum est, non posse quenquam sine certa simplicium medicamentorum cognitione, nec morbis ratione mederi, neque artem recta methodo exercere, nec nisi fortuna quandam, vel naturae ipsius robore aegros sanare.″

[124] Ibid., pt. 1, 2. Praefatio, line 32: "Hinc enim puto bonae indolis iuuenes incitatum iri, ut medicamentorum materiam cognoscant, ipsimet inspicientes, non semel aut bis, sed frequenter; ..." Ibid., pt. 1, 2. Praefatio, line 62: "..., ut non seplasiariorum modo, sed etiam medicorum quorumcunque qui rem plantariam profitentur oculos saepenumero fallant, nisi fraus gustu, & legitimi Turpeti scrutinio, & collatione deprehendatur."

[125] Ibid., pt. 1, 2. Praefatio from line 54. "Nam cum satis etc."

[126] An issue of much interest to European physicians in the late thirteenth and early fourteenth century. See n. 121.

plant are included here in the description of its different parts. Mattioli's commentary follows in *italics*. In this section there is usually updated information on where the plant and its different varieties occur, a comparison of its appearance to other plants, and a discussion of the different names the major authors gave it. With most plants there is a separate section at the end of the commentary on the medicinal "powers" and "faculties" which Galen attributed to the plant.[127] Often Mattioli also added his own information on these properties. He does not seem to be interested in checking all the properties, which other authors had attributed to the plants however, but takes them for granted. The pieces of information from Dioscorides, Galen, Mattioli himself and other authors[128] are clearly annotated and distinguished from each other.

Mattioli's edition reminds us as well that, attributing the qualities hot, dry, cold and moist in different degrees to simple drugs was not Galenic pharmacology's only feature. We notice that there was a significant correspondence between the kind of properties which Galen, Dioscorides and Mattioli himself attributed to the plants. Like Galen, Dioscorides had attributed warming, cooling and drying powers to plants.[129] Mattioli's descriptions of the properties that Galen attributed to the plants, are full of other properties besides these primary ones. For example, in the description of the plant *Althaea altera*, no degrees of properties are mentioned, nor are the primary qualities. Instead, according to Mattioli's account of Galen, the plant was given properties of dissolving, loosening, easing inflammations, mitigating, and ripening difficultly matured tubercles.[130]

These were the kinds of properties to which Galen had referred as secondary and tertiary qualities or faculties. Some sixteenth-century authors also distinguished quaternary properties.[131] However, none of these qualities were singled out as such in Mattioli's edition; they were treated as any other properties. Mattioli did not emphasise the details of Galenic pharmacology and its connections to Aristotelian physics and to medical theory. Instead he

[127] In the index of content Mattioli usually uses the word *vires* and occasionally also *facultates*. In his translation of Dioscorides and in the text itself they are used interchangeably.
[128] Such as Theophrastus (ca. 371- ca. 287 BC), Pliny the Elder (23-79 AD), Mesue the Elder (777-857) and Avicenna (980-1037).
[129] Riddle, *Dioscorides on pharmacy*, 33-34; Mattioli, *De medica materia* (1583) pt. 2. Spuma argenti (Cap LXII) 681, line 35: "Vis autem adstringere, mollire, explere caua, excrescentia in carne reprimere, ad cicatricem ducere, refrigerare, & occludere." Hyssopum, 56, line 32: "Vim habet extenuandi, & calfaciendi."
[130] Mattioli, *De medica materia* (1583) pt. 2, 277, line 61. "Meminit ibsci Galenus libro. 6 simpl. medic. ubi eius vires ita descripsit. Ebiscus, sive althea (est autem malva agrestis) facultatem habet digerendi, laxandi, phlegmone levandi, mitigandi, coneoquendo difficilia coctu tubercula."
[131] Harig, "Das Verhältnis"; Harig, *Bestimmung*, 105-114; John M. Forrester and John Henry, eds., *Jean Fernel's On the hidden causes of things: forms, souls, and occult diseases in Renaissance medicine* (Leiden 2005) 529-531; Johannes Heurnius, *Institutiones medicinae* (Leiden 1592[1]) Liber XII, Cap. II, 355-361; Rembert Dodoens, *Remberti Dodonaei Stirpium historiae pemptades sex* (Antwerp 1583[1]) Liber I, Cap. III-VIII, 7-14; Jean Fernel, *Universa medicina* (Frankfurt 1593) pt. II: Therapeutica, Methodi medendi, Liber IV.

emphasised the correct identification of simple drugs in different places, he distinguished a great variety of drug properties and defined these properties in terms of actions in the human body. Mattioli's commentary presented Galenic pharmacology in a much less philosophical way than Riddle suggested. Mattioli draws the attention of his readers away from the primary qualities and their different degrees, and instead shows the great variety of properties, which could be attributed to a plant.

The text and the garden

Although Paaw announced the publication of a two-part commentary on the *De Materia Medica* in the preface to *Primitiæ anatomicæ*, it was apparently never written.[132] Therefore, we do not know what Paaw had to say about this text. Some of the commentaries on Dioscorides that were published during the sixteenth century give us insight into the way in which his text was used as a pedagogical instrument. In the commentaries of Valerius Cordus (1515-1544), based on the notes taken by his students in Wittenberg and published in 1549, Cordus made no comments on the medicinal properties of the plants. Caspar Bauhin (1560-1624), who taught anatomy and botany in Basel, published his commentaries 1598. Like Cordus, he focused on correcting the text and straightening out confusions in Mattioli's edition and those of other authors.[133] These commentaries indicate that the medicinal properties of the plants and the particular way Galen and Dioscorides described them, were not issues of much interest to those who lectured on Dioscorides. They had much more to tell their students about the correct identifications of plants and other simples, especially those which were used in drugs.[134]

It is clear from Paaw's descriptions of his teaching in both the preface to *Primitiæ anatomicæ* and to *Hortus publicus*, that, for him, his lectures on Dioscorides and the observations of his students in the garden were closely related.[135] But while the garden

[132] Pavius, *Primitiæ anatomicæ*. Praefatio, *iiij r-**r.
[133] Reeds, *Botany*, 18, 23, 127-128; Dannenfeldt, "Wittenberg botanists", 223-248, specifically 233, 235; Mattioli, *Opera* (1598); Valerius Cordus, *Valerii Cordi Annotationes in Pedacij Dioscoridis Anazarbei de materia medica libros V* (Strasbourg 1561); Dioscorides Pedanius, *De medicinali materia libri sex* (Frankfurt 1549).
[134] The contemporary set of notes for lectures on simples, which Brian Ogilvie found in Basel, focused on those that were "commonly used in pharmacies". He concluded that, "In this regard, medical students' education was still practical". Brian Ogilvie, *The science of describing. Natural history in Renaissance Europe* (Chicago and London 2006) 186.
[135] Pavius, *Hortus publicus*, *4r. "Praeter Publicam quoque Dioscoridis quam a me habent praelectionem, hoc insuper commodi percipiunt; quod absque discrimine, quotidie in Hortum Publicum aditus illis pateat; …" Pavius, *Primitiæ anatomicæ*, *ij v. "Eidem fini Dioscoridem quoque (gravem, Deus bone etc vetustum Scriptorum) explicavi quotidie: ut quae in horto vidissent spectatores, ea pro lectione audirent discerentque auditores, atque ita gemino sensu viam sibi ad nostram facerent disciplinam."

offered the opportunity to investigate the appearances of the different plants further, it would not have been possible to show, display or demonstrate the medicinal properties of the plants since there were no patients present. Moreover, visitors were allowed to look at the plants and smell them, but not handle delicate plants, to break off or take anything from the plants, to take then out of the ground, or damage the garden in any other way.[136]

The medicinal properties were not entirely excluded from Paaw's teaching in the garden however. In the preface to *Hortus publicus* for example Paaw writes that in Leiden the students "are led from garden bed to garden bed, and from area to area" where "the plants (not just indigenous but also exotic ones, about 900) would be *shown* and their names, etymologies, powers and faculties would be produced."[137] Paaw used the words *vis* and *facultas* here to refer to the properties of the plants. *Facultas* might refer to the title of Galen's *De simplicium medicamentorum facultatibus* and its use in works such as the textbook for the foundations of medicine published by Paaw's colleague Heurnius and Fernel's work about therapy to describe Galenic drug properties.[138] "Power" might then refer more generally to the afflictions the plant was supposed to cure. On the other hand, as noted above in Mattioli's commentary their meaning cannot be distinguished easily. Paaw also mentioned that "How strong that faculty is, that is used in medicine, will be disclosed".[139]

Similarly, in the preface to *Primitiæ anatomicæ*, Paaw described what he taught to his students as "the nature, powers and affinities" of the plants.[140] The three words Paaw used, may well have referred to different kinds of medicinal properties as well, "nature" referring to a plant's essential properties, "powers" to the properties of a plant to cure certain afflictions[141], and "affinities" to the similarity of their properties. These comments show that Paaw considered the medicinal properties of the plants to be an intrinsic part of his lessons in the garden.

A closer look at the varieties of the plants in the *Index stirpium* and *Hortus publicus* on the one hand and those mentioned under the different chapters in Mattioli's edition on the

[136] See n. 98.
[137] Pavius, *Hortus publicus*, *4r. "Praeter Publicam quoque Dioscoridis quam a me habent praelectionem, hoc insuper commodi percipiunt; quod absque discrimine, quotidie in Hortum Publicum aditus illis pateat; a Puluillo in Puluillum, ab Area ad Aream a nobis ducantur, stripes (non solum indigenae sed etiam exoticae, quae DCCCC. aequarunt.) ostendantur nomina, etyma, vires, ac facultates edantur, quantum quaeque valeat, quis in medicina sit usus, explicetur."
[138] Heurnius, *Institutiones* (1592[1]) Liber XII, Cap. II, 355-361; Fernel, *Universa medicina* (1593).
[139] Pavius, *Hortus publicus*, *4r. "…, quantum quaeque valeat, quis in medicina sit usus, explicetur."
[140] Pavius, *Primitiæ anatomicæ*, Praefatio, *ijr.
[141] Following Leonhart Fuchs, Rembert Dodonaeus, Paaw's erstwhile colleague as medical professor at Leiden, had also distinguished between a plant's essential properties and the abilities of the plant to cure afflictions in his Dutch herbals, by using the words "natuere" and "cracht ende werkinghe" respectively. Dodonaeus, *Cruijdeboeck* (1563); Leonhart Fuchs, *New Kreüterbuch* (Basel 1543).

other, provides another insight into the way the lectures on *De materia medica* were related to the demonstrations in the garden. Overall such a comparison shows that the connection between the content of the garden and Mattioli's edition was not straightforward. Some of the chapters in *De materia medica* are dedicated to plants and mention plant varieties that were not in the garden. Two of the varieties of *Tithymalus* mentioned by Mattioli for example are also mentioned in the *Index*. The other four varieties mentioned in Mattioli are not in the *Index* though. By 1600, the varieties of *Tithymalus* had changed somewhat, but still only three of the varieties in the garden correspond with *De materia medica*. There is some overlap though in the varieties which they distinguish, for example in cases where different varieties have different properties.[142] Paaw could have stuck closely to Mattioli for his description of these plants and their properties.

More often though, the garden contained varieties of plants which were not distinguished by Dioscorides or Mattioli, such as five more varieties of Hellebore and two more varieties of Absinth.[143] The presence of these varieties is not explained by looking at Mattioli's text. For some plants that were in the garden in many different varieties however, Mattioli was concerned with indicating that the plant could have different colours or that different kinds could be distinguished.[144] Sometimes he gives illustrations of different examples, distinguished from each other by roman numerals, such as in the case of Anemones (five varieties), Ranunculus (five), Testiculus (five), Geranium (six).[145] While giving further descriptions of the distinguishing characteristics of the plants' varieties, he does not refer to specific illustrations. He does not distinguish between the different properties of these varieties either, discussing just the properties of the group of plants as a whole. In the *Index stirpium* however, precisely distinguishing these varieties, by their flowers and colours, the person who described them first or by their place of origin, was the most important thing.[146]

To conclude, there is a marked difference between the varieties Mattioli distinguished as compared with the garden in Leiden. Varieties of plants that Mattioli did not name or describe were present there. In the *Index* and the *Hortus publicus* these varieties were

[142] Both distighuish between Absinthium, Absinthium Marinum, and Absinthium Ponticum or Romanum. Mattioli, *De medica materia* (1583) pt. 2. Absinthium, 46-52; Ibid., pt. 2, 587-595. Tithymalus Characias, Tithymalus Myrsinites, Tithymalus Paralius, Tithymalus Helioscopius, Tithymalus Cyparissias, Tithymalus Dendroides, Tithymalus Leptiphylios. Anon., *Index stirpium*, Quadra quarta, Area decima. Tithymalus, Tithymalus Cyparissus, Tithymalus Characias. *Hortus publicus* mentions the Tithymalus Paralius, Helioscopius, and Cyparissias on M7 v, but also the tuberosus, not mentioned by Mattioli.
[143] Ibid.. Absinthium, 46-52; Elleborus, 559-564.
[144] Ibid., pt. 1. Ranunculus, 559, line 8: "Planta est vulgo nota, pluribus tamen, & diversis generibus distincta." Iris, 14-18; Pavius, *Hortus publicus*. Ranunculus, M6 v-M7 r.
[145] Ibid., pt. 1. Ranunculus, 558-562, Anemone, 561-568; Pt.2. Geranium, 207-213, Testiculus, 231-235.
[146] A kind of anemone is noted down in the *Index* as number three in Mattioli though. Anon., *Index stirpium*, Quadra tertia, Area secunda XVII, XVIII.

distinguished from each other by much more precise names. We can see then that Mattioli and the authors of the *Index* and *Hortus publicus* differed somewhat on the kind of plant varieties they were interested in. Given differences like these between the text and the content of the garden, relating what students had seen in the garden to what Dioscorides and Mattioli had described, required some mediation on Paaw's part.[147] Furthermore, walking around in the garden, Paaw would have had a hard time telling his audience of medical students about the "nature, powers and the affinities" of each plant in the garden.[148]

Natural history and medicine

One final issue with regard to Paaw's teaching of *materia medica* needs to be addressed. That is his teaching of non-botanical materials, which I will discuss in connection with Erik de Jong's argument that the garden was not so much a site for medicine or botany, but for natural history. In De Jong's account, the meaning of the garden as a medical garden is not offset against its broader botanical meaning, but expanded further to encompass natural history. He has argued that the garden in Leiden "could be interpreted as a 'musaeum', meaning it provided collections of a diverse kind." The possibility of exhibiting other things besides plants in the garden was especially created in 1600 when a gallery, also called an *Ambulacrum* or 'walking gallery', was completed. Paaw was the driving force behind the building of this gallery and supplying its content.[149] We can see what objects he collected in the lists of his possessions present in the *Ambulacrum* and the anatomic theater drawn up after his death. The kinds of objects listed reflect a similar combination of functions we found in the garden.

De Jong argued that most of the objects in the *Ambulacrum* "were in the first place tied up with the study of *materia medica*, as were the plants in the garden, hence [with] the

[147] We can doubt whether Paaw himself possessed this ability. A contemporary of his, Johan van Hoghelande (1546-1614) wrote from Leiden to Clusius that Paaw did "not know any plant, however commonly known it is among herbarists." Egmond, *World of Clusius*, 160. Suringar mentiones that, on page 99 of his *De vegetabilibus, plantis, suffruticibus et fruticibus in genere, Libri duo* (Jena 1670) Werner Rolfinck (1599-1673) discussed an incident were Paaw once demonstrated a *Fraxinus* instead of a *Pistacia terebinthus* to his students. Suringar dismisses this claim as not very grievous, but since both kinds of trees are mentioned separately in *De materia medica* and since one of Paaw's tasks was to teach this text, Rolfinck's allegation is quite a serious one. Suringar, "Over de beoefening der voorbereidende en hulpwetenschappen", *Nederlands tijdschrift voor geneeskunde* vol. 5 (1861) 121-38, specifically 127. Still, a son of his former colleage Bontius, Jacobus Bontius (1592-1631) had a very different opinion from Hoghelande. He called Paaw "the greatest botanist of our age." See Cook, *Matters of exchange*, 120.

[148] cf. Rembert Dodoens' discussion of the Tithymalus in *Purgantium aliarumque eo facientium, tum et radicum, conuoluulorum ac deleteriarum herbarum historiae libri IIII* (Antwerp 1574) 138-152.

[149] De Jong, "*Nature and art*", 38-40; Erik de Jong, *Natuur en kunst. Nederlandse tuin- en landschapsarchitectuur 1650-1740* (Amsterdam 1993) 206; Molhuysen, *Bronnen*, pt. 1, 119.

books of Dioscorides and Pliny." "Yet most of the items to see or study could not be checked in these handbooks since they had only recently become known through the early voyages of discovery".[150] In the *ambulacrum* then the new interest in natural history described by Findlen is most clearly visible. Just as we have seen in the garden though, in the gallery the distinction between materials, which were gathered for medicinal purposes and which were gathered for their novelty and rarity is not clear. Were there containers with minerals, resins, and several other extracts in the gallery to study as medicines or as part of a natural historical collection?[151]

From at least 1598 Paaw's assignment stipulated that he should teach about minerals in his house in the winter. It is noteworthy that Paaw's original assignment states that his lessons about minerals should take place at his house, which, as mentioned earlier, was situated on the grounds of the garden. The phrasing of the assignment suggests that Paaw could show these materials to students there, like he could show the plants in the lessons in the garden itself. After the building of the gallery, it could have provided a suitable location for these lessons. Paaw doesn't mention these lessons, so we have no clues as to their purpose or content. We also do not know whether Paaw used any texts to teach about these materials. As De Jong stated, most of the items in the gallery were not described by Pliny or Dioscorides, but book five of the *De materia medica* was apparently used by Ghini to teach 'minerals' in Pisa.[152]

Johannes Heniger has supplied a detailed account of Paaw's efforts in 1599 to add to the plant and mineral collections by enlisting the help of the VOC. Doctor Nicolaas Coolmans, who was sailing on a ship heading for the East Indies in December of 1599, was consigned to gather materials there to enrich the garden and "mineraelplaetze" or mineral collection with "some Indian herbs, seeds, flowers, gums, roots and such" and "with some spices, drugs and minerals from the Indies". Paaw was supposed to provide instructions to the leader of the expedition, but these appear to have been lost. Upon the return of the ship two years later, the senate of the university repeated Paaw's appeal to supply the medical garden and the "mineraulxplaatse" of Leiden University with:

[150] Ibidem, "Nature and art", 44; De Jong's conclusion is based on a depiction of the garden from 1610, and an inventory of the objects in the gallery which belonged to Paaw drawn up on the occasion of his death in 1617; De Jong, *Natuur en kunst*, 208-212.
[151] Ibidem, *Natuur en kunst*, 213, 232-233. Transcribed by De Jong from *Arch. Curatoren van de Leidse universiteit*, no. 228.
[152] Findlen, *Possessing nature*, 250; De Jong, "Nature and art", 44.

> seeds, fruits, bulbs, roots, herbs, flowers, gums, resins, animals and things that had been tossed up by the sea and such, unusual and unknown here, as can be found in those lands.

The primary criterion for the materials to be gathered that is mentioned is that they were rare and unknown.

Coolmans died shortly before the ship returned and Clusius appears to have been disappointed with the result of the physician's work since he drew up a "Memorie for those Apothecaries and surgeons that will sail on the fleet to the East Indies in the Year 1602". Clusius instructed them that, if possible, they should bring along, laid between paper, "the leaves, fruits and flowers of nutmeg, both male and female, black pepper, white pepper, long piper betle, cubeb, mangos, mangosteens, and such beans of a kind of cotton that grows at Bantam including braches and leaves and ask what it is called there". They should do the same with all other kinds of trees that are "strange" and grew there with flowers, leaves and fruits, and if possible, draw the appearance of the trees, whether they were large or small, remained green in winter or not. Their colloquial name and what they were used for. He also described "little trees" that grow in the sea (apparently coral) that the sailors should look out for. But there were many other trees and fruits that should be brought, "if one knew the name, and what they are good for".[153]

The studies of medicine, natural history and botany are indistinguishable in this collection of exotic *naturalia*. One would perhaps expect that Paaw, being a physician, would be the one concerned about gathering local knowledge about the names and uses of these materials. It is striking then that we find such interest only in Clusius' *Memorie*.

Did Paaw notice any kind of tension between the study of medicine, and the study of natural history and botany? It appears that at one point at least, he must have been made aware of it, because contemporaries questioned the connection of the garden with the study of medicine. A declaration by the Curators of the university and mayors of the city of Leiden from May 1602 makes it clear that Paaw's position as prefect of the garden was not entirely secure. Paaw had apparently come to them expressing his fear that some "malicious" people might want to take this job away from him. They had suggested that a professor should not have two different jobs, that is professor of medicine and prefect of the *hortus medicus*. The

[153] Johannes Heniger, "De eerste Nederlandse wetenschappelijke reis naar Oost-Indië, 1599-1601", *Jaarboekje voor de geschiedenis en oudheidkunde van Leiden en omstreken* vol. 65 (1973) 27-49. Claudia Swan incorporated Heniger's paper in, "Collecting *naturalia* in the shadow of early modern Dutch trade", in: Londa Schiebinger and Claudia Swan, *Colonial botany. Science, commerce, and politics in the early modern world* (Philadelphia 2005) 223-236, specifically 235-236.

Curators of the university and mayors of the city declared officially that "they understood the prefecture of the garden, as well as the lessons and examinations in the garden, not to be a profession separate from the profession of medicine, [….], but as being one profession, though it required double the effort". They declared that Paaw should not be bothered any more with such rumors or suspicions.[154]

This incident shows that it was important to both Paaw and the government of the university to insist on the natural connection between the teaching of plants and the study of medicine. This was a connection on which Paaw would continue to insist.[155] The instructions the curators gave in 1604 of books that should be available in "the gallery of the medical garden", show that they struck a similar balance between medicine, botany and natural history. The works by "botanical authors" they mentioned were Dioscorides with commentary by Mattioli, Theoprastus' *De plantis* with commentaries by Julius Caesar Scaliger, works by Hippocrates and works by Galen and Pliny.[156]

Looking at the content of the garden and later that of the *Ambulacrum*, and considering Paaw's interests and activities as prefect to both, it is understandable that the feasibility of the connection between the garden and the study of medicine was called in question in 1602. As we have seen, Mattioli made a claim for the necessity of the connection between the practice of medicine and the study of medical materials, by referring to the authority of both Galen and Dioscorides. In making this claim, Mattioli and both Galen and Dioscorides had focused their studies on the medicinal properties of these materials and the proper treatment of patients. Paaw similarly insisted on the necessity of studying the *materia medica* for medicine. In Leiden however the study and collection of materials was interpreted in a much broader sense than Galen and Dioscorides had intended. Broader because all kinds of materials were collected and studied and because these materials were not studied exclusively for their medicinal properties.

[154] Kroon, *Bijdragen*, bijlage XII; Molhuysen, *Bronnen*, pt. 1, 142. By insisting that these two jobs were at the same time part of the same profession and double the effort, the curators and mayors of course made sure that Paaw would still be rewarded separately for his professorship and his occupation as prefect of the garden.
[155] Paaw, *Primitiæ anatomicæ*, Praefatio, *ijr. See n. 56.
[156] Molhuysen, *Bronnen*, pt. 1, p. 154. 'Praeterea ut certi aliquot authores Botanici, puta Dioscorides cum Commentariis And. Mathioli. Theophrastus de Plantis cum comm. Iulii Caes. Scaligeri, Opera Hippocratis graeco-Latina, Opera Galeni, Plinius, catenis affixi in porticu Horti Medici ad manum sint.' Julius Caesar Scaliger, *In libros de plantis Aristotelis inscriptos commentarii* (Geneva 1566).

Conclusion

In the introduction to *Primitiæ anatomicæ*, Paaw presented a picture of his lessons which included lectures on Dioscorides, lessons in the garden, and fieldtrips, as an interlinked whole. Through the investigation of Paaw's teaching, I showed however that there were tensions between medicine and botany, and between medicine and natural history hidden underneath this apparent harmony. For one, the text of *De materia medica* didn't correspond entirely with the content of the garden. There were other varieties in the garden besides the ones Mattioli had discussed, but Mattioli had also included varieties for a different purpose, to wit that they seemed important for identifying plant groups and drug ingredients correctly. Yet no confusion about medicinal properties seems to have been possible with respect to many of the varieties in the garden and these varieties seem to have been gathered there especially for their beauty and rarity and the variety in nature they showcased. Secondly, Paaw's own interests, those of the contributors to the garden and those of the university in collecting all kinds of materials, exposed Paaw to criticism for maintaining two separate professions. Finally, Paaw remained notably vague or even silent on some parts of his curriculum that is his involvement with field excursions and his teaching of 'minerals'. In this respect, he appears to have differed from contemporaries such as Outgert Cluyt, Van Hoghelande, Bauhin and Aldrovandi and perhaps also from his own students. For them these field excursions were of particular importance. The content of the garden depended heavily on such field excursions as well as on the efforts, skills and expertise of people like Cluyt.

Maintaining this balance of interests was possible, I would argue, because the categories of medicinal plants and non-medicinal plants overlapped significantly and because it was not easy to determine which particular varieties were especially important for learning how to recognise a drug ingredient. It would seem that drawing a strict line between these categories was against the interests of all who were involved with the garden. Also, *De materia medica* itself allowed for the discussion of a broad array of materials and subjects. Especially through the tradition developed around it during the sixteenth century it left room for the consideration of plants and other materials with no particular medicinal properties while maintaining a connection to medicine.

The original claim made by Dioscorides, Galen and also by Mattioli for the necessity for physicians to study the medical materials was used in Leiden and elsewhere to justify the study and collection of materials in a much broader sense than they had intended. Furthermore, Paaw emphasised in his publications that he paid attention in his lectures to both

the rare and exotic plants and the properties of the plants present in the garden. Thus he added substance to the purported relevance of the study of the *materiae medicae* for medicine, while he used the presence of rare and exotic plants in the garden to add to the University's prestige as possessing a collection of desirable specimens.

Recent historical research has shown abundantly that late sixteenth century investigators of plants put an emphasis on the description and depiction of plants in terms of their outward appearance.[157] The skill to recognise plants was fostered at Leiden University, as it was in others, by the publication of a plant catalogue, the organization of field excursions and of course also by the importance Mattioli attached to this skill as commentator of *De materia medica*. There is however another aspect of the presence of *De materia medica* in the curriculum, which is at least as important. This was that it introduced to students a particular way of considering the medicinal properties of these materials. In Mattioli's portrayal of pharmacology, philosophical considerations were mostly ignored and no attention was given to establishing a connecting between the different properties that a plant could have. Instead, Mattioli emphasised other aspects of Dioscorides' and Galen's work, especially the importance they attached to knowledge of medicinal properties for proper medical practice and the skill to detect fraud or mistaken substitutions.

In his teaching of *De materia medica* in connection to the academic garden, Paaw did not make a choice between natural history, botany or medicine. With the teaching of this text a particular direction for the study of drug properties and pharmacology was introduced into the curriculum though. This pharmacology was much more associated with physiology, anatomy and practical medicine than with Aristotelian physics and its four elements. But of course Paaw's lessons were only one part of the medical curriculum. How were plants and their properties presented in contemporary textbooks such as the aforementioned *Universa medicina* by Fernel from which Paaw taught in 1591 and *Institutiones medicinae* by Paaw's close colleague Heurnius? Should we expect a shift away from the primary qualities and their different degrees similar to the one we have seen in Mattioli's commentaries?

[157] Ogilvie, *Science of describing*.

Intermezzo 1

Adrianus Spigelius' *Isagoges in rem herbariam libri duo* (1606)

While Paaw was teaching about plants in Leiden, Adrianus Spigelius published a book that offered a very different picture of this subject in Padua. Spigelius was born in Brussels and had studied medicine in Leiden, as his signature under the request to appoint Ougert Cluyt as his father's successor testifies.[158] Evidently, his interest in plants was well established by the time he moved to Padua. He was educated mainly at this city's university where he also got his doctoral degree, probably in 1603. After a distinguished career as a practising physician, he taught anatomy at the university from 1616 and had a successful medical practice in the city. Before he established his career as an anatomist however, he published his first work *Isagoges in rem herbariam libri duo* (1606), an introduction into *Res herbaria*, or botany.[159] Besides the *Isagoges*, Spigelius did not publish any further works on the subject of plants. *Isagoges* was republished in Amsterdam as part of an *Opera Omnia*, which was edited by Johannes Antonides van der Linden (1609-1664) who was a medical professor at the University of Franeker at the time. Van der Linden added material by William Harvey, Gaspare Aselli (1581–1626) and Johannes Walaeus (1604-1649).[160] Van der Linden thus especially prized Spigelius' achievements as anatomist. His biographer Gerrit Lindeboom also focused on his work in this discipline.[161]

Isagoges has not been studied much. Ogilvie discussed Spigelius as a late example of someone who discussed the use of taste to discover the medicinal properties of plants.[162] In the literature it is also well known that *Isagoges* contained the first printed instructions on how to assemble a "winter garden", or a herbarium.[163] Brigitte Hoppe was more thorough when she discussed the book to show that morphology was the only tool for the identification and ordering of plants for Spigelius.[164]

The limited attention is understandable. It is difficult to place the book in a particular genre or tradition. It is not a medical textbook, nor is it a herbal, nor has it been regarded as especially important with regard to plant taxonomy, a subject most interesting to historians of botany. As we will see in the next chapter however, it offered some novel insights into the way the properties of medical materials were supposed to be investigated according to

[158] Molhuysen, *Bronnen*, pt. 1, 380*-381*.
[159] Adrianus Spigelius, *Isagoges in rem herbariam libri duo* (Padua 1606[1]).
[160] William Harvey, *De motu cordis et sanguinis in animalibus* (1628), Gaspare Aselli, *De lactibus sive de lacteis venis* (1627) and Johannes Walaeus, *Epistolae de motu chyli et sanguinis* (1641). Gerrit Lindeboom, *Adriaan van den Spiegel (1578-1625) hoogleraar in de ontleed- en heelkunde te Padua* (Amsterdam 1978) 69, 71; Gerrit A. Lindeboom, "Johannes Antonius van der Linden", in: G. Th. Jensma *et al*., eds., *Universiteit te Franeker 1585-1811. Bijdragen tot de geschiedenis van de Friese Hogeschool* (Leeuwarden 1985) 362-363.
[161] Lindeboom, *Adriaan van den Spiegel*.
[162] Ogilvie, *Science of describing*, 205.
[163] Arber, *Herbals* (1989) 142; Ogilvie, *Science of describing*, 165; Van Gelder, *Hof*, 290-291, 296.
[164] Brigitte Hoppe, *Biologie, Wissenschaft von der belebten Materie von der Antike zur Neuzeit. Biologische Methodologie und Lehren von der stofflichen Zusammensetzung der Organismen* (Wiesbaden 1976) 32-34, 57.

physicians of this time. As such, Spigelius' little book acquires new meaning both in the context of the relationship between botany and medicine and with regard to the study of drug properties.

In the *Isagoges in rem herbariam*, Spigelius discussed the study of plants in two unrelated ways, in two separate books. In the first, he focused on the appearance of plants. Various plants were discussed under thirty-nine headings, but Spigelius never mentioned their medicinal properties.[165] Knowledge of this last subject could be found in herbals, a genre that had taken flight in the sixteenth century and continued to exist in the seventeenth century.[166] Spigelius also gave us an impression of the hands-on-work that he thought a student should be familiar with, such as the construction of a *hortus hiemalis*.[167] Some of those who studied plants had developed and taken up this practice during the sixteenth century.[168] Dirck Cluyt owned a well-known and quite substantial herbarium, which his son was supposed to use in his teaching in the winter semester according to the request presented to the curators of the university in 1598.[169]

In the second book of *Isagoges*, Spigelius described the medicinal properties of drugs and how they should be investigated. How these plants could be identified and where they occurred was not discussed. His description was typical for a particular representation of Galenic pharmacology developed during the sixteenth century. We can find descriptions similar to Spigelius' in medical textbooks used and often also produced in Leiden. The next two chapters are dedicated to these representations of Galenic pharmacology.

In the introduction, Spigelius did not write about the purpose of the knowledge of plants and he easily switched between calling the subject of his work an art and a science. He also did not give an outline of the content of the book or explain why he organised it in this particular way. By retelling Plinius' story about the pup-rearing habits of seals, he explained how a student should not be introduced to the subject all at once, but should be made accustomed to it gradually.[170] One specific case in which Spigelius discussed the relation between the appearance of a plant and its medicinal properties can be found in the sixth chapter of the second book. There he made clear that he did not agree with the Neapolitan scholar Giambattista della Porta or John Baptista Porta (1535-1615) that the outer appearance

[165] Adrianus Spigelius, *Opera quae extant, Omnia* (Amsterdam 1645) a5v-a6r.
[166] Ibid., a5v-a6r.
[167] Ibid., 71-72. LVIII. Hortos hyemales conficiendi ratio.
[168] Ogilvie, *Science of describing*, 165-174.
[169] Molhuysen, *Bronnen*, pt 1, 380*-381*.
[170] Spigelius, *Opera* (1645) a2r-a4v; Plinius, *Historia naturalis*, Liber IX, Caput XIII.

of a plant would indicate medicinal properties that would remain hidden otherwise.[171] According to Spigelius, the consideration of the form of plants had nothing to do with these medicinal properties.

While the appearance of plants and their medicinal properties were treated together in some books, such as the herbals of Dodonaeus and Dioscorides' *De materia medica*, Spigelius considered them separately. On the one hand he considered them as part of philosophy and natural history in the tradition of Theophrastus (ca. 371–287 BCE) and on the other hand as part of medicine in the tradition of Galen. In this way, his little book indicates how the academic study of plants would develop later in the seventeenth century.

Isagoges was first published in the Dutch Republic in 1633 together with *Catalogus plantarum horti academici Lugduno Batavi* put together by Adolph van Voorst or Aldophus Vorstius, who was current prefect of the *hortus* in Leiden. The catalogue included an alphabetical list of plants that grew in the marshy, meadowy, sandy and wooded places near Leiden.[172] Alix Cooper has discussed these kinds of lists as a particular genre of writing, later called local flora, which was developed as part of the practice to teaching medical students about plants through fieldtrips.[173] The smaller format of this edition and Vorstius' additions, confirmed the purpose of the text as a practical introductory to the study of plants.

Vorstius had studied in Leiden for seven years before traveling for two years to Belgium, England, France and Italy. In 1622, he received his medical degree in Padua under Spigelius.[174] Three years later Vorstius succeeded his father Aelius Everardus Vorstius (1565-1624) as professor of botany and *praefectus* of the "medical garden" and as extraordinary professor of *Institutiones medicinae*. From the incomplete records of the University of Leiden, we know that in 1631 he combined the teaching of the *Institutiones medicinae* with explaining Dioscorides in his morning lessons and held public lectures in the garden in the summer afternoons.[175] Somewhere between 1631 and 1654 however, Vorstius stopped teaching *De*

[171] Ibid., 86-87. Rembert Dodoens had argued against the same position in Dodonaeus, *Stirpium* (1583[1]) 16-18; cf. John Henry, "The fragmentation of Renaissance occultism and the decline of magic", *History of science: an annual review of literature, research and teaching* vol. 46 no. 1 (2008) 1-48.
[172] Adrianus Spigelius, *Isagoges in rem herbariam libri duo* (Leiden 1633); Adolphus Vorstius, *Catalogus plantarum horti academici Lugduno Batavi, quibus is instructus erat Anno 1633 praefecto eiusdem Horti Adolfo Vorstio, medicina & botanices professore. Accedit Index plantarum indigarum, quae propé Lugdunum in Batavis nascuntur*.
[173] Alix Cooper, *Inventing the indigenous. Local knowledge and natural history in early modern Europe* (Cambridge 2007) 51-87.
[174] Vorstius' studies in Leiden resulted in a disputation about motion defended under Jacchaeus in 1620. Abraham Jacob van der Aa, *Biographisch woordenboek der Nederlanden* pt. 19 (Haarlem 1876) 369-371; Henning Witte, *Memoriae medicorum nostri seculi clarissimorum renovatae decas prima* (Frankfurt am Main 1676) 231.
[175] Anon., *Series Lectionum Academiae Lugduno Batavae Aestivarum 1631*, Special collections Leiden University 21229, A 1, B 1-2, C 1-2.

materia medica and *Institiones medicinae*. He now only demonstrated plants in the academic garden. Thus, Dioscorides disappeared from the curriculum. This in it's self tells us little about the actual content of the lectures which Vorstius gave in the *hortus*. There are other indications however that medicine became of increasingly smaller significance for the study of plants in the Dutch Republic.

As keeper of the Leiden garden Vorstius was mainly occupied with adding to the collection of plants in the academic garden and assembling rare and exotic plants for it. This can be illustrated by two of the letters he sent Constantijn Huygens (1596–1687) to ask him for passports to travel into Flanders and Brabant to obtain "zeldzame", "rare" plants.[176] Whereas Paaw had suggested publishing a commentary on Dioscorides, Van der Linden wrote that Vorstius had been working on a commentary on Theophrastus before his death, which was never published.[177] Vorstius had been instrumental however in the posthumous publication of the commentary on the ancient philosophers work by Jan van Meurs or Johannes Meursius (1579-1639) in 1640.[178]

Four years later a commentary on Theophrastus' *De historia plantarum* followed, this one by one of Vorstius' former students Johannes Bodaeus à Stapel (1602-1636). His father Egbertus published it after the author's death.[179] The commentary that Julius Caesar Scaliger wrote on this book was included in the 1644 edition, which became a standard work in the study of plants.[180] The author of its preface, Johannes Arnoldus Corvinus or Joannes Arnoldszoon Ravens (ca. 1582-1650) explained that Bodaeus à Stapel's commentaries on Theophrastus and Dioscorides testified to his knowledge of Greek, Latin and Arab authors. Death had prevented the production of the commentaries on Dioscorides, but Corvinus assured readers that Bodaeus à Stapel would have given these completely if only he had lived longer. The commentaries on Theophrastus were published now, Corvinus wrote, but only those in the books on the history of plants, because those on the causes required the final hand

[176] 3255, Leiden, May 15 1643: A. Vorstius, De curatoren der Hoogeschool willen den hortulanus, Hendrik Carthagen, naar Vlaanderen en Brabant zenden, om zeldzame planten te koopen voor den plantentuin, die vergroot wordt. Wilt gij Z.H. verzoeken om een paspoort voor hem? 3947, Leiden, May 10 1645: A. Vorstius, "Koome mits desen versoeucken van U Eed. een paspoort voor Franciscus Godtschalck, der medicinen licentiaet tot Iperen in Vlaenderen, mijnen goeden vrindt, met denwelcken ick correspondere in materie van planten. Sal herwaerts overkomen, om den hof van onse Academie te versien met verscheijden rare planten vandaer, ende werdt hooch tijt, dat dese reijse vordere'.

[177] Johannes Antonides van der Linden, *In V. cl. Adolfi Vorstii, medicinæ & botanices professoris primarii, excessum oratio fvnebris: habita martis XVI Octobris CIↃIↃCLXIII* (Leiden 1664).

[178] Johannes Meursius, *Theophrastus sive de illius libria qui injuriâ temporis interciderunt liber singularis. acc. Theophrastus lectionum libellus Theophrastus* (Leiden 1640). Meursius (1579-1639) was professor of Greek in Leiden since 1610.

[179] Johannes Bodaeus à Stapel, *Theophrasti Eresii de historia plantarum liber decem, Graecè & Lati* (Amsterdam 1644); Molhuysen, *Nieuw Nederlandsch biografisch woordenboek (NNBW)* 263; Egbertus Bodaeus, *Theses medicae de phrenitide praeside Joh. Heurnio* (Leiden 1597).

[180] Edward Lee Greene, *Landmarks of botanical history* pt. 1 (Stanford, CA 1983) 133, 459-460.

of their author.[181] Towards the end, Corvinus pointed out the education Bodaeus à Stapel had received from Vorstius during his medical studies. Bodaeus had continuously listened to his lectures on botany in the medical garden and observed and examined the appearance, nature and powers of the herbs that were demonstrated. He had also traveled around fields, marches and dunes with fellow students to acquire knowledge of and collect herbs, either under the guidance of Vorstius or leading himself by way of spontaneous exercise.[182]

Bodaeus à Stapel's book has been said to be about medical plants.[183] Certainly, Corvinus started his preface by praising the art of medicine and spent the next two pages discussing its different aspects, before considering botany. Botany made the medical art certain, he stated.[184] For safety reasons, the physician needed to be able to assess if the simples that were used to make composite drugs were genuine.[185] Without a solid knowledge of simples he would not be able to judge what faculties were present in a composite drug, or how strong it was.[186] When Corvinus moved on to discuss the work of Theophrastus and Stapelius, there was no further mention of drugs or their medicinal properties.[187]

Taking a closer look at the content of the commentary shows us how "medical" the plants it discussed were. In the last of the ten books of *De historia plantarum*, Theophrastus did discuss some medicinal properties of plants. He for example discussed the different properties of black and white hellebore. He also remarked that different properties could be found in different parts of some plants and examined how this could be. Bodaeus à Stapel's comments demonstrate however that he was concerned with the correct identification of

[181] Bodaeus à Stapel, *De historia plantarum*, **6v. "Testantur id doctissimi ipsius in Theophrastum & Dioscoridem Commentarii ; …" "Commentarios in in Dioscoridem, morte praeventus, nobis dare non potuit ; daturus omnino, siquidem vitam optimus Deus prorogasset. Alterum in Theophrastum nunc damus ; sed modo in libros de plantarum historia ; quod quae in libros de Causis ὸ μακαρίτης est meditatus ultimam Authoris manum desiderant."

[182] Ibid., **8r. "Medicus fuit vir Clarissimus Stapelius, & studio Medico juvando incubuit. Utinam diutius incumbere potuisset vir indefessi laboris, judicii acerrimi, memoriae confirmatissimae. Botanicam pro Sparta habebat; quam nactus ornare omni ope nitebatur. In quo conatu se publico quin probaverit, nullum est dubium. Cum in Academiâ Lugduno-Batavâ operam studiis daret, Clarissimi viri D. Aelii Everardi Vorstii, Medicinae Professoris tum primarii, & horti Medici Praesidis lectiones Botanicas assiduous audiebat; herbarum demonstrandarum formas, naturam, vires accuratè & observabat & examinabat. Sed & earum se non ignarum ostendebat. Cum studiorum sociis cognoscendarum & colligendarum herbarum causâ sive sub Vorstio praeceptore, sive spontaneo modò exercitio, ipse dux, prata, paludes, colles circumivit."

[183] Ferry Bouman, Bob Baljet, Erik Zevenhuizen, eds., *Kruidenier aan de Amstel. De Amsterdamse Hortus volgens Johannes Snippendaal (1646)* (Amsterdam 2007) 84-85.

[184] Bodaeus à Stapel, *De historia plantarum,* **5r-v. "Medendi ars non dubiam quin sit praestantissima." "Botanicam, nunc quidem, cogitamus". **6r: "Etenim haec in herbarum, plantarum, stirpium, fruticum, suffruticum, arborum, radicum, foliorum, florum, & omnium, hominum caussa nascentium frugum ducens cognitionem, nae Medicum artis suae certum facit." **6v. "Sanè, sine solida simplicium cognitione, nec quae sit compositi facultas, nec quo medicamentorum sit ordine, mollissimo medio, an vehementissimo potest judicare."

[185] Ibid., **6r-v: "Medicamenta sunt simplicia, vel composita. Sed non est nisi est nisi ex simplicia, ...- .. , quin & cum maximo famae suae periculo artem suam exerceat, & cum aegrorum summa iniuria."

[186] Ibidem*,* **6v. "Sanè, sine solida simplicium cognitione, nec quae sit compositi facultas, nec quo medicamentorum sit ordine, mollissimo medio, an vehementissimo potest judicare."

[187] Ibid., **6v-**8v.

plants through their appearance to the exclusion of other aspects of the plants. Not surprisingly, he cited Spigelius' *Isagoges* several times regarding details on this aspect of the plants.[188] While this knowledge of plants would allow someone to distinguish between plants with different physiological affects, defining *De historia plantarum*'s topic as medical plants appears ill suited.

Corvinus' concern over the ingredients used in drugs corresponds with the concerns over the trade in and production process of drugs that had motivated sixteenth-century physicians to investigate especially herbal simples. Around 1640 similar concerns appear to have motivated the issuing of municipal pharmacopoeia. In the spring of 1636 for example, the *Pharmacopoea amsteldamensis* was issued in which the recipes of these drugs were described.[189] Some of the most prominent physicians and apothecaries of the city were part of the committee that composed it, three of whom we have already come across, namely Egbertus Bodaeus à Stapel, Augerius Clutius and Joannes Antonius van der Linden. Nicolaes Tulp (1593–1674) was chairman of the committee.[190]

In other cities the example of Amsterdam was followed. Through the efforts of Otto Heurnius the city government of Leiden authorised the use of a list of drugs for the poor two years later.[191] Similar publications and regulations were issued in Utrecht (1656), in The Hague (1659) and in Middelburg (1668).[192] In The Hague, the committee that compiled the book consisted of only physicians. In 1682 the newly established *Collegium medico pharmaceuticum* of Delft chose to adopt the pharmacopoeia of Amsterdam as its official prescription book. The government of the College consisted of a permanent chairman, who was a physician, and three assessors, one physician and two apothecaries.[193] Physicians were only allowed to prescribe the drugs included in the pharmacopoeia and apothecaries were obligated to prepare them according to these recipes. As part of these new regulations, the production process was checked at regular intervals.

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[188] Bodaeus à Stapel, *De historia plantarum,* 8: "Haec pessimam expositione viri longe doctissimi, in re botanica, decepti videntur; inter quos Spigelius, qui in Isagoges in rem herbariam Theophrasti mentem sic exponere conatur."
[189] Bouman *et al*., *Kruidenier aan de Amstel*, 73.
[190] Ibid., 196; Cook, *Matters of exchange*, 161-162; The other physicians in the committee were Robertus van der Houve, Aegidius Snoeck, Franciscus de Vinck and the apothecaries who joint it later in the year were Remmert Antonisz. Fonteijn, Jan Jansz. Commersteyn and Isac Mavie.
[191] Willem Otterspeer, *Het bolwerk van de vrijheid: de Leidse universiteit, 1575-1672* (Leiden 2008) 203; Anon., *Pharmacopoea, et hortvs, ad usum pauperum Reipublicæ Leydensis: publicabantur ex decreto magistratvs anno MDCXXXVIII* (Leiden 1638).
[192] Cook, *Matters of exchange*, 162; *Pharmacopoea Hagiensis communi collegii medici ejusdem loci opera adornata* (The Hague 1659); *Pharmacopoea Ultrajectina, senatus auctoritate edita et munita* (Utrecht 1656).
[193] Henriette A. Bosman-Jelgersma, *Vijf eeuwen Delftse apothekers: een bronnenstudie over de geschiedenis van de farmacie in een Hollandse stad* (Amsterdam 1979) 104-106. Bosman-Jelgersma mentions that the "physician-doctor" always had priority in voting over his fellow "assessor-apothecaries".

There were new opportunities for physicians and apothecaries to learn about the drugs they would prescribe as well. In 1638 a public garden was established in Amsterdam in conjunction with the publication of the *Pharmacopoeia*. Inspectors of the *Collegium medicum* of the city had argued for the establishment of the garden in order to examine the future apothecaries of the city about plants, drugs and minerals.[194] Johannes Snippendaal (1616-1670) was appointed as keeper of the garden in 1645.[195] From his extensive acquisitions and the preface to the catalogue of the garden published in November 1646, it seems Snippendaal sought to make the garden in the image of the one in Leiden and Utrecht, in regards to their plant collections. Snippendaal suggested the possibility of trading plants with other gardens, emphasised the large size of the collection, and that it was a public place where visitors could view the plants. From 1642, the apothecary Nicolaes Chimaer received a fee of twenty-five guilders a year "for the extraordinary accommodation, services and troubles he took for the instruction of the students of medicine" in Leiden.[196]

All in all, although we can assume that physicians and apothecaries were educated about the medicinal properties of plants in these public gardens, there is nothing that indicates that the gardens were used as a place to investigate these properties. This is in clear contrast to the activities at the *Jardin Royal* in Paris. As we saw in the previous chapter it was expressly established to search for new medicines. From the 1640s the Paris garden developed as a renowned research and teaching institute.[197] In 1628, Guy de la Brosse (1586–1641) had published *De la vertu et utilité des plantes*, the title page of which displayed Hippocrates, Dioscorides, Paracelsus and Theophrastus.[198] De la Brosse made a point of arguing that it was not possible to know the virtues of plants perfectly through taste and not at all with odour. He argued that dissecting the parts of plants was a better way of finding these virtues than by taste, odour or colour. To explain why De la Brosse found it relevant to explicitly make these points, we have to look back in time at the tradition of Galenic pharmacology in which large parts of the second book of Spigelius' *Isagoges* was written.

[194] Bouman *et al*., *Kruidenier aan de Amstel*, 73-74.
[195] Ibid., 83; Cook, *Matters of exchange*, 163.
[196] Otterspeer, *Bolwerk*, 203.
[197] Bouman *et al*., *Kruidenier aan de Amstel*, 50.
[198] Guy de la Brosse, *De la nature, vertu et utilité des plantes* (Paris 1628[1], 1678). Under Hippocrates it said: *des effects et causes*, under Dioscorides: *de experience la connoissance*, under Paracelsus: *Chaque chose a san Ciel et ses astres* and under Theophrastus: *En vain la medicine sans les plantes*.

Chapter 2

Materia medica and the *methodus medendi*. Galenic pharmacology as part of the Leiden curriculum (1575-1625)

Introduction

In the previous chapter, we have considered how Pietro Andrea Mattioli's commentary on Dioscorides became part of the medical curriculum in Leiden. Dioscorides and Galen's different approaches to the properties of simple drugs were also discussed. According to both authors, properties of medical materials were defined in relation to the human body, by how they worked in the body. The main difference between the two was that Galen explained many of these observed properties on the basis of the Aristotelian primary qualities, while Dioscorides had an aversion to searching for explanations and to investigating how different drug properties were related to each other. At the end of the last chapter, I wondered how pharmacology was presented in the textbooks that were used in Leiden. Can we observe a shift of attention away from the primary qualities as we have noticed in Mattioli's commentaries? This chapter and the next are intended to explore this question.

There seems to have been a particular tradition in Leiden in the way Galen's theory of drug properties was presented. The discussion of drug properties by four physicians connected to the University of Leiden will receive special attention. Dodonaeus, Heurnius, Spigelius and Jacchaeus all spent time there at some point in their careers. Heurnius taught medicine in Leiden from 1581, Dodonaeus taught practical medicine for three years from 1582. As discussed in the first intermezzo, Spigelius studied there in 1598 and Jacchaeus, though he had a medical degree, only taught philosophy in Leiden intermittently from 1585. Their descriptions of pharmacology share important characteristics and together provide a good example of how it developed in the late sixteenth and early seventeenth century. In their discussions, they built on the works of sixteenth century authors such as Euricius Cordus, Fernel, Fuchs, and Mattioli.

Each of these authors gave brief descriptions of Galen's complex and elaborate writings about drugs and their properties.[199] Dodonaeus' description was part of his last publication, *Stirpium historiae pemptades sex*. It was the only piece of writing Dodonaeus ever published in which he dealt with the theoretical issues involved in the investigation of drug properties. Heurnius included a similar description in his innovative textbook *Institutiones medicinae* (principles of medicine), a kind of compendium of medicine. With the *Institutiones*, Heurnius put a firm stamp on medical education in Leiden. In 1601 it was the title of a course taught at the university and courses on or that included *Institutiones medicae*

[199] Dodonaeus, *Stirpium* (1583[1]) 6-18; Heurnius, *Institutiones* (1592[1]), (1609) 132-138; Spigelius, *Isagoges* (1606[1]), (1633) B2 recto, 136-186: Lib. II; Gilbertus Jacchaeus, *Institutiones medicae* (Leiden 1624[1]) 230-292: Lib. V.

or *Institutiones medicinae* remained part of the medical curriculum into the second half of the century.[200] As just discussed, the second part of Spigelius' *Isagoges in rem herbariam* was largely reserved for discussions of pharmacology.[201] Finally, in 1624 Jacchaeus published a book modeled after Heurnius' *Institutiones*. From his account, we can learn how the debates that Heurnius addressed, had developed in the intervening thirty-three years.

I cannot be exhaustive in my discussion of the texts these physicians produced. However, my discussion in this chapter and the following suffices to illustrate that Galen's own instructions on how to categorise and investigate the properties of drugs became a topic of special interest within late sixteenth-century Galenic medicine. In the work of Mattioli, Dodonaeus and Spigelius this interest was closely associated with their study of plants. As we will see the study of plants was much less important in the work of Fernel, Heurnius and Jacchaeus. Their interest in pharmacology was part of an interest not in medical theory or practical medicine *per se*, but in their relation to each other.

Especially Heurnius made it clear that his efforts to account for different drug properties within the framework of Galenic pharmacology were part of a broader attempt to formulate a *methodus medendi*, a rational method for the practice of medicine. Galen had devoted a book to this subject, which received increasing attention in late sixteenth-century medical education and writing.[202] In this chapter, I will discuss the different roles that this description of pharmacology played in the work of Dodonaeus and Heurnius. In the next one, I will focus more closely on the way in which these descriptions of pharmacology reflected sixteenth century discussions of the relation between the properties of drugs and how they should be investigated.

Besides informing us about the investigation of drug properties in the sixteenth century, studying the work of Dodonaeus, Heurnius, Spigelius and Jacchaeus also highlights

[200] In one of the few *series lectionum* that have remained from Heurnius' lifetime, one for the summer curriculum of 1601, Heurnius is listed as teaching Galen's books on the differences, causes and symptoms of diseases and *Institutiones medicinae* was the title of a course taught by Aelius Everhardus Vorstius (1565-1624). In the year of Heurnius' death, his son Otto or Otthonius (1577–1652) was appointed to teach the *Institutiones medicinae.* Molhuysen, *Bronnen*, pt.1, 133, 157*, 191*-192*, 384, pt. 2, 102, pt. 3 14, 53, 135, 139, 140, 150, 400*-401*; Anon., *Series lectionum*. Also see about the medical curriculum in Leiden: Cook, *Matters of exchange*, 110-111.

[201] Hoppe, *Biologie*, 32-34, 57.

[202] Heurnius, *Institutiones medicinae* (Leiden 1609) 132-157; Galen, *Methodus medendi*; Andrew Wear, "Galen in the Renaissance", in: Vivian Nutton, *Galen: problems and prospects* (London 1981) 229-262, specifically 238-245; Nancy G. Siraisi, *Avicenna in Renaissance Italy: the Canon and medical teaching in Italian universities after 1500* (Princeton, NJ 1987) 99; Ian Maclean, *Logic, signs and nature in Renaissance: The case of learned medicine* (Cambridge 2002) 200-202, 205; Grendler, *Universities*, 342; Jerome Bylebyl, "The school of Padua: humanistic medicine in the sixteenth century", in: Charles Webster, ed., *Health, medicine and mortality in the sixteenth century* (Cambridge and New York 1979); Jerome Bylebyl, "Teaching *Methodus medendi* in the Renaissance", in: Fridolf Kudlien and Richard J. Durling, *Galen's method of healing. Proceedings of the 1982 Galen Symposium* (Leiden etc. 1991); Donald G. Bates, "Sydenham and the medical meaning of "method"", *Bulletin of the history of medicine* vol. 51 no. 3 (1977) 324-38.

parts of the Leiden medical curriculum that have been largely neglected by historians. The University of Leiden, established in 1575, was the first university in the Northern Netherlands. It was to become the leading medical school of the Dutch Republic and attracted many students from abroad.[203] The establishment of a well-provided academic garden (in 1590–1594) and an anatomical theatre (in 1592–1596) reflected the influence of the University of Padua. These institutions and the efforts of several professors to introduce clinical teaching have traditionally received the greatest attention.[204] However, medical students were also introduced to those parts of academic medicine that were closely connected to physics, such as physiology. Especially through the use of Heurnius' textbook, the *Institutiones medicinae*, students were taught a type of Galenic medicine that was developed during the sixteenth century and that would serve as a reference point for critics, commentators and practitioners in the following century.[205] The following chapters focus on one component of this type of medicine, that is, pharmacology.

Rembertus Dodonaeus

Today, three busts of the most famous botanists connected to the academic garden stand in the academic building of the University of Leiden. These are Carolus Clusius, Rembertus Dodonaeus and Carolus Linnaeus (1707–1778). Though he is best known for his study of plants, Dodonaeus was a physician first and foremost.[206] For many years Dodonaeus was a greatly respected and sought-after medical practitioner in his native Mechelen or Malines in Flanders where he settled in 1546 after studying medicine in Leuven or Louvain. He was offered a post at his *alma mater* and a position as physician to King Philip II of Spain, but did not accept either offer. Later in 1574 he accepted a post as physician to Emperor Maximilian II (1527–1576) in Vienna where he lived until 1578.[207] Only after spending time in Cologne,

[203] Ole Peter Grell, "The attraction of Leiden University for english students of medicine and theology, 1590–1642", in: Cedric Charles Barfoot *et al*., eds., *The great emporium. The Low Countries as a cultural crossroads in the Renaissance and the eighteenth century* (Amsterdam 1992) 83–104, particularly 97–98, 100–102, 103. Grell points to the significance of Leiden for the development of English medicine; Robert William Innes Smith, *English-speaking students of medicine at the University of Leyden* (Edinburgh 1932).
[204] Lindeboom, "Medical education", 202-206; Harm Beukers, "Clinical teaching in Leiden from its beginning until the end of the eighteenth Century", *Clio medica: acta academiae internationalis historiae medicinae* 21 (1987–1988) 139–152; Antonie M. Luyendijk-Elshout, "Der Einfluß der italienischen Universitäten auf die medizinische Fakultät in Leiden (1575–1620)", in: Georg Kauffmann, ed., *Die Renaissance im Blick der nationen Europas* (Wiesbaden 1991) 339–353; Grell, "Attraction", 92–97; Cook, *Matters of exchange*, 110–111.
[205] Heurnius, *Institutiones* (1592[1]).
[206] The same is true of Linnaeus though recently several attempts have been undertaken to study the medical interest with which he studied plants. Koerner, *Linnaeus*.
[207] The city of Mechelen had been reconquered from troops of Willem van Oranje and plundered by Spanish ones in 1572. Antwerp suffered a similar fate in 1576.

Mechelen and Antwerp, did he settle in Leiden where he taught practical medicine as professor at the new university from 1582.[208]

In the first intermezzo, I discussed Spigelius' *Isagoges in rem herbariam* (1606) to show that it presented the study of the appearance of plants and the study of their medicinal properties as two separate enterprises. In contrast, for Dodonaeus and many authors of his and earlier generations, they were intimately connected. By looking at his work, we can begin to see how Galenic pharmacology was relevant for his study of plants, both of their appearance and their medicinal properties.

During his lifetime he published many books on medicine and plants and two on astronomy and cosmography.[209] Towards the end of his life, he shared his "observations" on rare diseases and ailments that he had encountered in his medical practice and considered the cures, that could be offered to them. In *Medicinalium observationum exempla rara, recognita et aucta*, Dodonaeus showed himself a typical sixteenth-century humanistic physician. Physicians developed ways to share their knowledge of individual cases of ailment and of the treatments that were available to cure them, but also their opinions on the classical authorities on all sorts of matters that affected medicine. This kind of knowledge was especially shared through letters, which were sometimes also collected and published. In recent years, historians have begun to study these letters more extensively and showed them to be part of a larger humanistic culture in which all sorts of "particulars" of nature and history were noted down, commented on and exchanged.[210] Keenly aware of the variety of natural occurrences and events and of points of view expressed by authors of the past and present, humanists explored how they could relate there own, individual experiences and opinions to those of others. Dodonaeus found it important to establish how to act in individual medical cases and he did this by comparing them with cases of a similar kind. By assembling and sharing his medical observations, he showed his proficiency in evaluating medical cases and his ability to contribute to the collective knowledge of physicians. Several times, Dodonaeus observed that there was no known cure for the affliction he discussed.[211]

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[208] Chris Coppens and Roger Tavernier, *Hortus botanicus. Vijf eeuwen plantenboeken te Leuven* (Leuven 2004) 81; Armand Louis, "De historische betekenis van de botanicus Rembert Dodoens", *Handelingen van de Koninklijke kring voor oudheidkunde, letteren en kunst van Mechelen* pt. 89 (Mechelen 1986) 49-105, specifically 62.

[209] Rembertus Dodonaeus, *Cosmographica in astronomiam et geographiam isagoge* (Antwerp 1548); Rembertus Dodonaeus, *De sphaera sive de astronomiae et geographiae principiis cosmographica isagoge* (Antwerp 1584).

[210] Nancy G. Siraisi, *History, medicine, and the traditions of Renaissance learning* (Ann Arbor, MI 2007) 193; Idem, *Communities of learned experience: epistolary medicine in the Renaissance* (Baltimore 2013); Dirk van Miert, ed., *Communicating observations in early modern letters (1500-1675). Epistolography and epistemology in the age of the Scientific Revolution* (London and Turin 2013).

[211] Rembertus Dodonaeus, *Medicinalium observationum exempla rara, recognita et aucta* (Cologne 1581).

Dodonaeus did not discuss the medicinal properties of plants in all his books on plants. His interest in these properties is clear however from the first herbal that he published in 1554, as historians have noted. Dodonaeus was very probably the translator of by Leonhart Fuchs' herbal of 1542 and he modeled his own herbals on those by Fuchs (1501–1566). Under separate headings they listed information of the nature of the plant and its operations.[212] Fuchs clearly found precedent for this arrangement in the herbals of some of his German colleagues.[213] Dodonaeus differed from Fuchs in the way he arranged the plants in his herbal. Fuchs arranged his herbal alphabetically as was common. Dodonaeus however seems to have been aware that Dioscorides had listed the materials in *De materia medica* according to the similarity of their properties as indicated in its introduction. Dodonaeus, to a certain extent, arranged the plants in his book in a comparable way, that is non-alphabetically, but according to their similarities in appearance and properties.[214]

As city physician of Mechelen, Dodonaeus was directly involved in the supervision of apothecaries, which the city had ordered at the occasion of a plague epidemic. One of the regulations instituted in 1536 was that apothecaries had to be inspected by physicians twice a year. Henriette Bosman-Jelgersma has cited the different places in the herbal of 1554 where Dodonaeus was critical about both apothecaries and physicians. Many apothecaries, Dodonaeus argued, were deceitful and they easily deceived physicians because of these possessed inadequate knowledge of drugs.[215] His herbal would help to improve knowledge of drug ingredients on both sides. Accordingly, Dodonaeus sometimes mentioned if apothecaries knew a plant. For example, he described two kinds of Melisse. One was "unknown in apothecary shops" the other was "mistakenly used as genuine Melisse by the uneducated Apothecaries".[216] He thus expressed the same concerns as many humanistic physicians of the sixteenth century, such as Nicolo Leoniceno (1428-1524), Euricius Cordus, his son Valerius (1515-1544), Mattioli, Conrad Gessner (1516–1565) and Fuchs, for the correct identification of drug ingredients. It was the importance attached to this skill, which spurred on the development of the study of plants from the late fifteenth into the sixteenth century.[217]

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[212] Leonhart Fuchs, *New Kreüterbuch* (Basel 1543); Rembertus Dodonaeus, *Cruydeboeck* (Antwerp 1554).
[213] Johannes Wonnecke von Kaube, *Gart der Gesundheit* (Augsburg 1487).
[214] Chris Coppens and Roger Tavernier, *Hortus botanicus. Vijf eeuwen plantenboeken te Leuven* (Leuven 2004) 81, 82; Robert Visser, "Dodonaeus and the herbal tradition", in: Willy F. Vande Walle and Kazuhiko Kasaya, eds., *Dodonaeus in Japan. Translation and the scientific mind in the Tokugawa period* (Leuven 2001) 45-58.
[215] Henriette Bosman-Jelgersma, "Dodonaeus en de farmacie", in: Raphaël De Smedt, ed., *Handelingen van de Koninklijke kring oudheidkunde, letteren en kunst van Mechelen* no. 89 (Mechelen 1985) 129-140, specifically 130-134.
[216] Dodonaeus, *Cruydeboeck* (1554) h4 recto.
[217] e.g. Richard Durling, "Girolamo Mercuriale's *De modo studendi*", *Osiris: Renaissance medical learning: evolution of a tradition* ser. 2 vol. 6 (1990) 181-185, specifically 182; Jerry Stannard, "Dioscorides and Renaissance materia medica", in: Marcel Florkin, ed., *Analecta Medico-historica. Materia medica in the XVth*

Medicinal properties in Dodonaeus' herbals

Dodonaeus' attitude towards investigating the properties of plants is made clear in this first edition. In the letter of dedication to Maria of Hungary and Bohemia (1505–1558)[218] he wrote that he had gathered knowledge of the properties of the plants he described "from the oldest, best and most distinguished medicine masters and authors and added to that, what was found by us by certain experience of some herbs over long years, with which we have concluded and completed the history of each herb".[219] In other places in the book, he also refers to the knowledge of drug properties gained through experience. For example, he discussed the *Water Arum* and mentioned that some had concluded that it had properties similar to the regular Arum and the Speerwortel or *Dracunculus*, "although the same had not yet been found by experience".[220] In other words, the family resemblance of these plants suggested a similarity of properties. This however needed to be investigated by experience, that is clinical or therapeutic experience.

Besides an interest in discovering and confirming the properties of plants through therapeutic experience and the correct identification of plants, Dodonaeus surveyed the many different properties, which the plants he described could possess. In the second edition of his *Cruijdeboeck*, he added an *Appendix secondas qualitates simplicium medicamentorum ostendens, medicis et chirurgis perutilis a studioso quodam hisce*, which took up twenty pages. These qualities varied from opening, softening, thinning, pain relieving, astringent, coagulating, drugs that produce red bile, that strengthen the whole body, that are easily or difficult to digestible, generate milk, that cool or that moisten, that attract and many more.[221]

This list showed that an individual simple drug could have an array of properties, which Dodonaeus here called qualities. Through the appendix, the properties of plants could be related to each other, and it facilitated arranging the plants in the herbal according to their medical properties. It also aided in figuring out the correct treatment of particular afflictions

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century (Oxford etc. 1966) 1-21, specifically 12; Vivian Nutton, "The rise of medical humanism: Ferrara, 1464-1555", *Renaissance studies* vol. 11 no. 1 (1997) 2-19, specifically 11, 14-15, 17-18.

[218] From 1530 to 1555 she was governess of the territories of her brother emperor Charles V (1500-1558) in the Low Countries. Her court was in Brussels.

[219] In the letter Dodonaeus referred to himself in the first person plural. Rembertus Dodonaeus, *Cruydeboeck* (Antwerp 1554) *iij(r): "Ten laetsten zoo hebben wy die natuere/cracht/werckinghe/ende van den quaden cruyden die hindernisse ende beeteringhe / wt den alder outsten / besten ende vernaemsten Medecijnmeesters ende authueren ghetrocken/ende daer by ghevuecht/met dat van ons by sekere experientie van sommighen cruyden over langhe iaren ghevonden es gheweest/daer mede wy die historie van elck cruyt ghesloten ende volendt hebben."

[220] Dodonaeus, *Cruydeboeck* (1554) "..., hoewel tselve by experientie noch niet bevonden en is."

[221] Rembertus Dodonaeus, *Cruijdeboeck* (Antwerp 1563) biiij(r)-diiij (r). "Appendix secundas qualitates simplicium medicamentorum ostendens, medicis et chirurgis perutilis a studioso quodam hisce".

and in coming up with a suitable replacement in case a particular drug was unavailable. According to the rules in the city of Mechelen, if an apothecary could not provide a drug ingredient he was allowed to replace it only after a physician had been consulted.[222]

In Dodonaeus' last work the *Stirpium historiæ pemptades sex* (1583), it once more becomes clear that the medicinal properties of plants were important to him. At the end of the description of each plant, he took great care to consider what was known about a plant's qualities, taste and medicinal properties. In determining which plant had which properties, Dodonaues closely considered how the plant was related to other kinds of plants. Sometimes their appearance, time of blooming or place of occurrence was different, while its taste and qualities were the same. He also mentioned when a plant's medicinal properties were unknown.[223]

Furthermore, in the first book of *Stirpium*, Dodonaeus considered the investigation of the medicinal properties of plants extensively. One feature of this book puts Dodonaeus firmly in the group of writers that Arber credited with advancing the knowledge of plants and was in the "main stream of botanical progress". For here, Dodonaeus argued against Paracelsus' directions to consider the similarity of a plant's appearance to a body part or fluid, as a sign of their beneficiality to that body part. This idea is commonly known as the "doctrine of signatures" and, to Arber, works supporting this doctrine did not further "the science".[224]

Dodonaeus' discussion of this issue helps to distinguish his own use of the appearance of plants, to that of some contemporary authors. Dodonaeus emphasised several times that the tradition to ascertain a plant's powers and faculties with certainty "from imprinted marks or signs in the plant or parts of it that happened to be observed", was "not found mentioned by the esteemed amongst ancient authors". Instead, it was a recent invention.[225] Besides the fact

[222] Bosman-Jelgersma, "Dodonaeus en de farmacie", 129-140, specifically, 131.
[223] Dodonaeus, *Stirpium* (1583[1]) e.g. 399-400, "De Vitalba cap. XV". "Facultate autem acris & calida haec est, usum tamen nobis compertum, non habet ullum." "De Flammula cap. XVI."
[224] Arber, *Herbals*, 204; Renowed Dutch ethnographer Pieter J. Veth discussed this section of *Stirpium* in: Pieter Johannes Veth, "De leer der signatuur: met een naschrift "De Mandragora"", *Internationales Archiv für Ethnographie* (Leiden etc. 1894) 75-105, specifically 75-77; Dodonaeus, *Stirpium* (1583[1]) 17. Until 1578, Dodonaeus was court physician to Emperor Rudolf II, who was a known supporter of Paracelsian ideas.
[225] Dodonaeus, *Stirpium* (1583[1]) 16: "Ex characteribus sive signis quae in stirpibus, aut earum partibus observari contingit, ipsarum cognosci facultates posse, à probatis inter veteres auctoribus traditum non reperitur: Nonnullorum posterioris aetatis, & nostri sęculi recentiorum haec inuenta, aut verius commenta sunt. Qui naturam quolibet à se procreatum suis peculiaribus signaturis manifestissimè notasse existimant ac docent; per quas vires & facultates, praesertim occultae & latentes, certò cognoscantur:..." Dodonaeus, *Cruydt-boeck* (1608) 20. "Men heeft noint in de Schriften van de vermaerde ende geloofwaerdige oude schrijvers bevonden, dat men de erachter der gewassen soude moghen comen te kennen en te doorgronden uit sommige indruckselen oft merekteeckenen, de welcke in sommige gewassen ofte in eenige deelen van dien gemerekt ende bevonden worden. Alle dese bevindingen, ofte (om beter te seggen) versieringen, zijn van sommige nieuwe ende min vermaerde schrijvers in dese onse laetste tijden onlanx gevonden onde voor den dach gebracht: Die welcke

that the doctrine of signatures was such a new concept, Dodonaeus main objection was that it was unreliable and uncertain as a way to establish the properties of plants and therefore should in no way be regarded as science or doctrine.[226] Through a multitude of examples, he hoped to show that oftentimes the faculties were very varied and contradictory to the signatures. He concluded that sometimes the powers corresponded to a particular signature by chance, but this did not mean that one could safely, certainly and always know the faculties based on signatures. Certain judgment on the faculties of medicaments was drawn by means of experience.[227] Dodonaeus therefore judged the doctrine of signatures for its ability to discover new drug properties with a degree of certainty.

As Dodonaeus indicated, this discussion of signatures was one part of a more extensive discussion of how medicinal properties could be investigated. This discussion is a kind of summary of Galen' pharmacological works that appears typical for the period. Dodonaeus discussed the primary, secondary, tertiary and quarternary faculties, the tastes and how drug properties should be investigated through reason and experience. These features of the first book of *Stirpium* will be examined more closely further on.

The fact that such a summary of pharmacology was connected to a book specifically devoted to the study of plants seems to have been unprecedented. It is the only thing Dodonaeus ever published on a subject that belonged to the more theoretical part of medicine. Moreover, as I will examine more closely in later chapters, Dodonaeus' comments to Maria of Hungary on how he had assembled the medicinal properties he described in his herbal of 1554 and his approach to the investigation of drug properties as shown in his Cologne publications, can be contrasted with the instructions and guidelines he descibed in the first chapter of *Stirpium*. This chapter and Fernel's *Universa medicina* seem to have been a great inspiration for a physician who later became Dodonaeus' colleague at Leiden, Johannes Heurnius. *Universa medicina*'s influence is especially noticeable in the innovative textbook,

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houden staen ende met redenen bevestigen willen/ dat de Aert van alle wereltlycke dingen (die men op 't Latynsche Natura noemt) al t'gene dat hij ter werelt geschapen oft gemaect heeft, sijne eygene teeckenen ende mereken uitdruckelycken gegeven ende ingeprent heeft, door de welcke de krachten en werekingen van dien/ besonder de verborgee ende heymelycke/ sekerlycken bekent mögen worden: ..."

[226] Dodonaeus, *Stirpium* (1583[1]) 16: "...: Doctrina verò de signaturis stirpium, à nullo alicuius aestimationis veterum testimonium accepit: deinde tam fluxa & incerta est, ut pro scientia aut doctrina nullatenus habenda videatur." Dodonaeus, *Cruydt-boeck* (1608) 20: "Maer daer en tegen de leere oft wetenschap van dese voorseyde Teeckenen ende Indrucksels der gewassen/ en is van niemant van de oude die eenighen loff waerdig zy/noyt geacht of gepresen geweest, ende ooc boven dien/sij is soo los/wanckelbaer/twijfelachtigh ende onseker/dat sij geensins voor eenige kennisse ofte wetenschap en behoort ghehouden te worden.

[227] Ibid., 18: Quod si verò & fortuito casu vires quandoque signaturis respondeant; non tamen idcirco tutò, certo, aut perpetuò ex iis, quae pro signatures habentur, facultates cognosci, aut manifestas fieri consequens est. Saepenumerò facultates multum differentes, signaturis repugnant, ut superioribus exemplis satis dilucide ostensum. Atque idcirco quoque signaturis nullatenus fidendum est; nisi experientia adstipuletur, per quam de facultatibus medicamentorum iudicium certius depromitur, ut superiore capite quoque scripsimus.

Institutiones medicinae (1592) that Heurnius and his former student Petrus Paaw composed together.

***Institutiones medicinae*: the composition of a textbook**

After studying medicine in Leuven, Paris, Padova and Pavia, where he graduated in 1571, Heurnius practiced medicine in his native Utrecht from 1573 until 1581, when he began teaching in Leiden. From the biography, which Otto Heurnius (1577–1652) attached to his father's *Opera omnia* in 1609, we can learn that Johannes started out teaching about the *Institutiones medicinae* though it is not clear if this term was used at the time.[228] Indeed, there are few *series lectionum* remaining from this period and the university records give us no clues about the subjects that Heurnius taught. During his life Heurnius published primarily about subjects to do with practical medicine.[229] Most importantly this was his *Praxis medicinae nova ratio* (1590).[230] In his *Institutiones medicinae* or "The principles of medicine" of 1592, he shows that where it came to these principles, Galen and to a lesser extent Avicenna were still the most important medical authors.

According to Heurnius, Paaw had helped and encouraged him to assemble this book and prepare it for printing.[231] Paaw's letter to the readers of the *Institutiones* provides us with some idea of the circumstances under which it was composed. As we have seen, Paaw was given the task to teach whatever he was found to be capable of and taught from Fernel's *Universa medicina* 1591. He was unsatisfied however by the way medicine was usually taught in his time. According to him, it did not exactly foster much enthusiasm because it mostly covered the beaten paths.[232] The solution he came up with was to go back to the lectures he had received from his teacher Heurnius, "since once upon a time I laid the foundations of medicine" under Heurnius' guidance. Paaw assembled the papers with notes from Heurnius' public lectures, which had been scattered and dispersed. In these lectures,

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[228] Johannes Heurnius, *Opera omnia* (Leiden 1609) **4(r).
[229] Johannes Heurnius, *De morbis qui in singulis partibus humani capitis insidere consueverunt* (Leiden 1594); Idem, *Prolegomena, et prognosticorvm libri tres* (Leiden 1597); Ibidem, *De febribus liber* (Leiden 1598); Idem, *Praxis medicinae nova ratio: qua, libris tribus methodi ad praxin medicam, aditus facillimè aperitur ad omnes morbos curandos* (Leiden 1590). cf. the *Index contentorum* of his *Opera omnia* (Leiden 1609) ***2 (v).
[230] The title shows an interest in establishing a new, rational practice of medicine.
[231] Heurnius, *Institutiones* (1609) º2r-v. "Quorum parturiginem cum animaduerti, & inter illos doctissimum professorem Medicinae (collegam iam, & olim discipulum meum) D. Petrum Pauvium, qui editionem (quod illi Medicinam longe lateque diffusam & quasi incertis sedibus vagantem componere hae Institutiones viderentur) urgebat, & iam ad praelum a se descriptas monstrabat; quare aliquid etiam has esse persuasus sum." º2v: "Nam cum haec parari praelo a doctissimo Pauvio sensi, (testis erit ille semper mihi) ut non meo, sed suo nomine haec mea ederet volui: noluit illi, qui eius est candor, sed meo."
[232] Ibid., *4r-*4v. Petrus Pavius, Lectori s.: "ille futili & gregario nimis stylo, rebusque via pervulgata tritis. Fastidium potius quam appetitum lectori parere videbantur."

dictated from memory, Heurnius had displayed "the general points of our art". It appears that when studying these papers, Paaw's enjoyment of the material had returned.[233] He emphasised how very briefly, neatly and aptly Heurnius had brought the teaching material together.[234]

Paaw's account of how the *Institutiones* was constructed partially fits in with contemporary practices for textbook production as described by Ann Blair. Blair discussed the importance of dictation in university education, even in the study of medicine. Student manuscripts of books would circulate even when printed versions existed. In contrast to the Leiden *Institutiones*, the textbooks from early seventeenth-century Paris, that Blair examined, were published posthumously by former students.[235] Paaw's account of the origin of the *Institutiones* as based on his student notes was thus not entirely unusual, although his professor, Heurnius, was still alive when it was published.

In Heurnius' *Modus ratioque studendi eorum, qui medicinae operam suam dicarunt*, which was attached to *Institutiones medicinae*, we can discern again that *Institutiones* was composed mainly for educational purposes. Heurnius explained that the medical student should start his studies by reading the *Institutiones*. This would give him a first idea of medicine and an overview of the study of medicine as a whole. After all, as Heurnius himself described in flowery language, the *Institutiones* was nothing more than the best from all medical authors, selected and brought together.[236]

The medicine Heurnius discussed in his *Institutiones* is comparable to other medical textbooks. Like others, such as the *Ars parva*, the summary of Galen's works, Avicenna's *Canon* (1025), Fuchs' *Institutiones* (1555) and Fernel's *Medicina,* Heurnius' *Institutiones* was arranged from the simplest to the most complex aspects of medicine.[237] The closest example appears to have been *Medicina*, as *Physiologia* was taught as early as 1587 and *Universa*

[233] Ibid., *4v. Petrus Pavius, Lectori s.: "Denuo itaque hic quid agerem incertus, en opportune mentem mihi subit, Claris. Virum Ioannem Heurnium praeceptorem meum, cum sub eo olim medicinae fundamenta iacerem, universae nostrae artis capita nobis auditoribus suis lectionibus publicis memoriter dictando proposuisse; schedas meas, licet iam laceras & disiectas, in unum colligo, avideque adhibito iudicio lustro: mirum quam me confestim eorum lectio affecerit, tum quod iucunda existeret praeteritorum studiorum recordatio; tum vel maxime quod commodissima esse viderem quae publice proponerentur, idque praesertim in hac Academia, in qua nata, cuius genio accommodata." Paaw was a medical student in Leiden from 1581 to 1584.
[234] Ibid., *4v. Petrus Pavius, Lectori s. : "… ; plurima nova accessisse; quaedam apud omnes passim obvia, ademta ; breviter, adeo concinne apteque omnia composita, … "
[235] Ann Blair, "Student manuscripts and the textbook", in: Emidio Campi, ed., *Scholarly knowledge. Textbooks in early modern Europe* (Geneva 2008) 39-73, especially 47-57.
[236] Heurnius, *Institutiones* (1609) º3r, 170-171.
[237] Siraisi, *Avicenna*, specifically 102: "Johannes Crato of Krafftheim, a pupil of Da Monte, has left an account of the rapid reception of Fernel's work at Padua, of Da Monte's interest in it, and of the eager pronouncement by Bassiano Landi [?-ca.1563] that Fernel had superseded Avicenna. Yet Fernel's unorthodoxy was sufficient to make his work unacceptable to some Galenists."

medicina was used in the teaching of medicine in Leiden the year before the *Institutiones* was published.[238]

John Forrester has discussed the genesis of Fernel's *Universa medicina* extensively. This *Opera omnia* was published posthumously, however its constituent parts were published during Fernel's life. His two most famous works, *De naturali parte medicinae* (1542), which is best known by its later title *Physiologia*, and *De abditis rerum causis* (1548) were also his earliest publications on medicine. Of these, *De abditis* was almost certainly written before *Physiologia* and to have circulated in manuscript form by 1538. *Pathologia* and *Therapeutice* first appeared, together with the now re-named *Physiologia*, under the simple title *Medicina* (1554). These three books have the character of comprehensive textbooks. The posthumously published *Universa medicina* then added *De abditis* to *Medicina*. *De abditis* differed from *Medicina* in organization and was seen by Fernel as a more original contribution to medicine.[239] We will come to examine *De abditis* and *Therapeutice* more closely.

There is another clue that Fernel influenced the composition of the *Institutiones*, in Heurnius' *Modus ratioque studendi*. Heurnius was especially appreciative of Fernel and Fernel was the only non-practical modern writer whom Heurnius recommended to students. Specifically, he lauded the way Fernel "conversed" with them, added his own arguments and noted the sources, or "rivulets" from which he drew his material. He truly brought together the best out of all these sources.[240]

Heurnius appears to have been interested in the way physics and medicine were connected to each other because he praised Fernel for summarising the writings of Greek and Barbarian medical authors in one book and he pointed out that Fernel had introduced physics into medicine in the right places. Heurnius stated that now, not the entirety of physics needed to be investigated for its use in medicine, since Fernel had done this already. He did mention that the author's work was difficult however and should not be considered as the first

[238] A lecture on Fernel's *Physiologia* by Gerardus Bontius is listed in the series lectionem dating probably from the autumn of 1587. Molhuysen, *Bronnen*, 157*; Guillaúme H.M. Delprat, *De allereerste* series lectionum *der Leidsche hoogeschool* (Leiden 1852); Bronchorst and Van Slee, eds., *Diarium Everardi Bronchorstii*, 19. At the time Bronchorst (1554-1627) was professor of civil law in Leiden.

[239] Forrester, *Jean Fernel's*, 12-17; Jean Fernel, *De naturali parte medicinae* (Paris 1542[1]); Jean Fernel, *De abditis rerum causis libri duo* (Paris 1548[1]); Jean Fernel, *Medicina* (Paris 1554[1]); Jean Fernel, *Universa medicina* (Paris 1567[1]). Incidentally, *Universa medicina* seems to have been published right around the time that Heurnius studied in Paris from 1564 to 1567. G.A. Lindeboom, *Dutch medical biography. A biographical dictionary of Dutch physicians and surgeons 1475-1975* (Amsterdam 1984) 858.

[240] Heurnius, *Institutiones* (1609) 169-170. "Unum ex huius temporis scriptoribus his addo, doctissimum Fernelium, qui Arabum ductum non sine Graecorum demonstrationibus secutus fuit. Eius lectionem laudo, modo cum iam dictis auctoribus conferatur, locaque annotentur ex quibus suos rivulos traxerit: optima enim ex cunctis selegit."

beginning of medicine.[241] This might have something to do with the fact that Fernel, particularly in *De abditis rerum causis*, had sometimes diverted from his sources in ways that not all contemporary Galenists agreed with.[242] As Heurnius acknowledged, Fernel was not able to derive everything from ancient sources, since he sometimes freely avoided and passed them over.[243] This put the student in a difficult position. What do you do then, Heurnius asked. The demonstration of the ancients joined by reasons could be used to end the dispute.[244]

As historian John Forrester pointed out, Fernel took care to show that the medical theory he expounded in *De abditis*, "emerged logically out of the traditional theory" and that it was "for the most part, an extension and refinement of current beliefs, it was an innovation which was not in any way iconoclastic". This was "not always convincingly for some of his more conservative readers".[245]

Like Heurnius, Forrester noted that Fernel pointed "to places in the ancient literature where his ideas are adumbrated." We can observe that Forrester's assessment of Fernel's position in *De abditis causis* as a balance between originality and Antiquity was very much how Heurnius perceived this work as well.[246] The appreciation of Fernel's work in the Leiden curriculum made the University one of the "Modern schools" described by Robert Boyle (1627–1691) when he commented on Galenic medical practice.[247] Heurnius showed his intentions to preserve and recover the teachings of ancient and Arabic writers as much as

[241] Heurnius, *Institutiones* (1609) 170. "Sed gravis hic est auctor, nec in primo Medicinae limine ponendus: sed a Galeno hoc potius utendum. Qui tamen compensiosam medicinam nimium amat, hunc legat cum iudicio: is enim, ut verum fatear, Graecam & Barbaram medicinam fere uno in volumine conclusit, & propriis locis philosophiam medicinae intulit: ut non sit necesse aliam physicam usibus medicis quaerere, cum ex latissimo naturae ambitu foecunde medicum campum rigarit."
[242] Siraisi, *Avicenna*, 102, 104, 202; Forrester, *Jean Fernel's*, 17.
[243] Heurnius, *Institutiones* (1609) 170. "sed stare eius auctoritati non potis est, nisi ubi firma demonstratione sua stabilivit. Quare in antiquos suos fontes si refundi possit sane limpidissimam firmamque scientiam pareret. Sed totius eo abduci nequit, ut qui sponte interdum declinat & abit."
[244] Heurnius, *Institutiones* (1609) 169-170. "Quid tunc agas? litem dirimet antiquorum demonstratio collata cum huius rationibus; & usus. haec si vicerint, excutiantur nova tanquam amentatae hastae: sin Fernelius quid melius, retineatur, & gratiae illi ascribantur, ut qui pomoeria medica auxerit."
[245] Forrester, *Jean Fernel's*, 21; Siraisi, *Avicenna*, particularly 102: "Johannes Crato of Krafftheim, a pupil of Da Monte, has left an account of the rapid reception of Fernel's work at Padua, of Da Monte's interest in it, and of the eager pronouncement by Bassiano Landi that Fernel had superseded Avicenna. Yet Fernel's unorthodoxy was sufficient to make his work unacceptable to some Galenists."
[246] Forrester, *Jean Fernel's*, 17-21.
[247] In a manuscript transcribed by Michael Hunter, Boyle wrote: "the Doctrine & Prescriptions of the Greek & Arabian Galenists [...] is tho with some variety & Innovation embraced by Fernelius & others, whose Institutions are wont to be read in the Modern Schools..." Michael Hunter, "Boyle versus the Galenists: a suppressed critique of seventeenth-century medical practice and its significance", *Medical history: the official journal of the British society for the history of medicine* vol. 41 (1997) 322–361, particularly 353–354.

possible, but appreciated the compromise that Fernel struck between the new and the ancient.[248]

Heurnius' *Institutiones* was fairly successful. From 1592 to 1666 the book went through six editions in Leiden alone and already in 1593 it was reprinted in Frankfurt.[249] From the first edition to the last, little changed in the text, even when Otto Heurnius took over its publication after his father's death. In the following years other medical teachers in Leiden, the Dutch Republic and outside of it published *Institutiones medicinae* or *Institutiones medicae*. Thus, a great number of individual publications and editions of these publications appeared under this title between Heurnius' *Institutiones* and the one by that famous Leiden professor Herman Boerhaave (1668–1738) in 1707. Examples of these are Daniel Sennert's first book *Institutiones medicinae* (1611) and the *Institutiones medicinae* by Lazare Rivière (1589-1655) in 1657.

Gilbertus Jacchaeus, a physician and professor of philosophy at Leiden published his *Institutiones medicae* in 1624.[250] He was born in Aberdeen, Scotland and was educated there, at the Lutheran school of Helmstedt from 1598 and from 1601 at Herborn, where he was appointed *professor extraordinarius* shortly after. In 1603, he registered as a theology student in Leiden and in the same year was permitted to give lectures on the *Isagoge* by Porphyrios (234–ca. 305 AD), a work on Aristotelian logic and philosophy.[251] He was appointed as extraordinary professor of logic two years later and in 1607 as professor of ethics at the university. A year after getting a medical degree in 1611, he started teaching physics as ordinary professor. Only in 1624, after he had been suspended from teaching because of his Remonstrant sympathies in 1619 and had been reinstated in 1623, did he publish *Institutiones medicae*. There is much continuity between Heurnius' and Jacchaeus' representation of the properties of drugs, their place in medicine and the connection that is established between medicine and physics through them. Jacchaeus clearly wanted to make his *Institutiones medicae* up-to-date and recorded some of the latest ideas on drug properties. After Jacchaeus'

[248] Heurnius, *Institutiones* (1609) 170. "haec si vicerint, excutiantur nova tanquam amentatae hastae: sin Fernelius quid melius, retineatur, & gratiae illi ascribantur, ut qui pomoeria medica auxerit."
[249] This succes is extremely limited if compared to the "ninety-seven complete editions or translations" of Fernel's *Medicina* that Roy Porter reported to have appeared between 1554 and 1680. Roy Porter, *The greatest benefit to mankind. A medical history of humanity* (New York 1997) 174. I have only counted the editions of Heurnius published in Leiden and so the numbers are not entirely comparable.
[250] It was republished in 1631 and 1653 "prout autor eam ante mortem recognovit, emendata". Examples of such works published later in the century are *Institutionum medicarum compendium, disputationibus XII ... absolutum* (Amsterdam 1667) by Gerardus Blasius (1625-1692) and *Institutiones medicinae rationalis, recentiorum theoriae & praxi accommodatae* (Leiden 1689) by Johann Jacob Waldschmidt (1644-1689).
[251] Jonathan Barnes, *Porphyry: introduction* (Oxford 2003); Christos Evangeliou, "The Aristotelianism of Averroes and the problem of Porphyry's Isagoge", *Philosophia* no. 15–16 (1985–86) 318–331.

Institutiones, no new Latin works in which Galenic pharmacology was discussed were published in the Dutch Republic.

Heurnius and the study of plants

At the time Heurnius was writing the *Institutiones*, he was also occupied with arranging for Clusius to come to Leiden to take charge of the academic garden. This can be concluded from the correspondence between Clusius and Johan van Hoghelande (1546-1614).[252] Van Hoghelande was a minor nobleman from Zeeland who owned several gardens in and around Leiden. He followed the establishment of the academic garden closely and reported new developments to Clusius. Though Hoghelande was certainly not an unbiased witness, much of what we know about the knowledge of plants of the Leiden medical professors comes from his letter to Clusius. Before Clusius' arrival in Leiden, Hoghelande assured him that a person such as him was very much required in Leiden.

> What you wrote about the Viennese students, I certainly cannot wonder enough about their idleness: our students here would have considered themselves very fortunate, if they had had someone who accompanied them in such activity: which I, for a lack of better was accustomed to do in fact, before the arrival of the late Dodonaeus, and also pretty often have done after his death. You surely laugh; but I speak true. D. Heurnius after all studious and wise indeed, prevents them from exercising this skill, insufficiently involves himself in this undertaking. That a man who is very learned in other regards, will neglect the subject of plants, is to be regretted.[253]

According to Van Hoghelande, Gerhard Bontius had shown himself to be laughably ignorant of the correct identification of plants during one of his fieldtrips.[254] Consequently, students

[252] About Van Hoghelande's opinion of Paaw see: Egmond, *World of Clusius*, 164-168, particularly160.
[253] Letter from Johannes Hoghelande to Carolus Clusius, 1591-03-02. "Quod de studiosis Viennensibus scribis, non possum certe illorum ignaviam satis mirari: nimis quam felices se merito arbitrarentur hi nostri si quem haberent qui illos ad huiusmodi exercitium deduceret: quod quidem prae melioris inopia ante adventum Dodonaei p.m. ego facere consueveram, feci quoque saepiuscule post eius obitum. Rides fortisan; atqui verum dico. D. Heurnius enim studiose et sapientur quidem illis in hac palaestra exercendis abstinet, se hoc in negotio non satis versatum conscius, dolendum quod vir alioqui doctissimus hanc materiam ita neglexerit."
[254] Letter from Johannes Hoghelande to Carolus Clusius, 1591-03-02. D. Bontius vero dum plus aequo sibi hac in re arrogat, frequentissime studiosis se ridendum praebet: ille enim hac quoque aestate cum quosdam in scaturigines Hollandicas ad hoc exercitium deduxistes (vel regatus comitaretur) requisitus a quodam novitio qui

would show those herbs or roots they had not recognised to Van Hoghelande and would visit his garden at the same time.[255] He added that besides him and the apothecary Christiaen Porret (1554-1627), there was absolutely no one in the city who derived pleasure from the variety of herbs.[256] From this anecdote it is clear that Hoghelande did not consider the medical professors in Leiden to be very interested or indeed knowledgeable about plants at the time Paaw and Heurnius were putting together the *Institutiones*.

Heurnius does not say much about gardens and the study of plants in his publications. In a very general way, he brought up the study of anatomy, botany and astronomy in his *Modus ratioque studendi*. He mentioned the visits to fields, pleasure-gardens, meadows and parks that students could make. He suggested that a student scale hills, climb mountains, and search the shelter of forests, "wherever the matter of their interest, and not without the delight of riches". In this way, he would come to known many metals and animals.[257] He only mentioned Dioscorides and his *De materia medica* however in an enumeration of several minor Greek authors, which readers could consider. He described no particular aspects of the study of plants or how to study them, not even when he wrote about Theophrastus (371–ca. 287 BC).[258]

The impression we get from this text that Heurnius was interested in and enjoyed visiting places were plants could be found, without studying them particularly diligently, is confirmed by his treatise on the nature of human happiness, *De humana foelicitate libellus* (1596). As Chris Heesakker has described, the treatise took the shape of a letter, addressed to the famous Dutch physician Pieter van Foreest or Petrus Forestus (1521-1597). Heesakker noted the similarities between the lyrical passage that Heurnius wrote about the pleasure and delight that was to be enjoyed in experiencing nature and a section of *De Constantia* (1584) written by Justus Lipsius (1547-1606) a patron, colleague and patient of Heurnius, who had moved away from Leiden in 1590. Heurnius thus mentioned the impressive beauty of growing seeds, he compared the colours of flowers to gemstones and remarked on the pleasant smells

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tormentillam emeserat, quaenam illa esset herba, respondit quinquefolij esse speciem: similiter de Mijrtho Brabantica, salicis esse speciem respondit, ac nescio quae alia prorsus ridenda. "

[255] Ibid., "Itaque oblata herba aut stirpe quapiam ipsis incognita, ad me plerumque illam deserunt, atque eadem opera hortum meum visunt, ex quo si quid illis commodi accredit, sicut certe hactenus accessit plurimum, ut nunc, alio alium docente, enctore vix egeant."

[256] Letter from Johannes Hoghelande to Carolus Clusius, 1591-03-02. "Praeter me autem et pharmocopolam Poret, Plantini p. m. nepotem, nemo prorsus in hac civitate est qui herbarum varietate delectur;" About Porret see i.a. Egmond, *World of Clusius*, 162-164.

[257] Heurnius, *Institutiones* (1609) 167. "Campos adeant, & amoenissimos invisant hortos, praeta & viridaria, ac tot pictas nativis suis varijsque coloribus planicies. colles subeat, conscendat montes, ac sylvarum latebras quaerat, ubique huius studii materia, & non absque voluptate lucrum. Ita metalla & animalia noscat tantum."

[258] Heurnius, *Institutiones* (1609) 167.

of some vegetation, the sounds of the forest such as the wind through leaves and the singing of nightingales and noted the different stages of the growth of fruit.[259]

There is a marked contrast between the way in which and the reason why Hoghelande and Heurnius and Paaw studied plants. His letters to Clusius show Hoghelande to have been interested in discussing many different varieties of plants and in sharing his experiences in growing them. We find no such interest in the work of Heurnius and Paaw. Nor did they share in Dodonaeus' endeavor to investigate the medicinal properties of plants from their varieties, appearance and occurrence. While Dodonaeus had been eager to combine the study of plants with that of medicine in this way, they apparently did not follow his example.

Institutiones medicinae and the *methodus medendi*

The novelty of the *Institutiones medicinae* has been recognised by Siraisi and French, though they did not trace this title to Heurnius.[260] Although the kinds of topics in this *Institutiones*, and the order in which they were discussed, had a long history of medical writing, such a concise summary of the material had not been written under this particular title. While there had been *Institutiones* in the fields of linguistics, law and theology, I only know of two earlier *Institutiones* dedicated to the field of medicine. As Siraisi pointed out, one was "a work on anatomy, not general medicine".[261] The other, by Leonhart Fuchs, was also designed for students and was similarly intended to present an overview of medicine. There are some similarities between Fuchs' and Heurnius' *Institutiones* in the subjects they dealt with and the order in which these were discussed. The main differences are that Heurnius did not discuss anatomy while Fuchs did and Fuchs did not discuss *methodus medendi* as a separate subject while Heurnius did.[262] Although the subject matter and order of discussing it were not unique,

[259] Chris Heesakkers, "In de tuin van de buren", in: Willem van den Berg en Herman Pleij, eds., *Mooi meegenomen? Over de genietbaarheid van oudere teksten uit de Nederlandse letterkunde* (Amsterdam 1997) 60-63.
[260] Siraisi, *Avicenna*, 101, n. 77; French, *Medicine*, 188.
[261] Guinter of Andernacht, *Institutionum anatomicarum Galeni Sententiam, ad candidatos medicinae* (Paris 1536).
[262] Leonhart Fuchs, *Institutiones medicinae: ad Hippocratis, Galeni aliorumque veterum scripta recte intelligenda mire utiles, libri quinque* (Lyon 1555). There Fuchs discussed general therapeutics under the title of *De curandi ratione*, thus not referring to it with the term *methodus medendi* as Bylebyl claimed. Fuchs did however use Galen's *Methodus medendi* as his main source. Bylebyl, "Teaching *Methodus medendi*", 165. Fuchs had not discussed the *methodus medendi* in his *De medendi singularum humani corporis partium. A summo capite ad imos usque pedes passionibus ac febribus* (Basel 1539), his *Methodus seu ratio compendiaria perveniendi ad veram solidamque medicinam, mirifice ad Galeni libros recte intelligendos utilis, nunc recens in lucem aedita* (Basel 1541) or his *De curandi ratione libri octo: causarum signorumque catalogum breviter continentes* (Paris 1548) either. For a discussion of Fuchs' *Institutiones* and its relation to contemporary debates of the medical method see Andrew Wear, "Galen in the Renaissance", in: Vivian Nutton, *Galen: problems and prospects* (London 1981) 229-262, specifically 239-240 and Wear, "Explorations", 123.

with the *Institutiones* Heurnius constructed an innovative book, especially since it was meant to give a relatively brief overview of medicine.

Fuchs did not discuss the *methodus medendi* as a separate subject in his work, but in the dedicatory letter to his *De medendi singularum humani corporis partium* (1539) he did express his wish "to produce a method or ratio for treatment which would reflect Galen's views, especially as they related to the indications for cure".[263] As particularly Bylebyl and Wear have discussed, Fuchs shared this interest in making the practice of medicine more methodical or rational with his contemporaries. Heurnius' *Institutiones* can similarly be situated within contemporary discussions about the way medicine should be taught and about how the relationship between theory and practice should be restored. Of most interest here is the last part of his *Institutiones*, that about the *methodus medendi*.

In Padua especially this methodical way of healing received renewed attention in the second half of the sixteenth century. By the study of the *methodus medendi* discussed by Galen and developing it further, Renaissance physicians hoped to overcome the division of medical theory and medical practice, which had been established in Avicenna's *Canon* and had been implemented in the curricula of European universities since then.[264] Giovanni Battista da Monte, or Johannus Baptista Montanus (1498–1551), professor of medicine in Padua, was critical of this division. According to Siraisi,

> In Da Monte's view, what was needed was a unified introductory overview of "universal medicine." This would from the beginning teach students method and principles as they related to practica – not only principles of natural philosophy and the elements, temperaments, humors, members, virtues, and spirits, but also the rest of medicine: the disposition of the body and their causes and signs, the conservation of health, and the alteration of bodily dispositions.[265]

[263] Wear, "Explorations", 121.
[264] Nancy G. Siraisi, "Changing concepts of the organization of medical knowledge in the Italian universities: Fourteenth to sixteenth centuries", in: B. Scarcia Amoretti, ed., *La diffusione delle scienze islamiche nel medio evo Europeo (Roma, 2-4 ottobre 1984)* (Roma 1987) 291-321, particularly 295-297, 301; eadem, *Avicenna*, 99-101; Maclean, *Logic, signs and nature*, 200-202, 205; Grendler, *The universities*, 342; Bylebyl, "The school of Padua"; Bylebyl, "Teaching *Methodus medendi*"; Carrara, "Epistemological problems", 263; Andrew Wear, "Learned medicine in early modern England", in: Don Bates, ed. *Knowledge and the scholarly medical traditions* (Cambridge 1995) 151-173, there 155.
[265] Siraisi, "Changing concepts", 311; Siraisi, *Avicenna*, 99-100.

In effect, Fernel's *Universa medicina* and Heurnius' *Institutiones* gave such introductory overviews. Heurnius assembled the most important parts of both the theory and practice of medicine into one volume and presented it as a consistent, comprehensive whole.

Although grounded in Galenic medicine, Heurnius' *methodus medendi* differed significantly from Galen's book on this topic.[266] Historians have remarked that in earlier and contemporary commentaries on Galen's *Methodus medendi*, the theoretical basis of symptoms and diseases became more important. In order to come to a proper treatment, not just the humoral imbalance that lay at the basis of an affliction needed to be considered. The individual circumstances of a patient needed to be considered more thoroughly as well. Besides conveying the general cause of the disease, as was common in works on practical medicine, more specific causes were also given. It was indicated where in the body, in what way, and at what point in time a particular vapour, poison, or quality injured the body.[267]

How these more specific ideas about the causes of diseases were related to ideas about the way in which drugs cured them, has not been investigated to my knowledge. In Heurnius' discussion of the *methodus medendi* we can observe that for him there was an especially strong connection between this method and the many different drug properties that he distinguished. Heurnius makes this clear by starting his discussion of the method with two chapters about the properties of drugs and by citing Galen as saying that the *methodus medendi* and the contemplation of the faculties of drugs were mutually connected and joined, so that neither could be understood without the other.[268] The properties of simple drugs were essential to developing the *methodus medendi*.

In conformity with the introductory design of the *Institutiones*, Heurnius' and Jacchaeus' discussion of the *methodus medendi* were much briefer than that by, for example, Fernel. Issues such as the composition of drugs and the properties of individual simples were not discussed as Fernel had done. Neither did Heurnius, or Mattioli, Dodonaeus, Spigelius or Jacchaeus for that matter, distinguish between internal and external drug effects as Fernel

[266] Philip J. van der Eijk, "Therapeutics", in: R.J. Hankinson, ed., *The Cambridge companion to Galen* (Cambridge 2008) 283-303. cf. Fernel's book on the subject, which was included in the *Universa medicae*.
[267] Jerome Bylebyl, "The school of Padua: humanistic medicine in the sixteenth century", in: Charles Webster, ed., *Health, medicine and mortality in the sixteenth century* (Cambridge and New York 1979) 335-370; Idem, "Teaching *methodus medendi* in the Renaissance", in: Fridolf Kudlien and Richard J. Durling, *Galen's method of healing. Proceedings of the 1982 Galen symposium* (Leiden etc. 1991) 157-189; Andrew Wear, "Explorations in Renaissance writings on the practice of medicine", in: Andrew Wear *et al*., eds., *The medical renaissance of the sixteenth century* (Cambridge 1985) 118-145, specifically 124, 130, 136-139.
[268] Johannes Heurnius, *Institutiones medicinae* (Leiden 1593) 346 a4(v): "Sed quia medicinam sine medicamentis eorumque perceptis viribus facete non possimus, quiodque, ut scribit Galenus, methodus medendi & contemplation de medicamentorum facultatibus mutuo connexu sunt ita consociate, ut neutral sine altera intelligi posit; pauca de internoscendis viribus subdam, moxque ad methodum medendi veniam."

had.[269] A student would have to consult Fernel's work on the *methodus medendi*, or herbals such as that by Dodonaeus to find out more about these issues. Heurnius referred to his own work about practical medicine for a discussion of compound drugs.[270] Only a very limited amount of the issues with regarded to the properties of drugs, which Galen and his later commentators had discussed, were considered in any depth by Heurnius. The topics he did discuss corresponded to those, which Dodonaeus had focused on before him.

The *methodus medendi* was important in the examination of students in Leiden. As part of their philosophy or medical degree, students would defend several theses or positions on a particular subject. Most medical theses at this time discussed a particular disease.[271] These theses followed the *methodus medendi*, at least to a great extent, by discussing the causes of the disease, often both external and internal,[272] followed by the different signs which would help in the diagnoses, a prognosis, curative indications and a description of the proper chirurgical, pharmaceutical and or dietary treatment.[273] In these medical examinations then, the philosophical and medical principles on which the method was based were usually assumed and used rather than considered in themselves.

We have come across a discussion regarding the aspects of Galenic pharmacology similar to the one we have found in Dodonaeus and Heurnius in Spigelius' *Isagoges*. Spigelius' discussion however was especially extensive. Under different headings, Spigelius discussed topics that Fernel had only touched upon. As Ogilvie has remarked, the former's discussion covered fifteen pages.[274] Now that we have encountered the four authors connected to the University of Leiden who discussed Galenic pharmacology, we will turn to the content of these pages.

The properties of medical materials

In their summaries of Galenic pharmacology, the authors only dealt with the properties of simple drugs and made a distinction between two different kinds of properties: qualities and faculties. By qualities they mainly meant a drug's primary, elementary qualities: hot, dry, cold and moist. These were also referred to as manifest qualities. The terms 'complexion',

[269] Fernel, *Universa medicina* (1665) 377.
[270] Heurnius, *Institutiones* (1609) 132. "Nam de compositione medicamentorum eorum quae nunc publici usus sunt, libro primo nostrae Methodi ad Praxin, abunde egimus: ac cunctam varietatem remediorum selectissimorum illia inclusimus."
[271] For a partial overview see Kroon, *Bijdragen*, 119, 121, 127, 129.
[272] The external ones were the non-naturals, the internal ones described the events that took place in the body.
[273] Kroon, *Bijdragen*, 30-41; Cf. Egbert Bodaeus, *Theses medicae de phrenitide* (Leiden 1597); Balthasarus Schonaeus, *Theses medicae de lethargo* (Leiden 1597); Lindeboom, "Medical education", 203, n. 11.
[274] Ogilvie, *Science of describing*, 205.

'temperament' or 'nature' indicated the balance of these qualities. The authors discussed the faculties much more elaborately than the qualities. By 'faculties', 'powers' or 'virtues', they referred to the many different effects a drug could have on the body or rather how the drug appeared to work in the body.[275] Dodonaeus, Heurnius, Spigelius and Jacchaeus focused on describing the different tastes of drugs, their operations in the body and the way drug properties should be investigated through reason, experience and the senses. Describing the relationships between the different drug properties was as much about ordering and defining them properly, as it was about determining their causes.

Heurnius, Dodonaeus and Jacchaeus dedicated little space to a discussion of the primary qualities. They only mentioned the primary qualities in their discussions of the faculties and of taste. The qualities had already been discussed earlier in the *Institutiones* and medical students had acquired a basic knowledge of them in their philosophical studies. The faculties of drugs were divided into primary, secondary, tertiary and quaternary faculties. The primary faculties were the powers produced by the qualities: warming, cooling, drying and moistening, most often in orders of strength from one to four. Dodonaeus, Heurnius and Paaw outlined the difference between actual and potential faculties. Galen had adopted this distinction from Aristotle.[276] The two words cover their meaning well. Referring to Galen, Dodonaeus described that the first type of faculty showed itself straightaway and worked by itself. The other was only possibly, took some time to occur and required interaction with the body. While the heat of fire and the wetness of water worked directly, the properties of drug needed to be activated in the body. Heurnius' and Jachaeus' descriptions were along the same lines.[277]

When it comes to the secondary and tertiary faculties, it will suffice here to discuss only the difference between Heunius' and Jacchaeus' discussions. Heurnius designated the secondary faculties as rarefying, opening, thinning, attracting, repelling, dense making, closing, thickening, mollifying, hardening, purifying, causing to adhere, diluting, binding, pulling or drawing, wiping off or dispelling, obstructing, hurting and purifying.[278] Heurnius and Jacchaeus discussed the degrees of strength of remedies briefly. They differed slightly in the way they described how the secondary and tertiary faculties were connected to the

[275] This distinction is similar to that made by Galen between "elementary or basic qualities" and "derivative qualities." See Vogt, "Drugs", 308, 319, n. 16, 320, n. 19. In the next chapter, Jacchaeus' distinction between two kinds of secondary qualities is discussed.
[276] Vogt, "Drugs", 308-309.
[277] Dodonaeus, *Stirpium* (1583[1]) 6; Heurnius, *Institutiones* (1609) 133; Jacchaeus, *Institutiones medicinae* (1624[1]) 244-245.
[278] Heurnius, *Institutiones* (1609) 133–134.

primary ones. Of all the faculties Heurnius and Jacchaeus paid most attention to the secondary and tertiary faculties.

In Heurnius' account, the secondary faculties of simple drugs were distinguished from each other by the way they acted in the body as well as the consistency of their material and the amount of dryness, warmth, moistness and cold present in them. Matter could be thick or thin. Heurnius explained that simples were thin if they could easily be broken into smaller parts, whereas thick, hard, solid and tough simples were not particularly brittle.[279] Simples that rarified, opened, thinned and attracted, acted then by uniting heat and thin matter. Repelling, dense making, closing and thickening occurred when thickness was joined with coldness; the power of mollification when moistness came with this thickness and cold; of hardening if it were accompanied by dryness instead of moistness. In this vein, Heurnius continued to discuss drugs which purified, caused to adhere, diluted, bound, pulled or drew, wiped off or dispelled, obstructed and thickened, hurt and purified.[280] According to Jacchaeus, the secondary faculties originated in the temperament of a drug.[281] Rephrasing Heurnius, he described the secondary qualities as "special dispositions of the primary qualities in matter".[282]

Heurnius described the tertiary faculties as originating from an association of the primary and secondary ones. With each different tertiary faculty, he mentioned the different degrees of primary qualities present in drugs with the faculty. He did not indicate how a drugs' substance was an influence on its tertiary faculties.[283] Jacchaeus' description was more detailed. The tertiary faculties were distinguished from the secondary ones both by the particularity of their effects on a body part and their substance. He wrote about the tertiary faculties:

> sometimes regard what is retained in the body, such as drugs which rouse semen, or move urine, shatter stones: sometimes body parts themselves, hence head-, heart-, etc drugs because they affect such parts with their manifest quality.[284]

[279] Ibid., 133.
[280] Ibid., 133-134.
[281] Jacchaeus, *Institutiones medicinae* (1624[1]) 249. "…, actiones enim hae secundae sequuntur primarum actiones: nam calidum medicamentum primò calefacit; postea, si tenuis sit essentiae, attenuat, rarefacit, discutit. unde constat, actiones secundarum qualitatum oriri à medicamentorum temperamentis."
[282] Ibid. "sunt itaque; secundae qualitates, peculiares dispositions primarum in materia."
[283] Heurnius, *Institutiones* (1609) 136-137.
[284] Jacchaeus, *Institutiones medicinae* (1624[1]) 249-250. "respiciunt interdum contenta in corpore, ut medicamenta semen excitantia, aut urinas moventia, calculos frangentia: interdum ipsa membra, unde medicamenta cephalica, cardiaca, etc. quia manifesta qualitate tales partes afficiunt."

He added that, "all these evident qualities were produced by the primary faculties in conformity with the disposition of the matter of a drug".[285] Like Heurnius when he defined the secondary qualities, Jacchaeus mentioned thick and thin matter, and he added "moderate" matter. Warmth or cold were supposed to work differently in thick matter than in thin matter.[286] Thus, not just the arrangement of the primary qualities within a drug's substance was used by Jacchaeus to explain the different effects of a drug; also the consistency of the substance was of importance. In this way Jacchaeus used the relationship between the substance and the primary faculties, which Heurnius had used to define the secondary faculties, to define the tertiary faculties instead.

The descriptions of Galenic pharmacology which Dodonaeus, Heurnius, Spigelius and Jacchaeus provided were no systematic discussion of the individual plants and the different properties they could have. Following the Galenic tradition however, these physicians mentioned simples, which possessed the properties or the particular principles, which they described. Jacchaeus for example gave the following clarification to explain how the primary qualities worked in combination with the consistency of a drug's substance to produce particular tertiary faculties: "If a drug is of thin substance and is warm at the same time, such as fennel, it thins strongly, dispels, opens."[287]

The way these simples were brought up in the text shows that Galen's theory of drug properties did not only work from the top down as a theory with particular consequences, which could be tested. Instead, the presentation of individual drugs as examples makes clear that physicians also reasoned from the individual simples and their effects on the body and their substance and taste, to find a place for them in the Galenic framework. In order to be able to categorise a particular drug property within this framework, Heurnius and Jacchaeus had to figure out if and how they were connected to the primary qualities or to a combination of primary qualities and the substance of a drug. In this way, physicians followed Galen's example by attempting to give a philosophical or theoretical account of the properties that drugs were shown to have when being administered to patients.

Heurnius and Jacchaeus thus connected the secondary and tertiary faculties to the primary qualities. The different expressions of these qualities in the body could be explained by the relationship between these qualities and the matter in which they were located. Fernel, Dodoens, Heurnius, Spigelius and Jacchaeus agreed however that some faculties could not be

[285] Ibid., 250. "Omnes hae qualitates evidentes promanant a primis medicamentorum facultatibus pro materiae dispositione."
[286] Ibid.
[287] Ibid. "Medicamentum tenuis substantiae, si sit simul calidum, ut feniculum, valide attenuat, discusit, aperit."

connected to the primary qualities. Instead they were understood to be based on the total substance of the drug. While Fernel had classified these properties as tertiary faculties in his book on the *methodus medendi*, Dodoens, Heurnius, Spigelius and Jacchaeus classified them as quaternary faculties.[288] These properties will be discussed more extensively in the next chapter.

Conclusion

We have now only partially investigated how Galenic pharmacology was presented in the textbooks that were used in Leiden and we can only come to some modest conclusions. The presentations of drug properties that we have examined focused on three aspects of Galen's writings on the subject; the different tastes, the faculties of drugs and the way drug properties should be investigated through reason and experience. Heurnius, Spigelius, and Jacchaeus adopted Dodonaeus' discussion of quaternary faculties in the first chapter of *Stirpium*. These late sixteenth- and early seventeenth-century accounts of drug properties did not focus on the primary qualities and their different degrees of strength in the way that previous accounts of Galenic pharmacology have presented it. The connection between these drug properties and the drug´s faculties, did play a particular role in the systematic account of the properties of simple drugs, which these physicians tried to produce. Drug faculties, the particular ways in which drugs worked on and in particular parts of the body, received most attention from them. They tried to incorporate properties of simple drugs that were used and distinguished in the practice of medicine into an elaborate system of different tastes and primary, secondary, tertiary and quaternary faculties. In the following chapter, we will turn our attention to the way in which taste, reason and experience were interrelated in the investigation of the properties of drugs.

However systematic these accounts were, they also limited the drug properties that could be incorporated in it. We have already seen that Dodonaeus, Heurnius, Spigelius, and Jacchaeus only discussed the properties of simple drugs. They did not discuss the primary qualities and their degrees in connection to compound drugs. We have also briefly encountered some properties, which could not be connected to the primary qualities and were understood to be based on the drug's total substance instead.

[288] Fernel, *Universa medicina* (Leiden 1656) 351. Lib. IV, Cap. V; Dodonaeus, *Stirpium* (1583[1]) 6-16, 18, there 12-13; Johannes Heurnius, *Institutiones medicinae* (Leiden 1592[1]), (Leiden 1609) 132-138; Adrianus Spigelius, *Isagoges in rem herbariam* (Padua 1606[1]), (Leiden 1633) B2 recto, 136-186. Lib. II; Jacchaeus, *Institutiones medicae* (1624[1]) 230-292: Lib. V.

Some further limitations can be gauged from comparing the table of secondary qualities in the preliminary work of Dodonaeus' *Cruijdeboeck* and the account of Galenic pharmacology in his *Stirpium*. In the first, Dodonaeus surveyed the way the simples worked to cure particular afflictions by the actions they performed in the body. Since some of the same simples occurred under different headings, this survey showed that simples could possess various combinations of such actions. In the second preliminary work, Dodonaeus summarised the main points of Galen's pharmacology and engaged in a discussion of how drug properties could be investigated and how they were connected to the primary qualities. Thus, the variation of faculties that a simple could possess was more limited. This comparison makes clear once again how a discussion of drug properties akin to that of Dioscorides differed from one based on Galen.

Whereas Spigelius described the investigation of the medicinal properties of plants separately from the investigation of its appearance, Dodonaeus clearly considered how these investigations as interconnected. He included both a description of the appearance of the plant and its medicinal properties in his herbals and *Stirpium historiae pemptades sex* and ordered his book according to the similarities in both appearance and medicinal properties. Dodonaeus' account of Galenic pharmacology in his *Stirpium* was of some influence on Heurnius' account. But while the study of plants was central to Dodoneaus' study of drug properties this was not the case for Heurnius. In his innovative and influential textbook *Institutiones medicinae* or "the principles of medicine" (1592) Heurnius assembled the most important parts of both the theory and practice of medicine into one volume and presented it as a consistent, comprehensive whole. He made Galenic pharmacology a cornerstone of his description of a *methodus medendi*.

Intermezzo 2

Criticism and approval in Francis Bacon's *Novum organum* (1620)

We have now become further acquainted with what students in Leiden were taught about plants and their medicinal properties. As we have observed, Dodonaeus, Heurnius, Spigelius and Jacchaeus understood the properties, which simples exhibited in the body in relation to the primary qualities. In his *Novum organum*, published four years prior to Jacchaeus' *Institutiones medicae*, Francis Bacon (1561–1626) observed that to his regret this was the case with most physicians of his time. But in his opinion, at least physicians were still doing better than natural philosophers were in came to the investigation of matter.

In the sixty-sixth aphorism of the first book, Bacon discussed what according to him was the *vitiosa materia contemplationum*, or "the defective subject matter of studies", especially that in natural philosophy. He referred to "the fiction of the elements and of their coming together to form natural bodies". He explained that "the primary elementary qualities, the second, occult properties and specific virtues", represented to him two hollow compendia or "empty collections of ideas in which the mind finds rest and is turned away from things of more substance".[289] Bacon thought physicians did better however by distinguishing "secondary qualities and the operations of things, attracting, repelling, thinning, thickening, dilating, binding, shattering, ripening, and such." In his views, they would have made more progress however, if they had not ruined the consideration of these properties by "reducing them to the primary qualities and their subtle and incommensurable mixtures". They had also refrained from extending them "by greater and more thorough study to tertiary and quaternary qualities, breaking off their studies too soon." In some of his works, Bacon showed that this way of dealing with qualities was possible. He discussed the properties of many different plants, stones and animal materials in *Historia naturalis*. He presented this information as the product of experiments and observations.[290]

Modern commentators have not always understood this passage in the *Novum organum*.[291] Hopefully, what Bacon was discussing in this aphorism sounds familiar after reading the preceding chapter. Only in the last part of this passage does it become clear that Bacon has been talking about the way physicians dealt with the properties of drugs. There he wrote:

[289] Francis Bacon, Peter Urbach and John Gibson, trans. ed., *Novum Organum. With other parts of The Great Instauration* (Chicago 1994) 72.
[290] Francis Bacon, *Historia naturalis et experimentalis ad condendam philosophiam* (London 1622).
[291] Francis Bacon, Henri Oosthout, intro., trans., annot., *Aforismen over de interpretatie van de natuur en het rijk van de mens* (Kampen 2006) 81-82; Pedro Cintas, "Francis Bacon: an alchemical odyssey through the novum organum", *Bulletin of the history of chemistry* vol. 28 no. 2 (2003) 65-75, specifically 67.

> Nor are powers of this kind (I do not say the same, but similar ones) to be sought for only in medicines of the human body, but also in changes in all other bodies.[292]

Clearly, Bacon was familiar with contemporary discussions about the properties of drugs and expected the same from his readers. Although he rejected the project of late sixteenth- and early seventeenth-century physicians to relate the properties of drugs to the primary elementary qualities and "occult properties and specific virtues", they at least recognised that things had "operations" and that they acted in particular ways. In this aspect physicians served as an example for those investigating natural bodies.

Bacon's interest in the way in which matter works is emphasised in the following section. There Bacon added that it is yet "a far greater evil that they [physicians/philosophers] give so much attention and inquiry to static principles, *wherefrom*, rather than to moving principles, *whereby*, things happen."[293] Indeed, as I discussed in the introduction, some Galenic physicians in the late sixteenth and the beginning of the seventeenth century had already become more specific about how drugs worked to cure, before Bacon comments.

Many educated Dutch citizens including Daniel Heins, or *Heinsius* (1580–1655), Caspar van Baerle, or Caspar Barlaeus (1584–1648), Isaac Beeckman (1588-1637), Constantijn Huygens (1596–1687) were well aware of Bacon's publications, studied parts of it and some explicitly promoted, praised or criticised it. Bacon's writings appear to have fostered few specific investigations of the properties of drugs however. Dutch citizens especially appreciated his critical attitude towards Plato and Aristotle and his promotion of open-minded and critical investigation of nature.[294] His work probably most directly influenced that of Hendrik de Roy, or Henricus Renerius (1593-1639). Robin Buning has thoroughly investigated how Bacon's "method of science" related to Renerius' teaching of natural philosophy at the University of Utrecht.[295]

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[292] Francis Bacon, Fulton H. Anderson, ed. intr., *The New Organon and related writings* (New York 1980) 64.
[293] Bacon, Oosthout, *Aforismen*, 73, n. 48; Bacon, Anderson, *The New Organon*, 64.
[294] Paul Dibon, "Sur la réception de l'oeuvre de F. Bacon en Hollande dans la première moitié du XVIIe siècle", in: Paul Dibon, *Regards sur la Hollande du Siècle d'Or* (Naples 1990) 191–220; J.C.G. Boot, "Korte biographische aanteekeningen van Constantijn Huygens", *Verslagen en mededeelingen der Kon. Akademie van Wetenschappen. Afdeling letterkunde* 2nd series pt. 3 (1873) 344-356; J. A. Worp, "Fragment eener autobiographie van Constantijn Huygens", *Bijdragen en mededelingen van het Historisch Genootschap gevestigd te Utrecht* pt. 18 (The Hague 1897); A. H. Kan, ed., *De jeugd van Constantijn Huygens door hem zelf beschreven* (Rotterdam 1946); C. L. Heesakkers, ed., *Mijn jeugd* (Amsterdam 1987); Frans Blom, ed*., Mijn leven verteld aan mijn aan mijn kinderen* 2 vols (Amsterdam 2003); Klaas van Berkel, *Isaac Beeckman on matter and motion. Mechanical philosophy in the making* (Baltimore 2013) 52, 119, 146, 223-224 n. 106, 234 n. 87.
[295] Ferdinand Sassen, "Henricus Renerius: de eerste "Cartesiaansche" hoogleeraar te Utrecht", *Mededeelingen der Nederlandsche akademie van wetenschappen, afd. letterkunde* no. 514, no. 20, 25-30 vol. 4, issue 20;

Through Huygens' son Christiaan (1629-1695), Bacon's work influenced that of the *Académie Royale des Sciences*. Alice Stroup described the research on natural history and plants that was Baconian in design, proposed in the 1660s by four members of the academy, including Huygens.[296] She and Lawrence Principe showed the great efforts that the Academy devoted to the investigation of the material properties of plants with the goal of improving therapeutics. Although the projects of Duclos and Dodart did not yield much valuable result, the fact that such projects were organised is markedly contrasted by their absence in the Dutch Republic.[297] There were no organisations comparable to the Academy to finance and foster them, even if the desire was there.

Estimating the influence of Bacon's writings on developments in medicine, natural history and natural philosophy is especially problematic, because Bacon had read widely and commented on current developments in many related fields. For example, Bacon was not the first to argue that the properties of drugs should not be linked to a particular theory of matter. We have already encountered Dioscorides' opinion on this point. In the next chapter, we will encounter the discussion of Dioscorides' position again, when we consider the correct way of studying medicinal properties according to physicians in the sixteenth and early seventeenth century. Did physicians recognise that there were problems with their approach?

Alberto Elena, "*Baconianism* in the seventeenth-century Netherlands: a preliminary survey", *Nuncius*. *Annali di storia della scienza* 6 (1991) 33–47, there 40: "So for instance, it is hardly surprising that in the first of his *disputationes physicae* held in Utrecht in 1635, *De natura et constitutione physicae*, Henricus Renerius championed Bacon's inductive method." Robin Buning, *Henricus Reneri (1593-1639): Descartes' quartermaster in Aristotelian territory* diss. (Utrecht 2013).

[296] Alice Stroup, *A company of scientists: botany, patronage and community at the seventeenth-century Parisian Royal Academy of Sciences* (Berkeley, CA 1990) 70-79. The others were Charles Perrault (1628–1703), Samuel Cottereau Duclos (1598-1685) and Denis Dodart (1634–1707).

[297] Lawrence Principe, "The chymist and the physician: rivalry and conflict at the *Académie Royale des Sciences*", presented at the Centre for Research in the Arts, Social Sciences and Humanities conference: *Alchemy and medicine from Antiquity to the Enlightenment, 22 September 2011- 24 September 2011*, Peterhouse College, University of Cambridge.

Chapter 3

The trouble with opium. Taste, reason and experience, philosophy and medicine

Introduction

In his work on the history of experimental pharmacology, Andreas-Holger Maehle recounts how Jan Baptist van Helmont used discrepancies between the taste and the effects of opium to criticise Galenic medicine.[298] Opium is an especially interesting case, because it was not an import from the New World. While Galen himself had described and studied it centuries earlier, its properties apparently did not present any problems for his theory of drug properties, until the sixteenth century. Did its properties become problematic because of a rival theory, such as Van Helmont's? Or was it because of comments by scholars like Julius Caesar Scaliger (1484–1558), who discussed the problem of establishing a causal link between flavours and the primary qualities of matter in his book on plants of 1556?[299] In order to understand how opium became a problem in this period and in what context Van Helmont presented his critique of academic medicine, it is important to consider how the study of drug properties was discussed in contemporary medical texts.[300]

I will argue in this chapter that the properties of opium became problematic in the sixteenth century as a result of medical humanism and its interest in the study of classical sources, in reforming medical education and in uniting theoretical and practical medicine. These interests were reflected in the study of *materia medica* and in the presentation of their properties in herbals and medical textbooks. The humanist physicians whom I discuss here took their lead from Galen's works in order to categorise and investigate the properties of simple drugs. They attached great value to Galen's tenet to use both reason and experience in such an investigation and applied it more strictly than Galen and some of their other predecessors appear to have done.

In recent years, historians have pointed to the contribution of physicians to epistemological debates. Physicians are now recognised for their role in increasing the importance of experience, observation and the senses as sources of knowledge in the fourteenth, fifteenth and sixteenth centuries.[301] The physicians I discuss here also participated

[298] Maehle, *Drugs on trial*, 2–3, 131–132; Jan Baptist van Helmont, *Ortus medicinae*, *id est initia physicae inaudita: progressus medicinae novus in morborum ultionem ad vitam longam* (Amsterdam 16481). *Ortus Medicinae* was published by Jan Baptist's son Franciscus Mercurius van Helmont (1614–1699).
[299] Evan Ragland, "Chymistry and taste in the seventeenth century", *Ambix* vol. 59 (2012) 1–22, particularly 7, n. 26; Julius Caesar Scaliger, *In Libros de plantis Aristotelis inscriptos Commentarii* (Paris 1556) 110v.
[300] Maehle, *Drugs on trial*, 2-3, 131-132.
[301] See e.g., Gianna Pomata, "Sharing cases: the *Observationes* in early modern medicine", *Early science and medicine* vol. 15 (2010) 193–236; idem, "A word of the empirics: the ancient concept of observation and its recovery in early modern medicine", *Annals of science*, vol. 68 (2011) 1–26; eadem, "Observation rising: birth of an epistemic genre, 1500–1650", in: Lorraine Daston and Elizabeth Lunbeck, eds, *Histories of scientific observation* (Chicago and London 2011) 45–80; Katharine Park, "Natural particulars: medical epistemology, practice, and the literature of healing springs", in: Anthony Grafton and Nancy Siraisi, eds, *Natural particulars.*

in such debates through their examination of the properties of *materia medica*. In particular, the investigation of their work can enrich our understanding of the relationship between experience, reason and the senses in sixteenth-century debates.

To some extent, I will also explore in this chapter how the study of plants and their properties within medicine was linked to the study of physics. I will suggest that discussions of Galenic pharmacology can offer some important clues about the significance of developments in sixteenth-century medicine, especially in the study of the *materiae medicae*, for the major changes that took place in seventeenth-century physics regarding epistemology and the properties and constitution of matter. We can discuss the relationship between reason and experience in medicine together with the consideration of the properties of matter in physics, by focusing on discussions from around the year 1600 about the properties of a particular drug. This is opium, the juice of the *Papaver somniferum L.*, or the Opium poppy.

Innovation in pharmacology

The existing historiography of Galenism provides us with a fragmented picture of the importance attached to and the changes occurring in Galenic pharmacology in the long period from classical and medieval to early modern times.[302] The relationships between medical theory and practice, and between reason and experience, have featured prominently in

Nature and the disciplines in renaissance Europe (Cambridge, MA and London 1999) 347–368; Thomas DaCosta Kaufmann, "Empiricism and community in early modern science and art: some comments on baths, plants and courts", in: Grafton and Siraisi, *Natural particulars*, 401–418.

[302] Georg Harig, "Leonhart Fuchs und die Theoretische Pharmakologie der Antike", in: Jan Burian and Ladislav Vidman, eds., *Antiquitas graeco-romana ac tempora nostra* (Prague 1968) 505-512; Georg Harig, "Zur Einschätzung des Kräuterbuches von Leonhart Fuchs", *Beiträge zur Geschichte der Universität Erfurt* XIV (Erfurt 1968/1969) 71-77; Georg Harig, *Bestimmung der Intensität in medizinischen System Galens. Ein Beitrag zur theoretischen Pharmakologie, Nosologie und Therapie in der Galenischen Medizin* (Berlin 1974); McVaugh, "Quantified medical theory and practice", 397-413; idem, "An early discussion"; idem, *Arnaldi de Villanova*; Penelope Johnstone, "Galen in Arabic: the transformation of Galenic pharmacology", in: Vivian Nutton, ed., *Galen: problems and prospects* (London 1981) 197- 212; Philip M. Teigen, "Taste and qualities in 15th- and 16th-century Galenic pharmacology", *Pharmacy in history* vol. 29 (1987) 60-68; Christoph Schweikardt, "How do cathartic drugs act? A case study on Gregor Horst (1578-1636) and his attempt to defend Galenist theory", *Vesalius*, IV (1998) 9-78; Maehle, *Drugs*; Armelle Debru, ed., *Galen on Pharmacology. Philosophy, history and medicine: proceedings of the Vth International Galen colloquium, Lille, 16-17 March 1995* (Leiden etc. 1997); Jerry Stannard, "IV the theoretical bases of Medieval herbalism", in: Katherine E. Stannard and Richard Kay, eds., *Herbs and herbalism in the Middle Ages and Renaissance* (Aldershot etc. 1999); Vivian Nutton, "Ancient mediterranean pharmacology and cultural transfer", *European review* vol. 16 (2008) 211-217; Danielle Jacquart, "Islamic pharmacology in the Middle Ages: Theories and substances", ibid, vol. 16 (2008) 219-227; Teresa Huguet Termes, "Islamic pharmacology and pharmacy in the Latin West: an approach to early pharmacopoeias", *Ibidem* vol. 16 (2008) 229-239; Carmen Caballero Navas, "Medicine and pharmacy for women. The encounter of Jewish thinking and practices with the Arabic and Christian medical traditions", ibid., vol. 16 (2008) 249-259; Vogt, "Drugs".

medical history literature.[303] This historical interest reflects the interest in these relationships since Antiquity. Galen positioned himself in contemporary debates between three medical schools, the Rationalists or Dogmatists, the Empiricists and the Methodists.[304]

As Andrew Wear pointed out almost twenty years ago, "Galen's epistemology was a blend of the empirical and the rational, for Galen believed that one without the other led to the excesses of the empiricists and the methodists".[305] Our investigation of sixteenth-century and early seventeenth-century texts shows that their authors agreed that drug properties should be studied according to this epistemology. We will examine more specifically what combination of the empirical and the rational they had in mind.

Wear also stated that for sixteenth-century Galenic medicine, accepting Galen's doctrines was crucial "rather than developing new fundamental theories by experience or reason". This adherence to Galenic doctrine was related to "the humanist revival of the *prisca medicina* of the Greeks". However, he acknowledged that:

> Innovation within learned medicine did occur, but only in one or two areas such as anatomy, where new observational knowledge contradicted Galen's observations but not his physiological theories of the body, or in relation to diseases such as syphilis and plague.[306]

Wear's statement should be amended in at least two ways. Firstly, other studies have shown that there was innovation in sixteenth-century learned medicine in areas besides anatomy, also in areas that Wear specifically excluded.[307] The study of drug properties can similarly be

[303] To name only a few, Claire Crignon, "The debate about *methodus medendi* during the second half of the seventeenth century in England: Modern philosophical readings of classical medical empiricism in Bacon, Nedham, Willis and Boyle", *Early science and medicine* vol. 18 (2013) 339–335; Monica Calabritto, "Curing melancholia in sixteenth-century medical *consilia* between theory and practice", *Medicina nei secoli* vol. 24 (2012) 627–664; Emilie Savage-Smith, "Were the four humours fundamental to Medieval Islamic medical practice?", in: Peregrine Horden and Elizabeth Hsu, eds., *The body in balance: humoral medicines in practice* (New York and London 2013) 89-106; Peter Murray Jones, "*Complexio* and *experimentum*: Tensions in late Medieval English practice", in: Peregrine Horden and Elizabeth Hsu, eds., *The body in balance: humoral medicines in practice* (New York and London 2013) 107-128; most papers in Michael R. McVaugh and Nancy G. Siraisi, eds., *Osiris. Renaissance medical learning. Evolution of a tradition* series 2 vol. 6 (1990); Bates, ed., *Knowledge*.

[304] Michael Frede, "On Galen's epistemology", in: Nutton, ed., *Galen: problems*, 65–86, specifically 71–85; Teun Tieleman, "Methodology", in: Hankinson, ed., *Cambridge companion*, 49–65; Siraisi, *Medieval and early Renaissance medicine*, 3–4.

[305] Wear, "Learned", 154.

[306] Ibid., 154, 155.

[307] Wear acknowledged this himself: Andrew Wear, "Medicine in early modern Europe, 1500-1700", in: Lawrence I. Conrad *et al*., ed., *The western medical tradition 800 BC to AD 1800* (Cambridge 1996) 215-361, there 260-264; Cf. e.g. Jon Arrizabalaga *et al*., *The great pox: the French disease in Renaissance Europe* (New Haven etc. 1997); Porter, *The greatest benefit to mankind*, 174-176; Pomata, "Sharing cases"; Pomata, "Empirics"; Hiro Hirai, *Le concept de semence dans les théories de la matière à la Renaissance: de Marsile*

considered an area of innovation, precisely because of the reassessment of the works of Galen and Dioscorides (ca. 40-90 AD) on this subject.

Secondly, the term "observational knowledge" itself is not as neutral as Wear seems to assume.[308] What was considered to be "an observation" changed over time and varied according to epistemological presuppositions. Therefore, I use the term very broadly to describe any comments that were made about the properties that drugs were supposed to possess and exhibit. The efforts of sixteenth-century physicians to understand the properties of drugs within a Galenic framework exposed the troublesome relationship between reasoning and the experiences gained from medical practice. As in anatomy, these investigations of drug properties resulted in "new observational knowledge" that sometimes "contradicted Galen's observations".[309]

Galen or Dioscorides

A passage from *De abditis rerum causis* (1548) by one of the foremost medical authors of the sixteenth century, Jean Fernel, serves well to introduce sixteenth- century discussions about the assessment of drug properties. In *De abditis*, Fernel touched upon some controversial subjects in theoretical medicine, including the study of drug properties. He discussed the hidden causes of things in a dialogue between literary characters called Philiatros, Brutus and Eudoxus, the last-named representing Fernel's own point of view. At one point, Philiatros expresses his doubts about the Galenic enterprise "to restore all the powers of the medicaments to the ordinary faculties of the elements." According to Philiatros, Galen's reasoning included the *artificium*, or artifice "to reach the primary and secondary faculties of plants from their colour, odour or taste."[310] In this passage, gaining knowledge of the innate properties of *materia medica* through colour, odour and taste is considered to be a particular process of reasoning.[311] Philiatros however puts little faith in this procedure and would prefer an approach based on experience. He has more confidence in Dioscorides,

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Ficin à Pierre Gassendi (Turnhout 2005); Hiro Hirai, *Medical humanism and natural philosophy. Renaissance debates on matter, life and the soul* (London and Boston 2011).

[308] The historical meaning of the term "observation" was the focus of the introduction and the first part of a recent collection of papers; Daston and Lunbeck, eds., *Histories*. The introduction examines the relation of this term with experience, experiment, the senses, theory and practice.

[309] Wear, "Learned", 154, 155.

[310] Forrester, *Jean Fernel's*, 694–695; Jean Fernel, *De abditis rerum causis* (Paris 1581). I have translated *facultates* here as "faculties," not as "qualities" as the editors of the 2005 edition did.

[311] Hence, considering colours, flavours and odours as "empirical qualities", as Ragland does in "Chymistry", 9, 10, does not seem entirely appropriate. The philosophical understanding of the primary and secondary qualities has recently received renewed attention. Cf. Lawrence Nolan, ed., *Primary and secondary qualities: the*

> who recounted the powers of simple medicaments in pure and sparing words, with no reasoning to follow, rather than in Galen who is provided with so many baseless reasonings. And I would rate experience of medicaments above reasoning.[312]

Philiatros thus prefers Dioscorides' example to Galen's: he prefers to study the powers of simples solely by means of experience without referring to the "ordinary faculties of the elements" or working out "the causes and reasons of them." Eudoxus' response to Philiatros is brief. He simply advises Philiatros not to dismiss Galen's work as trivial or void.[313] Eudoxus' defence of Galen seems to be directed against the radical empiricism expressed by Philiatros and not intended to support a specific position of Galen. Fernel himself continued to search for the causes of the powers of drugs, as is evident in *De abditis* and in his *Therapeutices universalis seu medendi rationis*.[314]

We can see from this discussion in *De abditis* that Fernel was clearly aware of the profound objections to Galenic pharmacology. In *De abditis*, he maintained the Galenic distinction between different kinds of qualities. He wrote:

> Whatever medicaments human art and diligence have found suitable for curing diseases possess their powers from primary or secondary or tertiary qualities, and some people add quaternary qualities too.[315]

However, he found it problematic how these qualities were linked to each other through the four primary elements. Earlier in *De abditis*, Eudoxus suggests that the way in which the primary, secondary, tertiary and quaternary faculties are interlinked is problematic and argues that the hierarchical connection Galen had provided between them is unsatisfactory. Instead, he tried to propose an alternative to the Galenic understanding of the faculties and the diseases they cured by making a distinction between "diseases of defective temperament" and "diseases of matter."[316] In general, Fernel suggested that the emphasis that philosophers put on the four elements and indeed on Democritus' atoms as explanations for material properties

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historical and ongoing debate (Oxford 2011). Perhaps it would be more correct to speak of "sensory qualities", adopting Nolan and Pasnau's use of the term.

[312] Forrester, *Jean Fernel's*, 695.

[313] Ibid.

[314] Prepared between 1555 and his death in 1558. Published as part of Fernel, *Universa medicina* (Paris 1567).

[315] Forrester, *Jean Fernel's*, 528-531.

[316] Ibid., 530-531.

was too strong and that they should consider alternatives. He expressed this opinion clearly, in the preface of the second book of *De abditis*.[317] As the title of *De abditis* suggests, Fernel had hidden or occult causes in mind as an important alternative to the four elements as explanations for some material properties. These occult causes were also supposed to cause certain diseases.[318]

The kind of disregard for theorising about the properties of simples as expressed by Dioscorides and now also Philiatros, is relatively well known.[319] Like Fernel, many sixteenth-century physicians did not share this disregard. Amongst them were the above-mentioned Dodonaeus, Heurnius, Spigelius and Jacchaeus. Their brief descriptions of Galen's complex and elaborate writings about *materia medica* were very similar to that found in Fernel's textbook *Therapeutices universalis*. In this book, Fernel presented a more traditional Galenic interpretation of pharmacology than in *De abditis*. These five authors all considered the use of experience and reason in studying drug properties.[320] Before we examine their epistemological discussions in more detail, we should consider the contemporary distinction between two kinds of secondary qualities.

Two ways to discuss secondary qualities

Michael Petry has noted that there seemed to be a strong connection between the medicine and philosophy at the University of Leiden. He indicates that since the appointment of Reinier de Bont (1576-1623), Jacchaeus' predecessor and Gerard Bontius' son, as extraordinary professor of philosophy in 1599, physics was often taught by medically qualified professors. Petry suggested that this was a "fruitful combination", but does not indicate how medicine

[317] Ibid., *Jean Fernel's*, 396-401. Nancy Siraisi has also drawn attention to this passage: Siraisi, *Avicenna*, 242.
[318] The fact that these occult causes were also supposed to cause certain diseases, has received much attention as it suggests a more ontological understanding of diseases than was customary in Galenic medicine. See e.g. Forrester, *Jean Fernel's*, 22-27; Vivian Nutton, "The seeds of disease: an explanation of contagion and infection from the Greeks to the Renaissance", *Medical history* vol. 1 (Jan. 27 1983) 1–34; Linda Deer Richardson, "The generation of disease: occult causes and diseases of the total substance", in: Andrew Wear *et al*., eds., *The medical Renaissance of the sixteenth century* (Cambridge 1985) 175–194; Hirai, *Concept*; William R. Newman, *Atoms and alchemy. Chymistry and the experimental origins of the Scientific Revolution* (Chicago 2006) 140, 143–144.
[319] Touwaide, "Thérapeutique médicamenteuse", 255–282; John Scarborough, *Pharmacy's Ancient Heritage: Theophrastus*, *Nicander and Dioscorides* (Lexington 1985); Thomas Peter Gariepy, *Mechanism without Metaphysics: Henricus Regius and the Establishment of Cartesian Medicine*, facs. (Ann Arbor, MI 1997) 50–53; Nutton, "Ancient Pharmacology", 211–217; Pedanius Dioscorides of Anazarbus, *De materia medica*, trans. Lily Y. Beck (Hildesheim etc. 2005) 2.
[320] Dodonaeus, *Stirpium* (1583[1]) 6–18; Heurnius, *Institutiones* (1592[1]), (1609) 132–138; Adrianus Spigelius, *Isagoges in rem herbariam* (Padua 1606[1]), (1633), B2 recto, 136–186: lib. II; Jacchaeus, *Institutiones medicae* (1624[1]) 230–292: lib. V.

and physics were combined or how this combination was fruitful.[321] Indeed in 1617, Reinier de Bont was appointed ordinary professor of medicine and assumed the task of teaching the *institutiones medicae*.[322] As we have seen, Jacchaeus too was qualified in philosophy and medicine. Before publishing an *Institutiones medicae* (1624), he published *Institutiones physicae* (1614[1]) and *Primæ philosophiæ institutiones* (1616[1]).[323] When we compare these works by Jacchaeus, we can see that the properties of drugs were not discussed as part of physics but only as part of the *methodus medendi* in *Institutiones medicae*.

Like the physicians I have considered, philosophers distinguished between primary and secondary qualities. These qualities had a long history within scholastic discussions of the Aristotelian primary and secondary qualities. Much attention has been given to discussions of these primary and secondary qualities in the work of John Locke (1632-1704), and some authors have examined discussions of these qualities in the work of Galileo, Gassendi, Descartes and Leibniz.[324] Philosophers and physicians had different definitions of the secondary qualities and faculties however. Jacchaeus noted this as well.

In *Institutiones medicae* he pointed out that, "Philosophers and physicians think differently about secondary qualities and faculties". He continued to explain that philosophers called all properties "secondary which follow the primary ones in the course of their actions; odour, taste, colour etc. which have power of movement in particular senses, not really in another part of the body; because taste affected just the tongue, […] Physicians only called those secondary which move through the power of the primary qualities".[325] In explaining the way philosophers defined the secondary qualities, Jaccheaus stayed firmly within the Aristotelian framework. The philosophical secondary qualities were defined by their interaction with specific senses, while the medical secondary faculties only worked through the primary qualities and worked in the body in a certain and definite way. The examples of such faculties that Jacchaeus provided here, are drug properties.[326]

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[321] Michael John Petry, *Geschiedenis van de wijsbegeerte in Nederland* (Baarn 1988-1993) 93.
[322] Philipp Christiaan Molhuysen and Petrus Johannes Blok, eds., *Nieuw Nederlandsch biografisch woordenboek* (Leiden 1918) 197.
[323] Molhuysen and Blok, eds., *Nieuw Nederlandsch biografisch woordenboek* pt. 4 (Leiden 1918) 1197-1198; Gilbertus Jacchaeus, *Institutiones physicae* (1614[1]); Idem, *Primæ philosophiæ institutiones* (Leiden 1616[1]).
[324] A great number of articles on this subject have recently been published together: Nolan, ed., *Primary and secondary qualities*.
[325] Jacchaeus, *Institutiones medicae* (1624[1]) 248. "aliter Philosophi ac Medici sentiunt de secundis qualitatibus, & facultatibus. Illi enim omnes eas vocant secundas, quae sequuntur primarum inter se actionem; ut odorem, saporem, colorem &c. qui quidem vim agendi habent in propria sensoria, non verò in aliam corporis partem; nam sapor afficit solam linguam, odor processus mammillares. Hi eas solas, quae viribus primarum qualitatum agunt; …"
[326] Ibid., 248-249. "hi eas solas, quae viribus primarum qualitatum agunt; dicuntur autem activae, quia subjectum ijs praeditum, aptum est ut certo, & determinato modo in corpus nostrum agat. huiusmodi facultates sunt variae: emolliens, indurans, intendens, relaxans, condensans, rarefaciens, incrassans, attenuans, attrahens, repellens,

The connection between philosophy and medicine can be investigated further by considering the philosophical *theses* and *positiones* defended at the university in around 1600. Jacchaeus himself presided over several of these. Discussions of the elements and qualities usually stay firmly within the Aristotelian scheme and mostly refer to his works. The discussions of primary and secondary qualities in the theses did not refer to the properties of drugs and very rarely to medicine in general.

In only one of the remaining philosophical *theses* or *positiones* does the defendant expressly connect the study of philosophy to that of medicine. In 1605, Hieronimus Smallegange, who later became physician of his hometown of Goes in the southeastern province of Zeeland, defended philosophical positions on the elements. In the introductory part, he claimed that the contemplation of the elements was not only pleasant for the philosopher but also necessary for the physician. When he did not know the elements of natural things, a philosopher could not get to know the generation and corruption of natural things nor could a physician consider good health and understand the causes of diseases.[327] In the rest of the *positiones*, Smallegange discussed the effects of food on the body and indicated that the primary qualities heat and cold had secondary operations. Heat for example had the operation to warm, thin, dissolve, ripen, separate, cut, open and dry.[328] These were operations, which Dodoens and Heurnius had discussed as drug properties.

Richardus Bland (ca. 1583–unknown), an Englishman, started his philosophical positions by copying a large part of the introduction to Fernel's *De abditis*' second book, which I pointed out earlier.[329] It is interesting that the quotation stops where Fernel brought up Democritus and his atomism and Hippocrates' four elements. Fernel argued that philosophers on both sides should consider "how precarious and how grounded in uncertain belief is all that is usually debated about the original causes of thing, and that on these nothing can be taken as certain nor as known and grasped by the mind". He concludes by stating that "people

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dolorem leniens, irritans, etc." Ibid., 248-249 "actiones enim hae secundae sequuntur primarum actiones: nam calidum medicamentum primò calefacit; postea, si tenuis sit essentiae, attenuat, rarefacit, discutit."

[327] R. Maas, "De muskusstrijd te Goes in de jaren 1612-1614", *Aere perennius* vol. 25 (Jan. 1977) 9-14; Hieronimus Smallegange, *Positiones philosophicae de elementis, eorumque primis Qualitatibus. D. Gilberto Jacchaeo, in celeberrimâ Lugduno-Batavâ Academiâ Logices Professore dignissimo, tueri conabitur Hieronimus Smallegange Goesa-Zeeland* (Leiden 1605). "quare non tantum jucunda Philosopho, verum etiam medico necessaria est Elementorum contemplatio, cum nec rerum naturalium generationem corruptionemque cognoscere Philosophus, nec bonam valetudinem tueri, morbumque causas intelligere poterit Medicus, qui rerum naturalium Elementa ignoraverit; Itaque non abs re futurum existimamus, si brevem quandam De Elementis, eorumque primis qualitatibus ..... instituamus."

[328] Smallegange, *Positiones philosophicae*, A4r, B4v: "Praeter has secundarias caloris operationes, sunt aliae remotiores, nimirum fovere, attenuare, dissolvere, maturare, digerere, incidere, aperire, siccare, quae omnes sunt caloris operationes." B5r: Remotiores frigidi effectus sunt, constringere, densare, refrigerare, obstuere, stupefacere, gravare.

[329] Richardus Bland, *Philosophos seu positiones philosophicae, pro gradu ... sub praeside Ant. Trutio* (Leiden 1601).

who necessarily derive the efficient causes of everything from these elements, elements established by no more than plausible reasoning, are greatly deluded by their arguing, and that the causes of many [natural] events belong elsewhere."[330] Further on, Bland connected the fact that the causes of the all effects were not completely familiar, to the position of God as the final cause of all movement and change.[331] In the same year, Gisbert van Schoten defended *Theses physicae* about taste and the tastable. He indicated the tastes of different hot materials and referred to the fourth book of Galen's *De simplicium medicamentorum facultatibus* where the tastes of other materials were discussed.[332]

In the *theses* and *positiones* about the elements or the qualities defended in Leiden around 1600 that remain in Dutch libraries, medicine and philosophy are mostly discussed as separate subjects. This despite the fact that Bland showed his knowledge of *De abditis*, a text with medical interests that had implications for philosophy. In the examination of philosophy, the qualities distinguished in pharmacology are generally not discussed. In this particular area, physicians at Leiden had their own categories and concepts to work with. The relative independence of the consideration of drug properties by Mattioli, Fernel, Dodonaeus, Heurnius, Spigelius, Jacchaeus from philosophy becomes all the more clear, if we observe the shortage of references to Aristotle and the large number of references to Galen. In the textbooks written and the examinations taken at the university then, medicine and physics were mostly studied as two distinct subjects. However, the secondary qualities discussed in physics were discussed as part of pharmacology for their role in examining the properties of drugs.

Taste and drug properties in the work of Euricius Cordus and Leonhart Fuchs

In their work, Dodonaeus, Heurnius, Spigelius and Jacchaeus built on discussions of the investigation of drug properties through taste that developed during the sixteenth century. As we noted with regard to the brief discussion in *De abditis* between Eudoxus and Philiatros,

[330] Forrester, *Jean Fernel's*, 396-401; Bland, *Philosophos seu positiones*, Br: "Sciendum tamen eum aliter esse efficientem, quam causae quas nos efficientes dicimus. Causae enim nobis familiares non sunt omni ex parte, neque omnium effectuum causae. Non enim efficiunt nisi per motum & mutationem: Deus vero immediate haec omnia protulit;imo & profert voluntarie, non coacte."

[332] Gisbertus a Schoten Harlemensis, *Theses physicae de gustu et gustabili* (Leiden 1601) A3r. "Differentiae Saporum eodem fere modo se habent ad sua extrema, quo colorum ad sua: Dulce in melle, in uvis maturis, etc. Amarum in absynthio, genista, felle: Pingue in rebus unctuosis, ut oleo, melle, lacte: Salsum in sale, in aqua marina: Acutum in pipere, raphano, zingibere: Austerum in fructibus ante maturitatem: Stipticum in fructu myrti. Reliqua qui volet petat ex Gale. Lib. 4. de simplicium medicamentorum facultatibus, ubi plura non minus utilia quam jucunda recensentur."

Galen's reasoning included the device "to reach the primary and secondary qualities of plants from their colour, odour or taste".[333]

In the sixteenth century, taste was certainly used to investigate the qualities of drugs.[334] The work of Euricius Cordus offers a good example of this. Cordus was one of the first to carry the interest in the correct identification of simple drug ingredients at the University of Ferrara over the Alps into Germany. In the *Botanologicon* (1534), he takes a few of his students at Marburg for a fieldtrip in the neighborhood of the city and tells them about the plants they come across on the way.[335] They encounter a little plant called *Mauerpfeffer* and when a student asks Cordus about it, he tells him that some of "our physicians" said the plant was cold. Cordus however continues to say it is not so, "if taste is to be believed, as Galen instructs." Accordingly, the sharp taste of *Mauerpfeffer* shows that it is hot.[336] He does not discuss how the other physicians in Germany came to attribute cold qualities to the plant, in clear opposition to its taste. Elsewhere in the text, he uses taste in the same way, to determine the primary qualities of a plant.[337]

The application, by Cordus of Galen's instruction to investigate drug properties through taste, can be connected to the humanist revival of the Greek author and the interest in plants amongst sixteenth-century physicians. In the work of Leonhart Fuchs, the famous German author of herbals and a great proponent of this revival movement, we can find the same application of taste.[338] As Georg Harig has pointed out, Fuchs applied Galen's way of

[333] Forrester, *Jean Fernel's*, 694–695.
[334] Teigen, "Taste".
[335] Peter Dilg, *Das Botanologicon des Euricius Cordus. Ein beitrag zur botanischen Literatur des Humanismus* (Marburg 1969); Ogilvie, *Science of describing*, 133-138. As is well known, Cordus was a student of Niccolò Leoniceno (1428–1524), who is most noted for the value he attached to the correct identification of plants mentioned in classical sources.
[336] Euricius Cordus, *Botanologicon* (Cologne 1534) 69. "(ut hoc illi nomen concedam), quam tamen frigitatem medici nostri tribuunt nego, si gustui, quod Galenus praecipit, credi debet. Nog. Hei quam acer sapor est. Cord. Atque is eam calidam arguit. Gal. Qui Germanice nominatur. Cord. Mauerpheffer." The *Mauerpfeffer* Cordus referred to is probably *Sedum acre* L. In *Gart der Gesundheit*, the plant is said to be cold to the third degree and somewhat dry and to be useful for many things that are hot. Johannes Wonnecke von Kaube, *Gart der Gesundheit* (Augsburg 1487) 450–451.
[337] Cordus, *Botanologicon* (1534) 134. Ogilvie and Ragland claimed that Euricus Cordus wrote that taste was infallible in identifying a plant and could "determine its medical qualities." Ogilvie, *Science*, 135; Ragland, "Chymistry", 6. Cordus did in fact write that, in identifying a plant, taste, as opposed to colour, could not mislead. As he pointed out, colour often changed in different regions, taste however would remain fixed. Cordus, *Botanologicon* (Paris 1551) 92: "Tertium, ut parum de colore referat, quod is secundum diversas regiones in eadem saepe herba mutantur, tamen sapor qui fallere non potest, dissidet."
[338] Leonhart Fuchs, *New Kreüterbuch* (Basel 1543); Leonhart Fuchs, *Paradoxorum medicinae libri tres: in quibus sane multa a nemina hactenus prodita, Arabum aetatisque nostrae medicorum errata non tantum indicantur, sed & probatissimorum autorum scriptis firmissimisque rationibus ac argumentis confutantur* (Basel 1535). See e.g., Peter Dilg, "The antarabism in the medicine of humanism", in: Amoretti, ed., *La diffusione delle scienze islamiche nel medio evo Europeo (Roma, 2-4 ottobre 1984)* (Roma 1987) 269-289, there 277-278; Richard Durling, "Leonhart Fuchs and his commentaries on Galen", in: Gunter Mann *et al*., ed., *Medizinhistorisches Journal. Internationale Viertaljahresschrift fur Wissenschaftsgeschichte* Band 14 Heft ¾ (Stuttgart and New York 1989) 42-47, there 42, 46; Miriam Zitter, "Im Kampf gegen die "Irrtümer der Ärzte".

determining a plant's "Natur und Complexion [sic]" through taste in his herbal.[339] In his *Institutiones medicinae*, Fuchs discussed taste together with other secondary qualities, colour, odour and touch. He distinguished eight different tastes, which originated from the primary qualities hot and cold and attributed many different properties to these tastes.[340] Only once did he refer to a plant, a specific kind of pear tree, to discuss its particularly bitter taste.[341] At the end of the discussion he referred to particular parts of Galen's *De simplicium medicamentorum facultatibus* for more extended discussions of taste. *De simplicium* then seems to be an important source for ideas about the relationship between taste and the properties of drugs. When we look at the sections Fuchs indicated, we find some of Galen's convoluted discussions of drug properties.[342]

We come across two other important features of the sixteenth-century interpretation of Galenic pharmacology in Fuch's work. Earlier, in his *Methodus seu ratio compendiaria*, Fuchs had discussed the primary, secondary and tertiary faculties.[343] Even earlier, in *De historia stirpium*, he had pointed out the difference between Galen, Dioscorides and Pliny the Elder (23-79 AD) in the way they studied the properties of plants. He sided with Galen's opinion that their faculties should be ascertained partially by reason, method and partially by experience.[344] He did not elaborate on what reason, method and experience meant in this particular case. As we have already observed and will examine further on, some of Fuchs's contemporaries and successors had a particular type of "reason" in mind in this context.

Some of Fuchs' contemporaries similarly studied Galen's many books that dealt with drugs, in particular *De simplicium*. In 1569 for example, a little book was published in Lyon under the name of Pietro Andrea Mattioli.[345] Comparing this *Opusculum de simplicium medicamentorum facultatibus* with the edition of *De simplicium* published by the same

Leonhart Fuchs in der Medizin seiner Zeit", in: Gerd Brinkhus and Claudine Pachnicke, eds., *Leonhart Fuchs (1501-1566): Mediziner und Botaniker* (Tübingen 2001) 69-84; Klaus Dobat, "Grundlagenforschung für die Botanik. Die Kräuterbücher des Leonhart Fuchs", in: ibid., 85-111; Sachiko Kusukawa, *Picturing the book of nature. Image, text and argument in sixteenth-century human anatomy and medical botany* (Chicago and London 2012) 101–103, 109–111.

[339] Georg Harig, "Zur Einschätzung des Kräuterbuches von Leonhart Fuchs", *Beiträge zur Geschichte der Universität Erfurt* XIV (Erfurt 1968/1969) 71-77, particularly 72-75.

[340] Fuchs, *Institutiones medicinae* (Lyon 1555), (Lyon 1560) 66-70, there 67-69. cap. 8: De qualitatibus secundis "…., ut copiosius locis Paulo ante indicates Gal. docet. Porro genera differentiaeúe saporum numerum numero sunt octo."

[341] Fuchs, *Institutiones medicinae* (1560) 66-70, specifically 67: cap. 8. De qualitatibus secundis "…Latinis acerbus, Germanis herb dicitur, qualem pyra sylvestria inmatura in se habent."

[342] Ibidem, 66-70, there 69: cap. 8. De qualitatibus secundis. "Quod si vero de illis quispiam plura cognoscere velit, is caput 37. libri primi de Simplicium medicamentorum facultatibus, & cap. 6. lib. 4. cum sequentibus omnibus usque ad finem libri, & 26 libri quinti Galeni perlegat."

[343] Leonhart Fuchs, *Methodus seu ratio compendiaria cognoscendi veram solidamque medicinam* (Paris 1550) 33r-34r, 298r-312r. Lib. I cap. X, cap. XXI-LXXIII.

[344] Fuchs, *Historia*, α6v; cf. Kusukawa, *Picturing*, 111.

[345] Pietro Andrea Mattioli, *Opusculum de simplicium medicamentorum facultatibus secundum locos & genera* (Venice 1569[1]), (Lyon 1569).

publisher eight years previously, is especially effective in showing the characteristics of some sixteenth-century treatments of Galen.[346] Mattioli's book starts with discussions of the same topics Dodonaeus, Heurnius, Spigelius and Jachaeus would later include in their summaries of Galenic pharmacology.[347]

Significantly, the author did not only refer to Galen and Dioscorides, but also to Joannes Farnelius, that is Jean Fernel and the discussion of tastes contained in the fourth book of his *Methodi medendi*. We have encountered this book earlier as *Therapeutices universalis*. It was published only two years before *Opusculum*.[348] In this chapter of *Methodi medendi*, Fernel discussed not just the tastes, but all the same topics that Mattioli, Dodonaeus, Heurnius, Spigelius and Jacchaeus, Fernel's *Therapeutices universalis* appears to be the first that discussed the taste of drugs, the relationships between the various faculties or qualities and the investigation of drug properties together.

Taste and drug properties according to Fernel, Mattioli, Dodonaeus, Heurnius, Spigelius and Jacchaeus

Fernel, Mattioli, Dodonaeus, Heurnius, Spigelius and Jacchaeus all discussed the role of taste in ascertaining the properties of drugs in some ways. All agreed about the certainty of the knowledge that was gained through taste compared to that from touch, odour and colour. Dodonaeus stated that compared to odour or colour, the temperament and faculties of a drug could be judged with much greater certainty by means of taste.[349] Heurnius, Spigelius and Jacchaeus agreed that taste was more certain in judging, indicating or deducing the qualities or temperament of simples than odour, touch and colour.[350] Spigelius stated that, "nothing is a more certain index of the manifest qualities than taste".[351]

[346] Galen, *De simplicium medicamentorum facultatibus libri XI* (Lyon 1561).
[347] Mattioli, *Opusculum*, 7–28.
[348] Ibidem, 14r–v. "Caeterum non desunt quoque, qui acetum adstringenti ui praeditum esse negant, inter quos reperio Ioannem Fernelium virum quirem aetatis nostrae clarissimum, medicumque insignem; quippe qui universam medicinam divina sane oratione descripsit. Etenim is lib. Quarto cap tertio methodi medendi de saporibus scribens, sic de aceto disseruit." Fernel, *Universa* (1567) 411–414. With "methodi medendi", Mattioli referred to *Therapeutices seu medendi rationis*.
[349] Dodonaeus, *Stirpium* (1583[1]) 14. " Sapores ex quibus de stirpium, tum, & aliorum simplicium temperamento ac facultatibus iudicari, & certius quàm ex odoribus, potest, novem sunt…"
[350] Mattioli, *Opusculum* (1569) 5r, 5v; Spigelius, *Isagoges* (1633) 158, 164, 173-182. Heurnius, *Institutiones* (1609) 133, 135; Jacchaeus, *Institutiones medicinae* (1624[1]) 261: "notum est ex Philosopho accidentia rerum, deducere in earum cognitionem. Cum vero in medicamentos varia sint accidentia, colores, odores, gravitas, levitas: nulla tamen aeque commode, & certe deducunt in cognitoinem temperamentorum quam sapores."
[351] Spigelius, *Isagoges* (1633) 158: "Qualitatum autem manifestarum nullus certior index est, quam sapor; quod per contactum linguae fiat."

Whereas Fernel expressed doubts about the hierarchical connection between drug qualities in his *De abditis*, in *Therapeutices universalis* he maintained this connection.[352] In the latter work, he also expanded on the Galenic position expressed in *De abditis* to investigate the properties through a combination of taste and experience.[353] Before we turn to a discussion of these two ways of investigating drug properties however, let us first examine more closely how Mattioli, Fernel, Dodonaeus, Heurnius, Spigelius and Jacchaeus described taste. I will take Dodonaeus' description of sharpness as an example.

Dodonaeus distinguished nine "unmixed" tastes starting with the three warm tastes: these are sharp (*acer*), bitter (*amarus*) and salty (*salsus*).[354] He described sharpness as a cutting or stinging taste that bit the tongue and mouth, pinched and heated tremendously, sometimes it also burned the throat. He then offered several examples of simple drugs with this taste. In long sentences, he continued to enumerate simples and their properties, often without explicitly mentioning their sharp taste. For example, he wrote that those simples that were without any humidity, with some thinness and fineness of substance and hot in the third degree could be considered as diuretics and sweat-producing, and also as cutting or passing through, "which are called *digerentia* in Latin".

He went on to say that, "Of this kind [i.e., sharp simples] are also those that help cough up mucus from the chest and lung and those that provoke menses".[355] Apparently, things that were "hot to the third degree, sharp and of thicker and cruder substance and burned and made blisters and redness or scabs from their great heat", also belonged to this group. These were for example "Spanish flies, Ranunculus or Chamomile and others that if they by their whole matter and substance are counter to the nature of animals, together were called Rotting or Spoiling like the things that are called *deleteria*".[356] Dodonaeus thus used these descriptions of taste as a way to categorise drugs with sometimes quite different kinds of effects in and on the body together. Like Galen, he knew that some drugs tasted a certain way and that they exhibited certain discernable properties in the body and bodily substances as for instance provoking the menses or loosening mucus from the chest and lungs or burning the throat. All these drugs had their sharp taste in common. Many of the drugs that are categorised under sharpness were said to be hot to the third degree.

[352] Fernel, *Universa* (1656) 342–352: lib. IV: "Methodi medendi. De summis medicamentorum generibus & facultatibus."
[353] Fernel, *Universa* (1656) 346, 352.
[354] *Acer* (sharp), *amarus* (bitter), *salsus* (salty), *acerbus* (tart), *austerus* (wry), *acidus* (sour), *dulcis* (sweat), *pinguis* or *unctuosus* (oily) and *insipidus* (tasteless).
[355] Dodonaeus, *Stirpium* (1583[1]) 14–15: "Ex horum genere quoque, sputi è thorace ac pulmone excreationem adiuvantia, mensesque promoventia."
[356] Ibid., 15.

Mattioli, Fernel, Dodonaeus, Heurnius, Spigelius and Jacchaeus all illustrated their discussions by mentioning simples that exemplified the tastes. This means that the reader of these books could check for himself what kind of taste the author was trying to indicate. They also listed the kind of qualities and faculties that the different tastes indicated. There are some variations in their descriptions of the different tastes. They sometimes distinguished between a different number of tastes and also often provided different examples.[357] Mattioli and Jacchaeus mentioned relatively few simples with a particular taste. In accordance with Galen, pepper is always indicated as a sharp simple.[358] The sixteenth-century authors often added different plants and substances to this example.[359] There were some variations in the properties that were gathered under particular tastes as well. The six authors all agreed that sharpness was associated with a strong heat, but not entirely on what other properties were associated with it. These variations indicate that there was no complete consensus about what plants could be said to have a particular taste or about how the taste of a drug could be accorded with the properties that drug exhibited in the body. It also indicates that these authors did not simply copy what someone else had written.

Spigelius' statement that, "nothing is a more certain index of the manifest qualities than taste", has been interpreted by historians as meaning that the "medical qualities" of plants could be "determined" by taste.[360] The wording of Spigelius' statement is important here. First of all, with "manifest qualities" Spigelius did not mean medical qualities. What we call medical qualities, these Galenic physicians called "faculties" and sometimes, "powers" or "virtues", meaning what the drug did in the body. When Spigelius wrote "manifest qualities", he meant a drug's temperament or nature, that is, its primary qualities and the secondary qualities, which were directly derived from them.[361] Secondly, the word "index" meant sign or indication, not determination.

Although taste was considered to provide the greatest degree of certainty in judging, indicating or deducing the qualities, temperament or faculties of simples, as compared to three

[357] Dodonaeus and Heurnius for example gave nine: Dodonaeus, *Stirpium* (1583[1]) 14; Heurnius, *Institutiones* (Leiden 1609) 134, Spigelius seven: Spigelius, *Isagoges* (1633) 159-160; Jacchaeus, *Institutiones medicinae* (1624[1]) 262. In *De simplicium*, Galen identified seven. For a discussion of the number of tastes identified by Galen's sources, Aristotle and Theophrastus, cf. Robert W. Sharples, "Theophrastus on Tastes and Smells", in: William Wall Fortenbaugh *et al*., *Theophrastus of Eresus: on his life and work* (New Brunswick 1985) 183–204; David N. Sedley, "Three Notes on Theophrastus' Treatment of Tastes and Smells", in: Fortenbaugh *et al*., *Theophrastus*, 205–207.
[358] Galen, *Simplicium* (1561) 223.
[359] Adrianus Spigelius, *Isagoges in rem herbariam* (Leiden 1633) 159-160; Heurnius, *Institutiones medicinae* (Leiden 1609) 134; Jacchaeus, *Institutiones medicinae* (1624[1]) 262.
[360] Spigelius, *Isagoges* (1633) 158: "Qualitatum autem manifestarum nullus certior index est, quam sapor; quod per contactum linguae fiat." Ogilvie, *Science of describing*, 136 n. 205, 205.
[361] Cordus made the distinction between qualities and faculties as well, but he did not explore the relation between these properties and taste. Cordus, *Botanologicon* (1534) 134; Spigelius, *Isagoges* (1633) 173, 178.

other secondary qualities (odour, touch and colour), Fernel, Mattioli, Dodonaeus, Heurnius, Spigelius and Jacchaeus expressed some reservations about the knowledge that taste could yield about a drug's faculties, powers or virtues. In investigating these properties of a drug, to adopt the words of Philiatros, Galen's artifice "to reach the primary and secondary faculties of plants from their colour, odour or taste," always had to be complemented by experience.[362] Fernel explicitly wrote that taste could "not reflect the power and faculty of a drug, it only gives an indication of the primary and secondary faculties."[363]

Dodonaeus concluded his discussion of the tastes by pointing out that the nature or temperament of drugs and also their secondary and tertiary faculties could be assessed from unmixed tastes. This was supposed to be "not at all difficult" as long as the drug had one single *qualitatem gustabilem* (tastable quality). But sometimes, the different tastes were blended to such an extent that they were "not able to render the powers and faculties of a drug with certainty." In those cases experience helped, because, as Dodonaeus stated: "From experience alone, without the determination of the tastes, the faculty of any drug can be discovered." Indeed, it was proper to employ experience "even when the faculty, known or inspected with taste or reason, is obtained. Since sometimes what reason approves, experience refutes."[364] In Dodonaeus' case, a discussion of the kind of knowledge of drug properties that can be obtained from the tastes, led to a discussion of the relationship between knowledge from experience and from reason.

Reason, experience and investigating drug faculties

Dodonaeus returned to this topic later in the text, when he discussed how the faculties of simple medicines could be known through experience. He only added that if it was possible to

[362] Forrester, *Jean Fernel's*, 694–695; Spigelius, *Isagoges* (1633) 157; Mattioli, *Opusculum* (1569) cap. 14. 27v-28r; Heurnius, *Institutiones* (1609) 135; Jacchaeus, *Institutiones medicinae* (1624[1]) 261.
[363] Fernel, *Universa* (1656) 346, 349: lib. IV, cap. III: "De saporibus."
[364] Dodonaeus, *Stirpium* (1583[1]) 16: "Et totidem quidem simplices sapores, ex quibus de stirpis aut alterius medicamenti temperatura ac substantive essentia iudicatur, atque ex his deinde, quipus id Secundis ac subinde Tertiis facultatibus sit praeditum, cognoscitur: quod, ubi unicam tantum qualitatem gustabilem possidet, haud difficile. Quod si plures sapores sentiantur, ex omnibus mistam medicamentum facultatem & actionem edet: veluti Absinthium, quod praeter amaritudinem, & adstrictionem habet, unde& diversae substantiae & facultates insunt: ab amaritudine extergendi, ab altera adstringendi ac corroborandi. Sunt autem differentes sapores, quandoque ita interse confuse, ut nequeant certo medicamenti vim ac facultatem exprimere. Atqui tunc quidem experientia succurrit, qua sola etiam, citra saporum dignotionem, medicamenti cuiusuis facultas reperiri potest. Quam etiam semper adhibere convenit, etiamsi gustu aut ratione facultas cognita videatur aut perspecta. Quandoque siquidem, quae ratio probavit, experientia redargit."

complement experience with reason, experience became all the more certain.[365] While Heurnius discussed how the properties of drugs became known through taste and experience, he was remarkably silent on the use of reason. Jacchaeus insisted that reason and experience were both needed to investigate the powers of drugs.[366] Spigelius wrote:

> There are two ways that lead us to the virtue of these [plants]; of course use, or experience and reason. But reason is difficult and experience dangerous. Often reason convinces of much that use refutes; and use discovers much that reason can by no means investigate. Yet, one needs both ways for a considered investigation of the faculties.[367]

Spigelius here referred to the well-known first aphorism of Hippocrates that had been interpreted and commented upon in different ways over centuries. Other authors had also linked the aphorism specifically to the investigation of drug properties. For example, Al-Rāzi (854–925 ad) had used his discussion of the aphorism to point out that testing the effectiveness of a therapy required reason and guidelines.[368] Reason was an inextricable part of designing and interpreting an empirical test of a drug's effectiveness. Medieval authors embraced this view of the investigation of drug properties when they provided particular instructions about the proper way to test drugs on animals and people.[369] In a way, Dodonaeus acknowledged this tradition by providing similar instructions in *Stirpium* about "making a test" and "making a trial of" a drug.[370] Contrary to this Arabic tradition, Spigelius spoke of

[365] Ibidem, 18. "Quod si vero ratio etiam adstipuletur, tanto experientia certior habenda. Nam sicut experientia de ratione inventorum virtute decernit: Ita experientia a consentiente ratione non exiguum ornamentum ac firmum stabilimentum accipit: si modo accedere queat."
[366] Jacchaeus, *Institutiones medicinae* (1624[1]) 261: lib. V cap. VI. "Modus explorandi vires medicamentorum."
[367] Spigelius, *Isagoges* (1633) 157: "Duo sunt quae nos in harum virtutum dignotionem deducunt; scilicet usus, seu experientia, & ratio. Sed ratio difficilis est; experientia periculosa. Saepe multa persuadet ratio, quae usus redarguit; multaque usus adinvenit, quae neutiquam ratio investigare potuit. Ad exactam tamen facultatum indagationem utroque opus est."
[368] Peter Pormann, "Medical methodology and hospital practice: the case of fourth-/tenthcentury Baghdad", in: Peter Adamsom, ed., *In the Age of al-Fārābī: arabic philosophy in the fourth/tenth century* (London and Turin 2008) 95–118.
[369] Ibn Sina (980–103 AD) famously incorporated such guidelines in the second book of his *Canon*. McVaugh, "Quantified", 402–404; Brian Lawn, *The rise and decline of the scholastic 'questio disputata' with special emphasis on its use in the teaching of medicine and science* (Leiden 1993) 68; Philip van der Eijk, "Galen's use of the concept of 'qualified experience' in his dietic and pharmacological works", in: Armelle Debru, ed., *Galen on pharmacology*, 35–57; Heinrich von Staden, "Inefficacy, error, and failure: Galen on *dokima pharmaka aprakta*", in: ibid., 59–84, particularly 61, 64–73, 76–81; D. Craig Brater and Walter J. Daly, "Clinical pharmacology in the Middle Ages: principles that presage the 21st Century", *Clinical pharmacology & therapeutics* vol. 67 (2000) 447–450; Plinio Prioreschi, *A history of medicine. Byzantine and Islamic medicine* (Omaha 2001) 267–268.
[370] Dodonaeus, *Stirpium* (1583[1]) 18. "Qualiter per experientiam medicamentorum simplicium facultas cognoscenda"; "Illud autem de quo experimentum faciendum simplex esse debere, non mistum, Galenus docet: & in iis periculum faciendum, qui ...."; "Iam& hoc ipsum medicamentum, cuius periculum faciendum, & quod

experience and reason as two distinct ways of proceeding or of approaching the properties of a drug. Moreover, he defined reason as that "which is undertaken by tastes and scents, which are contained in every Plant."[371] From this description of the Galenic investigation of drug properties, we recognise Wear's point about Galen's epistemology being "a blend of the empirical and the rational" very much applied to it.[372] What kind of blend was used in the investigation of drug properties?

The authors I have examined here were convinced that it was possible or even necessary to investigate simples both via experience and reason. Generally, they presented the Galenic scheme as coherent and comprehensive. They were unclear however about what exactly experience and reason said about the properties of drugs and about how the knowledge provided by each should be combined. Though Dodonaeus was partial to relying on experience, as were most of his fellow physicians, he did not specifically address cases in which reason and experience contradicted each other in what they said about a simple drug's qualities and faculties. Such cases did occur however. We have already come across an example of a plant whose taste did not accord with the qualities that were attributed to it by certain German physicians: Cordus' *Mauerpfeffer*. How could such a case be resolved?

The problematic properties of opium

Spigelius discussed a similar case when he made a special effort to lay out how taste and experience could complement each other in determining the qualities of opium. He presented his discussion of opium as part of a discussion of other soporifics. The issue he was about to address was not new, as he acknowledged himself.[373] Both Dioscorides and Galen had written that opium had a strongly cooling and drying effect, which led to a thickening of the humors, diminution or loss of sensitivity, and sleep. Maehle mentions that, "from the sixteenth century onwards some medical authors, such as Pierandrea Mattioli, Felix Platter, and Michael Döring, had attributed a warm quality to opium."[374] Thus, some physicians ascribed different

experimento examinandum, ..." Heurnius gave similar, but more limited instructions. Heurnius, *Institutiones* (1609) 137.

[371] Spigelius, *Isagoges* (1633) 157. "Occultarum autem facultatum, & quae tota substantia agere dicuntur, experientia inventrix est, ac judicatrix: reliquarum autem, quae à tribus manifestis qualitatibus dependent, ratio ipsa quae desumitur a saporibus & odoribus, qui cuique Stirpi insunt." Again, the sense of taste and odor are presented as playing a role in a specific process of reasoning.

[372] Wear, "Learned medicine", 154.

[373] Spigelius, *Isagoges* (1633) 168.

[374] Maehle, *Drugs*, 131–132. Maehle only gives sources for the opinions of Döring and Mattioli; Michaël Döring, *Mithridateiotechnia: hoc est*, *de mithridati legitima constructione Nicolai Mutoni collectanea …cum auctario gemino: quorum prius exhibit acroama medico-philosophicum*, *de opii usu*, *qualitate calefaciente*, *virtute narcotica*, *et ipsum corrigenda modo* (Jena 1620); Friedrich Hoffmann, *Clavis pharmaceutica*

qualities to opium than Galen and Dioscorides had, before Van Helmont presented his alternative view of its properties. This inconsistency between what the taste of opium and what its effects on the body said about its qualities had already been noticed in the sixteenth century.

Mattioli's commentaries on Dioscorides' *De materia medica* contain the earliest mention I have found of the idea that the properties of opium posed a problem to Galenic theory. Mattioli discussed the taste of the poppy and, referring to Dioscorides, warned his readers about the ways in which its sharp and bitter taste could be adulterated with Glaucium.[375] Here he also pointed out the problematic role played by experience and taste in the determination of its temperament and qualities in particular. Mattioli acknowledged that opium was determined to be above four degrees cold [due to its soporific effects]. However, "if the temperaments and qualities are known from taste and the effect of things," then opium did not only taste bitter. From just a little bit of it, Mattioli also tasted sharpness.[376] He believed that from these tastes he could undoubtedly infer the very hot qualities that were present in opium. According to Mattioli, this was confirmed by its heavy smell.[377] He was well aware of the destructive implications the conflict between knowledge through reason and experience could have for the *sententia* or way of thinking of almost all physicians. He decided to leave the issue to "the judgment of those who considered the qualities or faculties of opium very diligently before us."[378]

Fernel discussed the properties of opium in *Therapeutices*, but did not deal with the challenge they posed. In one place, he attributed cold qualities over four degrees and dry qualities in the first degree to opium in accordance with Galen. Elsewhere in the text however, he called the stupefying quality of opium "occult" without explaining why. Dodonaeus came to very similar conclusions about opium, even though he categorised

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Schroederiana seu animadversiones cum annotationibus in pharmacopoejam Schroederianam Baconiania, *Cartesianis*, *et Helmontianis principiis illustratae* (Halle 1675) 592–593; Margit Kreutel, *Die Opiumsucht* (Stuttgart 1988) 111 n. 5, 6, 147, n. 5, refers to Platter's *Praxeos medicae* (Basel 1656).

[375] Pietro Andrea Mattioli, *Commentarii in libros sex Pedacii Dioscoridis Anazarbei*, *de medica materia* (Venice 1554) 470 line 47: "Sed forté ea acris, amaraque facultas in opium facilé invehitur ex glaucij adulteratione, quod illi saepius admiscent, ut Dioscorides adnotavit." Mattioli discussed this plant on p. 380 and is identified by some authors, though not Mattioli, as a variety of the Horned Poppy with red flowers, but the identification of the plant is uncertain to this day. Cf. Rembert Dodonaeus, *Cruydt-boeck*, vols. 2 (Leiden 1608) vol. 1, 800.

[376] Mattioli, *Commentarii* (1554) 470 line 41: "Et quanvis Opium quarto excessu frigidum statuatur, tamen si ex sapore, & effectu rerum temperamenta, & qualitates cognoscuntur, opium nostri usus (quantum equidem deprehendere potui) non modo gustu amarum percipitur, sed etiam acre, adeò ut paululum in ore detentum linguam, & palatum exculceret."

[377] Ibid., line 44: "Unde haud dubie colligi posse putauerim, calidissimas illi inesse qualitates. Cuius rei fidem augere potest, quae ex eo prodit odoris gravitas."

[378] Ibid., line 45: "Veruntamen ne impudentis, atque arrogantis nomen subeam, quod in hoc omnium fere medicorum sententiam destruere velim, eorum iudicio rem hanc aestimandam relinquam, qui ante nos opij tum qualitates, tum facultates diligentissime expenderunt."

soporifics among the secondary faculties. He stuck to Galen's attribution of strongly cold qualities, though like Mattioli he noted its bitterness. He concluded that this meant that its properties could not flow from only these qualities, but also from the total substance.[379]

We have noted that Spigelius was especially adamant that both reason and experience should be used to investigate drug faculties. He made a special effort to show how they could be used to determine the temperament or qualities of opium. He agreed with Galen who said that opium, mandrake and nightshade induced sleep and numbness through coldness, however he insisted that they worked not just through coldness, but also,

> by a special power directed at the brain, that is based on the total substance, as we will examine in a more suitable place. All soporifics in fact produce sleep with a particular pleasant vapor rising to the brain either through the nostrils, the mouth, the veins and arteries, or through the throat, which they call the esophagus.[380]

In this way, Spigelius not only attributed the faculty of opium to its total substance, but also tried to specify this faculty by describing how drugs like opium worked in the body. He added that among moderns, the disagreement about opium was so great that "there are some amongst the most experienced physicians who attribute warmth to it." Indeed, in no way could the fourth degree of coldness attributed to it be encountered, because "in as much as it has bitterness, in that amount it has heat."[381] From opium's taste, Spigelius had apparently concluded that Galen's attribution of very cold qualities to it could not be correct. Its sleep-inducing effects however could not be caused by heat either and must therefore be caused by a special power based on its "total substance."[382] Thus, though Galen had favored experience over reason by attributing cooling qualities to opium, Spigelius attributed a more important

[379] Fernel, *Universa* (1656) 351b, 402a, 423a–b, 431a, b. Dodonaeus, *Stirpium* (1583[1]) 10. Ragland writes that "the trouble with tasting was carried into mainstream medical pedagogy" by Heurnius. He gives the problematic properties of opium as an example of "the trouble" that physicians like Heurnius are supposed to have encountered. On the page to which Ragland referred, Heurnius, *Institutiones* (1609) 135, we can only find a discussion of the tastes, not of opium. I have not found where else Heurnius discusses the conflicting properties of opium.

[380] Spigelius, *Isagoges* (1633) 167–168: "…, non solum frigiditate hoc efficiunt, sed peculiam quadam virtute cerebro destinata, quae à tota substantia dependet, uti aptiori loco probabimus. Soporifera enim cuncta suavi quadam evaporatione ad cerebrum ascendente sive per nares, sive per os, sive per carotidas venas, & arterias, sive per gulam, quam stomachum vocant, somnum movent."

[381] Ibid., 168: "De opio tanta est inter recentiores dissentio, ut inter peritissimos medicos non desint, qui id calidum asseverent. Sane quartum nulla ratione attingere frigiditatis gradum potest, cum namque habet amaroris, tantum caliditatis."

[382] Johan van Beverwijck (1594–1647) apparently adopted a similar point of view. Kreutel, *Opiumsucht*, 148.

role to reason. This led him to categorise the effects of opium as based on its total substance. But what were these properties that originated in the total substance of the drug?

Opium and the distinction between manifest and occult qualities

We have already encountered these special powers based on the total substance in the previous chapter. Fernel categorised these as tertiary qualities, Dodonaeus, Heurnius, Spigelius and Jacchaeus as quaternary faculties. In conformity with Galen, they agreed that powers from the total substance could not be discovered through reason, but only through experience.[383] These powers could not be connected to the primary qualities and their causes remained hidden or occult.[384]

Accordingly, these sixteenth- and early seventeenth-century physicians tried to determine whether the properties of medical materials could be understood as resulting from the four primary qualities or if they should be classified as occult. Especially Jacchaeus was specific about making this distinction. His discussion shows that next to taste, considerations about how a drug worked in the body gained importance in making the distinction between the occult and the manifest. He distinguished between a *modo occulto*, a hidden way and a *modo evidente*, an evident, apparent or manifest way in which the drug worked.[385] Drugs that worked in an occult way either moved something locally or simply changed something.[386] Some retained what should have moved out of the body, others attracted by similarity of their substance. Some simples drew a particular humor out of the body or a particular part of the body. Although these drugs might have primary and secondary faculties, they attracted particular humors through the fourth, occult faculty. Jacchaeus added that the quaternary faculties also applied to poisons, antidotes and drugs that affected a particular part of the body. However, not all poisons achieved their powers through an occult property; some were

[383] Fernel, *Universa* (1565) 352; Mattioli, *Opusculum*, 5v, 23r; Dodonaeus, *Stirpium* (1583[1]) 13, 18; Heurnius, *Institutiones* (1609) 137; Spigelius, *Isagoges* (1633) 157–158, 173, 178: "Qualitatum autem manifestarum nullus certior index est, quam sapor; quod per contactum linguae fiat"; Jacchaeus, *Institutiones medicinae* (1624[1]) 245, 265: lib.V cap. III. "Haec occulta qualitas, non sensu, non ratione, sed sola experientia deprehendi creditur; & quanquam a temperamento non immediate fluat, supponit tamen debitum commodumque temperamentum."; lib. cap. VI. "Quod ad occultas vires attinet, ex sola experientia cognoscuntur non ratione, ut dictum est."; Wear, "Medicine", 262.

[384] Heurnius, *Institutiones* (1609) 137. "Dicuntur hae occultae, specificae, latentes."; Jacchaeus, *Institutiones medicinae* (1624[1]) 259. "Diximus esse quartas medicamentorum facultates, consequentes immediatè formam substantialem rei, non autem temperamentum." Though Mattioli had referred to drugs that exercised their powers through their total substance, he paid very little attention to this category of drugs compared to Fernel, Dodonaeus, Heurnius, Spigelius and Jacchaeus. Mattioli, *Opusculum*, 5v, 22v, 23r.

[385] Jacchaeus, *Institutiones medicinae* (1624[1]) 249. "Agunt hae [tertiae] qualitates non modo occulto, sed evidente, …"

[386] Ibid., 259. "Haec afficiunt nostrum corpus, non tantum manifeste, sed & occulta ratione. agunt in nostrum corpus dupliciter, vel movendo localiter aliquid in eo, aut simpliciter tantum alterando ut theriaca."

simply warm, cold or dry. Finally, there were drugs that affected a particular part with a hidden sympathy or antipathy.

Jacchaeus supplied examples of the simples that possessed each of these properties.[387] Jacchaeus' description of the quaternary faculties shows that it was important, but not straightforward, to distinguish between faculties that could be attributed to either manifest or occult qualities. Jacchaeus mentioned at the end of the chapter that it was a matter of agreement and discussion among physicians:

> The things I said about the faculties of drugs are accepted almost generally by physicians. It is not to be denied however, there are many that can render this received opinion doubtful.[388]

Elsewhere, Jacchaeus noted that there were further disagreements, not just about the properties of opium, as Spigelius had indicated, but also about the occult qualities as a category. He wrote:

> There is doubt about the occult [qualities]. Some dispense with them altogether and claim that all actions are produced from manifest qualities: some allow them and assert them to emanate very closely from the substantial form, as for instance the stupefying power in opium.[389]

As it happens, Jacchaeus' *Institutiones medicae* was the last new publication to be issued in the Dutch Republic that discussed Galenic pharmacology in this way.[390] In his *Institutiones*, we find an explicit mention of the dubious status of the distinction between the manifest and occult qualities of matter. The disappearance of this distinction has been claimed as a major characteristic of the Scientific Revolution.[391] In the work of Jacchaeus, this categorical distinction and the doubt that existed about it were discussed as part of medicine, in the consideration of the properties of *materia medica*. Jacchaeus did not discuss it in his textbook

[387] Ibid., 259–260.
[388] Ibid., 260–261: "quae dixi de medicamentorum facultatibus, vulgo a medicis fere recipiuntur, negandum tamen non est multa esse, quae receptam sententiam dubiam reddere possunt, de quibus alij."
[389] Ibidem, 245: cap. V, "de occultis dubitur. Quibus omnino eas tollunt, ajuntque omnes actiones a manifestis fieri qualitatibus: quibus admittunt, asseruntque a forma substantiali proxime manare, sicut vis stupefaciendi in opio." Jacchaeus did not identify the other authors that had written about these subjects, or who could render the received opinion doubtful or who was doubtful about the occult qualities.
[390] There were at least two reprints of Jacchaeus' *Institutiones medicinae* (in 1631 and 1653), of Spigelius' *Isagoges* (in 1633 and 1645), of Heurnius' *Institutiones* (in 1627, 1638, 1666) and of Fernel's *Universa* (in 1645, 1656).
[391] John Henry, *The scientific revolution and the origins of modern science* (London 1997) 52–53, 57.

on the principles of physics.[392] This indicates that investigating the history of the distinction between manifest and occult qualities should also involve the study of medical materials.

Eighteen years after Spigelius, Jacchaeus mentioned opium as an example in his explanation of the difference between occult and manifest qualities.[393] As a result of the investigations we have examined, opium, which had cooling qualities according to Dioscorides and Galen, was reclassified as a drug with a specific power that could not be connected to the four primary elements. Galen's theory of drug properties as a whole was not refuted by the reallocation of opium as a drug with an occult quality. It was however a small piece of evidence to the effect that Galen could be wrong in the attribution of drug properties and that applying his method of determining a drug's faculties and qualities could be problematic.

Probably even more troubling about drugs such as opium was that formulating a rational treatment of patients was difficult on the basis of occult properties. As Heurnius explained, these powers, "called occult, specific or latent," scarcely had a place in the *methodus medendi*.[394] Resistance against the attribution of properties as occult or specific can be observed in Heurnius' effort to explain the apparently contradictory secondary and tertiary faculties of Aloë. Although a drug could have many different faculties, this did not mean that these properties should be attributed to special powers. Heurnius referred to various Galenic texts to support this point. He concluded:

> Therefore it does not follow logically, that because Aloe closes the sides of veins, it does not open: because it performs much owing to the diverse powers with which it is equipped.[395]

Ironically, attempts like Heurnius' to make medical practice consistent and systematic and to impose order on to Galen's writings on drug properties, appear to have exposed the "significant difference between theory and its application in practice at the very core of Galen's pharmacological work."[396]

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[392] Jacchaeus, *Institutiones physicae* (1614[1]). He did discuss the senses there.
[393] Jacchaeus, *Institutiones medicae* (1624[1]) 245: lib. V, cap III.
[394] Heurnius, *Institutiones* (1609) 137: "Methodo medendi vix locum habent: usu solo compertae." Again, in conformity with Galen in *Methodus medendi*, see Wear, "Medicine", 262 and in *De simplicium*, see Temkin, *"On second thought"*, 172, 179.
[395] Heurnius, *Institutiones* (1609) 137. "Quare nec consectarium est, Aloe venarum ora claudit, ergo non aperit: nam multa simul facit ob diuersas vires quibus praedita est."
[396] Vogt, "Drugs", 311.

Conclusion

In the attempts by sixteenth-century physicians to understand the various properties of *materia medica*, including their taste, within the Galenic framework, the properties of some became unintentionally problematic. I have indicated that the significance of the knowledge of drug properties for the *methodus medendi* made discrepancies between the taste of a drug and its therapeutic effects noticeable, relevant and subsequently problematic for Galenic medicine. In conformity with what Wear has argued, the physicians I have mentioned did not develop "new fundamental theories by experience or reason." Instead, they "emphasised orthodoxy" and accepted Galen's doctrines as they interpreted them. They continued to insist that taste, reason and therapeutic experience could and should be used to investigate a drug's properties.[397] Yet, they did not simply copy Galen's writings about the properties of drugs, but focused on particular parts of them and tried to apply his instructions about how to investigate drugs.

In Wear's terms, we could say that opium was a case in which "new observational knowledge" contradicted Galen's observations. Alternatively, we could point to the somewhat different epistemological positions on which these observations were based. According to late sixteenth-century Galenic pharmacology, two different kinds of "observational knowledge," one derived from taste and the other derived from experience, should be combined in determining a drug's properties. Galen had privileged experience over reason by attributing cooling qualities to opium. Mattioli pointed out that using both taste and experience produced conflicting properties for opium. Finally, Spigelius combined these positions with those of Fernel and Dodonaeus, and concluded that the quality producing the special soporific powers of opium was occult. Through the sixteenth-century engagement with Galenic epistemology, evidence of which we can find at least as early as 1534 in Cordus' work, the properties of opium were found to differ from Galen's observations.

Van Helmont's arguments about the investigation of drug properties fitted in well with debates about the use of reason and experience within Galenic medicine. Like the physicians I have discussed, Van Helmont wanted to use taste to investigate drug properties.[398] To the Galenic physicians taste and the determination of a drug's qualities or temperament could only provide an indication of the properties the drug would exhibit in the body however. In Van Helmont's system there was supposed to be a more direct correspondence between a

[397] Wear, "Learned", 154, 155.
[398] Ragland, "Chymistry and taste", 10-12 .

drug's taste and its effects. A closer look at these Galenic debates has shown moreover that knowledge from taste was defined as a tool or device of *ratio* or reason, not of experience.

This would mean that in proposing a different system of taste, Van Helmont was not proposing to enhance medicine *empirically*. Within the terms of his own time he was proposing a new and, so he argued, better system of *reasoning* about medicine and the effects of drugs on the human body. Thus his position with regard to the use of taste to gain knowledge of the properties of drugs was different from Philiatros', as it was described by Fernel in his *De abditis*. Like Van Helmont, Philiatros considered Galen's use of taste to find the causes of the properties of drugs insufficient. But contrary to Van Helmont, Philiatros opted to disregard the search for causes and preferred empiricism, which meant that he put little faith in the possibility of gaining knowledge of drug properties through the sense of taste, colour or odour.

Finally, to some extent, these attempts to understand the various properties of drugs within the Galenic framework exposed prevailing ideas about matter to criticism. In medicine, the question was raised which properties of matter could be categorised as derived from manifest qualities and which could not and should therefore be attributed to an occult quality. Answering this question conclusively was difficult to the extent that it began to undermine the categorical distinction between manifest and occult qualities. This suggests that the shift in ideas about the qualities of matter that occurred in natural philosophy around this time may have arisen, at least partially, from discussions about the properties of *materia medica*.

Intermezzo 3

A crisis of theory?

As I discussed in the introduction, Roger French suggested that, in order to make a living, "learned physicians" needed a good story about their medical practice to tell their patients. According to French, this "good story" was under pressure in the period from 1630s to about 1660s, due to what French called a "crisis of theory". Accordingly, French focused his discussion on changes in the theoretical foundations of academic medical practice. As he summarised "... by the 1630s not only were philosophers seeing a battle between Aristotelianism and the mechanical philosophy, but within medicine some of the major doctrines of Hippocrates and Galen had been shown to be wrong".[399] Using French's term "crisis of theory" here would be problematic since the idea behind the *methodus medendi* was that there was no distinction between theory and practice. Examining developments in pharmacology helps to say more exactly what issues confronted physicians.

Another point of contention evoked by French's idea of a "crisis of theory" is how it occurred in different places. French himself focused on England, but the examples that French provides, indicate that he considered the crisis was felt throughout Europe, amongst others in the Dutch Republic.[400] In contrast, Cook presented medicine in the Dutch Republic in this period as undergoing a rather smooth development. According to Cook, the particular importance in Dutch society of trade fostered a culture focused on collecting "matters of fact". As such, it seems Dutch medicine was from the outset focused on practical medicine, careful observation and experience and Hippocratic texts. Galen or his medical doctrines seem to have played no part in the medicine taught at the University of Leiden.[401] Preserving these doctrines or defending them against criticism then, would not have been much of an issue for Dutch physicians.

This view of Dutch medicine requires closer consideration. The work of Heurnius is particularly illustrative. On the one hand, Heurnius did teach and publish on subjects that confirm the image of Dutch academic medicine as based in the Hippocratic corpus and practical medicine. After Heurnius' death, his son Otto (1577-1652) continued to publish his father's works on practical medicine.[402] Also, students in Leiden had to undergo an exam in

[399] French, *Medicine*, 157.
[400] Ibid., 157, 183-184, 187-190.
[401] Cook, *Matters of exchange*, 111.
[402] Johannes Heurnius, *Praxis medicinae nova ratio: qua, libris tribus methodi ad praxin medicam, aditus facillimus aperitur ad omnes morbos curandos. Recognita & emendata ab auctore, & auctior ac melior reddita Auctore Ioanne Heurnio Ultraiectino, professore medicinae* (Leiden 1587); Johannes Heurnius, *De morbis qui in singulis partibus humani capitis insidere consueverunt* (Leiden 1594); Hippocrates of Cos and Johannes Heurnius, *Hippocratis Coi Prolegomena, et prognosticorvm libri tres: cum paraphrastica versione & brevibus commentariis Iohannis Heurnii Ultraiectini* (Leiden 1597); Johannes Heurnius, *De febribus liber* (Leiden 1598); Johannes Heurnius, *Aphorismi Graecè, & Latinè/ Hippocrates; Brevi enarratione, fidaqúe interpret. ita ill.; Cum historiis observationibus cautionibus et remediis, selectis, a J. Heurnio* (Leiden 1601); Johannes Heurnius, *De morbis pectoris liber editus post mortem auctoris, ab eius filio Othone Heurnio* (Leiden 1601); Johannes

which they explained two Hippocratic aphorisms.[403] Finally, most of the texts taught at the university were on the prognosis and curing of diseases.

On the other hand, through Heurnius' writing on the principles of medicine and the *methodus medendi*, Galenic theory played a bigger part in his authoritative medical teaching than Cook and some other historians of Dutch medicine acknowledged.[404] For healing to be methodical it needed to be guided by the identification of disease cause, observation of the symptoms that indicated the stage and progress of the affliction and identification of the correct treatment suitable for the particularities of the case. Students attested to their abilities in following this procedure in the *theses* and *positiones* they defended in Leiden in the late sixteenth and early seventeenth century.[405] The practical medicine they exihited very much depended on knowledge of the inner workings of the body. Therefore, equating great attention for Hippocrates and practical medicine with a non-Galenic type of medicine is not necessarily correct. We can observe this as well if we look at the historical literature in which Cook found support for his representation of Dutch medicine, that is the historiography on sixteenth-century Galenism and Hippocratism.

Indeed, the historical literature stresses that as early as the end of the sixteenth century:

> Galenic medicine was declining and Galen's works were less sought after since they had been criticised, starting with the refusal of Galen's anatomy by Vesalius in *De humani corporis fabrica*.[406]

Stefania Fortuna discusses some of the results of this more critical attitude towards Galen's writings. These show that the critical attitude towards Galen and the growing attention for Hippocrates did not imply a wholesale rejection of Galen's writings. She contends that, when Galen's pre-eminence was declining towards the end of the sixteenth century, "interest shifted from his own works to his commentaries on Hippocratic treatises".[407] That some of Galen's

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Heurnius, *De morbis ocvlorvm, avrivm, nasi, dentivm et oris, liber, / editus post mortem auctoris, ab eius filio Othone Hevrnio* (Leiden 1602); Johannes Heurnius, *De morbis ventricvli liber: responsvm ad nobiliß. & ampliß præsidem, Ioannem Banchemivm ... oratio de medicinae origine, Æsculapidum, ac Hippocratis stirpe & scriptis. Edidit post mortem autoris eius filius Ottho Heurnius Vltraiectinus* (Leiden 1608).

[403] Cook, *Matters of exchange*, 111; Lindeboom, "Medical education", 203.

[404] Jelle Banga, *Geschiedenis van de geneeskunde en van hare beoefenaren in Nederland, vóór en na de stichting der hoogeschool te Leiden tot aan den dood van Boerhaave* (Leeuwarden 1868); Lindeboom, "Medical education", 201-216, specifically 203-204.

[405] See n. 273.

[406] Stefania Fortuna, "The Latin editions of Galen's *Opera Omnia* (1490-1625) and their prefaces", *Early science and medicine* vol. 17 no. 4 (2012) 391-412, specifically 407.

[407] Vivian Nutton, "Hippocrates in the Renaissance", in: Gerhard Baader and Rolf Winau, eds., *Die hippokratischen Epidemien: Theorie-Praxis-Tradition, Verhandlungen des V Colloque International Hippocratique (Berlin 10-15 Sept. 1984)* (Stuttgart 1989) 420-39; Fortuna, "The Latin editions", 407, 408.

works were regarded more critically than others is shown in the preface of the 1576-1577 edition of his works by the Giuntine printers, which Fortuna discusses. The author of the preface, Girolamo Mercuriale (1530-1606), who taught at Padua at this time, wrote that, "the physician should read *De methodo medendi*, *Ad Glaucomen*, *De locis affectis*, *De sanitate tuenda*, but not the works on anatomy, pulses, surgery, and philosophy, which are mistaken, useless, aggressive, and not original".[408] Indeed, the only texts by Galen to be read at the University of Leiden in 1601 were his books on the distinctions, causes and symptoms of diseases.[409]

The relationship between the Hippocratic and the Galenic tradition has proven to be particularly difficult to disentangle because Galen very consciously and carefully incorporated Hippocratic works in his own. He interpreted them and obscured the variety that existed in the Hippocratic corpus.[410] Nutton is confident in his statement that:

> Galen's Hippocrates, while crucially flawed as a representation of the historical figure, is at the same time significant for understanding both Galen and the way in which subsequent generations thought of Hippocrates and what he stood for.[411]

To what extent Galen influenced the interpretation of Hippocratic texts by sixteenth-century physicians through his commentaries and other works, such as *De optimo medico cognoscendo*, remains to be investigated. In particular, Iain M. Lonie has made a great start in this direction, when he investigated the teaching of Hippocratic texts in Paris. He went as far as to say that:

[408] Ibid., 409; Stefania Fortuna, "Girolamo Mercuriale editore di Galeno", in: Alessandro Arcangeli and Vivian Nutton, eds., *Girolamo Mercuriale. Medicina e cultura nell'Europa del Cinquecento, Atti del convegno (Forlì 8-11 Nov. 2006)* (Florence 2008) 217-31.
[409] Molhuysen, *Bronnen*, pt. 1, 400*-401*. These were probably *De differentiis morborum*, *De morborum causis*, *De symptomatum differentiis* and the three books of *De symptomatum causis*.
[410] Vivian Nutton, "The fatal embrace: Galen and the history of ancient history", *Science in context* vol. 18 no. 1 (2005) 111-121, specifically 112; Cantor, *Reinventing Hippocrates*, 4-5.
[411] Vivian Nutton, "Review of Manfred Horstmanshoff, ed., Hippocrates and medical education. Selected papers presented at the XIIth international Hippocrates colloquium, Leiden University, 24-26 August 2005 (Studies in ancient medicine 35) (Leiden and Boston 2010)", *Early science and medicine* vol. 17 no. 6 (2012) 643-644, there 643.

> The Galenic version of Hippocrates was accepted without question by the Parisians, as indeed it was by all sixteenth-century medical writers with the notable exception of the Paracelsians.[412]

Particularly in the work of Heurnius, it seems Galen's writings had this influence on the interpretation of Hippocratic medicine and the practice of medicine.

On the basis of the *Institutiones*, Ingo Müller took Heurnius as a typical Galenic physician in his study of Friedrich Hoffmann's medical theory and practice.[413] From the title of his first book, *Praxis medicinae nova ratio*, we can recognise that even when discussing practical medicine, Heurnius intended that practice to be rational and methodical.[414] Vivian Nutton described the same book as a "mighty tome" in which Heurnius had "systematically rearranged medical facts to suit a Galenist […] standpoint".[415] We can also recognise Galen's influence in Heurnius *De medicinae origine* of 1608. Heurnius recounted the history of medicine and in doing so pointed out the defining characteristics of his discipline. For example, he followed Galen's characterisation of the relationship between Hippocrates and the Empirics. Heurnius wrote that when this sect,

> had chosen to affirm human experiences of things with causes, and had discerned observation as yet to be very little completed by unknown causes, began to turn to the contemplation thereof: and therefore accordingly reasonable medicine gradually began to grow up: which was before Hippocrates of Cnidus, Rhodos and Cos: onto this Hippocrates first of all breathed splendour, proliferation and greatness, and most excellently, says Galen, brought her forth to the light with the Greeks.[416]

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[412] Iain M. Lonie, "The 'Paris Hippocratics': teaching and research in Paris in the second half of the sixteenth century", in: Andrew Wear *et al*., eds., *The medical renaissance of the sixteenth century* (Cambridge 1985) 155-174, specifically 163. Vivian Nutton supported and elaborated on this point in "Hippocrates in the Renaissance", in: Gerhard Baader and Rolf Winau, *Die hippokratischen Epidemien: Theorie, Praxis, Tradition: Verhandlungen des Ve Colloque International Hippocratique veranstaltet von der Berliner Gesellschaft für Geschichte der Medizin in Verbindung mit dem Institut für Geschichte der Medizin der Freien Universität Berlin, 10.15.9. 1984* (Stuttgart 1989) 420-439; French, *Medicine before science*, 48-53. As we saw in the introduction, Banga accepted this interpretation of Hippocrates as well. See n. 27.

[413] Müller, *Iatromechanische Theorie*, 52.

[414] Johannes Heurnius, *Praxis medicinae nova ratio: qua, libris tribus methodi ad praxin medicam, aditus facillimus aperitur ad omnes morbos curandos. Recognita & emendata ab auctore, & auctior ac melior reddita Auctore Ioanne Heurnio Ultraiectino, professore medicinae* (Leiden 1587).

[415] Vivian Nutton, "Medicine in the age of Montaigne", in: Keith Cameron, ed., *Montaigne and his age* (Exeter 1981) 15-26, 163-170, specifically 21.

[416] Johannes Heurnius, *De medicinae origine, Aesculapidum ac Hippocratis stirpe & scriptis oratio* (Leiden 1608) 49. "Empirica secta iam facta cum homines rerum experientias causis firmare optarent, viderentque ignotis causis effectuum, etiam observationem minimè firmam esse, ad earum contemplationem inclinare coeperunt:

Heurnius then presented Galen as the person who had saved Hippocrates' medical doctrine from oblivion and rid it of the follies of the Empirics and Methodists.[417] Heurnius also distinguished between the "knowledge of herbs, rather a certain experience" of the Empirics and possessing "the art of healing".[418] The definition of medicine, which he provided in *Institutiones,* was very much in line with this view of medicine as an art. While medicine was an art, first and foremost, it possessed properties of both *scientia* and *ars*.[419] From reading *De medicinae origine*, it seems then that Heurnius' Hippocrates and his works on practical medicine were embedded in a Galenic view of proper medicine as an art.

French's idea that learned physicians needed a "good story" about the basis of their medical practice would in principle be applicable to Dutch physicians as much as to their English colleagues. In the story which Heurnius presented in *De medicinae origine*, the art of medicine did not depend so much on a specific piece of Galenic doctrine, as it was rooted in a long history and required contemplating the causes of natural occurrences in order to heal the body. This granted medicine a related, but different foundation from the one, which Heurnius had provided in his *Institutiones*. There he put forward particular, Galenic explanations, including for the operations of drugs.

We have already observed that these explanations were contested from different sides in the late sixteenth and early seventeenth century. However the medicine taught at Leiden in this period is characterised, as either practical or bound by theory, as Hippocratic or as Galenic, it seems that at least when it came to pharmacology, changes needed to be made.

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atque ita sensim rationalis Medicina subnasci coepit: quae fuit ante Hippocratem penes Cnidios, Rhodios, & Coos: cui splendorem, incrementum & maiestatem primus omnium afflavit Hippocrates, ac eam primus, dicit Galenus, apud Graecos in lucem protulit:..."

[417] Heurnius, *De medicinae origine* (Leiden 1608) 58, 59. "Ita doctrina Medica pene proiecta, & factionum contentionibus quasi exossata iacuit, ad Galeni usque tempora, qui Hippocraticam lucem à tenebris vindicavit, excussis Empiricorum & Methodicorum insaniis, quae nitore exsplendescentis veritatis ex animis & memoria hominum evanuere." "Galeno igitur debemus quòd genuína ab adulterinis dignoscimus, qui & menda scripturae emendavit, & quae fraude iminisa & quae Hippocrati consentânea demonstravit." In this, Heurnius followed Galen's account of events. cf. Vivian Nutton, *Ancient medicine* (London and New York 2004) 201.

[418] Ibid., 48. "Ante Empiricam conditam sectam, Graeci eos, qui hac arte excellebant, Deorum filios vocabant: qui profectò herbariam potius quandam experientiam habuisse videntur, quàm artem medendi."

[419] Heurnius, *Institutiones medicinae*, Lib. I, Chap II: "Medicina est ars, corporis humani vitia per adiectionem est abstractionem emendandi. Artem esse dicimus, quia multa ex artis natura mutuatur, alioqui mixtam esse facultatem dicere possumus ex scientia & arte. Pura enim scientia esse non potest, quoniam non omnia demonstrat sua, sed plurima levibus signaturis adsequitur, & signis T....Praeterea circa aeterna non versatur, sed quae conditia sunt & interitura. Praeterea quod principium suum non habeat in reipsa, nempè natura, sed aliquod eius principium in artifice est. Nec pura ars esse potest, quòd principium eius solum non consistat in artifice, sed partim quoque in natura. Praeterea quòd non sit purus habitus cum ratione aliquid faciendi, sed multae quoque contemplatione adsequitur. Artem tamen esse dicimus, quòd principium eius aliquod in artifice consistat, quòdque finem artis habeas, nempe opus. Sed cùm artes aliae sint factivae, aliae activae: inter factivas cum Galeno medicinam numeramos: ut que opus post actionem, hos est sanitatem relinquat."

Could physicians deal with these issues while preserving the idea of medicine as an art, which, as outlined by Heurnius, contemplated causes?

As discussed in the previous chapter, in the Republic the books of Fernel, Dodonaeus, Heurnius, Spigelius and Jacchaeus were reprinted up to the second half of the seventeenth century. From these reprints, we cannot tell how medical theory in general and pharmacology in particular changed in middle decades of the century. Nor can we consult records comparable to those of the Royal College of Physicians to ascertain this, since Dutch physicians did not organise themselves into a single elite society as the English physicians had. We will have to look at other sources to ascertain what changes occurred in pharmacology. If major changes did occur, we still cannot get a very clear idea of whether physicians in the Republic experienced a crisis such as the one French discussed and of whether it was such a crisis that induced them to develop medicine in this way, as French assumed.

Chapter 4

Medicine for a young Republic. The properties of drugs and the foundations of medicine (1600-1655)

Introduction

In the preceding two chapters, I have investigated how the properties of drugs were considered in sixteenth-century and early seventeenth-century academic medicine. I have examined the writings of several leading physicians whose work was studied at the University of Leiden. We have learned that discussions on the investigation of drug properties revolved around the question in what way reason and experience should be used to establish these properties. In some cases, these discussions explicitly addressed the distinct positions taken by Dioscorides and Galen regarding this question. Dioscorides was considered as the representative of the position that only experience should be used, whereas Galen represented the position that both reason and experience were required. Physicians like Fernel, Dodonaeus, Heurnius, Spigelius and Jacchaeus supported this last position. These physicians discussed the use of odour, touch, colour and taste to indicate the primary qualities of different materials, as a type of reasoning.

From considering Jachaeus' *Institutiones medicae* of 1624, it became clear however that the elaborate system of Galenic pharmacology that had been developed during the second half of the sixteenth century had become increasingly difficult to utilise in understanding the properties of medical materials. In the process, the properties of materials like opium became problematic. I argued that Van Helmont, an author with decidedly different ideas about the basic constituents of matter and its innate properties and about the composition and workings of the body, held a very similar opinion about the use of the senses in investigating drug properties to that of the Galenic physicians of his time. In this view the senses and especially taste could be used to some extent to identify the presence of a limited number of basic properties of matter in different materials. This use of the senses was thus tied in with a particular theory of matter.

In the following, I will examine how drug properties were considered in the period from the 1600s to about 1660. This is considered to be a period of great upheaval in the history of medicine, botany and philosophy. The investigation of drug properties was part of these changes, as the teachings of Fernel, Dodonaeus, Heurnius and Jacchaeus on this topic, were reinterpreted. In studying the sources, I have focused on tracking the fate of the *methodus medendi* and the role of pharmacology in it, rather than on developments in physiology, anatomy and physics.

From the previous chapters, we would expect to find discussions of the properties of drugs and how to investigate them in at least three places. For one, we would expect to find

them in the many herbals that were produced during the seventeenth century. Secondly, we would expect a discussion of the properties as part of writings about the *methodus medendi*, since according to Heurnius knowledge of these properties was central to this method of healing. Finally, we would presume such discussions to have taken place in the context of the public and academic gardens of the Dutch Republic instituted as they were for the education of future physicians and apothecaries. In the first intermezzo, some developments in this last area have already been discussed. Here, I will focus on the first two.

Dodonaeus' herbal according to the brothers Van Ravelingen

In 1608 and 1618, a Dutch translation of Dodonaeus' *Stirpium historiae pemptades sex* was published. The two brothers who translated and supplemented it, were Franciscus Raphelengius or Frans van Ravelingen Jr (1568-1643) and his younger brother Joost van Ravelingen (1573-1628). Both partly owned the Leiden branch of the Plantijn publishing house until 1618, when they decided to close down their business and sent almost all printing equipment to Antwerp.[420] Dodonaeus' herbal was last published in 1644 by Balthasar Moretus (1615-1674) in Antwerp. This was three years after Balthasar had taken charge of the Plantijn printing and publishing house following the death of his uncle.[421] This last publication was based on a 1618 edition, which had been annotated by Joost who was educated as a physician. On the basis of this fact and other arguments assembled by Isidoor Teirlinck, it is likely that Joost was the editor of Dodonaeus' herbal and author of its new address to the reader.[422] We can see that the author of the address had an outspoken opinion about how the properties of drugs should be investigated. This opinion differed slightly from that expressed by Dodonaeus in *Stirpium*. The brothers emphasised the discovery of new medicinal powers through experience and testing and the certainty of knowledge attained in this way compared to that attained by the use of reason.

The address to the reader of the 1608 edition appears to have been written by both brothers Van Ravelingen since the first pronoun plural "we" was used. The same address was

[420] Isidoor Teirlinck, "Joost van Ravelingen, botanist en dichter", *Verslagen en mededeelingen der koninklijke Vlaamsche academie voor taal en letterkunde* (Nov. 1913) 871-892, specifically 873-879; Paul G. Hoftijzer, "De houding van de Moretussen en de Van Ravelingens tegenover het Plantijnse erfgoed", in: Marcus de Schepper and Francine de Nave, eds., *De gulden passer. Ex officina Plantiniana Moretorum. Studies over het drukkersgeslacht Moretus* vol. 74 (Antwerpen 1996) 41-57, specifically 57.
[421] Rembertus Dodonaeus, *Cruydt-boeck Remberti Dodonaei: volghens sijne laetste verbeteringhe : met biivoeghsels achter elck capitel, uyt verscheyden cruydt-beschrijvers: item, in 't laetste een beschrijvinghe van de Indiaensche ghewassen, meest ghetrocken uyt de schriften van Carolus Clusius / nu wederom van nieuws oversien ende verbetert* (Leiden 1644); Leo Voet, "Het geslacht Moretus en de plantijnse drukkerij", in: De Schepper and De Nave, eds., *De gulden passer* vol. 74 (1996) 9-32, specifically 20; Hoftijzer, "De houding".
[422] Teirlinck, "Joost van Ravelingen", 873-879.

attached to the 1618 and to the 1644 editions and was now signed by Joost van Ravelingen (from Antwerp). In what follows, I will take the use of "we" in the address at face value and take both brothers as its authors. The brothers Van Ravelingen summarised the content of the book and the additions they had made.

What they found most important was matching plant names and their "powers and effects" with the correct description of the plants. In their view quite an elaborate discussion of the name of each plant was necessary because "in the books of Theophrastus, Dioscorides, Plinius, Apuleius, Macer and many others" only the names of the plants were given without a proper description "as if their essence was known to everyone, and being satisfied with only the story of their name, powers and effects or usefulness, left their descendants very insecure and doubtful." As such, one could not "guess, think or suspect which herbs they had meant or intended."[423] In this way, the editors place themselves in the tradition that stimulated the humanistic study of plants from the late fifteenth century by its focus on the issue of the correct identification of the plants whose medicinal properties was described in ancient and medieval medical texts.

It is interesting to note the authors who were mentioned by the editors of Dodonaeus' herbal here. They referred to works with no proper description of the plants, but only of their name, powers and effects or usefulness. In the second intermezzo, I showed that Theophrastus had actually done the opposite of what the editors of the *Cruydt-boeck* claim. His various works, including *Historia plantarum* (*Treatise on plants*) and *De causis plantarum* (*On the causes of plants*), barely contained anything about the "powers and effects or usefulness" of the many plants and substances he described. Dioscorides especially suited the ideal of the Van Ravelingens by providing descriptions of both the simples' appearances and names, and their medicinal properties. Plinius provided some descriptions of the plants he discussed in the twenty-seventh book (from chap. IIII) of *Naturalis historia*. Apuleius and Macer too included brief descriptions of the appearance of plants and their properties. These descriptions required readers to be familiar with the plants described. Communicating the acknowledged medicinal properties of plants to people speaking a different language, living in a different place or even in a different time, required a better description of their appearance.

[423] Dodonaeus, *Cruydt-boeck* (1608) *3v. "….: ende (dat het erghtste ende beklaeghlijckste van allen is) de Cruyden nerghens eyghentlijck en beschrijven, al oft hun wesen een ieder bekent waer gheweest; dan alleen met 't verhael van haer naemen, krachten ende werckinghen oft nuttigheden te vreden wesende, hun naekomelinghen heel onseker ende twijffelachtigh laten: 't welck in de boecken van Theophrastus, Dioscorides, Plinius, Apuleius, Macer ende meer andere al te dickwijls ghebeurt : sulcx datmen uyt heur woorden hedensdaechs niet gheramen, dencken oft bevroeyen en kan, welckerhande cruyden sy verstaen oft gemeynt moghen hebben."

One author who fits the description that the editors presented, is Galen. The descriptions of substances he provided in books six to eleven of his *De simplicium medicamentorum facultatibus*, lack any description of their appearance, yet he did discuss their other properties. This made the demonstration of living or freshly cut plants as additional information to this text, as initiated in sixteenth-century universities, especially appropriate. The brothers Van Ravelingen entirely omitted Galen's name, however, and they do not appear to have been concerned with any problems that understanding his writings produced.

The editors mentioned their own sources for the information they included about exotic herbs and drugs. Their primary aim to match the names and powers of the plants with a description of their appearance, was just as important for the study of these materials, as it was for the study of materials described in ancient and medieval texts. In the last book of the *Cruydt-boeck*, readers could find a description of foreign plants and drugs from Garcias ab Horto, Nicolaus Monardes and Christophorus a Costa. The address to the reader mentions that he or she could especially find "all the most certain that one has come to know up to now from the recently published writings of Carolus Clusius and some others about those strange herbs and drugs, that are currently used in and are very much esteemed and bought dearly in apothecary shops".[424] Many different drugs and herbs arrived daily from the Indies, the Van Ravelingens wrote, but these had not been included because their names and uses were not known yet. Those who sailed to foreign countries should pay more attention to these strange things and more thoroughly investigate their powers or names.[425] The editors thus encouraged an established practice of recording and enquiring about the local customs in the use of natural resources when visiting Africa, Asia and America. Clusius wished to foster the same practice with his *Memorie*. Several physicians and their patrons in the next generation took up this appeal.[426]

[424] Ibidem, *4v. "Beneffens al tvoorseyde/soo hebben in't laetste van dit Boeck gestelt een Beschrijving van de Indiaensche oft Uutlantsche Gewassen ende Drogen : ende aldaer hebben wij uut Garcias ab Horto, Nicolaus Monardes, Christophorus a Costa (somtijts oock uut den eersten oft ouden Duytschen ende franschen Druck van desen Cruydtboeck self) maer meest uut de onlancx in't licht gecomen schriften van Carolus Clusius/ende sommige ander/verhaelt al het sekerste datmen van die vreemde Cruyden ende Droghen/die hedensdaechs in de Apoteken gebruyct/seer geacht ende dier gecocht worden, tot nu toe heeft connen geweten: …."

[425] Ibidem, *4v. "..: daer toe zijn al daer veel ander min gebruyckelicke Indische cruyden beschreven/doch alleen de gene wiens naemen oft crachten eenichsins bekent zijn : want al ist sake datmen noch veel ende verscheyden ander drogen ende cruyden dagelijcx uut Indien ontfangt/nochtans om dies wille dat haer naemen ende nutticheden noch niet bekent en zijn/daerom en hebben wij de selve alhier geensins niet willen stellen/eensdeels om desen boeck met geen onnutte woorden te vullen/ende eensdeels om te betoonen/dat de gene die in vreemde landen plegen te vaeren/wat beter op de selve vreemdicheden behoorden te letten/ ende heur krachten oft naemen wat naerstichlijcker te ondersoecken….".

[426] Stephen Snelders, *Vrijbuiters van de heelkunde. Op zoek naar medische kennis in de tropen 1600-1800* (Amsterdam and Antwerpen 2012) particularly 59-60, 64, 70-94; Cook, *Matters of exchange*, 2, 174-225; Timothy D. Walker, "The medicine trade in the Portuguese atlantic world: acquisition and dissemination of

The Van Ravelingens reported that they had added "the powers, names and all accompanying things that Dodonaeus had not told about" to the description of each herb.[427] Amongst these things were "powers from various other Herb-describers: of which there are some that are not tried out as soundly or surely as those that Dodonaeus had held as good and credible in the Latin edition". In cases where the editors "cannot and do not want to ensure", they always mentioned the source of what they wrote. Nonetheless, whoever wanted "to use the herbs sensibly and carefully, would find many more other powers in the herbs".[428]

This approach to the gathering and acquisition of knowledge of the medicinal properties was in line with Dodonaeus' approach as the Van Ravelingen brothers presented it. According to them, Dodonaeus had only investigated the herbs empirically. They largely repeated Dodonaeus' own words in his letter of dedication to Maria of Hungary and Bohemia in the first edition of his herbal. Dodonaeus had "pulled and put together the nature and the power and effect of the useful and harmful herbs, from the oldest, best and most important Medicine-master." This is the only time they mention the fact that Dodonaeus had discussed not only the powers and effects of the plants, but also their nature. Furthermore, the Van Ravelingens expanded Dodonaeus' words, when he wrote about "certain experience of some herbs over long years".[429] In the words of the address, Dodonaeus had added what he had found "very certainly and unmistakably through diligent testing (*versoek*) and prolonged visiting of the sick in the use of herbs or what other credible men had discovered and made known to him."[430] They did not distinguish between the knowledge gained from what Dodonaeus had described as a trial and the knowledge based on extensive clinical experience.

The Van Ravelingens retained the first book of Dodonaeus' *Stirpium*, in which he had described the four kinds of faculties of *materia medica* and how they should be investigated.

healing knowledge from Brazil (c. 1580-1800)", *Social history of medicine* vol. 26, no. 3 (2013) 403-43, specifically 422; Heniger, "De eerste Nederlandse wetenschappelijke reis".

[427] Dodonaeus, *Cruydt-boeck* (1608) *4r.

[428] Ibidem, *4r-v. "Tot den Goetgunstigen Leser": "…ende daerom hebben wij daer noch sommighe ander crachten bij gevoegt/ uut verscheyden ander Cruydtbeschrijvers : van de welcke nochtans sommige zijn/ die soo vastelijck niet versocht/ oft soo seker niet en zijn als de gene die Dodonaeus selve in sijnen Latijnschen Cruydtboeck voor goet ende onbedriegelick gehouden heeft : doch in het gene dat ick niet versekeren en wil, noem ick altijt van wien ick dat hebbe/oft geef te kennen dat Sommige iet sulcx seggen oft schrijven. Niet te min /soo wie de cruyden met verstant ende voorsichticheyt gebruycken wil/ die sal niet alleen diergelijcke/maer oock veel meer andere crachten daer in bevinden."

[429] In the letter Dodoens referred to himself in the first person plural. Rembert Dodoens, *Cruydeboeck* (Antwerp 1554) *iij(r): "Ten laetsten zoo hebben wy die natuere/cracht/werckinghe/ende van den quaden cruyden die hindernisse ende beeteringhe / wt den alder outsten / besten ende vernaemsten Medecijnmeesters ende authueren ghetrocken/ende daer by ghevuecht/met dat van ons by sekere experientie van sommighen cruyden over langhe iaren ghevonden es gheweest/daer mede wy die historie van elck cruyt ghesloten ende volendt hebben."

[430] Dodonaeus, *Cruydt-boeck* (1608) *4r: "Ten sesten heeft hij de Nature oft Aert, ende daer nae de Cracht ende Wercking van de nutte ende schadelicke cruyden/ uit de alderoudste/beste/ ende vernaemste medicijnmeesters getrocken ende by een ghevoeght/ midtsgaders tgene dat hij door naerstich versoeck ende langdurich besoeck der crancken/ in 't gebruyck der Cruyden/ heel seker ende onbedriechlick gevonden heeft/oft dat ander geloofwaerdige mannen hem ontdect ende te kennen gegeven hebben."

Subtle changes were made to the text influencing the way readers would interpret this section of Dodonaeus' herbal. These changes reinforced Dodonaeus' reflections and his doubts about the reliability of reason. For example, the translator made *experientia* more explicit by rendering it as, "ervarentheyt en versoekinge", or "experience and trial". In the previous chapter, we saw that in his description of the tastes in *Stirpium*, Dodonaeus stated that the power of "most drugs" could be found without taste.[431] He also advised his readers always to appeal to experience even when a faculty was obtained through taste or reason, "since sometimes what reason approves, experience refutes".[432] In the translated text, the reference to taste and reason in this sentence was removed and a warning about the dangers of relying on only reason was added in the form of a skeptical argument. The section now reads as follows.

> Therefore one must always appeal to and follow [experience and trial] even though we had considered the power of a thing well known and understood. Since one has seen many times that there are many things that with all human reasons are considered and judged genuine, that are nonetheless found in trials and testing to be different, that is, harmful and bad. Such that reason, through frailty of the human mind, is so unreliable and deceptive that one ought not to build on it alone, without calling upon trial as a judge.[433]

This appears to be a faithful translation of Dodonaeus' text, since the editors refrained from putting these changes in italics or from inserting them as comments after Dodonaeus' own text. They did both these things in the layout of the main text, when they added to the plant descriptions. Through Van Ravelingens' edition, this slightly modified version of the

[431] Dodonaeus, *Cruydt-boeck* (1608) 20 . "Maer als dan komt ons de ervarentheydt ende versoekinghe te baet door de welcke alleen dickmael/sonder der onderkennisse vanden smaek/de kracht van 't meeste deel der gheneesdingen gevonden kan worden." Cf. Dodonaeus, *Stirpium* (1583[1]) 16 . "Atqui tunc quidem experientia succerrit, qua sola etiam, citra saporum dignotionem, medicamenti cuiusuis facultatas reperiri potest."
[432] Dodonaeus, *Stirpium* (1583[1]) 16. "Quam etiam semper adhibere convenit etiamsi gustu aut ratione facultas cognita videatur aut perspecta. Quandoque siquidem, quae ratio probavit, experientia redarguit."
[433] Dodonaeus, *Cruydt-boeck* (1608) 20. "Daerom moetmen de selve altijt tot ons roepen ende volghen/hoe wel ons dochte/dat wy de kracht van eenigh dingh wel bekent ende doorgront hadden: Aanghesien datmen dickwijls ghesien heeft dat vele dinghen by alle menschelijcke redenen goedt ende oprecht ghehouden ende gheoordeelt zijn/de welcke nochtans daer nae anders/dat is schadelijck ende quaedt/in't versoecken ende beproeven bevonden geweest zijn. Sulcks dat de reden/door de broosheydt des menschen verstands/soo ongewis ende bedrieghelijck is/datmen daer op alleen niet bouwen en magh/sonder de versoeckinghe daer toe/als eenen rechter/te roepen."

framework for drug properties, devised by sixteenth-century physicians, was introduced to a Dutch audience.

Finally, the emphasis the authors put on knowledge of the medicinal powers of plants is further confirmed by another addition to the herbal. In their address to the reader, the editors and translators wrote that they had included a register or table in which they had assembled of the *Kracht, Werckinghe ende Nuttigheydt oft Schadelijckheydt der Cruyden met de naemen der siecten ende gebreken des menschen lichaems tegen de welcke sy gebruyct mogen worden*, that is the "Power, Effects and Usefulness or Harmfulness of the Herbs with the names of the diseases and ailments of the human body against which they can be used". Neither Dodonaeus' earlier Dutch herbals or his *Stirpium* had included such a table.

It is interesting to compare this herbal with another less well-known herbal, which had been published after Dodonaeus' last Dutch herbal of 1563. Heyman Jacobs (?-1645) had created a "small herbal" directed at the daily use of common herbs and fruits to maintain health and cure all kinds of diseases. Many editions of this small herbal were published throughout the seventeenth century.[434] Its size and lack of illustrations obviously made it much cheaper than Dodonaeus' herbals. Whereas the Van Ravelingens had emphasised the importance of linking the name and medicinal properties of plants with a description of their appearance, Jacobs did not provide such descriptions, but only listed the plant's medicinal properties. And whereas the brothers were careful to explain the source of their knowledge and how reliable it was, Jacobs did not discuss this topic. In the second half of the century other herbals began to be published which superseded Dodonaeus'.[435] Their authors followed the example of Dodonaeus by adding information about the appearance of the plants and their names as well as describing the medicinal afflictions for which they were used. Interestingly, they did not discuss how this information was gathered, but it can be assumed that their

[434] Heyman Jacobs, *Den kleynen herbarius ofte kruydt boecxken: inhoudende de kracht ende operatie van ghemeene kruyden en bekende vruchten diemen dagelijcx gebruyct ... waer door men ... syn gesondtheydt mach onderhouden, ende allerhande siecten kan ghenesen* (Amsterdam 1602 or before, 1603, 1606, 1607, 1614, 1618, 1623, 1625, 1626, 1632, 1637, 1638, 1638, 1640, 1660, 1667, 1683, 1699).

[435] Pieter van Aengelen, *Herbarius kruyt en bloem-hof. Of de Natuerlijcke secreten en verborgentheden van besondere uytgelesene kruyden, boomen, bloemen, vruchten, wortelen, zaden, gommen, sappen ende mineralen der aerden. Als een extract uyt de alder vermaerste herbarien, kruyt en medecijn-boecken, in t kort by een vergadert en beschreven* (Amsterdam 1663); Petrus Nylandt, *De Nederlandtse herbarius, of kruydt-boeck, beschryvende de geslachten, gedaente, plaetse, tijt, oeffeninghe, aert, krachten, en medicinael gebruyck van allerhande boomen, heesteren, boom-gewassen, kruyden en planten, die in de Nederlanden gevonden worden, ende in de hoven onderhouden worden; alsmede de uytlandtsen of vreemde droogens, die gemeenlijck in de apothekers winckels gebruyckt worden. Uit verscheyde kruydt-beschrijvers tot nut van alle natuur-kunders, geneesmeesters, apothekers, chirurgijns en liefhebbers van kruyden en planten by een vergadert en beschreven* (Amsterdam 1670); Steven Blankaart, *Den Neder-landschen herbarius ofte kruid-boek der voornaamste kruiden, tot de medicyne, spysbereidingen en konstwerken dienstig, handelende van zommige hier te lande wassende boomen* (Amsterdam 1698).

sources were similar to those mentioned in the address to Dodonaeus' *Cruydt-boeck* by the Van Ravelingens.

Frans and Joost van Ravelingen left out any mention of Dodonaeus' efforts to understand the relationships between the medicinal properties of plants and the investigation of these through reason and the senses. They invited readers to add to the knowledge of the properties of plants in the same way as physicians did. That is by "sensible and careful" repeated use and by experience and trial. Those who knew and could distinguish all illnesses and ailments and knew the nature of the human body, they added, could benefit from the herbs discussed in the register they had added to the book.[436] As such, they narrowed the gap between the knowledge of physicians and of well-informed and considerate medical practitioners and patients. One physician in the Republic in particular would take advantage of the room the Van Ravelingens left for medical practitioners like him, to claim a privileged position for academic physicians in prescribing drugs.

Johan van Beverwijck (1594-1647)

Johan van Beverwijck addressed the elite citizens of the newly established Republic when, from the 1630s onwards, he presented a kind of medicine that would make him well-known figure in the Dutch Republic. He himself, both a practicing physician and a public servant in his native town of Dordrecht, was clearly a member of this elite group of citizens by birth, education and later occupation. Van Beverwijck settled in Dordrecht in 1618, established a thriving medical practice, and six years later became city doctor. Among his other offices were administrator of the city library, curator of the Latin school, orphan master, lector of anatomy for the surgeons' guild, alderman of the city and member of the States of Holland, which governed the province of Holland and sent representatives to the States General of the Republic gathered in The Hague. Van Beverwijck had studied at the Latin school of the city, taking classes in rhetoric by Gerardus Vossius (1577-1649), before studying medicine in Leiden and Padua, where he obtained his medical degree in 1616.[437]

[436] Dodonaeus, *Cruydt-boeck*, (1608) *4v: "Voorts/ om de Cruydtbeminners noch meer te helpen/ naemetlick in t'gene waerom de Cruyden meest gesocht ende geacht worden/soo hebben wy de Crachten/Nutticheden ende oock Schadelickheden der Cruyden/ by een versamelt/ende in een seer groot Register oft Tafel gestelt/ op dat de gene die alle siecten ende gebreken genoechsaem kennen ende onderscheyden/ ende den aert des menschen lichaems wel weten/ eenige baet/troost ende hulp van de Cruyden mogen genieten/…"

[437] Lia van Gemert, "Johan van Beverwijck als instituut", *De zeventiende eeuw* vol. 8 (1992) 99-106, specifically 99; Erik D. Baumann, *Johan van Beverwijck in leven en werken geschetst* (Amsterdam 1910) 1-2, 16, 24-24, 35-37.

Van Beverwijck has been described by historians as an "institution" and as "the medical *vade mecum* of the Golden Age". They have described how Van Beverwijck became the best-known physician of his time. He gained his reputation for medical advice in the Dutch Republic mainly with two books written in Dutch and printed relatively late in life; *Schat der gesontheyt* (Treasure of health) (1636[1]) and *Schat der ongesontheyt, ofte Genees-konste van de sieckten* (Treasure of unhealthiness, or Healing art of diseases) (1641-1642[1]).[438] New editions of these publications were printed many times throughout the seventeenth century and it is these publications that have received most attention in the historical literature.

Van Beverwijck published some of his works in both Latin and Dutch. In 1633 for example, *Medicinae encomium: eiusdem Montanus elegchomenos sive refutatio argumentorum quibus necessitatem medicinae*, which consisted of two texts, was published. Two years later, the first part, *Medicinae encomium sive oratio de laude Medicinae habita in ill. Dordrechtanorum Gymnasio*, was reprinted as *Lof der medicine* (Praise of medicine), while a Dutch translation of *Montanus elegchomenos* appeared as *Bergh-val, ofte Wederlegginge van Michiel de Montaigne, tegens de nootsakelickheyt der genees-konste* together with *Praise of medicine, or the art of healing* in 1641.[439] Another example of an earlier Latin work is *Idea medicinae veterum*, which was published only once in 1637 and never translated into Dutch. Historian Baumann has assembled some evidence that scholars in and outside of the Republic knew Van Beverwijck best for this tract and another one, published a year later, about kidney and bladder stones.[440]

A closer look at these less well-known publications will provide some context for his much better known *Schat der ongesontheyt* and *Schat der gesontheyt*. From studying both these Latin and Dutch texts, we can learn how Van Beverwijck positioned learned medicine in contemporary debates about medicine's philosophical foundations and what role

[438] Baumann, *Johan van Beverwijck*, 189, 219; Anthonie Stolk, *Johan van Beverwyck, de medische vraagbaak van de Gouden Eeuw; zijn werk en zijn tijd* (Amsterdam 1973); Lia van Gemert, *De schat der gezondheid, ziekte en genezing in de Gouden Eeuw: bloemlezing uit het werk van de Dordtse arts Johan van Beverwijck* (Amsterdam 1992); Van Gemert, "Johan van Beverwijck", 99-106; Johan van Beverwijck, *Schat der gesontheyt* (Dordecht 1636); Johan van Beverwijck, *Schat der ongesontheyt, ofte Genees-konste van de sieckten* (Dordrecht 1641-1642[1]).

[439] Johan van Beverwijck, *Medicinae encomium: eiusdem Montanus elegchomenos sive refutatio argumentorum quibus necessitatem medicinae* (Dordrecht 1633); Johan van Beverwyck, *Lof der medicine, eertijts in Latijn gemaeckt, ende nu eerst in onse tale overgeset* (Dordrecht 1635); Johan van Beverwijck, *Lof der medicine, ofte Genees-konste* and *Bergh-val, ofte Wederlegginge van Michiel de Montaigne, tegens de nootsakelickheyt der genees-konste* (Dordrecht 1641, 1642, 1644). And several times thereafter from 1652 as part of an *opera omnia* called *Alle de wercken, soo in de medecyne als chirurgye* (Amsterdam 1652).

[440] Baumann, *Johan van Beverwijck*, 147-148; Johan van Beverwijck, *Idea medicinae veterum* (Leiden 1637); Johan van Beverwijck, *De calcvlo renum & vesicæ liber singularis, cum epistolis et consultationibus magnorum virorum* (Leiden 1638).

knowledge of drug properties played in establishing this position. Did he confront the issues that Fernel, Dodonaeus, Heurnius, Spigelius and Jacchaeus had encountered in the investigation of drug properties?

Van Beverwijck's response to Michel Eyquem de Montaigne (1533-1592)

Van Beverwijck self-consciously presented himself as a defender of learned medicine in *Medicinae encomium: eiusdem Montanus elegchomenos*, which was he first publication since establishing himself as a physician in Dordrecht.[441] G.G. Ellerbroek gave an account of the 1660 edition of the text in which Van Beverwijck defended medicine against the doubts Montaigne had expressed in his essay *De la ressemblance des enfants aux pères* about the necessity of the art of medicine and about consulting physicians.[442] Van Beverwijck divided the essay into twenty-seven parts, rendered a faithful translation of them and commented on each, leaving out the first pages, which did not concern medicine.[443]

Vivian Nutton has written about Montaigne's point of view on medicine and indicated that his dislike of medicine can be traced to Pliny's criticism of Greek physicians, but was also grounded in handbooks of medicine for the layman.[444] Elsewhere, Nutton expressed his intention to prepare a longer article on the controversy between Montaigne and Van Beverwijck, which would "resolve the bibliographical problems and set the debate in context."[445] One bibliographical problem Nutton referred to, is that between the first, Latin edition of 1633, and the second, Dutch edition of 1641, Van Beverwijck had greatly revised the original text and extended it.[446] The Latin version takes the shape of a letter addressed to

[441] Johan van Beverwijck, *Medicinae encomium: eiusdem Montanus elegchomenos sive refutatio argumentorum quibus necessitatem medicinae* (Dordrecht 1633); Idem, *Lof der medicine* (Dordrecht 1635); republished in 1641 as *Lof der medicine, ofte Genees-konste* together with *Bergh-val, ofte Wederlegginge van Michiel de Montaigne, tegens de nootsakelickheyt der genees-konste*.
[442] Michel de Montaigne, *Les essais* (Bordeaux 1580[1]) pt. 2, chap. 37. Montaigne wrote *De la ressemblance des enfants aux pères* between 1579 and the first months of 1580. Cf. e.g. Andrea Carolino, "Affliction and skepticism: Montaigne and anti-medical literature", *Medicina nei secoli* vol. 14 no. 2 (2002) 479-97.
[443] G.G. Ellerbroek, "Un adversaire hollandais de Montaigne: Johan van Beverwijck", *Neophilologus* vol. 31 no. 1 (1947) 2-8, specifically 3, 4; Johan van Beverwijck, *Alle wercken zo in de medicijne als chirurgie van de heer Ioan van Beverwijck* (Amsterdam 1660).
[444] Vivian Nutton, "Lay attitudes to medicine in classical Antiquity", in: Roy Porter, ed., *Patients and practitioners: lay perceptions of medicine in pre-industrial society* (Cambridge 1985) 51-53.
[445] Nutton, "Medicine", in: Cameron, ed., *Montaigne and his age*, 170 n. 64; Nutton did some more research on this issue, some of which was published in: Nutton, "Lay attitudes", 51-53.
[446] Van Beverwijck himself did not mention this earlier Latin edition in *Bergh-val*, but wrote that the latter was written earlier for the late Adriaan van Blyenborgh in Latin. Van Beverwijck, *Bergh-val*, 40. Baumann noted the existence of these two different versions of "Montaignes wederleyt" and discussed the last work in general terms. Baumann, *Johan van Beverwijck*, 31-33, 56-57. To Albert J.J. van de Velde the two versions appear the same, "Bio-bibliographische aanteekeningen over Johan van Beverwijck (1594 † 1647)", in: *Verslagen en meededeelingen der koninklijke vlaamsche academie voor taal-en letterkunde* (Feb.-Mar. 1933) 71-121, specifically 73, 81-82.

Jacobus Crucius (1579-1655) and did not include the text of Montaigne's essay and so Van Beverwijck did not go into each section separately. In 1641, Van Beverwijck could also refer to his *Treasure of health* (1637) and his *Treasure of unhealthiness* (1641).[447] From these references in *Bergh-val* we can draw an idea of why he chose to write books on these subjects in the way he did between the first publication of *Montanus elegchomenos* and *Bergh-val*.

The genre of the essay and the kind of topics Montaigne brought up, left much room for Van Beverwijck to demonstrate his reasoning skills and erudition. It was also ideal for conveying the importance not of a specific kind of learned medicine, but of humanistic and medical learning in general. This message was in line with the treatise it was always published with, Van Beverwijck's *Praise of medicine*, which originated as an oration held at his *alma mater* in Dordrecht, where he had been curator since 1631. The importance of Van Beverwijck's training in rhetoric clearly shines through in this oration. Its reprints from 1644 and 1665 show some elements of the tradition in which it can be situated.[448] Both publications by Rotterdam printer Arnold Leers (1616-1673), collated it with similar ones by Erasmus (*Declamatio in laudem artis medicae* (1518[1])), Gerolamo Cardanus (*Medicinae encomium* (1599)) and Melanchton (*De arte medica sive de honore habendo corporis nostris* perhaps written in 1526).[449] Vossius already mentioned these authors in his prefatory text to *Medicinae encomium*.[450]

In both *Medicinae encomium* and *Montanus elegchomenos*, Van Beverwijck fostered and made use of an existing tradition in which medicine was defended and disputed. Later, in *Bergh-val*, he referred to a long tradition in which Hippocrates and Galen had been followed "by all people of intellect". With these two "chieftains", the healing art had been established by reason, and afterwards strengthened by experience and accepted by the judgment of learned men during many centuries. The objections that had been made, had been easily refuted according to Van Beverwijck. Those who dismissed the healing art had no reason, he wrote.[451]

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[447] Van Beverwijck, *Bergh-val*, 49, 71, 81, 98, 118, 136, 145.
[448] Johan van Beverwijck, *Epistolicae quaestiones, cum doctorum responsis accedit ejusdem, nec non Erasmi, Cardani, Melanchthonis, Medicinae encomium* (Rotterdam 1644) also under just *Medicinae encomium* (Rotterdam 1644) and Johan van Beverwijck, Desiderius Erasmus, Gerolamo Cardano and Philipp Melanchthon, *Encomia medicinae* (Rotterdam 1665).
[449] About the orations of Cardanus and Melanchton and medical orations of this period in general, see Siraisi, *History*, 113-118, 165-166; About these publications see also, Vivian Nutton, "Lay attitudes to medicine in classical Antiquity", in: Roy Porter, ed., *Patients and practitioners: lay perceptions of medicine in pre-industrial society* (Cambridge 1985) 51, n. 93 and 94.
[450] Van Beverwijck, *Medicinae encomium* (1633). The prefatory text did not contain page numbers or collation signs.
[451] Van Beverwijck, *Bergh-val*, 112.

He referred to the same long tradition to counter Montaigne's appeal to the uncertainty of the mind to find the right cures.[452] Van Beverwijck started his defense in *Bergh-val* with a letter to a fellow alderman and physician in Dordrecht, Dr Cornelis Van Someren (1593-1649).[453] The first line refers to the medical training they had in common:

> The prince and chieftain of our order, Hippocrates, writes, in his book about the art, with true words, that some people can be found, that make it an art to despise the arts and sciences and that such [people] do not affect what they intend, but in this only show their wisdom (or much rather their unwisdom).[454]

Van Beverwijck counted Montaigne among such people. Indeed, Montaigne conveyed his skeptical point of view when writing in his essay: "I mistrust the findings of our mind, of our sciences and arts".[455]

In the letter to Van Someren, Van Beverwijck explained how he had come to write this defense. He mentioned that up to that point no one had written against Montaigne and that his writings were much read in their country.[456] He reported that their friend and fellow knight in the order of Saint Michael with Montaigne, the late Adriaan van Blyenborgh (1589-1630), had read his book of essays many times.[457] Many had esteemed the book greatly and had praised it into the heavens. It was far beyond his intellect to judge the writings of such an outstanding gentleman, Van Beverwijck continued, yet he could not have a high regard for what Montaigne had written, "from an inborn hatred", against the necessity of the healing art. Since men were never more sensitive than when it affected their purse, he had thought it well to argue on behalf of the art from which both he and Van Someren had profited. Van Blyenborgh had enjoyed the trifles Van Beverwijck had hastily put to paper in Latin, in order to read them to him when he was suffering from kidney stones.[458] In his letter to Van Someren, Van Beverwijck thus told his readers that of course as a pastime it was enjoyable to

[452] Ibid., 56.
[453] Baumann, *Johan van Beverwijck*, 22-23.
[454] Van Beverwijck, *Bergh-val*, 39; Van Beverwijck referred to the pseudo-Hippocratic treatise *On the art of medicine*, which was actually a sophist text from the fifth century BC. Joel E. Mann, *Hippocrates, On the art of medicine* (Leiden etc. 2012). It was included as a Hippocratic text in Johannes Heurnius' *Hippocratis Coi Prolegomena, et prognosticorvm libri tres: cum paraphrastica versione & brevibus commentariis Iohannis Heurnii Ultraiectini* (Leiden 1597).
[455] Ibidem, 56.
[456] For a view on the Dutch responses to Montaigne's work in this period see, Paul J. Smith and Karl A.E. Enenkel, eds., *Montaigne and the low countries* (1580-1700) (Leiden 2007).
[457] Van Beverwijck, *Bergh-val*, 39.
[458] Ibid., 40.

think about the topics Montaigne had discussed, but that it was foolish to agree with the Frenchman and not value the arts and sciences.

Montaigne did not argue against particular tenets of learned medicine in *De la ressemblance* and did not put forward an alternative system of medicine. He mainly questioned the usefulness of learned medicine in general and focused on the use of drugs. His line of reasoning went two ways. For one, using drugs was often not necessary. Montaigne argued that the redundancy of using drugs was proved by the fact that his father, grandfather and great-grandfather had died at a very old age without using them.[459] According to Van Beverwijck, Hippocrates had already refuted this argument. People of a strong constitution, which they supported with a sober and well-considered way of living, could indeed do without drugs. He had set out these parts of medicine called hygiene and dietetics in his *Treasure of health*.[460] Montaigne also suggested that it was better to rely on the natural healing capacity of the body to cure a disease and not use drugs.[461] Van Beverwijck conceded this point, but argued that the body was not strong enough to cure all diseases.[462]

The second point of contention in Montaigne's essay was whether it was any use to consult a physician if one did want to take drugs. Margaret Brunyate has carefully assessed Montaigne's position on medicine and health care. She has pointed out that Montaigne was "not entirely skeptical about the efficacy of certain types of treatment for medical conditions" and did consult physicians himself. But she also reported "his glee and his underlying confidence in his own therapeutics", indicating the writings of Hippocrates as the source of his medical ideas.[463] Consulting a physician was not necessary, Montaigne argued in *De la ressemblance des enfants aux pères*

In *Bergh-val*, Van Beverwijck made a special effort to show that it was. He acknowledged that Montaigne did not deny that the art of healing could exist, or that herbs had medicinal powers. Indeed, how could he, since "daily experience" and Scripture taught that medicine came from "the highest"?[464] The success of treatments prescribed by physicians did not depend on good fortune as Montaigne had claimed. In the art of healing, diseases were cured "by the capable administration of drugs, which did not depend on precarious fortune but depended on learning and the judgment of the agile healing-master" and "by solid science". Someone who did not have complete knowledge of the art shot blindly and if he did hit his

[459] Ibid., 47.
[460] Ibid., 46-51.
[461] Ibid., 55.
[462] Ibid., 57-58.
[463] Margaret Brunyate, "Montaigne and medicine", in: Keith Cameron, ed., *Montaigne and his age* (Exeter 1981) 27-38, there 30, 33-35; Van Beverwijck, *Bergh-val*, 55.
[464] Van Beverwijck, *Bergh-val*, 56.

target this was accidental. A happy outcome could be expected when the "healing-master" had complete knowledge of the nature of disease, and of drugs, and administers drugs "in the right place, time, order and according to the principles of the art".[465] Van Beverwijck thus repeated the ideal of the *methodus medendi*.

The Galenic understanding of the properties of drugs that was central to the *methodus medendi* was vulnerable to Montaigne's criticism. Section 20 of *Bergh-val* was especially significant for Van Beverwijck's argument that the knowledge of drugs of physicians was superior to that of ordinary patients. In *Treasure of unhealthiness*, Van Beverwijck referred to his defense against Montaigne in this section.[466] Montaigne expressed his incredulity at the claim of physicians that they could cure several and contradictory afflictions at the same time through the contradictory properties present in compound drugs. He gave examples of the kind of claims physicians made about the properties of drugs.[467] Van Beverwijck's defense was particularly long. First, he corrected the diagnosis of Montaigne's hypothetical physician and argued that the afflictions, which the physician should have diagnosed, were not contradictory.[468] Then he simply affirmed the claim, which Montaigne found incredible, that drugs had properties that enabled them to work on different parts of the body and on different bodily fluids. He added several examples of simples that helped one organ, but negatively affected another. These hidden properties had been granted by God and were attested by experience. Referring to Galen, Van Beverwijck argued that a physician should not just have knowledge of the "general nature of things" and "the powers of the various *Hoedanigheden*" or capacities, but also of hidden properties.[469]

He then argued that this was the reason why it was dangerous to base curing on herbals. These books, Van Beverwijck wrote, praised the use of pretty much all the herbs they described against several afflictions. They mistakenly did not "move beyond the public capacities of the natural things". They ignored their hidden properties of which apparently physicians were aware. It was a difficult argument to make. Van Beverwijck had to maintain the same balance as his teachers had. Resorting to occult properties solved the problem of specific and conflicting drug properties, but, as Van Beverwijck also pointed out, those who explained everything from the hidden properties and used them without distinction to various

[465] Ibid., 51-55.
[466] Van Beverwijck, *Schat der ongesontheyt* (1651) (c) 3 v .
[467] Van Beverwijck, *Bergh-val*, 124.
[468] Ibid., 124-126.
[469] Ibid., 127-130.

diseases should not be believed.[470] Presumably, only physicians could tell the difference between genuine occult properties and spurious ones.

Van Beverwijck showed this specialist knowledge of drugs elsewhere in *Bergh-val* as well. Montaigne told the story of the bad influence a physician had had on an isolated community that lived in the valley of Angrogna when he had advised them to use "strange mixtures" instead of the garlic they had been using.[471] Van Beverwijck gave an extensive exposition of the beneficial properties of garlic and the proper way of using it according to Galen. In other words, a proper physician would have given no such advice to the people in Montaigne's story and actually would know more about the properties of simples than an uneducated person. He concluded his exposition with a reference to chapter four of the third book of part one of *Treasure of unhealthiness*.[472] The Dutch translation of *Montanus elegchomenos* referred to *Treasure of unhealthiness* several other times. In the sixth chapter of the first part of *Treasure*, for instance, Van Beverwijck showed why one sometimes had to use compound drugs in contrast to Montaigne's insistence on only using simples. In *Treasure*'s second part, he discussed how to carefully cure dysentery.[473]

Treasure of health and *Treasure of unhealthiness* appear to be the answer to two main objections of Montaigne against the usefulness of consulting a physician and which Van Beverwijck attempted to refute in *Bergh-val*. Van Beverwijck was strikingly open about the fact that the healing art needed defending, not against competing medical theories, but against the critical and skeptical attitude of a knowledgeable patient like Montaigne. By writing these texts in Dutch, he provided a version of learned medicine that met with the concerns of a lay audience, as he perceived them.

While Montaigne repeatedly insisted on relying on his own personal experiences, Van Beverwijck put forward that this was not enough to build a reliable medical practice.[474] He did not have to argue with Montaigne on issues that directly concerned the basis of the art of healing in physics, physiology or anatomy. But he did argue that the knowledge of physicians about drugs depended on their specialist knowledge of different afflictions and of how drugs interacted with the body and its various parts. We will examine how Van Beverwijck presented medicine in his *Treasure of unhealthiness*, but let us first look briefly at a work

[470] Ibid., 128-130.
[471] The valley of Angrogna in Piedmont was an important centre of the Waldensian church. Apparently, Montaigne remembered the community there as having possessed its own tradition of medical practices.
[472] Van Beverwijck, *Bergh-val*, 141-145.
[473] Ibid., 118, 136.
[474] Ibid., 47, 50, 55, 58, 122.

published only once between the Latin and the Dutch edition of *Montanus elegchomenos*. What does this work tell us about how Van Beverwijck positioned medicine?

Methodus medendi in *Idea medicinae veterum* (1637)

In his 1637 publication *Idea medicinae veterum*, Van Beverwijck addressed the same audience as in *Medicinae encomium* and *Montanus elegchomenos*: the well-educated elite of the Republic with an interest in history and eloquence as much as in medicine. He did not explain what the occasion was for composing the book as he had done in *Bergh-val*. We can tell however that he had the same audience in mind by, of course, the Latin in which he wrote the book, but also by looking at its content.

The set-up of *Idea medicinae* is curious because of the many citations of many different authors.[475] The book was about the idea of medicine of the ancients, but not of all ancients. In the dedicatory letter addressed to Adolphus Vorstius, whom we encountered in the first intermezzo, Van Beverwijck explained that he focused on non-medical authors:

> Rarely have I drawn something from Hippocrates, Galen, or Celsus; but not unless it was associated with others, or made these particularly clear. Concerning recent authors what is said [that is, he used recent medical authors in the same way as ancient medical authors]. In this way the idea of medicine of the ancients was born from non-physicians.

He explained that the "idea of medicine of the ancient" encompassed all parts of the medical art and represented "whatsoever was believed in former times by individuals".[476] By inserting a quote from Cicero, he argued that these individuals spoke about what "many nations" agreed

[475] Baumann quoted a letter from René Moreau (1587-1656) to Van Beverwijck, in which Moreau also noted its "wonderlijcke t'samensettinge". Baumann, *Johan van Beverwijck*, 147-148. Moreau himself apparently also "ingeniously planned an extremely subtle and elaborate history of the whole of medicine". Moreau did indeed write histories of the Medieval school of Salerno (published in 1625) and of early sixteenth-century faculty of medicine in Paris. See Siraisi, *History*, 128-129. *Idea medicinae veterum* provides a particularly good example of the use of commonplace books in the construction of an argument. Van Beverwijck made much use of citations in *Inleidinge tot de Hollantsche geneesmiddelen ofte korte bericht. Dat elck landt genoegh heeft, tot onderhoudt van het leven, ende de gesontheyt der inwoonders* (Amsterdam 1642[1]) as well. Cooper, *Inventing the indigenous*, 43.

[476] Van Beverwijck, *Idea medicinae veterum*, *3r-v: Epistola dedicatoria: "Raro ex Hippocrate, Galeno, vel Celso quid adduxi; nec nisi cum reliquis affine esset, aut iis illustrandis magnopere faceret. Quod & de recentioribus dictum sit. Ita nata ex non medicis Idea Medicinae veterum; quam hoc nomine donavi, quod nulla artis parte omissa, referat quicquid de singulis antiquitis creditum sit."

on.[477] Cicero (106 BC–43 BC) was amongst those most often quoted of the ancient authors. As C.B. Schmitt wrote, "For thinkers of the period, whatever Cicero had written was worthy of serious consideration".[478]

The quoted authors can be found in the *Index authorum* attached to it and preceding the *Index rerum*. Hundred-thirty-seven ancient and thirty-six modern authors were cited. Amongst them are a number of Dutch humanistic scholars, Caspar Barlaeus (1584–1648), Hugo Grotius (1583–1645), Daniel Heinsius (1580–1655) and Vossius. Van Beverwijck thus presented an ancient idea of medicine that did not originate from physicians, but was widely held by non-medical authors. The authority of their opinions about medicine could therefore exist independently of those of physicians.

Historians Jon Arrizabalaga, John Henderson and Roger French distinguished three reasons for physicians, "from the Greeks to the enlightenment", to write about the history of medicine. The first one was "to enhance the dignity of their profession by giving it a distinguished ancestry." The second and related tactic was "to seek credibility for novel systems by claiming that the ancients knew something of them." The third reason was "to improve directly their own knowledge of medicine and therefore its practice."

The first of these reasons was clearly in play in *Medicinae encomium: eiusdem Montanus elegchomenos* and in *Idea medicinae veterum*.[479] In the composition of the later text, Van Beverwijck seems to have sought to enhance the dignity of his profession not just by providing it with a distinguished ancestry, but also an ancestry outside of the strictly medical community. He offered readers from the educated citizen elite an example, primarily based in Antiquity, with which they already had an affinity, on which they could based their own idea of medicine.

The second reason mentioned by Arrizabalaga, Henderson and French seems to have played a part in the composition of *Idea medicinae* as well, as Van Beverwijck presented a particular idea of medicine through citing these non-medical authors. A quite considerable book of three hundred ninety pages, *Idea medicinae* consisted of four parts giving an overview of medicine somewhat differently in form from the textbooks used in Leiden.

The first part was a preface in which Van Beverwijck described medicine, its origin, definition, subject, goal and its subtopics. The second part, entitled physiology, comprised the

[477] Ibidem, *3v. "Summae enim authoritatis esse debet, in quod uno ore plurimae consentiunt gentes, & qui in iis ingenio & doctrina maximè excellunt."
[478] Charles B. Schmitt, *Cicero* scepticus*. A study of the influence of the* Academica *in the Renaissance* (The Hague 1972) 165.
[479] Jon Arrizabalaga, John Henderson and Roger French, *The great pox. The French disease in Renaissance Europe* (New Haven and London 1997) 3.

nature of different parts of the human body and their functions, and the elements, especially heat and cold. In this structure, Van Beverwijck deviated from the *Institutiones* written and taught by his professors, since these textbooks did not include anatomy and started with the elements. *Idea* provided a detailed description of the anatomy of the sensory organs, without describing how they worked to fulfill the functions they were best known for. For example, he described the mouth and tongue as the places where flavor was perceived, but not these flavors themselves and what use they were for gaining knowledge of the material that was tasted.[480] In this regards too, Van Beverwijck handled the topic of taste in a different way than his teachers in Leiden had.

The third part of *Idea medicinae* related to diet or the six non-naturals and to what extent they influenced health and caused diseases. The fourth and last part concerned the diagnosis and cure of diseases. It contained a book on the diagnostic signs and one on therapy or the general *methodus medendi*. This last book started with a discussion of the proposition that the perfect physician connected experience with learning, before moving on to describe the treatment of various diseases according to the "right way of curing".[481] Thus, although he discussed the *methodus medendi*, pharmacology, which was a central part of that *methodus medendi* in the textbooks of Heurnius and Jacchaeus, was not present in the *Idea medicinae*. Van Beverwijck discussed neither the different kinds of drug properties nor how they should be investigated.

These omissions are difficult to explain and conclusions cannot be drawn from them. Van Beverwijck had much freedom over what topics he included in *Idea medicinae*, but was perhaps also restricted because only medical authors had closely considered pharmacology and the role of taste in medicine. It seems however that the idea of medicine, that Van Beverwijck wanted to present, including a method of healing, could be valid without a consideration of these topics. By considering two other works by Van Beverwijck, we can observe how he further rearranged aspects of discussion of drug properties, as presented by the sixteenth-century authors discussed in the previous two chapters. They had consistently tried to investigate the relationships between the method of curing, the primary qualities, tastes, the faculties of simple drugs through experience and reason. These topics were discussed separately from each other in Van Beverwijck's works.

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[480] Van Beverwijck, *Idea medicinae veterum*, 47-50. "Iam gustatus, qui sentire eorum quibus vescimur, genera debet, habitat in ea parte oris, qua esculentis ac poculentis iter natura patefecit." "Gustatus praeclarè septus est. ore enim continetur, & ad usum aptè, & ad incolumitatis custodiam. Omnisque sensus hominum multò antecellit sensibus bestiarum." "Nariumque item & gustandi & apertè tangendi magna judicia sunt: ad quos sensus capiendos & perfruendos plures etiam quam vellem artes repertae sunt. Perspicuum est enim, quò compositiones unguentorum, quò ciborum conditiones, quò corporum lenocinia processerint."

[481] Ibid., 167-168. "Experientam eruditioni conjunctam perfectum reddere Medicum", "Recta medendi ratio".

Drug properties in *Treasure of unhealthiness* (1641-1642)

The subtitle of *Treasure of unhealthiness* summarised its content as, "the powers of the means by which unhealthiness is averted".[482] In the first of the its two books, Van Beverwijck focused on describing the different forms of diagnosis, surgical procedures and the different types of drugs available. In the second he focused on the treatment of various common afflictions and diseases. The treatments discussed in *Treasure of unhealthiness* were very traditional. Nonetheless, it is striking that Van Beverwijck, on the one hand, left out some things that learned Dutch physicians of the previous generation had found important and elaborated on, and on the other hand, brought up some subjects they had hardly mentioned. In so doing, he developed learned medicine in a particular direction. As in *Bergh-val*, this learned medicine emphasised the expert knowledge of the physician of the properties of drugs and his ability to decide when to prescribe them and in what amount. Van Beverwijck warned against the danger of applying drugs imprudently, which he encountered daily amongst the most *verstandige* or sensible health care providers.

> Because I understand something of the Art, I also know the danger of administering drugs without complete knowledge. Such I experience also daily amongst the most sensible healing-masters and apothecaries. [483]

Almost at the start of the first book, Van Beverwijck championed reason, contrary to the doubts expressed in the Van Ravelingen editions of Dodonaeus. He emphasised that man, gifted with a reasonable soul "by the benevolent God", had found it necessary to discover, "through his intellect and ingenuity", an art with which health could be preserved and restored.[484]

He largely repeated the story about the origin and history of the art of healing told by Heurnius in his oration. The art had originated in experience. However, "ingenious and inquisitive" people had sought to strengthen *Bevindinge* or experience with "her causes", since without the causes the outcome was treacherous. Chief amongst these people was

[482] "Aenwijsende. De kracht der middelen; door de welcke de ongesontheyt geweert wert."
[483] Van Beverwijck, *Schat der ongesontheyt* (1644) *6v. "Dewijl ick van de Konste wat verstae, soo weet ick oock wat gevaer het loopt sonder volkomen kennisse eenige Genees-middelen in te geven. Diergelijcke werdervaert mij oock dagelijcx onder de verstandighste Heel-meesters, ende Apothekers."
It is ambivalent here, whether van Beverwijck's experience told him that these healing-masters and apothecaries administered drugs imprudently, or whether they agreed about the danger of such an action.
[484] Ibid., 5. "Derhalven is de Mensche, van den goedertieren Godt, met een Redelijcke Ziele begaeft zijnde, genootsaekt geweest, door sijn verstant, ende vernuft, een konste op te speuren, waer door hy sijn tegenwoordige Gesontheyt mocht bewaren, ende die, by ongeluck, ofte versuym verloren hebbende, wederom bekomen."

Hippocrates. After being weakened in the time of the first emperors, his teachings had recovered under the direction of Galen, who had brought to light the dated and obscure books of Hippocrates through his learned exegeses and through his writings had enforced the "reason-giving teachings" and given them solid foundations.[485]

Van Beverwijck concluded that medicine must be based on both experience and reason. One should not rely on "singular and naked experience" if it were not attached to reason. Not all drugs worked the same way in different people. Nor should one rely on reason and judgment alone, since it had frequently occurred that, *Bevindinge* or daily experience repudiated what had seemed to be certain from reason.[486] Of course this was exactly what Dodonaeus had pointed out when discussing the relationship between reason and experience in the investigation of medicinal properties. Whereas in *Idea medicinae*, Van Beverwijck had connected this epistemological principle to the *methodus medendi*, in *Treasure of unhealthiness* he did not mention this method at all. The only other mention of epistemology concerning the medicinal properties that I have found, is in the seventh chapter, where Van Beverwijck observed that "all the powers of drugs that were described by the ancients and still remain, were tested and found in their entirety", that is unprocessed or distilled. Any other discussion of epistemology, whether in the case of medicinal properties or otherwise, is absent.

In discussing the types of drugs available, in the fifth chapter of the first book, Van Beverwijck distinguished between the bodily fluids on which different purgatives and emetics were supposed to work. The purgatives that worked in the entire body, also "opened the veins, through which the purgative action took place".[487] In the following chapter, he described what can be recognised as the qualities and faculties of simple drugs. Yet he avoided speaking about the properties of drugs in the same terms as his schoolmasters. Instead of qualities, he spoke of *gematigheyt* or temperance and of *hoedanigheyt* or capacity instead of faculties. The first *hoedanigheyt* came from the mixture of elements and consisted of hot, dry, cold and moist. The secondary capacities originated from the drug's matter (thin, thick and tough and moderate) and the first capacity. These were "mainly" attenuating, thickening, purifying, plastering, *rauw-makende* or raw-making, soothing, opening, closing, tightening, dispelling, repelling, softening, hardening, ripening, putrefying, healing and opening, *vlees-makende* or flesh-making, biting, blister-making and burning. Van Beverwijck gave several examples of

[485] Ibid., 7-8.
[486] Ibid., 7-9.
[487] Ibid., 49-61.

simples whose properties could be attributed to its substance and to the primary qualities in degrees from one to four.

Both the first and second type of capacities changed the body.[488] Tertiary capacities were defined as not coming from the "gematigheyt" or its "matter", but as "a hidden property from the total nature of the drug". In this category he in effect combined the drug properties we have encountered as tertiary and quaternary faculties. These were divided into "removing" drugs, which attracted "particulars" by the similarity of their nature and many drugs, which changed through their entire nature.[489] As his statements on the properties of drugs in *Bergh-val* indicated, Van Beverwijck made much use of these tertiary capacities. For example, on the next page he explained the fact that drugs with the same secondary capacities were effective against different afflictions and beneficial for different body parts by attributing another "special power" to them.[490]

In the remaining chapters, he organised plants and materials derived from animals not according to these capacities, but according to the body parts that their actions could affect. He added recipes for preparing these materials as drugs and occasionally mentioned the taste of the materials and very rarely their scent as well.[491] Hardly ever did he make a connection between this taste and a simple's primary faculties; usually he simply mentioned a taste as a characteristic feature of the plant.[492] On one occasion, he noted that an opinion about the property of a simple had been confirmed sufficiently by experience and reason. In another instance, such an opinion was supported by Scaliger's testimony of forty years of experiences from his medical practice and was corroborated through reason by Fernel.[493]

[488] Ibid., 65-68.
[489] Ibid., 68-69.
[490] Ibid., 75. "Want alle die onder een geslacht behooren, gelijck verdunnende, versterckende, &c. en zijn malkander in alles niet gantsch gelijck: maar besitten daerenboven elck noch een bysondere kracht, waer door sy tot het een ofte ander gebreck bequamer zijn, ofte 't een deel beter helpen, als 't andere. Dit hebben wy breeder aengewesen in de wederlegginge van Montaigne op de 20 verdeelinge."
[491] The 1656 edition of *Heel-konste ofte derde deel van de genees-konste* did include descriptions of the properties of simples according to some of these capacities, without mentioning their taste. Van Beverwijck, *Heel-konste ofte derde deel van de genees-konste* (Amsterdam 1656) 7-33.
[492] Van Beverwijck, *Schat der ongesontheyt*, 79, 80, 81, 91, 103, 107, 110.
[493] Ibid., 105, 107. "dan het gevoelen van Mesue wert wel te recht voorgestaen van den Italiaenschen Kruyt-beschrijver Matthiolus, ende door reden (alsoo de t'samen-treckinge, die wy geseyt hebben dat hy nae laet, voor soodanige dienstigh is) ende ervarentheyt genoeghsaem bevestight." "Aloë moet verkosen werden, die suyver, glinterende, uyt den rossen, ende vast is, de Lever in gedaente gelijkende, ende daerom Hepatica genaemt; ofte om dat sy gelooft werde daer toe nut te zijn, gelijck oock den Italiaenschen Manardus, een den Duytschen Fuchsius soucken te beweren; dan sulcx wert wel te rechtmispresen van den hogh-geleerden Scaliger. Die, seyt hy Exercit. 160. sect. 3. ontkennen, dat de Lever door den Aloë beschadight wert, zijn waerdigh den geessel van de ervarentheyt. Wy hebben sulcx nu veertigh jaren ondervonden, ende ondertusschen vele genese, die 't ghebruyck qualick bekomen was. Ende de treffelicke Genees-meester van wijlen den Koningh van Vranckijck, Fernelius geeft reden, dat Aloë de Lever schadelick is, om datse des selve teere en dunne aderen door haer bitterheyt, ende scherpte al te veel schrapt, ende ophaelt."

A significant case in which he connected the taste of a simple and its effects on the body to its primary quality, was opium. He repeated Mattioli's observations on this subject almost word for word.

> Then if the temperament and capacities of drugs are known from taste and operation, the opium we use is not only bitter of taste, but also sharp to such an extent that only a little of it kept in the mouth, inflamed the mouth, throat and the chest.

From this, it appeared clearly that opium was "of a very hot capacity". This was confirmed by its strong and heavy scent. Thus, taste and smell demonstrated opium's qualities. He went on to say, in an echo of Francis Bacon:

> From this it is completely evident, what a harmful doctrine it is of some, who want to bring everything to the first capacities, and want to get all causes from heat, cold, moistness, and dryness.

Then, he drew conclusions about the case of opium that were much more in line with both Galenists like Spigelius and Jacchaeus and the views expressed by Van Helmont. First, he pointed out that it was a great abuse to believe that sleep was induced by cold and that other drugs administered to produce sleep were not cold but hot like opium. He then concluded that it was "better that one ascribed the sleeping power to a hidden, and special property, existing in the sulfurous spirit, as could be noticed from the smell and slight burning". This sulfurous spirit would make the "sickly spirits in the brain slow, languid, and unmoving".[494] *Treasure of unhealthiness* thus presented the image of a physician who, by his experience and intellect, could reconcile the opinions of various authors and come to a sensible and considered conclusion.

Finally, Van Beverwijck dedicated a chapter in a relatively short treatise, *Introduction to the Hollandish drugs or short notice that each country had enough, to the support of the life, and health of its inhabitants* to the way simples should be investigated and to a discussion of the reliability of experience. A plant's taste and scent and the similarity of a plant's colour and shape to that of body part or bodily fluid, could all provide knowledge of that plant's medicinal properties. Contrary to Dodonaeus and Spigelius, he was positive that a simple's

[494] Ibid., 138-140.

shape and colour were related to the effects of that simple on the body or the affliction it was beneficial for. As we might have suspected from the example of opium in *Ongesontheyt*, he supported the idea that the effects of a drug's substance could be known from taste. However, *ervarentheydt* or experience was necessary because reason would often appear to allow what would turn out differently afterwards in the *bevindinge* or observation or experience. This was especially the case with the drugs of Chymists, so Van Beverwijck wrote. The miraculous properties attributed to them could not withstand the "sun of experience". He then proceeded to list rules similar to those listed by Dodonaeus, which should be observed to gain knowledge of medicinal properties through experience. For example, he mentioned that experience should consist of what had been found often and had been observed well, and that one should follow the advice of Avicenna that the drug should be used on a single, unmixed disease. The healer should know about herbs, because he had to mind the place and time that the simple had been collected.[495]

Van Beverwijck does not seem to have been very interested in matter theory. The only places besides the *Idea medicinae veterum* that he broached the subject was in his oration on the necessity of anatomy, which served as a preface to the second book of *Treasure of unhealthiness* and in *Treasure of health*. In the first, he briefly repeated the Galenic idea of how the four elements expressed themselves in the four humours in the body, starting by saying "What shall I say of the four elements, that can nowhere be found more completely."[496] In the second, he discussed how the four elements where present in the four bodily fluids in some more detail, incidentally mentioning that these fluids all came together in the veins and were generally known as blood.[497]

Thus we can find, throughout Van Beverwijck's works, various parts of the pharmacology promoted in the textbooks used in Leiden. Overall the medicine he presented was Galenic. Considering what kind of discussions Van Beverwijck entered into, which details about treatments and the properties of simples he added and how this knowledge was arranged however, his medicine can be said to have focused more on practical medicine than on the theory or physical underpinnings of that medicine. The epistemological basis of medical knowledge as a whole was not much different from that of the physicians discussed in the previous chapters, though Van Beverwijck considered it less extensively than some of

[495] Van Beverwijck, *Inleidinge tot de Hollantsche geneesmiddelen ofte korte bericht. Dat elck landt genoegh heeft, tot onderhoudt van het leven, ende de gesontheyt der inwoonders* (Amsterdam 1642[1], 1672) 115-123. The Latin reworking of this book, *Autarkeia Bataviae, sive introductio ad medicinam indigenam* (Leiden 1644) was discussed in Cooper, *Inventing the indigenous*, 41-45.
[496] Van Beverwijck, *Schat der ongesontheyt*, 285. "Wat zal ick van de vier Elementen seggen, die nergens volkomender gevonden werden?"
[497] Ibid., *Schat der gesontheyt* (Amsterdam 1643) 56-58.

these physicians. Despite his impressive reputation, Van Beverwijck cannot of course be said to have spoken for all his fellow Dutch physicians. Some of them developed medicine, including the study of drug properties, in a different direction.

Matter theory and the properties of drugs

At the Latin school of Dordrecht, of which Van Beverwijck was curator from 1631, worked a man still best known for his influence on the work of René Descartes (1596–1650).[498] Isaac Beeckman (1588-1637) started his university education in 1607 as a student of arts and philosophy at Leiden, supposedly to prepare him for his theology studies. When he was there however, he soon decided to focus his studies on mathematics, receiving help in this endeavor from the chancellor of the school, the mathematician Rudolf Snellius (1546-1613). After taking a break from his studies in 1608, he seems to have finished his studies in 1610 and returned to his native Middelburg to become a candlestick maker and occupy himself with the construction of water pipes and pumps. Between 1616 and 1618, he studied medicine privately, attaining his medical degree at the University of Caen.[499]

An important source on Beeckman is his book of daily notes that was only published in the twentieth century. Beeckman himself regarded his notes as *myn speculatien*, or "my speculations", or as *mijn gedachten*, that is, "my thoughts".[500] Recently, Elisabeth Moreau gave an account of some of the medical aspects of Beeckman's notes. She explained how atomistic ideas about matter were compatible with his views on the functioning of the body and on pharmaceutics. Partially by referring to particles, Beeckman further developed Galen's ideas about how some drugs worked in the body.[501] He frequently mentioned medical authors such as Galen, Fernel, Giovanni Argenterio (1515-1572), Johannes Heurnius and Andreas Libavius (ca. 1558-1616) in his notes.[502] Also mentioned, amongst others, were Cardanus, Forestus, Avicenna and Paaw.[503] Beeckman's biographer, Klaas van Berkel, agrees with

[498] Klaas van Berkel, *Isaac Beeckman (1588-1637) en de mechanisering van het wereldbeeld* (Amsterdam 1983) 1, 5, 43-47, 292-301. About Beeckman's acquaintance with van Beverwijck see, 117- 120; idem, *Isaac Beeckman on matter and motion. Mechanical philosophy in the making* (Baltimore 2013); Christoph Lüthy, *David Gorlaeus (1591-1612). An enigmatic figure in the history of philosophy and science* (Amsterdam 2012) 17 n. 18.
[499] Van Berkel, *Isaac Beeckman (1588-1637)* 24-31, 34-40, 130-131; Isaac Beeckman, Cornelis de Waard jr, ed., *Journal tenu par Isaac Beeckman de 1604-1634* (The Hague 1939-1953) pt. 1, 100-103.
[500] Van Berkel, *Isaac Beeckman (1588-1637)* 6.
[501] Moreau, "Le substrat galénique", 149; Beeckman, *Journal*, pt. I, 216-217, pt. II, 109-113.
[502] Elisabeth Moreau, "Le substrat galénique des idées médicales d'Isaac Beeckman (1616-1627)", *Studium* vol. 3 (2011) 137-151, there 137; Beeckman, *Journal*, pt. 1, 100, 102-103, 128, 140, 144-145, 148-151, 168-171, 197, 218-222, 224-227, 243-245, 339-348;
[503] Beeckman, *Journal*, 3, 132, 135-136, 143, 146, 152-153, 196, 270.

Moreau that the work of Fernel formed the basis of these studies. Beeckman knew of Fernel's *Universa medicina*, which contained *De abditis* as well as his work on therapy, since 1613 or 1614.[504] According to Van Berkel, Beeckman "definitely became an atomist in the course of his medical studies", but whether the two were otherwise connected is hard to tell.

Other seventeenth-century physicians shared Beeckman's interest in matter theory, partly to understand the properties of drugs.[505] Among these, Cartesian physician Henricus Regius (1598-1679) has been investigated most thoroughly. Regius was appointed extra-ordinary professor of medicine in Utrecht in the summer of 1638, two years after the university was established, to teach botany and theoretical medicine. In 1639 he became ordinary professor and also became responsible for the planning and design of the new academic garden of which he published a catalogue in 1650.[506]

Historians have mostly focused on Regius' involvement in the conflict about Cartesian philosophy played out between 1641 and 1642 at the University of Utrecht through the medical dissertations Regius had his students defend. Much attention has also been paid to his *Fundamenta physices* (1646) and the lack of metaphysical basis for his views on epistemology and physics.[507] Gariepy has given the most detailed overview of what he called "Regius' application of mechanism to therapy" in *Fundamenta medica*, its 1657 reprint *Medicinae, lib iv. editio secunda*, and *Praxis medica, medicationum exemplis demonstrata*, a medical handbook appended to the *Medicinae*.[508] This first text especially shows us what Regius himself thought distinguished his account of drug properties from others.

[504] Van Berkel, *Isaac Beeckman on matter and motion*, 86; Moreau, "Le substrat galénique', 138. In 1983 van Berkel wrote that, "Beeckman tried to give an atomistic foundation to the Aristotelian doctrine of elements which Fernel took for granted, even though Fernel had rejected atomism and even though Galen himself had polemised against atomists. Beeckman had already chosen for a atomistic view on matter during his studies in Leiden or shortly after and was not inclined to let go of that opinion because renowned medical authors had contested that theory. A personal contribution of Beeckman was his free use of analogies derived from practical mechanics and the candlestick makers trade. Van Berkel, *Isaac Beeckman (1588-1637)* 37; Beeckman, *Journal*, 22, 152, 247, 272-273. In the previous chapter, we have come across a philosophy student who showed his knowledge of Fernel's *De abditis* in the thesis that he defended in Leiden somewhat before Beeckman arrived there.

[505] The few notes on the properties of drugs, which Descartes left behind, also show his interest in the operations of drugs. Charles Adam and Paul Tannery, *Oeuvres de Descartes* 13 vols. (Paris 1897-1913) vol. XI (1910) 641-644. "Remedia et vires medicamentorum"

[506] Gerhard W. Kernkamp, *Acta et decreta Senatus: vroedschapsresolutiën en andere bescheiden betreffende de Utrechtsche Academie* (Utrecht 1936) pt.1, 127, 132.

[507] Henricus Regius, *Fundamenta physices* (Amsterdam 1646). e.g., G.A. Lindeboom, *Descartes and medicine* (Amsterdam 1979) 22-27; Theo Verbeek, "Regius's Fundamenta Physices", *Journal of the history of ideas: a quarterly devoted to cultural and intellectual history* vol. 55 no. 4 (1994) 533-552; Lüthy, *David Gorlaeus*, 144-151; Delphine Bellis, "Empiricism without metaphysics: Regius' Cartesian natural philosophy", in: Mihnea Dobre and Tammy Nyden, eds., *Cartesian empiricisms* (New York etc. 2013); Delphine Kolesnik-Antoine, "Le rôle des expériences dans la physioligie d´Henricus Regius: les "pierres lydiennes" du cartésianisme", *Journal of early modern studies II* (2013) 125-145.

[508] Gariepy, *Mechanism*, 226; Henricus Regius, *Fundamenta medica* (Utrecht 1647).

Gariepy writes that, "Regius had often written that medicine was divided into theory and practice." This is not however what Regius wrote on the first page of *Fundamenta medica*. Medicine did consist of two parts, yet these were cognition and curing. *Cognitio* consisted of physiology and pathology, while *curatio* was therapeutics.[509] Rather surprisingly considering that he was appointed to teach theoretical medicine, Regius commented that medicine was commonly, yet wrongly, divided into theory and practice. This was incorrect since in medicine, as in all arts, principles were practical. They "taught the way to treat something properly". Thus while *cognitio* did guide medical action, Regius did not mention how curing might inform cognition.[510] His position on this point was very similar to that of the famous Da Monte over a century earlier. Historian Bylebyl has pointed out that the Italian started his lectures as professor of medical theory in Padua by denouncing the custom of dividing the teaching of medicine into theory and practice. Like Regius, he followed this statement up by noting that medicine,

> could be divided divided into theory and practice, or into speculation and action, but the action is nothing other than the exercise of the art of curing, and the speculation should itself be wholly oriented towards the same end.[511]

This similarity indicates that Regius' support of Descartes coincided with the continuing importance in his work of medical humanism and its ideal of achieving a methodical way of curing.

Gariepy had a point when he wrote that, "Regius' theory of medicaments drew entirely upon Galenic theory of complexions, even though he never used that title". Regius did distinguish between primary, secondary and tertiary faculties and the faculties that could be categorised as such were by and large those of the Galenic accounts of drug properties that we have become familiar with. He however made changes to this account that justify, to some extent, his promises in the dedication to *Fundamenta medica*, regarding clarification and

[509] Regius, *Fundamenta medica*, *2v, 2. "Ac universam Medicinam ad valitudinis Cognitionem & Curationem, quae unica sunt Medici officia, methodicè revocari." "Medicinae partes duae sunt: Cognitio, & Curatio".
[510] Ibid., 1. "Atque hinc constat illam [Medicam] vulgo male in Theoreticam & Practicam divide: cum omnes artes, quantae quantae sunt, doctrinae sint practicae; utpote quae tradant modum aliquid recte agendi. Neque his adversatur prior Medicinae pars, quae Cognitio à nobis appellatur: uti nec sanitatis, remedii, & multorum aliorum in medicina tradendorum, definitiones. Nam haec omnia revera sunt practica; cum ad actionem medicam, sive medendum, cuncta dirigantur."
[511] Bylebyl, "Teaching *Methodus medendi*", 181; Quote from Bylebyl who translated this from Da Monte, *In artem parvam Galeni explanationes* (Lyon 1566) 1-32, in particular 3, 18-20, 27-32.

cutting away the superfluous.[512] In this dedication, Regius wrote to the councillors and senators of the city of Utrecht about the purpose behind his writing on medicine. This included explaining the most obscure faculties of medicaments and detaching "all mysteries from our entire art", and also rendering "the most hidden and difficult, transparent and easy."[513]

Regius started his discussion of drug properties by distinguishing between two kinds of heat and cold, namely "actual" or active and "potential" heat and cold. As we noted previously, the distinction between active and potential faculties was also made in the accounts of drug properties by Dodonaeus, Heurnius and Jacchaeus. Regius' use of the distinction is slightly different however. Potential and active properties were each characterised by the different material properties by which materials transferred heat or cold to the body.[514] Regius wrote that an actively hot or cold medicament transferred its qualities to the body upon contact, like a glowing iron or cold water. Potential heat or cold only revealed their power thereafter. Examples of potential properties were pepper and wine, which were cold on first contact, but were "nonetheless taken for warming after that". Conversely, lettuce, fleawort, poppy and similar simples, exercised "heat on our body" and cooled shortly after.[515] Regius thus only mentioned materials whose initial sensible property was completely contrary to the property they later showed, not ones whose initial property complied with their eventual property.

These examples show that by maintaining the distinction between active and potential heat and cold, Regius found grounds to deny the link between the effect of a material at first contact and its eventual effects on the body. The fact that poppy was hot on first contact, presumably to the sense of smell and taste, did not imply it later had heating properties in the body, nor did it disprove that poppy exhibited cooling properties. In this manner, he explained why the senses did not provide an indication about the properties a drug would exhibit in the body. The investigation of drug properties through the senses was not just unreliable; it was

[512] Gariepy, *Mechanism*, 226; Regius, *Fundamenta medica*, *2r. "Idque facilè obtineri posse speravi, si superfluis amputatis, & obscuris dilucidatis, sola necessaria & sufficientia totius Medicinae praecepta, accurato ordine, absque ullis verborum & inanium disputationum ambagibus, perspicuè proponerè, eorumque usum exemplis ostenderem."

[513] Regius, *Fundamenta medica*, *3r. "Obscurissimas Medicamentorum facultates explanavi." "Et ut verbo absolvam, omnia universae nostrae Artis mysteria, etiam abditissima & difficillima, perspicua & facilia reddere tentavi."

[514] Ibid., 142-143, 145-146. "Medicamentum primo est actuale, vel potentiale. Actuale est, quod primo contact corpus nostrum eam, quam praeditum est qualitate, afficit: ut ferrum candens, aqua frigida." Gariepy, *Mechanism*, 226.

[515] Ibid., 142. "Talia sunt piper & vinum, quae licet primo contact sint frigida, nihilominus, postquam sunt assumta, calefaciunt. Contra vero lactuca, plantago, papaver aliaque similia, corpori nostro etiam calidè adhibita, illud paulo post refrigerant." Gariepy made a slight mistake here by recording this example as "Pepper may be hot on contact, but later it cooled." See Gariepy, *Mechanism*, 226.

impossible. This is in line with what Regius said next about how the primary, secondary and tertiary faculties of drugs could be investigated. They originated from the temperament, or the disposition of insensible particles, and only became known by experience.[516] Thus, on this point, Regius abandoned the principle defended by sixteenth-century Galenists that drug faculties should or at least could be investigated with both reason and experience.

Another aspect in which Regius' account of the properties of drugs differed from Galenic ones, is that he did not defined the categories of secondary and tertiary faculties by their relation to the primary faculties or to the kind of matter that they consisted of. Instead, he enumerated all these faculties before discussing them individually. This meant that the "total substance" of simple drug was not mentioned as the cause of the tertiary faculties. The distinction between manifest and occult properties seemed to have disappeared.

A closer look at the descriptions of the individual secondary faculties though, shows that they often still included the primary faculties that they exhibited, and sometimes also mentioned the kind of matter the drug consisted of, which Regius described in terms of different kinds of particles. He could now be very flexible in what operations he attributed to the simples and what kind of matter they consisted of.[517] Although he did not attribute tertiary faculties to "total substance", the four kinds of tertiary faculties he distinguished were similar to those described by Van Beverwijck. Those that changed a certain humour or prepared it for purging and those that purged by a peculiar power, had a "peculiar conformity" with a body part, or "halted a malignant potion".[518]

We can conclude then that Regius did indeed remove existing obscurities in understanding the properties of drugs, but did not introduce new issues. As Gariepy wrote, he, for example, "ignored rather than denied the issue of faculties as the innate power of a substance to effect a cause."[519] Later in the century, Albert Kyper (1614-1655) published a work in which he approached pharmacology in a very different way. Contrary to Regius, he severed all connections between the properties of drugs and matter theory.

[516] Regius, *Fundamenta medica*, 142. "Deinde medicamentum vel primis, vel secundis, vel tertiis facultatibus est praeditum. Eaque omnes à temperamento, seu insensibilium particularum, dispositione, antehac in Physicis *pag*. 95 & seqq. explicatam, originem ducentes, per solam experientiam innotuerunt."
[517] Ibid., 149-171.
[518] Ibid., 171.
[519] Gariepy, *Mechanism*, 228.

Drug properties according to Albert Kyper (1614-1655)

Roger French mentioned two Dutch physicians, Jacobus de Back (1593-1658) and Albert Kyper to argue that either they experienced a "crisis in theory" or responded to it. The quote from De Back is taken from a work first published as an attachment to an edition of *Exercitatio anatomica de motu cordis et sanguinis* by William Harvey (1578–1657) published by the printer Leers, whom we met earlier in this chapter.[520] In this dissertation, De Back dealt with the consequences of William Harvey's work on the movement of the heart and the blood. He wrote that because of the acceptance of the circulation of the blood many old doctrines were upset and the entire order of teaching was in disorder. This order should be restored with a coherent and a certain method of teaching.[521] Though De Back mentioned that Harvey's work had consequences for the teaching of medicine as a whole in his dissertation, he only considered its consequences for physiology. We incidentally encounter a view of the use of the senses that differs from what we have seen until now. De Back argued that Hippocrates and Galen should not be discarded, if the truth were to be pursued by reason and the senses. Later he added that the writings of the most learned men should be investigated by the senses.[522] Reason was thus considered separately from the senses.

Supposedly the crisis in theory was visible in Kyper's *Institutiones medicae* (1654).[523] Along with a great number of eastern Europeans, Kyper had moved from Königsberg to continue his academic training in the Republic, in his case to study medicine in Leiden.[524] He received his medical degree there in 1640. In this year and the following ones, Kyper was given permission to preside over the defence of philosophical theses and to give lectures and

[520] William Harvey, *Exercitatio anatomica de motu cordis et sanguinis. Cum praefatione Zachariae. Sylvii medici Roterodamensis Accessit Dissertatio de corde Jacobi de Back urbis Roterodami Medici ordinarii* (Rotterdam 1648); French, *Medicine*.

[521] Jacobus de Back, *Dissertatio de corde* (Rotterdam 1648) 12. "... : sic contigit concesso, statuque sanguinis circulatorio motu, innumera veteris doctrinae statuta inverit; unde totus docendi ordo turbatus, praeposterè & sine certam methodo doctrina omnino confusè instituitur & addiscitur, quam, positionibus catenatim cohaerentibus & certo ordine instructis, stabiliri decet." Robert Martensen wrote that, "Anecdotal evidence suggests that Harvey planned to write a final work that integrated his anatmical knowledge of healthy and sick bodies with diagnostic and therapeutic approaches, but abandoned the project when his records were destroyed late in his life". Robert Martensen, "Hippocrates and the politics of medical knowledge in early modern England", in: Cantor, ed., *Reinventing Hippocrates*, 91-135, specifically 118, 132.

[522] De Back, *Dissertatio*, 11. "Quid faciendum? Anne reliquendus Hippocrates, post ponendusque Galenus? Minimè: si veritatem, rationibus, ipsisque sensibus munitam, sectamur, sumus Hippocratis, sumus Galeni." "Clarissimorum virorum scripta, hic, anne sensibus pateant, anne dissentiant, examinare jubet: ..."

[523] Albert Kyper, *Institutiones medicae, ad hypothesin de circulari sanguinis motu compositae. Subj. eiusdem Transsumpta medica, quibus continentur medicinae fundamenta* (Amsterdam 1654). As the series lectionum of the University of Leiden show, Kyper taught from this work at Leiden in the last year of his life.

[524] Stefan Kiedron, "'Voorwaarts naar het land van de orakels!" Oosteuropeanen aan Noordnederlandse universiteiten na de Opstand", *De zeventiende eeuw* vol. 10 (1994) 73-78.

hold disputations on Aristotelian physics.[525] In the meantime, he published substantial works.[526] After a short period from 1646 as professor of medicine at the short-lived illustrious school in Breda, he accepted the same post in Leiden in 1650.[527] There he taught anatomy and medical practice in the Leiden hospitals and *Institutiones medicinae*.[528]

During Kyper's tenure, Heurnius' *Institutiones medicinae* was a regular part of the medical curriculum in Leiden.[529] As both *series lectionum* of the year 1654 show, Kyper taught from his own *Institutiones medicae* in the year before his death. These *series* also mention the instructions he and Johannes van der Linden would give in the public hospital.[530] The *Institutiones* was very different from both Heurnius' book and Regius' *Fundamenta medica* published seven years earlier. The preface shows that the book was very much intended to prepare students for medical practice. Kyper listed four principles that he would discuss in the four parts of the book. The second principle is described in most detail and is of most interest here.

Kyper explained that he taught the way to prepare and compile medicaments, and how to prescribe these formulas. He also taught the *methodus medendi* and the use of selected composed medicaments to almost all diseases. These medicaments were reduced to classes, Kyper wrote, "as they were often repeated in practice from now on". He added that it was not necessary to include what was commonly written.[531] Indeed, not primary, secondary or tertiary faculties, nor individual simples, nor a discussion of how knowledge of drug properties was to be acquired were included in the book. Further on, Kyper discussed the four main ways in which materials could be removed from the body, which were purgation, salivation, sudation or perspiration and diuretics.[532] He thus considered his practice "methodical", but this method clearly did not require an extensive investigation of the material properties of drugs or how these were related to a drug's effects on the body.

[525] Molhuysen, *Bronnen*, pt. 2, 243, 244, 250, 272, 273, 274, 275, 278, 286.
[526] Albert Kyperus, *Medicinam rite discendi et exercendi methodvs* (Leiden 1643); Albert Kyperus, *Institutiones physicæ; in fine adjecta est Confutatio pseud-apologematis, quod Plempius fundamentis suis medicinæ subjunxit* (Leiden 1645-1646);
[527] Molhuysen, *Bronnen*, pt. 3, 40, 42.
[528] Ibid., 46.
[529] Ibid., 14.
[530] Ibid., 26*-27*, 31*-32*. "1654 Sept. Series lectionum. Ordo lectionum hiemalium in academia batava Leidensi, anno 1654. Mane. Hora undecima. D. Albertus Kyperus Institutiones suas medicas publice interpretabtur." "D. Albertus Kyperus et D. Iohannes Antonius van der Linden alternis trimestribus Periodis in publico Nosocomio studiosos Medicinae singulis septemanis aliquoties instruunt in aegrotorum visitationibus, et morborum curationibus, causasque mortis in cadaveribus dissectis ad oculatatm fidem demonstrant."
[531] Kyperus, *Institutiones*, ††. "In hoc, quae in Institutionibus desiderantur, latè deducuntur: in hoc item medicamenta ad eas classes revocantur, ut dehinc in praxi eadem saepius repeti, quod vulgò fit, non sit necessum."
[532] Ibid., 317-330.

We do encounter some of the drug properties recognised in other accounts as secondary faculties. The influence of both Fernel and his *De adbitis* can be observed in Kyper's *Institutiones*. Kyper distinguished between internal and external drugs and between different kinds of diseases; diseases of intemperance, of secondary qualities, of the total substance and of the organs.[533] Taste was also discussed, but now among the other senses in the first part of the book. Kyper mentioned the eight main tastes and focused on how taste was perceived.[534]

In the treatise attached to *Institutiones medicae*, called *Transsumpta medica*, Kyper considered the relationship between physics and medicine more closely.[535] He had had ample opportunity to consider this relationship in his writing and teaching and would be confronted with it again in the following year, when he was *Rector magnificus* and was warned of the danger that Cartesian philosophy posed to medicine.[536] Like De Back, Kyper wanted to combine the modern with the old. Indeed, in *Transsumpta* he defined medicine as an art based on reason and experience. "When reason and experience agreed they delivered certain medicine, if they appeared to conflict, what was most evident was trustworthy".[537] Knowledge was not so much discovered by reason but was rather established by experience acquired about "singularia". From these *singularia* were built *universalia* by induction. However, it was not necessary to acquire experience about all *singularia*. Because students could not rely on their own experience, as knowledge of simple drugs came from years of use, they should draw on authoritative and approved authors.[538]

Conclusion

Between the 1610s and 1650s some physicians in the Dutch Republic distanced themselves from what Dodonaeus, Heurnius and Paaw had taught about the properties of drugs in different ways. In their Dutch adaptation of Dodonaeus' *Stirpium*, the Van Ravelingens invited their readers to follow Dodonaeus' instructions and example to rely on repeated experience and trials. They affirmed his warnings about the use of reason, including taste, by introducing a skeptical argument about the unreliability of the human mind. In the address to

[533] Ibid., 306-307.
[534] Ibid, 104-105.
[535] Albert Kyperus, *Transsumpta medica. Ea ex pysicis repetentia, quibus continentur medicinae fundamenta* (Amsterdam 1654).
[536] Molhuysen, *Bronnen*, pt. 3, 107; Albert Kyperus, *Collegium medicum*, *viginti sex disputationibus breviter complectens, quae ad institutionibus pertinent. Acc. ejusdem disputationes physico-medicae miscellaneae atque politicae de origine et jure magistratus, de jure belli, et de foederibus* (Leiden 1655).
[537] Kyperus, *Transsumpta*, 1.
[538] Ibid., † 4v.

their readers, they encouraged the gathering of information about the medicinal properties of exotic materials by enquiring with local people. They themselves added to the medicinal properties in the description of the plants they described, admitting however that this knowledge was perhaps not as reliable as that supplied by Dodonaeus himself.

One prominent physician in the Dutch Republic, Johan van Beverwijck, was particularly self-conscious in navigating academic medicine between the radical empiricism of Montaigne and physics. Montaigne especially criticised physicians for their ill understanding of drug properties. Though the type of medicine that Van Beverwijck personified was based in the writings of the ancient medical authorities, it differed from that taught at universities. It was not directed at firmly establishing the connection between physics and the practice of medicine but instead focused on the knowledge necessary to preserve health and to cure disease. Different aspects of Galenic pharmacology were dispersed over Van Beverwijck's different works, which were directed at a general public, instead of at medical students and fellow physicians. In the process, the investigation of drug properties fell away as a central part of the *methodus medendi*. Van Beverwijck still argued for the superiority of the learned physician's knowledge and understanding of drug properties and incorporated much of this knowledge in his works.

I have examined the writings of two Dutch physicians who published on the foundations or principles of medicine in the 1640s and 1650s. Both Regius and Kyper were employed by universities to teach about this subject, but their approach to it was very different. As teachers, they were confronted with the problematic relation between physics and medicine and did not take up the question of in what way the medical knowledge of physicians differed from that of a lay person or in fact that of other medical practitioners. Though Regius acknowledged that medicine consisted of physiology and pathology on the one hand and curing on the other, he emphasised that curing was informed by physiology and pathology. The association of medicine with Cartesian philosophy that he encouraged in the dissertations of his students during the early 1640s, did not directly affect his writing on the properties of drugs as Gariepy noted. He retained the division between primary, secondary and tertiary faculties. He did however make some changes to the Galenic pharmacology we have discussed in the previous chapters. By introducing the notion of actual and potential heat and cold, he gave non-skeptical as well as non-empirical grounds for the fact that the sensible quality of a drug sometimes completely contradicted the actions of that drug in the body. While the faculties of drugs could be explained by the temperament and insensible qualities, these faculties could only be investigated by experience.

Kyper focused his *Institutiones medicae* on preparing students for medical practice and this had major implications for the kind of topics he discussed and how he discussed them. As a consequence, he wrote a very unorthodox textbook. He left out the most important features of Galenic pharmacology in the form in which it was established in the sixteenth century. He directly addressed the relation between physics and medicine in his *Transsumpta medica* and chose to give practical guidelines and stay out of "subtle disputations".

Although he made changes in matter theory and rejected the Galenic epistemology of his predecessors, Regius maintained the distinction between primary, secondary and tertiary qualities that his readers were familiar with in his account of the properties of drugs. French wrote that "knowledge of the properties of the powers of natural substances" survived the "crisis of medical theory".[539] From the works discussed in this chapter however, it appears that what was taught in academic medicine about drug properties and how to investigate them, was affected by the criticism that the Galenic approach had received. It seems that what knowledge of drug properties remained, inside and outside of academic teaching, remained because it was part of the conventions and practices of physicians, patients and apothecaries. These conventions of practice where only partially established through the teaching of academic medicine.

[539] French, *Medicine*, 189.

Intermezzo 4

Personal knowledge, trust and medicaments

People in the seventeenth century were not uncritical of physicians and apothecaries. As we saw in the first intermezzo, from the 1630s onwards Dutch apothecaries and physicians showed their concern over the quality of the drugs sold in apothecary shops and over the possible exploitation of customers. They worked together to establish regulations for the trade of drugs, standardised production processes and offered educational opportunities in public gardens. These measures would ensure customers that even if they did not know the apothecary, the products that he sold were trustworthy. Despite these regulations, we can find traces of similar distrust of the remedies and services supplied by apothecaries and physicians among their customers.[540]

Distrust of products sold in apothecary shops was not a typically Dutch phenomenon. Patrick Wallis even argued that since the end of the sixteenth century, apothecary shops in England, in parallel with earlier developments in the United Provinces, France and Italy, were set-up in such a way as to instil trust in customers under circumstances of what he calls "asymmetries of information".[541] In a classic paper, Kenneth J. Arrows introduced the concept of "informational inequality" into the study of "the medical-care industry" to describe a situation where a medical practitioner knows more about a treatment than a patient does. Arrows generalised his point to say that, "When there is uncertainty, information or knowledge becomes a commodity."[542] The point then of course is to identify what sources of uncertainty people in the past considered important to remedy. Wallis indicated that the most important source of this asymmetry in the sale of drugs in apothecary shops was "the incipient separation of retailing and production" on separated sites.[543]

In 1696, a polemic published by Theodorus Schoon (ca. 1656-unknown), a medical practitioner in The Hague, magnified the distrust of apothecaries and physicians and their regulations of drug production.[544] In his three published works he painted a caricature of prevailing medical practice, which he called Galenic. His works seem aimed at collecting all the censure of this type of medicine that he could think of. We can see from the title of an

[540] Barend Haeseker, *'Vileine hippocraten'. Geneeskunde in dichtvorm door Constantijn Huygens (1596-1687)* (Rotterdam 2010).
[541] Patrick Wallis, "Consumption, retailing, and medicine in early-modern London", *Economic history review*, 61, 1 (2008) 26-53, 26-27, 28, 32, 33.
[542] Kenneth J. Arrows, "Uncertainty and the welfare economics of medical care", *The American economic review* vol. 53 no. 3 (dec. 1963) 941-973, there 941, 946, 961. Reproduced in: Peter J. Hammer, eds., *Uncertain times: Kenneth Arrow and the changing economics of health care* (Durham etc. 2003) 1-33.
[543] Wallis, "Consumption", 26-27, 28, 32, 33.
[544] Theodorus Schoon was Cornelis Solingen's pen name. For a short discussion of Schoon's relationship with Bontekoe and Theodorus Craanen (1633 -1688), see Caroline Louise Thijssen-Schoute, *Nederlands Cartesianisme* (Utrecht 1989) 272, 343. The dispute was also mentioned in Mart van Lieburg, *Nieuw licht op Hendrik van Deventer (1651-1724)* (Rotterdam 2002) 38, 55.

earlier publication that Schoon was very critical of the way the powers and operations were described in Galenic medicine and by herbalists.[545] The second to last sentence reads:

> As well as a clear exposition of the grave fallacies and ignorance of the Galenic schools and their herbalists, in describing both the curing of the sick as well as the herbs, their power and operations.

Schoon claimed that he could provide the true foundations for understanding the different operations of drugs.[546] In the pamphlet of 1696 he expressed similar ideas.[547] He explained that he was moved to publish this pamphlet because of the demand of the guild of apothecaries in the city to either give up his secret drug recipe to them, or pay a large sum of money to the guild to be allowed to sell it himself.[548] In response, he accused apothecaries and physicians of a wholesale conspiracy against patients made possible by the close family or business relationships between the two groups. Referring to Moliere's *L'Amour médecin* (1665) he accused them of keeping their patients sick so that they could earn as much money from them as possible.[549]

He had only started producing drugs himself, he says, because the drugs apothecaries sold were "foul mixtures", especially when produced by their "little wives" or ignorant servants.[550] The doctors that were supposed to inspect shops allowed the use of inferior ingredients or were cheated by apothecaries themselves. He claimed he had witnessed the tampering with ingredients of compound drugs in the apothecary shop when he lived and worked in Leiden for eight years while studying medicine.[551] He could prove the malpractice

[545] Theodorus Schoon, *Waare ontledinge en oeffeninge der planten, handelende van haren oorspronk ontledinge; wijze van groeijinge; voorteelinge, chymische ontbindinghe; kragt; werkinge; gebruik, misbruik, byzondere eigenschappen, en eyndelijk hare ziektens en sterven, alsmede een nette ontvouwinge van alle datgene, dat zig, zoo in de lugt, hemelskring, en aartkloot vertoond, en 't welk tot groeijinge, en voorteelinge der planten contribueert. Hier nevens werd ter nedergesteld, de culture oft voortqueekinge van de tabak, haar gebruik, misbruik, kragt en werkinge, tot een generale wederlegginge van dat buitensporige boekje, tabaks verhandelinge, genaamt, en door Beintema à Peyma uitgegeven. Alsmede een klaar vertoog van de grove dwalinge en onkunde de Galenistische scholen en haar kruidbeschrijvers, zoo in 't genezen der ziekten, als in de kruiden, hare kracht en werkinge te beschrijven. Dit alles op een ware natuurkunde gebouwd, uitgehaald, en op vaste bewijzen ter neder gesteld* (The Hague 1592).
[546] Schoon, *Waare ontledinge*, 433.
[547] Theodorus Schoon, *Den apotheker in 't hemd, of de wederspannige knegt tegen syn meester* (The Hague 1696) 12-13.
[548] Schoon, *Den apotheker*, 4, 5.
[549] Ibid., 19, 21-22; Schoon, *Waare ontledinge*, 436-437; Schoon, *Den verwaande campioen Ougenius Eyben, voor de naam-doctoren, de plamoters, en haar kraam. Geharnast in't strijdperk tredende, nedergeveld* (The Hague 1696) 11. In *De la ressemblance des enfants aux pères*, Montaigne had also noted the self-interested behavior of physicians. Van Beverwijck, *Bergh-val*, 60, 104.
[550] Schoon, *Den apotheker*, 3-4.
[551] Ibid., 23-24, 26-29, 31.

of apothecaries, if he were allowed to inspect their *kraam* or "stall".[552] Thus Schoon pointed out the exact same source of asymmetries of information that Wallis identified. Due to the way apothecary shops were set up, customers could not witness the production process of drugs themselves. Unlike regular customers, Schoon had seen what happened behind the scenes as it were. Also, he downgraded the exquisitely organised apothecary shops of Wallis' account to mere market "stalls".

Schoon had already offered a solution to rectify this abuse in *Waare ontledinge*. Referring to Van Helmont, he suggested that if the physician preparing the drugs - a physician like Schoon - were invited to prepare them in the patient's home, the production process could be supervised by the patient himself. It would be safer and less expensive and this way only the physician could be blamed if the drugs had ill consequences.[553] Contrary to apothecaries, physicians at least were bound by an oath of honour, yet they released part of their responsibility by employing apothecaries.[554] Rather than offer certainty, Schoon offered privileged information about uncertainty to his readers and promoted himself as the person who could alleviate their doubt.

In his responding pamphlet, fellow physician in The Hague, Eugenius Eyben noted that Schoon had no proof for his accusations and that physicians certainly did have knowledge of simples.[555] He also argued that no one would deny that chemistry was a great help in finding many excellent cures.[556] In his earlier *Waare ontledinge*, Schoon had made the claim that physicians had not tried to use chemistry to improve and discover both the power and operation of drugs.[557] First and foremost Eyben argued against Schoon's insistence, in his *Waare ontledinge*, on the sole use of reason in investigating the properties of drugs. Citing Galen, he was adamant that new drugs had been discovered by the combination of reason and experience. Figuring out the relation between these two ways of investigating nature was especially important in investigating drug properties. The role of the senses was also part of that puzzle, since they were considered for their part in reasoning about the properties of drugs. These discussions would remain relevant for the two Dutch physicians discussed in the final chapter.

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[552] Schoon, *Den verwaande campioen*, 44-45. Ik hebbe boven al voor afgeseyd, dat ik, zo my de visitatie van de kraan toegelaten werd, overvloedig dat aantoonen zal, niet alleen dat ik te zagt geschreven hebbe, maar ook datmen tegen dezelve niet hard genoeg schruyven kan.
[553] Schoon**,** *Den apotheker*.
[554] Ibid., 38.
[555] Eugenius Eyben, *Den doctor in 't harnasch tegens den apotheker in 't hemd: behelsende een wederlegginge van seker libel, onlangs door Th. Schoon in 's-Gravenhage uitgegeven* (The Hague 1696) 57-62.
[556] Eyben, *Den doctor in 't harnasch*, 23-26, 32, 39. Similarly, Van Beverwijck had not rejected "the drugs of the Alchymists", but stated that many were of great help "to the old art of healing" in his defense against de Montaigne. Van Beverwijck, *Bergh-val*, 119.
[557] Schoon, *Waare ontledinge*, 462.

Pamphlets such as those by Schoon seem to have been quite exceptional in the United Provinces. By the end of the seventeenth century, Dutch medicine had not experienced a conflict similar to the one occasioned by the short-lived and unsuccessful attempt by Helmontian physicians to establish a medical society to rival the Galenist Royal College of Physicians in 1665.[558] Nor similar to the intermittent struggles between the University of Paris on the one hand and the University of Montpellier and those working at the Jardin Royal on the other hand.[559] Neither do we hear much of conflicts between physicians and apothecaries such as occurred elsewhere from time to time.[560] In general, Dutch physicians, apothecaries and the governments of Dutch universities seem to have been quite prepared to accept innovation. Those who wanted to reform medicine in the United Provinces in general took a somewhat less antagonising, but still self-assured approach.

Compared to Schoon, for example physician Steven Blankaart (1650-1704), who sold his own secret remedy like other physicians had before him, was relatively nuanced about the well-known suspicions against the trustworthiness of the goods sold by apothecaries. He referred to the double-faced reputation of apothecaries, but also assured his potential customers that he could testify from experience that there were still good apothecaries in Amsterdam, as well as "cheats", and added that he would refer patients only to the reliable ones and that he would check whether his patients had received the correct drugs when he visited their house. He even threatened to publically expose apothecaries who had changed his prescriptions in his *Collegium medicum*.[561] Though Blankaart's strategy was more to divide and conquer than Schoon's, like Schoon he insisted that he would provide the certainty that he had ensured his readers they needed.

Of course, Schoon's accusations of a kind of conspiracy between apothecaries and physicians were not altruistic and what truth there was to them is hard to assess. One would have to investigate the relationship between apothecaries and physicians in a way similar to

[558] Hunter, "Boyle versus the Galenists", *Medical history* vol. 41 no. 3 (1997) 322-361; Allen G. Debus, *Chemistry and medical debate: Van Helmont to Boerhaave* (Canton, MA 2001) 59, 86-102.
[559] Debus, "The chemical philosophy", 27-48; Laurence W.B. Brockliss, "Medical teaching at the University of Paris, 1600–1720", *Annals of science* vol. 35 no. 3 (1978) 221-251.
[560] Aaron Mauck, "'By merit raised to that bad eminence': Christopher Merrett, artisanal knowledge, and professional reform in restoration London", *Medical history* vol. 56 no. 1 (2012) 26-47, especially 35-36; Harold Cook, *The decline of the old medical regime in Stuart London* (Ithaca etc. 1989) 127.
[561] Steven Blankaart, *Venus belegert en ontset. Oft verhandelinge van de pokken, en des selfs toevallen, met een grondige en zekere genesinge: steunende meest op de gronden van Cartesius* (Amsterdam 1685) 219. "…, want de doorwormde en verwormde is goed voor d'Apothekers, die de luiden willen bedriegen, makende geld, van 't geene weg-werpens waardig is, en daar van komt dat vervloekte spreekwoord, dat een Apotheker die aardig is, … al hoe wel ik wel weet dat 'er in ons Amsterdam nog wel goede Apothekers zijn, … en hier kan ik soo wel getuigenisse van dragen, als van d'andere die bedriegers zijn." Stephanus Blankaart, *De Kartesiaanse academie ofte institutie der medicyne* (Amsterdam 1684) 341.

Richard Palmer's investigation of pharmacy in the Republic of Venice.[562] From anecdotal evidence we do know that there were certainly close, family relations between some apothecaries and physicians in the Dutch Republic as well.[563] From just looking at the organisation of the trade in medicines, it is not too far-fetched to claim that the self-regulation that physicians and apothecaries had implemented was flawed in some ways. The system was regulated by those who would profit from it. Importantly, Schoon was not part of that regulatory system like Blankaart, and by producing and selling his own medicaments he attempted to circumvent it.[564] Dirk Kranen has reproduced advertisements by doctors and surgeons, the heirs of Sylvius among them, offering remedies they had produced and that could be bought at their house.[565] These same advertisements were used by others working outside of the regulations instituted in Dutch cities. Frank Huisman has investigated this group of medical practitioners in detail.[566]

It is widely understood in the historical literature that sixteenth- and seventeenth-century patients actively pursued the procurement of drugs, medical advice and recorded their experiences for posterity.[567] Perhaps distrust or uncertainty regarding the quality of the services offered by apothecaries and physicians encouraged patients to at least inform themselves about the properties of simple drugs and the production of compound and chemical drugs. In the seventeenth century a market was created for books in which the investigation and application of the properties of simple drugs and the preparation of

[562] Richard Palmer, "Pharmacy in the Republic of Venice in the sixteenth century", in: Andrew Wear *et al.*, eds., *The medical renaissance of the sixteenth century* (Cambridge 1985) 100-117.
[563] Henriette A. Bosman-Jelgersma, *Pieter van Foreest. De Hollandse Hippocrates 1521-1597* (Heiloo 1984) 22; Haeseker, *'Vileine hippocraten'*.
[564] See Kenneth Dewhurst, *Thomas Willis's Oxford lectures* (Oxford 1980) 23-24, 26 for a short discussion of the (secret) medical recipes of members of the College of Physicians.
[565] Dick Kranen, *Advertenties van kwakzalvers en meesters in de Oprechte Haerlemse Courant uit de periode 1656 tot 1733* (Ede 2008). Those by surgeons and physicians on page 26, 113, 90; Frank G. Huisman, "Itinerant medical practitioners in the Dutch Republic: the case of Groningen", *Tractrix: yearbook for the history of science, medicine, technology and mathematics* vol. 1 (1989) 63-83.
[566] Huisman, "Itinerant medical practitioners", *Tractrix* vol.1 (1989) 63-83.
[567] Paul Slack, "Mirrors of health an treasures of poor men", in: Charles Webster, *Health, medicine and mortality* (Cambridge 1979) 237-274; Nutton, "Medicine", in: Cameron, ed., *Montaigne and his age*, 23; Deborah Harkness, "Nosce Teipsum: Curiosity, the humoral body, and the culture of therapeutics in late sixteenth- and early seventeenth-century England", in: Robert J.W. Evans and Alexander Marr, eds., *Curiosity and wonder from the Renaissance to the Enlightenment* (Aldershot 2006) 171-192; Elaine Leong and Sara Pennell, "Recipe collections and the currency of medical knowledge in the early modern medical marketplace", in: Wallis and Jenner, eds., *Medicine and the market*, 133-152; Alisha Rankin, "Duchess, heal thyself: Elisabeth of Rochlitz and the patient's perspective in early modern Germany", *Bulletin of the history of medicine* vol. 82 (2008) 109-144; Elaine Leong, "Collecting knowledge for the family: recipes, gender and practical knowledge in the early modern household", *Centaurus* vol. 55 no. 2 (2013) 81-103; Anon, *Verzameling geneeskundige recepten (ca. 1677)*, Leiden UB: BPL 3603.

medicines were described. The list of books put up for auction after his death in 1688 shows that Constantijn Huygens (1596–1687) owned a number of these books.[568]

Through his personal connections Huygens had some access to unpublished information as well. He and his many correspondents exchanged information about their personal experiences with the use of remedies.[569] The recipes for perfumes and remedies, in the form of balsams, powders, pills and drinks, which he assembled during his life, have been preserved in forms varying from a short list of ingredients on paper fragments to detailed descriptions of the production process and how to use the resulting product. On some, Huygens carefully noted down who, often a woman, had recommended the remedy and when.[570] Sources like these thus open up a world of medical knowledge in which the positive or negative experiences with particular treatments were recorded and exchanged. They contain a wealth of information about the way an affluent and well-connected patient like Huygens established an understanding of the utility of natural materials and chemical processes and about the multiformity of treatments and ingredients available to him.[571]

They also confirm conclusions drawn elsewhere that there was no fundamental difference between the kind of knowledge that physicians and patients had access to.[572] In this way, at least the information inequality Arrows spoke about was evened out to a significant

[568] Anon., *Catalogus variorum & insignium in omni facultate & lingua librorum, bibliothecae nob. amplissimique viri Constantini Hugenii Zulichemii, &c. Toparchae & dum viveret. Serenissimi Arausionensi Principis Concilii Praesidi. Quorum auctio habebitur Hagae-Comitis in officina Abrahami Troyel Bibliopolae op de groote Zael van 't Hof. Ad diem Lunae 15 Martius 1688*. (The Hague 1688); The catalogue lists for example: Valerius Cordus, *Den leytsman ende onderwijser der medicijnen, oft ordentlicke uytdeylinghe ende bereydingh-boeck vande medicamenten* (Amsterdam 1614); Joannes Hagius, *Den lust-hof der medicijnen* (Dordrecht 1616); Jean Beguin, *Les élémens de chymie* (Paris 1620); Guy de la Brosse, *De la nature vertu et utilité des plantes* (Paris 1628, 1678); Johann Agricola, *Commentaria et observationes in die chymische artzeney Johannes Poppii* (Leipzig 1638); Brice Bauderon, *Pharmacopee de Bauderon* (Lyon 1640); Jan Bisschop, *Pharmacia galenica & chymica, dat is apotheker ende alchymiste ofte distiller-konste* (Amsterdam 1657, 1667); Edward Bolnest, *Medicina instaurata ... principles of the art of physick* (London 1665); Moyse Charas, *Histoire naturelle des animaux, des plantes et des minéraux qui entrent dans la composition de la thériaque d'Andromachus, dispensée et achevée publiquement à Paris* (Paris 1668); Moyse Charas, *Nouvelles expériences sur la vipère, les effets de son venin, et les remèdes exquis que les artistes peuvent tirer du corps de cet animal* (Paris 1669); Moyse Charas, *Theriaque d'Andromaeus* (Paris 1685). These books are not included in the discussion of Huygens' library in Ad Leerintveld, "Ex libris: "Constanter." Boeken uit de bibliotheek van Constantijn Huygens", *Jaarboek voor Nederlandse boekgeschiedenis* no. 16 (2009) 151-176.

[569] All in: *De briefwisseling van Constantijn Huygens 1608-1687*.

[570] Mss. KB: listed as KA 48, actually KA 47, *Verzameling van brieven en stukken over allerlei onderwerpen bijeengebracht door Constantijn Huygens (1596-1687)* (The Hague 1620-1680); Willem Ploeg, *Constantijn Huygens en de natuurwetenschappen* (Leiden 1934) 83-85, 140-146. Huygens' recipes should be examined more thoroughly than I have opportunity here. Similar notes can be found in the notebook of Beeckman. Beeckman, *Journal*, 87-88.

[571] The ingredients of some of these recipes are exotic and expensive. The only part of Huygens' gardens at his estate De Hofwijck outside of The Hague that contained anything but trees, was designated as a medicinal garden on the etching produced in 1652.

[572] Frank Huisman, *Stadsbelang en standsbesef. Gezondheidszorg en medisch beroep in Groningen 1500-1730* (Rotterdam 1992) 194-195.

degree.[573] Yet especially, physicians like Dodonaeus, Van Beverwijck and Blankaart who published in Dutch would beg to differ. Although they were from different generations, they each in their way claimed that they as physicians knew best when and where to apply what substance.

[573] Arrows, "Uncertainty", 951.

Chapter 5

An epistemic labyrinth. The observable and the unobservable, reason and imagination

Introduction

In the preceding chapter, we have examined how between the 1600s and 1650s some physicians in the Dutch Republic partially distanced themselves from what Dodonaeus, Heurnius and Paaw had taught about the properties of drugs. In the writings I examined, they preferred experience and repeated observation to investigate drug properties over reasoning from the senses. The properties of drugs continued to be described as particular faculties or operations in and on the body. Outside of the sources I have reviewed, there was not much discussion about investigating drug properties however. In general, the curative and beneficial effects of drugs in alleviating particular afflictions was discussed rather than the way these effects had been established or how they where related to each other.

In this final chapter, we will encounter some authors who did discuss these subjects. I will investigate the decades between the death of those physicians and philosophers who instigated these discussions in academic medicine on the one hand and the appearance of the works of the famous Dutch physician Herman Boerhaave (1668-1738) on the other. The main purpose is to evaluate what changes the discussions about the properties of drugs underwent in this period as compared to those of a century earlier.

The work of two physicians in particular shows some of the ways in which practicing physicians evaluated ways of investigating drug properties that had developed by the second half of the seventeenth century to the understanding of drug properties. They were both born in Middelburg, the capital of Zeeland, the most south westerly province of the Dutch Republic. One was Steven Blankaart (1650-1704), a practicing physician and prolific author, translator and commentator.[574] Historian Baumann described Blankaart as "*rerum novarum cupidus* in the original sense of the phrase".[575] Caroline Louise Thijssen-Schoute agreed, but added less flattering impressions, writing that it would have been better if Blankaart "had written less, and had done more experiments and that his "childish vanity" led to "an overestimation of the strength of his reasoning".[576] His publications certainly convey the impression that Blankaart wanted to share his love for new things with others, but also that he wished to incorporate them in his work as physician. He only published things that would reflect well on his practice and he was not very original. Many of his publications were translations and compilations of other people's writings to which he had added his own comments. The other physician that I focus on in this

[574] Debus, *Chemistry*, 57-64.
[575] Erik Dirk Baumann, *François dele Boe Sylvius* (Leiden 1949) 196.
[576] Thijssen-Schoute, *Nederlands*, 259, 320. She wrote that it would have been better if Blankaart "had written less, and had done more experiments and that his "childish vanity" led to "an overestimation of the strength of his reasoning".

chapter is Antonie de Heide or Antonius Heidanus (1646-ca. 1702). De Heide is less well known than Blankaart. Historians know him best for his investigations using microscopes.[577] His other publications provide insight into the concerns of a practicing physician over the knowledge physicians had of the properties and composition of the drugs that were regularly prescribed.

The first aim now is to clarify the relationship between De Heide and Blankaart. Huib Zuidervaart briefly discusses it in connection to the anatomical theatre in Middelburg. He also thoroughly investigates the course of De Heide's remarkable life, tracing it from his early education as surgeon's apprentice in Middelburg to his studies under Sylvius in Leiden, his return to Middelburg in 1668 to practice medicine and his move to Rijnsburg twenty years later. He suggests that the two physicians knew each other from the mid-1660s when Blankaart visited the *theatrum anatomicum* with his father and De Heide was a surgeon's assistant there under Cornelis van de Voorde (1628-1678).[578] After the dissolution of the Illustrious School in Middelburg, the Blankaart family moved to the Frisian city of Heerenveen, before settling in Franeker in 1669, when Blankaart's father Nicolaas (1624-1703) became professor of Greek and Antiquities. Between 1668 and 1671, Steven was an apothecary's apprentice at Amsterdam and thereafter joined his family in Franker to study medicine. Three years later, he received his medical degree there and established a medical practice in Amsterdam.[579]

De Heide and Blankaart became professionally entangled with each other, through the translations of the work of the English physician Thomas Willis (1621–1675), which they produced between the late 1670s and the early 1680s and their common interest in the study of drug properties. A translation of Willis' work, by an anonymous translator, was undoubtedly the starting point of their rather peculiar relationship.

[577] Jan C. de Man, *Antonius de Heide, med. doctor te Middelburg, ontdekker der later zoo beroemd geworden trilhaarbeweging* (Middelburg 1905); Peter M.N. Eldering, "Leerlingen, practicum en haarvaten", *Bulletin voor het onderwijs in de biologie* vol. 11 (1980) 283-289; Gerrit A. Lindeboom, "De ontdekking van de haarvaten door Antonius de Heide (1683)", *Nederland tijdschrift voor geneeskunde* vol. 124 (1980) 839-841; Lodewijk Palm, "Antoni van Leeuwenhoek's malacological researches as an example of his biological studies", in: Lodewijk C. Palm and Harry A.M. Snelders, eds., *Antoni van Leeuwenhoek 1632-1723* (Amsterdam 1982) 164; Gerrit A. Lindeboom, "Anton de Heide als proefondervindelijk onderzoeker", *Gewina* vol. 6 no. 3 (1983) 121-134.

[578] Huib Zuidervaart, "Het in 1658 opgerichte theatrum anatomicum te Middelburg. Een medisch-wetenschappelijk en cultureel convergentie punt in een vroege stedelijke context", *Mededelingen van het Koninklijk Zeeuwsch Genootschap der Wetenschappen* (2009) 102, 110-111.

[579] Charles E. Daniëls, "Blankaart, Steven B.", *Biographisches Lexikon der hervorragenden Ärzte aller Zeiten und Völker* (München etc. 1962) 565.

Dutch translations of Thomas Willis' work

In 1676, the translations of three treatises by Thomas Willis, *De fermentatione* and the parts of *Pathologiæ cerebri* about scurvy and epileptic fits were published together in Middelburg.[580] A printer established in Middelburg called Willem Goeree (1635-1711) and his father-in-law Johannes Janssonius van Waesberge (1616-1681), a bookseller working in Amsterdam, cooperated on the publication. Four years later, Van Waesberge also became De Heide's father-in-law.[581] Goeree and Van Waesberge would work together on other publications besides the translations of Willis, De Heide assisting them on several occasions.[582] To complicate the story, Blankaart Sr also worked on a number of publications with Van Waesberge.

By the time of the publication of these translations, Willis' books were available in the Dutch Republic for those who knew Latin. *Diatribae duae* had been reproduced in the The Hague in the same year as the first London publication appeared and a number of times after that. *Pathologiae cerebri*, which included Willis' treatise about scurvy, was published in Amsterdam.[583] As Mart van Lieburg reports, the works of Willis were much discussed in disputations at the University of Groningen and fermentation became a subject discussed in

[580] Thomas Willis, *Diatribae duae medico-philosophicae: quarum prior agit de fermentatione, sive de motu intestino particularum in quovis corpore; altera de febribus, sive de motu earundem in sanguine animalium. acc. Dissertatione de urinis* (London 1659[1]); Thomas Willis, *Pathologiæ cerebri, et nervosi generis specimen: in quo agitur de morbis convulsivis, et de scorbuto* (Oxford 1667); Thomas Willis, *Nieuwe en Geneeskundige verhandeling vande Fermentatie ofte rysing, Hoedanig ons die inde beschouwing aller mineralen, planten, dieren, als in der selver Chymische behandeling voorkomt. Leerende uit d'Algemene Grond-vest der Stofscheyding, op een ligt verstandelijke manier de ware kenisse der Natuurkunde beginselen tot alle Genees-kunde waarnemingen, en Artzeny Bereidingen over-brengen. Beneffens een tractaat van des scheurbuiks oorsprong, soorten toevallen en konstige Genesing, volgens de Nieuwe Chymische Gronden van den selven Autheur. Beide nu eerst tot dienst der Heel-meesters en Apothekers uyt Latijn vertaalt en door-gaans met Aanteykeningen en Blat-wijser verrijkt* (Middelburg 1676).

[581] Zuidervaart, "Theatrum anatomicum", 110. Janssonius van Waesberge himself had inherited the business of his father-in-law Johannes Janssonius (1588-1664); Adrianus Marinus Ledeboer, *Het geslacht van Waesberghe: eene bijdrage tot de geschiedenis der boekdrukkunst en van den boekhandel in Nederland* (The Hague etc. 1869) 118-122.

[582] Cornelis van de Voorde and Antonius de Heide, *Nieuw lichtende fakkel der chirurgie of hedendaagze heel-konst. Verrijkt met een chirurgijns of heel-meesters zee-compas* (Middelburg 1680).

[583] Thomas Willis, *Diatribae duae medico-philosophicae: quarum prior agit de fermentatione, sive de motu intestino particularum in quovis corpore; altera de febribus, sive de motu earundem in sanguine animalium. acc. Dissertatione de urinis* (The Hague 1659, 1662) and (Amsterdam 1663, 1669) Editie uitgegeven in Londen van 1662/63 en van andere werken uit 1664 en 1672 in bezit van Huygens; Thomas Willis, *Pathologiae cerebri, et nervosi generis specimen. In quo agitur de morbis convulsivis, et de scorbuto* (Amsterdam 1670).

the work of some Groninger professors as well.[584] Some Dutchmen apparently also acquired English editions of Willis' work.[585]

Michael Hawkins has recently pointed out that Willis had not been able to obtain a substantial medical education due to the English civil war (1642–1651) before starting to practice medicine.[586] He argued that Willis' first publication was intended to establish his reputation as a natural philosopher by showing how chemistry, a field in which he had developed practical knowledge from the late 1640s, was fundamental for medicine.[587] It was in the study of chemistry, anatomy, pathology and animal experimentation that he allied himself with other founding members of the Royal Society of London in the Oxford Philosophical Club.[588] In *Diatribae duae*, he set forth his theory that matter consisted of five types of particles, spirit, sulphur, salt, water and earth.[589] His strategy appears to have been successful. The following year, on August 8 1660 Willis was appointed as Sedleian professor of natural philosophy at Oxford University. Although he had received permission to practice medicine and graduated as bachelor of medicine in 1646, he became a medical doctor only on the 30th of October of 1660.[590]

If it was indeed Willis' objective to promote chemistry as providing the foundation for medicine, it appears to have been clearly recognised by the author of the Dutch translation of 1676, who relayed the same message to a Dutch-speaking audience. In the title, the translator is actually much clearer about the purpose of the text than Willis was in the original. The Latin title of Willis' work on fermentation merely speaks about the internal movement of particles to any place in the body. The information on the Dutch title page is much more elaborate and thus served as an advertisement for the book.[591] The title indicates

[584] M.J. van Lieburg, "De medische faculteit te Groningen en de ontwikkeling van de medische wetenschap. Een studie van de Groningse academische geschriften uit de jaren 1614-1714", in: Arend Hendrik Huussen jr., ed., *Onderwijs en onderzoek: studie en wetenschap aan de academie van Groningen in de 17e en 18e eeuw* (Hilversum 2003) 31-83, there 64-76.
[585] Anon., *Catalogus Variorum & Insignium in omni Facultate & Lingua librorum, bibliothecae nob. amplissimique viri Constantini Hugenii Zulichemii, &c. Toparchae & dum viveret. Serenissimi Arausionensi Principis Concilii Praesidi. Quorum auctio habebitur Hagae-Comitis in officina Abrahami Troyel Bibliopolae op de groote Zael van 't Hof. Ad diem Lunae 15 Martius 1688*. (The Hague 1688).
[586] Also described in Kenneth Dewhurst, *Thomas Willis's Oxford lectures* (Oxford 1980) 4.
[587] Michael Hawkins, "Piss Profits: Thomas Willis, his *diatribae duae* and the formation of his professional identity", *History of science* vol. 49 no. 1 (2001) 1-24.
[588] Dewhurst, *Thomas Willis's*, 8-9.
[589] Hansruedi Isler, *Thomas Willis 1621-1675. Doctor and scientist* (New York and London 1968) 47.
[590] He would hold his position at Oxford until 1667, when he left to live in London. Dewhurst, *Thomas Willis's*, 4, 17.
[591] In her recent dissertation Isabelle Clairmont wrote about Mary Tyre' *Medicatrix* of 1675 that "The lower on the scale of medical hierarchy, the more the title page was used as an advertisement to demarcate one's position. In this way, irregular authors such as Trye could use print to defend their medical ideology as well as to advertise their practice." Isabelle Clairmont, *Midwifery, kitchen physick, and the medicatrix. Science and the female author in early modern England* (Gent 2013) 217.

how fermentation "appears to us in the consideration of all minerals, plants, animals as well as in the chemical treatment of these."[592] It also informs us that the book's main purpose is:

> Learning from the general foundation of chemistry, in an easily understood manner, the true knowledge of physics principles to all medical observations and to giving an account of drug preparations.[593]

In a roundabout way, the author claimed *Stofscheiding* or chemistry provided the basis for *Natuurkunde* or physics, which, in turn, supplied the principles for the observations made in *Genees-kunde* or medicine and for the preparation of drugs. The preface repeated this last function of chemistry twice, adding that,

> the healing-master also draws this use from chemistry, that he gets a clear understanding of the way in which medicaments work in people.

The translator thus presented the "art" of chemistry as providing the basis for exploring topics from physics and medicine, rather than as producing its own questions pertaining to its own area of nature. [594]

The comments added to the text by the translator mostly clarify Willis' writing or the preparation of drugs. One in particular exemplifies what Dewhurst has called Willis' way of arguing, "by using many agricultural and culinary analogies based on his own observations and experience best described as a rough and ready farmhouse empiricism."[595] To Willis' treatise on scurvy the translator added:

> This substance became powerless, because it consists of sulphur salt particles, that appear to be contrary to the particles of the solid salt; and from this cause, produce an effervescence: because bodies that consist of such particles, are easily mixed and unified; as one can see when water is poured with water. If then these conflicting salts bubble up, the sharp

[592] "Hoedanig ons die inde beschouwing aller mineralen, planten, dieren, als in der selver Chymische behandeling voorkomt."
[593] "Leerende uit d'Algemene Grond-vest der Stofscheyding, op een ligt verstandelijke manier de ware kenisse der Natuurkunde beginselen tot alle Genees-kunde waarnemingen, en Artzeny Bereidingen over-brengen."
[594] Willis, *Nieuwe en geneeskundige verhandeling van de Fermentatie ofte rysing*, *5v, *6r-v. "Behalven dese verhaalde nuttigheden, so trekt den Heel-meester ook dit voordeel uit de Stof-scheiding , dat hy klaar begrip krijgt vande wyse, op welke de Genees-middelen in den mensche werken: …"
[595] Dewhurst, *Thomas Willis's*, 11.

> points, with which the salt and sulphur particles appear to be armed, are either snipped off or bent and tangled up, so that they are unable to sting sharply or to bite. From which the reason becomes clear why vitriolated wine-stone does not reach by far as sharpness found in Oil of Vitriol, or in Wine-stone-salt.[596]

Later on, we will consider this type of reasoning further.

One comment in the preface makes it quite clear that Zuidervaart's attribution of this work to De Heide is correct.[597] The author announced his plans,

> to bring more works of Willis into our language, and provide the same with some notes, to the use and enjoyment of readers. At the moment under the press is a treatise that Willis calls the arithmetical explanation of the operations of medicaments in the human body.[598]

Indeed a year later, a translation by De Heide of the first part of Willis' last work *Pharmaceutis rationalice sive diatriba de medicamentorum operationibus in humano corpore*, originally published in 1674, appeared with the same printers.[599] A translation of the second part appeared in 1681 without the cooperation of Van Waesberge.[600] Goeree had sold

[596] Willis, *Nieuwe*, 234, Q3v: "Kracheloos werd dese stof, om dat het suur sout uit deeltjes bestaat, die strijdig schijnen tegen de deeltjes van 't vast Sout; en uit dese oorsaak verwekken sy te gaar een op-sieding: want lichamen die uit eendaanige deeltjes bestaan werden ligt te gaar vermengt en vereenigt; gelijkmen sien kan als water by water gegoten werd. Als dan dese strijdige souten te gaar opsieden, dan werden de scherpe puntjes, waar mede de soute en suure deeltjes schijnen gewapent te sijn, of afgeknakt, of omgebogen en door malkander verwart, soo datse onbequaam sijn om scherp te steken of te bijten. Waar uit de reden openbaar werd, waarom de gevitrioleerde Wijn-steen op veer na niet bereikt de scherpheit, die inde Olie van Vitriol, of in't Wijn-steen-sout gevonden werd." Vitriolated wine-stone is now commonly called potassium sulphate or tartar, while Oil of Vitriol is sulfuric acid and Wine-stone-salt is a tartrate, a salt of tartaric acid.

[597] Zuidervaart, "Theatrum anatomicum", 102.

[598] Willis, *Nieuwe en Geneeskundige verhandeling*, *7r. "Wy hebben voor meer werken van Willis in onse Taal te brengen, en deselfde met eenige aanteekeningen , tot nut en vermaak des Lesers, te voorsien. Jegenwoordig ligt onder de Pers een Verhandeling, die Willis noemt , Reden-konstighe Verklaringh van de werckingh der Genees-middelen in 's Menschen Lichaam".

[599] Thomas Willis, *Pharmaceutice rationalis, sive Diatriba de medicamentorum operationibus in humano corpore. Autore Thomas Willis M.D. in Univ. Oxon. Prof. Sedleiano, nec non Coll. Med. Lond. & Societ. Reg. Socio* (London 1674); Thomas Willis, Antonie de Heide, trans., *'Algemeende En bysondere werking der genees-middelen in s'Menschen lichaam, Door een wis-konstige redeneringh volgens de nieuwe gronden der Genees-kunde, nader als oyt voor desen verklaart en met Print-verbeeldingen vertoont, Door Thomas Willis, Hoog-leeraar in de Genees-oeffening tot Oxfort: Uyt het latijn vertaalt, en met noodighe aanteyckeningen verrijkt* (Middelburg, Willem Goeree and Johannes Janssonius van Waesberge; 1677).

[600] Thomas Willis, *Pharmaceutice rationalis, sive Diatriba de medicamentorum operationibus in humano corpore. Pars secunda. Autore Thomas Willis M.D. in Univ. Oxon. Prof. Sedleiano* (Oxford 1675); Thomas Willis, *Vervolg of tweede deel der redenkundige verhandeling van de kragt en werking der genees-middelen, ontrent de deelen en siekten des menschen lichaams in 't bysonder; vervat in III boeken Verligt met verscheide*

the earlier translations in Amsterdam, but from 1681 he printed them there as well. As was the case with Willis' first work, Latin editions of *Pharmaceutice rationalis* came off the presses in The Hague shortly after the English editions.[601] Both the The Hague editions and the Dutch translations of *Pharmaceutice rationalis* contained the original copper engravings.

The string of Dutch translations ended with Willis' work on fever by Blankaart, twenty-two years after its original publication. Here the Dutch title offered the same information as the original Latin one.[602] It never seems to have been De Heide's intention to translate all Willis' works into Dutch. He actually chose to translate works from two different publications by Willis, instead of translating both publications completely. He elaborately explained why he did not translate the treatise on fever, in the preface to Willis' treatise. Firstly, the "accidents" of scurvy could be explained well by the principles that Willis had introduced in his work on fevers. As such, scurvy provided proof of the solidity of those principles. Secondly, seafaring "healing masters" were very likely to be asked to treat cases of scurvy on long journeys.[603] Nevertheless, Blankaart wrote that he himself had translated the work in order to help De Heide achieve the goal of translating Willis' complete oeuvre. He enumerated those works by Willis that De Heide had left untranslated and expressed his

kopere print-verbeeldingen Uit 't Latijn vertaald, en met noodige aantekeningen verrijkt. Door A.D.H. medicinae doctor (Amsterdam, Wilhelmus Goeree; 1681).

[601] Thomas Willis**,** *Pharmaceutice rationalis sive diatriba de medicamentorum operationibus in humano corpore* (The Hague 1674); Thomas Willis**,** *Pharmaceutice Rationalis sive diatriba de medicamentorum operationibus in humano corpore* (The Hague 1675-1677).

[602] Thomas Willis, *De febribus, sive de motu eorumdem in sanguine animalium* (London 1659) and *Dissertatio epistolica de urinis* (London 1659); Thomas Willis, *Nieuwe verhandeling van de koorsen, of derzelver beweging in 't bloed der dieren, als ook een beschryving der menschelyke wateren uit het Latyn vert., en met noodige aanteikeningen verrykt door S.B* (Amsterdam, Jan ten Hoorn; 1681).

[603] Willis, *Des Scheur-Buiks* (Middelburg, Wilhelmus Goeree; 1676) M2v, 168. "Maar of schoon Willis de verhandeling der Koortsen op sijn voorgaande tractaat laat volgen; echter hebben wy dienstiger geoordeelt de verhandelingh van 't Scheur-buik in plaats van die der Koortsen te stellen; en sulx is geschied om de volgende redenen: Eerstelijk, sijn in het Scheur-buik by na allerlei slag van siekten opgewonden; gelijk uit 1,3,4, en 5 Hooftstukken van de volgende verhandeling blijken sal. Derhalven indien de Natuur en toe (M3r, 169) vallen van het Scheur-buik op de voor af-gelegde gronden wel verklaart konnen werden, soo sal sulx een bewijs sijn vande vastigheit en klaarblijkelijkheid deser gronden; om dat niet mojelijk valt een of twee toevallen en siekten te verklaren volgens eenige gronden, welkers losheit en valsheit nochtans aan den dag komt, alsmen op dezelfde de verklaring van aale siekten bouwen wilt; doch de beginselen, daar door al de siekten verklaart werden, konnen niet wel valsch sijn. De tweede reden, daardoor ik beweegt ben, om in plaatse van de verhandelingh der Koortsen, die van 't Scheur-buick te stellen, is dese: dat de Scheur-buik als een eige siekte der Noordsche Gewesten gehouden werd, die, in dese onse Nederlanden ook seer gemeen sijnde , en op lang-duurige reisen dikwils voor-vallende, van de Heel-meesters, tot welkers nut ik de moeite van dit Over-setten meest gedaan heb, veel moet behandelt werden. Want ofwel de Koortsen aan de scheepvarende Heel-meesters ook dikwils voorkomen, nadien nochtans de geduurige meer door de natuur, dan door genees-middelen (M 3v, 170) geholpen werden, soo dat de geneser slechts moet versorgen, dat de dingen, die de wel werkende Natuur konnen beletten, geweert werden; en de afgaande ongestadige Koortsen ontstaan uit het Scheur-buik, of gaan daar mede verselt; daarom dacht ons den Heel-meester meer aan de kennisse des Scheur-buiks, als aan de kennisse der Koortsen gelegen te sijn."

intention to publish translations of them in the future. Together, Blankaart said, they would soon make all the works available.[604]

These translations never appeared, but apparently Blankaart and his publisher Ten Hoorn were made aware that Dutch translations of medical and chemical authors would sell and that Blankaart could use them to promote his reputation as connoisseur of the most recent developments in medicine. Ten Hoorn's portfolio shows the large size of Blankaart's share in it. In 1680 they had cooperated on the publication of a translation of *De brandende salamander, ofte Ontleedinge der chymicale stoffen* by physician and chemist Carlo Lancilotti (active 1672-1679)[605] and would go on to publish translations of Nicolas L'Emery's *Cours de chymie* and all medical and physical works of John Marow (1640-1679) in 1683. Blankaart's notes on a translation of twelve books on surgery by Thomas Fienus (1567-1631) and Isaac van Bebber's *Ware en vaste gronden van de heelkonst* (True and solid grounds of medicine) were published together in 1685.[606] The introduction to this last translation tells us that Blankaart understood the importance of Fienus and Bebber in light of the "reformation" of Sylvius. According to Blankaart, Bebber had been one of the first reformers besides Sylvius.[607] A collection of all Cornelis Bontekoe's (1647-1685) philosophical, medical and chemical works followed in 1689.[608]

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[604] Willis, *Nieuwe verhandeling van de koorsen,* *2r. "Wetende dat na de stukken van Willis in onse taal zeer gehongert werd, en het by na geen een mans werk is over te setten, vermids die goede Heer veel geschreven heeft, heb ik raadsaam gedagt de Heer de Heide, die 't werk begonnen heeft, wat behulpzaam te zyn, om so gesamentlyk in 't korte alle de stukken aan den dag te brengen. Ben ook van mening in 't toekomende de stuiptrekkingen, de ontsteking des bloeds, beweging der spieren, de verhandeling der hersenen en zenuwen in't ligt te geven."

[605] Carel Lancilot, *De brandende salamander, ofte Ontleedinge der chymicale stoffen zijnde een weg-wijzer, oft institute om sich in alle operatien der schey-konst te oeffenen : Item den ontwaakten chymist, met een byvoegsel van de verkiesinge des vitriols / Uytgegeven door medicus en chymicus ; uit het Italiaans vertaalt door Jacob Leeuw; Verciert met nooten van S.B.M.D.* (Amsterdam, Jan ten Hoorn; 1680); Carlo Lancilotti, *Guida alla chimica* (Modena 1672). For a discussion of the facsimile edition issued in 1980 see: Harry A.M. Snelders, "Boekbesprekingen", *Gewina* vol. 4 no. 2 (1981) 113.

[606] Nicolaus Lemery, *Het philosoophische laboratorium, of Der chymisten stook-huis. : Leerende op een korte en ligte wyse alle de gebruikelykste medicamenten op de chymische wyse bereiden; tegelyk met aanmerkingen en naukeurige redeneringen over yder preparatie in 't besonder. Vertaalt na het laatste France exemplaar, en met noodige aanteikeningen verrijkt* (Amsterdam, Jan ten Hoorn; 1683); Nicolas L'Emery, *Cours de chymie* (Paris 1675); Johannes Marow, *Alle de medicinale en natuurkundige werken uit het Lat. vert. en met aanm. verrijkt door S.B* (Amsterdam 1683); Santorio Santorio, *De ontdekte doorwaasseming of de leidstar der genees-heeren*. Philippe La Grue, trans. (Amsterdam 1683); Thomas Fienus, *Libri chirurgi XII De praecipuis artis chirurgicae contraversiis ... Opera posthuma Hermanni Conringii cura nunc primum edita* (Frankfurt 1649); Isaac Bebber, *Ware en vaste gronden van de heelkonst* (Dordrecht, Simon onder de Linde; 1668); Thomas Fienus, *De twaalf voornaamste handgrepen der heelkonst, ...* Isaac Bebber, *Ware en vaste gronden van de heel-konst met noodige aanmerkingen verrijkt door S.B* (Amsterdam 1685). Blankaart also added notes to the second edition of the Dutch translation of Santorio Santorio's *De medicina statica* (1614) by Phillippe Lagruë (1683[1], 1684). Neither editions were published by Ten Hoorn. Thijssen-Schoute, *Nederlands*, 330-331.

[607] Thomas Fienus, *De twaalf voornaamste handgrepen der heelkonst, ...* Isaac Bebber, *Ware en vaste gronden van de heel-konst met noodige aanmerkingen verrijkt door S.B* (Amsterdam 1685) *2r-v.

[608] Cornelis Bontekoe, *Alle de Philosophische, Medicinale en chemische werken van den heer Corn. Bontekoe, in sijn leven Med. Raad, en Oppergenees-Heer van de Keurvorst van Brandenburg, Professor tot-Frankfort aan den Oder. Behelsende Een afwerp der ongefondeerde Medicyne, Chirurgie en Pharmacie der oude Genees-*

In this translation of Willis' *De febribus* and *De urinis*, Blankaart added relatively few of his own notes, and he followed the content of the text in saying little about medication. The preface did offer an opportunity to promote chemistry as the foundation of Willis' and his own work.[609] Other publications that I will discuss show that he was interested in properties of drugs by this time.

Pharmaceutice rationalis

In *Pharmaceutice rationalis*, published in two parts, Willis discussed a topic that had also been identified in the preface of the 1676 translation, that is, the operations of medicines in the human body. In the preface to the first part of *Pharmaceutice rationalis*, Willis presented ignorance of the operations of drugs as the main obstacle in attaining perfect knowledge of medicine.

> In fact, the neglected or unknown principle of the operations of medicaments; like a great opened chasm, thus far prevented solely or at least most of all that a medicine, as far as a complete system thereof, finally duly composed and in all parts completed, has appeared.[610]

Historians agree that Willis did not succeed in attaining his objective. They disapprove in particular of the drugs he discussed. These were neither "rational nor scientific" according to Kenneth Dewhurst.[611] Hansruedi Isler considered this last effort of Willis to achieve "a scientific medicine" as a failure as well. Willis' program of reform "remained utopian, and the pharmacological contents of the book are seldom more than a very good survey of contemporary therapy". He writes that Willis rationalised the traditional and empiric foundations for therapies by, "substituting the missing correlation between observations and therapy by means of his chymical conjectures".[612] These historians were clearly of the opinion that the understanding of the properties of drugs should have led to an improvement of

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heeren. Neffens Den opbouw van een ware Philosophie, Medicyne en Chymie, dienende om de gesondheid lang te bewaren, en de siektens kort en veilig te genesen. (Amsterdam, Jan ten Hoorn; 1689). Bontekoe was the pen name of Cornelis Dekker.

[609] Willis, *Koorsen*, *3r.

[610] Willis, *Pharmaceutice rationalis* (1674) a3v. "Enimvero haec sive neglecta, sive ignorata, Operationum medicinalium doctrina; magnum velut Chasma pandens, unice aut saltem potissime impediit ne hactenus Iatrice quoad systema eius integrum tandem rite compacta, omnibusque numeris absoluta prodierit."

[611] Dewhurst, *Thomas Willis's*, 24.

[612] Isler, *Thomas Willis 1621-1675*, 182, 185.

therapeutics. However, Willis does not appear to have been dissatisfied with the medicaments themselves, but only with the understanding of their properties.

Indeed, Willis carefully observed and investigated the effects of drugs on the body, but does not question how these drugs had come into use or how these effects were beneficial for patients - questions that are central in modern pharmaceutical research. Willis himself was frank about the fact that the drugs he included in both parts of *Pharmaceutice rationalis* were both "old and new, dogmatic and empirical" and that he extracted some "from the books of healers from all centuries". He had collected some of the drugs "most celebrated amongst vagrant men and little women".[613] And he entertained no doubts about the efficacy of the empirical drugs that he discussed. According to him, the difference that clarifying how drugs worked would make, was that these known remedies would be used more prudently, more safely, more certainly and with counsel and method.[614] This point of view allowed Willis to take aim against "pseudo-chemists" who, without counsel or method, produced or used new drugs "whose powers were completely unknown" and often non-existent or harmful.

Crucially, *Pharmaceutice rationalis* was far less chemical in nature than the works assembled in *Diatribae duae*. According to historian Roger French, the rationality of the book's title was "a mechanical rationality". In its preface, Willis indeed mentioned that mathematics and mechanics had clarified and expanded the practice of medicine by providing explanations and foundations of things. He identified the lack of understanding of drug properties and the composition of drugs as the main reason that medicine was criticised, amongst others by chemists.[615] French situates *Pharmaceutice* in the "highly charged political atmosphere" of the "disputes between the Galenists and the mechanists, between the mechanists themselves, and between the chemists and everyone else". Under these circumstances, *Pharmaceutice* provided a link between "the practice of traditional medicine" of the College of Physicians and the "new philosophy". Willis had constructed "mechanical reasons" for that practice by accounting for the actions of *materia medica* in association with anatomy.[616]

Willis described the operations of drugs as the effect of nondescript particles on the different parts of the body that he had investigated. Unlike in his *Diatribae duae*, he made no

[613] Thomas Willis, *Pharmaceutice rationalis* (1675) A5 r: "…tum ex libris medicis cuiusque seculi excerpta, tum vulgo apud Agyrtas, & mulierculas maxime celebria congressimus..". Thomas Willis, *Vervolg* (1681) † 4. "....oude en nieuwe, op reden-gegronde en proefkundige, uit de Boeken der Genesers van alle eeuwen gehaald, als ook die by de Quaksalvers en Vrouwtjes in gebruik zijn."
[614] Thomas Willis, *Pharmaceutice rationalis* (1674) a3r-a3v, a4r-a4v, b1r; Willis, *Algemeende en bysondere*, *2v, *3v, *4r. Thomas Willis, *Vervolg of tweede deel*, 108, 122.
[615] In Dutch, "Hondswyse". Willis, *Algemeende en bysondere*, *2v.
[616] French, *Medicine before science*, 195-199.

mention of the basic constituent elements of matter or of the material properties of particles, such as their shape, that provoked the effects he had observed. Instead, he remarked more simply that the particles in the drugs had the ability to irritate the part of the body with which they came into contact and that this irritation provoked the observed effects. The concept of irritation was important in the work of Francis Glisson (ca. 1599-1677) and was also explored by Robert Boyle. The work of the latter also criticised reasonings about corpuscular properties of the kind that Willis presented in *Diatribae duae*.[617] With *Pharmaceutice rationalis*, Willis appears to have distanced himself from more Helmontian physicians who had taken him as one of their examples when, a decade earlier, they endeavoured to establish a Society of Chemical Physicians to rival the Royal College of Physicians.[618] The developments that have been noted in Willis' works can be understood as firmly grounded within the English context of the civil war, the new philosophy promoted in the Royal Society and the conflicts between the physicians of the College of Physicians and chemical physicians.

French presented Willis' last work as a resolution of the problems, which learned physicians faced in the last quarter of the seventeenth century. By looking at the work of De Heide and Blankaart, we can see how Willis' publications were interpreted and used in a different, Dutch context. Neither Blankaart nor De Heide was satisfied by Willis' explanation of the operations of drugs. As we shall see, Blankaart sought to provide an explanation for drug properties from the basic constituent elements of matter and from the material properties of particles - an explanation of the kind Willis had refrained from suggesting in *Pharmaceutice rationalis*. In De Heide's case, the translation of Willis' works instead provided the start of a discussion about the foundations of medical practice.

In the first Dutch translation of Willis' work, as we have noted, De Heide emphasised the use of chemistry for the understanding of medicine, the properties of drugs and their application. Like the original Latin, the Dutch titles of *Pharmaceutice rationalis* emphasised the rational treatment of the subject. Judging from the title of the Dutch translation of the first part of *Pharmaceutice rationalis*, its publisher was not quite sure how to summarise its content. According to the title it was about "the general and special operation of medicaments, by a mathematical reasoning according to the new foundations of medicine,

[617] Francis Glisson, *Tractatus de natura substantiae energetica seu de vita naturae ejusque tribus primis facultatibus* (London 1672); Idem, *Tractatus de ventriculo et intestinis. Cui praemittitur alius, de partibus continentibus in genere; & in specie de iis abdominis* (London 1677); Owsei Temkin, "The classical roots of Glisson's doctrine of irritation", *Bulletin of the history of medicine* vol. 38 (1964) 297-328; Xavier Bichat, "Irritability and sensibility: the forces of life", *Medical historical supplement* vol. 4 (1984) 47-65, especially 48; Michael Hunter, *The Boyle papers. Understanding the manuscripts of Robert Boyle* (Aldershot etc. 2007) 262-265; Guido Giglioni, "What happened to Francis Glisson? Albrecht Haller and the fate of eighteenth-century irritability", *Science in context* vol. 21 no. 4 (2008) 465-493.
[618] Debus, *Chemistry*, 86-102.

explained closer than ever before".[619] Here, the Dutch word "*wis-konstig*" or "mathematical" was used in the same way as in the title of many contemporary works. Historian Rienk Vermij remarked that there is little for us to discover in these works that is mathematical. Apparently the word was accorded a broader significance, implying that the authors had followed their natural reason. Thus they advertised themselves as philosophers whose work was "part of a larger philosophical programme to rearrange the world".[620] The Dutch title of part two is less convoluted and stayed much closer to the original Latin and its use of the word *rationalis*, by calling it a "*redenkundige verhandeling*" or rational treatise.

De Heide only added a preface of his own to the translation of the first part of *Pharmaceutice rationalis*. From this we cannot gather much about his motives for preparing the translations. Like Willis, he said nothing about the importance of chemistry for the foundations of medicine but focused on anatomy and the correct preparation of chemical and plant-based remedies instead.[621] Only from the few notes he added may we gain an idea of what he made of the books. He once objected to Willis when he said he "believes" something about what happened in the body. Employing the same "agricultural and culinary analogies" as Willis, De Heide offered his own estimation of what could possibly happen when that particular drug entered the body.[622] He elaborated on Willis' suggestion that a patient's imagination could enhance the operations of a drug and stated that the occult properties of some remedies could not be attributed solely to imagination as Willis suggested.[623] Occasionally, he commented on the preparation of chemicals.[624]

Reason, chemistry, anatomy and magnifying glasses

Historian Dewhurst especially valued *Pharmaceutice rationalis* because of the research Willis and his assistants had done into the anatomy of the digestive and respiratory systems. Willis focused on these body parts as being the ones on which medicaments acted. His anatomical research, performed with the help of a microscope, was shown in engravings that depicted the components of the relevant parts and their tissues in great detail. These illustrations played an

[619] *'Algemeende En bysondere werking der genees-middelen in s'Menschen lichaam, Door een wis-konstige redeneringh volgens de nieuwe gronden der Genees-kunde, nader als oyt voor desen verklaart.*
[620] Rienk H. Vermij, *Secularisering en natuurwetenschap in de zeventiende en achttiende eeuw: Bernard Nieuwentijt* (Amsterdam 1991) 68-69.
[621] Willis, *'Algemeende En bysondere werking der genees-middelen in s'Menschen lichaam*, *6r-**r.
[622] Dewhurst, 11; Willis, *Vervolg of tweede deel*, 19-20.
[623] Willis, *Vervolg of tweede deel*, 414, 415.
[624] Ibid., 462.

important part in Willis' argument and they accentuate the changes in the epistemology of examining the properties of drugs by the 1670s.

The seventeenth-century rise of the microscope as an instrument for the investigation of nature has been well documented.[625] Historians have noted that it was not widely adopted as a scientific instrument after its invention.[626] Although one argued that, "in contrast to the telescope, the microscope was never invented".[627] They generally agree about what caused its popularity. Christoph Lüthy, Catherine Wilson and Marian Fournier have argued that microscopical investigations were closely associated with the conviction, inherent to mechanical philosophy and the corpuscular view of matter, that the basic components of matter could be made visible. Fournier concluded that, "the earliest microscopic investigations were indeed presented by their respective authors within the context of a mechanistic interpretation of the phenomena of nature".[628]

Edward Ruestow asserted the importance of the telescope as inspiration for these investigations, but also of the "cultural traditions, social relations, and personal sensibilities in the Dutch Republic" that "would seem to have offered encouraging contexts for the early and systematic use of magnifying lens". Prominent amongst the currents of thought and practices there were Descartes' "corpuscular mechanism" and the "increasing commitment to 'subtle anatomy'" and a much earlier pictorial "preoccupation with nature's smaller forms".[629] As he also pointed out however, Cartesian rationalism, which assumed that particles and the interior structures of bodies were beyond the senses, could work against the use of the microscope. Accordingly, "the realm of unseen particles and pores in particular was to be explored by reason alone." The "mechanistic imagination" could prove stimulating to microscopy as well however.[630]

Finally, they agreed as well that after its regular use as a scientific instrument from the 1660s onwards, this use declined from at least the late 1680s. Fournier in particular arged that although the microscope was widely used in eighteenth-century natural history, microscopical observations "no longer had a significant bearing on the development of the pivotal scientific ideas of the eighteenth century". One contributing factor that Lüthy

[625] i.a. In three books and one article published around the same time. Ruestow, *Microscope*; Catherine Wilson, *The invisible world. Early modern philosophy and the invention of the microscope* (Princeton 1995); Marian Fournier, *The fabric of life. Microscopy in the seventeenth century* (Baltimore etc. 1996); Christoph Lüthy, "Atomism, Lynceus, and the fate of seventeenth-century microscopy", *Early science and medicine* vol. 1 (1996) 1-27.
[626] Fournier, *Fabric*, 1, 4; Lüthy, "Atomism", 4-5; Wilson, *Invisible world*, 40; Ruestow, *Microscope*, 2, 5.
[627] Lüthy, "Atomism", 2.
[628] Fournier, *Fabric*, 4-5, 186; Lüthy, "Atomism", 14-16; Wilson, *Invisible world*, 40, 57, 58, 68.
[629] Ruestow, *Microscope*, 5, 39-41, 48.
[630] Ibid., 62-63, 67.

mentioned was that "by the 1680's it had become clear even to the most fervent enthusiast" that the levels of magnification that were required in making elemental atoms visible, "would never be achieved".[631]

These considerations about the use of reason and the microscope can be recognised in the way Willis, De Heide and Blankaart considered the investigation of drug properties. They similarly presented the relative use of reason, anatomy, the microscope and chemistry as a matter of practical concern, as much as a matter of philosophical commitment.

Very much how Ruestow described, investigations, anatomical and others that had been made with microscopes, shaped their "experience of discovery".[632] To De Heide and Blankaart, such discoveries set an important standard for the kind of knowledge that could be attained about the body. They themselves were familiar with using microscopes. De Heide is still best known for the microscopical investigations he made in the early 1680s and Blankaart's considerable interest in anatomical and microscopical research has also been acknowledged.[633] They considered them of limited use in the investigation of drug properties however.

De Heide discussed the connection between investigating the operations of drugs and anatomy, in his preface to the translation of the first part of *Pharmaceutice rationalis*. He wrote that many things were discovered in anatomy. He compared this knowledge to that of the wheels and springs in a clock and argued that in order to cure, knowledge of the shape and movement of the fluids and spirits was necessary as well. He concluded that from what he had said about anatomy it appeared that much was to be investigated about the operation of drugs.[634] Investigating the "movement of particles" and the investigation of the structure and fluids of the body complemented each other in inquiring into the operations of drugs.

The author of the preface, to the 1676 translation of Willis, presumably De Heide, mentioned the limitations of the *vergroot-glas* or magnifying glass when he considered the conditions under which the operations of the body could be studied. He wrote that,

> because the tools and movements, that nature uses, are so fine and small, that they possibly would not be discovered by a magnifying-glass, which

[631] Ruestow, *Microscope*, 2, 82-83; Fournier, *Fabric*, 4, 45, 185; Lüthy, "Atomism", 16, 22-23, 26; Wilson, *Invisible world*, 67-68.
[632] Ruestow, *Microscope*, particularly, 4-5.
[633] De Man, *Antonius de Heide*; Antonius de Heide, *Anatome mytuli, Belgicè mossel, structuram elegantem eiusque motum mirandum exponens, nec non centuria observationum medicarum* (Amsterdam, Janssonius-Waesberge; 1683[1]); Ruestow, *Microscope*. On Blankaart see 34-35, 84 n.18, 87, 91, 93, 101, 108, 229, 139. On De Heide see 82.
[634] Willis, *'Algemeende En bysondere*, *7r-*8r.

> enlarges the objects a hunderd-thousand times. So that there appears no other way open to explain these things, than to compare these to the sensible particles, and the operations, that meet us in works of art and chemistry.

He considered fermentation or *rijsiing* to be the most important operation that chemistry described. This was also "the best guide in this labyrinth". He supposed it to be "general knowledge [...] that no change in the body can be thought of without the movement of particles".[635] The use of chemistry seems to be a stopgap though, much more so than the use of magnifying glasses. There seemed to be no alternative to the study of the invisible than through analogy from the "sensible" or *voelbare* works of art and chemistry.

Three years later, Blankaart was more confident about the kind of knowledge produced by chemistry when he placed it on equal terms with anatomy and "vergroot-glasen" as an instrument to make discoveries about nature.

> Who shall not say that by the use of Chymia, Anatomy and magnifying glasses, one has found as many things in the last thirty years, as in all the previous centuries together.[636]

Shortly after, Blankaart argued that chemistry was superior to Cartesian philosophy in investigating the realm of the unobservable. As Blankaart proclaimed, one draws from chemistry,

> true reasonings, that no Descartes or his equal could shed light on with their mind. Here one has to arrange no supposition, but everything is

[635] Willis, *Nieuwe en geneeskundige verhandeling van de fermentatie ofte rysing*, *6r-v. "Het meeste, dat de oude van dese dingen gesegt hebben, werd door de hedendaagse bevindingen omver gestooten; en of schoon die selfde bevindingen veel onwrik-bare waar-heden aan den dag brengen , echter blijven noch veel verborgen; om dat de werktuigen en bewegingen, die de natuur gebruikt, soo fijn en kleen sijn, datse door een vergroot-glas, twelk de voorwerpen hondert-duisentmaal vergroot, mogelijk niet souden ontdekt werden. Soo dat geen andere weg openschijnt, om deze saken te verklaren, als met de selfde te vergelijken by de voelbare deeltjes, en de werkingen, die ons in de konst-werken, en Stof-scheiding ontmoeten. De voornaamste werkinge, en die ons in deze dool-hof de beste Leidsman is, achtte ik de rijsiing, dat is, de innige en onmerkbare beweging en beroering der deeltjes."

[636] Steven Blankaart, *Nieuwe konst-kamer der chirurgie, ofte heel-konst, gefondeert op nieuwer gronden als oyt voor desen* (Amsterdam, Johannes ten Hoorn; 1680) *3v. "Wie zal niet seggen dat men door 't gebruik van Chymie, Anatomie, en vergroot-glasen, naast dertig jaren soo veel gevonden heeft, als al de eeuwen hebben t'saam gedaan."

> shown with finger and thumb, so that chemistry has more unshakable foundations than common philosophy.[637]

Blankaart thus differentiated between Cartesian reasoning from the mind on the one hand, and his "true reasonings" from manual work on the other. "Common philosophy" was far less reliable than chemistry. Four years later, Blankaart published a work called *The Cartesian academy or principles of medicine* in which it appeared that Cartesianism and chemistry could be combined without any conflict.

It is striking to observe that in *Koorsen*, Blankaart detached the mind and the body from each other in such a way, while we noted the close ties between the senses of smell and taste and reason in earlier chapters. Both De Heide and Blankaart wanted to investigate the properties of drugs as something "sensible", be it visible or tangible. Earlier, Willis had offered a view on the investigation of drug properties in which he conflated the sense of sight with the senses in general. He too distinguished between reason and the senses as distinct sources of knowledge, but came to a different conclusion about what this meant for the investigation of drug properties. In the preface of part one of *Pharmaceutice rationalis*, Willis wrote:

> The circumstances of the drama of pharmaceuticals are usually accomplished behind the curtain, for that reason the various combinations of particles, fermentations, impulses, and other diverse movements, which, accomplished on the inside [of the body], are hidden from the senses, must be investigated deeper by the scrutiny of the intellect.[638]

The curtain in a theatre compromises sight, but Willis extended the metaphor to include all senses. He indicated the intellect as the source of knowledge about things that could not be investigated by the senses. The investigation of the matter that drugs consisted of and of how drugs worked in the body, was one area in which physicians were confronted with the relationship between the senses and reason. To De Heide and Blankaart, the question of how the properties of drugs should be investigated did not finish with Willis' work.

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[637] Willis, *Koorsen* (1681) *3v. "want hier uit trekt men ware redeneringen, die geen Cartes of syn gelyke met haar verstand konden doorstralen: hier behoeft men geen onderstelling te versieren, maar alles werd met vinger en duim getoont, so dat de Scheikonst onwrikbaarder grond-steunsels heeft, dan de gemeene wys-geerte."
[638] Thomas Willis, *Pharmaceutice rationalis* (1674) a4r. "Enimvero Dramatis huius pharmaceutici res fere tota sub velo peragitur, quapropter varii particularum congressus, fermentationes, impulsus, aliique motus diversimodi, qui intus peracti sensus latent, altiori intellectus scrutinio indaganda fuerant."

Blankaart's explanation of the properties of drugs

Blankaart attached great importance to his supposed knowledge of matter in his works of the 1680s. He was a prolific publisher and his works were translated into Latin, Germen, French and English.[639] The heavy influence of many other authors, especially Sylvius, Willis and Lemery, is clear in the works in which Blankaart presented his own brand of medicine. Time and again he demonstrated his belief that he knew what operations drugs had and why they were effective. We can see this for example in his assessment of the usefulness of Moxa in the treatment of gout or podagra, as Ruben Verwaal has demonstrated. The burning of the exotic substance was effective due to the heat that was applied to the body and not to a property that was particular to the Moxa itself.[640]

Blankaart presented a more complete view of the properties of drugs in some of his works. These are especially *De Kartesiaanse academie ofte institutie der medicyne* (The Cartesian academy or principles of medicine) and *Verhandeling van de operatien ofte werkingen der medicamenten in 's menschen lighaam* (Treatise of the operations or actions of medicaments in the human body). The title of the last work was clearly inspired by Willis' last two publications.[641] In his works, Blankaart gave various accounts of the properties of drugs and how they should be used in practice. This shows that giving such an account was important to him, but at the same time that he found none of the ones he tried satisfactory.

The title of the Cartesian academy displays the mix of the traditional and the modern in Blankaart's work. The public certainly would have recognised his reference to the other *Institutiones medicinae* published since the sixteenth centuries. As we have seen in chapter two, in this type of book the author was supposed to provide his readers with a complete overview of the most important components of medicine, from the basic constituents of matter to the treatment of specific diseases. Accordingly, Blankaart presented his theory of matter through which he thought he could explain the functions of the body, disease and the

[639] Abraham Schierbeek, "Over enkele tot heden onbekend gebleven handschriften van Stephaan Blankaart", *Nederlands tijdschrift voor geneeskunde* vol. 86 no. 5 (1942) 3069-3075, there 3070-3071.
[640] Blankaart*, De nieuwe Nederlantsche apothekers winckel, t'eenemaal gestoffeert met inlandsche genees-middelen, in welke klaarlijk getoont wert, dat wij niet genoodsaakt zijn, andere uit verre gewesten te halen* (Amsterdam, Jan Claesz. ten Hoorn; 1678); Ruben E. Verwaal, *Hippocrates Meets the Yellow Emperor. On the reception of Chinese and Japanese medicine in early modern Europe* (Master Thesis, Utrecht University 2009) 14.
[641] Blankaart, *Nieuw lichtende praktyk der medicynen gefondeert op de gronden van de deftighste autheuren deses tijdts: nevens de hedendaagse chymia, als ook de Nederlantsche apothekers winkel; rijkelijk met inlantsche geneesmiddelen voorsien* (Amsterdam, Jan Claesz. ten Hoorn; 1678); Stephanus Blankaart, *De Kartesiaanse academie ofte institutie der medicyne* (Amsterdam; Joh. Claesz ten Hoorn; 1684); Steven Blankaart, *Verhandeling van de operatien ofte werkingen der medicamenten in 's Menschen Lighaam. Toonende de ware oosaak van der selver verscheide uitwerkeselen. Alsmede het ontwerp van een nieuwe pharmacie, volgens de hedendaagse wyse van ordineren* (Amsterdam, Jan ten Hoorn; 1690).

treatment of disease, in *The Cartesian academy* and included an account of the different kinds of drugs and drug properties available to physicians.[642] In the same year he mentioned Descartes in the title of another publication, *Nauwkeurige verhandelinge* or *Accurate treatise*. From its title the influence of the work of both Willis and De Heide is patently clear. Blankaart took part of the original Latin title of Willis' work on fermentation and like De Heide's translation of 1676, *Accurate treatise* concerned fermentation, scurvy and fits. Blankaart added however that the treatise was "mostly based on the foundations of Descartes".[643]

The references to Descartes associated his medicine with innovative approaches to philosophy and medicine in general. Only three years previously, Blankaart had argued that contrary to Cartesian philosophy, "true reasonings" could be drawn from chemistry. By 1684, he apparently considered this distinction redundant, because in *The academy* he easily mixed Cartesian and chemical ideas. He not only discussed the basic constituent elements of matter as Sylvius and Willis had done, but also explained their interaction from the shape of each element. He added an illustration of the interaction of the "little pipes" of alkali particles, the "points" of acid particles and the branchlike shape of oily particles in digestion.[644] Like physicians of the previous generation, he discussed heat and cold in terms of the amount of movement of particles. For example, this idea was also proliferated in the work of physician Isaac Bebber, from the town of Dordrecht.[645] Blankaart extended this idea while evaluating the four primary faculties of Galenic pharmacology and argued that particles were more or less susceptible to "divine particles" of heat and that simples could thus be organised into categories of four degrees of mobility.[646] Thus, traditional cooling drugs did not work through cold, but through their "ability to contract or rather because they curdled and thickened" the fluids.

In general, the curative powers of drugs consisted in their ability to remove obstructions in the body, which were the cause of "diseases of the humors". These obstructions were relieved by the motion of particles. Thus, according to Blankaart, all acidic things were cooling to the body, not because their particles were immobile, but because they

[642] This theory of the basic constituent elements of matter, which was similar to that of physicians such as those described by Sylvius and Willis.
[643] Steven Blankaart, *Nauwkeurige verhandelinge van de scheur-buik en des selfs toevallen; als ook een naakt vertoog wegens de fermentatie oft innerlijke bewegingen der lighamen, meest op de gronden van Des-Cartes gebouwt* (Amsterdam, Jan ten Hoorn; 1684).
[644] Steven Blankaart, *De Kartesiaanse academie ofte institutie der medicyne* (Amsterdam, Joh. Claesz ten Hoorn; 1684) fig. 1.
[645] Bebber, *Ware en vaste gronden* (1685) 6.
[646] Blankaart, *Kartesiaanse academie,* 345-348.

could take away obstructions and thus prevented "fermentation" in that part of the body.[647] He did not have much to say about "moist making" drugs, basically dismissing their existence. He took the opportunity to criticise Regius' recognition of this category of drugs. Finally, he acknowledged that some drugs could dry ulcers but drying the inside of the body was not possible other than through drugs like diuretics and sudorifics.[648]

Blankaart then proceeded to describe various categories of drugs. These categories collected drugs that had a single, clear, observable effect on the body. He described purgatives, sudorifics, emetics, diuretics, analgesics, soporifics, tempering drugs, heart strengthening drugs, and many more. We can recognise categories that had existed in Galenic medical practice and some of the effects that had been acknowledged as secondary, tertiary or quaternary faculties in Galenic pharmacology.[649] Blankaart attributed all the principal effects of these drugs to particles of a particular shape. Inevitably however, he also described drug effects besides the principal effects. Diuretics for example were "able to temper the acidity in the blood and thin all viscous and mucous fluids" besides promoting the production of urine.[650] In accordance with Willis, he stated that purgatives and emetics irritated and stung the intestines.[651] Blankaart added recipes for these compound drugs, some of which were chemically prepared.

The full title of *Treatise of the operations or actions of medicaments in the human body* (1690) shows the twofold function of considering the properties of drugs for Blankaart, that is, to find the causes of the properties of drugs and to come up with a good way of categorising them. The title also reflects the influence of Willis' last two publications. As in *The academy*, Blankaart discussed the different types of drugs that were in use. He also repeated that in order for the drug the have an effect on the body, its particles needed to move and that therefore no drug properties could be attributed to cold things. He added to *The Academy* where he had only discussed the warming, cooling, moistening and drying operations of drugs. Here Blankaart reflected on the traditional categorisation of the faculties of drugs. He decided that because of the circulation of the blood, *specifica*, which were supposed to work on specific organs, also worked "generally".

Blankaart accepted most of what "apothecaries" called "the secundary faculties of powers and qualities". He enumerated all of these and discussed how they could be explained

[647] Ibid., 349.
[648] Ibid., 350.
[649] Ibid., 351-429. Such as *emollientia* or softening, *maturantia* or ripening, *attrahentia* or "pulling" drugs.
[650] Ibid., 365.
[651] Ibid., 351.

from the type of particles of which they consisted.[652] He seems to have investigated the simples chemically and occasionally this gave him opportunity to argue against particular ideas about the kind of particles that caused an operation. Thus purifying drugs did not consist of "sharp or comblike and broomlike particles" that "scrub away" "grime" as people said they did. Blankaart writes "But I find that those things, which consist of volatile oil-like salts, [....] like little chisels, make free what has to be purified".[653] Finally, he decided that repelling drugs did not exist and "hardening things" were not necessary.

These descriptions by Blankaart show that he, like Galenic physicians, was interested in how drugs work in the body. Like earlier physicians of the second half of the seventeenth century, he acknowledged these properties having been established in the first place through general usage. However, through his knowledge of physiology and his investigation of the medical materials themselves, he could decide which drug properties could exist and which could not. Blankaart continued to attach great importance to theorising about the kind of particles that existed and how they interacted. Meanwhile, De Heide had argued for a different approach to the investigation of the properties of drugs.

Testing, predicting and discovering the properties of drugs

We have noted that Willis, in his *Pharmaceutis rationalis* and subsequently De Heide and Blankaart, were concerned with investigating how drugs worked on the body to produce their effects. Only one year after publishing the translation of the second part of *Pharmaceutis rationalis*, De Heide published a book which showed his concern with a different question: Do drugs in fact work? He called his book *New light of apothecaries, pointing out the ignorance around the power of medicaments, and improving the large mistakes in the prescription and preparing medicaments generally committed*.[654] In the preface, he connected this subject to a classic issue in the history of medicine, the relation between itinerant and

[652] Blankaart, *Verhandeling*, 208, N8v: "….versagtende en verhardende: dun en dikmakende: openende en stoppende: logtigmakende en styfmakende: rypende, vleismakende, toelymende, wond-middelen, velmakende, lidteikenen verdwynende, weer-doen groeijende, inbrandende: melk en zaad vermeerderende en verminderende; lust-verwekkende en benemende: steen-brekende-middelen, en de selve uitdryvende: slaap-aanbrengende en pynstillende: bloed-stelpende en diergelyke."
[653] Blankaart, *Verhandeling*, O5v-O6r.
[654] Antonius de Heide, *Nieu ligt der apotekers, aanwijsende de onkennis ontrent de kragt der Genees-middelen, en verbeterende grove mis-slagen in 't voorschrijven en bereiden der Genees-middelen gemeenlijk begaan* (Amsterdam, heirs of Joannes Janssonius van Waasberge; 1682). It was "new" compared to the "Licht der apothekers", *Light of apothecaries* or the Dutch translation of *Lumen Apothecariorum* by Quiricus de Augustis from Tortona (active between 1460-1495), whose publishing history was surveyed by Leo J. Vandewiele in "Het "Licht der apothekers", *Bulletin/Kring voor de geschiedenis van de pharmacie in Benelux* no. 27 Oct. (1961) 2-3.

ignorant medical practitioners and educated practitioners.[655] De Heide tells us that of all the arts, medicine is the one in which people are least careful when they require help. They trust all kinds of unqualified healers with their health "without considering what is involved in curing and what difficulties well trained and careful healers find themselves involved in".[656] Right from the beginning, De Heide made clear that the issue he wanted to address affected all medical practitioners, addressing them as healers. People in general thought very little about difficulties in the practice of medicine according to De Heide.

These difficulties had made it necessary for De Heide "to unearth the foundations of medicine somewhat further, than her practitioners generally do". Using a beautiful metaphor grounded in the environment of his seaside hometown, he asked a profoundly epistemological question. Was medicine "built on a solid rock of truth and not on the sandy soil of imagination"?[657] In this book he applied this question to the investigation of drug properties as well when he asked,

> whether there are sufficient tests, from which one is assured that drugs have the powers for which they are applied and whether they should be prepared the way it is described in the common books of drugs.[658]

Nobody should think this research was useless, De Heide warned, because daily many medicaments were used in vain and not seldom to the patient's detriment. He directed his argument at his fellow physicians who prescribed drugs unnecessarily. They should not be afraid to openly admit their ignorance, especially if they showed their diligence in acquiring more knowledge, and particularly if it was clear that the knowledge sought-after was difficult to obtain. Rather those physicians that claimed that they knew a lot and could cure all disease, without being able to do more than others, were justly despised, according to De Heide. Keeping medicine's inadequacies hidden would invite ridicule and would be a great hindrance

[655] This topic was important to the famous Dutch physician Pieter van Foreest (1521-1597). Foreest prepared a manuscript in which he discussed this topic and was instrumental in establishing regulations for medical practitioners in the Delft and Alkmaar where he was city physician. Pieter van Foreest, *Vander empiriken, landloeperen ende valscher medicynsbedroch* MSS City archive Alkmaar; Henriette A. van Bosman-Jelgersma, ed., *Petrus Forestus medicus* (Amsterdam 1996).
[656] De Heide, *Nieu ligt der apotekers*, *2r-*2v.
[657] Ibid., *2v. "te ondersoeken, of dezelfde ook op een vaste rots van waarheid, en niet op de sandgrond van inbeelding is gebouwd." He interpreted imagination here negatively as a kind of fancy of illusion, using not the more positive Dutch word *verbeelding*, but the more negative *inbeelding*. We can find a more positive position in a later statement. See n. 85.
[658] Ibid., *2v-*3r. "in welke wy ondersoeken of er genoegsame proeven zijn, daaruit men versekerd is, dat de Geneesmiddelen de toegepaste krachten hebben, en of de selfde so behoren bereid te werden gelijk in de gemeene Artsenie-boeken werd beschreven."

to the progress of medicine.[659] Throughout the book De Heide makes two claims. For one, there were many drugs in use whose operations were unknown. Either they did not work in the way they were supposed to, or it was not known how they work. Secondly, medicaments were not prepared correctly.

De Heide argued that the operations of drugs could only be discovered by *het gebruik*, that is "usage" or "practice" and *ondervinding* or experience. Rightly, physicians did not rely much on the "coincidences" of simple drugs like their odour, taste, colour and shape.[660] The powers of drugs could also not be discovered through what De Heide called "comparison", that is, through knowledge of "the make, the shape and the interconnection" of the body parts and the drugs. Only if this knowlegde was available could one know what drug operation to expect in the body.[661] Medical knowledge however, De Heide wrote, had not risen to the level where this kind of knowledge was possible, because these medicinal powers depended on the shape, movement and other characteristics of "the insensible particles" of both the body and the drugs. He repeated that "the best magnifying glasses" available had not been able to help alleviate this issue.[662] Philosophers and physicians had devised suppositions and grounds to explain and recount the powers and operations of drugs, but these did not serve to discover these powers.[663]

Now De Heide asked how to use experience and use correctly to investigate the powers of drugs. Had the drugs that were commonly used been discovered by these means? De Heide listed four things that should at least have been observed regarding a drug's use in order to answer this question. For one, the disease or affliction should be known. By this De Heide meant that it should be known how the disease affected the body. He gives several examples of when this rule would apply. One could not say that,

> the cooling and clogged liver-opening power of Cichorey was known through use, if it was not known that the defect against which Cichorey was used with benefit, was an inordinate heat and clogging in the liver.

Even though it was not possible to predict or determine the properties of drugs from the knowledge available at that point, according to De Heide, knowledge of the structure of the body and how disease affected it, was necessary in order to determine if a drug was effective

[659] Ibid., *3r.
[660] Ibid., 3. De Heide briefly reiterated the argument about the colour and shape of plants later, 29.
[661] Ibid., 4.
[662] Ibid., 5.
[663] Ibid., 6.

against a particular disease. In De Heide's plea for better research into the properties of drugs, his preoccupation with how drugs worked in the body thus manifested itself.

Secondly, the result of the power of a drug, "known through usage and experience", should "often and nearly always" be the same. Otherwise, one could not attribute the improvement of a patient to the drug. When the remedy had the same effect for ten, twenty, hundred and more times, then one had ground to attribute a power to that remedy. By analogy with the operation of a clock, he argued that this was because the same effect would not follow the use of the same remedy so often without they presence of a power in that remedy to cause the operation. Here, De Heide again added examples of remedies that were "known by usage" to have such consistent effects, such as for instance glass of antimony and opium.[664] Thirdly, the drugs that were tested should not be compound drugs. De Heide stated that drugs like "Theriakel may be taken for a simple, even though it was prepared with many different simples".[665] Finally, the benefit and operation of the drug could not be said to be known by "experience and use" if the benefit and operation was not noticeable and apparent.[666]

The most elaborate instructions for how to use experience to investigate drug properties that we have encountered thus far are those by Dodonaeus. These instructions differ somewhat from De Heide's. Instead of the instruction that the patients on which the drug was tested should all have the same affliction, De Heide argued that the disease against which the drug was supposed to be effective should be known, although it was often unknown. In his second instruction, De Heide is more specific than Dodonaeus about how many times and with what regularity the same effect should have been observed. The third rule was very similar to one of the prescripts of Dodonaeus, but he and his predecessors were more specific than De Heide about what other provisions should be made regarding the simple that was tested. The fourth rule did not appear in Dodonaeus at all.

Continuing his overall argument that the power of many drugs was unknown, De Heide spent five pages arguing against the attribution of primary, secondary, tertiary and quaternary *hoedanigheden*, or traits, to drugs. He explicitly pointed out what consequences the new conception of matter, as particles of a particular shape in motion, had for the Galenic distinction between qualities and faculties and between primary, secondary, tertiary and quaternary faculties as well. He wrote:

[664] Ibid., 8-10. Glass of antimony or *vitrum antimonii* was used as an emetic.
[665] Ibid., 11.
[666] Ibid.

> We consider certain that drugs work through traits, that is, by the various shape and movement of impalpable particles, because about the operation of the body no other mode of working can be devised.[667]

Therefore it was "unfounded" to consider these traits or properties to be something separate from that shape and movement. Furthermore, because the traits had in common that they existed in the shape and movement of the impalpable particles, it went "off track" to divide them into three or four types.[668] Explaining the heating properties of pepper from its heating properties was superfluous according to De Heide. Attributing heating powers to a trait, which was then said to produce the laxative powers of rhubarb and the soporific powers of poppies also complicated things unnecessarily.

De Heide did not deny the existence of the properties traditionally categorised as primary, secondary and tertiary. These properties continued to be described as operations in the body. However, De Heide objected to assuming the existence of Galenic primary qualities as the cause of these properties and to hierarchically categorising of them. While "healers" did claim that the qualities and categories of drugs were "discovered and confirmed by use", this overcomplicated things and went "beyond experience and use" argued De Heide.[669] Of course the same could be said about the idea that matter consisted of particles in motion, which De Heide supported.

He acknowledged that part of his explanations of the operations of drugs did not provide certainty. De Heide wrote that he considered it "very probable that pepper heated the body, certainly if the case was looked into more accurately", because it produced movement in the particles of the blood and the solid parts of the body. Finally, he presented an explanation of the properties of poppies that was "apparently certain" and concluded that,

> though it is difficult to determine the quality imparted on the brain fluid by soporifics, it is however certain, that the operation is performed by a movement and appearance of particles in those drugs.

[667] Ibid., 25. "…. dat de Genees middelen werken door haar hoedanigheden, Dat is door het onderscheide fatsoen, en beweging der onvoelbare deeldjes; agten wy seker: want ontrent lighamelijke werkingen kan geen andere werk-wijse bedagt werden." The certainty identified here was thus derived from the fact that no alternative could be thought of. The author of the preface to Willis, *Nieuwe en geneeskundige* (1676) said something similar, *6v: "Want het is een al gemeene kundigheit, die door het natuurlijk licht openbaar is, dat geen verandering in eenig lichaam kan bedacht werden, sonder beweging der deeltjes."
[668] Ibid.
[669] Ibid., 25, 26.

His explanation of the properties of rhubarb and other laxatives included Willis' idea of irritation or "prikkeling" of the body parts involved.[670]

We can observe that De Heide actually argued that primary qualities and corpuscularism were on more or less equal terms when it came to the proof of their existence. Neither could be proven by experience and use or by the senses. Instead, the choice came down to what seemed to be the most plausible and most simple reflection of unobserved reality through what was visible of the properties of matter. Determining how drugs worked in the body to achieve their effects remained illusive, no matter what theory of matter was proposed.

Despite this, De Heide continued his investigations of medical materials to some extent. A year after publishing *Nieu Ligt*, several of De Heide's chemical investigations of such materials were published as part of *Anatome Mytuli*. He recorded which materials he put together, the approximate time he had left the mixtures, whether he had heated or cooled them and the sensible properties of the substances that were produced. In some places he mentioned how a material could be used in medical practice, what questions might be pursued in the future and the conclusion about the kind of particles present in a material that might be drawn from these observations or experiments.[671] While the colour, odour, taste and shape of a material could not be depended on to discover its operations in the body, De Heide clearly relied heavily on them in his chemical explorations through nature's labyrinth.

Nieu Ligt reprinted

In the following year, Ten Hoorn and fellow printer Jan Bouman included De Heide's work in one of their publications.[672] Historian Zuidervaart reports that around this time, De Heide was very irritated by the publication of a "pharmaceutical collection".[673] The Ten Hoorn and Boumann publication of 1683 fits much better with the description of "pharmaceutical collection" than the 1684 publication, which Zuidervaart seems to have in mind. Furthermore,

[670] Ibid., 27-28.
[671] De Heide, *Anatome Mytuli* (1683[1]) e.g. 163-172. These pages contain observations on Opium tincture, a solution of Aloë, Colocynth extract, Jalap resin, Rhubarb tincture and on Senna leaf extract. Lindeboom mentioned observations on such materials in *Anatome Mytuli*. Gerrit A. Lindeboom, "Anton de Heide als proefondervindelijk onderzoeker", *Gewina* vol. 6 no. 3 (1983) 121-134, specifically 125.
[672] Anon, *'t Nieuw-ligt des apotheker, of nieuwe-gronden en fondamenten der artzeni- en chymise-bereiding: Verm. met nooten en voorschriften van Silvius, Willis, Blankaart etc. Met een aanhangsel der misslagen over de artzenij-bereiding enz. door A. de Heide* (Amsterdam, Jan ten Hoorn and Jan Bouman; 1683).
[673] Zuidervaart, "Theatrum anatomicum", 102.

that 1684 edition contained all of De Heide's works up to that point and was published with his regular printers instead of with Ten Hoorn and Bouman.[674]

If this is correct, De Heide's irritation at the republication is understandable and not just because it happened without his permission. The title of the 1683 edition only mentioned, that it was enriched "with notes and instructions by Sylvius, Willis, Blankaart, etc." The printers adopted the first part of De Heide's original title, "The new light of apothecaries" as it's own, adding that it provided "new grounds and foundations of preparation of medicines and chemicals". The subject of De Heide's book is now described as "the faults in the preparations of medicines etc." and the preface also only mentions "the mistakes and abuses of drugs". Part of De Heide's original title, "ignorance about the powers of medicaments", was left out except for the separate title page printed for De Heide's *Nieu ligt*.[675]

The best evidence against De Heide's authorship of the first, anonymously published part of *'t Nieuw-ligt* is that it dealt with drugs in ways that De Heide had expressly challenged in his *Nieu ligt*. In the juxtaposition of these two works in one publication we can discern especially clearly what De Heide was up against by arguing for discarding the distinction between primary, secondary, tertiary and quaternary "traits", by arguing against the usefulness of the senses in investigating the properties of drugs, and by describing the necessary conditions for determining the properties of drugs through experience.

Firstly, the properties of drugs are discussed in the "usual" way, the anonymous author wrote. They were usually divided into four groups, hot, dry, cold and wet.[676] These originated in the four elements fire, air, water and earth. Here the footnotes mention that at that time entirely different substances, spirit, water, sulphur, salt and earth were considered as base materials into which all things "were decomposed", thus indicating analysis through a chemical procedure. One could be aware of the hot, dry, cold and wet properties in materials, or they could be "noticed" when the materials in which they were present were applied to the body. The four degrees of strength are described and the footnotes labelled these as "imagined following the four elements".[677] The substance of the materials was then described as either fine or crude.

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[674] Antonius de Heide, *Ontledinge des mossels en ontleed-, genees- en heelkundige waarnemingen, beide met kopere platen versien, / uit het Latyn vertaalt door Theod. Jansson. van Almeloveen; Nog desselfs Nieu ligt der apothekers, of noodige aanmerkinge omtrent de misslagen in 't berieden der artzenye, ende bedrieglijkheitder pis kykerye* (Amsterdam, Joannes and Gillis Janssonius van Waesberge; 1684); Ledeboer, *Geslacht*, 145-148.
[675] This interchange in the title confused Thijssen-Schoute into thinking that the publication was indeed by De Heide as a whole *Nederlands Cartesianisme*, 344. De Heide is still listed as the author in library catalogues.
[676] Anon, *'t Nieuw-ligt*, 6. "De krachten van de gewassen ofte droogen zyn verscheyden, ende veelderley, hoewel sy gemeynlijk in vier worden gedeylt, dat is heet en droog, kout en nat."
[677] Anon, *'t Nieuw-ligt*, 7.

According to the anonymous author, "the apothecaries" described the secondary powers of drugs with Greek and Latin words in their dispensaries. Description of the secondary, tertiary and quaternary powers then followed. Like the Galenic faculties, the secondary powers followed directly from the primary ones, whereas the tertiary sprang from the first and secondary powers.[678] The quaternary ones were also called "specific faculties" and were not connected to any of the previous ones, but could only be found by experience. God had impressed these powers onto these materials, the author wrote.[679] Never does the author refer to particles as the cause of these properties.

Equally traditionally, smell and taste could both be used to investigate the properties of drugs. "All that smelled sour and like vinegar, is cold and everything that is aromatic is hot. [....] Furthermore all that is aromatic, is thin and fine of parts: but which doesn't smell, is crude and thick." The nine tastes that were distinguished were linked with warmth or coldness.[680] In the descriptions of each of these tastes they are sometimes also linked to the texture and substance of the simple, to the effects it had on the tongue, to many others kinds of operations in the body from drying or controlling drought, to mollifying, to obstructing, to contracting, to sticking. The notes with each of these tastes show that all kinds of materials, including chemically prepared ones, could be used as examples of them.[681]

The printers wrote that they had also assembled some drugs from the writings of Silvius, Willis, Paul Berbette (1619-1665), Blankaart, Heydentryk Overkamp (1651-1693) and others.[682] The anonymous work contained many different recipes for preparing drugs and also contained information about against which afflictions the drugs were effective, for what body parts they were beneficial and how they should be used. They did not discuss how the effectiveness of these recipes had been investigated. They were included very similarly to the ways recipes were included in Willis work, but also to some of the recipes that Constantijn Huygens collected, though without the personal recommendations which Huygens received

[678] Secundary: *emollientia*, *pus moventia*, *indurantia*, *resolventia*, *condensantia*, *aperientia*, *constipantia*, *attrahentia*, *repercutientia*, *abstergentia*, *expurgantia*, *attenuantia*, *illinentia*, *incrassantia*, *anodyna, somnifera*, *rubefacientia*. Tertiary: *maturantia*, *carnem generantia*, *conglutinantia*, *cicatricem inducentia*, *callum gignentia*, *urinam cientia* (*diuretica* in Greek), *calculum comminuentia* (stone breaking) (here the author mentioned that according to Galen and Dodonaeus drugs that could break stones did not exist), *menses moventia* (stimulating menstruation), *secundinas expellentia* (expelling the after birth), *bechia* (cough-soothing), *lac & semen generantia*.
[679] Quaternary: *deleteria* or poisonous properties, *cathartica*, *somnifera*, *opiata*, *theriacalia*, *alexipharmaca*, *periammata*, 15.
[680] Sharp, bitter, salty, tart, a tarty and soury taste, sour, sweet, oily and tasteless (Scherp, bitter, zout, wrang, sarp, suur, soet, vetachtigh, onsmakelijk).
[681] Anon, *'t Nieuw-ligt*, 21-24.
[682] "…dewijl die Heeren haar Schriften nu in dagelijks gebruik komen, en men by gevolg veele van haar dingen niet kan missen."

and noted down. This also did not satisfy De Heide's rules for assessing the efficacy of medicaments.

Conclusion

In the English literature, Wilis' final work, *Pharmaceutice rationalis, sive, Diatriba de medicamentorum operationibus in humano corpore* (1674-75) is characterised as a compromise between traditional medical practice and the "new philosophy". Historian Isler wrote that his "reform program probably gave an essential impulse to the development of pharmacology as a science".[683] In the Dutch Republic, Willis' publications certainly attracted the avid attention of two very different physicians. De Heide and Blankaart showed their support for Willis by translating his work into Dutch. Their explorations in these and their own later works show the success of anatomy and magnifying glasses in studying the body. Both De Heide and Blankaart acknowledged the discoveries that had been made in this way and especially De Heide contributed his own microscopical discoveries. They also show however that Willis, De Heide and Blankaart were aware that the knowledge these instruments provided was limited. They were all convinced that matter consisted of particles and that, by interacting with the body, these particles caused the effects of drugs that were known from experience. However, the particles could not be observed even with the best magnifying glasses. Instead, their existence was established by reason. Reason in turn could not say anything in particular about the properties of these particles or how they caused the effects of drugs. At different points in the work of Willis, De Heide and Blankaart, chemistry was offered as a way to overcome these limitations. By analogy from the observation of everyday chemical processes they could investigate the properties of different materials.

Despite their enthusiasm for Wilis' work, neither De Heide nor Blankaart was satisfied by the compromise he reached in *Pharmaceutice rationalis*. Blankaart developed the theory of matter that Willis described in his earlier works further and was convinced that a limited number of basic materials could explain the properties of all other materials. These properties could be established through chemical experiments and since these same materials were present in the body, the medicinal effects could be assessed before the drug was administered. Using his knowledge of matter, Blankaart determined which of the commonly recognised drug properties, could not exist because they were nonsensical or were harmful

[683] Isler, *Thomas Willis*, 185.

instead of beneficial. Because they had the same material properties, chemical drugs and plant-based drugs could be used alongside each other.

Shortly after translating the second part of *Pharmaceutis rationalis*, De Heide published a work in which he assessed the foundation of medical knowledge. In *New light of apothecaries*, he considered the basis of existing knowledge of drugs as profoundly flawed. A drug's odour, taste, colour or shape and the similarities between body parts and the appearance of the drug were not reliable sources for knowledge about its medicinal properties. Perhaps the existence of a drug property could be explained by the "suppositions" of philosophers and physicians, but whether they existed in the first place could not be established in this way. The operations of drugs could only be discovered by usage or experience. De Heide outlined very strict requirements for determining whether the drugs that were commonly used, actually possessed the properties attributed to them. Most could not meet these conditions. De Heide concluded his treatise by repeating the notion that the operations of drugs were explained by the movement of particles which a particular shape. He did not deny that faculties existed, but objected that explaining them from qualities was not based on experience and was superfluous. Instead, he suggested some ways in which the movement and shape of their particles could explain the properties of pepper and poppy. The choice between the primary qualities and corpuscularism was ultimately made on the basis of what seemed most plausible.

In 1683, a short treatise that was published anonymously under almost the same title as De Heide's, set forth exactly the kind of pharmacology against which De Heide had argued. Contrary to De Heide's assumption that smell and taste were rightly commonly understood not to provide knowledge of drug properties, here they were discussed elaborately. All kinds of simples, including chemically prepared ones, could be described as possessing one of nine flavours. The treatise shows that despite Blankaart and De Heide's attempts to establish a better understanding of drug properties with a corpuscular theory of matter, the different properties of drugs could still be explained by essentially Galenic principles. Thus Blankaart, De Heide and this anonymous tract offered three very different perspectives, not just on what drug properties existed, but also on how their existence could be established.

Conclusion

Conclusion

My research into the investigation of drug properties in the Dutch Republic from the sixteenth to the end of the seventeenth century, started with an examination of the curriculum established in Leiden around 1600. I ascertained that the curriculum incorporated many of the ways to study plants that had been developed in the preceding century. The result was far from the homogenous whole that Paaw presented in his publications and the people involved with developing the curriculum appear to have been aware of this to various degrees. In Paaw's teaching and in the academic garden various purposes were served and no choice between pursuing medicine, botany or natural history was made.

The teaching of Mattioli's commentaries on *De materia medica* by Dioscorides helped in combining the interest in identifying simples correctly and the investigation of the medicinal properties of natural materials. Mattioli incorporated the writings on simples by Galen in his commentary. The book was less compatible with the study of the rich variety of plants and materials that could be found in gardens and in their natural environment. In gathering plants to send to Leiden, Outgert Cluyt used not Mattioli's commentaries, but Clusius' printed works and the academic garden designed by Outgert's father and Clusius, as references both for the regions that he visited and the plants that he selected. The approach to the study of plants that Clusius was instrumental in developing, continued to influence the composition of the garden, while Clusius' own involvement with the garden decreased.

The presentation of drug properties within a Galenic framework, as developed during the sixteenth century, became part of the curriculum through the teaching of the *Institutiones medicinae* and the importance attached to the *methodus medendi*. The understanding of the medicinal properties of simple drugs was essential in the method of curing, or *methodus medendi* that they presented. The wealth of sixteenth-century discussions about natural materials only partially comes across in the *Institutiones* and the discussions of drug properties that I have examined, incorporated only a small part of Galen's extensive writings. Compound drugs for example were not discussed. In texts such as the *Institutiones*, we have thus been able to observe the characteristics of late sixteenth-century Galenic pharmacology.

This study has shown that the curriculum established in Leiden remained central to discussions about drug properties and how to investigate them throughout the examined period. The epistemological discussions that it produced about the relationships between and relative importance of experience, reason and the senses in establishing the efficacy of drugs, were ongoing. The idea that drugs had particular operations in the body and the division of

these operations into categories of primary, secondary, tertiary and sometimes quaternary faculties, also continued to be commonly used.

While these aspects of the Leiden curriculum remained meaningful, the fact that it was partially inspired by Galen's writings became mostly irrelevant during the seventeenth century as pharmacology was shaped, reformulated and amended by generations of physicians. This accounts to some extent for the seemingly paradoxical observations of Temkin. On the one hand, his Galenism seems to have been defeated in the middle of the seventeenth century, on the other hand, the discerning historian can recognise aspects of the comprehensive presentation of pharmacology supplied by Fernel, Mattioli, Dodonaeus, Heurnius, Jacchaeus and Spigelius, in later periods.

This also brings us back to the question of the relationship between the downfall of Artistotelian physics and the rejection of Galenism. The study of drug properties in the Galenic tradition was one point at which they were fundamentally connected. My investigation has demonstrated that several problems arose from the study of these properties.

The attempt by Fernel, Mattioli, Dodonaeus, Heurnius, Jacchaeus and Spigelius to arrange drug properties into a Galenic framework, produced problems, precisely because the framework assumed strict relationships between its various parts; relationships that were supposed to enable the prediction of a drug's effects. Taste was considered to be the most reliable indication of what properties the drug would have when applied to the human body, because it provided knowledge of the drug's primary qualities. However, it sometimes contradicted what therapeutic experience said about these same primary qualities. Furthermore, drug properties attributed to occult qualities did not fit in with the method of healing outlined by Heurnius.

Additionally, there was difference of opinion about the way in which the various drug faculties were related to the primary qualities. Physicians and philosophers thus shared such problems as making the distinction between occult and manifest qualities as well as the doubt about the sensible qualities as sources of knowledge about matter compared to experience. Jean Fernel had acknowledged this in his *De abditis* and he had attempted to address the fundamental problems in understanding drug properties solely on the basis of the four elements. This was one of the issues that Isaac Beeckman took up when he developed a corpuscular understanding of matter and its properties. Hence, the investigation of drug properties stimulated the reconsideration of matter theory.

If we can speak of a crisis in medicine around this time, it was not just one of medical theory, since by definition theory and practice were supposed to be connected through the

methodus medendi. Since the proper understanding of drug properties was central to this method, problems in this field did not only pertain to theory, but to the very possibility of maintaining a rational and effective practice of healing.

Such issues surrounding the proper understanding of the, sometimes contradictory, properties of drugs, were commented on by Roger Bacon and were central to Michel de Montaigne's critique of academic medicine. Van Beverwijck was keenly aware that such criticism affected his own medical practice, and several of the works he published from the 1630s were shaped as a response to it. Van Beverwijck focused on the practice of medicine and was not concerned with examining its connections to physics. Investigating the properties of drugs within the Galenic framework was not required in order to use them correctly in everyday medical practice. Still, although it should be complemented by experience, reason was the most important basis of Van Beverwijck's medicine. He argued that many of the best minds in history had investigated the questions that were now put to ancient medicine again. It would be foolish for modern men to think they knew better. In Van Beverwijck's view not an alternative medical system was the greatest threat to learned medicine, but the critical writings of people such as Montaigne.

While Dodonaeus, Heurnius and Van Beverwijck identified with the opinions of their ancient predecessors, many of their fellow physicians do not appear to have felt a particular bond with the ancient history of medicine. Received opinions should rather be considered carefully. We have not observed a separation between Hippocrates and Galen of the kind examined in the historiography of British medicine. This partially confirms Martenson's suggestion that physicians on the continent did not feel they had to make a choice between the two. Neither were the names of Galen or Hippocrates reinvented in the seventeenth-century Dutch Republic.

As striking as the growing irrelevance of what Galen and Hippocrates had written about the properties of drugs, is that in the same period, Dioscorides' *De materia medica* lost its role in education and plant research. In Spigelius' *Isagoges in rem herbariam*, the medicinal properties of plants were considered separately from their appearance. Plants were not related to each other by the similarity of their appearance and their medicinal properties, as they had been in Dodonaeus' herbals. In the teaching by Spigelius' student, Vorstius in Leiden as well, the middle ground that Dioscorides' *De materia medica* had offered, fell away. The conviction that considering a plant's appearance could not help to discover the effect of a plant on the human body, facilitated the replacement of Dioscorides by Theophrastus as a model for writing about plants. The ability to identify simples correctly

remained vital to the production and administration of drugs however. Such concerns resulted in the establishment of pharmacopoeia. Physicians still required knowledge of both the appearance of plants and their medicinal properties, but investigating these plant properties did not depend upon a connection between the two. In this way, medicine and botany continued to complement each other.

Some approaches to the investigation of plants and their medicinal properties that developed in the course of the seventeenth century, fitted in well with Cook's image of the Dutch studying nature on the basis of experience, observation and "matters of fact". Yet different authors came to similar conclusions by completely different routes. Thus different points of view and an eclectic attitude existed below the surface of the uniformity that Banga and Cook emphasised. It is perhaps this eclecticism that best characterises the investigation of drugs in the Dutch Republic.

In the 1608 edition of Dodonaeus' *Cruydt-boeck*, the Van Ravelingen brothers invited their readers to follow Dodonaeus' instructions and example, to discover a drug's properties through repeated experience and trials. They encouraged their readers to investigate the medicinal properties of plants themselves and to inquire after these properties with people familiar with local plants. This approach had earlier been proposed by Clusius and was embraced by several physicians and citizens of the next generation. The senses, the Van Ravelingen brothers argued, were not reliable due to the frailty of the human mind. Reason could have only a very limited role in determining a drug's properties.

Regius in turn modified the distinction between actual and potential properties, as it was used in Galenic pharmacology, to argue that only experience and not the senses could discover medicinal properties. In this respect, he reestablished the separation between the explanation of a drug's property and its discovery, into two distinct lines of inquiry. The first occurred through reason, the second through experience. Kyper's much more unorthodox textbook included descriptions of *methodi medendi*, but explaining how drug properties worked, played no part in it. Kyper agreed however that only therapeutic practice informed physicians about the properties of drugs. In these decades of the seventeenth century, the model, set by the textbooks of Fernel and Heurnius, was thus adapted in different ways. With Regius and Kyper, medical practice and theory, and experience and reason seemed once again divided where it came to the investigation of drug properties.

However, especially amongst physicians the ideal of a *methodus medendi*, which included knowledge of how drugs cured, remained influential. Some people remained convinced that knowledge of matter and of the structure and functioning of the body, could

and should inform the procurement of appropriate therapies. To attain such a curative method, experience and observation needed to be supplemented in some way. This became clear when we examined Blankaart and De Heide's interest in the work of Thomas Willis. The discussions his work engendered, show how problematic pharmacology had become in the final decades of the century.

They also show how the epistemological circumstances under which the investigation of matter and the efficacy of materials could take place had changed compared to the previous century. While the two Dutch physicians considered reason and sight, enhanced by magnifying glasses, to be the most reliable sources of knowledge, both these approaches had their limits. Chemistry appeared to be able to connect the visible with the invisible. De Heide however questioned its usefulness in establishing whether a drug worked to cure a particular affliction. His instructions for the proper use of experience show that ideas for testing medicaments, such as those put forward by Dodonaeus in his *Stirpium*, were still around. Achieving the desired certainty about the effectiveness of a drug was practically impossible however. One would not only have to observe its beneficial effects time and time again, but also to know the intricate workings of the body and the particles of matter in it. Yet these particles could not be observed or perceived in any way. Especially this holding on to a corpuscular view of matter set the standards of establishing a drug's efficacy unattainably high.

De Heide's critical review of the existing knowledge of drug properties was published together with an anonymous tract. A comparison between the two works shows that the ideas of some, about the investigation of drug properties, changed in the seventeenth century. De Heide deemed reason to be entirely independent from the sensible qualities, at least where it came to the investigation of drug properties. The work to which his *Nieu Ligt* was attached however maintained the connection of the tastes to the four primary qualities and incorporated chemical drugs in the scheme of nine basic tastes. The comparison also shows that the idea that drugs had a particular operation in the body in itself was not new, nor was it controversial. What distinguished De Heide's and some other seventeeenth-century physicians' accounts of these operations from those of Galenic physicians, was the theory of matter by which a drug's interactions with the body were understood. In the search for certain knowledge, the uncertainty involved in investigating the properties of drugs only seems to have increased during the seventeenth century.

In my research into the investigation of drug properties in the Dutch Republic from the sixteenth to the end of the seventeenth century, I have considered these investigations not so

much as a field of activity that was influenced or impacted by wider debates about how nature could be known, but rather as the scene of such debates. This means that ways of knowing nature were appraised and created in the act of investigating drug properties. The approaches that physicians considered in their investigations were not confined within disciplinary boundaries, as we know them.

When considering developments in pharmacology in the way I have done in the preceding chapters, attempting to identify a Scientific Revolution or to assess its effects on Galenism, is rather beside the point. Such an attempt would reflect a historiographic approach that prioritises philosophical shifts, over the practices and practical concerns they were connected with. By adjusting our focus to the study of drug properties, we were able to observe that philosophy was just one field of inquiry that physicians and other citizens involved in their investigations of nature. If there is one important change in the investigation of drug properties that took place in the period I have investigated, it is that the deep complexities of such investigations had become clear. If we as historians conclude that, by the end of the period, a revolution had taken place in pharmacology, this may well be justified from our point of view, but such a conclusion does little justice to, nor is it helpful in understanding the intentions of the historical actors involved.

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Curriculum Vitae

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