Hybrid ambitions : science, governance, and empire in the career of Caspar G.C. Reinwardt (1773-1854)

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PART I

Amsterdam,
Harderwijk, Haarlem

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Learning About Nature

Who after this excellent attempt of Lavoisier, wants to reprimand me that I distinguish the new chemistry from the old one, and [that] I consider her the best interpreter of nature and the most excellent helper of human industry? For which product of nature exists which she cannot elucidate, which human industry [exists] which she cannot improve?

Reinwardt in a lecture on the benefits of the 'new chemistry' for Dutch science and industry held in Harderwijk in 1805.[1]

Caspar Georg Carl Reinwardt was born in Lüttringhausen in the kingdom of Prussia in June 1773. After the early death of his father Johann Georg, a student of the German poet Christian Fürchtegott Gellert (1715-1769), his mother Catherina Goldenberg and his uncle Melchior took care of the boy's upbringing. In 1787, at the age of fifteen, Reinwardt moved to be with his older brother, Johann Christian Mattheus (*-1811), who worked as apothecary and chemist in Amsterdam.[2] At that time, the city numbered around 200.000 inhabitants.[3]

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[1] C.G.C. Reinwardt, "Redevoering over de voortreffelijkheid der nieuwe scheikunde boven de oude in het verklaaren der verschijnselen der natuur en kunst," *Vaderlandsch magazijn van wetenschap, kunst en smaak* (1805), 198: "Wie zal, na deze uitmuntende poogingen van Lavoisier, mijn nog berispen, dat ik de nieuwe Scheikunde onderscheiden van de oude, en de beste uitlegster der natuur, en de voortreffelijkste helpster der menschelijke kunsten genoemd heb? Want welk gewrocht der natuur is 'er, 't welk zij niet verklaaren, welke menschelijke kunst, welke zij niet bevorderen kan?"

[2] SA Amsterdam, 27: Archief van het collegium medicum, collegium obstetricium en plaatselijke commissie van geneeskundig toevoorzicht, inv. 19 and 23. Reinwardt's

After some initial doubts and deliberations with his family in Lüttringhausen, the young Reinwardt decided to prolong his stay and work as assistant at his brother's chemical workshop on the Lauriergracht, which Johann Christian ran together with his companion J.C. Sleesen.[4] Reinwardt himself later summarized his relationship with his brother, who died young, to an Amsterdam professor of natural history and chemistry as follows:

> Everything which I have achieved is due to the companionship, the example and the advice of my tenderly beloved brother—a pleasure which has been preserved until this very day. Fostering a strong interest in all sciences [*omnium litterarum*], he made me strive for the same goal and to compete with him. You, highly esteemed Sir, know how thoroughly he understands his profession, and in particular chemistry.[5]

Reinwardt's self-description as an ambitious and highly motivated 'scientist'—the term 'scientist' is here used in the more encompassing sense of the German term *Wissenschaftler*—needs some explanation. None of Reinwardt's previous biographers has scrutinized this rather idealized self-image which the naturalist sketched of his apprenticeship. The following chapter offers an in-depth reconstruction of the milieu in which Reinwardt was socialized and trained. [6]

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brother started an apprenticeship in October 1782 under the apothecary Jacobus Luckemeyer.

[3] H.A. Diederiks, *Een stad in verval. Amsterdam omstreeks 1800. Demografisch, economisch, ruimtelijk* (Rotterdam: Krips Repro Meppel, 1982), 145.

[4] Unfortunately the workshop is not mentioned in the detailed survey of Amsterdam's processing industry by L. van Nierop, "Gegevens over de nijverheid van Amsterdam bijeengelezen uit de advertenties in de Amsterdamsche Courant," *Jaarboek van het Genootschap Amstelodamum* 28 (1931): 95-170; and *Ibidem*, 29 (1932): 253-310.

[5] Parts of the original Latin letter are reprinted in De Vriese, *Reinwardt's reis,* 6, footnote 1. Reinwardt to G. Vrolik, circa 1800: "Hujus fratris, carissimi mortalium, consuetudini, exemplo, consiliis, quibus in hunc usque diem usus sum, omnia debeo et accepta refero. Namque ut fuit omnium litterarum semper studiosissimus, ita et me sui imitatorem aemulumque fecit. Neque tu ignoras, vir ornatissime, quam sit suae artis, chemicaeque imprimis peritissimus."

[6] For earlier biographies of Reinwardt see: T.W. van Heiningen, *The correspondence of Caspar Georg Carl Reinwardt (1773-1854)*, vol. 1: 1802-1819 (The Hague: Dutch – History of Science – Web Centre, 2011), 13-37; T.W. van Heiningen, "Caspar Georg

By focusing on the realm of chemists and apothecaries in Amsterdam in the late eighteenth century, the chapter also offers a fresh picture of Amsterdam's pharmaceutical and chemical industry in the second half of the eighteenth century.[7] While economic historians have focused their analysis on the economic stagnation of the Low Countries in general and the staple market in Amsterdam in particular,[8] the following chapter uncovers a dynamic community of merchants, academically schooled physicians, manufacturers of chemicals, and apothecaries that provided fertile ground for the innovative chemical practices necessary for the efficient processing of raw material and the production of drugs and chemicals on a larger scale.[9]

The subsequent analysis of the material world and practices of chemists, apothecaries and producers of chemicals in Amsterdam in the late eighteenth century also supports the view, as expressed by historians of chemistry, that there were hardly any borders between the different professional realms in the field.[10] Similarly in Germany and France, chemistry and pharmaceutical art appeared as closely intertwined

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Carl Reinwardt. Wissenschaftliche Aktivitäten im Dienste des ostindischen Gouvernements," in *Medizingeschichte in Schlaglichtern. Beiträge des "Rheinischen Kreises der Medizinhistoriker"*, ed. Dominik Groß et al., 179-91 (Kassel: Kassel University Press, 2011); W.H. de Vriese, "Reinwardt's leven en werken, eene bijdrage tot de geschiedenis der natuurkundige wetenschappen, inzonderheid in betrekking tot Nederlandsch Oost-Indië, en als inleiding tot de uitgave zijner reize naar de Ooster-eilanden van den Indischen archipel," in *Reis naar het oostelijk gedeelte van den Indischen Archipel, in het jaar 1821*, ed. W.H. de Vriese and J. Pynappel (Amsterdam: Frederik Muller, 1858), 1-98; P.J. Veth, "C.G.C. Reinwardt," *Handelingen en geschriften van het Indisch genootschap te 's-Gravenhage* (1856): 185-225; and W. Vrolik, "Levensberigt van C.G.C. Reinwardt," *Verslagen en mededeelingen van de Koninklijke Akademie van Wetenschappen* (1854): 214-31.

[7] For a similar view, see K. Davids, "Shifts of technological leadership in early modern Europe," in *A miracle mirrored. The Dutch Republic in European perspective*, ed. Karel Davids, et al. (Cambridge: Cambridge University Press, 1995), 358.

[8] See for instance J.L. van Zanden and A. van Riel, *Nederland 1780-1914. Staat, instituties en economische ontwikkeling* (Amsterdam: Balans, 2000), 27-70.

[9] A similar view is expressed in J. Jonker, *Merchants, bankers, middlemen. The Amsterdam money market during the first half of the 19th century* (Amsterdam: Neha, 1996), 77-8.

[10] U. Klein, "Die technowissenschaftlichen Laboratorien der frühen Neuzeit," *NTM. Zeitschrift für Geschichte der Wissenschaften, Technik und Medizin* 16:1 (2008): 5-38; U. Klein and W. Lefèvre, *Materials in eighteenth-century science. A historical ontology* (Cambridge: MIT Press, 2007), 33-37.

endeavors.[11] Chemistry in the late eighteenth century was, as Jan Golinski, a historian of chemistry, puts it, "a discipline without rigid boundaries."[12]

During his years as chemist in Amsterdam, Reinwardt laid the basis for his later career as professor, administrator, and colonial advisor. Later chapters will show how chemists such as Reinwardt, who were thought to know how to survey and manipulate nature for medicinal and other useful ends, found their way through the complex political and social landscape of the Netherlands in the decades around 1800.[13]

Apprentice at a Chemical Workshop

Owing to the lack of archival records it remains unclear when exactly Reinwardt's assistantship at his brother's chemical workshop started. Since the requirements for apothecary apprentices were demanding—beside a minimum age of sixteen, apprentices had to dispose of a sufficient knowledge of Latin and Dutch[14]—it seems that Johann Christian Mattheus managed to employ his younger brother first as 'servant' *(knegt)* at his chemical workshop on the Lauriergracht. In contrast to regular apothecaries, such workshops usually produced chemicals for both medicinal and various industrial purposes. Their preparations thus ranged from all kinds of medicinal drugs to chemicals for Amsterdam's textile, glass, sugar, porcelain, paper, soap, metal and dying industries.[15] Among the more important chemicals were

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[11] U. Klein, "Apothecary's shops, laboratories and chemical manufacture in eighteenth-century Germany," in *The mindful hand: inquiry and invention from the late Renaissance to early industrialization,* ed. Lissa Roberts, et al., 247-76 (Amsterdam: Edita, 2007).

[12] J. Golinski, "Chemistry," in *Cambridge History of Science*, vol. 4, *Eighteenth-century science,* ed. R. Porter (Cambridge: Cambridge University Press, 2003), 376.

[13] For an inspiring overview of similar careers and reflections on general patterns see A. Maas, "Civil scientists: Dutch scientists between 1750 and 1875," *History of Science* 48:1 (2010): 75-103.

[14] On the training of apothecaries in the Dutch Republic in general and Amsterdam in particular see E.L. Ahlrichs, "Van leerjongen tot meester-apotheker VII," *Pharmaceutisch weekblad* 116:45 (1981): 1369-73.

[15] For an overview of Amsterdam's industry in those years, see J. Goldberg, "Journaal der reize van den agent van Nationale Oeconomie der Bataafsche Republiek, a. 1800," *Tijdschrift voor staathuishoudkunde en statistiek* 19 (1860): 185-86; H. Diederiks, *Een stad in verval*, 152-4, 161-5, 174-83 and 198-200, who discusses various branches. As regards sugar refineries see also M.S.C. Bakker, "Suiker," in *Geschiedenis van de techniek in Nederland. De wording van een moderne samenleving 1800-1900*, vol. 1, *Techniek en*

borax, camphor and saltpeter. While borax and camphor were used in the glass and porcelain production, saltpeter was a key ingredient in fertilizers and gunpowder.

A survey carried out in 1799 and 1800 by the Minister for National Oeconomy (Agent van Nationale Oeconomie), Johannes Goldberg (1763-1828), gives good insight into Amsterdam's chemical industry.[16] According to Goldberg, Amsterdam housed four borax, four camphor, three saltpetre, three sulphur and fifty-nine sugar refineries as well as two alcohol (*sterkwater*), five vermillion and two salt factories.[17]

When Reinwardt started his assistantship in 1786, the number of chemical factories in Amsterdam was dwindling. A major reason for this decline was the Fourth Anglo-Dutch War in which the Dutch East India Company lost many of its ships and thus access to colonial possessions in India and the Malay Archipelago.[18] The sugar and camphor industry—the so-called traffics (*trafieken*)—in particular depended heavily on cheap raw materials from overseas territories.[19] As regards the sugar refineries, Goldberg noted in his survey that the number of companies declined from 120 refineries before the war to 59 in the late 1790s. The difficulties associated with the war were aggravated by rising competition within Europe. Administrators and chemists in France, Britain, Russia, Denmark, Norway and Sweden had stimulated the establishment of new chemical companies and succeeded in introducing new and efficient refining processes in the second half of the eighteenth century. In order to protect domestic markets, they even started to raise high import tariffs on refined sugar from abroad.

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modernisering. Landbouw en voeding, ed. H.W. Lintsen, (Zutphen: Walburg Pers, 1992), 217-18.

[16] K. Davids, *The rise and decline of Dutch technological leadership. Technology, economy and culture in the Netherlands, 1350-1800* (Brill: Leiden, 2008), 2.473-74. For more background information on the Goldberg survey see A.M. van der Woude, "Ontstaan en plaatsbepaling van de Goldberg-enquête," *Economisch en sociaal-historisch jaarboek* 55 (1992): 15-28.

[17] NA The Hague, collectie Goldberg, inv. 50 II, fol. 453-66.

[18] F. Gaastra, *De geschiedenis van de VOC* (Zutphen: Walburg Pers, 2002), 166-70 and E.S. van Eyck van Hesling, *Van compagnie naar koopvaardij. De scheepvaartverbinding van de Bataafse Republiek met de koloniën in Azië 1795-1806* (Amsterdam: De Bataafsche Leeuw, 1988), 17′-36.

[19] J. Mokyr, *Industrialization in the Low Countries, 1795-1850* (New Haven: Yale University Press, 1976), 2-3, and J. de Vries and A. van der Woude, *The first modern economy. Success, failure, and perseverance of the Dutch economy, 1500-1815* (Cambridge: Cambridge University Press, 1997), 328.

According to Goldberg, Britain also subsidized the export of sugar to other European countries. [20]

Figure 3: Portrait of Caspar Georg Carl Reinwardt
by Mattheus I. van Bree and R. Vinkeles
(around 1800).

The fate of the company of Theodorus Petrus Schonck (1736-1812) and his successor Anthoni d'Ailly (1766-1825) gives good insight into the material world of chemists and apothecaries in Amsterdam at the time.[21] Schonck and his companion D'Ailly processed and produced saltpeter, borax, camphor and alcohol for various industrial and medicinal purposes.[22] Reinwardt must have become acquainted with Schonk and D'Ailly in starting in the 1790s, for in April 1801, he acted as godfather to D'Ailly's daughter Caroline Elisabeth.[23] In his botanical diary, he mentions earlier

[20] NA The Hague, collectie Goldberg, inv. 50 II, fol. 459.
[21] D.A. Wittop Koning, "Bijdragen tot the pharmaceutische prijsgeschiedenis", *Kring voor de geschiedenis van de pharmacie in Benelux* 17 (1958): 11-12.
[22] D.A. Wittop Koning, *Compendium voor de geschiedenis van de pharmacie van Nederland* (Lochem: De Tijdstroom, 1986), 90.
[23] SA Amsterdam, doopregister (1564-1811), 113, p. 574 (fol. 275), no. 15.

visits of Schonck's and D'Ailly's company.[24] In 1776, Schonck had moved his small laboratory from the Haarlemmerdijk to the Zaagmolenpoort in Amsterdam, where various small manufactures and companies had settled in the course of the seventeenth and eighteenth century.[25] At this new venue, Schonck set up a small laboratory with a furnace and distilling apparatuses that allowed him to produce chemicals on a larger scale. Apparently, the company also owned a collection of living animals whose excrement was necessary for various chemical preparations.[26]

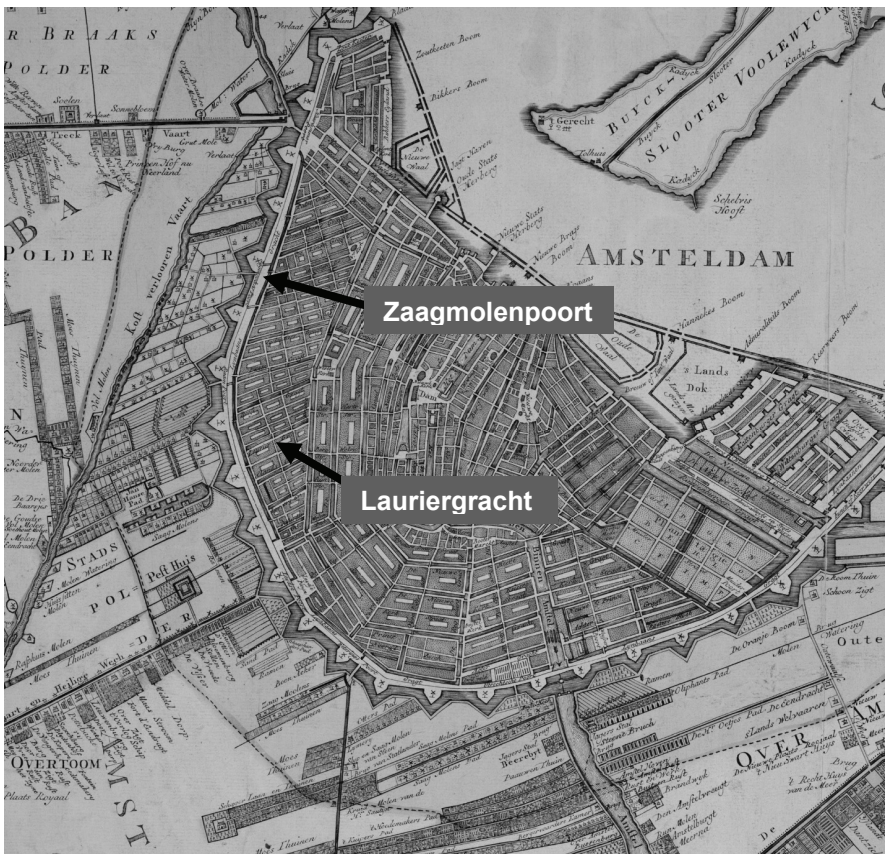

Figure 4: Map of Amsterdam, 1770.

[24] See, for instance, UL Leiden, BPL 611, botanical diary, entries: 25 and 26 November 1797.

[25] NA The Hague, collectie Goldberg, inv. 50 II, fol. 453-66.

[26] J.A. Bierens de Haan, *De Hollandsche Maatschappij der Wetenschappen 1752-1952* (Haarlem: H.D. Tjeenk Willink & Zoon N.V., 1970), 257.

Instead of following the curriculum of regular apothecary apprentices, chemist-apothecaries like Reinwardt learned their trade through daily practice in the small laboratories of the chemical workshops. His training involved a large array of raw materials, long-term experimentation and regular practice with various instruments. According to descriptions that Goldberg compiled in the late 1790s, the processing of alcohol, camphor, sal ammoniac, sugar and borax involved raw materials such as saltpetre, vitriol, iron vitriol, raw camphor from Japan, raw borax, chalk, egg white, fish glue, soda water, butter, oxblood, pipe clay from Cologne, milk, fat, bones (*beenderen*), urine, soot (*roet*), *wollen vod* and strong sulphuric acids. Moreover, it involved a variety of tools and instruments such as different forms of furnaces, distilling jars, retorts and receivers (*ontvangers*), sublimation glasses, bins, bowls, copper kettles, crystallization barrels (*cristallizeervaten*), skimmers, a filter machine (*defiltreermachine*), thermometers, balances, a copper kettle in a cold store, and special kettles for evaporation.[27]

According to Goldberg's descriptions, camphor usually reached Amsterdam in the form of little balls which were pressed in big barrels. The balls had been produced in Japan, Ceylon, Borneo and Java by soaking and cooking the leaves, branches, wood, roots and the bark of camphor trees. Since the camphor balls were rather impure, they had to be further purified by sublimation which was first done by chemists in Venice but was now carried out directly in Amsterdam. Goldberg described the sublimation process as follows: first, the raw camphor balls were sieved in order to remove crude impurities. After that, the camphor was mixed with chalk and placed in spherical sublimation bulbs which were narrowed at their neck and at the bottom. The opening of those bulbs was sealed with cotton and hot sand. In order to start the sublimation, the bulbs were carefully heated until the camphor dispersed as dehydrated oil. Thereafter the heat had to be decreased and the hot sand at the top of the bulbs was replaced by a cap (*muts*) made of cardboard through which the camphor could evaporate and settle in the upper and colder parts of the bulb. Finally, the bulb could be broken and the purified camphor which was now in the form of a large *bollekoek* (thick cake) could be taken out. Beside sublimation camphor could also be purified by dissolving the camphor balls in wine spirit (*wijngeest*) and filtered by precipitating the camphor with water. The outcome had to be poured into

[27] The descriptions can be found in NA The Hague, collectie Goldberg, inv. 45.

spherical bulbs and carefully heated and then cooled down to let the camphor harden.[28]

Usually chemists such as Schonck and D'Ailly did not employ more than ten servants (*knegts*). Such companies were not attached to guilds, which usually regulated the education of apprentices. It is therefore not surprising that Reinwardt does not appear as an apprentice in the archives of the Amsterdam *collegium medicum* which was responsible for the examination and supervision of apothecaries and surgeons. The records only list his brother Johann Mattheus who apprenticed with the Amsterdam apothecary Jacobus Luckemeyer from 1782 until 1785.[29]

Figure 5: View on the distillery (*stoockhuys*) of the chemical workshop of Anthoni d'Ailly (1766-1825).

[28] NA The Hague, collectie Goldberg, 45, on camphor refineries.

[29] SA Amsterdam, 27: Archief van het collegium medicum, collegium obstetricium en plaatselijke commissie van geneeskundig toevoorzicht, inv. 19 and 23.

The Chemical Education of Apothecaries

When Reinwardt started his assistantship in the late 1780s, new ideas about how chemistry should be practiced played a growing role in the professional life of chemists and apothecaries in Amsterdam and throughout the Low Countries.[30] While on a provincial level reform societies such as the Provincial Utrecht Society of Arts and Sciences (Provinciaal Utrechtsch Genootschap van Kunsten en Wetenschappen), the Society for the Improvement of Agriculture (Maatschappij tot de Bevordering van de Landbouw), the Society for the Benefit of the People (Maatschappij tot Nut van 't Algemeen) and the Economic Branch of the Dutch Society of Science (Oeconomische tak van de Hollandsche Maatschappij der Wetenschappen) promoted chemical knowledge as a general tool to mitigate the relative economic decline of the Dutch Republic,[31] Amsterdam's chemists rather stressed the importance of a thorough chemical education in order protect their profession from untrained and unexamined practitioners who, as the Amsterdam chemist and apothecary Johannes Petrus Kasteleyn (1746-1794) and his colleague Schonck put it, fabricated and sold drugs and other chemicals without having been carefully trained and examined.[32] In an answer to an essay competition of the Utrecht Learned Society in 1785, Kasteleyn and Schonck summarized the situation in Amsterdam as follows:

> It is *Amsterdam*, the mighty, the populated *Amsterdam*, where in the shops of the *chymisten,* apothecaries [*drogistenwinkels*] and herbal shops, and who knows where else, one daily can witness how hundreds of drugs prescribed by physicians are prepared without any punishment. It is particularly *Amsterdam* where one can find all sorts of pernicious so-called drugs fabricated by entirely inexperienced [practitioners] who, year after year, offer their drugs in public. . . . It is in *Amsterdam* where around 150

[30] Regarding apothecaries in Rotterdam see M.J. van Lieburg, *Het medisch onderwijs te Rotterdam (1467-1967). Een kort historisch overzicht* (Radopi: Amsterdam, 1978), 56-7.

[31] See W.W. Mijnhardt, *Tot heil van 't menschdom. Culturele genootschappen in Nederland, 1750-1850* (Amsterdam: Radopi, 1987), chapter 3, and G.P.J. Verbong, "De uitgangssituatie," in *Geschiedenis van de Techniek in Nederland. De wording van een moderne samenleving, 1800-1900,* vol. 5, *Techniek, beroep en praktijk,* ed. H.W. Lintsen, et al. (Zutphen: Walburg Pers, 1994), 36-45.

[32] For a detailed study on Kasteleyn see L. Roberts, "P.J. Kasteleyn and the "Oeconomics" of Dutch chemistry," *Ambix* 53:3 (2006): 255-72.

> apothecaries are trying . . . pretending to be medical doctors in order to secure their living in a quacksalvering way . . . . Look at the disastrous situation of pharmacy, in the most powerful, most populated city of our Union.[33]

According to the two apothecaries, two measures had to be taken in order to improve the situation in the Dutch Republic in general and in Amsterdam in particular: first, the city council had to take care that all new chemists and apothecaries were carefully chosen and examined. Second, every apothecary in the country should have the opportunity for special training in the field of pharmaceutical chemistry as it was practiced in Germany.[34]

In Germany, similar claims about apothecaries had led to the establishment of special institutes for pharmacy and chemistry which were supposed to train apothecaries and manufacturers. The first institute was set up in Langensalza in the north of Thuringia by the apothecary Johann Christian Wiegleb (1732-1800) in 1778. Wieglieb's Educative Institute for Young Chemists (Erziehungsanstalt für junge Scheidekünstler) rapidly attracted young apothecaries and manufacturers from all parts of the German empire, England, Switzerland, Denmark, Poland, Prussia, Hannover and Württemberg. Wiegleb's institute was innovative in two respects: on the one hand Wiegleb taught classes on chemistry and pharmacy in which he demonstrated the practical application of various chemical substances and instruments such as thermometers and balances. On the other hand, instead of focusing only on medicinal drugs produced for a tiny market he instructed

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[33] T.P. Schonk and J.P. Kasteleyn, "Tweede antwoord op de vraag…", *Verhandelingen van het Provinciaal Genootschap van Kunsten en Wetenschappen* 4 (1786): 176-77: "'t is Amsterdam, het magtig, het volkrijk Amsterdam, waar men in Chymistenwinkels, Drogistwinkels, Kruidenwinkels, en wie weet waar niet al meer, dagelijksch eenige honderde Ordonnantiën door Doctoren voorgeschreeven, ongestraft durft en ziet gereed maaken. 't Is Amsterdam vooral, waar men allerhande verdervelijke zogenaamde geneesmiddelen door volkoomen onkundigen, in de openbaare nieuwsmaaren, jaar uit, jaar in, openbaar, te koop veilt. . . . 't Is Amsterdam, waar een aantal van 150 Apothekers zich vermoeijen, . . . met den Doctor uithangen, ten einde op eene zekere kwakzalverachtige wijze hun bestaan te vinden. . . . Zie daar, den rampzaligen toestand der Pharmazie, in de magtigste, de volkrijkste Stad onzer Unie."

[34] Ibidem, 164.

his disciples in how to prepare chemical products such as soap and mineral alkalis on a larger scale.[35]

The success of Wiegleb's approach led to the establishment of similar schools in Berlin, Hamburg, Kassel, Naumburg and other places in Germany. One of the most important foundations was the pharmaceutical school (Chemisch-physikalisch-pharmeceutische Pensionsanstalt) of the chemist Johann Bartholomäus Trommsdorff (1770-1837) in Erfurt in 1795.[36] In contrast to Wiegleb, Trommsdorff gave classes not only in analytical chemistry but also in botany, zoology, mineralogy and herbology. Moreover, Trommsdorff started publishing a new chemical journal, *Journal der Pharmacie,* which he used as a platform to spread information about innovative chemical techniques and new chemical instruments. Trommsdorff trained more than 300 apprentices and he later got engaged in the large-scale production of soda and indigo.[37]

In order to follow the German example, Kasteleyn and Schonck called for the appointment of public lecturers for chemistry in six or, better still, eight major cities in the Republic who would teach the basic principles of chemistry in Dutch. For, as the two chemists put it,

> There is not a single branch of the traffics or workshop which is not indebted to chemistry; and which, if it is to flourish, has to be managed according to chemical principles, for almost all their manufacturing processes [*bewerkingen*] are chemical processes.[38]

Those lecturers had to be carefully chosen and examined in advance to guarantee the quality of their courses and lectures. Moreover, every lecturer

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[35] E. Homburg, *Van beroep 'Chemiker'. De opkomst van de industriële chemicus en het polytechnische onderwijs in Duitsland (1790-1850)* (Delft: Delftse Universitaire Press, 1993), 103-104.

[36] E. Homburg, "Industrie, chemie en milieu (1750-1815)," in *Geschiedenis van de techniek in Nederland. De wording van een moderne samenleving*, vol. 4, *Delfstoffen, machine- en scheepsbouw. Stoom. Chemie. Telegrafie en telefonie* (Zutphen: Walburg Pers, 1993), 162.

[37] Homburg, *Van beroep* 'Chemiker', 105, and H.R. Abe, W. Goetz, and H. Bettin, *Der Briefwechsel von Johann Bartholomäus Tromsdorff (1770-1837)* (Halle, Saale: Deutsche Akademie der Naturforscher Leopoldina, 1987), 8-9.

[38] Schonk and Kasteleyn, "Tweede antwoord op de vraag…", 142: "Er is niet eenige Trafiek, of Fabriek, welke niet haaren oorsprong aan de Scheikunde verschuldigd is; en die, zal zij bloeijen, volgens Scheikundige grondregelen, moet bestuurd worden; dewijl verre de meeste dier bewerkingen Scheikundige bewerkingen zijn."

should receive a well equipped laboratory in order to demonstrate and explain the chemical techniques and instruments which were necessary to improve the production of drugs and industrial chemicals. These instruments and techniques would also enable the identification of adulterated substances produced by untrained practitioners.[39] Amsterdam's *collegium medicum* regularly had to deal with cases in which 'unauthorized' practitioners were accused of counterfeiting drugs.[40]

In the years to come, Kasteleyn in particular never tired of admonishing colleagues and administrators to improve the chemical education in order to improve public health care and to stimulate economic growth. He repeatedly stressed the importance of combining theory and practice.[41] From 1785 on, he published the journal *Chemische oefeningen* (Chemical exercises) dedicated to the application of chemistry for manufacturers and apothecaries. Beside lecturing and giving papers, he also edited a series of books that described how industrial processes such as the dying of textiles with indigo, distilling of alcohol and the manufacturing of porcelain could be improved. The books that came off the press in Dordrecht between 1788 and 1792 were mainly translations of German and French titles.[42] In his *Beschouwende en werkende pharmaceutische-, oeconomische- en natuurkundige chimie* (Theoretical and practical pharmaceutical, oeconomic and physical chemistry), which appeared between 1786 and 1794, Kasteleyn tried to give a concise overview of the available useful chemical techniques and practices in various industrial contexts such as soap manufacturing and alcohol production.[43]

Similar ideas were echoed in other Dutch cities. Petrus Driessen (1753-1828), since 1778 lecturer in chemistry, pharmacy and *materia medica* in Groningen, proposed comparable reforms for the training of future apothecaries and manufacturers. Driessen taught various classes on industrial processing (*fabriekkunde*) and 'oeconomic' and technological chemistry.

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[39] Ibidem, 181.

[40] J.J. Haver Droeze, *Het collegium medicum Amstelaedamense, 1637-1798* (Haarlem, 1921), 151-52.

[41] For a detailed analysis of Kasteleyn's work see Roberts, "P.J. Kasteleyn and the "Oeconomics," 255-72.

[42] The full title of this series of monographs is: *Volledige beschrijving van alle konsten, ambachten, handwerken, fabrieken, trafieken, derzelver werkhuizen, enz.* (Entire description of all arts, trades, crafts, fabrics, industries and their working places, tools, etc.).

[43] P.J. Kasteleyn, *Beschouwende en werkende pharmaceutische, oeconomische, en natuurkundige chemie*, 3 vols. (Amsterdam: Willem Holtrop, 1786-1794).

Together with his students he regularly visited manufactures and industries in the environs of Groningen to gain insight into pressing technical problems. By doing so, his students received a unique training in which theoretical insights and practical expertise were narrowly intertwined.[44] In Delft, Abraham van Stipriaan Luiscius (1763-1829) was appointed public lecturer for chemistry in 1790, and commenced his new position with a lecture on the general usefulness of chemistry and its relationship with medicine.[45] Other cities followed. In Haarlem, Martinus van Marum was appointed as lecturer of botany and chemistry in 1795. One year later, Nicolaas Cornelis de Frémery (1770-1844) was appointed teacher for chemistry and pharmacy in Utrecht. In Rotterdam, the physician and chemist Willem Rouppe (1765-1816) started lecturing in chemistry for the Batavian Society for Experimental Philosophy (Bataafsch Genootschap der Proefondervindelijke Wijsbegeerte).[46] In Dordrecht and The Hague, Willem van der Leeuw (1763-1801) and Florentius Jacobus van Maanen (1777-1861) were later employed in similar positions.[47]

Weak Echoes of the *Collegium Medicum*

In Amsterdam, however, Kasteleyn's and Schonck's ideas remained disputed. In 1785, five wealthy Amsterdam merchants—J.J. van Hagen, J.H. Johansen, J. Joosten, J. van Etten and C. van Bevoord—approached the city council with a request to employ a public lecturer to improve the chemical expertise of manufacturers, chemists, and apothecaries. When asked for advice, the *collegium medicum* was rather sceptical about the initiative. In the opinion of the *collegium*'s board, chemistry formed part of the practical training of apothecary apprentices, which had to take place in apothecaries and not in a lecture hall. A public lecturer would only spread chemical knowledge among unskilled practitioners who in turn would compete with examined apothecaries in the city.[48]

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[44] Homburg, "Industrie, chemie en milieu (1750-1815)," 163.

[45] The full title of the lecture is: *Het nut der scheikunde in het algemeen en derzelver invloed op de Geneeskunde in het bijzonder.* On Luiscius, see Anonymous, "Levensberigt van den Heere A. Stipriaan Luiscius," *Algeemene Konst- en Letter-Bode* 22 (1829): 338-44 and 23 (1829): 354-59.

[46] On Rouppe see: Van Lieburg, *Het medisch onderwijs te Rotterdam*, 56-57.

[47] Homburg, "Industrie, chemie en milieu (1750-1815), " 163-4.

[48] W.P. Jorissen and L. Th. Reicher. *J.H. van `t Hoffs Amsterdamer periode: 1877-1895* (Helder: C. de Boer jr., 1912), 13.

Since the merchants offered to pay for the salary of the new lecturer, the city council eventually agreed to appoint the Amsterdam physician Dirk van Rhyn (1745-1817) as public lecturer for chemistry, pharmaceutics and *materia medica* at Amsterdam's university, the Athenaeum Illustre. Owing to the limited teaching facilities in the city, Van Rhyn's chemistry classes at the *hortus botanicus* remained on a rather basic level. In the academic year 1803/04, Van Rhyn even declined to continue his classes owing to the lack of a well-equipped laboratory. Only later did he manage to set up a very small and still inadequate chemical workplace at his house in the Staalstraat (De Saaihal).[49] It is doubtful whether Van Rhyn was allowed to use the chemical laboratory of the learned society *Felix Meritis* established in 1786 on the neighboring Keizersgracht.[50]

Amsterdam's chemists were also doubtful about Van Rhyn's teaching activities. In 1796, Schonck and his colleague Anthony Lauwerenburg (1758-1820), who had been asked by the city council to report on the state of chemists' education in Amsterdam and to develop an outline for a new laboratory, severely criticized Van Rhyn's approach. According to them, Van Rhyn considered chemistry only as an auxiliary science to medicine and thus would not demonstrate or explain useful chemical procedures and instruments. Schonck and Van Lauwerenburg put it as follows:

> The man who wants to enrich his skills, the inquisitive manufacturer, who is no longer satisfied with only passively watching phenomena which he encounters during his chemical preparations, but who wants to know the underlying reasons, the most important ingredients [*hoofdstoffe*], and the basic elements [*beginselen*] . . . of which the items [already] manufactured or to be manufactured consist, may find he has achieved his goal, if the various subjects of that discipline ['chemistry'] are being taught . . . and applied [in an industrial context]. It is something which many have longed for but which has never happened until now and we are fully convinced that those who have

[49] A.I. Bierman, *Van artsenijmengkunde naar artsenijbereidkunde. Ontwikkeling van de Nederlandse farmacie in de negentiende eeuw* (Amsterdam: Radopi, 1988), 178-79.

[50] W.P. Jorissen, "Iets over het onderwijs in de chemie aan het Athenaeum Illustre te Amsterdam voor de komst van J.W. Gunning," *Chemisch Weekblad* 27 (1911): 505.

> stimulated the establishment of such an institute will be praised after a few years. [51]

According to Schonck and Lauwerenburg, the new laboratory had to comprise basic instruments (*eenvoudige instrumenten*) which chemists used in their daily practice. Moreover, the new laboratory should provide enough space for a larger audience to attend classes and watch public demonstration of experiments. The classes had to be given by a lecturer trained in all facets of chemistry. If the number of students exceeded the maximum capacity of the new venue, the classes had to be divided into three different series: one for physicians, one for apothecaries and chemists and one for their apprentices. Since in particular chemists and apothecaries would probably be unable to read and understand Latin, the classes had to be held in Dutch. Moreover, the new lecturer had to base his classes on the ideas and practices which the French chemist Antoine-Laurent Lavoisier (1743-1794) and others had introduced into the field. Their approach, which Lavoisier eventually fixed in his famous text book, *Traité élémentaire de chimie* (1789), comprised two core features: on the one hand an extensive usage of thermometers, clocks, gasometres, and most important, balances in order to weigh, measure, split, and combine various natural elements such as gases and minerals, and on the other hand the introduction of a standardized chemical nomenclature to allow chemical treatments to be recorded and reproduced in a formalized manner.[52]

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[51] SA Amsterdam, 27: Archief van het collegium medicum, collegium obstetricium en plaatselijke commissie van geneeskundig toevoorzicht, inv. 6, fol. 30 and following folios. Letter Schonk and Lauwerenburg to city council, Amsterdam, 19 May 1796: "Den man die zijne kundigheden wenscht te vermeerderen, de weetgierige Fabrikeur, die zig niet langer wil vergenoegen de verschijnselen in bloot aanschouw te nemen, die hem in zijn scheikundige werkzaamheden voordoen, maar de redenen hiervan wil weten, de hoofdstoffe, de beginselen wil kennen, waaruit zijn, te vervaardigen of vervaardigde stoffe bestaan, kan zijn oogmerk bereikt zien, waneer in der onderscheidene vakken dier wetenschap geleeraard werd en deze op alle Fabrieken invloed heeft, werd toepasselijk gemaakt waarna helaas zo veelen jaren gereikhalst hebben, en nimmer tot heden hebben mogen zien gebeuren en wij houden ons ten vollen overtuigd dat na verloop van weinige jaren, en in zeegening zal gedagt worden, aan hen wien men die gelegenheid van zodanig instituut te danken heeft."

[52] Klein and Lefèvre, *Materials in eighteenth-century science*, 87-95, and Golinski, "Chemistry," 392-96, and B. Bensaude-Vincent, "Lavoisier: Eine wissenschaftliche Revolution, in *Elemente einer Wissenschaftsgeschichte*, ed. Michel Serres (Suhrkamp: Frankfurt am Main, 1995), 645-85.

In order to demonstrate and explain the usefulness of Lavoisier's chemistry, special classes on topics such as the manufacturing of metal, glass, paint and dye had to be held as well. Since the classes were supposed to have a rather practical character, the new laboratory should also comprise a cabinet where chemicals necessary for practical demonstrations could be stored.[53]

The answer of the *collegium medicum*, which at that time consisted of the Amsterdam professor of anatomy Andreas Bonn (1738-1817), the physicians F.E. Willet, Van Rhyn, and the apothecaries J. Frescarode and D.H. Post, gives further insights into the state of chemical education in Amsterdam at the time. Although the *collegium medicum* also emphasized the close relationship between chemistry and medicine, pharmacy and the processing industry, its members doubted whether the new laboratory should serve as a place where useful chemical practices for manufacturers and chemists ought to be taught. In their opinion, Amsterdam already housed a community of dynamic and innovative manufacturers who were encumbered by political turmoil rather than by a lack of chemical expertise. Moreover, learned societies such as the *Oeconomische Tak* stimulated the production of useful knowledge by launching essay competitions. Nor did physicians need a new laboratory. Since they had studied at the Athenaeum Illustre or even abroad, they possessed enough chemical expertise to carry out their profession properly. The only group which perhaps needed a better chemical training were the apothecaries and their apprentices.[54]

Instead of appointing a new lecturer, the *collegium medicum* proposed to employ Van Rhyn as head of the new laboratory. Moreover, they rejected the proposal to instruct the new lecturer in how the laboratory should be equipped and how chemistry should be taught. And instead of offering three courses, the *collegium medicum* suggested that Van Rhyn teach two courses: In the first course, to be taught in Dutch, the focus had to be on the practical application of chemistry in various technological contexts. A second course on the *chymia pharmaceutica* for physicians, apothecaries and their apprentices had to be based on the *Nieuwe Amsterdamsche Apotheek*

[53] SA Amsterdam, 27: Archief van het collegium medicum, collegium obstetricium en plaatselijke commissie van geneeskundig toevoorzicht, inv. 6, fol. 31-4. Schonk and Lauwerenburg to city council, Amsterdam, 19 May 1796.

[54] Ibidem, inv. 6, fol. 36-40. Consideratien en advies van het collegium medicum op het rapport van T.P. Schonk en A. Lauwerenburg wegens een laboratorium chemicum. Amsterdam, 6 July 1796.

(1795), the practical manual for apothecaries in the city compiled by the members of the *collegium medicum*.[55]

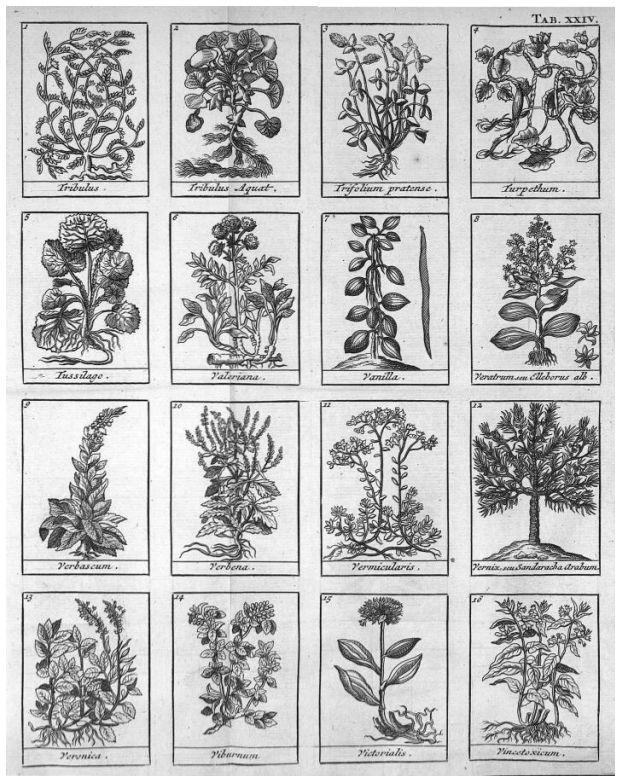

Figure 6: Illustration of medicinal plants in N. Lémery. *Dictionnaire ou traité universel des drogues simples*. Amsterdam 1716. Table XXIV.

The *Nieuwe Amsterdamsche Apotheek* contained an exact definition of weights, a list of all medicinal herbs and plants and practical information on topics such as syrups, various oils, extracts from resins, the distillation of liquids, oils and alcohols (*geesten*), saltpeter, simple preparations with chalk magnesia, salts such as potash, and sulphur, the preparation of metals, powders, pills, balms and salves, and plasters, as well as the correct use of a hygrometer in order to guarantee the correct mixing ratio of liquids. In two letters of advice later added to manual, Jan Hendrik van Swinden (1746-1823) and Gerardus Vrolik (1775-1859) even offered a reading list

[55] Ibidem.

comprising eleven French, German, and British books on botany and chemistry such as the latest edition of the British *Pharmacopoeia*, Nicholas Lémery's *Dictionnaire ou traité universel des drogues* (various editions), Antoine François Fourcroy's *Leçons élémentaires d'histoire naturelle et de chimie* (1782), Christoph Girtanner's *Neue Chemische Nomenklatur* (1791) and Johann Christian Wilhelm Remler's *Das Neue Chemische Wörterbuch* (1793).[56] From that moment on, these titles played an important role in the education of apothecaries in Amsterdam.

Studying Medicinal Plants at the *Hortus*

Until the emergence of an industrial chemical industry in the second half of the nineteenth century, knowledge about living and dried plants and herbs formed one of the competences chemist-apothecaries needed to acquire. Reinwardt and his brother thus frequently went on botanical field trips and excursions to the environs of Amsterdam and participated in classes at Amsterdam's *hortus medicus* at the Plantage Middenlaan.[57] These classes were usually conducted by the professor for botany at the Amsterdam Athenaeum Illustre. The *hortus* was thus one of the primary places where generations of young chemist-apothecaries learned how to identify medicinal and other plants. Before the foundation of the Amsterdam *hortus* in 1636, medicinal herbs and plants were mostly grown in gardens attached to monasteries and hospitals such as the Minderbroederklooster at the Kloveniersburgwal in the centre of Amsterdam.[58] The access to the Amsterdam *hortus medicus* was, however, restricted. While normal visitors had to pay an entrance fee, medical doctors, surgeons, chemists, apothecaries and their apprentices and assistants could enter the garden as often as they wanted. Their yearly contribution to the guild included free entrance to the garden. Apothecaries could even purchase medicinal herbs.[59]

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[56] W.F. Daems, "Onze Nederlandsche Pharmacopeeën," *Pharmaceutisch weekblad* 72 (1935): 1092-3.

[57] UB Leiden, BPL 611, Reinwardt's botanical diary, which runs from 1797 until 1850.

[58] On the close relationship between the education of apothecaries and the *hortus* see D.O. Wijnands, E.J.A. Zevenhuizen and J. Heniger, *Een sieraad voor de stad. De Amsterdamse Hortus Botanicus, 1638-1993* (Amsterdam: Amsterdam University Press, 1994), chapters 1-4, and Haver Droeze, *Het collegium medicum*, 138-45.

[59] See also W. Stoeder, *Geschiedenis der pharmacie in Nederland*, 1891 (Reprint Schiedam: Schie-Pers, 1974) for regulations and lists of fees.

The Amsterdam *hortus* housed several beds and greenhouses for a large number of domestic and exotic plants. At least in 1768, a couple of years before Reinwardt arrived in Amsterdam, the external area was divided into two large beds, one for medicinal plants and one for flowers. The bed for medicinal plants was again divided into three parts which were surrounded by a boxwood hedge. Every bed had its specific number. The plants in the beds were sorted according to the *Florae Leydensis prodromus* which Adriaan van Royen (1704-79), director of the botanical garden in Leiden, and the Swedish botanist Carolus Linneaus (1707-1778), had devised in the 1730s. Along the eastern walls of the garden one could find useful plants which the director of the garden used to instruct apothecaries, students and surgeons. The various heated glass houses contained plants from South Europe, the Middle East and the East and West Indies.[60]

When Reinwardt and his brother started visiting the garden in the late 1780s, the *hortus medicus* was directed by Nicolaas L. Burman (1734-1793) who had succeeded his father Johannes Burman (1706-1777) in 1777. Burman junior, who had studied medicine and botany in Leiden and Uppsala, held several positions in Amsterdam: beside his function as director of the *hortus,* he was attached to the Athenaeum Illustre as professor for botany and worked as physician at a female shelter. Moreover, he was inspector of the *collegium medicum,* the central regulatory institution for medical practitioners in Amsterdam.[61]

The staff of the *hortus* was quite limited. Beside its director and a few garden workers, the *hortus* only employed one hortulanus. While the hortulanus took care of the cultivation and cataloguing of the plants in the garden, the director was responsible for the exchange of plants with other botanical gardens within the Low Countries and abroad. The Burmans regularly exchanged seeds and living plants with gardens in Leiden, The Hague, Utrecht, Groningen and Rotterdam. Moreover, they acquired flowers, trees and medicinal herbs from farmers and planters in Aalsmeer, Haarlem, Lisse, Naarden, Kampen and Noordwijk. They also regularly corresponded with plant experts in Denmark, Sweden, Russia, Italy, the Americas and German speaking countries.

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[60] One of the most important contemporary descriptions of the Amsterdam hortus is a handwritten overview by D. Deutz who inspected the garden in 1768. The manuscript is published in E. van der Pool-Stoofkoper, *Een reconstructie van de Hortus Medicus Amstelodamensis, 1682-1800* (Amsterdam: 1984), 73-86. (= doctoraalscriptie/MA thesis).

[61] Wijnands, Zevenhuizen, and Heniger, *Een sieraad voor de stad*, 104-105.

The most important deliveries, however, came from the overseas territories where the Dutch West India Company (Geoctroyeerde Westindische Compagnie) and East India Companies (Verenigde Oostindische Compagnie, or VOC) had established a powerful network of botanical gardens which regularly exchanged flowers, herbs, and other economically exploitable plants.[62] Important collectors were company servants such as Christiaan Kleynhoff, Franciscus Albertus Pryon, Henricus van Santen and Hendrik Otto van Oudgaarden. Kleynhoff and Pryon had first served as ship's surgeons aboard VOC ships and subsequently established a garden for medicinal plants in the outskirts of Batavia. From 1760 onwards Pryon regularly dispatched plants and drawings from Java to the *hortus* in Amsterdam. Van Santen provided Burman father and son with specimens from the Coromandel Coast where the Dutch had established several settlements. Van Oudgaarden gathered specimens at the Cape.[63] The *hortus* thus housed a large number of living and dried plants from the Cape, India, the Malay Archipelago, Japan, China, Brazil, and Suriname. In the 1780s, Burman junior even managed to further increase their collection by exchanging plant seeds with the botanical garden in Kew.[64]

The immense influx of useful and other plants from abroad transformed the Amsterdam medicinal garden into a vital centre for the study of the flora of extra-European regions and its collection was a major resource for a number of botanical works on the flora of the Asian and American tropics as well as South Africa. Using his immense library and private herbarium, Burman published on the flora of Ceylon (*Thesaurus Zeylanicus*, 1737) and the Cape (*Rariorum Africanarum plantarum decades*, 1738-39) and he won the right to publish the manuscript of *Het Amboinsche Kruid-boek* (1741-1750), which the VOC servant Georg Everhard Rumphius (1627-1702) had compiled on Ambon during his service there. In the 1760s, his son Nicholaas Burman focused his attention on the flora of the Cape, and the East- and West Indies. In his *Flora Indica* (1768) he compiled an overview of all known plants of those regions.[65]

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[62] For an overview, see Cook, *Matters of exchange*, chapter 8.

[63] For an in-depth research of these four collectors, see P.J. Florijn, "Biographical notes about four plant collectors in Asia mentioned by N.L. Burman in his *Flora Indica* (1768)," *Taxon* 36:1 (1987): 34-36.

[64] For an overview of the collectors network of Johannes and Nicolaas Burman, see Wijnands, Zevenhuizen, and Heniger, *Een sieraad voor de stad*, 107-11.

[65] Ibidem, 111-16.

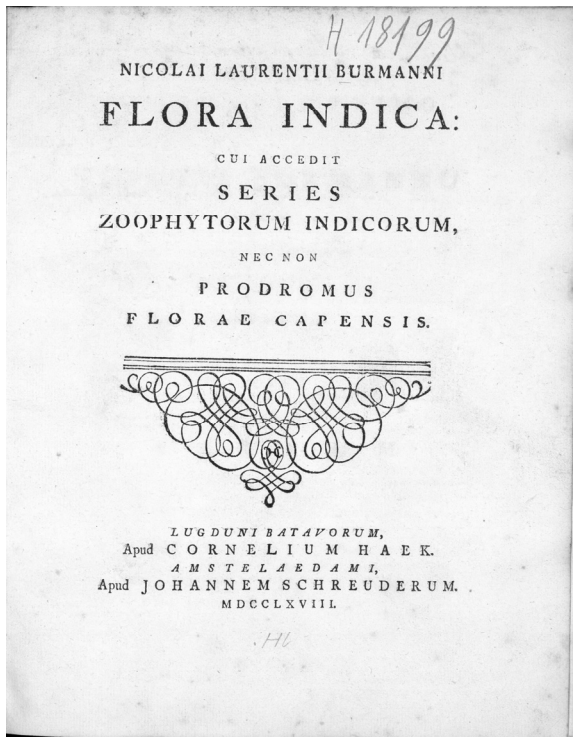

Figure 7: Cover of *Flora Indica* by N. Burman, Amsterdam, 1768.

The Burmans had to teach four times a week at the *hortus medicus*. On Tuesdays and Thursdays, they instructed apothecaries, chemists and surgeons in Dutch about useful medicinal plants (*usualia*) which were listed in the latest version of the *Pharmacopoea,* the practical manual for every apothecary in Amsterdam. One of the first botanists in Europe, Johannes Burman used and taught the binominal nomenclature of Linneaus, who visited him in Amsterdam in 1735 in order to study the rich herbaria, botanical gardens, private cabinets and libraries which the Low Countries offered.[66]

On behalf of Burman, the Linnaean system of naming plants was also added to the *Nieuwe Amsterdamsche Apotheek*, the practical manual for apothecaries in Amsterdam published in 1795.[67] After the younger Burman's

[66] P.L. Farber, *Finding order in nature. The naturalist tradition from Linnaeus to E.O. Wilson* (Baltimore: Johns Hopkins University Press, 2000), 9.

[67] SA Amsterdam, 27: Archief van het collegium medicum, collegium obstetricium en plaatselijke commissie van geneeskundig toevoorzicht, inv. 6, fol. 36-40.

death in 1793, the botanical classes were taken over first by Nicolaas Bondt (1765-1796) and then by Gerardus Vrolik.

Enjoying Patriot Sociability

Although Reinwardt must have spent most of his time earning his living at his brother's chemical workshop, much evidence points to the fact he and his brother became involved in two of Amsterdam's oldest literary societies: Concordia et Libertate (1748) and then Libertate et Concordia, the so-called 'Friday society' founded a few years later. Reinwardt's practical expertise as chemist and his command of Latin and Greek, which he studied at night, must have paved the way to his being accepted in these circles. Almost all of Reinwardt's later acquaintances and friends such as Jeronimo de Vries (1776-1853), Anton Reinhard Falck (1777-1843), Johan Melchior Kemper (1776-1824), Matthijs Siegenbeek (1774-1854), Cornelis van Vollenhoven (1778-1849), David Jacob van Lennep (1774-1853) and others participated in one or more of these societies.[68] In later letters, Reinwardt often refers to lively and amicable discussions in these societies which shared, as W. van den Berg has put it, a strong belief in the 'progress in arts and sciences'.[69]

The members of Concordia et Libertate met every Tuesday in the St. Luciensteeg, near the Pijpenmarkt, to discuss literary texts or listen to lectures from experts in various scientific fields. Every member was allowed to introduce three friends, unless the speaker refused their presence. Although the Tuesday society did not publish proceedings, every member was obliged to give at least three lectures in six years. Many of the members

[68] J. van Lennep, *Het leven van mr. Cornelis en mr. David Jacob van Lennep*, vol. 3 (Amsterdam: Frederik Muller, 1861-62), 200-201, and A. Hanou, *Sluiers van Isis. Johannes Kinker als voorvechter van de Verlichting in de vrijmetselarij en andere Nederlandse genootschappen, 1790-1845* (Deventer: Uitgeverij Sub Rosa, 1988), 445-49.

[69] Quote by W. van den Berg, "Literary sociability in the Netherlands, 1750-1840," in *The Dutch Republic in the eighteenth century. Decline, enlightenment, and revolution*, ed. Margret C. Jacob et al. (Ithaca: Cornell University Press, 1992), 253. For Reinwardt's retrospective references, see Reinwardt to Falck, Batavia, 20 May 1818, in *Gedenkstukken der Algemeene Geschiedenis van Nederland 1795-1840*, ed. H.T. Colenbrander, ('s-Gravenhage: Martinus Nijhoff, 1915), vol. 8 (II), 193. and NHA Haarlem, letter Reinwardt to Van Marum, Kaapstadt, 4 February 1816.

also used the meetings to voice their concerns about the moral, political and economic decline of the late Dutch Republic.[70]

Concordia et Libertate thus formed an important platform for the so-called patriot movement in the city which had gained momentum in the city after the disastrous outcome of the Fourth Anglo-Dutch War. In particular the loss of nearly the entire merchant fleet stirred unrest among merchants, bankers, manufacturers, lawyers, apothecaries, and chemists, all of whose businesses depended on the import of raw material from the colonies in the East and West Indies and the Baltic Sea.[71] Many believed that Willem V (1748-1806), the official commander of the army and navy, would prove too weak to reform the country's economy and administration to prevent similar attacks from external powers. In the preceding decades, Willem had made a major effort to merge the military interests of the coastal provinces with those in the hinterland. While the former demanded more money for the equipment of a better fleet to safeguard their mercantile interests, the latter sought more expenditures for a powerful army to protect their inland borders.[72]

The members of Concordia et Liberate considered chemistry as a crucial tool to improve the country's political and economic situation. From 1790 onwards, the society's meetings formed an important platform for The Society of Dutch Chemists (Het Gezelschap der Hollandsche Scheikundigen). The Society was a group of friends who irregularly came together at the Plantage in Amsterdam to socialize and carry out experiments in public, which allowed them to engage in a broader international debate on various issues in chemistry, such as the new claim that water was a compound of oxygen and hydrogen. The core of their chemistry was the extensive usage of measuring devices.[73]

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[70] M.C. Jacob, "Radicalism in the Dutch Enlightenment," in *The Dutch Republic in the Eighteenth Century. Decline, Enlightenment, and Revolution,* ed. Margret C. Jacob et al. (Ithaca: Cornell University Press, 1992), 236-37.

[71] For an overview of the events in Amsterdam, see M. Hell, "Revolte, rust en revolutie, 1747-1795," in *Geschiedenis van Amsterdam*, vol. 2b, Zelfbewuste *stadstaat, 1650-1813*, ed. Willem Frijhoff, et al., 355-75 (Amsterdam: Sun, 2005).

[72] N.C.F. van Sas, "The patriot revolution: New perspectives," in *The Dutch Republic in the Eighteenth Century. Decline, Enlightenment, and Revolution,* ed. Margret C. Jacob et al. (Ithaca: Cornell University Press, 1992), 97-98.

[73] H.A.M. Snelders, *Het gezelschap der Hollandsche scheikundigen: Amsterdamse chemici uit het einde van de achttiende eeuw* (Amsterdam: Rodopi, 1980).

Despite the informal organization of the members of the Society, they managed to carry out important experiments and published a large amount of influential chemical publications in a period of only ten years. The majority of the results were published in the journals *Recherches physico-chymiques* (1792-94) and the *Natuur-Scheikundige Verhandelingen* (1799-1808). In order to inform others about their results, they regularly summarized their proofs in the form of letters which various learned and amateur societies in the Netherlands and abroad published in their proceedings.[74]

The journal of the Society of Dutch Chemists was financially supported by five wealthy Amsterdam merchant bankers who were in close contact with Amsterdam's chemical industry.[75] Two of the sponsors, Henry Hope (1735-1811) and his brother Thomas Hope (1769-1831) specialized in the diamond trade, international banking, and the export of sugar to Russia.[76] Other sponsors were Willem Six van Otterleek (1761-1811), Hendrik Muilman (1743-1812) and Pieter Muilman (1750-1819), and as well as Theodorus Pieter de Smeth (1789-1843). Van Otterleek worked as secretary of a private colonial enterprise, the Societeit van Suriname, which had been tightly interwoven with the Dutch West India Company, which was dissolved in 1791. Pieter Muilman was an alderman in Amsterdam. De Smeth was engaged in the company of Raymond en Theodoor de Smeth, which his father had founded in Amsterdam in 1736. His father also owned a brewery in Amsterdam. Like Hope & Co., Raymond en Theodoor de Smeth specialized in international trade banking with a special focus on Russia.[77]

In the 1790s, the members of the Society of Dutch Chemists held various lectures at Concordia et Libertate in which they promoted the usefulness of their experimental and quantitative approach for physicians,

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[74] L. Roberts, "Science dynamics". The Dutch meet the 'new' chemistry," in *Lavoisier in European context. Negotiating a new language for chemistry,* ed. Bernadette Bensaude-Vincent, et al. (Canton, Mass.: Science History Publications, 1995), 103-104.

[75] E. Cohen, "Chemisch-historische aanteekeningen XVII," *Chemisch weekblad* 37 (1940): 489.

[76] On the connection between the Hope brothers and the Amsterdam chemical community, see L. Roberts, "An Arcadian apparatus. The introduction of the steam engine into the Dutch Landscape," *Technology and Culture* 45:2 (2004): 251-76, and the more general M.G. Buist, *At spes non fracta. Hope & Co 1770-1815. Merchants bankers and diplomats at work* (Den Haag: Martinus Nijhoff, 1974), 3-69.

[77] Jonker, *Merchants, bankers, middlemen,* 190.

apothecaries and manufacturers.[78] In December 1789, the merchant Adriaan Paets van Troostwijk (1752-1837), one of the founders of the Society, discussed the experiments which they had carried out to analyze the composition of water, and in November 1795, the merchant gave a general overview of the history of chemistry. A year later the director of the Amsterdam hortus Nicolaas Bondt lectured on the medical applications of chemistry. In late 1799, the doctor Jan Rudolph Deiman (1743-1808) lectured about the positive consequences of Lavoisier's chemical practices and on the question of how to identify and measure the different physical forces in nature. In the same year, Vrolik explained the similarities between animals and plants and the simplicity of nature as regards the cultivation of economically exploitable crops. Reinwardt himself lectured at Concordia et Libertate in 1803 and 1804. In his first lecture, he discussed how our knowledge of the earth's atmosphere can explain and improve various industries (*menselijke kunstverrichtingen*). His second presentation dealt with observations regarding the age of the earth and the geological changes which must have taken place in the past.[79]

In contradiction to Concordia et Libertate, the so-called Friday's society, Libertate et Concordia, put its emphasis on the pleasant, amicable and enjoyable exchange of ideas during their weekly gatherings. Central aim of Libertate et Concordia was to establish and promote contacts across social classes. During their weekly gatherings, it was quite normal for academics to mingle with learned merchants, apothecaries, medical doctors and even farmers. The freedom to discuss literature and political and social issues formed the uniting element of the group.

Some members of Libertate et Concordia even initiated publication of a weekly journal, *De Arke Noach*, which appeared first in January 1799. The most important contributors were Van Lennep, De Vries and Falck. Various other Amsterdam *literati* such as Cornelis Loots (1765-1834), Jan Frederik Helmers (1767-1813), Robert Hendrik Arntzenius (1777-1823), Johannes Kinker (1764-1845) and Jacobus Scheltema (1767-1835) regularly

[78] The titles of the lectures can be found in M. van Hattum, *Lezingen en verhandelingen in 'Concordia et Libertate' (1769-1806) en 'Felix Meritis' (Dep. Letterk.) (1779-1808, 1810-1832, 1865-1873)* (Amstelveen: 1983).

[79] The full titles of Reinwardt's lectures were: *Over de invloed onzer tegenwoordige kennis van de dampkring op de voornaamste verschijnselen der natuur en op die menselijke kunstverrichtingen die hieruit alleen kunnen en moeten worden verklaard* (1803) and *Enige gedenkstukken van de ouderdom der aarde en de verbaazende omwentelingen die aan haar tegenwoordige gesteldheid moeten zijn voorafgegaan* (1804).

contributed articles. These covered a wide range of topics and the authors promoted literature and art as a crucial means of mitigating the seeming moral and economic decline of the Dutch Republic.[80]

This brief analysis of Concordia et Libertate and Libertate et Concordia has revealed that both societies functioned as important platforms in Amsterdam for propagating various reform ideas. While some claimed reforms on a political level, others considered literature, arts, sociability, medicine, education, and useful 'scientific' knowledge as primary tools for the improvement of Dutch society, and precise borders between the different groups can hardly be drawn. But it was this shared culture of civic improvement that provided historical actors such as Reinwardt with a powerful social and intellectual framework for their future careers.

It is therefore not surprising that Reinwardt first aimed at continuing his career at the Georgia Augusta University in Göttingen, where he had established contact with the plant physiologist and physician Johann Friedrich Blumenbach (1752-1840).[81] Since its foundation in 1734, the university in Göttingen had served as an important stepping stone for young students from all over Europe to further their career as academically trained administrators. By studying 'cameral sciences', which comprised a wide range of subjects such as taxation systems, land rights, regalian rights, botany, technology, chemistry, mining, geology, forestry, and natural history, they hoped to receive high positions at one of the courts or academies of the fragmented Holy Roman Empire. As 'cameralists' they were responsible for the efficient exploitation of the land and inhabitants of their superiors' territories. Since most German states did not possess any colonies and were not connected with international trading networks, efficient and innovative agricultural practices and processing industries were vital for the functioning of the often small territories.[82]

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[80] Van Lennep, *Het leven van mr. Cornelis*, 3.200-201, and Hanou, *Sluiers van Isis*, 484-94.

[81] For more details on Blumenbach's vitalist physiology, see P.H. Reill, "The legacy of the "Scientific Revolution. Science and the enlightenment," in *Cambridge History of Science*, vol. 4, *Eighteenth-Century science*, ed. Roy Porter (Cambridge: Cambridge University Press, 2003), 32-41.

[82] For a fascinating analysis of the complex relationship between economic development, cameralism and agricultural science in the states of the Holy Roman Empire, see A. Wakefield, *The disordered police state. German cameralism as science and practice* (Chicago: University of Chicago Press, 2009) and M. Popplow, "Economizing agricultural resources in the German economic enlightenment," in *Materials and expertise in Early*

Conclusion

This chapter has focused on Reinwardt's socialization as Dutch citizen and his training as chemist in Amsterdam in the late 1780s and 1790s. A reconstruction of his social and material world has revealed that in particular the chemical education underwent major transformations in this period. While Amsterdam's academically trained physicians considered chemistry as an annex to the medical sciences, engaged apothecaries, chemists and merchants launched various initiatives to improve the chemical education in the city. The underlying reasons for these initiatives were wide ranging. 'Oeconomic patriots' such as Schonck and Kasteleyn argued for reform and greater attention to chemistry out of their concern for the state of their enterprises, Dutch society and the economy. Some apothecaries and producers of chemicals hoped that a standardized training of apprentices would protect their businesses from untrained practitioners, while Amsterdam's merchants hoped that a better chemical education would increase the efficiency of the city's refineries in times of dwindling stocks and rising prices for raw material from overseas. They not only urged the city council to install a public lecturer for chemistry, but they agreed to pay his entire salary. Moreover, they helped finance the Society of Dutch Chemists' publication of a journal in order to spread the results of their various experiments.

During his years as apprentice at his brother's chemical workshop, Reinwardt was thus trained in four fields. He became an expert in observing and harnessing the forces of nature in laboratories in an 'oeconomic' way. He received training as an observer and collector of medicinal plants in the field. He learned how to handle the large number of measuring devices which were necessary to enhance procedures such as distillation and sublimation. And he acquired a thorough understanding of Latin and Greek in order to read the classical literature, one of the most important preconditions for acceptance among Amsterdam's learned elite which regularly came together to practice different forms of 'sociability'. The following chapters will show that it was exactly this mix of expertise that allowed Reinwardt to embark quickly on his career as an academic at the university in Harderwijk in the aftermath of the Batavian Revolution of 1795, following which improvement, efficiency, quantification, and standardization became the guiding principles for reform in almost all public domains.

Modern Europe. Between market and laboratory, ed. Ursula Klein and E.C. Spary (Chicago: University of Chicago Press, 2010), 261-87.